VMS Software

VSI OpenVMS

RTL Library (LIB$) Manual

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RTL Library (LIB$) Manual

Legal Notice

Preface

This manual documents the library routines contained in the LIB$ and CVT$ facilities of the OpenVMS Run-Time Library.

1. About VSI

VMS Software, Inc. (VSI) is an independent software company licensed by Hewlett Packard Enterprise to develop and support the OpenVMS operating system.

2. Intended Audience

This manual is intended for system and application programmers who write programs that call LIB$ and CVT$ Run-Time Library routines.

3. Document Structure

This manual is organized into three parts as follows:

- The overview chapter provides a brief overview of the LIB$ and CVT$ Run-Time Library facility and lists the LIB$ routines and their functions. It also provides guidelines and information on using the LIB$ facility with VAX and Alpha platforms.
- The LIB$ reference section describes each library routine contained in the LIB$ Run-Time Library facility. This information is presented using the documentation format described in *VSI OpenVMS Programming Concepts Manual*. Routine descriptions appear alphabetically by routine name.
- The CVT$ reference section describes the routines contained in the CVT$ Run-Time Library facility. This information is presented using the documentation format described in *VSI OpenVMS Programming Concepts Manual*.

4. Related Documents

The Run-Time Library (RTL) routines are documented in a series of reference manuals.

General descriptions of OpenVMS RTL routines appear in the following manual:

- *VSI OpenVMS Programming Concepts Manual*—A description of OpenVMS features and functionality available through calls to the LIB$ Run-Time Library

Specific descriptions of the other RTL facilities and their corresponding routines appear in the following manuals:

- *Compaq Portable Mathematics Library*
- *OpenVMS VAX RTL Mathematics (MTH$) Manual*
- *OpenVMS RTL DECtalk (DTK$) Manual*
- *VSI OpenVMS RTL General Purpose (OTS$) Manual*
- *OpenVMS RTL Parallel Processing (PPL$) Manual*

- *VSI OpenVMS RTL Screen Management (SMG$) Manual*
- *VSI OpenVMS RTL String Manipulation (STR$) Manual*

Application programmers using any language can refer to the *Guide to Creating OpenVMS Modular Procedures* for writing modular and reentrant code.

High-level language programmers will find additional information on calling Run-Time Library routines in their language reference manuals. Additional information may also be found in the language user's guide provided with your OpenVMS language software.

5. VSI Encourages Your Comments

You may send comments or suggestions regarding this manual or any VSI document by sending electronic mail to the following Internet address: <docinfo@vmssoftware.com>. Users who have VSI OpenVMS support contracts through VSI can contact <support@vmssoftware.com> for help with this product.

6. OpenVMS Documentation

The full VSI OpenVMS documentation set can be found on the VMS Software Documentation webpage at https://docs.vmssoftware.com.

7. Typographical Conventions

The following conventions are also used in this manual:

Convention	Meaning
Ctrl/ *x*	A sequence such as **Ctrl/** *x* indicates that you must hold down the key labeled Ctrl while you press another key or a pointing device button.
PF1 *x*	A sequence such as PF1 *x* indicates that you must first press and release the key labeled PF1 and then press and release another key or a pointing device button.
Return	In examples, a key name enclosed in a box indicates that you press a key on the keyboard. (In text, a key name is not enclosed in a box.)
...	A horizontal ellipsis in examples indicates one of the following possibilities: • Additional optional arguments in a statement have been omitted. • The preceding item or items can be repeated one or more times. • Additional parameters, values, or other information can be entered.
⋮	A vertical ellipsis indicates the omission of items from a code example or command format; the items are omitted because they are not important to the topic being discussed.
( )	In command format descriptions, parentheses indicate that you must enclose the options in parentheses if you choose more than one.
[ ]	In command format descriptions, brackets indicate optional choices. You can choose one or more items or no items. Do not type the brackets on the command line. However, you must include the brackets in the syntax for OpenVMS directory specifications and for a substring specification in an assignment statement.

Convention	Meaning
[|]	In command format descriptions, vertical bars separate choices within brackets or braces. Within brackets, the choices are options; within braces, at least one choice is required. Do not type the vertical bars on the command line.
{ }	In command format descriptions, braces indicate required choices; you must choose at least one of the items listed. Do not type the braces on the command line.
bold text	This typeface represents the introduction of a new term. It also represents the name of an argument, an attribute, or a reason.
italic text	Italic text indicates important information, complete titles of manuals, or variables. Variables include information that varies in system output (Internal error *number*), in command lines (/PRODUCER= *name*), and in command parameters in text (where *dd* represents the predefined code for the device type).
UPPERCASE TEXT	Uppercase text indicates a command, the name of a routine, the name of a file, or the abbreviation for a system privilege.
`Monospace type`	Monospace type indicates code examples and interactive screen displays. In the C programming language, monospace type in text identifies the following elements: keywords, the names of independently compiled external functions and files, syntax summaries, and references to variables or identifiers introduced in an example.
-	A hyphen at the end of a command format description, command line, or code line indicates that the command or statement continues on the following line.
numbers	All numbers in text are assumed to be decimal unless otherwise noted. Nondecimal radixes—binary, octal, or hexadecimal—are explicitly indicated.

Chapter 1. Overview of the LIB$ Facility

This chapter provides a brief overview of the LIB$ and CVT$ Run-Time Library facilities and lists the LIB$ and CVT$ routines and their functions. It also provides guidelines and information on using the LIB$ facility with VAX, Alpha, and VSI OpenVMS Industry Standard 64 for Integrity Servers (I64) platforms.

1.1. Run-Time Library LIB$ Routines

This manual discusses the Run-Time Library (RTL) LIB$ routines that perform general purpose (library) functions. One of the functions of the LIB$ facility is to provide a callable interface to components of OpenVMS operating systems that are difficult to use in a high-level language. LIB$ routines allow access to the following:

- System services
- The command language interpreter (CLI)
- Some VAX machine instructions or the equivalent Alpha or I64 instructions

In addition, LIB$ routines allow you to perform the following operations:

- Allocate resources that your process needs, such as virtual memory and event flags
- Convert data types for I/O
- Enable detection of hardware exceptions (VAX only)
- Establish condition handlers (VAX only)
- Generate and display timing statistics while your program is running
- Get and put strings in the process common storage area
- Obtain records from devices
- Obtain the system date and time in various formats
- Process cross-reference data
- Process VSI DECnet-Plus for OpenVMS full names
- Search for specified files
- Set up and use binary trees
- Signal exceptions

1.1.1. 64-Bit Addressing Support (Alpha and I64 Only)

On Alpha and I64 systems, the Run-Time Library (LIB$) routines provide 64-bit virtual addressing capabilities as follows:

- Most routines now accept 64-bit addresses for arguments passed by reference. Footnotes in the Reference Section of this manual indicate those routines that do not.
- Most routines also accept either 32-bit or 64-bit descriptors for arguments passed by descriptor. Footnotes in the Reference Section of this manual indicate those routines that do not.
- In some cases, a new routine was added to support a 64-bit addressing or data capability. These routines carry the same name as the original routine but with a _64 suffix. In general, both versions of the routine support 64-bit addressing, but the routine with the _64 suffix also supports additional 64-bit capability. The 32-bit capabilities of the original routine are unchanged.
- Specialized routines create and manipulate storage zones in the 64-bit virtual address space. The names of these routines are the same as their 32-bit counterparts but with a _64 suffix. One example is LIB$CREATE_VM_ZONE and LIB$CREATE_VM_ZONE_64. LIB$CREATE_VM_ZONE creates a storage zone in the 32-bit virtual address space, and LIB$CREATE_VM_ZONE_64 creates a storage zone in the 64-bit virtual address space. The function of the original routine is unchanged.

See the *VSI OpenVMS Programming Concepts Manual* for more information about 64-bit virtual addressing capabilities.

1.1.2. The LIB$ Routines

Table 1.1 lists all of the LIB$ routines and their functions.

Table 1.1. LIB$ Routines

Routine Name	Function
LIB$ADAWI	Add adjacent word with interlock.
LIB$ADDX	Add two multiple-precision binary numbers.
LIB$ADD_TIMES	Add two quadwords times.
LIB$ANALYZE_SDESC	Analyze a string descriptor.
LIB$ANALYZE_SDESC_64	Analyze a string descriptor.[1]
LIB$ASN_WTH_MBX	Assign a channel to a mailbox.
LIB$AST_IN_PROG	Check for active AST.
LIB$ATTACH	Attach a terminal to a process.
LIB$BBCCI	Test and clear a bit with interlock.
LIB$BBSSI	Test and set a bit with interlock.
LIB$BUILD_NODESPEC	Build a node-name specification.
LIB$CALLG	Call a procedure with a general argument list.
LIB$CALLG_64	Call a procedure with a general argument list. [1]
LIB$CHAR	Transform a byte to the first character of a string.
LIB$COMPARE_NODENAME	Compare two node names.
LIB$COMPRESS_NODENAME	Compress a node name to its short form equivalent.
LIB$CONVERT_DATE_STRING	Convert a date string to a quadword.
LIB$CRC	Calculate a cyclic redundancy check (CRC).
LIB$CRC_TABLE	Construct a cyclic redundancy check (CRC) table.
LIB$CREATE_DIR	Create a directory.
LIB$CREATE_USER_VM_ZONE	Create a user-defined storage zone.
LIB$CREATE_USER_VM_ZONE_64	Create a user-defined storage zone. [1]
LIB$CREATE_VM_ZONE	Create a new storage zone.
LIB$CREATE_VM_ZONE_64	Create a new storage zone. [1]
LIB$CRF_INS_KEY	Insert a key in the cross-reference table.
LIB$CRF_INS_REF	Insert a reference to a key in the cross-reference table.
LIB$CRF_OUTPUT	Output some cross-reference table information.
LIB$CURRENCY	Get the system currency symbol.
LIB$CVTF_FROM_INTERNAL_TIME	Convert internal time to external time (F-floating value).
LIB$CVTS_FROM_INTERNAL_TIME	Convert internal time to external time (IEEE S-floating value).
LIB$CVTF_TO_INTERNAL_TIME	Convert external time to internal time (F-floating value).
LIB$CVTS_TO_INTERNAL_TIME	Convert external time to internal time (IEEE S-floating value).

Routine Name	Function
LIB$CVT_DX_DX	Convert the specified data type.
LIB$CVT_FROM_INTERNAL_TIME	Convert internal time to external time.
LIB$CVT_TO_INTERNAL_TIME	Convert external time to internal time.
LIB$CVT_VECTIM	Convert 7-word vector to internal time.
LIB$CVT_ *x*TB	Convert numeric text to binary.
LIB$CVT_ *x*TB_64	Convert numeric text to binary. [1]
LIB$DATE_TIME	Return the date and time as a string.
LIB$DAY	Return the day number as a longword integer.
LIB$DAY_OF_WEEK	Return the numeric day of the week.
LIB$DECODE_FAULT	Decode instruction stream during a fault.[2]
LIB$DEC_OVER	Enable or disable decimal overflow detection. [2]
LIB$DELETE_FILE	Delete one or more files.
LIB$DELETE_LOGICAL	Delete a logical name.
LIB$DELETE_SYMBOL	Delete a CLI symbol.
LIB$DELETE_VM_ZONE	Delete a virtual memory zone.
LIB$DELETE_VM_ZONE_64	Delete a virtual memory zone. [1]
LIB$DIGIT_SEP	Get the digit separator symbol.
LIB$DISABLE_CTRL	Disable CLI interception of control characters.
LIB$DO_COMMAND	Execute the specified command.
LIB$EDIV	Perform an extended-precision divide.
LIB$EMODD	Perform extended multiply and integerize for D-floating values.
LIB$EMODF	Perform extended multiply and integerize for F-floating values.
LIB$EMODG	Perform extended multiply and integerize for G-floating values.
LIB$EMODH	Perform extended multiply and integerize for H-floating values. [2]
LIB$EMODS	Perform extended multiply and integerize for IEEE S-floating values.
LIB$EMODT	Perform extended multiply and integerize for IEEE T-floating values.
LIB$EMUL	Perform an extended-precision multiply.
LIB$ENABLE_CTRL	Enable CLI interception of control characters.
LIB$ESTABLISH	Establish a condition handler. [2] [3]
LIB$EXPAND_NODENAME	Expand a node name to its full name equivalent.
LIB$EXTV	Extract a field and sign-extend.
LIB$EXTZV	Extract a zero-extended field.
LIB$FF *x*	Find the first clear or set bit.

Routine Name	Function
LIB$FID_TO_NAME	Convert a device and file ID to a file specification.
LIB$FILE_SCAN	Perform a file scan.
LIB$FILE_SCAN_END	End a file scan.
LIB$FIND_FILE	Find a file.
LIB$FIND_FILE_END	End of find file.
LIB$FIND_IMAGE_SYMBOL	Merge activate an image symbol.
LIB$FIND_VM_ZONE	Find the next valid zone.
LIB$FIND_VM_ZONE_64	Find the next valid zone. [1]
LIB$FIT_NODENAME	Fit a node name into an output field.
LIB$FIXUP_FLT	Fix floating reserved operand. [2]
LIB$FLT_UNDER	Detect a floating-point underflow. [2]
LIB$FORMAT_DATE_TIME	Format a date and/or time.
LIB$FORMAT_SOGW_PROT	Format protection mask. [4]
LIB$FREE_DATE_TIME_CONTEXT	Free the context used to format a date.
LIB$FREE_EF	Free an event flag.
LIB$FREE_LUN	Free a logical unit number.
LIB$FREE_TIMER	Free timer storage.
LIB$FREE_VM	Free virtual memory from the program region.
LIB$FREE_VM_64	Free virtual memory from the program region. [1]
LIB$FREE_VM_PAGE	Free a virtual memory page.
LIB$FREE_VM_PAGE_64	Free a virtual memory page. [1]
LIB$GETDVI	Get device/volume information.
LIB$GETJPI	Get job/process information.
LIB$GETQUI	Get queue information.
LIB$GETSYI	Get systemwide information.
LIB$GET_ACCNAM	Get access name table for a security object identified by name. [4]
LIB$GET_ACCNAM_BY_CONTEXT	Get access name table for a security object identified by $GET_SECURITY or $SET_SECURITY context. [4]
LIB$GET_COMMAND	Get line from SYS$COMMAND.
LIB$GET_COMMON	Get string from common area.
LIB$GET_CURR_INVO_CONTEXT	Get current invocation context. [1]
LIB$GET_DATE_FORMAT	Return the user's date input format.
LIB$GET_EF	Get an event flag.
LIB$GET_FOREIGN	Get foreign command line.
LIB$GET_FULLNAME_OFFSET	Get the offset to the starting position of the most significant part of a full name.
LIB$GET_HOSTNAME	Get host node name.
LIB$GET_INPUT	Get line from SYS$INPUT.

Routine Name	Function
LIB$GET_INVO_CONTEXT	Get invocation context. [1]
LIB$GET_INVO_HANDLE	Get invocation handle. [1]
LIB$GET_LUN	Get logical unit number.
LIB$GET_MAXIMUM_DATE_LENGTH	Get the maximum possible date/time string length.
LIB$GET_PREV_INVO_CONTEXT	Get previous invocation context. [1]
LIB$GET_PREV_INVO_HANDLE	Get previous invocation handle. [1]
LIB$GET_SYMBOL	Get the value of a CLI symbol.
LIB$GET_USERS_LANGUAGE	Return the user's language choice.
LIB$GET_VM	Allocate virtual memory.
LIB$GET_VM_64	Allocate virtual memory. [1]
LIB$GET_VM_PAGE	Get a virtual memory page.
LIB$GET_VM_PAGE_64	Get a virtual memory page. [1]
LIB$ICHAR	Convert the first character of a string to an integer.
LIB$I64_CREATE_INVO_CONTEXT	Allocate and initialize an invocation context block. [5]
LIB$I64_GET_CURR_INVO_CONTEXT	Get current invocation context. [5]
LIB$I64_FREE_INVO_CONTEXT	Deallocate an invocation context block. [5]
LIB$I64_GET_CURR_INVO_HANDLE	Get current invocation handle. [5]
LIB$I64_GET_FR	Get floating-point register value. [5]
LIB$I64_GET_GR	Get general register value. [5]
LIB$I64_GET_INVO_HANDLE	Get invocation handle. [5]
LIB$I64_GET_INVO_CONTEXT	Get invocation context. [5]
LIB$I64_GET_PREV_INVO_CONTEXT	Get previous invocation context. [5]
LIB$I64_GET_PREV_INVO_END	Free memory used to process unwind descriptors. [5]
LIB$I64_GET_PREV_INVO_HANDLE	Get previous invocation handle. [5]
LIB$I64_GET_UNWIND_HANDLER_FV	Given a *pc_value*, find the function value (address of the procedure descriptor) for the condition handler, if present, and write it to *handler_fv*. [5]
LIB$I64_GET_UNWIND_LSDA	Find Address of Unwind Information Block Language-Specific Data. [5]
LIB$I64_GET_UNWIND_OSSD	Find address of the unwind information block operating system-specific data area. [5]
LIB$I64_INIT_INVO_CONTEXT	Initialize an invocation context block that has already been allocated. [5]
LIB$I64_IS_AST_DISPATCH_FRAME	Determine whether a given PC value represents an AST dispatch frame. [5]
LIB$I64_IS_EXC_DISPATCH_FRAME	Determine whether a given PC value represents an exception dispatch frame. [5]
LIB$I64_PUT_INVO_REGISTERS	Update register contents using a given invocation context. [5]
LIB$I64_PREV_INVO_END	Free memory used to process unwind descriptors. [5]

Routine Name	Function
LIB$I64_SET_FR	Write context of invocation context block. [5]
LIB$I64_SET_GR	Write invocation block general register value. [5]
LIB$I64_SET_PC	Write pc_copy value of invocation context block. [5]
LIB$INDEX	Index to relative position of substring.
LIB$INIT_DATE_TIME_CONTEXT	Initialize the context used in formatting date/time strings.
LIB$INIT_TIMER	Initialize times and counts.
LIB$INSERT_TREE	Insert entry in a balanced binary tree.
LIB$INSERT_TREE_64	Insert entry in a balanced binary tree. [1]
LIB$INSQHI	Insert entry at the head of a queue.
LIB$INSQHIQ	Insert entry at the head of a queue. [1]
LIB$INSQTI	Insert entry at the tail of a queue.
LIB$INSQTIQ	Insert entry at the tail of a queue. [1]
LIB$INSV	Insert a variable bit field.
LIB$INT_OVER	Detect integer overflow. [2]
LIB$LEN	Return the length of a string as a longword.
LIB$LOCC	Locate a character.
LIB$LOCK	Lock a specified image in the process's working set.
LIB$LOOKUP_KEY	Look up keyword in table.
LIB$LOOKUP_TREE	Look up an entry in a balanced binary tree.
LIB$LOOKUP_TREE_64	Look up an entry in a balanced binary tree. [1]
LIB$LP_LINES	Specify the number of lines on each printer page.
LIB$MATCHC	Match characters, return relative position.
LIB$MATCH_COND	Match condition values.
LIB$MOVC3	Move characters.
LIB$MOVC5	Move characters with fill.
LIB$MOVTC	Move translated characters.
LIB$MOVTUC	Move translated until character.
LIB$MULTF_DELTA_TIME	Multiply delta time by F-floating scalar.
LIB$MULTS_DELTA_TIME	Multiply delta time by IEEE S-floating scalar.
LIB$MULT_DELTA_TIME	Multiply delta time by scalar.
LIB$PARSE_ACCESS_CODE	Parse access-encoded name string. [4]
LIB$PARSE_SOGW_PROT	Parse protection string. [4]
LIB$PAUSE	Pause program execution.
LIB$POLYD	Evaluate polynomials for D-floating values.
LIB$POLYF	Evaluate polynomials for F-floating values.
LIB$POLYG	Evaluate polynomials for G-floating values.
LIB$POLYH	Evaluate polynomials for H-floating values. [2]
LIB$POLYS	Evaluate polynomials for IEEE S-floating values.

Routine Name	Function
LIB$POLYT	Evaluate polynomials for IEEE T-floating values.
LIB$PUT_COMMON	Put string into common area.
LIB$PUT_INVO_REGISTERS	Put invocation registers. [1]
LIB$PUT_OUTPUT	Put line to SYS$OUTPUT.
LIB$RADIX_POINT	Radix point symbol.
LIB$REMQHI	Remove entry from head of queue.
LIB$REMQHIQ	Remove entry from head of queue. [1]
LIB$REMQTI	Remove entry from tail of queue.
LIB$REMQTIQ	Remove entry from tail of queue. [1]
LIB$RENAME_FILE	Rename one or more files.
LIB$RESERVE_EF	Reserve an event flag.
LIB$RESET_VM_ZONE	Reset virtual memory zone.
LIB$RESET_VM_ZONE_64	Reset virtual memory zone. [1]
LIB$REVERT	Revert to the handler of the procedure activator. [2] [3]
LIB$RUN_PROGRAM	Run new program.
LIB$SCANC	Scan for characters and return relative position.
LIB$SCOPY_DXDX	Copy source string by descriptor to destination.
LIB$SCOPY_R_DX	Copy source string by reference to destination.
LIB$SCOPY_R_DX_64	Copy source string by reference to destination. [1]
LIB$SET_LOGICAL	Set logical name.
LIB$SET_SYMBOL	Set the value of a CLI symbol.
LIB$SFREE1_DD	Free one or more dynamic strings.
LIB$SFREEN_DD	Free *n* dynamic strings.
LIB$SGET1_DD	Get one dynamic string.
LIB$SGET1_DD_64	Get one dynamic string. [1]
LIB$SHOW_TIMER	Show accumulated times and counts.
LIB$SHOW_VM	Show virtual memory statistics.
LIB$SHOW_VM_64	Show virtual memory statistics. [1]
LIB$SHOW_VM_ZONE	Display information about a virtual memory zone.
LIB$SHOW_VM_ZONE_64	Display information about a virtual memory zone. [1]
LIB$SIGNAL	Signal exception condition.
LIB$SIG_TO_RET	Convert a signaled message to a return status.
LIB$SIG_TO_STOP	Convert a signaled condition to a signaled stop.
LIB$SIM_TRAP	Simulate floating trap. [2]
LIB$SKPC	Skip equal characters.
LIB$SPANC	Skip selected characters.
LIB$SPAWN	Spawn a subprocess.
LIB$STAT_TIMER	Return accumulated time and count statistics.

Routine Name	Function
LIB$STAT_VM	Return virtual memory statistics.
LIB$STAT_VM_64	Return virtual memory statistics. [1]
LIB$STOP	Stop execution and signal the condition.
LIB$SUBX	Perform multiple-precision binary subtraction.
LIB$SUB_TIMES	Subtract two quadword times.
LIB$SYS_ASCTIM	Invoke $ASCTIM to convert binary time to ASCII.
LIB$SYS_FAO	Invoke $FAO system service to format output.
LIB$SYS_FAOL	Invoke $FAOL system service to format output.
LIB$SYS_FAOL_64	Invoke $FAOL system service to format output. [1]
LIB$SYS_GETMSG	Invoke $GETMSG system service to get message text.
LIB$TABLE_PARSE	Implement a table-driven, finite-state parser.
LIB$TPARSE	Implement a table-driven, finite-state parser. [2]
LIB$TRAVERSE_TREE	Traverse a balanced binary tree.
LIB$TRAVERSE_TREE_64	Traverse a balanced binary tree. [1]
LIB$TRA_ASC_EBC	Translate ASCII to EBCDIC.
LIB$TRA_EBC_ASC	Translate EBCDIC to ASCII.
LIB$TRIM_FILESPEC	Fit a long file specification into a fixed field.
LIB$TRIM_FULLNAME	Trim a full name to fit into a desired output field.
LIB$UNLOCK	Unlock a specified image in the process's working set.
LIB$VERIFY_VM_ZONE	Verify a virtual memory zone.
LIB$VERIFY_VM_ZONE_64	Verify a virtual memory zone. [1]
LIB$WAIT	Wait a specified period of time.

[1]Alpha and I64 specific.

[2]Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha or I64 systems.

[3]This routine or an equivalent mechanism is supplied by compilers on OpenVMS Alpha and I64 systems.

[4]VAX specific.

[5]I64 specific.

1.2. Translated Version of LIB$ Facility (Alpha and I64 Only)

The RTL LIB$ facility exists in two forms on OpenVMS Alpha and I64 systems: native and translated. The translated LIB$ library contains routines specific to VAX systems only, and are executed in the Translated Image Environment (TIE). These routines are not available to native OpenVMS Alpha and I64 programs. See *Migrating an Application from OpenVMS VAX to OpenVMS Alpha* for additional information on using translated images and the TIE.

Table 1.2 lists the translated LIB$ routines.

Table 1.2. Translated LIB$ Routines (Alpha Only)

Routine Name	Restriction
LIB$DECODE_FAULT	Decodes VAX instructions.

Routine Name	Restriction
LIB$DEC_OVER	Applies to VAX PSL only.
LIB$ESTABLISH	Supported by compilers on OpenVMS Alpha systems.
LIB$FIXUP_FLT	Applies to VAX PSL only.
LIB$FLT_UNDER	Applies to VAX PSL only.
LIB$INT_OVER	Applies to VAX PSL only.
LIB$REVERT	Supported by compilers on OpenVMS Alpha systems.
LIB$SIM_TRAP	Applies to VAX code.
LIB$TPARSE	Requires action routine interface changes. Replaced by LIB $TABLE_PARSE.

LIB$ routines that are called using JSB linkages may function differently on OpenVMS VAX and OpenVMS Alpha systems. See *OpenVMS Programming Interfaces: Calling a System Routine* for more information on using JSB linkages.

1.3. Run-Time Library CVT$ Facility

This manual describes the Run-Time Library CVT$ facility and its routines: CVT$CONVERT_FLOAT and CVT$FTOF. The CVT$ facility lets you convert data stored in one OpenVMS data type into data of another data type. Table 1.3 lists the routines in the CVT$ facility.

Table 1.3. CVT$ Routines

Routine Name	Function
CVT$CONVERT_FLOAT	Converts data in one of several floating-point data types to another floating-point data type.
CVT$FTOF	Enhanced version of CVT$CONVERT_FLOAT that provides better performance and more output options than CVT$CONVERT_FLOAT, and also enhances portability between supported platforms.

Chapter 2. LIB$ Reference

This chapter provides a detailed discussion of the routines provided by the OpenVMS RTL (CVT$) facility.

LIB$ADAWI

LIB$ADAWI — The Add Aligned Word with Interlock routine allows the user to perform an interlocked add operation using an aligned word.

Format

```
LIB$ADAWI add ,sum ,sign
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

add

OpenVMS usage:	word_signed
type:	word (signed)
access:	read only
mechanism:	by reference

The addend operand to be added to the value of **sum**. The **add** argument is the address of a signed word that contains the addend operand.

sum

OpenVMS usage:	word_signed
type:	word integer (signed)
access:	modify
mechanism:	by reference

The word to which **add** is added. The **sum** argument is the address of a signed word integer containing this value. The **add** operand is added to the sum operand, and the value of the sum argument is replaced by the result of this addition. The **sum** argument must be word-aligned; in other words, its address must be a multiple of 2.

sign

OpenVMS usage:	word_signed

type:	word integer (signed)
access:	write only
mechanism:	by reference

Sign of the **sum** argument. The **sign** argument is the address of a signed word integer that is assigned the value –1, 0, or 1, depending on whether the new value of **sum** is negative, 0, or positive.

Description

LIB$ADAWI allows the user to perform an interlocked add operation using an aligned word, and makes the VAX ADAWI instruction available as a callable routine. This routine also enables the user to implement synchronization primitives for multiprocessing. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

The add operation is interlocked against similar operations on other processors in a multiprocessor environment. This provides an atomic addition operation. The destination must be aligned on a word boundary; that is, bit 0 of the address of the sum operand must be 0.

If the addend and the sum operand overlap, the result of the addition, the value of the *sign* argument, and the associated condition codes are unpredictable.

The value of the *sign* argument is useful when LIB$ADAWI is used to implement locking in a multiprocessing program. For example, a process that is waiting to seize a lock or a resource calls LIB $ADAWI to add 1 to the sum. When the call returns, the waiting process checks the value of *sign*.

One possible algorithm would interpret the value of *sign* as follows:

Value of *sign* Argument	**Status of Lock or Resource**
–1	Open lock or free resources
0	Closed lock or no free resources, with no processes waiting
+1	Closed lock or no free resources, with processes waiting

In this algorithm, if the value of the *sign* argument is –1, that indicates that the process successfully seized the lock or resource, and other free resources are available. A value of 0 indicates that the process successfully seized the lock or the last available resource. A value of 1 indicates that the process was unable to seize the lock.

It is not sufficient for a waiting process to test the value of *sum*. The result is unpredictable because other processes can alter the value of *sum* after the original process executes the ADAWI instruction but before it tests the value of *sum*. However, a process can safely test the value of *sign* because its value is determined by the ADAWI instruction and is unaffected by other processes' activities.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INTOVF	Integer overflow error.

LIB$ADDX

LIB$ADDX — The Add Two Multiple-Precision Binary Numbers routine adds two signed two's complement integers of arbitrary length.

Format

LIB$ADDX addend-array ,augend-array ,resultant-array [,array-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

addend-array

OpenVMS usage:	vector_longword_signed
type:	unspecified
access:	read only
mechanism:	by reference, array reference

First multiple-precision, signed two's complement integer that LIB$ADDX adds to the second two's complement integer. The **addend-array** argument is the address of the array containing the two's complement number to be added.

augend-array

OpenVMS usage:	vector_longword_signed
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Second multiple-precision, signed two's complement integer that LIB$ADDX adds to the first two's complement integer. The **augend-array** argument is the address of the array containing the two's complement number.

resultant-array

OpenVMS usage:	vector_longword_signed
type:	unspecified
access:	write only
mechanism:	by reference, array reference

Multiple-precision, signed two's complement integer result of the addition. The **resultant-array** argument is the address of the array into which LIB$ADDX writes the result of the addition.

array-length

OpenVMS usage:	longword_signed
type:	longword_integer (signed)

access:	read only
mechanism:	by reference

Length in longwords of the arrays to be operated on; each array is of length **array-length**. The **array-length** argument is the address of a signed longword integer containing the length. The **array-length** argument must not be negative. This is an optional argument. If omitted, the default is 2.

Description

LIB$ADDX adds two signed two's complement integers of arbitrary length. The integers are located in arrays of longwords. The higher addresses of these longwords contain the higher precision parts of the values. The highest- addressed longword contains the sign and 31 bits of precision. The remaining longwords contain 32 bits of precision in each. The number of longwords in each array is specified in the optional argument *array-length*. The default array length is 2, which corresponds to the OpenVMS quadword data type.

Any two or all three of the first three arguments can be the same.

Condition Value Returned

SS$_NORMAL	Routine successfully completed.
SS$_INTOVF	Integer overflow. The result is correct, except that the sign bit is lost.

Example

```
C+
C This Fortran example program shows the use
C of LIB$ADDX.
C-

        INTEGER
        A(2),B(2),C(2),RETURN
        DATA A/'00000001'x,'7FFF407F'x/
        DATA B/'FFFFFFFF'x,'8000BF80'x/

C+
C The highest addressed longword of "A" is A(2).
C So, "A" represents the integer value ('7FFF407F'x) * 16**7 + 1.
C That is, A(2) is 576447592255193089.
C "B" is the twos complement representation of "-A".
C-

        RETURN
        = LIB$ADDX(A,B,C)
        TYPE *,'Let A = 576447592255193089.'
        TYPE *,'Then A + B is 0.'
        TYPE 1,C(2),C(1)
        1 FORMAT(' "A" - "A" is ',1H',I1,I1,3H'x.)
        TYPE *,'Note that C is C(2) concatenated with C(1).'

C+
C Let "A" have the value 72057594037927937 = '1000000000000001'x.
C Let "B" have the value 4294967295 = '00000000FFFFFFFF'x.
C

        A(1) = '00000001'x
        A(2) = '10000000'x
        B(1) = 'FFFFFFFF'x
```

```
        B(2) = '00000000'x
C+
C Then "A" + "B" is 72057598332895232.
C-

lib
        RETURN = LIB$ADDX(A,B,C)
        TYPE *,' '
        TYPE *,'LET A = 72057594037927937 and B = 4294967295'
        TYPE *,'Then A + B is ',C
        TYPE 2,C(2),C(1)
2       FORMAT(' 72057598332895232 is represented as ',1H',Z8.8,Z8.8,3H'x.)
        TYPE *,'Recall that 72057598332895232 is C(2) concatenated
      1 with C(1).'
        END
```

This Fortran example demonstrates how to call LIB$ADDX. The output generated by this program is as follows:

```
Let A = 576447592255193089.
Then A + B is 0.
"A" - "A" is '00'x.
Note that C is C(2) concatenated with C(1).
LET A = 72057594037927937 and B = 4294967295
Then A + B is            0   268435457
72057598332895232 is represented as '10000001       0'x.
Recall that 72057598332895232 is C(2) concatenated  with C(1).
```

LIB$ADD_TIMES

LIB$ADD_TIMES — The Add Two Quadword Times routine adds two internal format times.

Format

LIB$ADD_TIMES time1 ,time2 ,resultant-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

time1

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

First time that LIB$ADD_TIMES adds to the second time. The **time1** argument is the address of an unsigned quadword containing the first time to be added. The **time1** argument may be either a delta time or an absolute time; however, at least one of the arguments, **time1** or **time2**, must be a delta time.

time2

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Second time that LIB$ADD_TIMES adds to the first time. The **time2** argument is the address of an unsigned quadword containing the second time to be added. The **time2** argument may be either a delta time or an absolute time; however, at least one of the arguments, **time1** or **time2**, must be a delta time.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

The result of adding **time1** and **time2**. The resultant-time argument is the address of an unsigned quadword containing the result. If both **time1** and **time2** are delta times, then resultant-time is a delta time. Otherwise, resultant-time is an absolute time.

Description

LIB$ADD_TIMES adds two OpenVMS internal times. It can add two delta times or a delta time and an absolute time. LIB$ADD_TIMES cannot add two absolute times.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_IVTIME	Invalid time.
LIB$_ONEDELTIM	At least one delta time is required.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$ANALYZE_SDESC

LIB$ANALYZE_SDESC — The Analyze String Descriptors routine extracts the length and the address at which the data starts for a variety of 32-bit string descriptor classes.

Format

```
LIB$ANALYZE_SDESC input-descriptor ,data-length ,data-address
```

Corresponding JSB Entry Point

```
LIB$ANALYZE_SDESC_R2
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

input-descriptor

OpenVMS usage:	descriptor
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Input descriptor from which LIB$ANALYZE_SDESC extracts the length of the data and the address at which the data starts. The **input-descriptor** argument is the address of a descriptor pointing to the input data.

data-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the data; LIB$ANALYZE_SDESC extracts this length value from the input descriptor. The **data-length** argument is the address of an unsigned word integer into which LIB$ANALYZE_SDESC writes the length.

data-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Starting address of the data; LIB$ANALYZE_SDESC extracts this address from the input descriptor. The **data-address** argument is the address of an unsigned longword into which LIB $ANALYZE_SDESC writes the starting address of the data.

Description

LIB$ANALYZE_SDESC extracts the length and the address at which the data starts for a variety of 32-bit string descriptor classes. Following is a description of the classes of string descriptors.

Class	Description	Restrictions/Notes
A	Array	DSC$L_ARSIZE must be less than 65,536 bytes.

Class	Description	Restrictions/Notes
D	Decimal string	Treated as class S.
NCA	Noncontiguous array	Same as class A.
S	Scalar, string	None.
SD	Decimal scalar	Treated as class S.
VS	Varying string	Length returned is CURLEN.
Z	Unspecified	Treated as class S.

See STR$ANALYZE_SDESC for a similar routine that signals an error rather than returning a status.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVSTRDES	Invalid string descriptor. An array descriptor has an ARSIZE greater than 65,535 bytes, or the class is unsupported.

LIB$ANALYZE_SDESC_64

LIB$ANALYZE_SDESC_64 — The Analyze String Descriptor routine extracts the length and the address at which the data starts for a variety of 32-bit and 64-bit string descriptor classes.

Format

```
LIB$ANALYZE_SDESC_64 input-descriptor ,data-length ,data-address [,descriptor-type
```

Corresponding JSB Entry Point

LIB$ANALYZE_SDESC_R2	Refer to the LIB$ANALYZE_SDESC routine for information about the JSB entry point, LIB$ANALYZE_SDESC_R2. This JSB entry point returns 64-bit results on Alpha and I64 systems.

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

input-descriptor

OpenVMS usage:	descriptor
type:	longword (unsigned) or quadword (unsigned)
access:	read only
mechanism:	by reference

Input descriptor from which LIB$ANALYZE_SDESC_64 extracts the length of the data and the address at which the data starts. The **input-descriptor** argument is the address of a descriptor pointing to the input data. The input descriptor can be a longword (unsigned) or a quadword (unsigned).

data-length

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Length of the data; LIB$ANALYZE_SDESC_64 extracts this length value from the input descriptor. The **data-length** argument is the address of an unsigned quadword integer into which LIB $ANALYZE_SDESC_64 writes the length.

data-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Starting address of the data; LIB$ANALYZE_SDESC_64 extracts this address from the input descriptor. The **data-address** argument is the address of an unsigned quadword into which LIB $ANALYZE_SDESC_64 writes the starting address of the data.

descriptor-type

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Flag value indicating the type of input descriptor. The **descriptor-type** argument contains the address of an unsigned longword integer to which LIB$ANALYZE_SDESC_64 writes a 0 for a 32-bit input descriptor or a 1 for a 64-bit descriptor.

This argument is optional.

Description

LIB$ANALYZE_SDESC_64 extracts the length and the address at which the data starts for a variety of 32-bit and 64-bit string descriptor classes. Following is a description of the classes of string descriptors:

Class	Description	Restrictions/Notes
A	Array	For 32-bit descriptors, DSC$L_ARSIZE must be less than 2^{16}, or 65,536, bytes. For 64-bit descriptors, DSC64$Q_ ARSIZE must be less than 2^{64} bytes.
D	Decimal string	Treated as class S.
NCA	Noncontiguous array	Same as class A.

Class	Description	Restrictions/Notes
S	Scalar, string	None.
SD	Decimal scalar	Treated as class S.
VS	Varying string	Length returned is CURLEN.
Z	Unspecified	Treated as class S.

See STR$ANALYZE_SDESC_64 for a similar routine that signals an error rather than returning a status.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVSTRDES	Invalid string descriptor. An array descriptor has an ARSIZE greater than 65,535 bytes, or the class is unsupported.

LIB$ASN_WTH_MBX

LIB$ASN_WTH_MBX — The Assign Channel with Mailbox routine assigns a channel to a specified device and associates a mailbox with the device. It returns both the device channel and the mailbox channel.

Format

```
LIB$ASN_WTH_MBX device-name [,maximum-message-size] [,buffer-quota] ,device-channe
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

device-name

OpenVMS usage:	device_name
type:	character string
access:	read only
mechanism:	by descriptor

Device name that LIB$ASN_WTH_MBX passes to the $ASSIGN service. The **device-name** argument is the address of a descriptor pointing to the device name.

maximum_message_size

OpenVMS usage:	longword_signed

type:	longword integer (signed)
access:	read only
mechanism:	by reference

Maximum message size that can be sent to the mailbox; LIB$ASN_WTH_MBX passes this argument to the $CREMBX service. The **maximum-message-size** argument is the address of a signed longword integer containing this maximum message size.

buffer-quota

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of system dynamic memory bytes that can be used to buffer messages sent to the mailbox; LIB $ASN_WTH_MBX passes this argument to the $CREMBX service. The **buffer-quota** argument is the address of a signed longword integer containing this buffer quota.

device-channel

OpenVMS usage:	word_unsigned
type:	word integer (unsigned)
access:	write only
mechanism:	by reference

Device channel that LIB$ASN_WTH_MBX receives from the $ASSIGN service. The **device-channel** argument is the address of an unsigned word integer into which $ASSIGN writes the device channel.

mailbox-channel

OpenVMS usage:	channel
type:	word integer (unsigned)
access:	write only
mechanism:	by reference

Mailbox channel that LIB$ASN_WTH_MBX receives from the $CREMBX service. The **mailbox-channel** argument is the address of an unsigned word integer into which $CREMBX writes the mailbox channel.

Description

A mailbox is a virtual device used for communication between processes. A channel is the communication path that a process uses to perform I/O operations to a particular device. LIB $ASN_WTH_MBX assigns a channel to a device and associates a mailbox with the device. It returns both the device channel and the mailbox channel to the mailbox.

Normally, a process calls the $CREMBX system service to create a mailbox and assign a channel and logical name to it. Any process running in the same job and using the same logical name uses the same mailbox.

LIB$ASN_WTH_MBX associates the physical mailbox name with the channel assigned to the device. To create a temporary mailbox for itself and other processes cooperating with it, your program calls LIB$ASN_WTH_MBX. The Run-Time Library routine assigns the channel and creates the temporary mailbox by using the system services $GETDVIW, $ASSIGN, and $CREMBX. Instead of a logical name, the mailbox is identified by a physical device name of the form MB*cu*. The physical device name MB*cu* is made up of the following elements:

MB	Indicates that the device is a mailbox
c	Is the controller
u	Is the unit number

The routine returns the channel for this device name to the calling program, which then must pass the mailbox channel to the other programs with which it cooperates. In this way, the cooperating processes access the mailbox by its physical name, instead of by a logical name.

The calling program passes the routine a device name, which specifies the device to which the channel is to be assigned. For this argument (called **device-name**), you may use a logical name. If you do so, the routine attempts one level of logical name translation.

The privilege restrictions and process quotas required for using this routine are those required by the $GETDVIW, $CREMBX, and $ASSIGN system services.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

Any condition value returned by the called system services $ASSIGN, $CREMBX, $GETDVI, or the RTL routines LIB$GET_EF and LIB$FREE_EF.

LIB$AST_IN_PROG

LIB$AST_IN_PROG — The AST in Progress routine indicates whether an AST is currently in progress.

Format

LIB$AST_IN_PROG

Returns

OpenVMS usage:	boolean
type:	boolean
access:	write only
mechanism:	by value

Truth value that indicates whether an AST is currently in progress (value = 1) or not (value = 0).

Arguments

None.

Description

An asynchronous system trap (AST) is an OpenVMS mechanism for providing a software interrupt when an external event occurs, such as the user pressing Ctrl/C. When an external event occurs, the OpenVMS operating system interrupts the execution of the current process and calls a routine that you supply. While that routine is active, the AST is said to be in progress, and the process is said to be executing at AST level. When your AST routine returns control to the original process, the AST is no longer active, and execution continues where it left off.

LIB$AST_IN_PROG indicates to the calling program whether an AST is currently in progress. Your program can call LIB$AST_IN_PROG to determine whether it is executing at AST level and then take appropriate action. This routine is useful if you are writing AST-reentrant code, which takes different actions depending on whether an AST is in progress. For example, the routine might have two separate statically allocated storage areas, one for AST level and one for non-AST level.

LIB$AST_IN_PROG calls the RTL routines LIB$FREE_EF and LIB$GET_EF, and the $GETJPI system service. If LIB$AST_IN_PROG or any of these routines encounters an error, LIB $AST_IN_PROG calls LIB$STOP.

Condition Values Returned

None.

Example

```
PROGRAM AST_IN_PROGRESS(INPUT, OUTPUT);
FUNCTION LIB$AST_IN_PROG : INTEGER; EXTERN;
VAR
  ASTVALUE : INTEGER;
BEGIN
  ASTVALUE := LIB$AST_IN_PROG;
  CASE ASTVALUE OF
    0 :   WRITELN('AN AST IS NOT IN PROGRESS');
     1   :  WRITELN('AN AST IS IN PROGRESS');
  END { of the case statement }
END.
```

This Pascal program determines whether or not an AST is in progress.

LIB$ATTACH

LIB$ATTACH — The Attach Terminal to Process routine requests the calling process's command language interpreter (CLI) to detach the terminal of the calling process and to reattach it to a different process.

Format

LIB$ATTACH process-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

process-id

OpenVMS usage:	process_id
type:	longword integer (unsigned)
access:	read only
mechanism:	by reference

Identification of the process to which LIB$ATTACH requests the calling process to attach its terminal. The **process-id** argument is the address of an unsigned longword integer containing the process identification. The specified process must be currently detached (by means of a SPAWN or ATTACH command or by a call to LIB$SPAWN or LIB$ATTACH) and must be part of the caller's job.

Description

LIB$ATTACH requests the calling process's command language interpreter (CLI) to detach the terminal of the calling process and reattach it to a different process. The calling process then hibernates. LIB $ATTACH provides the same function as the DCL command ATTACH. For more information on ATTACH, see the *VSI OpenVMS DCL Dictionary*.

LIB$ATTACH is supported for use with the DCL CLI. If used with the Monitor Control Routine (MCR) CLI, the error status LIB$_NOCLI is returned. If an image is run directly as a subprocess or detached process, no CLI is present to perform this function. In such cases, the error status LIB$_NOCLI is returned.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_NONEXPR	Nonexistent process. The process specified by **process-id** does not exist.
LIB$_ATTREQREF	Attach request refused. The specified process could not be attached to. Either it was not detached or it did not belong to the caller's job.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status, which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL CLI, please report the problem to your VSI support representative.

LIB$BBCCI

LIB$BBCCI — The Test and Clear Bit with Interlock routine tests and clears a selected bit under memory interlock. LIB$BBCCI makes the VAX BBCCI instruction available as a callable routine.

Format

```
LIB$BBCCI position ,bit-zero-address
```

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

State of the bit before it was cleared by LIB$BBCCI: 1 if the bit was previously set, and 0 if the bit was previously clear.

Arguments

position

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Bit position, relative to **bit-zero-address**, of the bit that LIB$BBCCI tests and clears. The **position** argument is the address of a signed longword integer containing the bit position. A position of zero denotes the low-order bit of the byte base. The bit position is equal to the offset of the bit chosen from the base position. This offset may span the entire range of a signed longword integer; negative offsets access bits in lower addressed bytes.

bit-zero-address

OpenVMS usage:	unspecified
type:	address
access:	read only
mechanism:	by value

Address of the byte containing bit 0 of the field that LIB$BBCCI references. The **bit-zero-address** argument is the location of the base position. The bit that LIB$BBCCI tests and clears is position bits offset from the low bit of **bit-zero-address**.

Description

The single bit specified by *position* and *bit-zero-address* is tested, the previous state of the bit remembered, and the bit cleared. The reading of the state of the bit and its clearing are interlocked

against similar operations by other processors or devices in the system. The remembered previous state of the bit is then returned as the function value of LIB$BBCCI.

Condition Values Returned

None.

Example

```
C+
C This Fortran program demonstrates the use of
C LIB$BBCCI.
C-
        INTEGER*4 STATES(4)        ! 128 shared state bits
        COMMON /STATES/ STATES     ! Could be shared memory
        LOGICAL*4 LIB$BBCCI
        IF (LIB$BBCCI (42, STATES)) THEN
            TYPE *,'State bit 42 was set'
        ELSE
            TYPE *,'State bit 42 was clear'
        END IF
        END
```

This Fortran example tests and clears bit 42 of array STATES, which is in a COMMON area (possibly shared between two processors).

The output generated by this program is as follows:

```
$ RUN STATE
State bit 42 was clear.
```

LIB$BBSSI

LIB$BBSSI — The Test and Set Bit with Interlock routine tests and sets a selected bit under memory interlock. LIB$BBSSI makes the VAX BBSSI instruction available as a callable routine.

Format

LIB$BBSSI position ,bit-zero-address

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

The state of the bit before it was set by LIB$BBSSI: 1 if it was previously set, and 0 if it was previously clear.

Arguments

position

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Bit position, relative to **bit-zero-address**, of the bit that LIB$BBSSI tests and sets. The **position** argument is the address of a signed longword integer containing the bit position. A position of zero denotes the low-order bit of the byte base. The bit position is equal to the offset of the bit chosen from the base position. This offset may span the entire range of a signed longword integer; negative offsets access bits in lower addressed bytes.

bit-zero-address

OpenVMS usage:	unspecified
type:	address
access:	read only
mechanism:	by value

Address of the byte containing bit 0 of the field that LIB$BBSSI references. The **bit-zero-address** argument is the location of the base position. The bit that LIB$BBSSI tests and sets is position bits offset from the low bit of **bit-zero-address**.

Description

The single bit specified by *position* and *bit-zero-address* arguments is tested, the previous state of the bit remembered, and the bit set. The reading of the state of the bit and its setting are interlocked against similar operations by other processors or devices in the system. The remembered previous state of the bit is then returned as the function value of LIB$BBSSI.

Condition Values Returned

None.

Example

```
C+
C This Fortran example program demonstrates
C the use of LIB$BBSSI.
C-

      INTEGER*4 STATES(4)       ! 128 shared state bits
      COMMON /STATES/ STATES    ! Could be shared memory
      LOGICAL*4 LIB$BBSSI
      IF (LIB$BBSSI (104, STATES)) THEN
       TYPE *,'State bit 104 was set'
      ELSE
       TYPE *,'State bit 104 was clear'
      END IF
      END
```

This Fortran example tests and sets bit 104 of array STATES, which is in a COMMON storage area (possibly shared between two processors).

The output generated by this program is as follows:

```
$ RUN STATEB
State bit 104 was clear.
```

LIB$BUILD_NODESPEC

LIB$BUILD_NODESPEC — The Build a Node-Name Specification routine builds a node-name specification from the primary node name. The output node-name specification can be used for other node-name parsing operations.

Format

LIB$BUILD_NODESPEC primary-nodename, nodespec [,acs] [,secondary-nodename] [,nodes

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

primary-nodename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Primary node name. The **primary-nodename** argument contains the address of a descriptor pointing to this node-name string. The primary node name should not contain unnecessary quotation marks (that is, quotation marks (" ") that are not part of a simple name within the node name).

The error LIB$_INVARG is returned if **primary-nodename** points to a null string. The error LIB $_INVSTRDES is returned if **primary-nodename** is an invalid descriptor.

nodespec

OpenVMS usage:	
type:	
access:	
mechanism:	

Node-name specification. The **nodespec** argument contains the address of a descriptor pointing to this output node-name specification string. LIB$BUILD_ NODESPEC writes the output node-name specification into the buffer pointed to by the **nodespec** descriptor.

The error LIB$_INVSTRDES is returned if **nodespec** is an invalid descriptor.

The length field of the **nodespec** descriptor is not updated unless **nodespec** is a dynamic descriptor with a length less than the resultant node-name specification. Refer to the *OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The **nodespec** argument contains an unusable result when LIB$BUILD_NODESPEC returns in error.

acs

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	dy descriptor

Access control string. The **acs** argument contains the address of a descriptor pointing to this access control string. The access control string must be a quoted string.

The error LIB$_INVSTRDES is returned if **acs** is an invalid descriptor.

secondary-nodename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	dy descriptor

Secondary node name. The **secondary-nodename** argument contains the address of a descriptor pointing to this secondary node-name string.

The error LIB$_INVSTRDES is returned if **secondary-nodename** is an invalid descriptor.

nodespec-length

OpenVMS usage:	unsigned_word
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the output node-name specification. The **nodespec-length** argument is the address of an unsigned word that contains this length in bytes.

The **nodespec-length** argument contains an unusable result when LIB$BUILD_ NODESPEC returns in error.

Description

This routine builds the parsable form of a node name as the output node-name specification from the network usable form. Refer to LIB$GET_HOSTNAME for the definitions of both the parsable form and the network usable form.

The network usable form is specified by the argument *primary-nodename*. If *primary-nodename* contains special characters, it is enclosed in quotation marks (" ") to build the node-name specification. The quotation marks prevent the special characters from being recognized as terminator characters and enables correct parsing of the node-name syntax.

If you enclose *primary-nodename* in quotation marks, any quotation marks that are part of any simple names within *primary-nodename* are doubled (that is, each quotation mark (") is turned into two quotation marks (")). LIB$BUILD_NODESPEC checks if the fully quoted primary node name exceeds 1024 characters. The error condition LIB$_NODTOOLNG is returned if this is the case.

To form the output node-name specification, the fully quoted primary node name is concatenated with the access control string (if supplied) and the double colons and is followed by the secondary node name (if supplied).

This routine does not validate any of the input arguments to ensure they can form a syntactically valid node name when they are concatenated.

If the routine overflows the output buffer pointed to by *nodespec*, the output node-name specification is truncated, and the alternate successful status LIB$_STRTRU is returned.

The *nodespec-length* argument, if supplied, is always set to the length of the node-name specification that is written into the output buffer pointed to by *nodespec*.

Condition Value Returns

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. The **primary-nodename** argument points to a null string.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_NODTOOLNG	The primary node name after quoting exceeds 1024 characters.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by the **nodespec** argument.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by LIB$SCOPY_DXDX.

LIB$CALLG

LIB$CALLG — The Call Routine with General Argument List routine calls a routine with an argument list specified as an array of longwords, the first of which is a count of the remaining longwords. LIB $CALLG is a callable version of the VAX CALLG instruction.

Format

LIB$CALLG argument-list ,user-procedure

Returns

OpenVMS usage:	longword_unsigned

type:	longword (unsigned)
access:	write only
mechanism:	by value

Return value, if any, of the called routine, unchanged by LIB$CALLG.

Arguments

argument-list

OpenVMS usage:	arg_list
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Argument list to be passed to user-procedure. The argument-list argument is the address of an array of longwords that is the argument list. The first longword contains the count of the remaining longwords, to a maximum of 255.

user-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

Routine that LIB$CALLG calls with the specified argument list.

Description

LIB$CALLG is used to call routines that accept variable-length argument lists when the number of arguments to be passed is not known until execution time. LIB$CALLG is also used to call such routines from strongly typed languages, which require routines to be declared as having a fixed number of arguments.

Condition Values Returned

None.

LIB$CALLG_64

LIB$CALLG_64 — The Call Routine with General Argument List routine calls a routine with an argument list specified as an array of quadwords, the first of which is a count of the remaining quadwords.

Format

```
LIB$CALLG_64 argument-list ,user-procedure
```

Returns

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	write only
mechanism:	by value

Return value, if any, of the called routine, unchanged by LIB$CALLG_64.

Arguments

argument-list

OpenVMS usage:	arg_list
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Argument list to be passed to user-procedure. The argument-list argument is the address of an array of quadwords that is the argument list. The first quadword contains the count of the remaining quadwords, to a maximum of 255.

user-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

Routine that LIB$CALLG_64 calls with the specified argument list.

Description

LIB$CALLG_64 is useful for calling routines that accept variable-length argument lists when the number of arguments to be passed is not known until execution time. LIB$CALLG_64 can also be used to call such routines from strongly typed languages, which require routines to be declared as having a fixed number of arguments.

Condition Values Returned

None.

LIB$CHAR

LIB$CHAR — The Transform Byte to First Character of String routine transforms a single 8-bit ASCII character to an ASCII string consisting of a single character followed by trailing spaces, if needed, to fill out the string. The range of the input byte is 0 through 255.

Format

LIB$CHAR one-character-string ,ascii-code

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

one-character-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

ASCII character string consisting of a single character followed by trailing spaces, if needed, that LIB $CHAR creates when it transforms the ASCII character code. The one-character-string argument is the address of a descriptor pointing to the character string that LIB$CHAR writes.

ascii-code

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Single 8-bit ASCII character code that LIB$CHAR transforms to an ASCII string. The ascii-code argument is the address of an unsigned byte containing the ASCII character code.

Description

LIB$CHAR is the inverse of LIB$ICHAR. (See the description of LIB$ICHAR.) LIB$CHAR is not a binary-to-ASCII conversion routine. LIB$CHAR merely interprets ascii-code as an ASCII character code and converts it to a string.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.

LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Routine successfully completed, but the string was truncated. The destination string could not contain all of the characters.

LIB$COMPARE_NODENAME

LIB$COMPARE_NODENAME — The Compare Two Node Names routine compares two node names to see if they resolve to the same full name. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$COMPARE_NODENAME nodename1 ,nodename2 ,comparison-result
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

nodename1

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

First node name to be compared. The **nodename1** argument contains the address of a descriptor pointing to this node-name string.

The error LIB$_INVARG is returned if **nodename1** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if nodename1 is an invalid descriptor.

nodename2

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Second node name to be compared. The **nodename2** argument contains the address of a descriptor pointing to this node-name string.

The error LIB$_INVARG is returned if **nodename2** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if nodename2 is an invalid descriptor.

comparison-result

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Result of the comparison. The **comparison-result** argument is the address of an unsigned longword that contains the comparison result. If the two node names are equal, 0 is returned. If they are not equal, 1 is returned.

Comparison-result contains an unusable result when LIB$COMPARE_ NODENAME returns in error.

Description

This routine compares two node names and checks to see if they resolve to the same full name. The two node names are first expanded using LIB$EXPAND_NODENAME. Any errors that result from expanding the input node names are propagated and returned as condition values. A string comparison is performed on the expanded node names to check if they resolve to the same full name. The result of the comparison is returned in **comparison-result** as follows:

comparison-result **Value**	**Meaning**
0	Node names are equal.
1	Node names are not equal.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument: • **nodename1** or **nodename2** is an invalid node name. • **nodename1** or **nodename2** points to a null string. • The length of the node name is more than 1024 characters. • The expanded DECnet-Plus for OpenVMS node name is invalid in a DECnet for OpenVMS environment.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by RTL routine LIB$SCOPY_R_DX or by the $IPC DECnet service.

LIB$COMPRESS_NODENAME

LIB$COMPRESS_NODENAME — The Compress a Node Name to Its Short Form Equivalence routine compresses a node name to an unambiguous short form usable within the naming environment where the compression is performed. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$COMPRESS_NODENAME nodename ,compressed-nodename [,resultant-length]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

nodename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Node name to be compressed. The **nodename** argument contains the address of a descriptor pointing to this node-name string.

The error LIB$_INVARG is returned if **nodename** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if the **nodename** descriptor is invalid.

compressed-nodename

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Compressed node name. The **compressed-nodename** argument contains the address of a descriptor pointing to the compressed node-name string. LIB$COMPRESS_NODENAME writes the compressed node name into the buffer pointed to by **compressed-nodename**.

The error LIB$_INVSTRDES is returned if **compressed-nodename** is an invalid descriptor.

The length field of the **compressed-nodename** descriptor is not updated unless **compressed-nodename** is a dynamic descriptor with a length less than the resulting compressed node name. Refer to the *OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The **compressed-nodename** argument contains an unusable result when LIB $COMPRESS_NODENAME returns in error.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the compressed node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB$COMPRESS_NODENAME returns in error.

Description

This routine compresses a given node name to a short form that is usable within the local naming environment in which the compression is performed. The local naming environment is defined by the underlying network directory services. Be careful when using the compressed node name for making network connections. Using the compressed node name outside the intended local naming environment may result in an ambiguous reference. Use the full name whenever you need to eliminate ambiguity.

The *nodename* argument is validated against the supported form of node names. The error LIB $_INVARG is returned if the input node name is invalid.

When calling LIB$COMPRESS_NODENAME in a DECnet-Plus for OpenVMS environment, the underlying network layer verifies the existence of the input node name. If the input node name does not resolve to an existing node name in the naming environment, an error condition is returned by the underlying network layer and propagated back to the caller of LIB$COMPRESS_NODENAME.

If the returned compressed node name overflows the buffer pointed to by *compressed-nodename*, the compressed node name is truncated, and the alternate successful status LIB$_STRTRU is returned.

The actual length of the compressed node name written to the output buffer *compressed-nodename* is returned in *resultant-length* if this argument is supplied.

In a DECnet environment, compressing a DECnet-Plus node name results in the error condition LIB $_INVARG.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by **compressed-nodename**.
LIB$_INVARG	Invalid argument: • **nodename** is invalid. • **nodename** points to a null string.

	• The length of the node name is more than 1024 characters. • The compressed DECnet-Plus for OpenVMS node name is invalid in a DECnet for OpenVMS environment.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by RTL routine LIB$SCOPY_R_DX or by the $IPC DECnet service.

LIB$CONVERT_DATE_STRING

LIB$CONVERT_DATE_STRING — The Convert Date String to Quadword routine converts an absolute date string into an OpenVMS internal format date-time quadword. That is, given an input date/time string of a specified format, LIB$CONVERT_DATE_STRING converts this string to an OpenVMS internal format time.

Format

```
LIB$CONVERT_DATE_STRING date-string ,date-time [,user-context] [,flags] [,defaults
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

date-string

OpenVMS usage:	time_name
type:	character-coded text string
access:	read only
mechanism:	by descriptor

Date string that specifies the absolute time to be converted to an internal system time. The **date-string** argument is the address of a descriptor pointing to this date string. This string must have a format corresponding to the currently defined input format, or it must be one of the relative day strings YESTERDAY, TODAY, or TOMORROW, or their equivalents in the currently selected language.

date-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Receives the converted time. The **date-time** argument is the address of an unsigned quadword that contains this OpenVMS internal format converted time.

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context variable that receives the translation context from a call to LIB $INIT_DATE_TIME_CONTEXT and then retains the translation context over multiple calls to LIB $CONVERT_DATE_STRING. The **user-context** argument is the address of an unsigned longword that contains this context. The user program should not write directly to this variable once it is initialized.

The **user-context** parameter is optional. However, if a context cell is not passed, the routine LIB $CONVERT_DATE_STRING may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, VSI recommends that users specify a different context cell for each calling thread.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Specifies which date or time fields of the **date-string** argument might be omitted so that default values are applied. The **flags** argument is the address of a longword bit mask that contains these flags. A set bit indicates that the field may be omitted. The bit definitions for the mask correspond to the fields in a $NUMTIM “timbuf” structure as follows:

Field	**Bit Number**	**Mask**
Year	0	#1
Month	1	#2
Day of month	2	#4
Hours	3	#8
Minutes	4	16
Seconds	5	32
Fractional seconds	6	64

Bits 7 through 31 must be zero and are reserved for use by VSI. If this parameter is omitted, a default value of 120 (78H) is used, indicating that the time fields may be defaulted but the date fields may not.

defaults

OpenVMS usage:	vector_word_unsigned
type:	word (unsigned)

access:	read only
mechanism:	by reference, array reference

Supplies the defaults to be used for omitted fields. The **defaults** argument is the address of an array of unsigned words containing these default values. This array corresponds to a 7-word $NUMTIM "timbuf" structure. If the **defaults** argument is omitted, the following defaults are applied:

- For the date group, the default is the current date.
- For the time group, the default is 00:00:00.00.

defaulted-field

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Indicates which date or time fields have been defaulted. The **defaulted-fields** argument is the address of a longword bit mask that specifies these fields. The bit definitions are identical to those of the **flags** bit mask. A set bit indicates that the field was defaulted. Bits 7 through 31, which are reserved for use by VSI, are zeroed.

Description

LIB$CONVERT_DATE_STRING converts an absolute date string into an OpenVMS internal format date-time quadword. The input date string can either correspond to the format specified, or it can be the language equivalent of one of the relative date strings YESTERDAY, TODAY, or TOMORROW. The language to be used and the format in which to interpret the information are programmable using either of the following methods:

- The language and format are programmable at compile time through the use of the routine LIB $INIT_DATE_TIME_CONTEXT.
- The language and format can be determined at run time through the translation of the logical names SYS$LANGUAGE and LIB$DT_INPUT_FORMAT.

In general, if an application is reading text from internal storage, the language and input format should be specified at compile time. If this is the case, use the routine LIB$INIT_DATE_TIME_CONTEXT to specify the language and input format of your choice.

If an application is accepting text from a user, the logical name method of specifying language and format should be used. In this method, the user assigns equivalence names to the logical names SYS $LANGUAGE and LIB$DT_INPUT_FORMAT, thereby selecting the language and input format of the date and time at run time.

The calling program can choose to apply defaults for omitted fields in the date string. To do this, the *flags* argument is used to indicate which fields are to be defaulted, and the *defaults* argument is used to supply the default values. If the *defaults* argument is not supplied, the following default values are applied:

- For the date group, the default is the current date.

- For the time group, the default is 00:00:00.00.

Optionally, you can use the *defaulted-fields* argument to receive information on which input fields were omitted and thus accepted default values.

Note

Because the default is the current date for the date group, if you specify a value of 00 with the !Y2 format, the year is interpreted as 1900. After January 1, 2000, the value 00 will be interpreted as 2000.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_AMBDATTIM	Ambiguous date or time.
LIB$_DEFFORUSE	Default format used; unable to determine desired format.
LIB$_ENGLUSED	English used by default; unable to translate SYS$LANGUAGE.
LIB$_ILLFORMAT	Illegal format string; too many or not enough fields.
LIB$_INCDATTIM	Incomplete date or time; missing fields with no defaults.
LIB$_INVARG	Invalid argument; a required argument was not specified.
LIB$_INVSTRDES	Invalid input string descriptor.
LIB$_IVTIME	Invalid date or time.
LIB$_REENTRANCY	Reentrancy detected.
LIB$_UNRFORCOD	Unrecognized format code.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by RTL routines LIBGET_VM, LIBFREE_VM, LIB$FREE1_DD, and LIB$SCOPY_R_DX, and system services $NUMTIM and $GETTIM.

LIB$CRC

LIB$CRC — The Calculate a Cyclic Redundancy Check routine calculates the cyclic redundancy check (CRC) for a data stream.

Format

LIB$CRC crc-table ,initial-crc ,stream

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only

mechanism:	by value

The computed cyclic redundancy check.

Arguments

crc-table

OpenVMS usage:	vector_longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference, array reference

The 16-longword cyclic redundancy check table created by a call to LIB$CRC_ TABLE. The crc-table argument is the address of a signed longword integer containing this table. Because this table is created by LIB$CRC_TABLE and then used as input in LIB$CRC, your program must call LIB$CRC_TABLE before it calls LIB$CRC.

initial-crc

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Initial cyclic redundancy check. The **initial-crc** argument is the address of a signed longword integer containing the initial cyclic redundancy check.

stream

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Data stream for which LIB$CRC is calculating the CRC. The stream argument is the address of a descriptor pointing to the data stream.

Description

Before your program can call LIB$CRC, it must call LIB$CRC_TABLE. LIB$CRC_TABLE takes a polynomial as its input and builds the table that LIB$CRC uses to calculate the CRC.

LIB$CRC allows your high-level language program to use the CRC instruction, which calculates the cyclic redundancy check. This instruction checks the integrity of a data stream by comparing its state at the sending point and the receiving point. Each character in the data stream is used to generate a value based on a polynomial. The values for each character are then added together. This operation is performed at both ends of the data transmission, and the two result values compared. If the results disagree, then an error occurred during the transmission.

Condition Values Returned

None.

Example

For an example on how to use LIB$CRC, refer to the BASIC example at the end of the description of LIB$CRC_TABLE

LIB$CRC_TABLE

LIB$CRC_TABLE — The Construct a Cyclic Redundancy Check Table routine constructs a 16-longword table that uses a cyclic redundancy check polynomial specification as a bit mask.

Format

LIB$CRC_TABLE polynomial-coefficient ,crc-table

Returns

None.

Arguments

polynomial-coefficient

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

A bit mask indicating which polynomial coefficients are to be generated by LIB$CRC_TABLE. The **polynomial-coefficient** argument is the address of an unsigned longword integer containing this bit mask.

crc-table

OpenVMS usage:	vector_longword_signed
type:	longword (integer)
access:	write only
mechanism:	by reference, array reference

The 16-longword table that LIB$CRC_TABLE produces. The crc-table argument is the address of a signed longword integer containing the table.

Description

The table created by LIB$CRC_TABLE can be passed to the LIB$CRC routine for generating the cyclic redundancy check value for a stream of characters.

Condition Values Returned

None.

Example

```
1   %TITLE "Demonstrate LIB$CRC and LIB$CRC_TABLE"
    %SBTTL "Declarations"
    %IDENT "1-001"

    !--
    OPTION TYPE = EXPLICIT
    DECLARE LONG CRC_TABLE(15), ! CRC table array &
            LONG CRC_VAL_1, ! CRC for first stream &
            LONG CRC_VAL_2, ! CRC for second stream &
            STRING DATA_1, ! First data stream &
           STRING DATA_2 ! Second data stream
    EXTERNAL LONG FUNCTION LIB$CRC ! Rtn to calculate CRC
    EXTERNAL SUB LIB$CRC_TABLE ! Rtn to set up table for CRC

    OPEN "SYS$INPUT:" FOR INPUT AS FILE 1%
    !+
    ! Initialize the CRC table. Use the CRC-16 polynomial (refer to the
    ! VAX Architecture Reference Manual). This is the polynomial used by
    ! DDCMP and Bisync.
    !-

    CALL LIB$CRC_TABLE( O'120001'L, CRC_TABLE() BY REF )
    !+
    ! Get data from user.
    !-

    LINPUT #1%, 'Enter string: ';DATA_1
    !+
    ! Calc the CRC for the user's input. This CRC polynomial needs
    ! an initial CRC of 0 (refer to the VAX Architecture Reference Manual).
    ! LIB$CRC returns a longword, but only the low-order word is valid
    ! for this polynomial.
    !-

    CRC_VAL_1 = LIB$CRC( CRC_TABLE() BY REF, 0%, DATA_1 )
    CRC_VAL_1 = CRC_VAL_1 AND 32767%

    !+
    ! Get more data from user.
    !-

    LINPUT #1%, 'Enter a second string: ';DATA_2
    CRC_VAL_2 = LIB$CRC( CRC_TABLE() BY REF, 0%, DATA_2 )
    CRC_VAL_2 = CRC_VAL_2 AND 32767%

    !+
    ! Tell the user the results of the CRC comparison.
    !-

    IF CRC_VAL_1 = CRC_VAL_2
    THEN
```

```
        PRINT "The two CRCs";CRC_VAL_1;" and ";CRC_VAL_2;" were the same"
    ELSE
        PRINT "The two CRCs";CRC_VAL_1;" and ";CRC_VAL_2;" were different"
    END IF

    IF DATA_1 = DATA_2
    THEN
        PRINT "The two strings were the same"
    ELSE
        PRINT "The two strings were different"
    END IF
    END
```

This BASIC example program shows the use of LIB$CRC and LIB$CRC_TABLE. One example of the output generated by this program is as follows:

```
$ RUN CRC
Enter string:  DOVE
Enter a second string:  HOSE
The two CRCs 29915 and 29915 were the same
The two strings were different
```

LIB$CREATE_DIR

LIB$CREATE_DIR — The Create a Directory routine creates a directory or subdirectory.

Format

LIB$CREATE_DIR device-directory-spec [,owner-UIC] [,protection-enable] [,prot

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

device-directory-spec

OpenVMS usage:	device_name
type:	character string
access:	read only
mechanism:	by descriptor

Directory specification of the directory or subdirectory that LIB$CREATE_DIR will create. The **device-directory-spec** argument is the address of a descriptor pointing to this directory specification.

The format of the **device-directory-spec** string conforms to standard OpenVMS Record Management Services (RMS) format. This specification must contain a directory or subdirectory specification. It may

contain a disk specification. SMD$:[THIS.IS.IT] is an example of a standard RMS file specification, where SMD$ is the disk specification and [THIS.IS.IT] is the subdirectory specification.

This specification cannot contain a node name, file name, file type, file version, or wildcard characters. The maximum size of this string is 255 characters on VAX, and 4095 characters on Alpha.

owner-UIC

OpenVMS usage:	uic
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User identification code (UIC) identifying the owner of the created directory or subdirectory. The **owner-UIC** argument is the address of an unsigned longword that contains the UIC. If **owner-UIC** is zero, the owner UIC is that of the parent directory. The specified value for **owner-UIC** is interpreted as a 32-bit octal number, with two 16-bit fields:

- bits 00–15 — Member number
- bits 16–31 — Group number

This is an optional argument. The default is the UIC of the current process except when the directory is in UIC format. For a directory in UIC format, for example [123,321], the UIC of the created directory is used.

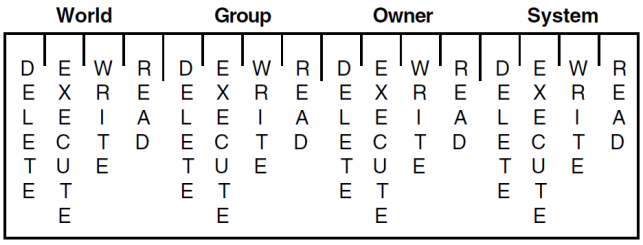
protection-enable

OpenVMS usage:	mask_word
type:	word (unsigned)
access:	read only
mechanism:	by reference

Mask specifying the bits of **protection-value** to be set. The **protection-enable** argument is the address of an unsigned word containing this protection mask.

The figure below shows the structure of a protection mask. Access is allowed for bits set to 0.

Figure 2.1. Structure of a Protection Mask



Bits set in the **protection-enable** mask cause corresponding bits of **protection-value** to be set. Bits not set in the **protection-enable** mask cause corresponding bits of **protection-value** to take the value of the corresponding bit in the parent directory's file protection. Bits in the parent directory's file protection that indicate delete access do not cause corresponding bits of **protection-value** to be set, however.

Following is an example of how the **protection-value** protection mask is defined:

Mask Name	Hexadecimal Number	Value
Protection enable	%XDBFF	S:None, O:None, G:E, W:W
Parent directory	%X13FF	S:RWED, O:RWED, G:RW, W:R
Protection value	%X37FF	S:RWE, O:RWE, G:RWE, W:RW

The **protection-enable** argument is optional. It should be used only when you want to change protection values from the parent directory's default file protection. The default for **protection-enable** is a mask of all zero bits, which results in the propagation of the parent directory's file protection. If the **protection-enable** mask contains zeros, **protection-value** is ignored.

protection-value

OpenVMS usage:	file_protection
type:	word (unsigned)
access:	read only
mechanism:	by reference

System/Owner/Group/World protection value of the directory you are creating. The **protection-value** argument is the address of an unsigned word that contains this protection mask.

The bits of protection-value are set or cleared in the method described in the definition of protection-enable above.

The protection-value argument is optional. The default is a word of all zero bits, which specifies full access for all access categories. Typically, protection-value is not omitted unless protection-enable is also omitted. If protection-enable is omitted, protection-value is ignored.

maximum-versions

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Maximum number of versions allowed for files created in the newly created directories. The **maximum-versions** argument is the address of an unsigned word containing the value of the maximum number of versions.

The **maximum-versions** argument is optional. The default is the parent directory's default version limit. If **maximum-versions** is zero, the maximum number of versions is not limited.

relative-volume-number

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only

mechanism:	by reference

Relative volume number within a volume set on which the directory or subdirectory is created. The **relative-volume-number** argument is the address of an unsigned word containing the relative volume number. The **relative-volume-number** argument is optional. The default is arbitrary placement within the volume set.

initial-allocation

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Initial number of blocks to be allocated to the directory. This argument is useful for creating large directories, for example MAIL.DIR;1. It can improve performance by avoiding the need for later dynamic expansion of the directory.

The **initial-allocation** argument applies only to Files–11 Level 2 volumes; it is ignored for other volumes.

This argument is the address of an unsigned longword that contains the initial number of blocks to be allocated to the directory.

The **initial-allocation** argument is optional. The default allocation is 1 block.

Description

LIB$CREATE_DIR creates a directory. You can specify:

- The owner and protection of the directory.
- The maximum number of different versions of a file that can exist in the directory.
- The relative volume number of the volume set member in which the directory is to be created.
- The number of blocks to be allocated initially to the directory.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_CREATED	Routine successfully completed; one or more directories created.
SS$_NORMAL	Routine successfully completed; all specified directories already exist.
LIB$_INVARG	Invalid argument to Run-Time Library. Either the required argument was omitted, or **device-directory-spec** is longer than 4095 characters.

LIB$_INVFILSPE	Invalid file specification. Either the file specification did not contain an explicit directory and device name, or it contained a node name, file name, file type, file version, or wildcard. This error is also produced if the device specified was not a disk.

Any condition values returned by system services $ASSIGN, $DASSGN, $PARSE, and $QIO, and RTL routines LIB$ANALYZE_SDESC, LIB$ANALYZE_SDESC_ 64, and LIB$GET_EF.

LIB$CREATE_USER_VM_ZONE

LIB$CREATE_USER_VM_ZONE — The Create User-Defined Storage Zone routine creates a new user-defined storage zone in the 32-bit virtual address space.

Format

```
LIB$CREATE_USER_VM_ZONE zone-id [,user-argument] [,user-allocation-procedure]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Zone identifier. The **zone-id** argument is the address of a longword that receives the identifier of the newly created zone.

user-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User argument. The **user-argument** argument is the address of an unsigned longword containing the user argument. LIB$CREATE_USER_VM_ZONE copies the value of **user-argument** and supplies the value to all user procedures invoked.

user-allocation-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User allocation routine.

user-deallocation-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User deallocation routine.

user-reset-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User routine invoked each time LIB$RESET_VM_ZONE is called for the zone.

user-delete-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User routine invoked when LIB$DELETE_VM_ZONE is called for the zone.

zone-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

Description

LIB$CREATE_USER_VM_ZONE creates a user-defined zone in the 32-bit virtual address space. If an error status is returned, the zone is not created.

Each time that one of the heap management routines (LIBGET_VM, LIBFREE_VM, LIB $RESET_VM_ZONE, or LIB$DELETE_VM_ZONE) is called to perform an operation on a user-defined zone, the corresponding user routine that you supplied is used.

You may omit any of the optional user routines. However, if you omit a routine and later call the corresponding heap management routine, the error status LIB$_INVOPEZON will be returned.

Call Format for User Routines

The user routines are called with arguments similar to those passed to LIBGET_VM, LIBFREE_VM, LIB$RESET_VM_ZONE, or LIB$DELETE_VM_ZONE. In each case, the *user-argument* argument from LIB$CREATE_USER_VM_ZONE is passed to the user routine rather than a *zone-id* argument.

The call format for a user get or free routine is as follows:

```
user-rtn   num-bytes ,base-adr ,user-argument
```

num-bytes

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes to allocate or free. The **num-bytes** argument is the address of a longword integer containing the number of bytes. The value of **num-bytes** must be greater than zero.

base-adr

OpenVMS usage:	address
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Virtual address of the first contiguous block of bytes allocated or freed. The **base-adr** argument is the address of an unsigned longword containing this base address. (This argument is write-only for a get routine and read-only for a free routine.)

user-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User argument. LIB$CREATE_USER_VM_ZONE copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB $GET_VM or LIB$FREE_VM.

The **zone-id** value that is returned can be used in calls to LIB$SHOW_VM_ZONE and LIB $VERIFY_VM_ZONE.

The call format for a user reset or delete routine is as follows:

user-rtn user-argument

user-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User argument. LIB$CREATE_USER_VM_ZONE copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB $RESET_VM_ZONE or LIB$DELETE_VM_ZONE.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor for **zone-name**.

LIB$CREATE_USER_VM_ZONE_64

LIB$CREATE_USER_VM_ZONE_64 — The Create User-Defined Storage Zone routine creates a new user-defined storage zone in the 64-bit virtual address space.

Format

```
LIB$CREATE_USER_VM_ZONE_64 zone-id [,user-argument] [,user-allocation-procedure] [
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	write only

mechanism:	by reference

Zone identifier. The **zone-id** argument is the address of a quadword that receives the identifier of the newly created zone.

user-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

User argument. The **user-argument** argument is the address of an unsigned quadword containing the user argument. LIB$CREATE_USER_VM_ZONE_64 copies the value of **user-argument** and supplies the value to all user procedures invoked.

user-allocation-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User allocation routine.

user-deallocation-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User deallocation routine.

user-reset-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User routine invoked each time LIB$RESET_VM_ZONE_64 is called for the zone.

user-delete-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User routine invoked when LIB$DELETE_VM_ZONE_64 is called for the zone.

zone-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

Description

LIB$CREATE_USER_VM_ZONE_64 creates a user-defined zone in the 64-bit virtual address space. If an error status is returned, the zone is not created.

Each time that one of the heap management routines (LIBGET_VM_64, LIBFREE_VM_64, LIB $RESET_VM_ZONE_64, or LIB$DELETE_VM_ZONE_ 64) is called to perform an operation on a user-defined zone, the corresponding user routine that you supplied is used.

You may omit any of the optional user routines. However, if you omit a routine and later call the corresponding heap management routine, the error status LIB$_INVOPEZON will be returned.

Call Format for User Routines

The user routines are called with arguments similar to those passed to LIB$GET_ VM_64, LIB $FREE_VM_64, LIB$RESET_VM_ZONE_64, or LIB$DELETE_VM_ ZONE_64. In each case, the **user-argument** argument from LIB$CREATE_ USER_VM_ZONE_64 is passed to the user routine rather than a **zone-id** argument.

The call format for a user get or free routine is as follows:

```
user-rtn num-bytes ,base-adr ,user-argument
```

num-bytes

OpenVMS usage:	quadword_signed
type:	quadword (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes to allocate or free. The **num-bytes** argument is the address of a quadword integer containing the number of bytes. The value of **num-bytes** must be greater than zero.

base-adr

OpenVMS usage:	address
type:	quadword (unsigned)
access:	modify

mechanism:	by reference

Virtual address of the first contiguous block of bytes allocated or freed. The **base-adr** argument is the address of an unsigned quadword containing this base address. (This argument is write-only for a get routine and read-only for a free routine.)

user-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

User argument. LIB$CREATE_USER_VM_ZONE_64 copies user-argument as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB $GET_VM_64 or LIB$FREE_VM_64.

The zone-id value that is returned can be used in calls to LIB$SHOW_VM_ZONE_64 and LIB $VERIFY_VM_ZONE_64.

The call format for a user reset or delete routine is as follows:

```
user-rtn user-argument
```

user-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

User argument. LIB$CREATE_USER_VM_ZONE_64 copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB $RESET_VM_ZONE_64 or LIB$DELETE_VM_ZONE_64.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor for **zone-name**.

LIB$CREATE_VM_ZONE

LIB$CREATE_VM_ZONE — The Create a New Zone routine creates a new storage zone in the 32-bit virtual address space, according to specified arguments. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$CREATE_VM_ZONE zone-id [,algorithm] [,algorithm-argument] [,flags] [,extend-si
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Zone identifier. The **zone-id** argument is the address of a longword that is set to the zone identifier of the newly created zone.

algorithm

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Algorithm. The **algorithm** argument is the address of a longword integer that contains a value representing one of the LIB$VM algorithms. Use one of the predefined symbols to specify this value.

Symbol	Value	Algorithm
LIB$K_VM_FIRST_FIT	1	First fit
LIB$K_VM_QUICK_FIT	2	Quick fit, lookaside list
LIB$K_VM_FREQ_SIZES	3	Frequent sizes, lookaside list
LIB$K_VM_FIXED	4	Fixed-size blocks

If **algorithm** is not specified, a default of 1 (first fit) is used.

algorithm-argument

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only

mechanism:	by reference

Algorithm argument. The **algorithm-argument** argument is the address of a longword integer that contains a value specific to the particular allocation algorithm as shown in the following table.

Algorithm	**Value**
First fit	Not used, may be omitted.
Quick fit	The number of lookaside lists used. The number of lists must be between 1 and 128.
Frequent sizes	The number of lookaside lists used. The number of lists must be between 1 and 16.
Fixed size blocks	The fixed request size (in bytes) for each get or free request. The request size must be greater than 0.

The **algorithm-argument** argument must be specified if you are using the quick-fit, frequent-sizes or fixed-size-blocks algorithms. However, this argument is optional, but ignored, if you are using the first-fit algorithm.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Flags. The **flags** argument is the address of a longword integer that contains flag bits that control various options, as follows:

Bit	**Value**	**Description**
0	LIB$M_VM_BOUNDARY_TAGS	Boundary tags for faster freeing. Adds a minimum of 8 bytes to each block.
1	LIB$M_VM_GET_FILL0	LIB$GET_VM; fill with bytes of 0.
2	LIB$M_VM_GET_FILL1	LIB$GET_VM; fill with bytes of FF (hexadecimal).
3	LIB$M_VM_FREE_FILL0	LIB$FREE_VM; fill with bytes of 0.
4	LIB$M_VM_FREE_FILL1	LIB$FREE_VM; fill with bytes of FF (hexadecimal).
5	LIB$M_VM_EXTEND_AREA	Adds extents to existing areas if possible.
6	LIB$M_VM_NO_EXTEND	Prevents zone from being extended beyond its initial size. If you specify this flag, you must also specify an **initial-size**. The **extend-size** argument is not used.
7	LIB$M_VM_TAIL_LARGE	Adds areas larger than **extend-size** areas to the end of the area list. Allocations that are larger than **extend-size** can result in new areas. These areas are added to the end of the area list. (This provides better memory

Bit	Value	Description
		reuse when allocating small and very large blocks from the same zone.)

Bits 8 through 31 are reserved and must be 0.

This is an optional argument. If **flags** is omitted, the default of 0 (no fill and no boundary tags) is used.

extend-size

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Zone extend size. The **extend-size** argument is the address of a longword integer that contains the number of (512-byte) pages on VAX systems or pagelets on Alpha and I64 systems to be added to the zone each time it is extended.

The value of **extend-size** must be greater than or equal to 1.

This is an optional argument. If **extend-size** is not specified, a default of 16 pages on VAX systems or pagelets on Alpha and I64 systems is used.

Note

The **extend-size** argument does not limit the number of blocks that can be allocated from the zone. The actual extension size is the greater of **extend-size** and the number of pages on VAX systems or pagelets on Alpha and I64 systems needed to satisfy the LIB$GET_VM call that caused the extension.

initial-size

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Initial size for the zone. The **initial-size** argument is the address of a longword integer that contains the number of (512-byte) pages on VAX systems or pagelets on Alpha and I64 systems to be allocated for the zone as the zone is created.

This is an optional argument. If you specify a value for **initial-size**, the value must be greater than or equal to 0; otherwise, LIB$_INVARG is returned. If **initial-size** is not specified or is specified as 0, no pages on VAX systems or pagelets on Alpha and I64 systems are allocated when the zone is created. The first call to LIB$GET_VM for the zone allocates **extend-size** pages on VAX systems or pagelets on Alpha and I64 systems.

block-size

OpenVMS usage:	longword_signed

type:	longword integer (signed)
access:	read only
mechanism:	by reference

Block size of the zone. The **block-size** argument is the address of a longword integer specifying the allocation quantum (in bytes) for the zone. All blocks allocated are rounded up to a multiple of **block-size**.

The value of **block-size** must be a power of 2 between 8 and 512. This is an optional argument. If **block-size** is not specified, a default of 8 is used.

alignment

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Block alignment. The **alignment** argument is the address of a longword integer that specifies the required address alignment (in bytes) for each block allocated.

The value of **alignment** must be a power of 2 between 4 and 512. This is an optional argument. If **alignment** is not specified, a default of 8 (quadword alignment) is used.

page-limit

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Maximum page limit. The **page-limit** argument is the address of a longword integer that specifies the maximum number of (512-byte) pages on VAX systems or pagelets on Alpha and I64 systems that can be allocated for the zone. The value of **page-limit** must be greater than or equal to 0. Note that part of the zone is used for header information.

This is an optional argument. If **page-limit** is not specified or is specified as 0, the only limit is the total process virtual address space limit imposed by OpenVMS. If **page-limit** is specified, then **initial-size** must also be specified.

smallest-block-size

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Smallest block size. The **smallest-block-size** argument is the address of a longword integer that specifies the smallest block size (in bytes) that has a lookaside list for the quick fit algorithm.

If **smallest-block-size** is not specified, the default of **block-size** is used. That is, lookaside lists are provided for the first n multiples of **block-size**.

zone-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

get-page

OpenVMS usage:	procedure
type:	procedure value
access:	read only
mechanism:	by value

Routine that allocates memory. The number and type of the arguments to this routine must match those of the LIB$GET_VM_PAGE routine. If **get-page** is not specified or is specified as 0, the LIB $GET_VM_PAGE routine is used to allocate memory.

free-page

OpenVMS usage:	procedure
type:	procedure value
access:	read only
mechanism:	by value

Routine that deallocates memory. The number and type of the arguments to this routine must match those of the LIB$FREE_VM_PAGE routine. If **free-page** is not specified or if **free-page** is specified as 0, the LIB$FREE_VM_PAGE routine is used to deallocate memory.

Description

LIB$CREATE_VM_ZONE creates a new storage zone. The zone identifier value that is returned can be used in calls to LIBGET_VM, LIBFREE_VM, LIB$RESET_VM_ZONE, LIB$DELETE_VM_ZONE, LIB$SHOW_VM_ZONE, LIB$VERIFY_VM_ZONE, and LIB $CREATE_USER_VM_ZONE.

The following restrictions apply when you are creating a zone:

- If you want the zone to be accessible from another process or processes, you must map the global section into the same virtual addresses in all processes. You can use PPL $CREATE_SHARED_MEM to map to a global section after you have first called PPL $INITIALIZE.
- The zone cannot expand; in other words, additional areas cannot be added to the zone.

- The restrictions for LIB$RESET_VM_ZONE also apply to shared zones. That is, it is the caller's responsibility to ensure that the caller has exclusive access to the zone while the reset operation is being performed.

If an error status is returned, the zone is not created.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVARG	Invalid argument.
LIB$_INVSTRDES	Invalid string descriptor for **zone-name**.

LIB$CREATE_VM_ZONE_64

LIB$CREATE_VM_ZONE_64 — The Create a New Zone routine creates a new storage zone in the 64-bit virtual address space, according to specified arguments.

Format

```
LIB$CREATE_VM_ZONE_64 zone-id [,algorithm] [,algorithm-argument] [,flags] [,e
```

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Zone identifier. The **zone-id** argument is the address of a quadword that is set to the zone identifier of the newly created zone.

algorithm

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Algorithm. The **algorithm** argument is the address of a quadword integer that represents the code for one of the LIB$VM algorithms. Use one of the following predefined symbols to specify this value:

Symbol	Value	Algorithm
LIB$K_VM_FIRST_FIT		First fit
LIB$K_VM_QUICK_FIT		Quick fit, lookaside list
LIB$K_VM_FREQ_SIZES		Frequent sizes, lookaside list
LIB$K_VM_FIXED		Fixed-size blocks

If **algorithm** is not specified, a default of 1 (first fit) is used.

algorithm-argument

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Algorithm argument. The **algorithm-argument** argument is the address of a quadword integer that contains a value specific to the particular allocation algorithm.

Algorithm	Value
First fit	Not used, may be omitted.
Quick fit	The number of lookaside lists used. The number of lists must be between 1 and 128.
Frequent sizes	The number of lookaside lists used. The number of lists must be between 1 and 16.
Fixed size blocks	The fixed request size (in bytes) for each get or free request. The request size must be greater than 0.

The **algorithm-argument** argument must be specified if you are using the quick-fit, frequent-sizes or fixed-size-blocks algorithms. However, this argument is optional, but ignored, if you are using the first-fit algorithm.

flags

OpenVMS usage:	mask_quadword
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Flags. The **flags** argument is the address of a quadword integer that contains flag bits that control various options, as follows:

Bit	Value	Description
0	LIB$M_VM_BOUNDARY_TAGS	Boundary tags for faster freeing. Adds a minimum of 16 bytes to each block.
1	LIB$M_VM_GET_FILL0	LIB$GET_VM_64; fill with bytes of 0.

Bit	Value	Description
2	LIB$M_VM_GET_FILL1	LIB$GET_VM_64; fill with bytes of FF (hexadecimal).
3	LIB$M_VM_FREE_FILL0	LIB$FREE_VM_64; fill with bytes of 0.
4	LIB$M_VM_FREE_FILL1	LIB$FREE_VM_64; fill with bytes of FF (hexadecimal).
5	LIB$M_VM_EXTEND_AREA	Adds extents to existing areas if possible.
6	LIB$M_VM_NO_EXTEND	Prevents zone from being extended beyond its initial size. If you specify this flag, you must also specify an **initial-size**. **Extend-size** is not used.
7	LIB$M_VM_TAIL_LARGE	Adds areas larger than **extend-size** areas to the end of the area list. Allocations that are larger than **extend-size** can result in new areas. These areas are added to the end of the area list. (This provides better memory re-use when allocating small and very large blocks from the same zone.)

Bits 8 through 63 are reserved and must be 0.

This is an optional argument. If **flags** is omitted, the default of 0 (no fill and no boundary tags) is used.

extend-size

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Zone extend size. The **extend-size** argument is the address of a quadword integer that contains the number of Alpha and I64 pagelets to be added to the zone each time it is extended.

The value of **extend-size** must be greater than or equal to 1.

This is an optional argument. If **extend-size** is not specified, a default of 16 Alpha or I64 pagelets is used.

Note

The **extend-size** argument does not limit the number of blocks that can be allocated from the zone. The actual extension size is the greater of **extend-size** and the number of Alpha or I64 pagelets needed to satisfy the LIB$GET_VM_64 call that caused the extension.

initial-size

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only

mechanism:	by reference

Initial size for the zone. The **initial-size** argument is the address of a quadword integer that contains the number of Alpha or I64 pagelets to be allocated for the zone as the zone is created.

This is an optional argument. If you specify a value for **initial-size**, the value must be greater than or equal to 0; otherwise, LIB$_INVARG is returned. If initial-size is not specified or is specified as 0, no Alpha pagelets or I64 are allocated when the zone is created. The first call to LIB$GET_VM_64 for the zone allocates extend-size pagelets on Alpha or I64 systems.

block-size

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Block size of the zone. The **block-size** argument is the address of a quadword integer specifying the allocation quantum (in bytes) for the zone. All blocks allocated are rounded up to a multiple of **block-size**.

The value of **block-size** must be a power of 2 between 16 and 512. This is an optional argument. If **block-size** is not specified, a default of 16 is used.

alignment

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Block alignment. The **alignment** argument is the address of a quadword integer that specifies the required address alignment (in bytes) for each block allocated.

The value of **alignment** must be a power of 2 between 8 and 512. This is an optional argument. If **alignment** is not specified, a default of 16 (octaword alignment) is used.

page-limit

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Maximum page limit. The **page-limit** argument is the address of a quadword integer that specifies the maximum number of Alpha or I64 pagelets that can be allocated for the zone. The value of **page-limit** must be greater than or equal to 0. Note that part of the zone is used for header information.

This is an optional argument. If **page-limit** is not specified or is specified as 0, the only limit is the total process virtual address space limit imposed by OpenVMS. If **page-limit** is specified, then **initial-size** must also be specified.

smallest-block-size

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Smallest block size. The **smallest-block-size** argument is the address of a quadword integer that specifies the smallest block size (in bytes) that has a lookaside list for the quick fit algorithm.

If **smallest-block-size** is not specified, the default of block-size is used. That is, lookaside lists are provided for the first n multiples of block-size.

zone-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

get-page

OpenVMS usage:	procedure
type:	procedure value
access:	read only
mechanism:	by value

Routine that allocates memory. The number and type of the arguments to this routine must match those of the LIB$GET_VM_PAGE_64 routine. If **get-page** is not specified or is specified as 0, the LIB $GET_VM_PAGE_64 routine is used to allocate memory.

free-page

OpenVMS usage:	procedure
type:	procedure value
access:	read only
mechanism:	by value

Routine that deallocates memory. The number and type of the arguments to this routine must match those of the LIB$FREE_VM_PAGE_64 routine. If **free-page** is not specified or if **free-page** is specified as 0, the LIB$FREE_VM_PAGE_64 routine is used to deallocate memory.

Description

LIB$CREATE_VM_ZONE_64 creates a new storage zone. The zone identifier value that is returned can be used in calls to LIBGET_VM_64, LIBFREE_VM_ 64, LIB$RESET_VM_ZONE_64, LIB

$DELETE_VM_ZONE_64, LIB$SHOW_VM_ ZONE_64, LIB$VERIFY_VM_ZONE_64, and LIB $CREATE_USER_VM_ZONE_ 64.

The following restrictions apply when you are creating a zone:

- If you want the zone to be accessible from another process or processes, you must map the global section into the same virtual addresses in all processes.
- The zone cannot expand; in other words, additional areas cannot be added to the zone.
- The restrictions for LIB$RESET_VM_ZONE_64 also apply to shared zones. That is, it is the caller's responsibility to ensure that the caller has exclusive access to the zone while the reset operation is being performed.

If an error status is returned, the zone is not created.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVARG	Invalid argument.
LIB$_INVSTRDES	Invalid string descriptor for **zone-name**.

LIB$CRF_INS_KEY

LIB$CRF_INS_KEY — The Insert Key in Cross-Reference Table routine inserts information about a key into a cross-reference table. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

`LIB$CRF_INS_KEY control-table ,key-string ,symbol-value ,flags`

Returns

None.

Arguments

control-table

OpenVMS usage:	vector_longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference, array reference

Cross-reference table into which LIB$CRF_INS_KEY inserts information about the key. The **control-table** argument is the address of a signed longword integer pointing to the cross-reference table.

You must name this table each time you call a cross-reference routine because you can accumulate information for more than one cross-reference table at a time.

key-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

A counted ASCII string that contains a symbol name or an unsigned binary longword. The **key-string** argument is the address of a descriptor pointing to the key.

symbol-value

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Symbol value, the address of which LIB$CRF_INS_KEY inserts in the cross-reference table. The symbol-value argument is the address of a signed longword integer containing this value. Both the key and value addresses must be permanent addresses in the user's symbol table.

flags

OpenVMS usage:	
type:	
access:	
mechanism:	

Value used in selecting the contents of the KEY2 and VAL2 fields; **flags** is stored with the entry. The **flags** argument is the address of an unsigned longword containing the flags. When preparing the output line, LIB$CRF_OUTPUT uses **flags** and the 16-bit mask in the field descriptor table to extract the data. The high-order bit of the word is reserved for LIB$CRF_INS_KEY.

Description

LIB$CRF_INS_KEY stores information to be printed in the KEY1, KEY2, VAL1, and VAL2 fields. When you call this routine, an entry for the key is made in the cross-reference table if the key is not present in the table. If the key is present, only the value address and value flag fields are updated.

Using LIB$CRF_INS_KEY involves the following steps:

1. Define a table of control information using the $CRFCTLTABLE macro.
2. Define each field of the output line using the $CRFFIELD macro.
3. Using the $CRFFIELDEND macro, specify the end of each set of macros that define a field in the output line.

4. Provide data by calling LIB$CRF_INS_KEY to insert an entry for the specify key in the specified symbol table. This data is used to build tables in virtual memory.

5. Call LIB$CRF_OUTPUT, the cross-reference output routine, to summarize and format the data. Supply a routine that LIB$CRF_OUTPUT calls to print each line in the output file. Because you supply this routine, you can control the number of lines per page and the header lines.

Condition Values Returned

None.

LIB$CRF_INS_REF

LIB$CRF_INS_REF — The Insert Reference to a Key in the Cross-Reference Table routine inserts a reference to a key in a cross-reference symbol table.

Format

```
LIB$CRF_INS_REF control-table ,longword-integer-key ,reference-string ,longword-in
```

Returns

None.

Arguments

control-table

OpenVMS usage:	vector_longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference, array reference

Control table associated with this cross-reference. The **control-table** argument is the address of an array containing the control table.

longword-integer-key

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Key referred to by LIB$CRF_INS_REF. The **longword-integer-key** argument is the address of a signed longword integer containing the key. The key is a counted ASCII string that contains a symbol name or an unsigned binary longword. It must be a permanent address in the user's symbol table.

reference-string

OpenVMS usage:	char_string

type:	character string
access:	read only
mechanism:	by descriptor

Counted ASCII string with a maximum of 31 characters, not including the byte count. The **reference-string** argument is the address of a descriptor pointing to the counted ASCII string.

longword-integer-reference

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

The 16-bit value used in selecting the contents of the REF1 field. The **longword-integer-reference** argument is the address of a signed longword integer containing this value. When preparing the output line, LIB$CRF_OUTPUT uses **longword-integer-reference** and the bit mask in the field descriptor table to extract the data. The high-order bit of the word is reserved for LIB$CRF_INS_ REF.

ref-definition-indicator

OpenVMS usage:	
type:	
access:	
mechanism:	

Reference/definition indicator that LIB$CRF_INS_REF uses to distinguish between a reference to a symbol and the definition of the symbol. The **ref-definition-indicator** argument is the address of a signed longword integer containing this indicator. The only difference between processing a symbol reference and a symbol definition is where LIB$CRF_INS_REF stores the information.

The reference/definition indicator can have either of the following values:

Symbolic Name	Description
CRF$K_REF	Reference to a symbol
CRF$K_DEF	Definition of a symbol

Description

LIB$CRF_INS_REF inserts a reference to a key in the cross-reference symbol table. If you attempt to insert reference information for a key that was not specified in a call to LIB$CRF_INS_KEY, LIB $CRF_INS_REF uses the address of the key to locate the symbol name and set the KEY1 field. Once set, either as a result of LIB$CRF_INS_KEY or LIB$CRF_INS_REF, the KEY1 field is never changed. A KEY1 field set by LIB$CRF_INS_REF has a space-filled VAL1 field associated with it unless it is overridden by a subsequent call to LIB$CRF_INS_KEY.

Using LIB$CRF_INS_REF involves the following steps:

1. Define a table of control information using the $CRFCTLTABLE macro.

2. Define each field of the output line using the $CRFFIELD macro.
3. Using the $CRFFIELDEND macro, specify the end of each set of macros that define a field in the output line.
4. Provide data by calling LIB$CRF_INS_REF to insert a reference to a key in the specified symbol table. This data is used to build tables in virtual memory.
5. Call LIB$CRF_OUTPUT, the cross-reference output routine, to summarize and format the data. Supply a routine that LIB$CRF_OUTPUT calls to print each line in the output file. Because you supply this routine, you can control the number of lines per page and the header lines.

Condition Values Returned

None.

LIB$CRF_OUTPUT

LIB$CRF_OUTPUT — The Output Cross-Reference Table Information routine extracts the information from the cross-reference tables and formats the output pages. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$CRF_OUTPUT control-table ,output-line-width ,page1 ,page2 ,mode-indicator ,del
```

Returns

None.

Arguments

control-table

OpenVMS usage:	vector_longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference, array reference

Control table associated with the cross-reference. The **control-table** argument is the address of an array containing the control table. The table contains the address of the user-supplied routine that prints the lines formatted by LIB$CRF_ OUTPUT.

output-line-width

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Width of the output line. The **output-line-width** argument is the address of a signed longword integer containing the width.

page1

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of lines on the first page of the output. The **page1** argument is the address of a signed longword integer containing this number. This allows the user to reserve space to print header information on the first page of the cross-reference.

page2

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of lines per page for the other pages. The **page2** argument is the address of a signed longword integer containing this number.

mode-indicator

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Output mode indicator. The **mode-indicator** argument is the address of a signed longword integer containing the mode indicator.

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

This indicator allows the user to select which of three output modes is desired.

Output Mode	Description
CRF$K_VALUES	Only the value and key fields are to be printed. LIB$CRF_OUTPUT creates multiple columns across the page. Each column consists of the KEY1, KEY2, VAL1, and VAL2 fields. A minimum of one space between each column is guaranteed.

Output Mode	Description
CRF$K_VALS_REFS	Requests a cross-reference summary that has no column space saved for a defining reference. If the user inserted a reference with the CRF$K_DEF indicator, the entry is ignored.
CRF$K_DEFS_REFS	Requests a cross-reference summary with the first REF1 and REF2 fields used only for definition references. If no definition reference is provided, the fields are filled with spaces.

delete-save-indicator

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Delete/save indicator, which LIB$CRF_OUTPUT uses to determine whether the table's built-in accumulating symbol information is to be saved or deleted once the cross-reference is produced. The **delete-save-indicator** argument is the address of a signed longword integer containing the delete/save indicator.

The indicator can be either of the following:

CRF$K_SAVE	To preserve the tables for subsequent processing
CRF$K_DELETE	To delete the tables

Description

LIB$CRF_OUTPUT can format output lines for three types of cross-reference listings:

- A summary of symbol names and their values, as shown in Figure 2.2.
- A summary of symbol names, their values, and the names of modules that refer to each symbol, as shown in Figure 2.3.
- A summary of symbol names, their values, the names of the defining modules, and the names of those modules that refer to each symbol, as shown in Figure 2.4.

Figure 2.2. Summary of Symbol Names and Values

```
Symbol          Value       Symbol          Value
------          -----       ------          -----
BAS$INSTR       000020B0-RU  BAS$SCRATCH     00002308-RU
BAS$IN_D_R      000021F0-RU  BAS$STATUS      00002338-RU
BAS$IN_F_R      000021E8-RU  BAS$STR_D       000020C0-RU
BAS$IN_L_R      000021E0-RU  BAS$STR_F       000020B8-RU
BAS$IN_T_DX     000021F8-RU  BAS$STR_L       000020C8-RU
BAS$IN_W_R      000021D8-RU  BAS$UNLOCK      00002310-RU
BAS$IO_END      000021D0-RU  BAS$UPDATE      000022E8-RU
BAS$LINKAGE     00001674-R   BAS$UPDATE_COUN 000022F0-RU
BAS$LINPUT      000021A8-RU  BAS$VAL_D       00002110-RU
BAS$MAT_INPUT   00002268-RU  BAS$VAL_F       00002108-RU
```

Figure 2.3. Summary of Symbol Names, Values, and Names of Referring Modules

```
Symbol                Value       Referenced By ...
------                -----       ----------------
BAS$K_DIVBY_ZER       0000003D    ALLGBL          BAS$ERROR
                                  BAS$POWDJ       BAS$POWII
                                  BAS$POWRJ       BAS$POWRR
BAS$K_DUPKEYDET       00000086    ALLGBL          BAS$$SIGNAL_IO
BAS$K_ENDFILDEV       0000000B    ALLGBL          BAS$$REC_PROC
                                  BAS$$UDF_RL
BAS$K_ENDOF_STA       0000006C    ALLGBL
```

Figure 2.4. Summary Indicating Defining Modules

```
Symbol              Value         Defined By      Referenced By ...
------              -----         ----------      ----------------
LIB$FREE_VM         0001E185-R    LIB$VM          ALLGBL
                                                  BAS$MARGIN
                                                  BAS$XLATE
                                                  FOR$VM
                                                  STR$APPEND
                                                  STR$DUPL_CHAR
                                                  STR$REPLACE
LIB$GET_COMMAND     0001E2B0-R    LIB$GET_INPUT   ALLGBL
LIB$GET_COMMON      0001E4D6-R    LIB$COMMON      ALLGBL
```

Regardless of the format of the output, LIB$CRF_OUTPUT considers the output line as consisting of six different field types:

KEY1	Is the first field in the line. It contains a symbol name.
KEY2	Is the second field in the line. It contains a set of flags (for example, -R) that provide information about the symbol.
VAL1	Is the third field in the line. It contains the value of the symbol.
VAL2	Is the fourth field in the line. It contains a set of flags describing VAL1.
REF1 and REF2 fields	Within each REF1 and REF2 pair, REF1 provides a set of flags, and REF2 provides the name of a module that references the symbol.

Any of these fields can be omitted from the output.

For example:

```
Symbol          Value            Symbol          Value
------          -----            ------          -----
BAS$INSTR       000020B0-RU      BAS$SCRATCH     00002308-RU

KEY1            VAL1    VAL2      KEY1           VAL1    VAL2

Symbol            Value          Defined By      Referenced By ...
------            -----          ----------      ----------------
LIB$FREE_VM       0001E185-R     LIB$VM          ALLGBL
```

```
KEY1            VAL1    VAL2     REF2           REF2
                                 (CRF$K_DEF)    (CRF$K_REF)
```

Condition Values Returned

None.

LIB$CURRENCY

LIB$CURRENCY — The Get System Currency Symbol routine returns the system's currency symbol.

Format

LIB$CURRENCY currency-string [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

currency-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Currency symbol. The **currency-string** argument is the address of a descriptor pointing to the currency symbol.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of characters that LIB$CURRENCY has written into the **currency-string** argument, not counting padding in the case of a fixed-length string. The **resultant-length** argument is the address of an unsigned word containing the length of the currency symbol. If the input string is truncated to the size specified in the **currency-string** argument, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **currency-string**.

Description

LIB$CURRENCY attempts to translate the logical name SYS$CURRENCY as a process, group, or system logical name, in that order. If the translation fails, the routine returns the United States currency symbol ($). If the translation succeeds, the text produced is returned. Thus, a system manager can define SYS$CURRENCY as a systemwide logical name to provide a default for all users, and an individual user with a special need can define SYS$CURRENCY as a process logical name to override the system default.

For example, if you want to use the British pound sign (£) as the currency symbol within your process but you want to leave the dollar sign as the system's default, define SYS$CURRENCY to be the pound sign in your process logical name table. After this, any call to LIB$CURRENCY within your process returns the pound sign (£), while any call outside your process returns the dollar sign ($).

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Successfully completed, but the currency string was truncated.

Example

```
10 !+

   ! This BASIC program uses LIB$CURRENCY to
   ! return the default system currency symbol.
   !-

   OUTLEN = 1
   CALL LIB$CURRENCY (CURR$, OUTLEN)
   PRINT CURR$
99 END
```

This BASIC program uses LIB$CURRENCY to display the system currency symbol default. The output generated by the program is a dollar sign ($).

LIB$CVTF_FROM_INTERNAL_TIME

LIB$CVTF_FROM_INTERNAL_TIME — The Convert Internal Time to External Time (F-Floating-Point Value) routine converts a delta internal OpenVMS system time into an external F-floating time.

Format

LIB$CVTF_FROM_INTERNAL_TIME operation ,resultant-time ,input-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	
type:	
access:	
mechanism:	

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

Operation	**Interpretation**
LIB$K_DELTA_WEEKS_F	Fractional weeks
LIB$K_DELTA_DAYS_F	Fractional days
LIB$K_DELTA_HOURS_F	Fractional hours
LIB$K_DELTA_MINUTES_F	Fractional minutes
LIB$K_DELTA_SECONDS_F	Fractional seconds

resultant-time

OpenVMS usage:	floating_point
type:	F_floating
access:	write only
mechanism:	by reference

The external time that results from the conversion. The **resultant-time** argument is the address of an F-floating-point value containing the result.

input-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Delta time to be converted. The **input-time** argument is the address of an unsigned quadword containing the time.

Description

LIB$CVTF_FROM_INTERNAL_TIME converts a delta internal OpenVMS system time into an external F-floating-point time. The **operation** argument specifies the conversion. LIB$CVTF_FROM_INTERNAL_TIME converts the value of **input-time** into one of the external formats listed in the **operation** argument description. LIB$CVTF_FROM_INTERNAL_TIME then places the result into **resultant-time**.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_DELTIMREQ	Delta time required but absolute time supplied.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVTS_FROM_INTERNAL_TIME

LIB$CVTS_FROM_INTERNAL_TIME — The Convert Internal Time to External Time (IEEE S-Floating-Point Value) routine converts a delta internal OpenVMS system time into an external IEEE S-floating time.

Format

```
LIB$CVTS_FROM_INTERNAL_TIME operation ,resultant-time ,input-time
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	function_code
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

Operation	**Interpretation**
LIB$K_DELTA_WEEKS_F	Fractional weeks

Operation	Interpretation
LIB$K_DELTA_DAYS_F	Fractional days
LIB$K_DELTA_HOURS_F	Fractional hours
LIB$K_DELTA_MINUTES_F	Fractional minutes
LIB$K_DELTA_SECONDS_F	Fractional

resultant-time

OpenVMS usage:	floating_point
type:	IEEE S_floating
access:	write only
mechanism:	by reference

The external time that results from the conversion. The **resultant-time** argument is the address of an IEEE S-floating-point value containing the result.

input-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Delta time to be converted. The input-time argument is the address of an unsigned quadword containing the time.

Description

LIB$CVTS_FROM_INTERNAL_TIME converts a delta internal OpenVMS system time into an external IEEE S-floating-point time. The **operation** argument specifies the conversion. LIB $CVTS_FROM_INTERNAL_TIME converts the value of **input-time** into one of the external formats listed in the operation argument description. LIB$CVTS_FROM_INTERNAL_TIME then places the result into **resultant-time**.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_DELTIMREQ	Delta time required but absolute time supplied.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVTF_TO_INTERNAL_TIME

LIB$CVTF_TO_INTERNAL_TIME — The Convert External Time to Internal Time (F-Floating-Point Value) routine converts an external time interval into an OpenVMS internal format F-floating delta time.

Format

LIB$CVTF_TO_INTERNAL_TIME operation ,input-time ,resultant-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	function_code
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The conversion to be performed. The operation argument is the address of an unsigned longword specifying the operation. Valid values for operation are the following:

Operation	**Interpretation**
LIB$K_DELTA_WEEKS_F	Fractional weeks
LIB$K_DELTA_DAYS_F	Fractional days
LIB$K_DELTA_HOURS_F	Fractional hours
LIB$K_DELTA_MINUTES_F	Fractional minutes
LIB$K_DELTA_SECONDS_F	Fractional seconds

input-time

OpenVMS usage:	varying_arg
type:	F_floating
access:	read only
mechanism:	by reference

Delta time to be converted. The **input-time** argument is the address of this input time. The value you supply for **input-time** must be greater than 0.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)

access:	write only
mechanism:	by reference

The OpenVMS internal format delta time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

Description

LIB$CVTF_TO_INTERNAL_TIME converts an external time interval, such as 3.5 weeks, into an OpenVMS internal format F-floating delta time. The **operation** argument specifies the conversion. LIB $CVTF_TO_INTERNAL_TIME converts the value of **input-time** into one of the internal format delta times listed in the operation argument description. LIB$CVTF_TO_INTERNAL_TIME then places the result into **resultant-time**.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVTS_TO_INTERNAL_TIME

LIB$CVTS_TO_INTERNAL_TIME — The Convert External Time to Internal Time (IEEE S-Floating-Point Value) routine converts an external time interval into an OpenVMS internal format IEEE S-floating delta time.

Format

```
LIB$CVTS_TO_INTERNAL_TIME operation ,input-time ,resultant-time
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	function_code
type:	longword (unsigned)
access:	read only

mechanism:	by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

Operation	Interpretation
LIB$K_DELTA_WEEKS_F	Fractional weeks
LIB$K_DELTA_DAYS_F	Fractional days
LIB$K_DELTA_HOURS_F	Fractional hours
LIB$K_DELTA_MINUTES_F	Fractional minutes
LIB$K_DELTA_SECONDS_F	Fractional seconds

input-time

OpenVMS usage:	varying_arg
type:	IEEE S_floating
access:	read only
mechanism:	by reference

Delta time to be converted. The **input-time** argument is the address of this input time. The value you supply for **input-time** must be greater than 0.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

The OpenVMS internal format delta time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

Description

LIB$CVTS_TO_INTERNAL_TIME converts an external time interval, such as 3.5 weeks, into an OpenVMS internal format IEEE S-floating delta time. The **operation** argument specifies the conversion. LIB$CVTS_TO_INTERNAL_TIME converts the value of **input-time** into one of the internal format delta times listed in the **operation** argument description. LIB$CVTS_TO_INTERNAL_TIME then places the result into **resultant-time**.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVT_DX_DX

LIB$CVT_DX_DX — The General Data Type Conversion routine converts OpenVMS standard atomic or string data described by a source descriptor to OpenVMS standard atomic or string data described by a destination descriptor. This conversion is supported over a subset of the OpenVMS standard data types.

Format

LIB$CVT_DX_DX source-item ,destination-item [,word-integer-dest-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

source-item

OpenVMS usage:	unspecified
type:	unspecified
access:	read only
mechanism:	by descriptor

Source item to be converted by LIB$CVT_DX_DX. The **source-item** argument is the address of a descriptor pointing to the source item to be converted. The type of the item to be converted is contained in the descriptor.

The combination of source descriptor class and data type is restricted as described in Table lib–1 and Table lib–2.

destination-item

OpenVMS usage:	unspecified
type:	unspecified
access:	write only
mechanism:	by descriptor

Destination of the conversion. The **destination-item** argument is the address of a descriptor pointing to the destination item. The destination descriptor specifies the data type to which the source item is converted.

The combination of destination descriptor class and data type is restricted as described in Table lib–1 and Table lib–2.

word-integer-dest-length

OpenVMS usage:	word_unsigned

type:	word (unsigned)
access:	write only
mechanism:	by reference

Length in bytes of the destination item (when that item is a string) that has been converted by LIB $CVT_DX_DX, not including any space filling. The **word-integer-dest-length** argument contains the address of an unsigned word containing this length.

If the destination string is truncated, the returned length reflects the truncation. This word can be used by the calling program to determine if truncation has occurred or to extract the exact length of the string when the string contains space filling.

Description

LIB$CVT_DX_DX is a universal conversion utility routine. Table 2.1 shows the complete matrix of data type and descriptor class combinations (as specified in the fields of the descriptor) supported by LIB $CVT_DX_DX.

Conversion is defined over three sets of data types: atomic, string, and numeric byte data strings. Although some of the functions of this routine may be found in other Run-Time Library routines, LIB $CVT_DX_DX packages the conversion functions with a general interface. Because of this general interface, the calling program does not have to specify what conversion should be done for which data type.

Refer to LIB$CVT_ *x*TB if you want to convert the ASCII text string representation of a decimal, hexadecimal, or octal number into a binary representation.

The description of this routine has been divided into the following parts:

- the section called “Guidelines for Using LIB$CVT_DX_DX”
- the section called “Use of Numeric Byte Data Strings (NBDS)”

For more information about numeric byte data strings, see the section called the section called “Use of Numeric Byte Data Strings (NBDS)”. Although the set of data types in NBDS is actually a subset of the atomic and string data types, the three sets are mutually exclusive in this routine. For more information on the OpenVMS atomic and string data types and the argument descriptor classes supported by this routine, see the *VSI OpenVMS Calling Standard* manual.

Table 2.1. OpenVMS Descriptor Class and Data Type Combinations Accepted by LIB $CVT_DX_DX

	Descriptor Class					
DSC$K_DTYPE_ *yyy*	**A**	**D**	**NCA**	**S**	**SD**	**VS**
B				Non-NBDS	Non-NBDS	
BU	NBDS		NBDS	Non-NBDS		
D				Non-NBDS	Non-NBDS	
Invalid combinations are blank. Any source data can be converted into any other destination data as long as they are both represented by one of the valid combinations. **Note: LIB$CVT_DX_DX treats an array, described by a CLASS_A or CLASS_NCA descriptor, as a character string. NBDS must have the format defined in Table 2.2.**						

	Descriptor Class					
DSC$K_DTYPE_ *yyy*	**A**	**D**	**NCA**	**S**	**SD**	**VS**
F				Non-NBDS	Non-NBDS	
FS				Non-NBDS	Non-NBDS	
FT				Non-NBDS	Non-NBDS	
G				Non-NBDS	Non-NBDS	
H				Non-NBDS	Non-NBDS	
L				Non-NBDS	Non-NBDS	
LU				Non-NBDS		
NL				Non-NBDS	Non-NBDS	
NLO				Non-NBDS	Non-NBDS	
NR				Non-NBDS	Non-NBDS	
NRO				Non-NBDS	Non-NBDS	
NU				Non-NBDS	Non-NBDS	
NZ				Non-NBDS	Non-NBDS	
P				Non-NBDS	Non-NBDS	
Q				Non-NBDS	Non-NBDS	
T	NBDS	NBDS	NBDS	NBDS	NBDS	
VT						NBDS
W				Non-NBDS	Non-NBDS	
WU				Non-NBDS		

Invalid combinations are blank. Any source data can be converted into any other destination data as long as they are both represented by one of the valid combinations.

Note: LIB$CVT_DX_DX treats an array, described by a CLASS_A or CLASS_NCA descriptor, as a character string. NBDS must have the format defined in Table 2.2.

Guidelines for Using LIB$CVT_DX_DX

The data type and descriptor class of the source and destination arguments determine how LIB $CVT_DX_DX performs the conversion, according to the following rules:

- Scale is applied when indicated in the descriptor (descriptor CLASS_SD only), and scaling is defined for the data type.
- No language-specific semantics are applied, such as BASIC scale for DSC$K_DTYPE_D.
- Some conversions must use intermediate values to arrive at the destination requested. Although some loss of speed is inevitable, intermediate values will not cause a loss of precision.
- Results are always rounded instead of truncated, except for the case described below. Note that loss of precision or range may be inherent in the destination data type or in the NBDS destination size. No errors are reported if there is a loss of precision or range as a result of destination data type.
- When the destination is an NBDS and has fixed-string semantics, then if the source does not fill the destination, the destination is padded with blanks.

- When the source and destination are both NBDS and no scaling is requested, then a straight copy is done without translation or conversion, and truncation is possible. If scaling is requested, then a conversion takes place as defined in Table 2.2.
- When the source is an NBDS and the destination is non-NBDS, if there is an invalid character in the source or the value is outside the range that can be represented by the destination, then LIB $_INVNBDS is returned.
- Attempts to convert a negative value to an unsigned data type cause the LIB$_INVCVT error to be returned.
- If the destination is an NBDS of descriptor CLASS_D, then a new string of appropriate size is allocated for it, if necessary.
- Invalid conversions resulting in an error produce an unpredictable result.

Use of Numeric Byte Data Strings (NBDS)

For simplicity, and to define a generic numeric string that LIB$CVT_DX_DX understands to be a numeric string, the set Numeric Byte Data String (NBDS) is defined to be the set of NBDS descriptors shown in Table 2.1.

The combination of data type and descriptor class determines whether an argument is an NBDS. For example, LIB$CVT_DX_DX treats the combination DSCK_DTYPE_B/DSCK_CLASS_S (unsigned byte scalar) as an atomic data type. However, the routine considers DSCK_DTYPE_BU/ DSCK_CLASS_NCA (noncontiguous array of unsigned bytes) to be an NBDS.

A destination NBDS is always left-justified.

If a destination NBDS requires more than 50 digits for its format (including the sign, if any), then it is expressed in exponential format.

For a conversion of NBDS to NBDS, this format is used if scaling is requested. Otherwise, a straight copy is done. The format of a source NBDS is the same as the format defined for the input argument *inp* in OTS$_CVT_T_z, with bits 0, 2, and 4 set in the *flags* argument. That is, blanks are ignored, underflow causes an error, and tabs are ignored.

Table 2.2 defines the format of a destination NBDS.

Table 2.2. LIB$CVT_DX_DX Destination NBDS Formats

Source Data Type	Destination NBDS Format
Byte integer (signed)	sdigits
Byte (unsigned)	digits

Key to Destination NBDS Formats

- **digits: Digits 0 through 9, and a decimal point only if source descriptor specifies the value of the SCALE field as less than 0.**
- **w: Width of destination in bytes.**
- **s: Sign. For positive numbers, the sign is implied.**
- **min: Minimum of two values.**

Source Data Type	Destination NBDS Format
Word integer (signed)	sdigits
Word (unsigned)	digits
Longword integer (signed)	sdigits
Longword (unsigned)	digits
Quadword integer (signed)	sdigits
D_floating	s0.min(16,w-7)E±*nn*
F_floating	s0.min(7,w-7)E±*nn*
G_floating	s0.min(15,w-8)E±*nnn*
H_floating	s0.min(33,w-9)E±*nnnn*
FS_floating (IEEE)	s0.min(7,w-7)E±*nn*
FT_floating (IEEE)	s0.min(15,w-8)E±*nnn*
NBDS	s0.min(33,w-9)E±*nnnn*
Decimal string	sdigits (as defined by VAX architecture)
Key to Destination NBDS Formats • **digits: Digits 0 through 9, and a decimal point only if source descriptor specifies the value of the SCALE field as less than 0.** • **w: Width of destination in bytes.** • **s: Sign. For positive numbers, the sign is implied.** • **min: Minimum of two values.**	

The A and NCA array descriptor classes are supported with the following restrictions:

An array is written with the semantics of a fixed string.	
DIMCT = 1	Only one-dimensional arrays are recognized.
LENGTH = 1	The length of each array element must be a byte.
ARSIZE ≤ 65,535	The total size of the array must be less than 65,535 bytes. If ARSIZE = 0, the array has a length of zero.
S1 = 1	The stride of an array passed by a noncontiguous array descriptor must be 1. That is, even if the class of the array's descriptor is noncontiguous array (NCA), the array itself must be contiguous.

For more information about the semantics of writing output strings, see the *VSI OpenVMS RTL String Manipulation (STR$) Manual*.

If the calling program passes a descriptor to LIB$CVT_DX_DX that does not comply with Table 2.1, one of the following error messages is returned:

LIB$_INVDTYDSC
LIB$_INVCLADSC
LIB$_INVCLADTY

LIB$_INVNBDS

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_DECOVF	Packed decimal overflow error. Severe error.
LIB$_FLTOVF	Floating overflow error. Severe error.
LIB$_FLTUND	Floating underflow error. Severe error.
LIB$_INTOVF	Integer overflow error. Severe error.
LIB$_INVCLADSC	Invalid class in descriptor. This class of descriptor is not supported. Severe error.
LIB$_INVCLADTY	Invalid class and data type in descriptor. This class and data type combination is not supported. Severe error.
LIB$_INVCVT	If the source value is negative and the destination data type is unsigned, this error is returned.
LIB$_INVDTYDSC	Invalid data type in descriptor. This data type is not supported. Severe error.
LIB$_INVNBDS	Invalid NBDS. There is an invalid character in the input, or the value is outside the range that can be represented by the destination, or the NMDS descriptor is invalid. This error is also signaled when the array size of an NBDS is larger than 65,535 bytes or the array is multidimensional.
LIB$_OUTSTRTRU	Output string truncated. This is returned only when NBDS is both source and destination and no scaling is requested. The result is truncated.
LIB$_ROPRAND	Reserved operand error. Severe error.

LIB$CVT_FROM_INTERNAL_TIME

LIB$CVT_FROM_INTERNAL_TIME — The Convert Internal Time to External Time routine converts an internal OpenVMS system time (either absolute or delta) into an external time.

Format

```
LIB$CVT_FROM_INTERNAL_TIME operation ,resultant-time [,input-time]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	function_code
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword containing the operation. The following table shows valid values for **operation**:

Operation	**Type**	**Return Range**
LIB$K_MONTH_OF_YEAR	Absolute	1 to 12
LIB$K_DAY_OF_YEAR	Absolute	1 to 366
LIB$K_HOUR_OF_YEAR	Absolute	1 to 8784
LIB$K_MINUTE_OF_YEAR	Absolute	1 to 527,040
LIB$K_SECOND_OF_YEAR	Absolute	1 to 31,622,400
LIB$K_DAY_OF_MONTH	Absolute	1 to 31
LIB$K_HOUR_OF_MONTH	Absolute	1 to 744
LIB$K_MINUTE_OF_MONTH	Absolute	1 to 44,640
LIB$K_SECOND_OF_MONTH	Absolute	1 to 2,678,400
LIB$K_DAY_OF_WEEK	Absolute [1]	1 to 7
LIB$K_HOUR_OF_WEEK	Absolute [2]	1 to 168
LIB$K_MINUTE_OF_WEEK	Absolute [3]	1 to 10,080
LIB$K_SECOND_OF_WEEK	Absolute [4]	1 to 604,800
LIB$K_HOUR_OF_DAY	Absolute	0 to 23
LIB$K_MINUTE_OF_DAY	Absolute	0 to 1439
LIB$K_SECOND_OF_DAY	Absolute	0 to 86,399
LIB$K_MINUTE_OF_HOUR	Absolute	0 to 59
LIB$K_SECOND_OF_HOUR	Absolute	0 to 3599
LIB $K_SECOND_OF_MINUTE	Absolute	0 to 59
LIB$K_JULIAN_DATE	Absolute [5]	Julian date
LIB$K_DELTA_WEEKS	Delta [6]	
LIB$K_DELTA_DAYS	Delta [7]	
LIB$K_DELTA_HOURS	Delta [8]	
LIB$K_DELTA_MINUTES	Delta [9]	
LIB$K_DELTA_SECONDS	Delta [10]	

[1]Day 1 is Monday.

[2]Hours since midnight on previous Monday.

[3]Minutes since midnight on previous Monday.

[4]Seconds since midnight on previous Monday.

[5]Number of days since system zero time (17–Nov–1858).

[6]Whole weeks.

[7]Whole days.

[8]Whole hours.

[9]Whole minutes.

[10]Whole seconds.

resultant-time

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

The external time that results from the conversion. The **resultant-time** argument is the address of an unsigned longword containing the result.

input-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Optional absolute or delta time to be converted. The **input-time** argument is the address of an unsigned quadword containing the time. If you do not supply a value for **input-time**, the current system time is used.

Description

LIB$CVT_FROM_INTERNAL_TIME converts an internal OpenVMS system time (either absolute or delta) into an external time. The *operation* argument specifies the conversion. LIB $CVT_FROM_INTERNAL_TIME converts the value of *input-time* (or the current system time if *input-time* is not supplied) into one of the external formats listed in the *operation* argument description. LIB$CVT_FROM_INTERNAL_TIME then places the result into *resultant-time*.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_ABSTIMREQ	Absolute time required but delta time supplied.
LIB$_DELTIMREQ	Delta time required but absolute time supplied.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVT_TO_INTERNAL_TIME

LIB$CVT_TO_INTERNAL_TIME — The Convert External Time to Internal Time routine converts an external time interval into an OpenVMS internal format delta time.

Format

LIB$CVT_TO_INTERNAL_TIME operation ,input-time ,resultant-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

operation

OpenVMS usage:	function_code
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

Operation	Description
LIB$K_DELTA_WEEKS	Whole weeks in delta time
LIB$K_DELTA_DAYS	Whole days in delta time
LIB$K_DELTA_HOURS	Whole hours in delta time
LIB$K_DELTA_MINUTES	Whole minutes in delta time
LIB$K_DELTA_SECONDS	Whole seconds in delta time

input-time

OpenVMS usage:	varying_arg
type:	longword (signed)
access:	read only
mechanism:	by reference

Delta time to be converted. The **input-time** argument is the address of this input time. The value you supply for **input-time** must be greater than 0.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

The OpenVMS internal format delta time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

Description

LIB$CVT_TO_INTERNAL_TIME converts an external time interval, such as three weeks, into an OpenVMS internal format delta time. The *operation* argument specifies the conversion. LIB $_CVT_TO_INTERNAL_TIME converts the value of *input-time* into one of the internal format delta times listed in the *operation* argument description. LIB$_CVT_TO_INTERNAL_TIME then places the result into *resultant-time*.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INVOPER	Invalid operation.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVT_VECTIM

LIB$CVT_VECTIM — The Convert 7-Word Vector to Internal Time routine converts a 7-word vector into an OpenVMS internal format delta or absolute time.

Format

```
LIB$CVT_VECTIM input-time ,resultant-time
```

Returns

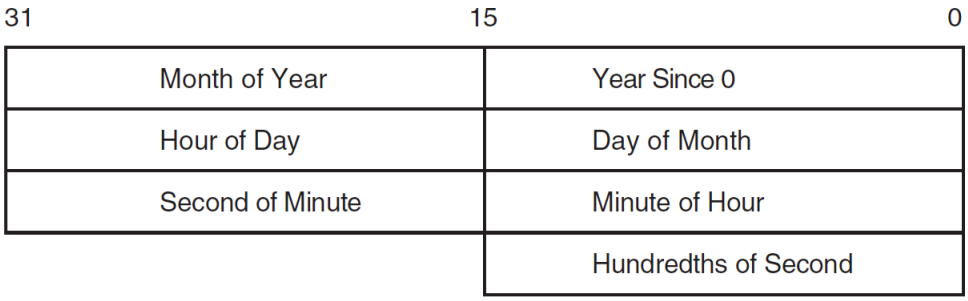
OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

input-time

OpenVMS usage:	vector_word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference, array reference

Time to be converted. The **input-time** argument is the address of a 7-word structure containing this time. This vector directly corresponds to a $NUMTIM *timbuf* structure. The following diagram depicts the fields in this structure:



The **input-time** argument can represent an absolute or a delta time. In order for **input-time** to represent a delta time, the **year since 0** and **month of year** fields must equal zero. If those fields do not equal zero, an absolute time is returned.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

The OpenVMS internal format delta or absolute time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

Description

LIB$CVT_VECTIM converts a 7-word vector (in the format output by the $NUMTIM system service) into an OpenVMS internal format delta or absolute time. LIB$CVT_VECTIM then places the result into *`resultant-time`*.

See the *VSI OpenVMS System Services Reference Manual: GETUTC-Z* for more information about $NUMTIM.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$CVT_xTB

LIB$CVT_xTB — The Convert Numeric Text to Binary routines return a binary representation of the ASCII text string representation of a decimal, hexadecimal, or octal number.

Format

`LIB$CVT_DTB byte-count ,numeric-string ,result`

`LIB$CVT_HTB byte-count ,numeric-string ,result`

`LIB$CVT_OTB byte-count ,numeric-string ,result`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

byte-count

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by value

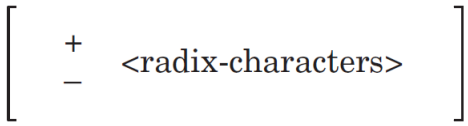
Byte count of the input ASCII text string. The **byte-count** argument is a signed longword integer containing the byte count of the input string.

numeric-string

OpenVMS usage:	
type:	
access:	
mechanism:	

ASCII text string representation of a decimal, hexadecimal, or octal number that LIB$CVT_xTB converts to binary representation. The **numeric-string** argument is the address of a character string containing this input string to be converted.

The syntax of a valid ASCII text input string is as follows:



LIB$CVT_xTB allows only an optional plus (+) or minus (–) sign followed by a string of decimal, hexadecimal, or octal characters appropriate to the routine being called.

result

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

Binary representation of the input string. The **result** argument is the address of a signed longword integer containing the converted string.

Description

LIB$CVT_DTB converts the ASCII text string representation of a decimal number into binary representation. LIB$CVT_HTB converts the ASCII text string representation of a hexadecimal number into binary representation. LIB$CVT_OTB converts the ASCII text string representation of an octal number into binary representation.

Note

LIBCVT_DTB, LIBCVT_HTB, and LIB$CVT_OTB are intended to be called primarily from BLISS and MACRO programs. Therefore, the routines expect input scalar arguments to be passed by value and strings by reference.

Condition Values Returned

1	Routine successfully completed.
0	Nonradix character in the input string or a sign in any position other than the first character. An overflow from 32 bits (unsigned) causes an error.

LIB$CVT_xTB_64

LIB$CVT_xTB_64 — The Convert Numeric Text to Binary routines return a binary representation of the ASCII text string representation of a decimal, hexadecimal, or octal number.

Format

```
LIB$CVT_DTB_64 byte-count ,numeric-string ,result

LIB$CVT_HTB_64 byte-count ,numeric-string ,result

LIB$CVT_OTB_64 byte-count ,numeric-string ,result
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

byte-count

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only

mechanism:	by value

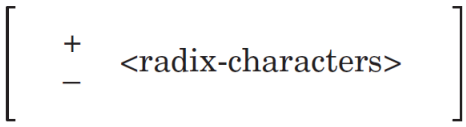
Byte count of the input ASCII text string. The **byte-count** argument is a signed longword integer containing the byte count of the input string.

numeric-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by reference

ASCII text string representation of a decimal, hexadecimal, or octal number that LIB$CVT_xTB_64 converts to binary representation. The **numeric-string** argument is the address of a character string containing this input string to be converted.

The syntax of a valid ASCII text input string is as follows:



LIB$CVT_xTB_64 allows only an optional plus (+) or minus (–) sign followed by a string of decimal, hexadecimal, or octal characters appropriate to the routine being called.

result

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	write only
mechanism:	by reference

Binary representation of the input string. The **result** argument is the address of a signed quadword integer containing the converted string.

Description

LIB$CVT_DTB_64 converts the ASCII text string representation of a decimal number into binary representation. LIB$CVT_HTB_64 converts the ASCII text string representation of a hexadecimal number into binary representation. LIB$CVT_OTB_64 converts the ASCII text string representation of an octal number into binary representation.

Note

LIBCVT_DTB_64, LIBCVT_HTB_64, and LIB$CVT_OTB_64 are intended to be called primarily from BLISS and MACRO programs. Therefore, the routines expect input scalar arguments to be passed by value and strings by reference.

Condition Values Returned

1	Routine successfully completed.

0	Nonradix character in the input string or a sign in any position other than the first character. An overflow from 64 bits (unsigned) causes an error.

LIB$DATE_TIME

LIB$DATE_TIME — The Date and Time Returned as a String routine returns the OpenVMS system date and time in the semantics of a user-provided string.

Format

LIB$DATE_TIME date-time-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

date-time-string

OpenVMS usage:	time_name
type:	character string
access:	write only
mechanism:	by descriptor

Destination string into which LIB$DATE_TIME writes the system date and time. The **date-time-string** argument is the address of a descriptor pointing to the destination string. This string is 23 characters long; its format is as follows:

```
dd-mmm-yyyy hh:mm:ss.hh
```

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Success, but destination string was truncated.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.

Example

```
10 !+
   ! This BASIC program demonstrates the use of LIB$DATE_TIME.
   !-
   CALL LIB$DATE_TIME(DSTSTR$)
   PRINT DSTSTR$
99 END
```

This BASIC program uses LIB$DATE_TIME to display the current system date and time. The output generated by one run of this program follows:

```
26-JUL-2000 13:41:22.67
```

LIB$DAY

LIB$DAY — The Day Number Returned as a Longword Integer routine returns the number of days since the system zero date of November 17, 1858, or the number of days from November 17, 1858, to a user-supplied date.

Format

LIB$DAY number-of-days [,user-time] [,day-time]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

number-of-days

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

Number of days since the system zero date. The **number-of-days** argument is the address of a signed longword integer containing the day number.

user-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

User-supplied time, in 100-nanosecond units. The **user-time** argument is the address of a signed quadword integer containing the user time. A positive value indicates an absolute time, while a negative value indicates a delta time. This is an optional argument. If **user-time** is omitted, the default is the current system time. This quadword time value is obtained by calling the $BINTIM system service.

If time is passed as zero by value, the numeric value for the current day is returned. If time is passed as a zero by reference, the number returned represents the day of November 17, 1858, rather than the current day.

day-time

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

Number of 10-millisecond units since midnight of the **user-time** argument. The **day-time** argument is the address of a signed longword integer into which LIB$DAY writes this number of units.

Description

LIB$DAY returns the number of days since the system zero date of November 17, 1858. Optionally, the caller can supply a time in system time format to be used instead of the current system time. In this case, LIB$DAY returns the number of days from November 17, 1858, to the user-supplied date.

The number of 10-millisecond units since midnight is an optional return argument.

Note

If the caller supplies a quadword time, it is not verified. If it is negative (bit 63 on), the *number-of-days* value returned is negative.

The Run-Time Library provides the date/time utility routines for languages that do not have built-in time and date functions and for particular applications that require the time or date in a different format from the one that the language supplies. In general, it is simpler to call the Run-Time Library routines for the system date and time than to call a system service.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_INTOVF	The optional argument **user-time** is present and represents a date and time well beyond the year 9999.

Example

```
PROGRAM DAY(INPUT, OUTPUT);
{+}
{ This is a VAX Pascal example program showing
{ the use of LIB$DAY.
{-}
VAR
  DAYNUMBER : INTEGER;
```

```
routine LIB$DAY(VAR DAYNUM : INTEGER);
  EXTERN;
BEGIN
  LIB$DAY(DAYNUMBER);
  WRITELN('The day number is ', DAYNUMBER);
END.
```

This Pascal program retrieves and prints the day number. A sample of the output generated by this program is as follows.

```
The day number is 46738
```

LIB$DAY_OF_WEEK

LIB$DAY_OF_WEEK — The Show Numeric Day of Week routine returns the numeric day of the week for an input time value. If 0 is the input time value, the current day of the week is returned. The days are numbered 1 through 7, with Monday as day 1 and Sunday as day 7.

Format

LIB$DAY_OF_WEEK [user-time,] day-number

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

user-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Time to be translated to a day of the week, or zero. The optional **user-time** argument is the address of an unsigned quadword containing the value of time. Time must be supplied as an absolute system time. To obtain this time value in proper quadword format, call the $BINTIM system service.

If time is passed as zero by value, the numeric value for the current day is returned. If time is passed as a zero by reference, the number returned represents the day of November 17, 1858. If the **user-time** argument is omitted, it is equivalent to passing a zero by value.

day-number

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only

mechanism:	by reference

Numeric day of week. The **day-number** argument is the address of a longword into which LIB $DAY_OF_WEEK writes the integer value representing the day of the week.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

Example

```
PROGRAM DAYOFWEEK(INPUT, OUTPUT);
{+}
{ This is an example showing
{ the use of LIB$DAY_OF_WEEK.
{-}
VAR
  OUTDAT : INTEGER;
routine LIB$DAY_OF_WEEK(TIM : INTEGER; %REF OUTDA : INTEGER); EXTERN;
BEGIN
  LIB$DAY_OF_WEEK(%IMMED 0, OUTDAT);
  WRITELN(OUTDAT);
END.
```

This Pascal program shows the use of LIB$DAY_OF_WEEK. This example was tested on a Monday, and the output generated was 1.

LIB$DECODE_FAULT

LIB$DECODE_FAULT — The Decode Instruction Stream During Fault routine is a tool for building condition handlers that process instruction fault exceptions. It is called from a condition handler. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. This routine is not available to native OpenVMS Alpha and I64 programs but is available to translated VAX images.

Format

LIB$DECODE_FAULT signal-arguments ,mechanism-arguments ,user-procedure [,unspecifi

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

signal-arguments

OpenVMS usage:	vector_longword_unsigned

type:	unspecified
access:	read only
mechanism:	by reference, array reference

Signal arguments array that was passed from the OpenVMS operating system to your condition handler. The **signal-arguments** argument is the address of the signal arguments array.

mechanism-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Mechanism arguments array that was passed from OpenVMS to your condition handler. The **mechanism-arguments** argument is the address of the mechanism arguments array.

user-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	call after stack unwind
mechanism:	by descriptor, procedure descriptor

User-supplied action routine that LIB$DECODE_FAULT calls to handle the exception. The **user-procedure** argument is the address of a descriptor pointing to your user action routine. The **user-procedure** argument may be of type ‘‘procedure value’’ when called by languages with up-level addressing. If **user-procedure** is not of type ‘‘bound routine value,’’ it is assumed to be the address of an entry mask.

For further information on the user action routine, see the section called Call Format for a User Action Routine in the Description section.

unspecified-user-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

Additional information passed from your handler without interpretation to your user action routine. The **unspecified-user-argument** argument contains the value of this additional information. The **unspecified-user-argument** argument is optional; if it is omitted, zero is used as the default.

instruction-definitions

OpenVMS usage:	vector_byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference, array reference

Array of bytes specifying instruction opcodes and operand definitions that are to replace or supplement the standard instruction definitions. The *instruction-definitions* argument is the address of this array.

If *instruction-definitions* is omitted, only the standard instruction definitions are used. If supplied, *instruction-definitions* is searched first, followed by the standard definitions.

Each instruction definition consists of a series of bytes, the first one or two of which is the instruction opcode. If the instruction is a 2-byte opcode, the escape byte, which must be hex FD, FE, or FF, is placed in the first of the two bytes. Following the opcode may be from 0 to 16 operand definition bytes. These bytes indicate the operand's access type and data type.

The end of each instruction definition is denoted by a byte containing the value LIB$K_DCFOPR_END (zero). The list of instruction definitions is terminated by two bytes, each of which contains the value –1 (hexadecimal FF). For further information, see the section called the section called “Instruction Operand Definition Codes” in the Description section.

Description

The Description section of the LIB$DECODE_FAULT routine is divided into the following parts:

- the section called “Guidelines for Using LIB$DECODE_FAULT”
- the section called “Exceptions Recognized by LIB$DECODE_FAULT”
- the section called “Instruction Operand Definition Codes”
- the section called “Call Format for a User Action Routine”
- the section called “Call Format for a Signal Routine”

Guidelines for Using LIB$DECODE_FAULT

LIB$DECODE_FAULT is a tool for building condition handlers that process instruction fault exceptions. Called from a condition handler, LIB$DECODE_FAULT performs the following actions:

1. Unwinds intermediate stack frames back to that of the exception
2. Decodes the instruction stream to determine the operation and its operands
3. Calls a user-supplied action routine and passes it a consistent and easy-to-access description of the instruction's context

Your user action routine performs whatever tasks are necessary to handle the fault and returns to LIB $DECODE_FAULT. LIB$DECODE_FAULT then restores the context as modified by your user action routine and continues execution.

Your condition handler must first decide whether or not it wants to handle the exception. The signal arguments list contains the exception code and the address of the program context (PC) that is usually sufficient for this determination. Once LIB$DECODE_FAULT is called, if the exception is a fault LIB$DECODE_FAULT can analyze, control does not return to the condition handler. Therefore, your handler must not depend on regaining control by a routine return once it has called LIB $DECODE_FAULT. With your user action routine, LIB$DECODE_FAULT makes the original fault disappear.

Note

Your user action routine is capable of generating a new exception, including one that looks identical to the original exception. Your user action routine may also resignal, but if the decision to resignal is made inside the user action routine, all post-signal stack frames are lost.

Once your condition handler has decided that it wants to handle the exception, it calls LIB $DECODE_FAULT, passing as arguments the addresses of the signal and mechanism argument lists and a descriptor for your user action routine entry point. LIB$DECODE_FAULT then performs the following actions:

1. Determines if the exception is a fault it understands. If not, it returns SS$_RESIGNAL.
2. Determines the context in which the exception occurred, including register and processor status longword (PSL) contents, and saves it.
3. Unwinds all stack frames back to that frame in which the exception occurred.
4. Evaluates each operand's addressing mode, computing the resulting location for the operand. Immediate mode operands are expanded into their full form. If an invalid addressing mode is found, an SS$_RADRMOD exception is generated.
5. Unless the original exception was SS$_ACCVIO, tests each operand for accessibility. If necessary, an access violation is signaled as if the instruction had tried to execute normally. See the paragraph following this list for more information.
6. Unless the original exception was SS$_ROPRAND, tests each floating-point operand that is to be read for a reserved floating operand. If necessary, a reserved operand fault is signaled. See the paragraph following this list for more information.
7. Determines the address of the next sequential instruction.
8. Calls your user action routine with arguments as described below.
9. Upon return from your user action routine, reflects changes to the registers and PSL and continues execution at the instruction address specified by your user action routine. Optionally, your user action routine may resignal the original exception.

Some instructions can generate more than one fault if evaluation of one operand causes a fault that occurs before a later operand (which would also cause a fault). An example of this is the possibility that a floating-point divide instruction might report a divide-by-zero fault upon seeing a zero divisor before noticing that the dividend was a reserved operand or was inaccessible.

In these cases, operand-specific faults are signaled immediately by LIB$DECODE_FAULT in the expectation that another condition handler (or the same one) can repair the situation. This may reorder the sequence of exceptions as seen by a program. If the operand exception is corrected, the original exception reoccurs, and the proper action is taken.

If at all possible, try to determine if a resignal is necessary inside the condition handler that calls LIB$DECODE_FAULT, rather than inside your user action routine. The reason for this is that LIB $DECODE_FAULT removes all post-signal stack frames before calling your user action routine.

Your user action routine may fetch and store the operands, *registers*, and *PSL* as necessary for handling the exception. You should follow the VAX architecture rule of reading all input operands in left-to-right order, then writing all output operands in left-to-right order, to avoid inconsistent results with overlapping operands. This is especially necessary with register operands.

PSL may be modified in a manner consistent with the VAX architecture. If the T-bit in the PSL was set at the beginning of the instruction, LIB$DECODE_FAULT sets the TP bit. To initiate tracing, you must set only the T bit. To disable tracing, you must clear both the T and TP bits. See the *VAX Architecture Reference Manual* for more information.

If the first-part-done (FPD) bit in the PSL was set when the instruction faulted, LIB$DECODE_FAULT only advances the PC over the instruction; it does not reevaluate the operands, and it sets *operand-count* to zero. It is assumed that if FPD is set, the operands are in known locations (typically the registers).

For the CASEB, CASEW, and CASEL instructions, only the *selector*, *base*, and *limit* operands are represented in *operand-count* and *read-operand-locations*. The element of registers that corresponds to the PC, described in the following text as R15, points to the first of the word-length displacements. Your user action routine must modify R15 to reflect the location of the next instruction to execute.

The standard instruction definitions used by LIB$DECODE_FAULT specify the XFC instruction (which causes an SS$_OPCCUS fault) as having zero operands. You may redefine XFC if needed using the *instruction-definitions* argument to LIB$DECODE_FAULT.

If you do not want instruction execution to resume with the next sequential instruction, you must modify R15 appropriately. Your user action routine then returns to LIB$DECODE_FAULT, which restores the registers and PSL, and resumes instruction execution. See also the LIB$_RESTART condition value in the section called the section called “Condition Values Returned from the User Action Routine”.

Note

Vector context is not saved or restored.

Exceptions Recognized by LIB$DECODE_FAULT

LIB$DECODE_FAULT recognizes the following VAX faults:

- SS$_ACCVIO, access violation.
- SS$_BREAK, breakpoint fault.
- SS$_FLTDIV_F, floating divide by zero.
- SS$_FLTOVF_F, floating overflow.
- SS$_FLTUND_F, floating underflow.
- SS$_OPCCUS, opcode reserved to customers.
- SS$_OPCDEC, opcode reserved to VSI.
- SS$_ROPRAND, reserved operand.
- SS$_TBIT, T-bit pending trap. This is actually a fault caused by the TP bit being set at the beginning of instruction execution. It allows you to interpret all instructions by setting the PSL T-bit and allowing each instruction to trace-fault.

All other exceptions, including SS$_COMPAT and SS$_RADRMOD, cause LIB$DECODE_FAULT to return immediately with the return status SS$_RESIGNAL.

SS$_COMPAT is generated by compatibility-mode instructions. LIB$DECODE_FAULT does not handle compatibility-mode instructions.

SS$_RADRMOD is generated by a reserved addressing-mode fault. LIB$DECODE_FAULT assumes that all instructions follow VAX addressing-mode specifications.

Instruction Operand Definition Codes

Each instruction operand has an access type (read, write, …) and a data type (byte, word, …) associated with it. The operand definition codes used in both the *instruction-definitions* argument passed to LIB$DECODE_FAULT and in the *operand-types* argument passed to the user action routine encode the access and data types in a byte. The fields and values for operand access and data types are described using the symbols in Table 2.3. These symbols are defined in definition libraries supplied by VSI as macro or module name $LIBDCFDEF.

Table 2.3. Symbols for Fields and Values for Operand Access and Data Types Using LIB $DECODE_FAULT

Symbol	Description	
LIB$V_DCFACC	The field of the operand description code that describes the operand access type (bits 0–2).	
LIB$S_DCFACC	The size of the access type field (3 bits).	
LIB$M_DCFACC	The mask for the access type field. This is a 3-bit field that can contain any binary value from 000 through 111. The integer value of these bit settings defines the operand access type code for the LIB $M_DCFACC field. Currently, six codes are defined. These codes have symbolic names and are explained below. It is important to remember that LIB$M_DCFACC is not a bit mask. The values 0 through 6 do not refer to bits 0 through 6. They represent the binary values 001 through 110 as contained in the 3-bit field. The operand access type codes defined for the LIB$M_DCFACC field are:	
	LIB$K_DCFACC_R = 1	Operand is read-only.
	LIB$K_DCFACC_M = 2	Operand is to be modified.
	LIB$K_DCFACC_W = 3	Operand is write-only.
	LIB$K_DCFACC_A = 4	Operand is an address (must not be a register).
	LIB$K_DCFACC_V = 5	Operand is the base of a bit field (same as address except that it may be a register).
	LIB$K_DCFACC_B = 6	Operand is a branch address.
LIB$V_DCFTYP	The field of the operand descriptor code that describes the operand data type (bits 3–7).	
LIB$S_DCFTYP	The size of the operand data type field (5 bits).	
LIB$M_DCFTYP	The mask for the operand data type field. This is a 5-bit field (bits 3–7) that can contain any binary value from 00000 through 11111. The integer value of these bit settings defines the operand access type code for the LIB$M_DCFACC field. Currently, nine codes	

Symbol	Description	
	are defined. These codes have symbolic names and are explained below. It is important to remember that LIB$M_DCFTYP is not a bit mask. The values 0 through 9 do not refer to bits 0 through 9. They represent the binary values 00001 through 01001 as contained in the 5-bit field. The operand access type codes defined for the LIB $V_DCFTYP field are:	
	LIB$K_DCFTYP_B = 1	Operand is a byte.
	LIB$K_DCFTYP_W = 2	Operand is a word.
	LIB$K_DCFTYP_L = 3	Operand is a longword.
	LIB$K_DCFTYP_Q = 4	Operand is a quadword.
	LIB$K_DCFTYP_O = 5	Operand is a octaword.
	LIB$K_DCFTYP_F = 6	Operand is F_floating.
	LIB$K_DCFTYP_D = 7	Operand is D_floating.
	LIB$K_DCFTYP_G = 8	Operand is G_floating.
	LIB$K_DCFTYP_H = 9	Operand is H_floating.

Symbols of the form LIB$K_DCFOPR_xy, where *x* is the access type and *y* is the data type, are also defined. These combine the notions of access and data type. For example, LIB$K_DCFOPR_MF has the following value:

```
50 (2+(6*8))
```

It denotes modify access of an F_floating item. For the branch access type, only the types BB, BW, and BL are defined; otherwise, all combinations are available.

Call Format for a User Action Routine

LIB$DECODE_FAULT calls the user action routine when it finds an exception to be handled. Your user action routine handles the exception in any manner that you specify and then returns to LIB $DECODE_FAULT.

action-routine opcode ,instr-PC ,PSL ,registers ,operand-count

##############,operand-types ,read-operand-locations

##############,write-operand-locations,signal-arguments

##############,signal-procedure ,context

##############,unspecified-user-argument ,original-registers

opcode

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Opcode of the instruction that caused the fault. The *opcode* argument is the address of a longword that contains this opcode. LIB$DECODE_FAULT supplies this opcode when it calls the user action routine.

For 2-byte opcodes, the escape code (for example, hex FD) is in the low-order byte. You must use this argument to examine the opcode instead of reading the bytes pointed to by *instr-PC*. This is because if a debugger breakpoint has been set on the instruction, only *opcode* contains the original instruction.

instr-PC

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Value of the PC for the instruction that caused the fault. The *instr-PC* argument is the address of a longword that contains the PC value.

Note the difference between this value and the contents of the *registers* array element that corresponds to the PC. R15 of the *registers* array element contains the address of the byte after the instruction that caused the fault.

PSL

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Processor status longword (PSL) at the time of the fault. The *PSL* argument is the address of a longword that contains this PSL. Your user action routine may modify this PSL within the restrictions of the VAX architecture.

registers

OpenVMS usage:	vector_longword_unsigned
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Contents of registers R0 through R15 (PC) at the time of the fault but after operand addressing-mode processing. This includes any autoincrements or autodecrements. The *registers* argument is the address of this 16-longword array. Each longword of the registers array contains the contents of one register.

Your user action routine may modify these values. If it does, the new values will be reflected when instruction execution continues.

To modify vector registers, execute a vector instruction. Executing a vector instruction in the handler modifies the state of the vector processor. The state of the vector processor is not restored when the handler returns. This has the effect of altering the state when the execution continues.

R15 denotes the sixteenth longword in the *registers* array, which corresponds to the PC. R15 contains the address of the next byte after the current instruction. Unless this value is modified by your user action routine, instruction execution will resume at that address. An exception is for the CASEB,

CASEW, and CASEL instructions; R15 contains the address of the first displacement word. For these instructions, your user action routine must modify R15 to point to the next instruction to execute.

Upon instruction completion, registers R0-R15 are restored from this array. However, if *signal-procedure* is used to cause a fault or if instruction restart is specified by returning LIB$_RESTART, *original-registers* is used instead.

operand-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Number of operands in the instruction currently being decoded. The *operand-count* is the address of a longword that contains this number.

operand-types

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Array of longwords, one element for each operand, that contains the type codes for the associated operand. The *operand-types* argument is the address of this array.

The operand type codes are further defined in the section called the section called “Instruction Operand Definition Codes”.

read-operand-locations

OpenVMS usage:	vector_longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference, array reference

Array of longwords, one element for each operand, that contains the addresses of the operands to be read. The *read-operand-locations* argument is the address of this array.

The address given in the array may not be the actual address of the operand if the operand is not a memory location. If the operand is a register, the address indicates a copy of the register values at the time of operand evaluation. If the operand access type is ADDRESS or FIELD and the operand is not a register, the address is the address of the item. If the operand access type is FIELD and the operand is a register, the address refers to the appropriate element in the *registers* array. If the operand access type is BRANCH, the address is the destination PC of the branch. For WRITE access operands, the address value is zero.

write-operand-locations

OpenVMS usage:	vector_longword_unsigned
type:	longword (unsigned)

access:	read only
mechanism:	by reference, array reference

Array of longwords, one element for each operand, that contains the addresses of operands that are to be written. The *write-operand-locations* argument is the address of this array. If the operand access type is not MODIFY, WRITE, ADDRESS, or FIELD, the pointer value is zero.

signal-arguments

OpenVMS usage:	vector_longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference, array reference

Signal arguments list of the original exception, as passed from OpenVMS to your condition handler and then to LIB$DECODE_FAULT. The *signal-arguments* argument is the address of an array of longwords that contains these signal arguments.

signal-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	call without stack unwinding
mechanism:	by reference

Entry mask of a routine that your user action routine must call if it wants to report an exception for the instruction that faulted. The *signal-procedure* argument is the address of this entry mask.

For further information, see the section called the section called “Call Format for a Signal Routine”.

context

OpenVMS usage:	context
type:	unspecified
access:	read only
mechanism:	by value

Context in which the exception occurs, including the register and PSL contents, to be used when calling the signal-procedure. The *context* argument contains the value of this context.

unspecified-user-argument

OpenVMS usage:	
type:	
access:	
mechanism:	

Optional argument passed to LIB$DECODE_FAULT. If the argument was not specified, the value zero is substituted. The *unspecified-user-argument* argument contains the value of this optional argument.

original-registers

OpenVMS usage:	vector_longword_unsigned
type:	longword (unsigned)
access:	modify
mechanism:	by reference, array reference

Array containing the values of registers R0 through R15 (PC) at the time of the fault, before operand processing. The *original-registers* argument is the address of this 16-longword array.

If the action routine specifies that the instruction should restart or that a fault should be generated, the registers are restored from *original-registers*. See also the description of *registers* above.

Condition Values Returned from the User Action Routine

The user action routine can return the following condition values to LIB$DECODE_FAULT:

Condition Value	Description
SS$_CONTINUE	If the user action routine returns a value of SS$_CONTINUE, instruction execution will continue as specified by the current contents of the *registers* element for the PC.
SS$_RESIGNAL	If the user action routine returns SS$_RESIGNAL, the original exception is resignaled, with the only changes reflected being those specified by *registers* elements for R0 and R1 (which are stored in the mechanism arguments vector), PC, and PSL. All other registers are restored from original registers.
LIB$_RESTART	If the user action routine returns LIB$_RESTART, the current instruction is restarted with registers restored from *original-registers* and a PSL from *PSL*. This feature is useful for writing trace handlers.

Call Format for a Signal Routine

Your action routine calls the signal routine using this format:

```
signal-procedure   fault-flag ,context ,signal-arguments
```

fault-flag

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Longword flag whose low-order bit determines whether the exception is to be signaled as a fault or as a trap. The fault-flag argument contains the address of this longword.

If the low-order bit of *fault-flag* is set to 1, the exception is signaled as a fault. If the low-order bit of *fault-flag* is set to 0, the exception is signaled as a trap; the current contents of the *registers* array are used. In either case, the current contents of *PSL* are used to set the exception PSL.

context

OpenVMS usage:	context
type:	unspecified
access:	read only
mechanism:	by reference

Context in which the new exception is to occur, as passed to your user action routine by LIB $DECODE_FAULT. The *context* argument is the address of this context value.

signal-arguments

OpenVMS usage:	arg_list
type:	longword (unsigned)
access:	read only
mechanism:	by reference, array reference

Signal arguments to be used. The *signal-arguments* argument is the address of an array of longwords that contains these signal arguments.

The first longword contains the number of following longwords; the remainder of the list contains signal names and arguments. Unlike the signal argument list passed to a condition handler, no PC or PSL is present.

Before the exception is signaled, the stack frames are unwound back to the original exception. You should be careful when causing a new signal that a loop of faults is not inadvertently generated. For example, the condition handler that called LIB$DECODE_FAULT will usually be called for the second signal. If the handler does not analyze the second signal as such, it may cycle through the identical path as for the first signal.

To resignal the current exception, have the user action routine return a value of SS$_RESIGNAL instead of calling the signal routine (unless you want previously called condition handlers to be called again).

Condition Values Returned

SS$_RESIGNAL	Resignal condition to next handler. The exception described by **signal-arguments** was not an instruction fault handled by LIB $DECODE_ FAULT. If LIB$DECODE_FAULT can process the fault, it does not return to its caller.

Condition Value Signaled

LIB$_INVARG	Invalid argument to Run-Time Library. The instruction definition contained more than 16 operands or an operand definition contained an invalid data type or access code. This message is signaled after the stack frames have been unwound so that it appears to have

	been signaled from a routine that was called by the instruction that faulted.

Example

The following Fortran example implements a simple recovery scheme for floating underflow and overflow faults, replacing the result of the instruction with the correctly signed, smallest possible value for underflows or largest possible value for overflows.

```
C+
C Example condition handler and user-action routine using
C LIB$DECODE_FAULT. This example demonstrates the use of
C most of the features of LIB$DECODE_FAULT. Its purpose
C is to handle floating underflow and overflow faults,
C replacing the result of the instruction with the correctly
C signed smallest possible value for underflows, or greatest
C possible value for overflows.
C
C For simplicity, faults involving the POLYx instructions are
C not handled.
C
C***
C FIXUP_RESULT is the condition handler enabled by the program
C desiring the fixup of overflows and underflows.
C***
C-

        INTEGER*
        4 FUNCTION FIXUP_RESULT(SIGARGS, MECHARGS)
        IMPLICIT NONE
        INCLUDE '($SSDEF)' ! SS$_ symbols
        INCLUDE '($LIBDCFDEF)' ! LIB$DECODE_FAULT symbols
        INTEGER*4 SIGARGS(1:*) ! Signal arguments list
        INTEGER*4 MECHARGS(1:*) ! Mechanism arguments list

C+
C This is a sample redefinition of MULH3 instruction.
C-

        BYTE OPTABLE(8) /'FD'X,'65'X, ! MULH3 opcode
        1 LIB$K_DCFOPR_RH, ! Read H_floating
        2 LIB$K_DCFOPR_RH, ! Read H_floating
        3 LIB$K_DCFOPR_WH, ! Write H_floating
        4 LIB$K_DCFOPR_END, ! End of operands
        5 'FF'X,'FF'X/ ! End of instructions
        INTEGER*4 LIB$DECODE_FAULT ! External function
        EXTERNAL FIXUP_ACTION ! Action routine to do the fixup

C+
C Determine if the exception is one we want to handle.
C-

        IF ((SIGARGS(2) .EQ. SS$_FLTOVF_F) .OR.
        1 (SIGARGS(2) .EQ. SS$_FLTUND_F)) THEN

C+
C         We think we can handle the fault. Call
```

```
C         LIB$DECODE_FAULT and pass it the signal arguments and
C         the address of our action routine and opcode table.
C-

          FIXUP_RESULT = LIB$DECODE_FAULT (SIGARGS,
         1 MECHARGS, %DESCR(FIXUP_ACTION),, OPTABLE)
          RETURN
         END IF
C+
C        We can only get here if we couldn't handle the fault.
C        Resignal the exception.
C-

         FIXUP_RESULT = SS$_RESIGNAL
         RETURN
         END

C+
C User action routine to handle the fault.
C-

         INTEGER*4 FUNCTION FIXUP_ACTION (OPCODE,INSTR_PC,PSL,
         1                                REGISTERS,OP_COUNT,
         2                                OP_TYPES,READ_OPS,
         3                                WRITE_OPS,SIGARGS,
         4                                SIGNAL_ROUT,CONTEXT,
         5                                USER_ARG,ORIG_REGS)

         IMPLICIT NONE
         INCLUDE '($SSDEF)'              ! SS$_ definitions
         INCLUDE '($PSLDEF)'             ! PSL$ definitions
         INCLUDE '($LIBDCFDEF)'          ! LIB$DECODE_FAULT
                                         ! definitions
         INTEGER*4 OPCODE                ! Instruction opcode
         INTEGER*4 INSTR_PC              ! PC of this instruction
         INTEGER*4 PSL                   ! Processor status
                                         ! longword
         INTEGER*4 REGISTERS(0:15)       ! R0-R15 contents
         INTEGER*4 OP_COUNT              ! Number of operands
         INTEGER*4 OP_TYPES(1:*)         ! Types of operands
         INTEGER*4 READ_OPS(1:*)         ! Addresses of read operands
         INTEGER*4 WRITE_OPS(1:*)        ! Addresses of write operands
         INTEGER*4 SIGARGS(1:*)          ! Signal argument list
         INTEGER*4 SIGNAL_ROUT           ! Signal routine address
         INTEGER*4 CONTEXT               ! Signal routine context
         INTEGER*4 USER_ARG              ! User argument value
         INTEGER*4 ORIG_REGS(0:15)       ! Original registers

C+
C Declare and initialize table of class codes for each of the
C "real" opcodes. We'll index into this by the first byte of
C one-byte opcodes, the second byte of two-byte opcodes. The
C class codes will be used in a computed GOTO (CASE). The
C codes are:

C             0 - Unsupported
C             1 - ADD
C             2 - SUB
```

```
C             3 - MUL,DIV
C             4 - ACB
C             5 - CVT
C             6 - EMOD
C
C The class mainly determines how we compute the sign of the
C result, except for ACB.
C-

        BYTE INST_CLASS_TABLE(0:255)
        DATA INST_CLASS_TABLE /
        1     48*0,                                  ! 00-2F
        2     0,0,0,5,0,0,0,0,0,0,0,0,0,0,0,0,      ! 30-3F
        3     1,1,2,2,3,3,3,3,0,0,0,0,0,0,0,4,      ! 40-4F
        4     0,0,0,0,6,0,0,0,0,0,0,0,0,0,0,0,      ! 50-5F
        5     1,1,2,2,3,3,3,3,0,0,0,0,0,0,0,4,      ! 60-6F
        6     0,0,0,0,6,0,5,0,0,0,0,0,0,0,0,0,      ! 70-7F
        7     112*0,                                 ! 80-EF
        8     0,0,0,0,0,0,5,5,0,0,0,0,0,0,0,0/      ! F0-FF

C+
C Table of operand sizes in 8-bit bytes, indexed by the
C datatype code contained in the OP_TYPES array. Only floating
C types matter.
C-

        BYTE OP_SIZES(9) /0,0,0,0,0,4,8,8,16/
        INTEGER*4 LIB$EXTV              ! External function
        INTEGER*4 RESULT_NEGATIVE       ! -1 if result negative,
                                        ! 0 if positive
        INTEGER*4 SIGN1,SIGN2,SIGN3     ! Signs of operands
        INTEGER*4 INST_BYTE             ! Current opcode byte
        INTEGER*4 INST_CLASS            ! Class of instruction
                                        ! from table
        INTEGER*4 OP_DTYPE ! Datatype of operand
        INTEGER*4 OP_SIZE ! Size of operand in
        ! 8-bit bytes
        INTEGER*4 RESULT_OP ! Position of result
        ! in WRITE_OPS array
        LOGICAL*4 OVERFLOW ! TRUE if SS$_FLTOVF_F
        LOGICAL*4 SMALLER ! Function which
        ! compares operands
        PARAMETER ESCD = '0FD'X ! First byte of G,H instructions
        INTEGER*2 SMALL_F(2) ! Smallest F_floating
        DATA SMALL_F /'0080'X,0/
        INTEGER*2 SMALL_D(4) ! Smallest D_floating
        DATA SMALL_D /'0080'X,0,0,0/
        INTEGER*2 SMALL_G(4) ! Smallest G_floating
        DATA SMALL_G /'0010'X,0,0,0/
        INTEGER*2 SMALL_H(8) ! Smallest H_floating
        DATA SMALL_H /'0001'X,0,0,0,0,0,0,0/
        INTEGER*2 BIGGEST(8) ! Biggest value (all datatypes)
        DATA BIGGEST /'7FFF'X,7*'FFFF'X/
        INTEGER*4 SIGNAL_ARRAY(2) ! Array for signalling new
        ! exception

C+
C
```

```
C     NOTE: Because the operands arrays contain the locations of
C           the operands, rather than the operands themselves,
C           we must call a routine using the %VAL function to
C           "fool" the called routine into considering the
C           contents of an operands array element as the address
C           of an item. This would not be necessary in a
C           language that understood the concept of pointer
C           variables, such as PASCAL.
C
C
C If FPD is set in the PSL, signal SS$_ROPRAND (reserved operand). In
C reality this shouldn't happen since none of the instructions we
C handle can set FPD, but do it as an example.
C-

        IF (BTEST(PSL,PSL$V_FPD)) THEN
          SIGNAL_ARRAY(1) = 1           ! Count of signal arguments
          SIGNAL_ARRAY(2) = SS$_ROPRAND ! Error status value
          CALL SIGNAL_ROUT (
        1     1,                        ! Fault flag - signal as fault
        2     SIGNAL_ARRAY,             ! Signal arguments array
        3     CONTEXT)                  ! Context as passed to us
                                        ! Call will never return
          END IF

C+
C Set OVERFLOW according to the exception type. We assume that
C the only alternatives are SS$_FLTOVF_F and SS$_FLTUND_F.
C-

        OVERFLOW = (SIGARGS(2) .EQ. SS$_FLTOVF_F)

C+
C Determine the datatype of the instruction by that of its
C second operand, since that is always the type of the
C destination.
C-

        OP_DTYPE = IBITS(OP_TYPES(2),LIB$V_DCFTYP,LIB$S_DCFTYP)

C+
C Get the size of the datatype in words.
C-

        OP_SIZE = OP_SIZES (OP_DTYPE)

C+
C Determine the class of instruction and dispatch to the
C appropriate routine.
C-

        INST_BYTE = IBITS(OPCODE,0,8)   ! Get first byte
        IF (INST_BYTE .EQ. ESCD) INST_BYTE = IBITS(OPCODE,8,8)
        INST_CLASS = INST_CLASS_TABLE(INST_BYTE)
        GO TO (1000,2000,3000,4000,5000,6000),INST_CLASS

C+
C If we get here, the instruction's entry in the
```

```
C INST_CLASS_TABLE is zero. This might happen if the instruction was
C a POLYx, or was some other unsupported instruction. Resignal the
C original exception.
C-

        FIXUP_ACTION = SS$_RESIGNAL     ! Resignal condition to next
 handler
        RETURN                          ! Return to LIB$DECODE_FAULT

C+
C 1000 - ADDF2, ADDF3, ADDD2, ADDD3, ADDG2, ADDG3, ADDH2, ADDH3
C
C Result's sign is the same as that of the first operand,
C unless this is an underflow, in which case the magnitudes of
C the values may change the sign.
C-

1000     RESULT_NEGATIVE = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
         IF (.NOT. OVERFLOW) THEN
           IF (SMALLER(OP_SIZE,%VAL(READ_OPS(1)),
         1 %VAL(READ_OPS(2))))
         2 RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
           END IF
         GO TO 9000

C+
C 2000 - SUBF2, SUBF3, SUBD2, SUBD3, SUBG2, SUBG3, SUBH2, SUBH3
C
C Result's sign is the opposite of that of the first operand,
C unless this is an underflow, in which case the magnitudes of
C the values may change the sign.
C-

2000     RESULT_NEGATIVE = .NOT. LIB$EXTV (15,1,%VAL(READ_OPS(1)))
         IF (.NOT. OVERFLOW) THEN
         IF (SMALLER(OP_SIZE,%VAL(READ_OPS(1)),
         1 %VAL(READ_OPS(2))))
         2 RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
            END IF
         GO TO 9000

C+
C 3000 - MULF2, MULF3, MULD2, MULD3, MULG2, MULG3, MULH2, MULH3,
C DIVF2, DIVF3, DIVD2, DIVD3, DIVG2, DIVG3, DIVH2, DIVH3,
C
C If the signs of the first two operands are the same, then the
C result's sign is positive, if they are not it is negative.
C-

3000     SIGN1 = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
         SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(2)))
         RESULT_NEGATIVE = SIGN1 .XOR. SIGN2

         GOTO 9000

C+
C 4000 - ACBF, ACBD, ACBG, ACBH
C
```

```
C The result's sign is the same as that of the second operand
C (addend), unless this is underflow, in which case the
C magnitudes of the addend and index may change the sign.
C We must also determine if the branch is to be taken.
C-

4000    SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(2)))
        RESULT_NEGATIVE = SIGN2
        IF (.NOT. OVERFLOW) THEN
          -IF (SMALLER(OP_SIZE,%VAL(READ_OPS(2)),
        1 %VAL(READ_OPS(3))))
        2 RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
        END IF

C+
C If this is overflow, then the branch is not taken, since the
C result is always going to be greater or equal in magnitude
C to the limit, and will be the correct sign. If underflow,
C the branch is ALMOST always taken. The only case where the
C branch might not be taken is when the result is exactly
C equal to the limit. For this example, we are going to ignore
C this exceptional case.
C-

        IF (.NOT. OVERFLOW)
        1 REGISTERS(15) = READ_OPS(4) ! Branch destination
        GO TO 9000

C+
C 5000 - CVTDF, CVTGF, CVTHF, CVTHD, CVTHG
C
C Result's sign is the same as that of the first operand.
C-

        5000 RESULT_NEGATIVE = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
        GO TO 9000
C+
C-

6000 - EMODF, EMODD, EMODG, EMODH
C
C If the signs of the first and third operands are the same, then the
C result's sign is positive, else it is negative.
C-

6000    SIGN1 = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
        SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(3)))
        RESULT_NEGATIVE = SIGN1 .XOR. SIGN2
        GOTO 9000

C+
C All code paths merge here to store the result value. We also
C set the PSL appropriately. First, determine which operand is
C the result.
C-

9000    RESULT_OP = OP_COUNT
        IF (INST_CLASS .EQ. 4)
```

```
        1 RESULT_OP = RESULT_OP - 1 ! ACBx

C+
C Select result based on datatype and exception type.
C-

        IF (OVERFLOW) THEN
          CALL LIB$MOVC3 (OP_SIZE,BIGGEST,%VAL(WRITE_OPS(RESULT_OP)))
        ELSE
          GO TO (9100,9200,9300,9400), OP_DTYPE-(LIB$K_DCFTYP_F-1)

C+
C         Should never get here. Resignal original exception.
C-
          FIXUP_ACTION = SS$_RESIGNAL
          RETURN

C+
C     9100 - F_floating result
C-

9100     CALL LIB$MOVC3 (OP_SIZE,SMALL_F,%VAL(WRITE_OPS(RESULT_OP)))
         GOTO 9500

C+
C     9200 - D_floating result
C-

9200     CALL LIB$MOVC3 (OP_SIZE,SMALL_D,%VAL(WRITE_OPS(RESULT_OP)))
         GOTO 9500
C+
C     9300 - G_floating result
C-

9300     CALL LIB$MOVC3 (OP_SIZE,SMALL_G,%VAL(WRITE_OPS(RESULT_OP)))
         GOTO 9500
C+
C     9400 - H_floating result
C-

9400     CALL LIB$MOVC3 (OP_SIZE,SMALL_H,%VAL(WRITE_OPS(RESULT_OP)))
         GOTO 9500

9500    END IF

C+
C Modify the PSL to reflect the stored result. If the result was
C negative, set the N bit. Clear the V (overflow) and Z (zero) bits.
C If the instruction was an ACBx, leave the C (carry) bit unchanged,
C otherwise clear it.
C-

        IF (RESULT_NEGATIVE) THEN
          PSL = IBSET (PSL,PSL$V_N)      ! Set N bit
        ELSE
          PSL = IBCLR (PSL,PSL$V_N)      ! Clear N bit
        END IF
        PSL = IBCLR (PSL,PSL$V_V)        ! Clear V bit
```

```
        PSL = IBCLR (PSL,PSL$V_Z)        ! Clear Z bit
        IF (INST_CLASS .NE. 4)
        1 PSL = IBCLR (PSL,PSL$V_C)      ! Clear C bit if not ACBx

C+
C Set the sign of result.
C-

        IF (RESULT_NEGATIVE)
        1 CALL LIB$INSV (1,15,1,%VAL(WRITE_OPS(RESULT_OP)))

C+
C Fixup is complete. Return to LIB$DECODE_FAULT.
C-

        FIXUP_ACTION = SS$_CONTINUE
        RETURN
        END

C+
C Function which compares two floating values. It returns .TRUE. if
C the first argument is smaller in magnitude than the second.
C-
        LOGICAL*4 FUNCTION SMALLER(NBYTES,VAL1,VAL2)
        INTEGER*4 NBYTES              ! Number of bytes in values
        INTEGER*2 VAL1(*),VAL2(*)     ! Floating values to compare
        INTEGER*4 WORDA,WORDB
        SMALLER = .TRUE.              ! Initially return true

C+
C       Zero extend to a longword for unsigned compares.
C       Compare first word without sign bit.
C-

        WORDA = IBCLR(ZEXT(VAL1(1)),15)
        WORDB = IBCLR(ZEXT(VAL2(1)),15)
        IF (WORDA .LT. WORDB) RETURN

        DO I=2,NBYTES/2
        WORDA = ZEXT(VAL1(I))
        WORDB = ZEXT(VAL2(I))
        IF (WORDA .LT. WORDB) RETURN
        END DO

        SMALLER = .FALSE. ! VAL1 not smaller than VAL2
        RETURN
        END
```

LIB$DEC_OVER

LIB$DEC_OVER — The Enable or Disable Decimal Overflow Detection routine enables or disables decimal overflow detection for the calling routine activation. The previous decimal overflow setting is returned. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. This routine is available on OpenVMS Alpha and I64 systems in translated form and is applicable to translated VAX images only.

Format

LIB$DEC_OVER new-setting2

Returns

OpenVMS usage:	longword_unsigned
type:	longword integer (unsigned)
access:	write only
mechanism:	by value

The old decimal overflow enable setting (the previous contents of SF$W_ PSW[PSW$V_DV] in the caller's frame).

Argument

new-setting

OpenVMS usage:	
type:	
access:	
mechanism:	

New decimal overflow enable setting. The **new-setting** argument is the address of an unsigned longword that contains the new decimal overflow enable setting. Bit 0 set to 1 means enable; bit 0 set to 0 means disable.

Description

The caller's stack frame is modified by this routine.

A call to LIB$DEC_OVER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting does remain in effect for any routines that are subsequently entered through a JSB entry point.

Example

```
DECOVF: ROUTINE OPTIONS (MAIN);
DECLARE LIB$DEC_OVER ENTRY (FIXED BINARY (7))     /* Address of byte for
                                                  /* enable/disable
                                                  /* setting         */
        RETURNS (FIXED BINARY (31));              /* Old setting     */

DECLARE DISABLE FIXED BINARY (7) INITIAL (0) STATIC READONLY;
DECLARE RESULT FIXED BINARY (31);
DECLARE (A,B) FIXED DECIMAL (4,2);

ON FIXEDOVERFLOW PUT SKIP LIST ('Overflow');

RESULT = LIB$DEC_OVER (DISABLE);     /* Disable recognition of decimal
```

```
                                        /* overflow in this block      */

A = 99.99;
B = A + 2;
PUT SKIP LIST ('In MAIN');
        BEGIN;
        B = A + 2;
        PUT LIST ('In BEGIN block');
        CALL Q;
                Q: ROUTINE;
                B = A + 2;
                PUT LIST ('In Q');
                END Q;
                END /* Begin */;
END DECOVF;
```

This PL/I program shows how to use LIB$DEC_OVER to enable or disable the detection of decimal overflow. Note that in PL/I, disabling decimal overflow using this routine causes the condition to be disabled only in the current block; descendent blocks will enable the condition unless this routine is called in each block.

LIB$DELETE_FILE

LIB$DELETE_FILE — The Delete One or More Files routine deletes one or more files. The specification of the files to be deleted may include wildcards. LIB$DELETE_FILE is similar in function to the DCL command DELETE.

Format

LIB$DELETE_FILE filespec [,default-filespec] [,related-filespec] [,user-succe

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String containing the OpenVMS Record Management Services (RMS) file specification of the files to be deleted. The **filespec** argument is the address of a descriptor pointing to the file specification. If the

specification includes wildcards, each file that matches the specification is deleted. If running on Alpha or I64 and flag LIB$M_FIL_LONG_NAMES is set, the string must not contain more characters than specified by NAML$C_MAXRSS, otherwise the string must not contain more than 255 characters. Any string class is supported.

default-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Default file specification of the files to be deleted. The **default-filespec** argument is the address of a descriptor pointing to the default file specification. This is an optional argument; if the argument is omitted, the default is the null string. Any string class is supported.

See the *VSI OpenVMS Record Management Services Reference Manual* for information about default file specifications.

related-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Related file specification of the files to be deleted. The `related-filespec` argument is the address of a descriptor pointing to the related file specification. Any string class is supported. This is an optional argument; if the argument is omitted, the default is the null string.

Input file parsing is used. See the *VSI OpenVMS Record Management Services Reference Manual* for information on related file specifications and input file parsing.

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed.

user-success-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied success routine that LIB$DELETE_FILE calls after it successfully deletes a file.

The success routine can be used to display a log of the files that were deleted. For more information on the success routine, see Call Format for a Success Routine in the Description section.

user-error-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied error routine that LIB$DELETE_FILE calls when it detects an error.

The error routine returns a success/fail value that LIB$DELETE_FILE uses to determine if more files should be processed. For more information on the error routine, see Call Format for an Error Routine in the Description section.

user-confirm-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied confirm routine that LIB$DELETE_FILE calls before each file is deleted. The value returned by the confirm routine determines whether or not the file will be deleted. The confirm routine can be used to select specific files for deletion based on criteria such as expiration date, size, and so on. For more information about the confirm routine, see Call Format for a Confirm Routine in the Description section.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

User-supplied argument that LIB$DELETE_FILE passes to the error, success, and confirm routines each time they are called. Whatever mechanism is used to pass **user-specified-argument** to LIB $DELETE_FILE is also used to pass it to the routines. This is an optional argument; if the argument is omitted, zero is passed by value.

resultant-name

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String into which LIB$DELETE_FILE writes the RMS resultant file specification of the last file processed. The **resultant-name** argument is the address of a descriptor pointing to the resultant name.

If present, **resultant-name** is used to store the file specification passed to the user-supplied routines, instead of a default class S, type T string. Therefore, this argument should be specified when the user-

supplied routines are used and those routines require a descriptor type other than class S, type T. Any string class is supported.

If you specify one or more of the user-supplied action routines, the descriptor used to pass **resultant-name** must be:

- Of the same class as the descriptor required by the **filespec** argument of any action routines. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.
- (Alpha and I64 only) Of the same form as the descriptor required by the **filespec** argument of all action routines. For example, if the **filespec** argument of an action routine uses a 64-bit descriptor, then the **resultant-name** argument must also use a 64-bit descriptor.

file-scan-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context for deleting a list of file specifications. The **file-scan-context** argument is the address of a longword containing the context value.

You must initialize the file scan context to zero before the first of a series of calls to LIB $DELETE_FILE. LIB$FILE_SCAN uses this context to retain the file context for multiple input files. You must specify this context only when you are dealing with multiple input files, as the DCL command DELETE does. You may deallocate the context allocated by LIB$FILE_SCAN by calling LIB $FILE_SCAN_ END after all calls to LIB$DELETE_FILE have been completed.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User flags. The **flags** argument is the address of an unsigned longword containing the user flags.

The flag bits and their corresponding symbols are described in the following table:

Bit	Symbol	Description
0		Reserved to VSI.
1		Reserved to VSI.
2	LIB$M_FIL_LONG_NAMES	(Alpha or I64 only) If set, LIB $DELETE_FILE can process file names with a maximum length of NAML$C_MAXRSS.

Bit	Symbol	Description
		If clear, LIB$DELETE_FILE can process file specifications with a maximum length of 255 (default).

Description

This Description section is divided into the following parts:

- the section called “Call Format for a Success Routine”
- the section called “Call Format for an Error Routine”
- the section called “Call Format for a Confirm Routine”

Call Format for a Success Routine

The success routine is called only if the *user-success-procedure* argument was specified in the LIB$DELETE_FILE argument list.

The calling format of a success routine is as follows:

```
user-success-procedure   filespec [,user-specified-argument]
```

filespec

OpenVMS usage:	
type:	
access:	
mechanism:	

RMS resultant file specification of the file being deleted. The *filespec* argument is the address of a descriptor pointing to the file specification. If the *resultant-name* argument was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

On Alpha and I64 systems, the descriptor specified by each of the action routines for the *filespec* argument and the descriptor specified by the LIB$DELETE_FILE *resultant-name* argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you do not specify a *resultant-name* argument, then the *filespec* argument must use a 32-bit descriptor.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	unspecified

Value of *user-specified-argument* passed by LIB$DELETE_FILE to the success routine. The same passing mechanism that was used to pass *user-specified-argument* to LIB

$DELETE_FILE is used by LIB$DELETE_FILE to pass *user-specified-argument* to the success routine. This is an optional argument.

Call Format for an Error Routine

The error routine is called only if the *user-error-procedure* argument was specified in the LIB $DELETE_FILE argument list.

The calling format of an error routine is as follows:

```
user-error-procedure   filespec ,rms-sts ,rms-stv ,error-source [,user-
specified-argument]
```

filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String containing the RMS resultant file specification of the file being deleted. If *resultant-name* was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

On Alpha and I64 systems, the descriptor specified by each of the action routines for the *filespec* argument and the descriptor specified by the LIB$DELETE_FILE *resultant-name* argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you specify no *resultant-name* argument, then the *filespec* argument must use a 32-bit descriptor.

rms-sts

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Primary condition code (FAB$L_STS) that describes the error that occurred. The *rms-sts* argument is the address of an unsigned longword that contains the primary condition code.

rms-stv

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Secondary condition code (FAB$L_STV) that describes the error that occurred. The *rms-stv* argument is the address of an unsigned longword that contains the secondary condition code.

error-source

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Integer code that indicates the point at which the error was found. The *error-source* argument is the address of a longword integer containing the code of the error source.

Possible values for the error code are as follows:

0	Error searching for file specification
1	Error deleting file

user-specified-argument

OpenVMS usage:	
type:	
access:	
mechanism:	

Value passed to LIB$DELETE_FILE that is then passed to user-error-procedure using the same passing mechanism that was used to pass it to LIB$DELETE_FILE. This is an optional argument.

If the error routine returns a success status (bit 0 set), then LIB$DELETE_FILE continues processing files. If a failure status (bit 0 clear) is returned, then processing ceases immediately, and LIB $DELETE_FILE returns with the error status.

If the *user-error-procedure* argument is not specified, LIB$DELETE_FILE returns to its caller the most severe error status encountered while deleting the files. If the error routine is called for an error, the success status LIB$_ERRROUCAL is returned.

The error routine is not called for errors related to string copying.

Call Format for a Confirm Routine

The confirm routine is called only if the *user-confirm-procedure* argument was specified in the call to LIB$DELETE_FILE.

The calling format of the confirm routine is as follows:

```
user-confirm-procedure   filespec ,fab [,user-specified-argument]
```

filespec

OpenVMS usage:	char_string
type:	character string
access:	read only

mechanism:	by descriptor

RMS resultant file specification of the file to be deleted. The *filespec* argument is the address of a descriptor pointing to the file specification.

If *resultant-name* was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

On Alpha and I64 systems, the descriptor specified by each of the action routines for the *filespec* argument and the descriptor specified by the LIB$DELETE_FILE *resultant-name* argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you do not specify a *resultant-name* argument, then the *filespec* argument must use a 32-bit descriptor.

fab

OpenVMS usage:	fab
type:	unspecified
access:	read only
mechanism:	by reference

RMS file access block (FAB) that describes the file being deleted. Your program may perform an RMS $OPEN on the FAB to obtain file attributes to determine whether the file should be deleted, but it must close the file with $CLOSE before returning to LIB$DELETE_FILE.

On Alpha and I64 systems, if the LIB$M_FIL_LONG_NAMES FLAGS is set, the FAB references a NAML block rather than a NAM block. The NAML block supports the use of long file names with a maximum length of NAML$C_MAXRSS. See the *VSI OpenVMS Record Management Services Reference Manual* for information on NAML blocks.

user-specified-argument

OpenVMS usage:	user_arg
type:	unspecified
access:	read only
mechanism:	unspecified

The value of the *user-specified-argument* argument that LIB$DELETE_FILE passes to the confirm routine using the same passing mechanism that was used to pass it to LIB$DELETE_FILE. This is an optional argument.

If confirm routine returns a success status (bit 0 set), the file is then deleted; otherwise, the file is not deleted.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ERRROUCAL	Success, but an error routine was called. A file error was encountered, but the error routine was called to handle the condition.
LIB$INVARG	Invalid argument. The *flags* argument has one or more undefined bits set.

LIB$_INVFILSPE	Invalid file specification. *Filespec* or *default-filespec* is longer than 4095 characters.
LIB$_INVSTRDES	Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$DELETE_FILE.

Any condition value returned by LIB$SCOPY_ *xxx* except those condition values specifying truncation errors.

Any condition value returned by RMS. If *user-error-procedure* is not specified, this is the most severe of the RMS errors encountered while deleting the files.

Example

```
PROGRAM DELETE_EXAMPLE(INPUT, OUTPUT);

{+}
{ Declare external function LIB$DELETE_FILE. Throughout this
{ example, the user-arg argument is not used.
{-}

FUNCTION LIB$DELETE_FILE(
        FILESPEC: VARYING [A] OF CHAR;
        DEFAULT_FILESPEC: VARYING [B] OF CHAR;
        REL_FILESPEC : VARYING [D] OF CHAR;
        %IMMED [UNBOUND] ROUTINE SUCCESS_ROUTINE
            (FILESPEC : VARYING [A] OF CHAR) := %IMMED 0;
        %IMMED [UNBOUND] FUNCTION ERROR_ROUTINE
            (FILESPEC : VARYING [A] OF CHAR; RMS_STS, RMS_STV : INTEGER)
            : BOOLEAN := %IMMED 0;
        %IMMED [UNBOUND] FUNCTION CONFIRM_ROUTINE
            (FILESPEC: VARYING [A] OF CHAR): BOOLEAN := %IMMED 0;
        VAR USER_ARG : [UNSAFE] INTEGER := %IMMED 0;
        VAR RESULT_NAME : VARYING [C] OF CHAR := %IMMED 0
    ) : INTEGER; EXTERN;

{+}
{ Declare a routine which will display the names of the files
{ as they are deleted.
{-}

ROUTINE LOG_ROUTINE(FILESPEC : VARYING [A] OF CHAR);
    BEGIN
        WRITELN('File ', FILESPEC, ' successfully deleted');
    END;

{+}
{ Declare a routine which will notify the user that an error
{ occurred.
{-}

FUNCTION ERR_ROUTINE(FILESPEC: VARYING [A] OF CHAR;
        RMS_STS, RMS_STV: INTEGER): BOOLEAN;
    BEGIN
        WRITELN('Delete of ', FILESPEC, ' failed ', HEX(RMS_STS));
```

```
        ERR_ROUTINE := TRUE;
    END;

{+}
{ Declare a routine which checks to see if the file should be
{ deleted. If the filename contains the string 'XYZ', then it is
{ deleted.
{-}

FUNCTION CONFIRM_ROUTINE( FILESPEC: VARYING [A] OF CHAR): BOOLEAN;
        BEGIN
            IF INDEX(FILESPEC, 'XYZ') <> 0
            THEN
                CONFIRM_ROUTINE := TRUE
            ELSE
                CONFIRM_ROUTINE := FALSE;
        END;

{+}
{ The main program begins here.
{-}

VAR
    FILES_TO_DELETE, RESULTANT_NAME : VARYING [255] OF CHAR;
    RET_STATUS : INTEGER;
BEGIN
    WRITE ('Files to delete: ');
    READLN(FILES_TO_DELETE);
    RET_STATUS := LIB$DELETE_FILE(
        FILES_TO_DELETE, '*;', '', LOG_ROUTINE, ERR_ROUTINE,
                CONFIRM_ROUTINE,,RESULTANT_NAME);
    IF NOT ODD(RET_STATUS)
    THEN
        WRITELN('Delete failed. The error was ', HEX(RET_STATUS));
END.
```

This Pascal program prompts the user for file specifications of files to be deleted. Of those, it deletes only files that contain the string XYZ somewhere in their resultant file specification. The names of deleted files are displayed.

LIB$DELETE_LOGICAL

LIB$DELETE_LOGICAL — The Delete Logical Name routine requests the calling process' command language interpreter (CLI) to delete a supervisor-mode process logical name. LIB$DELETE_LOGICAL provides the same function as the DCL command DEASSIGN.

Format

LIB$DELETE_LOGICAL logical-name [,table-name]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

logical-name

OpenVMS usage:	logical_name
type:	character string
access:	read only
mechanism:	by descriptor

Logical name to be deleted. The *logical-name* argument is the address of a descriptor pointing to this logical name string. The maximum length of a logical name is 255 characters.

table-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the table from which the logical name is to be deleted. The *table-name* argument is the address of a descriptor pointing to this name string. This is an optional argument. If the argument is omitted, the LNM$PROCESS table is used.

Description

LIB$DELETE_LOGICAL requests the calling process's command language interpreter (CLI) to delete a supervisor-mode process logical name. If the optional *table-name* argument is defined, the logical name is deleted from that table. Otherwise, the logical name is deleted from the LNM$PROCESS table.

Unlike the system service $DELLOG and $DELLNM, LIB$DELETE_LOGICAL does not require the caller to be executing in supervisor mode to delete a supervisor-mode logical name.

This routine is supported for use with the DCL and MCR command language interpreters.

This routine does not support the DCL DEFINE and DEASSIGN commands' special side effect of opening and closing a process-permanent file if the logical name “SYS$OUTPUT” is specified.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In that case, the error status LIB$_NOCLI is returned.

See the *VSI OpenVMS DCL Dictionary* for a description of the DCL command DEASSIGN.

Condition Values Returned

SS$_ACCVIO	Access violation. The logical name could not be read.

SS$_IVLOGNAM	Invalid logical name. The logical name contained illegal characters or more than 255 characters.
SS$_IVLOGTAB	Invalid logical name table
SS$_NOLOGNAM	No logical name match. The logical name was not defined as a supervisor-mode process logical name.
SS$_NOPRIV	No privilege for attempted operation.
SS$_NORMAL	Routine successfully completed.
SS$_TOOMANYLNAM	Logical name translation exceeded allowed depth.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to your VSI support representative.

LIB$DELETE_SYMBOL

LIB$DELETE_SYMBOL — The Delete CLI Symbol routine requests the calling process's command language interpreter (CLI) to delete an existing CLI symbol.

Format

`LIB$DELETE_SYMBOL symbol [,table-type-indicator]`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

symbol

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the symbol to be deleted by LIB$DELETE_SYMBOL. The *symbol* argument is the address of a descriptor pointing to this symbol string. The symbol name is converted to uppercase, and trailing blanks are removed before use.

Symbol must begin with a letter, a digit, a dollar sign ($), a hyphen (-), or an underscore (_). The maximum length of *symbol* is 255 characters.

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Indicator of the table that contains the symbol to be deleted. The *table-type-indicator* argument is the address of a signed longword integer that is this table indicator.

If *table-type-indicator* is omitted, the local symbol table is used. The following are possible values for the *table-type-indicator* argument:

Symbolic Name	Value	Table Used
LIB$K_CLI_LOCAL_SYM	1	Local symbol table
LIB$K_CLI_GLOBAL_SYM	2	Global symbol table

Description

LIB$DELETE_SYMBOL is supported for use with the DCL CLI. The error status LIB$_NOCLI is returned if LIB$DELETE_SYMBOL is used with the MCR CLI or called from an image run directly as a subprocess or as a detached process.

LIB$K_CLI_LOCAL_SYM and LIB$K_CLI_GLOBAL_SYM are defined in symbol libraries supplied by VSI (macro or module name $LIBCLIDEF) and as global symbols.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to VSI.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVARG	Invalid argument. The value of *table-type-indicator* was invalid.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_INVSYMNAM	Invalid symbol name. The symbol name contained more than 255 characters or did not begin with a letter, a digit, a dollar sign, a hyphen, or an underscore.

LIB$_NOCLI	No CLI present to perform the function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_NOSUCHSYM	No such symbol. The symbol was not defined.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to your VSI support representative.

LIB$DELETE_VM_ZONE

LIB$DELETE_VM_ZONE — The Delete Virtual Memory Zone routine deletes a zone from the 32-bit virtual address space and returns all pages on VAX systems or pagelets on Alpha and I64 systems owned by the zone to the processwide 32-bit page pool. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$DELETE_VM_ZONE zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier. The *zone-id* is the address of a longword that contains the identifier of a zone created by a previous call to LIB$CREATE_VM_ZONE or LIB$CREATE_USER_VM_ZONE.

Description

LIB$DELETE_VM_ZONE deletes a zone and returns all pages on VAX systems or pagelets on Alpha and I64 systems owned by the zone to the processwide pool managed by LIB$GET_VM_PAGE.

The pages or pagelets are then available for reallocation by later calls to LIB$GET_VM or LIB $GET_VM_PAGE.

It takes less time to free memory in a single operation by calling LIB$DELETE_VM_ZONE than to individually account for and free every block of memory that was allocated by calling LIB$GET_VM.

You must ensure that your program is no longer using any of the memory in the zone before you call LIB$DELETE_VM_ZONE. Your program must not do any further operations on the zone after you call LIB$DELETE_VM_ZONE.

If you specified deallocation filling when you created the zone, LIB$DELETE_VM_ZONE will fill all of the allocated blocks that are freed.

If the zone you are deleting was created using the LIB$CREATE_USER_VM_ZONE routine, then you must have an appropriate action routine for the delete operation. That is, in your call to LIB $CREATE_USER_VM_ZONE, you must have specified a *user-delete-procedure*.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	An invalid *zone-id* argument or a corrupted zone.

LIB$DELETE_VM_ZONE_64

LIB$DELETE_VM_ZONE_64 — The Delete Virtual Memory Zone routine deletes a zone from the 64-bit virtual address space and returns all Alpha and I64 system pagelets owned by the zone to the processwide 64-bit page pool.

Format

LIB$DELETE_VM_ZONE_64 zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only

mechanism:	by reference

Zone identifier. The *zone-id* is the address of a quadword that contains the identifier of a zone created by a previous call to LIB$CREATE_VM_ZONE_64 or LIB$CREATE_USER_VM_ZONE_64.

Description

LIB$DELETE_VM_ZONE_64 deletes a zone and returns all pagelets on Alpha and I64 systems owned by the zone to the processwide pool managed by LIB$GET_VM_PAGE_64. The pagelets are then available for reallocation by later calls to LIB$GET_VM_64 or LIB$GET_VM_PAGE_64.

It takes less time to free memory in a single operation by calling LIB$DELETE_ VM_ZONE_64 than to individually account for and free every block of memory that was allocated by calling LIB $GET_VM_64.

You must ensure that your program is no longer using any of the memory in the zone before you call LIB$DELETE_VM_ZONE_64. Your program must not do any further operations on the zone after you call LIB$DELETE_VM_ZONE_64.

If you specified deallocation filling when you created the zone, LIB$DELETE_ VM_ZONE_64 will fill all of the allocated blocks that are freed.

If the zone you are deleting was created using the LIB$CREATE_USER_VM_ ZONE_64 routine, then you must have an appropriate action routine for the delete operation. That is, in your call to LIB $CREATE_USER_VM_ZONE_64, you must have specified a **user-delete-procedure**.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	An invalid *zone-id* argument or a corrupted zone.

LIB$DIGIT_SEP

LIB$DIGIT_SEP — The Get Digit Separator Symbol routine returns the system's digit separator symbol.

Format

LIB$DIGIT_SEP digit-separator-string [,resultant-length]

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

digit-separator-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Digit separator symbol returned by LIB$DIGIT_SEP. The *digit-separator-string* argument is the address of a descriptor pointing to the digit separator.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of characters written into *digit-separator-string*, not counting padding in the case of a fixed-length string. The *resultant-length* argument is the address of an unsigned word containing the length of the digit separator symbol. If the input string is truncated to the size specified in the *digit-separator-string* descriptor, *resultant-length* is set to this size. Therefore, *resultant-length* can always be used by the calling program to access a valid substring of *digit-separator-string*.

Description

LIB$DIGIT_SEP returns the symbol that is used to separate groups of three digits in the integer part of a number, for readability. A common digit separator is a comma (,) as in 3,006,854.

LIB$DIGIT_SEP attempts to translate the logical name SYS$DIGIT_SEP as a process, group, or system logical name. If the translation fails, LIB$DIGIT_SEP returns a comma (,), the United States digit separator. If the translation succeeds, the text produced is returned. Thus, a system manager can define SYS$DIGIT_SEP as a systemwide logical name to provide a default for all users, and an individual user with a special need can define SYS$DIGIT_SEP as a process logical name to override the default symbol. For example, you may want to use the European digit separator, the period (.).

BASIC implicitly uses LIB$DIGIT_SEP.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to VSI.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Successfully completed, but the digit separator string was truncated.

Example

```
PROGRAM DIGIT_SEP(INPUT, OUTPUT);

{+}
{ This program uses LIB$DIGIT_SEP to return current
{ value of SYS$DIGIT_SEP.
{-}

routine LIB$DIGIT_SEP(%DESCR DIGIT_SEPSTR : VARYING [A]
   OF CHAR; %REF OUT_LEN : INTEGER); EXTERN;

VAR
  SEPARATOR : VARYING [256] OF CHAR;
  LENGTH : INTEGER;

BEGIN
  LIB$DIGIT_SEP(SEPARATOR, LENGTH);
  WRITELN('104',SEPARATOR,'567',SEPARATOR,'934');
END.
```

This Pascal example demonstrates how to use LIB$DIGIT_SEP. The output generated by this program is as follows:

```
104,567,934
```

LIB$DISABLE_CTRL

LIB$DISABLE_CTRL — The Disable CLI Interception of Control Characters routine requests the calling process's command language interpreter (CLI) to not intercept the selected control characters when they are entered during an interactive terminal session. LIB$DISABLE_CTRL provides the same function as the DCL command SET NOCONTROL.

Format

LIB$DISABLE_CTRL disable-mask [,old-mask]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

disable-mask

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Bit mask indicating which control characters are not to be intercepted. The *disable-mask* argument is the address of an unsigned longword containing this bit mask.

Each of the 32 bits corresponds to one of the 32 possible control characters. If a bit is set, the corresponding control character is no longer intercepted by the CLI. Currently, only bits 20 and 25, corresponding to Ctrl/T and Ctrl/Y, are recognized.

The following mask is defined in symbol libraries supplied by VSI to specify the value of *disable-mask*:

Symbol	Hex Value	Function
LIB$M_CLI_CTRLT	%X ’00100000 ’	Disables Ctrl/T
LIB$M_CLI_CTRLY	%X ’02000000 ’	Disables Ctrl/Y

If a set bit does not correspond to a character that the CLI can intercept, LIB$DISABLE_CTRL returns an error.

old-mask

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Previous bit mask. The *old-mask* argument is the address of an unsigned longword into which LIB $DISABLE_CTRL writes the old bit mask. The old bit mask is of the same form as *disable-mask* and indicates those control characters that were previously enabled. It may therefore be given to LIB $ENABLE_CTRL to reinstate the previous condition.

Description

The DCL and MCR CLIs can intercept the Ctrl/Y control character. The DCL CLI can intercept the Ctrl/T character. See the *VSI OpenVMS DCL Dictionary* for information on how the DCL CLI processes control characters.

LIB$DISABLE_CTRL is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, LIB$DISABLE_CTRL returns the error status LIB$_NOCLI.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_INVARG	Invalid argument. A bit in *disable-mask* was set that did not correspond to a control character supported by the CLI.
LIB$_NOCLI	No CLI present. Either the calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to your VSI support representative.

LIB$DO_COMMAND

LIB$DO_COMMAND — The Execute Command routine stops program execution and directs the command language interpreter (CLI) to execute a command that you supply as the argument. If successful, LIB$DO_COMMAND does not return control to the calling program. Instead, LIB $DO_COMMAND begins execution of the specified command. If you want control to return to the caller, use LIB$SPAWN instead.

Format

LIB$DO_COMMAND command-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

command-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Text of the command that LIB$DO_COMMAND executes. The *command-string* argument is the address of a descriptor pointing to the command text. The maximum length of the command is 255 characters.

Description

LIB$DO_COMMAND terminates your current image and then executes the contents of *command-string* as a command. The command is parsed using normal DCL rules.

LIB$DO_COMMAND is especially useful when you want to execute a CLI command after your program has finished executing. For example, you could use the routine to execute a SUBMIT or PRINT command to handle a file that your program has created.

Because of the following restrictions on LIB$DO_COMMAND, you should be careful when you incorporate it in your program:

- During the call to LIB$DO_COMMAND, the current image exits and control cannot return to it.
- The text of the command is passed to the current command language interpreter. Because you can define your own CLI in addition to DCL and MCR, you must make sure that the command will be handled by the intended CLI.
- If LIB$DO_COMMAND is called from an image run directly as a subprocess or detached process, it will not execute correctly, because no CLI is associated with a subprocess.

LIB$DO_COMMAND is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB$_NOCLI is returned. Note that the command can execute an indirect file using the at sign (@) feature of DCL.

Condition Values Returned

LIB$_INVARG	Invalid argument. *command-string* was more than 255 characters.
LIB$_NOCLI	No CLI present. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to your VSI support representative.

Example

```
PROGRAM DO_COMMAND(INPUT, OUTPUT);

{+}
{ This example uses LIB$DO_COMMAND to execute
{ any DCL command that is entered by the user
{ at the prompt.
{-}

PROCEDURE LIB$DO_COMMAND(CMDTXT : VARYING [A] OF CHAR);
   EXTERN;

VAR
  COMMAND : VARYING [256] OF CHAR;

BEGIN
  WRITELN('ENTER THE COMMAND YOU WANT TO EXECUTE: ');
  READLN(COMMAND);
```

```
  LIB$DO_COMMAND(COMMAND);
END.
```

This Pascal program shows how to call LIB$DO_COMMAND. An example of the output of this program is as follows:

```
$ RUN DO_COMMAND
ENTER THE COMMAND YOU WANT TO EXECUTE:  SHOW TIME
  30-MAY-2000 14:07:28
```

LIB$EDIV

LIB$EDIV — The Extended-Precision Divide routine performs extended-precision division. LIB$EDIV makes the VAX EDIV instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$EDIV longword-integer-divisor ,quadword-integer-dividend ,longword-integer-quo

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

longword-integer-divisor

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by value

Divisor. The *longword-integer-divisor* argument is the address of a signed longword integer containing the divisor.

quadword-integer-dividend

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Dividend. The *quadword-integer-dividend* argument is the address of a signed quadword integer containing the dividend.

longword-integer-quotient

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by value

Quotient. The *longword-integer-quotient* argument is the address of a signed longword integer containing the quotient.

remainder

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by value

Remainder. The *remainder* argument is the address of a signed longword integer containing the remainder.

Condition Value Returned

SS$_NORMAL	Normal successful operation.
SS$_INTDIV	Integer divide by zero. The quotient is replaced by bits 31:0 of the dividend, and the remainder is replaced by zero.
SS$_INTOVF	Integer overflow. The quotient is replaced by bits 31:0 of the dividend, and the remainder is replaced by zero.

Example

```
C+
C This Fortran program demonstrates how to use LIB$EDIV.
C-

        INTEGER DIVISOR,DIVIDEND(2),QUOTIENT,REMAINDER

C+
C Find the quotient and remainder of 4600387192 divided by 4096.
C Because 4600387192 is too large to store as a longword, use LIB$EDIV.
C-

        DIVISOR= 4096

C+
C The dividend must be represented as a quadword. To do this use a vector
C of length 2. The first element is the low-order longword, and the second
C element is the high-order longword.
C Now, 4600387192 = '00000000112345678'x. So,
C-
```

```
DIVIDEND(1) = ’12345678’X
DIVIDEND(2) = ’00000001’X

C+
C Compute the quotient and remainder of 4600387192 divided by 4096.
C-

        RETURN = LIB$EDIV(DIVISOR,DIVIDEND,QUOTIENT,REMAINDER)
        TYPE *,’The longword integer quotient of 4600387192/4096 is:’
        TYPE *,’ ’,QUOTIENT
        TYPE *,’The longword integer remainder of 4600387192/4096 is:’
        TYPE *,’ ’, REMAINDER
        END
```

This Fortran example demonstrates how to call LIB$EDIV. The output generated by this program is as follows:

```
  The longword integer quotient of 4600387192/4096 is:
                      1123141
  The longword integer remainder of 4600387192/4096 is:
                        1656
```

LIB$EMODD

LIB$EMODD — The Extended Multiply and Integerize routine (D-Floating-Point Values) allows higher-level language users to perform accurate range reduction of D-floating arguments. On Alpha and I64 systems, D-floating-point values are not supported in full precision in native OpenVMS Alpha and I64 programs. They are precise to 56 bits on VAX systems, 53 or 56 bits in translated VAX images, and 53 bits in native OpenVMS Alpha and I64 programs.

Format

LIB$EMODD floating-point-multiplier ,multiplier-extension ,floating-point-multipli

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point
type:	D_floating
access:	read only

mechanism:	by reference

The multiplier. The **floating-point-multiplier** argument is a D-floating number.

multiplier-extension

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is an unsigned byte.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	D_floating
access:	read only
mechanism:	by reference

The multiplicand. The **floating-point-multiplicand** argument is a D-floating number.

integer-portion

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point
type:	D_floating
access:	write only
mechanism:	by reference

The fractional portion of the result. The **fractional-portion** argument is a D-floating number.

Description

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain x additional low-order fraction bits. The multiplicand is multiplied by

the extended multiplier. After multiplication, the integer portion is extracted, and a y-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of y bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of *x* and *y* are as follows:

Routine	x	Bits	y
LIB$EMODD	8	7:0	64

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero (0).
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMODF

LIB$EMODF — The Extended Multiply and Integerize routine (F-Floating-Point Values) allows higher-level language users to perform accurate range reduction of F-floating arguments.

Format

```
LIB$EMODF floating-point-multiplier ,multiplier-extension ,floating-point-multipli
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point

type:	F_floating
access:	read only
mechanism:	by reference

The multiplier. The **floating-point-multiplier** argument is the address of an F-floating number containing the number.

multiplier-extension

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is the address of an unsigned byte containing these multiplier extension bits.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference

The multiplicand. The **floating-point-multiplicand** argument is an F-floating number.

integer-portion

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point
type:	F_floating
access:	write only
mechanism:	by reference

The fractional portion of the result. The fractional-portion argument is the address of an F-floating number containing the fractional portion of the result.

Description

LIB$EMODF allows higher-level language users to perform accurate range reduction of F-floating arguments.

The floating-point *multiplier-extension* operand (second operand) is concatenated with the *floating-point-multiplier* (first operand) to gain x additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a y-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of y bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of x and y are as follows:

Routine	x	Bits	y
LIB$EMODF	8	7:0	32

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero.
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMODG

LIB$EMODG — The Extended Multiply and Integerize routine (G-Floating-Point Values) allows higher-level language users to perform accurate range reduction of G-floating arguments.

Format

```
LIB$EMODG floating-point-multiplier ,multiplier-extension ,floating-point-multipli
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point
type:	G_floating
access:	read only
mechanism:	by reference

The multiplier. The *floating-point-multiplier* argument is a G-floating number.

multiplier-extension

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The *multiplier-extension* argument is an unsigned word.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	G_floating
access:	read only
mechanism:	by reference

The multiplicand. The *floating-point-multiplicand* argument is a G-floating number.

integer-portion

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The *integer-portion* argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point
type:	G_floating
access:	write only

mechanism:	by reference

The fractional portion of the result. The *fractional-portion* argument is a G-floating number.

Description

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain x additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a y-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of y bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of x and y are as follows:

Routine	x	Bits	y
LIB$EMODG	11	15:5	64

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero.
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMODH

LIB$EMODH — On OpenVMS VAX systems, the Extended Multiply and Integerize routine (HFloating- Point Values) allows higher-level language users to perform accurate range reduction of H-floating arguments. This routine is not available to native OpenVMS Alpha programs but is available to translated VAX images.

Format

LIB$EMODH floating-point-multiplier ,multiplier-extension ,floating-point-multipli

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point
type:	H_floating
access:	read only
mechanism:	by reference

The multiplier. The *floating-point-multiplier* argument is an H-floating number.

multiplier-extension

OpenVMS usage:	word_unsigned
type:	word (signed)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The *multiplier-extension* argument is an unsigned word.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	H_floating
access:	read only
mechanism:	by reference

The multiplicand. The **floating-point-multiplicand** argument is an H-floating number.

integer portion

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The *integer-portion* argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point

type:	H_floating
access:	write only
mechanism:	by reference

The fractional portion of the result. The *fractional-portion* argument is an H-floating number.

Description

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain *x* additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a *y*-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of *y* bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of *x* and *y* are as follows:

Routine	**x**	**Bits**	**y**
LIB$EMODH	15	15:1	128

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero.
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMODF

LIB$EMODF — The Extended Multiply and Integerize routine (F-Floating-Point Values) allows higher-level language users to perform accurate range reduction of F-floating arguments.

Format

```
LIB$EMODF floating-point-multiplier ,multiplier-extension ,floating-point-multipli
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference

The multiplier. The *floating-point-multiplier* argument is the address of an F-floating number containing the number.

multiplier-extension

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The *multiplier-extension* argument is the address of an unsigned byte containing these multiplier extension bits.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference

The multiplicand. The *floating-point-multiplicand* argument is an F-floating number.

integer-portion

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The *integer-portion* argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point
type:	F_floating
access:	write only
mechanism:	by reference

The fractional portion of the result. The *fractional-portion* argument is the address of an F-floating number containing the fractional portion of the result.

Description

LIB$EMODF allows higher-level language users to perform accurate range reduction of F-floating arguments.

The floating-point *multiplier-extension* operand (second operand) is concatenated with the *floating-point-multiplier* (first operand) to gain x additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a y-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of y bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of x and y are as follows:

Routine	**x**	**Bits**	**y**
LIB$EMODF	8	7:0	32

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero.
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMODT

LIB$EMODT — The Extended Multiply and Integerize routine (IEEE T-Floating-Point Values) allows higher-level language users to perform accurate range reduction of IEEE T-floating arguments.

Format

LIB$EMODT floating-point-multiplier ,multiplier-extension ,floating-point-multipli

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

floating-point-multiplier

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	read only
mechanism:	by reference

The multiplier. The *floating-point-multiplier* argument is the address of an IEEE T-floating number containing the number.

multiplier-extension

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

The left-justified multiplier-extension bits. The *multiplier-extension* argument is the address of an unsigned byte containing these multiplier extension bits.

floating-point-multiplicand

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	read only
mechanism:	by reference

The multiplicand. The floating-point-multiplicand argument is an IEEE T-floating number.

integer-portion

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

The integer portion of the result. The *integer-portion* argument is the address of a signed longword integer containing the integer portion of the result.

fractional-portion

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	write only
mechanism:	by reference

The fractional portion of the result. The *fractional-portion* argument is the address of an IEEE T-floating number containing the fractional portion of the result.

Description

LIB$EMODT allows higher-level language users to perform accurate range reduction of IEEE T-floating arguments.

The floating-point *multiplier-extension* operand (second operand) is concatenated with the *floating-point-multiplier* (first operand) to gain x additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a y-bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of *y* bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

Routine	**x**	**Bites**	**y**
LIB$EMODT	11	11:0	64

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTUND	Floating underflow. The integer and fraction operands are replaced by zero.
SS$_INTOVF	Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS $_INTOVF also.
SS$_ROPRAND	Reserved operand. The integer and fraction operands are unaffected.

LIB$EMUL

LIB$EMUL — The Extended-Precision Multiply routine performs extended-precision multiplication. LIB$EMUL makes the VAX EMUL instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$EMUL longword-integer-multiplier ,longword-integer-multiplicand ,addend ,

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Arguments

longword-integer-multiplier

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Multiplier used by LIB$EMUL in the extended-precision multiplication. The *longword-integer-multiplier* argument is the address of a signed longword integer containing the multiplier.

longword-integer-multiplicand

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Multiplicand used by LIB$EMUL in the extended-precision multiplication. The *longword-integer-multiplicand* argument is the address of a signed longword integer containing the multiplicand.

addend

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Addend used by LIB$EMUL in the extended-precision multiplication. The *addend* argument is the address of a signed longword integer containing the addend.

product

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	write only
mechanism:	by reference

Product of the extended-precision multiplication. The *product* argument is the address of a signed quadword integer into which LIB$EMUL writes the product.

Description

The multiplicand argument is multiplied by the multiplier argument giving a double-length result. The addend argument is sign-extended to double-length and added to the result. LIB$EMUL then writes the result into the *product* argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

Example

```
    INTEGER MULT1,MULT2,ADDEND,PRODUCT(2)

C+
C Find the extended precision multiplication of 268435456 times 4096.
C That is, find the extended precision product of 2**28 times 2**12.
C Since 268435456 times 4096 is 2**40, a quadword value is needed for
C the calculation: use LIB$EMUL.
C-

    MULT1= 4096
    MULT2 = 268435456
    APPEND = 0

C+
C Compute 268435456*4096.
C Note that product will be stored as a quadword. This value will be stored
C in the 2 dimensional vector PRODUCT. The first element of PRODUCT will
C contain the low order bits, while the second element will contain the
 high
C order bits.
C-

    RETURN= LIB$EMUL(MULT1,MULT2,APPEND,PRODUCT)
    TYPE *,'PRODUCT(2) =',PRODUCT(2),' and PRODUCT(1) = ',PRODUCT(1)
    TYPE *,' '
    TYPE *,'Note that 256 and 0 represent the hexadecimal value'
    type *,14H'10000000000'x,', which in turn, represents 2**40.'
    END
```

This Fortran program demonstrates how to use LIB$EMUL. The output generated by this program is as follows:

```
    PRODUCT(2) =         256 and PRODUCT(1) =            0
```

Note that 256 and 0 represent the hexadecimal value ’10000000000 ’x, which in turn represents 2 [40].

LIB$ENABLE_CTRL

LIB$ENABLE_CTRL — The Enable CLI Interception of Control Characters routine requests the calling process's command language interpreter (CLI) to resume interception of the selected control characters when they are typed during an interactive terminal session. LIB$ENABLE_CTRL provides the same function as the DCL command SET CONTROL.

Format

`LIB$ENABLE_CTRL enable-mask [,old-mask]`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

enable-mask

OpenVMS usage:	enable_mask
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Bit mask indicating for which control characters LIB$ENABLE_CTRL is to enable interception. The *`enable-mask`* argument is the address of an unsigned longword containing this bit mask. Each of the 32 bits corresponds to one of the 32 possible control characters. If a bit is set, the corresponding control character is intercepted by the CLI. Currently, only bits 20 and 25, corresponding to Ctrl/T and Ctrl/Y, are recognized.

The following mask is defined in symbol libraries supplied by VSI to specify the value of *`enable-mask`*:

Symbol	Hex Value	Function
LIB$M_CLI_CTRLT	%X ’00100000 ’	Enables Ctrl/T
LIB$M_CLI_CTRLY	%X ’02000000 ’	Enables Ctrl/Y

If a set bit does not correspond to a character that the CLI can intercept, an error is returned.

old-mask

OpenVMS usage:	mask_longword

type:	longword (unsigned)
access:	write only
mechanism:	by reference

The following mask is defined in symbol libraries supplied by VSI to specify the value of *enable-mask*:

Symbol	Hex Value	Function
LIB$M_CLI_CTRLT	%X ’00100000 ’	Enables Ctrl/T
LIB$M_CLI_CTRLY	%X ’02000000 ’	Enables Ctrl/Y

If a set bit does not correspond to a character that the CLI can intercept, an error is returned. Previous bit mask. The *old-mask* argument is the address of an unsigned longword containing the old bit mask. The old bit mask is of the same form as *enable-mask*.

Description

LIB$ENABLE_CTRL provides the functions of the DCL command SET CONTROL. Normally, Ctrl/Y interrupts the current command, command procedure, or image. After a call to LIB$DISABLE_CTRL, Ctrl/Y is treated like Ctrl/U followed by a carriage return. LIB$ENABLE_CTRL restores the normal operation of Ctrl/Y or Ctrl/T.

Both the DCL and MCR CLIs can intercept control characters. See the *VSI OpenVMS DCL Dictionary* for information on how the CLI processes control characters.

LIB$ENABLE_CTRL is supported for use with the DCL or MCR CLIs.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB$_NOCLI is returned.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. A bit in *enable-mask* was set which did not correspond to a control character supported by the CLI.
LIB$_NOCLI	No CLI present. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to your VSI support representative.

LIB$ESTABLISH

LIB$ESTABLISH — The Establish a Condition Handler routine moves the address of a condition handling routine (which can be a user-written or a library routine) to longword 0 of the stack frame

of the caller of LIB$ESTABLISH. This routine is not available to native OpenVMS Alpha and I64 programs but is recognized and handled appropriately by most high-level language compilers. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$ESTABLISH new-handler

Returns

OpenVMS usage:	routine
type:	procedure value
access:	write only
mechanism:	by reference

Previous contents of SF$A_HANDLER (longword 0) of the caller's stack frame; zero if no handler existed.

Argument

new-handler

OpenVMS usage:	procedure
type:	procedure value
access:	read only
mechanism:	by value

Routine to be set up as the condition handler. The *new-handler* argument is the address of the procedure value to this routine.

Description

LIB$ESTABLISH moves the address of a condition-handling routine to longword 0 of the stack frame of the caller of LIB$ESTABLISH. This condition-handling routine then becomes the caller's condition handler. LIB$ESTABLISH returns the previous contents of longword 0. This can either be the address of the caller's previous condition handler or zero if no handler existed.

The new condition handler remains in effect for your routine until you call LIB$REVERT or until control returns to the caller of the routine that called LIB$ESTABLISH. Once this happens, you must call LIB$ESTABLISH again if the same (or a new) condition handler is to be associated with the routine that called LIB$ESTABLISH.

LIB$ESTABLISH modifies the caller's stack frame.

LIB$ESTABLISH is provided primarily for use with languages without built-in error handling facilities. Do not use LIB$ESTABLISH with languages that provide error handling, such as BASIC, COBOL,

Pascal, and PL/I. The language-support library for these languages depends on predefined language-specific handlers, and use of LIB$ESTABLISH with these languages may adversely affect the behavior of your program. See the language documentation for more information about how each language handles errors.

In VAX MACRO, use the following instruction instead of calling LIB$ESTABLISH:

```
MOVAB HANDLER, (FP)         ; set handler address
                            ; in current stack frame
```

Condition Values Returned

None.

Example

```
C+
C This Fortran program demonstrates the
C use of LIB$ESTABLISH.
C
C This is the main program.
C-

        EXTERNAL
        LOG_HANDL
        CHARACTER TIMBUF
        OPEN (UNIT=99, FILE = 'ERRLOG', STATUS = 'NEW')
        CALL LIB$ESTABLISH (LOG_HANDL)
        CALL SYS$BINTIM (TIMBUF, TIMADR)

C+
C The rest of the main program would go here.
C-

        END

        INTEGER*4 FUNCTION LOG_HANDL (SIGARGS, MECHARGS)
        INTEGER*4 SIGARGS (*), MECHARGS (5)

C+
C This is the handler to journal any signaled error messages.
C-

        INCLUDE'($SSDEF)'
        EXTERNAL PUT_LINE
        LOG_HANDL = SS$_RESIGNAL
        CALL SYS$PUTMSG (SIGARGS, PUT_LINE, )
        RETURN
        END
C+
C This is the action subroutine.
C-

        LOGICAL*4 FUNCTION PUT_LINE (LINE)
        CHARACTER*(*)LINE
        PUT_LINE = .FALSE.
```

```
100     WRITE (99,200)LINE
200     FORMAT (A)
        RETURN
        END
```

In this Fortran example, the function **log_handl** is the condition handler for the program, and thus receives control when an error occurs.

LIB$EXPAND_NODENAME

LIB$EXPAND_NODENAME — The Expand a Node Name to Its Full Name Equivalent routine expands a node name to its full name equivalent. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$EXPAND_NODENAME nodename, fullname [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Arguments

nodename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Node name to be expanded. The *nodename* argument contains the address of a descriptor pointing to this node-name string.

The error LIB$_INVARG is returned if *nodename* contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if *nodename* is an invalid descriptor.

fullname

OpenVMS usage:	char_string
type:	character string
access:	write only

mechanism:	by descriptor

Expanded node name. The *fullname* argument contains the address of a descriptor pointing to the expanded node-name string. LIB$EXPAND_NODENAME writes the expanded node-name string into the buffer pointed to by the *fullname* descriptor.

The error LIB$_INVSTRDES is returned if *fullname* is an invalid descriptor.

The length field of the *fullname* descriptor is not updated unless *fullname* is a dynamic descriptor with a length less than the resulting expanded full name. Refer to the *VSI OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The fullname argument contains an unusable result when LIB$EXPAND_NODENAME returns in error.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the expanded node name. The *resultant-length* argument is the address of an unsigned word that contains this length in bytes.

The *resultant-length* argument contains an unusable result when LIB$EXPAND_NODENAME returns in error.

Description

This routine expands the input node name to its full name equivalent. Input is validated against the supported form of node names. The error LIB$_INVARG is returned if the input node name is invalid.

If the returned full name overflows the buffer pointed to by *fullname*, the returned full name is truncated, and the alternate successful status LIB$_STRTRU is returned. The *resultant-length* argument is set to the value of the length field of the *fullname* descriptor if this argument is supplied.

If the length of the returned full name is less than or equal to the output buffer, the expanded full name is returned in *fullname*. *Resultant-length* is set to the actual length of the expanded full name if this argument is supplied.

In a DECnet environment, expanding a DECnet-Plus node name results in the error condition LIB $_INVARG.

LIB$EXPAND_NODENAME uses the underlying network directory services to look up the full name. In a DECnet-Plus for OpenVMS environment, LIB$EXPAND_NODENAME verifies the existence of the expanded full name in the naming environment. If the expanded full name does not exist in the naming environment, an error condition is returned from the underlying network services and is propagated back to the caller of LIB$EXPAND_NODENAME.

It is recommended that applications use full names instead of the short form of full names whenever possible. Because the short form of a full name is intended to be used only in a specific naming

environment, make sure the short form of a full name is expanded in the right naming environment to avoid ambiguity. See LIB$COMPRESS_NODENAME for more information about where and when to use the short form of a full name.

Any error resulting from calling the underlying network services is propagated and returned as condition values in this routine.

LIB$EXPAND_NODENAME supports any string class for the **nodename** and **fullname** string arguments.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by the *fullname* descriptor.
LIB$_INVARG	Invalid argument: • *nodename* is invalid. • *nodename* points to a null string. • The length of the node name is more than 1024 characters. • The expanded DECnet Phase V node name is invalid in a DECnet for OpenVMS environment.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by RTL routine LIB$SCOPY_R_DX or DECnet service $IPC.

LIB$EXTV

LIB$EXTV — The Extract a Field and Sign-Extend routine returns a sign-extended longword field that has been extracted from the specified variable bit field. LIB$EXTV makes the VAX EXTV instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$EXTV position ,size ,base-address

Returns

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by value

Field extracted by LIB$EXTV, sign-extended to a longword.

Arguments

position

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Position (relative to the base address) of the first bit in the field that LIB$EXTV extracts. The *position* argument is the address of a signed longword integer containing the position.

size

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Size of the bit field LIB$EXTV extracts. The *size* argument is the address of an unsigned byte containing the size. The maximum size is 32 bits.

base-address

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by value

Base address of the bit field LIB$EXTV extracts from the specified variable bit field. The *base-address* argument is an unsigned longword containing the base address.

Description

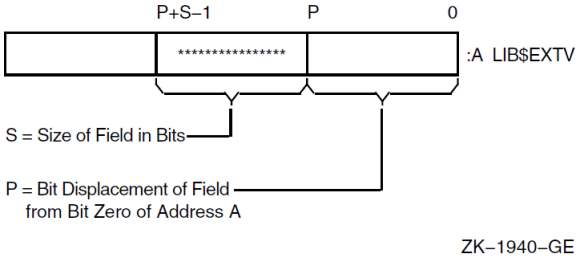
The variable-length bit field is an OpenVMS data type used to store small integers packed together in a larger data structure. It is often used to store single flag bits.

Three scalar attributes define a variable bit field:

- The base address is the address of a byte in memory that serves as a reference point for locating the bit field.
- The bit position is a signed longword containing the displacement of the least significant bit of the field with respect to bit 0 of the base address.

- The size is a byte integer indicating the size of the bit field in bits (in the range 0 ≤ size ≤ 32). That is, a bit field can be no more than one longword in length.

A variable-length bit field has the following format. The area containing asterisks indicates the field.



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Bit fields are zero-origin, which means that the routine regards the first bit in the field as being the zero position.

Condition Value Returned

SS$_ROPRAND	A reserved operand fault occurs if a size greater than 32 is specified.

Example

```
SIGN_EXTEND: ROUTINE OPTIONS (MAIN);

DECLARE LIB$EXTV ENTRY
       (FIXED BINARY (31),      /* Address of longword containing
                                /* beginning bit position            */
        FIXED BINARY (7),       /* Address of byte containing size
                                /* of field                          */
        FIXED BINARY (31)) /* Address of field                       */
        RETURNS (FIXED BINARY (31)); /* Return value                 */

DECLARE (VALUE, SMALL_INT) FIXED BINARY (31);

ON ENDFILE (SYSIN) STOP;

DO WHILE ('1'B);           /* Loop continuously, until end of file */
        PUT SKIP(2);
        GET LIST (VALUE) OPTIONS (PROMPT ('Value: '));
        SMALL_INT = LIB$EXTV ( 0, 4, VALUE);   /* Extract and sign-extend
                                               /*  first 4 bits       */
        PUT SKIP LIST (VALUE, SMALL_INT);
        END;

END SIGN_EXTEND;
```

This PL/I program extracts a field and returns it sign-extended into a longword.

LIB$EXTZV

LIB$EXTZV — The Extract a Zero-Extended Field routine returns a longword zero-extended field that has been extracted from the specified variable bit field. LIB$EXTZV makes the VAX EXTZV

instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$EXTZV position ,size ,base-address

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by value

Field extracted by LIB$EXTZV, zero-extended to a longword.

Arguments

position

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Position (relative to the base address) of the first bit in the field LIB$EXTZV extracts. The *position* argument is the address of a signed longword integer containing the position.

size

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Size of the bit field LIB$EXTZV extracts. The *size* argument is the address of an unsigned byte containing the size. The maximum size is 32 bits.

base-address

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by value

Base address of the bit field LIB$EXTZV extracts. The *base-address* argument is an unsigned longword containing the base address.

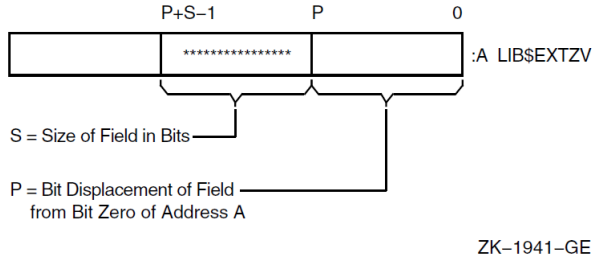
Description

The variable-length bit field is an OpenVMS data type used to store small integers packed together in a larger data structure. It is often used to store single flag bits.

Three scalar attributes define a variable bit field:

- The base address is the address of the byte in memory that serves as a reference point for locating the bit field.
- The bit position is a signed longword containing the displacement of the least significant bit of the field with respect to bit 0 of the base address.
- The size is a byte integer indicating the size of the bit field in bits (in the range 0 ≤ size ≤ 32). That is, a bit field can be no more than one longword in length.

A variable-length bit field has the following format. The area containing asterisks indicates the field.



Bit fields are zero-origin fields, which means that the routine regards the first bit in the field as being the zero position.

Condition Values Returned

SS$_ROPRAND	A reserved operand fault occurs if a size greater than 32 is specified.

LIB$FFx

LIB$FFx — The Find First Clear or Set Bit routines search the field specified by the start position, size, and base for the first clear or set bit. LIB$FFC and LIB$FFS make the VAX FFC and VAX FFS instructions available as callable routines.

Format

```
LIB$FFC position ,size ,base ,find-position
```

```
LIB$FFS position ,size ,base ,find-position
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

position

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Starting position, relative to the base address, of the bit field to be searched by LIB$FF *x*. The *position* argument is the address of a signed longword integer containing the starting position.

size

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Number of bits to be searched by LIB$FF*x*. The *size* argument is the address of an unsigned byte containing the size of the bit field to be searched. The maximum size is 32 bits.

base

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The *base* argument is the address of the bit field that LIB$FF *x* searches.

find-position

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by reference

Bit position of the first bit in the specified state (clear or set), relative to the base address. The *find-position* argument is the address of a signed longword integer into which LIB$FFC writes the position of the first clear bit and into which LIB$FFS writes the position of the first set bit.

Description

LIB$FFC searches the field specified by the start position, size, and base for the first clear bit. LIB$FFS searches the field for the first set bit.

If a bit in the specified state is found, LIB$FF *x* writes the position (relative to the base) of that bit into *find-position* and returns a success status. If no bits are in the specified state or if *size* is zero, LIB$FF *x* returns LIB$_NOTFOU and sets *find-position* to the starting position plus the size.

LIB$FF *x* regards the first bit in the field as being the zero position.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. A bit in the specified state was found.
LIB$_NOTFOU	A bit in the specified state was not found.

Condition Value Signaled

SS$_ROPRAND	Reserved operand fault. A size greater than 32 was specified.

LIB$FID_TO_NAME

LIB$FID_TO_NAME — The Convert Device and File ID to File Specification routine converts a disk device name and file identifier to a file specification.

Format

```
LIB$FID_TO_NAME device-name ,file-id ,filespec [,filespec-length] [,directory
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Arguments

device-name

OpenVMS usage:	char_string
type:	character string
access:	read only

mechanism:	by descriptor

Device name to be converted. The *device-name* argument is the address of a descriptor pointing to the device name. It must reference a disk device, and must contain 64 characters or less. LIB $FID_TO_NAME obtains *device-name* from the NAM$T_DVI field of an OpenVMS RMS name block.

file-id

OpenVMS usage:	vector_word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference, array reference

Specifies the file identifier. The *file-id* argument is the address of an array of three words containing the file identification. LIB$FID_TO_NAME obtains *file-id* from the NAM$W_FID field of an OpenVMS RMS name block. The $FIDDEF macro defines the structure of *file-id*.

filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Receives the file specification. The **filespec** argument is the address of a descriptor pointing to the file specification string. As of OpenVMS Version 7.2, the maximum file specification string that can be returned is 4095 bytes on Alpha and I64 systems, and 510 bytes on VAX systems. On versions prior to Version 7.2, the maximum is 510 bytes on both platforms. Refer to the Description section for more information about the file specification returned.

filespec-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Receives the number of characters written into *filespec*, excluding padding in the case of a fixed-length string. The optional *filespec-length* argument is the address of an unsigned word containing the number of characters.

If the output string is truncated to the number of characters specified in *filespec*, then *filespec-length* is set to that truncated size. Therefore, you can always use *filespec-length* to access a valid substring of *filespec*.

directory-id

OpenVMS usage:	vector_word_unsigned

type:	word (unsigned)
access:	read only
mechanism:	by reference, array reference

Specifies a directory file identifier. The *directory-id* argument is the address of an array of three words containing the directory file identifier. LIB$FID_TO_ NAME obtains this array from the NAM$W_DID field of an OpenVMS RMS name block. The $FIDDEF macro defines the structure of *directory-id*.

This parameter is relevant only for a structure level-1 disk on OpenVMS VAX systems. This parameter is ignored on OpenVMS Alpha and I64 systems because level-1 disks are not supported on OpenVMS Alpha and I64 systems.

acp-status

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

The status resulting from traversing the backward links. The optional *acp-status* argument is the address of an unsigned longword containing the status.

Description

LIB$FID_TO_NAME converts a disk device name and file identifier to a file specification by requesting the ACP file specification attribute.

On OpenVMS Alpha and I64 systems, if the file specification is longer than can be accommodated by the *filespec* buffer, a directory in the path may be replaced by a DID abbreviation (see the *Guide to OpenVMS File Applications*). If the file specification, even after DID abbreviation, is longer than can be accommodated by the buffer, the file specification is truncated, and LIB$STRTRU is returned as an alternate success status.

On OpenVMS VAX systems, if you use the LIB$FID_TO_NAME routine on a structure level 1 disk, specify the *directory-id* argument to ensure proper operation of the routine.

LIB$FID_TO_NAME uses the directory backpointer stored in the file header. With files in SYS $COMMON, the directory structure is duplicated because of some SET FILE/ENTERs of directory names. If directory names have been renamed or the tree structure modified (which the OpenVMS operating system does with the [SYCOMMON] tree), the file specification returned by this routine may not be useful.

LIB$FID_TO_NAME stores the output arguments (*filespec*, *filespec-length*, and *acp-status*) only if the routine successfully finishes.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$STRTRU	Output string truncated (qualified success).
LIB$_INVARG	Required argument omitted, or **device-name** is longer than 64 characters.
LIB$_INVFILSPE	The **device-name** argument does not reference a disk.

Any condition value returned by RTL routine LIB$ANALYZE_SDESC, or the $ASSIGN, $QIO, or $DASSGN system services.

LIB$FILE_SCAN

LIB$FILE_SCAN — The File Scan routine searches an area, such as a directory, for all files matching the file specification given and transfers program execution to the specified user-written routine. Wildcards are acceptable. An action routine is called for each file and/or error found. LIB$FILE_SCAN allows the search sequence to continue even if an error occurs while processing a particular file.

Format

```
LIB$FILE_SCAN fab ,user-success-procedure ,user-error-procedure [,context]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

fab

OpenVMS usage:	fab
type:	unspecified
access:	read only
mechanism:	by reference

File Access Block (FAB) referencing a valid NAM block or NAML block. The **fab** argument is the address of the FAB that contains the address and length of the file specification being searched for by LIB$FILE_SCAN. On Alpha and I64 systems, NAML blocks support the use of file specifications with a maximum length of NAML$C_MAXRSS. See the *OpenVMS Record Management Services Reference Manual* for information on NAML blocks.

user-success-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied success routine that LIB$FILE_SCAN calls when a file is found. The success routine is invoked with the FAB address that was passed to LIB$FILE_SCAN. The user context may be pased to this routine using the FAB$L_CTX field in the FAB.

user-error-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied error routine that LIB$FILE_SCAN calls when it encounters an error. The error routine is called with the FAB argument that was passed to LIB$FILE_SCAN.

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Default file context used in processing file specifications for multiple input files. The *context* argument is the address of a longword, which must be initialized to zero by your program before the first call to LIB$FILE_SCAN. After the first call, LIB$FILE_SCAN maintains this longword. You must not change the value of *context* in subsequent calls to LIB$FILE_SCAN.

Name blocks and file specification strings are allocated by LIB$FILE_SCAN, and *context* is used to retain their addresses so they may be deallocated later. If the *context* argument is not passed, unspecified portions of the file specification will be inherited from the previous file specification processed, rather than from multiple input file specifications.

Description

LIB$FILE_SCAN is called with the address of a File Access Block (FAB) and calls an action routine for each file found and/or error returned. LIB$FILE_SCAN allows the search sequence to continue even if an error occurs while processing a particular file.

If this routine is called once for each file specification argument in a command line, portions of the file specifications which are not specified by the user are inherited from the last files processed.

On Alpha and I64 systems, support for a file specification greater than 255 characters is provided by the use of NAML blocks rather than NAM blocks. See the *OpenVMS Record Management Services Reference Manual* for information on NAML blocks.

You must call LIB$FILE_SCAN_END before initiating a new sequence of calls to LIB$FILE_SCAN.

Condition Values Returned

Any condition value returned by the RMS Parse service.

LIB$FILE_SCAN_END

LIB$FILE_SCAN_END — The End-of-File Scan routine is called after each sequence of calls to LIB$FILE_SCAN. LIB$FILE_SCAN_END deallocates any saved OpenVMS RMS context and/or deallocates the virtual memory that had been allocated for holding the related file specification information.

Format

LIB$FILE_SCAN_END [fab] [,context]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

fab

OpenVMS usage:	fab
type:	unspecified
access:	modify
mechanism:	by reference

File access block (FAB) used with LIB$FILE_SCAN. The optional *fab* argument is the address of the FAB that contains the address and length of the file specification.

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Temporary default context used in LIB$FILE_SCAN. The optional *context* argument is the address of a longword containing this temporary default context.

Description

Your program should call LIB$FILE_SCAN_END after each sequence of calls to LIB$FILE_SCAN. The function that LIB$FILE_SCAN_END performs depends upon the arguments you specify. If you specify *fab*, LIB$FILE_SCAN_END parses the null string to deallocate any saved RMS context. If you specify *context*, LIB$FILE_SCAN_END deallocates any virtual memory that was allocated for holding the related file specification information. If you specify both *fab* and *context*, LIB $FILE_SCAN_END performs both functions. However, if you do not specify either argument, LIB $FILE_SCAN_END does nothing.

If LIB$FILE_SCAN is directed to process the specifications for multiple input files, LIB $FILE_SCAN_END is used to deallocate those saved file specifications. If LIB$FILE_SCAN_END is called by your program after each sequence of calls to LIB$FILE_SCAN, it will prevent the defaults from the previous call from affecting context value in the next call to LIB$FILE_SCAN. LIB $FILE_SCAN_END does this by replacing the context value passed to it with a temporary context value that your program passes to LIB$FILE_SCAN the next time it is called.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
RMS$_FAB	The *fab* argument is not the address of a valid FAB.

LIB$FIND_FILE

LIB$FIND_FILE — The Find File routine is called with a file specification for which it searches. LIB $FIND_FILE returns one file specification for each call. The file specification may contain wildcards.

Format

```
LIB$FIND_FILE filespec ,resultant-filespec ,context [,default-filespec] [,rel
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

filespec

OpenVMS usage:	char_string
type:	character string
access:	read only

mechanism:	by descriptor

File specification, which may contain wildcards, that LIB$FIND_FILE uses to search for the desired file. The *filespec* argument is the address of a descriptor pointing to the file specification. If running on Alpha or I64 and flag LIB$M_FIL_LONG_NAMES is set, the maximum length of a file specification is specified by NAML$C_MAXRSS, otherwise the maximum length of a file specification is 255 bytes.

The file specification used may also contain a search list logical name. If present, the search list logical name elements can be used as accumulative to related file specifications, so that portions of file specifications not specified by the user are inherited from previous file specifications.

resultant-filespec

OpenVMS usage:	char_string
type:	character string
access:	modify
mechanism:	by descriptor

Resultant file specification that LIB$FIND_FILE returns when it finds a file that matches the specification in the *filespec* argument. The *resultant-filespec* argument is the address of a descriptor pointing to the resultant file specification.

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

A longword integer variable into which the routine stores a context value for use by future calls to LIB $FIND_FILE or LIB$FIND_FILE_END. The *context* argument is an unsigned longword integer containing the address of the context. This variable must be set to zero before the first call to LIB $FIND_FILE. You can use the same *context* argument from one LIB$FIND_FILE call to another provided you have not called LIB$FIND_FILE_END for that *context* first. LIB$FIND_FILE uses this argument to retain the context when processing multiple input files. Portions of file specifications that the user does not specify may be inherited from the last files processed because the file contexts are retained in this argument. You must not change the value of *context* in subsequent calls to LIB $FIND_FILE.

default-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Default file specification. The *default-filespec* argument is the address of a descriptor pointing to the default file specification. See the *VSI OpenVMS Record Management Services Reference Manual* for information about default file specifications.

related-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Related file specification containing the context of the last file processed. The *related-filespec* argument is the address of a descriptor pointing to the related file specification.

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. For more information on related file specifications, see the *VSI OpenVMS Record Management Services Reference Manual*.

status-value

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

RMS secondary status value from a failing RMS operation. The *status-value* argument is an unsigned longword containing the address of a longword-length buffer to receive the RMS secondary status value (usually returned in the file access block field, FAB$L_STV).

flags

OpenVMS usage:	
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User flags. The *flags* argument is the address of an unsigned longword containing the user flags.

The flag bits and their corresponding symbols are described in the following table:

Bit	Symbol	Description
0	LIB$M_FIL_NOWILD	If set, LIB$FIND_FILE returns an error if a wildcard character is input.
1	LIB$M_FIL_MULTIPLE	If set, this performs temporary defaulting for multiple input files and the *related-filespec* argument is ignored. See description of *context* in LIB$FILE_SCAN. Each time LIB$FIND_FILE is called with a different file specification, the specification from the previous call is automatically used as a related file specification. This allows parsing of the elements of a search-list logical name such as DISK2: [SMITH] FIL1.TYP,FIL*2.TYP, and so on. Use of this

Bit	Symbol	Description	
		feature is required to get the desired defaulting with search list logical name. LIB$FIND_FILE_END must be called between each command line in interactive use or the defaults from the previous command line affect the current file specification.	
2	LIB $M_FIL_LONG_NAMES	(Alpha and I64 only) If set, LIB$FIND_FILE can process file specifications with a maximum length of NAML $C_MAXRSS. If clear, LIB$FIND_FILE can process file specifications with a maximum length of 255 (default).	
4	LIB $M_FIL_OPEN_SPECIAL	Find symlink instead of symlink target.	
5-6	LIB $M_FIL_SYMLINK_MODE	Control matching of symlinks in directory wildcarding:	
		LIB$M_FIL_SYMLINK_ DEFAULT	Use the RMS default.
		LIB$M_FIL_SYMLINK_ NONE	Match no symlinks.
		LIB$M_FIL_SYMLINK_ ALL	Match all symlinks.
		LIB$M_FIL_SYMLINK_ NOELLIPS	Match all symlinks except with ellipsis in pattern string.

Description

LIB$FIND_FILE returns one file specification per call unless it fails to find the target file specification. In this case, the routine returns the condition value RMS$_NMF (no more files). Each successful call to LIB$FIND_FILE results in a new *resultant-filespec*.

When you call LIB$FIND_FILE repeatedly using the same *context*, *filespec* is saved only if you set the MULTIPLE bit. If you specify a different *filespec* on your next call and set the MULTIPLE bit, the file specification from the previous call defaults as the related file specification.

For each LIB$FIND_FILE call, RMS first applies the defaults from *default-filespec* and then uses the defaults from *related-filespec*, if relevant. Default file specifications are used only if components are missing from the *filespec* argument and the needed components are found in *default-filespec*. The *related-filespec* argument is used when you process lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. This provides an extra level of file specification defaults. For additional information on related file specifications and input file parsing, see the *VSI OpenVMS Guide to OpenVMS File Applications*.

The *filespec* argument can contain wildcard characters. LIB$FIND_FILE can be called repeatedly using the same *context* argument until the error RMS$_NMF (no more files) is returned.

LIB$FIND_FILE searches for a certain wildcard file specification and returns all file specifications that satisfy that wildcard file specification.

If you make multiple calls to LIB$FIND_FILE, be aware of the following behavior:

- If the NOWILD bit is not set and the file specification does not contain any wildcard characters, LIB $FIND_FILE returns the appropriate file name on the first call and the condition value RMS$_NMF on the next call.

- If the NOWILD bit is set and you use the same nonwildcard file specification, LIB$FIND_FILE returns the file name on the first call as well as each subsequent call.

On Alpha and I64 systems, support for file specifications longer than 255 characters is provided only when the LIB$M_FIL_LONG_NAMES flag is set in the *flags* argument. When this flag is set, a NAML block (rather than a NAM block) is part of the context, and file specifications can have a maximum length of NAML$C_MAXRSS. See the *VSI OpenVMS Record Management Services Reference Manual* for information on NAML blocks.

You must call LIB$FIND_FILE_END before initiating a new sequence of calls to LIB$FIND_FILE to properly deallocate all of the internal data structures that were allocated in the calls to LIB$FIND_FILE. After you call LIB$FIND_FILE_END, the context value is no longer valid and cannot be used on any subsequent LIB$FIND_FILE calls.

If the error RMS$_CHN is returned, RMS has no more channels to assign. There are two possible reasons for this:

- You did not call LIB$FIND_FILE_END before initiating a new call with a context variable to LIB $FIND_FILE. (This is the most common reason.)
- The system parameter CHANNELCNT is too low.

Condition Values Returned

RMS$_NORMAL	Routine successfully completed.
LIB$_NOWILD	A wildcard character was present in the file specification parsed, and the wildcard flag bit was set to no wildcard. (This is actually the SHR$_NOWILD error message after application of the LIB$ facility code.)
RMS$_CHN	No more channels.
RMS$_NMF	No more files.

Any condition value returned by RMS Parse and Search services, LIBGET_VM, LIBGET_VM_64, LIB$FREE_VM, LIB$FREE_VM_64, LIB$SCOPY_R_DX, or LIB$SCOPY_R_DX_64.

LIB$FIND_FILE_END

LIB$FIND_FILE_END — The End of Find File routine is called once after each sequence of calls to LIB$FIND_FILE. LIB$FIND_FILE_END deallocates any saved OpenVMS RMS context and deallocates the virtual memory used to hold the allocated context block.

Format

LIB$FIND_FILE_END context

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Argument

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Zero or the address of a FAB/NAM buffer from a previous call to LIB$FIND_FILE. The *context* argument is the address of a longword that contains this context.

Description

LIB$FIND_FILE_END should be called by your program after each sequence of calls to LIB $FIND_FILE. This will prevent the default values from the previous call from affecting the next file specification.

LIB$FIND_FILE_END deallocates the context used in the last call to LIB$FIND_FILE so that the context retained will not be used in subsequent calls to LIB$FIND_FILE. If LIB$FIND_FILE was directed to process file specifications for multiple input files, the saved file specifications are also deallocated.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
RMS$_FAB	File access block argument is not the address of a valid FAB.

LIB$FIND_IMAGE_SYMBOL

LIB$FIND_IMAGE_SYMBOL — The Find Universal Symbol in Shareable Image File routine reads universal symbols from the shareable image file. This routine then dynamically activates a shareable image into the P0 address space of a process.

Format

```
LIB$FIND_IMAGE_SYMBOL filename ,symbol ,symbol-value [,image-name] [,flags]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

filename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the file for which LIB$FIND_IMAGE_SYMBOL is searching. The *filename* argument is the address of a descriptor pointing to this file name string. This argument may contain only the file name. File type cannot be indicated. If any file specification punctuation characters (:, [, <, ;, .) are present, the error SS$_IVLOGNAM is returned.

You can specify a file specification for the image name with the optional *image-name* argument. If you do not specify *image-name*, a default file specification of SYS$SHARE:.EXE is applied to the file name. If the file is not in SYS$SHARE:.EXE, a logical name must be used to direct this routine to locate the correct file. Only logical names defined in the system logical name table with the /EXEC attribute will be considered while the image activator is processing a request from an image that was installed with privileges. If the calling image was installed with privileges, the image being activated and any shareable images or message sections it references must be installed as a known image with the INSTALL utility. Running an image to which you have only Execute (not Read) access results in the same restrictions on logical names and shareable images as does running a privileged image.

On VAX systems, the *filename* descriptor must be class D, S, or Z.

symbol

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Symbol for which LIB$FIND_IMAGE_SYMBOL is searching in the *filename* file. The *symbol* argument is the address of a descriptor pointing to the symbol name string. The symbol name string can be input in uppercase, lowercase, or mixed case letters.

symbol-value

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

Symbol value that LIB$FIND_IMAGE_SYMBOL has located. The *symbol-value* argument is the address of a signed longword integer into which LIB$FIND_ IMAGE_SYMBOL returns the symbol

value. If the symbol is relocatable, the starting virtual address of the shareable image in memory is added to the symbol value.

image-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Default file specification applied to the image name. The optional *image-name* argument is a string used as the RMS default file specification when parsing *filename* as the primary filename. If *image-name* is not supplied, then a default file specification of SYS$SHARE:.EXE is applied to the image name.

On VAX systems, the *image-name* descriptor must be class D, S, or Z.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by value

Control flags. The *flags* argument is the address of a longword integer that contains the control flags.

Bit	Value	Description
0	Reserved to VSI	
1	Reserved to VSI	
2	Reserved to VSI	
3	Reserved to VSI	
4	LIB$M_FIS_MIXEDCASE	Causes LIB$FIND_IMAGE_ SYMBOL to look for the symbol without converting it to uppercase.

This is an optional argument. If omitted, the default is 0. If omitted, or if LIB$M_FIS_MIXEDCASE (bit 4) is 0, LIB$FIND_IMAGE_SYMBOL converts the specified symbol to uppercase before it is used.

Description

The shareable image that LIB$FIND_IMAGE_SYMBOL activates must have been already linked and must be position independent. You must have read access to the shareable image file to use this routine.

LIB$FIND_IMAGE_SYMBOL writes the symbol value that it has located into the *symbol-value* argument.

After the first call to LIB$FIND_IMAGE_SYMBOL for a particular image, successive calls for that image are processed quickly. The image is activated only once and an in-memory database is maintained.

There is no way to deallocate this database, nor is there any supported method to remove an activated image from the address space. All images are activated into P0 space.

LIB$FIND_IMAGE_SYMBOL locates the universal symbol in its database qualified by the file name exactly as given in the *filename* argument. Therefore, a reference to a lexically different but equivalent file name causes a new copy of the same shareable image to be loaded and searched. To avoid this situation, *always specify the desired file name in the same form*.

To work properly with translated VAX images on Alpha and I64 systems, LIB $FIND_IMAGE_SYMBOL may modify the name of the file being searched and may retry the search if the first search failed. If called from a translated image, LIB$FIND_IMAGE_SYMBOL appends "_TV" to the file name before searching. This locates the translated version of the image being searched. If the search fails to find the file or the file does not define the symbol, LIB$FIND_ IMAGE_SYMBOL trys again with the unmodified original file name. This locates the native Alpha or I64 version of the image. If the second search also fails, an error is returned. If LIB$FIND_IMAGE_SYMBOL is called from a native Alpha or I64 program, the order of the searches is reversed. The first search is done with the unmodified original file name. If that fails, the second search is done with "_TV" appended to the file name. If the second search fails, an error is returned.

LIB$FIND_IMAGE_SYMBOL disables AST recognition while it is executing. AST recognition is reenabled before returning to the caller only if AST recognition was previously enabled.

LIB$FIND_IMAGE_SYMBOL signals all errors and returns the status in R0.

LIB$FIND_IMAGE_SYMBOL may signal a warning (LIB$_EOMWARN) to indicate that the image being activated contains modules that had compilation warnings. A condition handler used with LIB $FIND_IMAGE_SYMBOL should probably handle this as a special case.

To allow LIB$FIND_IMAGE_SYMBOL to continue executing after signaling LIB$_EOMWARN, the condition handler should exit with SS$CONTINUE. For this reason, you may choose not to use LIB $SIG_TO_RET as a condition handler for LIB$FIND_IMAGE_SYMBOL.

Condition Values Returned

LIB$_BADCCC	Illegal compilation code.
LIB$_EOMERROR	Compilation errors.
LIB$_EOMFATAL	Fatal compilation errors.
LIB$_EOMWARN	Compilation warnings.
LIB$_GSDTYP	Illegal universal symbol directory record type.
LIB$_ILLFMLCNT	Maximum argument count exceeds maximum for routine.
LIB$_ILLMODNAM	Illegal module name length.
LIB$_ILLPSCLEN	Illegal program section length.
LIB$_ILLRECLEN	Illegal record length in module.
LIB$_ILLRECLN2	Illegal record length.
LIB$_ILLRECTYP	Illegal record type in module.
LIB$_ILLRECTY2	Illegal record type.
LIB$_ILLSYMLEN	Illegal symbol length.
LIB$_NOEOM	No end of module record contained in the module.

LIB$_RECTOOSML	Record too small; data overflows object record in module.
LIB$_SEQUENCE	Illegal record sequence in module.
LIB$_SEQUENCE2	Illegal record sequence.
LIB$_STRVL	Illegal object language structure level in module.
Note that all of the above error messages indicate a format error in the shareable image.	
LIB$_INSVIRMEM	Insufficient virtual memory.
SS$_IVLOGNAM	The *filename* argument contained more than just a file name; a device or directory specification was found in the string.

LIB$FIND_VM_ZONE

LIB$FIND_VM_ZONE — The Return the Next Valid Zone Identifier routine returns the zone identifier of the next valid zone in the heap management 32-bit database. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$FIND_VM_ZONE context ,zone-id

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context specifier. The *context* argument is the address of an unsigned longword used to keep the scan context for finding the next valid zone. The *context* argument must be 0 to initialize the scan and to start with the first returnable zone identifier.

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)

access:	write only
mechanism:	by reference

Zone identifier. The *zone-id* argument is the address of an unsigned longword that receives the zone identifier for the next zone.

Description

At each call, LIB$FIND_VM_ZONE scans the heap management 32-bit zone database and returns the *zone-id* of the next valid zone. (The first and second calls to LIB$FIND_VM_ZONE return the *zone-id* of the 32-bit default zone and the 32-bit string zone, respectively.) This capability allows a program to deal with each 32-bit VM zone created during the invocation, including those created outside of the program.

Note

LIB$FIND_VM_ZONE finds only 32-bit zones. You must use LIB$FIND_VM_ZONE and LIB $FIND_VM_ZONE_64 to loop through all VM zones.

The *context* argument controls the state of the scan. It determines what zone to return (the first, the next, and so forth). On the initial call, specified by *context*=0, LIB$VERIFY_VM_ZONE is called to verify the heap management zone database. If the database is corrupt, further calls to this routine will produce no additional useful output.

When no more zones can be found, the routine returns the condition value LIB$_NOTFOU.

If a zone has been corrupted in some major way (for example, if the validity code has been changed), then this routine may not be able to locate it in the zone database.

Note that ASTs may be disabled while LIB$FIND_VM_ZONE is executing code that depends on the stability of the heap management zone database. In general it is the caller's responsibility to ensure that the calling program has exclusive access to the zone database while scanning for multiple zones with this routine. Results are unpredictable if another thread of control modifies the zone database or the associated areas during the scanning.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone.
LIB$_NOTFOU	Zone identifier not found (alternate success status).
LIB$_WRONUMARG	Wrong number of arguments.

Example

```
IMPLICIT NONE
INTEGER*4 status,context,zone_id
INTEGER*4 lib$find_vm_zone,lib$show_vm_zone

context = 0
status = lib$find_vm_zone (context, zone_id)
```

```
DO WHILE (status)
    print *
    status = lib$show_vm_zone (zone_id, 0)
    status = lib$find_vm_zone (context, zone_id)
END DO
END
```

Sample output for this Fortran program is shown below:

```
  Zone Id = 00020020,  Zone name = "DEFAULT_ZONE"
  Zone Id = 000200B0,  Zone name = "STRING_ZONE"
```

LIB$FIND_VM_ZONE_64

LIB$FIND_VM_ZONE_64 — The Return the Next Valid Zone Identifier routine returns the zone identifier of the next valid zone in the heap management 64-bit database.

Format

LIB$FIND_VM_ZONE_64 context ,zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

context

OpenVMS usage:	context
type:	quadword (unsigned)
access:	modify
mechanism:	by reference

Context specifier. The *context* argument is the address of an unsigned quadword used to keep the scan context for finding the next valid zone. The *context* argument must be 0 to initialize the scan and to start with the first returnable zone identifier.

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Zone identifier. The *zone-id* argument is the address of an unsigned quadword that receives the zone identifier for the next zone.

Description

At each call, LIB$FIND_VM_ZONE_64 scans the heap management 64-bit zone database and returns the zone-id of the next valid zone. (The first and second calls to LIB$FIND_VM_ZONE_64 return the *zone-id* of the 64-bit default zone and the 64-bit string zone, respectively.) This capability allows a program to deal with each VM 64-bit zone created during the invocation, including those created outside of the program.

Note

LIB$FIND_VM_ZONE_64 finds only 64-bit zones. You must use LIB$FIND_VM_ZONE and LIB $FIND_VM_ZONE_64 to loop through all VM zones.

The context argument controls the state of the scan. It determines what zone to return (the first, the next, and so forth). On the initial call, specified by context=0, LIB$VERIFY_VM_ZONE_64 is called to verify the heap management zone database. If the database is corrupt, further calls to this routine will produce no additional useful output.

When no more zones can be found, the routine returns the condition value LIB$_ NOTFOU.

If a zone has been corrupted in some major way (for example, if the validity code has been changed), then this routine may not be able to locate it in the zone database.

Note that ASTs may be disabled while LIB$FIND_VM_ZONE_64 is executing code that depends on the stability of the heap management zone database. In general it is the caller's responsibility to ensure that the calling program has exclusive access to the zone database while scanning for multiple zones with this routine. Results are unpredictable if another thread of control modifies the zone database or the associated areas during the scanning.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone.
LIB$_NOTFOU	Zone identifier not found (alternate success status).
LIB$_WRONUMARG	Wrong number of arguments.

Example

```
IMPLICIT NONE
INTEGER*4 status
INTEGER*8 context,zone_id
INTEGER*4 lib$find_vm_zone_64,lib$show_vm_zone_64

context = 0
status = lib$find_vm_zone_64 (context, zone_id)
DO WHILE (status)
    print *
    status = lib$show_vm_zone_64 (zone_id, 0)
```

```
    status = lib$find_vm_zone_64 (context, zone_id)
END DO
END
```

Sample output for this Fortran program is as follows:

```
    Zone Id = 0000000000020040, Zone name = "DEFAULT_ZONE"
    Zone Id = 0000000000020140, Zone name = "STRING_ZONE"
```

LIB$FIT_NODENAME

LIB$FIT_NODENAME — The Fit a Node Name Into an Output Field routine fits a node name into an output field. It attempts to compress the node name to fit the output field. If this fails, it trims the node name. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$FIT_NODENAME nodename, output-buffer [,output-width][,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

nodename

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Node name to be fitted into the desired output field. The *nodename* argument contains the address of a descriptor pointing to this node-name string.

The error LIB$_INVARG is returned if *nodename* contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if *nodename* is an invalid descriptor.

output-buffer

OpenVMS usage:	char_string
type:	character string

access:	write only
mechanism:	by descriptor

The output buffer. The *output-buffer* argument contains the address of a descriptor pointing to the output buffer. LIB$FIT_NODENAME writes the final output node name into the buffer pointed to by *output-buffer*.

The error LIB$_INVSTRDES is returned if *output-buffer* is an invalid descriptor.

The length field of the *output-buffer* descriptor is not updated unless *output-buffer* is a dynamic descriptor with a length less than the resulting fitted node name. Refer to the *VSI OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The *output-buffer* argument contains an unusable result when LIB$FIT_NODENAME returns in error. Field width desired for the fit operation. The *output-width* argument is the address of an unsigned word that contains this field width in bytes.

output-width

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Field width desired for the fit operation. The *output-width* argument is the address of an unsigned word that contains this field width in bytes.

If *output-width* is omitted, the current length of *output-buffer* is used. If *output-buffer* is not a fixed-length string, specify *output-width* to ensure that the desired width is used.

If the lengths of both *output-buffer* and *output-width* are specified, the length in *output-width* is used. In this case, if the current length of *output-buffer* is smaller than the length of *output-width*, the output node name is truncated at the end, and the alternate successful status LIB$_STRTRU is returned. Length of the output node name. The *resultant-length* argument is the address of an unsigned word that contains this length in bytes.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

The *resultant-length* argument contains an unusable result when LIB$FIT_NODENAME returns in error.

Description

This routine fits the input node name into the desired output field for display purposes. It first attempts to get the usable short form of the input node name by calling LIB$COMPRESS_NODENAME. If that

fails, the input node name is expanded by LIB$EXPAND_NODENAME and then trimmed by LIB $TRIM_FULLNAME to fit the desired output width.

The input is validated against the supported form of input node names. The error LIB$_INVARG is returned if the input node name is invalid.

Node-name compression is always attempted even if the length of the input node name is less than or equal to the desired output width. This is to ensure that the short form of a full name is always chosen for display purposes.

When the compressed node name is too long to fit the desired output width, the input node name is expanded using LIB$EXPAND_NODENAME and trimmed using LIB$TRIM_FULLNAME. In this case, the alternate success status LIB$_STRTRU is returned.

When LIB$FIT_NODENAME encounters errors from the underlying network services, it tries to return the string-truncated compressed node name. If it is the compression operation that fails, LIB $FIT_NODENAME returns the string-truncated input node name. The alternate successful status LIB $_STRTRU is returned.

Note that the returned node name can be either a compressed usable short form of the input node name or an unusable trimmed or truncated node name. The caller should always assume an unusable node name is returned when it finds the alternate success return status LIB$_STRTRU. On the other hand, the SS$_NORMAL return status means that a usable form of a node name is returned.

LIB$FIT_NODENAME adds padding spaces to the end of the output buffer if the output node name is shorter than the size of the output buffer. The argument **resultant-length**, if supplied, is set to the length of the output node name, excluding any padding spaces.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by *output-buffer*.
LIB$_INVARG	Invalid argument: • *nodename* is invalid. • *nodename* points to a null string. • The length of the node name is more than 1024 characters.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by LIB$SCOPY_R_DX.

LIB$FIXUP_FLT

LIB$FIXUP_FLT — The Fix Floating Reserved Operand routine finds the reserved operand of any F-floating, D-floating, G-floating, or H-floating instruction (with some exceptions) after a reserved operand fault has been signaled. No support for arguments passed by 64-bit address reference or for use

of 64-bit descriptors, if applicable, is planned for this routine. LIB$FIXUP_FLT changes the reserved operand from –0.0 to the value of the *new-operand* argument, if present; or to +0.0 if *new-operand* is absent. This routine is available on OpenVMS Alpha and I64 systems in translated form and is applicable to translated VAX images only.

Format

LIB$FIXUP_FLT signal-arguments ,mechanism-arguments [,new-operand]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

signal-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Signal argument vector. The *signal-arguments* argument is the address of an array of unsigned longwords containing the signal argument vector.

mechanism-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Mechanism argument vector. The *mechanism-arguments* argument is the address of an array of unsigned longwords containing the mechanism argument vector.

new-operand

OpenVMS usage:	floating-point
type:	F_floating
access:	read only
mechanism:	by reference

An F-floating value to replace the reserved operand. The *new-operand* argument is the address of an F-floating number containing the new operand. This is an optional argument. If omitted, the default value is +0.0.

Description

LIB$FIXUP_FLT finds the reserved operand of any F-floating, D-floating, G-floating, or H-floating instruction (with some exceptions) after a reserved operand fault has been signaled. LIB$FIXUP_FLT changes the reserved operand from –0.0 to the value of the *new-operand* argument, if present; or to +0.0 if *new-operand* is absent. LIB$FIXUP_FLT cannot handle the following cases and will return a status of SS$_RESIGNAL if any of them occur:

- The currently active signaled condition is not SS$_ROPRAND.
- The reserved operand's data type is not F-floating, D-floating, G-floating, or H-floating.
- The reserved operand is an element in the coefficient table for one of the VAX POLY *x* instructions.

If the status value returned from LIB$FIXUP_FLT is seen by the condition handling facility (as would be the case if LIB$FIXUP_FLT was the handler), any success value is equivalent to SS$_CONTINUE, which causes the instruction to be restarted. Any failure value is equivalent to SS$_RESIGNAL, which causes the condition to be resignaled to the next handler. This resignal status is because the condition handler (LIB$FIXUP_FLT) was unable to handle the condition correctly.

LIB$FIXUP_FLT can be enabled directly as a condition handler. The *signal-arguments* and *mechanism-arguments* arguments are passed to the condition handler by OpenVMS exception dispatching.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The reserved operand was found and has been fixed.
SS$_ACCVIO	Access violation. An argument to LIB$FIXUP_FLT or an operand of the faulting instruction could not be read or written.
SS$_RESIGNAL	The signaled condition was not SS$_ROPRAND, or the reserved operand was not a floating-point value or was an element in a POLY*x* table.
SS$_ROPRAND	Reserved operand fault. The optional argument *new-operand* was supplied but was itself an F-floating reserved operand.
LIB$_BADSTA	Bad stack. The stack frame linkage has been corrupted since the time of the reserved operand exception.

LIB$FLT_UNDER

LIB$FLT_UNDER — The Floating-Point Underflow Detection routine enables or disables floating-point underflow detection for the calling routine activation. The previous setting is returned as a function value. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. This routine is available on OpenVMS Alpha and I64 systems in translated form and is applicable to translated VAX images only.

Format

LIB$FLT_UNDER new-setting

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

new-setting

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

New floating-point underflow enable setting. The *new-setting* argument is the address of an unsigned byte containing the new setting. Bit 0 set to 1 means enable; bit 0 set to 0 means disable.

Description

LIB$FLT_UNDER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting does remain in effect for any routines entered through a JSB entry point.

The caller's stack frame will be modified by this routine.

Condition Values Returned

None.

Example

```
C+
C This Fortran example program shows
C the use of LIB$FLT_UNDER.
C-

        INTEGER*4 NEW_SETTING
        REAL*4 X , Y , Z

        NEW_SETTING = 0
        X = 1E-20
        Y = 1E20
```

```
        CALL LIB$FLT_UNDER( NEW_SETTING )

        TYPE *,'First Case: This should not have an underflow exception'

        Z = X / Y

        TYPE *, 'If this lines prints then the underflow exception
    1   was disabled.'
        TYPE *

        NEW_SETTING = 1
        X = 1E-20
        Y = 1E20

        CALL LIB$FLT_UNDER( NEW_SETTING )

        TYPE * , 'Second Case: This should have an underflow exception
    1   and then stop.'

        Z = X / Y

        TYPE * , 'If this line prints, then the underflow exception
    1   was disabled.'

END
```

In this Fortran example, floating-point underflow detection is disabled the first time X is divided by Y. The second time, underflow detection is enabled, and the program stops because of the error generated.

LIB$FORMAT_DATE_TIME

LIB$FORMAT_DATE_TIME — The Format Date and/or Time routine allows the user to select at run time a specific output language and format for a date or time, or both.

Format

LIB$FORMAT_DATE_TIME date-string [,date] [,user-context] [,date-length] [,flags]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

date-string

OpenVMS usage:	char_string
type:	character string

access:	write only
mechanism:	by descriptor

Receives the requested date or time, or both, that has been formatted for output according to the currently selected format and language. The *date-string* argument is the address of a descriptor pointing to this string.

date

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

The date or time, or both, to be formatted for output. The *date* argument is the address of an unsigned quadword that contains the absolute date or time, or both to be formatted. If you omit this argument, or if you supply a zero passed by value, then the current system time is used. Note that the *date* argument must represent an absolute time, not a delta time.

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

User context that retains the translation context over multiple calls to this routine. The *user-context* argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The *user-context* parameter is optional. However, if a context cell is not passed, the routine LIB $FORMAT_DATE_TIME may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, VSI recommends that users specify a different context cell for each calling thread.

date-length

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

Number of bytes of text written to the *date-string* argument. The *date-length* argument is the address of a signed longword that receives this string length. Note that *date-length* specifies the number of bytes of text, not the number of characters, written to *date-string*.

flags

OpenVMS usage:	mask_longword

type:	longword (unsigned)
access:	read only
mechanism:	by reference

Bit mask that allows the user to specify whether the date, time, or both are output. The *flags* argument is the address of an unsigned bit mask containing the specified values. Valid values are LIB $M_DATE_FIELDS and LIB$M_TIME_FIELDS.

Default values are determined as follows:

- If the *flags* argument is omitted, LIB$FORMAT_DATE_TIME determines which fields to format according to the current definition of LIB$DT_FORMAT.
- If the *flags* argument is specified, LIB$FORMAT_DATE_TIME uses the *flags* value to determine which fields to format. That is, the *flags* argument can be used to override the definition of LIB$DT_FORMAT when specifying which fields should be formatted for output. If the field specified by *flags* was not assigned a format through the definition of LIB$DT_FORMAT, the standard OpenVMS format is used.

Description

The LIB$FORMAT_DATE_TIME routine formats an OpenVMS internal format date-time quadword into a textual string of some predefined format. The language to be used and the format in which to output the information are programmable using either of the following methods.

- The language and format are programmable at compile time through the use of the routine LIB $INIT_DATE_TIME_CONTEXT.
- The language and format are determined at run time through the translation of the logical names SYS$LANGUAGE and LIB$DT_FORMAT.

In general, if an application is formatting text for internal storage or transmission, the language and format should be specified at compile time. If this is the case, use the routine LIB $INIT_DATE_TIME_CONTEXT to specify the language and format of your choice.

If an application is formatting text for presentation to a user, the logical name method of specifying language and format should be used. In this method, the user assigns equivalence names to the logical names SYS$LANGUAGE and LIB$DT_FORMAT, thereby selecting the language and format of the date and time at run time.

If the logical name method is used, the translations of the logical names SYS$LANGUAGE and LIB $DT_FORMAT specify one or more executive mode logicals, which in turn must be translated to determine the actual format string. These additional logicals supply such things as the names of the days of the week and the months in the selected language (determined by SYS$LANGUAGE). All of these logicals are predefined, so that a non-privileged user can select any one of these languages and formats. A user can create his or her own languages and formats; however, the CMEXEC, SYSNAME, and SYSPRV privileges are required.

With the exception of SYS$LANGUAGE and LIB$DT_FORMAT, all logical names used by this routine must be defined from the executive mode.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ABSTIMREQ	Absolute time required.
LIB$_DEFFORUSE	Default format used; unable to determine the desired format.
LIB$_ENGLUSED	English used; unable to determine or use the specified language.
LIB$_REENTRANCY	Reentrant invocation with same context variable.
LIB$_STRTRU	Output string truncated.
LIB$_UNRFORCOD	Unrecognized format code.

Any condition values returned by the $NUMTIM system service, or RTL routines LIB$GET_VM, LIB GET_VM_64, LIBANALYZE_SDESC, or LIB$ANALYZE_SDESC_64.

LIB$FORMAT_SOGW_PROT

LIB$FORMAT_SOGW_PROT — The Format Protection Mask routine translates a protection mask into a formatted string.

Format

```
LIB$FORMAT_SOGW_PROT protection-mask, [access-names], [ownership-names], [owr
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

protection

OpenVMS usage:	protection-mask
type:	word (unsigned)
access:	read only
mechanism:	by reference

The address of a word that holds a 16-bit protection mask to be translated.

access-names

OpenVMS usage:	access_names

type:	array [0..31] of quadword string descriptor
access:	read only
mechanism:	by reference

The address of the access name table for the associated object class. For example, it is the value returned in *accnam* by LIB$GET_ACCNAM. This parameter defaults to the access name table for the FILE object class.

ownership-names

OpenVMS usage:	char_string
type:	array [0..3] of quadword string descriptor
access:	read only
mechanism:	by reference

The address of a vector of 4 quadword descriptors that points to the ownership name. The default value is the full ownership category names (System, Owner, Group, World).

ownership-separator

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a descriptor that points to the ownership separator string. The separator string is inserted after the ownership name to introduce a nonempty set of access names. By default, the value is ": " (the colon and space characters).

list-separator

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a descriptor that points to the list separator string. The list separator string is inserted between ownership-access type pairs. By default, the value is ", " (the comma and space characters).

protection-string

OpenVMS usage:	char_string
type:	character-coded text string
access:	write only
mechanism:	by descriptor

The address of a character-string descriptor that receives the output of the routine call. The *protection-string* argument points to the formatted protection string at the end of a call. The protection string has the following components repeated for each of: System, Owner, Group, World.

ownership-name[ownership-separator][access-types][list-separator]

An example of a formatted protection string is

System: RWED, Owner: RWED, Group: RW, World: R

protection-length

OpenVMS usage:	word_signed
type:	word (signed)
access:	write only
mechanism:	by reference

The address of a word that receives the length of the string returned in the *protection-string* argument.

Description

LIB$FORMAT_SOGW_PROT translates a 16-bit protection mask into a formatted string. This routine works for any protected object class by specifying the correct access name table. The address of the access name table can be obtained from the LIB$GET_ACCNAM routine.

Several formatting options are available. The caller can specify ownership names, ownership separators, or list separators.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Required parameter missing.
LIB$_WRONGNUMARG	Wrong number of arguments.
STR$_TRU	String truncation warning.

LIB$FREE_DATE_TIME_CONTEXT

LIB$FREE_DATE_TIME_CONTEXT — The Free the Context Area Used When Formatting Dates and Times for Input or Output routine frees the virtual memory associated with the context area used by the date/time input and output formatting routines.

Format

LIB$FREE_DATE_TIME_CONTEXT [user-context]

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

User context that retains the translation context over multiple calls to the date/time input and output formatting routines. The *user-context* argument is the address of an unsigned longword that contains this context. If the *user-context* argument was not specified in the call to LIB$FORMAT_DATE_TIME, LIB$CONVERT_DATE_STRING, or LIB $GET_MAXIMUM_DATE_LENGTH, then no argument should be supplied when calling this routine.

Description

The LIB$FREE_DATE_TIME_CONTEXT routine frees the virtual memory associated with the context area used by the date/time input and output formatting routines. A call to this routine is optional, since the same functions are performed at image exit.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

Any condition value returned by LIB$FREE_VM. If one of these condition values is returned, it indicates either an internal coding error or that memory was corrupted by the user's program.

LIB$FREE_EF

LIB$FREE_EF — The Free Event Flag routine frees a local event flag previously allocated by LIB $GET_EF or by LIB$RESERVE_EF. LIB$FREE_EF is the complement of LIB$GET_EF.

Format

LIB$FREE_EF event-flag-number

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Argument

event-flag-number

OpenVMS usage:	ef_number
type:	longword integer (unsigned)
access:	read only
mechanism:	by reference

Event flag number to be deallocated by LIB$FREE_EF. The *event-flag-number* argument is the address of a signed longword integer that contains the event flag number, which is the value allocated to the user by LIB$GET_EF or LIB$RESERVE_EF.

Description

When a local event flag allocated by calling LIB$GET_EF or LIB$RESERVE_EF is no longer needed, LIB$FREE_EF should be called to free the event flag for use by other routines.

See the *VSI OpenVMS Programming Concepts Manual* for more information.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_EF_ALRFRE	Event flag already free.
LIB$_EF_RESSYS	Event flag reserved to system. This error occurs if the event flag number is outside the ranges of 1 to 23 and 32 to 63.

LIB$FREE_LUN

LIB$FREE_LUN — The Free Logical Unit Number routine releases a logical unit number allocated by LIB$GET_LUN to the pool of available numbers. LIB$FREE_LUN is the complement of LIB $GET_LUN.

Format

LIB$FREE_LUN logical-unit-number

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Argument

logical-unit-number

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Logical unit number to be deallocated. The *logical-unit-number* argument is the address of a signed longword integer that contains this logical unit number, which is the value previously returned by LIB$GET_LUN.

Description

When a logical unit number allocated by calling LIB$GET_LUN is no longer needed, it should be released for use by other routines.

This routine is useful only in BASIC or Fortran programs.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_LUNALRFRE	Logical unit number is already free.
LIB$_LUNRESSYS	Logical unit number reserved to system. This occurs if the specified logical unit number is outside the range of 100 through 299.

LIB$FREE_TIMER

LIB$FREE_TIMER — The Free Timer Storage routine frees the storage allocated by LIB $INIT_TIMER.

Format

LIB$FREE_TIMER handle-address

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

handle-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Pointer to a block of storage containing the value returned by a previous call to LIB$INIT_TIMER; this is the storage that LIB$FREE_TIMER deallocates. The *handle-address* argument is the address of an unsigned longword containing that value.

Description

LIB$FREE_TIMER frees a block of storage previously allocated by LIB$INIT_TIMER. LIB $FREE_TIMER assumes that *handle-address* was returned by a previous call to LIB $INIT_TIMER. If the block referred to by *handle-address* was not allocated by LIB $INIT_TIMER, LIB$FREE_TIMER returns an error. If the routine completes successfully, LIB $FREE_TIMER sets *handle-address* to zero.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	Bad block address; LIB$FREE_TIMER could not deallocate the block to which *handle-address* points.
LIB$_INVARG	Invalid argument; *handle-address* was not supplied or did not point to a timer block.

LIB$FREE_VM

LIB$FREE_VM — The Free Virtual Memory from Program Region routine deallocates an entire block of contiguous bytes that was allocated by a previous call to LIB$GET_VM. The arguments passed are the same as for LIB$GET_VM. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$FREE_VM number-of-bytes ,base-address [,zone-id]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

number-of-bytes

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes to be deallocated by LIB$FREE_VM. The *number-of-bytes* argument is the address of a signed longword integer that contains this number. The value of *number-of-bytes* must be greater than zero.

Byte counts are rounded in the same manner as in LIB$GET_VM.

Note

You may omit the *number-of-bytes* argument if you are using boundary tags (LIB $M_VM_BOUNDARY_TAGS).

base-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Address of the first byte to be deallocated by LIB$FREE_VM. The *base-address* argument contains the address of an unsigned longword that is this address. The value of *base-address* must be the address of a block of memory that was allocated by a previous call to LIB$GET_VM.

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The address of a longword that contains a zone identifier created by a previous call to LIB $CREATE_VM_ZONE or LIB$CREATE_USER_VM_ZONE.

You must specify the same *zone-id* value as when you called LIB$GET_VM to allocate the block. An error status will be returned if you specify an incorrect *zone-id*. The *zone-id* argument is optional. If *zone-id* is omitted or if the longword contains the value 0, the 32-bit default zone is used.

Description

LIB$FREE_VM returns the block of memory to a free list associated with the zone, so the block is available on a subsequent call to LIB$GET_VM for the zone.

The *base-address* argument must contain the address of the first byte of memory that was allocated by a previous call to LIB$GET_VM. LIB$FREE_VM rounds up the value of *number-of-bytes* to a multiple of the block size for the zone.

Note

You cannot free part of a block that was allocated by a call to LIB$GET_VM. The whole block must be freed by a single call to LIB$FREE_VM.

Neither can you combine contiguous blocks of memory that were allocated by several calls to LIB $GET_VM into one larger block that is freed by a single call to LIB$FREE_VM.

If you specified deallocation filling when you created the zone, LIB$FREE_VM will fill each byte freed. Note that part of a free block is used to store control information, so some bytes will not contain the fill value.

LIB$FREE_VM is fully reentrant, so it can be called by routines executing at AST-level or in an Ada multitasking environment.

If the zone you are freeing was created using the LIB$CREATE_USER_VM_ZONE routine, then you must have an appropriate action routine for the free operation. That is, in your call to LIB $CREATE_USER_VM_ZONE, you must have specified a user deallocation procedure.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	The *base-address* argument contained a bad block address. Either an address was outside of the area allocated by LIB $GET_VM, the contents of *base-address* were not properly aligned, part of the space being deallocated was previously deallocated, or a zone was found to be corrupt.
LIB$_BADBLOSIZ	The *number-of-bytes* argument is less than or equal to 0, or the *number-of-bytes* argument is incorrect for a zone containing fixed size blocks.
LIB$_BADTAGVAL	For a zone that uses boundary tags, the tag field was corrupted.

LIB$FREE_VM_64

LIB$FREE_VM_64 — The Free Virtual Memory from Program Region routine deallocates an entire block of contiguous bytes that was allocated by a previous call to LIB$GET_VM_ 64. The arguments passed are the same as for LIB$GET_VM_64.

Format

LIB$FREE_VM_64 number-of-bytes ,base-address [,zone-id]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-bytes

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes to be deallocated by LIB$FREE_VM_64. The *number-of-bytes* argument is the address of a signed quadword integer that contains this number. The value of *number-of-bytes* must be greater than zero.

Byte counts are rounded in the same manner as in LIB$GET_VM_64.

Note

You may omit the *number-of-bytes* argument if you are using boundary tags (LIB $M_VM_BOUNDARY_TAGS).

base-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Address of the first byte to be deallocated by LIB$FREE_VM_64. The *base-address* argument contains the address of an unsigned quadword that is this address. The value of *base-address* must be the address of a block of memory that was allocated by a previous call to LIB$GET_VM_64.

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only

mechanism:	by reference

The address of a quadword that contains a zone identifier created by a previous call to LIB $CREATE_VM_ZONE_64 or LIB$CREATE_USER_VM_ZONE_64.

You must specify the same *zone-id* value as when you called LIB$GET_VM_64 to allocate the block. An error status will be returned if you specify an incorrect *zone-id*. The *zone-id* argument is optional. If *zone-id* is omitted or if the quadword contains the value 0, the 64-bit default zone is used.

Description

LIB$FREE_VM_64 returns the block of memory to a free list associated with the zone, so the block is available on a subsequent call to LIB$GET_VM_64 for the zone.

The *base-address* argument must contain the address of the first byte of memory that was allocated by a previous call to LIB$GET_VM_64. LIB$FREE_VM_64 rounds up the value of *number-of-bytes* to a multiple of the block size for the zone.

Note

You cannot free part of a block that was allocated by a call to LIB$GET_ VM_64. The whole block must be freed by a single call to LIB$FREE_ VM_64.

Neither can you combine contiguous blocks of memory that were allocated by several calls to LIB $GET_VM_64 into one larger block that is freed by a single call to LIB$FREE_VM_64.

If you specified deallocation filling when you created the zone, LIB$FREE_VM_64 will fill each byte freed. Note that part of a free block is used to store control information, so some bytes will not contain the fill value.

LIB$FREE_VM_64 is fully reentrant, so it can be called by routines executing at AST-level or in an Ada multitasking environment.

If the zone you are freeing was created using the LIB$CREATE_USER_VM_ ZONE_64 routine, then you must have an appropriate action routine for the free operation. That is, in your call to LIB $CREATE_USER_VM_ZONE_64, you must have specified a user deallocation procedure.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	The *base-address* argument contained a bad block address. Either an address was outside of the area allocated by LIB $GET_VM_64, the contents of *base-address* were not properly aligned, part of the space being deallocated was previously deallocated, or a zone was found to be corrupt.
LIB$_BADBLOSIZ	The *number-of-bytes* argument is less than or equal to 0, or the *number-of-bytes* argument is incorrect for a zone containing fixed size blocks.
LIB$_BADTAGVAL	For a zone that uses boundary tags, the tag field was corrupted.

LIB$FREE_VM_PAGE

LIB$FREE_VM_PAGE — The Free Virtual Memory Page routine deallocates a block of contiguous pages on VAX systems or pagelets on Alpha and I64 systems that were allocated by previous calls to LIB $GET_VM_PAGE. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$FREE_VM_PAGE number-of-pages ,base-address

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-pages

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of pages on VAX systems or pagelets on Alpha and I64 systems. The *number-of-pages* argument is the address of a longword integer that specifies the number of contiguous pages on VAX systems or pagelets on Alpha and I64 systems to be deallocated. The value of *number-of-pages* must be greater than zero.

base-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Block address. The *base-address* argument is the address of a longword that contains the address of the first byte of the first VAX page or Alpha or I64 pagelet to be deallocated.

Description

LIB$FREE_VM_PAGE deallocates a block of contiguous 512-byte pages starting at *base-address*. Each of the pages or pagelets specified by *number-of-pages* and *base-address* must have

been allocated by previous calls to LIB$GET_ VM_PAGE. The pages or pagelets are returned to the processwide pool and are available to satisfy subsequent calls to LIB$GET_VM_PAGE.

You can free a smaller group of pages or pagelets than you allocated. That is, if you allocated a group of contiguous pages or pagelets by a single call to LIB$GET_VM_PAGE, you can deallocate them in several calls to LIB$FREE_ VM_PAGE. You can also combine contiguous groups of pages or pagelets that were allocated in several calls to LIB$GET_VM_PAGE into one large group that is freed by a single call to LIB$FREE_VM_PAGE.

LIB$FREE_VM_PAGE is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	Pages on VAX systems or pagelets on Alpha and I64 systems not allocated by LIB$GET_VM_ PAGE, the value of *base-address* is not a page boundary, or the pages were previously freed.
LIB$_BADBLOSIZ	The *number-of-pages* argument is less than or equal to zero.

LIB$FREE_VM_PAGE_64

LIB$FREE_VM_PAGE_64 — The Free Virtual Memory Page routine deallocates a block of contiguous Alpha or I64 pagelets that was allocated by previous calls to LIB$GET_VM_PAGE_64.

Format

LIB$FREE_VM_PAGE_64 number-of-pages ,base-address

Returns

OpenVMS usage:	cond_value
type:	quadword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-pages

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Number of Alpha or I64 pagelets. The address of a quadword integer that specifies the number of contiguous Alpha or I64 pagelets to be deallocated. The value of *number-of-pages* must be greater than zero.

base-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Block address. The *base-address* argument is the address of a quadword that contains the address of the first byte of the first Alpha or I64 pagelet to be deallocated.

Description

LIB$FREE_VM_PAGE_64 deallocates a block of contiguous Alpha or I64 pagelets starting at *base-address*. Each of the pagelets specified by *number-of-pages* and *base-address* must have been allocated by previous calls to LIB$GET_VM_ PAGE_64. The pagelets are returned to the processwide pool and are available to satisfy subsequent calls to LIB$GET_VM_PAGE_64.

You can free a smaller group of pagelets than you allocated. That is, if you allocated a group of contiguous pagelets by a single call to LIB$GET_VM_PAGE_ 64, you can deallocate them in several calls to LIB$FREE_VM_PAGE_64. You can also combine contiguous groups of pagelets that were allocated in several calls to LIB$GET_VM_PAGE_64 into one large group that is freed by a single call to LIB$FREE_VM_PAGE_64.

LIB$FREE_VM_PAGE_64 is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	Alpha pagelets not allocated by LIB$GET_VM_ PAGE_64, the value of *base-address* is not a pagelet boundary, or the pagelets were previously freed.
LIB$_BADBLOSIZ	The *number-of-pages* argument is less than or equal to zero.

LIB$GETDVI

LIB$GETDVI — The Get Device/Volume Information routine provides a simplified interface to the $GETDVI system service. It returns information about the primary and secondary device characteristics of an I/O device. The calling process need not have a channel assigned to the device about which it wants information.

Format

LIB$GETDVI item-code [,channel] [,device-name] [,longword-integer-value] [,resulta

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

item-code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Code specifying the item of information you are requesting. The *item-code* argument is the address of a signed longword containing the item code. All valid $GETDVI item codes whose names begin with DVI$_ are accepted.

See the Description section for more information on item codes.

channel

OpenVMS usage:	channel
type:	word (unsigned)
access:	read only
mechanism:	by reference

OpenVMS I/O channel assigned to the device for which LIB$GETDVI returns information. The *channel* argument is the address of an unsigned word containing the channel specification. If *channel* is not specified, *device-name* is used instead. You must specify either *channel* or *device-name*, but not both. If neither is specified, the error status SS$_IVDEVNAM is returned.

device-name

OpenVMS usage:	device_name
type:	character string
access:	read only
mechanism:	by descriptor

Name of the device for which LIB$GETDVI returns information. The *device-name* argument is the address of a descriptor pointing to the device name string. If this string contains a colon, the colon and the characters that follow it are ignored.

The *device-name* may be either a physical device name or a logical name. If the first character in the string is an underscore character (_), the name is considered a physical device name. Otherwise,

the name is considered a logical name, and logical name translation is performed until either a physical device name is found or the system default number of translations has been performed.

If *device-name* is not specified, *channel* is used instead. You must specify either *channel* or *device-name*, but not both. If neither is specified, the error status SS$_IVDEVNAM is returned. The device name must not be longer than 255 characters.

longword-integer-value

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

Numeric value of the information requested. The *longword-integer-value* argument is the address of a signed longword containing the numeric value. If an item is listed as only returning a string value, this argument is ignored.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String representation of the information requested. The *resultant-string* argument is the address of a descriptor pointing to this information. If *resultant-string* is not specified and if the value returned has only a string representation, the error status LIB$_INVARG is returned.

Refer to Table 2.4 for a description of the string representation used for each item.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of significant characters written to *resultant-string* by LIB$GETDVI. The *resultant-length* argument is the address of an unsigned word containing this length.

pathname

OpenVMS usage:	path_name
type:	character text string
access:	read only

mechanism:	by descriptor

(I64 and Alpha only) The name of the path about which $GETDVI is to return information. The *pathname* argument is the address of a character string descriptor pointing to this name string. The path name may be used with either the *channel* or *device-name* arguments.

Check the definitions of the item codes to see if the *pathname* argument is used. In general, item codes that return information that may vary by path will make use of the *pathname* argument. The paths for a multipath device can be seen with the SHOW DEVICE /FULL command, the SYS $DEVICE_PATH_SCAN system service, or the F$MULTIPATH DCL lexical function.

If the *pathname* argument is used, it will be validated against the existing paths for the device specified. If the path does not exist, the error SS$_NOSUCHPATH will be returned, even if the item codes(s) used do not make use of the *pathname* argument.

Description

LIB$GETDVI returns two categories of information:

- Primary device characteristics
- Secondary device characteristics

LIB$GETDVI does not allow you to get more than one item of information in a single call.

LIB$GETDVI provides the following features in addition to those provided by the $GETDVI system service.

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB$GETDVI can optionally provide a formatted string interpretation of the value. For example, if the device owner UIC is requested, LIB$GETDVI can return the UIC formatted as [identifier].
- For string arguments, LIB$GETDVI understands all string classes supported by the Run-Time Library.
- Calls to LIB$GETDVI are synchronous; LIB$GETDVI calls LIB$GET_EF to allocate a local event flag number for synchronization.

See the description of the $GETDVI system service in the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for more detailed information.

Item Codes

All item codes that can be used with the $GETDVI system service may be used as the *item-code* argument to LIB$GETDVI. These codes have symbolic names beginning with DVI$_.

The use of a DVI$_ code by itself will return the primary device characteristic associated with that code. To obtain the secondary device characteristics, add 1 to the code. See the description of the $GETDVI

system service for a list of the defined item codes. The symbolic names for these items are defined in VSI supplied symbol libraries in module $DVIDEF (where appropriate).

Value Formats

By using the *longword-integer-value* and *resultant-string* arguments to LIB $GETDVI, the information requested can be returned in two different fashions.

- For each item described as a "string" in the table of Item Codes for the $GETDVI service, the value is returned in *resultant-string*.
- For all other items—those that have numeric values—the numeric representation is returned in *longword-integer-value* (if specified), and a formatted string interpretation of the value is returned in *resultant-string*.

Each formatted item is written left-justified; *resultant-length*, if specified, gives the number of characters used. Table 2.4 lists the formats used for the string interpretations.

Table 2.4. Formats Used for LIB$GETDVI Strings

Item or Format	Description	
DVI$_ACPPID	The string value is returned as an 8-digit hexadecimal number.	
DVI$_PID	The string value is returned as an 8-digit hexadecimal number.	
DVI$_ACPTYPE	The ACP type string is one of the following:	
	NONE	No ACP
	F11V1	Files-11 Level 1
	F11V2	Files-11 Level 2
	F11V3	Files-11 presentation of ISO 9660
	F11V4	Files-11 presentation of High Sierra
	F11V5	Files-11 structure level 5 (ODS-5)
	F11V6	Files-11 structure level 5 (ODS-6)
	F64	Files 64 support for Spiralog
	HBS	Not currently defined
	HBVS	ACP for Host Based Volume Shadowing
	MTA	Magnetic Tape
	NET	Networks
	REM	Remote I/O
	UCX	ACP for TCP/IP Services for OpenVMS
DVI$_OWNUIC	The standard UIC format [group,member] is used. If the format of a UIC includes identifiers from the access rights database in place of the octal group and member numbers, the UIC string returned will have these identifiers, if available.	

Item or Format	Description
DVI$_VPROT	The volume protection string is in the following form: `SYSTEM=RWLP,OWNER=RWLP,GROUP=RWLP,WORLD=RWLP` If a category has no access, the equal sign is omitted. The string will not contain any embedded spaces.
Boolean	The value string returned is TRUE if the low bit of the value is set, or FALSE if the low bit is clear.
All others	The value string is returned in the form of an unsigned decimal integer.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_NORMAL	Normal successful completion.
LIB$_STRTRU	String truncated. This is an alternate success return status. The *resultant-string* argument could not contain all the characters of the returned item.
SS$_BADPARAM	Unrecognized item code. The *item-code* argument was not recognized as valid by $GETDVI.
SS$_IVDEVNAM	The device name string contains invalid characters, or neither the *channel* nor *device-name* arguments were specified.
LIB$_INSEF	Insufficient event flags. A local event flag number could not be allocated by a call to LIB$GET_EF.
LIB$_INVARG	Invalid arguments. The $GETDVI Item Code describes the item as a *string*, and no *resultant-string* argument was specified.
LIB$_INVSTRDES	Invalid string descriptor. The descriptor of the *resultant-string* argument is not a valid descriptor.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$GETDVI.

Any condition values returned by LIB$SCOPY_ xxx, or the $GETDVI system service.

LIB$GETJPI

LIB$GETJPI — The Get Job/Process Information routine provides a simplified interface to the $GETJPI system service. It provides accounting, status, and identification information about a specified process. LIB$GETJPI obtains only one item of information in a single call.

Format

LIB$GETJPI item-code [,process-id] [,process-name] [,resultant-value] [,resul

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

item-code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Item identifier code specifying the item of information you are requesting. The *item-code* argument is the address of a signed longword containing the item code. You may request only one item in each call to LIB$GETJPI.

LIB$GETJPI accepts all $GETJPI item codes. These names begin with JPI$_ and are defined in symbol libraries in module $JPIDEF supplied by VSI.

process-id

OpenVMS usage:	process_id
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Process identifier of the process for which you are requesting information. The *process-id* argument is the address of an unsigned longword containing the process identifier. If you do not specify *process-id*, *process-name* is used.

The *process-id* is updated to contain the process identifier actually used, which may be different from what you originally requested if you specified *process-name* or used wildcard process searching.

process-name

OpenVMS usage:	process_name
type:	character string
access:	read only
mechanism:	by descriptor

A 1- to 15-character string specifying the name of the process for which you are requesting information. The *process-name* argument is the address of a descriptor pointing to the process name string. The

name must correspond exactly to the name of the process for which you are requesting information; LIB $GETJPI does not allow trailing blanks or abbreviations.

If you do not specify *process-name*, *process-id* is used. If you specify neither *process-name* nor *process-id*, the caller's process is used. Also, if you do not specify *process-name* and you specify zero for *process-id*, the caller's process is used. In this way, you can fetch the item you want and the caller's PID in a single call to LIB$GETJPI.

resultant-value

OpenVMS usage:	varying_arg
type:	unspecified
access:	write only
mechanism:	by reference

Numeric value of the information you request. The *resultant-value* argument is the address of a longword or quadword into which LIB$GETJPI writes the numeric value of this information. Refer to Table 2.5 for information on which items return longword values and which return quadword values. If the item you request returns only a string value, this argument is ignored.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String representation of the information you request. The *resultant-string* argument is the address of the descriptor for a character string into which LIB$GETJPI writes the string representation. Table 2.5 describes the string representation used for each item.

If you do not include *resultant-string*, but the item you request has only a string representation, the error status LIB$_INVARG is returned.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of significant characters written to *resultant-string* by LIB$GETJPI. The *resultant-length* argument is the address of an unsigned word integer into which LIB$GETJPI writes the number of characters.

Description

LIB$GETJPI provides the following features in addition to those provided by the $GETJPI system service:

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB$GETJPI can optionally provide a formatted string interpretation of the value. For example, if the process UIC is requested, LIB$GETJPI can return the UIC formatted as [g,m].
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB$GETJPI are synchronous. LIB$GETJPI calls LIB$GET_EF to allocate a local event flag number for synchronization.

See the description of the $GETJPI system service in the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for more information.

By using the `resultant-value` and `resultant-string` arguments to LIB$GETJPI, you can request that the information be returned in two ways. For each item described as a "string" in the table of Item Codes for the $GETJPI service, the value is returned in `resultant-string`. For all other items—those which have numeric values—the numeric representation is returned in `resultant-value` (if specified), and a formatted string interpretation of the value is returned in `resultant-string`.

Each formatted item is written left-justified; `resultant-length`, if specified, gives the number of characters used.

Table 2.5 lists the formats used for the string interpretations.

Table 2.5. Item Code Formats for LIB$GETJPI

Item or Format	Description	
JPI$_AUTHPRIV	The string representation of these quadword privilege masks is a list of each privilege that is enabled. The privilege names are in uppercase, and are separated by commas.	
JPI$_CURPRIV	Same as for JPI$AUTHPRIV.	
JPI$_IMAGPRIV	Same as for JPI$AUTHPRIV.	
JPI$_PROCPRIV	Same as for JPI$AUTHPRIV.	
JPI$_LOGINTIM	The string representation of the quadword time is a standard absolute date-time string.	
JPI$_PID	The process identification string is an 8-digit hexadecimal number.	
JPI$_STATE	The process state string is one of the following:	
	CEF	Common event flag wait
	COM	Computable
	COMO	Computable, outswapped
	CUR	Current process
	COLPG	Collided page wait
	FPG	Free page wait
	HIB	Hibernate wait
	HIBO	Hibernate wait, outswapped

Item or Format	Description	
	LEF	Local event flag wait
	LEFO	Local event flag wait, outswapped
	MWAIT	Mutex and miscellaneous resource wait
	PFW	Page fault wait
	SUSP	Suspended
	SUSPO	Suspended, outswapped
JPI$_UIC	The standard UIC format [group,member] is used. If the format of a UIC includes identifiers from the access rights database in place of the octal group and member numbers, the UIC string returned will have these identifiers, if available.	
JPI$_MODE	The current mode string is one of the following: BATCH, INTERACTIVE or NETWORK.	
All others	The string value is returned as an unsigned decimal integer.	

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	String truncated. This is an alternate success return status. The *resultant-string* argument could not contain all the characters of the returned item.
SS$_BADPARAM	Unrecognized item code. The *item-code* argument was not recognized as valid by $GETJPI.
LIB$_INSEF	Insufficient event flags. A local event flag number could not be allocated by a call to LIB$GET_EF.
LIB$_INVARG	Invalid arguments. The $GETJPI Item Code describes the item as a “string”, and no *resultant-string* argument was specified.
LIB$_INVSTRDES	Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$GETJPI.

Any condition value returned by LIB$SCOPY_ *xxx*, or the $GETJPI system service.

LIB$GETQUI

LIB$GETQUI — The Get Queue Information routine provides a simplified interface to the $GETQUI system service. It provides queue, job, file, characteristic, and form information about a specified process. LIB$GETQUI obtains only one item of information in a single call.

Format

```
LIB$GETQUI function-code [,item-code] [,search-number] [,search-name] [,search-fla
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

function-code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Function code specifying the function that LIB$GETQUI is to perform. The *function-code* argument is the address of a signed longword containing the function code.

LIB$GETQUI accepts all $GETQUI function codes. These names begin with QUI$_ and are defined in symbol libraries in module $QUIDEF supplied by VSI.

item-code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Item identifier code specifying the item of information you are requesting. The *item-code* argument is the address of a signed longword containing the item code. You may request only one item in each call to LIB$GETQUI.

LIB$GETQUI accepts all $GETQUI item codes. These names begin with QUI$_ and are defined in symbol libraries in module $QUIDEF supplied by VSI.

search-number

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only

mechanism:	by reference

Numeric value used to process your request. The *search-number* argument is the address of a signed longword integer containing the number needed to process your request. The *search-number* argument corresponds directly to QUI$_SEARCH_NUMBER as described by the $GETQUI system service.

search-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Character string used to process your request. The *search-name* argument is the address of a string descriptor that provides the name needed to process your request. The *search-name* argument corresponds directly to QUI$_SEARCH_NAME as described by the $GETQUI system service.

search-flags

OpenVMS usage:	longword_unsigned
type:	longword integer (unsigned)
access:	read only
mechanism:	by reference

Optional bit mask indicating request to be performed. The *search-flags* argument is the address of an unsigned longword integer containing the bit mask. The *search-flags* argument directly corresponds to $QUI_SEARCH_FLAGS as described by the $GETQUI system service.

resultant-value

OpenVMS usage:	varying_arg
type:	unspecified
access:	write only
mechanism:	by reference

Numeric value of the information you requested. The *resultant-value* argument is the address of a longword, quadword or octaword into which LIB$GETQUI writes the numeric value of this information. Refer to Table 2.6 for information on which items return values other than longwords.

If the item you requested returns only a string value, this argument is ignored.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String representation of the information you requested. The *resultant-string* argument is the address of the descriptor for a character string into which LIB$GETQUI writes the string representation. Table 2.6 describes the string representation used for each item.

If you do not include *resultant-string*, but the item you request has only a string representation, the error status LIB$_INVARG is returned.

resultant-length

OpenVMS usage:	word_signed
type:	word integer (signed)
access:	write only
mechanism:	by reference

Number of significant characters written to *resultant-string* by LIB$GETQUI. The *resultant-length* argument is the address of a signed word integer into which LIB$GETQUI writes the number of characters.

Description

LIB$GETQUI provides a simplified interface to the $GETQUI system service. It provides queue, job, file, characteristic, and form information about a specified process. This routine obtains only one item of information in a single call.

LIB$GETQUI provides the following features in addition to those provided by the $GETQUI system service.

- Instead of a list of item descriptors that may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items that return numeric values, LIB$GETQUI optionally can provide a formatted string interpretation of the value. For example, if you request the characteristics of a queue, LIB$GETQUI can return the list of characteristics as “23,42,76,98,125”.
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB$GETQUI are synchronous. LIB$GETQUI calls $GETQUIW to force the synchronization.

LIB$GETQUI retains context. This means that previous calls to LIB$GETQUI affect current calls to LIB$GETQUI.

See the description of the $GETQUI system service in the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for more information.

By using the *resultant-value* and *resultant-string* arguments to LIB$GETQUI, you can request that the information be returned in two ways. For items that have numeric values, the numeric representation is returned in *resultant-value* (if specified), and a formatted string interpretation of the value is returned in *resultant-string*. For each item described as a “string” in the table of Item Codes for the $GETQUI service, the value is returned in *resultant-string*.

Each formatted item is written left-justified; *resultant-length*, if specified, gives the number of characters used.

The $GETQUI system service requires some item codes. LIB$GETQUI provides those item codes for you by corresponding your input to LIB$GETQUI directly to the required input codes.

The following table describes all of the required and optional input needed to perform your task with LIB$GETQUI:

Function	Input Description
QUI$_CANCEL	Accepts no input.
QUI$_DISPLAY_CHARACTERISTIC	A characteristic name or number, or both. Optionally, a search flags number.
QUI$_DISPLAY_ENTRY	Optionally, an entry number, user name, and search flags number. The default user name is that of the calling process.
QUI$_DISPLAY_FILE	Optionally, a search flags number.
QUI$_DISPLAY_FORM	A form name or number, or both. Optionally, a search flags number.
QUI$_DISPLAY_JOB	Optionally, a search flags number.
QUI$_DISPLAY_QUEUE	A queue name. Optionally, a search flags number.
QUI$_TRANSLATE_QUEUE	A queue name.

Table 2.6 lists the formats used for the string interpretations.

Table 2.6. Item Code Formats for LIB$GETQUI

Item or Format	Description
QUI$_AFTER_TIME	Returns a quadword *resultant-value* as well as a *resultant-string*.
QUI$_CHARACTERISTICS	Returns an octaword *resultant-value* as well as a comma-separated list that lists all the characteristic numbers, output as a *resultant-string*.
QUI$_SUBMISSION_TIME	Returns a quadword *resultant-value* as well as a *resultant-string*.
QUI$_UIC	Returns a formatted *resultant-string* as well as a longword.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	String truncated. This is an alternate success return status. The *resultant-string* argument could not contain all the characters of the returned item.

SS$_BADPARAM	Unrecognized item code. The *item-code* argument was not recognized as valid by $GETQUI.
LIB$_INSEF	Insufficient event flags. A local event flag number could not be allocated by a call to LIB$GET_EF.
LIB$_INVARG	Invalid arguments. The $GETQUI Item Code describes the item as a "string", and no *resultant-string* argument was specified.
LIB$_INVSTRDES	Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$GETQUI.

Any condition value returned by LIB$SCOPY_ *xxx*, or the $GETQUI system service.

LIB$GETSYI

LIB$GETSYI — The Get Systemwide Information routine provides a simplified interface to the $GETSYI system service. The $GETSYI system service obtains status and identification information about the system. LIB$GETSYI returns only one item of information in a single call.

Format

```
LIB$GETSYI item-code [,resultant-value] [,resultant-string] [,resultant-length] [,
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

item-code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Item code specifying the desired item of information. The *item-code* argument is the address of a signed longword containing this item code. All valid $GETSYI item codes are accepted.

resultant-value

OpenVMS usage:	varying_arg

type:	unspecified
access:	write only
mechanism:	by reference

Numeric value returned by LIB$GETSYI. The *resultant-value* argument is the address of a longword or quadword containing this value. If an item is listed as returning only a string value, this argument is ignored.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Information returned by LIB$GETSYI. The *resultant-string* argument is the address of a descriptor pointing to the character string that will receive this information.

See the Description section for more information about value formats. If *resultant-string* is not specified and if the returned value has only a string representation, the error status LIB$_INVARG is returned.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of significant characters written to *resultant-string*, not including blank padding or truncated characters. The *resultant-length* argument is the address of an unsigned word into which LIB$GETSYI returns this number.

cluster-system-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Cluster system identification (CSID) of the node for which information is to be returned. The *cluster-system-id* argument is the address of this CSID. If *cluster-system-id* is specified and is nonzero, *node-name* is not used. If *cluster-system-id* is specified as zero, LIB$GETSYI uses *node-name* and writes into the *cluster-system-id* argument the CSID corresponding to the node identified by *node-name*.

The *cluster-system-id* of an OpenVMS node is assigned by the cluster-connection software and may be obtained by the DCL command SHOW CLUSTER. The value of the *cluster-system-*

id for an OpenVMS node is not permanent; a new value is assigned to an OpenVMS node whenever it joins or rejoins the OpenVMS Cluster.

If *cluster-system-id* is specified as –1, LIB$GETSYI assumes a wildcard operation and returns the requested information for each OpenVMS node in the cluster, one node per call.

If *cluster-system-id* is not specified, *node-name* is used.

node-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the node for which information is to be returned. The *node-name* argument is the address of a descriptor pointing to the node name string. If *cluster-system-id* is not specified or is specified as zero, *node-name* is used. If neither *node-name* nor *cluster-system-id* is specified, the caller's node is used. See the *cluster-system-id* argument for more information.

The node name string must contain from 1 to 15 characters and must correspond exactly to the OpenVMS node name; no trailing blanks nor abbreviations are permitted.

Description

LIB$GETSYI provides the following features in addition to those provided by the $GETSYI system service:

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB$GETSYI can optionally provide a formatted string interpretation of the value.
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB$GETSYI are synchronous. LIB$GETSYI calls LIB$GET_EF to allocate a local event flag number for synchronization.

All item codes that can be used with the $GETSYI system service may be used as the *item-code* argument to LIB$GETSYI. See the description of the $GETSYI system service for a list of the defined item codes. Note that the symbolic names for these items are defined in symbol libraries in module $SYIDEF (where appropriate) supplied by VSI.

Value Formats

By using the *resultant-value* and *resultant-string* arguments to LIB$GETSYI, you can request that the information be returned in two ways. For each item described as a “string” in the table of Item Codes for the $GETSYI service, the value is returned in *resultant-string*. For all other items—those which have numeric values—the numeric representation is returned in *resultant-*

value (if specified), and an unsigned decimal integer representation is stored in *resultant-string*.

Each formatted item is written left-justified; *resultant-length*, if specified, gives the number of characters used.

See the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for a description of the $GETSYI system service.

Note

This routine calls LIB$GET_EF. Please read the note in the Description section of that routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_BADPARAM	Unrecognized item code. The *item-code* argument was not recognized as valid by $GETSYI.
LIB$_INSEF	Insufficient event flags. A local event flag number could not be allocated by a call to LIB$GET_EF.
LIB$_INVARG	Invalid arguments. The $GETSYI Item Code describes the item as a "string", and no *resultant-string* argument was specified.
LIB$_INVSTRDES	Invalid string descriptor. The descriptor of the *resultant-string* argument is not a valid descriptor.
LIB$_STRTRU	String truncated. This is an alternate success return status. The *resultant-string* argument could not contain all the characters of the returned item.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$GETSYI.

Any condition values returned by LIB$SCOPY_*xxx*, or the $GETSYI system service.

LIB$GET_ACCNAM

LIB$GET_ACCNAM — The Get Access Name Table for Protected Object Class (by Name) routine is a simplified interface to the $GET_SECURITY system service, and returns a pointer to the access name table for a protected object class that is specified by name.

Format

LIB$GET_ACCNAM [clsnam] , [objnam] ,accnam

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

clsnam

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a character-string descriptor pointing to the name of a protected object class. This argument is optional and defaults to FILE.

objnam

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a character-string descriptor pointing to the name of a protected object. This argument is optional. If it is omitted, the access name table returned is that used for objects of the class specified by the **clsnam** argument.

accnam

OpenVMS usage:	access_names
type:	longword (unsigned)
access:	write only
mechanism:	by reference

The address of a longword into which this routine writes the address of the access name table.

Description

LIB$GET_ACCNAM returns the address of the access name table for the specified protected object. The format of the table is a vector of 32 quadword string descriptors. Each table entry points to the name of an access type. The index into the vector is the bit position in an access-desired mask. Undefined access types have zero-length names. The table can be used as input to the LIB$PARSE_SOGW_PROT, LIB$FORMAT_SOGW_PROT, LIB$PARSE_ACCESS_CODE, $PARSE_ACL, and $FORMAT_ACL routines.

The semantics of this routine are as follows:

1. If the *clsnam* parameter is omitted, *clsnam* defaults to “FILE.”

2. If **clsnam** is not the name of an object class, then the routine returns an error status (SS$_NOCLASS), and the value of **accnam** is undefined.

3. If the **objnam** parameter is omitted, then **accnam** points to the table corresponding to **clsnam**, and the routine returns a success status (SS$_NORMAL). The table returned is the table of access names for a new object of class **clsnam**.

4. Otherwise, if **clsnam** and **objnam** do in fact name a protected object, then **accnam** points to the table corresponding to the protected object class, and the routine returns a success status (SS$_NORMAL).

5. Otherwise, if **clsnam** and **objnam** do *not* name a protected object, then the routine returns an error status (the exact status value depends on the security class), and the value of **accnam** is undefined.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_NOCLASS	No matching object class was found.
LIB$_INVARGLIB $_WRONUMARG	The *accnam* argument was omitted.
	Wrong number of arguments.

In addition, any completion status may be returned from $GET_SECURITY.

LIB$GET_ACCNAM_BY_CONTEXT

LIB$GET_ACCNAM_BY_CONTEXT — The Get Access Name Table for Protected Object Class (by Context) routine is a simplified interface to the $GET_SECURITY system service, and returns a pointer to the access name table for a protected object class that is specified by a context longword returned from $GET_SECURITY or $SET_SECURITY.

Format

LIB$GET_ACCNAM_BY_CONTEXT contxt ,accnam

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

contxt

OpenVMS usage:	context

type:	longword (unsigned)
access:	read only
mechanism:	by reference

The address of a nonzero longword context value returned by $GET_SECURITY or $SET_SECURITY.

accnam

OpenVMS usage:	access_names
type:	longword (unsigned)
access:	write only
mechanism:	by reference

The address of a longword into which this routine writes the address of the access name table.

Description

LIB$GET_ACCNAM_BY_CONTEXT returns the address of the access name table for the specified protected object class. The format of the table is a vector of 32 quadword string descriptors. Each table entry points to the name of an access type. The index into the vector is the bit position in an access-desired mask. Undefined access types have zero-length names. The table can be used as input to the LIB$PARSE_SOGW_PROT, LIB$FORMAT_SOGW_PROT, LIB$PARSE_ACCESS_CODE, $PARSE_ACL, and $FORMAT_ACL routines.

The semantics of this routine are as follows:

- If the *contxt* argument is valid, then the *accnam* argument points to the table corresponding to the protected object class, and the routine returns a success status (SS$_NORMAL).
- If the *contxt* argument is not valid, then the routine returns an error status, and the value of *accnam* is undefined.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_WRONUMARG	Wrong number of arguments.

In addition, error status may be returned from $GET_SECURITY.

LIB$GET_COMMAND

LIB$GET_COMMAND — The Get Line from SYS$COMMAND routine gets one record of ASCII text from the current controlling input device, specified by the logical name SYS$COMMAND.

Format

```
LIB$GET_COMMAND resultant-string [,prompt-string] [,resultant-length]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String that LIB$GET_COMMAND gets from SYS$COMMAND. The *resultant-string* argument is the address of a descriptor pointing to this string.

prompt-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Prompt message that LIB$GET_COMMAND displays on the controlling terminal. The *prompt-string* argument is the address of a descriptor pointing to the prompt. Any string can be a valid prompt. By convention however, a prompt string consists of text followed by a colon (:), a space, and no carriage-return/line-feed combination. The maximum size of the prompt message is 255 characters. If the controlling input device is not a terminal, this argument is ignored.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of bytes written into *resultant-string* by LIB$GET_COMMAND, not counting padding in the case of a fixed string. The *resultant-length* argument is the address of an unsigned word containing this length. If the input string is truncated to the size specified in the *resultant-string* descriptor, *resultant-length* is set to this size. Therefore, *resultant-length* can always be used by the calling program to access a valid substring of *resultant-string*.

Description

LIB$GET_COMMAND uses the OpenVMS RMS $GET service (see the *VSI OpenVMS Record Management Services Reference Manual*) to get one record of ASCII text from the current controlling input device, specified by SYS$COMMAND.

When you log in, the OpenVMS operating system creates three files as default I/O control streams for your process.

- SYS$INPUT, your default input device
- SYS$OUTPUT, your default output device
- SYS$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or your batch commands and the OpenVMS software. Initially, all three files are equated with the terminal. However, with the DCL command ASSIGN, you can change these assignments to obtain information from a file or put information into a file. SYS$INPUT and SYS$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS$COMMAND refers to the terminal and SYS $INPUT refers to the command file.

LIB$GET_COMMAND opens file SYS$COMMAND on the first call. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls. Hence, this routine is not AST reentrant.

If *prompt-string* is provided and if the SYS$COMMAND device is a terminal, LIB $GET_COMMAND displays the prompt message. If the device is not a terminal, the *prompt-string* is ignored.

LIB$GET_COMMAND is used when a program needs input from some source other than the current input stream. Usually, it is used to input from the terminal rather than from an indirect command file. For example, a program may ask a question which cannot be answered by an indirect command file entry. In this case the program would call LIB$GET_COMMAND to get one record of ASCII text from SYS$COMMAND, the terminal.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. RMS completion status.
LIB$_FATERRLIB	An internal consistency check on Run-Time Library data structures has failed. This may indicate a programming error in the Run-Time Library, or that your program may have overwritten those data structures.
LIB$_INPSTRTRU	The input string has been truncated to the size specified in the *resultant-string* descriptor (fixed-length strings only). The *resultant-length* argument is also set to this size. This is an error (as opposed to LIB$_STRTRU which is a success) because the truncation is not under program control.
LIB$_INSVIRMEM	Insufficient virtual memory to allocate the dynamic string.
LIB$_INVARG	Invalid arguments. The descriptor class field is not a recognized code or is zero.

Any valid RMS status code.

Any code returned by LIBGET_VM, LIBGET_VM_64, LIB$SCOPY_R_DX, or LIB $SCOPY_R_DX_64.

LIB$GET_COMMON

LIB$GET_COMMON — The Get String from Common routine copies a string in the common area to the destination string. (The common area is an area of storage that remains defined across multiple image activations in a process.) The string length is taken from the first longword of the common area.

Format

LIB$GET_COMMON resultant-string [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string into which LIB$GET_COMMON writes the string copied from the common area. The *resultant-string* argument is the address of a descriptor pointing to the destination string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of characters written into *resultant-string* by LIB$GET_COMMON, not counting padding in the case of a fixed-length string. The *resultant-length* argument is the address of an unsigned word integer containing the number of characters copied. If the input string is truncated to the size specified in the *resultant-string* descriptor, *resultant-length* is set to this size.

Therefore, *resultant-length* can always be used by the calling program to access a valid substring of *resultant-string*.

Description

LIB$PUT_COMMON allows a program to copy a string into the process's common storage area. This area remains defined during multiple image activations. LIB$GET_COMMON allows a program to copy a string from the common area into a destination string. The programs reading and writing the data in the common area must agree upon its amount and format.

The maximum number of characters that can be copied is 252. The actual number of characters copied is returned by the optional argument, *resultant-length* (if given).

You can use LIB$PUT_COMMON and LIB$GET_COMMON to pass information between images run successively, such as chained images run by LIB$RUN_PROGRAM. Since the common area is unique to each process, do not use LIB$GET_COMMON and LIB$PUT_COMMON to share information across processes.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to VSI.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Successfully completed. The string was longer than the buffer and was truncated.

LIB$GET_CURR_INVO_CONTEXT

LIB$GET_CURR_INVO_CONTEXT — The Get Current Invocation Context routine gets the current invocation context of any active procedure. A thread can obtain the invocation context of a current procedure using the following function format:

Format

LIB$GET_CURR_INVO_CONTEXT invo_context

Returns

None.

Arguments

invo_context

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Address of an invocation context block into which the procedure context of the caller will be written.

Description

LIB$GET_CURR_INVO_CONTEXT gets the current invocation context of any active procedure.

See the *VSI OpenVMS Calling Standard* manual for additional information.

Condition Values Returned

None.

LIB$GET_DATE_FORMAT

LIB$GET_DATE_FORMAT — The Get the User's Date Input Format routine returns information about the user's choice of a date/time input format.

Format

LIB$GET_DATE_FORMAT format-string [,user-context]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

format-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Receives the translation of LIB$DT_INPUT_FORMAT. The *format-string* argument is the address of a descriptor pointing to this format string.

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context variable that retains the translation context over multiple calls to this routine. The *user-context* argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The *user-context* argument is optional. However, if a context cell is not passed, LIB $GET_DATE_FORMAT may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, VSI recommends that users specify a different context cell for each calling thread.

Description

Depending on which method was used to specify the input formats, LIB$GET_DATE_FORMAT either translates the logicals LIB$DT_INPUT_FORMAT and LIB$FORMAT_MNEMONICS, or uses the preinitialized context components LIB$K_FORMAT_MNEMONICS and LIB$K_INPUT_FORMAT to return the user's specified date/time input format in a “legible” form. This format string can then be used as a guideline for entering date/time strings.

The string returned by LIB$GET_DATE_FORMAT parallels the currently defined input format string, consisting of the format punctuation (with most whitespace compressed) and “legible” mnemonics representing the various format fields. The English (default) versions of these mnemonics are as follows:

Format Field	**Legible Mnemonic (Default)**
Year	YYYY [1]
Numeric month	MM
Alphabetic month	MONTH
Numeric day	DD
Hours (12- or 24-hour)	HH
Minutes	MM
Seconds	SS
Fractional seconds	CC [1]
Meridiem indicator	AM/PM

[1]This variable-length field mnemonic has a numeric suffix representing the number of digits allowed or required in the field. For instance, YYYY4 indicates a four-digit year field.

For example, consider the following input format string:

```
$ DEFINE LIB$DT_INPUT_FORMAT -
_$ "!MAAU !D0, !Y2 !H02:!M0:!S0.!C4 !MIU"
```

If LIB$GET_DATE_FORMAT were called for this format string, the format string returned would be as follows:

```
MONTH DD, YYYY2 HH:MM:SS.CC4 AM/PM
```

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_DEFFORUSE	Default format used; unable to determine desired format.
LIB$_ENGLUSED	English used; unable to determine or use desired language.
LIB$_ILLFORMAT	Illegal format string.
LIB$_INVARG	Invalid argument; a required argument was not specified.
LIB$_INVSTRDES	Invalid input string descriptor.
LIB$_REENTRANCY	Reentrancy detected.
LIB$_STRTRU	String truncated.
LIB$_UNRFORCOD	Unrecognized format code.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by LIBGET_VM, LIBSCOPY_R_DX, and LIB$SFREE1_DD.

LIB$GET_EF

LIB$GET_EF — The Get Event Flag routine allocates one local event flag from a processwide pool and returns the number of the allocated flag to the caller. If no flags are available, LIB$GET_EF returns an error as its function value.

Format

LIB$GET_EF event-flag-number

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

event-flag-number

OpenVMS usage:	ef_number
type:	longword (unsigned)

access:	write only
mechanism:	by reference

Number of the local event flag that LIB$GET_EF allocated, or –1 if no local event flag was available. The *event-flag-number* argument is the address of a signed longword integer into which LIB $GET_EF writes the number of the local event flag that it allocates.

Description

LIB$GET_EF and LIB$FREE_EF cause local event flags to be allocated and deallocated at run time, so that your routine remains independent of other routines executing in the same process.

LIB$GET_EF provides your program with an arbitrary event flag number. You can obtain a specific event flag number by calling LIB$RESERVE_EF.

Note

Beware of running multiple images linked with /NOSYSSHR in the same process and having more than one image make calls to LIB$GET_EF. Each image contains its own copy of the event flag bit array that is designed to be process-wide and synchronize ownership of event flags. Multiple calls to LIB$GET_EF could cause the same event flag to be allocated more than once.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSEF	Insufficient event flags. There were no more event flags available for allocation.

See the *VSI OpenVMS Programming Concepts Manual* for more information.

LIB$GET_FOREIGN

LIB$GET_FOREIGN — The Get Foreign Command Line routine requests the calling image's command language interpreter (CLI) to return the contents of the “foreign command” line that activated the current image.

Format

```
LIB$GET_FOREIGN resultant-string [,prompt-string] [,resultant-length] [,flags]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String that LIB$GET_FOREIGN uses to receive the foreign command line. The *resultant-string* argument is the address of a descriptor pointing to this string. If the foreign command text returned was obtained by a prompt to SYS$INPUT (see the description of *flags*), the text is translated to uppercase so as to be more consistent with text returned from the CLI.

prompt-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Optional user-supplied prompt for text that LIB$GET_FOREIGN uses if no command-line text is available. The *prompt-string* argument is the address of a descriptor pointing to the user prompt. If omitted, no prompting is performed. It is recommended that *prompt-string* be specified. If *prompt-string* is omitted and if no command-line text is available, a zero-length string will be returned.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of bytes written into *resultant-string* by LIB$GET_FOREIGN, not counting padding in the case of a fixed-length *resultant-string*. The *resultant-length* argument is the address of an unsigned word into which LIB$GET_FOREIGN writes the number of bytes.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Value that LIB$GET_FOREIGN uses to control whether or not prompting is to be performed. The *flags* argument is the address of an unsigned longword integer containing this value. If the low bit of

flags is zero, or if *flags* is omitted, prompting is done only if the CLI does not return a command line. If the low bit is 1, prompting is done unconditionally. If specified, *flags* is set to 1 before returning to the caller.

The primary use of *flags* is to allow a utility program to be invoked once with subcommand text on the command line, and then to repeatedly prompt for further subcommands from SYS$INPUT. This is accomplished by calling LIB$GET_FOREIGN repeatedly, specifying in the call a *prompt-string* string and a *flags* variable that is initialized to zero at the beginning of the program. The first call gets the subcommand text from the command line, after which *flags* will be set to 1, causing further subcommands to be requested through prompts to SYS$INPUT.

Description

LIB$GET_FOREIGN returns the contents of the command line that you use to activate an image. It can be used to give your program access to the qualifiers of a foreign command or to prompt for further command line text.

A foreign command is a command that you can define and then use as if it were a DCL or MCR command in order to run a program. When you use the foreign command at command level, the CLI parses the foreign command only and activates the image. It ignores any options or qualifiers that you have defined for the foreign command. Once the CLI has activated the image, the program can call LIB $GET_FOREIGN to obtain and parse the remainder of the command line (after the command itself) for whatever options it may contain. See the *VSI OpenVMS User's Manual* for information on how to define a foreign command.

If no command line is available, LIB$GET_FOREIGN can optionally call LIB$GET_INPUT to prompt the user for command text. If desired, LIB$GET_FOREIGN can be called repetitively, returning the command line on the first call, but prompting for further text on subsequent calls.

LIB$GET_FOREIGN can also be used for images invoked by the RUN command, for which further text must be obtained by prompting. Such an image can also be invoked by the DCL command MCR or by the MCR CLI. The text following the image name will be returned to the executing image.

The action of LIB$GET_FOREIGN depends on the environment in which the image is activated.

- If you use a foreign command to invoke the image, you can call LIB$GET_FOREIGN to obtain the command qualifiers following the foreign command. You can also use LIB$GET_FOREIGN to prompt repeatedly for more qualifiers after the command. This technique is shown in the example.
- If the image is in the SYS$SYSTEM: directory, the image can be invoked by the DCL command MCR or by the MCR CLI. In this case, LIB$GET_FOREIGN returns the command line text following the image name.
- If the image is invoked by a DCL command RUN, LIB$GET_FOREIGN can be used to prompt for additional text.
- If the image is not invoked by a foreign command or MCR, or if there is no information remaining on the command line, and the user-supplied prompt is present, LIB$GET_INPUT is called to prompt for a command line. If the prompt is not present, LIB$GET_FOREIGN returns a zero length string.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_FATERRLIB	A fatal internal error was detected.
LIB$_INPSTRTRU	The input string was truncated. The *resultant-string* argument could not contain all of the characters. The *resultant-length* argument reflects the truncated length.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor.

A condition value returned by OpenVMS RMS. SYS$INPUT was prompted for command text and RMS returned an error. The most typical error will be RMS$_EOF, end-of-file.

Example

```
EXAMPLE: ROUTINE OPTIONS (MAIN);

%INCLUDE $STSDEF; /* Status-testing definitions */

DECLARE COMMAND_LINE CHARACTER(80) VARYING,
        PROMPT_FLAG FIXED BINARY(31) INIT(0),
        LIB$GET_FOREIGN ENTRY (CHARACTER(*) VARYING,
                               CHARACTER(*) VARYING,
                               FIXED BINARY(15),
                               FIXED BINARY(31))
           OPTIONS(VARIABLE) RETURNS (FIXED BINARY(31)),
        RMS$_EOF GLOBALREF FIXED BINARY(31) VALUE;

/* Repeat forever calling LIB$GET_FOREIGN to obtain
   subcommand text and print the text. Exit when an
   end-of-file is found. */

DO WHILE ('1'B); /* Do while TRUE */
  STS$VALUE = LIB$GET_FOREIGN
                 (COMMAND_LINE,'Input: ',,
                  PROMPT_FLAG);
  IF STS$SUCCESS THEN
    PUT LIST (' Command was ',COMMAND_LINE);
  ELSE DO;
    IF STS$VALUE ^= RMS$_EOF THEN
      PUT LIST ('Error encountered');
    RETURN;
    END;
  PUT SKIP; /* Skip to next line */
  END; /* End of DO WHILE loop */
END;
```

This PL/I example shows the use of the optional *flags* argument to permit repeated calls to LIB $GET_FOREIGN. The command line text is retrieved on the first pass only; after the first pass, the program prompts from SYS$INPUT.

LIB$GET_FULLNAME_OFFSET

LIB$GET_FULLNAME_OFFSET — The Get the Offset to the Starting Position of the Most Significant Part of a Full Name routine returns the offset to the starting position of the most significant part of a full name. No support for arguments passed by 64-bit address reference or for use of 64-

bit descriptors, if applicable, is planned for this routine. The most significant part of a full name is determined by the underlying network services.

Format

LIB$GET_FULLNAME_OFFSET fullname, offset

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

fullname

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Full name. The *fullname* argument contains the address of the descriptor pointing to this full name string.

The error LIB$_INVARG is returned if *fullname* contains an invalid full name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if *fullname* is an invalid descriptor.

offset

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

The offset in bytes of the starting position of the most significant part of *fullname*. The *offset* argument is the address of an unsigned word that contains this offset.

The *offset* argument contains an unusable result when LIB$GET_FULLNAME_OFFSET returns in error.

Description

This routine returns the byte offset of the starting position of the most significant part of the input full name. The returned offset can be used to position the display of a full name in a fixed-size output region,

for example, scroll regions in DECwindows applications. The most significant part of a full name is determined by the underlying network services.

You must validate **fullname** by expanding it with LIB$EXPAND_NO DENAME before calling LIB $GET_FULLNAME_OFFSET. LIB$GET_FULLNAME_OFFSET returns the error LIB$_INVARG if **fullname** is invalid.

In a DECnet for OpenVMS environment, processing a DECnet-Plus for OpenVMS full name using LIB $GET_FULLNAME_OFFSET results in the error condition LIB$_INVARG.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument: • **fullname** is invalid. • **fullname** points to a null string. • The length of the full name is more than 1024 characters. • Processing a DECnet-Plus for OpenVMS node name in a DECnet for OpenVMS environment is invalid.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by the $IPC DECnet service.

Examples

The following table gives some examples of the results of LIB$GET_FULLNAME_OFFSET:

Full Name	**Offset**
NODE	0
DEC:.FOO.NODE	9

LIB$GET_HOSTNAME

LIB$GET_HOSTNAME — The Get Host Node Name routine returns the host node name of the local system. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$GET_HOSTNAME hostname [,resultant-length] [,flags]
```

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

hostname

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

The host node name. The *hostname* argument contains the address of a descriptor pointing to the host node name. LIB$GET_HOSTNAME writes the host node-name string into the buffer pointed to by the *hostname* descriptor.

The error LIB$_INVSTRDES is returned if *hostname* is an invalid descriptor.

The length field of the *hostname* descriptor is not updated unless *hostname* is a dynamic descriptor with a length less than the host node name to be returned. Refer to the *VSI OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The *hostname* argument contains an unusable result when LIB$GET_HOSTNAME returns in error.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the host node name. The *resultant-length* argument is the address of an unsigned word that contains this length in bytes.

The *resultant-length* argument contains an unusable result when LIB$GET_HOSTNAME returns in error.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by value

The value LIB$GET_HOSTNAME uses to control the form of the host node name that it returns in the output descriptor *hostname*. If *flags* is equal to 0, or if *flags* is omitted, the host node name

returned is in the network usable form. If *flags* is equal to 1, the host node name returned is in the parsable form.

Unused bits in *flags* must be 0. Nonzero unused bits result in the error condition LIB$_INVARG.

Description

This routine returns the host node name. The routine searches for the first host node name using the following order:

1. Get host node name from $GETSYI system service.
2. Translate the executive mode logical SYS$NODE_FULLNAME once.
3. Translate the executive mode logical SYS$NODE once.

The error LIB$_NOHOSNAM is returned if no host node name is found.

LIB$GET_HOSTNAME can return the host node name in the following two forms:

- Network usable form — The form that can be passed directly to the network. This form does not contain unnecessary double quotation marks (double quotation marks ["] that are not part of the node name) and also does not contain trailing double colons, for example:

  ```
  DEC:.FOO."simple name with spaces"
  ```

- Parsable form — The form that can be passed directly to the part of the system that does node-name syntax parsing, for example, $FILESCAN and DCL command parsing. This form contains trailing double colons and is fully quoted if there are special characters. Individual double quotation marks (") that are part of a simple name are doubled (" "), for example:

  ```
  "DEC:.FOO.""simple name with spaces""":: 
  ```

  You must use double quotation marks for a node name with special characters to facilitate correct parsing.

If the returned node name overflows the buffer pointed to by **hostname**, the host node name is truncated at the end, and the alternate success status LIB$_STRTRU is returned.

The **resultant-length** argument, if supplied, is set to the length of the node-name string copied to the output buffer pointed to by **hostname**.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by **hostname**.
LIB$_INVARG	Invalid input argument. Unused bits in **flags** are not set to 0.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.
LIB$_NOHOSNAM	No host node name found.

Any condition value returned by LIB$SCOPY_R_DX, or the $FILESCAN system service.

LIB$GET_INPUT

LIB$GET_INPUT — The Get Line from SYS$INPUT routine gets one record of ASCII text from the current controlling input device, specified by SYS$INPUT.

Format

LIB$GET_INPUT resultant-string [,prompt-string] [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String that LIB$GET_INPUT gets from the input device. The *resultant-string* argument is the address of a descriptor pointing to the character string into which LIB$GET_INPUT writes the text received from the current input device.

prompt-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Prompt message that is displayed on the controlling terminal. The *prompt-string* argument is the address of a descriptor containing the prompt. Any string can be a valid prompt. By convention however, a prompt consists of text followed by a colon (:), a space, and no carriage-return/line-feed combination. The maximum size of the prompt message is 255 characters. If the controlling input device is not a terminal, this argument is ignored.

resultant-length

OpenVMS usage:	word_unsigned

type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of bytes written into *resultant-string* by LIB$GET_INPUT, not counting padding in the case of a fixed string. The *resultant-length* argument is the address of an unsigned word containing this number. If the input string is truncated to the size specified in the *resultant-string* descriptor, *resultant-length* is set to this size. Therefore, *resultant-length* can always be used by the calling program to access a valid substring of *resultant-string*.

Description

LIB$GET_INPUT uses the OpenVMS RMS $GET service to get one record of ASCII text from the current controlling input device, specified by SYS$INPUT. (For more information about the RMS $GET service, see the *VSI OpenVMS Record Management Services Reference Manual*.)

When you log in, the OpenVMS operating system creates three files as default I/O control streams for your process.

- SYS$INPUT, your default input device
- SYS$OUTPUT, your default output device
- SYS$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or your batch commands and the OpenVMS software. Initially, all three names are equated with the terminal. However, with the DCL command ASSIGN, you can change these assignments to obtain information from a file or put information into a file. SYS$INPUT and SYS$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS$COMMAND refers to the terminal and SYS $INPUT refers to the command file.

LIB$GET_INPUT opens file SYS$INPUT on the first call. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls.

If *prompt-string* is provided and the SYS$INPUT device is a terminal, LIB$GET_INPUT displays the prompt message. If the device is not a terminal, the *prompt-string* argument is ignored.

If you want to get input from some source other than the current input stream, use LIB $GET_COMMAND.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. RMS completion status.
LIB$_FATERRLIB	An internal consistency check on Run-Time Library data structures has failed. This may indicate a programming error in the Run-Time Library, or that your program may have overwritten those data structures.
LIB$_INPSTRTRU	The input string has been truncated to the size specified in the *resultant-string* descriptor (fixed-length strings only). The

	resultant-length argument is also set to this size. This is an error (as opposed to LIB$_STRTRU, which is a success) because the truncation is not under program control.
LIB$_INSVIRMEM	Insufficient virtual memory to allocate the dynamic string.
LIB$_INVARG	Invalid arguments. The descriptor class field is not a recognized code or is zero.

Any RMS condition value returned by $GET.

Any condition value returned by LIBGET_VM, LIBGET_VM_64, LIB$SCOPY_R_DX, or LIB $SCOPY_R_DX_64.

LIB$GET_INVO_CONTEXT

LIB$GET_INVO_CONTEXT — The Get Invocation Context routine gets the invocation context of any active procedure.

Format

LIB$GET_INVO_CONTEXT invo_handle, invo_context

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_handle

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	read only
mechanism:	by value

Handle for the desired invocation. Returned by LIB$GET_INVO_HANDLE.

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	write only
mechanism:	by reference

Address of an invocation context block into which the procedure context of the frame specified by *invo_handle* will be written.

Description

LIB$GET_INVO_CONTEXT gets the invocation context of any active procedure.

Note

If *invo_handle* does not represent any procedure context in the active call chain, the new contents of the invocation context block are unpredictable.

See the *VSI OpenVMS Calling Standard* manual for additional information.

Condition Values Returned

0	Indicates failure.
0	Indicates success.

LIB$GET_INVO_HANDLE

LIB$GET_INVO_HANDLE — The Get Invocation Handle routine gets an invocation handle of any active procedure. A thread can obtain an invocation handle corresponding to any invocation context block by using the following function format.

Format

LIB$GET_INVO_HANDLE invo_context

Returns

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	write only
mechanism:	by value

Invocation handle of the invocation context that was passed. If the returned value is LIB $K_INVO_HANDLE_NULL, the invocation context that was passed was invalid.

Argument

invo_context

OpenVMS usage:	invo_handle
type:	structure
access:	read only

mechanism:	by reference

Address of an invocation context block. Here, only the frame pointer and stack pointer fields of an invocation context block must be defined.

Description

LIB$GET_INVO_HANDLE gets an invocation handle of any active procedure.

See the *VSI OpenVMS Calling Standard* manual for additional information.

Condition Values Returned

None.

LIB$GET_LOGICAL

LIB$GET_LOGICAL — The Get Logical Name routine calls the system service routine $TRNLNM to return information about a logical name.

Format

```
LIB$GET_LOGICAL logical-name [,resultant-string] [,resultant-length] [,table-name]
```

Returns

OpenVMS usage:	cond_value
type:	longword
access:	write only
mechanism:	by value

Arguments

logical-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Logical name for which LIB$GET_LOGICAL searches. The *logical-name* argument is the address of a descriptor pointing to the logical name string.

resultant-string

OpenVMS usage:	char_string

type:	character string
access:	write only
mechanism:	by descriptor

Logical name equivalent returned. The *resultant-string* argument is the address of a descriptor pointing to a character string into which LIB$GET_ LOGICAL writes the equivalence name of the logical.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the equivalence name string returned by LIB$GET_LOGICAL. The *resultant-length* argument is the address of an unsigned word integer into which LIB$GET_LOGICAL writes the length.

table-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the table in which to search for the logical name. The *table-name* argument contains the address of a descriptor pointing to a character string which contains the table name. If no table is specified, LNM$FILE_DEV is used.

max-index

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

Largest equivalence name index. Each equivalence name for the logical name has an index associated with it. The *max-index* argument is the address of a signed longword integer into which LIB $GET_LOGICAL write the value. If no equivalence names (and, therefore, no index values) exist, LIB $GET_LOGICAL returns a value of -1.

index

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only

mechanism:	by reference

Equivalence name index value. LIB$GET_LOGICAL will return the equivalence name string that has the specified index value. The *index* argument is the address of an unsigned longword integer specifying the index value.

acmode

OpenVMS usage:	access_mode
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Access mode to be used in the translation. The *acmode* argument is the address of a byte specifying the access mode. The $PSLDEF macro defines symbolic names for the four access modes.

When you specify the *acmode* argument, all names at access modes which are less privileged than the specified access mode are ignored.

If you do not specify *acmode*, the translation is performed without regard to access mode; however, the translation process proceeds from the outermost to the innermost access modes. Thus, if two logical names with the same name, but at different access modes, exist in the same table, the name with the outermost access mode is translated.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Flags controlling the search for the logical name. The *flags* argument is the address of a longword integer that contains the control flags. The $LNMDEF macro defines these flags. Currently only bit 0 of this argument is used.

Bit	Value	Description
0	LNM$M_CASE_BLIND	If set, LIB$GET_LOGICAL does not distinguish between uppercase and lowercase letters in the logical name to be translated.

This is an optional argument. If omitted the default is 0.

Description

LIB$GET_LOGICAL provides a simplified interface to the $TRNLNM system service. It provides most of the features found in $TRNLNM with some additional benefits. For string arguments, all string classes supported by the Run-Time Library are understood. The list of item descriptors, which may be difficult to construct in high-level languages, is handled internally by LIB$GET_LOGICAL.

See the description of the $TRNLNM system service in the *VSI OpenVMS System Services Reference Manual* for more information.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_ACCVIO	Access violation. Cannot access the location specified.
SS$_BADPARAM	Bad parameter value.
SS$_IVLOGNAM	Invalid logical name. The logical name or its value contained more than 255 characters.
SS$_IVLOGTAB	Invalid logical name table.
SS$_NOLOGNAM	The logical name was not found in the specified table.
SS$_NOPRIV	No privileges for attempted operation.
SS$_TOOMANYLNAM	Logical name translation exceeded allowed depth.
LIB$_INVARG	Required argument is missing.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_STRTRU	Success, but source string truncated.
LIB$_WRONUMARG	Wrong number of arguments.

LIB$GET_LUN

LIB$GET_LUN — The Get Logical Unit Number routine allocates one logical unit number from a processwide pool. If a unit is available, its number is returned to the caller. Otherwise, an error is returned as the function value.

Format

`LIB$GET_LUN logical-unit-number`

Return

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

logical-unit-number

OpenVMS usage:	longword_signed
type:	longword integer (signed)

access:	write only
mechanism:	by reference

Allocated logical unit number or –1 if none was available. The *logical-unit-number* argument is the address of a longword into which LIB$GET_LUN returns the value of the allocated logical unit. LIB $GET_LUN can allocate logical unit numbers 100 through 119 on VAX, and 100 through 299 on Alpha and I64.

Description

LIB$GET_LUN allocates one logical unit number from a processwide pool. If a unit is available, its number is returned to the caller. Otherwise, an error is returned as the function value.

On VAX systems, LIB$GET_LUN reserves logical unit numbers starting at 119 and continues in descending order through 100.

On Alpha and I64 systems, LIB$GET_LUN reserves logical unit numbers 100 through 299. To maintain compatibility with VAX systems, LIB$GET_LUN reserves logical unit numbers starting at 119 and continues in descending order through 100. When these are exhausted, LIB$GET_LUN reserves logical unit numbers starting at 299 and continues in descending order through 120.

LIB$GET_LUN assumes that the logical unit numbers in the range 0 through 99 may be in use by your program, but it cannot determine which logical unit numbers are actually in use by your program.

Call LIB$GET_LUN only from Fortran or BASIC programs. Those languages and LIB$GET_LUN share the concept of unit numbers and a similar number space.

Note

Beware of running multiple images linked with /NOSYSSHR in the same process and having more than one image make calls to LIB$GET_LUN. Each image contains its own copy of the event flag bit array that is designed to be process-wide and synchronize ownership of event flags. Multiple calls to LIB $GET_EF could cause the same event flag to be allocated more than once.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSLUN	Insufficient logical unit numbers. No logical unit numbers were available.

LIB$GET_MAXIMUM_DATE_LENGTH

LIB$GET_MAXIMUM_DATE_LENGTH — Given an output format and language, the Retrieve the Maximum Length of a Date/Time String routine determines the maximum possible length for the *date-string* string returned by LIB$FORMAT_DATE_TIME.

Format

LIB$GET_MAXIMUM_DATE_LENGTH date-length [,user-context] [,flags]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

date-length

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	write only
mechanism:	by reference

Receives the maximum possible length of the *date-string* argument returned to LIB $FORMAT_DATE_TIME. The *date-length* argument is the address of a signed longword that receives this maximum length. The length written to *date-length* reflects the greatest possible length of an output date/time string for the currently selected output format and natural language.

For example, if the selected output date/time format includes the alphabetic, unabbreviated month name (assuming English as the natural language), the longest month name (September) would have to be taken into consideration when determining the maximum possible length of *date-string*.

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context variable that retains the translation context over multiple calls to this routine. The *user-context* argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The *user-context* parameter is optional. However, if a context cell is not passed, the routine LIB $GET_MAXIMUM_DATE_LENGTH may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, VSI recommends that users specify a different context cell for each calling thread.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Bit mask that allows the user to specify whether the date, time, or both are to be included in the calculation of the maximum date length. The *flags* argument is the address of an unsigned bit mask containing the specified values. Valid values are LIB$M_DATE_FIELDS and LIB $M_TIME_FIELDS. The values specified for *flags* must correspond to the *flags* argument passed to LIB$FORMAT_DATE_ TIME.

Description

The LIB$GET_MAXIMUM_DATE_LENGTH routine determines the maximum possible length for a formatted date/time string as returned by LIB$FORMAT_DATE_ TIME. The maximum length returned takes into account the currently specified output format and natural language; *date-length* represents the maximum possible length of the string written to the *date-string* argument of LIB $FORMAT_DATE_ TIME.

Consider the following example, in which the output format is defined as follows.

```
DEFINE LIB$DT_FORMAT LIB$DATE_FORMAT_012, LIB$TIME_FORMAT_012
```

This date/time format would appear as follows:

```
!MAU !DD, !Y4 !HH2:!M0 !MIU
```

Given this format, the maximum possible length for this date/time string is calculated using the longest possible date string followed by a space and the longest possible time string. One example that meets these requirements is as follows (assuming English as the selected language):

```
SEPTEMBER 21, 2000 11:24 PM
```

The maximum possible length of this *date-string* would then be 28.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ABSTIMREQ	Absolute time required.
LIB$_DEFFORUSE	Default format used; unable to determine desired format.
LIB$_ENGLUSED	English used by default; unable to translate SYS$LANGUAGE.
LIB$_REENTRANCY	Reentrant invocation with same context variable.
LIB$_STRTRU	Output string truncated.
LIB$_UNRFORCOD	Unrecognized format code.

Any condition value returned by LIB$GET_VM.

LIB$GET_PREV_INVO_CONTEXT

LIB$GET_PREV_INVO_CONTEXT — The Get Previous Invocation Context routine gets the previous invocation context of any active procedure. A thread can obtain the invocation context of the procedure context preceding any other procedure context using the following function format.

Format

```
LIB$GET_PREV_INVO_CONTEXT invo_context
```

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify
mechanism:	by reference

Address of an invocation context block. The given context block is updated to represent the context of the previous (calling) frame.

For the purposes of this function, the minimum fields of an invocation block that must be defined are those IREG and FREG fields corresponding to registers used by a context whether the registers are preserved or not. Note that the invocation context blocks written by the routines specified in these sections define all possible fields in a context block. Such context blocks satisfy this minimum requirement.

Description

LIB$GET_PREV_INVO_CONTEXT gets the previous invocation context of any active procedure.

See the *VSI OpenVMS Calling Standard* manual for more information.

Condition Values Returned

0	The initial context represents the bottom of the call chain.
1	Indicates success.

LIB$GET_PREV_INVO_HANDLE

LIB$GET_PREV_INVO_HANDLE — The Get Previous Invocation Handle routine gets the previous invocation handle of any active procedure. A thread can obtain an invocation handle of the procedure context preceding that of a specified procedure context by using the following function format.

Format

LIB$GET_PREV_INVO_HANDLE invo_handle

Returns

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

invo_handle

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	read only
mechanism:	by value

An invocation handle that represents a target invocation context.

Description

LIB$GET_PREV_INVO_HANDLE gets the previous invocation handle of any active procedure.

See the *VSI OpenVMS Calling Standard* manual for more information.

Condition Values Returned

None.

LIB$GET_SYMBOL

LIB$GET_SYMBOL — The Get Value of CLI Symbol routine requests the calling process's command language interpreter (CLI) to return the value of a CLI symbol as a string. LIB$GET_SYMBOL then returns the string to the caller. Optionally, LIB$GET_SYMBOL can return the length of the returned value and the table in which the symbol was found.

Format

LIB$GET_SYMBOL symbol ,resultant-string [,resultant-length] [,table-type-indicator

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

symbol

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the symbol for which LIB$GET_SYMBOL searches. The *symbol* argument is the address of a descriptor pointing to the name of the symbol. LIB$GET_SYMBOL converts the symbol name to uppercase and removes trailing blanks before the search. The *symbol* argument must begin with a letter, a digit, a dollar sign ($), a hyphen (-), or an underscore (_). The maximum length of *symbol* is 255 characters.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Value of the returned symbol. The maximum length is 4096 characters. The *resultant-string* argument is the address of a descriptor pointing to a character string into which LIB$GET_SYMBOL writes the value of the symbol.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the symbol value returned by LIB$GET_SYMBOL. The *resultant-length* argument is the address of an unsigned word integer into which LIB$GET_SYMBOL writes the length.

table-type-indicator

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only

mechanism:	by reference

Indicator of which table contained the symbol. The *table-type-indicator* argument is the address of a signed longword integer into which LIB$GET_SYMBOL writes the table indicator.

Possible values of the table indicator are listed below.

Symbolic Name	Value	Table
LIB$K_CLI_LOCAL_SYM	1	Local symbol table
LIB$K_CLI_GLOBAL_SYM	2	Global symbol table

LIB$K_CLI_LOCAL_SYM and LIB$K_CLI_GLOBAL_SYM are defined in symbol libraries supplied by VSI (macro or module name $LIBCLIDEF) and as global symbols.

Description

LIB$GET_SYMBOL first searches the local symbol table for the symbol name, then searches the global symbol table. Numeric values are converted to an ASCII representation of a signed decimal number before being returned.

LIB$GET_SYMBOL is supported for use with the DCL command language interpreter. If used with the MCR CLI, the error status LIB$_NOCLI will be returned.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to get the symbol. In that case, LIB$GET_SYMBOL returns the error status LIB$_NOCLI.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed; string truncated. The destination string could not contain all the characters in the symbol value.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSCLIMEM	Insufficient CLI memory. The CLI could not obtain enough virtual memory to perform the function. This may be caused by having too many symbols defined. Deleting some symbol definitions may relieve the situation.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_INVSYMNAM	Invalid symbol name. The symbol name contained more than 255 characters or did not begin with a letter or dollar sign ($).
LIB$_NOCLI	No CLI present. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_NOSUCHSYM	No such symbol. The symbol was not defined in either the local or global symbol table.

LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to your VSI support representative.

LIB$GET_UIB_INFO

LIB$GET_UIB_INFO — Returns information from the unwind information block (UIB).

Format

LIB$GET_UIB_INFO uib_va [,gp_value] [,uw_desc_va] [,uw_desc_len] [,handler_fv

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

uib_va

OpenVMS usage:	address
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Address of a quadword that contains the virtual address of an unwind information block (UIB).

gp_value

OpenVMS usage:	address
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Address of a quadword that contains the GP value that must be added to the UIB condition handler value. Must be specified if *handler_fv* is specified.

uw_desc_va

OpenVMS usage:	address

type:	quadword (unsigned)
access:	write
mechanism:	by reference

Address of a quadword to store the virtual address of the unwind descriptor area. If none is present, then zero is returned. This is an optional argument.

un_desc_len

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write
mechanism:	by reference

Address of a quadword to store the length (in bytes) of the unwind descriptor area. If none are present, then zero is returned. This is an optional argument.

handler_fv

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write
mechanism:	by reference

Address of a quadword to store the function value of the condition handler. If none is present, then zero is returned. This is an optional argument.

ossd_va

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write
mechanism:	by reference

Address of a quadword to store the address of the operating system-specific data area. If none is present, then zero is returned. This is an optional argument.

lsda_va

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write
mechanism:	by reference

Address of a quadword to store the address of the language-specific data area (LSDA). If none is present, then zero is returned. This is an optional argument.

Description

Takes in the address of an unwind information block (UIB) and the GP value for a routine and returns the addresses of the start of the unwind descriptors (if any), the handler function descriptor (if any), and the operating system-specific data area (if any). The size in bytes of the unwind descriptors is also returned.

Related Services

SYSSET_UNWIND_TABLE, SYSCLEAR_UNWIND_TABLE, SYS$GET_
UNWIND_ENTRY_INFO,

Condition Values Returned

SS$_NORMAL	Routine completed successfully.
LIB$_INVARG	Bad UIB virtual address.

LIB$GET_USERS_LANGUAGE

LIB$GET_USERS_LANGUAGE — The Return the User's Language routine determines the user's choice of a natural language. The choice is determined by translating the logical SYS$LANGUAGE.

Format

`LIB$GET_USERS_LANGUAGE language`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

language

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Receives the translation of SYS$LANGUAGE. The *`language`* argument is the address of a descriptor pointing to this language name.

Description

The LIB$GET_USERS_LANGUAGE routine translates the logical SYS$LANGUAGE and returns the user's choice of a natural language. If the logical SYS$LANGUAGE does not translate for some reason, then the language defaults to English and the status LIB$_ENGLUSED is returned.

If a failure or truncation occurs while copying the language name to the *language* string argument, that error status overrides the LIB$_ENGLUSED or SS$_NORMAL status.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ENGLUSED	English used by default; unable to translate SYS$LANGUAGE.

Any condition value returned by LIB$SCOPY_R_DX.

LIB$GET_VM

LIB$GET_VM — The Allocate Virtual Memory routine allocates a specified number of contiguous bytes in the program region and returns the 32-bit virtual address of the first byte allocated. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$GET_VM number-of-bytes, base-address [,zone-id]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-bytes

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes that LIB$GET_VM allocates. The *number-of-bytes* argument is the address of a longword integer containing the number of bytes. LIB$GET_VM allocates enough memory to satisfy the request. Your program should not reference an address before the first byte

address allocated (*base-address*) or beyond the last byte allocated (*base-address* + *number-of-bytes* – 1) since that space may be assigned to another routine. The value of *number-of-bytes* must be greater than zero.

base-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

First virtual address of the contiguous block of bytes allocated by LIB$GET_VM. The *base-address* argument is the address of an unsigned longword containing this base address.

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The *zone-id* argument is the address of a longword that contains a zone identifier created by a previous call to LIB$CREATE_VM_ZONE or LIB$CREATE_USER_VM_ZONE. This argument is optional. If *zone-id* is omitted or if the longword contains the value 0, the 32-bit default zone is used.

Description

LIB$GET_VM satisfies an allocation request by reusing free memory in the zone, or by obtaining additional memory from the processwide 32-bit page pool managed by LIB$GET_VM_PAGE.

LIB$GET_VM rounds up the value of *number-of-bytes* to a multiple of the *block-size* specified for the zone. The first byte allocated is aligned on the boundary specified by the alignment value for the zone.

If you specified allocation filling when you created the zone, LIB$GET_VM will fill each byte allocated. Otherwise, LIB$GET_VM does not initialize the memory and its contents are unpredictable.

All memory allocated by LIB$GET_VM has user mode read/write access, even if the call to LIB $GET_VM was made from a more privileged access mode.

The space allocated by successive calls to LIB$GET_VM may be noncontiguous because another routine can call LIB$GET_VM between your calls. If AST interrupts occur, LIB$GET_VM may allocate space to another routine between execution of any two statements in your program. Even if successive calls to LIB$GET_VM return two contiguous blocks, you must not combine them into one large block that is freed by a single call to LIB$FREE_VM.

LIB$GET_VM is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Your program must retain the address of the allocated area. This allows you to access or deallocate the space later.

If the zone you are getting was created using the LIB$CREATE_USER_VM_ZONE routine, then you must have an appropriate action routine for the get operation. That is, in your call to LIB $CREATE_USER_VM_ZONE, you must have specified a *user-get-routine*.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	Invalid *zone-id* or a corrupt zone.
LIB$_BADBLOSIZ	Bad block size. The value of *number-of-bytes* was less than or equal to 0. For the fixed-size blocks algorithm, LIB$_BADBLOSIZ can also be generated if the value of *algorithm-argument* specified in the call to LIB$CREATE_VM_ZONE is less than *number-of-bytes*.
LIB$_INSVIRMEM	Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.
LIB$_PAGLIMEXC	Allocation exceeds the *page-limit*, set when the zone was create.

LIB$GET_VM_64

LIB$GET_VM_64 — The Allocate Virtual Memory routine allocates a specified number of contiguous bytes in the program region and returns the 64-bit virtual address of the first byte allocated.

Format

```
LIB$GET_VM_64 number-of-bytes, base-address [,zone-id]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-bytes

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Number of contiguous bytes that LIB$GET_VM_64 allocates. The *number-of-bytes* argument is the address of a longword integer containing the number of bytes. LIB$GET_VM allocates enough

memory to satisfy the request. Your program should not reference an address before the first byte address allocated (*base-address*) or beyond the last byte allocated (*base-address* + *number-of-bytes* – 1) since that space may be assigned to another routine. The value of *number-of-bytes* must be greater than zero.

base-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

First virtual address of the contiguous block of bytes allocated by LIB$GET_VM_64. The *base-address* argument is the address of an unsigned longword containing this base address.

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

The *zone-id* argument is the address of a longword that contains a zone identifier created by a previous call to LIB$CREATE_VM_ZONE_64 or LIB$CREATE_USER_VM_ZONE_64. This argument is optional. If *zone-id* is omitted or if the longword contains the value 0, the 32-bit default zone is used.

Description

LIB$GET_VM_64 satisfies an allocation request by reusing free memory in the zone, or by obtaining additional memory from the processwide 32-bit page pool managed by LIB$GET_VM_PAGE_64.

LIB$GET_VM_64 rounds up the value of *number-of-bytes* to a multiple of the *block-size* specified for the zone. The first byte allocated is aligned on the boundary specified by the alignment value for the zone.

If you specified allocation filling when you created the zone, LIB$GET_VM_64 will fill each byte allocated. Otherwise, LIB$GET_VM_64 does not initialize the memory and its contents are unpredictable.

All memory allocated by LIB$GET_VM_64 has user mode read/write access, even if the call to LIB $GET_VM was made from a more privileged access mode.

The space allocated by successive calls to LIB$GET_VM_64 may be noncontiguous because another routine can call LIB$GET_VM_64 between your calls. If AST interrupts occur, LIB$GET_VM_64 may allocate space to another routine between execution of any two statements in your program. Even if successive calls to LIB$GET_VM_64 return two contiguous blocks, you must not combine them into one large block that is freed by a single call to LIB$FREE_VM_64.

LIB$GET_VM_64 is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Your program must retain the address of the allocated area. This allows you to access or deallocate the space later.

If the zone you are getting was created using the LIB$CREATE_USER_VM_ZONE_64 routine, then you must have an appropriate action routine for the get operation. That is, in your call to LIB $CREATE_USER_VM_ZONE_64, you must have specified a *user-get-routine*.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	Invalid *zone-id* or a corrupt zone.
LIB$_BADBLOSIZ	Bad block size. The value of *number-of-bytes* was less than or equal to 0. For the fixed-size blocks algorithm, LIB$_BADBLOSIZ can also be generated if the value of *algorithm-argument* specified in the call to LIB$CREATE_VM_ZONE_64 is less than *number-of-bytes*.
LIB$_INSVIRMEM	Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.
LIB$_PAGLIMEXC	Allocation exceeds the *page-limit*, set when the zone was create.

LIB$GET_VM_PAGE

LIB$GET_VM_PAGE — The Get Virtual Memory Page routine allocates a specified number of contiguous pages on VAX systems or pagelets on Alpha and I64 systems of memory in the program region and returns the virtual address of the first allocated page on VAX or pagelet on Alpha or I64. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$GET_VM_PAGE number-of-pages ,base-address

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-pages

OpenVMS usage:	longword_signed

type:	longword integer (signed)
access:	read only
mechanism:	by reference

Number of pages on VAX systems or pagelets on Alpha and I64 systems. The *number-of-pages* argument is the address of a longword integer that specifies the number of contiguous pages on VAX systems or pagelets on Alpha and I64 systems to be allocated. The value of *number-of-pages* must be greater than 0.

base-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Block address. The *base-address* argument is the address of a longword that is set to the address of the first byte of the newly allocated block of pages on VAX systems or pagelets on Alpha and I64 systems.

Description

LIB$GET_VM_PAGE allocates blocks of contiguous (512 byte) pages on VAX systems and pagelets on Alpha and I64 systems in the program region. LIB$GET_VM_PAGE manages a processwide pool of free pages. If there are not enough contiguous free pages or pagelets to satisfy an allocation request, additional pages are created by calling the system service $EXPREG. All memory allocated by LIB $GET_VM_PAGE is pagelet aligned; that is, the low-order nine bits of the base address are zero.

All memory allocated by LIB$GET_VM_PAGE has user-mode read/write access, even if the call to LIB $GET_VM_PAGE is made from a more privileged access mode.

The contents of memory allocated by LIB$GET_VM_PAGE are unpredictable. Your program must assign values to all locations that it uses.

LIB$GET_VM_PAGE is designed for request sizes ranging from one page or pagelet to a few hundred pages or pagelets. For very large request sizes (over 1000 pages or pagelets in a single request), you should call the system service $EXPREG.

LIB$GET_VM_PAGE is fully reentrant, so it can be called by routines executing at AST level or in an Ada multitasking environment.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOSIZ	The value of the *number-of-pages* argument is less than or equal to 0.
LIB$_INSVIRMEM	Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.

LIB$GET_VM_PAGE_64

LIB$GET_VM_PAGE_64 — The Get Virtual Memory Page routine allocates a specified number of contiguous Alpha or I64 pagelets of memory in the program region and returns the virtual address of the first allocated pagelet.

Format

LIB$GET_VM_PAGE_64 number-of-pages ,base-address

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-pages

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Number of Alpha or I64 pagelets. The *number-of-pages* argument is the address of a quadword integer that specifies the number of contiguous Alpha or I64 pagelets to be allocated. The value of number-of-pages must be greater than 0.

base-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Block address. The *base-address* argument is the address of a quadword that is set to the address of the first byte of the newly allocated block of Alpha or I64 pagelets.

Description

LIB$GET_VM_PAGE_64 allocates blocks of contiguous Alpha or I64 pagelets in the program region. LIB$GET_VM_PAGE_64 manages a processwide pool of free pagelets. If there are not enough contiguous free pagelets to satisfy an allocation request, additional pagelets are created by calling the

system service $EXPREG_64. All memory allocated by LIB$GET_VM_PAGE_64 is aligned to physical page size.

All memory allocated by LIB$GET_VM_PAGE_64 has user-mode read/write access, even if the call to LIB$GET_VM_PAGE_64 is made from a more privileged access mode.

The contents of memory allocated by LIB$GET_VM_PAGE_64 are unpredictable. Your program must assign values to all locations that it uses.

LIB$GET_VM_PAGE_64 is fully reentrant, so it can be called by routines executing at AST level or in an Ada multitasking environment.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOSIZ	The value of the argument *number-of-pages* is less than or equal to 0.
LIB$_INSVIRMEM	Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.

LIB$I64_CREATE_INVO_CONTEXT

LIB$I64_CREATE_INVO_CONTEXT — The Create Invocation Context routine allocates an invocation context block from heap storage and initializes it.

Format

LIB$I64_CREATE_INVO_CONTEXT [malloc] [,free] [,ident]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

malloc

OpenVMS usage:	function_value
type:	procedure
access:	read
mechanism:	by value

A procedure reference for a user callback routine that allocates memory. This is an optional argument. The default is to use an implementation of the C RTL routine *malloc*. If specified, this routine is used to allocate the invocation context block field LIBICB$PH_UO_MALLOC for use during the stack walk.

free

OpenVMS usage:	function_value
type:	procedure
access:	read
mechanism:	by value

A procedure reference for a user callback routine that deallocates memory. This value is placed in the invocation context block field LIBICB$PH_UO_FREE. This is an optional argument; however, it must be specified if *malloc* is specified. The default is to use an implementation of the C RTL routine *free*.

free

OpenVMS usage:	user_value
type:	quadword
access:	read
mechanism:	by value

Specifies a user *ident* value to be placed in the invocation context block LIBICB$IH_UO_IDENT field. In turn, this value is passed to the *malloc* and free routines. This is an optional argument; the default value is zero.

Description

LIB$I64_CREATE_INVO_CONTEXT simplifies creating and properly initializing an invocation context block. The routine allocates an invocation context block from heap storage and initializes it. Users of this routine should call LIB$I64_ FREE_INVO_CONTEXT when the invocation context block is no longer required.

This routine sets the cache unwind flag LIBICB$V_UO_FLAG_CACHE_UNWIND in the invocation context block to speed up the stack walk. Do not use this routine in conjunction with LIB $I64_INIT_INVO_CONTEXT, as the same initialization is performed by both routines.

Condition Values Returned

0	Indicates failure.
any non-zero value	Represents the address of the allocated invocation context block.

LIB$I64_FREE_INVO_CONTEXT

LIB$I64_FREE_INVO_CONTEXT — The Free Invocation Context Block routine deallocates an invocation context block that was previously allocated.

Format

LIB$I64_FREE_INVO_CONTEXT invo_context

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify only
mechanism:	by reference

Address of an invocation context block.

Description

LIB$I64_FREE_INVO_CONTEXT deallocates an invocation context block that was previously allocated using LIB$I64_CREATE_INVO_CONTEXT. This routine calls LIB$I64_PREV_INVO_END as a convenience.

Condition Values Returned

None.

LIB$I64_GET_CURR_INVO_CONTEXT

LIB$I64_GET_CURR_INVO_CONTEXT — The Get Current Invocation Context routine gets the invocation context of a current procedure.

Format

LIB$I64_GET_CURR_INVO_CONTEXT invo_context

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Argument

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify only
mechanism:	by reference

Address of an invocation context block into which the procedure context of the caller will be written.

Description

LIB$I64_GET_CURR_INVO_CONTEXT gets the invocation context of a current procedure. The invocation context block must be properly initialized as described in the *VSI OpenVMS Calling Standard* manual before calling this routine.

Condition Values Returned

0	Facilitates use in the implementation of the C language unwind *setjmp* or *longjmp* function. Check the LIBICB $L_ALERT_CODE field of the invocation context block for further status indication.

LIB$I64_GET_CURR_INVO_HANDLE

LIB$I64_GET_CURR_INVO_HANDLE — The Get Current Invocation Handle routine gets the invocation handle for the current procedure.

Format

LIB$I64_GET_CURR_INVO_HANDLE invo_handle

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_handle

OpenVMS usage:	invo_handle
type:	quadword
access:	write only
mechanism:	by reference

Address of a quadword into which the invocation handle of the caller will be written.

Description

LIB$I64_GET_CURR_INVO_HANDLE gets the invocation handle for the current procedure.

Condition Values Returned

0	The initial context represents the bottom of the call stack.
1	Indicates success.
3	The current operation completed without error, but a stack corruption was detected at the next level down.

LIB$I64_GET_FR

LIB$I64_GET_FR

Format

LIB$I64_GET_FR invo_context, index, fr_copy

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	read
mechanism:	by reference

Address of a valid invocation context block.

index

OpenVMS usage:	index
type:	longword
access:	read
mechanism:	by value

Floating point register index.

fr_copy

OpenVMS usage:	floating-point value
type:	octaword
access:	write
mechanism:	by value

Address of an octaword to receive the contents of the specified floating-point register.

Description

Given an invocation context block and floating-point register *index* such that 0 <= *index* < 128, LIB $I64_GET_FR copies the register value to *fr_copy*. For example, an *index* value of 4 fetches the value, which represents the contents of F4 for the context.

LIB$I64_GET_FR returns failure status if the index represents a scratch register whose contents have not been realized.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_GET_GR

LIB$I64_GET_GR — The Get Invocation Context Block Value routine fetches the invocation context block IREG[4] value.

Format

LIB$I64_GET_GR invo_context, index, gr_copy

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	read
mechanism:	by reference

Address of a valid invocation context block.

index

OpenVMS usage:	index
type:	longword
access:	read
mechanism:	by value

Index into the IREG array of the invocation context block.

gr_copy

OpenVMS usage:	floating-point value
type:	octaword
access:	write
mechanism:	by value

Address of an octaword to receive the value from the invocation context block.

Description

Given an invocation context block and general register *index* such that 0 <= *index* < 128, LIB $I64_GET_GR copies the register value to gr_copy, for example, *index* 4 fetches the invocation context block IREG[4] value, which represents the contents of R4 for the context.

If the register represented by *index* has its corresponding NaT bit set, the read succeeds and the return status is set to 3. If the register represented by *index* lies beyond the allocated general registers, the read fails and *gr_copy* is unchanged. That is, the highest allowed *index* is 32 + ICB.CFM.SOF - 1.

LIB$I64_GET_GR fails if the index represents a scratch register whose contents have not been realized.

Condition Values Returned

0	Indicates failure.

1	Indicates success, and that the NaT bit was clear.
3	Indicates success, and that the NaT bit was set.

LIB$I64_GET_INVO_CONTEXT

LIB$I64_GET_INVO_CONTEXT — The Get Invocation Context routine gets the invocation context of any active procedure.

Format

LIB$I64_GET_INVO_CONTEXT invo_handle, invo_context

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_handle

OpenVMS usage:	invo_handle
type:	quadword
access:	modify only
mechanism:	by reference

Address of an invocation context block into which the procedure context of the frame specified by *invo_handle* will be written.

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	write only
mechanism:	by reference

Address of an invocation context block into which the procedure context of the frame specified by *invo_handle* will be written.

Description

LIB$I64_GET_INVO_CONTEXT gets the invocation context of any active procedure.

Note

The invocation context block must be properly initialized as described in the *VSI OpenVMS Calling Standard* manual before calling this routine.

Condition Values Returned

0	Facilitates use in the implementation of the C language unwind `setjmp` or `longjmp` function. Check the LIBICB $L_ALERT_CODE field of the invocation context block for further status indication.

LIB$I64_GET_INVO_HANDLE

LIB$I64_GET_INVO_HANDLE — The Get Invocation Handle routine obtains the invocation handle corresponding to any invocation context block.

Format

`LIB$I64_GET_INVO_HANDLE invo_context, invo_handle`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	read only
mechanism:	by reference

Address of a valid invocation context block.

invo_handle

OpenVMS usage:	invo_handle
type:	quadword (unsigned)
access:	write only

mechanism:	by reference

Address of the location into which the invocation context handle is to be written. If the call fails, the value of the invocation context handle is LIB$K_INVO_HANDLE_NULL.

Description

LIB$GET_INVO_HANDLE gets the invocation context of any active procedure.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_GET_PREV_INVO_CONTEXT

LIB$I64_GET_PREV_INVO_CONTEXT — The Get Current Invocation Context routine obtains the invocation context of the procedure context preceding any other procedure context.

Format

```
LIB$I64_GET_PREV_INVO_CONTEXT invo_context
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify only
mechanism:	by reference

Address of a valid invocation context block. The given invocation context block is updated to represent the context of the previous (calling) frame.

The LIBICB$V_BOTTOM_OF_STACK flag of the invocation context block is set if the target frame represents the end of the invocation call chain or if stack corruption is detected.

Description

The LIB$I64_GET_PREV_INVO_CONTEXT routine obtains the invocation context of the procedure context preceding any other procedure context.

Condition Values Returned

0	The initial context represents the bottom of the call stack.
1	Indicates success.
3	The current operation completed without error, but a stack corruption was detected at the next level down.

LIB$I64_GET_UNWIND_HANDLER_FV

LIB$I64_GET_UNWIND_HANDLER_FV

Format

LIB$I64_GET_UNWIND_HANDLER_FV pc_value, handler_fv

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

pc_value

OpenVMS usage:	PC value
type:	quadword
access:	read
mechanism:	by reference

Address of a location that contains the PC value.

pc_value is used to find the unwind information block and the unwind information block condition handler pointer.

handler_fv

OpenVMS usage:	address

type:	quadword
access:	write
mechanism:	by reference

A quadword to receive the function value of the procedure descriptor for the condition handler, if there is one.

Description

Given a *pc_value*, LIB$I64_GET_UNWIND_HANDLER_FV finds the function value (address of the procedure descriptor) for the condition handler, if present, and writes it to *handler_fv*. If not present, then it writes 0 to *handler_fv*.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_GET_UNWIND_LSDA

LIB$I64_GET_UNWIND_LSDA — The Find Address of Unwind Information Block Language-Specific Data routine finds the address of the unwind information block language-specific data area.

Format

LIB$I64_GET_UNWIND_LSDA pc_value, unwind_lsda_p

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

pc_value

OpenVMS usage:	PC value
type:	quadword
access:	read
mechanism:	by reference

Address of a quadword to receive the address of the language-specific data area, if there is one.

unwind_lsda_p

OpenVMS usage:	address
type:	quadword
access:	write
mechanism:	by reference

Address of a location that contains the PC value. *pc_value* is used to find the unwind information block and the unwind information block language-specific data area address.

Description

Given a *pc_value*, LIB$I64_GET_UNWIND_LSDA finds the address of the unwind information block language-specific data area (LSDA), and writes it to *unwind_lsda_p*. If not present, it then writes 0 to *unwind_lsda_p*.

Condition Values Returned

0	Indicates failure
1	Indicates success.

LIB$I64_GET_UNWIND_OSSD

LIB$I64_GET_UNWIND_OSSD — The Find Address of the Unwind Information Block Operating System-Specific Data Area routine finds the address of the unwind information block operating system-specific data area.

Format

LIB$I64_GET_UNWIND_OSSD pc_value, unwind_ossd_p

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

pc_value

OpenVMS usage:	PC value
type:	quadword

access:	read
mechanism:	by reference

Address of a location that contains the PC value. *pc_value* is used to find the unwind information block and the unwind information block operating system-specific data area address.

unwind_ossd_p

OpenVMS usage:	address
type:	quadword
access:	write
mechanism:	by reference

Address of a quadword to receive the address of the operating system-specific data area.

Description

Given a *pc_value*, LIB$I64_GET_UNWIND_OSSD finds the address of the unwind information block operating system-specific data area, if present, and writes it to *unwind_ossd_p*. If not present, then it writes 0 to *unwind_ossd_p*.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_INIT_INVO_CONTEXT

LIB$I64_INIT_INVO_CONTEXT — The Initialize Invocation Context routine initializes an invocation context block that has already been allocated by the user.

Format

LIB$I64_INIT_INVO_CONTEXT invo_context, invo_version [,cache_unwind_flag]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify only
mechanism:	by reference

Address of an invocation context block.

invo_version

OpenVMS usage:	version_number
type:	byte
access:	read only
mechanism:	by value

The value LIBICB$K_INVO_CONTEXT_VERSION. This is used to verify the operating environment.

cache_unwind_flag

OpenVMS usage:	flag
type:	longword
access:	read only
mechanism:	by value

A flag indicating if the cache unwind flag, LIBICB$V_UO_FLAG_CACHE_ UNWIND, should be set in the invocation context block. A value of zero clears the flag; a value of one sets the flag. This is an optional argument. The default is zero.

Description

LIB$I64_INIT_INVO_CONTEXT initializes an invocation context block that the user has already allocated (on the stack, or from heap, or other storage). Use this routine as an alternative to LIB $I64_CREATE_INVO_CONTEXT, which both allocates and initializes an invocation context block.

Condition Values Returned

0	Indicates a version number mismatch.
1	Indicates success.

LIB$I64_IS_AST_DISPATCH_FRAME

LIB$I64_IS_AST_DISPATCH_FRAME — The Determine AST Exception Frame Dispatch routine determines whether a given PC value represents an AST dispatch frame.

Format

LIB$I64_IS_AST_DISPATCH_FRAME pc_value

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

pc_value

OpenVMS usage:	PC value
type:	quadword
access:	read
mechanism:	by reference

Address of a quadword that contains the PC value.

The *pc_value* is used to find the operating system-specific data area in the unwind information for this routine.

Description

LIB$I64_IS_AST_DISPATCH_FRAME determines whether a given PC value represents an AST dispatch frame.

Condition Values Returned

0	The operating system-specific data area is present and the EXCEPTION_FRAME flag is clear. Returns 0 if the operating system-specific data area is not present.
1	The operating system-specific data area is present and the EXCEPTION_FRAME flag is set.

LIB$I64_IS_EXC_DISPATCH_FRAME

LIB$I64_IS_EXC_DISPATCH_FRAME — The Determine Exception Frame Dispatch routine determines whether a given PC value represents an exception dispatch frame.

Format

LIB$I64_IS_EXC_DISPATCH_FRAME pc_value

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

pc_value

OpenVMS usage:	PC value
type:	quadword
access:	read
mechanism:	by reference

Address of a quadword that contains the PC value.

The *pc_value* is used to find the operating system-specific data area in the unwind information for this routine.

Description

LIB$I64_IS_EXC_DISPATCH_FRAME determines whether a given PC value represents an exception dispatch frame.

Condition Values Returned

0	The operating system-specific data area is present and the EXCEPTION_FRAME flag is clear. Returns 0 if the operating system-specific data area is not present.
1	The operating system-specific data area is present and the EXCEPTION_FRAME flag is set.

LIB$I64_PREV_INVO_END

LIB$I64_PREV_INVO_END — The End Call Tracing Operations routine should be called at the conclusion of call tracing operations to free the memory used to process unwind descriptors.

Format

LIB$I64_PREV_INVO_END (invo_context)

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify only
mechanism:	by reference

Address of a valid invocation context block previously used for call tracing.

Description

LIB$I64_PREV_INVO_END should be called at the conclusion of call tracing operations to free the memory used to process unwind descriptors. The call tracing routines are LIB $I64_GET_INVO_CONTEXT, LIB$I64_GET_PREV_INVO_CONTEXT, and LIB $I64_GET_CURR_INVO_CONTEXT.

To provide efficient call tracing, some unwind information is tracked in heap storage from one call to the next. This heap storage should be freed before you release or reuse the invocation context block.

Calling this routine is necessary if the LIBICB$V_UO_FLAG_CACHE_UNWIND flag is set in the LIBICB$Q_UO_FLAGS field of the invocation context block. If this flag is not set, unwind information is released and re-created at each call, and calling this routine is not required.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_PUT_INVO_REGISTERS

LIB$I64_PUT_INVO_REGISTERS — The Put Invocation Registers routine updates the fields of a given procedure invocation context. Note that if user override routines are specified in the invocation context block, then they are used to find and modify the invocation context.

Format

```
LIB$I64_PUT_INVO_REGISTERS invo_handle, invo_context, [,gr_mask] [,fr_mask] [,br_m
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_handle

OpenVMS usage:	invo_handle
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Handle for the invocation to be updated.

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	read only
mechanism:	by reference

Address of a valid invocation context block that contains new register contents.

Each register that is set in the ***xx*_mask** argument (along with its NaT bit, if any) is updated using the value found in the corresponding IREG[n], FREG[n], BRANCH[n], or PRED[n] field. GP, TP, and AI can also be updated in this way.

No other fields of the invocation context block are used.

gr_mask

OpenVMS usage:	mask_octaword
type:	128-bit vector
access:	read only
mechanism:	by reference

Address of a 128-bit bit vector, where each bit corresponds to a register field in the invo_context argument. Bits 0 through 127 correspond to IREG[0] through IREG[127].

Bit 0 corresponds to R0, which cannot be written, and is ignored.

Bit 1 corresponds to the global data pointer (GP).

Bit 13 corresponds to the thread pointer (TP).

Bit 25 corresponds to the argument information register (AI).

If bit 12, which corresponds to SP, is set, then no changes are made.

fr_mask

OpenVMS usage:	mask_octaword

type:	128-bit vector
access:	read only
mechanism:	by reference

Address of a 128-bit bit vector, where each bit corresponds to a register field in the passed **invo_context**.

To update floating-point registers F32-F127, provide a pointer to an array of 96 octawords in LIBICB $PH_F32_F127.

Bits 0 through 127 correspond to FREG[0] through FREG[127].

Bit 0 corresponds to F0, which cannot be written, and is ignored.

Bit 1 corresponds to F1, which cannot be written, and is ignored.

br_mask

OpenVMS usage:	mask_byte
type:	8-bit vector
access:	read only
mechanism:	by reference

Address of a 8-bit bit vector, where each bit corresponds to a register field in the passed invo_context. Bits 0 through 7 correspond to BRANCH[0] through BRANCH[7].

pr_mask

OpenVMS usage:	mask_quadword
type:	64-bit vector
access:	read only
mechanism:	by reference

Address of a 64-bit bit vector, where each bit corresponds to a register field in the passed *invo_context*. Bits 0 through 63 correspond to PRED[0] through PRED[63].

misc_mask

OpenVMS usage:	mask_quadword
type:	64-bit vector
access:	read only
mechanism:	by reference

Address of a 64-bit bit vector, where each bit corresponds to a register field in the passed *invo_context* as follows:

Bit 0=PC.

Bit 1=FPSR.

Bits 2–63 are reserved.

Description

LIB$I64_PUT_INVO_REGISTERS updates the fields of a given procedure invocation context.

Caution

Great care must be taken to ensure that a valid stack frame and execution environment result; otherwise, execution may become unpredictable.

Condition Values Returned

0	In the following circumstances: • When the invocation handle does not represent an active invocation context. • When bit 12 of the *gr_mask* argument is set • When a scratch register has not been saved, or a register's save location or status cannot be determined (valid bit clear).
1	Indicates success.

LIB$I64_SET_FR

LIB$I64_SET_FR — The Set Floating-Point Register routine writes the invocation context block floating-point registry entry corresponding to a floating-point register value.

Format

LIB$I64_SET_FR invo_context, index, fr_copy

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify
mechanism:	by reference

Address of a valid invocation context block.

index

OpenVMS usage:	index
type:	longword
access:	read
mechanism:	by value

Index into the FREG array of the invocation context block.

fr_copy

OpenVMS usage:	floating-point value
type:	octaword
access:	write
mechanism:	by value

Address of an octaword that contains the floating-point value to be written to the invocation context block.

Description

Given an invocation context block, a floating-point register index, and a floating-point register value in *fr_copy*, writes the corresponding invocation context block FREG entry, and calls LIB $I64_PUT_INVO_REGISTERS to write the actual context. The invocation context block remains unchanged if the routine fails.

LIB$I64_SET_FR fails if LIB$I64_PUT_INVO_REGISTERS fails.

Condition Values Returned

0	Indicates failure.
1	Indicates success.

LIB$I64_SET_GR

LIB$I64_SET_GR — The Copy Invocation Block General Register routine writes the invocation context block general register.

Format

LIB$I64_SET_GR invo_context, index, fr_copy

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify
mechanism:	by reference

Address of a valid invocation context block.

index

OpenVMS usage:	index
type:	longword
access:	read
mechanism:	by value

Index into the IREG array of the invocation context block.

gr_copy

OpenVMS usage:	integer value
type:	quadword
access:	write
mechanism:	by value

Address of a quadword that contains the value to be written to the invocation context block.

Description

Given an invocation context block, a general register *index* such that 1 <= *index* < 128, and a quadword value *gr_copy*, LIB$I64_SET_GR writes the corresponding invocation context block general register, clears the corresponding NaT bit and uses LIB$I64_PUT_INVO_REGISTERS to write to the actual context. The invocation context block remains unchanged if the routine fails.

LIB$I64_SET_GR fails if LIB$I64_PUT_INVO_REGISTERS fails.

Condition Values Returned

0	Indicates failure
1	Indicates success

LIB$I64_SET_PC

LIB$I64_SET_PC — The Write Context Block and Quadword PC Value routine writes invocation context block PC.

Format

LIB$I64_SET_PC invo_context, pc_copy

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	modify
mechanism:	by reference

Address of a valid invocation context block.

pc_copy

OpenVMS usage:	PC value
type:	quadword
access:	read
mechanism:	by reference

Address of a quadword that contains the PC value to be written to the invocation context block.

Description

Given an invocation context block and a quadword PC value in *pc_copy*, LIB$I64_SET_PC writes the *pc_copy* value to the invocation context block PC and then uses LIB$I64_PUT_INVO_REGISTERS to write to the actual context. The invocation context block remains unchanged if the routine fails.

LIB$I64_SET_PC fails if LIB$I64_PUT_INVO_REGISTERS fails.

Condition Values Returned

0	Indicates failure.

1	Indicates success.

LIB$ICHAR

LIB$ICHAR — The Convert First Character of String to Integer routine converts the first character of a source string to an 8-bit ASCII integer extended to a longword.

Format

LIB$ICHAR source-string

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

First character of the source string. This character is returned by LIB$ICHAR as an 8-bit ASCII value extended to a longword. If the source string has zero length, LIB$ICHAR returns a zero.

Argument

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string whose first character is converted to an integer by LIB$ICHAR. The *source-string* argument is the address of a descriptor pointing to this source string.

Description

Although Fortran users can call LIB$ICHAR, it is more efficient to use the Fortran intrinsic function ICHAR, which generates equivalent code in line.

Condition Values Returned

None.

Example

```
PROGRAM ICHAR(INPUT, OUTPUT);

{+}
```

```
{ This program demonstrates how to call LIB$ICHAR
{ to convert the first character of string to an
{ integer value.
{-}

FUNCTION LIB$ICHAR(SRCSTR : VARYING [A] OF CHAR) : INTEGER;
         EXTERN;
{+}
{ Declare the variables to be used.
{-}

VAR
  CHARSTR         : VARYING [256] OF CHAR;
  RET_STATUS      : INTEGER;

{+}
{ Begin the main program. Read the character string,
{ call LIBN$ICHAR, and print the result.
{-}

BEGIN
  WRITELN('Enter string: ');
  READLN(CHARSTR);
  RET_STATUS := LIB$ICHAR(CHARSTR);
  WRITELN(RET_STATUS);
END.
```

The output generated by this Pascal program is as follows:

```
$ RUN ICHAR
Enter string:
Pencil sharpener
        80
$ RUN ICHAR
Enter string:
pencil sharpener
       112
```

Notice that this routine changes any uppercase characters to lowercase.

LIB$INDEX

LIB$INDEX — The Index to Relative Position of Substring routine returns an index, which is the relative position of the first occurrence of a substring in the source string.

Format

LIB$INDEX source-string ,sub-string

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only

mechanism:	by value

The relative position of the first character of the substring if found, or zero if not found.

On Alpha and I64 systems, if the relative position of the substring can exceed 2^{32} - 1, assign the return value to a quadword to ensure that you retrieve the correct relative position.

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be searched by LIB$INDEX. The *source-string* argument is the address of a descriptor pointing to this source string.

sub-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Substring to be found. The *sub-string* argument is the address of a descriptor pointing to this substring.

Description

The relative character positions returned by LIB$INDEX are numbered 1, 2, ..., *n*. Zero means that the substring was not found.

If the substring has a zero length, LIB$INDEX returns the value 1, indicating success, no matter how long the source string is. If the source string has a zero length and the substring has a nonzero length, zero is returned, indicating that the substring was not found.

Fortran users may use the built-in INDEX function rather than calling LIB$INDEX directly.

Condition Values Returned

None.

LIB$INIT_DATE_TIME_CONTEXT

LIB$INIT_DATE_TIME_CONTEXT — The Initialize the Context Area Used in Formatting Dates and Times for Input or Output routine allows the user to initialize the context area used by LIB

$FORMAT_DATE_TIME or LIB$CONVERT_DATE_STRING with specific strings, instead of through logical name translation.

Format

LIB$INIT_DATE_TIME_CONTEXT user-context ,component ,init-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

user-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

User context that retains the translation context over multiple calls to this routine. The *user-context* argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

component

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The component of the context that is being initialized. The *component* argument is the address of a signed longword that indicates this component. Only one component can be initialized per call to LIB $INIT_DATE_TIME; these component codes are shown in the following list.

- LIB$K_MONTH_NAME
- LIB$K_MONTH_NAME_ABB
- LIB$K_FORMAT_MNEMONICS
- LIB$K_WEEKDAY_NAME
- LIB$K_WEEKDAY_NAME_ABB

- LIB$K_RELATIVE_DAY_NAME
- LIB$K_MERIDIEM_INDICATOR
- LIB$K_OUTPUT_FORMAT
- LIB$K_INPUT_FORMAT
- LIB$K_LANGUAGE

init-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

The characters that are to be used in formatting dates and times for input or output. The *init-string* argument is the address of a descriptor pointing to this string.

Description

The LIB$INIT_DATE_TIME_CONTEXT routine allows the user to initialize the context area used by either LIB$CONVERT_DATE_STRING or LIB$FORMAT_ DATE_TIME with specific strings instead of through logical name translations. This routine is therefore useful when the application is formatting either input or output strings that are used only by other computer applications and are not intended for presentation to users.

When the text will be parsed by another program, you must specify all of the context (including spellings). For applications where the context specifies a user's preferred format style, spellings can be looked up from the logical name tables.

Therefore, when the text will be parsed by another program, the minimum effort required to initialize the necessary format strings would be a call to LIB$INIT_ DATE_TIME_CONTEXT specifying the input or output format strings to be used. If the specified format requires spelled items, such as month names or day names, then additional calls to LIB$INIT_DATE_TIME_CONTEXT are required to provide the spellings of these items. Applications where the context specifies a user's preferred format style can specify only the language name, and allow the strings to be looked up from logical name tables.

The format of the strings used by this routine is as follows:

```
[delim][string-1][delim] [string-2][delim] . . . [delim][string-n][delim]
```

In this format, [**delim**] is any character that is not in any of the strings, and [string-x] is the spelling of that instance of the component.

For example, a string passed to this routine to specify the English spellings of the month names might be as follows:

|JAN|FEB|MAR|APR|MAY|JUN

|JUL|AUG|SEP|OCT|NOV|DEC|

Note that the string starts and ends with a delimiter. Thus, there is one more delimiter than there are string elements. Each type of component has a natural number of elements associated. The string must contain exactly that number of elements.

Month names (full or abbreviated)	12
Format mnemonics	9
Day names (full or abbreviated)	7
Relative day names	3
Meridiem indicators	2
Output format strings	2
Input format string	1
Language	1

In order to specify the input format mnemonics using LIB$INIT_DATE_ TIME_CONTEXT, the user must initialize the component LIB$K_FORMAT_ MNEMONICS with the appropriate values. The following table lists in order the 9 fields that must be initialized, along with their default (English) values.

Order	**Format Field**	**Legible Mnemonic**
1	Year	YYYY
2	Numeric month	MM
3	Numeric day	DD
4	Hours (12- or 24-hour)	HH
5	Minutes	MM
6	Seconds	SS
7	Fractional seconds	CC
8	Meridiem indicator	AM/PM
9	Alphabetic month	MONTH

For example, the following would be a valid definition of LIB$K_FORMAT_ MNEMONICS using Austrian as the natural language:

```
|JJJJ|MM|TT|SS|MM|SS|HH| |MONAT|
```

To specify an output format using LIB$INIT_DATE_TIME_CONTEXT, the user must initialize the variable LIB$K_OUTPUT_FORMAT. There are two elements associated with this output format string. One describes the date format fields, the other the time format fields. The order in which they appear in the string determines the order in which they are output. A single space is inserted into the output stream between the two elements, if the call to LIB$FORMAT_DATE_ TIME specifies that both be output. In the following example, the two elements associated with the output format string are delimited by vertical bars.

```
| !DB-!MAAU-!Y4 | !H04:!M0:!S0.!C2 |
```

This output format string represents the format used by the $ASCTIM system service for outputting times. Note that the middle delimiter is replaced by a space in the resultant output.

See the *VSI OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ILLCOMPONENT	Illegal value for the component.
LIB$_ILLINISTR	Illegally formed *init-string*.
LIB$_NUMELEMENTS	Incorrect number of elements for the component.
LIB$_UNRFORCOD	Unrecognized format code.

Any condition value returned by LIB$GET_VM or LIB$ANALYZE_SDESC.

LIB$INIT_TIMER

LIB$INIT_TIMER — The Initialize Times and Counts routine stores the current values of specified times and counts for use by LIB$SHOW_TIMER or LIB$STAT_TIMER.

Format

LIB$INIT_TIMER [context]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context variable that retains the values of the times and counts. The context argument contains the address of an unsigned longword that is this context. When you call LIB$INIT_TIMER, you must use the optional *context* argument only if you want to maintain several sets of statistics simultaneously.

- If *context* is omitted, the control block is allocated in static storage. This method is not AST reentrant.
- If *context* is zero, a control block is allocated in dynamic heap storage. The times and counts will be stored in that block and the address of the block returned in *context*. This method is fully reentrant and modular.

- If *context* is nonzero, it is considered to be the address of a control block previously allocated by a call to LIB$INIT_TIMER. If so, the control block is reused, and fresh times and counts are stored in it.

When LIB$INIT_TIMER returns, the block of storage referred to by *context* will contain the times and counts.

Description

LIB$INIT_TIMER stores the current values of specified times and counts in one of three places, depending on the value of the optional *context* argument.

You need to call LIB$FREE_TIMER only if you have specified *context* in LIB$INIT_TIMER and you want to deallocate all heap storage resources.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	The *context* argument is zero, and there is insufficient virtual memory to allocate a storage block.
LIB$_INVARG	Invalid argument; *context* is nonzero and the block to which it refers was not initialized on a previous call to LIB$INIT_TIMER.

LIB$INSERT_TREE

LIB$INSERT_TREE — The Insert Entry in a Balanced Binary Tree routine inserts a node in a balanced binary tree. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

```
LIB$INSERT_TREE treehead ,symbol ,flags ,user-compare-routine ,user-allocation-pro
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address

access:	modify
mechanism:	by reference

Tree head for the binary tree. The *treehead* argument is the address of a longword that is this tree head. The initial value of *treehead* is 0.

symbol

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	unspecified
mechanism:	unspecified

Key to be inserted.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Control flags. The *flags* argument is the address of the control flags. Currently only bit 0 is used.

Bit	Action if Set	Action if Clear
0	Duplicate entries are inserted.	The address of the existing duplicate entry is returned to the *new-node* argument.

user-compare-routine

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied compare routine that LIB$INSERT_TREE calls to compare a symbol with a node. The *user-compare-routine* argument is required; LIB$INSERT_TREE calls the compare routine for every node except the first node in the tree. The value returned by the compare routine indicates the relationship between the symbol key and the node.

For more information on the compare routine, see the section called “Call Format for a Compare Routine” in the Description section.

user-allocation-procedure

OpenVMS usage:	procedure

type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied allocate routine that LIB$INSERT_TREE calls to allocate virtual memory for a node. The *user-allocation-procedure* argument is required; LIB$INSERT_TREE always calls the allocate routine.

For more information on the allocate routine, see the section called “Call Format for an Allocate Routine” in the Description section.

new-node

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Location where the new key is inserted. The *new-node* argument is the address of an unsigned longword that is the address of the new node.

user-data

OpenVMS usage:	user_arg
type:	unspecified
access:	unspecified
mechanism:	by value

User data that LIB$INSERT_TREE passes to the compare and allocate routines. The *user-data* argument is optional.

Description

This Description section contains three parts:

- the section called “Guidelines for Using LIB$INSERT_TREE”
- the section called “Call Format for a Compare Routine”
- the section called “Call Format for an Allocate Routine”

Guidelines for Using LIB$INSERT_TREE

LIB$INSERT_TREE inserts a node in a balanced binary tree. You supply two routines: compare and allocate. The compare routine compares the symbol key to the node, and the allocate routine allocates virtual memory for the node to be inserted. LIB$INSERT_TREE first calls the compare routine to find the location at which the new node is inserted. Then LIB$INSERT_TREE calls the allocate routine to allocate memory for the new node. Most programmers insert data in the new node by initializing it within the allocate routine as soon as memory has been allocated.

You may pass the data to be inserted into the tree using either the *symbol* argument alone or both the *symbol* and *user-data* arguments. The *symbol* argument is required. It may contain all of the data, just the name of the node, or the address of the data. If you decide to use *symbol* to pass just the name of the node, you must use the *user-data* argument to pass the rest of the data to be inserted in the new node.

Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine   symbol ,comparison-node [,user-data]
```

LIB$INSERT_TREE passes both the *symbol* and *comparison-node* arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB$INSERT_TREE. The *user-data* argument is passed in the same way, but its use is optional.

The *user-compare-routine* argument in the call to LIB$INSERT_TREE specifies the compare routine. This argument is required. LIB$INSERT_TREE calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The following table interprets the possible values returned by the compare routine:

Return Value	**Meaning**
Negative	The *symbol* argument is less than the current node.
Zero	The *symbol* argument is equal to the current node.
Positive	The *symbol* argument is greater than the current node.

This is an example of a user-supplied compare routine, written in C.

```
struct Full_node
{     void*  left_link;
      void*  right_link;
      short  reserved;
      char   Text[80];
};

static long Compare_node(char* Key_string,
                         struct Full_node* Node,
                         void* Dummy)

/*
**  This function compares the string described by Key_string with
**  the string contained in the data node Node, and returns 0
**  if the strings are equal, -1 if Key_string is < Node, and
**  1 if Key_string > Node.
*/
{     int result;

      result = strcmp(Key_string, Node->Text);
```

```
        if (result < 0)
            return -1;
        else if (result == 0)
            return 0;
        else
            return 1;
}
```

Call Format for an Allocate Routine

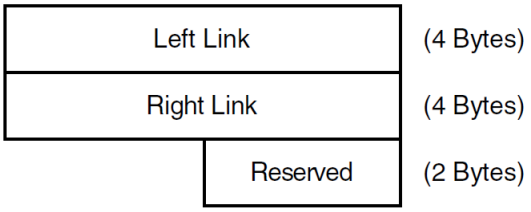
LIB$INSERT_TREE calls the allocate routine to allocate virtual memory for a node. The allocate routine then stores the value of *user-data* in the field of the allocated node.

The format of the call is as follows:

user-allocation-procedure symbol ,new-node [,user-data]

LIB$INSERT_TREE passes the *symbol*, *new-node*, and *user-data* arguments to your allocate routine, using the same passing mechanisms that were used to pass them to LIB$INSERT_TREE. Use of user data is optional.

A node header appears at the beginning of each node. The following figure shows the structure of a node header.

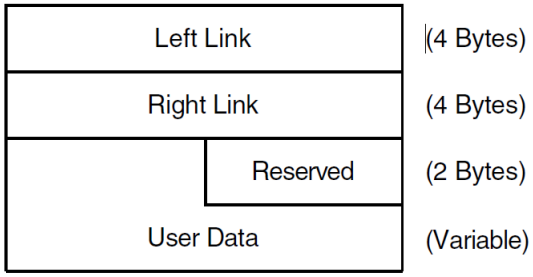


ZK-1926-GE

Therefore, any node you declare that LIB$INSERT_TREE manipulates must contain 10 bytes of reserved data at the beginning for the node header.

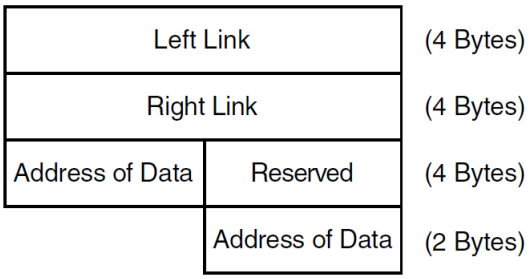
How a node is structured depends on how you allocate your user data. You can allocate data in one of two ways:

1. Your data immediately follows the node header. In this case, your allocation routine must allocate a block equal in size to the sum of your data plus 10 bytes for the node header, as shown in the following figure.



ZK-1927-GE

2. The node contains the 10 bytes of header information and a longword pointer to the user data, as shown in the following figure.



ZK–1928–GE

The *user-allocation-procedure* argument in the call to LIB$INSERT_TREE specifies the allocate routine. This argument is required. LIB$INSERT_TREE always calls the allocate routine.

Following is an example of a user-supplied allocate routine written in C.

```
struct Full_node
{
     void*  left_link;
     void*  right_link;
     short  reserved;
     char   Text[80];
};

static long Alloc_node(char* Key_string,
        struct Full_node** Ret_addr, void* Dummy)

{
     /*
     **  Allocate virtual memory for a new node.  Key_string
     **  is the string to be entered into the newly
     **  allocated node. RET_ADDR will contain the address
     **  of the allocated memory.
     */
     long Status_code;
     long Alloc_size = sizeof(struct Full_node);

     extern long lib$get_vm();

     /*
     ** Allocate node: size of header, plus the length of our data.
     */
     Status_code = lib$get_vm (&Alloc_size, Ret_addr);
     if (!(Status_code & 1))
         lib$stop(Status_code);

     /*
     ** Store the data in the newly allocated virtual memory.
     */     strcpy((*Ret_addr)->Text, Key_string);     return
 (Status_code); }
```

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory. The user-supplied allocation routine returned an error.

LIB$_KEYALRINS	Routine successfully completed, but a key was found in the tree. No new key was inserted.

Any other failure status reported by the user allocation procedure.

Example

The following C program shows the use of LIB$INSERT_TREE, LIB$LOOKUP_TREE, and LIB $TRAVERSE_TREE.

```
/*
** This program asks the user to enter a series of strings,
** one per line. The user can then query the program to find
** strings that were previously entered. At the end, the entire
** tree is displayed, along with sequence numbers that
** indicate the order in which each element was entered.
**
** This program serves as an example of the use of LIB$INSERT_TREE,
** LIB$LOOKUP_TREE and LIB$TRAVERSE_TREE.
*/

#include <stdio.h>
#include <string.h>
#include <libdef.h>

char Text_line[80];

struct Tree_element     /* Define the structure of our     */
{                       /* record. This record could       */
    long     Seq_num;   /* contain many useful data items. */
    char     Text[80];
};

struct Full_node
{
void*   left_link;
void*   right_link;
short   reserved;
struct Tree_element my_node;
};

struct Tree_element Rec; /* Declare an instance of the record */

extern long lib$insert_tree();     /* Function to insert node */
extern long lib$traverse_tree();   /* Function to walk tree */
extern long lib$lookup_tree();     /* Function to find a node */
extern void lib$stop();            /* Routine to signal fatal error */
static long Compare_node_2();      /* Compare entry (2 arg) */
static long Compare_node_3();      /* Compare entry (3 arg) */
static long Alloc_node();          /* Allocation entry */
static long Print_node();          /* Print entry for walk */
static void Display_Node();

main ()
{
    struct Full_node* Tree_head;   /* Head for the tree */
    struct Full_node* New_node;    /* New node after insert */
```

```
    long Status_code;              /* Return status code */
    long Counter;                  /* Sequence number */
    long flags = 1;

    /*
    ** Initialize the tree to null
    */
    Tree_head = NULL;

    printf("Enter one word per line, ^Z to begin searching the tree\n");

    /*
    ** Loop, reading lines of text until the end of the file.
    */
    Counter = 0;
    printf("> ");
    while (gets(Text_line))
        {
        Counter++;
        Rec.Seq_num = Counter;
        strcpy(Rec.Text, Text_line);
        Status_code = lib$insert_tree ( /* Insert the entry into the tree
 */
                                &Tree_head, &Rec, &flags,
                                Compare_node_3, Alloc_node, &New_node);
        if (!(Status_code & 1))
        lib$stop(Status_code);
        printf("> ");
        }
    /*
    ** End of file encountered. Begin searching the tree.
    */
    printf("\nYou will now be prompted for words to find. ");
    printf("Enter one per line.\n");
    Rec.Seq_num = -1;
    printf("Word to find? ");
    while (gets(Text_line))
        {
        strcpy(Rec.Text, Text_line);
        Status_code = lib$lookup_tree (&Tree_head, &Rec,
            Compare_node_2, &New_node);
        if (Status_code == LIB$_KEYNOTFOU)
            printf("The word you entered does not appear in the tree.\n");
        else
            Display_Node(New_node);
            printf("Word to find? ");
        }
    /*
    ** The user has finished searching the tree for specific items. It
    ** is now time to traverse the entire tree.
    */
    printf("\n");
    printf("The following is a dump of the tree. Notice that the words\n");
    printf("are in alphabetical order\n");
    Status_code = lib$traverse_tree(&Tree_head, Print_node, 0);
    return(Status_code);
}
static long Print_node(struct Full_node* Node, void* Dummy)
```

```
{

    /*
    ** Print the string contained in the current node.
    */
    printf("%d\t%s\n", Node->my_node.Seq_num, Node->my_node.Text);
    return(LIB$_NORMAL);
}

static long Alloc_node(struct Tree_element* Rec,
        struct Full_node** Ret_addr, void* Dummy)
{

    /*
    ** Allocate virtual memory for a new node. Rec is the
    ** data record to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    long Alloc_size = sizeof(struct Full_node);

    extern long lib$get_vm();

    /*
    ** Allocate node: size of header, plus the length of our data.
    */
    Status_code = lib$get_vm (&Alloc_size, Ret_addr);
    if (!(Status_code & 1))
        lib$stop(Status_code);

    /*
    ** Store the data in the newly allocated virtual memory.
    */
    (*Ret_addr)->my_node.Seq_num = Rec->Seq_num;
    strcpy((*Ret_addr)->my_node.Text, Rec->Text);
    return (Status_code);
}
static long Compare_node_3(struct Tree_element* Rec, struct Full_node*
 Node,
        void* Dummy)

{
    /*
    ** Call the 2 argument version of the compare routine
    */
    return(Compare_node_2 ( Rec, Node ));
}

static long Compare_node_2(struct Tree_element* Rec, struct Full_node*
 Node)
{
    /*
    ** This function compares the string described by Key_string with
    ** the string contained in the data node Node, and returns 0
    ** if the strings are equal, -1 if Key_string is < Node, and
    ** 1 if Key_string > Node.
    */
```

```
    int result;
    /*
    ** Return the result of the comparison.
    */
    result = strcmp(Rec->Text, Node->my_node.Text);
    if (result < 0)
        return -1;
    else if (result == 0)
             return 0;
         else
             return 1;

}
static void Display_Node(struct Full_node* Node)
{
    /*
    ** This routine prints the data into the node of the tree
    ** once LIB$LOOKUP_TREE has been called to find the node.
    */
    printf("The sequence number for \"%s\" is %d\n",
           Node->my_node.Text, Node->my_node.Seq_num);
}
```

The output generated by this program is as follows:

```
$ run tree
Enter one word per line, ^Z to begin searching the tree
> apple
> orange
> peach
> pear
> grapefruit
> lemon
> Ctrl/Z

You will now be prompted for words to find. Enter one per line.

Word to find?  lime
The word you entered does not appear in the tree

Word to find?  orange
The sequence number for "orange" is  2

Word to find?  Ctrl/Z

The following is a dump of the tree.  Notice that the words
are in alphabetical order
 1            apple
 5            grapefruit
 6            lemon
 2            orange
 3            peach
 4            pear
$
```

LIB$INSERT_TREE_64

LIB$INSERT_TREE_64 — The Insert Entry in a Balanced Binary Tree routine inserts a node in a balanced binary tree.

Format

```
LIB$INSERT_TREE_64 treehead ,symbol ,flags ,user-compare-routine ,user-allocation-
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address
access:	modify
mechanism:	by reference

Tree head for the binary tree. The *treehead* argument is the address of a quadword that is this tree head. The initial value of *treehead* is 0.

symbol

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	unspecified
mechanism:	unspecified

Key to be inserted.

flags

OpenVMS usage:	mask_quadword
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Control flags. The *flags* argument is the address of the control flags. Currently only bit 0 is used.

Bit	Description
0	If clear, the address of the existing duplicate entry is returned to the new-node argument. If set, duplicate entries are inserted.

user-compare-routine

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied compare routine that LIB$INSERT_TREE_64 calls to compare a symbol with a node. The *user-compare-routine* argument is required; LIB$INSERT_TREE_64 calls the compare routine for every node except the first node in the tree. The value returned by the compare routine indicates the relationship between the symbol key and the node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

user-allocation-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied allocate routine that LIB$INSERT_TREE_64 calls to allocate virtual memory for a node. The *user-allocation-procedure* argument is required; LIB$INSERT_TREE_64 always calls the allocate routine.

For more information on the allocate routine, see Call Format for an Allocate Routine in the Description section.

new-node

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Location where the new key is inserted. The *new-node* argument is the address of an unsigned quadword that is the address of the new node.

user-data

OpenVMS usage:	user_arg
type:	unspecified
access:	unspecified
mechanism:	by value

User data that LIB$INSERT_TREE_64 passes to the compare and allocate routines. The *user-data* argument is optional.

Description

This Description section contains three parts:

- Guidelines for Using LIB$INSERT_TREE_64
- Call Format for a Compare Routine
- Call Format for an Allocate Routine

Guidelines for Using LIB$INSERT_TREE_64

LIB$INSERT_TREE_64 inserts a node in a balanced binary tree. You supply two routines: compare and allocate. The compare routine compares the symbol key to the node, and the allocate routine allocates virtual memory for the node to be inserted. LIB$INSERT_TREE_64 first calls the compare routine to find the location at which the new node is inserted. Then LIB$INSERT_TREE_64 calls the allocate routine to allocate memory for the new node. Most programmers insert data in the new node by initializing it within the allocate routine as soon as memory has been allocated.

You may pass the data to be inserted into the tree using either the *symbol* argument alone or both the *symbol* and *user-data* arguments. The *symbol* argument is required. It may contain all of the data, just the name of the node, or the address of the data. If you decide to use *symbol* to pass just the name of the node, you must use the *user-data* argument to pass the rest of the data to be inserted in the new node.

Call Format for a Compare Routine

The call format of a compare routine is as follows:

user-compare-routine symbol ,comparison-node [,user-data]

LIB$INSERT_TREE_64 passes both the *symbol* and *comparison-node* arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB $INSERT_TREE_64. The *user-data* argument is passed in the same way, but its use is optional.

The *user-compare-routine* argument in the call to LIB$INSERT_TREE_64 specifies the compare routine. This argument is required. LIB$INSERT_TREE_ 64 calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. Following are the possible values returned by the compare routine:

Return Value	Meaning
Negative	The *symbol* argument is less than the current node.
Zero	The *symbol* argument is equal to the current node.
Positive	The *symbol* argument is greater than the current node.

This is an example of a user-supplied compare routine, written in C.

```
struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Compare_node(char* Key_string,
                         struct Full_node* Node,
                         void* Dummy)
```

```
/*
**  This function compares the string described by Key_string with
**  the string contained in the data node Node, and returns 0
**  if the strings are equal, -1 if Key_string is < Node, and
**  1 if Key_string > Node.
*/
{

    int result;

    result = strcmp(Key_string, Node->Text);
    if (result < 0)
        return -1;
    else if (result == 0)
        return 0;
    else
        return 1;
}
```

Call Format for an Allocate Routine

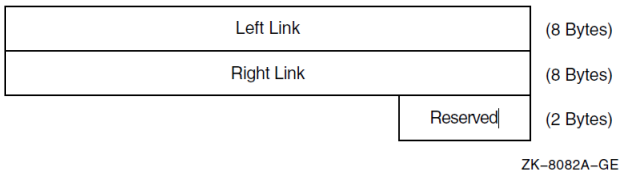
LIB$INSERT_TREE_64 calls the allocate routine to allocate virtual memory for a node. The allocate routine then stores the value of *user-data* in the field of the allocated node.

The format of the call is as follows:

```
user-allocation-procedure symbol ,new-node [,user-data]
```

LIB$INSERT_TREE_64 passes the *symbol*, *new-node*, and *user-data* arguments to your allocate routine, using the same passing mechanisms that were used to pass them to LIB $INSERT_TREE_64. Use of user data is optional.

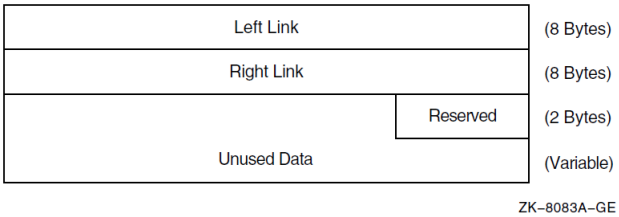
A node header appears at the beginning of each node. The following figure shows the structure of a node header.



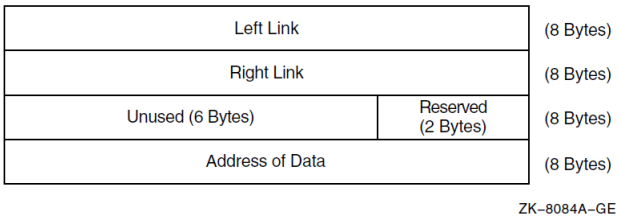
Therefore, any node you declare that LIB$INSERT_TREE_64 manipulates must contain 18 bytes of reserved data at the beginning for the node header.

How a node is structured depends on how you allocate your user data. You can allocate data in one of two ways:

1. Your data immediately follows the node header. In this case, your allocation routine must allocate a block equal in size to the sum of your data plus 18 bytes for the node header, as shown in the following figure.



2. The node contains the 18 bytes of header information and a quadword pointer to the user data as shown in the following figure.



The *user-allocation-procedure* argument in the call to LIB$INSERT_TREE_64 specifies the allocate routine. This argument is required. LIB$INSERT_TREE_64 always calls the allocate routine.

This is an example of a user-supplied allocate routine written in C.

```
struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Alloc_node(char* Key_string,
        struct Full_node** Ret_addr, void* Dummy)

{
    /*
    ** Allocate virtual memory for a new node. Key_string
    ** is the string to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    __int64 Alloc_size = sizeof(struct Full_node);
    extern long LIB$GET_VM_64();
    /*
    ** Allocate node: size of header, plus the length of our data.
    */
    Status_code = LIB$GET_VM_64 (&Alloc_size, Ret_addr);
    if (!(Status_code & 1))
        lib$stop(Status_code);
    /*
    ** Store the data in the newly allocated virtual memory.
    */
    strcpy((*Ret_addr)->Text, Key_string);
    return (Status_code);
}
```

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INSVIRMEM	Insufficient virtual memory. The user-supplied allocation procedure returned an error.

LIB$_KEYALRINS	Routine successfully completed, but a key was found in the tree. No new key was inserted.

Any other failure status reported by the user allocation procedure.

Example

The following C program shows the use of LIB$INSERT_TREE_64, LIB$LOOKUP_TREE_64, and LIB$TRAVERSE_TREE_64.

```
/*
** This program asks the user to enter a series of strings,
** one per line. The user can then query the program to find
** strings that were previously entered. At the end, the entire
** tree is displayed, along with sequence numbers that
** indicate the order in which each element was entered.
**
** This program serves as an example of the use of LIB$INSERT_TREE_64,
** LIB$LOOKUP_TREE_64 and LIB$TRAVERSE_TREE_64.
*/

#pragma pointer_size long

#include <stdio.h>
#include <string.h>
#include <libdef.h>

char Text_line[80];

struct Tree_element     /* Define the structure of our     */
{                       /* record. This record could       */
    long     Seq_num;   /* contain many useful data items. */
char Text[80];
};

struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    struct Tree_element my_node;
};

struct Tree_element Rec;     /* Declare an instance of the record */

extern long lib$insert_tree_64();     /* Function to insert node */
extern long lib$traverse_tree_64();   /* Function to walk tree */
extern long lib$lookup_tree_64();     /* Function to find a node */
extern void lib$stop();               /* Routine to signal fatal error */
static long Compare_node_2();         /* Compare entry (2 arg) */
static long Compare_node_3();         /* Compare entry (3 arg) */
static long Alloc_node();             /* Allocation entry */
static long Print_node();             /* Print entry for walk */
static void Display_Node();

main ()
{
```

```
    struct Full_node* Tree_head;      /* Head for the tree */
    struct Full_node* New_node;       /* New node after insert */
    long Status_code;                 /* Return status code */
    long Counter;                     /* Sequence number */
    long flags = 1;

    /*
** Initialize the tree to null
*/
Tree_head = NULL;

printf("Enter one word per line, ^Z to begin searching the tree\n");

/*
** Loop, reading lines of text until the end of the file.
*/
Counter = 0;
printf("> ");
while (gets(Text_line))
    {
    Counter++;
    Rec.Seq_num = Counter;
    strcpy(Rec.Text, Text_line);
    Status_code = lib$insert_tree_64 ( /* Insert the entry into the tree */
                          &Tree_head, &Rec, &flags,
                          Compare_node_3, Alloc_node, &New_node);
    if (!(Status_code & 1))
        lib$stop(Status_code);
    printf("> ");
    }
    /*
    ** End of file encountered. Begin searching the tree.
    */
    printf("\nYou will now be prompted for words to find. ");
    printf("Enter one per line.\n");

    Rec.Seq_num = -1;

    printf("Word to find? ");
    while (gets(Text_line))
        {
        strcpy(Rec.Text, Text_line);
        Status_code = lib$lookup_tree_64 (&Tree_head, &Rec,
            Compare_node_2, &New_node);
        if (Status_code == LIB$_KEYNOTFOU)
            printf("The word you entered does not appear in the tree.\n");
        else
            Display_Node(New_node);
            printf("Word to find? ");
        }
/*
** The user has finished searching the tree for specific items. It
** is now time to traverse the entire tree.
*/
printf("\n");
printf("The following is a dump of the tree. Notice that the words\n");
printf("are in alphabetical order\n");
    Status_code = lib$traverse_tree_64(&Tree_head, Print_node, 0);
```

```
    return(Status_code);
}

static long Print_node(struct Full_node* Node, void* Dummy)
{
    /*
    ** Print the string contained in the current node.
    */
    printf("%d\t%s\n", Node->my_node.Seq_num, Node->my_node.Text);
    return(LIB$_NORMAL);
}

static long Alloc_node(struct Tree_element* Rec,
         struct Full_node** Ret_addr, void* Dummy)
{
    /*
    ** Allocate virtual memory for a new node. Rec is the
    ** data record to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    __int64 Alloc_size = sizeof(struct Full_node);
    extern long lib$get_vm_64();
    /*
    ** Allocate node: size of header, plus the length of our data.
    */
    Status_code = lib$get_vm_64 (&Alloc_size, Ret_addr);
    if (!(Status_code & 1))
        lib$stop(Status_code);
    /*
    ** Store the data in the newly allocated virtual memory.
    */
    (*Ret_addr)->my_node.Seq_num = Rec->Seq_num;
    strcpy((*Ret_addr)->my_node.Text, Rec->Text);
    return (Status_code);
}

static long Compare_node_3(struct Tree_element* Rec, struct Full_node*
 Node,
        void* Dummy)

{
    /*
    ** Call the 2 argument version of the compare routine
    */
    return(Compare_node_2 ( Rec, Node ));
}

static long Compare_node_2(struct Tree_element* Rec, struct Full_node*
 Node)
{
    /*
    ** This function compares the string described by Key_string with
    ** the string contained in the data node Node, and returns 0
    ** if the strings are equal, -1 if Key_string is < Node, and
    ** 1 if Key_string > Node.
    */
```

```
    int result;
    /*
    ** Return the result of the comparison.
    */
    result = strcmp(Rec->Text, Node->my_node.Text);
    if (result < 0)
    return -1;
    else if (result == 0)
    return 0;
    else
    return 1;
}

static void Display_Node(struct Full_node* Node)
{
    /*
    ** This routine prints the data into the node of the tree
    ** once LIB$LOOKUP_TREE has been called to find the node.
    */
    printf("The sequence number for \"%s\" is %d\n",
    Node->my_node.Text, Node->my_node.Seq_num);
}
```

The output generated by this program is as follows:

```
    $ run tree
    Enter one word per line, ^Z to begin searching the tree
    > apple
    > orange
    > peach
    > pear
    > grapefruit
    > lemon
    > Ctrl/Z

    You will now be prompted for words to find. Enter one per line.

    Word to find?   lime
    The word you entered does not appear in the tree

    Word to find?   orange
    The sequence number for "orange" is 2

    Word to find?   Ctrl/Z

    The following is a dump of the tree. Notice that the words
    are in alphabetical order
     1          apple
     5          grapefruit
     6          lemon
     2          orange
     3          peach
     4          pear
    $
```

LIB$INSQHI

LIB$INSQHI — The Insert Entry at Head of Queue routine inserts a queue entry at the head of the specified self-relative longword interlocked queue. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. LIB$INSQHI makes the INSQHI instruction available as a callable routine.

Format

```
LIB$INSQHI entry ,header [,retry-count]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

entry

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Entry to be inserted by LIB$INSQHI. The *entry* argument contains the address of this signed quadword-aligned array that must be at least 8 bytes long. Bytes following the first 8 bytes can be used for any purpose by the calling program.

For Alpha and I64 systems, the *entry* argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

header

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue into which *entry* is to be inserted. The *header* argument contains the address of this signed aligned quadword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

For Alpha systems, the *header* argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The retry-count argument is the address of an unsigned longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue into which LIB$INSQHI inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB$INSQHI, LIB$INSQTI, LIB$REMQHI, and LIB$REMQTI routines to manage your self-relative longword queue on a VAX or an Alpha or I64 system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run- Time Library routine LIB$GET_VM on a VAX, Alpha, or I64 system to allocate quadword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains more than one entry.

SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains one entry.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by *retry-count*. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

Examples

1. ```
   INTEGER*4 FUNCTION INSERT_Q (QENTRY)
   COMMON/QUEUES/QHEADER
   INTEGER*4 QENTRY(10), QHEADER(2)
   INSERT_Q = LIB$INSQHI (QENTRY, QHEADER)
   RETURN
   END
   ```

   This is a Fortran application using processor-shared memory.

2. ```
         COM (QUEUES) QENTRY%(9), QHEADER%(1)
         EXTERNAL INTEGER FUNCTION LIB$INSQHI
         IF LIB$INSQHI (QENTRY%() BY REF, QHEADER%() BY REF) AND 1%
              THEN GOTO 1000
                  .
                  .
                  .
   1000 REM INSERTED OK
   ```

   In BASIC and Fortran, queues can be quadword aligned in a named COMMON block by using a linker option file to specify PSECT alignment. For instance, to create a COMMON block called QUEUES, use the LINK command with the FILE/OPTIONS qualifier, where FILE.OPT is a linker option file containing the following line:

   ```
   PSECT = QUEUES, QUAD
   ```

LIB$INSQHIQ

LIB$INSQHIQ — The Insert Entry at Head of Queue routine inserts a queue entry at the head of the specified self-relative quadword interlocked queue. LIB$INSQHIQ makes the INSQHIQ instruction available as a callable routine.

Format

LIB$INSQHIQ entry ,header [,retry-count]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

entry

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Entry to be inserted by LIB$INSQHIQ. The *entry* argument contains the address of this signed octaword-aligned array that must be at least 16 bytes long. Bytes following the first 16 bytes can be used for any purpose by the calling program.

header

OpenVMS usage:	octaword_signed
type:	octaword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue into which entry is to be inserted. The *header* argument contains the address of this signed aligned octaword integer. The header argument must be initialized to zero before first use of the queue; zero means an empty queue.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of an unsigned longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue into which LIB$INSQHIQ inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or cross-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB$INSQHIQ, LIB$INSQTIQ, LIB$REMQHIQ, and LIB$REMQTIQ routines to manage your self-relative quadword queue on an Alpha or I64 system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB$GET_VM_64 to allocate octaword aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains more than one entry.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains one entry.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by *retry-count*. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

Example

The following Fortran application uses processor-shared memory:

```
INTEGER*4 FUNCTION INSERT_Q (QENTRY)
COMMON/QUEUES/QHEADER
INTEGER*8 QENTRY(10), QHEADER(2)
```

```
INSERT_Q = LIB$INSQHIQ (QENTRY, QHEADER)
RETURN
END
```

In Fortran, queues can be octaword aligned in a named COMMON block by using a linker option file to specify PSECT alignment. For instance, to create a COMMON block called QUEUES, use the LINK command with the FILE/OPTIONS qualifier, where FILE.OPT is a linker option file containing the following line:

```
    PSECT = QUEUES, OCTA
```

LIB$INSQTI

LIB$INSQTI — The Insert Entry at Tail of Queue routine inserts a queue entry at the tail of the specified self-relative longword interlocked queue. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. LIB$INSQTI makes the INSQTI instruction available as a callable routine.

Format

LIB$INSQTI entry ,header [,retry-count]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

entry

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Entry to be inserted at the tail of the queue by LIB$INSQTI. The *entry* argument contains the address of this signed quadword-aligned array that must be at least 8 bytes long. Bytes following the first 8 bytes can be used for any purpose by the calling program.

For Alpha and I64 systems, the entry argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

header

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)

access:	modify
mechanism:	by reference

Queue header specifying the queue into which the queue entry is to be inserted. The *header* argument contains the address of this signed aligned quadword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

For Alpha and I64 systems, the header argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword which contains the retry count value. The default value is 10.

Description

The queue into which LIB$INSQTI inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB$INSQHI, LIB$INSQTI, LIB$REMQHI, and LIB$REMQTI routines to manage your self-relative longword queue on a VAX, Alpha, or I64 system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run- Time Library routine LIB$GET_VM on a VAX, Alpha, or I64 system to allocate quadword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains more than one entry.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains one entry.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by *retry-count*. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$INSQTIQ

LIB$INSQTIQ — The Insert Entry at Tail of Queue routine inserts a queue entry at the tail of the specified self-relative quadword interlocked queue. LIB$INSQTIQ makes the INSQTIQ instruction available as a callable routine.

Format

LIB$INSQTIQ entry ,header [,retry-count]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

entry

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Entry to be inserted at the tail of the queue by LIB$INSQTIQ. The *entry* argument contains the address of this signed octaword-aligned array that must be at least 16 bytes long. Bytes following the first 16 bytes can be used for any purpose by the calling program.

header

OpenVMS usage:	octaword_signed
type:	octaword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue into which the queue entry is to be inserted. The *header* argument contains the address of this signed aligned octaword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword that contains the retry count value. The default value is 10.

Description

The queue into which LIB$INSQTIQ inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB$INSQHIQ, LIB$INSQTIQ, LIB$REMQHIQ, and LIB$REMQTIQ routines to manage your self-relative quadword queue on an Alpha or I64 system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment.

The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB$GET_VM_64 to allocate octaword aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains more than one entry.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains one entry.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by retry-count. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$INSV

LIB$INSV — The Insert a Variable Bit Field routine replaces the variable bit field specified by the base, position, and size arguments with bits 0 through (*size* – 1) of the source field. If the size of the bit field is zero, nothing is inserted. LIB$INSV makes the VAX INSV instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

```
LIB$INSV longword-integer-source ,position ,size ,base-address
```

Returns

None.

Arguments

longword-integer-source

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Source field to be inserted by LIB$INSV. The *longword-integer-source* argument is the address of a signed longword integer that contains this source field.

position

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Bit position relative to the base address where insertion of *longword-integer-source* is to begin. The *position* argument is the address of a longword integer that contains this relative bit position.

size

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Size of the bit field to be inserted by LIB$INSV. The *size* argument is the address of an unsigned byte that contains the size of this bit field. The maximum size is 32 bits.

base-address

OpenVMS usage:	address
type:	address
access:	read only
mechanism:	by value

Field into which LIB$INSV writes the source field. The *base-address* argument is an unsigned longword containing the base address of this aligned bit string.

Condition Values Returned

SS$_ROPRAND	A reserved operand fault is signaled if a size greater than 32 is specified.

Examples

1. ```
   INTEGER*4  COND_VALUE
   CALL LIB$INSV (4, 0, 3, COND_VALUE)
   ```

   This example shows how to set bits 0 through 2 of longword COND_VALUE to the value 4 in Fortran.

2. ```
   DECLARE INTEGER COND_VALUE
   CALL LIB$INSV (4%, 0%, 3%, COND_VALUE)
   ```

This example uses BASIC to set bits 0 through 2 of longword COND_VALUE to the value 4.

LIB$INT_OVER

LIB$INT_OVER — The Integer Overflow Detection routine enables or disables integer overflow detection for the calling routine activation. The previous integer overflow enable setting is returned. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. This routine is available on OpenVMS Alpha and I64 systems in translated form and is applicable to translated VAX images only.

Format

LIB$INT_OVER new-setting

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

Old integer overflow enable setting (the previous contents of SF$W_PSW[PSW$V_ IV] in the caller's frame).

Arguments

new-setting

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

New integer overflow enable setting. The *new-setting* argument is the address of an unsigned longword that contains the new integer overflow enable setting. Bit 0 set to 1 means enable, bit 0 set to 0 means disable.

Description

The caller's stack frame will be modified by this routine.

LIB$INT_OVER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting remains in effect for any routines which are subsequently entered through a JSB entry point.

Condition Values Returned

None.

Example

```
INTOVF: ROUTINE OPTIONS (MAIN);

DECLARE LIB$INT_OVER ENTRY (FIXED BINARY (7))     /* Address of byte for
                                                  /* enable/disable
                                                  /* setting            */
        RETURNS (FIXED BINARY (31));              /* Old setting        */

DECLARE DISABLE FIXED BINARY (7) INITIAL (0) STATIC READONLY;

DECLARE (A,B) FIXED BINARY (7);

ON FIXEDOVERFLOW PUT SKIP LIST ('Overflow');

A = 127;
B = A + 2;
PUT LIST ('In MAIN');

        BEGIN;
        DECLARE RESULT FIXED BINARY (31);
/*   Disable recognition of integer overflow in this block */
        RESULT = LIB$INT_OVER (DISABLE);

        B = A + 2;
        PUT SKIP LIST ('In BEGIN block');

        CALL Q;
                Q: routine;
                B = A + 2;
                PUT LIST ('In Q');
                END Q;
        END /* Begin */;
END INTOVF;
```

This PL/I routine shows how to use LIB$INT_OVER to enable or disable the detection of integer overflow. Note that in PL/I, integer overflow is always enabled unless explicitly overridden by a call to this routine. However, disabling integer overflow is only effective for the block which calls this routine; descendent blocks are unaffected. The output generated by this PL/I program is as follows:

```
    In MAIN
    In BEGIN block
    Overflow        In Q
```

LIB$LEN

LIB$LEN — The Length of String Returned as Longword Value routine returns the length of a string.

Format

LIB$LEN source-string

Returns

OpenVMS usage:	word_unsigned

type:	word (unsigned)
access:	write only
mechanism:	by value

Argument

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string whose length is returned by LIB$LEN. The *source-string* argument contains the address of a descriptor pointing to this source string.

Description

The BASIC and Fortran intrinsic function LEN generates equivalent in-line code at run time. Therefore, it is more efficient for BASIC and Fortran users to use the intrinsic function LEN than to call LIB$LEN.

If you need both the length of the string and the address of its first byte, you should use LIB $ANALYZE_SDESC or LIB$ANALYZE_SDESC_64.

Condition Values Returned

None.

LIB$LOCC

LIB$LOCC — The Locate a Character routine locates a character in a string by comparing successive bytes in the string with the character specified. The search continues until the character is found or the string has no more characters. LIB$LOCC makes the VAX LOCC instruction available as a callable routine.

Format

LIB$LOCC character-string ,source-string

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

The relative position from the start of *source-string* to the first equal character or zero if no match is found.

Arguments

character-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String whose initial character is used by LIB$LOCC in the search. The *character-string* argument contains the address of a descriptor pointing to this string. Only the first character of *character-string* is used, and its length is not checked.

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String to be searched by LIB$LOCC. The *source-string* argument is the address of a descriptor pointing to this character string.

Description

LIB$LOCC returns the position of the first equal character relative to the start of the source string as an index. An index is the relative position of the first occurrence of a substring in the source string. If no character matches or if the string has a length of zero, then a zero is returned, indicating that the character was not found.

Condition Values Returned

None.

Examples

1.
```
IDENTIFICATION DIVISION.
PROGRAM-ID.        LIBLOC.

ENVIRONMENT DIVISION.

DATA DIVISION.

WORKING-STORAGE SECTION.

01    SEARCH-STRING PIC X(26)
                    VALUE "ABCDEFGHIJKLMNOPQRSTUVWXYZ".
01    SEARCH-CHAR   PIC X.
01    IND-POS       PIC 9(9) USAGE IS COMP.
01 DISP-IND PIC 9(9).

ROUTINE DIVISION.
```

```
001-MAIN.
        MOVE SPACE TO SEARCH-CHAR.
        DISPLAY " ".
        DISPLAY "ENTER SEARCH CHARACTER: " WITH NO ADVANCING.
        ACCEPT SEARCH-CHAR.
        CALL "LIB$LOCC"
            USING BY DESCRIPTOR SEARCH-CHAR, SEARCH-STRING
            GIVING IND-POS.
        IF IND-POS = ZERO
            DISPLAY
                "CHAR ENTERED (" SEARCH-CHAR ") NOT A VALID SEARCH CHAR"
            STOP RUN.
        MOVE IND-POS TO DISP-IND.
        DISPLAY
            "SEARCH CHAR (" SEARCH-CHAR ") WAS FOUND IN POSITION "
            DISP-IND.
        GO TO 001-MAIN.
```

This COBOL program accepts a character as input and returns as output the character's position in a search string. The output generated by this COBOL program is as follows:

```
$ RUN LIBLOC
ENTER SEARCH CHARACTER:  X
SEARCH CHAR (X) WAS FOUND IN POSITION 000000024

ENTER SEARCH CHARACTER:  Y
SEARCH CHAR (Y) WAS FOUND IN POSITION 000000025

ENTER SEARCH CHARACTER:  B
SEARCH CHAR (B) WAS FOUND IN POSITION 000000002

ENTER SEARCH CHARACTER:  b
CHAR ENTERED (b) NOT A VALID SEARCH CHAR
$
```

Notice that uppercase and lowercase letters are not considered equal.

2.

```
10    !+
      ! This is an BASIC program demonstrating the
      ! use of LIB$LOCC.
      !-

      EXTERNAL INTEGER FUNCTION LIB$LOCC
      I% = 0
      CHARSTR$ = 'DAY'
      SRCSTR$ = 'ONE DAY AT A TIME'
      I% = LIB$LOCC(CHARSTR$, SRCSTR$)
      PRINT I%
90    END
```

This BASIC example also shows the use of LIB$LOCC. The output generated by this BASIC program is “5”.

LIB$LOCK_IMAGE

LIB$LOCK_IMAGE — Locks the specified image in the process’s working set.

Format

LIB$LOCK_IMAGE address

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

address

OpenVMS usage:	address
type:	quadword
access:	read only
mechanism:	by value

Address of a byte within the image to be locked in the working set. If the address argument is 0, the current image (which contains the call to LIB$LOCK_IMAGE) is locked in the working set.

Description

LIB$LOCK_IMAGE locks the specified image in the process's working set.

This routine is typically used by a privileged user before the program, executing in kernel mode, raises IPL above IPL 2. Above IPL 2, paging is not allowed by the system. The program must access only pages valid in the process's working set.

Condition Values Returned

SS$_WASSET	The specified image is locked in the working set and had previously been locked in the working set.
SS$_WASCLR	The specified image is locked in the working set and had previously not been locked in the working set.

Other status codes returned by sys$lkwset_64.

LIB$LOOKUP_KEY

LIB$LOOKUP_KEY — The Look Up Keyword in Table routine scans a table of keywords to find one that matches the keyword or keyword abbreviation specified by *search-string*.

Format

LIB$LOOKUP_KEY search-string ,key-table-array [,key-value] [,keyword-string]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

search-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String for which LIB$LOOKUP_KEY will search in the keyword table. The search-string argument is the address of a descriptor pointing to this string.

key-table-array

OpenVMS usage:	unspecified
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Keyword table. The *key-table-array* argument contains the address of an array that is this keyword table.

key-value

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Associated value of the keyword found by LIB$LOOKUP_KEY. The *key-value* argument contains the address of an unsigned longword into which LIB$LOOKUP_KEY writes the associated value of the matched keyword.

keyword-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Full keyword string matched. The *keyword-string* argument contains the address of a character-string descriptor. LIB$LOOKUP_KEY writes the complete text of the matched keyword into the character string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of characters copied into the character-string pointed to by *keyword-string*, not counting padding in the case of a fixed-length string. The *resultant-length* argument is the address of an unsigned word integer that contains the number of characters in the matched keyword that were copied into the character-string.

Description

LIB$LOOKUP_KEY is intended to help programmers to write utilities that have command qualifiers with values.

LIB$LOOKUP_KEY locates a matching keyword or keyword abbreviation by comparing the first n characters of each keyword in the keyword table with the supplied string, where n is the length of the supplied string.

When a keyword match is found, the following information is optionally returned to the caller:

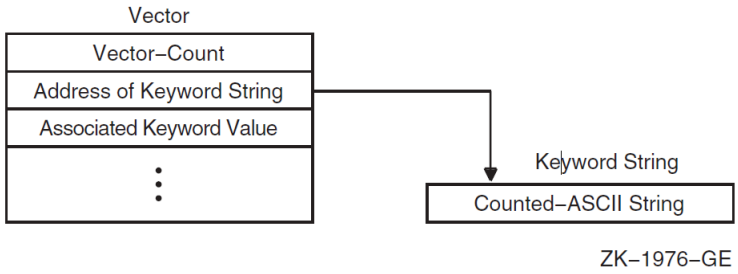
- The longword value associated with the matched keyword
- The full keyword string (any descriptor type)

An exact match is found if the length of the keyword found is equal to the length of the supplied string.

If an exact keyword match is found, no further processing is performed, and a normal return status is returned to the caller. Otherwise, after a match has been found, the rest of the keyword table is scanned. If an additional match is found, a “not enough characters” return status is returned to the caller. If the keyword table contains a keyword that is an abbreviation of another keyword in the table, an exact match can occur for short abbreviations.

Figure 2.5 shows the structure of the keyword table, which the calling program creates for this routine.

Figure 2.5. Keyword Table



Vector-count is the number of longwords that follow, and *counted-ASCII-string* starts with a byte that is the unsigned count of the number of ASCII characters that follow.

Because of the format of the keyword table, this routine cannot be called easily from high-level languages. The examples that follow show how to use a macro, $LIB_KEY_TABLE, to construct a keyword table from MACRO or BLISS. A separate example shows how a table could be constructed in Fortran.

Use of the $LIB_KEY_TABLE macro results in data that is not position-independent code (PIC). If your application requires PIC data, you must fill in the address of the keyword strings at execution time. See the Fortran example (example 3) for a demonstration of this technique.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. A unique keyword match was found.
LIB$_AMBKEY	Multiple keyword match found. Not enough characters were specified to allow a unique match.
LIB$_INSVIRMEM	Insufficient virtual memory to return keyword string. This is only possible if *keyword-string* is a dynamic string.
LIB$_INVARG	Invalid arguments, not enough arguments, and/or bad keyword table.
LIB$_STRTRU	String truncated.
LIB$_UNRKEY	The keyword you specified does not appear in the keyword table you specified.

Examples

1. ```
   KEYTABLE:
            $LIB_KEY_TABLE < -
                        <ADD, 1>, -
                        <DELETE, 2>, -
                        <EXIT, 3>>
   ```

   This VAX MACRO fragment defines a keyword table named KEYTABLE containing the three keywords ADD, DELETE, and EXIT with associated keyword values of 1, 2, and 3, respectively.

   The $LIB_KEY_TABLE macro is supplied in the default macro library SYS $LIBRARY:STARLET.MLB. Because this library is automatically searched by the assembler, you do not have to specify it in the DCL command MACRO.

2. ```
   LIBRARY 'SYS$LIBRARY:STARLET.L32';

   OWN
           KEYTABLE: $LIB_KEY_TABLE (
                (ADD, 1),
                (DELETE, 2),
                (EXIT, 3));
   ```

   This BLISS code fragment specifies that SYS$LIBRARY:STARLET.L32 is to be searched to resolve references. It defines a keyword table named KEYTABLE containing the three keywords ADD, DELETE, and EXIT with associated keyword values of 1, 2, and 3, respectively.

   The $LIB_KEY_TABLE macro is supplied in the BLISS library SYS$LIBRARY:STARLET.L32 and in the BLISS require file SYS$LIBRARY:STARLET.REQ. BLISS does not automatically search either of these files, so you must explicitly cause them to be searched by including the appropriate

LIBRARY or REQUIRE statement in your module. You should use the precompiled library because it is more efficient for the compiler.

3.
```
 PARAMETER (
1     MAXKEYSIZE = 6,          ! Maximum keyword size
2     NKEYS = 3)               ! Number of keywords
 BYTE KEYWORDS (MAXKEYSIZE+1, NKEYS)
 INTEGER*4 KEYTABLE (0:NKEYS*2)
 DATA KEYWORDS /
1     3,'A','D','D',' ',' ',' ',           ! Counted ASCII 'ADD'
2     6,'D','E','L','E','T','E',           ! Counted ASCII 'DELETE'
3     4,'E','X','I','T',' ',' '/           ! Counted ASCII 'EXIT'
 KEYTABLE(0) = NKEYS*2                     ! Number of longwords to
 follow
 KEYTABLE(1) = %LOC(KEYWORDS(1,1))         ! Address of keyword string
 KEYTABLE(2) = 1                           ! Keyword value for 'ADD'
 KEYTABLE(3) = %LOC(KEYWORDS(1,2))         ! Address of keyword string
 KEYTABLE(4) = 2                           ! Keyword value for 'DELETE'
 KEYTABLE(5) = %LOC(KEYWORDS(1,3))         ! Address of keyword string
 KEYTABLE(6) = 3                           ! Keyword value for 'EXIT'
```

This Fortran code fragment constructs a keyword table named KEYTABLE containing the three keywords ADD, DELETE, and EXIT with associated keyword values of 1, 2, and 3, respectively. This construction method results in position-independent coded data, although the generated code for the typical Fortran module contains other non-PIC values.

LIB$LOOKUP_TREE

LIB$LOOKUP_TREE — The Look Up an Entry in a Balanced Binary Tree routine looks up an entry in a balanced binary tree. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$LOOKUP_TREE treehead ,symbol ,user-compare-routine ,new-node

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address
access:	read only

mechanism:	by reference

Tree head for the binary tree. The *treehead* argument is the address of an unsigned longword that is this tree head.

symbol

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	unspecified
mechanism:	unspecified

Key to be looked up in the binary tree.

user-compare-routine

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied compare routine that LIB$LOOKUP_TREE calls to compare a symbol with a node. The value returned by the compare routine indicates the relationship between the symbol key and the current node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

new-node

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Location where the new symbol was found. The *new-node* argument is the address of an unsigned longword that is the new node location.

Description

Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine   symbol ,comparison-node [,user-data]
```

LIB$LOOKUP_TREE passes both the *symbol* and *comparison-node* arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB$LOOKUP_TREE. The *user-data* argument is passed in the same way, but its use is optional.

The *user-compare-routine* argument in the call to LIB$LOOKUP_TREE specifies the compare routine. This argument is required. LIB$LOOKUP_TREE calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The table below lists the possible values returned by the compare routine:

Return Value	Meaning
Negative	The *symbol* argument is less than the current node.
Zero	The *symbol* argument is equal to the current node.
Positive	The *symbol* argument is greater than the current node.

For an example of a user-supplied compare routine written in C, see the description of LIB $INSERT_TREE.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed. The key was found.
LIB$_KEYNOTFOU	Error. The key was not found.

Example

The C example provided in the description of LIB$INSERT_TREE also demonstrates how to use LIB $LOOKUP_TREE. Refer to that example for assistance in using this routine.

LIB$LOOKUP_TREE_64

LIB$LOOKUP_TREE_64 — The Look Up an Entry in a Balanced Binary Tree routine looks up an entry in a balanced binary tree.

Format

```
LIB$LOOKUP_TREE_64 treehead ,symbol ,user-compare-routine ,new-node
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address
access:	read only
mechanism:	by reference

Tree head for the binary tree. The *treehead* argument is the address of an unsigned quadword that is this tree head.

symbol

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	unspecified
mechanism:	unspecified

Key to be looked up in the binary tree.

user-compare-routine

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied compare routine that LIB$LOOKUP_TREE_64 calls to compare a symbol with a node. The value returned by the compare routine indicates the relationship between the symbol key and the current node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

new-node

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Location where the new symbol was found. The *new-node* argument is the address of an unsigned quadword that is the new node location.

Description

Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine symbol ,comparison-node [,user-data]
```

LIB$LOOKUP_TREE_64 passes both the *symbol* and *comparison-node* arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB $LOOKUP_TREE_64. The *user-data* argument is passed in the same way, but its use is optional.

The *user-compare-routine* argument in the call to LIB$LOOKUP_TREE_64 specifies the compare routine. This argument is required. LIB$LOOKUP_TREE_ 64 calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The following table lists the possible values returned by the compare routine:

Return Value	**Meaning**
Negative	The *symbol* argument is less than the current node.
Zero	The *symbol* argument is equal to the current node.
Positive	The *symbol* argument is greater than the current node.

For an example of a user-supplied compare routine written in C, see the description of LIB $INSERT_TREE_64.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed. The key was found.
LIB$_KEYNOTFOU	Error. The key was not found.

Example

The C example provided in the description of LIB$INSERT_TREE_64 also demonstrates how to use LIB$LOOKUP_TREE_64. Refer to that example for assistance in using this routine.

LIB$LP_LINES

LIB$LP_LINES — The Lines on Each Printer Page routine computes the default number of lines on a printer page. This routine can be used by native-mode OpenVMS utilities that produce listing files and paginate files.

Format

LIB$LP_LINES

Returns

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	write only
mechanism:	by value

The default number of lines on a physical printer page. If the logical name translation or conversion to binary fails, a default value of 66 is returned.

Arguments

None.

Description

LIB$LP_LINES computes the default number of lines on a printer page. This routine can be used by native-mode OpenVMS utilities that produce listing files and paginate files. The algorithm used by LIB $LP_LINES is:

1. Translate the logical name SYS$LP_LINES.
2. Convert the ASCII value obtained to a binary integer.
3. Verify that the resulting value is in the range [30:255].
4. If any of the prior steps fail, return the default paper size of 66 lines.

You can use LIB$LP_LINES to monitor the current default length of the line printer page. You can also supply your own default length for the current process. United States standard paper stock permits 66 lines on each physical page.

If you are writing programs for a utility that formats a listing file to be printed on a line printer, you can use LIB$LP_LINES to make your utility independent of the default page length. Your program can use LIB$LP_LINES to obtain the current length of the page. It can then calculate the number of lines of text on each page by subtracting the lines used for margins and headings.

The following is one suggested format:

- Three lines for the top margin
- Three lines for the bottom margin
- Three lines for listing heading information, consisting of:
  - A language-processor identification line
  - A source-program identification line
  - One blank line

Condition Values Returned

None.

Examples

1.
```
        lplines = LIB$LP_LINES()
        PRINT 10, lplines
10      Format (' Line printer page = ',I5,' lines.')
```

```
        end
```

This Fortran program displays the current default length of the line printer page.

2.
```
100  EXTERNAL INTEGER FUNCTION LIB$LP_LINES
200 DECLARE INTEGER LPLINES
300 LPLINES = LIB$LP_LINES
400 PRINT "Line printer page = "; LPLINES
32767 END
```

This BASIC program displays the current default length of the line printer page.

3.
```
PROGRAM LINES(OUTPUT);

FUNCTION LIB$LP_LINES : INTEGER;
 EXTERN;

BEGIN
 WRITELN('Line printer page = ',LIB$LP_LINES,' lines.');
END.
```

This Pascal program displays the current default length of the line printer page.

LIB$MATCHC

LIB$MATCHC — The Match Characters, Return Relative Position routine searches a source string for a specified substring and returns an index, which is the relative position of the first occurrence of a substring in the source string. The relative character positions returned by LIB$MATCHC are numbered 1, 2, …, *n*. Thus, zero means that the substring was not found.

Format

LIB$MATCHC sub-string ,source-string

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

The relative position of the first character of the substring if found, or zero if not found.

Arguments

sub-string

OpenVMS usage:	char_string
type:	character string
access:	read only

mechanism:	by descriptor

Substring to be found. The *sub-string* argument is the address of a descriptor pointing to this substring.

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be searched by LIB$MATCHC. The *source-string* argument is the address of a descriptor pointing to this source string.

Description

LIB$MATCHC searches a source string for a specified substring and returns an index, which is the relative position of the first occurrence of a substring in the source string.

The relative character positions returned by LIB$MATCHC are numbered 1, 2, …, *n*. Thus, zero means that the substring was not found.

If the substring has a zero length, LIB$MATCHC returns the value 1, indicating success, no matter how long the source string is. If the source string has a zero length and the substring has a nonzero length, zero is returned, indicating that the substring was not found.

Condition Values Returned

None.

LIB$MATCH_COND

LIB$MATCH_COND — The Match Condition Values routine checks to see if a given condition value matches a list of condition values that you supply.

Format

LIB$MATCH_COND match-condition-value ,compare-condition-value ,...

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

A zero, if the input condition value did not match any condition value in the list, or i-1, for a match between the first argument and the `i`th argument.

Arguments

match-condition-value

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Condition value to be matched. The *match-condition-value* argument is the address of an unsigned longword that contains this condition value.

compare-condition-value

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The condition values to be compared to *match-condition-value*. The *compare-condition-value* arguments are the addresses of the unsigned longwords that contain these condition values.

Description

LIB$MATCH_COND checks for a match between the condition value addressed by *match-condition-value* and the condition values addressed by the subsequent arguments. Each argument is the address of a longword containing a condition value.

LIB$MATCH_COND is provided for programmers who want to match a list of one or more condition values. It is designed to be used in multipath branch statements available in most higher-level languages.

LIB$MATCH_COND compares the portion (STS$V_COND_ID) of the condition value referenced by the first argument to the same portion of the condition value referenced by the second through Nth arguments. If the facility-specific bit (STS$V_FAC_SP = bit 15) is clear in *match-condition-value* (meaning that the condition value is systemwide rather than facility specific), the facility code field (STS$V_FAC_NO = bits 27:17) is ignored and only the STS$V_MSG_ID fields (bits 15:3) are compared.

The routine returns a 0 if a match is not found, a 1 if the condition value matches the first condition value in the list (the second argument), a 2 if it matches the second condition value (the third argument), and so on. LIB$MATCH_COND checks for null argument entries in the argument list.

When LIB$MATCH_COND is called with only two arguments, the possible values for the value returned are true (1) or false (0).

Each condition handler must examine the signal argument vector to determine which condition is being signaled. If the condition is not one that the handler knows about, the handler should resignal. A handler should not assume that only one kind of condition can occur in the routine which established it or in any routines it calls. However, because a condition value may be modified by an intervening handler, each handler should only compare that part of the condition value that distinguishes it from another.

Condition Values Returned

None.

Example

```
C+
C This Fortran program demonstrates the use of
C LIB$MATCH_COND.
C
C Declare handler routine as external.
C-
 EXTERNAL    HANDLER
C+
C Declare the handler that will be used.
C-
        TYPE *, 'Establishing handler...'
        CALL LIB$ESTABLISH ( HANDLER )
        OPEN ( UNIT = 1, NAME = 'MATCH.DAT', STATUS = 'OLD')
C+
C Revert to normal error processing.
C-
 CALL LIB$REVERT
 CLOSE ( UNIT = 1 )
 CALL EXIT
 END
C+
C This is the handler routine.
C-
 INTEGER*4 FUNCTION HANDLER ( SIGARGS, MECHARGS )
 INTEGER*4 SIGARGS(*), STATUS
 INCLUDE '($SSDEF)'
 INCLUDE '($FORDEF)'
 INCLUDE '($CHFDEF)'
 RECORD /CHFDEF2/ MECHARGS
 HANDLER = SS$_CONTINUE
C+
C This handler will type out an error message. In this case the
C message is regarding a file open status.
C-
 TYPE *, 'Entering handler...'
 STATUS = LIB$MATCH_COND ( SIGARGS (2) , FOR$_FILNOTFOU,
     1 FOR$_NO_SUCDEV, FOR$_FILNAMSPE, FOR$_OPEFAI )
 GOTO ( 100, 200, 300, 400 ) STATUS
 HANDLER = SS$_RESIGNAL
 GOTO 1000
100 TYPE *, 'ERROR -- File not found'
 GOTO 1000
200 TYPE *, 'ERROR -- No such device'
 GOTO 1000
300 TYPE *, 'ERROR -- File name specification'
 GOTO 1000
400 TYPE *, 'ERROR -- Open failure'
 GOTO 1000
C+
C On OpenVMS Alpha systems use MECHARGS.CHF$IS_MCH_DEPTH
C On OpenVMS VAX systems use MECHARGS.CHF$L_MCH_DEPTH
```

```
C-
1000 CALL SYS$UNWIND ( MECHARGS.CHF$IS_MCH_DEPTH , ) ! For OpenVMS Alpha
C 1000 CALL SYS$UNWIND ( MECHARGS.CHF$L_MCH_DEPTH , ) ! For OpenVMS VAX
 TYPE *, 'Returning from handler...'
 RETURN
 END
```

This Fortran program uses a computed GOTO to alter the program execution sequence on a condition value.

If the file called MATCH.DAT does not exist, the following output is returned:

```
  Establishing handler...
  Entering handler...
  ERROR  -  File not found
  Returning from handler...
```

If the file MATCH.DAT does exist, the output returned is as follows:

```
  Establishing handler...
```

LIB$MOVC3

LIB$MOVC3 — The Move Characters routine makes the VAX MOVC3 instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation. The source item is moved to the destination item. Overlap of the source and destination items does not affect the result.

Format

LIB$MOVC3 word-integer-length ,source ,destination

Returns

None.

Arguments

word-integer-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Number of bytes to be moved from *source* to *destination* by LIB$MOVC3. The *word-integer-length* argument is the address of an unsigned word that contains this number of bytes. The maximum transfer is 65,535 bytes.

source

OpenVMS usage:	unspecified
type:	unspecified

access:	read only
mechanism:	by reference

Item to be moved. The *source* argument is the address of this item.

destination

OpenVMS usage:	unspecified
type:	unspecified
access:	write only
mechanism:	by reference

Item into which *source* will be moved. The *destination* argument is the address of this item.

Description

LIB$MOVC3 is useful for moving large blocks of data, such as arrays, when such an operation would otherwise have to be performed by a programmed loop.

For more information, see the *VAX Architecture Reference Manual* or the *Alpha Architecture Reference Manual*. See also OTS$MOVE3.

Condition Values Returned

None.

LIB$MOVC5

LIB$MOVC5 — The Move Characters with Fill routine makes the VAX MOVC5 instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation. The source item is moved to the destination item. Overlap of the source and destination items does not affect the result.

Format

```
LIB$MOVC5 word-integer-source-length ,source [,fill] ,word-integer-destination-len
```

Returns

None.

Arguments

word-integer-source-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Number of bytes in the *source* item. The *word-integer-source-length* argument is the address of an unsigned word that contains this number of bytes. The maximum length of *source* is 65,535 bytes.

source

OpenVMS usage:	unspecified
type:	unspecified
access:	read only
mechanism:	by reference

Item to be moved by LIB$MOVC5. The *source* argument is the address of this item. If *word-integer-source-length* is zero, indicating that *destination* is to be entirely filled by the fill character, then *source* is ignored by LIB$MOVC5.

fill

OpenVMS usage:	byte_signed
type:	byte integer (signed)
access:	read only
mechanism:	by reference

Character used to pad *source* to the length of *destination*. The *fill* argument is the address of a signed byte integer that contains this fill character. If *word-integer-destination-length* is less than or equal to *word-integer-source-length*, *fill* is unused and may be omitted.

word-integer-destination-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Length of *destination* in bytes. The *word-integer-destination-length* argument is the address of an unsigned word that contains this number of bytes. The maximum value of *word-integer-destination-length* is 65,535 bytes.

destination

OpenVMS usage:	unspecified
type:	unspecified
access:	write only
mechanism:	by reference

Item into which *source* will be moved. The *destination* argument is the address of this item.

Description

If the destination item is shorter than the source item, the highest-addressed bytes of the source are not moved.

For more information, see the *VAX Architecture Reference Manual*. See also OTS$MOVE5.

Condition Values Returned

None.

LIB$MOVTC

LIB$MOVTC — The Move Translated Characters routine moves the source string, character by character, to the destination string after translating each character using the specified translation table. LIB$MOVTC makes the VAX MOVTC instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

```
LIB$MOVTC source-string ,fill-character ,translation-table ,destination-string
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be translated and moved by LIB$MOVTC. The *source-string* argument is the address of a descriptor pointing to this source string.

fill-character

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Fill character used to pad *source-string* to the length of *destination-string*. The *fill-character* argument is the address of a descriptor pointing to a string. The first character of this string is used as the fill character. The length of this string is not checked and *fill-character* is not translated.

translation-table

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Translation table used by LIB$MOVTC. The *translation-table* argument is the address of a descriptor pointing to the translation table string. The translation table string is assumed to be 256 characters long.

You can use any one of the translation tables included in the Description section that follows, supplied by VSI, or you can create your own. Translation tables supplied by VSI have names in the format LIB $AB_ *xxx*_ *yyy,* which represent the addresses of the 256-byte translation tables and can be accessed as external (string) variables. If a particular language cannot generate descriptors for external strings, then you must create them manually. The example following the Description section shows the creation of a string descriptor for a translation table using VAX BASIC. Destination string into which LIB$MOVTC writes the translated *source-string*. The *destination-string* argument is the address of a descriptor pointing to this destination string.

destination-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string into which LIB$MOVTC writes the translated *source-string*. The *destination-string* argument is the address of a descriptor pointing to this destination string.

Description

Each character in the source string is used as an index into the translation table. The byte found is then placed into the destination string. The fill character is used if the destination string is longer than the source string. If the source string is longer than the destination string, the source string is truncated. Overlap of the source and destination strings does not affect execution.

The translation tables used by LIB$MOVTC and LIB$MOVTUC follow. Each table is preceded by explanatory text.

ASCII to EBCDIC Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent EBCDIC characters in hexadecimal notation.

Figure 2.6 is the ASCII to EBCDIC translation table.

Figure 2.6. LIB$AB_ASC_EBC

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	40	F0	7C	D7	79	97	3F	3F	3F	3F	3F	3F	3F	3F
1	01	11	4F	F1	C1	D8	81	98	3F	3F	3F	3F	3F	3F	3F	3F
2	02	12	7F	F2	C2	D9	82	99	3F	3F	3F	3F	3F	3F	3F	3F
3	03	13	7B	F3	C3	E2	83	A2	3F	3F	3F	3F	3F	3F	3F	3F
4	37	3C	5B	F4	C4	E3	84	A3	3F	3F	3F	3F	3F	3F	3F	3F
5	2D	3D	6C	F5	C5	E4	85	A4	3F	3F	3F	3F	3F	3F	3F	3F
6	2E	32	50	F6	C6	E5	86	A5	3F	3F	3F	3F	3F	3F	3F	3F
7	2F	26	7D	F7	C7	E6	87	A6	3F	3F	3F	3F	3F	3F	3F	3F
8	16	18	4D	F8	C8	E7	88	A7	3F	3F	3F	3F	3F	3F	3F	3F
9	05	19	5D	F9	C9	E8	89	A8	3F	3F	3F	3F	3F	3F	3F	3F
A	25	3F	5C	7A	D1	E9	91	A9	3F	3F	3F	3F	3F	3F	3F	3F
B	0B	27	4E	5E	D2	4A	92	C0	3F	3F	3F	3F	3F	3F	3F	3F
C	0C	1C	6B	4C	D3	E0	93	6A	3F	3F	3F	3F	3F	3F	3F	3F
D	0D	1D	60	7E	D4	5A	94	D0	3F	3F	3F	3F	3F	3F	3F	3F
E	0E	1E	4B	6E	D5	5F	95	A1	3F	3F	3F	3F	3F	3F	3F	3F
F	0F	1F	61	6F	D6	6D	96	07	3F	3F	3F	3F	3F	3F	3F	FF

ASCII to EBCDIC Reversible Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represents the equivalent EBCDIC characters in hexadecimal notation.

Figure 2.7 is the ASCII to EBCDIC reversible translation table.

Figure 2.7. LIB$AB_ASC_EBC_REV

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	40	F0	7C	D7	79	97	20	30	41	58	76	9F	B8	DC
1	01	11	4F	F1	C1	D8	81	98	21	31	42	59	77	A0	B9	DD
2	02	12	7F	F2	C2	D9	82	99	22	1A	43	62	78	AA	BA	DE
3	03	13	7B	F3	C3	E2	83	A2	23	33	44	63	80	AB	BB	DF
4	37	3C	5B	F4	C4	E3	84	A3	24	34	45	64	8A	AC	BC	EA
5	2D	3D	6C	F5	C5	E4	85	A4	15	35	46	65	8B	AD	BD	EB
6	2E	32	50	F6	C6	E5	86	A5	06	36	47	66	8C	AE	BE	EC
7	2F	26	7D	F7	C7	E6	87	A6	17	08	48	67	8D	AF	BF	ED
8	16	18	4D	F8	C8	E7	88	A7	28	38	49	68	8E	B0	CA	EE
9	05	19	5D	F9	C9	E8	89	A8	29	39	51	69	8F	B1	CB	EF
A	25	3F	5C	7A	D1	E9	91	A9	2A	3A	52	70	90	B2	CC	FA
B	0B	27	4E	5E	D2	4A	92	C0	2B	3B	53	71	9A	B3	CD	FB
C	0C	1C	6B	4C	D3	E0	93	6A	2C	04	54	72	9B	B4	CE	FC
D	0D	1D	60	7E	D4	5A	94	D0	09	14	55	73	9C	B5	CF	FD
E	0E	1E	4B	6E	D5	5F	95	A1	0A	3E	56	74	9D	B6	DA	FE
F	0F	1F	61	6F	D6	6D	96	07	1B	E1	57	75	9E	B7	DB	FF

EBCDIC to ASCII Translation Table

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

Figure 2.8 is the EBCDIC to ASCII translation table.

Figure 2.8. LIB$AB_EBC_ASC

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	5C	5C	20	26	2D	5C	5C	5C	5C	5C	7B	7D	5C	30
1	01	11	5C	5C	5C	5C	2F	5C	61	6A	7E	5C	41	4A	5C	31
2	02	12	5C	16	5C	5C	5C	5C	62	6B	73	5C	42	4B	53	32
3	03	13	5C	5C	5C	5C	5C	5C	63	6C	74	5C	43	4C	54	33
4	5C	5C	5C	5C	5C	5C	5C	5C	64	6D	75	5C	44	4D	55	34
5	09	5C	0A	5C	5C	5C	5C	5C	65	6E	76	5C	45	4E	56	35
6	5C	08	17	5C	5C	5C	5C	5C	66	6F	77	5C	46	4F	57	36
7	7F	5C	1B	04	5C	5C	5C	5C	67	70	78	5C	47	50	58	37
8	5C	18	5C	5C	5C	5C	5C	5C	68	71	79	5C	48	51	59	38
9	5C	19	5C	5C	5C	5C	5C	60	69	72	7A	5C	49	52	5A	39
A	5C	5C	5C	5C	5B	5D	7C	3A	5C	5C	5C	5C	5C	5C	5C	5C
B	0B	5C	5C	5C	2E	24	2C	23	5C	5C	5C	5C	5C	5C	5C	5C
C	0C	1C	5C	14	3C	2A	25	40	5C	5C	5C	5C	5C	5C	5C	5C
D	0D	1D	05	15	28	29	5F	27	5C	5C	5C	5C	5C	5C	5C	5C
E	0E	1E	06	5C	2B	3B	3E	3D	5C	5C	5C	5C	5C	5C	5C	5C
F	0F	1F	07	1A	21	5E	3F	22	5C	5C	5C	5C	5C	5C	5C	FF

EBCDIC to ASCII Reversible Translation Table

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

Figure 2.9 is the EBCDIC to ASCII reversible translation table.

Figure 2.9. LIB$AB_EBC_ASC_REV

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	80	90	20	26	2D	BA	C3	CA	D1	D8	7B	7D	5C	30
1	01	11	81	91	A0	A9	2F	BB	61	6A	7E	D9	41	4A	9F	31
2	02	12	82	16	A1	AA	B2	BC	62	6B	73	DA	42	4B	53	32
3	03	13	83	93	A2	AB	B3	BD	63	6C	74	DB	43	4C	54	33
4	9C	9D	84	94	A3	AC	B4	BE	64	6D	75	DC	44	4D	55	34
5	09	85	0A	95	A4	AD	B5	BF	65	6E	76	DD	45	4E	56	35
6	86	08	17	96	A5	AE	B6	C0	66	6F	77	DE	46	4F	57	36
7	7F	87	1B	04	A6	AF	B7	C1	67	70	78	DF	47	50	58	37
8	97	18	88	98	A7	B0	B8	C2	68	71	79	E0	48	51	59	38
9	8D	19	89	99	A8	B1	B9	60	69	72	7A	E1	49	52	5A	39
A	8E	92	8A	9A	5B	5D	7C	3A	C4	CB	D2	E2	E8	EE	F4	FA
B	0B	8F	8B	9B	2E	24	2C	23	C5	CC	D3	E3	E9	EF	F5	FB
C	0C	1C	8C	14	3C	2A	25	40	C6	CD	D4	E4	EA	F0	F6	FC
D	0D	1D	05	15	28	29	5F	27	C7	CE	D5	E5	EB	F1	F7	FD
E	0E	1E	06	9E	2B	3B	3E	3D	C8	CF	D6	E6	EC	F2	F8	FE
F	0F	1F	07	1A	21	5E	3F	22	C9	D0	D7	E7	ED	F3	F9	FF

Packed Decimal to Trailing Overpunch Numeric Value Translation Table

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent trailing overpunch numeric values in hexadecimal notation.

Figure 2.10 is the packed decimal to trailing overpunch numeric value translation table.

Figure 2.10. LIB$AB_CVTPT_O

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
1	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
2	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
3	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
4	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
5	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
6	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
7	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
8	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
9	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B	7B
A	7B	41	42	43	44	45	46	47	48	49	7B	7B	7B	7B	7B	7B
B	7D	4A	4B	4C	4D	4E	4F	50	51	52	7B	7B	7B	7B	7B	7B
C	7B	41	42	43	44	45	46	47	48	49	7B	7B	7B	7B	7B	7B
D	7D	4A	4B	4C	4D	4E	4F	50	51	52	7B	7B	7B	7B	7B	7B
E	7B	41	42	43	44	45	46	47	48	49	7B	7B	7B	7B	7B	7B
F	7B	41	42	43	44	45	46	47	48	49	7B	7B	7B	7B	7B	7B

Packed Decimal to Unsigned Trailing Numeric Value Translation Table

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent unsigned trailing numeric values in hexadecimal notation.

Figure 2.11 is the packed decimal to unsigned trailing numeric value translation table.

Figure 2.11. LIB$AB_CVTPT_U

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
1	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
2	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
3	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
4	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
5	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
6	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
7	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
8	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
9	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
A	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00
B	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00
C	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00
D	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00
E	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00
F	30	31	32	33	34	35	36	37	38	39	00	00	00	00	00	00

Trailing Overpunch Numeric to Packed Decimal Value Translation Table

- The numbers on the left represent the low-order bits of the trailing overpunch numeric values in hexadecimal notation.

- The numbers across the top represent the high-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure 2.12 is the trailing overpunch numeric to packed decimal value translation table.

Figure 2.12. LIB$AB_CVTTP_O

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	00	00	0C	00	7D	00	00	00	00	00	00	00	00	00	00
1	00	00	0D	1C	1C	8D	00	00	00	00	00	00	00	00	00	00
2	00	00	00	2C	2C	9D	00	00	00	00	00	00	00	00	00	00
3	00	00	00	3C	3C	00	00	00	00	00	00	00	00	00	00	00
4	00	00	00	4C	4C	00	00	00	00	00	00	00	00	00	00	00
5	00	00	00	5C	5C	00	00	00	00	00	00	00	00	00	00	00
6	00	00	00	6C	6C	00	00	00	00	00	00	00	00	00	00	00
7	00	00	00	7C	7C	00	00	00	00	00	00	00	00	00	00	00
8	00	00	00	8C	8C	00	00	00	00	00	00	00	00	00	00	00
9	00	00	00	9C	9C	00	00	00	00	00	00	00	00	00	00	00
A	00	00	00	0D	1D	00	00	00	00	00	00	00	00	00	00	00
B	00	00	00	00	2D	0C	00	0C	00	00	00	00	00	00	00	00
C	00	00	00	00	3D	00	00	00	00	00	00	00	00	00	00	00
D	00	00	00	00	4D	0D	00	0D	00	00	00	00	00	00	00	00
E	00	00	00	00	5D	00	00	00	00	00	00	00	00	00	00	00
F	00	00	00	0C	6D	00	00	00	00	00	00	00	00	00	00	00

Unsigned Numeric to Packed Decimal Value Translation Table

- The numbers on the left represent the low-order bits of the unsigned numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the unsigned numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure 2.13 is the unsigned numeric to packed decimal value translation table.

Figure 2.13. LIB$AB_CVTTP_U

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	00	00	0C	00	00	00	00	00	00	00	00	00	00	00	00
1	00	00	00	1C	00	00	00	00	00	00	00	00	00	00	00	00
2	00	00	00	2C	00	00	00	00	00	00	00	00	00	00	00	00
3	00	00	00	3C	00	00	00	00	00	00	00	00	00	00	00	00
4	00	00	00	4C	00	00	00	00	00	00	00	00	00	00	00	00
5	00	00	00	5C	00	00	00	00	00	00	00	00	00	00	00	00
6	00	00	00	6C	00	00	00	00	00	00	00	00	00	00	00	00
7	00	00	00	7C	00	00	00	00	00	00	00	00	00	00	00	00
8	00	00	00	8C	00	00	00	00	00	00	00	00	00	00	00	00
9	00	00	00	9C	00	00	00	00	00	00	00	00	00	00	00	00
A	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
C	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
E	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
F	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

Trailing Overpunch Numeric to Unsigned Numeric Value Translation Table

- The numbers on the left represent the low-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent unsigned numeric values in hexadecimal notation.

Figure 2.14 is the trailing overpunch numeric to unsigned numeric value translation table.

Figure 2.14. LIB$AB_CVT_O_U

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	20	30	40	37	60	70	80	90	A0	B0	C0	D0	E0	F0
1	01	11	30	31	31	38	61	71	81	91	A1	B1	C1	D1	E1	F1
2	02	12	22	32	32	39	62	72	82	92	A2	B2	C2	D2	E2	F2
3	03	13	23	33	33	53	63	73	83	93	A3	B3	C3	D3	E3	F3
4	04	14	24	34	34	54	64	74	84	94	A4	B4	C4	D4	E4	F4
5	05	15	25	35	35	55	65	75	85	95	A5	B5	C5	D5	E5	F5
6	06	16	26	36	36	56	66	76	86	96	A6	B6	C6	D6	E6	F6
7	07	17	27	37	37	57	67	77	87	97	A7	B7	C7	D7	E7	F7
8	08	18	28	38	38	58	68	78	88	98	A8	B8	C8	D8	E8	F8
9	09	19	29	39	39	59	69	79	89	99	A9	B9	C9	D9	E9	F9
A	0A	1A	2A	30	31	5A	6A	7A	8A	9A	AA	BA	CA	DA	EA	FA
B	0B	1B	2B	3B	32	30	6B	30	8B	9B	AB	BB	CB	DB	EB	FB
C	0C	1C	2C	3C	33	5C	6C	7C	8C	9C	AC	BC	CC	DC	EC	FC
D	0D	1D	2D	3D	34	30	6D	30	8D	9D	AD	BD	CD	DD	ED	FD
E	0E	1E	2E	3E	35	5E	6E	7E	8E	9E	AE	BE	CE	DE	EE	FE
F	0F	1F	2F	30	36	5F	6F	7F	8F	9F	AF	BF	CF	DF	EF	FF

Unsigned Numeric to Trailing Overpunch Translation Table

Figure 2.15 is indexed by 0 through 9 for the positive overpunches and 10 through 19 for the negative overpunches.

The unsigned binary representation of the least significant digit is moved into R2. Then, if you require a positive result, the following code results:

```
MOVC3 LIB$AB_CVT_U_O[R2], #1,R0
```

If you require a negative result, the following code is generated:

```
MOVC3 LIB$AV_CVT_U_O + 10[R2], #1,R0
```

The result is the overpunch representation for the last byte of the negative number.

Figure 2.15 is the unsigned numeric to trailing overpunch translation table.

Figure 2.15. LIB$AB_CVT_U_O

0 – 9										10 – 19									
7B	41	42	43	44	45	46	47	48	49	7D	4A	4B	4C	4D	4E	4F	50	51	52

Packed Decimal to Zone Numeric Translation Table

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent zoned numeric values in hexadecimal notation.

Figure 2.16 is the packed decimal to zone numeric translation table.

Figure 2.16. LIB$AB_CVTPT_Z

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
1	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
2	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
3	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
4	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
5	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
6	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
7	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
8	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
9	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
A	30	31	32	33	34	35	36	37	38	39	30	30	30	30	30	30
B	70	71	72	73	74	75	76	77	78	79	30	30	30	30	30	30
C	30	31	32	33	34	35	36	37	38	39	30	30	30	30	30	30
D	70	71	72	73	74	75	76	77	78	79	30	30	30	30	30	30
E	30	31	32	33	34	35	36	37	38	39	30	30	30	30	30	30
F	30	31	32	33	34	35	36	37	38	39	30	30	30	30	30	30

ASCII Uppercase Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent uppercase ASCII characters in hexadecimal notation.

Figure 2.17 is the ASCII uppercase translation table.

Figure 2.17. LIB$AB_UPCASE

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	20	30	40	50	60	50	80	90	A0	B0	C0	D0	C0	F0
1	01	11	21	31	41	51	41	51	81	91	A1	B1	C1	D1	C1	F1
2	02	12	22	32	42	52	42	52	82	92	A2	B2	C2	D2	C2	F2
3	03	13	23	33	43	53	43	53	83	93	A3	B3	C3	D3	C3	F3
4	04	14	24	34	44	54	44	54	84	94	A4	B4	C4	D4	C4	F4
5	05	15	25	35	45	55	45	55	85	95	A5	B5	C5	D5	C5	F5
6	06	16	26	36	46	56	46	56	86	96	A6	B6	C6	D6	C6	F6
7	07	17	27	37	47	57	47	57	87	97	A7	B7	C7	D7	C7	F7
8	08	18	28	38	48	58	48	58	88	98	A8	B8	C8	D8	C8	F8
9	09	19	29	39	49	59	49	59	89	99	A9	B9	C9	D9	C9	F9
A	0A	1A	2A	3A	4A	5A	4A	5A	8A	9A	AA	BA	CA	DA	CA	DA
B	0B	1B	2B	3B	4B	5B	4B	7B	8B	9B	AB	BB	CB	DB	CB	DB
C	0C	1C	2C	3C	4C	5C	4C	7C	8C	9C	AC	BC	CC	DC	CC	DC
D	0D	1D	2D	3D	4D	5D	4D	7D	8D	9D	AD	BD	CD	DD	CD	DD
E	0E	1E	2E	3E	4E	5E	4E	7E	8E	9E	AE	BE	CE	DE	CE	FE
F	0F	1F	2F	3F	4F	5F	4F	7F	8F	9F	AF	BF	CF	DF	CF	FF

Zone to Packed Decimal Translation Table

- The numbers on the left represent the low-order bits of the zoned numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the zoned numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure 2.18 is the zone to packed decimal translation table.

Figure 2.18. LIB$AB_CVTTP_Z

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	00	00	0C	00	00	00	0D	00	00	00	00	00	00	00	00
1	00	00	00	1C	00	00	00	1D	00	00	00	00	00	00	00	00
2	00	00	00	2C	00	00	00	2D	00	00	00	00	00	00	00	00
3	00	00	00	3C	00	00	00	3D	00	00	00	00	00	00	00	00
4	00	00	00	4C	00	00	00	4D	00	00	00	00	00	00	00	00
5	00	00	00	5C	00	00	00	5D	00	00	00	00	00	00	00	00
6	00	00	00	6C	00	00	00	6D	00	00	00	00	00	00	00	00
7	00	00	00	7C	00	00	00	7D	00	00	00	00	00	00	00	00
8	00	00	00	8C	00	00	00	8D	00	00	00	00	00	00	00	00
9	00	00	00	9C	00	00	00	9D	00	00	00	00	00	00	00	00
A	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
B	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
C	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
D	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
E	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
F	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

ASCII Uppercase Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent uppercase ASCII characters in hexadecimal notation.

Figure 2.19 is the ASCII uppercase translation table.

Figure 2.19. LIB$AB_UPCASE

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	20	30	40	50	60	50	80	90	A0	B0	C0	D0	C0	F0
1	01	11	21	31	41	51	41	51	81	91	A1	B1	C1	D1	C1	F1
2	02	12	22	32	42	52	42	52	82	92	A2	B2	C2	D2	C2	F2
3	03	13	23	33	43	53	43	53	83	93	A3	B3	C3	D3	C3	F3
4	04	14	24	34	44	54	44	54	84	94	A4	B4	C4	D4	C4	F4
5	05	15	25	35	45	55	45	55	85	95	A5	B5	C5	D5	C5	F5
6	06	16	26	36	46	56	46	56	86	96	A6	B6	C6	D6	C6	F6
7	07	17	27	37	47	57	47	57	87	97	A7	B7	C7	D7	C7	F7
8	08	18	28	38	48	58	48	58	88	98	A8	B8	C8	D8	C8	F8
9	09	19	29	39	49	59	49	59	89	99	A9	B9	C9	D9	C9	F9
A	0A	1A	2A	3A	4A	5A	4A	5A	8A	9A	AA	BA	CA	DA	CA	DA
B	0B	1B	2B	3B	4B	5B	4B	7B	8B	9B	AB	BB	CB	DB	CB	DB
C	0C	1C	2C	3C	4C	5C	4C	7C	8C	9C	AC	BC	CC	DC	CC	DC
D	0D	1D	2D	3D	4D	5D	4D	7D	8D	9D	AD	BD	CD	DD	CD	DD
E	0E	1E	2E	3E	4E	5E	4E	7E	8E	9E	AE	BE	CE	DE	CE	FE
F	0F	1F	2F	3F	4F	5F	4F	7F	8F	9F	AF	BF	CF	DF	CF	FF

ASCII Lowercase Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent lowercase ASCII characters in hexadecimal notation.

Figure 2.20 is the ASCII lowercase translation table.

Figure 2.20. LIB$AB_LOWERCASE

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	20	30	40	70	60	70	80	90	A0	B0	E0	D0	E0	F0
1	01	11	21	31	61	71	61	71	81	91	A1	B1	E1	F1	E1	F1
2	02	12	22	32	62	72	62	72	82	92	A2	B2	E2	F2	E2	F2
3	03	13	23	33	63	73	63	73	83	93	A3	B3	E3	F3	E3	F3
4	04	14	24	34	64	74	64	74	84	94	A4	B4	E4	F4	E4	F4
5	05	15	25	35	65	75	65	75	85	95	A5	B5	E5	F5	E5	F5
6	06	16	26	36	66	76	66	76	86	96	A6	B6	E6	F6	E6	F6
7	07	17	27	37	67	77	67	77	87	97	A7	B7	E7	F7	E7	F7
8	08	18	28	38	68	78	68	78	88	98	A8	B8	E8	F8	E8	F8
9	09	19	29	39	69	79	69	79	89	99	A9	B9	E9	F9	E9	F9
A	0A	1A	2A	3A	6A	7A	6A	7A	8A	9A	AA	BA	EA	FA	EA	FA
B	0B	1B	2B	3B	6B	7B	6B	7B	8B	9B	AB	BB	EB	FB	EB	FB
C	0C	1C	2C	3C	6C	7C	6C	7C	8C	9C	AC	BC	EC	FC	EC	FC
D	0D	1D	2D	3D	6D	7D	6D	7D	8D	9D	AD	BD	ED	FD	ED	FD
E	0E	1E	2E	3E	6E	7E	6E	7E	8E	9E	AE	BE	EE	FE	EE	FE
F	0F	1F	2F	3F	6F	7F	6F	7F	8F	9F	AF	BF	EF	FF	EF	FF

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed; string truncated. The destination string could not contain all the characters.
LIB$_FATERRLIB	Fatal internal error.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor.

Example

```
1   !+
    !This BASIC program shows the method
    !of creating a descriptor for the appropriate
    !translation table in order to call LIB$MOVTC.
    !-

    OPTION TYPE = EXPLICIT

    !+
    !Declare the translation table as an
    !EXTERNAL LONG variable.
    !-

    EXTERNAL LONG LIB$AB_ASC_EBC
    EXTERNAL LONG FUNCTION LIB$MOVTC
    EXTERNAL SUB LIB$STOP
    EXTERNAL LONG CONSTANT DSC$K_CLASS_S, DSC$K_DTYPE_T

    !+
    !Define a record which models the required
    !translation table descriptor.
    !-

    RECORD STR_TYPE
        WORD    DSC$W_LENGTH
        BYTE DSC$B_DTYPE
        BYTE DSC$B_CLASS
        LONG DSC$A_POINTER
    END RECORD STR_TYPE

    DECLARE LONG I, RET_STS
    DECLARE STR_TYPE STR_VAR

    MAP (FOO) STRING DST = 3%
    MAP (FOO) BYTE DST_ARRAY(2)

    !+
    !Fill the translation table descriptor record.
    !Note that the length of the translation table string
    !is set to 256, and the pointer receives the address of
    !the HP translation table LIB$AB_ASC_EBC.
    !-
```

```
STR_VAR::DSC$W_LENGTH = 256
STR_VAR::DSC$B_DTYPE = DSC$K_DTYPE_T
STR_VAR::DSC$B_CLASS = DSC$K_CLASS_S
STR_VAR::DSC$A_POINTER = LOC(LIB$AB_ASC_EBC)

RET_STS = LIB$MOVTC( "ABC", " ", STR_VAR BY REF, DST )
IF (RET_STS AND 1%) = 0%
THEN
    CALL LIB$STOP( RET_STS BY VALUE )
END IF

!+
!Add 256 to the translated value in order to return
!an unsigned value.
!-

PRINT (256 + DST_ARRAY(I)) FOR I = 0% TO 2%

END
```

The output generated by this BASIC program is as follows:

```
193
194
195
```

LIB$MOVTUC

LIB$MOVTUC — The Move Translated Until Character routine moves the source string, character by character, to the destination string after translating each character using the specified translation table until the stop character is encountered. LIB$MOVTUC makes the VAX MOVTUC instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$MOVTUC source-string ,stop-character ,translation-table ,destination-stri

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

The relative position in the source string of the character that is translated to the stop character. Zero is returned if the stop character is not found. This value is set to –1 if *destination-string* cannot be allocated.

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be translated and moved by LIB$MOVTUC. The *source-string* argument is the address of a descriptor pointing to this source string.

stop-character

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Stop character that causes LIB$MOVTUC to stop translating the source string. The *stop-character* argument is the address of a descriptor pointing to a string. The first character of this string is used as the stop character. The length of this string is not checked. During the translation, LIB $MOVTUC accesses each character in the source string and uses it as an index into the translation table. If this translated character is the specified stop character, translation stops, and *stop-character* is not translated.

translation-table

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Translation table used by LIB$MOVTUC. The *translation-table* argument is the address of a descriptor pointing to the translation table string. The translation table string is assumed to be 256 characters long.

You can use any of the translation tables included in the Description section of LIB$MOVTC, or you can create your own. When using a translation table supplied by VSI, the names LIB$AB_ *xxx_ yyy* represent the addresses of the 256-byte translation tables, and can be accessed as external (string) variables. If a particular language cannot generate descriptors for external strings, then they must be created manually. The example for the routine LIB$MOVTC shows the creation of a string descriptor for a translation table using VAX BASIC.

destination-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string into which LIB$MOVTUC writes the translated *source-string*. The *destination-string* argument is the address of a descriptor pointing to this destination string.

fill-character

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Character used to pad *source-string* to the length of *destination-string*. The *fill-character* argument is the address of a descriptor pointing to a string. The first character of this string is used as the fill character. The length of this string is not checked and *fill-character* is not translated.

If the fill character is included, the remainder of the destination string (after the stop character) is filled with the specified fill character. If it is not included, the remainder of the destination string remains unchanged.

Description

During the translation, LIB$MOVTUC accesses each character in the source string and uses it as an index into the translation table. If the table entry contains the specified stop character, the routine is terminated and the relative position of the source character is returned.

If the source string is longer than the destination string, then the source string is truncated. If the optional fill character is present, any remaining positions in the destination string are filled with the fill character. If the source or destination string is exhausted (before the stop character is found), a zero index is returned.

The results are unpredictable if the source and destination strings overlap and have different starting addresses.

See the description of LIB$MOVTC for the translation tables used by LIB$MOVTC and LIB $MOVTUC. Each translation table is preceded by explanatory text.

Condition Values Returned

None.

LIB$MULT_DELTA_TIME

LIB$MULT_DELTA_TIME — The Multiply Delta Time by Scalar routine multiplies a delta time by a longword integer scalar.

Format

LIB$MULT_DELTA_TIME multiplier ,delta-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)

access:	write only
mechanism:	by value

Arguments

multiplier

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

The value by which LIB$MULT_DELTA_TIME multiplies the delta time. The *multiplier* argument is the address of a signed longword containing the integer scalar. If *multiplier* is negative, the absolute value of *multiplier* is used.

delta-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	modify
mechanism:	by reference

The delta time to be multiplied. The *delta-time* argument is the address of an unsigned quadword containing the number to be multiplied. The initial *delta-time* argument must be greater than 0. After LIB$MULT_DELTA_TIME performs the multiplication, the result is returned to *delta-time*. (The original *delta-time* value is overwritten.)

Description

LIB$MULT_DELTA_TIME multiplies a delta time by a longword integer scalar. The result of the multiplication is returned to the *delta-time* argument.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$MULTF_DELTA_TIME

LIB$MULTF_DELTA_TIME — The Multiply Delta Time by an F-Floating Scalar routine multiplies a delta time by an F-floating scalar.

Format

LIB$MULTF_DELTA_TIME multiplier ,delta-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

multiplier

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference

The value by which LIB$MULTF_DELTA_TIME multiplies the delta time. The *multiplier* argument is the address of an F-floating value containing the scalar. If *multiplier* is negative, the absolute value of *multiplier* is used.

delta-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	modify
mechanism:	by reference

The delta time to be multiplied. The *delta-time* argument is the address of an unsigned quadword containing the number to be multiplied. The initial *delta-time* argument must be greater than 0. After LIB$MULTF_DELTA_TIME performs the multiplication, the result is returned to *delta-time*. (The original *delta-time* value is overwritten.)

Description

LIB$MULTF_DELTA_TIME multiplies a delta time by an F-floating scalar. The result of the multiplication is returned to the *delta-time* argument.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$MULTS_DELTA_TIME

LIB$MULTS_DELTA_TIME — The Multiply Delta Time by an IEEE S-Floating Scalar routine multiplies a delta time by an IEEE S-floating scalar.

Format

LIB$MULTS_DELTA_TIME multiplier ,delta-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

multiplier

OpenVMS usage:	floating_point
type:	IEEE S_floating
access:	read only
mechanism:	by reference

The value by which LIB$MULTS_DELTA_TIME multiplies the delta time. The *multiplier* argument is the address of an IEEE S-floating value containing the scalar. If *multiplier* is negative, the absolute value of *multiplier* is used.

delta-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	modify
mechanism:	by reference

The delta time to be multiplied. The *delta-time* argument is the address of an unsigned quadword containing the number to be multiplied. The initial *delta-time* argument must be greater than 0. After LIB$MULTS_DELTA_TIME performs the multiplication, the result is returned to delta-time. (The original *delta-time* value is overwritten.)

Description

LIB$MULTS_DELTA_TIME multiplies a delta time by an IEEE S-floating scalar. The result of the multiplication is returned to the *delta-time* argument.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_IVTIME	Invalid time.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$PARSE_ACCESS_CODE

LIB$PARSE_ACCESS_CODE — The Parse Access Encoded Name String routine parses and translates a string of access names into a mask for a particular ownership category.

Format

```
LIB$PARSE_ACCESS_CODE access-string, [access-names,] ownership-category, acce
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

access-string

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a character-string descriptor pointing to a string of access names. Each access name is abbreviated to one letter. An example of a valid access string is RWE. Access names are specific to each of the different object classes. See the *VSI OpenVMS Guide to System Security* for a complete list of all valid access names.

access-names

OpenVMS usage:	access_names
type:	array [0..31] of quadword string descriptor
access:	read only
mechanism:	by reference

The address of the access name table for the associated object class. For example, it is the value returned by the LIB$GET_ACCNAM routine in the **accnam** longword. This parameter is optional and defaults to the access name table for the FILE object class.

ownership-category

OpenVMS usage:	mask_word
type:	word (unsigned)
access:	read only
mechanism:	by reference

The address of a word that indicates the ownership category the access names refer to:

Ownership Category	Mask Value
System	0000000000001111
Owner	0000000011110000
Group	0000111100000000
World	1111000000000000

access-mask

OpenVMS usage:	mask_word
type:	word (unsigned)
access:	write only
mechanism:	by reference

The address of a word into which this routine writes the access mask. In this mask, a set bit means the access was requested for the specified ownership. Note that this is the opposite of the standard protection format where a set bit means no access.

end-position

OpenVMS usage:	word_signed
type:	word (signed)
access:	write only
mechanism:	by reference

The number of characters from **access-string** processed by LIB$PARSE_ACCESS_CODE. In the case of an error in parsing the access string, the offset to the offending location is returned.

Description

LIB$PARSE_ACCESS_CODE parses a string of access names and translates the string into a mask for the requested ownership category. The string is a concatenated list of 1-letter abbreviations of access names.

This routine works for any protected object class by specifying the correct access name table. The address of the access name table can be obtained from the LIB$GET_ACCNAM routine.

This routine is useful for building a protection mask where the ownership names have already been parsed. Use LIB$PARSE_SOGW_PROT for parsing a string containing both ownership and access names.

The mask returned has bits set for the access requested for the specified ownership category. This is opposite the standard protection format where a set bit in the protection mask means no access.

The number of characters processed is optionally returned. This is useful for error processing. The end position will be the offset to the character that made the access category name string invalid.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_IVARG	Required parameter missing or a character in **access-string** did not represent a valid access type.
LIB$_WRONGNUMARG	Wrong number of arguments.

LIB$PARSE_SOGW_PROT

LIB$PARSE_SOGW_PROT — The Parse Protection String routine parses and translates a protection string into a protection mask.

Format

```
LIB$PARSE_SOGW_PROT protection-string, [access-names], protection-mask, owner
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

protection-string

OpenVMS usage:	char_string
type:	character-coded text string
access:	read only
mechanism:	by descriptor

The address of a character-string descriptor pointing to the protection string. The string components are:

- Ownership name — System,Owner,Group,World. Ownership names can be specified in full or truncated to any number of characters. Matching is case blind, and spacing is ignored.
- Access name — Access names are always abbreviated to one letter. For example, access names for files are R (for read), W (for write), E (for execute), and D (for delete). Any combination can be passed. For example, RWE is a valid combination. A null access name specification means no access.
- Separators — Access names are separated from ownership names by either a colon (:) or an equal sign (=). The comma (,) is the list separator. A null access name specification means no access.

An example of a valid protection string is:

SYSTEM=RWED,OWNER:RWED,GROUP,WORLD:R

access-names

OpenVMS usage:	access_names

type:	array [0..31] of quadword string descriptor
access:	read only
mechanism:	by reference

The address of the access name table for the associated object class. For example, it is the value returned by the LIB$GET_ACCNAM routine in the **accnam** longword. This parameter is optional and defaults to the access name table for the FILE object class.

protection-mask

OpenVMS usage:	protection
type:	word (unsigned)
access:	write only
mechanism:	by reference

The address of a word into which this routine writes a 16-bit protection mask translation of the protection string. Each bit set in the mask indicates no access for the access type it represents.

ownership-mask

OpenVMS usage:	mask_word
type:	word (unsigned)
access:	write only
mechanism:	by reference

The address of a word that indicates which ownership names were present in the protection string.

Ownership Category	**Mask Value**
System	0000000000001111
Owner	0000000011110000
Group	0000111100000000
World	1111000000000000

end-position

OpenVMS usage:	word_signed
type:	word (signed)
access:	write only
mechanism:	by reference

The number of characters from **protection-string** processed by LIB$PARSE_SOGW_PROT. In the case of an error in parsing the protection string, the offset to the offending location is returned.

Description

LIB$PARSE_SOGW_PROT parses a protection string and translates the string into a 16-bit protection mask. LIB$PARSE_SOGW_PROT works for any protected object class by specifying the correct access name table.

The address of the access name table can be obtained from the LIB$GET_ACCNAM routine. Note that file access names are valid for any protected object class.

The number of characters processed is optionally returned. This is useful in error processing. The end position will be the offset to the character that made the protection string invalid. Note that the entire protection string must be valid, or an error is returned.

Several scenarios can cause the protection string to be invalid. The format of the protection string may be invalid, or the access category abbreviations may not be valid with respect to the access name tables.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_IVARG	Required parameter missing or invalid protection string.
LIB$_WRONGNUMARG	Wrong number of arguments.

LIB$PAUSE

LIB$PAUSE — The Pause Program Execution routine suspends program execution and returns control to the calling command level.

Format

LIB$PAUSE

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

None.

Description

LIB$PAUSE suspends program execution and returns control to the calling command level. The suspended image may be continued with the CONTINUE command, or it may be terminated with the EXIT or STOP command. In the latter case, the image will not return to this routine.

Note that this routine functions only for interactive jobs. If this routine is invoked in batch mode, it has no effect.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_NOCLI	No CLI present. The calling process does not have a CLI or the CLI does not support the request. Note that DCL supports this function in INTERACTIVE mode only.

LIB$POLYD

LIB$POLYD — The Evaluate Polynomials routine (D-floating values) allows higher-level language users to evaluate D-floating value polynomials. D-floating values are not supported in full precision in native OpenVMS Alpha and I64 programs. They are precise to 56 bits on VAX systems, 53 or 56 bits in translated VAX images, and 53 bits in native OpenVMS Alpha and I64 programs.

Format

```
LIB$POLYD polynomial-argument ,degree ,coefficient ,floating-point-result
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	D_floating
access:	read only
mechanism:	by reference

The address of a D-floating number that is the argument for the polynomial.

degree

OpenVMS usage:	word_signed
type:	word integer (signed)
access:	read only
mechanism:	by reference

The address of a signed word integer that is the highest-numbered nonzero coefficient to participate in the evaluation.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point

type:	D_floating
access:	read only
mechanism:	by reference, array reference

The address of an array of D-floating coefficients. The coefficient of the highest order term of the polynomial is the lowest-addressed element in the array.

floating-point-result

OpenVMS usage:	floating_point
type:	D_floating
access:	write only
mechanism:	by reference

The address of a floating-point number that is the result of the calculation. LIB$POLYD writes the address of *floating-point-result* into a D-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (63 bits for POLYD).

Description

LIB$POLYD provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result `D` is the degree of the polynomial and `X` is the argument.

See the *VAX Architecture Reference Manual* for the detailed description of POLY.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

Example

The Fortran and Pascal examples provided in the description of LIB$POLYF also demonstrate how to use LIB$POLYD. Please refer to those examples for assistance in using this routine.

LIB$POLYF

LIB$POLYF — The Evaluate Polynomials routine (F-floating values) allows higher-level language users to evaluate F-floating polynomials.

Format

LIB$POLYF polynomial-argument ,degree ,coefficient ,floating-point-result

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference

Argument for the polynomial. The *polynomial-argument* argument is the address of a floating-point number that contains this argument. The *polynomial-argument* argument is an F-floating number.

degree

OpenVMS usage:	word_signed
type:	word (signed)
access:	read only
mechanism:	by reference

Highest-numbered nonzero coefficient to participate in the evaluation. The *degree* argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point
type:	F_floating
access:	read only
mechanism:	by reference, array reference

The address of an array of floating-point coefficients. The coefficient of the highest-order term of the polynomial is the lowest addressed element in the array. The *coefficient* argument is an array of F-floating numbers.

floating-point-result

OpenVMS usage:	floating_point
type:	F_floating

access:	write only
mechanism:	by reference

Result of the calculation. The *floating-point-result* argument is the address of a floating-point number that contains this result. LIB$POLYF writes the address of *floating-point-result* into an F-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (31 bits for POLYF).

Description

LIB$POLYF provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result `D` is the degree of the polynomial and `X` is the argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

Examples

1.
```
C+
C This Fortran example demonstrates how to use
C LIB$POLYF.
C-

        REAL*4 X,COEFF(5),RESULT
        INTEGER*2 DEG

C+
C Compute X^4 + 2*X^3 -X^2 + X - 3 using POLYF.
C Let X = 2.
C The coefficients needed are as follows:
C-

        DATA COEFF/1.0,2.0,-1.0,1.0,-3.0/
        X = 2.0
        DEG = 4 ! DEG has word length.

C+
C Calculate (2)^4 + 2*(2^3) -2^2 + 2 - 3.
C The result should be 27.
C-

        RETURN = LIB$POLYF(X,DEG,COEFF,RESULT)
        TYPE *,'(2)^4 + 2*(2^3) -2^2 + 2 - 3 = ',RESULT
        END
```

This Fortran example demonstrates how to call LIB$POLYF. The output generated by this program is as follows:

```
  (2)^4 + 2*(2^3) -2^2 + 2 - 3 =    27.00000
```

2.
```
PROGRAM POLYF(INPUT,OUTPUT);

{+}
{ This Pascal program demonstrates how to use
{ LIB$POLYF to evaluate a polynomial.
{-}

    TYPE
        WORD = [WORD] 0..65535;
    VAR
        COEFF : ARRAY [0..2] OF REAL := (1.0,2.0,2.0);
        RESULT : REAL;
        RETURNED_STATUS : INTEGER;

    [EXTERNAL] FUNCTION LIB$POLYF(
        ARG : REAL;
        DEGREE : WORD;
        COEFF : [REFERENCE] ARRAY [L..U:INTEGER] OF REAL;
        VAR RESULT : REAL
        ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STOP(
        CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
        FAO_ARGS : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
        ) : INTEGER; EXTERNAL;

BEGIN

{+}
{ Call LIB$POLYF to evaluate 2(X**2) + 2*X + 1.
{-}

RETURNED_STATUS := LIB$POLYF(1.0,2,COEFF,RESULT);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

WRITELN('F(1.0) = ',RESULT:5:2);

END.
```

This example program demonstrates how to call LIB$POLYF from Pascal. The output generated by this Pascal program is as follows:

```
$ RUN POLYF
F(1.0) = 5.00
```

LIB$POLYG

LIB$POLYG — The Evaluate Polynomials routine (G-floating values) allows higher-level language users to evaluate G-floating value polynomials.

Format

LIB$POLYG polynomial-argument ,degree ,coefficient ,floating-point-result

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	G_floating
access:	read only
mechanism:	by reference

Argument for the polynomial. The *polynomial-argument* argument is the address of a floating-point number that contains this argument. The *polynomial-argument* argument is a G-floating number.

degree

OpenVMS usage:	word_signed
type:	word integer (signed)
access:	read only
mechanism:	by reference

Highest-numbered nonzero coefficient to participate in the evaluation. The *degree* argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point
type:	G_floating
access:	read only
mechanism:	by reference, array reference

Floating-point coefficients. The *coefficient* argument is the address of an array of floating-point coefficients. The coefficient of the highest-order term of the polynomial is the lowest addressed element in the array. The *coefficient* argument is an array of G-floating numbers.

floating-point-result

OpenVMS usage:	floating_point
type:	G_floating
access:	write only
mechanism:	by reference

Result of the calculation. The *floating-point-result* argument is the address of a floating-point number that contains this result. LIB$POLYG writes the address of *floating-point-result* into a G-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (63 bits for POLYG).

Description

LIB$POLYG provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result `D` is the degree of the polynomial and `X` is the argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

Example

The Fortran and Pascal examples provided in the description of LIB$POLYF also demonstrate how to use LIB$POLYG. Please refer to those examples for assistance in using this routine.

LIB$POLYH

LIB$POLYH — On OpenVMS VAX systems, the Evaluate Polynomials routine (H-floating values) allows higher-level language users to evaluate H-floating value polynomials. This routine is not available to native OpenVMS Alpha and I64 programs but is available to translated VAX images.

Format

LIB$POLYH polynomial-argument ,degree ,coefficient ,floating-point-result

Returned

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	H_floating
access:	read only
mechanism:	by reference

Argument for the polynomial. The *polynomial-argument* argument is the address of a floating-point number that contains this argument. The *polynomial-argument* argument is an H-floating number.

degree

OpenVMS usage:	word_signed
type:	word integer (signed)
access:	read only
mechanism:	by reference

Highest-numbered nonzero coefficient to participate in the evaluation. The *degree* argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point
type:	H_floating
access:	read only
mechanism:	by reference, array reference

Floating-point coefficients. The *coefficient* argument is the address of an array of floating-point coefficients. The coefficient of the highest-order term of the polynomial is the lowest addressed element in the array. The *coefficient* argument is an array of H-floating numbers.

floating-point-result

OpenVMS usage:	floating_point
type:	H_floating
access:	write only
mechanism:	by reference

Result of the calculation. The *floating-point-result* argument is the address of a floating-point number that contains this result. LIB$POLYH writes the address of *floating-point-result* into an H-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (127 bits for POLYH).

Description

LIB$POLYH provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result `D` is the degree of the polynomial and `X` is the argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

Example

The Fortran and Pascal examples provided in the description of LIB$POLYF also demonstrate how to use LIB$POLYH. Please refer to those examples for assistance in using this routine.

LIB$POLYS

LIB$POLYS — The Evaluate Polynomials routine (IEEE S-floating values) allows higher-level language users to evaluate IEEE S-floating polynomials.

Format

`LIB$POLYS polynomial-argument ,degree ,coefficient ,floating-point-result`

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	IEEE S_floating
access:	read only

mechanism:	by reference

Argument for the polynomial. The *polynomial-argument* argument is the address of a floating-point number that contains this argument. The *polynomial-argument* argument is an IEEE S-floating number.

degree

OpenVMS usage:	word_signed
type:	word (signed)
access:	read only
mechanism:	by reference

Highest-numbered nonzero coefficient to participate in the evaluation. The *degree* argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point
type:	IEEE S_floating
access:	read only
mechanism:	by reference, array reference

The address of an array of floating-point coefficients. The coefficient of the highest-order term of the polynomial is the lowest addressed element in the array. The *coefficient* argument is an array of IEEE S-floating numbers.

floating-point-result

OpenVMS usage:	floating_point
type:	IEEE S_floating
access:	write only
mechanism:	by reference

Result of the calculation. The *floating-point-result* argument is the address of a floating-point number that contains this result. LIB$POLYS writes the address of *floating-point-result* into an IEEE S-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (31 bits for POLYS).

Description

LIB$POLYS provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result, D is the degree of the polynomial and X is the argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

Example

```
/*
** This C example demonstrates how to use LIB$POLYS.
*/

#if !(__IEEE_FLOAT)
#error "Compile module with /FLOAT=IEEE_FLOAT"
#endif

#include <stdio.h>
#include <lib$routines.h>

main ()
{
    float x = 2.0;
    float result = 0;
    float coeff[5] = {1.0, 2.0, -1.0, 1.0, -3.0};
    short deg = 4;
    int status;

    status = lib$polys(&x, &deg, &coeff, &result);
    if ((status & 1) != 1) lib$stop(status);

    printf ("(2)^4 + 2*(2^3) -2^2 + 2 - 3 = %f (27.000000)\n",
    result);
}
```

This C example demonstrates how to call LIB$POLYS. The output generated by this program is as follows:

```
(2)^4 + 2*(2^3) -2^2 + 2 - 3 = 27.000000 (27.000000)
```

LIB$POLYT

LIB$POLYT — The Evaluate Polynomials routine (IEEE T-floating values) allows higher-level language users to evaluate IEEE T-floating polynomials.

Format

LIB$POLYT polynomial-argument ,degree ,coefficient ,floating-point-result

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

polynomial-argument

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	read only
mechanism:	by reference

Argument for the polynomial. The *polynomial-argument* argument is the address of a floating-point number that contains this argument. The *polynomial-argument* argument is an IEEE T-floating number.

degree

OpenVMS usage:	word_signed
type:	word (signed)
access:	read only
mechanism:	by reference

Highest-numbered nonzero coefficient to participate in the evaluation. The *degree* argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

coefficient

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	read only
mechanism:	by reference,

The address of an array of floating-point coefficients. The coefficient of the highest-order term of the polynomial is the lowest addressed element in the array. The *coefficient* argument is an array of IEEE T-floating numbers.

floating-point-result

OpenVMS usage:	floating_point
type:	IEEE T_floating
access:	write only
mechanism:	by reference

Result of the calculation. The *floating-point-result* argument is the address of a floating-point number that contains this result. LIB$POLYT writes the address of *floating-point-result* into an IEEE T-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (31 bits for POLYT).

Description

LIB$POLYT provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

```
result = C[0]+X*(C[1]+X*(C[2]+...X*(C[D])...))
```

In the above result, D is the degree of the polynomial and X is the argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_FLTOVF	Floating overflow.
SS$_ROPRAND	Reserved operand.

LIB$PUT_COMMON

LIB$PUT_COMMON — The Put String to Common routine copies the contents of a string into the common area. The common area is an area of storage that remains defined across multiple image activations in a process. Optionally, LIB$PUT_COMMON returns the actual number of characters copied. The maximum number of characters that can be copied is 252.

Format

LIB$PUT_COMMON source-string [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be copied to the common area by LIB$PUT_COMMON. The *source-string* argument is the address of a descriptor pointing to this source string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of characters copied by LIB$PUT_COMMON to the common area. The *resultant-length* argument is the address of an unsigned word integer that contains this number of characters. LIB$PUT_COMMON writes this number into the *resultant-length* argument.

Description

LIB$PUT_COMMON and LIB$GET_COMMON allow programs to copy strings to and from the common area. The programs reading and writing the data in the common area must agree upon its amount and format. The maximum length of the destination string is defined as follows:

```
[min(256, the length of the data in the common storage area) - 4]
```

Thus, the maximum length is 252.

In BASIC and Fortran, you can use these routines to allow a USEROPEN routine to pass information back to the routine that called it. A USEROPEN routine cannot write arguments. However, it can call LIB$PUT_COMMON to put information into the common area. The calling program can then use LIB $GET_COMMON to retrieve it.

You can also use these routines to pass information between images run successively, such as chained images run by LIB$RUN_PROGRAM. Since the common area is unique to each process, do not use LIB$GET_COMMON and LIB$PUT_COMMON to share information across processes.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Successfully completed, but the source string was truncated.

LIB$PUT_INVO_REGISTERS

LIB$PUT_INVO_REGISTERS — The Put Invocation Registers routine modifies specified values in a procedure's invocation context. A procedure's invocation context consists of the values stored in the

integer and floating-point registers as well as the program counter and the processor status registers. LIB $PUT_INVO_REGISTERS updates internal register save areas with the new values. These values are written to the active register set by the time control returns to the procedure asociated with the specified invocation handle.

Format

LIB$PUT_INVO_REGISTERS invo_handle, invo_context, invo_mask

Returns

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	write only
mechanism:	by value

Status value. A value of 1 indicates success. When the initial context represents the bottom of the call chain, a value of 0 is returned.

Arguments

invo_handle

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	read only
mechanism:	by value

Handle for the invocation to be updated.

invo_handle

OpenVMS usage:	invo_handle
type:	longword (unsigned)
access:	read only
mechanism:	

Handle for the invocation to be updated.

invo_context

OpenVMS usage:	invo_context_blk
type:	structure
access:	read only
mechanism:	by reference

Address of an invocation context block that contains the values to be written to the registers.

Each register that is set in the *invo_mask* parameter is updated using the value found in the corresponding IREG or FREG field of the invocation context block. The program counter and processor status of the given invocation can also be updated in this way. No other fields of the invocation context block are used.

invo_mask

OpenVMS usage:	mask_quadword
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Address of a 64-bit vector, where each bit corresponds to a register field in the passed *invo_context*. Bits 0 through 29 correspond to IREG[0] through IREG[29], bit 30 corresponds to STACK_POINTER and cannot be changed, bit 31 corresponds to PROGRAM_COUNTER, bits 32 through 62 correspond to FREG[0] through FREG[30], and bit 63 corresponds to PROCESSOR_STATUS.

Description

LIB$PUT_INVO_REGISTERS updates a given procedure invocation context's fields with new register contents.

Note

Only the conventional saved registers (R2 through R15) can be modified reliably in this way. Any modification to scratch registers may be overwritten by code in intervening procedure invocations. Any attempt to modify the control register R29 may result in unpredictable program behavior. The control register R30 cannot be modified. A value of 0 will be returned if bit 30 is set.

Therefore, an action such as reading the context of a given procedure invocation and then updating that context in its entirety may not produce the desired results, whether or not you have made any modifications. When using this routine, the caller should plan carefully and should explicitly modify only those register values that need to be modified.

See the *VSI OpenVMS Calling Standard* manual for additional information.

Condition Values Returned

None.

LIB$PUT_OUTPUT

LIB$PUT_OUTPUT — The Put Line to SYS$OUTPUT routine writes a record to the current controlling output device, specified by SYS$OUTPUT using the OpenVMS RMS $PUT service.

Format

LIB$PUT_OUTPUT message-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

message-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Message string written to the current controlling output device by LIB$PUT_OUTPUT. The *message-string* argument is the address of a descriptor pointing to this message string. RMS handles all formatting, so the message does not need to include such ASCII formatting instructions as carriage return (CR).

Description

When you log in, OpenVMS operating systems create three files as default I/O control streams for your process:

- SYS$INPUT, your default input device
- SYS$OUTPUT, your default output device
- SYS$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or batch commands and the OpenVMS software. Initially, all three are equated with the terminal. However, with the DCL command ASSIGN, you can change these assignments to obtain information from a file or put information into a file. SYS$INPUT and SYS$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS$COMMAND refers to the terminal and SYS$INPUT refers to the command file.

On the first call to LIB$PUT_OUTPUT, if the output file is not a process-permanent file, LIB $PUT_OUTPUT opens the output file and positions it at the end-of-file mark. If no output file exits on the first call, LIB$PUT_OUTPUT creates a file. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls.

LIB$PUT_OUTPUT uses RMS to format records on output, and RMS records have implied carriage control. That is, a record normally corresponds to a line of text. Therefore, if you want explicit carriage control, instead of implied carriage control, you must supply it yourself within the source string.

LIB$PUT_OUTPUT is the most convenient way for a MACRO or BLISS program to write information to SYS$OUTPUT.

If you have several shareable images that call LIB$PUT_OUTPUT, and if each shareable image includes its own copy of LIB$PUT_OUTPUT, your program could produce multiple output streams and multiple versions of your output file. A single application should reference one copy of LIB$PUT_OUTPUT.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

Any condition values returned by RMS.

Example

```
10      !+
        ! This BASIC program demonstrates how to use
        ! LIB$PUT_OUTPUT to output a simple message.
        !-

        MSGSTR$ = 'This is a sample message'
        CALL LIB$PUT_OUTPUT(MSGSTR$)

        !+
        ! In this example, the default value of
        ! SYS$OUTPUT is used. Therefore, the
        ! output is 'put' to the terminal screen.
        !-

90      END
```

This BASIC program shows the use of LIB$PUT_OUTPUT. The output generated by this BASIC example is as follows:

```
    This is a sample message
```

LIB$RADIX_POINT

LIB$RADIX_POINT — The Radix Point Symbol routine returns the system's radix point symbol. This symbol is used inside a digit string to separate the integer part from the fraction part. This routine works by attempting to translate the logical name SYS$RADIX_POINT as a process, group, or system logical name.

Format

LIB$RADIX_POINT radix-point-string [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

radix-point-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Radix point string. The *radix-point-string* argument is the address of a descriptor pointing to this radix point string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

The number of characters written into *radix-point-string*, not counting padding in the case of a fixed-length string. The *resultant-length* argument is the address of an unsigned word that contains this number.

If the *radix-point-string* argument is the address of a fixed-length string descriptor, there may not be enough characters in the fixed-length string to contain the whole radix point string, and the radix point string is truncated. If the radix point string is truncated to the size specified in a fixed-length string descriptor, *resultant-length* is set to this size. Therefore, *resultant-length* can always be used by the calling program to access a valid substring of *radix-point-string*.

Description

If unable to translate the logical name SYS$RADIX_POINT, LIB$RADIX_POINT returns the United States radix point symbol (.). If the translation succeeds, the text produced is returned. Thus, a system manager can define SYS$RADIX_POINT as a systemwide logical name to provide a default for all users, and an individual user with a special need can define SYS$RADIX_POINT as a process logical name to override the default.

LIB$RADIX_POINT is used implicitly by BASIC.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Successfully completed, but the radix point string was truncated.
LIB$_FATERRLIB	Fatal internal error.
LIB$_INSVIRMEM	Insufficient virtual memory.

LIB$_INVSTRDES	Invalid string descriptor.

LIB$REMQHI

LIB$REMQHI — The Remove Entry from Head of Queue routine removes an entry from the head of the specified self-relative longword interlocked queue. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. LIB$REMQHI makes the REMQHI instruction available as a callable routine.

Format

LIB$REMQHI header ,remque-address [,retry-count]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

header

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue from which *entry* will be removed. The *header* argument contains the address of this signed aligned quadword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

On Alpha and I64 systems, the *header* argument must contain a 32-bit address. A 64-bit address results in an illegal operand exception.

remque-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Address of the removed entry. The *remque-address* argument is the address of an unsigned longword that contains this address. If the queue was empty, *remque-address* is set to the address of the header.

On Alpha and I64 systems, the *remque-address* argument must contain a 32-bit address. A 64-bit address results in an illegal operand exception.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue from which LIB$REMQHI removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB$INSQHI, LIB$INSQTI, LIB$REMQHI, and LIB$REMQTI routines to manage your self-relative longword queue on a VAX, Alpha, or I64 system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB$GET_VM on a VAX, Alpha, or I64 system to allocate quadword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue contains one or more entries.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue is empty.
LIB$_QUEWASEMP	The queue was empty. The queue is not modified.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by *retry-count*. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$REMQHIQ

LIB$REMQHIQ — The Remove Entry from Head of Queue routine removes an entry from the head of the specified self-relative quadword interlocked queue. LIB$REMQHIQ makes the REMQHIQ instruction available as a callable routine.

Format

LIB$REMQHIQ header ,remque-address [,retry-count]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

header

OpenVMS usage:	octaword_signed
type:	octaword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue from which entry will be removed. The *header* argument contains the address of this signed aligned octaword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

remque-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Address of the removed entry. The *remque-address* argument is the address of an unsigned quadword that contains this address. If the queue was empty, *remque-address* is set to the address of the header.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue from which LIB$REMQHIQ removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB$INSQHIQ, LIB$INSQTIQ, LIB$REMQHIQ, and LIB$REMQTIQ routines to manage your self-relative quadword queue on an Alpha or I64 system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB$GET_VM_64 to allocate octaword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue contains one or more entries.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue is empty.
LIB$_QUEWASEMP	The queue was empty. The queue is not modified.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by retry-count. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$REMQTI

LIB$REMQTI — The Remove Entry from Tail of Queue routine removes an entry from the tail of the specified self-relative longword interlocked queue. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. LIB$REMQTI makes the REMQTI instruction available as a callable routine.

Format

```
LIB$REMQTI header ,remque-address [,retry-count]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

header

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)

access:	modify
mechanism:	by reference

Queue header specifying the queue from which the entry is to be deleted. The *header* argument contains the address of this signed aligned quadword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

On Alpha and I64 systems, the *header* argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

remque-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Address of the removed entry. The *remque-address* argument is the address of a longword that contains this address. If the queue was empty, *remque-address* is set to the address of the header.

On Alpha and I64 systems, the *remque-address* argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword that is this retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue from which LIB$REMQTI removes an in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB$INSQHI, LIB$INSQTI, LIB$REMQHI, and LIB$REMQTI routines to manage your self-relative longword queue on a VAX, Alpha, or I64 system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB$GET_VM on a VAX, Alpha, or I64 system to allocate quadword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was removed from the queue tail, and the resulting queue contains one or more entries.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was removed from the queue tail, and the resulting queue is empty.
LIB$_QUEWASEMP	Queue was empty. The queue is not modified.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by *retry-count*. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$REMQTIQ

LIB$REMQTIQ — The Remove Entry from Tail of Queue routine removes an entry from the tail of the specified self-relative quadword interlocked queue. LIB$REMQTIQ makes the REMQTIQ instruction available as a callable routine.

Format

LIB$REMQTIQ header ,remque-address [,retry-count]

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

header

OpenVMS usage:	octaword_signed
type:	octaword integer (signed)
access:	modify
mechanism:	by reference

Queue header specifying the queue from which the entry is to be deleted. The *header* argument contains the address of this signed aligned octaword integer. The *header* argument must be initialized to zero before first use of the queue; zero means an empty queue.

remque-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Address of the removed entry. The *remque-address* argument is the address of a quadword that contains this address. If the queue was empty, *remque-address* is set to the address of the header.

retry-count

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The *retry-count* argument is the address of a longword that is this retry count value. A value of 1 causes no retries. The default value is 10.

Description

The queue from which LIB$REMQTIQ removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB$INSQHIQ, LIB$INSQTIQ, LIB$REMQHIQ, and LIB$REMQTIQ routines to manage your self-relative quadword queue on an Alpha or I64 system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB$GET_VM_64 to allocate octaword-aligned virtual memory for a queue.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. The entry was removed from the queue tail, and the resulting queue contains one or more entries.
SS$_ROPRAND	Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.
LIB$_ONEENTQUE	Routine successfully completed. The entry was removed from the queue tail, and the resulting queue is empty.
LIB$_QUEWASEMP	Queue was empty. The queue is not modified.
LIB$_SECINTFAI	A secondary interlock failure occurred; the insertion was attempted the number of times specified by retry-count. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB$RENAME_FILE

LIB$RENAME_FILE — The Rename One or More Files routine changes the names of one or more files. The specification of the files to be renamed can include wildcards. LIB$RENAME_FILE is similar in function to the DCL command RENAME.

Format

LIB$RENAME_FILE old-filespec ,new-filespec [,default-filespec] [,related-filespec]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

old-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

File specification of the files to be renamed. The *old-filespec* argument is the address of a descriptor pointing to the old file specification. The specification may include wildcards, in which case each file that matches the specification will be renamed. If running on Alpha or I64 and flag LIB $M_FIL_LONG_NAMES is set, the string must not contain more characters than specified by NAML $C_ MAXRSS, otherwise the string must not contain more than 255 characters. Any string class is supported.

new-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

File specification for the new file names. The *new-filespec* argument is the address of a descriptor pointing to the new file specification.

This specification need not be complete; fields omitted or specified by using the wildcard character (*) will be filled in from the existing file's name using the same rules as for the DCL command RENAME. If running on Alpha or I64 and flag LIB$M_FIL_LONG_NAMES is set, the string must not contain more characters than specified by NAML$C_MAXRSS, otherwise the string must not contain more than 255 characters. Any string class is supported.

default-filespec

OpenVMS usage:	char_string
type:	character string

access:	read only
mechanism:	by descriptor

Default file specification of the files to be renamed. The *default-filespec* argument is the address of a descriptor pointing to the default file specification.

This is an optional argument; if omitted, the default is the null string. See the *OpenVMS Record Management Services Reference Manual* for information on default file specifications. If running on Alpha or I64 and flag LIB$M_FIL_ LONG_NAMES is set, the string must not contain more characters than specified by NAML$C_MAXRSS, otherwise the string must not contain more than 255 characters. Any string class is supported.

related-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Related file specification of the files to be renamed. The *related-filespec* argument is the address of a descriptor pointing to the related file specification. This is an optional argument; if omitted, the default is the null string. Any string class is supported.

Input file parsing is used. (See the *OpenVMS Record Management Services Reference Manual* for information on related file specifications and input file parsing.)

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. Any string class is supported. This is an optional argument.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by descriptor

Longword of flag bits designating optional behavior. The *flags* argument is the address of an unsigned longword containing the flag bits. This is an optional argument; if omitted, the default is that all flags are clear.

The bit number and its meaning are as follows:

Bit	Symbol	Description
0	LIB$M_FIL_CUR_VER	If *new-filespec* does not specify a version number, this flag controls whether a new version number for the output file is to be assigned. If this bit is set, the current version number of the file is used.

Bit	Symbol	Description
		If this bit is clear, the file is given a version number 1 higher than any previously existing file of the same file name and file type. This is the default action. If a file already exists with the same file name, type and version number, the error RMS$_FEX is given. This flag is equivalent to the /NONEW_VERSION qualifier of the DCL command RENAME.)
1	LIB$M_FIL_INH_SECUR	Controls whether the renamed file takes on security attributes of the new location or keeps its existing security attributes. If this bit is clear, the attributes of the renamed file are inherited from the next lower version of the new file name, if any, the new parent directory, or both. If this bit is clear, the file's security attributes are not changed; this is the default action. For more information on file security, see the *VSI OpenVMS Guide to System Security*. This flag is equivalent to the /INHERIT_SECURITY qualifier of the DCL command RENAME.
2	LIB$M_FIL_LONG_NAMES	(Alpha and I64 only) Controls whether to accept file specifications greater than 255 characters in length. If this bit is set, LIB$RENAME_FILE can process files specifications with a maximum length of NAML$C_ MAXRSS characters. If this bit is clear, LIB $RENAME_FILE can process files names with a maximum length of 255 characters.

user-success-procedure

OpenVMS usage:	procedure

type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied success routine that LIB$RENAME_FILE calls after each successful rename.

For further information on the success routine, see Call Format for a Success Routine in the Description section.

user-error-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied error routine that LIB$RENAME_FILE calls when it detects an error. The value returned by the error routine determines whether LIB$RENAME_FILE processes more files. For further information on the error routine, see Call Format for an Error Routine in the Description section.

user-confirm-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied confirm routine that LIB$RENAME_FILE calls before it renames a file. The value returned by the confirm routine determines whether or not LIB$RENAME_FILE renames the file.

The confirm routine can be used to select specific files for renaming based on criteria such as expiration date, size, and so on.

For further information on the confirm routine, see Call Format for a Confirm Routine in the Description section.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

Value that LIB$RENAME_FILE passes to the success, error, and confirm routines each time they are called. Whatever mechanism is used to pass *user-specified-argument* to LIB $RENAME_FILE is also used to pass it to the user-supplied routines. This is an optional argument; if omitted, zero is passed by value.

old-resultant-name

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String into which LIB$RENAME_FILE copies the old resultant file specification of the last file processed. This is an optional argument. If present, it is used to store the file specification passed to the user-supplied routines instead of a default class S, type T string. Any string class is supported.

If you are specifying one or more of the action routine arguments, be sure that the descriptor class used to pass *resultant-name* is the same as the descriptor class required by the action routine. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines, but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.

new-resultant-name

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

String into which LIB$RENAME_FILE writes the new OpenVMS RMS resultant file specification of the last file processed. The *new-resultant-name* argument is the address of a descriptor pointing to the new name. This is an optional argument. If present, it is used to store the file specification passed to the user-supplied routines instead of a class S, type T string. Any string class is supported.

If you are specifying one or more of the action routine arguments, be sure that the descriptor class used to pass *resultant-name* is the same as the descriptor class required by the action routine. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines, but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.

file-scan-context

OpenVMS usage:	context
type:	longword (unsigned)
access:	modify
mechanism:	by reference

Context for renaming a list of file specifications. The *file-scan-context* is the address of a longword that contains this context. You must initialize this longword to zero before the first of a series of calls to LIB$RENAME_FILE. LIB$RENAME_FILE uses the file scan context to retain the file context for multiple input files.

LIB$FILE_SCAN uses this context to retain multiple input file related file context. This is an optional argument; it need only be specified if you are using multiple input files, as the DCL command RENAME does. You may deallocate the context allocated by LIB$FILE_SCAN while processing the LIB$RENAME_ FILE requests by calling LIB$FILE_SCAN_END after all calls to LIB$RENAME_

FILE have been completed. See the description of LIB$FILE_SCAN for a more detailed description of this argument.

Description

This description is divided into three parts:

- Call Format for a Success Routine
- Call Format for an Error Routine
- Call Format for a Confirm Routine

Call Format for a Success Routine

The success routine is optional; it is called only if the user-success-procedure argument is specified in the call to LIB$RENAME_FILE.

The calling format of a success routine is as follows:

```
user-success-procedure old-filespec ,new-filespec [,user-specified-
argument]
```

old-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification of the file before it was renamed. If *old-resultant-name* was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

new-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification of the newly renamed file. If *new-resultant-name* was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only

mechanism:	unspecified

Value of *user-specified-argument* passed by LIB$RENAME_FILE to the success routine using the same passing mechanism that was used to pass it to LIB$RENAME_FILE.

Call Format for an Error Routine

The error routine returns a success/fail value that LIB$RENAME_FILE uses to determine whether or not more files will be processed if an error is encountered. The error routine is called only if the *user-error-procedure* argument was specified in the call to LIB$RENAME_FILE. If the *user-error-procedure* argument was not specified, the default is to continue processing.

The calling format of the error routine is as follows:

```
user-error-procedure old-filespec ,new-filespec ,rms-sts ,rms-stv ,error-
source ,user-specified-argument
```

old-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification of the file being renamed when the error occurred. If *old-resultant-name* was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

new-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification of the new file name being used when the error occurred. If *new-resultant-name* was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

rms-sts

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Primary condition code (FAB$L_STS) which describes the error that occurred. The *rms-sts* argument is the address of an unsigned longword that contains this primary condition code.

rms-stv

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Secondary condition code (FAB$L_STV) which describes the error that occurred. The *rms-stv* argument is the address of an unsigned longword that contains this secondary condition code.

error-source

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Integer code indicating where the error was found. The *error-source* argument is the address of a longword containing the error source.

The values of *error-source* and their meanings are as follows:

0	Error searching for *old-filespec*
1	Error parsing *new-filespec*
2	Error renaming file

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	unspecified

Value of *user-specified-argument* that LIB$RENAME_FILE passes to the error routine using the same passing mechanism that was used to pass it to LIB$RENAME_FILE.

If the error routine returns a success status (bit 0 set), then LIB$RENAME_FILE will continue processing files. If the error routine returns a failure status (bit 0 clear), processing ceases immediately and LIB$RENAME_FILE returns with an error status.

If the *user-error-procedure* argument is not specified, LIB$RENAME_FILE will return to its caller the most severe error status encountered while renaming the files. If the error routine is called for an error, the success status LIB$_ ERRROUCAL is returned.

The error routine is not called for errors related to string copying.

Call Format for a Confirm Routine

The calling format of a confirm routine is as follows:

```
user-confirm-procedure old-filespec ,new-filespec ,old-fab [,user-
specified-argument]
```

old-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification of the file about to be renamed. If *old-resultant-name* was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

new-filespec

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

RMS resultant file specification which the file will be given. If *new-resultant-name* was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

old-fab

OpenVMS usage:	fab
type:	unspecified
access:	read only
mechanism:	by reference

Address of the RMS FAB that describes the file being renamed. Your program may perform an RMS $OPEN on the FAB to obtain file attributes it needs to determine whether the file should be renamed, but must close the file with $CLOSE before returning to LIB$RENAME_FILE.

(Alpha and I64 only) If the LIB$M_FIL_LONG_NAMES FLAGS is set, the FAB references a NAML block rather than a NAM block. The NAML block supports the use of long file specifications with a maximum length of NAML$C_MAXRSS. See the *OpenVMS Record Management Services Reference Manual* for information on NAML blocks.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	unspecified

Value of *user-specified-argument* passed by LIB$RENAME_FILE to the confirm routine using the same passing mechanism that was used to pass it to LIB$RENAME_FILE. This is an optional argument.

If the confirm routine returns a success value (bit 0 set), the file is renamed; otherwise, the file is not renamed.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_ERRROUCAL	Success—error routine called. A file error was encountered but the error routine was called to handle the condition.
LIB$_INVARG	Invalid argument. The *flags* argument has one or more undefined bits set.
LIB$_INVFILSPE	Invalid file specification. On VAX, *old-filespec*, *new-filespec*, or *default-filespec* contains more than 255 characters. On Alpha and I64, *old-filespec*, *new-filespec*, or *default-filespec* contains more than NAML $C_MAXRSS characters.
LIB$_INVSTRDES	Invalid string descriptor. One of the string argument descriptors was not a valid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$RENAME_FILE.

Any condition value returned by LIB$SCOPY_*xxx*; truncation errors are ignored.

Any condition value returned by RMS. If the *user-error-procedure* argument was not specified, this is the most severe of the RMS errors which occurred while renaming the files.

LIB$RESERVE_EF

LIB$RESERVE_EF — The Reserve Event Flag routine allocates a local event flag number specified by *event-flag-number*.

Format

LIB$RESERVE_EF event-flag-number

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

event-flag-number

OpenVMS usage:	ef_number
type:	longword (unsigned)

access:	read only
mechanism:	by reference

Event flag number to be allocated by LIB$RESERVE_EF. The *event-flag-number* argument contains the address of a signed longword integer that is this event flag number.

Description

LIB$RESERVE_EF allocates a specific local event flag. It differs from LIB$GET_EF, which allocates an arbitrary local event flag, which is the recommended procedure. Reserving a specific local event flag is not recommended because another routine may attempt to use the same flag, and the flag will no longer function as expected.

The following table lists the availability of local event flags.

Number	Availability
0	Never used by this routine and always available
1 through 23	Initially reserved; available after being freed by LIB$FREE_EF
24 through 31	Reserved to OpenVMS
32 through 63	Initially free

Note

Beware of running multiple images linked with /NOSYSSHR in the same process and having more than one image make calls to LIB$RESERVE_EF. Each image contains its own copy of the event flag bit array that is designed to be process-wide and synchronize ownership of event flags. Multiple calls to LIB $GET_EF could cause the same event flag to be allocated more than once.

See the *VSI OpenVMS Programming Concepts Manual* for more information.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_EF_ALRRES	Event flag already reserved.
LIB$_EF_RESSYS	Event flag reserved to system. This occurs if the event flag number is outside the ranges of 1 through 23 and 32 through 63.

Example

```
PROGRAM RESERVE_EF(INPUT, OUTPUT);

routine LIB$RESERVE_EF(%REF EVENT_FLAG_NUM : INTEGER); EXTERN;
routine LIB$FREE_EF(%REF EVENT_FLAG_NUM : INTEGER); EXTERN;

VAR
  FLAG_NUM : INTEGER;

BEGIN
```

```
  FLAG_NUM := 37;
  LIB$RESERVE_EF(FLAG_NUM);
  WRITELN(FLAG_NUM);
  LIB$FREE_EF(FLAG_NUM);
END.
```

This Pascal program generates the following output:

```
      37
```

LIB$RESET_VM_ZONE

LIB$RESET_VM_ZONE — The Reset Virtual Memory Zone routine frees all blocks of memory that were previously allocated from a zone in the 32-bit virtual address space. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$RESET_VM_ZONE zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier. The *zone-id* is the address of a longword that contains the identifier of a zone created by a previous call to LIB$CREATE_VM_ZONE or LIB$CREATE_USER_VM_ZONE.

Description

LIB$RESET_VM_ZONE frees all the blocks of memory that were previously allocated from the zone. The memory becomes available to satisfy further allocation requests for the zone; the memory is not returned to the processwide 32-bit page pool managed by LIB$GET_VM_PAGE. Your program can continue to use the zone after you call LIB$RESET_VM_ZONE.

Resetting a zone is a much more efficient way to reuse storage than individually freeing each allocated object in the zone.

It is the caller's responsibility to ensure that he or she has “exclusive” access to the zone while the reset operation is being performed. Results are unpredictable if another thread of control attempts to perform any operation on the zone while LIB$RESET_VM_ZONE is in progress.

If you specified deallocation filling when you created the zone, LIB$RESET_VM_ZONE will fill all of the allocated blocks that are freed.

If the zone you are resetting was created using the LIB$CREATE_USER_VM_ZONE routine, then you must have an appropriate action routine for the reset operation. That is, in your call to LIB $CREATE_USER_VM_ZONE, you must have specified a *user-reset-procedure*.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	An invalid *zone-id* argument.

LIB$RESET_VM_ZONE_64

LIB$RESET_VM_ZONE_64 — The Reset Virtual Memory Zone routine frees all blocks of memory that were previously allocated from a zone in the 64-bit virtual address space.

Format

LIB$RESET_VM_ZONE_64 zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier. The *zone-id* is the address of a quadword that contains the identifier of a zone created by a previous call to LIB$CREATE_VM_ZONE_64 or LIB$CREATE_USER_VM_ZONE_64.

Description

LIB$RESET_VM_ZONE_64 frees all the blocks of memory that were previously allocated from the zone. The memory becomes available to satisfy further allocation requests for the zone; the memory is

not returned to the processwide 64-bit page pool managed by LIB$GET_VM_PAGE_64. Your program can continue to use the zone after you call LIB$RESET_VM_ZONE_64.

Resetting a zone is a much more efficient way to reuse storage than individually freeing each allocated object in the zone.

It is the caller's responsibility to ensure that he or she has "exclusive" access to the zone while the reset operation is being performed. Results are unpredictable if another thread of control attempts to perform any operation on the zone while LIB$RESET_VM_ZONE_64 is in progress.

If you specified deallocation filling when you created the zone, LIB$RESET_VM_ ZONE_64 will fill all of the allocated blocks that are freed.

If the zone you are resetting was created using the LIB$CREATE_USER_VM_ ZONE_64 routine, then you must have an appropriate action routine for the reset operation. That is, in your call to LIB $CREATE_USER_VM_ZONE_64, you must have specified a *user-reset-procedure*.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADBLOADR	An invalid *zone-id* argument.

LIB$REVERT

LIB$REVERT — The Revert to the Handler of the Routine Activator routine deletes the condition handler established by LIB$ESTABLISH by clearing the address pointing to the condition handler from the activated routine's stack frame. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. This routine is not available to native OpenVMS Alpha and I64 programs but is recognized and handled appropriately by most high-level language compilers.

Format

LIB$REVERT

Returns

OpenVMS usage:	address
type:	address
access:	write only
mechanism:	by value

Previous contents of SF$A_HANDLER (longword 0) of the caller's stack frame. This is the address of the condition handler previously in effect. If no condition handler was in effect, zero is returned.

Arguments

None.

Description

LIB$REVERT returns the address that it clears from the calling routine's stack frame. LIB$REVERT is used only if your routine is to establish and then cancel a condition handler for a portion of its execution.

LIB$REVERT is provided primarily for use with languages without built-in error-handling facilities, such as Fortran. Do not use LIB$REVERT from BASIC, COBOL, Pascal, or PL/I. See the documentation for the language you are using for information about how that language handles errors.

In VAX MACRO, you merely use the following instruction rather than calling LIB$REVERT:

```
CLRL        (FP)        ; set handler address to 0
                        ; in current stack frame
```

Condition Values Returned

None.

LIB$RUN_PROGRAM

LIB$RUN_PROGRAM — The Run New Program routine causes the current program to stop running and begins execution of another program.

Format

LIB$RUN_PROGRAM program-name

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

program-name

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

File name of the program to be run in place of the current program. The *program-name* argument contains the address of a descriptor pointing to this file name string.

The maximum length of the file name is 255 characters. The default file type is .EXE.

Description

LIB$RUN_PROGRAM stops execution of the current program and begins execution of another program.

- If successful, control does not return to the calling program. Instead, the $EXIT system service is called, the new program image replaces the old image in the user process, and the command language interpreter (CLI) gives control to the new image.
- If unsuccessful, control returns to the command interpreter.

This routine is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB$_NOCLI is returned.

LIB$RUN_PROGRAM causes the current image to exit at the point of the call and directs the CLI, if one is present, to start running another program. If LIB$RUN_PROGRAM executes successfully, control passes to the second program; if not, control passes to the CLI. The calling program cannot regain control. This technique is called chaining.

This routine is provided primarily for compatibility with PDP-11 systems, where chaining is used to extend the address space of a system.

This routine may also be useful in an OpenVMS environment where address space is severely limited and large images are not possible. For example, you might use chaining to perform system generation on a small virtual address space, for a large page file.

With LIB$RUN_PROGRAM, the calling program can pass arguments to the next program in the chain only by using the common storage area. One way to do this is for the calling program to call LIB $PUT_COMMON to pass the information into the common storage area. Then the called program calls LIB$GET_COMMON to retrieve the data.

In general, this practice is not recommended. There is no convenient way to specify the order and type of arguments passed into the common storage area; so programs that pass arguments in this way must know about the format of the data before it is passed. When you use common storage, it is very difficult to keep your program modular and AST-reentrant; a method of arbitration must be designated to define which program can modify common storage and when.

Further, LIB$RUN_PROGRAM cannot be used if no command language interpreter is present, as in the case of image subprocesses and detached subprocesses.

If you want control to return to the caller, use LIB$SPAWN instead.

Condition Values Returned

LIB$_INVARG	Invalid argument.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to your VSI support representative.

LIB$SCANC

LIB$SCANC — The Scan for Characters and Return Relative Position routine is used to find a specified set of characters in the source string. LIB$SCANC makes the VAX SCANC instruction available as a callable routine.

Format

LIB$SCANC source-string ,table-array ,byte-integer-mask

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Relative position in the source string of the character that terminated the operation, or zero if the terminator character is not found. If the source string has a zero length, then a zero is returned.

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string used by LIB$SCANC to index into a table. The *source-string* argument contains the address of a descriptor pointing to this source string.

table-array

OpenVMS usage:	vector_mask_byte
type:	byte (unsigned)
access:	read only
mechanism:	by reference, array reference

Table that LIB$SCANC indexes into and performs a logical AND operation with the *byte-integer-mask* byte. The *table-array* argument contains the address of an unsigned byte array that is this table.

byte-integer-mask

OpenVMS usage:	mask_byte
type:	byte (unsigned)
access:	read only

mechanism:	by reference

Mask on which a logical AND operation is performed with bytes in *table-array*. The *byte-integer-mask* argument contains the address of an unsigned byte that is this mask.

Description

LIB$SCANC uses successive bytes of the string specified by *source-string* to index into a table. The byte selected from the table is the byte on which a logical AND operation is performed with the mask byte. The operation is terminated when the result of the AND operation is equal to 1.

Condition Values Returned

None.

LIB$SCOPY_DXDX

LIB$SCOPY_DXDX — The Copy Source String Passed by Descriptor to Destination routine copies a source string passed by descriptor to a destination string.

Format

LIB$SCOPY_DXDX source-string ,destination-string

Corresponding JSB Entry Point

LIB$SCOPY_DXDX6

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string to be copied to the destination string by LIB$SCOPY_DXDX. The *source-string* argument contains the address of a descriptor pointing to this source string. The descriptor class can be unspecified, fixed-length, decimal string, array, noncontiguous array, varying, or dynamic.

destination-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string to which the source string is copied. The *destination-string* argument contains the address of a descriptor pointing to this destination string.

The following actions occur depending on the class of the destination string's descriptor:

Descriptor Class	Action
S, Z, SD, A, NCA	Copy the source string. If needed, space-fill or truncate on the right.
D	If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor. If the area specified is not large enough, return the previous space allocation (if any) and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor.
VS	Copy source string to destination string up to the limit of the descriptor MAXSTRLEN field with no padding. Readjust the current length (CURLEN) field to the actual number of bytes copied.

Description

LIB$SCOPY_DXDX returns all condition values as a status; truncation is a qualified success condition value (bit 0 set to 1).

In addition, an equivalent JSB entry point is available, with R0 containing the first argument and R1 containing the second.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. All characters in the input string were copied to the destination string.
LIB$_STRTRU	Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.

LIB$SCOPY_R_DX

LIB$SCOPY_R_DX — The Copy Source String Passed by Reference to Destination String routine copies a source string passed by reference to a destination string, passed by descriptor.

Format

LIB$SCOPY_R_DX word-integer-source-length ,source-string ,destination-string

Corresponding JSB Entry Point

LIB$SCOPY_R_DX6

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

word-integer-source-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Length of the source string in bytes. The *word-integer-source-length* argument is the address of an unsigned word that contains the length of the source string.

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by reference

Source string to be copied to the destination string by LIB$SCOPY_R_DX. The *source-string* argument is the address of this source string.

destination-string

OpenVMS usage:	char_string

type:	character string
access:	write only
mechanism:	by descriptor

Destination string to which the source string is copied. The *destination-string* argument contains the address of a descriptor pointing to this destination string.

Description

LIB$SCOPY_R_DX copies a source string, passed by reference, to a destination string, passed by descriptor. It returns the status as a condition value. Truncation is a qualified success; LIB $SCOPY_R_DX sets bit 0 of the condition value to 1.

The actions taken by LIB$SCOPY_R_DX depend on the descriptor class of the destination string. The following table describes these actions for each descriptor class:

Descriptor Class	**Action**
S, Z, SD, A, NCA	Copy the source string. If needed, space fill or truncate on the right.
D	If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor.
	If the area specified is not large enough, return the previous space allocation, if any, and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor.
VS	Copy source string to destination string up to the limit of the descriptor's MAXSTRLEN field with no padding. Readjust the string's current length (CURLEN) field to the actual number of bytes copied.

An equivalent JSB entry is available, with R0 being the first argument, R1 the second, and R2 the third. The length argument is passed in bits 15:0 of R0.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. All characters in the input string were copied to the destination string.
LIB$_STRTRU	Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.

LIB$SCOPY_R_DX_64

LIB$SCOPY_R_DX_64 — The Copy Source String Passed by Reference to Destination String routine copies a source string passed by reference to a destination string, passed by descriptor.

Format

```
LIB$SCOPY_R_DX_64 quad-integer-source-length ,source-string ,destination-stri
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

quad-integer-source-length

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Length of the source string in bytes. The *quad-integer-source-length* argument is the address of an unsigned quadword that contains the length of the source string.

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by reference

Source string to be copied to the destination string by LIB$SCOPY_R_DX_64. The *source-string* argument is the address of this source string.

destination-string

OpenVMS usage:	char_string
type:	character string
access:	write only

mechanism:	by descriptor

Destination string to which the source string is copied. The *destination-string* argument contains the address of a descriptor pointing to this destination string.

Description

LIB$SCOPY_R_DX_64 copies a source string, passed by reference, to a destination string, passed by descriptor. It returns the status as a condition value. Truncation is a qualified success; LIB $SCOPY_R_DX_64 sets bit 0 of the condition value to 1.

The actions taken by LIB$SCOPY_R_DX_64 depend on the descriptor class of the destination string. The following table describes these actions for each descriptor class:

Descriptor Class	**Action**
S, Z, SD, A, NCA	Copy the source string. If needed, space fill or truncate on the right.
D	If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor. If the area specified is not large enough, return the previous space allocation, if any, and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor.
VS	Copy source string to destination string up to the limit of the descriptor's MAXSTRLEN field with no padding. Readjust the string's current length (CURLEN) field to the actual number of bytes copied.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. All characters in the input string were copied to the destination string.
LIB$_STRTRU	Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.

LIB$SET_LOGICAL

LIB$SET_LOGICAL — The Set Logical Name routine requests the calling process's command language interpreter (CLI) to define or redefine a supervisor-mode process logical name. It provides the same function as the DCL command DEFINE.

Format

LIB$SET_LOGICAL logical-name [,value-string] [,table] [,attributes] [,item-li

Either the *item-list* or *value-string* argument must be specified. If both *item-list* and *value-string* are specified, the *value-string* argument is ignored.

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

logical-name

OpenVMS usage:	logical_name
type:	character string
access:	read only
mechanism:	by descriptor

Logical name to be defined or redefined. The *logical-name* argument contains the address of a descriptor pointing to this logical name string. The maximum length of a logical name is 255 characters. Note that logical names are case sensitive.

value-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Value to be given to the logical name. The *value-string* argument contains the address of a descriptor pointing to this value string. The maximum length of a logical name value is 255 characters.

If omitted, an item list must be present to specify the values of the logical name.

table

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the table in which to create the logical name. The *table* argument contains the address of a descriptor pointing to the logical name table. If no table is specified, LNM$PROCESS is used as the default.

attributes

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Logical name or translation attributes. The *attributes* argument is the address of a longword bit mask that contains the logical name or translation attributes.

LNM$M_CONFINE and LNM$M_NO_ALIAS are currently available logical name attributes. See the description of the $CRELNM system service in the *VSI OpenVMS System Services Reference Manual: A–GETUAI* for definitions of LNM$M_CONFINE and LNM$M_NO_ALIAS. If omitted, no special logical name attribute is established.

If no *item-list* is specified, the translation attributes LNM$M_CONCEALED and LNM $M_TERMINAL may be specified. See the description of the ASSIGN command in the *VSI OpenVMS DCL Dictionary* for definitions of these attributes. If an item-list is specified, it will contain the translation attributes for each equivalence string in the attribute.

item-list

OpenVMS usage:	item_list_3
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Item list describing the equivalence names for this logical name. The *item-list* argument contains the address of an array that contains this item list. If *item-list* is not specified, the logical name will have only one value, as specified in the *value-string* argument. Item codes for use with this item list are included in libraries supplied by VSI in module $LNMDEF.

Either *value-string* or *item-list* must be specified. If neither is specified, the LIB$_INVARG error is produced. If both *value-string* and *item-list* are specified, the *value-string* argument is ignored.

If *item-list* is specified, only logical name attributes are permitted. Translation attributes appear in the item list.

The *item-list* argument is needed only when you want to create multiple equivalence strings for a single logical name.

Description

If the optional *table* argument is defined, the logical name will be placed in the table specified by the *table* argument; otherwise, the logical name is placed in the LNM$PROCESS table.

Unlike the system services $CRELOG and $CRELNM, LIB$SET_LOGICAL does not require the caller to be executing in supervisor mode to define a supervisor-mode logical name. Supervisor-mode logical names are not deleted when an image exits. A program can obtain the current value of any logical name by calling the system service $TRNLNM. For more information on logical names, see the *VSI OpenVMS System Services Reference Manual*.

This routine is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In that case, the error status LIB$_NOCLI is returned.

This routine does not support the DCL DEFINE and DEASSIGN commands' special side-effect of opening and closing a process-permanent file if the logical name SYS$OUTPUT is specified.

See the *VSI OpenVMS DCL Dictionary* for a description of the DEFINE command.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_ACCVIO	Access violation. The logical name or its value could not be read.
SS$_BADPARAM	Bad argument.
SS$_BUFFEROVF	Routine successfully completed; however, a buffer overflow occurred.
SS$_INSFMEM	Insufficient dynamic memory.
SS$_IVLOGNAM	Invalid logical name. The logical name or its value contained more than 255 characters.
SS$_IVLOGTAB	Invalid logical name table.
SS$_NOPRIV	No privileges for attempted operation.
SS$_SUPERSEDE	Routine successfully completed; the previous definition of the logical name was replaced.
SS$_TOOMANYLNAM	Logical name translation exceeded allowed depth.
LIB$_INVARG	Neither the *value-string* nor the *item-list* argument was specified.)
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to your VSI support representative.

Example

```
!+
! Initialize value for logical name MY_LOG
!-
SYMBOL$ = 'MY_LOG'
SETVAL$ = 'OFF'
CALL LIB$SET_LOGICAL (SYMBOL$, SETVAL$)
END
```

The BASIC program above sets the logical MY_LOG to OFF. This value can be displayed after the program is run with SHOW LOGICAL as follows:

```
$ SHOW LOGICAL MY_LOG
"MY_LOG" = "OFF" (LNM$PROCESS_TABLE)
```

LIB$SET_SYMBOL

LIB$SET_SYMBOL — The Set Value of CLI Symbol routine requests the calling process's command language interpreter (CLI) to define or redefine a CLI symbol.

Format

LIB$SET_SYMBOL symbol ,value-string [,table-type-indicator]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

symbol

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Name of the symbol to be defined or modified by LIB$SET_SYMBOL. The *symbol* argument is the address of a descriptor pointing to this symbol string. If you redefine a previously defined CLI symbol, the symbol value is modified to the new value that you provide.

value-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Value to be given to the symbol. The *value-string* argument is the address of a descriptor pointing to this value string.

Trailing blanks are not removed from the value string before use. The maximum length of *value-string* is 4096 characters. Integer values are not allowed; LIB$SET_SYMBOL is intended to set string CLI symbols, not integer CLI symbols.

table-type-indicator

OpenVMS usage:	longword_signed

type:	longword integer (signed)
access:	read only
mechanism:	by reference

Indicator of the table that will contain the defined symbol. The *table-type-indicator* argument is the address of a signed longword integer that is this table indicator.

If omitted, the local symbol table is used. The following are possible values for *table-type-indicator*:

Symbolic Name	Value	Table Used
LIB$K_CLI_LOCAL_SYM	1	Local symbol table
LIB$K_CLI_GLOBAL_SYM	2	Global symbol table

Description

LIB$SET_SYMBOL requests the calling process's CLI to define or redefine a CLI symbol.

CLI symbols created using LIB$SET_SYMBOL may be inaccessible by other CLI commands. To avoid this situation, make sure that your symbol names are alphanumeric and that the first character is alphabetic. LIB$SET_SYMBOL is intended to set string CLI symbols, not integer CLI symbols.

LIB$K_CLI_LOCAL_SYM and LIB$K_CLI_GLOBAL_SYM are defined as global symbols and in symbol libraries supplied by VSI (macro or module name $LIBCLIDEF).

This routine is supported for use with the DCL CLI. If used with the MCR CLI, the error status LIB $_NOCLI will be returned. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In this case, the error status LIB$_NOCLI is returned.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_AMBSYMDEF	Ambiguous symbol definition. The symbol name you want to define is ambiguous when compared with existing symbol names. This condition might arise if abbreviated symbols have been defined previously. See the *VSI OpenVMS DCL Dictionary* for more information on abbreviated symbols.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSCLIMEM	Insufficient CLI memory. The CLI could not get enough virtual memory to assign another symbol. This condition may be caused by having too many symbols defined; deleting some symbol definitions may make enough room for the new symbol.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.
LIB$_INVARG	Invalid argument. The value of *table-type-indicator* was invalid or the length of *value-string* was greater than 1024 characters.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_INVSYMNAM	Invalid symbol name. The length of *symbol* was greater than 255 characters or *symbol* did not begin with a letter.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.
LIB$_UNECLIERR	Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to your VSI support representative.

Example

```
!+
! Initialize value and symbol name
!-
SYMBOL$ = 'MY_SYM'
SETVAL$ = 'ON'
CALL LIB$SET_SYMBOL (SYMBOL$, SETVAL$)
END
```

The BASIC program above sets the symbol MY_SYM to ON. This value can be displayed after the program is run with SHOW SYMBOL as follows:

```
$ SHOW SYMBOL MY_SYM
"MY_SYM" = "ON" (LNM$PROCESS_TABLE)
```

LIB$SFREE1_DD

LIB$SFREE1_DD — The Free One Dynamic String routine returns the dynamically allocated storage for a dynamic string.

Format

LIB$SFREE1_DD descriptor-address

Corresponding JSB Entry Point

LIB$SFREE1_DD6

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Argument

descriptor-address

OpenVMS usage:	descriptor
type:	quadword (unsigned)
access:	modify
mechanism:	by reference

Dynamic descriptor specifying the area to be deallocated. The *descriptor-address* argument is the address of an unsigned quadword that is this descriptor. The descriptor is assumed to be dynamic and its class field is not checked.

Description

Before a routine deallocates a dynamic descriptor, it must use LIB$SFREE1_DD or LIB$SFREEN_DD to deallocate the string storage space specified by the dynamic descriptor. Otherwise, string storage is not deallocated and your program can run out of memory.

This routine deallocates the described string space and flags the descriptor as describing no string at all. The descriptor's POINTER and LENGTH fields contain zero (0).

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error.

LIB$SFREEN_DD

LIB$SFREEN_DD — The Free One or More Dynamic Strings routine returns one or more dynamic strings to free storage.

Format

LIB$SFREEN_DD number-of-descriptors ,first-descriptor-array

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

number-of-descriptors

OpenVMS usage:	longword_unsigned
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Number of adjacent descriptors freed by LIB$SFREEN_DD. The *number-of-descriptors* argument contains the address of an unsigned longword that is this number. The deallocated area is returned to free storage.

first-descriptor-array

OpenVMS usage:	descriptor_array
type:	quadword (unsigned)
access:	modify
mechanism:	by reference, array reference

First descriptor of an array of descriptors. The *first-descriptor-array* argument contains the address of this first descriptor. The descriptors are assumed to be dynamic, and their class fields are not checked.

The descriptor array must contain all 32-bit descriptors or all 64-bit descriptors. They cannot be mixed.

Description

Before a routine that allocates space returns to its caller, it must use LIB$SFREE1_DD or LIB $SFREEN_DD to deallocate the string storage space specified by any descriptors located in the stack. Otherwise, space is not deallocated and your program could run out of virtual memory.

LIB$SFREEN_DD deallocates the described string space and flags each descriptor as describing no string at all by setting the descriptor's POINTER and LENGTH fields to 0 (zero).

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error.

LIB$SGET1_DD

LIB$SGET1_DD — The Get One Dynamic String routine allocates dynamic virtual memory to the string descriptor you specify.

Format

LIB$SGET1_DD word-integer-length ,descriptor-part

Corresponding JSB Entry Point

LIB$SGET1_DD_R6

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

word-integer-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	read only
mechanism:	by reference

Number of bytes of dynamic virtual memory to be allocated by LIB$SGET1_DD. The *word-integer-length* argument is the address of an unsigned word that contains this number. The amount of storage allocated may be rounded up automatically.

descriptor-part

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Descriptor of the dynamic string to which LIB$SGET1_DD allocates the dynamic virtual memory. The *descriptor-part* argument contains the address of this descriptor.

The *descriptor-part* argument must contain the address of a dynamic string descriptor; LIB $SGET1_DD returns an unpredictable result if any other type of descriptor is specified by this argument.

The descriptor CLASS field is not checked but is set to dynamic (2). The LENGTH field is set to *word-integer-length*, and the POINTER field points to the string area allocated.

Description

LIB$SGET1_DD is similar to LIB$SCOPY_DXDX except that no source string is copied. You can write anything you want in the allocated area.

If *descriptor-part* already has dynamic memory allocated to it, but the amount allocated is less than *word-integer-length*, that space is deallocated before LIB$SGET1_DD allocates new space.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$SGET1_DD_64

LIB$SGET1_DD_64 — The Get One Dynamic String routine allocates dynamic virtual memory to the string descriptor you specify.

Format

LIB$SGET1_DD_64 quad-integer-length ,descriptor-part

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

quad-integer-length

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Number of bytes of dynamic virtual memory to be allocated by LIB$SGET1_DD_ 64. The *quad-integer-length* argument is the address of an unsigned quadword that contains this number. The amount of storage allocated can be rounded up automatically.

descriptor-part

OpenVMS usage:	quadword_unsigned
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Descriptor of the dynamic string to which LIB$SGET1_DD_64 allocates the dynamic virtual memory. The *descriptor-part* argument contains the address of this descriptor.

The *descriptor-part* argument must contain the address of a dynamic string descriptor; LIB $SGET1_DD_64 returns an unpredictable result if any other type of descriptor is specified by this argument.

The descriptor CLASS field is not checked but is set to dynamic (2). The LENGTH field is set to *quad-integer-length*, and the POINTER field points to the string area allocated.

Description

LIB$SGET1_DD_64 is similar to LIB$SCOPY_DXDX except that no source string is copied. You can write anything you want in the allocated area.

If *descriptor-part* already has dynamic memory allocated to it, but the amount allocated is less than *quad-integer-length*, that space is deallocated before LIB$SGET1_DD_64 allocates new space.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$SHOW_TIMER

LIB$SHOW_TIMER — The Show Accumulated Times and Counts routine returns times and counts accumulated since the last call to LIB$INIT_TIMER and displays them on SYS$OUTPUT. (LIB $INIT_TIMER must be called prior to invoking this routine.) A user-supplied action routine may change this default behavior.

Format

```
LIB$SHOW_TIMER [handle-address] [,code] [,user-action-procedure] [,user-argum
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

handle-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Block of storage containing the value returned by a previous call to LIB$INIT_TIMER. The *handle-address* argument is the address of an unsigned longword integer containing that value.

- If specified, the pointer must be the same value returned by a previous call to LIB$INIT_TIMER.
- If omitted, LIB$SHOW_TIMER will use a block of memory allocated by LIB$INIT_TIMER.
- If *handle-address* is omitted and LIB$INIT_TIMER has not been called previously, the error LIB$_INVARG is returned. LIB$INIT_TIMER must be called prior to a call to LIB $SHOW_TIMER. Note that the *handle-address* argument is the same as the *context* argument used in the LIB$INIT_TIMER call.

LIB$SHOW_TIMER assumes that LIB$INIT_TIMER has been previously called, and that the results of that call are stored either in a block pointed to by *handle-address*, or in the memory allocated by LIB$INIT_TIMER.

code

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

Integer specifying the statistic you want; if it is omitted or zero, all five statistics are returned on one line. The *code* argument is the address of a signed longword integer containing the statistic code.

The following values are allowed for the *code* argument:

Value	Description
1	Elapsed time
2	CPU time
3	Buffered I/O
4	Direct I/O
5	Page faults

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied action routine called by LIB$SHOW_TIMER. The default action of LIB$SHOW_TIMER is to write the results to SYS$OUTPUT. An action routine is useful if you want to write the results to a file or, in general, anywhere other than SYS$OUTPUT.

The action routine returns either a success or failure condition value; this status is returned to the calling program as the value of LIB$SHOW_TIMER.

user-argument-value

OpenVMS usage:	user-arg
type:	longword (unsigned) (on VAX systems) quadword (unsigned) (on Alpha and I64 systems)
access:	read only
mechanism:	by value

A value to be passed to the action routine without interpretation. If omitted, LIB$SHOW_TIMER passes a zero by value to the user routine.

Description

LIB$SHOW_TIMER returns the times and counts accumulated since the last call to LIB$INIT_TIMER. By default, when neither *code* nor *user-action-procedure* is specified in the call, LIB $SHOW_TIMER writes to SYS$OUTPUT a line giving the following information:

Shown on Line	Description
ELAPSED = dddd hh:mm:ss.cc	Elapsed real time
CPU = hhhh:mm:ss.cc	Elapsed CPU time
BUFIO = nnnn	Count of buffered I/O operations
DIRIO = nnnn	Count of direct I/O operations
PAGEFAULTS = nnnn	Count of page faults

Any one or all five statistics can be written to SYS$OUTPUT or passed to your user-supplied action routine for other processing.

Call Format for an Action Routine

Action routine is a user-supplied routine called by LIB$SHOW_TIMER. The action routine is used when you want to write results to anywhere other than SYS$OUTPUT. The action routine is called only when you specify the *user-action-procedure* argument in the call to LIB$SHOW_TIMER.

LIB$SHOW_TIMER calls the action routine using this format:

```
user-action-procedure   out-str [,user-argument-value]
```

out-str

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Fixed-length string containing the statistics requested. The string is formatted exactly as it would be if written to SYS$OUTPUT. The leading character is blank.

user-argument-value

OpenVMS usage:	user-arg

type:	longword (unsigned) (on VAX systems) quadword (unsigned) (on Alpha and I64 systems)
access:	read only
mechanism:	by value

A value passed to LIB$SHOW_TIMER. The user argument is passed without interpretation to the action routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. Either *code* or *handle-address* was invalid.

Any condition values returned by LIB$PUT_OUTPUT or your action routine.

Example

```
PROGRAM SHOW_TIMER(INPUT,OUTPUT);

{+}
{ This Pascal example demonstrates how to use LIB$SHOW_TIMER.
{-}

    VAR
        RETURNED_STATUS : INTEGER;

    [EXTERNAL] FUNCTION LIB$INIT_TIMER(
        HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
        ) : INTEGER; EXTERNAL;
    [EXTERNAL] FUNCTION LIB$SHOW_TIMER(
        HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0;
        CODE : INTEGER;
        [IMMEDIATE,UNBOUND]
          ROUTINE ACTION_RTN( OUT_STR : [CLASS_S] PACKED ARRAY
 [L..U:INTEGER] OF CHAR;
                              USER_ARG : INTEGER) := %IMMED 0;
        USER_ARG : INTEGER := %IMMED 0
        ) : INTEGER; EXTERNAL;
    [EXTERNAL] FUNCTION LIB$STOP(
        CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
        FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
        ) : INTEGER; EXTERNAL;

    ROUTINE USER_ACTION_RTN(
        OUT_STR : [CLASS_S] PACKED ARRAY [L..U:INTEGER] OF CHAR;
        USER_ARG : INTEGER);

        BEGIN
        WRITELN('User argument is ',USER_ARG:1);
        WRITELN(OUT_STR);
        END;
BEGIN
```

```
{+}
{ Call LIB$INIT_TIMER to initialize RTL internal counters.
{-}

RETURNED_STATUS := LIB$INIT_TIMER;
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print a line of text to waste time.
{-}

WRITELN('Spend time to acquire elapsed real time and page faults');

{+}
{ Call LIB$SHOW_TIMER to display counters.
{-}

RETURNED_STATUS := LIB$SHOW_TIMER(,0,USER_ACTION_RTN,5);
END.
```

This Pascal program demonstrates how to call LIB$SHOW_TIMER. The output generated by this Pascal example is as follows:

```
$ RUN SHOW_TIMER
Spend time to acquire elapsed real time and page faults
User argument is 5
 ELAPSED: 0 00:00:00.44  CPU: 0:00:00.04
 BUFIO: 1  DIRIO: 0  FAULTS: 18
```

LIB$SHOW_VM

LIB$SHOW_VM — The Show Virtual Memory Statistics routine returns the statistics accumulated from calls to LIBGET_VM/LIBFREE_VM and LIBGET_VM_PAGE/LIBFREE_VM_PAGE. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$SHOW_VM [code] [,user-action-procedure] [,user-specified-argument]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

code

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Code specifying any one of the statistics to be written to SYS$OUTPUT or passed to an action routine for processing. The *code* argument is the address of a signed longword integer containing the statistic code. This is an optional argument. If the statistic code is omitted or is zero, statistics for values 1, 2, and 3 are returned on one line.

The following values are allowed for the *code* argument:

Value	**Statistic**
0	Statistics for values 1, 2, and 3 are returned.
1	Number of successful calls to LIB$GET_VM.
2	Number of successful calls to LIB$FREE_VM.
3	Number of bytes allocated by LIB$GET_VM but not yet deallocated by LIB$FREE_VM.
4	Statistics for values 5, 6, and 7 are returned.
5	Number of calls to LIB$GET_VM_PAGE.
6	Number of calls to LIB$FREE_VM_PAGE.
7	Number of VAX pages or Alpha pagelets allocated by LIB$GET_VM_PAGE but not yet deallocated by LIB$FREE_VM_PAGE.

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied action routine called by LIB$SHOW_VM. By default, LIB$SHOW_VM returns statistics to SYS$OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any place other than SYS$OUTPUT. The routine returns either a success or failure condition value, which will be returned as the value of LIB$SHOW_VM.

For more information on the action routine, see the section called “Call Format for an Action Routine” in the Description section.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

A 32-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry *user-specified-argument* are copied to the argument list entry for *user-action-procedure*.

Description

LIB$SHOW_VM returns the statistics accumulated from calls to LIBGET_VM/LIBFREE_VM and LIBGET_VM_PAGE/LIBFREE_VM_PAGE. By default, with neither *code* nor *user-action-procedure* specified in the call, LIB$SHOW_VM writes a line giving the following information to SYS$OUTPUT:

```
mmm calls to LIB$GET_VM, nnn calls to LIB$FREE_VM, ppp bytes still
 allocated
```

Optionally, any one of six statistics can be output to SYS$OUTPUT and/or the line of information can be passed to a user-specified “action routine” for processing different from the default.

Call Format for an Action Routine

The action routine is a user-supplied routine that LIB$SHOW_VM calls if you specify the *user-action-procedure* argument in the call to LIB$SHOW_VM.

The call format for an action routine is:

user-action-procedure resultant-string ,user-specified-argument

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Statistics supplied by LIB$SHOW_VM. The *resultant-string* argument is the address of a descriptor pointing to an address into which LIB$SHOW_VM writes the statistics. The string is formatted exactly as it would be if written to SYS$OUTPUT. The first character is a blank; carriage-return/line-feed combinations are not included.

user-specified-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

The 32-bit value passed to LIB$SHOW_VM is passed to the action routine without interpretation. If the *user-specified-argument* argument is omitted in the call to LIB$SHOW_VM, a zero is passed by value to the user routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.

LIB$_INVARG	Invalid arguments. This can be caused by an invalid value for *code*.

Any condition values returned by LIB$PUT_OUTPUT or your action routine.

LIB$SHOW_VM_64

LIB$SHOW_VM_64 — The Show Virtual Memory Statistics routine returns the statistics accumulated from calls to LIBGET_VM_64/LIBFREE_VM_64 and LIB$GET_VM_PAGE_ 64/LIB $FREE_VM_PAGE_64.

Format

LIB$SHOW_VM_64 [code] [,user-action-procedure] [,user-specified-argument]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

code

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Code specifying any one of the statistics to be written to SYS$OUTPUT or passed to an action routine for processing. The *code* argument is the address of a signed quadword integer containing the statistic code. This is an optional argument. If the statistic code is omitted or is zero, statistics for values 1, 2, and 3 are returned on one line.

The following values are allowed for the code argument:

Value	**Static**
0	Statistics for values 1, 2, and 3 are returned.
1	Number of successful calls to LIB$GET_VM_64.
2	Number of successful calls to LIB$FREE_VM_64.
3	Number of bytes allocated by LIB$GET_VM_64 but not yet deallocated by LIB$FREE_VM_64.
4	Statistics for values 5, 6, and 7 are returned.
5	Number of calls to LIB$GET_VM_PAGE_64.
6	Number of calls to LIB$FREE_VM_PAGE_64.

Value	Static
7	Number of Alpha or I64 pagelets allocated by LIB $GET_VM_PAGE_64 but not yet deallocated by LIB $FREE_VM_PAGE_64.

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied action routine called by LIB$SHOW_VM_64. By default, LIB$SHOW_VM_64 returns statistics to SYS$OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any place other than SYS$OUTPUT. The routine returns either a success or failure condition value, which will be returned as the value of LIB$SHOW_VM_64.

For more information on the action routine, see Call Format for an Action Routine in the Description section.

user-specified-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by value

A 64-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry *user-specified-argument* are copied to the argument list entry for *user-action-procedure*.

Description

LIB$SHOW_VM_64 returns the statistics accumulated from calls to LIB$GET_ VM_64/LIB $FREE_VM_64 and LIB$GET_VM_PAGE_64/LIB$FREE_VM_PAGE_ 64. By default, with neither code nor *user-action-procedure* specified in the call, LIB$SHOW_VM_64 writes a line giving the following information to SYS$OUTPUT:

```
mmm calls to LIB$GET_VM_64, nnn calls to LIB$FREE_VM_64, ppp bytes still allo
```

Optionally, any one of six statistics can be output to SYS$OUTPUT and/or the line of information can be passed to a user-specified “action routine” for processing different from the default.

Call Format for an Action Routine

The action routine is a user-supplied routine that LIB$SHOW_VM_64 calls if you specify the **user-action-procedure** argument in the call to LIB$SHOW_VM_64.

The call format for an action routine is:

```
user-action-procedure resultant-string ,user-specified-argument
```

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Statistics supplied by LIB$SHOW_VM_64. The *resultant-string* argument is the address of a descriptor pointing to an address into which LIB$SHOW_ VM_64 writes the statistics. The string is formatted exactly as it would be if written to SYS$OUTPUT. The first character is a blank; carriage-return/line-feed combinations are not included.

user-specified-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by value

The 64-bit value passed to LIB$SHOW_VM_64 is passed to the action routine without interpretation. If the *user-specified-argument* argument is omitted in the call to LIB$SHOW_VM_64, a zero is passed by value to the user routine.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid arguments. This can be caused by an invalid value for *code*.

Any condition values returned by LIB$PUT_OUTPUT or your action routine.

LIB$SHOW_VM_ZONE

LIB$SHOW_VM_ZONE — The Return Information About a Zone routine returns formatted information about a zone in the 32-bit virtual address space, detailing such information as the zone's name, characteristics, and areas, and then passes the information to the specified or default action routine. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$SHOW_VM_ZONE zone-id [,detail-level] [,user-action-procedure] [,user-arg]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier. The *zone-id* argument is the address of an unsigned longword containing this identifier. Use zero to indicate the 32-bit default zone.

detail-level

OpenVMS usage:	longword_signed
type:	longword (signed)
access:	read only
mechanism:	by reference

An identifier code specifying the level of detail required by the user. The *detail-level* argument is the address of a signed longword containing this code. The default is minimal information. The following are valid values for *detail-level*:

0	*zone-id* and name
1	*zone-id*, name, algorithm, flags, and size information
2	*zone-id*, name, algorithm, flags, size information, cache information, and area summary
3	*zone-id*, name, algorithm, flags, size information, cache information, area summary, and queue validation

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

Optional user-supplied action routine called by LIB$SHOW_VM_ZONE. By default, LIB$SHOW_VM_ZONE prints statistics to SYS$OUTPUT by means of LIB$PUT_OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any location other than SYS$OUTPUT. If *user-action-procedure* fails, LIB$SHOW_VM_ZONE terminates and returns a failure code. Success codes are ignored.

For more information on the action routine, see the Description section.

user-arg

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

Optional 32-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry *user-arg* are copied to the argument list entry for *user-action-procedure*.

Description

LIB$SHOW_VM_ZONE returns formatted information about the specified zone and passes it to the action routine. The *detail-level* argument determines the degree of detail of the zone information returned, and this information is formatted into a readable display and passed to either a user action routine or to LIB$PUT_OUTPUT.

The action routine is a user-supplied routine that LIB$SHOW_VM_ZONE calls if you specify the *action-routine* argument in the call to LIB$SHOW_VM_ZONE. If you do not specify *action-routine*, the information is passed to LIB$PUT_OUTPUT for output to SYS$OUTPUT. The call format for an action routine is as follows:

```
action-routine string, user-arg
```

Arguments

string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Information supplied by LIB$SHOW_VM_ZONE. The *string* argument is the address of a descriptor pointing to an address into which LIB$SHOW_VM_ZONE writes the requested information. The string is formatted exactly as it would be if written to SYS$OUTPUT.

user-arg

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

The 32-bit value passed to LIB$SHOW_VM_ZONE is passed to the action routine without interpretation. If the *user-arg* argument is omitted in the call to LIB$SHOW_VM_ZONE, a zero is passed by value to the user routine.

If no *zone-id* is specified (0 is passed), the 32-bit default zone is used.

You must ensure that you have exclusive access to the zone while information is being displayed. Results are unpredictable and may be inconsistent if another thread of control modifies the zone while this routine is displaying data or scanning control blocks.

While scanning the queues and free lists, this routine may detect errors.

If the lookaside list summary discovers a block improperly linked into the list so that the list appears disjointed, the count of the number of blocks of that particular size will be displayed as asterisks.

Table 2.7 lists error and warning messages that can be displayed during the lookaside list and area free list scans. The format is:

```
**** ERROR - error description ****
**** WARNING - warning description ****
```

Table 2.7. LIB$SHOW_VM_ZONE Error and Warning Messages

Error Message	Description
Invalid block size	The size of the block is either not large enough to contain the necessary queue links or is unreasonably large. The size field has been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Block not owned by zone	The current block is not within a section of the virtual address space controlled by this zone. It is possibly attempting to free a block not originally allocated from this zone.
Block extends past the end of area; truncated	The end of the block is not in the area from which the block has been allocated. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Block extends into “unallocated” block, truncated	The end of the block extends past the allocated section of the area. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Current block not completely accessible	The current block extends into a nonexistent part of the virtual address space. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Back link does not return to previous block	The back link in a doubly linked list does not point to the previous block.
Forward link does not point to valid address	The forward link of current block points to a location that is not in the virtual address space.
Free-fill mismatch	One of the locations filled when the block was freed has been modified.
Boundary tag mismatch	One of the boundary tags of the block is not valid.
Warning	Description

Forward link of current block may not be valid	The back link of the block pointed to by the forward link of the current block does not point to the current block.
Block at *nnnnnnnn* is not accessible	The block at location *nnnnnnnn* could not be accessed and cannot be dumped.
Block truncated to *nnnnnnnn* bytes to prevent ACCVIO	The block to be dumped extends into the inaccessible part of the address space. The size of the block is reduced so that the block to be dumped fits within the accessible addresses.

When a block forward link is suspected of pointing to an invalid next block, the information from the next block is replaced by asterisks. The following is a sample error display:

```
**** ERROR - forward link does not point to valid address ****
**** ERROR - forward-link does not point to valid address ****
Link Analysis for Current Block:
                    Previous   Current      Next
                    --------  --------  --------
  Block adr      :  0014B270  0014C200  6B6E754A

  Forw link (abs):  0014C200  6B6E754A  ********

Block size = 32
Block contents:

  00000000 00000000 6B6E754A 00000020  ...Junk........ 00000 0014C200
  0014B270 00000008 00000000 00000000 ............p 00010 0014C210
```

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone. Routine was called with a *zone-id* that does not represent a valid VM zone.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVARG	Invalid argument.
LIB$_INVOPEZON	Invalid operation for zone; invalid use of unspecified user zone action routine.
LIB$_NOTFOU	Could not find another VM zone (alternate success status).
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by the user-formatted output action routine or LIB$PUT_OUTPUT.

Examples

1.
```
#include <lib$routines.h>

main()
{
    long zone_id = 0;
    long detail_level = 1;
```

```
    LIB$SHOW_VM_ZONE(&zone_id, &detail_level);
}
```

An example of the output generated by this C program using *detail-level* 1 is as follows:

```
Zone Id = 7FB96160,  Zone name = "DEFAULT_ZONE"
        Algorithm = LIB$K_VM_FIRST_FIT

        Flags = 00000020
                    LIB$M_VM_EXTEND_AREA

        Initial size =     124 pages     Current size = 0 pages in 0
 areas
        Extend size  =     128 pages     Page limit   = None

        Requests are rounded up to a multiple of 8 bytes,
        naturally aligned on 8 byte boundaries

        0 bytes have been freed and not yet reallocated

        72 bytes are used for zone and area control blocks, or 100.0%
 overhead
```

2.
```
#include <descrip.h>
#include <libvmdef.h>
#include <lib$routines.h>
#include <stdlib.h>

main()
{
    long zone_id;
    long algorithm = LIB$K_VM_QUICK_FIT;
    long algorithm_arg = 16;
    long flags = LIB$M_VM_FREE_FILL0 | LIB$M_VM_EXTEND_AREA;
    long detail_level = 3;
    $DESCRIPTOR(zone_name, "Mix of lookaside list and area blocks");
    int i;
#define NUM_BLOCKS 250
    char *blocks[NUM_BLOCKS];
    long sizes[NUM_BLOCKS];

    LIB$CREATE_VM_ZONE(&zone_id, &algorithm, &algorithm_arg, &flags,
        0, 0, 0, 0, 0, 0, /* Omitted arguments */
        &zone_name, 0, 0);

    for (i = 0; i < NUM_BLOCKS; i++)
        {
        sizes[i] = rand() % 300 + 9;
        LIB$GET_VM(&sizes[i], &blocks[i], &zone_id);
        }

    for (i = 0; i < NUM_BLOCKS; i++)
        LIB$FREE_VM(&sizes[i], &blocks[i], &zone_id);

    LIB$SHOW_VM_ZONE(&zone_id, &detail_level);
}
```

An example of the output generated by this C program using *detail-level* 3 is as follows:

```
Zone Id = 00045000,  Zone name = "Mix of lookaside list and area blocks"

    Algorithm = LIB$K_VM_QUICK_FIT  with 16 Lookaside Lists ranging from
                a minimum blocksize of 8, to a maximum blocksize of 128

    Flags = 00000028
                 LIB$M_VM_FREE_FILL0
                 LIB$M_VM_EXTEND_AREA
    Initial size =      16 pages     Current size = 96 pages in 1 area
    Extend size  =      16 pages     Page limit   = None

    Requests are rounded up to a multiple of 8 bytes,
    naturally aligned on 8 byte boundaries

    41512 bytes have been freed and not yet reallocated

    312 bytes are used for zone and area control blocks, or 0.6%
 overhead

    Quick Fit Lookaside List Summary:

         List         Block   Number of
        number         size     blocks
        ------  ----------  ----------
             2          16           7
             3          24           4
             4          32           4
             5          40           6
             6          48           5
             7          56           6
             8          64           6
             9          72           5
            10          80           6
            11          88           3
            12          96           8
            13         104           9
            14         112           9
            15         120           5
            16         128          10

    Area Summary:

          First     Last       Pages    Bytes not yet
         address   address    assigned    allocated
        --------  --------  ----------  -------------
        00045800  000517FF          96           7640

    Scanning Lookaside Lists in Zone Control Block
    Scanning Free List for Area at 00045800
      Number of blocks = 62, Min blocksize = 136, Max blocksize = 3160
```

LIB$SHOW_VM_ZONE_64

LIB$SHOW_VM_ZONE_64 — The Return Information About a Zone routine returns formatted information about a zone in the 64-bit virtual address space, detailing such information as the zone's

name, characteristics, and areas, and then passes the information to the specified or default action routine.

Format

LIB$SHOW_VM_ZONE_64 zone-id [,detail-level] [,user-action-procedure] [,user-a

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier. The *zone-id* argument is the address of an unsigned quadword containing this identifier. Use zero to indicate the 64-bit default zone.

detail-level

OpenVMS usage:	quadword_signed
type:	quadword (signed)
access:	read only
mechanism:	by reference

An identifier code specifying the level of detail required by the user. The *detail-level* argument is the address of a signed quadword containing this code. The default is minimal information. The following are valid values for *detail-level*:

0	*zone-id* and name
1	*zone-id*, name, algorithm, flags, and size information
2	*zone-id*, name, algorithm, flags, size information, cache information, and area summary
3	*zone-id*, name, algorithm, flags, size information, cache information, area summary, and queue validation

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)

mechanism:	by value

Optional user-supplied action routine called by LIB$SHOW_VM_ZONE_64. By default, LIB $SHOW_VM_ZONE_64 prints statistics to SYS$OUTPUT by means of LIB$PUT_OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any location other than SYS$OUTPUT. If *user-action-procedure* fails, LIB$SHOW_VM_ZONE_64 terminates and returns a failure code. Success codes are ignored.

For more information on the action routine, see the Description section.

user-arg

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by value

Optional 64-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry *user-arg* are copied to the argument list entry for *user-action-procedure*.

Description

LIB$SHOW_VM_ZONE_64 returns formatted information about the specified zone and passes it to the action routine. The *detail-level* argument determines the degree of detail of the zone information returned, and this information is formatted into a readable display and passed to either a user action routine or to LIB$PUT_OUTPUT.

The action routine is a user-supplied routine that LIB$SHOW_VM_ZONE_64 calls if you specify the *action-routine* argument in the call to LIB$SHOW_VM_ ZONE_64. If you do not specify *action-routine*, the information is passed to LIB$PUT_OUTPUT for output to SYS$OUTPUT. The call format for an action routine is as follows:

```
action-routine string, user-arg
```

Arguments

string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Information supplied by LIB$SHOW_VM_ZONE_64. The *string* argument is the address of a descriptor pointing to an address into which LIB$SHOW_VM_ ZONE_64 writes the requested information. The string is formatted exactly as it would be if written to SYS$OUTPUT.

user-arg

OpenVMS usage:	user_arg
type:	quadword (unsigned)

access:	read only
mechanism:	by value

The 64-bit value passed to LIB$SHOW_VM_ZONE_64 is passed to the action routine without interpretation. If the *user-arg* argument is omitted in the call to LIB$SHOW_VM_ZONE_64, a zero is passed by value to the user routine.

If no *zone-id* is specified (0 is passed), the 64-bit default zone is used.

You must ensure that you have exclusive access to the zone while information is being displayed. Results are unpredictable and may be inconsistent if another thread of control modifies the zone while this routine is displaying data or scanning control blocks.

While scanning the queues and free lists, this routine may detect errors.

If the lookaside list summary discovers a block improperly linked into the list so that the list appears disjointed, the count of the number of blocks of that particular size will be displayed as asterisks.

Table 2.8 lists error and warning messages that may be displayed during the lookaside list and area free list scans. The format is as follows:

```
**** ERROR -- error description ****
**** WARNING -- warning description ****
```

Table 2.8. LIB$SHOW_VM_ZONE_64 Error and Warning Messages

Error Message	Description
Invalid block size	The size of the block is either not large enough to contain the necessary queue links or is unreasonably large. The size field has been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Block not owned by zone	The current block is not within a section of the virtual address space controlled by this zone. It may be attempting to free a block not originally allocated from this zone.
Block extends past the end of area; truncated	The end of the block is not in the area from which the block has been allocated. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Block extends into ‘‘unallocated’’ block, truncated	The end of the block extends past the allocated section of the area. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.
Current block not completely accessible	The current block extends into a nonexistent part of the virtual address space. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.

Error Message	Description
Back link does not return to previous block	The back link in a doubly linked list does not point to the previous block.
Forward link does not point to valid address	The forward link of current block points to a location that is not in the virtual address space.
Free-fill mismatch	One of the locations filled when the block was freed has been modified.
Boundary tag mismatch	One of the boundary tags of the block is not valid.

Warning	Description
Forward link of current block may not be valid	The back link of the block pointed to by the forward link of the current block does not point to the current block.
Block at *nnnnnnnn* is not accessible	The block at location *nnnnnnnn* could not be accessed and cannot be dumped.
Block truncated to *nnnnnnnn* bytes to prevent ACCVIO	The block to be dumped extends into the inaccessible part of the address space. The size of the block is reduced so that the block to be dumped fits within the accessible addresses.

When a block forward link is suspected of pointing to an invalid next block, the information from the next block is replaced by asterisks. The following is a sample error display:

```
**** ERROR -- forward-link does not point to valid address ****
Link Analysis for Current Block:
                    Previous Current Next
                    -------- -------- --------
  Block adr : 00000001C0000050 00000001C0002040 4B4E556A6B6E754A

  Forw link (abs): 00000001C0002040 4B4E556A6B6E754A ****************

Block size =      64

Block contents:

4B4E556A 6B6E754A 00000000 00000040 @...JunkjUNK 00000 00000001C0002040
00000000 00000000 00000000 00000000 ............ 00010 00000001C0002050
```

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone. Routine was called with a *zone-id* that does not represent a valid VM zone.
LIB$_INVARG	Invalid argument.
LIB$_INVOPEZON	Invalid operation for zone; invalid use of unspecified user zone action routine.
LIB$_NOTFOU	Could not find another VM zone (alternate success status).
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by the user-formatted output action routine or LIB$PUT_OUTPUT.

Examples

1. ```
   #include <lib$routines.h>

   main()
   {
       __int64 zone_id = 0;
       __int64 detail_level = 1;

       LIB$SHOW_VM_ZONE_64(&zone_id, &detail_level);
   }
   ```

   An example of the output generated by this C program using detail-level 1 is as follows:

   ```
   Zone Id = 0000000000020040, Zone name = "DEFAULT_ZONE"
         Algorithm = LIB$K_VM_FIRST_FIT

         Flags = 00000020
                     LIB$M_VM_EXTEND_AREA

         Initial size =     124 pages     Current size = 0 pages in 0 areas
         Extend size =      128 pages     Page limit = None

         Requests are rounded up to a multiple of 16 bytes,
         naturally aligned on 16 byte boundaries

         0 bytes have been freed and not yet reallocated

         128 bytes are used for zone and area control blocks, or 100.0%
         overhead
   ```

2. ```
   #include <descrip.h>
   #include <libvmdef.h>
   #include <lib$routines.h>
   #include <stdlib.h>


   #pragma pointer_size(long)

   main()
   {
       __int64 zone_id;
       __int64 algorithm = LIB$K_VM_QUICK_FIT;
       __int64 algorithm_arg = 16;
       __int64 flags = LIB$M_VM_FREE_FILL0 | LIB$M_VM_EXTEND_AREA;
       __int64 detail_level = 3;
       $DESCRIPTOR(zone_name, "Lookaside list and area blocks");
       int i;
   #define NUM_BLOCKS 250
       char *blocks[NUM_BLOCKS];
       __int64 sizes[NUM_BLOCKS];
       LIB$CREATE_VM_ZONE_64(&zone_id, &algorithm, &algorithm_arg, &flags,
           0, 0, 0, 0, 0, 0, /* Omitted arguments */
           &zone_name, 0, 0);
       for (i = 0; i < NUM_BLOCKS; i++)
           {
           sizes[i] = rand() % 400 + 17;
           LIB$GET_VM_64(&sizes[i], &blocks[i], &zone_id);
   ```

```
          }
       for (i = 0; i < NUM_BLOCKS; i++)
           LIB$FREE_VM_64(&sizes[i], &blocks[i], &zone_id);
       LIB$SHOW_VM_ZONE_64(&zone_id, &detail_level);
   }
```

An example of the output generated by this C program using *detail-level* 3 is as follows:

```
Zone Id = 00000001C0002000, Zone name = "Lookaside list and area blocks"
        Algorithm = LIB$K_VM_QUICK_FIT with 16 Lookaside Lists ranging from
                    a minimum blocksize of 16, to a maximum blocksize of
                    256

        Flags = 00000028
                     LIB$M_VM_FREE_FILL0
                     LIB$M_VM_EXTEND_AREA

        Initial size =      16 pages     Current size = 112 pages in 1 area
        Extend size =       16 pages     Page limit = None

        Requests are rounded up to a multiple of 16 bytes,
        naturally aligned on 16 byte boundaries

        56992 bytes have been freed and not yet reallocated

        576 bytes are used for zone and area control blocks, or 0.9%
        overhead

        Quick Fit Lookaside List Summary:

             List        Block Number of
            number        size   blocks
            ------ ---------- ----------
                 2         32          6
                 3         48          7
                 4         64          7
                 5         80         14
                 6         96          6
                 7        112         12
                 8        128         14
                 9        144         14
                10        160          7
                11        176         14
                12        192          8
                13        208          9
                14        224          8
                15        240         12
                16        256         10

        Area Summary:

          First            Last            Pages    Bytes not yet
         address          address         assigned    allocated
        --------         --------        ----------  -------------
        00000001C0004000 00000001C0011FFF       112            352

Scanning Lookaside Lists in Zone Control Block
Scanning Free List for Area at 00000001C0004000
```

```
Number of blocks = 63, Min blocksize = 272, Max blocksize = 1360
```

LIB$SIGNAL

LIB$SIGNAL — The Signal Exception Condition routine generates a signal that indicates that an exception condition has occurred in your program. If a condition handler does not take corrective action and the condition is severe, then your program will exit.

Format

LIB$SIGNAL condition-value [,condition-argument...] [,condition-value-n [,cor

Returns

None.

Arguments

condition-value

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by value

OpenVMS 32-bit condition value. The *condition-value* argument is an unsigned longword that contains this condition value.

The *VSI OpenVMS Programming Concepts Manual* explains the format of an OpenVMS condition value.

condition-argument

OpenVMS usage:	varying_arg
type:	unspecified
access:	read only
mechanism:	by value

As many arguments as are required to process the exception specified by *condition-value*. Note that these arguments are also used as FAO (formatted ASCII output) arguments to format a message.

The *VSI OpenVMS Programming Concepts Manual* explains the message format.

condition-value-n

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by value

OpenVMS 32-bit condition value. The optional *condition-value-n* argument is an unsigned longword that contains this condition value. The calling routine can specify additional conditions to be processed by specifying *condition-value-2* through *condition-value-n*, with each

condition value followed by any arguments required to process the condition specified. However, the total number of arguments in the call to LIB$SIGNAL must not exceed 253.

The *VSI OpenVMS Programming Concepts Manual* explains the format of an OpenVMS condition value.

condition-argument-n

OpenVMS usage:	varying_arg
type:	unspecified
access:	read only
mechanism:	by value

As many arguments as are required to create the message reporting the exception specified by *condition-value-n*.

The *VSI OpenVMS Programming Concepts Manual* explains the message format.

Description

A routine calls LIB$SIGNAL to indicate an exception condition or output a message rather than return a status code to its caller.

LIB$SIGNAL creates a signal argument vector that contains all the arguments passed to it, with the PC and PSL (VAX) or PS (Alpha or I64) appended to it. LIB$SIGNAL also creates a mechanism argument vector that contains the state of the process at the time of the exception. LIB$SIGNAL then searches for a condition handler to process the exception condition.

LIB$SIGNAL first examines the primary and secondary exception vectors, then scans the stack, beginning with the most recent frame, searching for declared condition handlers. LIB$SIGNAL calls, in succession, each condition handler it finds, until a condition handler

- Returns a continue code
- Calls system service $UNWIND
- Calls LIB$STOP

LIB$SIGNAL uses each frame's saved frame pointer (FP) to chain back through the stack frames. The *VSI OpenVMS Programming Concepts Manual* provides additional information on this process.

The condition handler can do one of the following:

- Successfully process the condition and return a continue code (that is, any success completion code with bit 0 set to 1). In this case, LIB$SIGNAL returns to its caller, which should be prepared to continue execution.
- Fail to process the condition. The handler then returns a resignal code (that is, any completion code with bit 0 set to 0) and LIB$SIGNAL scans the stack for the next specified handler.
- Dismiss the signal and system service $UNWIND to cause the Condition Handling Facility (CHF) to perform some call stack cleanup and resume program execution (at a level specified by the condition handler) up on the call stack.

LIB$SIGNAL can, as necessary, scan up to 65,536 previous stack frames and then finally examine the last-chance exception vector. If called, the last-chance exception handler formats a message based on the condition codes and arguments contained within the signal argument vector.

Condition Values Returned

None.

Examples

1. ```
   C+
   C This Fortran example program demonstrates the use of
   C LIB$SIGNAL.
   C
   C This program defines SS$... signals and then calls LIB$SIGNAL
   C passing the access violation code as the argument.
   C-

           INCLUDE '($SSDEF)'
           CALL LIB$SIGNAL ( %VAL(SS$_ACCVIO) )
           END
   ```

   In Fortran, this code fragment signals the standard system message ACCESS VIOLATION.

   The output generated by this Fortran program on an OpenVMS Alpha system is as follows:

   ```
   %SYSTEM-F-ACCVIO, access violation, reason mask=10, virtual
    address=03C00020,_
    PC=00000000, PS=08000000
   %TRACE-F-TRACEBACK, symbolic stack dump follows
   module name     routine name                     line       rel PC
    abs PC
   D2$MAIN         D2$MAIN                           683      00000010
    00000410
   ```

2. ```
   ;+
   ; This VAX MACRO example program demonstrates the use of LIB$SIGNAL
   ; by forcing an access violation to be signaled.
   ;-

    .EXTRN SS$_ACCVIO ; Declare external symbol
    .ENTRY START,0
    PUSHL #SS$_ACCVIO ; Condition value symbol
        ; for access violation
    CALLS #1, G^LIB$SIGNAL ; Signal the condition
    RET
   .END START
          .EXTRN SS$_ACCVIO             ; Declare external symbol
          PUSHL #SS$_ACCVIO             ; Condition value symbol
                                        ; for access violation
          CALLS #1, LIB$SIGNAL          ; Signal the condition
   ```

   This example shows the equivalent VAX MACRO code. The output generated by this program on a OpenVMS VAX system is as follows:

   ```
   %SYSTEM-F-ACCVIO, access violation, reason mask=0F, virtual
    address=03C00000,_
    PC=00000000, PSL=00000000
   %TRACE-F-TRACEBACK, symbolic stack dump follows
   module name     routine name                     line       rel PC
    abs PC
   ```

```
.MAIN.          START                                           0000000F
 0000020F
```

3. ```
   #include <ssdef.h>
   #include <lib$routines.h>

   main()
   {
       /*
       ** lib$signal will append the PC/PS to argument list,
       ** so pass only first two FAO arguments to lib$signal
       */

       lib$signal(SS$_ACCVIO, 4, -559038737);     /* Shouldn't return */
       return (SS$_NORMAL);                       /* Exit if it does */
   }
   ```

   This example shows the equivalent C code. The output generated by this program on an OpenVMS Alpha system is as follows:

   ```
   %SYSTEM-F-ACCVIO, access violation, reason mask=04, virtual
    address=DEADBEEF,
    PC=00020034, PS=0000001B
   %TRACE-F-TRACEBACK, symbolic stack dump follows
    Image Name   Module Name     Routine Name    Line Number  rel PC
    abs PC
    LIB$SIGNAL                                              0 00010034
    00020034
    LIB$SIGNAL                                              0 000100A0
    000200A0
                                                            0 82F01158
    82F01158
                                                            0 7FF190D0
    7FF190D0
   ```

4. ```
   #include <stdio>
   #include <ssdef>
   #include <tlib$routines>

   /* Condition handler:
    */
   /*
    */
   /* This condition handler will print out the signal array, based on
    */
   /* the argument count in the first element of the array. The error
    */
   /* is resignalled and should be picked up by the last chance condition
    */
   /* handler which will format and print error messages and terminate the
    */
   /* program.
    */
   /*
    */
   int handler (int* sig, int*mech)
   {
       int i;
   ```

```
    printf ("*** Caught signal:\n\n");
    for (i = 0; i <= sig[0]; i++)
    {
        printf ("        %08X\n", sig[i]);
    }
    printf ("\n");
    return SS$_RESIGNAL;
}

/* Main program:
 */
/*
 */
/* Signal errors:
 */
/*
 */
/* SS$_BADPARAM has no arguments
 */
/* SS$_ACCVIO has 4 arguments, the last two (PC and PS) are
 */
/* automatically provided by LIB$SIGNAL.
 */
/*
 */
main ()
{
    lib$establish (handler);
    lib$signal (SS$_BADPARAM, SS$_ACCVIO, 2, 0xFACE);
}
```

This C example demonstrates the use of a condition handler to capture the signal generated by LIB $SIGNAL. The output is as follows:

```
$ CC SIGNAL.C
$ LINK SIGNAL
$ RUN SIGNAL
*** Caught signal:
        00000006
        00000014
        0000000C
        00000002
         0000FACE
        000201A0
        0000001B

%SYSTEM-F-BADPARAM, bad parameter value
-SYSTEM-F-ACCVIO, access violation, reason mask=02,
virtual address=000000000000FACE, PC=00000000000201A0, PS=0000001B
%TRACE-F-TRACEBACK, symbolic stack dump follows
  image    module    routine          line      rel PC           abs PC
 SIGNAL  SIGNAL  main                5961 00000000000001A0
 00000000000201A0
 SIGNAL  SIGNAL  __main                 0 0000000000000050
 0000000000020050
                                        0 FFFFFFFF82204914
 FFFFFFFF82204914
```

LIB$SIG_TO_RET

LIB$SIG_TO_RET — The Signal Converted to a Return Status routine converts any signaled condition value to a value returned as a function. The signaled condition is returned to the caller of the user routine that established the handler that is calling LIB$SIG_TO_RET. This routine may be established as or called from a condition handler.

Format

LIB$SIG_TO_RET signal-arguments ,mechanism-arguments

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

signal-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Signal argument vector. The *signal-arguments* argument contains the address of an array that is this signal argument vector stack.

See the *VSI OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

mechanism-arguments

OpenVMS usage:	structure
type:	unspecified
access:	read only
mechanism:	by reference

Mechanism arguments vector. The *mechanism-arguments* argument contains the address of a structure that is this mechanism argument vector stack.

See the *VSI OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

Description

LIB$SIG_TO_RET is called with the argument list that was passed to a condition handler by the OpenVMS Condition Handling Facility. The signaled condition is converted to a value returned to the routine that called the routine that established the handler. That action is performed by unwinding the stack to the caller of the establisher of the condition handler. The condition code is returned as the

value in R0. See the *VSI OpenVMS Programming Concepts Manual* for more information on condition handling.

LIB$SIG_TO_RET causes the stack to be unwound to the caller of the routine that established the handler which was called by the signal.

Condition Values Returned

SS$_NORMAL	Routine successfully completed; SS$_UNWIND completed. Otherwise, the error code from SS$_UNWIND is returned.

Example

```
C+
C This Fortran example demonstrates how to use LIB$SIG_TO_RET.
C
C This function subroutine inverts each entry in an array. That is,
C a(i,j) becomes 1/a(i,j). The subroutine has been declared as an integer
C function so that the status of the inversion may be returned. The status
C should be success, unless one of the a(i,j) entries is zero. If one of
C the a(i,j) = 0, then 1/a(i,j) is division by zero. This division by zero
C does not cause a division by zero error, rather, the routine will return
C signal a failure.
C-

        INTEGER*4 FUNCTION FLIP(A,N)
        DIMENSION A(N,N)
        EXTERNAL LIB$SIG_TO_RET
        CALL LIB$ESTABLISH (LIB$SIG_TO_RET)
        FLIP = .TRUE.

C+
C Flip each entry.
C-

         DO 1 I = 1, N
         DO 1 J = 1, N
1        A(I,J) = 1.0/A(I,J)
         RETURN
         END

C+
C This is the main code.
C-

         INTEGER STATUS, FLIP
         REAL ARRAY_1(2,2),ARRAY_2(3,3)
         DATA ARRAY_1/1,2,3,4/,ARRAY_2/1,2,3,5,0,5,6,7,2/
         CHARACTER*32 TEXT(2),STRING
         DATA TEXT(1)/' This array could be flipped. '/,
     1   TEXT(2)/' This array could not be flipped.'/

         STRING = TEXT(1)
         STATUS = FLIP(ARRAY_1,2)
         IF ( .NOT. STATUS) STRING = TEXT(2)
         TYPE '(a)', STRING
```

```
        STRING = TEXT(1)
        STATUS = FLIP(ARRAY_2,3)
        IF ( .NOT. STATUS) STRING = TEXT(2)
        TYPE '(a)',     STRING

        END
```

This Fortran example program inverts each entry in an array. The output generated by this program is as follows:

```
    This array could be flipped.
    This array could not be flipped.
```

LIB$SIG_TO_STOP

LIB$SIG_TO_STOP — The Convert a Signaled Condition to a Signaled Stop routine converts a signaled condition to a signaled condition that cannot be continued.

Format

LIB$SIG_TO_STOP signal-arguments ,mechanism-arguments

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

signal-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Signal argument vector. The *signal-arguments* argument contains the address of an array that is this signal argument vector stack.

See the *VSI OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

mechanism-arguments

OpenVMS usage:	structure
type:	unspecified
access:	read only
mechanism:	by reference

Mechanism argument vector. The *mechanism-arguments* argument contains the address of a structure that is this mechanism argument vector stack.

See the *VSI OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

Description

LIB$SIG_TO_STOP causes a signal to appear as though it had been signaled by a call to LIB$STOP. When a signal is generated by LIB$STOP, the severity code is forced to SEVERE and control cannot return to the routine that signaled the condition. LIB$SIG_TO_STOP may be enabled as a condition handler for a routine or it may be called from a condition handler.

If the condition value in *signal-arguments* is SS$_UNWIND, then LIB$SIG_TO_STOP returns the error condition LIB$_INVARG.

Condition Values Returned

SS$_NORMAL	Routine successfully completed; SS$_UNWIND completed. Otherwise, the error code from SS$_UNWIND is returned.
LIB$_INVARG	Invalid argument. The condition code in *signal-arguments* is SS$_UNWIND.

LIB$SIM_TRAP

LIB$SIM_TRAP — The Simulate Floating Trap routine converts floating faults to floating traps. It can be enabled as a condition handler or can be called by one. This routine is not available to native OpenVMS Alpha or I64 programs but is available to translated VAX images.

Format

LIB$SIM_TRAP signal-arguments ,mechanism-arguments

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

signal-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	modify
mechanism:	by reference, array reference

Signal argument vector. The *signal-arguments* argument contains the address of an array that is this signal argument vector stack. See the *VSI OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

mechanism-arguments

OpenVMS usage:	vector_longword_unsigned
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Mechanism argument vector. The *mechanism-arguments* argument contains the address of an array that is this mechanism argument vector stack.

See the *VSI OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

Description

LIB$SIM_TRAP converts floating faults to floating traps. It can be enabled as a condition handler or can be called by one.

LIB$SIM_TRAP intercepts floating overflow, underflow, and divide-by-zero faults. It simulates the instruction causing the condition up to the point where a fault should be signaled, then signals the corresponding floating trap.

Since LIB$SIM_TRAP nullifies the condition handling for the original fault condition, the final condition signaled by the routine will be from the context of the instruction itself, rather than from the condition handler. The signaling path is identical to that of a hardware-generated trap. The signal argument vector is placed so the last entry in the vector will be the user's stack pointer at the completion of the instruction (for a trap), or at the beginning of the instruction (for a fault).

See the *VAX Architecture Reference Manual* for more information on faults and traps.

Condition Values Returned

SS$_RESIGNAL	Resignal condition to next handler. The exception was one that LIB $SIM_TRAP could not handle.

LIB$SKPC

LIB$SKPC — The Skip Equal Characters routine compares each character of a given string with a given character and returns the relative position of the first nonequal character as an index. LIB$SKPC makes the VAX SKPC instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$SKPC character-string ,source-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

The relative position in the source string of the first unequal character. LIB$SKPC returns a zero if the source string was of zero length or if every character in *source-string* was equal to *character-string*.

Arguments

character-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String whose initial character is to be used by LIB$SKPC in the comparison. The *character-string* argument contains the address of a descriptor pointing to this string. Only the first character of *character-string* is used, and the length of *character-string* is not checked.

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

String to be searched by LIB$SKPC. The *source-string* argument contains the address of a descriptor pointing to this string.

Description

LIB$SKPC compares the initial character of *character-string* with successive characters of *source-string* until it finds an inequality or reaches the end of the *source-string*. It returns the relative position of this unequal character as an index, which is the relative position of the first occurrence of a substring in the source string.

Condition Values Returned

None.

Example

```
C+
C This Fortran example program shows the use of LIB$SKPC.
C LIB$SKPC compares each character of a given string with a given
 character.
C It returns the relative position of the first nonequal character as an
 index.
C-
      I = LIB$SKPC (' ', ' ABC')
      TYPE 1, I
    1 FORMAT(' The blank character matches the',I2,'nd character in')
      TYPE *,'the string " ABC"'
      J = LIB$SKPC ('A', 'AAA')
```

```
      TYPE 2, J
    2 FORMAT(' The character "A" matches the',I2,'th character in')
      TYPE *,'the string " AAA"'
      END
```

This Fortran example generates the following output:

```
The blank character matches the 2nd character in
the string " ABC"
The character "A" matches the 0th character in
the string " AAA"
```

LIB$SPANC

LIB$SPANC — The Skip Selected Characters routine is used to skip a specified set of characters in the source string. LIB$SPANC makes the VAX SPANC instruction available as a callable routine. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

Format

LIB$SPANC source-string ,table-array ,byte-integer-mask

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

The relative position in the source string of the character that terminated the operation is returned if such a character is found. Otherwise, zero is returned. If the source string has a zero length, then a zero is returned.

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string used by LIB$SPANC to index into *table-array*. The *source-string* argument contains the address of a descriptor pointing to this source string.

table-array

OpenVMS usage:	vector_mask_byte
type:	byte (unsigned)
access:	read only
mechanism:	by reference, array reference

Table that LIB$SPANC indexes into and performs an AND operation with the *byte-integer-mask* byte. The *table-array* argument contains the address of an unsigned byte array that is this table.

byte-integer-mask

OpenVMS usage:	mask_byte
type:	byte (unsigned)
access:	read only
mechanism:	by reference

Mask that an AND operation is performed with bytes in *table-array*. The *byte-integer-mask* argument contains the address of an unsigned byte that is this mask.

Description

LIB$SPANC uses successive bytes of the string specified by *source-string* to index into a table. An AND operation is performed on the byte selected from the table and the mask byte.

The operation is terminated when the result of the AND operation is zero.

Condition Values Returned

None.

Example

```
!+
! This Fortran program demonstrates how to use
! LIB$SCANC and STR$UPCASE.
!
! Declare the Run-Time Library routines to be used.
!-

       INTEGER*4 STR$UPCASE       ! Translate to upper case
       INTEGER*4 LIB$SCANC        ! Look for characters
       INTEGER*4 LIB$SPANC        ! Skip over characters

!+
! Declare the alphabet from which "words" are constructed.
!-

       CHARACTER*(38) ALPHABET
       DATA ALPHABET /'ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789$_'/

!+
! Local variable declarations
!-

       INTEGER*4 WORD_COUNT /0/        ! Count of words found
       INTEGER*4 WORD_LENGTH /0/       ! Length of a word
       INTEGER*4 TOTAL_LENGTH /0/      ! Sum of word lengths
       INTEGER*4 START_POS /0/         ! Position of start of word
       INTEGER*4 END_POS /0/           ! Position of end of word
       REAL*4 AVERAGE_LENGTH /0.0/     ! Average length of words
       CHARACTER*80 LINE               ! Line to examine for words
```

```
       BYTE MATCH_TABLE(0:255) /256*0/ ! Match table for scanning

!+
! The routines LIB$SCANC and LIB$SPANC require a table with an entry
! for each possible character. Create a match table from ALPHABET
! with an entry of 1 if the character is in ALPHABET, 0 otherwise.
! MATCH_TABLE has already been initialized to zeros.
!-

       DO I = 1, LEN(ALPHABET)
         MATCH_TABLE(ICHAR(ALPHABET(I:I))) = 1
         END DO

!+
! Loop forever finding words in LINE. When LINE is exhausted,
! indicated by a START_POS of zero, read another one. Upon
! end-of-file, leave the loop and print the statistics.
!-

       OPEN( UNIT = 1, FILE = 'TEST.DAT', TYPE = 'OLD' )
       DO WHILE (.TRUE.)
         DO WHILE (START_POS .EQ. 0)    ! Get a new line
           READ (1,'(A)',END=900) LINE  ! If EOF, skip to 900
           CALL STR$UPCASE (LINE,LINE)  ! Convert to upper
                                        ! case for matching
           START_POS = LIB$SCANC (LINE,MATCH_TABLE,1) ! Find beginning
           END DO                       ! of first word

!+
! START_POS now points to the beginning of a word. Call LIB$SPANC to
! find the first character that is not part of the word. Set
! START_POS to beginning of next word. If LIB$SPANC does not
! find a non-word character, it returns zero.
!-

         END_POS =
     1      START_POS + LIB$SPANC (LINE(START_POS:), MATCH_TABLE,1) - 1
         IF (END_POS .LT. START_POS) THEN   ! Word goes to end of line
           WORD_LENGTH = (LEN(LINE) + 1) - START_POS
           START_POS = 0                    ! Indicate line exhausted
         ELSE
           WORD_LENGTH = END_POS - START_POS
           START_POS =
     1       END_POS + LIB$SCANC (LINE(END_POS:),MATCH_TABLE,1) - 1
         IF (START_POS .LT. END_POS) START_POS = 0 ! No more words on line
         END IF

!+
! Update count and length statistics.
!-

         WORD_COUNT = WORD_COUNT + 1
         TOTAL_LENGTH = TOTAL_LENGTH + WORD_LENGTH
         END DO
900     CONTINUE

!+
! Compute average word length and display statistics.
```

```
!-

        IF (WORD_COUNT .NE. 0)
     1   AVERAGE_LENGTH = FLOAT(TOTAL_LENGTH) / FLOAT(WORD_COUNT)
        TYPE 901,WORD_COUNT,AVERAGE_LENGTH
901     FORMAT (1X,I10,' words found, average length was ',
     1          F4.1,' letters.')

        CLOSE (1)

        END
```

This Fortran program reads text from the default input unit and looks for words. A word is defined as a string containing only the characters A through Z (uppercase or lowercase), 0 through 9, and the dollar sign ($) and underscore (_) symbols. The program reports the total number of words found and their average length.

The program uses three Run-Time Library routines: STR$UPCASE, LIB$SCANC, and LIB$SPANC.

1. The string is converted to uppercase using STR$UPCASE so that the search for words will ignore the case of letters.

2. LIB$SCANC searches through the string for one of a set of characters, the set being specified as nonzero elements in a 256-byte table.

3. Similarly, LIB$SPANC uses the VAX SPANC instruction to search through a string for a character whose table entry is not zero. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

The value returned by each routine is the index into the string where the first matching (or nonmatching) character was found, or zero if no match was found.

The output generated by this Fortran program is as follows:

```
    12 words found, average length was  4.2 letters.
```

LIB$SPAWN

LIB$SPAWN — The Spawn Subprocess routine requests the command language interpreter (CLI) of the calling process to spawn a subprocess for executing CLI commands. LIB$SPAWN provides the same function as the DCL command SPAWN.

Format

LIB$SPAWN [command-string] [,input-file] [,output-file] [,flags] [,process-na

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only

mechanism:	by value

Arguments

command-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

CLI command to be executed by the spawned subprocess. The *command-string* argument is the address of a descriptor pointing to this CLI command string. If *command-string* is omitted, commands are taken from the file specified by *input-file*.

input-file

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Equivalence name to be associated with the logical name SYS$INPUT in the logical name table for the subprocess. The *input-file* argument is the address of a descriptor pointing to this equivalence string. If *input-file* is omitted, the default is the caller's SYS$INPUT.

output-file

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Equivalence name to be associated with the logical names SYS$OUTPUT and SYS$ERROR in the logical name table for the subprocess. The *output-file* argument is the address of a descriptor pointing to this equivalence string. If *output-file* is omitted, the default is the caller's SYS $OUTPUT.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Flag bits that designate optional behavior. The *flags* argument is the address of an unsigned longword that contains these flag bits. By default, all flags are clear.

These flags are defined as follows:

Bit	Symbol	Meaning
0	NOWAIT	If this bit is set, the calling process continues executing in parallel with the subprocess. If this bit is clear, the calling process hibernates until the subprocess completes.
1	NOCLISYM	If this bit is set, the spawned subprocess does not inherit CLI symbols from its caller. If this bit is clear, the subprocess inherits all currently defined CLI symbols. You may want to specify NOCLISYM to help prevent commands redefined by symbol assignments from affecting the spawned commands.
2	NOLOGNAM	If this bit is set, the spawned subprocess does not inherit process logical names from its caller. If this bit is clear, the subprocess inherits all currently defined process logical names. You may want to specify NOLOGNAM to help prevent commands redefined by logical name assignments from affecting the spawned commands.
3	NOKEYPAD	If this bit is set, the keypad symbols and state are not passed to the subprocess. If this bit is not set, the keypad settings are passed to the subprocess.
4	NOTIFY	If this bit is set, a message is broadcast to SYS$OUTPUT when the subprocess completes or aborts. If this bit is not set, no message is broadcast. This bit should not be set unless the NOWAIT bit is also set.
5	NOCONTROL	If this bit is set, no carriage-return/line-feed is prefixed to any prompt string. If this bit is not set, a carriage-return/line-feed is prefixed to any prompt string specified.
6	TRUSTED	If this bit is set, it indicates a SPAWN command on behalf of

Bit	Symbol	Meaning
		the application. If this bit is not set, it indicates that the SPAWN command originates from user. SPAWN commands originating from users are disallowed in captive accounts (DCL).
7	AUTHPRIV	If this bit is set, the subprocess inherits the caller's authorized privileges. If this bit is clear, the spawned processes' authorized mask is set equal to the caller's current (active) privilege mask.
8	SUBSYSTEM	If this bit is set, a spawned process inherits protected subsystem IDs for the duration of LOGINOUT.EXE (used to map the CLI). The IDs will be removed in the process of transferring control to the CLI (as a user mode $RUNDWN is performed). If this bit is clear, LOGINOUT does not execute under the subsystem IDs.

Bits 9 through 31 are reserved for future expansion and must be zero. Symbolic flag names are defined in libraries supplied by VSI in module $CLIDEF. They are CLI$M_NOWAIT, CLI$M_NOCLISYM, CLI$M_NOLOGNAM, CLI$M_NOKEYPAD, CLI$M_NOTIFY, CLI$M_NOCONTROL, CLI $M_TRUSTED, CLI$M_AUTHPRIV, and CLI$M_SUBSYSTEM.

process-name

OpenVMS usage:	process_name
type:	character string
access:	read only
mechanism:	by descriptor

Name defined for the subprocess. The *process-name* argument is the address of a descriptor pointing to this name string. If *process-name* is omitted, a unique process name will be generated. If you supply a name and it is not unique, LIB$SPAWN will return the condition value SS$_DUPLNAM.

The DCL_CTLFLAGS is a bitmask used to alter default behavior for certain commands on a systemwide basis. Currently, only the low bit of the bitmask is defined. The low bit controls the default *process-name* assignment for a subprocess created using the LIB$SPAWN routine.

Prior to OpenVMS Version 7.3-1, if no process name was supplied, the system constructed a name by appending _n to the username, where n was the next available non-duplicate integer for any process currently in the system. For example, the first spawned process from user SYSTEM would be called SYSTEM_1, the second, SYSTEM_2, and so on. The next available number was chosen, as soon as a gap was found.

Beginning in OpenVMS Version 7.3-1, the default constructed process name for subprocesses has changed. Instead of incrementally searching for the next unique number, a random number is chosen to append to the username. Therefore, the first processes that are spawned from user SYSTEM might be SYSTEM_154, SYSTEM_42, SYSTEM_87, and so on. This procedure results in a very high probability of finding a unique number on the first try since it is unlikely the same number is already in use.

However, some applications might rely on the previous method of assigning subprocess names. The DCL_CTLFLAGS parameter is available to allow you to configure the system as necessary.

Bit 0 of DCL_CTLFLAGS selects the behavior for assigning default subprocess names, as explained in the following:

- If clear, the new behavior is used. If the process name is not specified, it will be the username with a random number suffix. This is the default setting.
- If set, the previous behavior is used. If the process name is not specified, it will be the username with the next available number suffix.

process-id

OpenVMS usage:	process_id
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Process identification of the spawned subprocess. The *process-id* argument is the address of an unsigned longword that contains this process identification value.

This process identification value is meaningful only if the NOWAIT *flags* bit is set.

completion-status-address

OpenVMS usage:	address
type:	address
access:	read only
mechanism:	by value

The final completion status of the subprocess. The *completion-status-address* argument contains the address of the status. The system writes the value of the final completion status of the subprocess into *completion-status-address* when the subprocess completes. If the subprocess returns a status code of 0, the system writes SS$_NORMAL into this address.

If the NOWAIT *flags* bit is set, the *completion-status-address* is updated asynchronously when the subprocess completes. Use the *byte-integer-event-flag-num* or *AST-address* arguments to determine when the subprocess has completed. Your program must ensure that the address is still valid when the value is written.

byte-integer-event-flag-num

OpenVMS usage:	byte_unsigned
type:	byte (unsigned)

access:	read only
mechanism:	by reference

The number of a local event flag to be set when the spawned subprocess completes. The *byte-integer-event-flag-num* argument is the address of an unsigned byte that contains this event flag number. If *byte-integer-event-flag-num* is omitted, no event flag is set.

Specifying *byte-integer-event-flag-num* is meaningful only if the NOWAIT *flags* bit is set.

AST-address

OpenVMS usage:	procedure
type:	procedure value
access:	call without stack unwinding
mechanism:	by value

Routine to be called by means of an AST when the subprocess completes.

Specifying *AST-address* is meaningful only if the NOWAIT *flags* bit is set.

varying-AST-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by value

A value to be passed to the AST routine. Typically, the *varying-AST-argument* argument is the address of a block of storage the AST routine will use.

Specifying *varying-AST-argument* is meaningful only if the NOWAIT *flags* bit is set and if *AST-address* has been specified.

prompt-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Prompt string to use in the subprocess. The *prompt-string* argument is the address of a descriptor pointing to this prompt string. If *prompt-string* is omitted, the subprocess uses the same prompt string that the parent process uses.

cli

OpenVMS usage:	char_string
type:	character string
access:	read only

mechanism:	by descriptor

File specification for the command language interpreter (CLI) to be run in the subprocess. The *cli* argument is the address of this file specification string's descriptor. The CLI specified must reside in SYS $SYSTEM with a file type of .EXE, and it must be installed. No directory or file type may be specified. The *cli* argument must be specified in uppercase characters.

If *cli* is omitted, the subprocess uses the same CLI as the parent process. If *cli* is specified, no context is copied to the subprocess.

table

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

File specification for the command tables to be used by the spawned process. The *table* argument is the address of this file specification string's descriptor. The table specified must reside in SYS$SHARE with a file type of .EXE, and it must be installed.

If *table* is omitted, the subprocess uses the same table as the parent process.

Description

The subprocess created by LIB$SPAWN inherits the following attributes from the caller's environment:

- Process logical names
- Global and local CLI symbols
- Default device and directory
- Process privileges
- Process nondeductible quotas
- Current command verification setting

The subprocess does not inherit process-permanent files nor routine or image context.

Though the subprocess inherits the caller's process privileges as its own process privileges, the set of authorized privileges in the subprocess is inherited from the caller's current privileges. If the calling image is installed with elevated privileges, these privileges are not available to the subprocess until a SET PROCESS/PRIVILEGE command or equivalent $SETPRV call is performed in the subprocess to enable these privileges.

If the calling image is installed with elevated privileges, it should disable those privileges around the call to LIB$SPAWN unless the environment of the subprocess is strictly controlled. Otherwise, there is a possibility of a security breach due to elevated privileges accidentally being made available to the user.

If neither *command-string* nor *input-file* is present, command input is taken from the parent terminal. If both *command-string* and *input-file* are present, the subprocess first executes

command-string and then reads from *input-file*. If only *command-string* is specified, the command is executed, and the subprocess is terminated. If *input-file* is specified, the subprocess is terminated by either a LOGOUT command or an end-of-file.

The subprocess does not inherit process-permanent files nor routine or image context. No LOGIN.COM file is executed.

Unless the NOWAIT *flags* bit is set, the caller's process is put into hibernation until the subprocess finishes. Because the caller's process hibernates in supervisor mode, any user-mode ASTs queued for delivery to the caller are not delivered until the caller reawakes. Control can also be restored to the caller by means of an ATTACH command or by a suitable call to LIB$ATTACH from the subprocess.

This routine is supported for use only with the DCL command language interpreter. If used when the current CLI is MCR, the error status LIB$_NOCLI is returned.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In such cases, the error status LIB$_NOCLI is returned.

Programs depending on embedded DCL commands may not function properly when run under other command language interpreters that may be supported by future versions of OpenVMS operating systems.

See the *VSI OpenVMS DCL Dictionary* for a complete description of the SPAWN command.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_ACCVIO	Access violation. One of the string arguments to LIB$SPAWN could not be read, or *completion-status-address* could not be written.
SS$_DUPLNAM	Duplicate process name. If the argument *process-name* was specified, it duplicated an existing process name. If *process-name* was omitted, LIB$SPAWN was unable to create a unique name for the subprocess.
fac$_xxx	Other error trying to create subprocess.
LIB$_INVARG	Invalid argument. The optional argument *flags* was specified, and a bit other than bits 0 through 8 was set.
LIB$_INVSTRDES	Invalid string descriptor. One of the string arguments had an invalid descriptor.
LIB$_NOCLI	No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.

If an error is encountered during subprocess creation, the status value for that error is returned by LIB $SPAWN.

Example

```
ISTAT=LIB$SPAWN(,,,CLI$M_NOKEYPAD,,,,,,'> ')
IF (.NOT. ISTAT) CALL LIB$STOP(%VAL(ISTAT))
```

This Fortran fragment shows a call to LIB$SPAWN from within a Fortran program. A subprocess is spawned taking input from SYS$INPUT and giving output to SYS$OUTPUT. The keypad state is not passed to the subprocess. A prompt string of "> " is specified for the subprocess.

LIB$STAT_TIMER

LIB$STAT_TIMER — The Statistics, Return Accumulated Times and Counts routine returns to its caller one of five available statistics accumulated since the last call to LIB$INIT_TIMER. Unlike LIB $SHOW_TIMER, which formats the values for output, LIB$STAT_TIMER returns the value as an unsigned longword or quadword.

Format

LIB$STAT_TIMER code ,value-argument [,handle-address]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

code

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

The address of a signed longword integer that contains a code to specify the statistic to be returned. The code specification must be an integer from 1 to 5.

The following values are allowed for *code*:

Value	**Statistic Returned**
1	Elapsed real time (quadword, in system time format)
2	Elapsed CPU time (longword, in 10 millisecond increments)
3	Count of buffered I/O operations (longword)
4	Count of direct I/O operations (longword)
5	Count of page faults (longword)

value-argument

OpenVMS usage:	user_arg

type:	unspecified
access:	write only
mechanism:	by reference

The statistic returned by LIB$STAT_TIMER. The *value-argument* argument contains the address of a longword or quadword that is this statistic. All statistics are longword integers except elapsed real time, which is a quadword.

See the *VSI OpenVMS System Services Reference Manual* for more details on the system time format.

handle-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Pointer to a block of storage. The optional *handle-address* argument contains the address of an unsigned longword that is this pointer.

If *handle-address* is specified, LIB$STAT_TIMER assumes that LIB$INIT_TIMER has been called with the same value of *handle-address*. *Handle-address* is an optional argument. If it is not specified, LIB$STAT_TIMER uses internal storage.

Description

Only one of the five statistics is returned by each call to LIB$STAT_TIMER. The elapsed time is returned in the system quadword format. Therefore the receiving area should be eight bytes long. All other returned values are longwords.

LIB$SHOW_TIMER and LIB$STAT_TIMER are relatively simple tools for testing the performance of a new application. Note that LIB$INIT_TIMER must be called prior to any calls to LIB $SHOW_TIMER or LIB$STAT_TIMER.

To obtain more detailed information, use LIB$GETJPI (Get Job/Process Information) or the system service $GETTIM.

The following summary shows the differences between LIB$SHOW_TIMER and LIB$STAT_TIMER:

Code	**Statistic**	**Format for LIB $SHOW_TIMER**	**Format for LIB $STAT_TIMER**
1	Elapsed real time	*hhhh*: *mm*: *ss*. *cc*	Quadword in system time format
2	Elapsed CPU time	*hhhh*: *mm*: *ss*. *cc*	Longword in 10-millisecond increments
3	Count of buffered I/O operations	*nnnn*	Longword
4	Count of direct I/O operations	*nnnn*	Longword
5	Count of page faults	*nnnn*	Longword

When you call LIB$INIT_TIMER, you must use the optional *handle-address* argument only if you want to keep several sets of statistics simultaneously. This argument points to a block in heap storage where the statistics are to be stored.

You need to call LIB$FREE_TIMER only if you have specified *handle-address* in LIB $INIT_TIMER and you want to deallocate all heap storage resources. In most cases, the implicit deallocation at program exit time will be sufficient.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. Either *code* or *handle-address* is invalid.

Example

```
PROGRAM STAT_TIMER(INPUT,OUTPUT);

{+}
{ This Pascal example program demonstrates the use of
{ LIB$STAT_TIMER.
{-}

    TYPE
          BYTE = [BYTE] 0..255;
          WORD = [WORD] 0..65535;
          QUADWORD_SYSTEM_TIME = [QUAD] RECORD
              FIRST_LONGWORD  : UNSIGNED;
              SECOND_LONGWORD : UNSIGNED;
          END;

    VAR
          ELAPSED_REAL_TIME : QUADWORD_SYSTEM_TIME;
          ELAPSED_STRING    : VARYING [32] OF CHAR;
          PAGE_FAULT_COUNT  : UNSIGNED;
          RETURNED_STATUS   : UNSIGNED;

    [EXTERNAL] FUNCTION LIB$INIT_TIMER(
          HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
          ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STAT_TIMER(
          CODE       : INTEGER;
          VALUE      : [UNSAFE,REFERENCE] PACKED ARRAY [L..U:INTEGER]
                        OF BYTE;
          HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
          ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STOP(
          CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
          FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
          ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$SYS_ASCTIM(
          OUT_LEN     : [REFERENCE] WORD := %IMMED 0;
          VAR DST_STR : PACKED ARRAY [L..U:INTEGER] OF CHAR;
          USER_TIME   : QUADWORD_SYSTEM_TIME := %IMMED 0;
```

```
          CNV_FLG     : UNSIGNED := %IMMED 0
          ) : INTEGER; EXTERNAL;

BEGIN

{+}
{ Call LIB$INIT_TIMER to initialize RTL internal counters.
{-}

RETURNED_STATUS := LIB$INIT_TIMER;
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print a line of text to waste time.
{-}

WRITELN('Spend time to acquire elapsed real time and page faults');

{+}
{ Call LIB$STAT_TIMER to retrieve statistics values.
{-}

RETURNED_STATUS := LIB$STAT_TIMER(1,ELAPSED_REAL_TIME);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

RETURNED_STATUS := LIB$STAT_TIMER(5,PAGE_FAULT_COUNT);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print the statistics retrieved from LIB$STAT_TIMER.
{-}

WRITELN('Page fault count is ',PAGE_FAULT_COUNT:1);

RETURNED_STATUS := LIB$SYS_ASCTIM(
                      ELAPSED_STRING.LENGTH,
                      ELAPSED_STRING.BODY,
                      ELAPSED_REAL_TIME,
                      1);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

WRITELN('Elapsed real time is ',ELAPSED_STRING);

END.
```

This Pascal program demonstrates the use of LIB$STAT_TIMER. The output generated by this program is as follows:

```
    Spend time to acquire elapsed real time and page faults
    Page fault count is 22
```

```
Elapsed real time is 00:00:00.61
```

LIB$STAT_VM

LIB$STAT_VM — The Return Virtual Memory Statistics routine returns to its caller one of six statistics available from calls to LIBGET_VM/LIBFREE_VM and LIB$GET_VM_PAGE/LIB $FREE_VM_PAGE. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine. Unlike LIB$SHOW_VM, which formats the values for output and displays them on SYS$OUTPUT, LIB$STAT_VM returns the statistic in the *value-argument* argument. Only one of the statistics is returned by each call to LIB$STAT_VM.

Format

LIB$STAT_VM code ,value-argument

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

code

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Code specifying which statistic is to be returned. The *code* argument contains the address of a signed longword integer that is this code.

Code	Statistic
1	Number of successful calls to LIB$GET_VM
2	Number of successful calls to LIB$FREE_VM
3	Number of bytes allocated by LIB$GET_VM but not yet deallocated by LIB$FREE_VM
5	Number of calls to LIB$GET_VM_PAGE
6	Number of calls to LIB$FREE_VM_PAGE
7	Number of VAX pages or Alpha pagelets allocated by LIB$GET_VM_PAGE but not yet deallocated by LIB$FREE_VM_PAGE

Note that it is invalid to omit *code* or to give a *code* of 0 or 4.

value-argument

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	write only
mechanism:	by reference

Value of the statistic returned by LIB$STAT_VM. The *value-argument* argument contains the address of an unsigned longword integer that is this value.

Description

LIB$STAT_VM returns to its caller one of six available statistics. Unlike LIB$SHOW_VM, which formats the values for output, LIB$STAT_VM returns the value to a location specified as an argument.

Only one of the six statistics can be returned by one call to LIB$STAT_VM. The argument *code* must be one of six values described for LIB$SHOW_VM. A *code* value of 0 or 4 is invalid.

Unlike LIB$SHOW_VM, which produces ASCII values for output, LIB$STAT_VM returns the value in binary form to a location specified as an argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. The value of *code* was not one of the values allowed by LIB$STAT_VM.

LIB$STAT_VM_64

LIB$STAT_VM_64 — The Return Virtual Memory Statistics routine returns to its caller one of six statistics available from calls to LIB$GET_VM_64 and LIB$FREE_VM_64, as well as LIB $GET_VM_PAGE_64 and LIB$FREE_VM_PAGE_64. Unlike LIB$SHOW_VM_64, which formats the values for output and displays them on SYS$OUTPUT, LIB$STAT_VM_64 returns the statistic in the value-argument argument. Only one of the statistics is returned by each call to LIB$STAT_VM_ 64.

Format

LIB$STAT_VM_64 code ,value-argument

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

code

OpenVMS usage:	quadword_signed
type:	quadword integer (signed)
access:	read only
mechanism:	by reference

Code specifying which statistic is to be returned. The *code* argument contains the address of a signed quadword integer that is this code.

Code	Statistic
1	Number of successful calls to LIB$GET_VM_64
2	Number of successful calls to LIB$FREE_VM_64
3	Number of bytes allocated by LIB$GET_VM_64 but not yet deallocated by LIB$FREE_VM_64
5	Number of calls to LIB$GET_VM_PAGE_64
6	Number of calls to LIB$FREE_VM_PAGE_64
7	Number of Alpha or I64 pagelets allocated by LIB $GET_VM_PAGE_64 but not yet deallocated by LIB $FREE_VM_PAGE_64

Note that it is invalid to omit code or to give a code of 0 or 4.

value-argument

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

Value of the statistic returned by LIB$STAT_VM_64. The *value-argument* argument contains the address of an unsigned quadword integer that is this value.

Description

LIB$STAT_VM_64 returns to its caller one of six available statistics. Unlike LIB$SHOW_VM_64, which formats the values for output, LIB$STAT_VM_64 returns the value to a location specified as an argument.

Only one of the six statistics can be returned by one call to LIB$STAT_VM_64. The *code* argument must be one of six values described for LIB$SHOW_VM_64. A *code* value of 0 or 4 is invalid.

Unlike LIB$SHOW_VM_64, which produces ASCII values for output, LIB$STAT_ VM_64 returns the value in binary form to a location specified as an argument.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. The value of code was not one of the values allowed by LIB$STAT_VM_64.

LIB$STOP

LIB$STOP — The Stop Execution and Signal the Condition routine generates a signal that indicates that an exception condition has occurred in your program. Exception conditions signaled by LIB$STOP cannot be continued from the point of the signal.

Format

LIB$STOP condition-value [,number-of-arguments] [,FAO-argument...]

Returns

LIB$STOP generates a signal and stops execution of the calling program. No condition values are returned.

Arguments

condition-value

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by value

OpenVMS 32-bit condition value. The *condition-value* argument is an unsigned longword that contains this condition value.

The *VSI OpenVMS Programming Concepts Manual* explains the format of a condition value.

number-of-arguments

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by value

Number of FAO arguments associated with condition-value. The optional *number-of-arguments* argument is a signed longword integer that contains this number. If omitted or specified as zero, no FAO arguments follow.

FAO-argument

OpenVMS usage:	varying_arg
type:	unspecified
access:	read only
mechanism:	by value

Optional FAO (formatted ASCII output) argument that is associated with the specified condition value.

The *VSI OpenVMS Programming Concepts Manual* explains the message format.

Description

LIB$STOP is called whenever your program must indicate an exception condition because it is impossible to continue execution or return a status code to the calling program.

LIB$STOP scans the stack frame by frame, starting with the most recent frame, calling each established handler (see the *VSI OpenVMS Programming Concepts Manual*). LIB$STOP guarantees that control will not return to the caller.

The LIB$STOP argument list, the Program Counter (PC) and Processor Status Longword (PSL on OpenVMS VAX systems, PS on OpenVMS Alpha and I64 systems) of the caller are appended to build the signal argument vector.

The severity of **condition-value** is forced to SEVERE before each call to a handler.

If any handler attempts to continue by returning a success completion code, the error message ATTEMPT TO CONTINUE FROM STOP is printed and your program exits.

If the handler called by LIB$STOP in turn calls system service $UNWIND, control will not return to LIB$STOP's caller, thus changing the program flow. A handler can also modify the saved copy of R0/R1 in the mechanism vector, changing registers R0 and R1 after the stack has been unwound. If a handler does neither of these things, then all registers including R0/R1 and the hardware condition codes are preserved. On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

The only way a handler can prevent the image from exiting after a call to LIB$STOP is to unwind the stack using the $UNWIND system service.

Condition Values Returned

None.

Examples

```
10 EXTERNAL LONG FUNCTION LIB$RESERVE_EF
   DECLARE LONG RET_STATUS

   RET_STATUS = LIB$RESERVE_EF( 2% )
   IF (RET_STATUS AND 1%) = 0% THEN
       CALL LIB$STOP( RET_STATUS BY VALUE )
END IF

PRINT "Event flag 2 reserved successfully"

END
```

This BASIC example program uses LIB$STOP to stop executing if an error is signaled. This BASIC program tries to reserve an event flag that is not accessible to user programs, thus ensuring that an error will be signaled.

The output generated by this BASIC program is as follows:

```
    %LIB-F-EF_ALRRES, event flag already reserved
```

```
    %TRACE-F-TRACEBACK, symbolic stack dump follows
    module name     routine name                     line         rel PC
  abs PC
    2822XBLST$MAIN  2822XBLST$MAIN                      6        00000044
 00000644
```

LIB$SUBX

LIB$SUBX — The Multiple-Precision Binary Subtraction routine performs subtraction on signed two's complement integers of arbitrary length.

Format

LIB$SUBX minuend-array ,subtrahend-array ,difference-array [,array-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

minuend-array

OpenVMS usage:	vector_longword_signed
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Minuend; a multiple-precision, signed two's complement integer. The *minuend-array* argument is the address of an array of signed longword integers that contains the minuend.

subtrahend-array

OpenVMS usage:	vector_longword_signed
type:	unspecified
access:	read only
mechanism:	by reference, array reference

Subtrahend; a multiple-precision, signed two's complement integer. The *subtrahend-array* argument is the address of an array of signed longword integers that contains the subtrahend.

difference-array

OpenVMS usage:	vector_longword_signed
type:	unspecified

access:	write only
mechanism:	by reference, array reference

Difference; a multiple-precision, signed two's complement integer result. The *difference-array* argument is the address of an array of signed longword integers that contains the difference.

array-length

OpenVMS usage:	longword_signed
type:	longword integer (signed)
access:	read only
mechanism:	by reference

Length in longwords of the arrays to be operated on by LIB$SUBX. The *array-length* argument contains the address of a signed longword integer that is this length. The *array-length* argument must not be negative. The default length is 2 units.

Description

LIB$SUBX performs subtraction on signed two's complement integers of arbitrary length. The integers are located in arrays of longwords. The higher addresses contain the higher-precision parts of the values. The highest-addressed longword contains the sign and 31 bits of precision. The remaining longwords contain 32 bits of precision in each. The number of longwords to be operated on is given by the optional argument, *array-length*. The default length is 2, which corresponds to the OpenVMS quadword data type.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_INTOVF	Integer overflow. The result is correct, except that the sign bit is lost.
LIB$_INVARG	Invalid argument. Length is negative. The output array is unchanged.

Example

```
C+
C This Fortran example program demonstrates the use of LIB$SUBX.
C-

        INTEGER A(2),B(2),C(2),RETURN
C+
C Let "A" have the value 72057594037927937 = '1000000000000001'x.
C Let "B" have the value 4294967295        = '00000000FFFFFFFF'x.
C-

        A(1) = '00000001'x
        A(2) = '10000000'x
        B(1) = 'FFFFFFFF'x
        B(2) = '00000000'x

C+
C Then "A" - "B" is 72057589742960642.
```

```
C-

        RETURN = LIB$SUBX(A,B,C)
        TYPE *,' '
        TYPE *,'Let A = 72057594037927937 and B = 4294967295.'
        TYPE *,'Then C = A - B = 72057589742960642.'
        TYPE 2,C(2),C(1)
2       FORMAT(' 72057589742960642 is represented as ',1H',Z8,Z8,3H'x.)
        TYPE *, 51HThat is, C(2) = '0FFFFFFF'x and C(1) = '00000002'x.
        END
```

This Fortran example demonstrates how to call LIB$SUBX. The output generated by this program is as follows:

```
    Let A = 72057594037927937 and B = 4294967295.
    Then C = A - B = 72057589742960642.
    72057589742960642 is represented as ' FFFFFFF       2'x.
    That is, C(2) = '0FFFFFFF'x and C(1) = '00000002'x.
```

LIB$SUB_TIMES

LIB$SUB_TIMES — The Subtract Two Quadword Times routine subtracts two OpenVMS internal-time-format times.

Format

LIB$SUB_TIMES time1 ,time2 ,resultant-time

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

time1

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

First time, from which LIB$SUB_TIMES subtracts the second time. The *time1* argument is the address of an unsigned quadword containing this time. The *time1* argument must represent a later or equal time or a longer or equal time interval than *time2*. The *time1* argument may be either absolute time or delta time as long as *time2* is of the same type. If *time1* and *time2* are of different types, *time1* must be the absolute time.

time2

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Second time, which LIB$SUB_TIMES subtracts from the first time. The *time2* argument is the address of an unsigned quadword containing this time. The *time2* argument must represent an earlier or equal time or a shorter or equal time interval than *time1*. The *time2* argument may be either absolute time or delta time as long as *time1* is of the same type. If *time2* and *time1* are of different types, *time2* must be the delta time.

resultant-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	write only
mechanism:	by reference

The result of subtracting *time2* from *time1*. The *resultant-time* argument is the address of an unsigned quadword containing the result. If both *time1* and *time2* are delta times, then *resultant-time* is a delta time. If both *time1* and *time2* are absolute times, then *resultant-time* is a delta time. If *time1* is an absolute time and *time2* is a delta time, then *resultant-time* is an absolute time.

Description

LIB$SUB_TIMES subtracts two OpenVMS internal times. The second time, specified by *time2*, is subtracted from *time1*. The following table shows the only combinations of times you can subtract:

Time1	Time2	Subtraction	Resultant-Time
delta	delta	time1 - time2	delta
absolute	absolute	time1 - time2	delta
absolute	delta	time1 - time2	absolute

Delta time values cannot be a zero and always reflect time in the future. Binary format number will always be negative. Therefore, if *time1* and *time2* are equal, *resultant-time* cannot be 0. Instead, *resultant-time* is represented by .1 of one microsecond (the smallest interval of time recognized by the OpenVMS operating system). This interval is shown as “0 00:00:00.00” when formatted by the standard techniques.

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.
LIB$_INVARGORD	Invalid ordering of arguments.
LIB$_IVTIME	Invalid time.
LIB$_NEGTIM	Negative time computed.
LIB$_WRONUMARG	Incorrect number of arguments.

LIB$SYS_ASCTIM

LIB$SYS_ASCTIM — The Invoke $ASCTIM to Convert Binary Time to ASCII String routine calls the system service $ASCTIM to convert a binary date and time value, returning the ASCII string using the semantics of the caller's string.

Format

LIB$SYS_ASCTIM [resultant-length] ,time-string [,user-time] [,flags]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Number of bytes written into *time-string*, not counting padding in the case of a fixed-length string. The *resultant-length* argument contains the address of an unsigned word integer that is this number.

If the input string is truncated to the size specified in the *time-string* descriptor, resultant-length is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of *time-string*.

time-string

OpenVMS usage:	time_name
type:	character string
access:	write only
mechanism:	by descriptor

Destination string into which LIB$SYS_ASCTIM writes the ASCII time string. The *time-string* argument contains the address of a descriptor pointing to the destination string.

user-time

OpenVMS usage:	date_time
type:	quadword (unsigned)
access:	read only

mechanism:	by reference

Value that LIB$SYS_ASCTIM converts to ASCII string form. The *user-time* argument contains the address of a signed quadword integer that is this value.

If 0 or no address is specified, the current system date and time are returned. A positive value represents an absolute time. A negative value represents a delta time. Delta times must be less than 10,000 days.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Conversion indicator specifying which date and time fields LIB$SYS_ASCTIM should return. The *flags* argument is the address of an unsigned bit mask that contains this conversion indicator.

A value of 1 causes only the hour, minute, second, and hundredths of a second to be returned, depending on the length of the buffer. A value of 0 (the default) causes the full date and time to be returned, depending on the length of the buffer.

The results of specifying some possible combinations for the values of the flags and *time-string* arguments are shown below:

Time Value	Time-String Length	Flags Value	Information Returned
Absolute	23	0	Date and time
Absolute	12	0	Date
Absolute	11	1	Time
Delta	16	0	Days and time
Delta	11	1	Time

The *flags* argument is passed to LIB$SYS_ASCTIM by reference and is changed to value for use by $ASCTIM.

Description

See the *VSI OpenVMS System Services Reference Manual: A–GETUAI* for a complete description of $ASCTIM.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_IVTIME	The specified delta time is greater than or equal to 10,000 days.
LIB$_FATERRLIB	Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to your VSI support representative.
LIB$_INSVIRMEM	Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Routine successfully completed, but the source string was truncated on copy.

LIB$SYS_FAO

LIB$SYS_FAO — The Invoke $FAO System Service to Format Output routine calls the $FAO system service, returning a string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

Format

```
LIB$SYS_FAO character-string, [resultant-length] ,resultant-string [,directive-arg
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

character-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The *character-string* argument contains the address of a descriptor pointing to this control string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the output string. The *resultant-length* argument contains the address of an unsigned word integer that is this length.

resultant-string

OpenVMS usage:	char_string
type:	character string

access:	write only
mechanism:	by descriptor

Fully formatted output string returned by LIB$SYS_FAO. The *resultant-string* argument contains the address of a descriptor pointing to this output string.

directive-argument

OpenVMS usage:	varying_arg
type:	unspecified
access:	read only
mechanism:	unspecified

Directive argument contained in longwords. Depending on the directive, a *directive-argument* argument can be a value to be converted, the address of the string to be inserted, or a length or argument count. The passing mechanism for each of these arguments should be the one expected by the $FAO system service.

Description

See the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for a complete description of $FAO.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_BADPARAM	An invalid directive was specified in the FAO control string.
SS$_BUFFEROVF	Successfully completed, but the formatted output string overflowed the output buffer and was truncated.
LIB$_STRTRU	Success, but the source string was truncated on copy.
LIB$_INSVIRMEM	Insufficient virtual memory to allocate dynamic string.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.

LIB$SYS_FAOL

LIB$SYS_FAOL — The Invoke $FAOL System Service to Format Output routine calls the $FAOL system service, returning the string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

Format

```
LIB$SYS_FAOL character-string [,resultant-length] ,resultant-string ,directiv
```

Returns

OpenVMS usage:	cond_value

type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

character-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The *character-string* argument contains the address of a descriptor pointing to this control string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the output string. The *resultant-length* argument contains the address of an unsigned word integer that is this length.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Fully formatted output string returned by LIB$SYS_FAOL. The *resultant-string* argument contains the address of a descriptor pointing to this output string.

directive-argument-address

OpenVMS usage:	address
type:	longword (unsigned)
access:	read only
mechanism:	unspecified

Directive arguments. The *directive-argument-address* arguments are contained in an array of unsigned longword directive arguments. Depending on the directive, a *directive-argument-address* argument can be a value to be converted, the address of the string to be inserted, or a length

or argument count. The passing mechanism for each of these arguments should be the one expected by the $FAOL system service.

Description

See the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for a complete description of $FAOL.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_BADPARAM	An invalid directive was specified in the FAO control string.
SS$_BUFFEROVF	Successfully completed, but the formatted output string overflowed the output buffer and was truncated.
LIB$_INSVIRMEM	Insufficient virtual memory to allocate dynamic string.
LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Success, but the source string was truncated on copy.

LIB$SYS_FAOL_64

LIB$SYS_FAOL_64 — The Invoke $FAOL_64 System Service to Format Output routine calls the $FAOL_64 system service, returning the string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

Format

```
LIB$SYS_FAOL_64 character-string [,resultant-length] ,resultant-string ,direc
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

character-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The *character-string* argument contains the address of a descriptor pointing to this control string.

resultant-length

OpenVMS usage:	word_unsigned
type:	word (unsigned)
access:	write only
mechanism:	by reference

Length of the output string. The *resultant-length* argument contains the address of an unsigned word integer that is this length.

resultant-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Fully formatted output string returned by LIB$SYS_FAOL_64. The *resultant-string* argument contains the address of a descriptor pointing to this output string.

directive-argument-address

OpenVMS usage:	address
type:	quadword (unsigned)
access:	read only
mechanism:	unspecified

Directive arguments. The *directive-argument-address* arguments are contained in an array of unsigned quadword directive arguments. Depending on the directive, a *directive-argument-address* argument can be a value to be converted, the address of the string to be inserted, or a length or argument count. The passing mechanism for each of these arguments should be the one expected by the $FAOL_64 system service.

Description

See the *VSI OpenVMS System Services Reference Manual: A–GETUAI* for a complete description of $FAOL_64.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_BADPARAM	An invalid directive was specified in the FAO control string.
SS$_BUFFEROVF	Successfully completed, but the formatted output string overflowed the output buffer and was truncated.
LIB$_INSVIRMEM	Insufficient virtual memory to allocate dynamic string.

LIB$_INVSTRDES	Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.
LIB$_STRTRU	Success, but the source string was truncated on copy.

LIB$SYS_GETMSG

LIB$SYS_GETMSG — The Invoke $GETMSG System Service to Get Message Text routine calls the system service $GETMSG and returns a message string into *destination-string* using the semantics of the caller's string.

Format

LIB$SYS_GETMSG message-id [,message-length] ,destination-string [,flags] [,ur

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

message-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Message identification to be retrieved by LIB$SYS_GETMSG. The *message-id* argument contains the address of an unsigned longword integer that is this message identification.

message-length

OpenVMS usage:	word_unsigned
type:	word integer (unsigned)
access:	write only
mechanism:	by reference

Number of characters written into *destination-string*, not counting padding in the case of a fixed-length string. The *message-length* argument contains the address of an unsigned word integer that is this number.

If the input string is truncated to the size specified in the *destination-string* descriptor, *message-length* is set to this size. Therefore, *message-length* can always be used by the calling program to access a valid substring of *destination-string*.

destination-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string. The *destination-string* argument contains the address of a descriptor pointing to this destination string. LIB$SYS_GETMSG writes the message that has been returned by $GETMSG into *destination-string*.

flags

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Four flag bits for message content. The *flags* argument is the address of an unsigned longword that contains these flag bits. The default value is a longword with bits 0 through 3 set to 1. The *flags* argument is passed to LIB$SYS_GETMSG by reference and changed to value for use by $GETMSG.

The following table lists the bit numbers, their values, and corresponding descriptions:

Bit	Value	Description
0	1	Include text of message.
	0	Do not include text of message.
1	1	Include message identifier.
	0	Do not include message identifier.
2	1	Include severity indicator.
	0	Do not include severity indicator.
3	1	Include facility name.
	0	Do not include facility name.

unsigned-resultant-array

OpenVMS usage:	unspecified
type:	unspecified
access:	write only
mechanism:	by reference, array reference

A 4-byte array to receive message-specific information. The *unsigned-resultant-array* argument contains the address of this array.

The contents of this 4-byte array are as follows:

Byte	Contents
0	Reserved
1	Count of FAO arguments
2	User value
3	Reserved

Description

LIB$SYS_GETMSG calls the $GETMSG system service and returns a message string using the semantics of the caller's string. Note that, in order to retrieve a message string for a LIB$ facility message, you must include the file $LIBDEF in your program.

See the *VSI OpenVMS System Services Reference Manual: A-GETUAI* for a more complete description of $GETMSG.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
SS$_BUFFEROVF	Successfully completed, but the resultant string overflowed the buffer provided and was truncated.
SS$_MSGNOTFND	Successfully completed, but the message code does not have an associated message on file.
LIB$_STRTRU	Successfully completed, but the source string was truncated on copy.
LIB$_FATERRLIB	Fatal internal error.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVSTRDES	Invalid string descriptor.

LIB$TPARSE/LIB$TABLE_PARSE

LIB$TPARSE/LIB$TABLE_PARSE — The Table-Driven Finite-State Parser routine is a general-purpose, table-driven parser implemented as a finite-state automaton, with extensions that make it suitable for a wide range of applications. No support for arguments passed by 64-bit address reference or the use of 64-bit descriptors is planned for LIB$TPARSE. On Alpha and I64 systems, LIB$TABLE_PARSE supports arguments passed by 64-bit address reference and the use of 64-bit descriptors.
It parses a string and returns a message indicating whether or not the input string is valid. LIB$T[ABLE_]PARSE is called with the address of an argument block, the address of a state table, and the address of a keyword table. The input string is specified as part of the argument block. The LIB$ facility supports the following two versions of the Table-Driven Finite- State Parser: 1) LIB$TPARSE - Available on VAX systems. LIB$TPARSE is available on Alpha and I64 systems in translated form. In this form, it is applicable to translated VAX images only. 2) LIB$TABLE_PARSE Available on VAX, Alpha, and I64 systems. LIB$TPARSE and LIB$TABLE_PARSE differ mainly in the way they pass arguments to action routines. The term LIB$T[ABLE_]PARSE is used here to describe concepts that apply to both LIB$TPARSE and LIB$TABLE_PARSE.

Format

LIB$TPARSE/LIB$TABLE_PARSE argument-block ,state-table ,key-table

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

argument-block

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference

LIB$T[ABLE_]PARSE argument block. The *argument-block* argument contains the address of this argument block.

The LIB$T[ABLE_]PARSE argument block contains information about the state of the parse operation. It is a means of communication between LIB$T[ABLE_]PARSE and the user's program. It is passed as an argument to all action routines.

You must declare and initialize the argument block. Section 1.4 describes the argument block in detail. Section 2.2 illustrates the coding for an argument block declaration and discusses its initialization.

LIB$T[ABLE_]PARSE supports the following argument blocks:

- A 32-bit argument block that accommodates longword addresses, values, and input tokens on VAX, Alpha, and I64 systems.

  On Alpha and I64 systems, this argument block also accommodates a numeric token whose binary representation is less than or equal to 2**64.

- A 64-bit argument block that accommodates quadword addresses, values, and input tokens on Alpha and I64 systems.

state-table

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference

Starting state in the state table. The *state-table* argument is the address of this starting state. Usually, the name appearing as the first argument of the $INIT_STATE macro is used.

You must define the state table for your parser. LIB$T[ABLE_]PARSE provides macros in the MACRO and BLISS languages for this purpose. Section 1.3 describes these macros.

key-table

OpenVMS usage:	unspecified
type:	unspecified
access:	modify
mechanism:	by reference

Keyword table. The *key-table* argument is the address of this keyword table. This name must be the same as that which appears as the second argument of the $INIT_STATE macro.

You must only assign a name to the keyword table. The LIB$T[ABLE_]PARSE macros allocate and define the table. See Section 4 for more information about the keyword table.

Description

The following sections explain in detail how LIB$T[ABLE_]PARSE works and how to call it from both the MACRO assembly language and high-level languages:

1. How LIB$T[ABLE_]PARSE Works — Describes the data structures used by LIB $T[ABLE_]PARSE and how LIB$T[ABLE_]PARSE operates on them.

2. Coding and Using a Simple State Table — Explains how to construct and use a simple state table.

3. Using Advanced LIB$T[ABLE_]PARSE Features — Explains how to use subexpressions, abbreviations, action routines, and other advanced features.

4. Data Representation — Includes information for the low-level-language programmer, such as the binary representation of state table data.

How LIB$T[ABLE_]PARSE Works

LIB$T[ABLE_]PARSE analyzes an input string according to a set of states and transitions presented in a state table you define. It determines whether the input string is valid according to the rules you define for the input language.

There are three parts to any parsing operation:

- The set of symbol types, or *alphabet*, from which you can choose the vocabulary of your language.

  You specify a symbol type for each transition you define. The symbol type specifies what constitutes a matching substring from the input string.

  LIB$T[ABLE_]PARSE recognizes the ASCII character set and provides symbolic names for the most common combinations of ASCII characters, such as alphabetic and alphanumeric strings, OpenVMS symbols, and numbers. See Section 1.2 for a list of the symbol types that comprise the LIB$T[ABLE_]PARSE alphabet.

- The rules that govern how the alphabet is used—in other words, the language's grammar.

  You specify the rules for a language in a state table. A LIB$T[ABLE_]PARSE state table lists the possible states for your language. Each state consists of a list of the transitions to other states and the operations to be performed when a transition is executed (see Section 1.3).

- The string to be parsed.

  The argument block specifies the input string. It also contains additional information about the state of the parse—how much of the string has not been interpreted, what the current token is, and so forth (see Section 1.4).

Overview

Before discussing the alphabet, the state table, and the argument block in detail, this section provides an overview of how these three parts work together.

Evaluating the Input String

LIB$T[ABLE_]PARSE evaluates the input string from left to right as it transitions from state to state. For a particular transition in a particular state, it evaluates the beginning of the unprocessed part of the input string against the symbol type you specify for the transition to determine whether there is a match.

LIB$T[ABLE_]PARSE compares each character of the remaining input string, from left to right, against the transition's symbol type until it encounters a character in the input string that does not match. It takes the substring that matches the symbol type and stores a pointer to it in the argument block as the current `token`. In this way, any character in the input string that does not belong to the symbol type's constituent character set effectively becomes a separator.

If LIB$T[ABLE_]PARSE finds a match, it executes the transition.

If the input string does not match, LIB$T[ABLE_]PARSE attempts to match the next transition. It performs the comparison using the transitions in the order in which you define them for the state.

Executing a Transition

When LIB$T[ABLE_]PARSE finds a match with a transition, it performs the following steps:

1. Stores a pointer to the current token in the argument block. If the token matches one of the numeric symbol types, it also stores the token's binary representation in the argument block.

2. Calls the action routine, if any, specified by the transition and passes it the argument block and any additional user-specified arguments.

   You can use an action routine to reject a transition. In this case, LIB$T[ABLE_]PARSE performs none of the following steps. See Section 3.1 for more information.

3. Performs one of the following operations:

   - Stores the mask, if any, specified by the transition in the location specified by the transition.

   - Stores the value of token in the program location specified by the transition.

4. Transfers control to the specified state, if any, or to the next state in the state table.

Exiting LIB$T[ABLE_]PARSE

LIB$T[ABLE_]PARSE continues to match and execute transitions from state to state until one of the following occurs:

- For a valid match, it executes a user-specified transition to TPA$_EXIT at main level. It returns the value SS$_NORMAL.

- A transition requests that LIB$T[ABLE_]PARSE consider the string invalid by specifying a transition to TPA$_FAIL at main level (rather than at the level of a subexpression). LIB $T[ABLE_]PARSE returns with the value LIB$_ SYNTAXERR.

  You can also request a transition to TPA$_FAIL from an action routine. The action routine can provide an alternate failure status.

- An error occurs at the main level. The error can be:

  - A syntax error. All transitions in the current state fail to match the remaining input string. LIB $T[ABLE_]PARSE returns LIB$_ SYNTAXERR or an alternate failure status returned by an action routine.

  - A state table format error. One of your state table entries is invalid. LIB$T[ABLE_]PARSE returns LIB$_INVTYPE.

Note

LIB$T[ABLE_]PARSE generates no signals and establishes no condition handler; action routines can signal through LIB$T[ABLE_]PARSE back to the calling program.

When LIB$T[ABLE_]PARSE cannot successfully parse the entire string, it defines the current token, as follows, and stores it in the argument block before returning:

- If LIB$T[ABLE_]PARSE fails to match a transition in the current state, it attempts to define the current token as the beginning of the remaining input string. You can incorporate this token in an error message or use it to determine the logical flow of your program.

  LIB$T[ABLE_]PARSE attempts to match the characters from the beginning of the remaining input string, one at a time, against the TPA$_SYMBOL alphabet symbol type until it encounters a character that does not match. The TPA$_SYMBOL symbol type consists of all the characters of the standard OpenVMS symbol constituent set.

  - If LIB$T[ABLE_]PARSE successfully matches one or more consecutive characters from the input string against TPA$_SYMBOL, then the substring that matched TPA$_SYMBOL becomes the current token.

  - If the first character of the remaining input string does not match TPA$_ SYMBOL, the first character becomes the current token.

- If LIB$T[ABLE_]PARSE matches the symbol type for a transition that specifies TPA$_FAIL as the next state, it leaves the token that matched the transition as the current token.

Alphabet of LIB$T[ABLE_]PARSE

The LIB$T[ABLE_]PARSE alphabet consists of a set of symbol types defined in the table below. This alphabet includes strings made up of elements of the ASCII character set. It provides all the basic building blocks needed for constructing a grammar using the ASCII character set. The alphabet also includes symbol types that represent the more complex constructions found in programming and command language grammar.

Use the symbols types that comprise the LIB$T[ABLE_]PARSE alphabet to define a vocabulary and grammar for your language. For each transition you define, you specify one of the alphabet symbol types. LIB$T[ABLE_]PARSE compares the characters at the beginning of the remaining input string with this

symbol type of each of the possible transitions. If LIB$T[ABLE_]PARSE finds a match, it enters the state specified by that transition.

Table 2.9. The Alphabet of LIB$T[ABLE_]PARSE

Symbol Type	Characters Matched
'x'	The particular ASCII character. In a state table, it is expressed by enclosing the character in single quotation marks. The character can be any member of the 8-bit ASCII code set. LIB $T[ABLE_]PARSE does not consider uppercase and lowercase alphabetic characters and codes with different values in bit 7 to be equivalent.
TPA$_ANY	Any single character.
TPA$_ALPHA	Any alphabetic character, which includes the DEC multinational character set.
TPA$_DIGIT	Any numeric character, that is, 0 through 9.
TPA$_STRING	Any string of one or more alphanumeric characters, that is, uppercase or lowercase A through Z, and the numeric characters 0 through 9. The string can be any length. It is bounded on the right by the first nonalphanumeric character or by the end of the string.
TPA$_SYMBOL	Any string of one or more through characters of the standard OpenVMS symbol constituent set, that is, uppercase and lowercase A through Z, the numeric characters 0 through 9 and all DEC multinational characters, in addition to the dollar sign ($) and the underscore (_). The string is bounded on the right by some character not in the symbol constituent set (usually a blank) or by the end of the string.
'keyword'	The string of characters enclosed in single quotation marks. A keyword can consist of one or more characters of the OpenVMS symbol constituent set, that is, uppercase and lowercase A through Z, the numeric characters 0 through 9, the dollar sign ($), and the underscore (_). Uppercase and lowercase alphabetics are treated as different characters. A state table can contain up to 220 keywords. The keyword is bounded on the right by a character not in the symbol constituent set or by the end of the string. Keywords that are one character in length are expressed in the form 'x*' to distinguish them from the single-character symbol ('x'). They must be differentiated because they are not the same in operation. For example, in the input string AB+C, the single character 'A' would match the first character of this string, whereas the

Symbol Type	Characters Matched
	keyword 'A*' would not, because B in the string is in the symbol constituent set.
TPA$_BLANK	Any string of one or more blanks and/or tabs.
TPA$_OCTAL	Any octal number (that is, any string of one or more numeric characters 0 through 7) whose magnitude is less than 2^{32} for a 32-bit argument block or less than 2^{64} for a 64-bit argument block.
TPA$_DECIMAL	Any decimal number (that is, any string of one or more numeric characters 0 through 9) whose magnitude is less than 2^{32} for a 32-bit argument block or less than 2^{64} for a 64-bit argument block.
TPA$_HEX	Any hexadecimal number (that is, any string of one or more numeric characters 0 through 9, A through F) whose magnitude is less than 2^{32} for a 32-bit argument block or less than 2^{64} for a 64-bit argument block.
TPA$_OCTAL_64	Alpha and I64 specific. Any octal number (that is, any string of one or more numeric characters 0 through 7) whose magnitude is less than 2^{64}.
TPA$_DECIMAL_64	Alpha and I64 specific. Any decimal number (that is, any string of one or more numeric characters 0 through 9) whose magnitude is less than 2^{64}.
TPA$_HEX_64	Alpha and I64 specific. Any hexadecimal number (that is, any string of one or more numeric characters 0 through 9, A through F) whose magnitude is less than 2^{64}.
TPA$_FILESPEC	Any string that constitutes a valid OpenVMS file specification. The string is bounded on the right by the first character that either is not a file specification constituent character or would cause the string to violate the syntax rules of a file specification.
TPA$_NODE	Matches a full node specification including the double colon (::).
TPA$_NODE_ACS	Matches a primary node specification including the access control string, if any, but not the double colon (::).
TPA$_NODE_ PRIMARY	Matches a primary node specification excluding both the access control string, if any, and the double colon (::).
TPA$_UIC	Any string that constitutes a valid OpenVMS numerical UIC specification, bounded by square brackets or angle brackets. The binary value of the UIC, converted in octal radix, is placed in the argument block. The wildcard character (*) is permitted in the group and/or member fields; its

Symbol Type	Characters Matched
	presence results in that field being set to its largest possible value in the binary representation.

TPA$_IDENT	Any string that constitutes a valid OpenVMS identifier. Identifiers may be given as numerical UICs according to the rules for TPA$_UIC, or as alphabetic identifier names that appear in the system's rights database. The binary value of the identifier, converted in either octal or hexadecimal radix or by lookup in the system rights database, is placed in the argument block. Identifiers can be entered in any of the following forms:
	
	`[n,m]` `<n,m>`
	`[name1,name2]` `<name1,name2>`
	`[name]` `<name>`
	`name`
	`%Xhex-value`
	
	You can use a wildcard (*) in place of any occurrence of *number* or *name* in an identifier form.

TPA$_LAMBDA	The empty string (always matches). As it executes the transition, LIB$T[ABLE_]PARSE does not remove any characters from the input string. LAMBDA transitions are useful in getting action routines called under otherwise awkward circumstances, providing unconditional GOTOs to link portions of a state table together, and providing default actions in certain cases.
TPA$_EOS	The end of the input string.
state label	The label of a state that functions as a subexpression. A subexpression is analogous to a subroutine within the state table. The subexpression facility permits complex syntactic constructs that appear in many places in grammar to appear only once in the state table. It also permits a degree of nondeterministic or pushdown parsing with a parser that is otherwise deterministic and finitestate. See Section 3.5 for detailed information about subexpressions and examples of their use.

Note

By default, LIB$T[ABLE_]PARSE treats blanks (defined to be either spaces or tabs), as though they belong to no symbol type constituent set. Effectively, this makes the blank a separator. LIB $T[ABLE_]PARSE begins its next comparison with the first nonblank character following the blanks. To have LIB$T[ABLE_]PARSE evaluate a blank as it would any other character in the input string, set the TPA$V_BLANKS flag in the argument block. Section 3.2 provides an example of the use of this flag.

State Tables

This section describes state table generation and the macros used to construct state tables. Section 2 explains how to use these macros.

The state table must be set up using either MACRO or BLISS. Everything else, including any action routines, can be coded in the language of your choice. Simply compile the state table separately, then link it with your program.

The body of the state table consists of one or more states, each of which defines one or more transitions to the same or other states. The order of the states and the order of the transitions for each state are important:

- If a transition does not specify a target state, LIB$T[ABLE_]PARSE transitions to the next state after the current state in the state table.
- For a given state, LIB$T[ABLE_]PARSE evaluates the input string against the transitions in the order in which they are defined and executes the first transition it matches.
    - If a state defines more than one transition with symbol types that match overlapping sets of tokens, the order of transition definitions within the state is significant. For example, the characters 123 followed by a comma (,) could match TPA$_DECIMAL, TPA$_OCTAL, TPA $_STRING, or one of several other symbol types.
    - It is best to order transitions in order of increasing generality of their symbol types. For example, the TPA$_SYMBOL symbol type matches all keyword strings. In general, LIB $T[ABLE_]PARSE never executes a keyword transition that follows a TPA$_SYMBOL transition. The symbol types, in order of increasing generality, are as follows:

      'keyword'

      'x'

      TPA$_EOS

      TPA$_ALPHA

      TPA$_DIGIT

      TPA$_BLANK

      TPA$_OCTAL

      TPA$_OCTAL_64 (Alpha and I64 only)

      TPA$_DECIMAL

      TPA$_DECIMAL_64 (Alpha and I64 only)

      TPA$_HEX

      TPA$_HEX_64 (Alpha and I64 only)

      TPA$_STRING

      TPA$_SYMBOL

TPA$_UIC

TPA$_IDENT

TPA$_NODE_PRIMARY

TPA$_NODE_ACS

TPA$_NODE

TPA$_FILESPEC

TPA$_ANY

TPA$_LAMBDA

Note

The list of symbol types does not include subexpression calls, because the generality of these calls depends on the symbol types recognized within the subexpression. If you use action routines to reject certain transitions, you can change the order in which that symbol type is placed in this order. In any case, LIB$T[ABLE_]PARSE executes the first transition listed in a state that you permit to match the leftmost portion of the remaining input string.

MACRO State Table Generation Macro Calls

The OpenVMS system MACRO library contains a set of assembler macros that allow convenient and readable coding of a LIB$T[ABLE_]PARSE state table. These macros generate symbol definitions and tables. They do not produce any executable code or routine calls.

There are four MACRO state table generation macros:

- $INIT_STATE—Initializes the LIB$T[ABLE_]PARSE macros and declares the beginning of a state table (see Section 1.3.1.1)
- $STATE—Defines a state (see Section 1.3.1.2)
- $TRAN—Defines a state transition (see Section 1.3.1.3)
- $END_STATE—Ends the state table (see Section 1.3.1.4)

A state table begins with a call to $INIT_STATE and ends with a call to $END_ STATE. Within the state table, define each state by a call to $STATE immediately followed by as many calls to $TRAN as you need to define the transitions from that state.

$INIT_STATE—Initializes the LIB$T[ABLE_]PARSE Macros

The $INIT_STATE macro declares the beginning of a state table. It initializes the internals of the table generator macros and declares the locations of the state table and the keyword table:

- The state table is the structure containing the definitions of the states and the transitions between them. LIB$T[ABLE_]PARSE builds the state table as it processes the $STATE and $TRAN macros you use to define the table.

- The keyword table contains the text of the keywords used in the state table. LIB$T[ABLE_]PARSE builds the keyword table as it processes the calls to $TRAN for each state.

Section 4 provides specific information on the allocation and binary representations of the state table and the keyword table. This information may be useful in debugging your program.

```
$INIT_STATE    state-table ,key-table
```

state-table

The name assigned to the state table. LIB$T[ABLE_]PARSE equates this label to the start of the first state in the state table.

key-table

The name assigned to the keyword table. LIB$T[ABLE_]PARSE equates this label to the start of the keyword table.

You must supply both the address of the state table and the address of the keyword table in the call to LIB$T[ABLE_]PARSE to perform a parse. The $INIT_STATE macro can appear more than once in a program. Each occurrence defines a separate state table. No part of any state table can refer to part of any other state table.

$STATE—Defines a State

The $STATE macro declares the beginning of a state.

```
$STATE    [label]
```

label

An optional label for the state. LIB$T[ABLE_]PARSE equates the label, if present, to the starting address of the state.

$TRAN—Defines a State Transition

The $TRAN macro defines a transition from the state in which it is defined to some other (or to the same) state. The arguments of the macro define, among other things, the symbol type that causes the transition to be executed, the state to which to transfer, and the action routine to call, if any. The transition defined by a $TRAN macro belongs to the state defined by the last preceding $STATE macro.

```
$TRAN type [,label] [,action] [,mask] [,msk-adr] [,argument]
```

type

The symbol type, taken from the LIB$T[ABLE_]PARSE alphabet, that is recognized by this transition. The transition is taken if the characters from the beginning of the remaining input string match the specified symbol type.

If the transition calls a subexpression to determine a match, the symbol type syntax includes the state label of the subexpression to be called. It is indicated with the MACRO expression **!label**. See Section 3.5 for information about subexpressions.

label

The optional target state of this transition. If present, it must be the label assigned to some state in the state table. If no **label** argument is present, LIB$T[ABLE_]PARSE transfers control to the state immediately following the current state in the state table.

LIB$T[ABLE_]PARSE defines two expressions you can also specify as the target state in the **label** argument:

- TPA$_EXIT — The parsing operation in progress terminates with a success status.
- TPA$_FAIL — The parsing operation stops with a failure status, as if a syntax error had occurred.

action

The optional address of a user-supplied action routine. If this argument is present, LIB $T[ABLE_]PARSE calls the named action routine before it executes the transition. Section 3.1 describes the calling sequence of action routines and the information available to them.

Because the action routine address is self-relative, it cannot be in a shared image separate from the state table.

mask

An optional 32-bit mask value used with the *msk-adr* argument.

When LIB$T[ABLE_]PARSE executes the transition, it performs an inclusive OR operation using the *mask* value and the contents of *msk-adr* and stores the result in *msk-adr*.

You can associate one or more bits in *mask* with a particular transition and set those bits. When LIB $T[ABLE_]PARSE returns, you can check the bits in *msk-adr* to determine which transitions were executed. You can also use an action routine to check the bit and ensure that a transition is executed only once.

If the *mask* argument is present, the *msk-adr* argument must also be present.

msk-adr

The *msk-adr* argument provides two mutually exclusive capabilities depending on whether the *mask* argument is present:

- If *mask* is present, *msk-adr* is the address of a longword associated with the preceding *mask* argument. LIB$T[ABLE_]PARSE performs the inclusive OR operation on the contents of this address and the *mask* argument and stores the result in *msk-adr*.

  Initialize the contents of *msk-adr* to zero before calling LIB$T[ABLE_]PARSE.

- If *mask* is not present, you can use *msk-adr* to specify the address of a location where LIB $T[ABLE_]PARSE stores information about the matching token. No OR operation is performed. This capability lets a program extract the most commonly needed information from the input string without using action routines.

  The kind of information that LIB$T[ABLE_]PARSE stores in the location you specify as the *msk-adr* argument depends on the symbol type specified for the *type* argument and on the argument block, as follows:

  - If the symbol type is TPA$_DECIMAL, TPA$_OCTAL, or TPA$_HEX, LIB $T[ABLE_]PARSE stores the binary representation of the matching number as an unsigned longword for a 32-bit argument block and as an unsigned quadword for a 64-bit argument block.
  - If the symbol type is TPA$_DECIMAL_64, TPA$_OCTAL_64, or TPA$_ HEX_64, LIB $T[ABLE_]PARSE stores the binary representation of the matching number as an unsigned quadword for both 32-bit and 64-bit argument blocks.

- If the symbol type is *'x'*, TPA$_ANY, TPA$_ALPHA, or TPA$_DIGIT, LIB$T[ABLE_]PARSE stores the 8-bit matching character as an unsigned byte.
- If the symbol is of any other type, you must specify msk-adr as the address of a 32-bit or 64-bit string descriptor, as appropriate, that you allocate in your program. LIB$T[ABLE_]PARSE assumes a 32-bit or 64-bit descriptor if the argument block with which you called it is 32-bit or 64-bit, respectively.

  For a 32-bit descriptor, LIB$T[ABLE_]PARSE stores the length of the token in the first 32 bits (longword) of the descriptor. It stores a pointer to the token in the second longword. This pointer is the address of the token in the input string.

  For a 64-bit descriptor, LIB$T[ABLE_]PARSE stores the length of the token in the second quadword of the descriptor and stores the address of the token in the input string in the third quadword. On entry, LIB$T[ABLE_]PARSE writes the fields of the first quadword as follows:

  DSC64$B_CLASS = DSC64$K_CLASS_S

  DSC64$B_DTYPE = DSC64$K_DTYPE_T

  DSC64$L_MBMO = –1

  DSC64$W_MBO = +1

Using *msk-adr* makes your parsing program nonmodular. The resulting program, which contains this state table, includes code that is not position independent.

Because the address specified by *msk-adr* is self-relative, it cannot be in a shared image separate from the state table.

argument

An optional 32-bit value that LIB$T[ABLE_]PARSE passes to the action routine without interpretation. This argument can be an identifier number, an address, or any other information your action routine needs. It allows a single action routine to serve many transitions for which similar, but slightly varying, actions must be performed.

Because LIB$T[ABLE_]PARSE does not know the form or meaning of argument the value is stored in its absolute form. If you use argument to pass an address, you must store the address in its absolute form rather than as a self-relative pointer. In this case the resulting program, which contains this state table, is nonmodular. That is, it includes code that is not position independent.

$END_STATE—Ends the State Table

The $END_STATE macro declares the end of the state table. It is mandatory, in order to permit the orderly cleanup of the LIB$T[ABLE_]PARSE macro system. The $END_STATE macro has no arguments. You code it as follows:

```
$END_STATE
```

BLISS State Table Generation Macro Calls

The SYS$LIBRARY:TPAMAC.L32 and SYS$LIBRARY:TPAMAC.L64 files each contain a set of BLISS macros that allow convenient and readable coding of LIB$T[ABLE_]PARSE state tables in BLISS.

Use one of the following BLISS state table generation macros:

- $INIT_STATE—Initializes the macros (see Section 1.3.2.1)
- $STATE—Defines a state and its transitions (see Section 1.3.2.2)

To make the macros available to the program, include the following declaration in the module containing the state tables:

```
LIBRARY 'SYS$LIBRARY:TPAMAC';
```

The BLISS compiler you use, BLISS-32 or BLISS-64, chooses the corresponding SYS $LIBRARY:TPAMAC file.

The BLISS table generation macros contain no BEGIN or END statements. This allows $STATE macros to refer to each other. They generate all storage with OWN declarations. This means that the macros modify PSECT declarations for OWN and GLOBAL storage. Thus if other data declarations follow the state table declarations, they may not have the correct attributes. You cannot simply surround the state table with BEGIN/END, because this constitutes an expression. No declarations of any kind, including ROUTINE declarations, can follow an expression.

Use one of the following techniques to include LIB$T[ABLE_]PARSE a state table in a BLISS module:

- Follow the state table with explicit redeclarations of the OWN and GLOBAL PSECTs. Example 3 illustrates this technique.
- Place the state table in a separate module. The high-level language examples in the next section use this technique.
- Place the state table between BEGIN and END statements after the declarations within a routine body.
- Place the state table between BEGIN and END statements at the end of a module.

In all cases you must define all action routines, masks, addresses, and arguments with suitable declarations (which can be FORWARD or EXTERNAL). The LIB$T[ABLE_]PARSE macros handle the necessary FORWARD declarations for forward references to labels within the state table.

$INIT_STATE—Initializes the LIB$T[ABLE_]PARSE Macros

The $INIT_STATE macro initializes the LIB$T[ABLE_]PARSE macro system in the same manner it does for MACRO.

```
$INIT_STATE    (state-table, key-table);
```

state-table

The name assigned to the state table. LIB$T[ABLE_]PARSE equates this label to the start of the first state in the state table.

key-table

The name assigned to the keyword table. LIB$T[ABLE_]PARSE equates this label to the start of the keyword table.

Both names are declared as global vectors of length zero. As with the MACRO state table generation macros, you can invoke $INIT_STATE more than once to declare several state tables within a single module.

$STATE—Declares a State and Its Transitions

In BLISS, you use the $STATE macro to declare a state in its entirety, including its transitions.

```
$STATE ([label],
              ( transition ),
              ( transition ),
              ( transition )
                    .
                    .
                    .
                          );
```

label

Optional address of the start of the state. The compiler declares *label* as a local vector of length zero. Note that the comma following the optional label is mandatory.

transtion

Each transition appears within parentheses in the same form as the transition argument list for the MACRO $TRAN macro.

```
type [,label] [,action] [,mask] [,msk-adr] [,argument]
```

The arguments of each transition are expressed in exactly the same format as in the MACRO macros, with the exception of the subexpression symbol type. In BLISS, this symbol type has the form (label).

Note that the transitions are not specified as keyword macros. Therefore, you must use commas to indicate arguments you have skipped.

LIB$T[ABLE_]PARSE Argument Block

LIB$T[ABLE_]PARSE finds the input string through the argument block. This argument block is the impure database upon which LIB$T[ABLE_]PARSE operates. That is, it is a set of variable data that can be written as well as read. It contains information about the string to be parsed, option flags for LIB $T[ABLE_]PARSE, and data about the current token. If LIB$T[ABLE_]PARSE calls an action routine, it passes the argument block to the action routine. This permits the action routine efficient reference to relevant data.

Choosing an Argument Block

LIB$T[ABLE_]PARSE provides an argument block for 32-bit operations on VAX, Alpha, and I64 systems. It also provides an argument block for 64-bit operations on Alpha and I64 systems.

32-Bit Argument Block

The 32-bit LIB$T[ABLE_]PARSE argument block accommodates longword addresses and values as well as input tokens whose binary representations require no more than 32 bits.

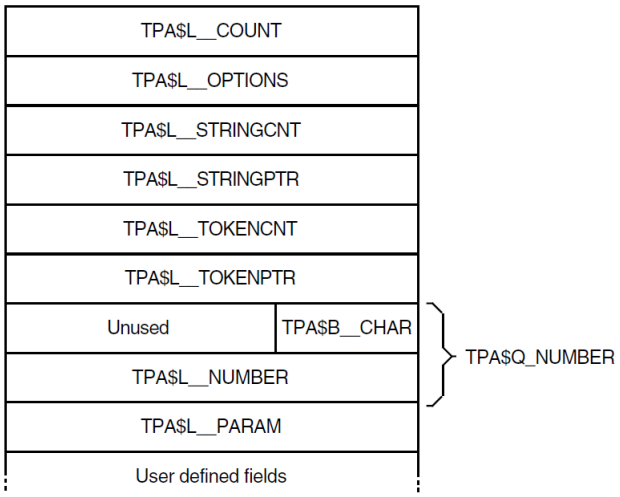
On Alpha and I64 systems, the LIB$T[ABLE_]PARSE 32-bit argument block can also accommodate a numeric input token whose binary representation requires up to 64 bits.

LIB$T[ABLE_]PARSE defines the first 9 longwords of the 32-bit argument block as shown in Figure lib–20. You must pass an argument block of at least this length as the first argument to LIB $T[ABLE_]PARSE. You can add fields to the end of the argument block as a means of passing user-defined data to action routines.

The TPA$K_LENGTH0 symbol represents the number of bytes (36) in the basic 32-bit argument block. You can use this symbol to determine the start of any user-defined fields you add to the argument block.

Table below describes the argument block fields.

Figure 2.21. LIB$T[ABLE_]PARSE 32-Bit Argument Block



64-Bit Argument Block (Alpha Only)

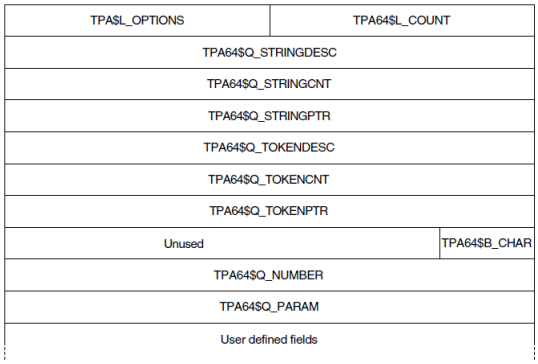
The 64-bit LIB$T[ABLE_]PARSE argument block accommodates quadword addresses and values as well as input tokens whose binary representations require no more than 64 bits.

LIB$T[ABLE_]PARSE defines the first 10 words of the 64-bit argument block as shown in Figure lib–21. You can add fields to the end of the argument block as a means of passing data to action routines.

The TPA64$K_LENGTH0 symbol represents the number of bytes (80) in the basic 64-bit argument block. You can use this symbol to determine the start of any user-defined fields you add to the argument block.

Table below describes the argument block fields.

Figure 2.22. LIB$T[ABLE_]PARSE 64-Bit Argument Block (Alpha and I64 Only)



Symbolic Names for Argument Block Fields

The fields in each type of argument block have symbolic names. Figure 20 and Figure 21 show some of these symbolic names. This section tells you how to access these names in some of the most commonly used languages:

- MACRO assembly language — MACRO language programs can define both the 32-bit and 64-bit argument block names by invoking the macro $TPADEF (automatically loaded from the system macro library). The field names define the byte offset of the field from the start of the argument block. This includes the bit fields ($V_names). In addition, bit mask values ($M_names) are available for the bit fields.
- BLISS — The field names are also available to BLISS programs from the system macro SYS $LIBRARY:STARLET.L32 and SYS$LIBRARY:STARLET.L64 libraries. Each name (except for the $M_ names) is defined as a fixed-reference macro that operates on a byte-based block. The $M_names are defined as literals.
- C — The same field names are available to C programs from the tpadef.h file. For the 32-bit and 64-bit argument blocks, the names are defined as elements of the *tpadef* and *tpa64def* structures, respectively.

See Section 2.2 for an example of an argument block declaration.

32-Bit and 64-Bit Argument Block Fields

Table below describes the fields of the 32-bit and 64-bit argument blocks.

Note that most fields have two symbols and one description. The symbol that begins with the prefix TPA $ is used with a 32-bit argument block, while the symbol that begins with the prefix TPA64$ is used with a 64-bit argument block. To prevent cumbersome explanations, Table lib–10 uses only the main part of a field name, without the prefix used in the actual code, when referring to a field for both the 32-bit and 64-bit argument blocks. For example, the options field is referred to as OPTIONS rather than specifying both TPA$L_OPTIONS and TPA64$L_OPTIONS. The complete field name is used only when referring to a field for one particular form of argument block.

Table 2.10. LIB$T[ABLE_]PARSE Argument Block Fields

Symbol	Description
TPA$L_COUNT TPA64$L_COUNT	A longword containing the value of TPA $K_COUNT0 for 32-bit argument blocks or TPA64$K_COUNT0 for 64-bit argument blocks. TPA$K_COUNT0 is defined to be 8. TPA64$K_COUNT0 is defined to be –1. If the value contained in this longword is greater than or equal to 8, LIB$T[ABLE_]PARSE treats the argument block as a 32-bit argument block. If the value is –1, LIB$T[ABLE_]PARSE treats the argument block as a 64-bit argument block. For LIB$TPARSE (VAX only), a longword containing the number of longwords that make up the rest of the argument block. This longword functions as the argument count when the argument block becomes the argument list to an action routine. This field must contain a value that is greater than or equal

Symbol	Description
	to the value of TPA$K_COUNT0, whose numeric value is 8.
TPA$L_OPTIONS TPA64$L_OPTIONS	Contains various flag bits and other options. The defined flags are as follows: • TPA$V_BLANKS, TPA64$V_BLANKS — Setting this bit causes LIB$T[ABLE_]PARSE to process blanks and tabs explicitly, rather than treating them as separators. See Section 3.2 for information about processing blanks. • TPA$V_ABBRFM, TPA64$V_ABBRFM — Setting this bit allows keywords to be abbreviated to any length. If an abbreviated keyword string is ambiguous, the first eligible transition listed in the state matches it. • TPA$V_ABBREV, TPA64$V_ABBREV — Setting this bit allows keywords to be abbreviated to the shortest length that is unambiguous in that state. See the Abbreviating Keywords section. • TPA$V_AMBIG, TPA64$V_AMBIG — LIB $T[ABLE_]PARSE sets this bit when it has detected an ambiguous keyword string in the current state. The OPTIONS field also contains the following option:
TPA64$Q_STRINGDESC	For a 64-bit argument block, the three quadwords starting with TPA64$Q_STRINGDESC form an embedded 64-bit descriptor for the input string. On entry, LIB$T[ABLE_]PARSE writes the fields of TPA64$Q_STRINGDESC as follows: DSC64$B_CLASS = DSC64$K_CLASS_S DSC64$B_DTYPE = DSC64$K_DTYPE_T DSC64$L_MBMO = –1 DSC64$W_MBO = +1
TPA$L_STRINGCNT TPA64$Q_STRINGCNT	Contains the number of characters remaining in the input string. For a 32-bit argument block, TPA $L_STRINGCNT and TPA$L_STRINGPTR form an embedded 32-bit descriptor for the input string. For both 32-bit and 64-bit argument blocks:

Symbol	Description
	• You must initialize the STRINGCNT and STRINGPTR fields to describe the input string. Use LIB$ANALYZE_SDESC or LIB$ANALYZE_ SDESC_64 to read the string length and address from the string's descriptor and write them in STRINGCNT and STRINGPTR, respectively. • Before LIB$T[ABLE_]PARSE calls an action routine, it modifies STRINGCNT and STRINGPTR to describe the remainder of the input string. • When LIB$T[ABLE_]PARSE returns, STRINGCNT and STRINGPTR describe the portion of the input string that LIB $T[ABLE_]PARSE did not process. This occurs whether LIB$T[ABLE_]PARSE returns success or failure.
TPA$L_STRINGPTR TPA64$Q_STRINGPTR	Contains the address of the remainder of the string being parsed.
TPA64$Q_TOKENDESC	For a 64-bit argument block, the three quadwords starting with TPA64$Q_TOKENDESC form an embedded 64-bit descriptor for the current token.2 On entry, LIB$T[ABLE_]PARSE writes the fields of TPA64$Q_TOKENDESC as follows: DSC64$B_CLASS = DSC64$K_CLASS_S DSC64$B_DTYPE = DSC64$K_DTYPE_T DSC64$L_MBMO = –1 DSC64$W_MBO = +1
TPA$L_TOKENCNT TPA64$Q_TOKENCNT	Contains the number of characters in the current token. For a 32-bit argument block, TPA$L_TOKENCNT and TPA$L_TOKENPTR form an embedded 32-bit descriptor for the input token. For both 32-bit and 64-bit argument blocks, LIB $T[ABLE_]PARSE updates TOKENCNT and TOKENPTR, to reflect the current token.
TPA$L_TOKENPTR TPA64$Q_TOKENPTR	Contains the address of the current token.
TPA$B_CHAR TPA64$B_CHAR	Contains the character matched by one of the single character symbol types: 'x', TPA$_ANY, TPA$_ ALPHA, or TPA$_DIGIT.

Symbol	Description
TPA$L_NUMBER TPA64$Q_NUMBER	Contains the binary representation of a numeric token that matches TPA$_OCTAL, TPA $_DECIMAL, TPA$_HEX, TPA$_UIC, or TPA $_IDENT. For a 64- bit argument block, it can also contain the binary representation of a numeric token that matches TPA$_DECIMAL_64, TPA $_OCTAL_64, or TPA$_ HEX_64.
(Alpha and I64 specific) TPA$Q_NUMBER	For a 32-bit argument block on an Alpha system, contains the binary representation of a numeric token that matches TPA$_DECIMAL_64, TPA$_OCTAL_64, or TPA$_HEX_64. LIB $T[ABLE_]PARSE coverts the numeric token in the appropriate radix before storing it in the TPA $Q_NUMBER field. In the 32-bit argument block, TPA$Q_NUMBER overlays TPA$L_NUMBER and the longword in which TPA$B_CHAR resides.
TPA$L_PARAM TPA64$Q_PARAM	Contains the optional 32-bit argument supplied by the state transition in its *argument* argument. For a 64-bit argument block, LIB $T[ABLE_]PARSE sign-extends the argument value before storing it in TPA64$Q_PARAM.

Coding and Using a Simple State Table

LIB$T[ABLE_]PARSE can parse programming languages, command languages, or any other grammar for which a deterministic parser is the best choice.

To code a program to use LIB$T[ABLE_]PARSE, perform the following steps:

- Set up state tables to implement the language's grammar (See Section 2.1)
- Define the argument block and other common variables (See Section 2.2)
- Include the call to LIB$T[ABLE_]PARSE in the main program (See Section 2.3)

This section provides examples that demonstrate the use of LIB$T[ABLE_]PARSE to perform these three steps. The examples parse the command language of a simple report management utility. This hypothetical utility allows a user to perform the following activities:

- Obtain a list of available reports (SHOW command).
- Read reports on the terminal (READ command).
- Print reports (PRINT command).
- Store new reports (FILE command).

The examples use the BASIC programming language for everything except the state and keyword tables, which are coded in BLISS.

This simple state table program does not use any action routines or other arguments. See Section 3 for information about how to use these features of LIB$T[ABLE_]PARSE.

Setting Up a State Table

A state table associates the parser's alphabet with a set of possible transitions.

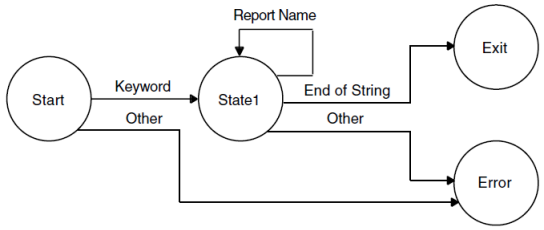
It is often helpful to create a graphical representation of a state table before attempting to code it. The following section illustrates two possible approaches.

Diagramming the Transitions

One way to set up these tables is to start from a transition diagram of the language you want to parse. (If you do not know how to construct a transition diagram, you might find it helpful to read an introductory text about compiler design and construction before you start.) Each circle represents a state in the state table. Each arrow, labeled with an input option, represents a transition out of one state to another state or within the same state.

Figure below shows a transition diagram for the hypothetical utility described in this section.

Figure 2.23. Transition Diagram for a Hypothetical Utility



Another technique for developing a state table starts with a tabular diagram in which the first column is the starting state, the second column identifies the input token, or keyword, and the third gives the resultant state.

Figure below is a tabular diagram of the utility that appears in figure above.

Figure 2.24. Tabular Diagram of a Hypothetical Utility

Starting State	Input	Resulting State
Start	PRINT READ FILE SHOW Other	State1 State1 State1 State1 Error
State1	Report Name End of String Other	State1 Exit Error

In this case, each unique entry in the Starting State or Resulting State column represents a state in the state table. Each entry in the Input column represents a possible transition out of the state in the Starting State column to a state in the Resulting State column.

Coding a State Table

For both MACRO and BLISS, you begin the state table with an $INIT_STATE macro. If you use MACRO to define your state table, then:

- Use the $STATE macro to define each state.
- Follow each $STATE macro with one instance of the $TRAN macro for each transition from this state to another state or within the same state.

If you use BLISS to define the state table, then:

- Use the $STATE macro to define each state and its associated transitions.

> **Note**
>
> The order in which you define the states is important. If you do not specify a target state for a transition, LIB$T[ABLE_]PARSE transfers control to the next state in the state table.

The following MACRO and BLISS examples code the state table for the hypothetical utility diagrammed in the two figures above. Note that neither of these state tables includes the error state, because LIB $T[ABLE_]PARSE automatically generates an error if the input token does not match a transition in the current state. To provide a transition to your own error state, code the last transition in the state with the TPA$_LAMBDA symbol type and specify a transition to your error state. The TPA$_LAMBDA symbol type matches any input token.

The state table, coded using MACRO, for this simple language looks like this:

```
        .TITLE simplelang
        .ident 'v1'

;+
; Define the LIB$TABLE_PARSE control symbols
;-

        $TPADEF

        $INIT_STATE SIMPLE_LANGUAGE_TABLE, SIMPLE_KEYWORD_TABLE

        $STATE START

        $TRAN 'PRINT', STATE1
        $TRAN 'READ', STATE1
        $TRAN 'FILE', STATE1
        $TRAN 'SHOW', STATE1
        $STATE STATE1
        $TRAN TPA$_STRING, STATE1
        $TRAN TPA$_EOS, TPA$_EXIT
        $END_STATE
        .END
```

Using the BLISS macros yields the following state table definition:

```
MODULE simple_statetable =

BEGIN

 !+
 ! These libraries contain the macros and other definitions
 ! needed to generate the state tables.
 !-

LIBRARY 'SYS$LIBRARY:STARLET';
LIBRARY 'SYS$LIBRARY:TPAMAC';
 !+
 ! UFD_STATE is the name you are giving the state table.
 ! UFD_KEY names the keyword table.
```

```
 ! Be sure to use the same name in the call to LIB$T[ABLE_]PARSE.
 !-

$INIT_STATE    (UFD_STATE, UFD_KEY);
 !+
 ! Read the command name (to the first blank in the command).
 ! Each string is a keyword; you are limited to 220 keywords
 ! per state table.
 !-

$STATE   (START,            !Be careful of your punctuation here.
         ('CREATE',STATE1), ! Each transition is surrounded by
         ('FILE',STATE1),   ! parentheses; each entry except the
         ('PRINT',STATE1),  ! last is followed by a comma.
         ('READ',STATE1)
         );

$STATE   (STATE1,
         (TPA$_STRING, STATE1), ! If there is more than one report name
         (TPA$_EOS, TPA$_EXIT)  ! specified, go back and process it.
          ); ! exit when done.

END

ELUDOM                          ! End of module CREATE_TABLE
```

Assemble or compile this module as you would any other program module.

Defining the Argument Block

After you have set up the state tables, you need to declare the LIB$T[ABLE_]PARSE argument block in such a way that both your program and LIB$T[ABLE_]PARSE can use it. This means the data must be defined in an area common to the calling program and the program module containing the state table definitions.

In most programming languages you will use a combination of EXTERNAL statements and common data definitions to create and access a separate data PSECT. If you do not know what mechanisms the language you are using provides, consult the documentation for that language.

The following example shows the LIB$T[ABLE_]PARSE argument block defined for use in a BASIC program.

```
!LIB$T[ABLE_]PARSE requires that TPA$K_COUNT0 be eight.

DECLARE INTEGER CONSTANT TPA$K_COUNT0 = 8,             &
                BTPA$L_COUNT = 0,                      &
                BTPA$L_OPTIONS=1,                      &
                BTPA$L_STRINGCNT=2,                    &
                BTPA$L_STRINGPTR=3,                    &
                BTPA$L_TOKENCNT=4,                     &
                BTPA$L_TOKENPTR=5,                     &
                BTPA$B_CHAR=6,                         &
                BTPA$L_NUMBER=7,                       &
                BTPA$L_PARAM=8

!+
! The LIB$T[ABLE_]PARSE argument block.
!-
```

```
MAP (TPARSE_BLOCK) LONG TPARSE_ARRAY (TPA$K_COUNT0)

!+
! Redefining the map allows you to use the standard
! LIB$T[ABLE_]PARSE symbolic names. TPA$L_STRINGCNT,
! for example, references the same storage location
! as TPARSE_ARRAY(2) and TPARSE_ARRAY(BTPA$L_STRINGCNT).
!-
MAP (TPARSE_BLOCK) LONG                 &
                TPA$L_COUNT ,           &
                TPA$L_OPTIONS,          &
                TPA$L_STRINGCNT,        &
                TPA$L_STRINGPTR,        &
                TPA$L_TOKENCNT,         &
                TPA$L_TOKENPTR,         &
                TPA$B_CHAR,             &
                TPA$L_NUMBER,           &
                TPA$L_PARAM
```

Before your program can call LIB$T[ABLE_]PARSE, it must place the necessary information in the argument block.

The example utility does not need to set any flags because it uses the LIB$T[ABLE_]PARSE defaults for options such as blanks processing and abbreviations. However, it must put the address and length of the string to be parsed into the TPA$L_STRINGCNT and TPA$L_STRINGPTR fields.

The address and the length of the string to be parsed are available in the descriptor of the input string (called COMMAND_LINE in the following program). However, BASIC, like most high-level languages, does not allow you to look at the descriptors of your strings. Instead, you can use LIB $ANALYZE_SDESC or LIB$ANALYZE_SDESC_64 to read the length and address from the string descriptor and place them in the argument block.

Coding the Call to LIB$T[ABLE_]PARSE

The following example demonstrates calling LIB$T[ABLE_PARSE from a high-level language (BLISS). This program uses the BLISS state table described in previous section.

```
5 %TITLE "BLISS Program to Call LIB$T[ABLE_]PARSE

        OPTION TYPE=EXPLICIT

        !+
        ! COMMAND_LINE is the string to receive the input
        ! command from the terminal.
        ! ERROR_MSG_TEXT is the system error message
        ! returned from LIB$SYS_GETMSG
        ! (used in the error handling routine)
        !-
        DECLARE STRING COMMAND_LINE, ERROR_MSG_TEXT

        !+
        ! RET_STATUS receives the status from the system calls.
        ! SAVE_STATUS is used when an error occurs
        ! and the error handling routine calls
        ! LIB$SYS_GETMSG to obtain the error text.
        !-
```

```
        DECLARE LONG RET_STATUS, SAVE_STATUS

        !+
        ! UFD_STATE is the address of the state table.
        ! UFD_KEY is the address of the key table.
        ! Both addresses are set up by the macros in module
        ! SIMPLE_STATETABLE32.
        !-

        EXTERNAL LONG UFD_STATE, UFD_KEY

        !+
        ! To allow us to compare returned statuses more easily.
        !-

        EXTERNAL INTEGER CONSTANT SS$_NORMAL,   &
                LIB$_SYNTAXERR,                 &
                LIB$_INVTYPE

        !+
        ! This program calls the following Run-Time Library
        ! routines:
        !
        ! LIB$T[ABLE_]PARSE to parse the input string
        !
        ! LIB$ANALYZE_SDESC to get the length and starting
        ! address of the command string and place them
        ! in the LIB$T[ABLE_]PARSE argument block.
        !
        ! LIB$SYS_GETMSG to find the facility, severity, and text
        ! of any system errors that occur
        ! during program execution.
        !-

EXTERNAL LONG FUNCTION LIB$TABLE_PARSE,     &
                       LIB$ANALYZE_SDESC,   &
                       LIB$SYS_GETMSG

        !+
20      ! This file defines the argument block that is passed
        ! to LIB$T[ABLE_]PARSE. It also defines subscripts that
        ! make it easier to access the array.
        !
        ! Keeping the argument block definitions in a separate
        ! file makes them easier to modify and lets other
        ! programs use the same definitions.
        !-

        %INCLUDE "SIMPLE_TPARSE_BLOCK"

50      ON ERROR GOTO ERROR_HANDLER

60      !+
        ! LIB$T[ABLE_]PARSE requires that TPA$L_COUNT, the
        ! first field in the argument block, have a value
        ! of TPA$K_COUNT0, whose value is 8.
        !-
```

```
        TPA$L_COUNT = TPA$K_COUNT0

75      !+
        ! Prompt at the terminal for the user's action.
        ! A real utility should provide a friendlier,
        ! clearer interface.
        !-

        GET_INPUT:      PRINT "Your options are: " , " READ report "
                        PRINT , " FILE report "
                        PRINT , " PRINT report "
                        PRINT , " CREATE report "
                        PRINT
                        INPUT "What would you like to do"; COMMAND_LINE
        !+
        ! Get the length and starting address of the command line
        ! and place them in the LIB$T[ABLE_]PARSE argument block. Note
        ! that LIB$ANALYZE_SDESC stores the length as a word.
        !-

        RET_STATUS = LIB$ANALYZE_SDESC (COMMAND_LINE BY DESC, &
                    TPARSE_ARRAY (BTPA$L_STRINGCNT) BY REF, &
                    TPARSE_ARRAY (BTPA$L_STRINGPTR) BY REF)

        IF RET_STATUS <> SS$_NORMAL THEN
                        GOTO ERROR_HANDLER
END IF

100     !+
        ! Call LIB$T[ABLE_]PARSE to process the input string.
        !
        ! Note that LIB$T[ABLE_]PARSE expects to receive its arguments
        ! by reference, while BASIC's default for arrays and
        ! strings is by descriptor. Therefore the BY REF
        ! clauses are required. Without them, LIB$T[ABLE_]PARSE
        ! cannot find the input string
        ! and the parse will always fail.
        !-

        RET_STATUS = LIB$TABLE_PARSE (TPARSE_ARRAY () BY REF, &
        UFD_STATE BY REF, &
        UFD_KEY BY REF )

        !+
        ! This simple program provides no information except that
        ! a valid command was entered. The next section discusses
        ! techniques for gathering more information.
        !-

        IF RET_STATUS = SS$_NORMAL

        !+
        ! For now, exit on success.
        !-

                THEN PRINT "Parse successful"
                        GOTO 9999
        !+
```

```
        ! If the parse failed, give the user a chance to try again.
        !-

                ELSE IF RET_STATUS = LIB$_SYNTAXERR THEN
                            PRINT "You did not enter a valid command."
                            PRINT "Please try again."
                            GOTO GET_INPUT

!+
        ! If a more serious error occurred, inform the user
        ! and exit.
!-

                ELSE
                            Goto ERROR_HANDLER
                END IF
        END IF

500     ERROR_HANDLER: SAVE_STATUS = RET_STATUS

        RET_STATUS = LIB$SYS_GETMSG (SAVE_STATUS,,ERROR_MSG_TEXT)
        PRINT "Something went wrong."
        PRINT ERL, ERROR_MSG_TEXT
        RESUME 9999

9999    END
```

Compile this program as you would any other BASIC program.

When both the state tables and the main program have been compiled, link them together to form a single executable image, as follows:

```
$ LINK SIMPLANG,SIMPLANG_STATETABLE
```

Using Advanced LIB$T[ABLE_]PARSE Features

The LIB$T[ABLE_]PARSE call in the previous program tells you that the command the user entered was valid, but nothing else—not even which command was entered. A program usually needs more information than this.

The following sections describe some of the more complicated ways to process input strings or to gather extra information for your program, including:

- Action routines
- Blanks in the input string
- Special characters in the input string
- Abbreviated keywords
- Subexpressions
- Modular use of LIB$T[ABLE_]PARSE

Using Action Routines

After LIB$T[ABLE_]PARSE finds a match between a transition and the leading portion of the input string, it determines if the transition that made the match specified an action routine. If it did, LIB

$T[ABLE_]PARSE stores the value of the transition's *argument* longword, if any, in the argument block PARAM field and calls the action routine.

- If the action routine returns success, LIB$T[ABLE_]PARSE processes the *mask* or *msk-adr* arguments, if any, and continues to execute the transition as it would if there was no action routine.
- If the action routine returns failure, LIB$T[ABLE_]PARSE does not execute the transition and continues attempting to match successive transitions.

Passing Data to an Action Routine

An action routine has only one argument, the argument block. You can pass additional data to the action routine using:

- The transition's optional *argument* argument
- Fields you add to the end of the argument block

LIB$TABLE_PARSE and LIB$TPARSE use different linkages for passing the argument block to the action routine:

- LIB$TABLE_PARSE uses the standard calling mechanism and passes the argument block, by reference, as the only argument to the action routine.

  Therefore, for OpenVMS systems, action routines are written as:

```
ROUTINE TEST( TPARSE_ARGUMENT_BLOCK : REF BLOCK[ , BYTE ] ) =
BEGIN

TPARSE_ARGUMENT_BLOCK[ TPA$V_ABBREV ] = 1

END;
```

- On VAX systems, LIB$TPARSE uses a nonstandard linkage that establishes the address of the argument block as the routine's actual argument pointer. Therefore an action routine can reference fields in the argument block by their symbolic offsets relative to the AP (argument pointer) register.

  For example:

```
ROUTINE TEST =
BEGIN

BUILTIN
    AP;

BIND
    TPARSE_ARGUMENT_BLOCK = AP : REF BLOCK[ , BYTE ];

TPARSE_ARGUMENT_BLOCK[ TPA$V_ABBREV ] = 1

END;
```

Action Routine Return Values

The action routine returns a value to LIB$T[ABLE_]PARSE in R0 that controls execution of the current state transition. If the action routine returns success (low bit set in R0) then LIB$T[ABLE_]PARSE proceeds with the execution of the state transition. If the action routine returns failure (low bit clear

in R0), LIB$T[ABLE_]PARSE rejects the transition that was being processed and acts as if the symbol type of that transition had not matched. It proceeds to evaluate other transitions in that state for eligibility.

Note

Prior to calling an action routine, LIB$T[ABLE_]PARSE sets the low bit of R0 to make it easier for the action routine to return success.

If an action routine returns a nonzero failure status to LIB$T[ABLE_]PARSE and no subsequent transitions in that state match, LIB$T[ABLE_]PARSE will return the status of the action routine, rather than the status LIB$_SYNTAXERR. In longword-valued functions in high-level languages, this value is returned in R0.

Using an Action Routine to Reject a Transition

An action routine can intentionally return a failure status to force LIB$T[ABLE_]PARSE to reject a transition. This allows you to implement symbol types specific to particular applications. To recognize a specialized symbol type, code a state transition using a LIB$T[ABLE_]PARSE symbol type that describes a superset of the desired set of possible tokens. The associated action routine then performs the additional discrimination necessary and returns success or failure to LIB$T[ABLE_]PARSE, which then accordingly executes or fails to execute the transition.

A pure finite-state machine, for instance, has difficulty recognizing strings that are shorter than some maximum length or accepting numeric values confined to some particular range.

Blanks in the Input String

The default mode of operation in LIB$T[ABLE_]PARSE is to treat blanks as separators. That is, they can appear between any two tokens in the string being parsed without being called for by transitions in the state table. Because blanks are significant in some situations, LIB$T[ABLE_]PARSE processes blanks if you have set the bit TPA$V_BLANKS in the options longword of the argument block. The following input string shows the difference in operation:

```
ABC   DEF
```

LIB$T[ABLE_]PARSE recognizes the string by the following sequences of state transitions, depending on the state of the blanks control flag. The following examples illustrate processing with and without TPA$V_BLANKS set:

- TPA$V_BLANKS set:

```
$STATE
$TRAN TPA$_STRING

$STATE
$TRAN TPA$_BLANK

$STATE
$TRAN TPA$_STRING
```

- TPA$V_BLANKS clear:

```
$STATE
$TRAN TPA$_STRING
```

```
   $STATE
   $TRAN TPA$_STRING
```

Your action routines can set or clear TPA$V_BLANKS as LIB$T[ABLE_]PARSE enters or leaves sections of the state table in which blanks are significant. LIB$T[ABLE_]PARSE always checks the blanks control flag as it enters a state. If the flag is clear, it removes any space or tab characters present at the front of the input string before it proceeds to evaluate transitions. Note that when the TPA $V_BLANKS flag is clear, the TPA$_BLANK symbol type will never match. If TPA$V_BLANKS is set, you must explicitly process blanks.

Special Characters in the Input String

Not all members of the ASCII character set can be entered directly in the state table definitions. Examples include the single quotation mark and all control characters.

In MACRO state tables, such characters can be specified as the symbol type with any assembler expression that is equivalent to the ASCII code of the desired character, not including the single quotes. For example, you could code a transition to match a backspace character as follows:

```
BACKSPACE = 8
    .
    .
    .
$TRAN BACKSPACE, ...
```

MACRO places extra restrictions on the use of a comma in arguments to macros; often they must be surrounded by one or more angle brackets. Using a symbolic name for the comma will avoid such difficulties.

To build a transition matching such a single character in a BLISS state table, you can use the %CHAR lexical function as follows:

```
LITERAL BACKSPACE = 8;
    .
    .
    .
$STATE (label,
        (%CHAR (BACKSPACE), ... )
         );
```

Abbreviating Keywords

The default mode of LIB$T[ABLE_]PARSE is exact match. All keywords in the input string must exactly match their spelling, length and case in the state table. However, many languages (command languages in particular) allow you to abbreviate keywords. For this reason, LIB$T[ABLE_]PARSE has three abbreviation facilities to permit the recognition of abbreviated keywords when the state table lists only the full spellings. All three are controlled by flags and options defined in the argument block OPTIONS field. Table lib–11 describes these flags.

Table 2.11. Keyword Abbreviation Flags

Flag	Description
TPA$B_MCOUNT TPA64$B_MCOUNT	By setting a value in the MCOUNT argument block field, the calling program or action routine specifies a minimum number of characters from the abbreviated keyword that must be present for a match to occur. For example, setting the byte to

Flag	Description
	the value 4 would allow the keyword DEASSIGN to appear in an input string as DEAS, DEASS, DEASSI, DEASSIG, or DEASSIGN. LIB$T[ABLE_]PARSE checks all the characters of the keyword string. Incorrect spellings beyond the minimum abbreviation are not permitted.
TPA$V_ABBRFM TPA64$V_ABBRFM	If you set the ABBRFM flag in the argument block OPTIONS field, LIB$T[ABLE_]PARSE recognizes any leftmost substring of a keyword as a match for that keyword. LIB$T[ABLE_]PARSE does not check for ambiguity; it matches the first keyword listed in the state table of which the input token is a subset. For proper recognition of ambiguous keywords, the keywords in each state must be arranged in alphabetical order by the ASCII collating sequence as follows: Dollar sign ($) Numerics Uppercase alphabetics Underscore (_) Lowercase alphabetics
TPA$V_ABBREV TPA64$V_ABBREV	If you set the ABBREV flag in the argument block OPTIONS field, LIB$T[ABLE_]PARSE recognizes any abbreviation of a keyword as long as it is unambiguous among the keywords in that state. If LIB$T[ABLE_]PARSE finds that the front of the input string contains an ambiguous keyword string, it sets the AMBIG flag in the OPTIONS field and refuses to recognize any keyword transitions in that state. (It still accepts other symbol types.) The AMBIG flag can be checked by an action routine that is called when coming out of that state, or by the calling program if LIB $T[ABLE_]PARSE returns with a syntax error status. LIB$T[ABLE_]PARSE clears the flag when it enters the next state.
If both the ABBRFM and ABBREV flags are set, ABBRFM takes precedence.	

Note

Using a keyword abbreviation option can permit short abbreviations or ambiguity, which restricts the extensibility of a language. Adding a new keyword can make a formerly valid abbreviation ambiguous.

Using Subexpressions

LIB$T[ABLE_]PARSE subexpressions are analogous to subroutines within the state table. You can use subexpressions as you would use subroutines in any program:

- To avoid replication of complex expressions.
- For a limited form of pushdown parsing, in which the state table contains recursively nested subexpressions.
- For nondeterministic parsing, that is, parsing in which you need some number of states of look-ahead. To do this, place each path of look-ahead in a separate subexpression and call the subexpressions in the transitions of the state that needs the look-ahead. When a look-ahead path fails, the subexpression failure mechanism causes LIB$T[ABLE_]PARSE to back out and try another path.

A subexpression call is indicated with the MACRO expression *!label* or the BLISS expression (*label*) as the transition type argument. Transfer of control to a subexpression causes LIB $T[ABLE_]PARSE to call itself recursively, using the same argument block and keyword table as the original call, and using the specified state label as a starting state.

The following statement is an example of a $TRAN macro that calls a subexpression:

```
$TRAN !Q_STRING,,,,Q_DESCRIPTOR
```

In this example, Q_STRING is the label of another state, a subexpression, in the same state table.

When LIB$T[ABLE_]PARSE evaluates a transition that transfers control to a subexpression, it evaluates the subexpression's transitions and processes the remaining input string.

- If the subexpression succeeds, it returns success to LIB$T[ABLE_]PARSE by executing a transition to TPA$_EXIT. LIB$T[ABLE_]PARSE thus considers the calling transition to have made a match. It calls that transition's action routine, if any, and executes the transition.
- If the subexpression fails, LIB$T[ABLE_]PARSE considers the calling transition to have no match. It backs up the input string, leaving it as it was at the start of the subexpression, and continues processing by evaluating the remaining transitions in the calling state.

Using Action Routines and Storing Data in a Subexpression

Be careful when designing subexpressions whose transitions provide action routines or use the *mask* and *msk-adr* arguments. As LIB$T[ABLE_]PARSE processes the state transitions of a subexpression, it calls the specified action routines and stores the *mask* and *msk-adr*. If the subexpression fails, LIB $T[ABLE_]PARSE backs up the input string and resumes processing in the calling state. However, any effect that an action routine has had on the caller's database cannot be undone.

If subexpressions are used only as state table subroutines, there is usually no harm done, because when a subexpression fails in this mode, the parse generally fails. This is not true of pushdown or nondeterministic parsing. In applications where you expect subexpressions to fail, design action routines

to store results in temporary storage. You can then make these results permanent at the main level, where the flow of control is deterministic.

An Example: Parsing a Quoted String

The following example is an excerpt of a state table that parses a string quoted by an arbitrary character. The table interprets the first character that appears as a quote character. Many text editors and some programming languages contain this sort of construction.

LIB$T[ABLE_]PARSE processes a transition that invokes a subexpression as it would any other transition:

- If the subexpression returns success by executing a transition to TPA$_ EXIT, LIB $T[ABLE_]PARSE considers the calling transition to have a match. It updates Q_DESCRIPTOR to describe the substring parsed by the subexpression and executes the transition to the next state in the state table.
- If the subexpression returns failure by executing a transition to TPA$_FAIL, LIB$T[ABLE_]PARSE considers the calling transition to have no match. It restores the input string as it was when the subexpression was called and continues by evaluating the next transition in the state.

```
;+
; Main level state table. The first transition accepts and
; stores the quoting character.
;-
     $STATE    STRING
     $TRAN     TPA$_ANY,,,,Q_CHAR
;+
; Call the subexpression to accept the quoted string and store
; the string descriptor. Note that the descriptor spans all
; the characters accepted by the subexpression.
;-
     $STATE
     $TRAN     !Q_STRING,,,,Q_DESCRIPTOR
     $TRAN     TPA$_LAMBDA,TPA$_FAIL
;+
; Accept the trailing quote character, left behind by the
; subexpression
;-
     $STATE
     $TRAN     TPA$_ANY,NEXT
;+
; Subexpression to scan the quoted string. The second transition
; matches until it is rejected by the action routine. The subexpression
; should never encounter the end of string before the final quoting
; character.
;-
     $STATE     Q_STRING
     $TRAN     TPA$_EOS,TPA$_FAIL
     $TRAN     TPA$_ANY,Q_STRING,TEST_Q
     $TRAN     TPA$_LAMBDA,TPA$_EXIT
;+
; The following MACRO subroutine compares the current character
; with the quoting character and returns failure if it matches.
;-

TEST_Q: .WORD     0                          ; null entry mask
```

```
        CMPB    TPA$B_CHAR(AP),Q_CHAR     ; check the character
        BNEQ    10$                       ; note R0 is already 1
        CLRL    R0                        ; match - reject transition
10$:    RET
```

An Example: Parsing a Complex Grammar

The following example is an excerpt from a state table that shows how to use subexpressions to parse a complex grammar. The state table accepts a number followed by a keyword qualifier. Depending on the keyword, the table interprets the number as decimal, octal, or hexadecimal. The state table accepts strings such as the following:

10/OCTAL

32768/DECIMAL

77AF/HEX

This sort of grammar is difficult to parse with a deterministic finite-state machine. Using a subexpression look-ahead of two states permits a simpler expression of the state tables.

```
;+
; Main state table entry. Accept a number of some type and store
; its value at the location NUMBER.
;-
     $STATE
     $TRAN !OCT_NUM,NEXT,,,NUMBER
     $TRAN !DEC_NUM,NEXT,,,NUMBER
     $TRAN !HEX_NUM,NEXT,,,NUMBER
;+
; Subexpressions to accept an octal number followed by the OCTAL
; qualifier.
;-
     $STATE OCT_NUM
     $TRAN TPA$_OCTAL
     $STATE
     $TRAN '/'
     $STATE
     $TRAN 'OCTAL',TPA$_EXIT
;+
; Subexpression to accept a decimal number followed by the DECIMAL
; qualifier.
;-
     $STATE DEC_NUM
     $TRAN TPA$_DECIMAL
     $STATE
     $TRAN '/'
     $STATE
     $TRAN 'DECIMAL',TPA$_EXIT
;+
; Subexpression to accept a hex number followed by the HEX
; qualifier.
;-
     $STATE HEX_NUM
     $TRAN TPA$_HEX
     $STATE
     $TRAN '/'
     $STATE
```

```
$TRAN 'HEX',TPA$_EXIT
```

Note that the transitions that follow a match with a numeric token do not disturb the NUMBER field in the argument block. This allows the main level subexpression call to retrieve it when the subexpression returns.

LIB$T[ABLE_]PARSE and Modularity

To use LIB$T[ABLE_]PARSE in a modular and shareable fashion:

- Avoid using OWN storage. Instead, allocate the argument block on the stack or the heap.
- Do not use the *msk-adr* argument.
- Do not use the *argument* argument as an address. If additional context is needed, allocate it at the end of the argument block.
- Use action routines to control flags such as TPA$V_BLANKS. The MACRO example at the end of the LIB$TPARSE/LIB$TABLE_PARSE section shows such an action routine, though the program itself is not modular.

Data Representation

This section describes the binary representation and allocation of a LIB$T[ABLE_]PARSE state table and a keyword table. While this information is not required to use LIB$T[ABLE_]PARSE, it may be useful in debugging your program.

State Table Representation

Each state consists of its transitions concatenated in memory. LIB$T[ABLE_]PARSE equates the state label to the address of the first byte of the first transition. A marker in the last transition identifies the end of the state. The LIB$T[ABLE_]PARSE table macros build the state table in the PSECT_LIB$STATE$.

Each transition in a state consists of 2 to 23 bytes containing the arguments of the transition. The state table generation macros do not allocate storage for arguments not specified in the transition macro. This allows simple transitions to be represented efficiently. For example, the following transition, which simply accepts the character "?" and falls through to the next state, is represented in two bytes:

$TRAN '?'

In this section, pointers described as self-relative are signed displacements from the address following the end of the pointer (this is identical to branch displacements in the OpenVMS VAX instruction set).

Table below describes the elements of a state transition in the order in which they appear, if present, in the transition. If a transition does not include a specific option, no bytes are assigned to the option within the transition.

Table 2.12. Binary Representation of a LIB$T[ABLE_]PARSE State Transition

Transition Element	No. of Bytes	Description
Symbol type	1	The first byte of a transition always contains the binary coding of the symbol type accepted by this transition. Flag bit 0 in the flags byte controls the interpretation of the type byte. If the flag is clear, the type byte represents a single character (the 'x' construct). If the flag bit is set, the type byte is one

<table>
<tr><th>Transition Element</th><th>No. of Bytes</th><th>Description</th></tr>
<tr><td></td><td></td><td>
of the other type codes (keyword, number, and so on). The following table lists the symbol types accepted by LIB$T[ABLE_]PARSE:
<table>
<tr><th>Symbol Type</th><th>Binary Encoding</th></tr>
<tr><td>'x'</td><td>ASCII code of the character (8 bits)</td></tr>
<tr><td>'keyword'</td><td>The keyword index (0 to 219)</td></tr>
<tr><td>TPA$_DECIMAL_64 (Alpha and I64 only)</td><td>228</td></tr>
<tr><td>TPA$_OCTAL_64 (Alpha and I64 only)</td><td>229</td></tr>
<tr><td>TPA$_HEX_64 (Alpha and I64 only)</td><td>230</td></tr>
<tr><td>TPA$_NODE_ACS</td><td>231</td></tr>
<tr><td>TPA $_NODE_PRIMARY</td><td>232</td></tr>
<tr><td>TPA$_NODE</td><td>233</td></tr>
<tr><td>TPA$_FILESPEC</td><td>234</td></tr>
<tr><td>TPA$_UIC</td><td>235</td></tr>
<tr><td>TPA$_IDENT</td><td>236</td></tr>
<tr><td>TPA$_ANY</td><td>237</td></tr>
<tr><td>TPA$_ALPHA</td><td>238</td></tr>
<tr><td>TPA$_DIGIT</td><td>239</td></tr>
<tr><td>TPA$_STRING</td><td>240</td></tr>
<tr><td>TPA$_SYMBOL</td><td>241</td></tr>
<tr><td>TPA$_BLANK</td><td>242</td></tr>
<tr><td>TPA$_DECIMAL</td><td>243</td></tr>
<tr><td>TPA$_OCTAL</td><td>244</td></tr>
<tr><td>TPA$_HEX</td><td>245</td></tr>
<tr><td>TPA$_LAMBDA</td><td>246</td></tr>
<tr><td>TPA$_EOS</td><td>247</td></tr>
<tr><td>TPA$_SUBEXPR</td><td>248 (subexpression call) (Other codes are reserved for expansion)</td></tr>
</table>
Use of the TPA$_FILESPEC, TPA$_NODE, TPA $_NODE_ PRIMARY, or TPA$_NODE_ACS symbol type results in calls to the $FILESCAN system service. Use of the symbol type TPA $_IDENT results in calls to the $ASCTOID system service. If your application of LIB $T[ABLE_]PARSE runs in an environment other
</td></tr>
</table>

<table>
<tr><th>Transition Element</th><th>No. of Bytes</th><th>Description</th></tr>
<tr><td></td><td></td><td>than OpenVMS user mode, you must carefully evaluate whether use of these services is consistent with your environment.</td></tr>
<tr><td>First flags byte</td><td>1</td><td>This byte contains the following bits, which specify the options of the transition. It is always present.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td>Set if the type byte is not a single character.</td></tr>
<tr><td>1</td><td>Set if the second flags byte is present.</td></tr>
<tr><td>2</td><td>Set if this is the last transition in the state.</td></tr>
<tr><td>3</td><td>Set if a subexpression pointer is present.</td></tr>
<tr><td>4</td><td>Set if an explicit target state is present.</td></tr>
<tr><td>5</td><td>Set if the mask longword is present.</td></tr>
<tr><td>6</td><td>Set if the msk-adr longword is present.</td></tr>
<tr><td>7</td><td>Set if an action routine address is present.</td></tr>
</table></td></tr>
<tr><td>Second flags byte</td><td>1</td><td>This byte is present if any of its flag bits is set. It contains an additional flag describing the transition. It is used as follows:
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>0</td><td>Set if the action routine argument is present.</td></tr>
</table></td></tr>
<tr><td>Subexpression pointer</td><td>2</td><td>This word is present in transitions that are subexpression calls. It is a 16-bit signed self-relative pointer to the starting state of the subexpression.</td></tr>
<tr><td>Argument longword</td><td>4</td><td>This longword field contains the 32-bit action routine argument, when specified.</td></tr>
<tr><td>Action routine address</td><td>4</td><td>This longword contains a self-relative pointer to the action routine, when specified.</td></tr>
<tr><td>Bit mask</td><td>4</td><td>This longword contains the mask argument, when specified.</td></tr>
<tr><td>Mask address</td><td>4</td><td>This longword, when specified, contains a self-relative pointer through which the mask, or data that depends on the symbol type, is to be stored. Because the pointer is self-relative, when it points to an absolute location, the state table is not PIC (position-independent code).</td></tr>
</table>

Transition Element	No. of Bytes	Description
Transition target	2	This word, when specified, contains the address of the target state of the transition. The address is stored as a 16-bit signed self-relative pointer. The final state TPA$_EXIT is coded as a word whose value is –1; the failure state TPA$_FAIL is coded as a word whose value is –2.

Keyword Table Representation

The keyword table is a vector of 16-bit signed pointers that address locations in the keyword string area, relative to the start of the keyword vector. It is the structure to which the $INIT_STATE macro equates its second argument.

The LIB$T[ABLE_]PARSE macros assign an index number to each keyword. The index number is stored in the symbol type byte in the transition; it locates the associated keyword vector entry. The keyword strings are stored in the order encountered in the state table. Each keyword string is terminated by a byte containing the value –1. Between the keywords of adjacent states is an additional –1 byte to stop the ambiguous keyword scan.

To ensure that the keyword vector is adjacent to the keyword string area, the keyword vector is located in PSECT_LIB$KEY0$ and the keyword strings and stored in PSECT_LIB$KEY1$.

Your program should not use any of the three PSECTs used by LIB$T[ABLE_]PARSE (_LIB$STATE$, _LIB$KEY0$, and _LIB$KEY1$). The PSECTs _LIB$KEY0$ and _LIB$KEY1$ refer to each other using 16-bit displacements, so user PSECTs inserted between them can cause truncation errors from the linker.

Condition Values Returned

SS$_NORMAL	Routine successfully completed. LIB$T[ABLE_]PARSE has executed a transition to TPA$_EXIT at main level, not within a subexpression.
LIB$_SYNTAXERR	Parse completed with syntax error. LIB$T[ABLE_]PARSE has encountered a state at main level in which none of the transitions match the input string, or in which a transition to TPA$_FAIL was executed.
LIB$_INVTYPE	State table error. LIB$T[ABLE_]PARSE has encountered an invalid entry in the state table.
Other	If an action routine returns a failure status other than zero, and the parse consequently fails, LIB$T[ABLE_]PARSE returns the status returned by the action routine.

Examples

Example 1a

The following DEC C program accepts and parses the command line of a CREATE/DIRECTORY command using LIB$TABLE_PARSE. It uses the state table defined in Example 1b.

```
/*
** This DEC C program accepts and parses the command line of a CREATE/
** DIRECTORY command. This program uses the LIB$GET_FOREIGN call to
```

```
** acquire the command line from the CLI and parse it with
** LIB$TABLE_PARSE, leaving the necessary information in its global
** data base. The command line is of the following format:
**
**      CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
**                 /OWNER_UIC=[2437,25]
**                 /ENTRIES=100
**                 /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
**
** The three qualifiers are optional.  Alternatively, the command
** may take the form:
**
**       CREATE/DIR DEVICE:[202,31]
**
** using any of the optional qualifiers.
**
** The source for this program can be found in:
**
**       SYS$EXAMPLES:LIB$TABLE_PARSE_DEMO.COM
**
*/

/*
** Specify the required header files
*/

# include <tpadef.h>
# include <descrip.h>
# include <starlet.h>
# include <lib$routines.h>

/*
** Specify macro definitions
*/

# define max_name_count 8
# define max_token_size 9
# define uic_string_size 6
# define command_buffer_size 256


/*
** Specify persistent data that's local to this module
*/

static
  union
    uic_union {
      __int32 bits;
      struct {
        char first;
        char second;
        } bytes;
      struct {
        __int16 first;
        __int16 second;
        } words;
      }
```

```
      file_owner;                           /* Actual file owner UIC */

static
  int
    name_count;                             /* Number of directory names */

static
  char
    uic_string[ uic_string_size + 1 ];      /* Buffer for string */

static
  struct
    dsc$descriptor_s
      name_vector[ max_name_count ];        /* Vector of descriptors */

/*
** Specify persistent data that's global to this module.
** This data is referenced externally by the state table definitions.
*/

union
  uic_union
    uic_group,                              /* Tempt for UIC group */
    uic_member;                             /* Tempt for UIC member */


int
  parser_flags,                             /* Keyword flags */
  entry_count,                              /* Space to preallocate */
  file_protect;                             /* Directory file protection */

struct
  dsc$descriptor_s
    device_string =                         /* Device string descriptor */
      { 0, DSC$K_DTYPE_T, DSC$K_CLASS_S, (char *) 0 };

/*
** Specify the user action routines.
**
** Please note that if it were LIB$TPARSE being called, the user action
** routines would have to be coded as follows:
**
**       int user_action_routine( __int32 psuedo_ap )
**         {
**         struct tpadef
**           *tparse_block = (tpadef *) (&psuedo_ap - 1);
**         printf( "Parameter value: %d\n",
**                 tparse_block->tpa$l_param
**                 );
**         }
*/

/*
** Shut off explicit blank processing after passing the command name.
*/

int blanks_off( struct tpadef *tparse_block ) {
  tparse_block->tpa$v_blanks = 0;
```

```
  return( 1 );
  }

/*
** Check the UIC for legal value range.
*/

int check_uic( struct tpadef *tparse_block ) {
  if ( (uic_group.words.second != 0) ||
       (uic_member.words.second != 0)
       )
    return( 0 );


  file_owner.words.first = uic_member.words.first;
  file_owner.words.second = uic_group.words.first;

  return( 1 );
  }

/*
** Store a directory name component.
*/

int store_name( struct tpadef *tparse_block ) {
  if ( (name_count >= max_name_count) ||
       (tparse_block->tpa$l_tokencnt > max_token_size)
       )
    return( 0 );

name_vector[ name_count ].dsc$w_length = tparse_block->tpa$l_tokencnt;
name_vector[ name_count ].dsc$b_dtype = DSC$K_DTYPE_T;
name_vector[ name_count ].dsc$b_class = DSC$K_CLASS_S;
name_vector[ name_count++ ].dsc$a_pointer = tparse_block->tpa$l_tokenptr;

  return( 1 );
  }

/*
** Convert a UIC into its equivalent directory file name.
*/

int make_uic( struct tpadef *tparse_block ) {

  $DESCRIPTOR( control_string, "!OB!OB" );
  $DESCRIPTOR( dirname, uic_string );

  if ( (uic_group.bytes.second != '\0') ||
       (uic_member.bytes.second != '\0')
       )
    return( 0 );

  sys$fao( &control_string,
           &dirname.dsc$w_length,
           &dirname,
           uic_group.bytes.first,
           uic_member.bytes.first
           );
```

```
  return( 1 );
  }

/*
** The main program section starts here.
*/

main( ) {

/*
** This program creates a directory. It gets the command
** line from the CLI and parses it with LIB$TABLE_PARSE.
*/

extern
  char
    ufd_state,
    ufd_key;

char
  command_buffer[ command_buffer_size + 1 ];

int
  status;

$DESCRIPTOR( prompt, "Command> " );
$DESCRIPTOR( command_descriptor, command_buffer );

struct
  tpadef
    tparse_block = { TPA$K_COUNT0,        /* Longword count */
                     TPA$M_ABBREV         /* Allow abbreviation */
                          |
                     TPA$M_BLANKS         /* Process spaces explicitly */
                     };

status = lib$get_foreign( &command_descriptor,
                          &prompt,
                          &command_descriptor.dsc$w_length
                          );

if ( (status & 1) == 0 )
  return( status );


/*
** Copy the input string descriptor into the control block
** and then call LIB$TABLE_PARSE. Note that impure storage is assumed
** to be zero.
*/

tparse_block.tpa$l_stringcnt = command_descriptor.dsc$w_length;
tparse_block.tpa$l_stringptr = command_descriptor.dsc$a_pointer;

return( status = lib$table_parse( &tparse_block, &ufd_state, &ufd_key ) );
```

```
}
```

Example 1b

The following MACRO assembly language program module defines the state tables for the preceding sample program.

```
.TITLE        CREATE_DIR_TABLES - Create Directory File (tables)
        .IDENT        "X-1"

;+
;
; This module defines the state tables for the preceding
; sample program, which accepts and parses the command line of the
; CREATE/DIRECTORY command. The command line has the following format:
;
;        CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
;                /OWNER_UIC=[2437,25]
;                /ENTRIES=100
;                /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
;
; The three qualifiers are optional. Alternatively, the command
; may take the form
;
;        CREATE/DIR DEVICE:[202,31]
;
; using any of the optional qualifiers.
;
;-

;+
;
; Global data, control blocks, etc.
;
;-
         .PSECT  IMPURE,WRT,NOEXE
;+
; Define control block offsets
;-

        $CLIDEF
        $TPADEF

         .EXTRN BLANKS_OFF, -            ; No explicit blank processing
                CHECK_UIC, -             ; Validate and assemble UIC
                STORE_NAME, -            ; Store next directory name
                MAKE_UIC                 ; Make UIC into directory name


;+
; Define parser flag bits for flags longword
;-

UIC_FLAG            = 1        ; /UIC seen
ENTRIES_FLAG        = 2        ; /ENTRIES seen
PROT_FLAG           = 4        ; /PROTECTION seen

        .SBTTL        Parser State Table
```

```
;+
; Assign values for protection flags to be used when parsing protection
; string.
;-

SYSTEM_READ_FLAG = ^X0001
SYSTEM_WRITE_FLAG = ^X0002
SYSTEM_EXECUTE_FLAG = ^X0004
SYSTEM_DELETE_FLAG = ^X0008
OWNER_READ_FLAG = ^X0010
OWNER_WRITE_FLAG = ^X0020
OWNER_EXECUTE_FLAG = ^X0040
OWNER_DELETE_FLAG = ^X0080
GROUP_READ_FLAG = ^X0100
GROUP_WRITE_FLAG = ^X0200
GROUP_EXECUTE_FLAG = ^X0400
GROUP_DELETE_FLAG = ^X0800
WORLD_READ_FLAG = ^X1000
WORLD_WRITE_FLAG = ^X2000
WORLD_EXECUTE_FLAG = ^X4000
WORLD_DELETE_FLAG = ^X8000

$INIT_STATE     UFD_STATE,UFD_KEY

;+
; Read over the command name (to the first blank in the command).
;-

        $STATE       START
        $TRAN        TPA$_BLANK,,BLANKS_OFF
        $TRAN        TPA$_ANY,START


;+
; Read device name string and trailing colon.
;-

        $STATE
        $TRAN        TPA$_SYMBOL,,,,DEVICE_STRING

        $STATE
        $TRAN        ':'
;+
; Read directory string, which is either a UIC string or a general
; directory string.
;-

        $STATE
        $TRAN        !UIC,,MAKE_UIC
        $TRAN        !NAME

;+
; Scan for options until end of line is reached
;-

        $STATE        OPTIONS
        $TRAN        '/'
```

```
        $TRAN        TPA$_EOS,TPA$_EXIT

        $STATE
        $TRAN        'OWNER_UIC',PARSE_UIC,,UIC_FLAG,PARSER_FLAGS
        $TRAN        'ENTRIES',PARSE_ENTRIES,,ENTRIES_FLAG,PARSER_FLAGS
        $TRAN        'PROTECTION',PARSE_PROT,,PROT_FLAG,PARSER_FLAGS

;+
; Get file owner UIC.
;-

        $STATE        PARSE_UIC
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        !UIC,OPTIONS


;+
; Get number of directory entries.
;-

        $STATE        PARSE_ENTRIES
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        TPA$_DECIMAL,OPTIONS,,,ENTRY_COUNT

;+
; Get directory file protection. Note that the bit masks generate the
; protection in complement form. It will be uncomplemented by the main
; program.
;-

        $STATE        PARSE_PROT
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        '('

        $STATE        NEXT_PRO
        $TRAN        'SYSTEM', SYPR
        $TRAN        'OWNER',  OWPR
        $TRAN        'GROUP',  GRPR
        $TRAN        'WORLD',  WOPR

        $STATE        SYPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        SYPRO
        $TRAN        'R',SYPRO,,SYSTEM_READ_FLAG,FILE_PROTECT
        $TRAN        'W',SYPRO,,SYSTEM_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',SYPRO,,SYSTEM_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',SYPRO,,SYSTEM_DELETE_FLAG,FILE_PROTECT
```

```
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        OWPR
        $TRAN        ':'
        $TRAN        '='


        $STATE        OWPRO
        $TRAN        'R',OWPRO,,OWNER_READ_FLAG,FILE_PROTECT
        $TRAN        'W',OWPRO,,OWNER_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',OWPRO,,OWNER_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',OWPRO,,OWNER_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        GRPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        GRPRO
        $TRAN        'R',GRPRO,,GROUP_READ_FLAG,FILE_PROTECT
        $TRAN        'W',GRPRO,,GROUP_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',GRPRO,,GROUP_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',GRPRO,,GROUP_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        WOPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        WOPRO
        $TRAN        'R',WOPRO,,WORLD_READ_FLAG,FILE_PROTECT
        $TRAN        'W',WOPRO,,WORLD_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',WOPRO,,WORLD_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',WOPRO,,WORLD_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        ENDPRO
        $TRAN        <',',NEXT_PRO
        $TRAN        ')',OPTIONS

;+
; Subexpression to parse a UIC string.
;-

        $STATE        UIC
        $TRAN        '['

        $STATE
        $TRAN        TPA$_OCTAL,,,,UIC_GROUP


        $STATE
        $TRAN        <',',>        ; The comma character must be
                                   ;   surrounded by angle brackets
                                   ;   because MACRO restricts the use
                                   ;   of commas in arguments to macros.

        $STATE
```

```
        $TRAN        TPA$_OCTAL,,,,UIC_MEMBER

        $STATE
        $TRAN        ']',TPA$_EXIT,CHECK_UIC

;+
; Subexpression to parse a general directory string
;-

        $STATE        NAME
        $TRAN        '['

        $STATE        NAMEO
        $TRAN        TPA$_STRING,,STORE_NAME

        $STATE
        $TRAN        '.',NAMEO
        $TRAN        ']',TPA$_EXIT
        $END_STATE

 .END
```

Example 2

The following OpenVMS BLISS program accepts and parses the command line of a CREATE/DIRECTORY command using LIB$TPARSE.

```
MODULE CREATE_DIR (                        ! Create directory file
                IDENT = 'X0000',
                MAIN = CREATE_DIR) =
BEGIN

 !+
 ! This OpenVMS BLISS program accepts and parses the command line
 ! of a CREATE/DIRECTORY command.  This program uses the
 ! LIB$GET_FOREIGN call to acquire the command line from
 ! the CLI and parse it with LIB$TPARSE, leaving the necessary
 ! information in its global data base.  The command line is of
 ! the following format:
 !
 !      CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
 !                 /UIC=[2437,25]
 !                 /ENTRIES=100
 !                 /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
 !
 ! The three qualifiers are optional.  Alternatively, the command
 ! may take the form
 !
 !       CREATE/DIR DEVICE:[202,31]
 !
 ! using any of the optional qualifiers.
 !-

 !+
 ! Global data, control blocks, etc.
 !-

LIBRARY 'SYS$LIBRARY:STARLET';
```

```
LIBRARY 'SYS$LIBRARY:TPAMAC.L32';

 !+
 ! Macro to make the LIB$TPARSE control block addressable as a block
 ! through the argument pointer.
 !-

MACRO
        TPARSE_ARGS =
                BUILTIN AP;
                MAP AP : REF BLOCK [,BYTE];
                %;
 !+
 ! Declare routines in this module.
 !-

FORWARD ROUTINE
        CREATE_DIR,                     ! Mail program
        BLANKS_OFF,                     ! No explicit blank processing
        CHECK_UIC,                      ! Validate and assemble UIC
        STORE_NAME,                     ! Store next directory name
        MAKE_UIC;                       ! Make UIC into directory name

 !+
 ! Define parser flag bits for flags longword.
 !-

LITERAL
        UIC_FLAG        = 0,                ! /UIC seen
        ENTRIES_FLAG    = 1,                ! /ENTRIES seen
        PROT_FLAG       = 2;                ! /PROTECTION seen
OWN
 !+
 ! This is the LIB$GET_FOREIGN descriptor block to get the command line.
 !-

        COMMAND_DESC        : BLOCK [DSC$K_S_BLN, BYTE],
        COMMAND_BUFF        : VECTOR [256, BYTE],

 !+
 ! This is the LIB$TPARSE argument block.
 !-

        TPARSE_BLOCK        : BLOCK [TPA$K_LENGTH0, BYTE]
                INITIAL (TPA$K_COUNT0,     ! Longword count
                        TPA$M_ABBREV       ! Allow abbreviation
                        OR TPA$M_BLANKS),  ! Process spaces explicitly

 !+
 ! Parser global data:
 !-

        PARSER_FLAGS   : BITVECTOR [32], ! Keyword flags
        DEVICE_STRING  : VECTOR [2],     ! Device string descriptor
        ENTRY_COUNT,                     ! Space to preallocate
        FILE_PROTECT,                    ! Directory file protection
        UIC_GROUP,                       ! Temp for UIC group
        UIC_MEMBER,                      ! Temp for UIC member
```

```
        FILE_OWNER,                     ! Actual file owner UIC
        NAME_COUNT,                     ! Number of directory names
        UIC_STRING     : VECTOR [6, BYTE],   ! Buffer for string

        NAME_VECTOR    : BLOCKVECTOR [0, 2], ! Vector of descriptors

        DIRNAME1        : VECTOR [2],         ! Name descriptor 1
        DIRNAME2        : VECTOR [2],         ! Name descriptor 2
        DIRNAME3        : VECTOR [2],         ! Name descriptor 3
        DIRNAME4        : VECTOR [2],         ! Name descriptor 4
        DIRNAME5        : VECTOR [2],         ! Name descriptor 5
        DIRNAME6        : VECTOR [2],         ! Name descriptor 6
        DIRNAME7        : VECTOR [2],         ! Name descriptor 7
        DIRNAME8        : VECTOR [2];         ! Name descriptor 8

 !+
 ! Structure macro to reference the descriptor fields in the vector of
 ! descriptors.
 !-

MACRO
        STRING_COUNT       = 0, 0, 32, 0%,         ! Count field
        STRING_ADDR        = 1, 0, 32, 0%;         ! Address field

 !+
 ! LIB$TPARSE state table to parse the command line
 !-

$INIT_STATE        (UFD_STATE, UFD_KEY);

 !+
 ! Read over the command name (to the first blank in the command).
 !-

$STATE  (START,
        (TPA$_BLANK, , BLANKS_OFF),
        (TPA$_ANY, START)
        );
 !+
 ! Read device name string and trailing colon.
 !-

$STATE  (,
        (TPA$_SYMBOL,,,, DEVICE_STRING)
        );

$STATE  (,
        (':')
        );


 !+
 ! Read directory string, which is either a UIC string or a general
 ! directory string.
 !-

$STATE  (,
        ((UIC),, MAKE_UIC),
```

```
        ((NAME))
        );

 !+
 ! Scan for options until end of line is reached.
 !-

$STATE  (OPTIONS,
        ('/'),
        (TPA$_EOS, TPA$_EXIT)
        );

$STATE  (,
        ('UIC', PARSE_UIC,, 1^UIC_FLAG, PARSER_FLAGS),
        ('ENTRIES', PARSE_ENTRIES,, 1^ENTRIES_FLAG, PARSER_FLAGS),
        ('PROTECTION', PARSE_PROT,, 1^PROT_FLAG, PARSER_FLAGS)
        );

 !+
 ! Get file owner UIC.
 !-

$STATE  (PARSE_UIC,
        (':'),
        ('=')
        );

$STATE  (,
        ((UIC), OPTIONS)
        );
 !+
 ! Get number of directory entries.
 !-

$STATE  (PARSE_ENTRIES,
        (':'),
        ('=')

        );

$STATE  (,
        (TPA$_DECIMAL, OPTIONS,,, ENTRY_COUNT)
        );

 !+
 ! Get directory file protection. Note that the bit masks generate the
 ! protection in complement form. It will be uncomplemented by the main
 ! program.
 !-

$STATE  (PARSE_PROT,
        (':'),
        ('=')
        );

$STATE  (,
        ('(')
        );
```

```
$STATE  (NEXT_PRO,
        ('SYSTEM', SYPR),
        ('OWNER',  OWPR),
        ('GROUP',  GRPR),
        ('WORLD',  WOPR)
        );

$STATE  (SYPR,
        (':'),
        ('=')
        );

$STATE  (SYPR0,
        ('R', SYPR0,, %X'0001', FILE_PROTECT),
        ('W', SYPR0,, %X'0002', FILE_PROTECT),
        ('E', SYPR0,, %X'0004', FILE_PROTECT),
        ('D', SYPR0,, %X'0008', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE  (OWPR,
        (':'),
        ('=')
        );


$STATE  (OWPR0,
        ('R', OWPR0,, %X'0010', FILE_PROTECT),
        ('W', OWPR0,, %X'0020', FILE_PROTECT),
        ('E', OWPR0,, %X'0040', FILE_PROTECT),
        ('D', OWPR0,, %X'0080', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE  (GRPR,
        (':'),
        ('=')
        );

$STATE  (GRPR0,
        ('R', GRPR0,, %X'0100', FILE_PROTECT),
        ('W', GRPR0,, %X'0200', FILE_PROTECT),
        ('E', GRPR0,, %X'0400', FILE_PROTECT),
        ('D', GRPR0,, %X'0800', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE  (WOPR,
        (':'),
        ('=')
        );

$STATE  (WOPR0,
        ('R', WOPR0,, %X'1000', FILE_PROTECT),
        ('W', WOPR0,, %X'2000', FILE_PROTECT),
        ('E', WOPR0,, %X'4000', FILE_PROTECT),
        ('D', WOPR0,, %X'8000', FILE_PROTECT),
```

```
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE  (ENDPRO,
        (', ', NEXT_PRO),
        (')', OPTIONS)
        );

 !+
 ! Subexpression to parse a UIC string.
 !-

$STATE  (UIC,

        ('[')
        );

$STATE  (,
        (TPA$_OCTAL,,,, UIC_GROUP)
        );

$STATE  (,
        (', ')
        );

$STATE  (,
        (TPA$_OCTAL,,,, UIC_MEMBER)
        );

$STATE  (,
        (']', TPA$_EXIT, CHECK_UIC)
        );

 !+
 ! Subexpression to parse a general directory string
 !-

$STATE  (NAME,
        ('[')
        );

$STATE  (NAME0,
        (TPA$_STRING,, STORE_NAME)
        );

$STATE  (,
        ('.', NAME0),
        (']', TPA$_EXIT)
        );
PSECT OWN = $OWN$;
PSECT GLOBAL = $GLOBAL$;


GLOBAL ROUTINE CREATE_DIR (START_ADDR, CLI_CALLBACK) =

BEGIN

 !+
```

```
 ! This program creates a directory. It gets the command

 ! line from the CLI and parses it with LIB$TPARSE.
 !-

LOCAL
        STATUS,                 ! Status from LIB$TPARSE
        OUT_LEN  : WORD;        ! length of returned command line
EXTERNAL
        SS$_NORMAL;

EXTERNAL ROUTINE
        LIB$GET_FOREIGN   : ADDRESSING_MODE (GENERAL),
        LIB$TPARSE        : ADDRESSING_MODE (GENERAL);

                COMMAND_DESC [DSC$W_LENGTH]  = 256;
                COMMAND_DESC [DSC$B_DTYPE]   = DSC$K_DTYPE_T;
                COMMAND_DESC [DSC$B_CLASS]   = DSC$K_CLASS_S;
                COMMAND_DESC [DSC$A_POINTER] = COMMAND_BUFF;


        STATUS = LIB$GET_FOREIGN (COMMAND_DESC,
                                  %ASCID'COMMAND: ',
                                  OUT_LEN
                                  );
        IF NOT .STATUS
                THEN
                SIGNAL (STATUS);


 !+
 ! Copy the input string descriptor into the LIB$TPARSE control block
 ! and call LIB$TPARSE. Note that impure storage is assumed to be zero.
 !-


TPARSE_BLOCK[TPA$L_STRINGCNT] = .OUT_LEN;
TPARSE_BLOCK[TPA$L_STRINGPTR] = .COMMAND_DESC[DSC$A_POINTER];

STATUS = LIB$TPARSE (TPARSE_BLOCK, UFD_STATE, UFD_KEY);
IF NOT .STATUS
THEN
        RETURN 0;
RETURN SS$_NORMAL
END;                                            ! End of routine CREATE_DIR

 !+

 ! Parser action routines
 !-

 !+
 ! Shut off explicit blank processing after passing the command name.
 !-

ROUTINE BLANKS_OFF =
    BEGIN
    TPARSE_ARGS;
```

```
    AP[TPA$V_BLANKS] = 0;
    1
    END;

 !+
 ! Check the UIC for legal value range.
 !-

ROUTINE CHECK_UIC =
    BEGIN
    TPARSE_ARGS;

    IF .UIC_GROUP<16,16> NEQ 0
    OR .UIC_MEMBER<16,16> NEQ 0
    THEN RETURN 0;

    FILE_OWNER<0,16> = .UIC_MEMBER;
    FILE_OWNER<16,16> = .UIC_GROUP;
    1
    END;

 !+
 ! Store a directory name component.
 !-

ROUTINE STORE_NAME =
    BEGIN
    TPARSE_ARGS;

    IF .NAME_COUNT GEQU 8
    OR .AP[TPA$L_TOKENCNT] GTRU 9
    THEN RETURN 0;
    NAME_COUNT = .NAME_COUNT + 1;
    NAME_VECTOR [.NAME_COUNT, STRING_COUNT] = .AP[TPA$L_TOKENCNT];

    NAME_VECTOR [.NAME_COUNT, STRING_ADDR] = .AP[TPA$L_TOKENPTR];
    1
    END;

 !+
 ! Convert a UIC into its equivalent directory file name.
 !-

ROUTINE MAKE_UIC =
    BEGIN
    TPARSE_ARGS;

    IF .UIC_GROUP<8,8> NEQ 0
    OR .UIC_MEMBER<8,8> NEQ 0
    THEN RETURN 0;
    DIRNAME1[0] = 0;
    DIRNAME1[1] = UIC_STRING;
    $FAOL (CTRSTR = UPLIT (6, UPLIT BYTE ('!OB!OB')),
           OUTBUF = DIRNAME1,
           PRMLST = UIC_GROUP
           );
    1
```

```
    END;
END
ELUDOM                                  ! End of module CREATE_DIR
```

Example 3

The following MACRO assembly language program accepts and parses the command line of a CREATE/DIRECTORY command using LIB$TPARSE. It also defines the state table for the parser.

```
     .TITLE        CREATE_DIR - Create Directory File
         .IDENT        "X0000"
;+
;
; This is a sample OpenVMS MACRO program that accepts and parses the
; command line of the CREATE/DIRECTORY command. This program contains
; the OpenVMS call to acquire the command line from the command interpreter
; and parse it with LIB$TPARSE, leaving the necessary information in
; its global data base. The command line has the following format:
;
;        CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
;                /OWNER_UIC=[2437,25]
;                /ENTRIES=100
;                /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
;

; The three qualifiers are optional. Alternatively, the command
; may take the form
;
;        CREATE/DIR DEVICE:[202,31]
;
; using any of the optional qualifiers.
;
;-

;+
;
; Global data, control blocks, etc.
;
;-
         .PSECT  IMPURE,WRT,NOEXE
;+
; Define control block offsets
;-
        $CLIDEF
        $TPADEF
;+
; Define parser flag bits for flags longword
;-

UIC_FLAG            = 1         ; /UIC seen
ENTRIES_FLAG        = 2         ; /ENTRIES seen
PROT_FLAG           = 4         ; /PROTECTION seen

;+
; LIB$GET_FOREIGN string descriptors to get the line to be parsed
;-
```

```
STRING_LEN = 256
STRING_DESC:
        .WORD STRING_LEN
        .BYTE DSC$K_DTYPE_T
        .BYTE DSC$K_CLASS_S
        .ADDRESS STRING_AREA
STRING_AREA:
        .BLKB STRING_LEN
PROMPT_DESC:
        .WORD PROMPT_LEN
        .BYTE DSC$K_DTYPE_T
        .BYTE DSC$K_CLASS_S
        .ADDRESS PROMPT

PROMPT:
        .ASCII /qualifiers: /
PROMPT_LEN = .-PROMPT


;+
; TPARSE argument block
;-

TPARSE_BLOCK:
         .LONG        TPA$K_COUNT0       ; Longword count
         .LONG        TPA$M_ABBREV!-     ; Allow abbreviation
                      TPA$M_BLANKS       ; Process spaces explicitly
         .BLKB        TPA$K_LENGTH0-8    ; Remainder set at run time
;+
; Parser global data
;-

RET_LEN:              .BLKW        1     ; LENGTH OF RETURNED COMMAND LINE
PARSER_FLAGS:         .BLKL        1     ; Keyword flags
DEVICE_STRING:        .BLKL        2     ; Device string descriptor
ENTRY_COUNT:          .BLKL        1     ; Space to preallocate
FILE_PROTECT:         .BLKL        1     ; Directory file protection
UIC_GROUP:            .BLKL        1     ; Temp for UIC group
UIC_MEMBER:           .BLKL        1     ; Temp for UIC member
UIC_STRING:           .BLKB        6     ; String to receive converted UIC
FILE_OWNER:           .BLKL        1     ; Actual file owner UIC
NAME_COUNT:           .BLKL        1     ; Number of directory names
DIRNAME1:             .BLKL        2     ; Name descriptor 1
DIRNAME2:             .BLKL        2     ; Name descriptor 2
DIRNAME3:             .BLKL        2     ; Name descriptor 3
DIRNAME4:             .BLKL        2     ; Name descriptor 4
DIRNAME5:             .BLKL        2     ; Name descriptor 5
DIRNAME6:             .BLKL        2     ; Name descriptor 6
DIRNAME7:             .BLKL        2     ; Name descriptor 7
DIRNAME8:             .BLKL        2     ; Name descriptor 8

         .SBTTL Main Program
;+
; This program gets the CREATE/DIRECTORY command line from
; the command interpreter and parses it.
;-
         .PSECT  CODE,EXE,NOWRT
CREATE_DIR::
```

```
         .WORD   ^M<R2,R3,R4,R5>        ; Save registers

;+
; Call the command interpreter to obtain the command line.
;-
        PUSHAW  RET_LEN
        PUSHAQ  PROMPT_DESC
        PUSHAQ  STRING_DESC
        CALLS   #3,G^LIB$GET_FOREIGN    ; Call to get command line
        BLBC    R0, SYNTAX_ERR

;+
; Copy the input string descriptor into the TPARSE control block
; and call LIB$TPARSE.  Note that impure storage is assumed to be zero.
;-
        MOVZWL          RET_LEN, TPARSE_BLOCK+TPA$L_STRINGCNT
        MOVAL           STRING_AREA, TPARSE_BLOCK+TPA$L_STRINGPTR
        PUSHAL          UFD_KEY
        PUSHAL          UFD_STATE
        PUSHAL          TPARSE_BLOCK
        CALLS           #3,G^LIB$TPARSE
        BLBC            R0,SYNTAX_ERR

;+
; Parsing is complete.
;
; You can include here code to process the string just parsed, to call
; another program to process the command, or to return control to
; a calling program, if any.
;-

SYNTAX_ERR:

;+
; Code to handle parsing errors.
;-

        RET

        .SBTTL          Parser State Table

;+
; Assign values for protection flags to be used when parsing protection
; string.
;-

SYSTEM_READ_FLAG = ^X0001
SYSTEM_WRITE_FLAG = ^X0002
SYSTEM_EXECUTE_FLAG = ^X0004
SYSTEM_DELETE_FLAG = ^X0008
OWNER_READ_FLAG = ^X0010
OWNER_WRITE_FLAG = ^X0020
OWNER_EXECUTE_FLAG = ^X0040
OWNER_DELETE_FLAG = ^X0080
GROUP_READ_FLAG = ^X0100
GROUP_WRITE_FLAG = ^X0200
GROUP_EXECUTE_FLAG = ^X0400
GROUP_DELETE_FLAG = ^X0800
```

```
WORLD_READ_FLAG = ^X1000
WORLD_WRITE_FLAG = ^X2000
WORLD_EXECUTE_FLAG = ^X4000
WORLD_DELETE_FLAG = ^X8000


$INIT_STATE     UFD_STATE,UFD_KEY

;+
; Read over the command name (to the first blank in the command).
;-
        $STATE       START
        $TRAN        TPA$_BLANK,,BLANKS_OFF
        $TRAN        TPA$_ANY,START
;+
; Read device name string and trailing colon.
;-
        $STATE
        $TRAN        TPA$_SYMBOL,,,,DEVICE_STRING

        $STATE
        $TRAN        ':'
;+
; Read directory string, which is either a UIC string or a general
; directory string.
;-
        $STATE
        $TRAN        !UIC,,MAKE_UIC
        $TRAN        !NAME

;+
; Scan for options until end of line is reached
;-

        $STATE        OPTIONS
        $TRAN        '/'
        $TRAN        TPA$_EOS,TPA$_EXIT

        $STATE
        $TRAN        'OWNER_UIC',PARSE_UIC,,UIC_FLAG,PARSER_FLAGS
        $TRAN        'ENTRIES',PARSE_ENTRIES,,ENTRIES_FLAG,PARSER_FLAGS
        $TRAN        'PROTECTION',PARSE_PROT,,PROT_FLAG,PARSER_FLAGS

;+
; Get file owner UIC.
;-
        $STATE        PARSE_UIC
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        !UIC,OPTIONS

;+
; Get number of directory entries.
;-

        $STATE        PARSE_ENTRIES
```

```
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        TPA$_DECIMAL,OPTIONS,,,ENTRY_COUNT

;+
; Get directory file protection. Note that the bit masks generate the
; protection in complement form. It will be uncomplemented by the main
; program.
;-

        $STATE        PARSE_PROT
        $TRAN        ':'
        $TRAN        '='

        $STATE
        $TRAN        '('

        $STATE        NEXT_PRO
        $TRAN        'SYSTEM', SYPR

        $TRAN        'OWNER',  OWPR
        $TRAN        'GROUP',  GRPR
        $TRAN        'WORLD',  WOPR

        $STATE        SYPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        SYPRO
        $TRAN        'R',SYPRO,,SYSTEM_READ_FLAG,FILE_PROTECT
        $TRAN        'W',SYPRO,,SYSTEM_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',SYPRO,,SYSTEM_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',SYPRO,,SYSTEM_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        OWPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        OWPRO
        $TRAN        'R',OWPRO,,OWNER_READ_FLAG,FILE_PROTECT
        $TRAN        'W',OWPRO,,OWNER_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',OWPRO,,OWNER_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',OWPRO,,OWNER_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO

        $STATE        GRPR
        $TRAN        ':'
        $TRAN        '='

        $STATE        GRPRO
        $TRAN        'R',GRPRO,,GROUP_READ_FLAG,FILE_PROTECT
        $TRAN        'W',GRPRO,,GROUP_WRITE_FLAG,FILE_PROTECT
        $TRAN        'E',GRPRO,,GROUP_EXECUTE_FLAG,FILE_PROTECT
        $TRAN        'D',GRPRO,,GROUP_DELETE_FLAG,FILE_PROTECT
        $TRAN        TPA$_LAMBDA,ENDPRO
```

```
        $STATE          WOPR
        $TRAN          ':'
        $TRAN          '='

        $STATE          WOPRO
        $TRAN          'R',WOPRO,,WORLD_READ_FLAG,FILE_PROTECT
        $TRAN          'W',WOPRO,,WORLD_WRITE_FLAG,FILE_PROTECT
        $TRAN          'E',WOPRO,,WORLD_EXECUTE_FLAG,FILE_PROTECT

        $TRAN          'D',WOPRO,,WORLD_DELETE_FLAG,FILE_PROTECT
        $TRAN          TPA$_LAMBDA,ENDPRO

        $STATE          ENDPRO
        $TRAN          <',',NEXT_PRO
        $TRAN          ')',OPTIONS

;+
; Subexpression to parse a UIC string.
;-

        $STATE          UIC
        $TRAN          '['

        $STATE
        $TRAN          TPA$_OCTAL,,,,UIC_GROUP

        $STATE
        $TRAN          <',',          ; The comma character must be
                                      ; surrounded by angle brackets
                                      ; because MACRO restricts the use
                                      ; of commas in arguments to macros.

        $STATE
        $TRAN          TPA$_OCTAL,,,,UIC_MEMBER

        $STATE
        $TRAN          ']',TPA$_EXIT,CHECK_UIC

;+
; Subexpression to parse a general directory string
;-
        $STATE          NAME
        $TRAN           '['

        $STATE          NAMEO
        $TRAN           TPA$_STRING,,STORE_NAME

        $STATE
        $TRAN          '.',NAMEO
        $TRAN          ']',TPA$_EXIT
        $END_STATE

        .SBTTL          Parser Action Routines
        .PSECT          CODE,EXE,NOWRT


;+
```

```
; Shut off explicit blank processing after passing the command name.
;-

BLANKS_OFF:
        .WORD        0                      ; No registers saved (or used)
        BBCC         #TPA$V_BLANKS,TPA$L_OPTIONS(AP),10$
10$:    RET

;+
; Check the UIC for legal value range.
;-

CHECK_UIC:
      .WORD     0                       ; No registers saved (or used)
      TSTW      UIC_GROUP+2             ; UIC components are 16 bits
      BNEQ      10$
      TSTW      UIC_MEMBER+2
      BNEQ      10$
      MOVW      UIC_GROUP,FILE_OWNER+2  ; Store actual UIC
      MOVW      UIC_MEMBER,FILE_OWNER   ;  after checking
      RET
10$:  CLRL      R0                      ; Value out of range - fail
      RET                               ;  the transition

;+
; Store a directory name component.
;-

STORE_NAME:
      .WORD     0                       ; No registers saved (or used)
      MOVL      NAME_COUNT,R1           ; Get count of names so far
      CMPL      R1,#8                   ; Maximum of 8 permitted
      BGEQU     10$
      INCL      NAME_COUNT              ; Count this name
      MOVAQ     DIRNAME1[R1],R1         ; Address of next descriptor
      MOVQ      TPA$L_TOKENCNT(AP),(R1) ; Store the descriptor
      CMPL      (R1),#9                 ; Check the length of the name
      BGTRU     10$                     ; Maximum is 9
      RET
10$:  CLRL      R0                      ; Error in directory name
      RET

;+

; Convert a UIC into its equivalent directory file name.
;-

MAKE_UIC:
      .WORD     0                        ; No registers saved (or used)
      TSTB      UIC_GROUP+1              ; Check UIC for byte values,
      BNEQ      10$                      ;  because UIC type directories
      TSTB      UIC_MEMBER+1             ;  are restricted to this form
      BNEQ      10$
      MOVL      #6,DIRNAME1              ; Directory name is 6 bytes
      MOVAL     UIC_STRING,DIRNAME1+4    ; Point to string buffer
      $FAOL     CTRSTR=FAO_STRING,-      ; Convert UIC to octal string
                OUTBUF=DIRNAME1,-
                PRMLST=UIC_GROUP
```

```
      RET
10$:  CLRL      R0                      ; Range error - fail it
      RET
FAO_STRING:     .LONG       STRING_END-STRING_START
STRING_START:   .ASCII  '!OB!OB'
STRING_END:


       .END        CREATE_DIR
```

LIB$TRAVERSE_TREE

LIB$TRAVERSE_TREE — The Traverse a Balanced Binary Tree routine calls an action routine for each node in a binary tree. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$TRAVERSE_TREE treehead ,user-action-procedure [,user-data-address]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address
access:	read only
mechanism:	by reference

Tree head of the binary tree. The **treehead** argument is the address of an unsigned longword that is the tree head in the binary tree traversal.

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied action routine called by LIB$TRAVERSE_TREE for each node in the tree. The **user-action-procedure** argument must return a success status for LIB$TRAVERSE_TREE to continue traversal.

user-data-address

OpenVMS usage:	user_arg
type:	longword (unsigned)
access:	read only
mechanism:	by reference

User data that LIB$TRAVERSE_TREE passes to your action routine. The **user-data-address** argument contains the address of this user data. This is an optional argument; the default value is 0.

Description

LIB$TRAVERSE_TREE calls a user-supplied action routine for each node to traverse a balanced binary tree.

Call Format for an Action Routine

The format of the call is as follows:

user-action-procedure node ,user-data-address

LIB$TRAVERSE_TREE passes the *node* and *user-data-address* arguments to your action routine by reference.

This action routine is defined by you to fit your own purposes. A common use of an action routine here is to print the contents of each node during the tree traversal.

The following is one example of a user-supplied action routine.

```
struct Full_node
{
    void*  left_link;
    void*  right_link;
    short  reserved;
    char   Text[80];
};

static long Print_Node(struct Full_node* Node, void* dummy)
{
/*
** Print the string contained in the current node
*/
    printf("%s\n", Node->Text);
    return LIB$_NORMAL;
}
```

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.

Any condition value returned by your action routine.

Example

The C example provided in the description of LIB$INSERT_TREE also demonstrates the use of LIB $TRAVERSE_TREE. Refer to that example for assistance in using this routine.

LIB$TRAVERSE_TREE_64

LIB$TRAVERSE_TREE_64 — The Traverse a Balanced Binary Tree routine calls an action routine for each node in a binary tree.

Format

```
LIB$TRAVERSE_TREE_64 treehead ,user-action-procedure [,user-data-address]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

treehead

OpenVMS usage:	address
type:	address
access:	read only
mechanism:	by reference

Tree head of the binary tree. The **treehead** argument is the address of an unsigned quadword that is the tree head in the binary tree traversal.

user-action-procedure

OpenVMS usage:	procedure
type:	procedure value
access:	function call (before return)
mechanism:	by value

User-supplied action routine called by LIB$TRAVERSE_TREE_64 for each node in the tree. The **user-action-procedure** argument must return a success status for LIB$TRAVERSE_TREE_64 to continue traversal.

user-data-address

OpenVMS usage:	user_arg
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

User data that LIB$TRAVERSE_TREE_64 passes to your action routine. The **user-data-address** argument contains the address of this user data. This is an optional argument; the default value is 0.

Description

LIB$TRAVERSE_TREE_64 calls a user-supplied action routine for each node to traverse a balanced binary tree.

Call Format for an Action Routine

The format of the call is as follows:

user-action-procedure node ,user-data-address

LIB$TRAVERSE_TREE_64 passes the **node** and **user-data-address** arguments to your action routine by reference.

This action routine is defined by you to fit your own purposes. A common use of an action routine here is to print the contents of each node during the tree traversal.

The following is one example of a user-supplied action routine.

```
struct Full_node
{
    void*  left_link;
    void*  right_link;
    short  reserved;
    char   Text[80];
};

static long Print_Node(struct Full_node* Node, void* dummy)
{
/*
** Print the string contained in the current node
*/
    printf("%s\n", Node->Text);
    return LIB$_NORMAL;
}
```

Condition Values Returned

LIB$_NORMAL	Routine successfully completed.

Any condition value returned by your action routine.

Example

The C example provided in the description of LIB$INSERT_TREE_64 also demonstrates the use of LIB $TRAVERSE_TREE_64. Refer to that example for assistance in using this routine.

LIB$TRA_ASC_EBC

LIB$TRA_ASC_EBC — The Translate ASCII to EBCDIC routine translates an ASCII string to an EBCDIC string.

Format

LIB$TRA_ASC_EBC source-string ,byte-integer-dest-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

source-string

OpenVMS usage:	char_string
type:	character string
access:	read only
mechanism:	by descriptor

Source string (ASCII) to be translated by LIB$TRA_ASC_EBC. The **source-string** argument contains the address of a descriptor pointing to this source string.

byte-integer-dest-string

OpenVMS usage:	char_string
type:	character string
access:	write only
mechanism:	by descriptor

Destination string (EBCDIC). The **byte-integer-dest-string** argument contains the address of a descriptor pointing to this destination string.

Description

LIB$TRA_ASC_EBC translates an ASCII string to an EBCDIC string. If the destination string is a fixed-length string, its length must match the length of the input string. The length of both the source and destination strings is limited to 65,535 characters. No filling is done.

A similar operation can be accomplished by specifying the ASCII to EBCDIC translation table, LIB $AB_ASC_EBC, in a routine using LIB$MOVTC, but no testing for untranslatable characters is done under those circumstances.

The LIB$TRA_ASC_EBC routine uses the ASCII to EBCDIC translation table.

ASCII to EBCDIC Translation Table

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.

- The numbers in the body of the table represent the equivalent EBCDIC characters in hexadecimal notation.

Figure 2.25 is the ASCII to EBCDIC translation table.

Figure 2.25. LIB$AB_ASC_EBC

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	40	F0	7C	D7	79	97	3F	3F	3F	3F	3F	3F	3F	3F
1	01	11	4F	F1	C1	D8	81	98	3F	3F	3F	3F	3F	3F	3F	3F
2	02	12	7F	F2	C2	D9	82	99	3F	3F	3F	3F	3F	3F	3F	3F
3	03	13	7B	F3	C3	E2	83	A2	3F	3F	3F	3F	3F	3F	3F	3F
4	37	3C	5B	F4	C4	E3	84	A3	3F	3F	3F	3F	3F	3F	3F	3F
5	2D	3D	6C	F5	C5	E4	85	A4	3F	3F	3F	3F	3F	3F	3F	3F
6	2E	32	50	F6	C6	E5	86	A5	3F	3F	3F	3F	3F	3F	3F	3F
7	2F	26	7D	F7	C7	E6	87	A6	3F	3F	3F	3F	3F	3F	3F	3F
8	16	18	4D	F8	C8	E7	88	A7	3F	3F	3F	3F	3F	3F	3F	3F
9	05	19	5D	F9	C9	E8	89	A8	3F	3F	3F	3F	3F	3F	3F	3F
A	25	3F	5C	7A	D1	E9	91	A9	3F	3F	3F	3F	3F	3F	3F	3F
B	0B	27	4E	5E	D2	4A	92	C0	3F	3F	3F	3F	3F	3F	3F	3F
C	0C	1C	6B	4C	D3	E0	93	6A	3F	3F	3F	3F	3F	3F	3F	3F
D	0D	1D	60	7E	D4	5A	94	D0	3F	3F	3F	3F	3F	3F	3F	3F
E	0E	1E	4B	6E	D5	5F	95	A1	3F	3F	3F	3F	3F	3F	3F	3F
F	0F	1F	61	6F	D6	6D	96	07	3F	3F	3F	3F	3F	3F	3F	FF

All ASCII graphics are translated to their equivalent EBCDIC graphics except for the graphics noted in Table 2.13.

Table 2.13. ASCII Graphics Not Translated to EBCDIC Equivalent by LIB $TRA_ASC_EBC

ASCII Graphic	EBCDIC Graphic
[(left square bracket)	¢ (cents sign)
! (exclamation point)	| (short vertical bar)
^ (circumflex)	¬ (logical not)
] (right square bracket)	! (exclamation point)

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	If the destination string is a fixed-length string and its length is not the same as the source string length, or if the length of the input string is greater than 65,535 characters, no translation is attempted.
LIB$_INVCHA	One or more occurrences of an untranslatable character have been detected during the translation.

Example

This COBOL program uses LIB$TRA_ASC_EBC to translate an ASCII string to EBCDIC. If successful, it then uses LIB$MOVTC to translate the EBCDIC string back to ASCII.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. TRANS.

ENVIRONMENT DIVISION.
DATA DIVISION.
```

```
WORKING-STORAGE SECTION.
01 INPUT-STRING PIC X(4).
01 EBCDIC-STRING   PIC X(4).
01 OUT-STRING PIC X(4).
01 FILL-CHAR PIC X  VALUE  "@".
01 SS-STATUS PIC S9(9)       COMP.
 88  SS-NORMAL   VALUE 01.

01 EBCDIC-TABLE.
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@@@@@@@".
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@@@@@@@".
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@@@@@@@".
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@@@@@@@".
 05 FILLER PIC X(16) VALUE " @@@@@@@@@@.<(+|".
 05 FILLER PIC X(16) VALUE "&@@@@@@@@@@!$*);@".
 05 FILLER PIC X(16) VALUE "-/@@@@@@@@@@,%_<?".
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@:#@'=""".
 05 FILLER PIC X(16) VALUE "@abcdefghi@@@@@@".
 05 FILLER PIC X(16) VALUE "@jklmnopqr@@@@@@".
 05 FILLER PIC X(16) VALUE "@@stuvwxyz@@@@@@".
 05 FILLER PIC X(16) VALUE "@@@@@@@@@@@@@@@@".
 05 FILLER PIC X(16) VALUE "@ABCDEFGHI@@@@@@".
 05 FILLER PIC X(16) VALUE "!JKLMNOPQR@@@@@@".
 05 FILLER PIC X(16) VALUE "@@STUVWXYZ@@@@@@".
 05 FILLER PIC X(16) VALUE "0123456789@@@@@@".

ROUTINE DIVISION.

001-MAIN.
 DISPLAY " ".
 DISPLAY "ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC: "
     WITH NO ADVANCING.
 ACCEPT INPUT-STRING
    AT END STOP RUN.
 IF INPUT-STRING = "EXIT"  OR  "exit"  OR  "     "
     STOP RUN.

 CALL "LIB$TRA_ASC_EBC"
     USING BY DESCRIPTOR INPUT-STRING, EBCDIC-STRING
     GIVING SS-STATUS.
 IF SS-NORMAL
     CALL "LIB$MOVTC"
  USING BY DESCRIPTOR EBCDIC-STRING,
      FILL-CHAR,
      EBCDIC-TABLE,
      OUT-STRING,
  GIVING SS-STATUS
     IF SS-NORMAL
  DISPLAY "ASCII ENTERED WAS: " INPUT-STRING
  DISPLAY "EBCDIC TRANSLATED IS: " OUT-STRING
     ELSE
  DISPLAY "*** LIB$MOVTC TRANSLATION UNSUCCESSFUL ***"
 ELSE
     DISPLAY "*** LIB$TRA_ASC_EBC TRANSLATION UNSUCCESSFUL ***".
 GO TO 001-MAIN.
```

To exit from this program, you must press Ctrl/Z. The output generated by this COBOL program is as follows:

```
$ RUN TRANS

ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  abdc
ASCII ENTERED WAS: abdc
EBCDIC TRANSLATED IS: abdc

ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  ~=b&
ASCII ENTERED WAS: ~=b&
EBCDIC TRANSLATED IS: @=b&

ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  8^%$
ASCII ENTERED WAS: 8^%$
EBCDIC TRANSLATED IS: 8@%$

ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:
/x\}
ASCII ENTERED WAS: /x\}
EBCDIC TRANSLATED IS: /x@!

ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  [Ctrl/Z
```

LIB$TRA_EBC_ASC

LIB$TRA_EBC_ASC — The Translate EBCDIC to ASCII routine translates an EBCDIC string to an ASCII string.

Format

LIB$TRA_EBC_ASC byte-integer-source-string ,destination-string

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	read only
mechanism:	by value

Arguments

byte-integer-source-string

OpenVMS usage:	**char_string**
type:	**character string**
access:	**read only**
mechanism:	**by descriptor**

String (EBCDIC) to be translated by LIB$TRA_EBC_ASC. The **byte-integer-source-string** argument contains the address of a descriptor pointing to this source string.

destination-string

OpenVMS usage:	**char_string**

type:	**character string**
access:	**write only**
mechanism:	**by descriptor**

Destination string (ASCII). The **destination-string** argument contains the address of the descriptor of this destination string.

The LIB$TRA_EBC_ASC routine uses the EBCDIC to ASCII translation table, LIB$AB_EBC_ASC.

Description

LIB$TRA_EBC_ASC translates an EBCDIC string to an ASCII string. If the destination string is a fixed-length string, its length must match the length of the input string. The length of both the source and destination strings is limited to 65,535 characters. No filling is done.

A similar operation can be accomplished by specifying the EBCDIC to ASCII translation table, LIB $AB_EBC_ASC, in a routine using LIB$MOVTC, but no testing for untranslatable characters is done under these circumstances.

The LIB$TRA_EBC_ASC routine uses the EBCDIC to ASCII translation shown in Figure 2.26.

Figure 2.26. LIB$AB_EBC_ASC

Row Bits 0 – 3	Column Bits 4 – 7															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	10	5C	5C	20	26	2D	5C	5C	5C	5C	5C	7B	7D	5C	30
1	01	11	5C	5C	5C	5C	2F	5C	61	6A	7E	5C	41	4A	5C	31
2	02	12	5C	16	5C	5C	5C	5C	62	6B	73	5C	42	4B	53	32
3	03	13	5C	5C	5C	5C	5C	5C	63	6C	74	5C	43	4C	54	33
4	5C	5C	5C	5C	5C	5C	5C	5C	64	6D	75	5C	44	4D	55	34
5	09	5C	0A	5C	5C	5C	5C	5C	65	6E	76	5C	45	4E	56	35
6	5C	08	17	5C	5C	5C	5C	5C	66	6F	77	5C	46	4F	57	36
7	7F	5C	1B	04	5C	5C	5C	5C	67	70	78	5C	47	50	58	37
8	5C	18	5C	5C	5C	5C	5C	5C	68	71	79	5C	48	51	59	38
9	5C	19	5C	5C	5C	5C	5C	60	69	72	7A	5C	49	52	5A	39
A	5C	5C	5C	5C	5B	5D	7C	3A	5C	5C	5C	5C	5C	5C	5C	5C
B	0B	5C	5C	5C	2E	24	2C	23	5C	5C	5C	5C	5C	5C	5C	5C
C	0C	1C	5C	14	3C	2A	25	40	5C	5C	5C	5C	5C	5C	5C	5C
D	0D	1D	05	15	28	29	5F	27	5C	5C	5C	5C	5C	5C	5C	5C
E	0E	1E	06	5C	2B	3B	3E	3D	5C	5C	5C	5C	5C	5C	5C	5C
F	0F	1F	07	1A	21	5E	3F	22	5C	5C	5C	5C	5C	5C	5C	FF

EBCDIC to ASCII Translation Table

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

All EBCDIC graphics are translated to their equivalent ASCII graphic except for the graphics noted in Table 2.14.

Table 2.14. EBCDIC Graphics Not Translated to ASCII Equivalent by LIB $TRA_EBC_ASC

EBCDIC Graphic	ASCII Graphic
¢ (cents sign)	[(left square bracket)

EBCDIC Graphic	ASCII Graphic
| (short vertical bar)	! (exclamation point)
¬ (logical not)	^ (circumflex)
! (exclamation point)	] (right square bracket)

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	If the destination string is a fixed-length string and its length is not the same as the source string length, or if the length of the input string is greater than 65,535 characters, no translation is attempted.
LIB$_INVCHA	One or more occurrences of an untranslatable character have been detected during the translation.

LIB$TRIM_FILESPEC

LIB$TRIM_FILESPEC — The Fit Long File Specification into Fixed Field routine takes a file specification, such as an OpenVMS RMS resultant name string, and shortens it (if necessary) so that it fits into a field of fixed width.

Format

```
LIB$TRIM_FILESPEC old-filespec ,new-filespec [,word-integer-width] [,resultar
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

old-filespec

OpenVMS usage:	**char_string**
type:	**character string**
access:	**read only**
mechanism:	**by descriptor**

File specification to be trimmed. The **old-filespec** argument contains the address of a descriptor pointing to this file specification string.

The file specification should be an RMS resultant name string.

new-filespec

OpenVMS usage:	**char_string**
type:	**character string**
access:	**write only**
mechanism:	**by descriptor**

Trimmed file specification. The **new-filespec** argument contains the address of a descriptor pointing to this trimmed file specification string. LIB$TRIM_FILESPEC writes the trimmed file specification into **new-filespec**.

word-integer-width

OpenVMS usage:	**word_unsigned**
type:	**word (unsigned)**
access:	**read only**
mechanism:	**by reference**

Maximum field width desired. The **word-integer-width** argument is the address of an unsigned word that contains this maximum field width.

If omitted, the current length of **new-filespec** is used. If **new-filespec** is not a fixed-length string, you should specify **word-integer-width** to ensure that the desired width is used.

resultant-length

OpenVMS usage:	**word_unsigned**
type:	**word (unsigned)**
access:	**write only**
mechanism:	**by reference**

Length of the trimmed file specification, not including any blank padding or truncated characters. The **resultant-length** argument is the address of an unsigned word that contains this length. This is an optional argument.

Description

This routine trims file specifications in a consistent, predictable manner to fit in a fixed-length field using the same algorithm that VSI software uses.

LIB$TRIM_FILESPEC allows compilers and other utilities which need to display file specifications in fixed-length fields, such as listing headers, to display file specifications in a consistent fashion.

If necessary to make the file specification fit into the specified field width, LIB$TRIM_FILESPEC removes portions of the file specification in this order:

1. Node (including access control)
2. Device
3. Directory

4. Version

5. Type

If, after removing all these fields, the file name is still longer than the field width, the file name is truncated and the alternate success status LIB$_STRTRU is returned.

LIB$TRIM_FILESPEC supports any string class for the *old-filespec* and *new-filespec* string arguments.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Success, but the output string was truncated. Significant characters of the trimmed file specification were truncated.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition values returned by LIB$SCOPY_R_DX, or the $FILESCAN system service.

Example

```
PROGRAM TRIM_FILESPEC(INPUT,OUTPUT);

{+}
{ This PASCAL example program demonstrates the
{ use of LIB$TRIM_FILESPEC.
{-}

    TYPE
        WORD = [WORD] 0..65535;

    VAR
        INPUT_FILESPEC  : VARYING [255] OF CHAR;
        OUTPUT_FILESPEC : VARYING [32] OF CHAR;
        RETURNED_STATUS : INTEGER;

    [EXTERNAL] FUNCTION LIB$TRIM_FILESPEC(
        IN_FILE      : VARYING [LEN1] OF CHAR;
        VAR OUT_FILE : VARYING [LEN2] OF CHAR;
        WIDTH        : WORD := %IMMED 0;
        OUT_LEN      : [REFERENCE] WORD := %IMMED 0
        ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STOP(
          CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
          FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
          ) : INTEGER; EXTERNAL;

BEGIN

{+}
{ Start with a large INPUT_FILESPEC.
{-}
```

```
INPUT_FILESPEC := 'DISK$NAME:[DIRECTORY1.DIRECTORY2]FILENAME.EXTENSION;1';

{+}
{ Use LIB$TRIM_FILESPEC to shorten it to fit a smaller variable.
{-}

RETURNED_STATUS := LIB$TRIM_FILESPEC(
                      INPUT_FILESPEC,
                      OUTPUT_FILESPEC,
                      SIZE(OUTPUT_FILESPEC.BODY));
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print out the original file name along with the
{ shortened file name.
{-}

WRITELN('Original file specification  ',INPUT_FILESPEC);
WRITELN('Shortened file specification ',OUTPUT_FILESPEC);

END.
```

This Pascal example program demonstrates the use of LIB$TRIM_FILESPEC. The output generated by this program is as follows:

```
Original file specification  DISK$NAME:
[DIRECTORY1.DIRECTORY2]FILENAME.EXTENSION;1
Shortened file specification FILENAME.EXTENSION;1
```

LIB$TRIM_FULLNAME

LIB$TRIM_FULLNAME — The Trim a Full Name to Fit into a Desired Output Field routine trims a full name to fit into a desired output field. The trimming preserves the most significant part of the full name. No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Format

LIB$TRIM_FULLNAME fullname, trimmed-nodename [,output-width] [,resultant-length]

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

fullname

OpenVMS usage:	**char_string**
type:	**character string**
access:	**read only**
mechanism:	**by descriptor**

Full name to be trimmed. The **fullname** argument contains the address of a descriptor pointing to this full name string.

The error LIB$_INVARG is returned if **fullname** contains an invalid full name, points to a null string, or contains more than 1024 characters. The error LIB$_INVSTRDES is returned if**fullname** is an invalid descriptor.

trimmed-nodename

OpenVMS usage:	**char_string**
type:	**character string**
access:	**write only**
mechanism:	**by descriptor**

Trimmed node name. The **trimmed-nodename** argument contains the address of a descriptor pointing to the trimmed node-name string. LIB$TRIM_FULLNAME writes the trimmed node name into the buffer pointed to by **trimmed-nodename**.

The error LIB$_INVSTRDES is returned if **trimmed-nodename** is an invalid descriptor.

The length field of the **trimmed-nodename** descriptor is not updated unless **trimmed-nodename** is a dynamic descriptor with a length less than the resultant trimmed node name. Refer to the *OpenVMS RTL String Manipulation (STR$) Manual* for dynamic string descriptor usage.

The **trimmed-nodename** argument contains an unusable result when LIB$TRIM_FULLNAME returns in error.

output-width

OpenVMS usage:	**word_unsigned**
type:	**word (unsigned)**
access:	**read only**
mechanism:	**by reference**

Field width desired for the trimmed node name. The **output-width** argument is the address of an unsigned word that contains this field width in bytes.

If **output-width** is omitted, the current length of **trimmed-nodename** is used. If **trimmed-nodename** is not a fixed-length string, specify **output-width** to ensure that the desired width is used.

If the lengths of both **trimmed-nodename** and **output-width** are specified, the length in **output-width** is used. In this case, if the current length of **trimmed-nodename** is smaller than the length of **output-width**, the output trimmed node name is truncated at the end, and the alternate successful status LIB $_STRTRU is returned.

resultant-length

OpenVMS usage:	**word_unsigned**
type:	**word (unsigned)**
access:	**write only**
mechanism:	**by reference**

Length of the trimmed node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB$TRIM_FULLNAME returns in error.

Description

This routine trims a full name to the length that fits the desired output field. It allows applications to trim long full names for displaying in a fixed-length field, such as listing headers, in a consistent manner.

Full names are validated. Valid full names are defined as full names expanded from using LIB$EXPAND_NODENAME. A node name must be expanded to a full name using LIB $EXPAND_NODENAME before calling LIB$TRIM_FULLNAME. The error LIB$_INVARG is returned if the input full name is invalid.

If the length of *fullname* is less than or equal to the desired output width, no trimming is performed, and *fullname* is returned in *trimmed-nodename*. Trailing blanks are padded if necessary.

Trimming is performed when the length of *fullname* is larger than the desired output width. The alternate successful status LIB$_STRTRU is returned.

The trimmed node name contains the significant part of the full name. This allows the most important information of a full name to be retained for display purposes. The significant part of a full name is determined by the underlying network services.

In a DECnet environment, trimming a DECnet-Plus full name results in the error condition LIB $_INVARG.

If a usable short form of a node name is desired for display purposes, call LIB $COMPRESS_NODENAME first. If LIB$COMPRESS_NODENAME returns LIB$_STRTRU, LIB $TRIM_FULLNAME can then be used to return the trimmed node name.

LIB$TRIM_FULLNAME adds padding spaces to the end of the output buffer if the trimmed node name is shorter than the size of the output buffer. The argument **resultant-length**, if supplied, is set to the length of the trimmed node name, excluding any padding spaces.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_STRTRU	Routine successfully completed. Characters are truncated in the output buffer pointed to by **trimmed-nodename**.
LIB$_INVARG	Invalid argument: • **fullname** is invalid.

	• **fullname** points to a null string. • The length of the input full name is more than 1024 characters. • The trimmed DECnet-Plus for OpenVMS node name is invalid in a DECnet for OpenVMS environment.
LIB$_INVSTRDES	Invalid string descriptor.
LIB$_WRONUMARG	Wrong number of arguments.

Any condition value returned by LIB$SCOPY_R_DX, or the $IPC DECnet service.

Examples

The following table gives some examples of the results of using LIB$TRIM_FULLNAME:

Full Name	Size of Output Field	Trimmed Node Name
NODE	3	NOD
NODE	8	NODE
DEC:.FOO.NODE	5	.NODE
DEC:.FOO.NODE	8	FOO.NODE
DEC:.FOO.NODE	20	DEC:.FOO.NODE

LIB$UNLOCK_IMAGE

LIB$UNLOCK_IMAGE — Unlocks the specified image in the process's working set.

Format

```
LIB$UNLOCK_IMAGE address
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

address

OpenVMS usage:	address
type:	quadword
access:	read only

mechanism:	by value

Address of a byte within the image to be unlocked in the working set. If the address argument is 0, the current image (which contains the call to LIB$UNLOCK_IMAGE) is unlocked in the working set.

Description

LIB$UNLOCK_IMAGE unlocks the specified image in the process's working set.

This routine is typically used by a privileged user after the program, executing in kernel mode, lowers IPL to 0 or 2. Above IPL 2, paging is not allowed by the system. The program must access only pages valid in the process's working set. LIB$LOCK_IMAGE is used to lock the image in the working set.

Condition Values Returned

SS$_WASSET	The specified image is unlocked in the working set and had previously been locked in the working set.
SS$_WASCLR	The specified image is unlocked in the working set and had previously not been locked in the working set.

Other status codes returned by sys$lkwset_64.

LIB$VERIFY_VM_ZONE

LIB$VERIFY_VM_ZONE — The Verify a Zone routine performs verification of a 32-bit zone.

Format

LIB$VERIFY_VM_ZONE zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	longword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier of the zone to be verified. The **zone-id** argument is the address of an unsigned longword that contains this zone identifier. A value of 0 indicates the 32-bit default zone.

Description

LIB$VERIFY_VM_ZONE verifies a zone. LIB$VERIFY_VM_ZONE performs verification of the zone header and scans all of the queues and lists maintained in the zone header; this includes the lookaside lists and the free lists. If the zone was created with LIB$M_VM_FREE_FILL0 or LIB $M_VM_FREE_FILL1, LIB$VERIFY_VM_ZONE also checks the contents of the free blocks.

As soon as an error is encountered, processing stops. If LIB$_BADZONE is returned, use the routine LIB$SHOW_VM_ZONE to dump the zone information.

You must have exclusive access to the zone while the verification is proceeding. Results are unpredictable if another thread of control modifies the zone while this routine is analyzing control data or scanning control blocks.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone.
LIB$_INSVIRMEM	Insufficient virtual memory.
LIB$_INVARG	Invalid or null argument.
LIB$_WRONUMARG	Wrong number of arguments.

LIB$VERIFY_VM_ZONE_64

LIB$VERIFY_VM_ZONE_64 — The Verify a Zone routine performs verification of a 64-bit zone.

Format

LIB$VERIFY_VM_ZONE_64 zone-id

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

zone-id

OpenVMS usage:	identifier
type:	quadword (unsigned)
access:	read only
mechanism:	by reference

Zone identifier of the zone to be verified. The **zone-id** argument is the address of an unsigned quadword that contains this zone identifier. A value of 0 indicates the 64-bit default zone.

Description

LIB$VERIFY_VM_ZONE_64 verifies a zone. LIB$VERIFY_VM_ZONE_64 performs verification of the zone header and scans all of the queues and lists maintained in the zone header; this includes the lookaside lists and the free lists. If the zone was created with the LIB$M_VM_FREE_FILL0 or LIB $M_VM_FREE_FILL1 algorithm, LIB$VERIFY_VM_ZONE_64 also checks the contents of the free blocks.

As soon as an error is encountered, processing stops. If LIB$_BADZONE is returned, use the routine LIB$SHOW_VM_ZONE_64 to dump the zone information.

You must have exclusive access to the zone while the verification is proceeding. Results are unpredictable if another thread of control modifies the zone while this routine is analyzing control data or scanning control blocks.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_BADZONE	Invalid zone.
LIB$_INVARG	Invalid or null argument.
LIB$_WRONUMARG	Wrong number of arguments.

LIB$WAIT

LIB$WAIT — The Wait a Specified Period of Time routine places the current process into hibernation for the number of seconds specified in its argument.

Format

```
LIB$WAIT seconds [,flags] [,float-type]
```

Returns

OpenVMS usage:	cond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

seconds

OpenVMS usage:	**floating_point**
type:	**F_floating**
access:	**read only**
mechanism:	**by reference**

The number of seconds to wait. The **seconds** argument contains the address of an F-floating number that is this number.

The value is rounded to the nearest hundredth-second before use. Seconds must be between 0.0 and 100,000.0.

flags

OpenVMS usage:	**mask_longword**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by reference**

Control flags. The **flags** argument is the address of a longword integer that contains the control flags. The following flag is defined:

Bit	Value	Description
0	LIB$K_NOWAKE	LIB$WAIT will not wake in the case of an interrupt.

This is an optional argument. If omitted, the default is 0, and LIB$WAIT will wake in the case of an interrupt.

float-type

OpenVMS usage:	**longword-unsigned**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by reference**

Float type. The **float-type** argument is the address of a longword integer that determines the floating-point type of the **seconds** argument. Use one of the following symbols:

Symbol	Value	Floating-Point Type
LIB$K_VAX_F	0	F_floating
LIB$K_VAX_D	1	D_floating
LIB$K_VAX_G	2	G_floating
LIB$K_VAX_H	3	H_floating
LIB$K_IEEE_S	4	IEEE_S_floating
LIB$K_IEEE_T	5	IEEE_T_floating

This is an optional argument. If omitted, the default is F_floating. F_floating is the required **float-type** when LIB$WAIT is called from a module written in a language that prototypes functions.

Description

LIB$WAIT rounds the value specified by seconds to the nearest hundredth-second, uses the $SCHDWK system service to schedule a wakeup for that interval, and then issues the $HIBER system service to hibernate until the wakeup occurs.

Because of other system activity, the length of time that the process actually waits may be somewhat longer than what was specified by **seconds**.

The process hibernates in the caller's access mode; therefore, asynchronous system traps (ASTs) may be delivered while the process is hibernating. However, if the process hibernates at AST level, further ASTs can not be delivered.

When the LIB$K_NOWAIT control flag is used, LIB$WAIT makes use of the $SETIMR system service to schedule the wakeup, and then issues a $SYNCH system service call to check for the completion status. In this case, LIB$WAIT will not be interrupted by $WAKE. Use LIB$K_NOWAKE when it is necessary for the wait to be completed without interruption.

Note

The NOWAKE option makes use of the $SETIMR and $SYNCH system services. Because use of these services requires that an AST be delivered, you should not use LIB$WAIT with the LIB$K_NOWAKE control flag at AST level.

See the *OpenVMS System Services Reference Manual* for more information.

Condition Values Returned

SS$_NORMAL	Routine successfully completed.
LIB$_INVARG	Invalid argument. The value of **seconds** was less than 0 or greater than 100,000.0
LIB$_WRONUMARG	Wrong number of arguments. An incorrect number of arguments was passed to LIB$WAIT.

Any condition values returned by the $SCHDWK or SETIMR system services, or by the RTL routine LIB$CVT_FTOF.

Example

```
IDENTIFICATION DIVISION.
PROGRAM-ID. T3.
DATA DIVISION.
WORKING-STORAGE SECTION.
01    WAIT-TIME    COMP-1.
01    FLOAT-TYPE   PIC 9(5) COMP VALUE 0.
PROCEDURE DIVISION.
p0.    MOVE 10 TO WAIT-TIME.
       CALL "LIB$WAIT"
       USING BY REFERENCE WAIT_TIME, OMITTED,
             BY REFERENCE FLOAT-TYPE.
       STOP RUN.
```

This COBOL program demonstrates the use of LIB$WAIT on both OpenVMS VAX and OpenVMS Alpha systems. When run, the process performs a 10 second wait.

Chapter 3. CVT$ Reference Section

This chapter provides a detailed discussion of the routines provided by the OpenVMS RTL (CVT$) facility.

CVT$CONVERT_FLOAT

CVT$CONVERT_FLOAT — The Convert Floating-Point Data Type routine provides a simplified options-interface for converting a floating-point data type to another supported floating-point data type.

Format

`CVT$CONVERT_FLOAT input_value, input_type_code, output_value, output_type_cod`

Returns

OpenVMS usage:	ond_value
type:	longword (unsigned)
access:	write only
mechanism:	by value

Arguments

input_value

OpenVMS usage:	**varying_arg**
type:	**unspecified**
access:	**read only**
mechanism:	**by reference**

The address of a data area containing a floating-point number that is to be converted. The **input_value** argument may contain floating-point data in F_Floating, D_Floating, G_Floating, H_Floating, IEEE_S_Floating, IEEE_T_Floating, IEEE_X_Floating, IBM_Long_Floating, IBM_Short_Floating, or CRAY_Floating format. The value of the **input_type_code** argument determines the format and size of the **input_value** argument.

input_type_code

OpenVMS usage:	**longword_unsigned**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by value**

The value of a longword bit mask specifying the type of floating-point data being passed in the **input_value** argument. Valid type codes are:

input_type_code	Format	Size in Bytes
CVT$K_VAX_F	F_Floating	4
CVT$K_VAX_D	D_Floating	8

CVT$K_VAX_G	G_Floating	8
CVT$K_VAX_H	H_Floating	16
CVT$K_IEEE_S	IEEE_S_Floating	4
CVT$K_IEEE_T	IEEE_T_Floating	8
CVT$K_IEEE_X	IEEE_X_Floating	16
CVT$K_IBM_LONG	IBM_Long_Floating	8
CVT$K_IBM_SHORT	IBM_Short_Floating	4
CVT$K_CRAY	CRAY_Floating	8

Declarations for the **input_type_code** argument are in the $CVTDEF module found in the system symbol libraries.

output_value

OpenVMS usage:	**varying_arg**
type:	**unspecified**
access:	**write only**
mechanism:	**by reference**

The address of a data area that receives the converted floating-point number. The **output_value** argument can contain floating-point data in F_Floating, D_Floating, G_Floating, H_Floating, IEEE_S_Floating, IEEE_T_Floating, IEEE_X_Floating, IBM_Long_Floating, IBM_Short_Floating, or CRAY_Floating format. The value of the **output_type_code** argument determines the size and format of the data placed into the **output_value** argument.

output_type_code

OpenVMS usage:	**longword_unsigned**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by value**

The value of a longword bit mask specifying the type of floating-point data that the **input_value** argument will be converted into and returned in the **output_value** argument. Valid type codes are:

output_type_code	Format	Size in Bytes
CVT$K_VAX_F	F_Floating	4
CVT$K_VAX_D	D_Floating	8
CVT$K_VAX_G	G_Floating	8
CVT$K_VAX_H	H_Floating	16
CVT$K_IEEE_S	IEEE_S_Floating	4
CVT$K_IEEE_T	IEEE_T_Floating	8
CVT$K_IEEE_X	IEEE_X_Floating	16
CVT$K_IBM_LONG	IBM_Long_Floating	8
CVT$K_IBM_SHORT	IBM_Short_Floating	4
CVT$K_CRAY	CRAY_Floating	8

Declarations for the **output_type_code** argument are in the $CVTDEF module found in the system symbol libraries.

options

OpenVMS usage:	**mask_longword**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by value**

Conversion option specifier. The **options** argument is the address of a longword bit mask in which each option bit set causes the corresponding option to be used during the conversion.

The following options can be specified using the **options** argument:

Option	Description
CVT$M_ROUND_TO_NEAREST	The default rounding option for conversions to IEEE data types. This IEEE Std. 754 rounding mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the one whose least significant bit is 0 is the result.
CVT$M_VAX_ROUNDING	The default rounding option for conversions to non-IEEE data types. Performs "traditional" style rounding. This mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the output value is the closest to either positive infinity or negative infinity, depending on the sign of the input value.
CVT$M_TRUNCATE	Round the output value toward zero (truncate).
CVT$M_ROUND_TO_POS	Round the output value toward positive infinity.
CVT$M_ROUND_TO_NEG	Round the output value toward negative infinity.
CVT$M_BIG_ENDIAN	Interprets IEEE data types as Big Endian.
CVT$M_ERR_UNDERFLOW	Report underflow conditions as errors.

Declarations for the options argument are in the $CVTDEF module found in the system symbol libraries.

Description

CVT$CONVERT_FLOAT is a general-purpose, floating-point conversion routine that converts any **input_type_code** floating-point data type into any **output_type_code** floating-point data type. The conversion is subject to the options specified in the **options** argument.

Note

OpenVMS compilers do not support arithmetic operations for all of the above floating-point data types. Additional floating-point data types are supported by this routine for data conversion purposes only.

Condition Values Returned

CVT$_NORMAL	Normal successful completion.
CVT$_INPCONERR	Input conversion error.
CVT$_INVINPTYP	Invalid input type code.
CVT$_INVOPT	Invalid option argument.
CVT$_INVOUTTYP	Invalid output type code.
CVT$_INVVAL	Input value was an invalid number or NaN.
CVT$_NEGINF	Input value was negative infinity.
CVT$_OUTCONERR	Output conversion error.
CVT$_OVERFLOW	Overflow detected during conversion.
CVT$_POSINF	Input value was positive infinity.
CVT$_UNDERFLOW	Underflow detected during conversion.

Return status values are in the $CVTMSG module found in the system symbol libraries.

Example

```
/*
** ====================================================================
**
**  Example of CVT$CONVERT_FLOAT
**
** --------------------------------------------------------------------
**
**  This example program reads IEEE T floating-point numbers from an
**  input file, converts them to VAX D floating-point numbers and
**  writes the result to an output file.
**
**  The input and output file names can be specified as the first and
**  second arguments on the command line as follows:
**
**     $ EXAMPLE IEEE_T_INPUT_FILE.DAT VAX_D_OUTPUT_FILE.DAT
**
**  If the input or output files are not included on the command
**  line then the program prompts the user for them.
**
** ====================================================================
*/
#include <stdio.h>

unsigned long CVT$CONVERT_FLOAT(void    *input_value,
                                unsigned long input_type,
                                void    *output_value,
                                unsigned long output_type,
                                unsigned long options);

globalvalue CVT$K_VAX_D;
globalvalue CVT$K_IEEE_T;
globalvalue CVT$M_ROUND_TO_NEAREST;
globalvalue CVT$_NORMAL;
```

```
main(int argc, char *argv[])

{

  double        D_Float_number;
  unsigned long IEEE_Double_number[2];
  unsigned long options;
  char          in_filename[80];
  char          out_filename[80];
  FILE          *in_file, *out_file;
  unsigned long ret_status;

/*
** Find out where we are going to get the data from.
** First look at the first argument of the command line.
** If nothing is there, then attempt to use IEEE_T_IN.DAT.
** ================================================================
*/
if (argc == 1)
{
  printf("Enter input data file: [IEEE_T_IN.DAT]: ");
  if (gets(in_filename) == NULL)
    exit(1);

  if (strlen(in_filename) == 0)
    strcpy(in_filename, "IEEE_T_IN.DAT");
}
else
  strcpy(in_filename, argv[1]);

/*
** Find out where we are going to put the output data.
** First look at the second argument of the command line.
** If nothing is there, then put it in VAX_D_OUT.DAT
** ================================================================
*/
if (argc <= 2)
{
  printf("Enter output data file: [VAX_D_OUT.DAT]: ");
  if (gets(out_filename) == NULL)
    exit(1);

  if (strlen(out_filename) == 0)
    strcpy(out_filename, "VAX_D_OUT.DAT");
}
else
  strcpy(out_filename, argv[2]);

/*
** Open the input and output files.
** ----------------------------------------------------------------
*/
if ((in_file = fopen(in_filename, "r")) == NULL)
{
  fprintf(stderr, "%s couldn't open file %s\n", argv[0], in_filename);
  exit(1);
}
```

```
out_file = fopen(out_filename, "wb");

options     = CVT$M_ROUND_TO_NEAREST;
ret_status  = CVT$_NORMAL;

/*
** Read in each number from the file, convert it, and write it to
** the output file.
** ================================================================
*/
while ((fread (&IEEE_Double_number[0],
               sizeof(IEEE_Double_number),
               1,
               in_file) == 1) &&
       (ret_status == CVT$_NORMAL))
{
  ret_status = CVT$CONVERT_FLOAT(&IEEE_Double_number[0], CVT$K_IEEE_T,
                                 &D_Float_number, CVT$K_VAX_D,
                                 options);

  if (ret_status == CVT$NORMAL)
  {
    fwrite(&D_Float_number, sizeof(D_Float_number), 1, out_file);
    printf("Converted data: %lf.\n", D_Float_number);
  }
}
fclose(in_file);
fclose(out_file);

if (ret_status == CVT$_NORMAL)
  exit(1);
else
  exit(ret_status);
}
```

CVT$FTOF

CVT$FTOF — The Convert Floating-Point Data Type routine converts floating-point data types to other supported floating-point data types and allows additional control over the converted results. CVT$FTOF functionality is also available on other platforms supported by VSI.

Format

status = CVT$FTOF input_value, input_type_code, output_value, output_type_code, op

Returns

OpenVMS usage:	mask_longword
type:	longword (unsigned)
access:	write only
mechanism:	by value

The **status** return value is an unsigned longword bit mask containing the condition codes raised by the function. CVT$FTOF returns CVT$K_NORMAL; otherwise, it sets one or more recoverable and unrecoverable conditions. Use the following condition names to determine which conditions are set:

Condition Name	Condition (always reported by default)
CVT$K_NORMAL	Normal successful completion.
CVT$M_INVALID_INPUT_TYPE	Invalid input type code.
CVT$M_INVALID_OUTPUT_TYPE	Invalid output type code.
CVT$M_INVALID_OPTION	Invalid option argument.

Condition Name	Condition (reported only if the CVT $M_REPORT_ALL option is selected)
CVT$M_RESULT_INFINITE	Conversion produced an infinite result. For IEEE data type conversions.
CVT$M_RESULT_DENORMALIZED	Conversion produced a denormalized result. For IEEE data type conversions.
CVT$M_RESULT_OVERFLOW_RANGE	Conversion yielded an exponent greater than 60000 (8). For CRAY data type conversions.
CVT$M_RESULT_UNDERFLOW_RANGE	Conversion yielded an exponent less than 20000 (8). For CRAY data type conversions.
CVT$M_RESULT_UNNORMALIZED	Conversion produced an unnormalized result. For IBM data type conversions.
CVT$M_RESULT_INVALID	Conversion result is either ROP (reserved operand), NaN (not a number), or closest equivalent. CRAY and IBM data types return 0. For all data type conversions.
CVT$M_RESULT_OVERFLOW	Conversion resulted in overflow. For all data type conversions.
CVT$M_RESULT_UNDERFLOW	Conversion resulted in underflow. For all data type conversions.
CVT$M_RESULT_INEXACT	Conversion resulted in a loss of precision. For all data type conversions.

Return status values are in the $CVTDEF module in the system symbol libraries.

Arguments

input_value

OpenVMS usage:	**varying_arg**
type:	**unspecified**
access:	**read only**
mechanism:	**by reference**

The address of a data area containing a floating-point number to be converted. The number can be floating-point data in one of the following formats:

F_Floating	Big_Endian_IEEE_S_Floating
D_Floating	Big_Endian_IEEE_T_Floating
G_Floating	Big_Endian_IEEE_X_Floating
H_Floating	IBM_Long_Floating
IEEE_S_Floating	IBM_Short_Floating
IEEE_T_Floating	CRAY_Floating_Single
IEEE_X_Floating	

The value of the **input_type_code** argument determines the format and size of the **input_value** argument.

input_type_code

OpenVMS usage:	**longword_unsigned**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by value**

The value of a longword bit mask specifying the type of floating-point data being passed in the **input_value** argument. Valid type codes are:

Input_type_code	Format	Size in Bytes
CVT$K_VAX_F	F_Floating	4
CVT$K_VAX_D	D_Floating	8
CVT$K_VAX_G	G_Floating	8
CVT$K_VAX_H	H_Floating	16
CVT$K_IEEE_S	IEEE_S_Floating	4
CVT$K_IEEE_T	IEEE_T_Floating	8
CVT$K_IEEE_X	IEEE_X_Floating	16
CVT $K_BIG_ENDIAN_IEEE_S	Big_Endian_IEEE_S_Floating	4
CVT $K_BIG_ENDIAN_IEEE_T	Big_Endian_IEEE_T_Floating	8
CVT $K_BIG_ENDIAN_IEEE_X	Big_Endian_IEEE_X_Floating	16
CVT$K_IBM_LONG	IBM_Long_Floating	8
CVT$K_IBM_SHORT	IBM_Short_Floating	4
CVT$K_CRAY_SINGLE	CRAY_Floating	8

Declarations for the **input_type_code** argument are in the $CVTDEF module found in the system symbol libraries.

output_value

OpenVMS usage:	**varying_arg**

type:	**unspecified**
access:	**write only**
mechanism:	**by reference**

The address of a data area that receives the converted floating-point number. The number can be floating-point data in F_Floating, D_Floating, G_Floating, H_Floating, IEEE_S_Floating, IEEE_T_Floating, IEEE_X_Floating, Big_Endian_IEEE_S_Floating, Big_Endian_IEEE_T_Floating, Big_Endian_IEEE_X_Floating, IBM_Long_Floating, IBM_Short_Floating, or CRAY_Floating_Single format. The value of the **output_type_code** argument determines the size and format of the converted floating-point number.

output_type_code

OpenVMS usage:	**longword_unsigned**
type:	**longword (unsigned)**
access:	**read only**
mechanism:	**by value**

The value of a longword bit mask specifying the type of floating-point data that the **input_value** argument will be converted into and returned in the **output_value** argument. Valid type codes are:

Output_type_code	Format	Size in Bytes
CVT$K_VAX_F	F_Floating	4
CVT$K_VAX_D	D_Floating	8
CVT$K_VAX_G	G_Floating	8
CVT$K_VAX_H	H_Floating	16
CVT$K_IEEE_S	IEEE_S_Floating	4
CVT$K_IEEE_T	IEEE_T_Floating	8
CVT$K_IEEE_X	IEEE_X_Floating	16
CVT $K_BIG_ENDIAN_IEEE_S	Big_Endian_IEEE_S_Floating	4
CVT $K_BIG_ENDIAN_IEEE_T	Big_Endian_IEEE_T_Floating	8
CVT $K_BIG_ENDIAN_IEEE_X	Big_Endian_IEEE_X_Floating	16
CVT$K_IBM_LONG	IBM_Long_Floating	8
CVT$K_IBM_SHORT	IBM_Short_Floating	4
CVT$K_CRAY_SINGLE	CRAY_Floating	8

Declarations for the **output_type_code** argument are in the $CVTDEF module found in the system symbol libraries.

options

OpenVMS usage:	**mask_longword**
type:	**longword (unsigned)**
access:	**read only**

mechanism:	**by value**

Conversion option specifier. The **options** argument is the address of a longword bit mask in which each option bit set causes the corresponding option to be used during the conversion. Provide a zero (0) value to the **options** argument to select default behavior or choose one or more options (status condition option, rounding options, "FORCE" options, CRAY and IBM options) from the following tables. Specify only the options that apply to your conversion. A conflicting or incompatible **options** argument is reported as an error (CVT$M_INVALID_OPTION).

Applicable Conversion	Option	Description
	Status Condition Option	
All	CVT$M_REPORT_ALL	Report all applicable status conditions as the default. The reporting of recoverable status conditions is disabled by default when this option is not used.
	Rounding Options	
All	CVT$M_ROUND_TO_NEAREST	The default rounding option for conversions to IEEE data types. This IEEE Std. 754 rounding mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the one whose least significant bit is 0 is the result.
All	CVT$M_BIASED_ROUNDING	The default rounding option for conversions to non-IEEE data types. Performs "traditional" style rounding. This mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the output value is the closest to either positive infinity or negative infinity depending on the sign of the input value.
All	CVT$M_ROUND_TO_ZERO	Round the output value toward zero (truncate).
All	CVT$M_ROUND_TO_POS	Round the output value toward positive infinity.
All	CVT$M_ROUND_TO_NEG	Round the output value toward negative infinity.
	"FORCE" Options	
All	CVT$M_FORCE_ALL_SPECIAL_VALUES	Apply all applicable "FORCE" options for the current conversion.
IEEE	CVT$M_FORCE_DENORM_TO_ZERO This option is valid only for conversions to IEEE output values.	Force a denormalized IEEE output value to zero.

IEEE	CVT$M_FORCE_INF_TO_MAX_FLOAT This option is valid only for conversions to IEEE output values.	Force a positive IEEE infinite output value to +max_float and force a negative IEEE infinite output value to --max_float.
IEEE or VAX	CVT$M_FORCE_INVALID_TO_ZERO This option is valid only for conversions to IEEE or VAX output values.	Force an invalid IEEE NaN (not a number) output value or a VAX ROP (reserved operand) output value to zero.
	CRAY Format Conversion Options	
CRAY	CVT $M_ALLOW_OVRFLW_RANGE_VALUES	Allow an input/output exponent value > 60000 (8).
CRAY	CVT $M_ALLOW_UDRFLW_RANGE_VALUES	Allow an input/output exponent value < 20000 (8).
IBM Format Conversion Option		
IBM	CVT $M_ALLOW_UNNORMALIZED_VALUES	Allow unnormalized input arguments. Allow an unnormalized output value for a small value that would normalize to zero.

The maximum representable floating-point values (max_float) for the IEEE_S_Floating, IEEE_T_Floating, IEEE_X_Floating, Big_Endian_IEEE_S_Floating, Big_Endian_IEEE_T_Floating, and Big_Endian_IEEE_X_Floating formats are:

Data Type	Value for: max_float
S	Decimal: 3.402823e38
T	Decimal: 1.797693134862316e308
X	Decimal: 1.189731495357231765085759326628007016196477e4932

Declarations for the options argument are in the $CVTDEF module found in the system symbol libraries.

Description

CVT$FTOF functionality is available on all VSI platforms and is the floating-point conversion routine of choice for portability. When compared with the standard CVT$CONVERT_FLOAT routine, CVT $FTOF includes additional functionality and increased performance.

CVT$FTOF is a general-purpose floating-point conversion routine that converts any **input_type_code** floating-point data type into any **output_type_code** floating-point data type. The conversion is subject to the options specified in the **options** argument.

Note

OpenVMS compilers do not support arithmetic operations for all of the floating-point data types described here. Additional floating-point data types are supported by this routine for data conversion purposes only.