# TMS320C5000 DSP/BIOS Application Programming Interface (API) Reference Guide

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Texas Instruments

## IMPORTANT NOTICE



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Preface

# Read This First

## *About This Manual*

DSP/BIOS gives developers of mainstream applications on Texas Instruments TMS320C5000™ DSP devices the ability to develop embedded real-time software. DSP/BIOS provides a small firmware real-time library and easy-to-use tools for real-time tracing and analysis.

You should read and become familiar with the *TMS320 DSP/BIOS User's Guide*, a companion volume to this API reference guide.

Before you read this manual, you may use the *Code Composer Studio* online tutorial and the DSP/BIOS section of the online help to get an overview of DSP/BIOS. This manual discusses various aspects of DSP/BIOS in depth and assumes that you have at least a basic understanding of DSP/BIOS.

## *Notational Conventions*

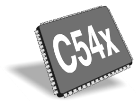
This document uses the following conventions:

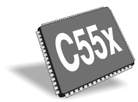
❏ Program listings, program examples, and interactive displays are shown in a `special typeface`. Examples use a **`bold version`** of the special typeface for emphasis; interactive displays use a **`bold version`** of the special typeface to distinguish commands that you enter from items that the system displays (such as prompts, command output, error messages, etc.).

Here is a sample program listing:

```
Void copy(HST_Obj *input, HST_Obj *output)
{
    PIP_Obj     *in, *out;
    Uns         *src, *dst;
    Uns         size;
}
```

- ❏ Square brackets ( [ and ] ) identify an optional parameter. If you use an optional parameter, you specify the information within the brackets. Unless the square brackets are in a **bold** typeface, do not enter the brackets themselves.
- ❏ Throughout this manual, 54 represents the two-digit numeric appropriate to your specific DSP platform. For example, DSP/BIOS assembly language API header files for the C5000 platform are described as having a suffix of .h54. For the C55 DSP platform, substitute 55 for each occurrence of 54.
- ❏ Information specific to a particular device is designated with one of the following icons:






## Related Documentation From Texas Instruments

The following books describe TMS320 devices and related support tools. To obtain a copy of any of these TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924. When ordering, please identify the book by its title and literature number.

***TMS320 DSP/BIOS User's Guide*** (literature number SPRU423) provides an overview and description of the DSP/BIOS real-time operating system.

***TMS320C54x Assembly Language Tools User's Guide*** (literature number SPRU102) describes the assembly language tools (assembler, linker, and other tools used to develop assembly language code), assembler directives, macros, common object file format, and symbolic debugging directives for the C54x generation of devices.

***TMS320C55x Assembly Language Tools User's Guide*** (literature number SPRU280) describes the assembly language tools (assembler, linker, and other tools used to develop assembly language code), assembler directives, macros, common object file format, and symbolic debugging directives for the C55x generation of devices.

***TMS320C54x Optimizing C Compiler User's Guide*** (literature number SPRU103) describes the C54x C compiler. This C compiler accepts ANSI standard C source code and produces TMS320 assembly language source code for the C54x generation of devices.

***TMS320C55x Optimizing C Compiler User's Guide*** (literature number SPRU281) describes the C55x C compiler. This C compiler accepts ANSI standard C source code and produces TMS320 assembly language source code for the C55x generation of devices.

***TMS320C55x Programmer's Guide*** (literature number SPRU376) describes ways to optimize C and assembly code for the TMS320C55x DSPs and includes application program examples.

***TMS320C54x DSP Reference Set, Volume 1: CPU and Peripherals*** (literature number SPRU131) describes the TMS320C54x 16-bit fixed-point general-purpose digital signal processors. Covered are its architecture, internal register structure, data and program addressing, the instruction pipeline, and on-chip peripherals. Also includes development support information, parts lists, and design considerations for using the XDS510 emulator.

***TMS320C54x DSP Enhanced Peripherals Ref Set, Vol 5*** (literature number SPRU302) describes the enhanced peripherals available on the TMS320C54x digital signal processors. Includes the multi channel buffered serial ports (McBSPs), direct memory access (DMA) controller, interprocesor communications, and the HPI-8 and HPI-16 host port interfaces.

***TMS320C54x DSP Mnemonic Instruction Set Reference Set Volume 2*** (literature number SPRU172) describes the TMS320C54x digital signal processor mnemonic instructions individually. Also includes a summary of instruction set classes and cycles.

***TMS320C54x DSP Reference Set, Volume 3: Algebraic Instruction Set*** (literature number SPRU179) describes the TMS320C54x digital signal processor algebraic instructions individually. Also includes a summary of instruction set classes and cycles.

***TMS320C54x Code Composer Studio Tutorial Online Help*** (literature number SPRH134) introduces the Code Composer Studio integrated development environment and software tools. Of special interest to DSP/BIOS users are the *Using DSP/BIOS* lessons.

***TMS320C55x Code Composer Studio Tutorial Online Help*** (literature number SPRH097) introduces the Code Composer Studio integrated development environment and software tools. Of special interest to DSP/BIOS users are the *Using DSP/BIOS* lessons.

***DSP/BIOS and TMS320C54x Extended Addressing*** (literature number SPRA599) provides basic run-time services including real-time analysis functions for instrumenting an application, clock and periodic functions, I/O modules, and a preemptive scheduler. It also describes the far model for extended addressing, which is available on the TMS320C54x platform.

## Related Documentation

You can use the following books to supplement this reference guide:

***The C Programming Language*** (second edition), by Brian W. Kernighan and Dennis M. Ritchie, published by Prentice-Hall, Englewood Cliffs, New Jersey, 1988

***Programming in C***, Kochan, Steve G., Hayden Book Company

***Programming Embedded Systems in C and C++***, by Michael Barr, Andy Oram (Editor), published by O'Reilly & Associates; ISBN: 1565923545, February 1999

***Real-Time Systems***, by Jane W. S. Liu, published by Prentice Hall; ISBN: 013099651, June 2000

***Principles of Concurrent and Distributed Programming*** (Prentice Hall International Series in Computer Science), by M. Ben-Ari, published by Prentice Hall; ISBN: 013711821X, May 1990

***American National Standard for Information Systems-Programming Language C*** X3.159-1989, American National Standards Institute (ANSI standard for C); (out of print)

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# Contents

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Chapter 1

# API Functional Overview

This chapter provides an overview to the TMS320C5000 DSP/BIOS API functions.

| Topic | Page |
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## 1.1 DSP/BIOS Modules

*Table 1-1. DSP/BIOS Modules*

| Module | Description |
|---|---|
| ATM Module | Atomic functions written in assembly language |
| BUF Module | Maintains buffer pools of fixed size buffers |
| C54 and C55 Modules | Target-specific functions |
| CLK Module | System clock manager |
| DEV Module | Device driver interface |
| GIO Module | I/O module used with IOM mini-drivers |
| Global Settings | Global setting manager |
| HOOK Module | Hook function manager |
| HST Module | Host channel manager |
| HWI Module | Hardware interrupt manager |
| IDL Module | Idle function and processing loop manager |
| LCK Module | Resource lock manager |
| LOG Module | Event Log manager |
| MBX Module | Mailboxes manager |
| MEM Module | Memory manager |
| PIP Module | Buffered pipe manager |
| PRD Module | Periodic function manager |
| QUE Module | Queue manager |
| RTDX Module | Real-time data exchange manager |
| SEM Module | Semaphores manager |
| SIO Module | Stream I/O manager |
| STS Module | Statistics object manager |
| SWI Module | Software interrupt manager |
| SYS Module | System services manager |
| TRC Module | Trace manager |
| TSK Module | Multitasking manager |
| std.h and stdlib.h functions | Standard C library I/O functions |

## 1.2 Naming Conventions

The format for a DSP/BIOS operation name is a 3- or 4-letter prefix for the module that contains the operation, an underscore, and the action.

In the Assembly Interface section for each macro, Preconditions lists registers that must be set before using the macro. Postconditions lists the registers set by the macro that you may want to use. Modifies lists all individual registers modified by the macro, including registers in the Postconditions list. Several macros modify a 32-bit register. In these cases, the Modifies list includes both the high and low registers that make up the 32-bit register.

## 1.3 Assembly Language Interface Overview

When calling DSP/BIOS APIs from assembly source code, you should include the module.h54 or module.h55 header file for any API modules used. This modular approach reduces the assembly time of programs that do not use all the modules.

Where possible, you should use the DSP/BIOS API macros instead of using assembly instructions directly. The DSP/BIOS API macros provide a portable, optimized way to accomplish the same task. For example, use HWI_disable instead of the equivalent instruction to temporarily disable interrupts. On some devices, disabling interrupts in a threaded interface is more complex than it appears. Some of the DSP/BIOS API functions have assembly macros and some do not.

Most of the DSP/BIOS API macros do not have parameters. Instead they expect parameter values to be stored in specific registers when the API macro is called. This makes your program more efficient. A few API macros accept constant values as parameters. For example, HWI_enter and HWI_exit accept constants defined as bitmasks identifying the registers to save or restore.

The **Preconditions** section for each DSP/BIOS API macro in this chapter lists registers that must be set before using the macro.

The **Postconditions** section lists registers set by the macro.

**Modifies** lists all individual registers modified by the macro, including registers in the Postconditions list.

### Example

### Assembly Interface

C54x

**Syntax** SWI_getpri

**Preconditions** ar2 = address of the SWI object

**Postconditions** a = SWI object’s priority mask

**Modifies** ag, ah, al, c

### Assembly Interface

C55x

**Syntax** SWI_getpri

**Preconditions** xar0 = address of the SWI object

**Postconditions** t0 = SWI object’s priority mask

**Modifies** t0

Assembly functions can call C functions. Remember that the C compiler adds an underscore prefix to function names, so when calling a C function from assembly, add an underscore to the beginning of the C function name. For example, call _myfunction instead of myfunction. See the *TMS320C54x Optimizing Compiler User’s Guide*, (literature number SPRU103E) or *TMS320C55x Optimizing Compiler User’s Guide* for more details.

The Configuration Tool creates two names for each object: one beginning with an underscore, and one without. This allows you to use the name without the underscore in both C and assembly language functions.

All DSP/BIOS APIs are preconditioned per standard C conventions. Individual APIs in this document only indicate additional conditions, if any.

BIOS APIs save/restore context for each task during the context switch that comprises all the registers listed as *Save by Child* in the C compiler manual appropriate for your platform. You must save/restore all additional register context you chose to manipulate directly in assembly or otherwise.

The large memory model (see GBL module, Page 2–113, for more detail) is the default while listing registers in the **Precondition**, **Postcondition** and **Modifies** sections of API descriptions. This means references to xarx, xsp, xssp, etc., are extended registers rather than their 16-bit variants such as arx and sp. In the small model, you can assume the upper bits of the extended register Are designated as *don't care* unless explicitly indicated as an *exception*.

## 1.4 DSP/BIOS TextConf Overview

The section describing each modules in this manual lists properties that can be configured in DSP/BIOS TextConf scripts, along with their types and default values. The sections on manager properties and instance properties also provide TextConf examples that set each property.

For details on DSP/BIOS TextConf scripts, see the *DSP/BIOS TextConf User's Guide* (SPRU007). The language used is JavaScript with an object model specific to the needs of DSP/BIOS configuration.

In general, property names of Module objects are in all uppercase letters. For example, "STACKSIZE". Property names of Instance objects begin with a lowercase word. Subsequent words have their first letter capitalized. For example, "stackSize".

Default values for many properties are dependent on the values of other properties. The defaults shown are those that apply if related property values have not been modified. The defaults shown are for 'C54x. The memory segment defaults are different for 'C55x. Default values for many HWI properties are different for each instance.

The data types shown for the properties are not used in TextConf scripts. However, they do indicate the type of values that are valid for each property. The types used are as follows:

- **Arg.** Arg properties hold arguments to pass to program functions. They may be strings, integers, labels, or other types as needed by the program function.
- **Bool.** You may assign a value of either true or 1 to set a Boolean property to true. You may assign a value of either false or 0 (zero) to set a Boolean property to false. Do not set a Boolean property to the quoted string "true" or "false".
- **EnumInt.** Enumerated integer properties accept a set of valid integer values. These values are displayed in a drop-down list in the DSP/BIOS Configuration Tool.

- **EnumString.** Enumerated string properties accept a set of valid string values. These values are displayed in a drop-down list in the DSP/BIOS Configuration Tool.
- **Extern.** Properties that hold function names use the Extern type. In order to specify a function Extern, use the prog.extern() method as shown in the examples to refer to objects defined as asm, C, or C++ language symbols. The default language is C.
- **Int16.** Integer properties hold 16-bit unsigned integer values. The value range accepted for a property may have additional limits.
- **Int32.** Long integer properties hold 32-bit unsigned integer values. The value range accepted for a property may have additional limits.
- **Numeric.** Numeric properties hold either 32-bit signed or unsigned values or decimal values, as appropriate for the property.
- **Reference.** Properties that reference other configures objects contain an object reference. Use the prog.get() method to specify a reference to another object.
- **String.** String properties hold text strings.

## 1.5 List of Operations

*Table 1-2. DSP/BIOS Operations*

*ATM module operations*

| Function | Operation |
|---|---|
| ATM_andi, ATM_andu | Atomically AND two memory locations and return previous value of the second |
| ATM_cleari, ATM_clearu | Atomically clear memory location and return previous value |
| ATM_deci, ATM_decu | Atomically decrement memory and return new value |
| ATM_inci, ATM_incu | Atomically increment memory and return new value |
| ATM_ori, ATM_oru | Atomically OR memory location and return previous value |
| ATM_seti, ATM_setu | Atomically set memory and return previous value |

*BUF module operations*

| Function | Operation |
|---|---|
| BUF_alloc | Allocate a fixed memory buffer out of the buffer pool |
| BUF_create | Dynamically create a buffer pool |
| BUF_delete | Delete a dynamically created buffer pool |
| BUF_free | Free a fixed memory buffer into the buffer pool |
| BUF_maxbuff | Check the maximum number of buffers used from the buffer pool |
| BUF_stat | Determine the status of a buffer pool (buffer size, number of free buffers, total number of buffers in the pool) |

*C54/55 operations*

| Function | Operation |
|---|---|
| C_disableIR | Disable certain maskable interrupts |
| C_enableIR | Enable certain maskable interrupts |
| C_plug | C function to plug an interrupt vector |

*CLK module operations*

| Function | Operation |
|---|---|
| CLK_countspms | Number of hardware timer counts per millisecond |
| CLK_gethtime | Get high-resolution time |
| CLK_getltime | Get low-resolution time |
| CLK_getprd | Get period register value |

*DEV module operations*

| Function | Operation |
|---|---|
| DEV_createDevice | Dynamically creates device with user-defined parameters |
| DEV_deleteDevice | Deletes the dynamically created device |
| DEV_match | Match a device name with a driver |
| Dxx_close | Close device |

| Function | Operation |
|---|---|
| Dxx_ctrl | Device control operation |
| Dxx_idle | Idle device |
| Dxx_init | Initialize device |
| Dxx_issue | Send a buffer to the device |
| Dxx_open | Open device |
| Dxx_ready | Check if device is ready for I/O |
| Dxx_reclaim | Retrieve a buffer from a device |
| DGN Driver | Software generator driver |
| DGS Driver | Stackable gather/scatter driver |
| DHL Driver | Host link driver |
| DIO Driver | Class driver |
| DNL Driver | Null driver |
| DOV Driver | Stackable overlap driver |
| DPI Driver | Pipe driver |
| DST Driver | Stackable split driver |
| DTR Driver | Stackable streaming transformer driver |

## *GIO module operations*

| Function | Operation |
|---|---|
| GIO_abort | Abort all pending input and output |
| GIO_control | Device-specific control call |
| GIO_create | Allocate and initialize a GIO object |
| GIO_delete | Delete underlying IOM mini-drivers and free GIO object and its structure |
| GIO_flush | Drain output buffers and discard any pending input |
| GIO_read | Synchronous read command |
| GIO_submit | Submit a GIO packet to the mini-driver |
| GIO_write | Synchronous write command |

### HOOK module operations

| Function | Operation |
|---|---|
| HOOK_getenv | Get environment pointer for a given HOOK and TSK combination |
| HOOK_setenv | Set environment pointer for a given HOOK and TSK combination |

### HST module operations

| Function | Operation |
|---|---|
| HST_getpipe | Get corresponding pipe object |

### HWI module operations

| Function | Operation |
|---|---|
| HWI_disable | Globally disable hardware interrupts |
| HWI_dispatchPlug | Plug the HWI dispatcher |
| HWI_enable | Globally enable hardware interrupts |
| HWI_enter | Hardware interrupt service routine prolog |
| HWI_exit | Hardware interrupt service routine epilog |
| HWI_restore | Restore global interrupt enable state |

### IDL module operations

| Function | Operation |
|---|---|
| IDL_run | Make one pass through idle functions |

### LCK module operations

| Function | Operation |
|---|---|
| LCK_create | Create a resource lock |
| LCK_delete | Delete a resource lock |
| LCK_pend | Acquire ownership of a resource lock |
| LCK_post | Relinquish ownership of a resource lock |

## LOG module operations

| Function | Operation |
|---|---|
| LOG_disable | Disable a log |
| LOG_enable | Enable a log |
| LOG_error/LOG_message | Write a message to the system log |
| LOG_event | Append an unformatted message to a log |
| LOG_printf | Append a formatted message to a message log |
| LOG_reset | Reset a log |

## MBX module operations

| Function | Operation |
|---|---|
| MBX_create | Create a mailbox |
| MBX_delete | Delete a mailbox |
| MBX_pend | Wait for a message from mailbox |
| MBX_post | Post a message to mailbox |

## MEM module operations

| Function | Operation |
|---|---|
| MEM_alloc, MEM_valloc, MEM_calloc | Allocate from a memory heap |
| MEM_define | Define a new memory heap |
| MEM_free | Free a block of memory |
| MEM_redefine | Redefine an existing memory heap |
| MEM_stat | Return the status of a memory heap |

### PIP module operations

| Function | Operation |
|---|---|
| PIP_alloc | Get an empty frame from a pipe |
| PIP_free | Recycle a frame that has been read back into a pipe |
| PIP_get | Get a full frame from a pipe |
| PIP_getReaderAddr | Get the value of the readerAddr pointer of the pipe |
| PIP_getReaderNumFrames | Get the number of pipe frames available for reading |
| PIP_getReaderSize | Get the number of words of data in a pipe frame |
| PIP_getWriterAddr | Get the value of the writerAddr pointer of the pipe |
| PIP_getWriterNumFrames | Get the number of pipe frames available to be written to |
| PIP_getWriterSize | Get the number of words that can be written to a pipe frame |
| PIP_peek | Get the pipe frame size and address without actually claiming the pipe frame |
| PIP_put | Put a full frame into a pipe |
| PIP_reset | Reset all fields of a pipe object to their original values |
| PIP_setWriterSize | Set the number of valid words written to a pipe frame |

### PRD module operations

| Function | Operation |
|---|---|
| PRD_getticks | Get the current tick counter |
| PRD_start | Arm a periodic function for one-time execution |
| PRD_stop | Stop a periodic function from execution |
| PRD_tick | Advance tick counter, dispatch periodic functions |

### QUE module operations

| Function | Operation |
|---|---|
| QUE_create | Create an empty queue |
| QUE_delete | Delete an empty queue |
| QUE_dequeue | Remove from front of queue (non-atomically) |
| QUE_empty | Test for an empty queue |
| QUE_enqueue | Insert at end of queue (non-atomically) |

| Function | Operation |
|---|---|
| QUE_get | Get element from front of queue (atomically) |
| QUE_head | Return element at front of queue |
| QUE_insert | Insert in middle of queue (non-atomically) |
| QUE_new | Set a queue to be empty |
| QUE_next | Return next element in queue (non-atomically) |
| QUE_prev | Return previous element in queue (non-atomically) |
| QUE_put | Put element at end of queue (atomically) |
| QUE_remove | Remove from middle of queue (non-atomically) |

## *RTDX module operations*

| Function | Operation |
|---|---|
| RTDX_channelBusy | Return status indicating whether a channel is busy |
| RTDX_CreateInputChannel | Declare input channel structure |
| RTDX_CreateOutputChannel | Declare output channel structure |
| RTDX_disableInput | Disable an input channel |
| RTDX_disableOutput | Disable an output channel |
| RTDX_enableInput | Enable an input channel |
| RTDX_enableOutput | Enable an output channel |
| RTDX_isInputEnabled | Return status of the input data channel |
| RTDX_isOutputEnabled | Return status of the output data channel |
| RTDX_read | Read from an input channel |
| RTDX_readNB | Read from an input channel without blocking |
| RTDX_sizeofInput | Return the number of bytes read from an input channel |
| RTDX_write | Write to an output channel |

## SEM module operations

| Function | Operation |
|---|---|
| SEM_count | Get current semaphore count |
| SEM_create | Create a semaphore |
| SEM_delete | Delete a semaphore |
| SEM_ipost | Signal a semaphore (interrupt only) |
| SEM_new | Initialize a semaphore |
| SEM_pend | Wait for a semaphore |
| SEM_post | Signal a semaphore |
| SEM_reset | Reset semaphore |

## SIO module operations

| Function | Operation |
|---|---|
| SIO_bufsize | Size of the buffers used by a stream |
| SIO_create | Create stream |
| SIO_ctrl | Perform a device-dependent control operation |
| SIO_delete | Delete stream |
| SIO_flush | Idle a stream by flushing buffers |
| SIO_get | Get buffer from stream |
| SIO_idle | Idle a stream |
| SIO_issue | Send a buffer to a stream |
| SIO_put | Put buffer to a stream |
| SIO_ready | Determine if device for stream is ready |
| SIO_reclaim | Request a buffer back from a stream |
| SIO_segid | Memory section used by a stream |
| SIO_select | Select a ready device |
| SIO_staticbuf | Acquire static buffer from stream |

## STS module operations

| Function | Operation |
|---|---|
| STS_add | Add a value to a statistics object |
| STS_delta | Add computed value of an interval to object |
| STS_reset | Reset the values stored in an STS object |
| STS_set | Store initial value of an interval to object |

## SWI module operations

| Function | Operation |
|---|---|
| SWI_andn | Clear bits from SWI's mailbox and post if becomes 0 |
| SWI_andnHook | Specialized version of SWI_andn |
| SWI_create | Create a software interrupt |
| SWI_dec | Decrement SWI's mailbox and post if becomes 0 |
| SWI_delete | Delete a software interrupt |
| SWI_disable | Disable software interrupts |
| SWI_enable | Enable software interrupts |
| SWI_getattrs | Get attributes of a software interrupt |
| SWI_getmbox | Return SWI's mailbox value |
| SWI_getpri | Return an SWI's priority mask |
| SWI_inc | Increment SWI's mailbox and post |
| SWI_or | Set or mask in an SWI's mailbox and post |
| SWI_orHook | Specialized version of SWI_or |
| SWI_post | Post a software interrupt |
| SWI_raisepri | Raise an SWI's priority |
| SWI_restorepri | Restore an SWI's priority |
| SWI_self | Return address of currently executing SWI object |
| SWI_setattrs | Set attributes of a software interrupt |

## SYS module operations

| Function | Operation |
|---|---|
| SYS_abort | Abort program execution |
| SYS_atexit | Stack an exit handler |
| SYS_error | Flag error condition |
| SYS_exit | Terminate program execution |
| SYS_printf, SYS_sprintf, SYS_vprintf, SYS_vsprintf | Formatted output |
| SYS_putchar | Output a single character |

## TRC module operations

| Function | Operation |
|---|---|
| TRC_disable | Disable a set of trace controls |
| TRC_enable | Enable a set of trace controls |
| TRC_query | Test whether a set of trace controls is enabled |

## TSK module operations

| Function | Operation |
|---|---|
| TSK_checkstacks | Check for stack overflow |
| TSK_create | Create a task ready for execution |
| TSK_delete | Delete a task |
| TSK_deltatime | Update task STS with time difference |
| TSK_disable | Disable DSP/BIOS task scheduler |
| TSK_enable | Enable DSP/BIOS task scheduler |
| TSK_exit | Terminate execution of the current task |
| TSK_getenv | Get task environment |
| TSK_geterr | Get task error number |
| TSK_getname | Get task name |
| TSK_getpri | Get task priority |
| TSK_getsts | Get task STS object |
| TSK_itick | Advance system alarm clock (interrupt only) |

| Function | Operation |
|---|---|
| TSK_self | Returns a handle to the current task |
| TSK_setenv | Set task environment |
| TSK_seterr | Set task error number |
| TSK_setpri | Set a task execution priority |
| TSK_settime | Set task STS previous time |
| TSK_sleep | Delay execution of the current task |
| TSK_stat | Retrieve the status of a task |
| TSK_tick | Advance system alarm clock |
| TSK_time | Return current value of system clock |
| TSK_yield | Yield processor to equal priority task |

### *C library stdlib.h*

| Function | Operation |
|---|---|
| atexit | Registers one or more exit functions used by exit |
| calloc | Allocates memory block initialized with zeros |
| exit | Calls the exit functions registered in atexit |
| free | Frees memory block |
| getenv | Searches for a matching environment string |
| malloc | Allocates memory block |
| realloc | Resizes previously allocated memory block |

### *DSP/BIOS std.h special utility C macros*

| Function | Operation |
|---|---|
| ArgToInt(arg) | Casting to treat Arg type parameter as integer (Int) type on the given target |
| ArgToPtr(arg) | Casting to treat Arg type parameter as pointer (Ptr) type on the given target |

Chapter 2

# Application Program Interface

This chapter describes the DSP/BIOS API functions, which are alphabetized by name. In addition, the reference sections describe the overall capabilities of each module.

**Topic** **Page**

## 2.1 ATM Module

The ATM module includes assembly language functions.

**Functions**

- ❏ ATM_andi, ATM_andu. AND memory and return previous value
- ❏ ATM_cleari, ATM_clearu. Clear memory and return previous value
- ❏ ATM_deci, ATM_decu. Decrement memory and return new value
- ❏ ATM_inci, ATM_incu. Increment memory and return new value
- ❏ ATM_ori, ATM_oru. OR memory and return previous value
- ❏ ATM_seti, ATM_setu. Set memory and return previous value

**Description**

ATM provides a set of assembly language functions that are used to manipulate variables with interrupts disabled. These functions can therefore be used on data shared between tasks, and on data shared between tasks and interrupt routines.

## ATM_andi

*Atomically AND Int memory location and return previous value*

### C Interface

**Syntax**

ival = ATM_andi(idst, isrc);

**Parameters**

| | | |
|---|---|---|
| volatile Int | *idst; | /* pointer to integer */ |
| Int | isrc; | /* integer mask */ |

**Return Value**

| | | |
|---|---|---|
| Int | ival; | /* previous value of *idst */ |

### Assembly Interface

none

### Description

ATM_andi atomically ANDs the mask contained in isrc with a destination memory location and overwrites the destination value *idst with the result as follows:

```
`interrupt disable`
ival = *idst;
*idst = ival & isrc;
`interrupt enable`
return(ival);
```

ATM_andi is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_andu
ATM_ori

## ATM_andu

*Atomically AND Uns memory location and return previous value*

### C Interface

**Syntax**

uval = ATM_andu(udst, usrc);

**Parameters**

| | | |
|---|---|---|
| volatile Uns | *udst; | /* pointer to unsigned */ |
| Uns | usrc; | /* unsigned mask */ |

**Return Value**

| | | |
|---|---|---|
| Uns | uval; | /* previous value of *udst */ |

### Assembly Interface

none

### Description

ATM_andu atomically ANDs the mask contained in usrc with a destination memory location and overwrites the destination value *udst with the result as follows:

```
`interrupt disable`
uval = *udst;
*udst = uval & usrc;
`interrupt enable`
return(uval);
```

ATM_andu is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_andi
ATM_oru

## ATM_cleari

*Atomically clear Int memory location and return previous value*

**C Interface**

**Syntax**

ival = ATM_cleari(idst);

**Parameters**

volatile Int *idst; /* pointer to integer */

**Return Value**

Int ival; /* previous value of *idst */

**Assembly Interface**

none

**Description**

ATM_cleari atomically clears an Int memory location and returns its previous value as follows:

```
`interrupt disable`
ival = *idst;
*dst = 0;
`interrupt enable`
return (ival);
```

ATM_cleari is written in assembly language, efficiently disabling interrupts on the target processor during the call.

**See Also**

ATM_clearu
ATM_seti

## ATM_clearu

*Atomically clear Uns memory location and return previous value*

### C Interface

**Syntax** uval = ATM_clearu(udst);

**Parameters** volatile Uns *udst; /* pointer to unsigned */

**Return Value** Uns uval; /* previous value of *udst */

### Assembly Interface

none

### Description

ATM_clearu atomically clears an Uns memory location and returns its previous value as follows:

```
`interrupt disable`
uval = *udst;
*udst = 0;
`interrupt enable`
return (uval);
```

ATM_clearu is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_cleari
ATM_setu

## ATM_deci

*Atomically decrement Int memory and return new value*

**C Interface**

**Syntax** ival = ATM_deci(idst);

**Parameters** volatile Int *idst; /* pointer to integer */

**Return Value** Int ival; /* new value after decrement */

**Assembly Interface** none

**Description** ATM_deci atomically decrements an Int memory location and returns its new value as follows:

```
`interrupt disable`
ival = *idst - 1;
*idst = ival;
`interrupt enable`
return (ival);
```

ATM_deci is written in assembly language, efficiently disabling interrupts on the target processor during the call.

Decrementing a value equal to the minimum signed integer results in a value equal to the maximum signed integer.

**See Also** ATM_decu
ATM_inci

## ATM_decu

*Atomically decrement Uns memory and return new value*

### C Interface

**Syntax** uval = ATM_decu(udst);

**Parameters** volatile Uns *udst; /* pointer to unsigned */

**Return Value** Uns uval; /* new value after decrement */

### Assembly Interface

none

### Description

ATM_decu atomically decrements a Uns memory location and returns its new value as follows:

```
`interrupt disable`
uval = *udst - 1;
*udst = uval;
`interrupt enable`
return (uval);
```

ATM_decu is written in assembly language, efficiently disabling interrupts on the target processor during the call.

Decrementing a value equal to the minimum unsigned integer results in a value equal to the maximum unsigned integer.

### See Also

ATM_deci
ATM_incu

## ATM_inci

*Atomically increment Int memory and return new value*

**C Interface**

**Syntax** ival = ATM_inci(idst);

**Parameters** volatile Int *idst; /* pointer to integer */

**Return Value** Int ival; /* new value after increment */

**Assembly Interface** none

**Description** ATM_inci atomically increments an Int memory location and returns its new value as follows:

```
`interrupt disable`
ival = *idst + 1;
*idst = ival;
`interrupt enable`
return (ival);
```

ATM_inci is written in assembly language, efficiently disabling interrupts on the target processor during the call.

Incrementing a value equal to the maximum signed integer results in a value equal to the minimum signed integer.

**See Also** ATM_deci
ATM_incu

## ATM_incu

*Atomically increment Uns memory and return new value*

**C Interface**

**Syntax**

uval = ATM_incu(udst);

**Parameters**

volatile Uns *udst; /* pointer to unsigned */

**Return Value**

Uns uval; /* new value after increment */

**Assembly Interface**

none

**Description**

ATM_incu atomically increments an Uns memory location and returns its new value as follows:

```
`interrupt disable`
uval = *udst + 1;
*udst = uval;
`interrupt enable`
return (uval);
```

ATM_incu is written in assembly language, efficiently disabling interrupts on the target processor during the call.

Incrementing a value equal to the maximum unsigned integer results in a value equal to the minimum unsigned integer.

**See Also**

ATM_decu
ATM_inci

## ATM_ori

*Atomically OR Int memory location and return previous value*

**C Interface**

**Syntax**

ival = ATM_ori(idst, isrc);

**Parameters**

```
volatile Int  *idst;    /* pointer to integer */
Int            isrc;    /* integer mask */
```

**Return Value**

```
Int            ival;    /* previous value of *idst */
```

**Assembly Interface**

none

**Description**

ATM_ori atomically ORs the mask contained in isrc with a destination memory location and overwrites the destination value *idst with the result as follows:

```
`interrupt disable`
ival = *idst;
*idst = ival | isrc;
`interrupt enable`
return(ival);
```

ATM_ori is written in assembly language, efficiently disabling interrupts on the target processor during the call.

**See Also**

ATM_andi
ATM_oru

## ATM_oru

*Atomically OR Uns memory location and return previous value*

### C Interface

**Syntax**

uval = ATM_oru(udst, usrc);

**Parameters**

```
volatile Uns   *udst;     /* pointer to unsigned */
Uns            usrc;      /* unsigned mask */
```

**Return Value**

```
Uns            uva;       /* previous value of *udst */
```

### Assembly Interface

none

### Description

ATM_oru atomically ORs the mask contained in usrc with a destination memory location and overwrites the destination value *udst with the result as follows:

```
`interrupt disable`
uval = *udst;
*udst = uval | usrc;
`interrupt enable`
return(uval);
```

ATM_oru is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_andu
ATM_ori

## ATM_seti

*Atomically set Int memory and return previous value*

### C Interface

**Syntax**

iold = ATM_seti(idst, inew);

**Parameters**

| | | |
|---|---|---|
| volatile Int | *idst; | /* pointer to integer */ |
| Int | inew; | /* new integer value */ |

**Return Value**

| | | |
|---|---|---|
| Int | iold; | /* previous value of *idst */ |

### Assembly Interface

none

### Description

ATM_seti atomically sets an Int memory location to a new value and returns its previous value as follows:

```
`interrupt disable`
ival = *idst;
*idst = inew;
`interrupt enable`
return (ival);
```

ATM_seti is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_setu
ATM_cleari

## ATM_setu

*Atomically set Uns memory and return previous value*

### C Interface

**Syntax**

uold = ATM_setu(udst, unew);

**Parameters**

```
volatile Uns   *udst;     /* pointer to unsigned */
Uns             unew;     /* new unsigned value */
```

**Return Value**

```
Uns     uold;          /* previous value of *udst */
```

### Assembly Interface

none

### Description

ATM_setu atomically sets an Uns memory location to a new value and returns its previous value as follows:

```
`interrupt disable`
uval = *udst;
*udst = unew;
`interrupt enable`
return (uval);
```

ATM_setu is written in assembly language, efficiently disabling interrupts on the target processor during the call.

### See Also

ATM_clearu
ATM_seti

## 2.2 BUF Module

The BUF module maintains buffer pools of fixed-size buffers.

**Functions**

- ❏ BUF_alloc. Allocate a fixed-size buffer from the buffer pool
- ❏ BUF_create. Dynamically create a buffer pool
- ❏ BUF_delete. Delete a dynamically-created buffer pool
- ❏ BUF_free. Free a fixed-size buffer back to the buffer pool
- ❏ BUF_maxbuff. Get the maximum number of buffers used in a pool
- ❏ BUF_stat. Get statistics for the specified buffer pool

**Constants, Types, and Structures**

```
#if defined(_55l_)
typedef  unsigned long  MEM_sizep;
#else
typedef  unsigned int   MEM_sizep;
#endif

#define BUF_ALLOCSTAMP 0xcafe
#define BUF_FREESTAMP 0xbeef

typedef struct BUF_Obj {
   Ptr startaddr;    /* Start addr of buffer pool */
   MEM_sizep size;   /* Size before alignment */
   MEM_sizep postalignsize; /* Size after align */
   Ptr nextfree;     /* Ptr to next free buffer */
   Uns totalbuffers; /* # of buffers in pool*/
   Uns freebuffers;  /* # of free buffers in pool */
   Int segid;        /* Mem seg for buffer pool */
} BUF_Obj, *BUF_Handle;

typedef struct BUF_Attrs {
   Int segid;  /* segment for element allocation */
} BUF_Attrs;

BUF_Attrs BUF_ATTRS = {/* default attributes */
   0,
};

typedef struct BUF_Stat {
   MEM_sizep postalignsize;  /* Size after align */
   MEM_sizep size;   /* Original size of buffer */
   Uns totalbuffers; /* Total buffers in pool */
   Uns freebuffers;  /* # of free buffers in pool */
} BUF_Stat;
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the BUF Manager Properties and BUF Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| bufSeg | Reference | prog.get("IDATA") |
| bufCount | Int32 | 1 |
| size | Int32 | 2 (’C54x) 4 (’C55x) |
| align | Int32 | 1 (’C54x) 2 (’C55x) |
| len | Int32 | 2 (’C54x) 4 (’C55x) |
| postalignsize | Int32 | 2 (’C54x) 4 (’C55x) |

**Description**

The BUF module maintains pools of fixed-size buffers. These buffer pools can be created statically or dynamically. Dynamically-created buffer pools are allocated from a dynamic memory heap managed by the MEM module. Applications typically allocate buffer pools statically when size and alignment constraints are known at design time. Run-time allocation is used when these constraints vary during execution.

Within a buffer pool, all buffers have the same size and alignment. Although each frame has a fixed length, the application can put a variable amount of data in each frame, up to the length of the frame. You can create multiple buffer pools, each with a different buffer size.

Buffers can be allocated and freed from a pool as needed at run-time using the BUF_alloc and BUF_free functions.

The advantages of allocating memory from a buffer pool instead of from the dynamic memory heaps provided by the MEM module include:

- **Deterministic allocation times.** The BUF_alloc and BUF_free functions require a constant amount of time. Allocating and freeing memory through a heap is not deterministic.
- **Callable from all thread types.** Allocating and freeing buffers is atomic and non-blocking. As a result, BUF_alloc and BUF_free can be called from all types of DSP/BIOS threads: HWI, SWI, TSK, and IDL. In contrast, HWI and SWI threads cannot call MEM_alloc.

- **Optimized for fixed-length allocation.** In contrast MEM_alloc is optimized for variable-length allocation.
- **Less fragmentation.** Since the buffers are of fixed-size, the pool does not become fragmented.

**BUF Manager Properties**

The following global properties can be set for the BUF module in the BUF Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment to contain all BUF objects. (A BUF object may be stored in a different location than the buffer pool memory itself.)

  TextConf Name: OBJMEMSEG    Type: Reference

  Example: `BUF.OBJMEMSEG = prog.get("myMEM");`

**BUF Object Properties**

The following properties can be set for a buffer pool object in the BUF Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script. To create an BUF object in a configuration script, use the following syntax:

```
var myBuf = BUF.create("myBUF");
```

The DSP/BIOS TextConf examples that follow assume the object has been created as shown.

- **comment**. Type a comment to identify this BUF object.

  TextConf Name: comment    Type: String

  Example: `myBuf.comment = "my BUF";`

- **Memory segment for buffer pool.** Select the memory segment in which the buffer pool is to be created. The linker decides where in the segment the buffer pool starts.

  TextConf Name: bufSeg    Type: Reference

  Example: `myBuf.bufSeg = prog.get("myMEM");`

- **Buffer count.** Specify the number of fixed-length buffers to create in this pool.

  TextConf Name: bufCount    Type: Int32

  Example: `myBuf.bufCount = 128;`

- **Buffer size.** Specify the size (in MADUs) of each fixed-length buffer inside this buffer pool. The default size shown is the minimum valid value for that platform. This size may be adjusted to accommodate the alignment in the "Buffer size after alignment" field.

  TextConf Name: size    Type: Int32

  Example: `myBuf.size = 4;`

- **Buffer alignment.** Specify the alignment boundary for fixed-length buffers in the pool. Each buffer is aligned on boundaries with a multiple of this number. The default size shown is the minimum valid value for that platform. The value must be a power of 2.

  TextConf Name: align Type: Int32

  Example: `myBuf.align = 2;`

- **Buffer pool length**. The actual length of the buffer pool (in MADUs) is calculated by multiplying the Buffer count by the Buffer size after alignment. You cannot modify this value directly.

  TextConf Name: len Type: Int32

  Example: `myBuf.len = 4;`

- **Buffer size after alignment.** This field shows the modified Buffer size after applying the alignment. For example, if the Buffer size is 9 and the alignment is 4, the Buffer size after alignment is 12 (the next whole number multiple of 4 after 9).

  TextConf Name: postalignsize Type: Int32

  Example: `myBuf.postalignsize = 4;`

## BUF_alloc

*Allocate a fixed-size buffer from a buffer pool*

### C Interface

**Syntax** bufaddr = BUF_alloc(buf);

**Parameters** BUF_Handle buf; /* buffer pool object handle */

**Return Value** Ptr bufaddr; /* pointer to free buffer */

**Assembly Interface** none

**Reentrant** yes

**Description**

BUF_alloc allocates a fixed-size buffer from the specified buffer pool and returns a pointer to the buffer. BUF_alloc does not initialize the allocated buffer space.

The buf parameter is a handle to identify the buffer pool object, from which the fixed size buffer is to be allocated. If the buffer pool was created dynamically, the handle is the one returned by the call to BUF_create. If the buffer pool was created statically, the handle can be referenced as shown in the example that follows.

If buffers are available in the specified buffer pool, BUF_alloc returns a pointer to the buffer. If no buffers are available, BUF_alloc returns NULL.

The BUF module manages synchronization so that multiple threads can share the same buffer pool for allocation and free operations.

The time required to successfully execute BUF_alloc is deterministic (constant over multiple calls).

**Example**

```
extern BUF_Obj bufferPool;
BUF_Handle buffPoolHandle = &bufferPool;

Ptr buffPtr;

/* allocate a buffer */
buffPtr = BUF_alloc(buffPoolHandle);
if (buffPtr == NULL ) {
    SYS_abort("BUF_alloc failed");
}
```

**See Also**

BUF_free
MEM_alloc

## BUF_create

*Dynamically create a buffer pool*

### C Interface

**Syntax**

buf = BUF_create(numbuff, size, align, attrs);

**Parameters**

```
Uns         numbuff;  /* number of buffers in the pool */
MEM_sizep   size;     /* size of a single buffer in the pool */
Uns         align;    /* alignment for each buffer in the pool */
BUF_Attrs   *attrs;   /* pointer to buffer pool attributes */
```

**Return Value**

```
BUF_Handle  buf;      /* buffer pool object handle */
```

**Assembly Interface**

none

**Reentrant**

no

**Description**

BUF_create creates a buffer pool object dynamically. The parameters correspond to the properties available for statically-created buffer pools, which are described in the BUF Object Properties topic.

The numbuff parameter specifies how many fixed-length buffers the pool should contain. This must be a non-zero number.

The size parameter specifies how long each fixed-length buffer in the pool should be in MADUs. This must be a non-zero number. The size you specify is adjusted as needed to meet the alignment requirements, so the actual buffer size may be larger. The MEM_sizep type is defined as follows:

```
#if defined(_55l_)
typedef  unsigned long  MEM_sizep;
#else
typedef  unsigned int   MEM_sizep;
#endif
```

The align parameter specifies the alignment boundary for buffers in the pool. Each buffer is aligned on a boundary with an address that is a multiple of this number. The value must be a power of 2. The size of buffers created in the pool is automatically increased to accommodate the alignment you specify.

BUF_create ensures that the size and alignment are set to at least the minimum values permitted for the platform. The minimum size permitted is 2 ('C54x) 4 ('C55x) MADUs. The minimum alignment permitted is 1 ('C54x) 2 ('C55x).

The attrs parameter points to a structure of type BUF_Attrs, which is defined as follows:

```
typedef struct BUF_Attrs {
   Int   segid;  /* segment for element allocation*/
} BUF_Attrs;
```

The segid element can be used to specify the memory segment in which buffer pool should be created. If attrs is NULL, the new buffer pool is created the default attributes specified in BUF_ATTRS, which uses the default memory segment.

BUF_create calls MEM_alloc to dynamically create the BUF object's data structure and the buffer pool.

BUF_create returns a handle to the buffer pool of type BUF_Handle. If the buffer pool cannot be created, BUF_create returns NULL. The pool may not be created if the numbuff or size parameter is zero or if the memory available in the specified heap is insufficient.

The time required to successfully execute BUF_create is not deterministic (that is, the time varies over multiple calls).

**Constraints and Calling Context**

- ❏ BUF_create cannot be called from a SWI or HWI.
- ❏ The product of the size (after adjusting for the alignment) and numbuff parameters should not exceed the maximum Uns value.
- ❏ The alignment should be greater than the minimum value and must be a power of 2. If it is not, proper creation of buffer pool is not guaranteed.

**Example**

```
BUF_Handle myBufpool;
BUF_Attrs myAttrs;

myAttrs = BUF_ATTRS;
myBufpool=BUF_create(5, 4, 2, &myAttrs);
if( myBufpool == NULL ){
   LOG_printf(&trace,"BUF_create failed!");
}
```

**See Also**

BUF_delete

## BUF_delete

*Delete a dynamically-created buffer pool*

### C Interface

**Syntax**

status = BUF_delete(buf);

**Parameters**

BUF_Handle buf; /* buffer pool object handle */

**Return Value**

Uns status; /* returned status */

### Assembly Interface

none

### Reentrant

no

### Description

BUF_delete frees the buffer pool object and the buffer pool memory referenced by the handle provided.

The buf parameter is the handle that identifies the buffer pool object. This handle is the one returned by the call to BUF_create. BUF_delete cannot be used to delete statically created buffer pool objects.

BUF_delete returns 1 if it has successfully freed the memory for the buffer object and buffer pool. It returns 0 (zero) if it was unable to delete the buffer pool.

BUF_delete calls MEM_free to delete the BUF object and to free the buffer pool memory. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock on the memory, there is a context switch.

The time required to successfully execute BUF_delete is not deterministic (that is, the time varies over multiple calls).

### Constraints and Calling Context

- BUF_delete cannot be called from a SWI or HWI.
- BUF_delete cannot be used to delete statically created buffer pool objects. No check is performed to ensure that this is the case.
- BUF_delete assumes that all the buffers allocated from the buffer pool have been freed back to the pool.

### Example

```
BUF_Handle myBufpool;
Uns delstat;

delstat = BUF_delete(myBufpool);
if( delstat == 0 ){
   LOG_printf(&trace,"BUF_delete failed!");
}
```

### See Also

BUF_create

## BUF_free

*Free a fixed memory buffer into the buffer pool*

### C Interface

**Syntax**

status = BUF_free(buf, bufaddr);

**Parameters**

| | | |
|---|---|---|
| BUF_Handle | buf; | /* buffer pool object handle */ |
| Ptr | bufaddr; | /* address of buffer to free */ |

**Return Value**

| | | |
|---|---|---|
| Bool | status; | /* returned status */ |

**Assembly Interface**

none

**Reentrant**

yes

**Description**

BUF_free frees the specified buffer back to the specified buffer pool. The newly freed buffer is then available for further allocation by BUF_alloc.

The buf parameter is the handle that identifies the buffer pool object. This handle is the one returned by the call to BUF_create.

The bufaddr parameter is the pointer returned by the corresponding call to BUF_alloc.

BUF_free always returns TRUE if DSP/BIOS real-time analysis is disabled (in the Global Settings Properties). If real-time analysis is enabled, BUF_free returns TRUE if the bufaddr parameter is within the range of the specified buffer pool; otherwise it returns FALSE.

The BUF module manages synchronization so that multiple threads can share the same buffer pool for allocation and free operations.

The time required to successfully execute BUF_free is deterministic (constant over multiple calls).

**Example**

```
extern BUF_Obj bufferPool;
BUF_Handle buffPoolHandle = &bufferPool;
Ptr buffPtr;

...

BUF_free(buffPoolHandle, buffPtr);
```

**See Also**

BUF_alloc
MEM_free

## BUF_maxbuff

*Check the maximum number of buffers from the buffer pool*

### C Interface

**Syntax** count = BUF_maxbuff(buf);

**Parameters** BUF_Handle buf; /* buffer pool object Handle */

**Return Value** Uns count; /*maximum number of buffers used */

**Assembly Interface** none

**Reentrant** no

**Description**

BUF_maxbuff returns the maximum number of buffers that have been allocated from the specified buffer pool at any time. The count measures the number of buffers in use, not the total number of times buffers have been allocated.

The buf parameter is the handle that identifies the buffer pool object. This handle is the one returned by the call to BUF_create.

BUF_maxbuff distinguishes free and allocated buffers via a stamp mechanism. Allocated buffers are marked with the BUF_ALLOCSTAMP stamp (0xcafe). If the application happens to change this stamp to the BUF_FREESTAMP stamp (0xbeef), the count may be inaccurate. Note that this is not an application error. This stamp is only used for BUF_maxbuff, and changing it does not affect program execution.

The time required to successfully execute BUF_maxbuff is not deterministic (that is, the time varies over multiple calls).

**Constraints and Calling Context**

- BUF_maxbuff cannot be called from a SWI or HWI.
- The application must implement synchronization to ensure that other threads do not perform BUF_alloc during the execution of BUF_maxbuff. Otherwise, the count returned by BUF_maxbuff may be inaccurate.

**Example**

```
extern BUF_Obj bufferPool;
BUF_Handle buffPoolHandle = &bufferPool;
Int  maxbuff;

maxbuff = BUF_maxbuff(buffPoolHandle);
LOG_printf(&trace, "Max buffers used: %d", maxbuff);
```

**See Also**

## BUF_stat

*Determine the status of a buffer pool*

**C Interface**

**Syntax**

BUF_stat(buf,statbuf);

**Parameters**

```
BUF_Handle  buf;        /* buffer pool object handle */
BUF_Stat    *statbuf;   /* pointer to buffer status structure */
```

**Return Value**

none

**Assembly Interface**

none

**Reentrant**

yes

**Description**

BUF_stat returns the status of the specified buffer pool.

The buf parameter is the handle that identifies the buffer pool object. This handle is the one returned by the call to BUF_create.

The statbuf parameter must be a structure of type BUF_Stat. The BUF_stat function fills in all the fields of the structure. The BUF_Stat type has the following fields:

```
typedef struct BUF_Stat {
   MEM_sizep postalignsize;  /* Size after align */
   MEM_sizep size;   /* Original size of buffer */
   Uns totalbuffers; /* Total # of buffers in pool */
   Uns freebuffers;  /* # of free buffers in pool */
} BUF_Stat;
```

Size values are expressed in Minimum Addressable Data Units (MADUs). BUF_stat collects statistics with interrupts disabled to ensure the correctness of the statistics gathered.

The time required to successfully execute BUF_stat is deterministic (constant over multiple calls).

**Example**

```
extern BUF_Obj bufferPool;
BUF_Handle buffPoolHandle = &bufferPool;
BUF_Stat stat;

BUF_stat(buffPoolHandle, &stat);
LOG_printf(&trace, "Free buffers Available: %d",
           stat.freebuffers);
```

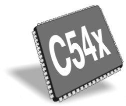
**See Also**

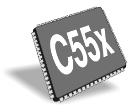
MEM_stat

## 2.3 C54 and C55 Modules

The C54 and C55 modules include target-specific functions for the TMS320C5000 family

**Functions**




- ❑ C54_disableIMR. ASM macro to disable selected interrupts in the IMR
- ❑ C54_enableIMR. ASM macro to enable selected interrupts in the IMR
- ❑ C54_plug. Plug interrupt vector
- ❑ C55_disableIER0, C55_disableIER1. ASM macros to disable selected interrupts in the IER0/IER1, respectively
- ❑ C55_enableIER0, C55_enableIER1. ASM macros to enable selected interrupts in the IER0/IER1, respectively
- ❑ C55_plug. Plug interrupt vector

**Description**

The C54 and C55 modules provide certain target-specific functions and definitions for the TMS320C5000 family of processors.

See the c54.h or c55.h files for a complete list of definitions for hardware flags for C. The c54.h and c55.h files contain C language macros, #defines for various TMS320C5000 registers, and structure definitions. The c54.h54 and c55.h55 files also contain assembly language macros for saving and restoring registers in interrupt service routines.

## C54_disableIMR *Disable certain maskable interrupts*

**C Interface**

**Syntax** oldmask = C54_disableIMR(mask);

**Parameters** Uns mask; /* disable mask */

**Return Value** Uns oldmask; /* actual bits cleared by disable mask */

**Assembly Interface** none

**Description** C54_disableIMR disables interrupts by clearing the bits specified by mask in the Interrupt Mask Register (IMR).

The C version of C54_disableIMR returns a mask of bits actually cleared. This return value should be passed to C54_enableIMR to re-enable interrupts.

See C54_enableIMR for a description and code examples for safely protecting a critical section of code from interrupts.

**See Also** C54_enableIMR

## C55_disableIER0, C55_disableIER1

*Disable certain maskable interrupts*

### C Interface

**Syntax**

```
oldmask = C55_disableIER0(mask);
oldmask = C55_disableIER1(mask);
```

**Parameters**

```
Uns      mask;      /* disable mask */
```

**Return Value**

```
Uns      oldmask;   /* actual bits cleared by disable mask */
```

### Assembly Interface

**Syntax**

```
C55_disableIER0 IEMASK, REG0
C55_disableIER1 IEMASK, REG0
```

**Preconditions**

```
IEMASK     ; interrupt disable mask
REG0       ; temporary register that can be modified
```

**Postconditions**

none

### Description

C55_disableIER0 and C55_disableIER1 disable interrupts by clearing the bits specified by mask in the Interrupt Enable Register (IER0/IER1).

The C versions of C55_disableIER0 and C55_disableIER1 return a mask of bits actually cleared. This return value should be passed to C55_enableIER0 or C55_enableIER1 to re-enable interrupts.

See C55_enableIER0, C55_enableIER1 for a description and code examples for safely protecting a critical section of code from interrupts.

### See Also

C55_enableIER0, C55_enableIER1

## C54_enableIMR

*Enable certain maskable interrupts*

**C Interface**

**Syntax** C54_enableIMR(oldmask);

**Parameters** Uns oldmask; /* enable mask */

**Return Value** Void

**Assembly Interface** none

**Description**

C54_disableIMR and C54_enableIMR are used to disable and enable specific internal interrupts by modifying the Interrupt Mask Register (IMR). C54_disableIMR clears the bits specified by the mask parameter in the IMR and returns a mask of the bits it cleared. C54_enableIMR sets the bits specified by the oldmask parameter in the IMR.

C54_disableIMR and C54_enableIMR are usually used in tandem to protect a critical section of code from interrupts. The following code example shows a region protected from all interrupts:

```
/* C example */
Uns  oldmask;

oldmask = C54_disableIER(~0);
  `do some critical operation; `
  `do not call TSK_sleep, SEM_post, etc.`
C54_enableIER(oldmask);
```

**Note:**

DSP/BIOS kernel calls that can cause a task switch (for example, SEM_post and TSK_sleep) should be avoided within a C54_disableIMR / C54_enableIMR block since the interrupts can be disabled for an indeterminate amount of time if a task switch occurs.

Alternatively, you can disable DSP/BIOS task scheduling for this block by enclosing it with TSK_disable and TSK_enable. You can also use C54_disableIMR / C54_enableIMR to disable selected interrupts, allowing other interrupts to occur. However, if another HWI does occur during this region, it could cause a task switch. You can prevent this by using TSK_disable / TSK_enable around the entire region:

```
Uns    oldmask;

TSK_disable();
oldmask = C54_disableIMR(INTMASK);
  `do some critical operation;`
  `NOT OK to call TSK_sleep, SEM_post, etc.`
C54_enableIMR(oldmask);
TSK_enable();
```

**Note:**

If you use C54_disableIMR and C54_enableIMR to disable only some interrupts, you must surround this region with SWI_disable and SWI_enable, to prevent an intervening HWI from causing a SWI or TSK switch.

The second approach is preferable if it is important not to disable all interrupts in your system during the critical operation.

**See Also** C54_disableIMR

## C55_enableIER0, C55_enableIER1

*Enable certain maskable interrupts*

### C Interface

**Syntax**

C55_enableIER0(oldmask);
C55_enableIER1(oldmask);

**Parameters**

Uns oldmask; /* enable mask */

**Return Value**

Void

### Assembly Interface

**Syntax**

C55_enableIER0 IEMASK, REG0
C55_enableIER1 IEMASK, REG0

**Preconditions**

| | |
|---|---|
| IEMASK | ; interrupt enable mask |
| REG0 | ; temporary register that can be modified by the API |

**Postconditions**

none

### Description

C55_disableIER0, C55_disableIER1, C55_enableIER0, and C55_enableIER1 disable and enable specific internal interrupts by modifying the Interrupt Enable Register (IER0/IER1). C55_disableIER0 and C55_disableIER1 clear the bits specified by the mask parameter in the Interrupt Mask Register and return a mask of the bits it cleared. C55_enableIER0 and C55_enableIER1 set the bits specified by the oldmask parameter in the Interrupt Mask Register.

C55_disableIER0 and C55_disableIER1 and C55_enableIER0 and C55_enableIER1 are usually used in tandem to protect a critical section of code from interrupts. The following code examples show a region protected from all maskable interrupts:

```
; ASM example

.include c55.h55
...

; disable interrupts specified by IEMASK
C55_disableIER0 IEMASK0, t0
C55_disableIER1 IEMASK1, t1

`do some critical operation`

; enable interrupts specified by IEMASK
C55_enableIER0 IEMASK0, t0
C55_enableIER1 IEMASK1, t1

/* C example */
Uns    oldmask;

oldmask0 = c55_disableIER0(~0);
  `do some critical operation; `
  `do not call TSK_sleep, SEM_post, etc.`
c55_enableIER0(oldmask0);
```

**Note:**

DSP/BIOS kernel calls that can cause rescheduling of tasks (for example, SEM_post and TSK_sleep) should be avoided within a C55_disableIER0, C55_disableIER1, C55_enableIER0, and / C55_enableIER1 block since the interrupts can be disabled for an indeterminate amount of time if a task switch occurs.

You can use C55_disableIER0, C55_disableIER1, C55_enableIER0, and C55_enableIER1 to disable selected interrupts, while allowing other interrupts to occur. However, if another ISR occurs during this region, it could cause a task switch. You can prevent this by enclosing it with TSK_disable / TSK_enable to disable DSP/BIOS task scheduling.

```
Uns    oldmask;

TSK_disable();
oldmask0 = C55_disableIER0(INTMASK0);
oldmask1 = C55_disableIER1(INTMASK1);
  `do some critical operation;`
  `NOT OK to call TSK_sleep, SEM_post, etc.`
C55_enableIER0(oldmask0);
C55_enableIER0(oldmask1);
TSK_enable();
```

**Note:**

If you use C55_disableIER0, C55_disableIER1, C55_enableIER0, and C55_enableIER1 to disable only some interrupts, you must surround this region with SWI_disable / SWI_enable, to prevent an intervening HWI from causing a SWI or TSK switch.

The second approach is preferable if it is important not to disable all interrupts in your system during the critical operation.

**See Also** C55_disableIER0, C55_disableIER1

## C54_plug

*C function to plug an interrupt vector*

**C Interface**

**Syntax**

C54_plug(vecid, fxn);

**Parameters**

| | | |
|---|---|---|
| Int | vecid; | /* interrupt id */ |
| Fxn | fxn; | /* pointer to HWI function */ |

**Return Value**

Void

**Assembly Interface**

none

**Description**

C54_plug writes a branch vector into the interrupt vector table, at the address corresponding to vecid. The op-codes written in the branch vector create a branch to the function entry point specified by fxn:

```
b       fxn
```

C54_plug does not enable the interrupt. Use C54_enableIMR to enable specific interrupts.

On the ’C5441, if OVLY = 1 (overlay enabled) and the vector table is in the lower 32 K of program memory, C54_plug can be used. However, since shared program memory space cannot be written to on the ’C5441, the C54_plug function cannot write to the interrupt vector table if OVLY=0 or the vector table extends beyond the lower 32 K. In such cases, use DMA to write the vector to the interrupt jump table.

**Constraints and Calling Context**

- vecid must be a valid interrupt ID in the range of 0-31.

**See Also**

C54_enableIMR

## C55_plug

*C function to plug an an interrupt vector*

### C Interface

**Syntax**

C55_plug(vecid, fxn);

**Parameters**

| | | |
|---|---|---|
| Int | vecid; | /* interrupt id */ |
| Fxn | fxn; | /* pointer to HWI function */ |

**Return Value**

Void

### Assembly Interface

none

### Description

C55_plug hooks up the specified function as the branch target or a hardware interrupt (fielded by the CPU) at the vector address specified in vecid. C55_plug does not enable the interrupt. Use C55_enableIER0, C55_enableIER1 to enable specific interrupts.

### Constraints and Calling Context

❏ vecid must be a valid interrupt ID in the range of 0-31.

### See Also

C55_enableIER0, C55_enableIER1

## 2.4 CLK Module

The CLK module is the system clock manager.

**Functions**

- ❏ CLK_countspms. Timer counts per millisecond
- ❏ CLK_gethtime. Get high resolution time
- ❏ CLK_getltime. Get low resolution time
- ❏ CLK_getprd. Get period register value

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the CLK Manager Properties and CLK Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| C55x Name | Type | Default (Enum Options) |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("DARAM") |
| TIMERSELECT | String | "Timer 0" |
| ENABLECLK | Bool | true |
| HIRESTIME | Bool | true |
| MICROSECONDS | Int16 | 1000.0071 |
| CONFIGURETIMER | Bool | false |
| FIXTDDR | Bool | false |
| TCRTDDR | EnumInt | 0 (0 to 15) |
| PRD | Int16 | 46666 |

| C54x Name | Type | Default (Enum Options) |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| ENABLECLK | Bool | true |
| HIRESTIME | Bool | true |
| MICROSECONDS | Int16 | 1000 |
| CONFIGURETIMER | Bool | false |
| FIXTDDR | Bool | false |
| TCRTDDR | EnumInt | 0 (0 to 15) |
| PRD | Int16 | 49999 |

### Instance Configuration Parameters

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| fxn | Extern | prog.extern("FXN_F_nop") |
| order | Int16 | 0 |

**Description**

The CLK module provides a method for invoking functions periodically.

DSP/BIOS provides two separate timing methods: the high- and low-resolution times managed by the CLK module and the system clock. In the default configuration, the low-resolution time and the system clock are the same.

The CLK module provides a real-time clock with functions to access this clock at two resolutions. This clock can be used to measure the passage of time in conjunction with STS accumulator objects, as well as to add timestamp messages to event logs. Both the low-resolution and high-resolution times are stored as 32-bit values. The value restarts at the value in the period register when 0 is reached.

If the Clock Manager is enabled in the DSP/BIOS Configuration Tool, the time counter is decremented at the following rate, where CLKOUT is the DSP clock speed in MHz (see the Global Settings Property dialog) and TDDR is the value of the timer divide-down register (see the CLK Manager Property dialog):

```
CLKOUT / (TDDR + 1)
```

When this register reaches 0, the counter is reset to the value in the period register and a timer interrupt occurs. When a timer interrupt occurs, the HWI object for the timer runs the CLK_F_isr function. This function causes these events to occur:

- ❑ The low-resolution time is incremented by 1
- ❑ All the functions specified by CLK objects are performed in sequence in the context of that HWI

Therefore, the low-resolution clock ticks at the timer interrupt rate and the clock’s value is equal to the number of timer interrupts that have occurred. You can use the CLK_getltime function to get the low-resolution time and the CLK_getprd function to get the value of the period register property.

The high-resolution time is the number of times the timer counter register has been decremented (number of instruction cycles). Given the high CPU clock rate, the 16-bit timer counter register wraps around quite fast.

The 32-bit high-resolution time is actually calculated by multiplying the low-resolution time by the value of the period register property and adding the difference between the value in the period register and the current value of the timer counter register. You can use the CLK_gethtime function to get the high-resolution time and the CLK_countspms function to get the number of hardware timer counter register ticks per millisecond.

The CLK functions performed when a timer interrupt occurs are performed in the context of the hardware interrupt that caused the system clock to tick. Therefore, the amount of processing performed within CLK functions should be minimized and these functions can only invoke DSP/BIOS calls that are allowable from within an HWI.

**Note:**

CLK functions should not call HWI_enter and HWI_exit as these are called internally by DSP/BIOS when it runs CLK_F_isr. Additionally, CLK functions should **not** use the *interrupt* keyword or the INTERRUPT pragma in C functions.

If you do not want the on-device timer to drive the system clock, you can disable the CLK Manager by clearing the Enable CLK Manager checkbox on the CLK Manager Properties dialog. If this box is gray, go to the PRD Manager Properties dialog and clear the Use CLK Manager to Drive PRD box. Then you can disable the CLK Manager.

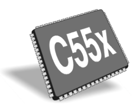
**CLK Manager Properties**

The following global properties can be set for the CLK module in the CLK Manager Properties dialog of the DSP/BIOS Configuration Tool or in a DSP/BIOS TextConf script:

❑ **Object Memory**. The memory segment that contains the CLK objects created with the DSP/BIOS Configuration Tool.

TextConf Name: OBJMEMSEG Type: Reference

Example: `CLK.OBJMEMSEG = prog.get("myMEM");`




❑ **CPU Interrupt**. Shows which HWI interrupt is used to drive the timer services. The value is changed automatically when you change the Timer Selection. This is an informational field only.

TextConf Name: N/A

- **Timer Selection**. The on-device timer to use. Changing this setting also automatically changes the CPU Interrupt used to drive the timer services and the function property of the relevant HWI objects.

  TextConf Name: TIMERSELECT Type: String

  Options: "Timer 0", "Timer 1"

  Example: `CLK.TIMERSELECT = "Timer 0";`

- **Enable CLK Manager**. If checked, the on-device timer hardware is used to drive the high- and low-resolution times and to trigger execution of CLK functions.

  TextConf Name: ENABLECLK Type: Bool

  Example: `CLK.ENABLECLK = true;`

- **Use high resolution time for internal timings**. If checked, the high-resolution timer is used to monitor internal periods; otherwise the less intrusive, low-resolution timer is used.

  TextConf Name: HIRESTIME Type: Bool

  Example: `CLK.HIRESTIME = true;`

- **Microseconds/Int**. The number of microseconds between timer interrupts. The period register is set to a value that achieves the desired period as closely as possible.

  TextConf Name: MICROSECONDS Type: Int16

  Example: `CLK.MICROSECONDS = 1000;`

- **Directly configure on-device timer registers**. If checked, the timer's hardware registers, PRD and TDDR, can be directly set to the desired values. In this case, the Microseconds/Int field is computed based on the values in PRD and TDDR and the CPU clock speed in the Global Settings Properties.

  TextConf Name: CONFIGURETIMER Type: Bool

  Example: `CLK.CONFIGURETIMER = false;`

- **Fix TDDR**. If checked, the value in the TDDR field is not modified by changes to the Microseconds/Int field.

  TextConf Name: FIXTDDR Type: Bool

  Example: `CLK.FIXTDDR = false;`

- **TDDR Register**. The on-device timer divide-down register.

  TextConf Name: TCRTDDR Type: EnumInt

  Options: 0 to 15

  Example: `CLK.TCRTDDR = 0;`

- **PRD Register**. The on-device timer period register.

  TextConf Name: PRD Type: Int16

  Example: `CLK.PRD = 33250;`

- **Instructions/Int**. The number of instruction cycles represented by the period specified above. This is an informational field only.

  TextConf Name: N/A

**CLK Object Properties**

The Clock Manager allows you to create an arbitrary number of CLK objects. Clock objects have functions, which are executed by the Clock Manager every time a timer interrupt occurs. These functions can invoke any DSP/BIOS operations allowable from within an HWI except HWI_enter or HWI_exit.

To create a CLK object in a configuration script, use the following syntax:

```
var myClk = CLK.create("myClk");
```

The following properties can be set for a clock function object in the CLK Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script. The DSP/BIOS TextConf examples assume the myClk object has been created as shown.

- **comment**. Type a comment to identify this CLK object.

  TextConf Name: comment Type: String

  Example: `myClk.comment = "Runs timeFxn";`

- **function**. The function to be executed when the timer hardware interrupt occurs. This function must be written like an HWI function; it must be written in C or assembly and must save and restore any registers this function modifies. However, this function can not call HWI_enter or HWI_exit because DSP/BIOS calls them internally before and after this function runs.

  These functions should be very short as they are performed frequently.

  Since all CLK functions are performed at the same periodic rate, functions that need to run at a multiple of that rate should either count the number of interrupts and perform their activities when the counter reaches the appropriate value or be configured as PRD objects.

  If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. (The DSP/BIOS Configuration Tool generates assembly code, which must use leading underscores when referencing C functions or labels.) If you are using TextConf scripts, do not add an underscore, because TextConf adds the underscore internally.

TextConf Name: fxn Type: Extern

Example: `myClk.fxn = prog.extern("timeFxn");`

- **order**. This field is not shown in the CLK Object Properties dialog. You can change the sequence in which CLK functions are executed by selecting the CLK Manager and dragging the CLK objects shown in the second pane up and down.

  TextConf Name: order Type: Int16

  Example: `myClk.order = 2;`

**CLK - Code Composer Studio Interface**

To enable CLK logging, choose DSP/BIOS→RTA Control Panel and put a check in the appropriate box. You see indicators for low resolution clock interrupts in the Time row of the Execution Graph, which you can open by choosing DSP/BIOS→Execution Graph.

## CLK_countspms — *Number of hardware timer counts per millisecond*

### C Interface

**Syntax** ncounts = CLK_countspms();

**Parameters** Void

**Return Value** LgUns ncounts;

### Assembly Interface

C54x

**Syntax** CLK_countspms

**Preconditions** none

**Postconditions** a = the number of hardware timer register ticks per millisecond

**Modifies** ag, ah, al, c

### Assembly Interface

C55x

**Syntax** CLK_countspms

**Preconditions** none

**Postconditions** ac0 = the number of hardware timer register ticks per millisecond

**Modifies** ac0g, ac0h, ac0l

### Reentrant

yes

### Description

CLK_countspms returns the number of hardware timer register ticks per millisecond. This corresponds to the number of high-resolution ticks per millisecond.

CLK_countspms can be used to compute an absolute length of time from the number of hardware timer interrupts. For example, the following code returns the number of milliseconds since the 32-bit high-resolution time last wrapped back to the value in the period register:

```
timeAbs = (CLK_getltime() * (CLK_getprd() + 1)) /
CLK_countspms();
```

### See Also

CLK_gethtime
CLK_getprd
STS_delta

## CLK_gethtime *Get high-resolution time*

**C Interface**

**Syntax** currtime = CLK_gethtime();

**Parameters** Void

**Return Value** LgUns currtime /* high-resolution time */

**Assembly Interface**

C54x

**Syntax** CLK_gethtime

**Preconditions** intm = 1
cpl = ovm = c16 = frct = cmpt = 0

**Postconditions** ah = bits 32 - 16 of high-resolution time
al = bits 15 - 0 of high-resolution time

**Modifies** ag, ah, al, ar5, bg, bh, bl, c, dp, t, tc

**Assembly Interface**

C55x

**Syntax** CLK_gethtime

**Preconditions** intm = 1

**Postconditions** ac0h = bits 32 - 16 of high-resolution time
ac0l = bits 15 - 0 of high-resolution time

**Modifies** ac0g, ac0h, ac0l, ac1g, ac1h, ac1l, t0, t1

**Reentrant** no

**Description** CLK_gethtime returns the number of high-resolution clock cycles that have occurred as a 32-bit value. When the number of cycles reaches the maximum value that can be stored in 32 bits, the value wraps back to 0.

High-resolution time is the number of times the timer counter register has been decremented. When the CLK manager is enabled in the DSP/BIOS Configuration Tool, the time counter is decremented at the following rate, where CLKOUT is the DSP clock speed in MHz (see the Global Settings Property dialog) and TDDR is the value of the timer divide-down register (see the CLK Manager Property dialog):

```
CLKOUT / (TDDR + 1)
```

When this register reaches 0, the counter is reset to the value in the period register and a timer interrupt occurs. When a timer interrupt occurs, the HWI object for the timer runs the CLK_F_isr function.

In contrast, CLK_getltime returns the number of timer interrupts that have occurred. When the timer counter register reaches 0, the counter is reset to the value set for the period register property of the CLK module and a timer interrupt occurs.

High-resolution time is actually calculated by multiplying the low-resolution time by the value of the period register property and adding to it the difference between the period and the timer register values. Although the CLK_gethtime uses the period register value to calculate the high-resolution time, the value of the high-resolution time is independent of the actual value in the period register. This is because the timer counter register is divided by the period register value when incrementing the low-resolution time, and the result is multiplied by the same period register value to calculate the high-resolution time.

CLK_gethtime provides a value with greater accuracy than CLK_getltime, but which wraps back to 0 more frequently. For example, if the device's clock rate is 200 MHz, then regardless of the period register value, the CLK_gethtime value wraps back to 0 approximately every 86 seconds.

CLK_gethtime can be used in conjunction with STS_set and STS_delta to benchmark code. CLK_gethtime can also be used to add a time stamp to event logs.

**Constraints and Calling Context**

- ❏ CLK_gethtime cannot be called from the program's main function.

**Example**

```
/* ======== showTime ======== */

    Void showTicks
    {
      LOG_printf(&trace, "time = %d", CLK_gethtime());
    }
```

**See Also**

CLK_getltime
PRD_getticks
STS_delta

## CLK_getltime

*Get low-resolution time*

**C Interface**

**Syntax** currtime = CLK_getltime();

**Parameters** Void

**Return Value** LgUns currtime /* low-resolution time */

**Assembly Interface**

C54x

**Syntax** CLK_getltime

**Preconditions** none

**Postconditions** ah = bits 32 - 16 of low-resolution time
al = bits 15 - 0 of low-resolution time

**Modifies** ag, ah, al, c

**Assembly Interface**

C55x

**Syntax** CLK_getltime

**Preconditions** none

**Postconditions** ac0h = bits 32 - 16 of low-resolution time
ac0l = bits 15 - 0 of low-resolution time

**Modifies** ac0g, ac0h, ac0l

**Reentrant** yes

**Description** CLK_getltime returns the number of timer interrupts that have occurred as a 32-bit time value. When the number of interrupts reaches the maximum value that can be stored in 32 bits, value wraps back to 0 on the next interrupt.

The low-resolution time is the number of timer interrupts that have occurred.

The timer counter is decremented every instruction cycle. When this register reaches 0, the counter is reset to the value set for the period register property of the CLK module and a timer interrupt occurs. When a timer interrupt occurs, all the functions specified by CLK objects are performed in sequence in the context of that HWI.

The default low resolution interrupt rate is 1 millisecond/interrupt. By adjusting the period register, you can set rates from less than 1 microsecond/interrupt to more than 1 second/interrupt.

If you use the default configuration, the system clock rate matches the low-resolution rate.

In contrast, CLK_gethtime returns the number of high resolution clock cycles that have occurred. When the timer counter register reaches 0, the counter is reset to the value set for the period register property of the CLK module and a timer interrupt occurs.

Therefore, CLK_gethtime provides a value with greater accuracy than CLK_getltime, but which wraps back to 0 more frequently. For example, if the device's clock rate is 80 MHz, and you use the default period register value of 40000, the CLK_gethtime value wraps back to 0 approximately every 107 seconds, while the CLK_getltime value wraps back to 0 approximately every 49.7 days.

CLK_getltime is often used to add a time stamp to event logs for events that occur over a relatively long period of time.

**Constraints and Calling Context**

- CLK_getltime cannot be called from the program's main function.

**Example**

```
/* ======== showTicks ======== */

   Void showTicks
   {
      LOG_printf(&trace, "time = 0x%x %x",
         (Int)(CLK_getltime() >> 16), (Int)CLK_getltime());
   }
```

**See Also**

CLK_gethtime
PRD_getticks
STS_delta

## CLK_getprd *Get period register value*

**C Interface**

**Syntax** period = CLK_getprd();

**Parameters** Void

**Return Value** Uns period /* period register value */

**Assembly Interface**

**Syntax** CLK_getprd

**Preconditions** none

**Postconditions** a = the value set for the period register property

**Modifies** ag, ah, al, c

**Assembly Interface**

**Syntax** CLK_getprd

**Preconditions** none

**Postconditions** ac0 = the value set for the period register property

**Modifies** ac0g, ac0h, ac0l

**Reentrant** yes

**Description** CLK_getprd returns the value set for the period register property of the CLK Manager in the DSP/BIOS Configuration Tool. CLK_getprd can be used to compute an absolute length of time from the number of hardware timer interrupts. For example, the following code returns the number of milliseconds since the 32-bit high-resolution time last wrapped back to the value in the period register:

```
timeAbs = (CLK_getltime() * (CLK_getprd() + 1)) /
CLK_countspms();
```

**See Also** CLK_countspms
CLK_gethtime
STS_delta

## 2.5 DEV Module

The DEV module provides the device interface.

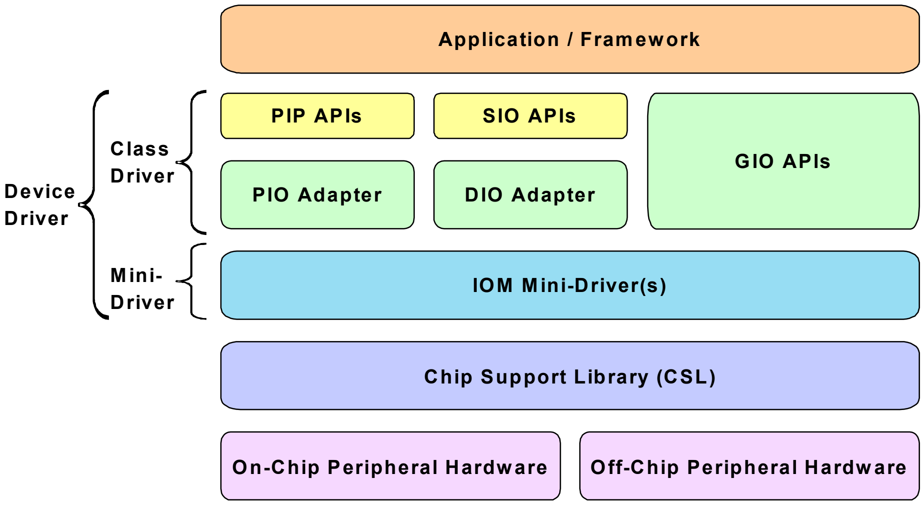
**Functions**

- ❏ DEV_createDevice. Dynamically create device
- ❏ DEV_deleteDevice. Delete dynamically-created device
- ❏ DEV_match. Match device name with driver
- ❏ Dxx_close. Close device
- ❏ Dxx_ctrl. Device control
- ❏ Dxx_idle. Idle device
- ❏ Dxx_init. Initialize device
- ❏ Dxx_issue. Send frame to device
- ❏ Dxx_open. Open device
- ❏ Dxx_ready. Device ready
- ❏ Dxx_reclaim. Retrieve frame from device

**Description**

DSP/BIOS provides two device driver models that enable applications to communicate with DSP peripherals: IOM and SIO/DEV.

The components of the IOM model are illustrated in the following figure. It separates hardware-independent and hardware-dependent layers. Class drivers are hardware independent; they manage device instances, synchronization and serialization of I/O requests. The lower-level mini-driver is hardware-dependent. See the *DSP/BIOS Driver Developer's Guide* (SPRU616) for more information on the IOM model.



The SIO/DEV model provides a streaming I/O interface. In this model, the application indirectly invokes DEV functions implemented by the driver managing the physical device attached to the stream, using generic functions provided by the SIO module. See the *DSP/BIOS User's Guide* (SPRU423) for more information on the SIO/DEV model.

The model used by a device is identified by its function table type. A type of IOM_Fxns is used with the IOM model. A type of DEV_Fxns is used with the DEV/SIO model.

The DEV module provides the following capabilities:

- **Device object creation.** You can create device objects through static configuration or dynamically through the DEV_createDevice function. The DEV_deleteDevice and DEV_match functions are also provided for managing device objects.
- **Driver function templates.** The Dxx functions listed as part of the DEV module are templates for driver functions. These are the functions you create for drivers that use the DEV/SIO model.

**Constants, Types, and Structures**

```
#define DEV_INPUT       0
#define DEV_OUTPUT      1

typedef struct DEV_Frame {  /* frame object */
   QUE_Elem   link;       /* queue link */
   Ptr        addr;       /* buffer address */
   Uns        size;       /* buffer size */
   Arg        misc;       /* reserved for driver */
   Arg        arg;        /* user argument */
   Uns        cmd;        /* mini-driver command */
   Int        status;     /* status of command */
} DEV_Frame;

typedef struct DEV_Obj {  /* device object */
   QUE_Handle todevice; /* downstream frames here */
   QUE_Handle fromdevice; /* upstream frames here */
   Uns      bufsize; /* buffer size */
   Uns      nbufs;   /* number of buffers */
   Int      segid;   /* buffer segment ID */
   Int      mode;    /* DEV_INPUT/DEV_OUTPUT */
#if (defined(_54_) && defined(_FAR_MODE)) || defined(_55_)
   LgInt    devid;   /* device ID */
#else
   Int      devid;   /* device ID */
#endif
   Ptr      params;  /* device parameters */
   Ptr      object;  /* ptr to dev instance obj */
```

```
   DEV_Fxns fxns;    /* driver functions */
   Uns      timeout; /* SIO_reclaim timeout value */
   Uns      align;   /* buffer alignment */
   DEV_Callback  *callback; /* pointer to callback */
} DEV_Obj;

typedef struct DEV_Fxns { /* driver function table */
   Int     (*close)(   DEV_Handle );
   Int     (*ctrl)(    DEV_Handle, Uns, Arg );
   Int     (*idle)(    DEV_Handle, Bool );
   Int     (*issue)(   DEV_Handle );
   Int     (*open)(    DEV_Handle, String );
   Bool    (*ready)(   DEV_Handle, SEM_Handle );
   Int     (*reclaim)( DEV_Handle );
} DEV_Fxns;

typedef struct DEV_Callback {
   Fxn      fxn;     /* function */
   Arg      arg0;    /* argument 0 */
   Arg      arg1;    /* argument 1 */
} DEV_Callback;

typedef struct DEV_Device { /* device specifier */
   String   name;    /* device name */
   Void *   fxns;   /* device function table*/
#if (defined(_54_) && defined(_FAR_MODE)) || defined(_55_)
   LgInt     devid;  /* device ID */
#else
   Int       devid;  /*device ID */
#endif
   Ptr       params; /* device parameters */
   Uns       type;   /* type of the device */
   Ptr       devp;   /* pointer to device handle */
} DEV_Device;

typedef struct DEV_Attrs {
#if (defined(_54_) && defined(_FAR_MODE)) || defined(_55_)
   LgUns     devid;  /* device id */
#else
   Int       devid;  /* device id */
#endif
   Ptr       params; /* device parameters */
   Uns       type;   /* type of the device */
   Ptr       devp;   /* device global data ptr */
} DEV_Attrs;
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the DEV Manager Properties and DEV Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| initFxn | Arg | 0x00000000 |
| fxnTable | Arg | 0x00000000 |
| fxnTableType | EnumString | "DEV_Fxns" ("IOM_Fxns") |
| deviceId | Arg | 0x00000000 |
| params | Arg | 0x00000000 |
| deviceGlobalDataPtr | Arg | 0x00000000 |

**DEV Manager Properties**

The default configuration contains managers for the following built-in device drivers:

- ❑ **DGN Driver (software generator driver).** pseudo-device that generates one of several data streams, such as a sin/cos series or white noise. This driver can be useful for testing applications that require an input stream of data.
- ❑ **DHL Driver (host link driver).** Driver that uses the HST interface to send data to and from the Host Channel Control Analysis Tool.
- ❑ **DIO Adapter (class driver).** Driver used with the device driver model.
- ❑ **DPI Driver (pipe driver).** Software device used to stream data between DSP/BIOS tasks.

To configure devices for other drivers, use the DSP/BIOS Configuration Tool to insert a User-defined Device object. There are no global properties for the user-defined device manager.

The following additional device drivers are supplied with DSP/BIOS:

- ❑ **DGS Driver.** Stackable gather/scatter driver
- ❑ **DNL Driver.** Null driver
- ❑ **DOV Driver.** Stackable overlap driver
- ❑ **DST Driver.** Stackable “split” driver
- ❑ **DTR Driver.** Stackable streaming transformer driver

**DEV Object Properties**

The following properties can be set for a user-defined device in the UDEV Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script. To create a user-defined device object in a configuration script, use the following syntax:

```
var myDev = UDEV.create("myDev");
```

The DSP/BIOS TextConf examples assume the myDev object has been created as shown.

- **comment**. Type a comment to identify this object.

  TextConf Name: comment    Type: String

  Example:
  ```
  myDev.comment = "My device";
  ```

- **init function**. Specify the function to run to initialize this device. Use a leading underscore before the function name if the function is written in C and you are using the DSP/BIOS Configuration Tool. If you are using TextConf scripts, do not add an underscore, because TextConf adds the underscore internally.

  TextConf Name: initFxn    Type: Arg

  Example:
  ```
  myDev.initFxn =
      prog.extern("myInitFxn");
  ```

- **function table ptr**. Specify the name of the device functions table for the driver or mini-driver. This table is of type DEV_Fxns or IOM_Fxns depending on the setting for the function table type property. Use a leading underscore before the table name if the table is declared in C and you are using the DSP/BIOS Configuration Tool.

  TextConf Name: fxnTable    Type: Arg

  Example:
  ```
  myDev.fxnTable =
      prog.extern("mydevFxnTable");
  ```

- **function table type**. Choose the type of function table used by the driver to which this device interfaces. Use the IOM_Fxns option if you are using the DIO class driver to interface to a mini-driver with an IOM_Fxns function table. Otherwise, use the DEV_Fxns option for other drivers that use a DEV_Fxns function table and Dxx functions. You can create a DIO object only if a UDEV object with the IOM_Fxns function table type exists.

  TextConf Name: fxnTableType    Type: EnumString

  Options: "DEV_Fxns", "IOM_Fxns"

  Example:
  ```
  myDev.fxnTableType = "DEV_Fxns";
  ```

- **device id**. Specify the device ID. If the value you provide is non-zero, the value takes the place of a value that would be appended to the device name in a call to SIO_create. The purpose of such a value is driver-specific.

  TextConf Name: deviceId    Type: Arg

  Example:
  ```
  myDev.deviceId =
      prog.extern("devID");
  ```

- **device params ptr**. If this device uses additional parameters, provide the name of the parameter structure. This structure should have a name with the format DXX_Params where XX is the two-letter code for the driver used by this device.

  Use a leading underscore before the structure name if the structure is declared in C and you are using the DSP/BIOS Configuration Tool.

  TextConf Name: params Type: Arg

  Example:
  ```
  myDev.params =
      prog.extern("myParams");
  ```

- **device global data ptr**. Provide a pointer to any global data to be used by this device. This value can be set only if the function table type is IOM_Fxns.

  TextConf Name: deviceGlobalDataPtr Type: Arg

  Example:
  ```
  myDev.deviceGlobalDataPtr =
      0x00000000;
  ```

## DEV_createDevice

*Dynamically create device*

### C Interface

**Syntax**

```
status = DEV_createDevice(name, fxns, initFxn, attrs);
```

**Parameters**

```
String      name;     /* name of device to be created */
Void        *fxns;    /* pointer to device function table */
Fxn         initFxn;  /* device init function */
DEV_Attrs   *attrs;   /* pointer to device attributes */
```

**Return Value**

```
Int         status;   /* result of operation */
```

### Assembly Interface

none

### Reentrant

no

### Description

DEV_createDevice allows an application to create a user-defined device object at run-time. The object created has parameters similar to those defined statically for the DEV Object Properties. After being created, the device can be used as with statically-created DEV objects.

The name parameter specifies the name of the device. The device name should begin with a slash (/) for consistency with statically-created devices and to permit stacking drivers. For example "/codec" might be the name. The name must be unique within the application. If the specified device name already exists, this function returns failure.

The fxns parameter points to the device function table. The function table may be of type DEV_Fxns or IOM_Fxns.

The initFxn parameter specifies a device initialization function. The function passed as this parameter is run if the device is created successfully. The initialization function is called with interrupts disabled. If several devices may use the same driver, the initialization function (or a function wrapper) should ensure that one-time initialization actions are performed only once.

The attrs parameter points to a structure of type DEV_Attrs. This structure is used to pass additional device attributes to DEV_createDevice. If attrs is NULL, the device is created with default attributes. DEV_Attrs has the following structure:

```
typedef struct DEV_Attrs {
#if (defined(_54_) && defined(_FAR_MODE)) || defined(_55_)
   LgUns     devid;  /* device id */
#else
   Int       devid;  /* device id */
#endif
   Ptr       params; /* device parameters */
   Uns       type;   /* type of the device */
   Ptr       devp;   /* device global data ptr */
} DEV_Attrs;
```

The devid item specifies the device ID. If the value you provide is non-zero, the value takes the place of a value that would be appended to the device name in a call to SIO_create. The purpose of such a value is driver-specific. The default value is NULL.

The params item specifies the name of a parameter structure that may be used to provide additional parameters. This structure should have a name with the format DXX_Params where XX is the two-letter code for the driver used by this device. The default value is NULL.

The type item specifies the type of driver used with this device. The default value is DEV_IOMTYPE. The options are:

| Type | Use With |
|---|---|
| DEV_IOMTYPE | Mini-drivers used in the IOM model. |
| DEV_SIOTYPE | DIO adapter with SIO streams<br>or<br>Other DEV/SIO drivers |

The devp item specifies the device global data pointer, which points to any global data to be used by this device. This value can be set only if the table type is IOM_Fxns.The default value is NULL.

If an initFxn is specified, that function is called as a result of calling DEV_createDevice. In addition, if the device type is DEV_IOMTYPE, the mdBindDev function in the function table pointed to by the fxns parameter is called as a result of calling DEV_createDevice. Both of these calls are made with interrupts disabled.

DEV_createDevice returns one of the following status values:

| Constant | Description |
|---|---|
| SYS_OK | Success. |
| SYS_EINVAL | A device with the specified name already exists. |
| SYS_EALLOC | The heap is not large enough to allocate the device. |

DEV_createDevice calls SYS_error if mdBindDev returns a failure condition. The device is not created if mdBindDev fails, and DEV_createDevice returns the IOM error returned by the mdBindDev failure.

**Constraints and Calling Context**

- This function cannot be called from a SWI or HWI.
- This function can only be used if dynamic memory allocation is enabled.
- The device function table must be consistent with the type specified in the attrs structure. DSP/BIOS does not check to ensure that the types are consistent.
- DEV_createDevice updates the list of devices maintained by the system. When DEV_createDevice is called, the application should ensure that other threads cannot call the following functions that operate on the device list: SIO_create, GIO_create, and DEV_match. This can be done by calling TSK_disable and TSK_enable around calls to DEV_createDevice if threads that may operate on the device list can preempt the current thread.

**Example**

```
Int status;

/* Device attributes of device "/pipe0" */
DEV_Attrs dpiAttrs = {
    NULL,
    NULL,
    DEV_SIOTYPE,
    0
};

status = DEV_createDevice("/pipe0", &DPI_FXNS,
        (Fxn)DPI_init, &dpiAttrs);
if (status != SYS_OK) {
    SYS_abort("Unable to create device");
}
```

**See Also**

SIO_create

## DEV_deleteDevice

*Delete a dynamically-created device*

**C Interface**

**Syntax**

status = DEV_deleteDevice(name);

**Parameters**

String name; /* name of device to be deleted */

**Return Value**

Int status; /* result of operation */

**Assembly Interface**

none

**Reentrant**

no

**Description**

DEV_deleteDevice deallocates the specified dynamically-created device and deletes it from the list of devices in the application.

The name parameter specifies the device to delete. This name must match a name used with DEV_createDevice.

Before deleting the device, the application should delete any SIO streams that use the device. SIO_delete cannot be called after the device is deleted.

If the device type is DEV_IOMTYPE, the mdUnBindDev function in the function table pointed to by the fxns parameter of the device is called as a result of calling DEV_deleteDevice. This call is made with interrupts disabled.

DEV_createDevice returns one of the following status values:

| Constant | Description |
|---|---|
| SYS_OK | Success. |
| SYS_ENODEV | No device with the specified name exists. |

DEV_deleteDevice calls SYS_error if mdUnBindDev returns a failure condition. The device is deleted even if mdUnBindDev fails, but DEV_deleteDevice returns the IOM error returned by the mdUnBindDev failure.

**Constraints and Calling Context**

- ❏ This function cannot be called from a SWI or HWI.
- ❏ This function can only be used if dynamic memory allocation is enabled.

- ❏ The device name must match a dynamically-created device. DSP/BIOS does not check to ensure that the device was not created statically.

**Example**

```
status = DEV_deleteDevice("/pipe0");
```

**See Also**

SIO_delete

# DEV_match

*Match a device name with a driver*

## C Interface

### Syntax

substr = DEV_match(name, device);

### Parameters

```
String        name;      /* device name */
DEV_Device    **device;  /* pointer to device table entry */
```

### Return Value

```
String        substr;    /* remaining characters after match */
```

## Assembly Interface

none

## Description

DEV_match searches the device table for the first device name that matches a prefix of name. The output parameter, device, points to the appropriate entry in the device table if successful and is set to NULL on error. The DEV_Device structure is defined in dev.h.

The substr return value contains a pointer to the characters remaining after the match. This string is used by stacking devices to specify the name(s) of underlying devices (for example, /scale10/sine might match /scale10 a stacking device which would, in turn, use /sine to open the underlying generator device).

## See Also

SIO_create

## Dxx_close *Close device*

**C Interface**

**Syntax** status = Dxx_close(device);

**Parameters** DEV_Handle device; /* device handle */

**Return Value** Int status; /* result of operation */

**Assembly Interface** none

**Description** Dxx_close closes the device associated with device and returns an error code indicating success (SYS_OK) or failure. device is bound to the device through a prior call to Dxx_open.

SIO_delete first calls Dxx_idle to idle the device. Then it calls Dxx_close.

Once device has been closed, the underlying device is no longer accessible via this descriptor.

**Constraints and Calling Context**

❏ device must be bound to a device by a prior call to Dxx_open.

**See Also**

Dxx_idle
Dxx_open
SIO_delete

## Dxx_ctrl

*Device control operation*

### C Interface

**Syntax**

```
status = Dxx_ctrl(device, cmd, arg);
```

**Parameters**

```
DEV_Handle device     /* device handle */
Uns        cmd;       /* driver control code */
Arg        arg;       /* control operation argument */
```

**Return Value**

```
Int        status;    /* result of operation */
```

### Assembly Interface

none

### Description

Dxx_ctrl performs a control operation on the device associated with device and returns an error code indicating success (SYS_OK) or failure. The actual control operation is designated through cmd and arg, which are interpreted in a driver-dependent manner.

Dxx_ctrl is called by SIO_ctrl to send control commands to a device.

### Constraints and Calling Context

- device must be bound to a device by a prior call to Dxx_open.

### See Also

SIO_ctrl

## Dxx_idle

*Idle device*

### C Interface

**Syntax**

status = Dxx_idle(device, flush);

**Parameters**

```
DEV_Handle device;   /* device handle */
Bool       flush;    /* flush output flag */
```

**Return Value**

```
Int        status;   /* result of operation */
```

### Assembly Interface

none

### Description

Dxx_idle places the device associated with device into its idle state and returns an error code indicating success (SYS_OK) or failure. Devices are initially in this state after they are opened with Dxx_open.

Dxx_idle returns the device to its initial state. Dxx_idle should move any frames from the device->todevice queue to the device->fromdevice queue. In SIO_ISSUERECLAIM mode, any outstanding buffers issued to the stream must be reclaimed in order to return the device to its true initial state.

Dxx_idle is called by SIO_idle, SIO_flush, and SIO_delete to recycle frames to the appropriate queue.

flush is a boolean parameter that indicates what to do with any pending data of an output stream. If flush is TRUE, all pending data is discarded and Dxx_idle does not block waiting for data to be processed. If flush is FALSE, the Dxx_idle function does not return until all pending output data has been rendered. All pending data in an input stream is always discarded, without waiting.

### Constraints and Calling Context

- device must be bound to a device by a prior call to Dxx_open.

### See Also

SIO_delete
SIO_idle
SIO_flush

## Dxx_init

*Initialize device*

### C Interface

**Syntax** Dxx_init();

**Parameters** Void

**Return Value** Void

### Assembly Interface

none

### Description

Dxx_init is used to initialize the device driver module for a particular device. This initialization often includes resetting the actual device to its initial state.

Dxx_init is called at system startup, before the application's main function is called.

# Dxx_issue

*Send a buffer to the device*

## C Interface

**Syntax** status = Dxx_issue(device);

**Parameters**

```
DEV_Handle device;     /* device handle */
```

**Return Value**

```
Int        status;     /* result of operation */
```

## Assembly Interface

none

## Description

Dxx_issue is used to notify a device that a new frame has been placed on the device->todevice queue. If the device was opened in DEV_INPUT mode then Dxx_issue uses this frame for input. If the device was opened in DEV_OUTPUT mode, Dxx_issue processes the data in the frame, then outputs it. In either mode, Dxx_issue ensures that the device has been started, and returns an error code indicating success (SYS_OK) or failure.

Dxx_issue does not block. In output mode it processes the buffer and places it in a queue to be rendered. In input mode, it places a buffer in a queue to be filled with data, then returns.

Dxx_issue is used in conjunction with Dxx_reclaim to operate a stream. The Dxx_issue call sends a buffer to a stream, and the Dxx_reclaim retrieves a buffer from a stream. Dxx_issue performs processing for output streams, and provides empty frames for input streams. The Dxx_reclaim recovers empty frames in output streams, retrieves full frames, and performs processing for input streams.

SIO_issue calls Dxx_issue after placing a new input frame on the device->todevice. If Dxx_issue fails, it should return an error code. Before attempting further I/O through the device, the device should be idled, and all pending buffers should be flushed if the device was opened for DEV_OUTPUT.

In a stacking device, Dxx_issue must preserve all information in the DEV_Frame object except link and misc. On a device opened for DEV_INPUT, Dxx_issue should preserve the size and the arg fields. On a device opened for DEV_OUTPUT, Dxx_issue should preserve the buffer data (transformed as necessary), the size (adjusted as appropriate by the transform) and the arg field. The DEV_Frame objects themselves do not need to be preserved, only the information they contain.

Dxx_issue must preserve and maintain buffers sent to the device so they can be returned in the order they were received, by a call to Dxx_reclaim.

**Constraints and Calling Context**

- device must be bound to a device by a prior call to Dxx_open.

**See Also**

Dxx_reclaim
SIO_issue
SIO_get
SIO_put

## Dxx_open

*Open device*

### C Interface

**Syntax**

status = Dxx_open(device, name);

**Parameters**

| | | |
|---|---|---|
| DEV_Handle | device; | /* driver handle */ |
| String | name; | /* device name */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* result of operation */ |

### Assembly Interface

none

### Description

Dxx_open is called by SIO_create to open a device. Dxx_open opens a device and returns an error code indicating success (SYS_OK) or failure.

The device parameter points to a DEV_Obj whose fields have been initialized by the calling function (that is, SIO_create). These fields can be referenced by Dxx_open to initialize various device parameters. Dxx_open is often used to attach a device-specific object to device->object. This object typically contains driver-specific fields that can be referenced in subsequent Dxx driver calls.

name is the string remaining after the device name has been matched by SIO_create using DEV_match.

### See Also

Dxx_close
SIO_create

## Dxx_ready

*Check if device is ready for I/O*

**C Interface**

**Syntax** status = Dxx_ready(device, sem);

**Parameters**

```
DEV_Handle device;   /* device handle */
SEM_Handle sem;      /* semaphore to post when ready */
```

**Return Value**

```
Bool       status;   /* TRUE if device is ready */
```

**Assembly Interface** none

**Description**

Dxx_ready is called by SIO_select to determine if the device is ready for an I/O operation. In this context, ready means a call that retrieves a buffer from a device does not block. If a frame exists, Dxx_ready returns TRUE, indicating that the next SIO_get, SIO_put, or SIO_reclaim operation on the device does not cause the calling task to block. If there are no frames available, Dxx_ready returns FALSE. This informs the calling task that a call to SIO_get, SIO_put, or SIO_reclaim for that device would result in blocking.

Dxx_ready registers the device's ready semaphore with the SIO_select semaphore sem. In cases where SIO_select calls Dxx_ready for each of several devices, each device registers its own ready semaphore with the unique SIO_select semaphore. The first device that becomes ready calls SEM_post on the semaphore.

SIO_select calls Dxx_ready twice; the second time, sem = NULL. This results in each device's ready semaphore being set to NULL. This information is needed by the Dxx HWI that normally calls SEM_post on the device's ready semaphore when I/O is completed; if the device ready semaphore is NULL, the semaphore should not be posted.

**See Also** SIO_select

## Dxx_reclaim

*Retrieve a buffer from a device*

**C Interface**

**Syntax**

```
status = Dxx_reclaim(device);
```

**Parameters**

```
DEV_Handle device;    /* device handle */
```

**Return Value**

```
Int        status;    /* result of operation */
```

**Assembly Interface**

none

**Description**

Dxx_reclaim is used to request a buffer back from a device. Dxx_reclaim does not return until a buffer is available for the client in the device->fromdevice queue. If the device was opened in DEV_INPUT mode then Dxx_reclaim blocks until an input frame has been filled with the number of MADUs requested, then processes the data in the frame and place it on the device->fromdevice queue. If the device was opened in DEV_OUTPUT mode, Dxx_reclaim blocks until an output frame has been emptied, then place the frame on the device->fromdevice queue. In either mode, Dxx_reclaim blocks until it has a frame to place on the device->fromdevice queue, or until the stream's timeout expires, and it returns an error code indicating success (SYS_OK) or failure.

If device->timeout is not equal to SYS_FOREVER or 0, the task suspension time can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

If device->timeout is SYS_FOREVER, the task remains suspended until a frame is available on the device's fromdevice queue. If timeout is 0, Dxx_reclaim returns immediately.

If timeout expires before a buffer is available on the device's fromdevice queue, Dxx_reclaim returns SYS_ETIMEOUT. Otherwise Dxx_reclaim returns SYS_OK for success, or an error code.

If Dxx_reclaim fails due to a time out or any other reason, it does not place a frame on the device->fromdevice queue.

Dxx_reclaim is used in conjunction with Dxx_issue to operate a stream. The Dxx_issue call sends a buffer to a stream, and the Dxx_reclaim retrieves a buffer from a stream. Dxx_issue performs processing for output streams, and provides empty frames for input streams. The Dxx_reclaim recovers empty frames in output streams, and retrieves full frames and performs processing for input streams.

SIO_reclaim calls Dxx_reclaim, then it gets the frame from the device->fromdevice queue.

In a stacking device, Dxx_reclaim must preserve all information in the DEV_Frame object except link and misc. On a device opened for DEV_INPUT, Dxx_reclaim should preserve the buffer data (transformed as necessary), the size (adjusted as appropriate by the transform), and the arg field. On a device opened for DEV_OUTPUT, Dxx_reclaim should preserve the size and the arg field. The DEV_Frame objects themselves do not need to be preserved, only the information they contain.

Dxx_reclaim must preserve buffers sent to the device. Dxx_reclaim should never return a buffer that was not received from the client through the Dxx_issue call. Dxx_reclaim always preserves the ordering of the buffers sent to the device, and returns with the oldest buffer that was issued to the device.

**Constraints and Calling Context**

❏ device must be bound to a device by a prior call to Dxx_open.

**See Also**

Dxx_issue
SIO_issue
SIO_get
SIO_put

# DGN Driver

*Software generator driver*

**Description**

The DGN driver manages a class of software devices known as generators, which produce an input stream of data through successive application of some arithmetic function. DGN devices are used to generate sequences of constants, sine waves, random noise, or other streams of data defined by a user function.The number of active generator devices in the system is limited only by the availability of memory.

**Configuring a DGN Device**

To add a DGN device, right-click on the DGN - Software Generator Driver icon and select Insert DGN. From the Object menu, choose Rename and type a new name for the DGN device. Open the DGN Object Properties dialog for the device you created and modify its properties.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the DGN Object Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| device | EnumString | "user" ("sine", "random", "constant", "printHex", or "printInt") |
| useDefaultParam | Bool | false |
| deviceId | Arg | prog.extern("DGN_USER", "asm") |
| constant | Numeric | 1 |
| seedValue | Int32 | 1 |
| lowerLimit | Numeric | -32767 |
| upperLimit | Numeric | 32767 |
| gain | Numeric | 32767 |
| frequency | Numeric | 1 |
| phase | Numeric | 0 |
| rate | Int32 | 256 |
| fxn | Extern | prog.extern("FXN_F_nop") |
| arg | Arg | 0x00000000 |

**Data Streaming**

DGN generator devices can be opened for input data streaming only; generators cannot be used as output devices.

The DGN driver places no inherent restrictions on the size or memory segment of the data buffers used when streaming from a generator device. Since generators are fabricated entirely in software and do not overlap I/O with computation, no more than one buffer is required to attain maximum performance.

Since DGN generates data “on demand,” tasks do not block when calling SIO_get, SIO_put, or SIO_reclaim on a DGN data stream. High-priority tasks must, therefore, be careful when using these streams since lower- or even equal-priority tasks do not get a chance to run until the high-priority task suspends execution for some other reason.

**DGN Driver Properties**

There are no global properties for the DGN driver manager.

**DGN Object Properties**

The following properties can be set for a DGN device on the DGN Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script. To create a DGN device object in a configuration script, use the following syntax:

```
var myDgn = DGN.create("myDgn");
```

The DSP/BIOS TextConf examples assume the myDgn object has been created as shown.

❑ **comment**. Type a comment to identify this object.

TextConf Name: comment Type: String

Example: `myDgn.comment = "DGN device";`

❑ **Device category**. The device category (user, sine, random, constant, printHex, or printInt) determines the type of data stream produced by the device. A sine, random, or constant device can be opened for input data streaming only. A printHex or printInt device can be opened for output data streaming only.

- **user.** Uses a custom function to produce or consume a data stream.
- **sine.** Produce a stream of sine wave samples.
- **random.** Produces a stream of random values.
- **constant.** Produces a constant stream of data.
- **printHex.** Writes the stream data buffers to the trace buffer in hexadecimal format.

- **printInt.** Writes the stream data buffers to the trace buffer in integer format.

TextConf Name: device Type: EnumString

Options: "user", "sine", "random", "constant", "printHex", or "printInt"

Example: `myDgn.device = "user";`

- ❏ **Use default parameters**. Check this box if you want to use the default parameters shown in this dialog for the Device category you selected.

TextConf Name: useDefaultParam Type: Bool

Example: `myDgn.useDefaultParam = false;`

- ❏ **Device ID**. This field is set automatically when you select a Device category.

TextConf Name: deviceId Type: Arg

Example:
```
myDgn.deviceId =
    prog.extern("DGN_USER", "asm");
```

- ❏ **Constant value**. The constant value to be generated if the Device category is constant.

TextConf Name: constant Type: Numeric

Example: `myDgn.constant = 1;`

- ❏ **Seed value**. The initial seed value used by an internal pseudo-random number generator if the Device category is random. Used to produce a uniformly distributed sequence of numbers ranging between Lower limit and Upper limit.

TextConf Name: seedValue Type: Int32

Example: `myDgn.seedValue = 1;`

- ❏ **Lower limit**. The lowest value to be generated if the Device category is random.

TextConf Name: lowerLimit Type: Numeric

Example: `myDgn.lowerLimit = -32767;`

- ❏ **Upper limit**. The highest value to be generated if the Device category is random.

TextConf Name: upperLimit Type: Numeric

Example: `myDgn.upperLimit = 32767;`

- ❏ **Gain**. The amplitude scaling factor of the generated sine wave if the Device category is sine. This factor is applied to each data point. To improve performance, the sine wave magnitude (maximum and minimum) value is approximated to the nearest power of two. This is done by computing a shift value by which each entry in the table is right-shifted before being copied into the input buffer. For example, if you set the Gain to 100, the sine wave magnitude is 128, the nearest power of two.

TextConf Name: gain Type: Numeric

Example: `myDgn.gain = 32767;`

- **Frequency**. The frequency of the generated sine wave (in cycles per second) if the Device category is sine. DGN uses a static (256 word) sine table to approximate a sine wave. Only frequencies that divide evenly into 256 can be represented exactly with DGN. A “step” value is computed at open time for stepping through this table:

  `step = (256 * Frequency / Rate)`

  TextConf Name: frequency Type: Numeric

  Example: `myDgn.frequency = 1;`

- **Phase**. The phase of the generated sine wave (in radians) if the Device category is sine.

  TextConf Name: phase Type: Numeric

  Example: `myDgn.phase = 0;`

- **Sample rate**. The sampling rate of the generated sine wave (in sample points per second) if the Device category is sine.

  TextConf Name: rate Type: Int32

  Example: `myDgn.rate = 256;`

- **User function**. If the Device category is user, specifies the function to be used to compute the successive values of the data sequence in an input device, or to be used to process the data stream, in an output device. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name.

  TextConf Name: fxn Type: Extern

  Example: `myDgn.fxn = prog.extern("usrFxn");`

- **User function argument**. An argument to pass to the User function.

  A user function must have the following form:

  ```
  fxn(Arg arg, Ptr buf, Uns nmadus)
  ```

  where buf contains the values generated or to be processed. buf and nmadus correspond to the buffer address and buffer size (in MADUs), respectively, for an SIO_get operation.

  TextConf Name: arg Type: Arg

  Example: `myDgn.arg = prog.extern("myArg");`

## DGS Driver

*Stackable gather/scatter driver*

**Description**

The DGS driver manages a class of stackable devices which compress or expand a data stream by applying a user-supplied function to each input or output buffer. This driver might be used to pack data buffers before writing them to a disk file or to unpack these same buffers when reading from a disk file. All (un)packing must be completed on frame boundaries as this driver (for efficiency) does not maintain remainders across I/O operations.

On opening a DGS device by name, DGS uses the unmatched portion of the string to recursively open an underlying device.

This driver requires a transform function and a packing/unpacking ratio which are used when packing/unpacking buffers to/from the underlying device.

**Configuring a DGS Device**

To add a DGS device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- ❏ **init function.** Type 0 (zero).
- ❏ **function table ptr.** Type _DGS_FXNS
- ❏ **function table type**. DEV_Fxns
- ❏ **device id.** Type 0 (zero).
- ❏ **device params ptr.** Type 0 (zero) to use the default parameters. To use different values, you must declare a DGS_Params structure (as described after this list) containing the values to use for the parameters.

DGS_Params is defined in dgs.h as follows:

```
/*  ======== DGS_Params ======== */
typedef struct DGS_Params {      /* device parameters
*/
    Fxn   createFxn;
    Fxn   deleteFxn;
    Fxn   transFxn;
    Arg   arg;
    Int  num;
    Int  den;
} DGS_Params;
```

The device parameters are:

- **create function**. Optional, default is NULL. Specifies a function that is called to create and/or initialize a transform specific object. If non-NULL, the create function is called in DGS_open upon creating the stream with argument as its only parameter. The return value of the create function is passed to the transform function.
- **delete function.** Optional, default is NULL. Specifies a function to be called when the device is closed. It should be used to free the object created by the create function.
- **transform function**. Required, default is localcopy. Specifies the transform function that is called before calling the underlying device's output function in output mode and after calling the underlying device's input function in input mode. Your transform function should have the following interface:

```
dstsize = myTrans(Arg arg, Void *src, Void *dst, Int srcsize)
```

  where arg is an optional argument (either argument or created by the create function), and *src and *dst specify the source and destination buffers, respectively. srcsize specifies the size of the source buffer and dstsize specifies the size of the resulting transformed buffer (srcsize * numerator/denominator).

- **arg**. Optional argument, default is 0. If the create function is non-NULL, the arg parameter is passed to the create function and the create function's return value is passed as a parameter to the transform function; otherwise, argument is passed to the transform function.
- **num** and **den** (numerator and denominator). Required, default is 1 for both parameters. These parameters specify the size of the transformed buffer. For example, a transformation that compresses two 32-bit words into a single 32-bit word would have numerator = 1 and denominator = 2 since the buffer resulting from the transformation is 1/2 the size of the original buffer.

**Transform Functions**

The following transform functions are already provided with the DGS driver:

- **u32tou8/u8tou32**. These functions provide conversion to/from packed unsigned 8-bit integers to unsigned 32-bit integers. The buffer must contain a multiple of 4 number of 32-bit/8-bit unsigned values.
- **u16tou32/u32tou16**. These functions provide conversion to/from packed unsigned 16-bit integers to unsigned 32-bit integers. The buffer must contain an even number of 16-bit/32-bit unsigned values.

- **i16toi32/i32toi16**. These functions provide conversion to/from packed signed 16-bit integers to signed 32-bit integers. The buffer must contain an even number of 16-bit/32-bit integers.
- **u8toi16/i16tou8**. These functions provide conversion to/from a packed 8-bit format (two 8-bit words in one 16-bit word) to a one word per 16 bit format.
- **i16tof32/f32toi16**. These functions provide conversion to/from packed signed 16-bit integers to 32-bit floating point values. The buffer must contain an even number of 16-bit integers/32-bit floats.
- **localcopy**. This function simply passes the data to the underlying device without packing or compressing it.

**Data Streaming**

DGS devices can be opened for input or output. DGS_open allocates buffers for use by the underlying device. For input devices, the size of these buffers is (bufsize * numerator) / denominator. For output devices, the size of these buffers is (bufsize * denominator) / numerator. Data is transformed into or out of these buffers before or after calling the underlying device's output or input functions respectively.

You can use the same stacking device in more that one stream, provided that the terminating device underneath it is not the same. For example, if u32tou8 is a DGS device, you can create two streams dynamically as follows:

```
stream = SIO_create("/u32tou8/codec", SIO_INPUT, 128, NULL);
...
stream = SIO_create("/u32tou8/port", SIO_INPUT, 128, NULL);
```

You can also create the streams with the DSP/BIOS Configuration Tool. To do that, add two new SIO objects. Enter /codec (or any other configured terminal device) as the Device Control String for the first stream. Then select the DGS device configured to use u32tou8 in the Device property. For the second stream, enter /port as the Device Control String. Then select the DGS device configured to use u32tou8 in the Device property.

**Example**

The following code example declares DGS_PRMS as a DGS_Params structure:

```
#include <dgs.h>

DGS_Params DGS_PRMS {
    NULL,       /* optional create function */
    NULL,       /* optional delete function */
    u32tou8,    /* required transform function */
    0,          /* optional argument */
    4,          /* numerator */
    1           /* denominator */
}
```

By typing _DGS_PRMS for the Parameters property of a device, the values above are used as the parameters for this device.

**See Also**

DTR Driver

## DHL Driver

*Host link driver*

**Description**

The DHL driver manages data streaming between the host and the DSP. Each DHL device has an underlying HST object. The DHL device allows the target program to send and receive data from the host through an HST channel using the SIO streaming API rather than using pipes. The DHL driver copies data between the stream's buffers and the frames of the pipe in the underlying HST object.

**Configuring a DHL Device**

To add a DHL device you must first add an HST object and make it available to the DHL driver. Right click on the HST – Host Channel Manager icon and add a new HST object. Open the Properties dialog of the HST object and put a checkmark in the Make this channel available for a new DHL device box. If you plan to use this channel for an output DHL device, make sure that you select output as the mode of the HST channel.

Once there are HST channels available for DHL, right click on the DHL – Host Link Driver icon and select Insert DHL. You can rename the DHL device and then open the Properties dialog to select which HST channel, of those available for DHL, is used by this DHL device. If you plan to use the DHL device for output to the host, be sure to select an HST channel whose mode is output. Otherwise, select an HST channel with input mode.

Note that once you have selected an HST channel to be used by a DHL device, that channel is now owned by the DHL device and is no longer available to other DHL channels.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the DHL Driver Properties and DHL Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| hstChannel | Reference | prog.get("myHST") |
| mode | EnumString | "output" ("input") |

**Data Streaming**

DHL devices can be opened for input or output data streaming. A DHL device used by a stream created in output mode must be associated with an output HST channel. A DHL device used by a stream created in input mode must be associated with an input HST channel. If these conditions are not met, a SYS_EBADOBJ error is reported in the system log during startup when the BIOS_start routine calls the DHL_open function for the device.

To use a DHL device in a stream created with the DSP/BIOS Configuration Tool, select the device from the drop-down list in the Device box of its Properties dialog.

To use a DHL device in a stream created dynamically with SIO_create, use the DHL device name (as it appears in the DSP/BIOS Configuration Tool) preceded by “/” (forward slash) as the first parameter of SIO_create:

```
stream = SIO_create(“/dhl0”, SIO_INPUT, 128, NULL);
```

To enable data streaming between the target and the host through streams that use DHL devices, you must bind and start the underlying HST channels of the DHL devices from the Host Channels Control in Code Composer Studio, just as you would with other HST objects.

DHL devices copy the data between the frames in the HST channel’s pipe and the stream’s buffers. In input mode, it is the size of the frame in the HST channel that drives the data transfer. In other words, when all the data in a frame has been transferred to stream buffers, the DHL device returns the current buffer to the stream’s fromdevice queue, making it available to the application. (If the stream buffers can hold more data than the HST channel frames, the stream buffers always come back partially full.) In output mode it is the opposite: the size of the buffers in the stream drives the data transfer so that when all the data in a buffer has been transferred to HST channel frames, the DHL device returns the current frame to the channel’s pipe. In this situation, if the HST channel’s frames can hold more data than the stream’s buffers, the frames always return to the HST pipe partially full.

The maximum performance in a DHL device is obtained when you configure the frame size of its HST channel to match the buffer size of the stream that uses the device. The second best alternative is to configure the stream buffer (or HST frame) size to be larger than, and a multiple of, the size of the HST frame (or stream buffer) size for input (or output) devices. Other configuration settings also work since DHL does not impose restrictions on the size of the HST frames or the stream buffers, but performance is reduced.

**Constraints**

- ❏ HST channels used by DHL devices are not available for use with PIP APIs.
- ❏ Multiple streams cannot use the same DHL device. If more than one stream attempts to use the same DHL device, a SYS_EBUSY error is reported in the system LOG during startup when the BIOS_start routing calls the DHL_open function for the device.

**DHL Driver Properties**

The following global property can be set for the DHL - Host Link Driver on the DHL Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script:

- ❏ **Object memory**. Enter the memory segment from which to allocate DHL objects. Note that this does not affect the memory segments from where the underlying HST object or its frames are allocated. The memory segment for HST objects and their frames can be set in the HST Manager Properties and HST Object Properties dialogs of the Configuration Tool.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `DHL.OBJMEMSEG = prog.get("myMEM");`

**DHL Object Properties**

The following properties can be set for a DHL device using the DHL Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script. To create a DHL device object in a configuration script, use the following syntax:

```
var myDhl = DHL.create("myDhl");
```

The DSP/BIOS TextConf examples assume the myDhl object has been created as shown.

- ❏ **comment**. Type a comment to identify this object.

  TextConf Name: comment Type: String

  Example: `myDhl.comment = "DHL device";`

- **Underlying HST Channel**. Select the underlying HST channel from the drop-down list. The HST Object Properties dialog must have a checkmark in the Make this channel available for a new DHL device box in order for that HST object to be listed here.

  TextConf Name: hstChannel Type: Reference

  Example:
  ```
  myDhl.hstChannel =
      prog.get("myHST");
  ```

- **Mode.** This informational property shows the mode (input or output) of the underlying HST channel. This becomes the mode of the DHL device.

  TextConf Name: mode Type: EnumString

  Options: "input", "output"

  Example:
  ```
  myDhl.mode = "output";
  ```

## DIO Adapter

*SIO Mini-driver adapter*

**Description**

The DIO adapter allows GIO-compliant mini-drivers to be used through SIO module functions. Such mini-drivers are described in the *DSP/BIOS Device Driver Developer's Guide* (SPRU616).

**Configuring a Mini-driver**

To add a DIO device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- **init function.** Type 0 (zero).
- **function table ptr.** Type _DIO_FXNS
- **function table type.** IOM_Fxns
- **device id.** Type 0 (zero).
- **device params ptr.** Type 0 (zero).

Once there are UDEV objects with the IOM_Fxns function table type, you can right click on the DIO – Class Driver icon and select Insert DIO. You can rename the DIO device and then open its Properties dialog.

**DIO Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the DIO Driver Properties and DIO Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| STATICCREATE | Bool | false |

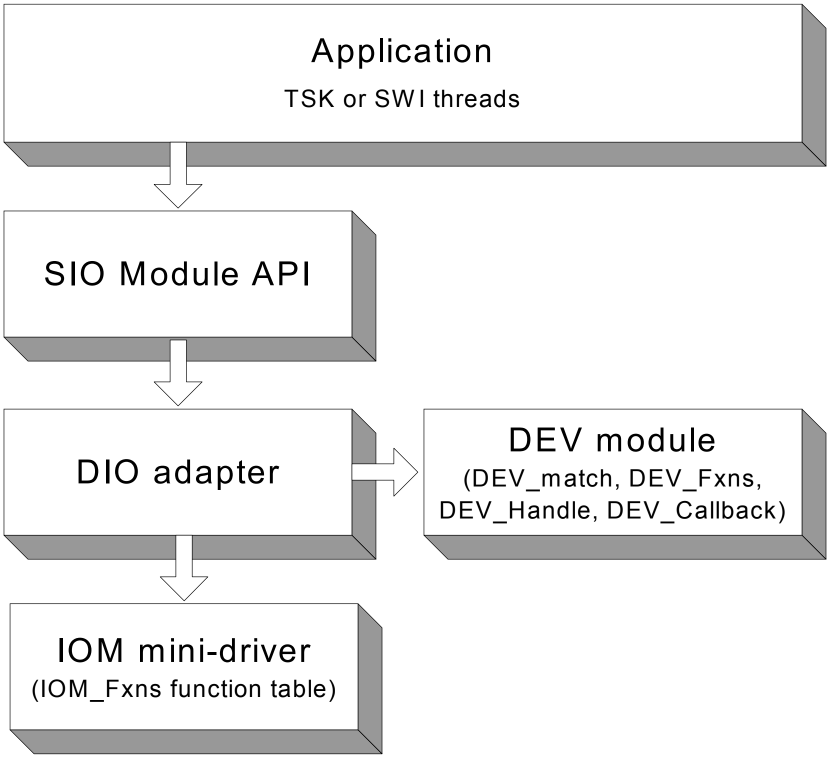
**Instance Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| useCallBackFxn | Bool | false |
| deviceName | Reference | prog.get("UDEV0") |
| chanParams | Arg | 0x00000000 |

**Description**

The mini-drivers described in the *DSP/BIOS Device Driver Developer's Guide* (SPRU616) are intended for use with the GIO module. However, the DIO driver allows them to be used with the SIO module instead of the GIO module.

The following figure summarizes how modules are related in an application that uses the DIO driver and a mini-driver:




**DIO Driver Properties**

The following global properties can be set for the DIO - Class Driver on the DIO Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script:

- ❏ **Object memory**. Enter the memory segment from which to allocate DIO objects.

  TextConf Name: OBJMEMSEG          Type: Reference

  Example: `DIO.OBJMEMSEG = prog.get("myMEM");`

- ❏ **Create All DIO Objects Statically**. Check this box if you want DIO objects to be created completely statically. If you leave this box unchecked, MEM_calloc is used internally to allocate space for DIO objects. If you check this box, you must create all SIO and DIO objects using the Configuration Tool or DSP/BIOS TextConf. Any calls to SIO_create fail. Checking this box reduces the application's code size (so long as the application does not call MEM_alloc or its related functions elsewhere).

TextConf Name: STATICCREATE Type: Bool

Example: `DIO.STATICCREATE = false;`

**DIO Object Properties**

The following properties can be set for a DIO device using the DIO Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script. To create a DIO device object in a configuration script, use the following syntax:

```
var myDio = DIO.create("myDio");
```

The DSP/BIOS TextConf examples assume the myDio object has been created as shown.

❏ **comment**. Type a comment to identify this object.

TextConf Name: comment Type: String

Example: `myDio.comment = "DIO device";`

❏ **use callback version of DIO function table**. Check this box if you want to use DIO with a callback function. Typically, the callback function is SWI_andnHook or a similar function that posts a SWI. Do not check this box if you want to use DIO with a TSK thread.

TextConf Name: useCallBackFxn Type: Bool

Example: `myDio.useCallBackFxn = false;`

❏ **fxnsTable**. This informational property shows the DIO function table used as a result of the settings in the "use callback version of DIO function table" and "Create ALL DIO Objects Statically" checkboxes. The four possible setting combinations of these two checkboxes correspond to the four function tables: DIO_tskDynamicFxns, DIO_tskStaticFxns, DIO_cbDynamicFxns, and DIO_cbStaticFxns.

TextConf Name: N/A

❏ **device name**. Name of the device to use with this DIO object.

TextConf Name: deviceName Type: Reference

Example: `myDio.deviceName = prog.get("UDEV0");`

❏ **channel parameters**. This field allows you to pass an optional argument to the mini-driver create function. See the chanParams parameter of the GIO_create function.

TextConf Name: chanParams Type: Arg

Example: `myDio.chanParams = 0x00000000;`

## DNL Driver

*Null driver*

**Description**

The DNL driver manages "empty" devices which nondestructively produce or consume data streams. The number of empty devices in the system is limited only by the availability of memory; DNL instantiates a new object representing an empty device on opening, and frees this object when the device is closed.

The DNL driver does not define device ID values or a params structure which can be associated with the name used when opening an empty device. The driver also ignores any unmatched portion of the name declared in the system configuration file when opening a device.

**Configuring a DNL Device**

To add a DNL device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- **init function.** Type 0 (zero).
- **function table ptr.** Type _DNL_FXNS
- **function table type**. DEV_Fxns
- **device id.** Type 0 (zero).
- **device params ptr.** Type 0 (zero).

**Data Streaming**

DNL devices can be opened for input or output data streaming. Note that these devices return buffers of undefined data when used for input.

The DNL driver places no inherent restrictions on the size or memory segment of the data buffers used when streaming to or from an empty device. Since DNL devices are fabricated entirely in software and do not overlap I/O with computation, no more that one buffer is required to attain maximum performance.

Tasks do not block when using SIO_get, SIO_put, or SIO_reclaim with a DNL data stream.

## DOV Driver

*Stackable overlap driver*

**Description**

The DOV driver manages a class of stackable devices that generate an overlapped stream by retaining the last N minimum addressable data units (MADUs) of each buffer input from an underlying device. These N points become the first N points of the next input buffer. MADUs are equivalent to a 16-bit word in the data address space of the processor on C54x and C55x platforms.

**Configuring a DOV Device**

To add a DOV device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- ❏ **init function.** Type 0 (zero).
- ❏ **function table ptr.** Type _DOV_FXNS
- ❏ **function table type**. DEV_Fxns
- ❏ **device id.** Type 0 (zero).
- ❏ **device params ptr.** Type 0 (zero) or the length of the overlap as described after this list.

If you enter 0 for the Device ID, you need to specify the length of the overlap when you create the stream with SIO_create by appending the length of the overlap to the device name. If you create the stream with the DSP/BIOS Configuration Tool instead, enter the length of the overlap in the Device Control String for the stream.

For example, if you create a device called overlap with the DSP/BIOS Configuration Tool, and enter 0 as its Device ID, you can open a stream with:

```
stream = SIO_create("/overlap16/codec", SIO_INPUT,
128,NULL);
```

This causes SIO to open a stack of two devices. /overlap16 designates the device called overlap, and 16 tells the driver to use the last 16 MADUs of the previous frame as the first 16 MADUs of the next frame. codec specifies the name of the physical device which corresponds to the actual source for the data.

If, on the other hand you add a device called overlap and enter 16 as its Device ID, you can open the stream with:

```
stream = SIO_create("/overlap/codec", SIO_INPUT, 128, NULL);
```

This causes the SIO Module to open a stack of two devices. /overlap designates the device called overlap, which you have configured to use the last 16 MADUs of the previous frame as the first 16 MADUs of the next frame. As in the previous example, codec specifies the name of the physical device that corresponds to the actual source for the data.

If you create the stream with the DSP/BIOS Configuration Tool and enter 16 as the Device ID property, leave the Device Control String blank.

In addition to the DSP/BIOS Configuration Tool properties, you need to specify the value that DOV uses for the first overlap, as in the example:

```
#include <dov.h>

static DOV_Config DOV_CONFIG = {
    (Char) 0
}
DOV_Config *DOV = &DOV_CONFIG;
```

If floating point 0.0 is required, the initial value should be set to (Char) 0.0.

**Data Streaming**

DOV devices can only be opened for input.

The overlap size, specified in the string passed to SIO_create, must be greater than 0 and less than the size of the actual input buffers.

DOV does not support any control calls. All SIO_ctrl calls are passed to the underlying device.

You can use the same stacking device in more that one stream, provided that the terminating device underneath it is not the same. For example, if overlap is a DOV device with a Device ID of 0:

```
stream = SIO_create("/overlap16/codec", SIO_INPUT, 128, NULL);
...
stream = SIO_create("/overlap4/port", SIO_INPUT, 128, NULL);
```

or if overlap is a DOV device with positive Device ID:

```
stream = SIO_create("/overlap/codec", SIO_INPUT, 128, NULL);
...
stream = SIO_create("/overlap/port", SIO_INPUT, 128, NULL);
```

To create the same streams with the DSP/BIOS Configuration Tool (rather than dynamically with SIO_create), add SIO objects with the DSP/BIOS Configuration Tool. Enter the string that identifies the terminating device preceded by “/” (forward slash) in the SIO object’s Device Control Strings (for example, /codec, /port). Then select the stacking device (overlap, overlapio) from the Device property.

**See Also**

DTR Driver
DGS Driver

## DPI Driver

*Pipe driver*

**Description**

The DPI driver is a software device used to stream data between tasks on a single processor. It provides a mechanism similar to that of UNIX named pipes; a reader and a writer task can open a named pipe device and stream data to/from the device. Thus, a pipe simply provides a mechanism by which two tasks can exchange data buffers.

Any stacking driver can be stacked on top of DPI. DPI can have only one reader and one writer task.

It is possible to delete one end of a pipe with SIO_delete and recreate that end with SIO_create without deleting the other end.

**Configuring a DPI Device**

To add a DPI device, right-click on the DPI - Pipe Driver folder, and select Insert DPI. From the Object menu, choose Rename and type a new name for the DPI device.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the DPI Object Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Instance Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| allowVirtual | Bool | false |

**Data Streaming**

After adding a DPI device called pipe0 in the DSP/BIOS Configuration Tool, you can use it to establish a communication pipe between two tasks. You can do this dynamically, by calling in the function for one task:

```
inStr = SIO_create("/pipe0", SIO_INPUT, bufsize, NULL);
...
SIO_get(inStr, bufp);
```

And in the function for the other task:

```
outStr = SIO_create("/pipe0", SIO_OUTPUT, bufsize, NULL);
...
SIO_put(outStr, bufp, nmadus);
```

or by adding with the DSP/BIOS Configuration Tool two streams that use pipe0, one in output mode (outStream) and the other one in input mode(inStream). Then, from the reader task call:

```
extern SIO_Obj inStream;
SIO_handle inStr = &inStream
...
SIO_get(inStr, bufp);
```

and from the writer task call:

```
extern SIO_Obj outStream;
SIO_handle outStr = &outStream
...
SIO_put(outStr, bufp, nmadus);
```

The DPI driver places no inherent restrictions on the size or memory segments of the data buffers used when streaming to or from a pipe device, other than the usual requirement that all buffers be the same size.

Tasks block within DPI when using SIO_get, SIO_put, or SIO_reclaim if a buffer is not available. SIO_select can be used to guarantee that a call to one of these functions do not block. SIO_select can be called simultaneously by both the input and the output sides.

**DPI and the SIO_ISSUERECLAIM Streaming Model**

In the SIO_ISSUERECLAIM streaming model, an application reclaims buffers from a stream in the same order as they were previously issued. To preserve this mechanism of exchanging buffers with the stream, the default implementation of the DPI driver for ISSUERECLAIM copies the full buffers issued by the writer to the empty buffers issued by the reader.

A more efficient version of the driver that exchanges the buffers across both sides of the stream, rather than copying them, is also provided. To use this variant of the pipe driver for ISSUERECLAIM, edit the C source file dpi.c provided in the C:\ti\c5000\bios\src\drivers folder. Comment out the following line:

```
#define COPYBUFS
```

Rebuild dpi.c. Link your application with this version of dpi.obj instead of the default one. To do this, add this version of dpi.obj to your project explicitly. This buffer exchange alters the way in which the streaming mechanism works. When using this version of the DPI driver, the writer reclaims first the buffers issued by the reader rather than its own issued buffers, and vice versa.

This version of the pipe driver is not suitable for applications in which buffers are broadcasted from a writer to several readers. In this situation it is necessary to preserve the ISSUERECLAIM model original mechanism, so that the buffers reclaimed on each side of a stream are the same that were issued on that side of the stream, and so that they are reclaimed in the same order that they were issued. Otherwise, the writer reclaims two or more different buffers from two or more readers, when the number of buffers it issued was only one.

**Converting a Single Processor Application to a Multiprocessor Application**

It is trivial to convert a single-processor application using tasks and pipes into a multiprocessor application using tasks and communication devices. If using SIO_create, the calls in the source code would change to use the names of the communication devices instead of pipes. (If the communication devices were given names like /pipe0, there would be no source change at all.) If the streams were created with the DSP/BIOS Configuration Tool instead, you would need to change the Device property for the stream in the configuration template, save and rebuild your application for the new configuration. No source change would be necessary.

**Constraints**

Only one reader and one writer can open the same pipe.

**DPI Driver Properties**

There are no global properties for the DPI driver manager.

**DPI Object Properties**

The following property can be set for a DPI device in the DPI Object Properties dialog on the Configuration Tool or in a DSP/BIOS TextConf script. To create a DPI device object in a configuration script, use the following syntax:

```
var myDpi = DPI.create("myDpi");
```

The DSP/BIOS TextConf examples assume the myDpi object has been created as shown.

- **comment**. Type a comment to identify this object.

  TextConf Name: comment Type: String

  Example: `myDpi.comment = "DPI device";`

- **Allow virtual instances of this device**. Put a checkmark in this box if you want to be able to use SIO_create to dynamically create multiple streams to use this DPI device. DPI devices are used by SIO stream objects, which you create with the DSP/BIOS DSP/BIOS Configuration Tool or the SIO_create function.

  If this box is checked, when you use SIO_create, you can create multiple streams that use the same DPI driver by appending numbers to the end of the name. For example, if the DPI object is named "pipe", you can call SIO_create to create pipe0, pipe1, and pipe2. Only integer numbers can be appended to the name.

  If this box is not checked, when you use SIO_create, the name of the SIO object must exactly match the name of the DPI object. As a result, only one open stream can use the DPI object. For example, if the DPI object is named "pipe", an attempt to use SIO_create to create pipe0 fails.

  TextConf Name: allowVirtual Type: Bool

  Example: `myDpi.allowVirtual = false;`

## DST Driver

*Stackable split driver*

**Description**

This stacking driver can be used to input or output buffers that are larger than the physical device can actually handle. For output, a single (large) buffer is split into multiple smaller buffers which are then sent to the underlying device. For input, multiple (small) input buffers are read from the device and copied into a single (large) buffer.

**Configuring a DST Device**

To add a DST device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- ❏ **init function**. Type 0 (zero).
- ❏ **function table ptr**. Type _DST_FXNS
- ❏ **function table type**. DEV_Fxns
- ❏ **device id**. Type 0 (zero) or the number of small buffers corresponding to a large buffer as described after this list.
- ❏ **device params ptr**. Type 0 (zero).

If you enter 0 for the Device ID, you need to specify the number of small buffers corresponding to a large buffer when you create the stream with SIO_create, by appending it to the device name.

**Example 1:**

For example, if you create a user-defined device called split with the DSP/BIOS Configuration Tool, and enter 0 as its Device ID property, you can open a stream with:

```
stream = SIO_create("/split4/codec", SIO_INPUT, 1024, NULL);
```

This causes SIO to open a stack of two devices: /split4 designates the device called split, and 4 tells the driver to read four 256-word buffers from the codec device and copy the data into 1024-word buffers for your application. codec specifies the name of the physical device which corresponds to the actual source for the data.

Alternatively, you can create the stream with the DSP/BIOS Configuration Tool (rather than by calling SIO_create at run-time). To do so, first create and configure two user-defined devices called split and codec. Then, create an SIO object. Type 4/codec as the Device Control String. Select split from the Device list.

**Example 2:** Conversely, you can open an output stream that accepts 1024-word buffers, but breaks them into 256-word buffers before passing them to /codec, as follows:

```
stream = SIO_create("/split4/codec", SIO_OUTPUT, 1024,
NULL);
```

To create this output stream with the DSP/BIOS Configuration Tool, you would follow the steps for example 1, but would select output for the Mode property of the SIO object.

**Example 3:** If, on the other hand, you add a device called split and enter 4 as its Device ID, you need to open the stream with:

```
stream = SIO_create("/split/codec", SIO_INPUT, 1024, NULL);
```

This causes SIO to open a stack of two devices: /split designates the device called split, which you have configured to read four buffers from the codec device and copy the data into a larger buffer for your application. As in the previous example, codec specifies the name of the physical device that corresponds to the actual source for the data.

When you type 4 as the Device ID, you do not need to type 4 in the Device Control String for an SIO object created with the DSP/BIOS Configuration Tool. Type only/codec for the Device Control String.

**Data Streaming**

DST stacking devices can be opened for input or output data streaming.

**Constraints**

- ❏ The size of the application buffers must be an integer multiple of the size of the underlying buffers.
- ❏ This driver does not support any SIO_ctrl calls.

## DTR Driver

*Stackable streaming transformer driver*

**Description**

The DTR driver manages a class of stackable devices known as transformers, which modify a data stream by applying a function to each point produced or consumed by an underlying device. The number of active transformer devices in the system is limited only by the availability of memory; DTR instantiates a new transformer on opening a device, and frees this object when the device is closed.

Buffers are read from the device and copied into a single (large) buffer.

**Configuring a DTR Device**

To add a DTR device, right-click on the User-defined Devices icon in the DSP/BIOS Configuration Tool, and select Insert UDEV. From the Object menu, choose Rename and type a new name for the device. Open the DEV Object Properties dialog for the device you created and modify its properties as follows.

- **init function**. Type 0 (zero).
- **function table ptr**. Type _DTR_FXNS
- **function table type**. DEV_Fxns
- **device id**. Type 0 (zero) or _DTR_multiply.

  If you type 0, you need to supply a user function in the device parameters. This function is called by the driver as follows to perform the transformation on the data stream:

  ```
  if (user.fxn != NULL) {
     (*user.fxn)(user.arg, buffer, size);
  }
  ```

  If you type _DTR_multiply, a data scaling operation is performed on the data stream to multiply the contents of the buffer by the scale.value of the device parameters.
- **device params ptr**. Enter the name of a DTR_Params structure declared in your C application code. See the information following this list for details.

The DTR_Params structure is defined in dtr.h as follows:

```
/*  ======== DTR_Params ======== */
typedef struct {           /* device parameters */
    struct {
        DTR_Scale  value;  /* scaling factor */
    } scale;
    struct {
        Arg        arg;    /* user-defined argument */
        Fxn        fxn;    /* user-defined function */
    } user;
} DTR_Params;
```

In the following code example, DTR_PRMS is declared as a DTR_Params structure:

```
#include <dtr.h>
...
struct DTR_Params DTR_PRMS = {
    10.0,
    NULL,
    NULL
};
```

By typing _DTR_PRMS as the Parameters property of a DTR device, the values above are used as the parameters for this device.

You can also use the default values that the driver assigns to these parameters by entering _DTR_PARAMS for this property. The default values are:

```
DTR_Params DTR_PARAMS = {
    { 1 },          /* scale.value */
    { (Arg)NULL,    /* user.arg */
      (Fxn)NULL },  /* user.fxn */
};
```

scale.value is a floating-point quantity multiplied with each data point in the input or output stream.

user.fxn and user.arg define a transformation that is applied to inbound or outbound blocks of data, where buffer is the address of a data block containing size points; if the value of user.fxn is NULL, no transformation is performed at all.

```
if (user.fxn != NULL) {
   (*user.fxn)(user.arg, buffer, size);
}
```

**Data Streaming**

DTR transformer devices can be opened for input or output and use the same mode of I/O with the underlying streaming device. If a transformer is used as a data source, it inputs a buffer from the underlying streaming device and then transforms this data in place. If the transformer is used as a data sink, it outputs a given buffer to the underlying device after transforming this data in place.

The DTR driver places no inherent restrictions on the size or memory segment of the data buffers used when streaming to or from a transformer device; such restrictions, if any, would be imposed by the underlying streaming device.

Tasks do not block within DTR when using the SIO Module. A task can, of course, block as required by the underlying device.

## 2.6 GIO Module

The GIO module is the Input/Output Module used with IOM mini-drivers as described in *DSP/BIOS Device Driver Developer's Guide* (SPRU616).

**Functions**

- GIO_abort. Abort all pending input and output.
- GIO_control. Device specific control call.
- GIO_create. Allocate and initialize a GIO object.
- GIO_delete. Delete underlying mini-drivers and free up the GIO object and any associated IOM packet structures.
- GIO_flush. Drain output buffers and discard any pending input.
- GIO_read. Synchronous read command.
- GIO_submit. Submits a packet to the mini-driver.
- GIO_write. Synchronous write command.

**Constants, Types, and Structures**

```
/* Modes for GIO_create */
#define IOM_INPUT    0x0001
#define IOM_OUTPUT   0x0002
#define IOM_INOUT    (IOM_INPUT | IOM_OUTPUT)

/* IOM Status and Error Codes */
#define IOM_COMPLETED SYS_OK  /* I/O successful */
#define IOM_PENDING   1 /* I/O queued and pending */
#define IOM_FLUSHED   2 /* I/O request flushed */
#define IOM_ABORTED   3 /* I/O aborted */
#define IOM_EBADIO   -1 /* generic failure */
#define IOM_ETIMEOUT -2 /* timeout occurred */
#define IOM_ENOPACKETS -3 /* no packets available */
#define IOM_EFREE    -4  /* unable to free resources */
#define IOM_EALLOC   -5  /* unable to alloc resource */
#define IOM_EABORT   -6 /* I/O aborted uncompleted*/
#define IOM_EBADMODE -7 /* illegal device mode */
#define IOM_EOF      -8 /* end-of-file encountered */
#define IOM_ENOTIMPL -9 /* operation not supported */
#define IOM_EBADARGS -10 /* illegal arguments used */
#define IOM_ETIMEOUTUNREC -11
                 /* unrecoverable timeout occurred */
#define IOM_EINUSE   -12 /* device already in use */

/* Command codes for IOM_Packet */
#define IOM_READ   0
#define IOM_WRITE  1
#define IOM_ABORT  2
#define IOM_FLUSH  3
#define IOM_USER   128 /* 0-127 reserved for system */
```

```
/* Command codes reserved for control */
#define IOM_CHAN_RESET    0 /* reset channel only */
#define IOM_CHAN_TIMEDOUT 1
                       /* channel timeout occurred */
#define IOM_DEVICE_RESET  2 /* reset entire device */
#define IOM_CNTL_USER   128
                     /* 0-127 reserved for system */

/* Structure passed to GIO_create */
typedef struct GIO_Attrs  {
    Int  nPackets; /* number of asynch I/O packets */
    Uns  timeout;  /* for blocking (SYS_FOREVER) */
} GIO_Attrs;

/* Struct passed to GIO_submit for synchronous use*/
typedef struct GIO_AppCallback {
    GIO_TappCallback      fxn;
    Ptr                   arg;
} GIO_AppCallback;

typedef struct GIO_Obj {
   IOM_Fxns   *fxns;      /* ptr to function table */
   Uns        mode;       /* create mode */
   Uns        timeout;    /* timeout for blocking */
   IOM_Packet syncPacket; /* for synchronous use */
   QUE_Obj    freeList;   /* frames for asynch I/O */
   Ptr        syncObj;    /* ptr to synchro. obj */
   Ptr        mdChan;     /* ptr to channel obj */
} GIO_Obj, *GIO_Handle;

typedef struct IOM_Fxns
{
    IOM_TmdBindDev        mdBindDev;
    IOM_TmdControlChan    mdControlChan;
    IOM_TmdCreateChan     mdCreateChan;
    IOM_TmdDeleteChan     mdDeleteChan;
    IOM_TmdSubmitChan     mdSubmitChan;
    IOM_TmdUnBindDev      mdUnBindDev;
} IOM_Fxns;

typedef struct IOM_Packet {  /* frame object */
   QUE_Elem   link;       /* queue link */
   Ptr        addr;       /* buffer address */
   Uns        size;       /* buffer size */
   Arg        misc;       /* reserved for driver */
   Arg        arg;        /* user argument */
   Uns        cmd;        /* mini-driver command */
   Int        status;     /* status of command */
} IOM_Packet;
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the GIO Manager Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

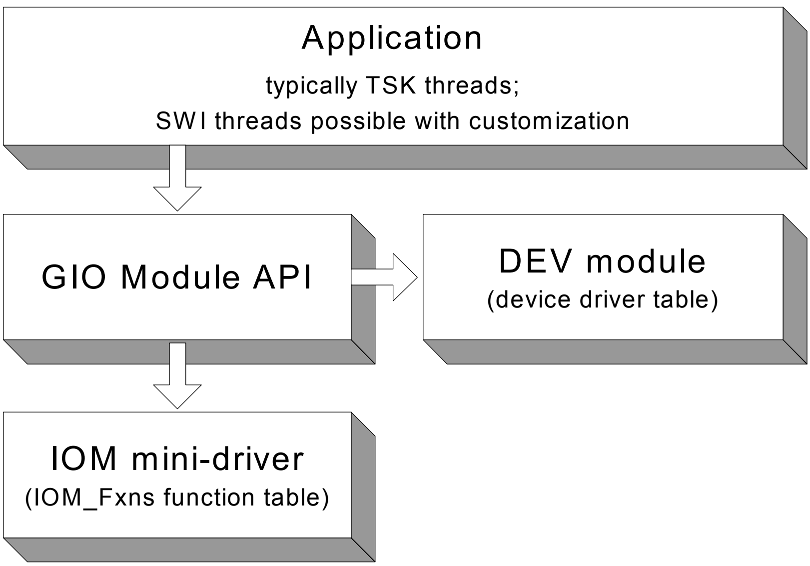
| Name | Type | Default |
|---|---|---|
| ENABLEGIO | Bool | false |
| CREATEFXN | Extern | prog.extern("FXN_F_nop") |
| DELETEFXN | Extern | prog.extern("FXN_F_nop") |
| PENDFXN | Extern | prog.extern("FXN_F_nop" |
| POSTFXN | Extern | prog.extern("FXN_F_nop") |

**Description**

The GIO module provides a standard interface to mini-drivers for devices such as UARTs, codecs, and video capture/display devices. The creation of such mini-drivers is not covered in this manual; it is described in *DSP/BIOS Device Driver Developer's Guide* (SPRU616).

The GIO module is independent of the actual mini-driver being used. It allows the application to use a common interface for I/O requests. It also handles response synchronization. It is intended as common "glue" to bind applications to device drivers.

The following figure shows how modules are related in an application that uses the GIO module and an IOM mini-driver:



The GIO module is the basis of communication between applications and mini-drivers. The DEV module is responsible for maintaining the table of device drivers that are present in the system. The GIO module obtains device information by using functions such as DEV_match.

**GIO Manager Properties**

The following global properties can be set for the GIO module in the GIO Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❑ **Enable General Input/Output Manager.** Check this box to enable use of the GIO module. If your application does not use GIO, you should leave it disabled to prevent additional modules (such as SEM) from being linked into your application.

  TextConf Name: ENABLEGIO Type: Bool

  Example:
```
GIO.ENABLEGIO = false;
```

❑ **Create Function**.The function the GIO module should use to create a synchronization object. This function is typically SEM_create. If you use another function, that function should have a prototype that matches that of SEM_create: Ptr CREATEFXN(Int count, Ptr attrs);

  TextConf Name: CREATEFXN Type: Extern

  Example:
```
GIO.CREATEFXN =
    prog.extern("SEM_create");
```

❑ **Delete Function**.The function the GIO module should use to delete a synchronization object. This function is typically SEM_delete. If you use another function, that function should have a prototype that matches that of SEM_delete: Void DELETEFXN(Ptr semHandle);

  TextConf Name: DELETEFXN Type: Extern

  Example:
```
GIO.DELETEFXN =
    prog.extern("SEM_delete");
```

❑ **Pend Function**.The function the GIO module should use to pend on a synchronization object. This function is typically SEM_pend. If you use another function, that function should have a prototype that matches that of SEM_pend: Bool PENDFXN(Ptr semHandle, Uns timeout);

  TextConf Name: PENDFXN Type: Extern

  Example:
```
GIO.PENDFXN =
    prog.extern("SEM_pend");
```

- **Post Function**.The function the GIO module should use to post a synchronization object. This function is typically SEM_post. If you use another function, that function should have a prototype that matches that of SEM_post: Void POSTFXN(Ptr semHandle);

  TextConf Name: POSTFXN Type: Extern

  Example:
  ```
  GIO.POSTFXN =
      prog.extern("SEM_create");
  ```

**GIO Object Properties** GIO objects cannot be created statically. In order to create a GIO object, the application should call GIO_create.

## GIO_abort

*Abort all pending input and output*

### C Interface

**Syntax** status = GIO_abort(gioChan);

**Parameters** GIO_Handle gioChan; /* handle to an instance of the device */

**Return Value** Int status; /* returns IOM_COMPLETED if successful */

### Assembly Interface

none

### Description

An application calls GIO_abort to abort all input and output from the device. When this call is made, all pending calls are completed with a status of GIO_ABORTED. An application uses this call to return the device to its initial state. Usually this is done in response to an unrecoverable error at the device level.

GIO_abort returns IOM_COMPLETED upon successfully aborting all input and output requests. If an error occurs, the device returns a negative value. For a list of error values, see "Constants, Types, and Structures" on page 2-96.

A call to GIO_abort results in a call to the mdSubmit function of the associated mini-driver. The IOM_ABORT command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_abort can result in the thread blocking.

### Constraints and Calling Context

- ❏ This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.
- ❏ GIO_abort cannot be called from a SWI or HWI unless the underlying mini-driver is a non-blocking driver and the GIO Manager properties are set to use non-blocking synchronization methods.

### Example

```
/* abort all I/O requests given to the device*/
gioStatus = GIO_abort(gioChan);
```

## GIO_control

*Device specific control call*

**C Interface**

**Syntax**

status = GIO_control(gioChan, cmd, args);

**Parameters**

| | | |
|---|---|---|
| GIO_Handle | gioChan; | /* handle to an instance of the device */ |
| Int | cmd; | /* control functionality to perform */ |
| Ptr | args; | /* data structure to pass control information */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* returns IOM_COMPLETED if successful */ |

**Assembly Interface**

none

**Description**

An application calls GIO_control to configure or perform control functionality on the communication channel.

The cmd parameter may be one of the command code constants listed in "Constants, Types, and Structures" on page 2-96. A mini-driver may add command codes for additional functionality.

The args parameter points to a data structure defined by the device to allow control information to be passed between the device and the application. This structure can be generic across a domain or specific to a mini-driver. In some cases, this argument may point directly to a buffer holding control data. In other cases, there may be a level of indirection if the mini-driver expects a data structure to package many components of data required for the control operation. In the simple case where no data is required, this parameter may just be a predefined command value.

GIO_control returns IOM_COMPLETED upon success. If an error occurs, the device returns a negative value. For a list of error values, see "Constants, Types, and Structures" on page 2-96.

A call to GIO_control results in a call to the mdControl function of the associated mini-driver. The mdControl call is typically a blocking call, so calling GIO_control can result in blocking.

**Constraints and Calling Context**

- This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.
- GIO_control cannot be called from a SWI or HWI unless the underlying mini-driver is a non-blocking driver and the GIO Manager properties are set to use non-blocking synchronization methods.

**Example**

```
/* Carry out control/configuration on the device*/
gioStatus = GIO_control(gioChan, XXX_RESET, &args);
```

## GIO_create

*Allocate and initialize a GIO object*

### C Interface

**Syntax**

gioChan = GIO_create(name, mode, *status, chanParams, *attrs)

**Parameters**

| | | |
|---|---|---|
| String | name | /* name of the device to open */ |
| Int | mode | /* mode in which the device is to be opened */ |
| Int | *status | /* address to place driver return status */ |
| Ptr | chanParams | /* optional */ |
| GIO_Attrs | *attrs | /* pointer to a GIO_Attrs structure */ |

**Return Value**

GIO_Handle gioChan; /* handle to an instance of the device */

### Assembly Interface

none

### Description

An application calls GIO_create to create a GIO_Obj object and open a communication channel. This function initializes the I/O channel and opens the lower-level device driver channel. The GIO_create call also creates the synchronization objects it uses and stores them in the GIO_Obj object.

The name argument is the name specified for the device when it was created in the configuration or at runtime.

The mode argument specifies the mode in which the device is to be opened. This may be IOM_INPUT, IOM_OUTPUT, or IOM_INOUT.

If the status returned by the device is non-NULL, a status value is placed at the address specified by the status parameter.

The chanParams parameter is a pointer that may be used to pass device or domain-specific arguments to the mini-driver. The contents at the specified address are interpreted by the mini-driver in a device-specific manner.

The attrs parameter is a pointer to a structure of type GIO_Attrs.

```
typedef struct GIO_Attrs  {
  Int  nPackets; /* number of asynch I/O packets */
  Uns  timeout;  /* for blocking calls (SYS_FOREVER) */
} GIO_Attrs;
```

If attrs is NULL, a default set of attributes is used. The default for nPackets is 2. The default for timeout is SYS_FOREVER.

The GIO_create call allocates a list of IOM_Packet items as specified by the nPackets member of the GIO_Attrs structure and stores them in the GIO_Obj object it creates.

GIO_create returns a handle to the GIO_Obj object created upon a successful open. The handle returned by this call should be used by the application in subsequent calls to GIO functions. This function returns a NULL handle if the device could not be opened. For example, if a device is opened in a mode not supported by the device, this call returns a NULL handle.

A call to GIO_create results in a call to the mdCreate function of the associated mini-driver.

**Constraints and Calling Context**

❏ This function can be called only after the device has been loaded and initialized.

**Example**

```
/* Create a device instance */
gioAttrs = GIO_ATTRS;
gioChan = GIO_create("\Codec0", IOM_INPUT, NULL, NULL,
                  &gioAttrs);
```

## GIO_delete

*Delete underlying mini-drivers and free GIO object and its structures*

**C Interface**

**Syntax** status = GIO_delete(gioChan);

**Parameters** GIO_Handle gioChan; /* handle to device instance to be closed */

**Return Value** Int status; /* returns IOM_COMPLETED if successful */

**Assembly Interface** none

**Description**

An application calls GIO_delete to close a communication channel opened prior to this call with GIO_create. This function deallocates all memory allocated for this channel and closes the underlying device. All pending input and output are cancelled and the corresponding interrupts are disabled.

The gioChan parameter is the handle returned by GIO_create.

This function returns IOM_COMPLETED if the channel is successfully closed. If an error occurs, the device returns a negative value. For a list of error values, see “Constants, Types, and Structures” on page 2-96.

A call to GIO_delete results in a call to the mdDelete function of the associated mini-driver.

**Constraints and Calling Context**

- This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.

**Example**

```
/* close the device instance */
GIO_delete(gioChan);
```

## GIO_flush

*Drain output buffers and discard any pending input*

**C Interface**

**Syntax** status = GIO_flush(gioChan);

**Parameters** GIO_Handle gioChan; /* handle to an instance of the device */

**Return Value** Int status; /* returns IOM_COMPLETED if successful */

**Assembly Interface** none

**Description**

An application calls GIO_flush to flush the input and output channels of the device. All input data is discarded; all pending output requests are completed. When this call is made, all pending input calls are completed with a status of IOM_FLUSHED, and all output calls are completed routinely.

The gioChan parameter is the handle returned by GIO_create.

This call returns IOM_COMPLETED upon successfully flushing all input and output. If an error occurs, the device returns a negative value. For a list of error values, see “Constants, Types, and Structures” on page 2-96.

A call to GIO_flush results in a call to the mdSubmit function of the associated mini-driver. The IOM_FLUSH command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_flush can result in the thread blocking while waiting for output calls to be completed.

**Constraints and Calling Context**

- ❏ This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.
- ❏ GIO_flush cannot be called from a SWI or HWI unless the underlying mini-driver is a non-blocking driver and the GIO Manager properties are set to use non-blocking synchronization methods.

**Example**

```
/* Flush all I/O given to the device*/
GIO_flush(gioChan);
```

## GIO_read

*Synchronous read command*

### C Interface

**Syntax**

status = GIO_read(gioChan, bufp, *pSize);

**Parameters**

| | | |
|---|---|---|
| GIO_Handle | gioChan; | /* handle to an instance of the device */ |
| Ptr | bufp | /* pointer to data structure for buffer data */ |
| Uns | *pSize | /* pointer to size of bufp structure */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* returns IOM_COMPLETED if successful */ |

### Assembly Interface

none

### Description

An application calls GIO_read to read a specified number of MADUs (minimum addressable data units) from the communication channel.

The gioChan parameter is the handle returned by GIO_create.

The bufp parameter points to a device-defined data structure for passing buffer data between the device and the application. This structure may be generic across a domain or specific to a single mini-driver. In some cases, this parameter may point directly to a buffer that holds the read data. In other cases, this parameter may point to a structure that packages buffer information, size, offset to be read from, and other device-dependent data. For example, for video capture devices this structure may contain pointers to RGB buffers, their sizes, video format, and a host of data required for reading a frame from a video capture device. Upon a successful read, this argument points to the returned data.

The pSize parameter points to the size of the buffer or data structure pointed to by the bufp parameter. When the function returns, this parameter points to the number of MADUs read from the device. This parameter is relevant only if the bufp parameter points to a raw data buffer. In cases where it points to a device-defined structure it is redundant—the size of the structure is known to the mini-driver and the application. At most, it can be used for error checking.

GIO_read returns IOM_COMPLETED upon successfully reading the requested number of MADUs from the device. If an error occurs, the device returns a negative value. For a list of error values, see “Constants, Types, and Structures” on page 2-96.

A call to GIO_read results in a call to the mdSubmit function of the associated mini-driver. The IOM_READ command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_read can result in the thread blocking.

**Constraints and Calling Context**

- This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.
- GIO_read cannot be called from a SWI or HWI unless the underlying mini-driver is a non-blocking driver and the GIO Manager properties are set to use non-blocking synchronization methods.

**Example**

```
/* Read from the device */
size = sizeof(readStruct);
status = GIO_read(gioChan, &readStruct, &size);
```

## GIO_submit

*Submit a GIO packet to the mini-driver*

### C Interface

**Syntax**

```
status = GIO_submit(gioChan, cmd, bufp, *pSize, *appCallback);
```

**Parameters**

```
GIO_Handle  gioChan;  /* handle to an instance of the device */
Uns         cmd       /* specified mini-driver command */
Ptr         bufp      /* pointer to data structure for buffer data */
Uns         *pSize    /* pointer to size of bufp structure */
GIO_AppCallback   *appCallback   /* pointer to callback structure */
```

**Return Value**

```
Int         status;   /* returns IOM_COMPLETED if successful */
```

### Assembly Interface

none

### Description

GIO_submit is not typically called by applications. Instead, it is used internally and for user-defined extensions to the GIO module.

GIO_read and GIO_write are macros that call GIO_submit with appCallback set to NULL. This causes GIO to complete the I/O request synchronously using its internal synchronization object (by default, a semaphore). If appCallback is non-NULL, the specified callback is called without blocking. This API is provided to extend GIO functionality for use with SWI threads without changing the GIO implementation.

The gioChan parameter is the handle returned by GIO_create.

The cmd parameter is one of the command code constants listed in “Constants, Types, and Structures” on page 2-96. A mini-driver may add command codes for additional functionality.

The bufp parameter points to a device-defined data structure for passing buffer data between the device and the application. This structure may be generic across a domain or specific to a single mini-driver. In some cases, this parameter may point directly to a buffer that holds the data. In other cases, this parameter may point to a structure that packages buffer information, size, offset to be read from, and other device-dependent data.

The pSize parameter points to the size of the buffer or data structure pointed to by the bufp parameter. When the function returns, this parameter points to the number of MADUs transferred to or from the device. This parameter is relevant only if the bufp parameter points to a raw data buffer. In cases where it points to a device-defined structure it is redundant—the size of the structure is known to the mini-driver and the application. At most, it can be used for error checking.

The appCallback parameter points to either a callback structure that contains the callback function to be called when the request completes is passed, or NULL which causes the call to be synchronous. When a queued request is completed, the callback routine if specified is invoked (i.e. blocking).

GIO_submit returns IOM_COMPLETED upon successfully carrying out the requested functionality. If the request is queued, then a status of IOM_PENDING is returned. If an error occurs, the device returns a negative value. For a list of error values, see "Constants, Types, and Structures" on page 2-96.

A call to GIO_submit results in a call to the mdSubmit function of the associated mini-driver. The specified command is passed to the mdSubmit function.

**Constraints and Calling Context**

- ❏ This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.

**Example**

```
/* write asynchronously to the device*/
size = sizeof(userStruct);
status = GIO_submit(gioChan, IOM_WRITE, &userStruct,
            &size, &callbackStruct);

/* write synchronously to the device */
size = sizeof(userStruct);
status = GIO_submit(gioChan, IOM_WRITE, &userStruct,
            &size, NULL);
```

## GIO_write

*Synchronous write command*

### C Interface

**Syntax**

status = GIO_write(gioChan, bufp, *pSize);

**Parameters**

```
GIO_Handle  gioChan;  /* handle to an instance of the device */
Ptr         bufp      /* pointer to data structure for buffer data */
Uns         *pSize    /* pointer to size of bufp structure */
```

**Return Value**

```
Int         status;   /* returns IOM_COMPLETED if successful */
```

### Assembly Interface

none

### Description

The application uses this function to write a specified number of MADUs to the communication channel.

The gioChan parameter is the handle returned by GIO_create.

The bufp parameter points to a device-defined data structure for passing buffer data between the device and the application. This structure may be generic across a domain or specific to a single mini-driver. In some cases, this parameter may point directly to a buffer that holds the write data. In other cases, this parameter may point to a structure that packages buffer information, size, offset to be written to, and other device-dependent data. For example, for video capture devices this structure may contain pointers to RGB buffers, their sizes, video format, and a host of data required for reading a frame from a video capture device. Upon a successful read, this argument points to the returned data.

The pSize parameter points to the size of the buffer or data structure pointed to by the bufp parameter. When the function returns, this parameter points to the number of MADUs written to the device. This parameter is relevant only if the bufp parameter points to a raw data buffer. In cases where it points to a device-defined structure it is redundant—the size of the structure is known to the mini-driver and the application. At most, it can be used for error checking.

GIO_write returns IOM_COMPLETED upon successfully writing the requested number of MADUs to the device. If an error occurs, the device returns a negative value. For a list of error values, see "Constants, Types, and Structures" on page 2-96.

A call to GIO_write results in a call to the mdSubmit function of the associated mini-driver. The IOM_WRITE command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_write can result in blocking.

**Constraints and Calling Context**

- ❏ This function can be called only after the device has been loaded and initialized. The handle supplied should have been obtained with a prior call to GIO_create.
- ❏ GIO_write cannot be called from a SWI or HWI unless the underlying mini-driver is a non-blocking driver and the GIO Manager properties are set to use non-blocking synchronization methods.

**Example**

```
/* write synchronously to the device*/
size = sizeof(writeStruct);
status = GIO_write(gioChan, &writeStrct, &size);
```

## 2.7 Global Settings

This module is the global settings manager.

**Functions**

None

**Configuration Properties**

The following list shows the properties for this module that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the Global Settings Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| C55x Name | Type | Default (Enum Options) |
|---|---|---|
| CLKOUT | Int16 | .0000 |
| DSPTYPE | Int16 | |
| CHIPTYPE | EnumString | "" ("5510", "5510PG1_2", "5510PG2_0", "other") |
| MEMORYMODEL | EnumString | "SMALL" ("LARGE") |
| CALLUSERINITFXN | Bool | false |
| USERINITFXN | Extern | prog.extern("FXN_F_nop") |
| ENABLEINST | Bool | true |
| ENABLEALLTRC | Bool | true |
| CDBRELATIVEPATH | String | "" |

| C54x Name | Type | Default (Enum Options) |
|---|---|---|
| CLKOUT | Int16 | 140.0000 |
| DSPTYPE | Int16 | 54 |
| CHIPTYPE | EnumString | "5402" ("5409", "5409A", "5410", "5410A", "5416", "5420", "5421", 5440", "5441", "5472", "other") |
| LOWERPMST | Numeric | 0x60 |
| SWWSR | Numeric | 0x0209 |
| BSCR | Numeric | 0x0002 |
| MODIFYCLKMD | Bool | false |
| CLKMD | Numeric | 0x0000 |
| CALLMODEL | EnumString | "near" ("far") |
| CALLUSERINITFXN | Bool | false |

| C54x Name | Type | Default (Enum Options) |
|---|---|---|
| USERINITFXN | Extern | prog.extern("FXN_F_nop") |
| ENABLEINST | Bool | true |
| ENABLEALLTRC | Bool | true |
| CDBRELATIVEPATH | String | "" |

**Description**

This module does not manage any individual objects, but rather allows you to control global or system-wide settings used by other modules.

**Global Settings Properties**

The following Global Settings can be made:

- ❏ **DSP Speed In MHz (CLKOUT)**. This number, times 1000000, is the number of instructions the processor can execute in 1 second. This value is used by the CLK manager to calculate register settings for the on-device timers.

  TextConf Name: CLKOUT    Type: Int16

  Example: `GBL.CLKOUT = 140.0000`

- ❏ **DSP Type**. Target CPU family. Specifies which family of DSP is being used. It is normally unwritable, and is controlled by the Chip Support Library (CSL) property. When the CSL is specified as other, this field becomes writable.

  TextConf Name: DSPTYPE    Type: Int16

  Example: `GBL.DSPTYPE = 54;`

- ❏ **Chip Support Library (CSL).** Specifies the specific chip type, such as 5402, 5440, 5510, etc. This controls which CSL library is linked with the application and also controls the DSP Type property. Select other to remove support for the CSL and to allow you to select a DSP family in the DSP Type field.

  TextConf Name: CHIPTYPE    Type: EnumString

  Options: "5402", "5409", "5409A", "5410", "5410A", "5416", "5420", "5421", 5440", "5441", "5472", "5509", "5510", "5510PG1_2", "5510PG2_0", ""other"

  Example: `GBL.CHIPTYPE = "5402";`

- ❏ **Chip Support Library Name.** Specifies the name of the CSL library to be linked with the application. This property is informational only. It is not writable.

  TextConf Name: N/A

❑ **PMST(6-0)**. The low seven bits of the PMST register (MP/MC, OVLY, AVIS, DROM, CLKOFF, SMUL, and SST). Only the low seven bits can be directly modified. The high nine bits (IPTR) of the PMST are computed based on the base address of the VECT memory segment.

TextConf Name: LOWERPMST Type: Numeric

Example: `GBL.LOWERPMST = 0x60;`

❑ **PMST(15-0)**. The entire PMST register. PMST(6-0) can be modified directly. PMST(15-7) are computed based on the base address of the VECT memory segment. Informational only.

TextConf Name: N/A

❑ **SWWSR**. The value for the Software Wait-State Register, which controls the software-programmable wait-state generator. The SWWSR, BSCR, and CLKMD registers are initialized during the boot initialization (via BIOS_init) before the program's main function is called. See *Volume 1: CPU and Peripherals* of the TMS320C5000 DSP Reference Set for details on the SWWSR, BSCR, and CLKMD.

TextConf Name: SWWSR Type: Numeric

Example: `GBL.SWWSR = 0x0209;`

❑ **BSCR**. The value for the Bank-Switching Control Register, which allows switching between external memory banks without requiring external wait states.

TextConf Name: BSCR Type: Numeric

Example: `GBL.BSCR = 0x0002;`

❑ **Modify CLKMD**. Put a checkmark in this box if you want to modify the value of the Clock Mode Register, which is used to program the PLL (phase-locked loop).

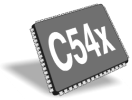
TextConf Name: MODIFYCLKMD Type: Bool

Example: `GBL.MODIFYCLKMD = false;`

❑ **CLKMD - (PLL) Clock Mode Register**. The value of the Clock Mode Register.

TextConf Name: CLKMD Type: Numeric

Example: `GBL.CLKMD = 0x0000;`

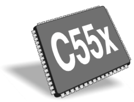



- **Function Call Model**. This setting controls which libraries are used to link the application. If you change this setting, you must set the compiler and linker options to correspond. Use the far option only with C54x devices that support extended addressing (for example, 5402, 549, 5410).

  TextConf Name: CALLMODEL Type: EnumString

  Options: "near", "far"

  Example: `GBL.CALLMODEL = "near";`




- **Memory Model**. This specifies the address reach within the program. The options are small and large. In the small model, the data address is limited to 16-bit addressing. In the large model, data addressability uses the full 23-bit range. Program space addressing always uses the full 24-bit range.

  TextConf Name: MEMORYMODEL Type: EnumString

  Options: "SMALL", "LARGE"

  Example: `GBL.MEMORYMODEL = "SMALL";`

- **Call User Init Function**. Put a checkmark in this box if you want an initialization function to be called early during program initialization, after .cinit processing and before the main function.

  TextConf Name: CALLUSERINITFXN Type: Bool

  Example: `GBL.CALLUSERINITFXN = false;`

- **User Init Function**. Type the name of the initialization function. This function runs early in the initialization process and is intended to be used to perform hardware setup that needs to run before DSP/BIOS is initialized. The code in this function should not use any DSP/BIOS API calls, since a number of DSP/BIOS modules have not been initialized when this function runs. In contrast, the Initialization function that may be specified for HOOK Module objects runs later and is intended for use in setting up data structures used by other functions of the same HOOK object.

  TextConf Name: USERINITFXN Type: Extern

  Example:

  ```
  GBL.USERINITFXN =
      prog.extern("FXN_F_nop");
  ```

- **Enable Real Time Analysis**. Remove the checkmark from this box if you want to remove support for DSP/BIOS implicit instrumentation from the program. This optimizes a program by reducing code size, but removes support for the analysis tools and the LOG, STS, and TRC module APIs.

  TextConf Name: ENABLEINST Type: Bool

  Example: `GBL.ENABLEINST = true;`

- **Enable All TRC Trace Event Classes**. Remove the checkmark from this box if you want all types of tracing to be initially disabled when the program is loaded. If you disable tracing, you can still use the RTA Control Panel or the TRC_enable function to enable tracing at run-time.

  TextConf Name: ENABLEALLTRC Type: Bool

  Example: `GBL.ENABLEALLTRC = true;`

- **CDB path relative to .out**. Type the relative path from the target executable on the host to the directory containing the application's CDB file. Use a single backslash (\) or slash (/) character as a directory separator, and do not end the path with a backslash. For example, ..\..\configs or ../../configs could be the path. If specified, the CDB path is stored in the .vers section of the COFF file. This path allows the DSP/BIOS Real-Time Analysis Tools to locate the CDB file, which they use to obtain host-based information about static objects. If this path is not specified, the analysis tools look for the CDB file in the . and .. directories relative to the executable.

  TextConf Name: CDBRELATIVEPATH Type: String

  Example:
  ```
  GBL.CDBRELATIVEPATH = "../config";
  or
  GBL.CDBRELATIVEPATH = "..\\config";
  ```

## 2.8 HOOK Module

The HOOK module is the Hook Function manager.

**Functions**

- ❏ HOOK_getenv. Get environment pointer for a given HOOK and TSK combination.
- ❏ HOOK_setenv. Set environment pointer for a given HOOK and TSK combination.

**Constants, Types, and Structures**

```
typedef Int HOOK_Id;        /* HOOK instance id */

typedef Void (*HOOK_InitFxn)(HOOK_Id id);
typedef Void (*HOOK_CreateFxn)(TSK_Handle task);
typedef Void (*HOOK_DeleteFxn)(TSK_Handle task);
typedef Void (*HOOK_ExitFxn)(Void);
typedef Void (*HOOK_ReadyFxn)(TSK_Handle task);
typedef Void (*HOOK_SwitchFxn)(TSK_Handle prev,
     TSK_Handle next);
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the HOOK Object Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Instance Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| initFxn | Extern | prog.extern("FXN_F_nop") |
| createFxn | Extern | prog.extern("FXN_F_nop") |
| deleteFxn | Extern | prog.extern("FXN_F_nop") |
| exitFxn | Extern | prog.extern("FXN_F_nop") |
| callSwitchFxn | Bool | false |
| switchFxn | Extern | prog.extern("FXN_F_nop") |
| callReadyFxn | Bool | false |
| readyFxn | Extern | prog.extern("FXN_F_nop") |
| order | Int16 | 2 |

**Description**

The HOOK module is an extension to the TSK function hooks defined in the TSK Manager Properties. It allows multiple sets of hook functions to be performed at key execution points. For example, an application that integrates third-party software may need to perform both its own hook functions and the hook functions required by the third-party software.

In addition, each HOOK object can maintain private data environments for each task for use by its hook functions.

The key execution points at which hook functions can be executed are during program initialization and at several TSK execution points.

The HOOK module manages objects that reference a set of hook functions. Each HOOK object is assigned a numeric identifier during DSP/BIOS initialization. If your program calls HOOK API functions, you must implement an initialization function for the HOOK instance that records the identifier in a variable of type HOOK_Id. DSP/BIOS passes the HOOK object's ID to the initialization function as the lone parameter.

The following function, myInit, could be configured as the Initialization function for a HOOK object using the DSP/BIOS Configuration Tool.

```
#include <hook.h>
HOOK_Id myId;

Void myInit(HOOK_Id id)
{
   myId = id;
}
```

The HOOK_setenv function allows you to associate an environment pointer to any data structure with a particular HOOK object and TSK object combination.

There is no limit to the number of HOOK objects that can be created. However, each object requires a small amount of memory in the .bss section to contain the object.

A HOOK object initially has all of its functions set to FXN_F_nop. You can set some hook functions and use this no-op function for the remaining events. Since the switch and ready events occur frequently during real-time processing, a checkbox controls whether any function is called.

When you create a HOOK object, any TSK module hook functions you have specified are automatically placed in a HOOK object called HOOK_KNL. To set any properties of this object other than the Initialization function, use the TSK module. To set the Initialization function property of the HOOK_KNL object, use the HOOK module.

When an event occurs, all HOOK functions for that event are called in the order they are listed in the DSP/BIOS Configuration Tool. When you select the HOOK manager in the DSP/BIOS Configuration Tool, you can change the execution order by dragging objects within the ordered list.

**HOOK Manager Properties**

There are no global properties for the HOOK manager. HOOK objects are placed in the C Variables Section (.bss).

**HOOK Object Properties**

The following properties can be set for a HOOK object in the DPI Object Properties dialog on the Configuration Tool or in a DSP/BIOS TextConf script. To create a HOOK object in a configuration script, use the following syntax:

```
var myHook = HOOK.create("myHook");
```

The DSP/BIOS TextConf examples that follow assume the object has been created as shown.

- **comment**. A comment to identify this HOOK object.

  TextConf Name: comment  Type: String

  Example: `myHook.comment = "HOOK funcs";`

- **Initialization function**. The name of a function to call during program initialization. Such functions run during the BIOS_init portion of application startup, which runs before the program's main function. Initialization functions can call most functions that can be called from the main() function. However, they should not call TSK module functions, because the TSK module is initialized after initialization functions run. In addition to code specific to the module hook, this function should be used to record the object's ID, if it is needed in a subsequent hook function. This initialization function is intended for use in setting up data structures used by other functions of the same HOOK object. In contrast, the User Init Function property of the Global Settings Properties runs early in the initialization process and is intended to be used to perform hardware setup that needs to run before DSP/BIOS is initialized.

  TextConf Name: initFxn  Type: Extern

  Example:
  ```
  myHook.initFxn =
      prog.extern("_myInit");
  ```

- **Create function**. The name of a function to call when any task is created. This includes tasks that are created statically in the Configuration Tool, or created dynamically using TSK_create. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_create topic describes the Create function. If you are using TextConf scripts, do not add an underscore, because TextConf adds the underscore internally.

  TextConf Name: createFxn  Type: Extern

  Example:
  ```
  myHook.createFxn =
      prog.extern("_myCreate");
  ```

- **Delete function**. The name of a function to call when any task is deleted at run-time with TSK_delete. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_delete topic describes the Delete function.

  TextConf Name: deleteFxn Type: Extern

  Example:
  ```
  myHook.deleteFxn =
      prog.extern("_myDelete");
  ```

- **Exit function**. The name of a function to call when any task exits. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_exit topic describes the Exit function.

  TextConf Name: exitFxn Type: Extern

  Example:
  ```
  myHook.exitFxn =
      prog.extern("_myExit");
  ```

- **Call switch function**. Check this box if you want a function to be called when any task switch occurs.

  TextConf Name: callSwitchFxn Type: Bool

  Example:
  ```
  myHook.callSwitchFxn = false;
  ```

- **Switch function**. The name of a function to call when any task switch occurs. This function can give the application access to both the current and next task handles. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK Module topic describes the Switch function.

  TextConf Name: switchFxn Type: Extern

  Example:
  ```
  myHook.switchFxn =
      prog.extern("_mySwitch");
  ```

- **Call ready function**. Check this box if you want a function to be called when any task becomes ready to run.

  TextConf Name: callReadyFxn Type: Bool

  Example:
  ```
  myHook.callReadyFxn = false;
  ```

- **Ready function**. The name of a function to call when any task becomes ready to run. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK Module topic describes the Ready function.

  TextConf Name: readyFxn Type: Extern

  Example:
  ```
  myHook.readyFxn =
      prog.extern("_myReady");
  ```

- **order**. This field is not shown in the HOOK Object Properties dialog. You can change the sequence in which HOOK functions are executed by selecting the HOOK Manager and dragging the HOOK objects shown in the second pane up and down.

  TextConf Name: order    Type: Int16

  Example: `myHook.order = 2;`

## HOOK_getenv

*Get environment pointer for a given HOOK and TSK combination*

### C Interface

**Syntax** environ = HOOK_getenv(task, id);

**Parameters**

```
TSK_Handle  task;      /* task object handle */
HOOK_Id     id;        /* HOOK instance id */
```

**Return Value**

```
Ptr         environ;   /* environment pointer */
```

**Assembly Interface** none

**Reentrant** yes

**Description** HOOK_getenv returns the environment pointer associated with the specified HOOK and TSK objects. The environment pointer, environ, references the data structure specified in a previous call to HOOK_setenv.

**See Also** HOOK_setenv
TSK_getenv

## HOOK_setenv

*Set environment pointer for a given HOOK and TSK combination*

**C Interface**

**Syntax**

HOOK_setenv(task, id, environ);

**Parameters**

```
TSK_Handle  task;     /* task object handle */
HOOK_Id     id;       /* HOOK instance id */
Ptr         environ;  /* environment pointer */
```

**Return Value**

Void

**Assembly Interface**

none

**Reentrant**

yes

**Description**

HOOK_setenv sets the environment pointer associated with the specified HOOK and TSK objects to environ. The environment pointer, environ, should reference an data structure to be used by the hook functions for a task or tasks.

Each HOOK object may have a separate environment pointer for each task. A HOOK object may also point to the same data structure for all tasks, depending on its data sharing needs.

The HOOK_getenv function can be used to get the environ pointer for a particular HOOK and TSK object combination.

**See Also**

HOOK_getenv
TSK_setenv

## 2.9 HST Module

The HST module is the host channel manager.

**Functions**

❏ HST_getpipe. Get corresponding pipe object

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the HST Manager Properties and HST Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| HOSTLINKTYPE | EnumString | "RTDX" ("NONE") |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| mode | EnumString | "output" ("input") |
| bufSeg | Reference | prog.get("IDATA") |
| bufAlign | Int16 | 4 |
| frameSize | Int16 | 128 |
| numFrames | Int16 | 2 |
| statistics | Bool | false |
| availableForDHL | Bool | false |
| notifyFxn | Extern | prog.extern("FXN_F_nop") |
| arg0 | Arg | 3 |

**Description**

The HST module manages host channel objects, which allow an application to stream data between the target and the host. Host channels are statically configured for input or output. Input channels (also called the source) read data from the host to the target. Output channels (also called the sink) transfer data from the target to the host.

**Note:**

HST channel names cannot begin with a leading underscore ( _ ).

Each host channel is internally implemented using a data pipe (PIP) object. To use a particular host channel, the program uses HST_getpipe to get the corresponding pipe object and then transfers data by calling the PIP_get and PIP_free operations (for input) or PIP_alloc and PIP_put operations (for output).

During early development, especially when testing software interrupt processing algorithms, programs can use host channels to input canned data sets and to output the results. Once the algorithm appears sound, you can replace these host channel objects with I/O drivers for production hardware built around DSP/BIOS pipe objects. By attaching host channels as probes to these pipes, you can selectively capture the I/O channels in real time for off-line and field-testing analysis.

The notify function is called in the context of the code that calls PIP_free or PIP_put. This function can be written in C or assembly. The code that calls PIP_free or PIP_put should preserve any necessary registers.

The other end of the host channel is managed by the LNK_dataPump IDL object. Thus, a channel can only be used when some CPU capacity is available for IDL thread execution.

**HST Manager Properties**

The following global properties can be set for the HST module in the HST Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- ❏ **Object Memory**. The memory segment containing HST objects.

  TextConf Name: OBJMEMSEG    Type: Reference

  Example: `HST.OBJMEMSEG = prog.get("myMEM");`

- ❏ **Host Link Type**. The underlying physical link to be used for host-target data transfer. If None is selected, no instrumentation or host channel data is transferred between the target and host in real time. The Analysis Tool windows are updated only when the target is halted (for example, at a breakpoint). The program code size is smaller when the Host Link Type is set to None because RTDX code is not included in the program.

  TextConf Name: HOSTLINKTYPE    Type: EnumString

  Options: "RTDX", "NONE"

  Example: `HST.HOSTLINKTYPE = "RTDX";`

**HST Object Properties**

A host channel maintains a buffer partitioned into a fixed number of fixed length frames. All I/O operations on these channels deal with one frame at a time; although each frame has a fixed length, the application can put a variable amount of data in each frame.

The following properties can be set for a host file object in the HST Object Properties dialog on the Configuration Tool or in a DSP/BIOS TextConf script. To create an HST object in a configuration script, use the following syntax:

```
var myHst = HST.create("myHst");
```

The DSP/BIOS TextConf examples that follow assume the object has been created as shown.

- **comment**. A comment to identify this HST object.

  TextConf Name: comment Type: String

  Example: `myHst.comment = "my HST";`

- **mode.** The type of channel: input or output. Input channels are used by the target to read data from the host; output channels are used by the target to transfer data from the target to the host.

  TextConf Name: mode Type: EnumString

  Options: "output", "input"

  Example: `myHst.mode = "output";`

- **bufseg.** The memory segment from which the buffer is allocated; all frames are allocated from a single contiguous buffer (of size framesize x numframes).

  TextConf Name: bufSeg Type: Reference

  Example: `myHst.bufSeg = prog.get("myMEM");`

- **bufalign.** The alignment (in words) of the buffer allocated within the specified memory segment.

  TextConf Name: bufAlign Type: Int16

  Options: must be >= 4 and a power of 2

  Example: `myHst.bufAlign = 4;`

- **framesize.** The length of each frame (in words)

  TextConf Name: frameSize Type: Int16

  Example: `myHst.frameSize = 128;`

- **numframes.** The number of frames

  TextConf Name: numFrames Type: Int16

  Example: `myHst.numFrames = 2;`

- **statistics.** Check this box if you want to monitor this channel with an STS object. You can display the STS object for this channel to see a count of the number of frames transferred with the Statistics View Analysis Tool.

  TextConf Name: statistics  Type: Bool

  Example: `myHst.statistics = false;`

- **Make this channel available for a new DHL device.** Check this box if you want to use this HST object with a DHL device. DHL devices allow you to manage data I/O between the host and target using the SIO module, rather than the PIP module. See the DHL Driver topic for more details.

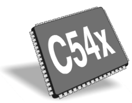
  TextConf Name: availableForDHL  Type: Bool

  Example: `myHst.availableForDHL = false;`

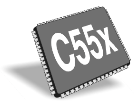
- **notify.** The function to execute when a frame of data for an input channel (or free space for an output channel) is available. To avoid problems with recursion, this function should not directly call any of the PIP module functions for this HST object.

  TextConf Name: notifyFxn  Type: Extern

  Example:
  ```
  myHst.notifyFxn =
      prog.extern("hstNotify");
  ```




- **arg0, arg1.** Two 16-bit arguments passed to the notify function. They can be either unsigned 16-bit constants or symbolic labels.




- **arg0, arg1.** Two Arg type arguments passed to the notify function.

  TextConf Name: arg0  Type: Arg

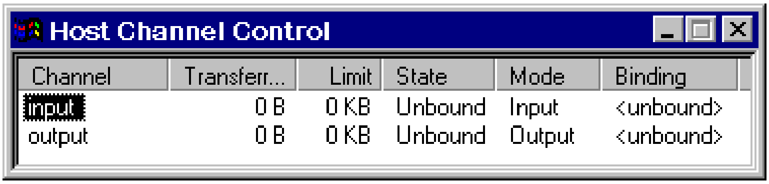
  TextConf Name: arg1  Type: Arg

  Example: `myHst.arg0 = 3;`

## HST - Host Channel Control Interface

If you are using host channels, use the Host Channel Control to bind each channel to a file on your host computer and start the channels.

1) Choose the DSP/BIOS→Host Channel Control menu item. You see a window that lists your host input and output channels.




2) Right-click on a channel and choose Bind from the pop-up menu.

3) Select the file to which you want to bind this channel. For an input channel, select the file that contains the input data. For an output channel, you can type the name of a file that does not exist or choose any file that you want to overwrite.

4) Right-click on a channel and choose Start from the pop-up menu. For an input channel, this causes the host to transfer the first frame of data and causes the target to run the function for this HST object (see HST Object Properties). For an output channel, this causes the target to run the function for this HST object.

## HST_getpipe — *Get corresponding pipe object*

**C Interface**

**Syntax** pipe = HST_getpipe(hst);

**Parameters** HST_Handle hst /* host object handle */

**Return Value** PIP_Handle pip /* pipe object handle*/

**Assembly Interface**

C54x

**Syntax** HST_getpipe

**Preconditions** ar2 = address of the host channel object

**Postconditions** ar2 = address of the pipe object

**Modifies** ar2, c

**Assembly Interface**

C55x

**Syntax** HST_getpipe

**Preconditions** xar0 = address of the host channel object

**Postconditions** xar0 = address of the pipe object

**Modifies** xar0

**Reentrant** yes

**Description** HST_getpipe gets the address of the pipe object for the specified host channel object.

**Example**

```
Void copy(HST_Obj *input, HST_Obj *output)
{
    PIP_Obj      *in, *out;
    Uns          *src, *dst;
    Uns          size;

    in = HST_getpipe(input);
    out = HST_getpipe(output);
    if (PIP_getReaderNumFrames == 0 ||
        PIP_getWriterNumFrames == 0) {
           error;
    }
```

```
    /* get input data and allocate output frame */
    PIP_get(in);
    PIP_alloc(out);

    /* copy input data to output frame */
    src = PIP_getReaderAddr(in);
    dst = PIP_getWriterAddr(out);

    size = PIP_getReaderSize();
    out->writerSize = size;

    for (; size > 0; size--) {
        *dst++ = *src++;
    }

    /* output copied data and free input frame */
    PIP_put(out);
    PIP_free(in);
}
```

**See Also**

PIP_alloc
PIP_free
PIP_get
PIP_put

## 2.10 HWI Module

The HWI module is the hardware interrupt manager.

**Functions**

- ❏ HWI_disable. Disable hardware interrupts
- ❏ HWI_dispatchPlug. Plug the HWI dispatcher
- ❏ HWI_enable. Enable hardware interrupts
- ❏ HWI_enter. Hardware ISR prolog
- ❏ HWI_exit. Hardware ISR epilog
- ❏ HWI_restore. Restore hardware interrupt state

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the HWI Manager Properties and HWI Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| C55x Name | Type | Default (Enum Options) |
|---|---|---|
| STACKMODE | EnumString | "C54X_STK" ("USE_RETA", "NO_RETA") |

C54x: No parameters.

### Instance Configuration Parameters

HWI instances are provided as a default part of the configuration and cannot be created. In the items that follow, HWI_INT* may be any provided instance. Default values for many HWI properties are different for each instance

| C55x Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| fxn | Extern | prog.extern("HWI_unused", "asm") |
| monitor | EnumString | "Nothing" ("Data Value", "xsp", "ac0g", "ac0h", "ac0l", "ac1g", "ac1h", "ac1l", "ac2g", "ac2h", "ac2l", "ac3g", "ac3h", "ac3l", "xar0", "xar1", "xar2", "xar3", "xar4", "xar5", "xar6", "xar7", "t0", "t1", "t2", "t3", "xssp", "tim", "st0_55", "st1_55", "st2_55", "st3_55", "trn0", "bk03", "brc0", "xdp", "xcdp", "dph", "mdp05", "mdp67", "pdp", "bk47", "bkc", "bsa01", "bsa23", "bsa45", "bsa67", "bsac", "trn1", "brc1", "csr", "rptc") |

<table>
<tr><th>C55x Name</th><th>Type</th><th>Default (Enum Options)</th></tr>
<tr><td>addr</td><td>Arg</td><td>0x00000000</td></tr>
<tr><td>dataType</td><td>EnumString</td><td>"signed" ("unsigned")</td></tr>
<tr><td>operation</td><td>EnumString</td><td>"STS_add(*addr)" ("STS_delta(*addr)", "STS_add(-*addr)", "STS_delta(-*addr)", "STS_add(|*addr|)", "STS_delta(|*addr|)")</td></tr>
<tr><td>useDispatcher</td><td>Bool</td><td>false</td></tr>
<tr><td>arg</td><td>Arg</td><td>3</td></tr>
<tr><td>interruptMask0</td><td>EnumString</td><td>"self" ("all", "none", "bitmask")</td></tr>
<tr><td>interruptMask1</td><td>EnumString</td><td>"self" ("all", "none", "bitmask")</td></tr>
<tr><td>interruptBitMask0</td><td>Numeric</td><td>0x0010</td></tr>
<tr><td>interruptBitMask1</td><td>Numeric</td><td>0x0010</td></tr>
</table>

<table>
<tr><th>C54x Name</th><th>Type</th><th>Default (Enum Options)</th></tr>
<tr><td>comment</td><td>String</td><td>"<add comments here>"</td></tr>
<tr><td>fxn</td><td>Extern</td><td>prog.extern("HWI_unused", "asm")</td></tr>
<tr><td>monitor</td><td>EnumString</td><td>"Nothing" ("Data Value", "Stack Pointer", "Top of SW Stack", "ag", "ah", "al", "ar0", "ar1", "ar2", "ar3", "ar4", "ar5", "ar6", "ar7", "bg", "bh", "bk", "bl", "brc", "ifr", "imr", "pmst", "rea", "rsa", "st0", "st1", "treg", "tim", "trn")</td></tr>
<tr><td>addr</td><td>Arg</td><td>0x00000000</td></tr>
<tr><td>dataType</td><td>EnumString</td><td>"signed" ("unsigned")</td></tr>
<tr><td>operation</td><td>EnumString</td><td>"STS_add(*addr)" ("STS_delta(*addr)", "STS_add(-*addr)", "STS_delta(-*addr)", "STS_add(|*addr|)", "STS_delta(|*addr|)")</td></tr>
<tr><td>useDispatcher</td><td>Bool</td><td>false</td></tr>
<tr><td>arg</td><td>Arg</td><td>3</td></tr>
<tr><td>interruptMask</td><td>EnumString</td><td>"self" ("all", "none", "bitmask")</td></tr>
<tr><td>interruptBitMask</td><td>Numeric</td><td>0x0010</td></tr>
</table>

**Description**

The HWI module manages hardware interrupts. Using the DSP/BIOS Configuration Tool, you can assign routines that run when specific hardware interrupts occur. Some routines are assigned to interrupts automatically by the HWI module. For example, the interrupt for the timer that you select for the CLK global properties is automatically configured to run a function that increments the low-resolution time. See the CLK Module for more details.

You can also dynamically assign routines to interrupts at run-time using the HWI_dispatchPlug function or the C54_plug or C55_plug functions.

Interrupt routines can be written completely in assembly, completely in C, or in a mix of assembly and C. In order to support interrupt routines written completely in C, an HWI dispatcher is provided that performs the requisite prolog and epilog for an interrupt routine.

**Note: RTS Functions Callable from TSK Threads Only**

Many runtime support (RTS) functions use lock and unlock functions to prevent reentrancy. However, DSP/BIOS SWI and HWI threads cannot call LCK_pend and LCK_post. As a result, RTS functions that call LCK_pend or LCK_post *must not be called in the context of a SWI or HWI thread*. For a list or RTS functions that should not be called from a SWI or an HWI function, see “LCK_pend” on page 2-167.

The C++ new operator calls malloc, which in turn calls LCK_pend. As a result, the new operator cannot be used in the context of a SWI or HWI thread.

The HWI dispatcher is the preferred method for handling an interrupt.

When an HWI object does not use the dispatcher, the HWI_enter assembly macro must be called prior to any DSP/BIOS API calls that affect other DSP/BIOS objects, such as posting a SWI or a semaphore, and the HWI_exit assembly macro must be called at the very end of the function’s code.

When an HWI object is configured to use the dispatcher, the dispatcher handles the HWI_enter prolog and the HWI_exit epilog, and the HWI function can be completely written in C. It would, in fact, cause a system crash were the dispatcher to call a function that contains the HWI_enter/HWI_exit macro pair. Using the dispatcher allows you to save code space by including only one instance of the HWI_enter/HWI_exit code.

**Note:**

CLK functions should not call HWI_enter and HWI_exit as these are called internally by DSP/BIOS when it runs CLK_F_isr. Additionally, CLK functions should **not** use the *interrupt* keyword or the INTERRUPT pragma in C functions.

Whether a hardware interrupt is dispatched by the HWI dispatcher or handled with the HWI_enter/HWI_exit macros, a common interrupt stack (called the system stack) is used for the duration of the HWI. This same stack is also used by all SWI routines.

In the following notes, references to the usage of HWI_enter/HWI_exit also apply to usage of the HWI dispatcher since, in effect, the dispatcher calls HWI_enter/HWI_exit.

**Note:**

Do not call SWI_disable or SWI_enable within an HWI function.

**Note:**

Do not call HWI_enter, HWI_exit, or any other DSP/BIOS functions from a non-maskable interrupt (NMI) service routine. In addition, the HWI dispatcher cannot be used with the NMI service routine.

**Note:**

Do not call HWI_enter/HWI_exit from a HWI function that is invoked by the dispatcher.

The DSP/BIOS API calls that require an HWI function to use HWI_enter and HWI_exit are:

- SWI_andn
- SWI_andnHook
- SWI_dec
- SWI_inc
- SWI_or
- SWI_orHook
- SWI_post
- PIP_alloc
- PIP_free
- PIP_get
- PIP_put
- PRD_tick
- SEM_post
- MBX_post
- TSK_yield
- TSK_tick

**Note:**

Any PIP API call can cause the pipe's notifyReader or notifyWriter function to run. If an HWI function calls a PIP function, the notification functions run as part of the HWI function.

**Note:**

An HWI function must use HWI_enter and HWI_exit or must be dispatched by the HWI dispatcher if it indirectly runs a function containing any of the API calls listed above.

If your HWI function and the functions it calls do not call any of these API operations, you do not need to disable software interrupt scheduling by calling HWI_enter and HWI_exit.

The register mask argument to HWI_enter and HWI_exit allows you to save and restore registers used within the function. Other arguments allow the HWI to control the settings of the IMR or, in the case of the C55x device, the IER0[IER1].

Hardware interrupts always interrupt software interrupts unless hardware interrupts have been disabled with HWI_disable.

**Note:**

By using HWI_enter and HWI_exit as an HWI function's prolog and epilog, an HWI function can be interrupted; that is, a hardware interrupt can interrupt another interrupt. For the c54x device, you can use the IMRDISABLEMASK parameter for the HWI_enter API to prevent this from occurring. For the c55x device, you can use the IER0DISABLEMASK and IER1DISABLEMASK parameters to prevent this from occurring.

**HWI Manager Properties**

DSP/BIOS manages the hardware interrupt vector table and provides basic hardware interrupt control functions; for example, enabling and disabling the execution of hardware interrupts.

C55x

The following global property can be set for the HWI module in the HWI Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Stack Mode.** Select the Stack Mode used for the application: C54X_STK, USE_RETA or NO_RETA. The stack mode selected here takes effect only if the program address 0xffff00 (the hardware reset vector location) is programmable. If this address is located in ROM space, it is not programmable. DSP/BIOS does not report an error if it is unable to modify the value at this address to set the specified stack mode.

  TextConf Name: STACKMODE Type: EnumString

  Options: "C54X_STK", "USE_RETA", "NO_RETA"

  Example: `HWI.STACKMODE = "C54X_STK";`

There are no global properties for the HWI manager for the C54x platform.

**HWI Object Properties**

The following properties can be set for a hardware interrupt service routine object in the HWI Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script.

The HWI objects for the platform are provided in the default configuration and cannot be created.

- **comment**. A comment is provided to identify each HWI object.

  TextConf Name: comment Type: String

  Example: `HWI_INT2.comment = "myISR";`

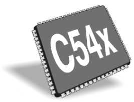
- **function**. The function to execute. Interrupt routines that use the dispatcher can be written completely in C or any combination of assembly and C but must not call the HWI_enter/HWI_exit macro pair. Interrupt routines that don't use the dispatcher must be written at least partially in assembly language. Within an HWI function that does not use the dispatcher, the HWI_enter assembly macro must be called prior to any DSP/BIOS API calls that affect other DSP/BIOS objects, such as posting a SWI or a semaphore. HWI functions can post software interrupts, but they do not run until your HWI function (or the dispatcher) calls the HWI_exit assembly macro, which must be the last statement in any HWI function that calls HWI_enter.

  TextConf Name: fxn Type: Extern

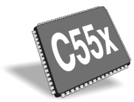
  Example:
  ```
  HWI_INT2.fxn = prog.extern("myHWI",
      "asm");
  ```

- **monitor**. If set to anything other than Nothing, an STS object is created for this HWI that is passed the specified value on every invocation of the interrupt service routine. The STS update occurs just before entering the HWI routine.

Be aware that when the monitor property is enabled for a particular HWI object, a code preamble is inserted into the HWI routine to make this monitoring possible. The overhead for monitoring is 20 to 30 instructions per interrupt, per HWI object monitored. Leaving this instrumentation turned on after debugging is not recommended, since HWI processing is the most time-critical part of the system.




Options:
"Nothing", "Data Value", "Stack Pointer", "Top of SW Stack", "ag", "ah", "al", "ar0", "ar1", "ar2", "ar3", "ar4", "ar5", "ar6", "ar7", "bg", "bh", "bk", "bl", "brc", "ifr", "imr", "pmst", "rea", "rsa", "st0", "st1", "treg", "tim", "trn"




Options:
"Nothing", "Data Value", "xsp", "ac0g", "ac0h", "ac0l", "ac1g", "ac1h", "ac1l", "ac2g", "ac2h", "ac2l", "ac3g", "ac3h", "ac3l", "xar0", "xar1", "xar2", "xar3", "xar4", "xar5", "xar6", "xar7", "t0", "t1", "t2", "t3", "xssp", "tim", "st0_55", "st1_55", "st2_55", "st3_55", "trn0", "bk03", "brc0", "xdp", "xcdp", "dph", "mdp05", "mdp67", "pdp", "bk47", "bkc", "bsa01", "bsa23", "bsa45", "bsa67", "bsac", "trn1", "brc1", "csr", "rptc"

Example: `HWI_INT2.monitor = "Nothing";`

- **addr**. If the monitor field above is set to Data Address, this field lets you specify a data memory address to be read; the word-sized value is read and passed to the STS object associated with this HWI object.

  TextConf Name: addr — Type: Arg

  Example: `HWI_INT2.addr = 0x00000000;`

- **type**. The type of the value to be monitored: unsigned or signed. Signed quantities are sign extended when loaded into the accumulator; unsigned quantities are treated as word-sized positive values.

  TextConf Name: dataType — Type: EnumString

  Options: "signed", "unsigned"

  Example: `HWI_INT2.dataType = "signed";`

- **operation**. The operation to be performed on the value monitored. You can choose one of several STS operations.

  TextConf Name: operation — Type: EnumString

  Options: "STS_add(*addr)", "STS_delta(*addr)", "STS_add(-*addr)", "STS_delta(-*addr)", "STS_add(|*addr|)", "STS_delta(|*addr|)"

  Example:
  ```
  HWI_INT2.operation =
      "STS_add(*addr)";
  ```

- **Use Dispatcher**. A check box that controls whether the HWI dispatcher is used. The HWI dispatcher cannot be used for the non-maskable interrupt (NMI) service routine.

  TextConf Name: useDispatcher Type: Bool

  Example: `HWI_INT2.useDispatcher = false;`

- **Arg**. This argument is passed to the function as its only parameter. You can use either a literal integer or a symbol defined by the application. This property is available only when using the HWI dispatcher.

  TextConf Name: arg Type: Arg

  Example: `HWI_INT2.arg = 3;`

- **Interrupt Mask**. A drop-down menu that specifies which interrupts the dispatcher should disable before calling the function. This property is available only when using the HWI dispatcher. (For the C55x platform, separate fields are provided for IER0 and IER1.)

  TextConf Name: interruptMask Type: EnumString

  TextConf Name: interruptMask0 Type: EnumString

  TextConf Name: interruptMask1 Type: EnumString

  Options: "self", "all", "none", "bitmask"

  Example: `HWI_INT2.interruptMask0 = "self";`

- **Interrupt Bit Mask**. An integer field that is writable when the interrupt mask is set as bitmask. This should be a hexadecimal integer bitmask specifying the interrupts to disable. (For the 'C55x platform, separate fields are provided for IER0 and IER1.)

  TextConf Name: interruptBitMask Type: Numeric

  TextConf Name: interruptBitMask0 Type: Numeric

  TextConf Name: interruptBitMask1 Type: Numeric

  Example: `HWI_INT2.interruptBitMask0 = 0x0010;`

Although it is not possible to create new HWI objects, most interrupts supported by the device architecture have a precreated HWI object. Your application can require that you select interrupt sources other than the default values in order to rearrange interrupt priorities or to select previously unused interrupt sources.

In addition to the precreated HWI objects, some HWI objects are preconfigured for use by certain DSP/BIOS modules. For example, the CLK module configures an HWI object.

Table 2-1 and Table 2-2 list these precreated objects and their default interrupt sources. The HWI object names are the same as the interrupt names.

*Table 2-1. HWI interrupts for the C54x*

| Name | intrid | Interrupt Type |
|---|---|---|
| HWI_RS | 0 | Reset interrupt. |
| HWI_NMI | 1 | Nonmaskable interrupt. |
| HWI_SINT17-30 | 2-15 | User-defined software interrupts #17 through #30. These interrupt service routines are only triggered by the intr instruction from within the application. These software interrupts are executed immediately upon being triggered. |
| HWI_INT0 | 16 | External user interrupt #0. |
| HWI_INT1 | 17 | External user interrupt #1. |
| HWI_INT2 | 18 | External user interrupt #2. |
| HWI_TINT | 19 | Internal timer interrupt. |
| HWI_SINT4 | 20 | Serial port A receive interrupt. |
| HWI_SINT5 | 21 | Serial port A transmit interrupt. |
| HWI_SINT6 | 22 | Serial port B receive interrupt. |
| HWI_SINT7 | 23 | Serial port B transmit interrupt. |
| HWI_INT3 | 24 | External user interrupt #3. |
| HWI_HPIINT | 25 | Host port interface interrupt. |
| HWI_BRINT1 | 26 | Buffered serial port receive interrupt |
| HWI_BXINT1 | 27 | Buffered serial port transmit interrupt |

*Table 2-2. HWI interrupts for the ‘C55x*

| Name | Interrupt Type |
|---|---|
| HWI_RESET | Reset interrupt. |
| HWI_NMI | Nonmaskable interrupt. |
| HWI_INT2 | Maskable (IER0, bit2) hardware interrupt. |
| HWI_INT3 | Maskable (IER0, bit3) hardware interrupt. |
| HWI_TINT | Timer interrupt. (IER, bit4) |
| HWI_INT5<br>through<br>HWI_INT15 | Maskable (IER0, bit5) hardware interrupt<br>through<br>Maskable (IER0, bit15) hardware interrupt. |
| HWI_INT16<br>through<br>HWI_INT23 | Maskable (IER1, bit0) hardware interrupt<br>though<br>Maskable (IER1, bit7) hardware interrupt. |
| HWI_BERR | Maskable (IER1, bit8) bus error interrupt. |
| HWI_DLOG | Maskable (IER1, bit9) data log interrupt. |
| HWI_RTOS | Maskable (IER1, bit10) RTOS interrupt. |
| HWI_SINT27 | Non maskable software interrupt. |
| HWI_SINT28 | Non maskable software interrupt. |
| HWI_SINT29 | Non maskable software interrupt. |
| HWI_SINT30 | Non maskable software interrupt. |
| HWI_SINT31 | Non maskable software interrupt. |

**HWI - Execution Graph Interface**

Time spent performing HWI functions is not directly traced for performance reasons. However, if you configure the HWI Object Properties to perform any STS operations on a register, address, or pointer, you can track time spent performing HWI functions in the Statistics View window, which you can open by choosing DSP/BIOS→Statistics View.

## HWI_disable — *Disable hardware interrupts*

### C Interface

**Syntax** oldST1 = HWI_disable();

**Parameters** Void

**Return Value** Uns oldST1;

### Assembly Interface

C54x

**Syntax** HWI_disable or HWI_disable var

**Preconditions** none

**Postconditions** intm = 1
a = old value of ST1 (if var specified)

**Modifies** intm, a

### Assembly Interface

C55x

**Syntax** HWI_disable

**Preconditions** none

**Postconditions** intm = 1

**Modifies** intm

### Reentrant

yes

### Description

HWI_disable disables hardware interrupts by setting the intm bit in the status register. Call HWI_disable before a portion of a function that needs to run without interruption. When critical processing is complete, call HWI_restore or HWI_enable to reenable hardware interrupts.

Interrupts that occur while interrupts are disabled are postponed until interrupts are reenabled. However, if the same type of interrupt occurs several times while interrupts are disabled, the interrupt's function is executed only once when interrupts are reenabled.

A context switch can occur when calling HWI_enable or HWI_restore if an enabled interrupt occurred while interrupts are disabled.

The Flag parameter is optional. It may be any character(s), and if specified, oldST1 is returned in register A. If Flag is not specified, there is no return value.

**Constraints and Calling Context**

❏ HWI_disable cannot be called from the program's main function.

**Example**

```
old = HWI_disable();
   'do some critical operation'
HWI_restore(old);
```

**See Also**

HWI_enable
HWI_restore
SWI_disable
SWI_enable

## HWI_dispatchPlug *Plug the HWI dispatcher*

### C Interface

**Syntax** HWI_dispatchPlug(vecid, fxn, attrs);

**Parameters**

| | | |
|---|---|---|
| Int | vecid; | /* interrupt id */ |
| Fxn | fxn; | /* pointer to HWI function */ |
| HWI_Attrs | *attrs | /*pointer to HWI dispatcher attributes */ |

**Return Value** Void

**Assembly Interface** none

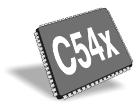
**Reentrant** yes

**Description** HWI_dispatchPlug writes four instruction words into the Interrupt-Vector Table, at the address corresponding to vecid. The instructions written in the Interrupt-Vector Table create a call to the HWI dispatcher.

The HWI dispatcher table gets filled with the function specified by the fxn parameter and the attributes specified by the attrs parameter.

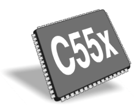
HWI_dispatchPlug does not enable the interrupt. Use C54_enableIMR or C55_enableIER0/C55_enableIER1 to enable specific interrupts.

If attrs is NULL, the HWI's dispatcher properties are assigned a default set of attributes. Otherwise, the HWI's dispatcher properties are specified by a structure of type HWI_Attrs defined as follows (depending on your platform):




```
typedef struct HWI_Attrs {
   Uns   intrMask;    /* IMR bitmask, 1="self" (default) */
   Arg   arg;         /* fxn arg (default = 0)*/
}  HWI_Attrs;
```

The intrMask element is a bitmask that specifies which interrupts to mask off while executing the HWI. Bit positions correspond to those of the IMR. A value of 1 indicates an interrupt is being plugged. The default value is 1.




```
typedef struct HWI_Attrs {
   Uns   ier0mask;    /* IER0 bitmask */
   Uns   ier1mask;    /* IER1 bitmask */
   Arg   arg;         /* fxn arg (default = 0)*/
}  HWI_Attrs;
```

The ier0Mask is a bitmask that specifies the ier0 interrupts to mask while executing the HWI. The bit positions in ier0mask correspond to those of IER0. The ier1Mask is a bitmask that specifies the ier1 interrupts to mask while executing the HWI. The bit positions in ier1mask correspond to those of IER1.

The arg element is a generic argument that is passed to the plugged function as its only parameter. The default value is 0.

**Constraints and Calling Context**

- ❏ vecid must be a valid interrupt ID in the range of 0-31.

**See Also**

HWI_enable
HWI_restore
SWI_disable
SWI_enable

## HWI_enable

*Enable interrupts*

**C Interface**

**Syntax** HWI_enable();

**Parameters** Void

**Return Value** Void

**Assembly Interface**

C54x

**Syntax** HWI_enable

**Preconditions** none

**Postconditions** intm = 0

**Modifies** intm

**Assembly Interface**

C55x

**Syntax** HWI_enable

**Preconditions** none

**Postconditions** intm = 0

**Modifies** intm, tc1

**Reentrant** yes

**Description**

HWI_enable enables hardware interrupts by clearing the intm bit in the status register.

Hardware interrupts are enabled unless a call to HWI_disable disables them. DSP/BIOS enables hardware interrupts after the program's main() function runs. Your main function can enable individual interrupt mask bits, but it should not call HWI_enable to globally enable interrupts.

Interrupts that occur while interrupts are disabled are postponed until interrupts are reenabled. However, if the same type of interrupt occurs several times while interrupts are disabled, the interrupt's function is executed only once when interrupts are reenabled. A context switch can occur when calling HWI_enable/HWI_restore if an enabled interrupt occurs while interrupts are disabled.

Any call to HWI_enable enables interrupts, even if HWI_disable has been called several times.

**Constraints and Calling Context**

❏ HWI_enable cannot be called from the program's main() function.

**Example**

```
HWI_disable();
"critical processing takes place"
HWI_enable();
"non-critical processing"
```

**See Also**

HWI_disable
HWI_restore
SWI_disable
SWI_enable

## HWI_enter

*Hardware ISR prolog*

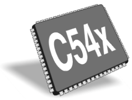
### C Interface

**Syntax** none

**Parameters** none

**Return Value** none

### Assembly Interface



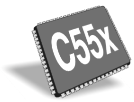

**Syntax** HWI_enter MASK, IMRDISABLEMASK

**Preconditions** intm = 1

**Postconditions** dp = GBL_A_SYSPAGE
cpl = ovm = c16 = frct = cmpt = braf = arp = 0
intm = 0
sp = even address

**Modifies** c, cpl, dp, sp

### Assembly Interface




**Syntax** HWI_enter AR_T_MASK, AC_MASK, MISC1_MASK, MISC2_MASK, MISC3_MASK, IER0DISABLEMASK, IER1DISABLEMASK

**Preconditions** intm = 1

**Postconditions** intm=0, braf=0, cpl=1, m40=0, satd=0, sxmd=0, c16=0, frct=0, c54cm=0, arms=1, rdm=0, cdplc=0, ar[0...7]lc=0, sata=0, smul=0, sst=0
Both the user stack pointer (XSP and the system stack pointer (XSSP) are left aligned to even address boundaries in compliance with standard C conventions.

**Modifies** xar0, xar1, ac0g, ac0h, ier0, ier1

**Reentrant** yes

**Description** HWI_enter is an API (assembly macro) used to save the appropriate context for a DSP/BIOS interrupt service routine (ISR).

HWI_enter is used by ISRs that are user-dispatched, as opposed to ISRs that are handled by the HWI dispatcher. HWI_enter must not be issued by ISRs that are handled by the HWI dispatcher.

If the HWI dispatcher is not used by an HWI object, HWI_enter must be used in the ISR before any DSP/BIOS API calls that could trigger other DSP/BIOS objects, such as posting a SWI or semaphore. HWI_enter is used in tandem with HWI_exit to ensure that the DSP/BIOS SWI or TSK manager is called at the appropriate time. Normally, HWI_enter and HWI_exit must surround all statements in any DSP/BIOS assembly language ISRs that call C functions.

One common mask, C54_CNOTPRESERVED, is defined in c54.h54. This mask specifies the C temporary registers and should be used when saving the context for an ISR that is written in C.

The following are the definitions of the masks specified above:

- **AR_T_MASK**. Mask of registers belonging to ar0-7, t0-3, sp-ssp
- **AC_MASK**. Mask of registers belonging to ac0-3
- **MISC1_MASK**. Mask of registers ier0, ifr0, dbier0, ier1, ifr, dbier1, st0, st1, st2, st3, trn0, bk03, brc0
- **MISC2_MASK**. Mask of registers dp, cdp, mdp, mdp05, mdp67, pdp, bk47, bkc, bof01, bof23, bof45, bof67, bofc, ivpd, ivph, trn1
- **MISC3_MASK**. Mask of registers brc1, csr, rsa0_h_addr, rsa0, rea0_h_addr, rea0, rsa1_h_addr, rsa1, rea1_h_addr, rea1, rptc
- **IER0DISABLEMASK**. Mask of ier0 bits to turn off
- **IER1DISABLEMASK**. Mask of ier1 bits to turn off

**Note:**

The macros C55_saveCcontext, C55_restoreCcontext C55_saveBiosContext and C55_restoreBiosContext preserve processor register context per C and DSP/BIOS requirements, respectively.

**Constraints and Calling Context**

- This API should not be used in the NMI HWI function.
- This API must not be called if the HWI object that runs this function uses the HWI dispatcher.
- This API cannot be called from the program's main function.
- This API cannot be called from a SWI, TSK, or IDL function.

- ❏ This API cannot be called from a CLK function.
- ❏ Unless the HWI dispatcher is used, this API must be called within any hardware interrupt function (except NMI's HWI function) before the first operation in an ISR that uses any DSP/BIOS API calls that might post or affect a software interrupt or semaphore. Such functions must be written in assembly language. Alternatively, the HWI dispatcher can be used instead of this API, allowing the function to be written completely in C and allowing you to reduce code size.
- ❏ If an interrupt function calls HWI_enter, it must end by calling HWI_exit.
- ❏ Do not use the interrupt keyword or the INTERRUPT pragma in C functions that run in the context of an HWI.
- ❏ On the C54x platform, the postconditions of HWI_enter do not completely satisfy C function calling conventions. Specifically, after calling HWI_enter, the CPL bit is not set. Before calling a C function, you must set the CPL bit and restore it afterwards to satisfy a precondition for calling HWI_exit. If using the HWI dispatcher, this is not necessary as the dispatcher assumes a C function and performs this step prior to calling the user function.

**Example**

CLK_isr:

```
HWI_enter C54_CNOTPRESERVED, 0008h
PRD_tick
HWI_exit C54_CNOTPRESERVED, 0008h
```

**Examples**

Example #1:

```
.include c55.h55

AR_T_MASK_clk         .set C55_AR57_MASK
AC_MASK_clk           .set C55_AC3_MASK
MISC1_MASK_clk        .set 0
MISC2_MASK_clk        .set C55_TRN1
MISC3_MASK_clk        .set 0
IER0DISABLEMASK_clk   .set 0008h
IER1DISABLEMASK_clk   .set 0h
IER0RESTOREMASK_clk   .set 0008h
IER1RESTOREMASK_clk   .set 0h
```

CLK_isr:

```
HWI_enter AR_T_MASK_clk, AC_MASK_clk, MISC1_MASK_clk,
MISC2_MASK_clk, MISC3_MASK_clk, IER0DISABLEMASK_clk,
IER1DISABLEMASK_clk
PRD_tick
HWI_exit AR_T_MASK_clk, AC_MASK_clk, MISC1_MASK_clk,
MISC2_MASK_clk, MISC3_MASK_clk, IER0RESTOREMASK_clk,
IER1RESTOREMASK_clk
```

Example #2:
Calling a C function from within an HWI_enter/HWI_exit block. Specify all registers in the C convention class, save-by-caller. Use the appropriate register save masks with the HWI_enter macro:

```
HWI_enter C55_AR_DR_SAVE_BY_CALLER_MASK,
C55_AC_SAVE_BY_CALLER_MASK,
C55_MISC1_SAVE_BY_CALLER_MASK,
C55_MISC2_SAVE_BY_CALLER_MASK,
C55_MISC3_SAVE_BY_CALLER_MASK, user_ier0_mask,
user_ier1_mask
```

The HWI_enter macro:

- ❑ preserves the specified set of registers that are being declared as trashable by the called function
- ❑ places the processor status register bit settings as required by C compiler conventions
- ❑ aligns stack pointers to even address boundaries, as well as remembering any such adjustments made to SP and SSP registers

The user's C function must have a leading underscore as in this example:

```
call _myCfunction;
```

When exiting the hardware interrupt, you need to call HWI_exit with the following macro:

```
HWI_exit C55_AR_DR_SAVE_BY_CALLER_MASK,
C55_AC_SAVE_BY_CALLER_MASK,
C55_MISC1_SAVE_BY_CALLER_MASK,
C55_MISC2_SAVE_BY_CALLER_MASK,
C55_MISC3_SAVE_BY_CALLER_MASK,       user_ier0_mask,
user_ier1_mask
```

The HWI_exit macro restores the CPU state that was originally set by the HWI_enter macro. It alerts the SWI scheduler to attend to any kernel scheduling activity that is required.

**See Also** HWI_exit

## HWI_exit

*Hardware ISR epilog*

### C Interface

**Syntax** none

**Parameters** none

**Return Value** none

### Assembly Interface

C54x

**Syntax** HWI_exit MASK IMRRESTOREMASK

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** intm = 0

**Modifies** Restores all registers saved in HWI_enter

### Assembly Interface

C55x

**Syntax** HWI_exit AR_T_MASK, AC_MASK, MISC1_MASK, MISC2_MASK, MISC3_MASK, IER0RESTOREMASK, IER1RESTOREMASK

**Preconditions** none

**Postconditions** intm=0

**Modifies** Restores all registers saved with the HWI_enter mask

### Reentrant

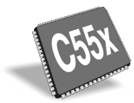
yes

### Description

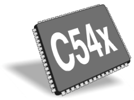
HWI_exit is an API (assembly macro) which is used to restore the context that existed before a DSP/BIOS interrupt service routine (ISR) was invoked.

HWI_exit is used by ISRs that are user-dispatched, as opposed to ISRs that are handled by the HWI dispatcher. HWI_exit must not be issued by ISRs that are handled by the HWI dispatcher.

If the HWI dispatcher is not used by an HWI object, HWI_exit must be the last statement in an ISR that uses DSP/BIOS API calls which could trigger other DSP/BIOS objects, such as posting a SWI or semaphore.



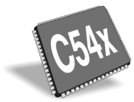

HWI_exit restores the registers specified by AR_T_MASK, AC_MASK, MISC1_MASK, MISC2_MASK, and MISC3_MASK. These masks are used to specify the set of registers that were saved by HWI_enter.




HWI_exit restores the registers specified by MASK. This mask is used to specify the set of registers that were saved by HWI_enter.

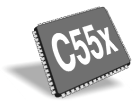
HWI_enter and HWI_exit must surround all statements in any DSP/BIOS assembly language ISRs that call C functions only for ISRs that are not dispatched by the HWI dispatcher.

HWI_exit calls the DSP/BIOS Software Interrupt manager if DSP/BIOS itself is not in the middle of updating critical data structures, or if no currently interrupted ISR is also in a HWI_enter/ HWI_exit region. The DSP/BIOS SWI manager services all pending SWI handlers (functions).




Of the interrupts in IMRRESTOREMASK, HWI_exit only restores those enabled upon entering the ISR. HWI_exit does not affect the status of interrupt bits that are not in IMRRESTOREMASK. If upon exiting an ISR you do not wish to restore an interrupt that was disabled with HWI_enter, do not set that interrupt bit in the IMRRESTOREMASK in HWI_exit.

If upon exiting an ISR you wish to enable an interrupt that was disabled upon entering the ISR, set the corresponding bit in IMR register. (Including a bit in IMR in the IMRRESTOREMASK of HWI_exit does not enable the interrupt if it was disabled when the ISR was entered.)




Of the interrupts in IER0RESTOREMASK/IER1RESTOREMASK, HWI_exit only restores those that were disabled upon entering the ISR. HWI_exit does not affect the status of interrupt bits that are not in IER0RESTOREMASK/IER1RESTOREMASK. If upon exiting an ISR you do not wish to restore one of the interrupts that were disabled with HWI_enter, do not set that interrupt bit in the IER0[IER1]RESTOREMASK in HWI_exit.

If upon exiting an ISR you do wish to enable an interrupt that was disabled upon entering the ISR, set the corresponding bit in IER0[IER1]RESTOREMASK before calling HWI_exit. (Simply setting bits in IER0RESTOREMASK/IER1RESTOREMASK that is passed as argument to HWI_exit does not result in enabling the corresponding interrupts if those were not originally disabled by the HWI_enter macro.)

**Constraints and Calling Context**

- ❏ This API should not be used for the NMI HWI function.
- ❏ This API must not be called if the HWI object that runs the ISR uses the HWI dispatcher.

- If the HWI dispatcher is not used, this API must be the last operation in an ISR that uses any DSP/BIOS API calls that might post or affect a software interrupt or semaphore. The HWI dispatcher can be used instead of this API, allowing the function to be written completely in C and allowing you to reduce code size.
- On the C54 platform, the MASK parameter must match the corresponding parameter used for HWI_enter.
- On the C55 platform, the AR_T_MASK, AC_MASK, MISC1_MASK, MISC2_MASK, and MISC3_MASK parameters must match the corresponding parameters used for HWI_enter.
- This API cannot be called from the program's main function.
- This API cannot be called from a SWI, TSK, or IDL function.
- This API cannot be called from a CLK function.
- On the C54x platform, the postconditions of HWI_enter do not completely satisfy C function calling conventions. Specifically, after calling HWI_enter, the CPL bit is not set. Before calling a C function, you must set the CPL bit and restore it afterwards to satisfy a precondition for calling HWI_exit. If using the HWI dispatcher, this is not necessary as the dispatcher assumes a C function and performs this step prior to calling the user function.

**Example**

CLK_isr:

```
HWI_enter C54_CNOTPRESERVED, 0008h
PRD_tick
HWI_exit C54_CNOTPRESERVED, 0008h
```

**Examples**

Example #1:

```
.include c55.h55

AR_T_MASK_clk           .set C55_AR57_MASK
AC_MASK_clk             .set C55_AC3_MASK
MISC1_MASK_clk          .set 0
MISC2_MASK_clk          .set C55_TRN1
MISC3_MASK_clk          .set 0
IER0DISABLEMASK_clk     .set 0008h
IER1DISABLEMASK_clk     .set 0h
IER0RESTOREMASK_clk     .set 0008h
IER1RESTOREMASK_clk     .set 0h
```

CLK_isr:

```
HWI_enter AR_T_MASK_clk, AC_MASK_clk, MISC1_MASK_clk,
MISC2_MASK_clk, MISC3_MASK_clk, IER0DISABLEMASK_clk,
IER1DISABLEMASK_clk
PRD_tick
HWI_exit AR_T_MASK_clk, AC_MASK_clk, MISC1_MASK_clk,
MISC2_MASK_clk, MISC3_MASK_clk, IER0RESTOREMASK_clk,
IER1RESTOREMASK_clk
```

Example #2: Calling a C function from within an HWI_enter/HWI_exit:

Specify all registers in the C convention class, save-by-caller. Use the appropriate register save masks with the HWI_enter macro:

```
HWI_enter C55_AR_DR_SAVE_BY_CALLER_MASK,
C55_AC_SAVE_BY_CALLER_MASK,
C55_MISC1_SAVE_BY_CALLER_MASK,
C55_MISC2_SAVE_BY_CALLER_MASK,
C55_MISC3_SAVE_BY_CALLER_MASK, user_ier0_mask,
user_ier1_mask
```

The HWI_enter macro:

❏ preserves the specified set of registers that are being declared as trashable by the called function

❏ places the processor status register bit settings as required by C compiler conventions

❏ aligns stack pointers to even address boundaries, as well as remembering any such adjustments made to SP and SSP registers

The user's C function must have a leading underscore as in this example:

```
call _myCfunction;
```

When exiting the hardware interrupt, you need to call HWI_exit with the following macro:

```
HWI_exit C55_AR_DR_SAVE_BY_CALLER_MASK,
C55_AC_SAVE_BY_CALLER_MASK,
C55_MISC1_SAVE_BY_CALLER_MASK,
C55_MISC2_SAVE_BY_CALLER_MASK,
C55_MISC3_SAVE_BY_CALLER_MASK, user_ier0_mask,
user_ier1_mask
```

The HWI_exit macro restores the CPU state that was originally set by the HWI_enter macro. It alerts the SWI scheduler to attend to any kernel scheduling activity that is required.

**See Also** HWI_enter

## HWI_restore

*Restore global interrupt enable state*

**C Interface**

**Syntax** HWI_restore(oldST1);

**Parameters** Uns oldST1;

**Returns** Void

**Assembly Interface**

C54x

**Syntax** HWI_restore

**Preconditions** al = a 16-bit mask
intm = 1

**Postconditions** intm is set to the value of bit 11 of al

**Modifies** ag, ah, al, intm

**Assembly Interface**

C55x

**Syntax** HWI_restore

**Preconditions** ac0l = = mask (intm is set to the value of bit 11)
intm = 1

**Postconditions** none

**Modifies** tc1, intm

**Reentrant** yes

**Description** HWI_restore sets the intm bit in the st1 register using bit 11 of the oldst1 parameter. If bit 11 is 1, the intm bit is not modified. If bit 11 is 0, the intm bit is set to 0, which enables interrupts.

When you call HWI_disable, the previous contents of the st1 register are returned. You can use this returned value with HWI_restore.

A context switch may occur when calling HWI_restore if HWI_restore reenables interrupts and if a higher-priority HWI occurred while interrupts were disabled.

**Constraints and Calling Context**

- ❏ HWI_restore cannot be called from the program's main function.
- ❏ HWI_restore must be called with interrupts disabled. The parameter passed to HWI_restore must be the value returned by HWI_disable.

**Example**

```
oldST1 = HWI_disable(); /* disable interrupts */
   'do some critical operation'
HWI_restore(oldST1);
      /* re-enable interrupts if they
         were enabled at the start of the
         critical section */
```

**See Also**

HWI_enable
HWI_disable

## 2.11 IDL Module

The IDL module is the idle thread manager.

**Functions**

- ❏ IDL_run. Make one pass through idle functions.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the IDL Manager Properties and IDL Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| AUTOCALCULATE | Bool | true |
| LOOPINSTCOUNT | Int32 | 1000 |

**Instance Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| fxn | Extern | prog.extern("FXN_F_nop") |
| calibration | Bool | true |
| order | Int16 | 0 |

**Description**

The IDL module manages the lowest-level threads in the application. In addition to user-created functions, the IDL module executes DSP/BIOS functions that handle host communication and CPU load calculation.

There are four kinds of threads that can be executed by DSP/BIOS programs: hardware interrupts (HWI Module), software interrupts (SWI Module), tasks (TSK Module), and background threads (IDL module). Background threads have the lowest priority, and execute only if no hardware interrupts, software interrupts, or tasks need to run.

An application’s main function must return before any DSP/BIOS threads can run. After the return, DSP/BIOS runs the idle loop. Once an application is in this loop, HWI hardware interrupts, SWI software interrupts, PRD periodic functions, TSK task functions, and IDL background threads are all enabled.

The functions for IDL objects registered with the DSP/BIOS Configuration Tool are run in sequence each time the idle loop runs. IDL functions are called from the IDL context. IDL functions can be written in C or assembly and must follow the C calling conventions described in the compiler manual.

When RTA is enabled (see page 2–116), an application contains an IDL_cpuLoad object, which runs a function that provides data about the CPU utilization of the application. In addition, the LNK_dataPump function handles host I/O in the background, and the RTA_dispatch function handles run-time analysis communication.

The IDL Function Manager allows you to insert additional functions that are executed in a loop whenever no other processing (such as hardware ISRs or higher-priority tasks) is required.

**IDL Manager Properties**

The following global properties can be set for the IDL module in the IDL Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **Object Memory**. The memory segment that contains the IDL objects.

TextConf Name: OBJMEMSEG Type: Reference

Example: `IDL.OBJMEMSEG = prog.get("myMEM");`

❏ **Auto calculate idle loop instruction count**. When this box is checked, the program runs the IDL functions one or more times at system startup to get an approximate value for the idle loop instruction count. This value, saved in the global variable CLK_D_idletime, is read by the host and used in the CPU load calculation. By default, the instruction count includes all IDL functions, not just LNK_dataPump, RTA_dispatcher, and IDL_cpuLoad. You can remove an IDL function from the calculation by removing the checkmark from the Include in CPU load calibration box in an IDL object's Properties dialog.

Remember that functions included in the calibration are run before the main function runs. These functions should not access data structures that are not initialized before the main function runs. In particular, functions that perform any of the following actions should not be included in the idle loop calibration:

- enabling hardware interrupts or the SWI or TSK schedulers
- using CLK APIs to get the time
- accessing PIP objects
- blocking tasks

- creating dynamic objects

  TextConf Name: AUTOCALCULATE Type: Bool

  Example: `IDL.AUTOCALCULATE = true;`

- **Idle Loop Instruction Count**. This is the number of instruction cycles required to perform the IDL loop and the default IDL functions (LNK_dataPump, RTA_dispatcher, and IDL_cpuLoad) that communicate with the host. Since these functions are performed whenever no other processing is needed, background processing is subtracted from the CPU load before it is displayed.

  TextConf Name: LOOPINSTCOUNT Type: Int32

  Example: `IDL.LOOPINSTCOUNT = 1000;`

**IDL Object Properties**

Each idle function runs to completion before another idle function can run. It is important, therefore, to ensure that each idle function completes (that is, returns) in a timely manner.

To create an IDL object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myIdl = IDL.create("myIdl");
```

The following properties can be set for an IDL object:

- **comment**. Type a comment to identify this IDL object.

  TextConf Name: comment Type: String

  Example: `myIdl.comment = "IDL function";`

- **function**. The function to be executed.

  If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. (The DSP/BIOS Configuration Tool generates assembly code, which must use leading underscores when referencing C functions or labels.) If you are using TextConf scripts, do not add an underscore, because TextConf adds the underscore internally.

  TextConf Name: fxn Type: Extern

  Example: `myIdl.fxn = prog.extern("myIDL");`

- **Include in CPU load calibration**. You can remove an individual IDL function from the CPU load calculation by removing the checkmark from this box. The CPU load calibration is performed only if the Auto calculate idle loop instruction count box is checked in the IDL

Manager Properties. You should remove a function from the calculation if it blocks or depends on variables or structures that are not initialized until the main function runs.

TextConf Name: calibration Type: Bool

Example: `myIdl.calibration = true;`

- **order**. This field is not shown in the IDL Object Properties dialog. You can change the sequence in which IDL functions are executed by selecting the IDL Manager and dragging the IDL objects shown in the second pane up and down.

  TextConf Name: order Type: Int16

  Example: `myIdl.order = 2;`

**IDL- Execution Graph Interface**

Time spent performing IDL functions is not directly traced. However, the Other Threads row in the Execution Graph, which you can open by choosing DSP/BIOS→Execution Graph, includes time spent performing both HWI and IDL functions.

## IDL_run

*Make one pass through idle functions*

### C Interface

**Syntax** IDL_run();

**Parameters** Void

**Return Value** Void

### Assembly Interface

none

### Description

IDL_run makes one pass through the list of configured IDL objects, calling one function after the next. IDL_run returns after all IDL functions have been executed one time. IDL_run is not used by most DSP/BIOS applications since the IDL functions are executed in a loop when the application returns from main. IDL_run is provided to allow easy integration of the real-time analysis features of DSP/BIOS (for example, LOG and STS) into existing applications.

IDL_run must be called to transfer the real-time analysis data to and from the host computer. Though not required, this is usually done during idle time when no HWI or SWI threads are running.

**Note:**

BIOS_init and BIOS_start must be called before IDL_run to ensure that DSP/BIOS has been initialized. For example, the DSP/BIOS boot file contains the following system calls around the call to main:

```
BIOS_init();  /* initialize DSP/BIOS */
main();
BIOS_start()  /* start DSP/BIOS */
IDL_loop();   /* call IDL_run in an infinite loop */
```

### Constraints and Calling Context

- ❏ IDL_run cannot be called by an HWI or SWI function.

## 2.12 LCK Module

The LCK module is the resource lock manager.

**Functions**

- ❏ LCK_create. Create a resource lock
- ❏ LCK_delete. Delete a resource lock
- ❏ LCK_pend. Acquire ownership of a resource lock
- ❏ LCK_post. Relinquish ownership of a resource lock

**Constants, Types, and Structures**

```
typedef struct LCK_Obj *LCK_Handle; /* resource handle */

/* lock object */
typedef struct LCK_Attrs LCK_Attrs;

struct LCK_Attrs {
    Int dummy;
};

LCK_Attrs LCK_ATTRS = {0}; /* default attribute values */
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the LCK Manager Properties and LCK Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameter**.

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

**Description**

The lock module makes available a set of functions that manipulate lock objects accessed through handles of type LCK_Handle. Each lock implicitly corresponds to a shared global resource, and is used to arbitrate access to this resource among several competing tasks.

The LCK module contains a pair of functions for acquiring and relinquishing ownership of resource locks on a per-task basis. These functions are used to bracket sections of code requiring mutually exclusive access to a particular resource.

LCK lock objects are semaphores that potentially cause the current task to suspend execution when acquiring a lock.

**LCK Manager Properties**

The following global property can be set for the LCK module on the LCK Manager Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment that contains the LCK objects.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `LCK.OBJMEMSEG = prog.get("myMEM");`

**LCK Object Properties**

To create a LCK object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myLck = LCK.create("myLck");
```

The following property can be set for a LCK object in the LCK Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this LCK object.

  TextConf Name: comment Type: String

  Example: `myLck.comment = "LCK object";`

## LCK_create

*Create a resource lock*

**C Interface**

**Syntax** lock = LCK_create(attrs);

**Parameters** LCK_Attrs attrs; /* pointer to lock attributes */

**Return Value** LCK_Handle lock; /* handle for new lock object */

**Assembly Interface** none

**Description**

LCK_create creates a new lock object and returns its handle. The lock has no current owner and its corresponding resource is available for acquisition through LCK_pend.

If attrs is NULL, the new lock is assigned a default set of attributes. Otherwise the lock's attributes are specified through a structure of type LCK_Attrs.

> **Note:**
>
> At present, no attributes are supported for lock objects.

All default attribute values are contained in the constant LCK_ATTRS, which can be assigned to a variable of type LCK_Attrs prior to calling LCK_create.

LCK_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module, page 2–200.

**Constraints and Calling Context**

- ❏ LCK_create cannot be called from a SWI or HWI.
- ❏ You can reduce the size of your application program by creating objects with the DSP/BIOS Configuration Tool rather than using the XXX_create functions.

**See Also**

LCK_delete
LCK_pend
LCK_post

## LCK_delete

*Delete a resource lock*

### C Interface

**Syntax**

LCK_delete(lock);

**Parameters**

LCK_Handle lock; /* lock handle */

**Return Value**

Void

### Assembly Interface

none

### Description

LCK_delete uses MEM_free to free the lock referenced by lock.

LCK_delete calls MEM_free to delete the LCK object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

### Constraints and Calling Context

- ❏ LCK_delete cannot be called from a SWI or HWI.
- ❏ No task should be awaiting ownership of the lock.
- ❏ No check is performed to prevent LCK_delete from being used on a statically-created object. If a program attempts to delete a lock object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

### See Also

LCK_create
LCK_pend
LCK_post

## LCK_pend

*Acquire ownership of a resource lock*

### C Interface

**Syntax**

status = LCK_pend(lock, timeout);

**Parameters**

```
LCK_Handle  lock;      /* lock handle */
Uns         timeout;   /* return after this many system clock ticks */
```

**Return Value**

```
Bool        status;    /* TRUE if successful, FALSE if timeout */
```

### Assembly Interface

none

### Description

LCK_pend acquires ownership of lock, which grants the current task exclusive access to the corresponding resource. If lock is already owned by another task, LCK_pend suspends execution of the current task until the resource becomes available.

The task owning lock can call LCK_pend any number of times without risk of blocking, although relinquishing ownership of the lock requires a balancing number of calls to LCK_post.

LCK_pend results in a context switch if this LCK timeout is greater than 0 and the lock is already held by another thread.

LCK_pend returns TRUE if it successfully acquires ownership of lock, returns FALSE if timeout.

**Note: RTS Functions Callable from TSK Threads Only**

Many runtime support (RTS) functions use lock and unlock functions to prevent reentrancy. However, DSP/BIOS SWI and HWI threads cannot call LCK_pend and LCK_post. As a result, RTS functions that call LCK_pend or LCK_post *must not be called in the context of a SWI or HWI thread*.

To determine whether a particular RTS function uses LCK_pend or LCK_post, refer to the source code for that function shipped with Code Composer Studio. The following table lists some RTS functions that call LCK_pend and LCK_post in certain versions of Code Composer Studio:

| | | | |
|---|---|---|---|
| fprintf | printf | vfprintf | sprintf |
| vprintf | vsprintf | clock | strftime |
| minit | malloc | realloc | free |
| calloc | rand | srand | getenv |

The C++ new operator calls malloc, which in turn calls LCK_pend. As a result, the new operator cannot be used in the context of a SWI or HWI thread.

**Constraints and Calling Context**

- ❏ The lock must be a handle for a resource lock object created through a prior call to LCK_create.
- ❏ LCK_pend should not be called from a SWI or HWI thread.

**See Also**

LCK_create
LCK_delete
LCK_post

## LCK_post

*Relinquish ownership of a resource LCK*

**C Interface**

**Syntax**

LCK_post(lock);

**Parameters**

LCK_Handle lock; /* lock handle */

**Return Value**

Void

**Assembly Interface**

none

**Description**

LCK_post relinquishes ownership of lock, and resumes execution of the first task (if any) awaiting availability of the corresponding resource. If the current task calls LCK_pend more than once with lock, ownership remains with the current task until LCK_post is called an equal number of times.

LCK_post results in a context switch if a higher priority thread is currently pending on the lock.

**Constraints and Calling Context**

- ❏ lock must be a handle for a resource lock object created through a prior call to LCK_create.
- ❏ LCK_post should not be called from a SWI or HWI thread.

**See Also**

LCK_create
LCK_delete
LCK_pend

## 2.13 LOG Module

The LOG module captures events in real time.

**Functions**

- ❑ LOG_disable. Disable the system log.
- ❑ LOG_enable. Enable the system log.
- ❑ LOG_error. Write a user error event to the system log.
- ❑ LOG_event. Append unformatted message to message log.
- ❑ LOG_message. Write a user message event to the system log.
- ❑ LOG_printf. Append formatted message to message log.
- ❑ LOG_reset. Reset the system log.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the LOG Manager Properties and LOG Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| bufSeg | Reference | prog.get("IDATA") |
| bufLen | EnumInt | 64 (0, 8, 16, 32, 64, ..., 32768) |
| logType | EnumString | "circular" ("fixed) |
| dataType | EnumString | "printf" ("raw data") |
| format | String | "0x%x, 0x%x, 0x%x" |

**Description**

The Event Log is used to capture events in real time while the target program executes. You can use the system log, or create user-defined logs. If the logtype is circular, the log buffer of size buflen contains the last buflen elements. If the logtype is fixed, the log buffer contains the first buflen elements.

The system log stores messages about system events for the types of log tracing you have enabled. See the TRC Module, page 2–399, for a list of events that can be traced in the system log.

You can add messages to user logs or the system log by using LOG_printf or LOG_event. To reduce execution time, log data is always formatted on the host.

LOG_error writes a user error event to the system log. This operation is not affected by any TRC trace bits; an error event is always written to the system log. LOG_message writes a user message event to the system log, provided that both TRC_GBLHOST and TRC_GBLTARG (the host and target trace bits, respectively) traces are enabled.

When a problem is detected on the target, it is valuable to put a message in the system log. This allows you to correlate the occurrence of the detected event with the other system events in time. LOG_error and LOG_message can be used for this purpose.

Log buffers are of a fixed size and reside in data memory. Individual messages use four words of storage in the log's buffer. The first word holds a sequence number that allows the Event Log to display logs in the correct order. The remaining three words contain data specified by the call that wrote the message to the log.

C55x

Log buffers are of a fixed size and reside in data memory. Individual messages hold four elements in the log's buffer. The first element holds a sequence number that allows the Event Log to display logs in the correct order. The remaining three elements contain data specified by the call that wrote the message to the log.

Each log event buffer uses four words in the small memory model and eight words in the large memory model.

See the *Code Composer Studio* online tutorialfor examples of how to use the LOG Manager.

### LOG Manager Properties

The following global property can be set for the LOG module in the LOG Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment that contains the LOG objects.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `LOG.OBJMEMSEG = prog.get("myMEM");`

## LOG Object Properties

To create a LOG object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myLog = LOG.create("myLog");
```

The following properties can be set for a log object on the LOG Object Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this LOG object.

  TextConf Name: comment Type: String

  Example: `myLog.comment = "trace LOG";`

- **bufseg**. The name of a memory segment to contain the log buffer.

  TextConf Name: bufSeg Type: Reference

  Example: `myLog.bufSeg = prog.get("myMEM");`

- **buflen**. The length of the log buffer (in words).

  TextConf Name: bufLen Type: EnumInt

  Options: 0, 8, 16, 32, 64, ..., 32768

  Example: `myLog.bufLen = 64;`

- **logtype**. The type of the log: circular or fixed. Events added to a full circular log overwrite the oldest event in the buffer, whereas events added to a full fixed log are dropped.

  - **Fixed**. The log stores the first messages it receives and stops accepting messages when its message buffer is full.
  - **Circular**. The log automatically overwrites earlier messages when its buffer is full. As a result, a circular log stores the last events that occur.

  TextConf Name: logType Type: EnumString

  Options: "circular", "fixed"

  Example: `myLog.logType = "circular";`

- **datatype**. Choose printf if you use LOG_printf to write to this log and provide a format string.

  Choose raw data if you want to use LOG_event to write to this log and have the Event Log apply a printf-style format string to all records in the log.

  TextConf Name: dataType Type: EnumString

  Options: "printf", "raw data"

  Example: `myLog.dataType = "printf";`

- **format**. If you choose raw data as the datatype, type a printf-style format string in this field. Provide up to three (3) conversion characters (such as %d) to format words two, three, and four in all records in the log. Do not put quotes around the format string. The format string can use %d, %x, %o, %s, %r, and %p conversion characters; it cannot use other types of conversion characters. See LOG_printf, page 2–183, and LOG_event, page 2–179, for information about the structure of a log record.

  TextConf Name: format Type: String

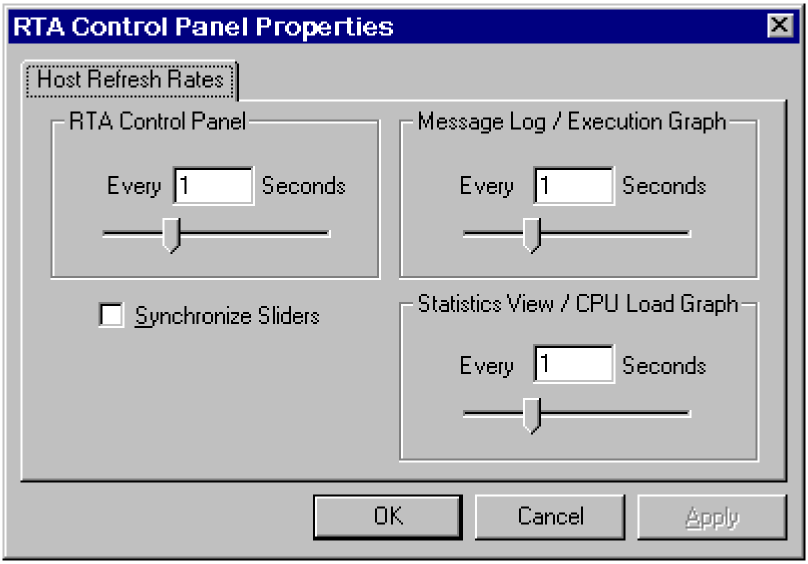
  Example: `myLog.format = "0x%x, 0x%x, 0x%x";`

**LOG - Code Composer Studio Interface**

You can view log messages in real time while your program is running with the Event Log. A pull-down menu provides a list of the logs you can view. To see the system log as a graph, choose DSP/BIOS→ Execution Graph Details. To see a user log, choose DSP/BIOS→Event Log and select the log or logs you want to see. The Property Page for the Message Log allows you to select a file to which the log messages are written. Right-click on the Message Log and select Property Page to name this file. You cannot open the named log file until you close the Message Log window.

You can also control how frequently the host polls the target for log information. Right-click on the RTA Control Panel and choose the Property Page to set the refresh rate as shown in Figure 2-1. If you set the refresh rate to 0, the host does not poll the target unless you right-click on the log window and choose Refresh Window from the pop-up menu.

*Figure 2-1. RTA Control Panel Properties Page*



## LOG_disable

*Disable a message log*

### C Interface

**Syntax** LOG_disable(log);

**Parameters** LOG_Handle log; /* log object handle */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** LOG_disable

**Preconditions** ar2 = address of the LOG object

**Postconditions** none

**Modifies** c

### Assembly Interface

C55x

**Syntax** LOG_disable

**Preconditions** xar0 = address of the LOG object

**Postconditions** none

**Modifies** none

**Reentrant** no

**Description** LOG_disable disables the logging mechanism and prevents the log buffer from being modified.

**Example**

```
LOG_disable(&trace);
```

**See Also** LOG_enable
LOG_reset

## LOG_enable *Enable a message log*

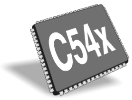
### C Interface

**Syntax** LOG_enable(log);

**Parameters** LOG_Handle log; /* log object handle */

**Return Value** Void

### Assembly Interface



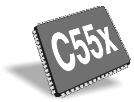

**Syntax** LOG_enable

**Preconditions** ar2 = address of the LOG object

**Postconditions** none

**Modifies** c

### Assembly Interface




**Syntax** LOG_enable

**Preconditions** xar0 = address of the LOG object

**Postconditions** none

**Modifies** none

**Reentrant** no

**Description** LOG_enable enables the logging mechanism and allows the log buffer to be modified.

**Example**

```
LOG_enable(&trace);
```

**See Also** LOG_disable
LOG_reset

## LOG_error

*Write an error message to the system log*

### C Interface

**Syntax** LOG_error(format, arg0);

**Parameters**

| | | |
|---|---|---|
| String | format; | /* printf-style format string */ |
| Arg | arg0; | /* copied to second word of log record */ |

**Return Value** Void

### Assembly Interface

C54x

**Syntax** LOG_error format [section]

**Preconditions** ar2 = format
bh = arg0
dp = GBL_A_SYSPAGE

**Postconditions** none (see the description of the section argument below)

**Modifies** ag, ah, al, ar0, ar2, ar3, bl, c, t, tc

### Assembly Interface

C55x

**Syntax** LOG_error format [section]

**Preconditions** format and optional section arguments are directly passed as macro parameters
xar1 = arg0

**Postconditions** none (see the description of the section argument below)

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, tc1, tc2, ac0

### Reentrant

yes

### Description

LOG_error writes a program-supplied error message to the system log, which is defined in the default configuration by the LOG_system object. LOG_error is not affected by any TRC bits; an error event is always written to the system log.

The format argument can contain any of the conversion characters supported for LOG_printf. See LOG_printf for details.

The LOG_error assembly macro takes an optional section argument. If you omit this argument, assembly code following the macro is assembled into the .text section. If you want your program to be assembled into another section, specify another section name when calling the macro.

**Example**

```
Void UTL_doError(String s, Int errno)
{
    LOG_error("SYS_error called: error id = 0x%x", errno);
    LOG_error("SYS_error called: string = '%s'", s);
}
```

**See Also**

LOG_event
LOG_message
LOG_printf
TRC_disable
TRC_enable

# LOG_event

*Append an unformatted message to a message log*

## C Interface

**Syntax**

LOG_event(log, arg0, arg1, arg2);

**Parameters**

| | | |
|---|---|---|
| LOG_Handle | log; | /* log objecthandle */ |
| Arg | arg0; | /* copied to second word of log record */ |
| Arg | arg1; | /* copied to third word of log record */ |
| Arg | arg2; | /* copied to fourth word of log record */ |

**Return Value**

Void

## Assembly Interface

**Syntax**

LOG_event

**Preconditions**

ar2 = address of the LOG object
bh = arg0
bl = arg1
t = arg2

**Postconditions**

none

**Modifies**

ag, ah, al, ar0, ar2, ar3, c, tc

## Assembly Interface

**Syntax**

LOG_message format [section]

**Preconditions**

xar0 = address of the LOG object
xar1 = arg0
xar2 = arg1
xar3 = arg2

**Postconditions**

none

**Modifies**

xar0, xar1, xar2, xar3, xar4, t0, tc1, tc2, ac0

## Reentrant

yes

## Description

LOG_event copies a sequence number and three arguments to the specified log buffer. Each log message uses four words in the small memory model and eight words in the large memory model. The contents of the four words written by LOG_event are shown here:

| | | | | |
|---|---|---|---|---|
| LOG_event | Sequence # | arg0 | arg1 | arg2 |

You can format the log by using LOG_printf instead of LOG_event.

If you want the Event Log to apply the same printf-style format string to all records in the log, use the DSP/BIOS Configuration Tool to choose raw data for the datatype property and type a format string for the format property (see “LCK Object Properties” on page 2-164).

If the logtype is circular, the log buffer of size buflen contains the last buflen elements. If the logtype is fixed, the log buffer contains the first buflen elements.

Any combination of threads can write to the same log. Internally, hardware interrupts are temporarily disabled during a call to LOG_event. Log messages are never lost due to thread preemption.

**Example**

```
LOG_event(&trace, (Arg)value1, (Arg)value2,
          (Arg)CLK gethtime());
```

**See Also**

LOG_error
LOG_printf
TRC_disable
TRC_enable

## LOG_message

*Write a program-supplied message to the system log*

**C Interface**

**Syntax** LOG_message(format, arg0);

**Parameters**

| | | |
|---|---|---|
| String | format; | /* printf-style format string */ |
| Arg | arg0; | /* copied to second word of log record */ |

**Return Value** Void

**Assembly Interface**

C54x

**Syntax** LOG_message format [section]

**Preconditions**
ar2 = format
bh = arg0
dp = GBL_A_SYSPAGE

**Postconditions** none (see the description of the section argument below)

**Modifies** ag, ah, al, ar0, ar2, ar3, bl, c, t, tc

**Assembly Interface**

C55x

**Syntax** LOG_message format [section]

**Preconditions**
format and optional section arguments are directly passed as macro parameters
xar1 = arg0

**Postconditions** none (see the description of the section argument below)

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, tc1, tc2, ac0

**Reentrant** yes

**Description**

LOG_message writes a program-supplied message to the system log, provided that both the host and target trace bits are enabled.

The format argument passed to LOG_message can contain any of the conversion characters supported for LOG_printf. See LOG_printf, page 2–183, for details.

The LOG_message assembly macro takes an optional section argument. If you do not specify a section argument, assembly code following the macro is assembled into the .text section by default. If you do not want your program to be assembled into the .text section, you should specify the desired section name when calling the macro.

**Example**

```
Void UTL_doMessage(String s, Int errno)
{
    LOG_message("SYS_error called: error id = 0x%x", errno);
   LOG_message("SYS_error called: string = '%s'", s);
}
```

**See Also**

LOG_error
LOG_event
LOG_printf
TRC_disable
TRC_enable

## LOG_printf

*Append a formatted message to a message log*

### C Interface

**Syntax**

```
LOG_printf(log, format);
   or
LOG_printf(log, format,arg0);
   or
LOG_printf(log, format, arg0, arg1);
```

**Parameters**

```
LOG_Handle log;      /* log object handle */
String     format;   /* printf format string */
Arg        arg0;     /* value for first format string token */
Arg        arg1;     /* value for second format string token */
```

**Return Value** Void

### Assembly Interface

**Syntax** LOG_printf format [section]

**Preconditions**
ar2 = address of the LOG object
bh = arg0
bl = arg1

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, c, t, tc

### Assembly Interface

**Syntax** LOG_printf format [section]

**Preconditions**
xar0 = address of the LOG object
xar1 = arg0
xar2 = arg1

**Postconditions** none

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, tc1, tc2, ac0

**Reentrant** yes

**Description** As a convenience for C (as well as assembly language) programmers, the LOG module provides a variation of the ever-popular printf.

LOG_printf copies a sequence number, the format address, and two arguments to the specified log buffer.

To reduce execution time, log data is always formatted on the host. The format string is stored on the host and accessed by the Event Log.

The arguments passed to LOG_printf must be integers, strings, or a pointer (if the special %r or %p conversion character is used).

Casting arg0 and arg1 using the Arg type causes an erroneous value to be printed. To print the value correctly, do not cast these parameters. This constraint applies even though the LOG_printf function defines arg0 and arg1 as Arg type.

The format string can use any of the conversion characters found in Table 2-3.

*Table 2-3. Conversion Characters for LOG_printf*

| Conversion Character | Description |
|---|---|
| %d | Signed integer |
| %x | Unsigned hexadecimal integer |
| %o | Unsigned octal integer |
| %s | Character string<br>This character can only be used with constant string pointers. That is, the string must appear in the source and be passed to LOG_printf. For example, the following is supported:<br>`char *msg = "Hello world!";`<br>`LOG_printf(&trace, "%s", msg);`<br>However, the following example is not supported:<br>`char msg[100];`<br>`strcpy(msg, "Hello world!");`<br>`LOG_printf(&trace, "%s", msg);`<br>If the string appears in the COFF file and a pointer to the string is passed to LOG_printf, then the string in the COFF file is used by the Event Log to generate the output.<br>If the string can not be found in the COFF file, the format string is replaced with *** ERROR: 0x%x 0x%x ***\n, which displays all arguments in hexadecimal. |

| Conversion Character | Description |
|---|---|
| %r | Symbol from symbol table<br>This is an extension of the standard printf format tokens. This character treats its parameter as a pointer to be looked up in the symbol table of the executable and displayed. That is, %r displays the symbol (defined in the executable) whose value matches the value passed to %r. For example:<br>`Int testval = 17;`<br>`LOG_printf("%r = %d", &testval, testval);`<br>displays:<br>`testval = 17`<br>If no symbol is found for the value passed to %r, the Event Log uses the string <unknown symbol>. |
| %p | data pointer |

LOG_printf does not provide a conversion character for code pointers. If you are using the ’C55x large model, you can use the %p character to print code pointers. For the ’C55x small model, you can print a code pointer by passing bits 16-24 and bits 0-15 separately as arg0 and arg1 of LOG_printf as shown in the following example:

```
#include <std.h>
LOG_Obj trace;

Void fxn()
{
    return;
}
Void main()
{
    Int upperHalf, lowerHalf;

    upperHalf = ((LgUns)fxn >> 16);
    lowerHalf = ((LgUns)fxn & 0xffff);
    LOG_printf(&trace, "func fxn address is %x%x",
        upperHalf, lowerHalf);
}
```

If you want the Event Log to apply the same printf-style format string to all records in the log, use the DSP/BIOS Configuration Tool to choose raw data for the datatype property of this LOG object and typing a format string for the format property.

The LOG_printf assembly macro takes an optional section parameter. If you do not specify a section parameter, assembly code following the LOG_printf macro is assembled into the .text section by default. If you do not want your program to be assembled into the .text section, you should specify the desired section name as the second parameter to the LOG_printf call.

Each log message uses four words in the small memory model and eight words in the large memory model. The contents of the four words written by LOG_printf are shown here:

| | | | | |
|---|---|---|---|---|
| LOG_printf | Sequence # | arg0 | arg1 | Format address |

You configure the characteristics of a log in the DSP/BIOS Configuration Tool. If the logtype is circular, the log buffer of size buflen contains the last buflen elements. If the logtype is fixed, the log buffer contains the first buflen elements.

Any combination of threads can write to the same log. Internally, hardware interrupts are temporarily disabled during a call to LOG_printf. Log messages are never lost due to thread preemption.

**Constraints and Calling Context**

- ❏ LOG_printf (even the C version) supports 0, 1, or 2 arguments after the format string.
- ❏ No compilation error is reported if a call to LOG_printf casts an parameter as Arg or attempts to print a code pointer using a single parameter. These actions cause erroneous output on ’C55x.

**Example**

```
LOG_printf(&trace, "hello world");
LOG_printf(&trace, "Size of Int is: %d", sizeof(Int));
```

**See Also**

LOG_error
LOG_event
TRC_disable
TRC_enable

## LOG_reset

*Reset a message log*

### C Interface

**Syntax** LOG_reset(log);

**Parameters** LOG_Handle log /* log object handle */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** LOG_reset

**Preconditions** ar2 = address of the LOG object

**Postconditions** none

**Modifies** ag, ah, al, ar3, ar4, c

### Assembly Interface

C55x

**Syntax** LOG_reset

**Preconditions** xar0 = address of the LOG object

**Postconditions** none

**Modifies** xar0, xar1, xar2, t0, ac0

**Reentrant** no

**Description** LOG_reset enables the logging mechanism and allows the log buffer to be modified starting from the beginning of the buffer, with sequence number starting from 0.

LOG_reset does not disable interrupts or otherwise protect the log from being modified by an HWI or other thread. It is therefore possible for the log to contain inconsistent data if LOG_reset is preempted by an HWI or other thread that uses the same log.

**Example**

```
LOG_reset(&trace);
```

**See Also** LOG_disable
LOG_enable

## 2.14 MBX Module

The MBX module is the mailbox manager.

**Functions**

- ❏ MBX_create. Create a mailbox
- ❏ MBX_delete. Delete a mailbox
- ❏ MBX_pend. Wait for a message from mailbox
- ❏ MBX_post. Post a message to mailbox

**Constants, Types, and Structures**

```
typedef struct MBX_Obj *MBX_Handle;
    /* handle for mailbox object */

struct MBX_Attrs {      /* mailbox attributes */
    Int    segid;
};

MBX_Attrs MBX_ATTRS = {/* default attribute values */
    0,
};
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the MBX Manager Properties and MBX Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

**Instance Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| messageSize | Int16 | 1 |
| length | Int16 | 1 |
| elementSeg | Reference | prog.get("IDATA") |

**Description**

The MBX module makes available a set of functions that manipulate mailbox objects accessed through handles of type MBX_Handle. Mailboxes can hold up to the number of messages specified by the Mailbox Length property in the DSP/BIOS Configuration Tool.

MBX_pend is used to wait for a message from a mailbox. The timeout parameter to MBX_pend allows the task to wait until a timeout. A timeout value of SYS_FOREVER causes the calling task to wait indefinitely for a message. A timeout value of zero (0) causes MBX_pend to return immediately. MBX_pend's return value indicates whether the mailbox was signaled successfully.

MBX_post is used to send a message to a mailbox. The timeout parameter to MBX_post specifies the amount of time the calling task waits if the mailbox is full. If a task is waiting at the mailbox, MBX_post removes the task from the queue and puts it on the ready queue. If no task is waiting and the mailbox is not full, MBX_post simply deposits the message and returns.

**MBX Manager Properties**

The following global property can be set for the MBX module on the MBX Manager Properties dialog in the Configuration Tool or in a DSP/BIOS TextConf script:

❑ **Object Memory**. The memory segment that contains the MBX objects created with the DSP/BIOS Configuration Tool.

TextConf Name: OBJMEMSEG Type: Reference

Example: `MBX.OBJMEMSEG = prog.get("myMEM");`

**MBX Object Properties**

To create an MBX object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myMbx = MBX.create("myMbx");
```

The following properties can be set for an MBX object in the MBX Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❑ **comment**. Type a comment to identify this MBX object.

TextConf Name: comment Type: String

Example: `myMbx.comment = "my MBX";`

❑ **Message Size**. The size (in MADUs) of the messages this mailbox can contain.

TextConf Name: messageSize Type: Int16

Example: `myMbx.messageSize = 1;`

❑ **Mailbox Length**. The number of messages this mailbox can contain.

TextConf Name: length Type: Int16

Example: `myMbx.length = 1;`

❑ **Element memory segment**. The memory segment to contain the mailbox data buffers.

TextConf Name: elementSeg Type: Reference

Example:
```
myMbx.elementSeg =
    prog.get("myMEM");
```

**MBX Code Composer Studio Interface**

The MBX tab of the Kernel/Object View shows information about mailbox objects.

## MBX_create

*Create a mailbox*

### C Interface

**Syntax**

mbx = MBX_create(msgsize, mbxlength, attrs);

**Parameters**

```
Uns         msgsize;   /* size of message */
Uns         mbxlength;/* length of mailbox */
MBX_Attrs   *attrs;    /* pointer to mailbox attributes */
```

**Return Value**

```
MBX_Handle mbx;        /* mailbox object handle */
```

### Assembly Interface

none

### Description

MBX_create creates a mailbox object which is initialized to contain up to mbxlength messages of size msgsize. If successful, MBX_create returns the handle of the new mailbox object. If unsuccessful, MBX_create returns NULL unless it aborts (for example, because it directly or indirectly calls SYS_error, and SYS_error causes an abort).

If attrs is NULL, the new mailbox is assigned a default set of attributes. Otherwise, the mailbox's attributes are specified through a structure of type MBX_Attrs.

All default attribute values are contained in the constant MBX_ATTRS, which can be assigned to a variable of type MBX_Attrs prior to calling MBX_create.

MBX_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module, page 2–200.

### Constraints and Calling Context

- MBX_create cannot be called from a SWI or HWI.
- You can reduce the size of your application program by creating objects with the DSP/BIOS Configuration Tool rather than using the XXX_create functions.

### See Also

MBX_delete
SYS_error

## MBX_delete

*Delete a mailbox*

**C Interface**

**Syntax** MBX_delete(mbx);

**Parameters** MBX_Handle mbx; /* mailbox object handle */

**Return Value** Void

**Assembly Interface** none

**Description** MBX_delete frees the mailbox object referenced by mbx.

MBX_delete calls MEM_free to delete the MBX object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

**Constraints and Calling Context**

- ❏ No tasks should be pending on mbx when MBX_delete is called.
- ❏ MBX_delete cannot be called from a SWI or HWI.
- ❏ No check is performed to prevent MBX_delete from being used on a statically-created object. If a program attempts to delete a mailbox object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

**See Also** MBX_create

## MBX_pend

*Wait for a message from mailbox*

### C Interface

**Syntax**

status = MBX_pend(mbx, msg, timeout);

**Parameters**

| | | |
|---|---|---|
| MBX_Handle | mbx; | /* mailbox object handle */ |
| Ptr | msg; | /* message pointer */ |
| Uns | timeout; | /* return after this many system clock ticks */ |

**Return Value**

| | | |
|---|---|---|
| Bool | status; | /* TRUE if successful, FALSE if timeout */ |

### Assembly Interface

none

### Description

If the mailbox is not empty, MBX_pend copies the first message into msg and returns TRUE. Otherwise, MBX_pend suspends the execution of the current task until MBX_post is called or the timeout expires. The actual time of task suspension can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

If timeout is SYS_FOREVER, the task remains suspended until MBX_post is called on this mailbox. If timeout is 0, MBX_pend returns immediately.

If timeout expires (or timeout is 0) before the mailbox is available, MBX_pend returns FALSE. Otherwise MBX_pend returns TRUE.

A task switch occurs when calling MBX_pend if the mailbox is empty and timeout is not 0, or if a higher priority task is blocked on MBX_post.

### Constraints and Calling Context

- ❏ MBX_pend can only be called from an HWI or SWI if timeout is 0.
- ❏ If you need to call MBX_pend within a TSK_disable/TSK_enable block, you must use a timeout of 0.
- ❏ MBX_pend cannot be called from the program's main function.

### See Also

MBX_post

## MBX_post

*Post a message to mailbox*

### C Interface

**Syntax**

status = MBX_post(mbx, msg, timeout);

**Parameters**

```
MBX_Handle mbx;       /* mailbox object handle */
Ptr        msg;       /* message pointer */
Uns        timeout;   /* return after this many system clock ticks */
```

**Return Value**

```
Bool       status;    /* TRUE if successful, FALSE if timeout */
```

### Assembly Interface

none

### Description

MBX_post checks to see if there are any free message slots before copying msg into the mailbox. MBX_post readies the first task (if any) waiting on mbx.

If the mailbox is full and timeout is SYS_FOREVER, the task remains suspended until MBX_pend is called on this mailbox. If timeout is 0, MBX_post returns immediately. Otherwise, the task is suspended for timeout system clock ticks. The actual time of task suspension can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

If timeout expires (or timeout is 0) before the mailbox is available, MBX_post returns FALSE. Otherwise MBX_post returns TRUE.

A task switch occurs when calling MBX_post if a higher priority task is made ready to run, or if there are no free message slots and timeout is not 0.

### Constraints and Calling Context

- If you need to call MBX_post within a TSK_disable/TSK_enable block, you must use a timeout of 0.
- MBX_post can only be called from an HWI or SWI if timeout is 0.
- MBX_post can be called from the program's main function. However, the number of calls should not be greater than the number of messages the mailbox can hold. Additional calls have no effect.

### See Also

MBX_pend

## 2.15 MEM Module

The MEM module is the memory segment manager.

**Functions**

- ❑ MEM_alloc. Allocate from a memory segment.
- ❑ MEM_calloc. Allocate and initialize to 0.
- ❑ MEM_define. Define a new memory segment.
- ❑ MEM_free. Free a block of memory.
- ❑ MEM_redefine. Redefine an existing memory segment.
- ❑ MEM_stat. Return the status of a memory segment.
- ❑ MEM_valloc. Allocate and initialize to a value.

**Constants, Types, and Structures**

```
MEM->MALLOCSEG = 0;     /* segid for malloc, free */

#define MEM_HEADERSIZE /* free block header size */
#define MEM_HEADERMASK /* mask to align on
                          MEM_HEADERSIZE */
#define MEM_ILLEGAL    /* illegal memory address */

MEM_Attrs MEM_ATTRS ={ /* default attribute values */
    0
};

typedef struct MEM_Segment {
    Ptr    base;     /* base of the segment */
    Uns    length;   /* size of the segment */
    Uns    space;    /* memory space */
} MEM_Segment;

typedef struct MEM_Stat {
    Uns  size;   /* original size of segment */
    Uns  used;   /* MADUs used in segment */
    Uns  length; /* largest contiguous block length */
} MEM_Stat;
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the MEM Manager Properties and MEM Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**.

| C55x Name | Type | Default |
|---|---|---|
| REUSECODESPACE | Bool | "false" |
| ARGSSIZE | Numeric | x0008 |
| STACKSIZE | Numeric | 0x0400 |

| C55x Name | Type | Default |
|---|---|---|
| SYSSTACKSIZE | Numeric | 0x0100 |
| NOMEMORYHEAPS | Bool | "false" |
| BIOSOBJSEG | Reference | prog.get("DARAM") |
| MALLOCSEG | Reference | prog.get("DARAM") |
| ARGSSEG | Reference | prog.get("DARAM") |
| STACKSEG | Reference | prog.get("DARAM") |
| SYSSTACKSEG | Reference | prog.get("DARAM") |
| GBLINITSEG | Reference | prog.get("SARAM") |
| TRCDATASEG | Reference | prog.get("SARAM") |
| SYSDATASEG | Reference | prog.get("DARAM") |
| OBJSEG | Reference | prog.get("DARAM") |
| BIOSSEG | Reference | prog.get("SARAM") |
| SYSINITSEG | Reference | prog.get("SARAM") |
| HWISEG | Reference | prog.get("SARAM") |
| HWIVECSEG | Reference | prog.get("VECT") |
| RTDXTEXTSEG | Reference | prog.get("SARAM") |
| USERCOMMANDFILE | Bool | "false" |
| TEXTSEG | Reference | prog.get("SARAM") |
| SWITCHSEG | Reference | prog.get("SARAM") |
| BSSSEG | Reference | prog.get("DARAM") |
| CINITSEG | Reference | prog.get("SARAM") |
| PINITSEG | Reference | prog.get("SARAM") |
| CONSTSEG | Reference | prog.get("DARAM") |
| DATASEG | Reference | prog.get("DARAM") |
| CIOSEG | Reference | prog.get("DARAM") |
| ENABLELOADADDR | Bool | "false" |
| LOADBIOSSEG | Reference | prog.get("SARAM") |
| LOADSYSINITSEG | Reference | prog.get("SARAM") |
| LOADGBLINITSEG | Reference | prog.get("SARAM") |
| LOADTRCDATASEG | Reference | prog.get("SARAM") |
| LOADTEXTSEG | Reference | prog.get("SARAM") |
| LOADSWITCHSEG | Reference | prog.get("SARAM") |
| LOADCINITSEG | Reference | prog.get("SARAM") |
| LOADPINITSEG | Reference | prog.get("SARAM") |
| LOADCONSTSEG | Reference | prog.get("DARAM") |
| LOADHWISEG | Reference | prog.get("SARAM") |
| LOADHWIVECSEG | Reference | prog.get("VECT") |
| LOADRTDXTEXTSEG | Reference | prog.get("SARAM") |

| C54x Name | Type | Default |
|---|---|---|
| REUSECODESPACE | Bool | "false" |
| ARGSSIZE | Numeric | 0x0004 |
| STACKSIZE | Numeric | 0x0400 |
| NOMEMORYHEAPS | Bool | "false" |
| BIOSOBJSEG | Reference | prog.get("IDATA") |
| MALLOCSEG | Reference | prog.get("IDATA") |
| ARGSSEG | Reference | prog.get("IDATA") |
| STACKSEG | Reference | prog.get("IDATA") |
| GBLINITSEG | Reference | prog.get("IPROG") |
| TRCDATASEG | Reference | prog.get("IPROG") |
| SYSDATASEG | Reference | prog.get("IDATA") |
| OBJSEG | Reference | prog.get("IDATA") |
| BIOSSEG | Reference | prog.get("IPROG") |
| BIOSNORPTBSEG | Reference | prog.get("IPROG") |
| SYSINITSEG | Reference | prog.get("IPROG") |
| HWISEG | Reference | prog.get("IPROG") |
| RTDXTEXTSEG | Reference | prog.get("IPROG") |
| USERCOMMANDFILE | Bool | "false" |
| TEXTSEG | Reference | prog.get("IPROG") |
| SWITCHSEG | Reference | prog.get("IPROG") |
| BSSSEG | Reference | prog.get("IDATA") |
| CINITSEG | Reference | prog.get("IPROG") |
| PINITSEG | Reference | prog.get("IPROG") |
| CONSTSEG | Reference | prog.get("IDATA") |
| DATASEG | Reference | prog.get("IDATA") |
| CIOSEG | Reference | prog.get("IDATA") |
| ENABLELOADADDR | Bool | "false" |
| LOADBIOSSEG | Reference | prog.get("IPROG") |
| LOADSYSINITSEG | Reference | prog.get("IPROG") |
| LOADGBLINITSEG | Reference | prog.get("IPROG") |
| LOADTRCDATASEG | Reference | prog.get("IPROG") |
| LOADTEXTSEG | Reference | prog.get("IPROG") |
| LOADSWITCHSEG | Reference | prog.get("IPROG") |
| LOADCINITSEG | Reference | prog.get("IPROG") |
| LOADPINITSEG | Reference | prog.get("IPROG") |

| C54x Name | Type | Default |
|---|---|---|
| LOADCONSTSEG | Reference | prog.get("IDATA") |
| LOADHWISEG | Reference | prog.get("IPROG") |
| LOADRTDXTEXTSEG | Reference | prog.get("IPROG") |

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| base | Numeric | 0x000000 |
| len | Numeric | 0x000000 |
| createHeap | Bool | "true" |
| heapSize | Numeric | 0x00400 |
| enableHeapLabel | Bool | "false" |
| heapLabel | Extern | prog.extern("segment_name","asm") |
| space | EnumString | "data" ("code", "io", "other") |

**Description**

The MEM module provides a set of functions used to allocate storage from one or more disjointed segments of memory. These memory segments are specified with the DSP/BIOS Configuration Tool.

MEM always allocates an even number of MADUs and always aligns buffers on an even boundary. This behavior is used to insure that free buffers are always at least two MADUs in length. This behavior does not preclude you from allocating two 512 buffers from a 1K region of on-device memory, for example. It does, however, mean that odd allocations consume one more MADU than expected.

If small code size is important to your application, you can reduce code size significantly by removing the capability to dynamically allocate and free memory. To do this, put a checkmark in the No Dynamic Memory Heaps box in the Properties dialog for the MEM manager. If you remove this capability, your program cannot call any of the MEM functions or any object creation functions (such as TSK_create). You need to create all objects to be used by your program with the DSP/BIOS Configuration Tool. You can also use the DSP/BIOS Configuration Tool to create or remove the dynamic memory heap from an individual memory segment.

Software modules in DSP/BIOS that allocate storage at run-time use MEM functions; DSP/BIOS does not use the standard C function malloc. DSP/BIOS modules use MEM to allocate storage in the segment selected for that module with the DSP/BIOS Configuration Tool.

The MEM Manager property, Segment for malloc()/free(), is used to implement the standard C malloc, free, and calloc functions. These functions actually use the MEM functions (with segid = Segment for malloc/free) to allocate and free memory.

**Note:**

The MEM module does not set or configure hardware registers associated with a DSP’s memory subsystem. Such configuration is the responsibility of the user and is typically handled by software loading programs, or in the case of Code Composer Studio, the startup or menu options. For example, to access external memory on a c6000 platform, the External Memory Interface (EMIF) registers must first be set appropriately before any access. The earliest opportunity for EMIF initialization within DSP/BIOS would be during the user initialization hook (see *Global Settings* in the *API Reference Guide*).

**MEM Manager Properties**

The DSP/BIOS Memory Section Manager allows you to specify the memory segments required to locate the various code and data sections of a DSP/BIOS application.

Note that settings you specify in the Visual Linker normally override settings you specify in the DSP/BIOS DSP/BIOS Configuration Tool. See the Visual Linker help for details on using the Visual Linker with DSP/BIOS.

The following global properties can be set for the MEM module in the MEM Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

**General tab**

- **Reuse Startup Code Space**. If this box is checked, the startup code section (.sysinit) can be reused after startup is complete.

  TextConf Name: REUSECODESPACE Type: Bool

  Example: `MEM.REUSECODESPACE = "false";`

- **Argument Buffer Size**. The size of the .args section. The .args section contains the argc, argv, and envp arguments to the program's main function. Code Composer loads arguments for the main function into the .args section. The .args section is parsed by the boot file.

  TextConf Name: ARGSSIZE Type: Numeric

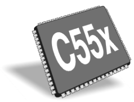
  Example: `MEM.ARGSSIZE = 0x0004;`

- **Stack Size**. The size of the global stack (data stack for the C55x platform) in MADUs. The upper-left corner of the DSP/BIOS Configuration Tool window shows the estimated minimum global stack size required for this application (as a decimal number).

  This size is shown as a hex value in Minimum Addressable Data Units (MADUs). An MADU is the smallest unit of data storage that can be read or written by the CPU. For the c5000 this is a 16-bit word.

  TextConf Name: STACKSIZE Type: Numeric

  Example: `MEM.STACKSIZE = 0x0400;`




- **System Stack Size (MADUs)**. The size of the system stack in MADUs, applicable only on the C55x device.

  TextConf Name: SYSSTACKSIZE Type: Numeric

  Example: `MEM.SYSSTACKSIZE = 0x0100;`

- **No Dynamic Memory Heaps**. Put a checkmark in this box to completely disable the ability to dynamically allocate memory and the ability to dynamically create and delete objects. If this box is checked, the program may not call the MEM_alloc, MEM_valloc, MEM_calloc, and malloc or the XXX_create function for any DSP/BIOS module. If this box is checked, the Segment For DSP/BIOS Objects, Segment for malloc()/free(), and Stack segment for dynamic tasks properties are set to MEM_NULL.

  When you check this box, heaps already specified in MEM segments are removed from the configuration. If you later uncheck this box, recreate heaps by configuring properties for individual MEM objects as needed.

  TextConf Name: NOMEMORYHEAPS Type: Bool

  Example: `MEM.NOMEMORYHEAPS = "false";`

- **Segment For DSP/BIOS Objects**. The default memory segment to contain objects created at run-time with an XXX_create function. The XXX_Attrs structure passed to the XXX_create function can override this default. If you select MEM_NULL for this property, creation of DSP/BIOS objects at run-time via the XXX_create functions is disabled.

  TextConf Name: BIOSOBJSEG Type: Reference

  Example: `MEM.BIOSOBJSEG = prog.get("myMEM");`

- **Segment For malloc() / free()**. The memory segment from which space is allocated when a program calls malloc and from which space is freed when a program calls free. If you select MEM_NULL for this property, dynamic memory allocation at run-time is disabled.

  TextConf Name: MALLOCSEG Type: Reference

  Example: `MEM.MALLOCSEG = prog.get("myMEM");`

**BIOS Data tab**

- **Argument Buffer Section (.args)**. The memory segment containing the .args section.

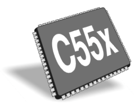
  TextConf Name: ARGSSEG Type: Reference

  Example: `MEM.ARGSSEG = prog.get("myMEM");`

- **Stack Section (.stack)**. The memory segment containing the global stack (data stack for the C55x platform). This segment should be located in RAM. The platform architecture requires that both the user and system stacks (pointed to by the XSP and XSSP registers, respectively) reside in the same 64K page of memory, that is, the upper 7 bits of the stack address (SPH) are shared.

  TextConf Name: STACKSEG Type: Reference

  Example: `MEM.STACKSEG = prog.get("myMEM");`




- **System Stack Section (.sysstack)**. The memory segment containing the system stack, applicable only on the C55x device.

  TextConf Name: SYSSTACKSEG Type: Reference

  Example: `MEM.SYSSTACKSEG = prog.get("myMEM");`

- **DSP/BIOS Init Tables (.gblinit)**. The memory segment containing the DSP/BIOS global initialization tables.

  TextConf Name: GBLINITSEG Type: Reference

  Example: `MEM.GBLINITSEG = prog.get("myMEM");`

- **TRC Initial Value (.trcdata)**. The memory segment containing the TRC mask variable and its initial value. This segment must be placed in RAM.

  TextConf Name: TRCDATASEG Type: Reference

  Example: `MEM.TRCDATASEG = prog.get("myMEM");`

- **DSP/BIOS Kernel State (.sysdata)**. The memory segment containing system data about the DSP/BIOS kernel state.

  TextConf Name: SYSDATASEG Type: Reference

  Example: `MEM.SYSDATASEG = prog.get("myMEM");`

- ❏ **DSP/BIOS Conf Sections (.obj)**. The memory segment containing configuration properties that can be read by the target program.

  TextConf Name: OBJSEG  Type: Reference

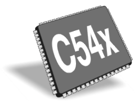
  Example: `MEM.OBJSEG = prog.get("myMEM");`

**BIOS Code tab**

- ❏ **BIOS Code Section (.bios)**. The memory segment containing the DSP/BIOS code.

  TextConf Name: BIOSSEG  Type: Reference

  Example: `MEM.BIOSSEG = prog.get("myMEM");`




- ❏ **BIOS NORPTB Section (.bios:.norptb)**. The memory segment containing DSP/BIOS code that must be placed on the overlay page when the far model is used. This property is visible only if the Function Call Model property in the Global Settings dialog is set to far. This section must be placed in program memory between the addresses 0x0 and 0x7fff. See the application note on DSP/BIOS and TMS320C54x Extended Addressing for more details.

  TextConf Name: BIOSNORPTBSEG  Type: Reference

  Example:
  ```
  MEM.BIOSNORPTBSEG =
      prog.get("myMEM");
  ```

- ❏ **Startup Code Section (.sysinit)**. The memory segment containing DSP/BIOS startup initialization code; this memory can be reused after main starts executing.

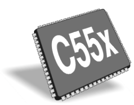
  TextConf Name: SYSINITSEG  Type: Reference

  Example: `MEM.SYSINITSEG = prog.get("myMEM");`

- ❏ **Function Stub Memory (.hwi)**. The memory segment containing dispatch code for interrupt service routines that are configured to be monitored in the HWI Object Properties.

  TextConf Name: HWISEG  Type: Reference

  Example: `MEM.HWISEG = prog.get("myMEM");`




- ❏ **Interrupt Service Table Memory (.hwi_vec)**. The memory segment containing the Interrupt Service Table (IST).

  TextConf Name: HWIVECSEG  Type: Reference

  Example: `MEM.HWIVECSEG = prog.get("myMEM");`

- ❏ **RTDX Text Segment (.rtdx_text)**. The memory segment containing the code sections for the RTDX module.

  TextConf Name: RTDXTEXTSEG  Type: Reference

  Example: `MEM.RTDXTEXTSEG = prog.get("myMEM");`

**Compiler Sections tab**

- **User .cmd File For Non-DSP/BIOS Sections**. Put a checkmark in this box if you want to have full control over the memory used for the sections that follow. You must then create a linker command file that begins by including the linker command file created by the DSP/BIOS Configuration Tool. Your linker command file should then assign memory for the items normally handled by the following properties. See the *TMS320C54x Optimizing Compiler User's Guide*, (literature number SPRU103E) for more details.

  TextConf Name: USERCOMMANDFILE Type: Bool

  Example: `MEM.USERCOMMANDFILE = "false";`

- **Text Section (.text)**. The memory segment containing the executable code, string literals, and compiler-generated constants. This segment can be located in ROM or RAM.

  TextConf Name: TEXTSEG Type: Reference

  Example: `MEM.TEXTSEG = prog.get("myMEM");`

- **Switch Jump Tables (.switch)**. The memory segment containing the jump tables for switch statements. This segment can be located in ROM or RAM.

  TextConf Name: SWITCHSEG Type: Reference

  Example: `MEM.SWITCHSEG = prog.get("myMEM");`

- **C Variables Section (.bss)**. The memory segment containing global and static C variables. At boot or load time, the data in the .cinit section is copied to this segment. This segment should be located in RAM.

  TextConf Name: BSSSEG Type: Reference

  Example: `MEM.BSSSEG = prog.get("myMEM");`

- **Data Initialization Section (.cinit)**. The memory segment containing tables for explicitly initialized global and static variables and constants. This segment can be located in ROM or RAM.

  TextConf Name: CINITSEG Type: Reference

  Example: `MEM.CINITSEG = prog.get("myMEM");`

- **C Function Initialization Table (.pinit)**. The memory segment containing the table of global object constructors. Global constructors must be called during program initialization. The C/C++ compiler produces a table of constructors to be called at startup. The table is contained in a named section called .pinit. The constructors are invoked in the order that they occur in the table. This segment can be located in ROM or RAM.

  TextConf Name: PINITSEG Type: Reference

  Example: `MEM.PINITSEG = prog.get("myMEM");`

- **Constant Section (.const)**. The memory segment containing string constants and data defined with the const C qualifier. If the C compiler is not used, this parameter is unused. This segment can be located in ROM or RAM.

  TextConf Name: CONSTSEG Type: Reference

  Example: `MEM.CONSTSEG = prog.get("myMEM");`

- **Data Section (.data)**. This memory segment contains program data. This segment can be located in ROM or RAM.

  TextConf Name: DATASEG Type: Reference

  Example: `MEM.DATASEG = prog.get("myMEM");`

- **Data Section (.cio)**. This memory segment contains C standard I/O buffers.

  TextConf Name: CIOSEG Type: Reference

  Example: `MEM.CIOSEG = prog.get("myMEM");`

**Load Address tab**

- **Specify Separate Load Addresses**. If you put a checkmark in this box, you can select separate load addresses for the sections listed on this tab.

  Load addresses are useful when, for example, your code must be loaded into ROM, but would run faster in RAM. The linker allows you to allocate sections twice: once to set a load address and again to set a run address.

  If you do not select a separate load address for a section, the section loads and runs at the same address.

  If you do select a separate load address, the section is allocated as if it were two separate sections of the same size. The load address is where raw data for the section is placed. References to items in the section refer to the run address. The application must copy the section from its load address to its run address. For details, see the topics on Runtime Relocation and the .label Directive in the Code Generation Tools help or manual.

  TextConf Name: ENABLELOADADDR Type: Bool

  Example: `MEM.ENABLELOADADDR = "false";`

- **Load Address - BIOS Code Section (.bios)**. The memory segment containing the load allocation of the section that contains DSP/BIOS code.

  TextConf Name: LOADBIOSSEG Type: Reference

  Example: `MEM.LOADBIOSSEG = prog.get("myMEM");`

- **Load Address - Startup Code Section (.sysinit)**. The memory segment containing the load allocation of the section that contains DSP/BIOS startup initialization code.

  TextConf Name: LOADSYSINITSEG Type: Reference

  Example:
  ```
  MEM.LOADSYSINITSEG =
      prog.get("myMEM");
  ```

- **Load Address - DSP/BIOS Init Tables (.gblinit)**. The memory segment containing the load allocation of the section that contains the DSP/BIOS global initialization tables.

  TextConf Name: LOADGBLINITSEG Type: Reference

  Example:
  ```
  MEM.LOADGBLINITSEG =
      prog.get("myMEM");
  ```

- **Load Address - TRC Initial Value (.trcdata)**. The memory segment containing the load allocation of the section that contains the TRC mask variable and its initial value.

  TextConf Name: LOADTRCDATASEG Type: Reference

  Example:
  ```
  MEM.LOADTRCDATASEG =
      prog.get("myMEM");
  ```

- **Load Address - Text Section (.text)**. The memory segment containing the load allocation of the section that contains the executable code, string literals, and compiler-generated constants.

  TextConf Name: LOADTEXTSEG Type: Reference

  Example:
  ```
  MEM.LOADTEXTSEG = prog.get("myMEM");
  ```

- **Load Address - Switch Jump Tables (.switch)**. The memory segment containing the load allocation of the section that contains the jump tables for switch statements.

  TextConf Name: LOADSWITCHSEG Type: Reference

  Example:
  ```
  MEM.LOADSWITCHSEG =
      prog.get("myMEM");
  ```

- **Load Address - Data Initialization Section (.cinit)**. The memory segment containing the load allocation of the section that contains tables for explicitly initialized global and static variables and constants.

  TextConf Name: LOADCINITSEG Type: Reference

  Example:
  ```
  MEM.LOADCINITSEG =
      prog.get("myMEM");
  ```

- **Load Address - C Function Initialization Table (.pinit)**. The memory segment containing the load allocation of the section that contains the table of global object constructors.

  TextConf Name: LOADPINITSEG Type: Reference

  Example:
  ```
  MEM.LOADPINITSEG =
      prog.get("myMEM");
  ```

- **Load Address - Constant Section (.const)**. The memory segment containing the load allocation of the section that contains string constants and data defined with the const C qualifier.

  TextConf Name: LOADCONSTSEG Type: Reference

  Example:
  ```
  MEM.LOADCONSTSEG =
      prog.get("myMEM");
  ```

- **Load Address - Function Stub Memory (.hwi)**. The memory segment containing the load allocation of the section that contains dispatch code for interrupt service routines configured to be monitored.

  TextConf Name: LOADHWISEG Type: Reference

  Example:
  ```
  MEM.LOADHWISEG = prog.get("myMEM");
  ```

- **Load Address - Interrupt Service Table Memory (.hwi_vec)**. The memory segment containing the load allocation of the section that contains the Interrupt Service Table.

  TextConf Name: LOADHWIVECSEG Type: Reference

  Example:
  ```
  MEM.LOADHWIVECSEG =
      prog.get("myMEM");
  ```

- **Load Address - RTDX Text Segment (.rtdx_text)**. The memory segment containing the load allocation of the section that contains the code sections for the RTDX module.

  TextConf Name: LOADRTDXTEXTSEG Type: Reference

  Example:
  ```
  MEM.LOADRTDXTEXTSEG =
      prog.get("myMEM");
  ```

**MEM Object Properties**

A memory segment represents a contiguous length of code or data memory in the address space of the processor.

Note that settings you specify in the Visual Linker normally override settings you specify in the DSP/BIOS DSP/BIOS Configuration Tool. See the Visual Linker help for details on using the Visual Linker with DSP/BIOS.

To create a MEM object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myMem = MEM.create("myMem");
```

The following properties can be set for a MEM object in the MEM Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this MEM object.

  TextConf Name: comment Type: String

  Example: `myMem.comment = "my MEM";`

- **base**. The address at which this memory segment begins. This value is shown in hex.

  TextConf Name: base Type: Numeric

  Example: `myMem.base = 0x000000;`

- **len**. The length of this memory segment in MADUs. This value is shown in hex.

  TextConf Name: len Type: Numeric

  Example: `myMem.len = 0x000000;`

- **create a heap in this memory**. If this box is checked, a heap is created in this memory segment. Memory can by allocated dynamically from a heap. In order to remove the heap from a memory segment, you can select another memory segment that contains a heap for properties that dynamically allocate memory in this memory segment. The properties you should check are in the Memory Section Manager (the Segment for DSP/BIOS objects and Segment for malloc/free properties) and the Task Manager (the Default stack segment for dynamic tasks property). If you disable dynamic memory allocation in the Memory Section Manager, you cannot create a heap in any memory segment.

  TextConf Name: createHeap Type: Bool

  Example: `myMem.createHeap = "true";`

- **heap size**. The size of the heap in MADUs to be created in this memory segment. You cannot control the location of the heap within its memory segment except by making the segment and heap the same sizes.

  A heap can potentially be sized to cross a 64K page boundary. See the MEM_alloc topic for information about the effects of page boundaries on heaps.

  TextConf Name: heapSize Type: Numeric

  Example: `myMem.heapSize = 0x00400;`

- **enter a user defined heap identifier**. If this box is checked, you can define your own identifier label for this heap.

  TextConf Name: enableHeapLabel Type: Bool

  Example: `myMem.enableHeapLabel = "false";`

- **heap identifier label**. If the box above is checked, type a name for this segment's heap.

  TextConf Name: heapLabel Type: Extern

  Example:
  ```
  myMem.heapLabel =
      prog.extern("seg_name", "asm");
  ```

- **space**. Type of memory segment. This is set to code for memory segments that store programs, and data for memory segments that store program data.

  TextConf Name: space Type: EnumString

  Options: "code", "data", "io", "other"

  Example: `myMem.space = "data";`

The predefined memory segments in a configuration file, particularly those for external memory, are dependent on the board template you select. In general, Table 2-4 lists segments that can be defined for the c5000:

*Table 2-4. Typical Memory Segments*

| Name | Memory Segment Type |
|---|---|
| USERREGS | User scratchpad memory |
| BIOSREGS | Scratchpad memory reserved for use by DSP/BIOS |
| VECT | Interrupt vector table |
| IDATA | Internal data RAM |
| IPROG | Internal program RAM |
| EDATA | External data memory |
| EPROG | External program memory |

**MEM Code Composer Studio Interface**

The MEM tab of the Kernel/Object View shows information about memory segments.

## MEM_alloc

*Allocate from a memory segment*

### C Interface

**Syntax**

addr = MEM_alloc(segid, size, align);

**Parameters**

```
Int     segid;   /* memory segment identifier */
Uns     size;    /* block size in MADUs */
Uns     align;   /* block alignment */
```

**Return Value**

```
Void    *addr;   /* address of allocated block of memory */
```

### Assembly Interface

none

### Description

MEM_alloc allocates a contiguous block of storage from the memory segment identified by segid and returns the address of this block.

The segid parameter identifies the memory segment from which memory is to be allocated. This identifier can be an integer or a memory segment name defined in the DSP/BIOS Configuration Tool. The files created by the DSP/BIOS Configuration Tool define each configured segment name as a variable with an integer value.

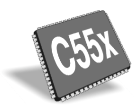
The block contains size MADUs and starts at an address that is a multiple of align. If align is 0 or 1, there is no alignment constraint.

MEM_alloc does not initialize the allocated memory locations.

If the memory request cannot be satisfied, MEM_alloc calls SYS_error with SYS_EALLOC and returns MEM_ILLEGAL.

MEM functions that allocate and deallocate memory internally lock the memory by calling the LCK_pend and LCK_post functions. If another task already holds a lock to the memory, there is a context switch. For this reason, MEM_alloc cannot be called from the context of a SWI or HWI.

### Page Boundary Issues on the ’C55x

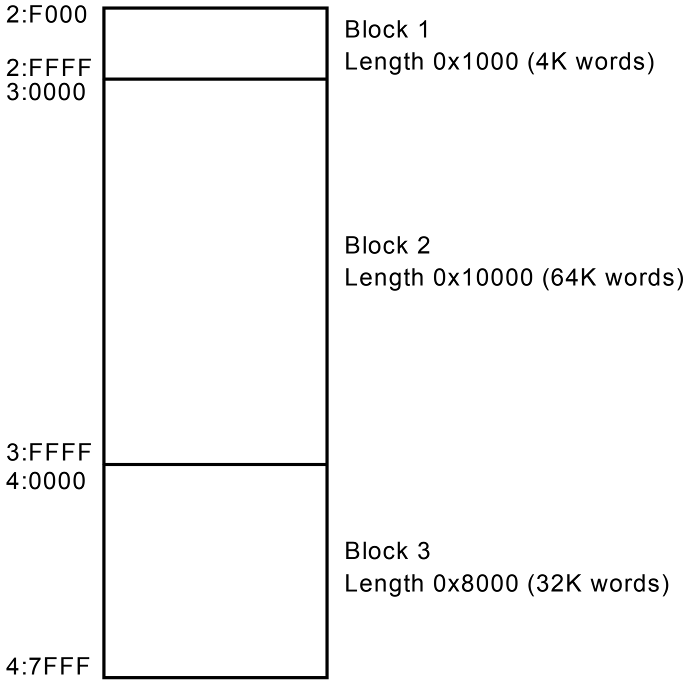



On the ’C55x using the large memory model, MEM objects can configure heaps larger than 64K MADUs (16-bit words for 'C55x). However, memory blocks that cross a 64K page boundary cause C compiler errors. (See the *TMS320C55x Optimizing C Compiler User’s Guide* for details.) To prevent such errors, the MEM module divides heaps that cross page boundaries into memory blocks that do not cross boundaries. As a result, MEM_alloc and MEM_free can only allocate and free memory within a single memory block, and the largest block that MEM_alloc can allocate in any case is 64K words (0x10000).

For example, suppose you create a RAM segment called MYRAM that is 100K words in length. MYRAM has a base address of 2:F000 and a length of 0x19000. The heap within MYRAM is also 100K words and has a heap identifier label of MYSEG. So this heap also has a base address of 2:F000 and ends at 4:7FFF.

To prevent a memory block from crossing a page boundary, the MEM Module separates this heap into the following memory blocks, which are aligned along 64K page boundaries:

*Figure 2-2. MYSEG Heap Initial Memory Map*



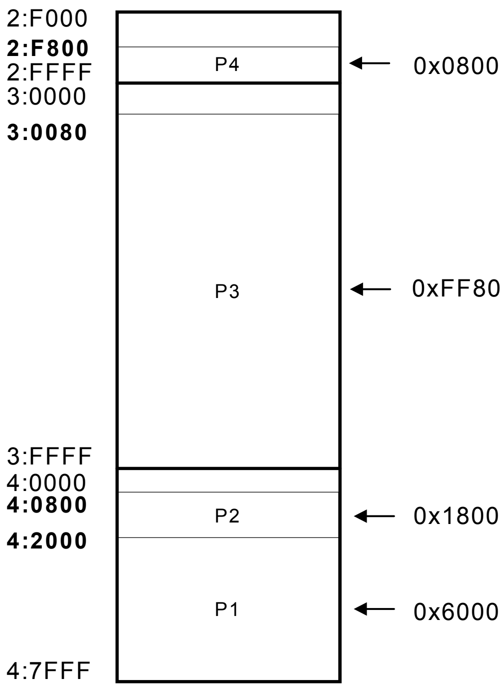

Suppose your program calls MEM_alloc in the following sequence:

```
P3 = MEM_alloc(MYSEG, 0xFF80, 0);
P1 = MEM_alloc(MYSEG, 0x6000, 0);
P2 = MEM_alloc(MYSEG, 0x1800, 0);
P4 = MEM_alloc(MYSEG, 0x800, 0);
```

MEM_alloc allocates memory from the first available memory block that is large enough. The memory block with the lowest address is the first available. In our example, the memory block with base address 2:F000 and length 0x1000 is the first available memory block. MEM_alloc gets memory sections from the bottom of a memory block. If the heap does not have enough memory for a particular call to MEM_alloc, that call returns an error and the next call to MEM_alloc is executed.

The results of these calls to MEM_alloc are shown in the figure and list that follow.

*Figure 2-3. MYSEG Memory Map After Allocation*




- `P3 = MEM_alloc(MYSEG, 0xFF80, 0);`

  This call requests 0xFF80 words. The first available block (at 2:F000) has a size of 0x1000; it is too small for 0xFF80. The next block (at 3:0000) has a size of 0x10000; it is large enough to allocate 0xFF80 words. So, P3 points to a block from 3:0080 to 3:FFFF (because MEM_alloc takes memory from the bottom of a memory block).

- `P1 = MEM_alloc(MYSEG, 0x6000, 0);`

  This call requests 0x6000 words. The first block has a size of 0x1000, which is still too small. The next block now has only 0x80 words available because of the previous memory allocation. The last memory block has a size of 0x8000, and is large enough for this allocation. So, P1 points to a block from 4:2000 to 4:7FFF.

- `P2 = MEM_alloc(MYSEG, 0x1800, 0);`

This call requests 0x1800 words. Blocks 1 and 2 are again too small. The last block has 0x2000 words remaining, and can accommodate this allocation. So, P2 points to a block from 4:0800 to 4:1FFF.

- `P4 = MEM_alloc(MYSEG, 0x800, 0);`

  This call requests 0x800 words. This time, the first block is large enough. So, P4 points to a block from 2:F800 to 2:FFFF.

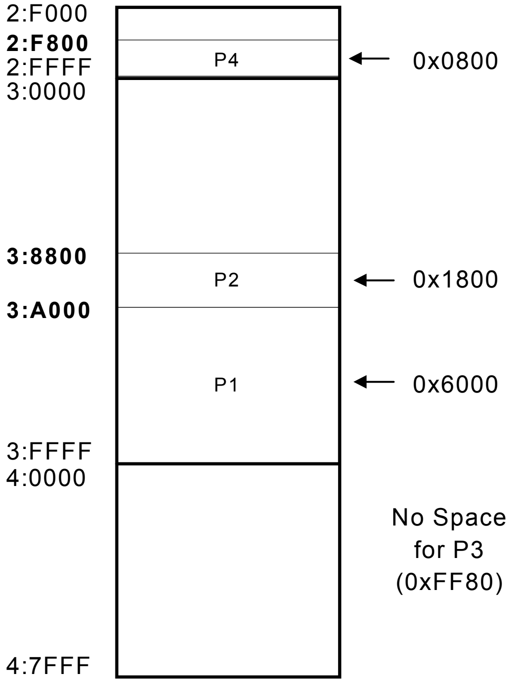
Consider how this memory map would change if the same MEM_alloc calls were made in the following sequence:

```
P1 = MEM_alloc(MYSEG, 0x6000, 0);
P2 = MEM_alloc(MYSEG, 0x1800, 0);
P3 = MEM_alloc(MYSEG, 0xFF80, 0);
P4 = MEM_alloc(MYSEG, 0x800, 0);
```

The results of this modified call sequence are as follows and are shown in Figure 2-4.

- P1 is allocated from 3:A000 to 3:FFFF.
- P2 is allocated from 3:8800 to 3:9FFF.
- P3 is not allocated because no unallocated memory blocks are large enough to hold 0xFF80.
- P4 is allocated from 2:F800 to 2:FFFF.

*Figure 2-4. MYSEG Memory Map After Modified Allocation*




As a result of page boundary limitations on MEM_alloc, you should follow these guidelines when using large heaps and multiple MEM_alloc calls:

❑ Create a memory segment specifically for a heap. Give the heap the same size as the memory segment so that the base of the memory segment is at the same location as the base of the heap. (You cannot specify the location of the heap within a memory segment if the memory segment is larger than the heap.) If possible, align the memory segment with a page boundary to maximize the size of memory blocks within the heap.

❑ If possible, allocate larger blocks of memory from the heap first. Previous allocations of small memory blocks can reduce the size of the memory blocks available for large memory allocations.

❑ Realize that MEM_alloc can fail and call SYS_error even if the heap contain a sufficient absolute amount of unallocated space. This is because the largest free memory block within the heap may be much smaller than the total amount of unallocated memory.

❑ If your application allocates memory in an unpredictable sequence, use a heap that is much larger than the amount of memory needed.

**Constraints and Calling Context**

- ❏ segid must identify a valid memory segment.
- ❏ MEM_alloc cannot be called from a SWI or HWI.
- ❏ MEM_alloc cannot be called if the TSK scheduler is disabled.
- ❏ align must be 0, or a power of 2 (for example, 1, 2, 4, 8).

**See Also**

MEM_calloc
MEM_free
MEM_valloc
SYS_error
std.h and stdlib.h functions

## MEM_calloc

*Allocate from a memory segment and set value to 0*

### C Interface

**Syntax**

addr = MEM_calloc(segid, size, align)

**Parameters**

```
Int     segid;   /* memory segment identifier */
Uns     size;    /* block size in MADUs */
Uns     align;   /* block alignment */
```

**Return Value**

```
Void    *addr;   /* address of allocated block of memory */
```

### Assembly Interface

none

### Description

MEM_calloc is functionally equivalent to calling MEM_valloc with value set to 0. MEM_calloc allocates a contiguous block of storage from the memory segment identified by segid and returns the address of this block.

The segid parameter identifies the memory segment from which memory is to be allocated. This identifier can be an integer or a memory segment name defined in the DSP/BIOS Configuration Tool. The files created by the DSP/BIOS Configuration Tool define each configured segment name as a variable with an integer value.

The block contains size MADUs and starts at an address that is a multiple of align. If align is 0 or 1, there is no alignment constraint.

If the memory request cannot be satisfied, MEM_calloc calls SYS_error with SYS_EALLOC and returns MEM_ILLEGAL.

MEM functions that allocate and deallocate memory internally lock the memory by calling the LCK_pend and LCK_post functions. If another task already holds a lock to the memory, there is a context switch. For this reason, MEM_calloc cannot be called from the context of a SWI or HWI.

### Constraints and Calling Context

- ❏ segid must identify a valid memory segment.
- ❏ MEM_calloc cannot be called from a SWI or HWI.
- ❏ MEM_calloc cannot be called if the TSK scheduler is disabled.
- ❏ align must be 0, or a power of 2 (for example, 1, 2, 4, 8).

### See Also

MEM_alloc
MEM_free
MEM_valloc
SYS_error
std.h and stdlib.h functions

## MEM_define

*Define a new memory segment*

### C Interface

**Syntax**

segid = MEM_define(base, length, attrs);

**Parameters**

```
Ptr         base;      /* base address of new segment */
Uns         length;    /* length (in MADUs) of new segment */
MEM_Attrs   *attrs;    /* segment attributes */
```

**Return Value**

```
Int         segid;     /* ID of new segment */
```

### Assembly Interface

none

### Description

MEM_define defines a new memory segment for use by the DSP/BIOS MEM Module.

The new segment contains length MADUs starting at base. A new table entry is allocated to define the segment, and the entry's index into this table is returned as the segid.

The new block should be aligned on a MEM_HEADERSIZE boundary, and the length should be a multiple of MEM_HEADERSIZE, otherwise the entire block is not available for allocation.

If attrs is NULL, the new segment is assigned a default set of attributes. Otherwise, the segment's attributes are specified through a structure of type MEM_Attrs.

**Note:**

No attributes are supported for segments, and the type MEM_Attrs is defined as a dummy structure.

### Constraints and Calling Context

- At least one segment must exist at the time MEM_define is called.
- MEM_define and MEM_redefine must not be called when a context switch is possible. To guard against a context switch, these functions should only be called in the main function.
- MEM_define should not be called from the function specified by the User Init Function property of the Global Settings module. The MEM module has not been initialized at the time the User Init Function runs.

### See Also

MEM_redefine

## MEM_free

*Free a block of memory*

### C Interface

**Syntax**

status = MEM_free(segid, addr, size);

**Parameters**

| | | |
|---|---|---|
| Int | segid; | /* memory segment identifier */ |
| Ptr | addr; | /* block address pointer */ |
| Uns | size; | /* block length in MADUs*/ |

**Return Value**

| | | |
|---|---|---|
| Bool | status; | /* TRUE if successful */ |

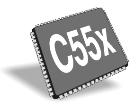
### Assembly Interface

none

### Description

MEM_free places the memory block specified by addr and size back into the free pool of the segment specified by segid. The newly freed block is combined with any adjacent free blocks. This space is then available for further allocation by MEM_alloc. The segid can be an integer or a memory segment name defined in the DSP/BIOS Configuration Tool

MEM functions that allocate and deallocate memory internally lock the memory by calling the LCK_pend and LCK_post functions. If another task already holds a lock to the memory, there is a context switch. For this reason, MEM_free cannot be called from the context of a SWI or HWI.




Although MEM_free combines newly freed blocks with adjacent free blocks, it does not combine blocks that cross a 64K page boundary. See the MEM_alloc topic for information about the effects of page boundaries on heaps.

### Constraints and Calling Context

- ❏ addr must be a valid pointer returned from a call to MEM_alloc.
- ❏ segid and size are those values used in a previous call to MEM_alloc.
- ❏ MEM_free cannot be called by HWI or SWI functions.
- ❏ MEM_free cannot be called if the TSK scheduler is disabled.

### See Also

MEM_alloc
std.h and stdlib.h functions

## MEM_redefine

*Redefine an existing memory segment*

### C Interface

**Syntax**

```
MEM_redefine(segid, base, length);
```

**Parameters**

```
Int     segid;    /* segment to redefine */
Ptr     base;     /* base address of new block */
Uns     length;   /* length (in MADUs) of new block */
```

**Return Value**

Void

### Assembly Interface

none

### Reentrant

no

### Description

MEM_redefine redefines an existing memory segment managed by the DSP/BIOS MEM Module. All pointers in the old segment memory block are automatically freed, and the new segment block is completely available for allocations.

The new block should be aligned on a MEM_HEADERSIZE boundary, and the length should be a multiple of MEM_HEADERSIZE, otherwise the entire block is not available for allocation.

### Constraints and Calling Context

- MEM_define and MEM_redefine must not be called when a context switch is possible. To guard against a context switch, these functions should only be called in the main function.

### See Also

MEM_define

## MEM_stat

*Return the status of a memory segment*

### C Interface

**Syntax**

status = MEM_stat(segid, statbuf);

**Parameters**

```
Int        segid;     /* memory segment identifier */
MEM_Stat   *statbuf;  /* pointer to stat buffer */
```

**Return Value**

```
Bool       status;    /* TRUE if successful */
```

### Assembly Interface

none

### Description

MEM_stat returns the status of the memory segment specified by segid in the status structure pointed to by statbuf.

```
struct MEM_Stat {
   Uns  size;   /* original size of segment */
   Uns  used    /* number of MADUs used in segment */
   Uns  length; /* largest free contiguous block length */
}
```

All values are expressed in terms of minimum addressable units (MADUs).

MEM_stat returns TRUE if segid corresponds to a valid memory segment, and FALSE otherwise. If MEM_stat returns FALSE, the contents of statbuf are undefined.

MEM functions that access memory internally lock the memory by calling the LCK_pend and LCK_post functions. If another task already holds a lock to the memory, there is a context switch. For this reason, MEM_stat cannot be called from the context of a SWI or HWI.

### Constraints and Calling Context

- ❏ MEM_stat cannot be called from a SWI or HWI.
- ❏ MEM_stat cannot be called if the TSK scheduler is disabled.

## MEM_valloc

*Allocate from a memory segment and set value*

### C Interface

**Syntax**

addr = MEM_valloc(segid, size, align, value);

**Parameters**

```
Int     segid;  /* memory segment identifier */
Uns     size;   /* block size in MADUs */
Uns     align;  /* block alignment */
Char    value;  /* character value */
```

**Return Value**

```
Void    *addr;  /* address of allocated block of memory */
```

### Assembly Interface

none

### Description

MEM_valloc uses MEM_alloc to allocate the memory before initializing it to value.

The segid parameter identifies the memory segment from which memory is to be allocated. This identifier can be an integer or a memory segment name defined in the DSP/BIOS Configuration Tool. The files created by the DSP/BIOS Configuration Tool define each configured segment name as a variable with an integer value.

The block contains size MADUs and starts at an address that is a multiple of align. If align is 0 or 1, there is no alignment constraint.

If the memory request cannot be satisfied, MEM_valloc calls SYS_error with SYS_EALLOC and returns MEM_ILLEGAL.

MEM functions that allocate and deallocate memory internally lock the memory by calling the LCK_pend and LCK_post functions. If another task already holds a lock to the memory, there is a context switch. For this reason, MEM_valloc cannot be called from the context of a SWI or HWI.

### Constraints and Calling Context

- ❏ segid must identify a valid memory segment.
- ❏ MEM_valloc cannot be called from a SWI or HWI.
- ❏ MEM_valloc cannot be called if the TSK scheduler is disabled.
- ❏ align must be 0, or a power of 2 (for example, 1, 2, 4, 8).

### See Also

MEM_alloc
MEM_calloc
MEM_free
SYS_error
std.h and stdlib.h functions

## 2.16 PIP Module

The PIP module is the buffered pipe manager.

**Functions**

- ❏ PIP_alloc. Get an empty frame from the pipe.
- ❏ PIP_free. Recycle a frame back to the pipe.
- ❏ PIP_get. Get a full frame from the pipe.
- ❏ PIP_getReaderAddr. Get the value of the readerAddr pointer of the pipe.
- ❏ PIP_getReaderNumFrames. Get the number of pipe frames available for reading.
- ❏ PIP_getReaderSize. Get the number of words of data in a pipe frame.
- ❏ PIP_getWriterAddr. Get the value of the writerAddr pointer of the pipe.
- ❏ PIP_getWriterNumFrames. Get the number of pipe frames available to write to.
- ❏ PIP_getWriterSize. Get the number of words that can be written to a pipe frame.
- ❏ PIP_peek. Get the pipe frame size and address without actually claiming the pipe frame.
- ❏ PIP_put. Put a full frame into the pipe.
- ❏ PIP_reset. Reset all fields of a pipe object to their original values.
- ❏ PIP_setWriterSize. Set the number of valid words written to a pipe frame.

**PIP_Obj Structure Members**

- ❏ **Ptr readerAddr**. Pointer to the address to begin reading from after calling PIP_get.
- ❏ **Uns readerSize**. Number of words of data in the frame read with PIP_get.
- ❏ **Uns readerNumFrames**. Number of frames available to be read.
- ❏ **Ptr writerAddr**. Pointer to the address to begin writing to after calling PIP_alloc.
- ❏ **Uns writerSize**. Number of words available in the frame allocated with PIP_alloc.
- ❏ **Uns writerNumFrames**. Number of frames available to be written to.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the PIP Manager Properties and PIP Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| bufSeg | Reference | prog.get("IDATA") |
| bufAlign | Int16 | 1 |
| frameSize | Int16 | 8 |
| numFrames | Int16 | 2 |
| monitor | EnumString | "reader" ("writer", "none") |
| notifyWriterFxn | Extern | prog.extern("FXN_F_nop") |
| notifyWriterArg0 | Arg | 0 |
| notifyWriterArg1 | Arg | 0 |
| notifyReaderFxn | Extern | prog.extern("FXN_F_nop") |
| notifyReaderArg0 | Arg | 0 |
| notifyReaderArg1 | Arg | 0 |

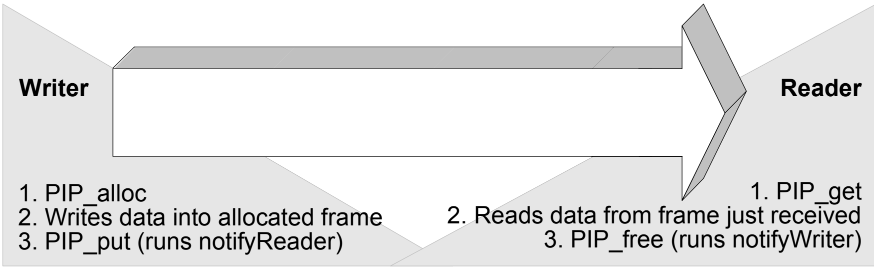
**Description**

The PIP module manages data pipes, which are used to buffer streams of input and output data. These data pipes provide a consistent software data structure you can use to drive I/O between the DSP device and all kinds of real-time peripheral devices.

Each pipe object maintains a buffer divided into a fixed number of fixed length frames, specified by the numframes and framesize properties. All I/O operations on a pipe deal with one frame at a time; although each frame has a fixed length, the application can put a variable amount of data in each frame up to the length of the frame.

A pipe has two ends, as shown in Figure 2-5. The writer end (also called the producer) is where your program writes frames of data. The reader end (also called the consumer) is where your program reads frames of data

*Figure 2-5. Pipe Schematic*




Internally, pipes are implemented as a circular list; frames are reused at the writer end of the pipe after PIP_free releases them.

The notifyReader and notifyWriter functions are called from the context of the code that calls PIP_put or PIP_free. These functions can be written in C or assembly. To avoid problems with recursion, the notifyReader and notifyWriter functions normally should not directly call any of the PIP module functions for the same pipe. Instead, they should post a software interrupt that uses the PIP module functions. However, PIP calls may be made from the notifyReader and notifyWriter functions if the functions have been protected against re-entrancy. The audio example, located on your distribution CD in `c:\ti\examples\`*`target`*`\bios\audio` folder, where *`target`* matches your board, is a good example of this. (If you installed in a path other than `c:\ti`, substitute your appropriate path.)

> **Note:**
>
> When DSP/BIOS starts up, it calls the notifyWriter function internally for each created pipe object to initiate the pipe's I/O.

The code that calls PIP_free or PIP_put should preserve any necessary registers.

Often one end of a pipe is controlled by an HWI and the other end is controlled by a SWI function, such as SWI_andnHook.

HST objects use PIP objects internally for I/O between the host and the target. Your program only needs to act as the reader or the writer when you use an HST object, because the host controls the other end of the pipe.

Pipes can also be used to transfer data within the program between two application threads.

**PIP Manager Properties**

The pipe manager manages objects that allow the efficient transfer of frames of data between a single reader and a single writer. This transfer is often between an HWI and an application software interrupt, but pipes can also be used to transfer data between two application threads.

The following global property can be set for the PIP module in the PIP Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **Object Memory**. The memory segment that contains the PIP objects.

  TextConf Name: OBJMEMSEG    Type: Reference

  Example: `PIP.OBJMEMSEG = prog.get("myMEM");`

**PIP Object Properties**

A pipe object maintains a single contiguous buffer partitioned into a fixed number of fixed length frames. All I/O operations on a pipe deal with one frame at a time; although each frame has a fixed length, the application can put a variable amount of data in each frame (up to the length of the frame).

To create a PIP object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myPip = PIP.create("myPip");
```

The following properties can be set for a PIP object in the PIP Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this PIP object.

  TextConf Name: comment Type: String

  Example: `myPip.comment = "my PIP";`

- **bufseg**. The memory segment that the buffer is allocated within; all frames are allocated from a single contiguous buffer (of size framesize x numframes).

  TextConf Name: bufSeg Type: Reference

  Example: `myPip.bufSeg = prog.get("myMEM");`

- **bufalign**. The alignment (in words) of the buffer allocated within the specified memory segment.

  TextConf Name: bufAlign Type: Int16

  Example: `myPip.bufAlign = 1;`

- **framesize**. The length of each frame (in words)

  TextConf Name: frameSize Type: Int16

  Example: `myPip.frameSize = 8;`

- **numframes**. The number of frames

  TextConf Name: numFrames Type: Int16

  Example: `myPip.numFrames = 2;`

- **monitor**. The end of the pipe to be monitored by a hidden STS object. Can be set to reader, writer, or nothing. In the Statistics View analysis tool, your choice determines whether the STS display for this pipe shows a count of the number of frames handled at the reader or writer end of the pipe.

  TextConf Name: monitor Type: EnumString

  Options: "reader", "writer", "none"

  Example: `myPip.monitor = "reader";`

- **notifyWriter**. The function to execute when a frame of free space is available. This function should notify (for example, by calling SWI_andnHook) the object that writes to this pipe that an empty frame is available.

  The notifyWriter function is performed as part of the thread that called PIP_free or PIP_alloc. To avoid problems with recursion, the notifyWriter function should not directly call any of the PIP module functions for the same pipe.

TextConf Name: notifyWriterFxn Type: Extern

Example:
```
myPip.notifyWriterFxn =
    prog.extern("writerFxn");
```

- **nwarg0, nwarg1**. Two Arg type arguments for the notifyWriter function.

  TextConf Name: notifyWriterArg0 Type: Arg

  TextConf Name: notifyWriterArg1 Type: Arg

  Example:
  ```
  myPip.notifyWriterArg0 = 0;
  ```

- **notifyReader**. The function to execute when a frame of data is available. This function should notify (for example, by calling SWI_andnHook) the object that reads from this pipe that a full frame is ready to be processed.

  The notifyReader function is performed as part of the thread that called PIP_put or PIP_get. To avoid problems with recursion, the notifyReader function should not directly call any of the PIP module functions for the same pipe.

  TextConf Name: notifyReaderFxn Type: Extern

  Example:
  ```
  myPip.notifyReaderFxn =
      prog.extern("readerFxn");
  ```

- **nrarg0, nrarg1**. Two Arg type arguments for the notifyReader function.

  TextConf Name: notifyReaderArg0 Type: Arg

  TextConf Name: notifyReaderArg1 Type: Arg

  Example:
  ```
  myPip.notifyReaderArg0 = 0;
  ```

**PIP - Code Composer Studio Interface**

To enable PIP accumulators, choose DSP/BIOS→RTA Control Panel and put a check in the appropriate box. Then choose DSP/BIOS→Statistics View, which lets you select objects for which you want to see statistics. If you choose a PIP object, you see a count of the number of frames read from or written to the pipe.

## PIP_alloc

*Allocate an empty frame from a pipe*

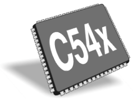
### C Interface

**Syntax** PIP_alloc(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle */

**Return Value** Void

### Assembly Interface



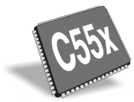

**Syntax** PIP_alloc

**Preconditions** ar2 = address of the pipe object
the pipe must contain empty frames before calling PIP_alloc

**Postconditions** none

**Modifies** ag, ah, al, ar2, ar3, ar4, ar5, asm, bg, bh, bl, braf, brc, c, ovb, rea, rsa, sxm

### Assembly Interface




**Syntax** PIP_alloc

**Preconditions** xar0 = the address of the pipe object;
the pipe must contain empty frames before calling PIP_alloc

**Postconditions** none

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, t1, ac0, ac1, ac2, ac3, rptc, trn1, brc1, brs1, csr, rsa0, rsa1, rea0, rea1 and any registers modified by the notifyWriter function

### Reentrant

no

### Description

PIP_alloc allocates an empty frame from the pipe you specify. You can write to this frame and then use PIP_put to put the frame into the pipe.

If empty frames are available after PIP_alloc allocates a frame, PIP_alloc runs the function specified by the notifyWriter property of the PIP object. This function should notify (for example, by calling SWI_andnHook) the object that writes to this pipe that an empty frame is available. The notifyWriter function is performed as part of the thread that calls PIP_free or PIP_alloc. To avoid problems with recursion, the notifyWriter function should not directly call any PIP module functions for the same pipe.

**Constraints and Calling Context**

- ❑ Before calling PIP_alloc, a function should check the writerNumFrames member of the PIP_Obj structure by calling PIP_getWriterNumFrames to make sure it is greater than 0 (that is, at least one empty frame is available).
- ❑ PIP_alloc can only be called one time before calling PIP_put. You cannot operate on two frames from the same pipe simultaneously.

**Example**

```
Void copy(HST_Obj *input, HST_Obj *output)
{
    PIP_Obj     *in, *out;
    Uns         *src, *dst;
    Uns         size;

    in = HST_getpipe(input);
    out = HST_getpipe(output);

    if (PIP_getReaderNumFrames(in) == 0 ||
        PIP_getWriterNumFrames(out) == 0) {
        error;
    }

    /* get input data and allocate output frame */
    PIP_get(in);
    PIP_alloc(out);

    /* copy input data to output frame */
    src = PIP_getReaderAddr(in);
    dst = PIP_getWriterAddr(out);
    size = PIP_getReaderSize(in);
    PIP_setWriterSize(out, size);
    for (; size > 0; size--) {
        *dst++ = *src++;
    }

    /* output copied data and free input frame */
    PIP_put(out);
    PIP_free(in);
}
```

The example for HST_getpipe, page 2–130, also uses a pipe with host channel objects.

**See Also**

PIP_free
PIP_get
PIP_put
HST_getpipe

## PIP_free

*Recycle a frame that has been read to a pipe*

### C Interface

**Syntax** PIP_free(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** PIP_free

**Preconditions** ar2 = address of the pipe object

**Postconditions** none

**Modifies** ag, ah, al, ar2, ar3, ar4, ar5, asm, bg, bh, bl, braf, brc, c, ovb, rea, rsa, sxm, and any registers modified by the notifyWriter function

### Assembly Interface

C55x

**Syntax** PIP_free

**Preconditions** xar0 = address of the pipe object

**Postconditions** none

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, t1, ac0, ac1, ac2, ac3, rptc, trn1, brc1, brs1, csr, rsa0, rsa1, rea0, rea1, and any registers modified by the notifyWriter function

### Reentrant

no

### Description

PIP_free releases a frame after you have read the frame with PIP_get. The frame is recycled so that PIP_alloc can reuse it.

After PIP_free releases the frame, it runs the function specified by the notifyWriter property of the PIP object. This function should notify (for example, by calling SWI_andnHook) the object that writes to this pipe that an empty frame is available. The notifyWriter function is performed as part of the thread that called PIP_free or PIP_alloc. To avoid problems with recursion, the notifyWriter function should not directly call any of the PIP module functions for the same pipe.

**Constraints and Calling Context**

- ❏ When called within an HWI ISR, the code sequence calling PIP_free must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

See the example for PIP_alloc, page 2–227. The example for HST_getpipe, page 2–130, also uses a pipe with host channel objects.

**See Also**

PIP_alloc
PIP_get
PIP_put
HST_getpipe

## PIP_get

*Get a full frame from the pipe*

### C Interface

**Syntax**

PIP_get(pipe);

**Parameters**

```
PIP_Handle   pipe;         /* pipe object handle */
```

**Return Value**

Void

### Assembly Interface

C54x

**Syntax**

PIP_get

**Preconditions**

ar2 = address of the pipe object
the pipe must contain full frames before calling PIP_get

**Postconditions**

none

**Modifies**

ag, ah, al, ar2, ar3, ar4, ar5, asm, bg, bh, bl, braf, brc, c, ovb, rea, rsa, sxm

### Assembly Interface

C55x

**Syntax**

PIP_get

**Preconditions**

xar0 = address of the pipe object;
the pipe must contain full frames before calling PIP_get

**Postconditions**

none

**Modifies**

xar0, xar1, xar2, xar3, xar4, t0, t1, ac0, ac1, ac2, ac3, rptc, trn1, brc1, brs1, csr, rsa0, rsa1, rea0, rea1 and any registers modified by the notifyReader function

**Reentrant**

no

**Description**

PIP_get gets a frame from the pipe after some other function puts the frame into the pipe with PIP_put.

If full frames are available after PIP_get gets a frame, PIP_get runs the function specified by the notifyReader property of the PIP object. This function should notify (for example, by calling SWI_andnHook) the object that reads from this pipe that a full frame is available. The notifyReader function is performed as part of the thread that calls PIP_get or PIP_put. To avoid problems with recursion, the notifyReader function should not directly call any PIP module functions for the same pipe.

**Constraints and Calling Context**

- ❏ Before calling PIP_get, a function should check the readerNumFrames member of the PIP_Obj structure by calling PIP_getReaderNumFrames to make sure it is greater than 0 (that is, at least one full frame is available).
- ❏ PIP_get can only be called one time before calling PIP_free. You cannot operate on two frames from the same pipe simultaneously.

**Example**

See the example for PIP_alloc, page 2–227. The example for HST_getpipe, page 2–130, also uses a pipe with host channel objects.

**See Also**

PIP_alloc
PIP_free
PIP_put
HST_getpipe

## PIP_getReaderAddr

*Get the value of the readerAddr pointer of the pipe*

### C Interface

**Syntax**

readerAddr = PIP_getReaderAddr(pipe);

**Parameters**

PIP_Handle pipe; /* pipe object handle */

**Return Value**

Ptr readerAddr

### Assembly Interface

none

### Reentrant

yes

### Description

PIP_getReaderAddr is a C function that returns the value of the readerAddr pointer of a pipe object. The readerAddr pointer is normally used following a call to PIP_get, as the address to begin reading from.

### Example

```
Void audio(PIP_Obj *in, PIP_Obj *out)
{
    Uns         *src, *dst;
    Uns         size;

    if (PIP_getReaderNumFrames(in) == 0 ||
    PIP_getWriterNumFrames(out) == 0) {
        error;    }
    PIP_get(in);      /* get input data */
    PIP_alloc(out);   /* allocate output buffer */

    /* copy input data to output buffer */
    src = PIP_getReaderAddr(in);
    dst = PIP_getWriterAddr(out);
    size = PIP_getReaderSize(in);
    PIP_setWriterSize(out,size);
    for (; size > 0; size--) {
        *dst++ = *src++;
    }

    /* output copied data and free input buffer */
    PIP_put(out);
    PIP_free(in);
}
```

## PIP_getReaderNumFrames

*Get the number of pipe frames available for reading*

### C Interface

**Syntax**

num = PIP_getReaderNumFrames(pipe);

**Parameters**

```
PIP_Handle   pipe;    /* pip object handle */
```

**Return Value**

```
Uns          num;     /* number of filled frames to be read */
```

**Assembly Interface**

none

**Reentrant**

yes

**Description**

PIP_getReaderNumFrames is a C function that returns the value of the readerNumFrames element of a pipe object.

Before a function attempts to read from a pipe it should call PIP_getReaderNumFrames to ensure at least one full frame is available.

**Example**

See the example for PIP_getReaderAddr, page 2–233.

## PIP_getReaderSize

*Get the number of words of data in a pipe frame*

**C Interface**

**Syntax** num = PIP_getReaderSize(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle*/

**Return Value** Uns num; /* number of words to be read from filled frame */

**Assembly Interface** none

**Reentrant** yes

**Description** PIP_getReaderSize is a C function that returns the value of the readerSize element of a pipe object.

As a function reads from a pipe it should use PIP_getReaderSize to determine the number of valid words of data in the pipe frame.

**Example** See the example for PIP_getReaderAddr, page 2–233.

## PIP_getWriterAddr

*Get the value of the writerAddr pointer of the pipe*

### C Interface

**Syntax** writerAddr = PIP_getWriterAddr(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle */

**Return Value** Ptr writerAddr;

**Assembly Interface** none

**Reentrant** yes

**Description** PIP_getWriterAddr is a C function that returns the value of the writerAddr pointer of a pipe object.

The writerAddr pointer is normally used following a call to PIP_alloc, as the address to begin writing to.

**Example** See the example for PIP_getReaderAddr, page 2–233.

## PIP_getWriterNumFrames

*Get number of pipe frames available to be written to*

**C Interface**

**Syntax** num = PIP_getWriterNumFrames(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle*/

**Return Value** Uns num; /* number of empty frames to be written */

**Assembly Interface** none

**Reentrant** yes

**Description** PIP_getWriterNumFrames is a C function that returns the value of the writerNumFrames element of a pipe object.

Before a function attempts to write to a pipe, it should call PIP_getWriterNumFrames to ensure at least one empty frame is available.

**Example** See the example for PIP_getReaderAddr, page 2–233.

## PIP_getWriterSize *Get the number of words that can be written to a pipe frame*

**C Interface**

**Syntax** num = PIP_getWriterSize(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle*/

**Return Value** Uns num; /* number of words to be written in empty frame */

**Assembly Interface** none

**Reentrant** yes

**Description** PIP_getWriterSize is a C function that returns the value of the writerSize element of a pipe object.

As a function writes to a pipe, it can use PIP_getWriterSize to determine the maximum number words that can be written to a pipe frame.

**Example**

```
if (PIP_getWriterNumFrames(rxPipe) > 0) {
    PIP_alloc(rxPipe);
    DSS_rxPtr = PIP_getWriterAddr(rxPipe);
    DSS_rxCnt = PIP_getWriterSize(rxPipe);
}
```

## PIP_peek

*Get pipe frame size and address without actually claiming pipe frame*

### C Interface

**Syntax**

framesize = PIP_peek(pipe, addr, rw);

**Parameters**

```
PIP_Handle  pipe;      /* pipe object handle */
Ptr         *addr;     /* the address of the variable that keeps the frame
                          address */
Uns         rw;        /* the flag that indicates the reader or writer side */
```

**Return Value**

```
Int         framesize;/* the frame size */
```

### Assembly Interface

none

### Description

PIP_peek can be used before calling PIP_alloc or PIP_get to get the pipe frame size and address without actually claiming the pipe frame.

The pipe parameter is the pipe object handle, the addr parameter is the address of the variable that keeps the retrieved frame address, and the rw parameter is the flag that indicates what side of the pipe PIP_peek is to operate on. If rw is PIP_READER, then PIP_peek operates on the reader side of the pipe. If rw is PIP_WRITER, then PIP_peek operates on the writer side of the pipe.

PIP_getReaderNumFrames or PIP_getWriterNumFrames can be called to ensure that a frame exists before calling PIP_peek, although PIP_peek returns –1 if no pipe frame exists.

PIP_peek returns the frame size, or –1 if no pipe frames are available. If the return value of PIP_peek in frame size is not –1, then *addr is the location of the frame address.

### See Also

PIP_alloc
PIP_free
PIP_get
PIP_put
PIP_reset

## PIP_put

*Put a full frame into the pipe*

### C Interface

**Syntax** PIP_put(pipe);

**Parameters** PIP_Handle pipe; /* pipe object handle */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** PIP_put

**Preconditions** ar2 = address of the pipe object

**Postconditions** none

**Modifies** ag, ah, al, ar2, ar3, ar4, ar5, asm, bg, bh, bl, braf, brc, c, ovb, rea, rsa, sxm, and any registers modified by the notifyReader function

### Assembly Interface

C55x

**Syntax** PIP_put

**Preconditions** xar0 = address of the pipe object

**Postconditions** none

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, t1, ac0, ac1, ac2, ac3, rptc, trn1, brc1, brs1, csr, rsa0, rsa1, rea0, rea1, and any registers modified by the notifyReader function

**Reentrant** no

**Description** PIP_put puts a frame into a pipe after you have allocated the frame with PIP_alloc and written data to the frame. The reader can then use PIP_get to get a frame from the pipe.

After PIP_put puts the frame into the pipe, it runs the function specified by the notifyReader property of the PIP object. This function should notify (for example, by calling SWI_andnHook) the object that reads from this pipe that a full frame is ready to be processed. The notifyReader function is performed as part of the thread that called PIP_get or PIP_put. To avoid problems with recursion, the notifyReader function should not directly call any of the PIP module functions for the same pipe.

**Constraints and Calling Context**

❏ When called within an HWI ISR, the code sequence calling PIP_put must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

See the example for PIP_alloc, page 2–227. The example for HST_getpipe, page 2–130, also uses a pipe with host channel objects.

**See Also**

PIP_alloc
PIP_free
PIP_get
HST_getpipe

## PIP_reset

*Reset all fields of a pipe object to their original values*

### C Interface

**Syntax**

```
PIP_reset(pipe);
```

**Parameters**

```
PIP_Handle   pipe;        /* pipe object handle */
```

**Return Value**

Void

### Assembly Interface

none

### Description

PIP_reset resets all fields of a pipe object to their original values.

The pipe parameter specifies the address of the pipe object that is to be reset.

### Constraints and Calling Context

- ❏ PIP_reset should not be called between the PIP_alloc call and the PIP_put call or between the PIP_get call and the PIP_free call.
- ❏ PIP_reset should be called when interrupts are disabled to avoid the race condition.

### See Also

PIP_alloc
PIP_free
PIP_get
PIP_peek
PIP_put

## PIP_setWriterSize *Set the number of valid words written to a pipe frame*

**C Interface**

**Syntax** PIP_setWriterSize(pipe, size);

**Parameters**

```
PIP_Handle  pipe;   /* pipe object handle */
Uns         size;   /* size to be set */
```

**Return Value** Void

**Assembly Interface** none

**Reentrant** no

**Description** PIP_setWriterSize is a C function that sets the value of the writerSize element of a pipe object.

As a function writes to a pipe, it can use PIP_setWriterSize to indicate the number of valid words being written to a pipe frame.

**Example** See the example for PIP_getReaderAddr, page 2–233.

## 2.17 PRD Module

The PRD module is the periodic function manager.

**Functions**

- ❏ PRD_getticks. Get the current tick count.
- ❏ PRD_start. Arm a periodic function for one-time execution.
- ❏ PRD_stop. Stop a periodic function from continuous execution.
- ❏ PRD_tick. Advance tick counter, dispatch periodic functions.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the PRD Manager Properties and PRD Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| USECLK | Bool | "true" |
| MICROSECONDS | Int16 | 1000.0 |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| period | Int16 | 65535 |
| mode | EnumString | "continuous" ("one-shot") |
| fxn | Extern | prog.extern("FXN_F_nop") |
| arg0 | Arg | 0 |
| arg1 | Arg | 0 |
| order | Int16 | 0 |

**Description**

While some applications can schedule functions based on a real-time clock, many applications need to schedule functions based on I/O availability or some other programmatic event.

The PRD module allows you to create PRD objects that schedule periodic execution of program functions. The period can be driven by the CLK module or by calls to PRD_tick whenever a specific event occurs.

There can be several PRD objects, but all are driven by the same period counter. Each PRD object can execute its functions at different intervals based on the period counter.

- **To schedule functions based on a real-time clock**. Set the clock interrupt rate you want to use in the CLK Object Properties dialog. Put a checkmark in the Use On-chip Clock (CLK) box in the PRD Manager Properties dialog. Set the frequency of execution (in number of ticks) in the period field for the individual period object.
- **To schedule functions based on I/O availability or some other event**. Remove the checkmark from the Use On-chip Clock (CLK) property field for the Periodic Function Manager. Set the frequency of execution (in number of ticks) in the period field for the individual period object. Your program should call PRD_tick to increment the tick counter.

The function executed by a PRD object is statically defined in the DSP/BIOS Configuration Tool. PRD functions are called from the context of the function run by the PRD_swi SWI object. PRD functions can be written in C or assembly and must follow the C calling conventions described in the compiler manual.

The PRD module uses a SWI object (called PRD_swi by default) which itself is triggered on a periodic basis to manage execution of period objects. Normally, this SWI object should have the highest software interrupt priority to allow this software interrupt to be performed once per tick. This software interrupt is automatically created (or deleted) by the DSP/BIOS Configuration Tool if one or more (or no) PRD objects exist. The total time required to perform all PRD functions must be less than the number of microseconds between ticks. Any more lengthy processing should be scheduled as a separate SWI, TSK, or IDL thread.

See the *Code Composer Studio* online tutorial for an example that demonstrates the interaction between the PRD module and the SWI module.

When the PRD_swi object runs its function, the following actions occur:

```
for ("Loop through period objects") {
   if ("time for a periodic function")
       "run that periodic function";
}
```

**PRD Manager Properties**

The DSP/BIOS Periodic Function Manager allows the creation of an arbitrary number of objects that encapsulate a function, two arguments, and a period specifying the time between successive invocations of the function. The period is expressed in ticks, and a tick is defined as a single invocation of the PRD_tick operation. The time between successive invocations of PRD_tick defines the period represented by a tick.

The following global properties can be set for the PRD module in the PRD Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment containing the PRD objects.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `PRD.OBJMEMSEG = prog.get("myMEM");`

- **Use CLK Manager to drive PRD**. If this field is checked, the on-device timer hardware (managed by the CLK Module) is used to advance the tick count; otherwise, the application must invoke PRD_tick on a periodic basis.

  TextConf Name: USECLK Type: Bool

  Example: `PRD.USECLK = "true";`

- **Microseconds/Tick**. The number of microseconds between ticks. If the Use CLK Manager to drive PRD field above is checked, this field is automatically set by the CLK module; otherwise, you must explicitly set this field. The total time required to perform all PRD functions must be less than the number of microseconds between ticks.

  TextConf Name: MICROSECONDS Type: Int16

  Example: `PRD.MICROSECONDS = 1000.0;`

**PRD Object Properties**

To create a PRD object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myPrd = PRD.create("myPrd");
```

If you cannot create a new PRD object (an error occurs or the Insert PRD item is inactive in the Configuration Tool), increase the Stack Size property in the MEM Manager Properties dialog before adding a PRD object.

The following properties can be set for a PRD object in the PRD Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this PRD object.

  TextConf Name: comment Type: String

  Example: `myPrd.comment = "my PRD";`

- **period (ticks)**. The function executes after period ticks have elapsed.

  TextConf Name: period Type: Int16

  Example: `myPrd.period = 65535;`

- **mode**. If continuous is selected the function executes every period ticks; otherwise it executes just once after each call to PRD_tick.

  TextConf Name: mode Type: EnumString

  Options: "continuous", "one-shot"

  Example: `myPrd.mode = "continuous";`

- **function**. The function to be executed. The total time required to perform all PRD functions must be less than the number of microseconds between ticks.

  TextConf Name: fxn Type: Extern

  Example: `myPrd.fxn = prog.extern("prdFxn");`

- **arg0, arg1**. Two Arg type arguments for the user-specified function above.

  TextConf Name: arg0 Type: Arg

  TextConf Name: arg1 Type: Arg

  Example: `myPrd.arg0 = 0;`

- **period (ms)**. The number of milliseconds represented by the period specified above. This is an informational field only.

  TextConf Name: N/A

- **order**. This field is not shown in the PRD Object Properties dialog. You can change the sequence in which PRD functions are executed by selecting the PRD Manager and dragging the PRD objects shown in the second pane up and down.

  TextConf Name: order Type: Int16

  Example: `myPrd.order = 2;`

**PRD - Code Composer Studio Interface**

To enable PRD logging, choose DSP/BIOS→RTA Control Panel and put a check in the appropriate box. You see indicators for PRD ticks in the PRD ticks row of the Execution Graph, which you can open by choosing DSP/BIOS→Execution Graph. In addition, you see a graph of activity, including PRD function execution.

You can also enable PRD accumulators in the RTA Control Panel. Then you can choose DSP/BIOS→Statistics View, which lets you select objects for which you want to see statistics. If you choose a PRD object, you see statistics about the number of ticks elapsed from the time the PRD object is ready to run until it finishes execution. It is important to note, however, if your system is not meeting its timing constraints, the

Max value displayed by the Statistics View results in a value that reflects the accumulation of missed deadlines for the PRD object. If Max value becomes greater than the PRD object's period, you can divide Max value by the period to determine how many real-time deadlines your PRD object has missed. While most statistical information can be cleared by right-clicking on the Statistics View and selecting Clear from the pull-down menu, once a periodic function has missed a real-time deadline, the max value returns to its high point as soon as it is recomputed. This is because the information stored about the PRD object used to compute Max value still reflects the fact that the PRD object has missed deadlines.

## PRD_getticks

*Get the current tick count*

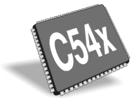
### C Interface

**Syntax** num = PRD_getticks();

**Parameters** Void

**Return Value** LgUns num /* current tick counter */

### Assembly Interface



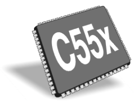

**Syntax** PRD_getticks

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** ah = upper 16 bits of the 32-bit tick counter
al = lower 16 bits of the 32-bit tick counter

**Modifies** ag, ah, al, c

### Assembly Interface




**Syntax** PRD_getticks

**Preconditions** none

**Postconditions** ac0h = upper 16 bits of the 32-bit tick counter

**Modifies** ac0

### Reentrant

yes

### Description

PRD_getticks returns the current period tick count as a 32-bit value.

If the periodic functions are being driven by the on-device timer, the tick value is the number of low resolution clock ticks that have occurred since the program started running. When the number of ticks reaches the maximum value that can be stored in 32 bits, the value wraps back to 0. See the CLK Module, page 2–36, for more details.

If the periodic functions are being driven programmatically, the tick value is the number of times PRD_tick has been called.

**Example**

```
/* ======== showTicks ======== */
Void showTicks
{
     LOG_printf(&trace, "ticks = %d", PRD_getticks());
}
```

**See Also**

PRD_start
PRD_tick
CLK_gethtime
CLK_getltime
STS_delta

## PRD_start

*Arm a periodic function for one-shot execution*

### C Interface

**Syntax** PRD_start(prd);

**Parameters** PRD_Handle prd; /* prd object handle*/

**Return Value** Void

### Assembly Interface

**Syntax** PRD_start

**Preconditions** ar2 = address of the PRD object

**Postconditions** none

**Modifies** c

### Assembly Interface

**Syntax** PRD_start

**Preconditions** xar0 = address of the PRD object

**Postconditions** none

**Modifies** t0

### Reentrant

no

### Description

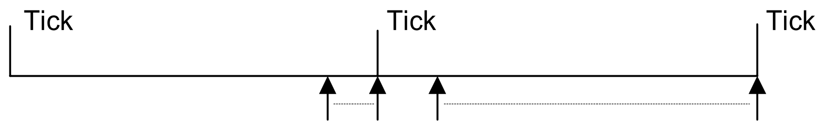
PRD_start starts a period object that has its mode property set to one-shot in the DSP/BIOS Configuration Tool.

Unlike PRD objects that are configured as continuous, one-shot PRD objects do not automatically continue to run. A one-shot PRD object runs its function only after the specified number of ticks have occurred after a call to PRD_start.

For example, you might have a function that should be executed a certain number of periodic ticks after some condition is met.

When you use PRD_start to start a period object, the exact time the function runs can vary by nearly one tick cycle. As Figure 2-6 shows, PRD ticks occur at a fixed rate and the call to PRD_start can occur at any point between ticks

*Figure 2-6. PRD Tick Cycles*




If PRD_start is called again before the period for the object has elapsed, the tick count is reset to zero. The PRD object does not run until its tick count has reached the period value for the object.

Due to implementation details, if a PRD function calls PRD_start for a PRD object that is lower in the list of PRD objects, the function sometimes runs a full tick cycle early.

**Example**

```
/* ======== startPRD ======== */
Void startPrd(Int periodID)
    {
       if ("condition met") {
          PRD_start(&periodID);
       }
    }
```

**See Also**

PRD_tick
PRD_getticks

## PRD_stop

*Stop a period object to prevent its function execution*

**C Interface**

**Syntax** PRD_stop(prd);

**Parameters** PRD_Handle prd; /* prd object handle*/

**Return Value** Void

**Assembly Interface**

C54x

**Syntax** PRD_stop

**Preconditions** ar2 = address of the PRD object

**Postconditions** none

**Modifies** c

**Assembly Interface**

C55x

**Syntax** PRD_stop

**Preconditions** xar0 = address of the PRD object

**Postconditions** none

**Modifies** none

**Reentrant** no

**Description**

PRD_stop stops a period object to prevent its function execution. In most cases, PRD_stop is used to stop a period object that has its mode property set to one-shot in the DSP/BIOS Configuration Tool.

Unlike PRD objects that are configured as continuous, one-shot PRD objects do not automatically continue to run. A one-shot PRD object runs its function only after the specified numbers of ticks have occurred after a call to PRD_start.

PRD_stop is the way to stop those one-shot PRD objects once started and before their period counters have run out.

**Example**

```
PRD_stop(&prd);
```

**See Also**

PRD_getticks
PRD_start
PRD_tick

## PRD_tick

*Advance tick counter, enable periodic functions*

### C Interface

**Syntax** PRD_tick();

**Parameters** Void

**Return Value** Void

### Assembly Interface

C54x

**Syntax** PRD_tick

**Preconditions** intm = 1
cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** dp = GBL_A_SYSPAGE

**Modifies** ag, ah, al, bg, bh, bl, c, tc

### Assembly Interface

C55x

**Syntax** PRD_tick

**Preconditions** intm = 1

**Postconditions** none

**Modifies** xar0, xar1, xar2, xar3, xar4, t0, t1, tc1, tc2, ac0

**Reentrant** no

**Description**

PRD_tick advances the period counter by one tick. Unless you are driving PRD functions using the on-device clock, PRD objects execute their functions at intervals based on this counter.

For example, a hardware ISR could perform PRD_tick to notify a periodic function when data is available for processing.

**Constraints and Calling Context**

- All the registers that are modified by this API should be saved and restored, before and after the API is invoked, respectively.

- When called within an HWI ISR, the code sequence calling PRD_tick must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.
- Interrupts need to be disabled before calling PRD_tick.

**See Also**

PRD_start
PRD_getticks

## 2.18 QUE Module

The QUE module is the atomic queue manager.

**Functions**

- ❏ QUE_create. Create an empty queue.
- ❏ QUE_delete. Delete an empty queue.
- ❏ QUE_dequeue. Remove from front of queue (non-atomically).
- ❏ QUE_empty. Test for an empty queue.
- ❏ QUE_enqueue. Insert at end of queue (non-atomically).
- ❏ QUE_get. Remove element from front of queue (atomically)
- ❏ QUE_head. Return element at front of queue.
- ❏ QUE_insert. Insert in middle of queue (non-atomically).
- ❏ QUE_new. Set a queue to be empty.
- ❏ QUE_next. Return next element in queue (non-atomically).
- ❏ QUE_prev. Return previous element in queue (non-atomically).
- ❏ QUE_put. Put element at end of queue (atomically).
- ❏ QUE_remove. Remove from middle of queue (non-atomically).

**Constants, Types, and Structures**

```
typedef struct QUE_Obj *QUE_Handle;  /* queue obj handle */
struct QUE_Attrs{     /* queue attributes */
   Int  dummy;     /* DUMMY */
};

QUE_Attrs QUE_ATTRS = {      /* default attribute values */
    0,
};

typedef QUE_Elem;        /* queue element */
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the QUE Manager Properties and QUE Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

### Instance Configuration Parameters

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |

**Description**

The QUE module makes available a set of functions that manipulate queue objects accessed through handles of type QUE_Handle. Each queue contains an ordered sequence of zero or more elements referenced through variables of type QUE_Elem, which are generally embedded as the first field within a structure. The QUE_Elem item is used as an internal pointer.

For example, the DEV_Frame structure, which is used by the SIO Module and DEV Module to enqueue and dequeue I/O buffers, contains a field of type QUE_Elem:

```
struct DEV_Frame {   /* frame object */
   QUE_Elem   link;       /* must be first field! */
   Ptr        addr;       /* buffer address */
   Uns        size;       /* buffer size */
   Arg        misc;       /* reserved for driver */
   Arg        arg;        /* user argument */
   Uns        cmd;        /* mini-driver command */
   Int        status;     /* status of command */
} DEV_Frame;
```

Many QUE module functions either are passed or return a pointer to an element having the structure defined for QUE elements.

The functions QUE_put and QUE_get are atomic in that they manipulate the queue with interrupts disabled. These functions can therefore be used to safely share queues between tasks, or between tasks and SWIs or HWIs. All other QUE functions should only be called by tasks, or by tasks and SWIs or HWIs when they are used in conjunction with some mutual exclusion mechanism (for example, SEM_pend / SEM_post, TSK_disable / TSK_enable).

Once a queue has been created, use MEM_alloc to allocate elements for the queue. You can view examples of this in the program code for quetest and semtest located on your distribution CD in `c:\ti\examples\`*`target`*`\bios\semtest` folder, where *`target`* matches your board. (If you installed in a path other than `c:\ti`, substitute your appropriate path.)

**QUE Manager Properties**

The following global property can be set for the QUE module in the QUE Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment that contains the QUE objects.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `QUE.OBJMEMSEG = prog.get("myMEM");`

**QUE Object Properties**

To create a QUE object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myQue = QUE.create("myQue");
```

The following property can be set for a QUE object in the PRD Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this QUE object.

  TextConf Name: comment Type: String

  Example: `myQue.comment = "my QUE";`

## QUE_create

*Create an empty queue*

### C Interface

**Syntax**

```
queue = QUE_create(attrs);
```

**Parameters**

```
QUE_Attrs     *attrs;      /* pointer to queue attributes */
```

**Return Value**

```
QUE_Handle queue;          /* handle for new queue object */
```

### Assembly Interface

none

### Description

QUE_create creates a new queue which is initially empty. If successful, QUE_create returns the handle of the new queue. If unsuccessful, QUE_create returns NULL unless it aborts (for example, because it directly or indirectly calls SYS_error, and SYS_error is configured to abort).

If attrs is NULL, the new queue is assigned a default set of attributes. Otherwise, the queue's attributes are specified through a structure of type QUE_Attrs.

---

**Note:**

At present, no attributes are supported for queue objects, and the type QUE_Attrs is defined as a dummy structure.

---

All default attribute values are contained in the constant QUE_ATTRS, which can be assigned to a variable of type QUE_Attrs prior to calling QUE_create.

You can also create a queue by declaring a variable of type QUE_Obj and initializing the queue with QUE_new. You can find an example of this in the semtest code example on your distribution CD in `c:\ti\examples\`*`target`*`\bios\semtest` folder, where *`target`* matches your board. (If you installed in a path other than `c:\ti`, substitute your appropriate path.)

QUE_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module, page 2–200.

**Constraints and Calling Context**

- ❏ QUE_create cannot be called from a SWI or HWI.
- ❏ You can reduce the size of your application program by creating objects with the DSP/BIOS Configuration Tool rather than using the XXX_create functions.

**See Also**

MEM_alloc
QUE_empty
QUE_delete
SYS_error

## QUE_delete

*Delete an empty queue*

**C Interface**

**Syntax**

QUE_delete(queue);

**Parameters**

QUE_Handle queue; /* queue handle */

**Return Value**

Void

**Assembly Interface**

none

**Description**

QUE_delete uses MEM_free to free the queue object referenced by queue.

QUE_delete calls MEM_free to delete the QUE object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

**Constraints and Calling Context**

- ❏ queue must be empty.
- ❏ QUE_delete cannot be called from a SWI or HWI.
- ❏ No check is performed to prevent QUE_delete from being used on a statically-created object. If a program attempts to delete a queue object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

**See Also**

QUE_create
QUE_empty

## QUE_dequeue

*Remove from front of queue (non-atomically)*

**C Interface**

**Syntax**

elem = QUE_dequeue(queue);

**Parameters**

QUE_Handle queue; /* queue object handle */

**Return Value**

Ptr elem; /* pointer to former first element */

**Assembly Interface**

none

**Description**

QUE_dequeue removes the element from the front of queue and returns elem.

The return value, elem, is a pointer to the element at the front of the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Calling QUE_dequeue with an empty queue returns the queue itself. However, QUE_dequeue is non-atomic. Therefore, the method described for QUE_get of checking to see if a queue is empty and returning the first element otherwise is non-atomic.

**Note:**

You should use QUE_get instead of QUE_dequeue if multiple threads share a queue. QUE_get runs atomically and is never interrupted; QUE_dequeue performs the same action but runs non-atomically. You can use QUE_dequeue if you disable interrupts or use a synchronization mechanism such as LCK or SEM to protect the queue. An ISR or task that preempts QUE_dequeue and operates on the same queue can corrupt the data structure.

QUE_dequeue is somewhat faster than QUE_get, but you should not use it unless you know your QUE operation cannot be preempted by another thread that operates on the same queue.

**See Also**

QUE_get

## QUE_empty *Test for an empty queue*

### C Interface

**Syntax** empty = QUE_empty(queue);

**Parameters** QUE_Handle queue; /* queue object handle */

**Return Value** Bool empty; /* TRUE if queue is empty */

### Assembly Interface

none

### Description

QUE_empty returns TRUE if there are no elements in queue, and FALSE otherwise.

### See Also

QUE_get

## QUE_enqueue

*Insert at end of queue (non-atomically)*

### C Interface

**Syntax**

QUE_enqueue(queue, elem);

**Parameters**

```
QUE_Handle queue;   /* queue object handle */
Ptr        elem;    /* pointer to queue element */
```

**Return Value**

Void

### Assembly Interface

none

### Description

QUE_enqueue inserts elem at the end of queue.

The elem parameter must be a pointer to an element to be placed in the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

**Note:**

Use QUE_put instead of QUE_enqueue if multiple threads share a queue. QUE_put is never interrupted; QUE_enqueue performs the same action but runs non-atomically. You can use QUE_enqueue if you disable interrupts or use a synchronization mechanism such as LCK or SEM to protect the queue.

QUE_enqueue is somewhat faster than QUE_put, but you should not use it unless you know your QUE operation cannot be preempted by another thread that operates on the same queue.

### See Also

QUE_put

## QUE_get
*Get element from front of queue (atomically)*

**C Interface**

**Syntax** elem = QUE_get(queue);

**Parameters** QUE_Handle queue; /* queue object handle */

**Return Value** Void *elem; /* pointer to former first element */

**Assembly Interface** none

**Description** QUE_get removes the element from the front of queue and returns elem.

The return value, elem, is a pointer to the element at the front of the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Since QUE_get manipulates the queue with interrupts disabled, the queue can be shared by multiple tasks, or by tasks and SWIs or HWIs.

Calling QUE_get with an empty queue returns the queue itself. This provides a means for using a single atomic action to check if a queue is empty, and to remove and return the first element if it is not empty:

```
if ((QUE_Handle)(elem = QUE_get(q)) != q)
    ` process elem `
```

**Note:**

Use QUE_get instead of QUE_dequeue if multiple threads share a queue. QUE_get is never interrupted; QUE_dequeue performs the same action but runs non-atomically. You can use QUE_dequeue if you disable interrupts or use a synchronization mechanism such as LCK or SEM to protect the queue.

QUE_dequeue is somewhat faster than QUE_get, but you should not use it unless you know your QUE operation cannot be preempted by another thread that operates on the same queue.

**See Also** QUE_create
QUE_empty
QUE_put

## QUE_head

*Return element at front of queue*

**C Interface**

**Syntax**

```
elem = QUE_head(queue);
```

**Parameters**

```
QUE_Handle queue;      /* queue object handle */
```

**Return Value**

```
QUE_Elem    *elem;      /* pointer to first element */
```

**Assembly Interface**

none

**Description**

QUE_head returns a pointer to the element at the front of queue. The element is not removed from the queue.

The return value, elem, is a pointer to the element at the front of the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Calling QUE_head with an empty queue returns the queue itself.

**See Also**

QUE_create
QUE_empty
QUE_put

## QUE_insert

*Insert in middle of queue (non-atomically)*

### C Interface

**Syntax** QUE_insert(qelem, elem);

**Parameters**

```
Ptr     qelem;   /* element already in queue */
Ptr     elem;    /* element to be inserted in queue */
```

**Return Value** Void

### Assembly Interface

none

### Description

QUE_insert inserts elem in the queue in front of qelem.

The qelem parameter is a pointer to an existing element of the QUE. The elem parameter is a pointer to an element to be placed in the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

**Note:**

If the queue is shared by multiple tasks, or tasks and SWIs or HWIs, QUE_insert should be used in conjunction with some mutual exclusion mechanism (for example, SEM_pend/SEM_post, TSK_disable/ TSK_enable).

### See Also

QUE_head
QUE_next
QUE_prev
QUE_remove

## QUE_new

*Set a queue to be empty*

**C Interface**

**Syntax** QUE_new(queue);

**Parameters** QUE_Handle queue; /* pointer to queue object */

**Return Value** Void

**Assembly Interface** none

**Description** QUE_new adjusts a queue object to make the queue empty. This operation is not atomic. A typical use of QUE_new is to initialize a queue object that has been statically declared instead of being created with QUE_create. Note that if the queue is not empty, the element(s) in the queue are not freed or otherwise handled, but are simply abandoned.

If you created a queue by declaring a variable of type QUE_Obj, you can initialize the queue with QUE_new. You can find an example of this in the semtest code example on your distribution CD in `c:\ti\examples\`*`target`*`\bios\semtest` folder, where *`target`* matches your board. (If you installed in a path other than `c:\ti`, substitute your appropriate path.)

**See Also** QUE_create
QUE_delete
QUE_empty

## QUE_next

*Return next element in queue (non-atomically)*

**C Interface**

**Syntax**

elem = QUE_next(qelem);

**Parameters**

Ptr qelem; /* element in queue */

**Return Value**

Ptr elem; /* next element in queue */

**Assembly Interface**

none

**Description**

QUE_next returns elem which points to the element in the queue after qelem.

The qelem parameter is a pointer to an existing element of the QUE. The return value, elem, is a pointer to the next element in the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Since QUE queues are implemented as doubly linked lists with a dummy node at the head, it is possible for QUE_next to return a pointer to the queue itself. Be careful not to call QUE_remove(elem) in this case.

**Note:**

If the queue is shared by multiple tasks, or tasks and SWIs or HWIs, QUE_next should be used in conjunction with some mutual exclusion mechanism (for example, SEM_pend/SEM_post, TSK_disable/ TSK_enable).

**See Also**

QUE_get
QUE_insert
QUE_prev
QUE_remove

## QUE_prev

*Return previous element in queue (non-atomically)*

### C Interface

**Syntax**

elem = QUE_prev(qelem);

**Parameters**

Ptr qelem; /* element in queue */

**Return Value**

Ptr elem; /* previous element in queue */

### Assembly Interface

none

### Description

QUE_prev returns elem which points to the element in the queue before qelem.

The qelem parameter is a pointer to an existing element of the QUE. The return value, elem, is a pointer to the previous element in the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Since QUE queues are implemented as doubly linked lists with a dummy node at the head, it is possible for QUE_prev to return a pointer to the queue itself. Be careful not to call QUE_remove(elem) in this case.

**Note:**

If the queue is shared by multiple tasks, or tasks and SWIs or HWIs, QUE_prev should be used in conjunction with some mutual exclusion mechanism (for example, SEM_pend/SEM_post, TSK_disable/ TSK_enable).

### See Also

QUE_head
QUE_insert
QUE_next
QUE_remove

## QUE_put

*Put element at end of queue (atomically)*

**C Interface**

**Syntax**

QUE_put(queue, elem);

**Parameters**

```
QUE_Handle queue;    /* queue object handle */
Void       *elem;    /* pointer to new queue element */
```

**Return Value**

Void

**Assembly Interface**

none

**Description**

QUE_put puts elem at the end of queue.

The elem parameter is a pointer to an element to be placed at the end of the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Since QUE_put manipulates queues with interrupts disabled, queues can be shared by multiple tasks, or by tasks and SWIs or HWIs.

**Note:**

Use QUE_put instead of QUE_enqueue if multiple threads share a queue. QUE_put is never interrupted; QUE_enqueue performs the same action but runs non-atomically. You can use QUE_enqueue if you disable interrupts or use a synchronization mechanism such as LCK or SEM to protect the queue.

QUE_enqueue is somewhat faster than QUE_put, but you should not use it unless you know your QUE operation cannot be preempted by another thread that operates on the same queue.

**See Also**

QUE_get
QUE_head

## QUE_remove

*Remove from middle of queue (non-atomically)*

### C Interface

**Syntax** QUE_remove(qelem);

**Parameters** Ptr qelem; /* element in queue */

**Return Value** Void

### Assembly Interface

none

### Description

QUE_remove removes qelem from the queue.

The qelem parameter is a pointer to an existing element to be removed from the QUE. Such elements have a structure defined similarly to that in the example in the QUE Module topic. The first field in the structure must be of type QUE_Elem and is used as an internal pointer.

Since QUE queues are implemented as doubly linked lists with a dummy node at the head, be careful not to remove the header node. This can happen when qelem is the return value of QUE_next or QUE_prev. The following code sample shows how qelem should be verified before calling QUE_remove.

```
QUE_Elem *qelem;.

/* get pointer to first element in the queue */
qelem = QUE_head(queue);

/* scan entire queue for desired element */
while (qelem != queue) {
    if(‘ qelem is the elem we’re looking for ‘) {
         break;
    }
    qelem = QUE_next(queue);
}

/* make sure qelem is not the queue itself */
if (qelem != queue) {
    QUE_remove(qelem);
}
```

**Note:**

If the queue is shared by multiple tasks, or tasks and SWIs or HWIs, QUE_remove should be used in conjunction with some mutual exclusion mechanism (for example, SEM_pend/SEM_post, TSK_disable/ TSK_enable).

**Constraints and Calling Context**

QUE_remove should not be called when qelem is equal to the queue itself.

**See Also**

QUE_head
QUE_insert
QUE_next
QUE_prev

## 2.19 RTDX Module

The RTDX modules manage the real-time data exchange settings.

**RTDX Data Declaration Macros**

- ❏ RTDX_CreateInputChannel
- ❏ RTDX_CreateOutputChannel

**Function Macros**

- ❏ RTDX_disableInput
- ❏ RTDX_disableOutput
- ❏ RTDX_enableInput
- ❏ RTDX_enableOutput
- ❏ RTDX_read
- ❏ RTDX_readNB
- ❏ RTDX_sizeofInput
- ❏ RTDX_write

**Channel Test Macros**

- ❏ RTDX_channelBusy
- ❏ RTDX_isInputEnabled
- ❏ RTDX_isOutputEnabled

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the RTDX Manager Properties and RTDX Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| ENABLERTDX | Bool | true |
| MODE | EnumString | "JTAG" ("HSRTDX" (C54x only), "Simulator") |
| RTDXDATASEG | Reference | prog.get("IDATA") |
| BUFSIZE | Int16 | 258 |
| INTERRUPTMASK | Int16 | 0x00000000 |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| channelMode | EnumString | "output" ("input") |

**Description**

The RTDX module provides the data types and functions for:

- ❏ Sending data from the target to the host.
- ❏ Sending data from the host to the target.

Data channels are represented by global structures. A data channel can be used for input or output, but not both. The contents of an input or output structure are not known to the user. A channel structure has two states: enabled and disabled. When a channel is enabled, any data written to the channel is sent to the host. Channels are initially disabled.

The RTDX assembly interface, *rtdx.i*, is a macro interface file that can be used to interface to RTDX at the assembly level.

**RTDX Manager Properties**

The following target configuration properties can be set for the RTDX module in the RTDX Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **Enable Real-Time Data Exchange (RTDX)**. This box should be checked if you want to link RTDX support into your application.

  TextConf Name: ENABLERTDX  Type: Bool

  Example: `RTDX.ENABLERTDX = true;`

❏ **RTDX Mode**. Select the port configuration mode RTDX should use to establish communication between the host and target. The default is JTAG for most targets. Set this to simulator if you use a simulator. The HS-RTDX emulation technology is also available. If this property is set incorrectly, a message says “RTDX target application does not match emulation protocol“ when you load the program.

  TextConf Name: MODE  Type: EnumString

  Options: "JTAG", "HSRTDX" (C54x only), "Simulator"

  Example: `RTDX.MODE = "JTAG";`

❏ **RTDX Data Segment (.rtdx_data)**. The memory segment used for buffering target-to-host data transfers. The RTDX message buffer and state variables are placed in this segment.

  TextConf Name: RTDXDATASEG  Type: Reference

  Example:
```
RTDX.RTDXDATASEG =
    prog.get("myMEM");
```

❏ **RTDX Buffer Size (MADUs)**. The size of the RTDX target-to-host message buffer, in minimum addressable data units (MADUs). The default size is 1032 to accommodate a 1024-byte block and two control words. HST channels using RTDX are limited by this value.

  TextConf Name: BUFSIZE  Type: Int16

  Example: `RTDX.BUFSIZE = 258;`

❏ **RTDX Interrupt Mask**. This mask interrupts to be temporarily disabled inside critical RTDX sections. The default value of zero (0) disables all interrupts within critical RTDX sections. Such sections are short (usually <100 cycles). Disabling interrupts also temporarily disables other RTDX clients and prevents other RTDX function calls.

You should allow all interrupts to be disabled inside critical RTDX sections if your application makes any RTDX calls from SWI or TSK threads. If your application does not make RTDX calls from SWI or TSK threads, you may modify bits in this mask to enable specific high-priority interrupts. See the RTDX documentation for details.

TextConf Name: INTERRUPTMASK Type: Int16

Example: `RTDX.INTERRUPTMASK = 0x00000000;`

**RTDX Object Properties**

To create an RTDX object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myRtdx = RTDX.create("myRtdx");
```

The following properties can be set for an RTDX object in the RTDX Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this RTDX object.

  TextConf Name: comment Type: String

  Example: `myRtdx.comment = "my RTDX";`

- **Channel Mode**. Select output if the RTDX channel handles output from the DSP to the host. Select input if the RTDX channel handles input to the DSP from the host.

  TextConf Name: channelMode Type: EnumString

  Options: "input", "output"

  Example: `myRtdx.channelMode = "output";`

**Examples**

The `rtdx.xls` example is in the `TI_DIR\examples\hostapps\rtdx` folder. The examples are described below.

- **Ta_write.asm**. Target to Host transmission example. This example sends 100 consecutive integers starting from 0. In the `rtdx.xls` file, use the h_read VB macro to view data on the host.
- **Ta_read.asm**. Host to target transmission example. This example reads 100 integers. Use the h_write VB macro of the `rtdx.xls` file to send data to the target.
- **Ta_readNB.asm**. Host to target transmission example. This example reads 100 integers. Use the h_write VB macro of the `rtdx.xls` file to send data to the target. This example demonstrates how to use the non-blocking read, RTDX_readNB, function.

**Note:** Programs must be linked with C run-time libraries and contain the symbol _main.

## RTDX_channelBusy

*Return status indicating whether data channel is busy*

**C Interface**

**Syntax**
int RTDX_channelBusy( RTDX_inputChannel *pichan );

**Parameters**
pichan /* Identifier for the input data channel */

**Return Value**
int /* Status: 0 = Channel is not busy. */
/* non-zero = Channel is busy. */

**Assembly Interface**

**Syntax**
RTDX_ChannelBusy .macro pichan

**Preconditions**
expect the TC bit to be modified by this macro

**Postconditions**
none

**Modifies**
TC

**Assembly Interface**
none

**Reentrant**
yes

**Description**
RTDX_channelBusy is designed to be used in conjunction with RTDX_readNB. The return value indicates whether the specified data channel is currently in use or not. If a channel is busy reading, the test/control flag (TC) bit of status register 0 (STO) is set to 1. Otherwise, the TC bit is set to O.

**Constraints and Calling Context**
❏ RTDX_channelBusy cannot be called by an HWI function.

**See Also**
RTDX_readNB

## RTDX_CreateInputChannel *Declare input channel structure*

**C Interface**

**Syntax** RTDX_CreateInputChannel( ichan );

**Parameters** ichan /* Label for the input channel */

**Return Value** none

**Assembly Interface**

C54x

**Syntax** RTDX_CreateInputChannel .macro ichan

**Preconditions** expect this macro to declare 3 words in the .bss section and initialize to zero

**Postconditions** none

**Modifies** 3 words in the .bss section

**Assembly Interface** none

C55x

**Reentrant** no

**Description** This macro declares and initializes to 0, the RTDX data channel for input.

Data channels must be declared as global objects. A data channel can be used either for input or output, but not both. The contents of an input or output data channel are unknown to the user.

A channel can be in one of two states: enabled or disabled. Channels are initialized as disabled.

Channels can be enabled or disabled via a User Interface function. They can also be enabled or disabled remotely from Code Composer or its COM interface.

**Constraints and Calling Context**

- ❏ RTDX_CreateInputChannel cannot be called by an HWI function.

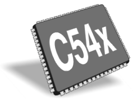
**See Also** RTDX_CreateOutputChannel

## RTDX_CreateOutputChannel *Declare output channel structure*

**C Interface**

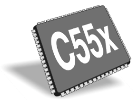
| | |
|---|---|
| **Syntax** | RTDX_CreateOutputChannel( ochan ); |
| **Parameters** | ochan /* Label for the output channel */ |
| **Return Value** | none |

**Assembly Interface**




| | |
|---|---|
| **Syntax** | RTDX_CreateOutputChannel .macro ochan |
| **Preconditions** | expect this macro to declare one word in the .bss section and initialize to zero |
| **Postconditions** | none |
| **Modifies** | one word in the .bss section |

**Assembly Interface** none




**Reentrant** no

**Description**

This macro declares and initializes the RTDX data channels for output.

Data channels must be declared as global objects. A data channel can be used either for input or output, but not both. The contents of an input or output data channel are unknown to the user.

A channel can be in one of two states: enabled or disabled. Channels are initialized as disabled.

Channels can be enabled or disabled via a User Interface function. They can also be enabled or disabled remotely from Code Composer Studio or its OLE interface.

**Constraints and Calling Context**

❏ RTDX_CreateOutputChannel cannot be called by an HWI function.

**See Also**

RTDX_CreateInputChannel

## RTDX_disableInput *Disable an input data channel*

**C Interface**

| | |
|---|---|
| **Syntax** | void RTDX_disableInput( RTDX_inputChannel *ichan ); |
| **Parameters** | ichan /* Identifier for the input data channel */ |
| **Return Value** | void |

**Assembly Interface** (C54x)

| | |
|---|---|
| **Syntax** | RTDX_DisableInput .macro ichan |
| **Preconditions** | Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call. |
| **Postconditions** | none |
| **Modifies** | CPL bit and register A |

**Assembly Interface** (C55x) none

| | |
|---|---|
| **Reentrant** | yes |
| **Description** | A call to a disable function causes the specified input channel to be disabled. |
| **Constraints and Calling Context** | ❑ RTDX_disableInput cannot be called by an HWI function. |
| **See Also** | RTDX_disableOutput<br>RTDX_enableInput<br>RTDX_read |

## RTDX_disableOutput

*Disable an output data channel*

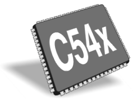
### C Interface

**Syntax**
void RTDX_disableOutput( RTDX_outputChannel *ochan );

**Parameters**
ochan /* Identifier for an output data channel */

**Return Value**
void

### Assembly Interface




**Syntax**
RTDX_DisableOutput .macro ochan

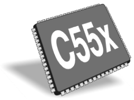
**Preconditions**
Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions**
none

**Modifies**
CPL bit and register A

### Assembly Interface

none




**Reentrant**
yes

**Description**
A call to a disable function causes the specified data channel to be disabled.

**Constraints and Calling Context**
- RTDX_disableOutput cannot be called by an HWI function.

**See Also**
RTDX_disableInput
RTDX_enableOutput
RTDX_read

## RTDX_enableInput *Enable an input data channel*

**C Interface**

**Syntax** void RTDX_enableInput( RTDX_inputChannel *ichan );

**Parameters**

| | |
|---|---|
| ochan | /* Identifier for an output data channel */ |
| ichan | /* Identifier for the input data channel */ |

**Return Value** void

**Assembly Interface**

**Syntax** RTDX_EnableInput .macro ichan

**Preconditions** Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions** none

**Modifies** CPL bit and register A

**Assembly Interface** none

**Reentrant** yes

**Description** A call to an enable function causes the specified data channel to be enabled.

**Constraints and Calling Context**

- RTDX_enableInput cannot be called by an HWI function.

**See Also**

RTDX_disableInput
RTDX_enableOutput
RTDX_read

## RTDX_enableOutput

*Enable an output data channel*

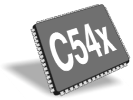
### C Interface

**Syntax** void RTDX_enableOutput( RTDX_outputChannel *ochan );

**Parameters** ochan /* Identifier for an output data channel */

**Return Value** void

### Assembly Interface




**Syntax** RTDX_EnableOutput .macro ochan

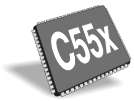
**Preconditions** Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions** none

**Modifies** CPL bit and register A

### Assembly Interface

none




**Reentrant** yes

**Description** A call to an enable function causes the specified data channel to be enabled.

**Constraints and Calling Context**

❏ RTDX_enableOutput cannot be called by an HWI function.

**See Also**

RTDX_disableOutput
RTDX_enableInput
RTDX_write

## RTDX_isInputEnabled *Return status of the input data channel*

### C Interface

**Syntax** RTDX_isInputEnabled( ichan );

| | | |
|---|---|---|
| **Parameter** | ichan | /* Identifier for an input channel. */ |
| **Return Value** | 0 | /* Not enabled. */ |
| | non-zero | /* Enabled. */ |

### Assembly Interface

**Syntax** RTDX_isInputEnabled .macro ichan

**Preconditions** Expect the TC bit to be modified by this macro.

**Postconditions** none

**Modifies** TC bit

### Assembly Interface

none

**Reentrant** yes

**Description** The RTDX_isInputEnabled macro tests to see if an input channel is enabled and sets the test/control flag (TC bit) of status register 0 to 1 if the input channel is enabled. Otherwise, it sets the TC bit to 0.

**Constraints and Calling Context**

- ❏ RTDX_isInputEnabled cannot be called by an HWI function.

**See Also** RTDX_isOutputEnabled

## RTDX_isOutputEnabled *Return status of the output data channel*

**C Interface**

| | | |
|---|---|---|
| **Syntax** | RTDX_isOutputEnabled(ohan ); | |
| **Parameter** | ochan | /* Identifier for an output channel. */ |
| **Return Value** | 0 | /* Not enabled. */ |
| | non-zero | /* Enabled. */ |

**Assembly Interface** (C54x)

| | |
|---|---|
| **Syntax** | RTDX_isOutputEnabled .macro ochan |
| **Preconditions** | Expect the TC bit to be modified by this macro. |
| **Postconditions** | none |
| **Modifies** | TC bit |

**Assembly Interface** (C55x) none

**Reentrant** yes

**Description**

The RTDX_isOutputEnabled macro tests to see if an output channel is enabled and sets the test/control flag (TC bit) of status register 0 to 1 if the output channel is enabled. Otherwise, it sets the TC bit to 0.

**Constraints and Calling Context**

❑ RTDX_isOutputEnabled cannot be called by an HWI function.

**See Also**

RTDX_isInputEnabled

## RTDX_read — *Read from an input channel*

### C Interface

**Syntax**

int RTDX_read( RTDX_inputChannel *ichan, void *buffer, int bsize );

**Parameters**

| | |
|---|---|
| ichan | /* Identifier for the input data channel */ |
| buffer | /* A pointer to the buffer that receives the data */ |
| bsize | /* The size of the buffer in address units */ |

**Return Value**

| | |
|---|---|
| > 0 | /* The number of address units of data */ /* actually supplied in buffer. */ |
| 0 | /* Failure. Cannot post read request */ /* because target buffer is full. */ |
| RTDX_READ_ERROR | /* Failure. Channel currently busy or not enabled. */ |

### Assembly Interface

**Syntax**

RTDX_read .macro ichan, buffer, bsize

**Preconditions**

Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit, register BL, and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions**

The return value of the read is placed in the accumulator (register A).

**Modifies**

CPL bit, register BL, and register A

### Assembly Interface

none

### Reentrant

yes

### Description

RTDX_read causes a read request to be posted to the specified input data channel. If the channel is enabled, RTDX_read waits until the data has arrived. On return from the function, the data has been copied into the specified buffer and the number of address units of data actually supplied is returned. The function returns RTDX_READ_ERROR immediately if the channel is currently busy reading or is not enabled.

When RTDX_read is used, the target application notifies the RTDX Host Library that it is ready to receive data and then waits for the RTDX Host Library to write data to the target buffer. When the data is received, the target application continues execution.

The specified data is to be written to the specified output data channel, provided that channel is enabled. On return from the function, the data has been copied out of the specified user buffer and into the RTDX target buffer. If the channel is not enabled, the write operation is suppressed. If the RTDX target buffer is full, failure is returned.

When RTDX_readNB is used, the target application notifies the RTDX Host Library that it is ready to receive data, but the target application does not wait. Execution of the target application continues immediately. Use RTDX_channelBusy and RTDX_sizeofInput to determine when the RTDX Host Library has written data to the target buffer.

**Constraints and Calling Context**

- ❑ RTDX_read cannot be called by an HWI function.

**See Also**

RTDX_channelBusy
RTDX_readNB

## RTDX_readNB

*Read from input channel without blocking*

### C Interface

**Syntax**

```
int RTDX_readNB( RTDX_inputChannel *ichan, void *buffer, int bsize );
```

**Parameters**

| | |
|---|---|
| ichan | /* Identifier for the input data channel */ |
| buffer | /* A pointer to the buffer that receives the data */ |
| bsize | /* The size of the buffer in address units */ |

**Return Value**

| | |
|---|---|
| RTDX_OK | /* Success.*/ |
| 0 (zero) | /* Failure. The target buffer is full. */ |
| RTDX_READ_ERROR | /*Channel is currently busy reading. */ |

### Assembly Interface

**Syntax**

```
RTDX_readNB .macro ichan, buffer, bsize
```

**Preconditions**

Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit, register BL, and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions**

The return value of the read is placed in the accumulator (register A).

**Modifies**

CPL bit, register BL, and register A

### Assembly Interface

none

### Reentrant

yes

### Description

RTDX_readNB is a nonblocking form of the function RTDX_read. RTDX_readNB issues a read request to be posted to the specified input data channel and immediately returns. If the channel is not enabled or the channel is currently busy reading, the function returns RTDX_READ_ERROR. The function returns 0 if it cannot post the read request due to lack of space in the RTDX target buffer.

When the function RTDX_readNB is used, the target application notifies the RTDX Host Library that it is ready to receive data but the target application does not wait. Execution of the target application continues immediately. Use the RTDX_channelBusy and RTDX_sizeofInput functions to determine when the RTDX Host Library has written data into the target buffer.

When RTDX_read is used, the target application notifies the RTDX Host Library that it is ready to receive data and then waits for the RTDX Host Library to write data into the target buffer. When the data is received, the target application continues execution.

**Constraints and Calling Context**

- RTDX_readNB cannot be called by an HWI function.

**See Also**

RTDX_channelBusy
RTDX_read
RTDX_sizeofInput

## RTDX_sizeofInput *Return the number of MADUs read from a data channel*

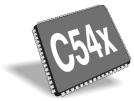
**C Interface**

**Syntax** int RTDX_sizeofInput( RTDX_inputChannel *pichan );

**Parameters** pichan /* Identifier for the input data channel */

**Return Value** int /* Number of sizeof units of data actually */
/* supplied in buffer */

**Assembly Interface**



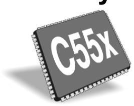

**Syntax** RTDX_sizeofInput .macro ichan

**Preconditions** Expect register A to be modified by this macro.

**Postconditions** The return value of the read is placed in the accumulator (register A).

**Modifies** register A

**Assembly Interface** none




**Reentrant** yes

**Description** RTDX_sizeofInput is designed to be used in conjunction with RTDX_readNB after a read operation has completed. The function returns the number of sizeof units actually read from the specified data channel into the accumulator (register A).

**Constraints and Calling Context**

- RTDX_sizeofInput cannot be called by an HWI function.

**See Also** RTDX_readNB

## RTDX_write

*Write to an output channel*

### C Interface

**Syntax**

int RTDX_write( RTDX_outputChannel *ochan, void *buffer, int bsize );

**Parameters**

```
ochan      /* Identifier for the output data channel */
buffer     /* A pointer to the buffer containing the data */
bsize      /* The size of the buffer in address units */
```

**Return Value**

```
int        /* Status: non-zero = Success. 0 = Failure. */
```

### Assembly Interface

**Syntax**

RTDX_write .macro ochan, buffer, bsize

**Preconditions**

Set the CPL bit before this macro calls the RTDX functions. Expect the CPL bit, register BL, and register A to be modified by this macro. Registers ar1, ar6, ar7, and sp can be modified by the function call.

**Postconditions**

The return value of the read is placed in the accumulator (register A).

**Modifies**

CPL bit, register BL, and register A

### Assembly Interface

none

### Reentrant

yes

### Description

RTDX_write causes the specified data to be written to the specified output data channel, provided that channel is enabled. On return from the function, the data has been copied out of the specified user buffer and into the RTDX target buffer. If the channel is not enabled, the write operation is suppressed. If the RTDX target buffer is full, Failure is returned.

### Constraints and Calling Context

❑ RTDX_write cannot be called by an HWI function.

### See Also

RTDX_read

## 2.20 SEM Module

The SEM module is the semaphore manager.

**Functions**

- ❏ SEM_count. Get current semaphore count
- ❏ SEM_create. Create a semaphore
- ❏ SEM_delete. Delete a semaphore
- ❏ SEM_ipost. Signal a semaphore (interrupt only)
- ❏ SEM_new. Initialize a semaphore
- ❏ SEM_pend. Wait for a semaphore
- ❏ SEM_post. Signal a semaphore
- ❏ SEM_reset. Reset semaphore

**Constants, Types, and Structures**

```
typedef struct SEM_Obj  *SEM_Handle;
                   /* handle for semaphore object */

struct SEM_Attrs { /* semaphore attributes */
    Int    dummy;  /* DUMMY */
};

SEM_Attrs SEM_ATTRS = { /* default attribute values */
    0,
};
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the SEM Manager Properties and SEM Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

### Instance Configuration Parameters

| Name | Type | Default |
|---|---|---|
| comment | String | "<add comments here>" |
| count | Int16 | 0 |

**Description**

The SEM module makes available a set of functions that manipulate semaphore objects accessed through handles of type SEM_Handle. SEM semaphores are counting semaphores that can be used for both task synchronization and mutual exclusion.

SEM_pend is used to wait for a semaphore. The timeout parameter to SEM_pend allows the task to wait until a timeout, wait indefinitely, or not wait at all. SEM_pend's return value is used to indicate if the semaphore was signaled successfully.

SEM_post is used to signal a semaphore. If a task is waiting for the semaphore, SEM_post removes the task from the semaphore queue and puts it on the ready queue. If no tasks are waiting, SEM_post simply increments the semaphore count and returns.

**SEM Manager Properties**

The following global property can be set for the SEM module in the SEM Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **Object Memory**. The memory segment that contains the SEM objects created with the DSP/BIOS Configuration Tool.

  TextConf Name: OBJMEMSEG  Type: Reference

  Example: `SEM.OBJMEMSEG = prog.get("myMEM");`

**SEM Object Properties**

To create a SEM object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var mySem = SEM.create("mySem");
```

The following properties can be set for a SEM object in the SEM Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **comment**. Type a comment to identify this SEM object.

  TextConf Name: comment  Type: String

  Example: `mySem.comment = "my SEM";`

❏ **Initial semaphore count**. Set this property to the desired initial semaphore count.

  TextConf Name: count  Type: Int16

  Example: `mySem.count = 0;`

**SEM - Code Composer Studio Interface**

The SEM tab of the Kernel/Object View shows information about semaphore objects.

## SEM_count

*Get current semaphore count*

**C Interface**

**Syntax** count = SEM_count(sem);

**Parameters** SEM_Handle sem; /* semaphore handle */

**Return Value** Int count; /* current semaphore count */

**Assembly Interface** none

**Description** SEM_count returns the current value of the semaphore specified by sem.

## SEM_create

*Create a semaphore*

### C Interface

**Syntax**

sem = SEM_create(count, attrs);

**Parameters**

```
Int         count;    /* initial semaphore count */
SEM_Attrs   *attrs;   /* pointer to semaphore attributes */
```

**Return Value**

```
SEM_Handle sem;       /* handle for new semaphore object */
```

### Assembly Interface

none

### Description

SEM_create creates a new semaphore object which is initialized to count. If successful, SEM_create returns the handle of the new semaphore. If unsuccessful, SEM_create returns NULL unless it aborts (for example, because it directly or indirectly calls SYS_error, and SYS_error is configured to abort).

If attrs is NULL, the new semaphore is assigned a default set of attributes. Otherwise, the semaphore's attributes are specified through a structure of type SEM_Attrs.

**Note:**

At present, no attributes are supported for semaphore objects, and the type SEM_Attrs is defined as a dummy structure.

Default attribute values are contained in the constant SEM_ATTRS, which can be assigned to a variable of type SEM_Attrs before calling SEM_create.

SEM_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module.

### Constraints and Calling Context

- ❏ count must be greater than or equal to 0.
- ❏ SEM_create cannot be called from a SWI or HWI.
- ❏ You can reduce the size of your application by creating objects with the DSP/BIOS Configuration Tool rather than XXX_create functions.

### See Also

MEM_alloc
SEM_delete

## SEM_delete

*Delete a semaphore*

**C Interface**

**Syntax**

SEM_delete(sem);

**Parameters**

SEM_Handle sem; /* semaphore object handle */

**Return Value**

Void

**Assembly Interface**

none

**Description**

SEM_delete uses MEM_free to free the semaphore object referenced by sem.

SEM_delete calls MEM_free to delete the SEM object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

**Constraints and Calling Context**

- ❏ No tasks should be pending on sem when SEM_delete is called.
- ❏ SEM_delete cannot be called from a SWI or HWI.
- ❏ No check is performed to prevent SEM_delete from being used on a statically-created object. If a program attempts to delete a semaphore object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

**See Also**

SEM_create

## SEM_ipost

*Signal a semaphore (interrupt use only)*

### C Interface

**Syntax**

SEM_ipost(sem);

**Parameters**

SEM_Handle sem; /* semaphore object handle */

**Return Value**

Void

### Assembly Interface

none

### Description

SEM_ipost readies the first task waiting for the semaphore. If no task is waiting, SEM_ipost simply increments the semaphore count and returns.

SEM_ipost is similar to SEM_post.

Use either SEM_ipost or SEM_post within an HWI or SWI. SEM_ipost is slightly more efficient than SEM_post, because it does not check to see whether it is being called from within a SWI or HWI.

Use SEM_post (not SEM_ipost) within a task.

### Constraints and Calling Context

- When called within an HWI ISR, the code sequence calling SEM_ipost must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.
- SEM_ipost should not be called from a TSK function.
- SEM_ipost cannot be called from the program's main function.

### See Also

SEM_pend
SEM_post

## SEM_new

*Initialize semaphore object*

**C Interface**

**Syntax**

Void SEM_new(sem, count);

**Parameters**

```
SEM_Handle sem;     /* pointer to semaphore object */
Int        count;   /* initial semaphore count */
```

**Return Value**

Void

**Assembly Interface**

none

**Description**

SEM_new initializes the semaphore object pointed to by sem with count. The function should be used on a statically created semaphore for initialization purposes only. No task switch occurs when calling SEM_new.

**Constraints and Calling Context**

❏ count must be greater than or equal to 0

❏ no tasks should be pending on the semaphore when SEM_new is called

**See Also**

QUE_new

## SEM_pend

*Wait for a semaphore*

### C Interface

**Syntax**

status = SEM_pend(sem, timeout);

**Parameters**

```
SEM_Handle sem;      /* semaphore object handle */
Uns        timeout;  /* return after this many system clock ticks */
```

**Return Value**

```
Bool       status;   /* TRUE if successful, FALSE if timeout */
```

### Assembly Interface

none

### Description

If the semaphore count is greater than zero, SEM_pend decrements the count and returns TRUE. Otherwise, SEM_pend suspends the execution of the current task until SEM_post is called or the timeout expires. If timeout is not equal to SYS_FOREVER or 0, the task suspension time can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

If timeout is SYS_FOREVER, the task remains suspended until SEM_post is called on this semaphore. If timeout is 0, SEM_pend returns immediately.

If timeout expires (or timeout is 0) before the semaphore is available, SEM_pend returns FALSE. Otherwise SEM_pend returns TRUE.

A task switch occurs when calling SEM_pend if the semaphore count is 0 and timeout is not zero.

### Constraints and Calling Context

- ❏ SEM_pend can only be called from an HWI or SWI if timeout is 0.
- ❏ SEM_pend cannot be called from the program's main function.
- ❏ If you need to call SEM_pend within a TSK_disable/TSK_enable block, you must use a timeout of 0.
- ❏ SEM_pend should not be called from within an IDL function. Doing so prevents analysis tools from gathering run-time information.

### See Also

SEM_post

## SEM_post

*Signal a semaphore*

**C Interface**

**Syntax**

SEM_post(sem);

**Parameters**

SEM_Handle sem; /* semaphore object handle */

**Return Value**

Void

**Assembly Interface**

none

**Description**

SEM_post readies the first task waiting for the semaphore. If no task is waiting, SEM_post simply increments the semaphore count and returns.

A task switch occurs when calling SEM_post if a higher priority task is made ready to run.

**Constraints and Calling Context**

- ❏ When called within an HWI ISR, the code sequence calling SEM_post must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.
- ❏ If SEM_post is called from within a TSK_disable/TSK_enable block, the semaphore operation is not processed until TSK_enable is called.

**See Also**

SEM_ipost
SEM_pend

## SEM_reset

*Reset semaphore count*

### C Interface

**Syntax**

```
SEM_reset(sem, count);
```

**Parameters**

```
SEM_Handle sem;     /* semaphore object handle */
Int        count;   /* semaphore count */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SEM_reset resets the semaphore count to count.

No task switch occurs when calling SEM_reset.

### Constraints and Calling Context

- ❏ count must be greater than or equal to 0.
- ❏ No tasks should be waiting on the semaphore when SEM_reset is called.
- ❏ SEM_reset cannot be called by an HWI or a SWI.

### See Also

SEM_create

## 2.21 SIO Module

The SIO module is the stream input and output manager.

**Functions**

- ❏ SIO_bufsize. Size of the buffers used by a stream
- ❏ SIO_create. Create stream
- ❏ SIO_ctrl. Perform a device-dependent control operation
- ❏ SIO_delete. Delete stream
- ❏ SIO_flush. Idle a stream by flushing buffers
- ❏ SIO_get. Get buffer from stream
- ❏ SIO_idle. Idle a stream
- ❏ SIO_issue. Send a buffer to a stream
- ❏ SIO_put. Put buffer to a stream
- ❏ SIO_ready. Determine if device is ready
- ❏ SIO_reclaim. Request a buffer back from a stream
- ❏ SIO_segid. Memory segment used by a stream
- ❏ SIO_select. Select a ready device
- ❏ SIO_staticbuf. Acquire static buffer from stream

**Constants, Types, and Structures**

```
#define SIO_STANDARD     0 /* open stream for */
                       /* standard streaming model */
#define SIO_ISSUERECLAIM 1 /* open stream for */
                   /* issue/reclaim streaming model */

#define SIO_INPUT       0  /* open for input */
#define SIO_OUTPUT      1  /* open for output */

typedef SIO_Handle;        /* stream object handle */

struct SIO_Attrs { /* stream attributes */
   Int  nbufs;     /* number of buffers */
   Int  segid;     /* buffer segment ID */
   Int  align;     /* buffer alignment */
   Bool flush;  /* TRUE-> don't block in DEV_idle */
   Uns  model;  /* SIO_STANDARD, SIO_ISSUERECLAIM */
   Uns  timeout;   /* passed to DEV_reclaim calls */
   DEV_Callback *callback;
                 /* initializes callback in DEV_Obj */
} SIO_Attrs;
```

```
SIO_Attrs SIO_ATTRS = {
    2,                      /* nbufs */
    0,                      /* segid */
    0,                      /* align */
    FALSE,                  /* flush */
    SIO_STANDARD,           /* model */
    SYS_FOREVER             /* timeout */
    NULL                    /* callback */
};
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the SIO Manager Properties and SIO Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |
| USEISSUERECLAIM | Bool | false |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| deviceName | Reference | prog.get("dev-name") |
| controlParameter | String | "" |
| mode | EnumString | "input" ("output") |
| bufSize | Int16 | 0x80 |
| numBufs | Int16 | 2 |
| bufSegId | Reference | prog.get("IDATA") |
| bufAlign | EnumInt | 1 (2, 4, 8, 16, 32, 64, ..., 32768) |
| flush | Bool | false |
| modelName | EnumString | "Standard" ("Issue/Reclaim") |
| allocStaticBuf | Bool | false |
| timeout | Int16 | -1 |
| useCallBackFxn | Bool | false |
| callBackFxn | Extern | prog.extern("FXN_F_nop") |
| arg0 | Arg | 0 |
| arg1 | Arg | 0 |

**Description**

The stream manager provides efficient real-time device-independent I/O through a set of functions that manipulate stream objects accessed through handles of type SIO_Handle. The device independence is afforded by having a common high-level abstraction appropriate for real-time applications, continuous streams of data, that can be associated with a variety of devices. All I/O programming is done in a high-level manner using these stream handles to the devices and the stream manager takes care of dispatching into the underlying device drivers.

For efficiency, streams are treated as sequences of fixed-size buffers of data rather than just sequences of MADUs.

Streams can be opened and closed during program execution using the functions SIO_create and SIO_delete, respectively.

The SIO_issue and SIO_reclaim function calls are enhancements to the basic DSP/BIOS device model. These functions provide a second usage model for streaming, referred to as the issue/reclaim model. It is a more flexible streaming model that allows clients to supply their own buffers to a stream, and to get them back in the order that they were submitted. The SIO_issue and SIO_reclaim functions also provide a user argument that can be used for passing information between the stream client and the stream devices.

Both SWI and TSK threads can be used with the SIO module. However, SWI threads can be used only with the issue/reclaim model. TSK threads can be use with either model.

**SIO Manager Properties**

The following global properties can be set for the SIO module in the SIO Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment that contains the SIO objects created with the DSP/BIOS Configuration Tool.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `SIO.OBJMEMSEG = prog.get("myMEM");`

- **Use Only Issue/Reclaim Model.** Enable this option if you want the SIO module to use only the issue/reclaim model. If this option is false (the default) you can also use the standard model.

  TextConf Name: USEISSUERECLAIM Type: Bool

  Example: `SIO.USEISSUERECLAIM = false;`

**SIO Object Properties**

To create an SIO object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var mySio = SIO.create("mySio");
```

The following properties can be set for an SIO object in the SIO Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this SIO object.

  TextConf Name: comment Type: String

  Example: `mySio.comment = "my SIO";`

- **Device**. Select the device to which you want to bind this SIO object. User-defined devices are listed along with DGN and DPI devices.

  TextConf Name: deviceName Type: Reference

  Example:
  ```
  mySio.deviceName =
      prog.get("UDEV0");
  ```

- **Device Control String**. Type the device suffix to be passed to any devices stacked below the device connected to this stream.

  TextConf Name: controlParameter Type: String

  Example:
  ```
  mySio.controlParameter =
      "/split4/codec";
  ```

- **Mode**. Select input if this stream is to be used for input to the application program and output if this stream is to be used for output.

  TextConf Name: mode Type: EnumString

  Options: "input", "output"

  Example: `mySio.mode = "input";`

- **Buffer size**. If this stream uses the Standard model, this property controls the size of buffers (in MADUs) allocated for use by the steam. If this stream uses the Issue/Reclaim model, the stream can handle buffers of any size.

  TextConf Name: bufSize Type: Int16

  Example: `mySio.bufSize = 0x80;`

- **Number of buffers**. If this stream uses the Standard model, this property controls the number of buffers allocated for use by the steam. If this stream uses the Issue/Reclaim model, the stream can handle up to the specified Number of buffers.

  TextConf Name: numBufs Type: Int16

  Example: `mySio.numBufs = 2;`

- **Place buffers in memory segment**. Select the memory segment to contain the stream buffers if Model is Standard.

  TextConf Name: bufSegId Type: Reference

  Example: `mySio.bufSegId = prog.get("myMEM");`

- **Buffer alignment**. Specify the memory alignment to use for stream buffers if Model is Standard. For example, if you select 16, the buffer must begin at an address that is a multiple of 16. The default is 1, which means the buffer can begin at any address.

  TextConf Name: bufAlign — Type: EnumInt

  Options: 1, 2, 4, 8, 16, 32, 64, ..., 32768

  Example: `mySio.bufAlign = 1;`

- **Flush**. Check this box if you want the stream to discard all pending data and return without blocking if this object is idled at run-time with SIO_idle.

  TextConf Name: flush — Type: Bool

  Example: `mySio.flush = false;`

- **Model**. Select Standard if you want all buffers to be allocated when the stream is created. Select Issue/Reclaim if your program is to allocate the buffers and supply them using SIO_issue. Both SWI and TSK threads can be used with the SIO module. However, SWI threads can be used only with the issue/reclaim model. TSK threads can be use with either model.

  TextConf Name: modelName — Type: EnumString

  Options: "Standard", "Issue/Reclaim"

  Example: `mySio.modelName = "Standard";`

- **Allocate Static Buffer(s)**. If this box is checked, the DSP/BIOS Configuration Tool allocates stream buffers for the user. The SIO_staticbuf function is used to acquire these buffers from the stream. When the Standard model is used, checking this box causes one buffer more than the Number of buffers property to be allocated. When the Issue/Reclaim model is used, buffers are not normally allocated. Checking this box causes the number of buffers specified by the Number of buffers property to be allocated.

  TextConf Name: allocStaticBuf — Type: Bool

  Example: `mySio.allocStaticBuf = false;`

- **Timeout for I/O operation**. This parameter specifies the length of time the I/O operations SIO_get, SIO_put, and SIO_reclaim wait for I/O. The device driver's Dxx_reclaim function typically uses this timeout while waiting for I/O. If the timeout expires before a buffer is available, the I/O operation returns (-1 * SYS_ETIMEOUT) and no buffer is returned.

  TextConf Name: timeout — Type: Int16

  Example: `mySio.timeout = -1;`

- **use callback function**. Check this box if you want to use this SIO object with a callback function. In most cases, the callback function is SWI_andnHook or a similar function that posts a SWI. Checking this box allows the SIO object to be used with SWI threads.

  TextConf Name: useCallBackFxn Type: Bool

  Example: `mySio.useCallBackFxn = false;`

- **callback function**. A function for the SIO object to call. In most cases, the callback function is SWI_andnHook or a similar function that posts a SWI. This function gets called by the class driver (see the DIO Adapter) in the class driver's callback function. This callback function in the class driver usually gets called in the mini-driver code as a result of the ISR.

  TextConf Name: callBackFxn Type: Extern

  Example:
  ```
  mySio.callBackFxn =
      prog.extern("SWI_andnHook");
  ```

- **argument 0**. The first argument to pass to the callback function. If the callback function is SWI_andnHook, this argument should be a SWI object handle.

  TextConf Name: arg0 Type: Arg

  Example: `mySio.arg0 = prog.get("mySwi");`

- **argument 1**. The second argument to pass to the callback function. If the callback function is SWI_andnHook, this argument should be a value mask.

  TextConf Name: arg1 Type: Arg

  Example: `mySio.arg1 = 2;`

## SIO_bufsize

*Return the size of the buffers used by a stream*

**C Interface**

**Syntax** size = SIO_bufsize(stream);

**Parameters** SIO_Handle stream;

**Return Value** Uns size;

**Assembly Interface** none

**Description** SIO_bufsize returns the size of the buffers used by stream.

**See Also** SIO_segid

## SIO_create

*Open a stream*

### C Interface

**Syntax**

stream = SIO_create(name, mode, bufsize, attrs);

**Parameters**

```
String      name;     /* name of device */
Int         mode;     /* SIO_INPUT or SIO_OUTPUT */
Uns         bufsize;  /* stream buffer size */
SIO_Attrs   *attrs;   /* pointer to stream attributes */
```

**Return Value**

```
SIO_Handle  stream;   /* stream object handle */
```

### Assembly Interface

none

### Description

SIO_create creates a new stream object and opens the device specified by name. If successful, SIO_create returns the handle of the new stream object. If unsuccessful, SIO_create returns NULL unless it aborts (for example, because it directly or indirectly calls SYS_error, and SYS_error is configured to abort).

Internally, SIO_create calls Dxx_open to open a device.

The mode parameter specifies whether the stream is to be used for input (SIO_INPUT) or output (SIO_OUTPUT).

If the stream is being opened in SIO_STANDARD mode, SIO_create allocates buffers of size bufsize for use by the stream. Initially these buffers are placed on the device todevice queue for input streams, and the device fromdevice queue for output streams.

If the stream is being opened in SIO_ISSUERECLAIM mode, SIO_create does not allocate any buffers for the stream. In SIO_ISSUERECLAIM mode all buffers must be supplied by the client via the SIO_issue call. It does, however, prepare the stream for a maximum number of buffers of the specified size.

If the attrs parameter is NULL, the new stream is assigned the default set of attributes specified by SIO_ATTRS. The following stream attributes are currently supported:

```
struct SIO_Attrs { /* stream attributes */
    Int  nbufs;     /* number of buffers */
    Int  segid;     /* buffer segment ID */
    Int  align;     /* buffer alignment */
    Bool flush; /* TRUE -> don't block in DEV_idle */
    Uns  model; /* SIO_STANDARD, SIO_ISSUERECLAIM */
    Uns  timeout;  /* passed to DEV_reclaim calls */
    DEV_Callback  *callback;
                /* initialize callback in DEV_Obj */
} SIO_Attrs;
```

- **nbufs.** Specifies the number of buffers allocated by the stream in the SIO_STANDARD usage model, or the number of buffers to prepare for in the SIO_ISSUERECLAIM usage model. The default value of nbufs is 2. In the SIO_ISSUERECLAIM usage model, nbufs is the maximum number of buffers that can be outstanding (that is, issued but not reclaimed) at any point in time.
- **segid.** Specifies the memory segment for stream buffers. Use the memory segment names defined using the DSP/BIOS Configuration Tool. The default value is 0, meaning that buffers are to be allocated from the Segment for DSP/BIOS objects defined in the MEM Manager Properties dialog.
- **align.** Specifies the memory alignment for stream buffers. The default value is 0, meaning that no alignment is needed.
- **flush.** Indicates the desired behavior for an output stream when it is deleted. If flush is TRUE, a call to SIO_delete causes the stream to discard all pending data and return without blocking. If flush is FALSE, a call to SIO_delete causes the stream to block until all pending data has been processed. The default value is FALSE.
- **model.** Indicates the usage model that is to be used with this stream. The two usage models are SIO_ISSUERECLAIM and SIO_STANDARD. The default usage model is SIO_STANDARD.
- **timeout.** Specifies the length of time the device driver waits for I/O completion before returning an error (for example, SYS_ETIMEOUT). timeout is usually passed as a parameter to SEM_pend by the device driver. The default is SYS_FOREVER which indicates that the driver waits forever. If timeout is SYS_FOREVER, the task remains suspended until a buffer is available to be returned by the stream. The timeout attribute applies to the I/O operations SIO_get, SIO_put, and SIO_reclaim. If timeout is 0, the I/O operation returns immediately. If the timeout expires before a buffer is available to be returned, the I/O operation returns the value of (-1 * SYS_ETIMEOUT). Otherwise the I/O operation returns the number of valid MADUs in the buffer, or -1 multiplied by an error code.

- **callback.** Specifies a pointer to channel-specific callback information. The DEV_Callback structure is defined by the DEV module. It contains the callback function and two function arguments. The callback function is typically SWI_andnHook or a similar function that posts a SWI. Callbacks can only be used with the issue/reclaim model.

  Existing DEV drivers do not use this callback function. While DEV drivers can be modified to use this callback, it is not recommended. Instead, the IOM device driver model is recommended for drivers that need the SIO callback feature. IOM drivers use the DIO module to interface with the SIO functions.

SIO_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Manager Properties dialog.

**Constraints and Calling Context**

- A stream can only be used by one task simultaneously. Catastrophic failure can result if more than one task calls SIO_get (or SIO_issue/ SIO_reclaim) on the same input stream, or more than one task calls SIO_put (or SIO_issue / SIO_reclaim) on the same output stream.
- SIO_create creates a stream dynamically. Do not call SIO_create on a stream that was created with the DSP/BIOS Configuration Tool.
- You can reduce the size of your application program by creating objects with the DSP/BIOS Configuration Tool rather than using the XXX_create functions. However, streams that are to be used with stacking drivers must be created dynamically with SIO_create.
- SIO_create cannot be called from a SWI or HWI.

**See Also**

Dxx_open
MEM_alloc
SEM_pend
SIO_delete
SIO_issue
SIO_reclaim
SYS_error

## SIO_ctrl

*Perform a device-dependent control operation*

**C Interface**

**Syntax**

status = SIO_ctrl(stream, cmd, arg);

**Parameters**

| | | |
|---|---|---|
| SIO_Handle | stream; | /* stream handle */ |
| Uns | cmd; | /* command to device */ |
| Arg | arg; | /* arbitrary argument */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* device status */ |

**Assembly Interface**

none

**Description**

SIO_ctrl causes a control operation to be issued to the device associated with stream. cmd and arg are passed directly to the device.

SIO_ctrl returns SYS_OK if successful, and a non-zero device-dependent error value if unsuccessful.

Internally, SIO_ctrl calls Dxx_ctrl to send control commands to a device.

**Constraints and Calling Context**

- SIO_ctrl cannot be called from an HWI.

**See Also**

Dxx_ctrl

## SIO_delete

*Close a stream and free its buffers*

### C Interface

**Syntax**

status = SIO_delete(stream);

**Parameters**

SIO_Handle stream; /* stream object */

**Return Value**

Int status; /* result of operation */

### Assembly Interface

none

### Description

SIO_delete idles the device before freeing the stream object and buffers.

If the stream being deleted was opened for input, then any pending input data is discarded. If the stream being deleted was opened for output, the method for handling data is determined by the value of the flush field in the SIO_Attrs structure (passed in with SIO_create). If flush is TRUE, SIO_delete discards all pending data and return without blocking. If flush is FALSE, SIO_delete blocks until all pending data has been processed by the stream.

SIO_delete returns SYS_OK if and only if the operation is successful.

SIO_delete calls MEM_free to delete a stream. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

Internally, SIO_delete first calls Dxx_idle to idle the device. Then it calls Dxx_close.

### Constraints and Calling Context

- SIO_delete cannot be called from a SWI or HWI.
- No check is performed to prevent SIO_delete from being used on a statically-created object. If a program attempts to delete a stream object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.
- In SIO_ISSUERECLAIM mode, all buffers issued to a stream must be reclaimed before SIO_delete is called. Failing to reclaim such buffers causes a memory leak.

### See Also

SIO_create
SIO_flush
SIO_idle
Dxx_idle
Dxx_close

## SIO_flush

*Flush a stream*

**C Interface**

**Syntax** status = SIO_flush(stream);

**Parameters**

| | | |
|---|---|---|
| SIO_Handle | stream; | /* stream handle */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* result of operation */ |

**Assembly Interface** none

**Description**

SIO_flush causes all pending data to be discarded regardless of the mode of the stream. SIO_flush differs from SIO_idle in that SIO_flush never suspends program execution to complete processing of data, even for a stream created in output mode.

The underlying device connected to stream is idled as a result of calling SIO_flush. In general, the interrupt is disabled for the device.

One of the purposes of this function is to provide synchronization with the external environment.

SIO_flush returns SYS_OK if and only if the stream is successfully idled.

Internally, SIO_flush calls Dxx_idle and flushes all pending data.

If a callback was specified in the SIO_Attrs structure used with SIO_create, then SIO_flush performs no processing and returns SYS_OK.

**Constraints and Calling Context**

- SIO_flush cannot be called from an HWI.
- If SIO_flush is called from a SWI, no action is performed.

**See Also**

Dxx_idle
SIO_create
SIO_idle

## SIO_get

*Get a buffer from stream*

### C Interface

**Syntax**

nmadus = SIO_get(stream, bufp);

**Parameters**

```
SIO_Handle  stream     /* stream handle */
Ptr         *bufp;     /* pointer to a buffer */
```

**Return Value**

```
Int         nmadus;    /* number of MADUs read or error if negative */
```

### Assembly Interface

none

### Description

SIO_get exchanges an empty buffer with a non-empty buffer from stream. The bufp is an input/output parameter which points to an empty buffer when SIO_get is called. When SIO_get returns, bufp points to a new (different) buffer, and nmadus indicates success or failure of the call.

SIO_get blocks until a buffer can be returned to the caller, or until the stream's timeout attribute expires (see SIO_create). If a timeout occurs, the value (-1 * SYS_ETIMEOUT) is returned. If timeout is not equal to SYS_FOREVER or 0, the task suspension time can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

To indicate success, SIO_get returns a positive value for nmadus. As a success indicator, nmadus is the number of MADUs received from the stream. To indicate failure, SIO_get returns a negative value for nmadus. As a failure indicator, nmadus is the actual error code multiplied by -1.

Since this operation is generally accomplished by redirection rather than by copying data, references to the contents of the buffer pointed to by bufp must be recomputed after the call to SIO_get.

A task switch occurs when calling SIO_get if there are no non-empty data buffers in stream.

Internally, SIO_get calls Dxx_issue and Dxx_reclaim for the device.

### Constraints and Calling Context

- ❏ The stream must not be created with attrs.model set to SIO_ISSUERECLAIM. The results of calling SIO_get on a stream created for the issue/reclaim streaming model are undefined.
- ❏ SIO_get cannot be called from a SWI or HWI.

### See Also

Dxx_issue
Dxx_reclaim
SIO_put

## SIO_idle

*Idle a stream*

### C Interface

**Syntax**

status = SIO_idle(stream);

**Parameters**

| | | |
|---|---|---|
| SIO_Handle | stream; | /* stream handle */ |

**Return Value**

| | | |
|---|---|---|
| Int | status; | /* result of operation */ |

### Assembly Interface

none

### Description

If stream is being used for output, SIO_idle causes any currently buffered data to be transferred to the output device associated with stream. SIO_idle suspends program execution for as long as is required for the data to be consumed by the underlying device.

If stream is being used for input, SIO_idle causes any currently buffered data to be discarded. The underlying device connected to stream is idled as a result of calling SIO_idle. In general, the interrupt is disabled for this device.

If discarding of unrendered output is desired, use SIO_flush instead.

One of the purposes of this function is to provide synchronization with the external environment.

SIO_idle returns SYS_OK if and only if the stream is successfully idled.

Internally, SIO_idle calls Dxx_idle to idle the device.

If a callback was specified in the SIO_Attrs structure used with SIO_create, then SIO_idle performs no processing and returns SYS_OK.

### Constraints and Calling Context

- ❏ SIO_idle cannot be called from an HWI.
- ❏ If SIO_idle is called from a SWI, no action is performed.

### See Also

Dxx_idle
SIO_create
SIO_flush

## SIO_issue

*Send a buffer to a stream*

### C Interface

**Syntax**

status = SIO_issue(stream, pbuf, nmadus, arg);

**Parameters**

```
SIO_Handle  stream;    /* stream handle */
Ptr         pbuf;      /* pointer to a buffer */
Uns         nmadus;    /* number of MADUs in the buffer */
Arg         arg;       /* user argument */
```

**Return Value**

```
Int         status;    /* result of operation */
```

### Assembly Interface

none

### Description

SIO_issue is used to send a buffer and its related information to a stream. The buffer-related information consists of the logical length of the buffer (nmadus), and the user argument to be associated with that buffer. SIO_issue sends a buffer to the stream and return to the caller without blocking. It also returns an error code indicating success (SYS_OK) or failure of the call.

Internally, SIO_issue calls Dxx_issue after placing a new input frame on the driver's device->todevice queue.

Failure of SIO_issue indicates that the stream was not able to accept the buffer being issued or that there was a device error when the underlying Dxx_issue was called. In the first case, the application is probably issuing more frames than the maximum MADUs allowed for the stream, before it reclaims any frames. In the second case, the failure reveals an underlying device driver or hardware problem. If SIO_issue fails, SIO_idle should be called for an SIO_INPUT stream, and SIO_flush should be called for an SIO_OUTPUT stream, before attempting more I/O through the stream.

The interpretation of nmadus, the logical size of a buffer, is direction-dependent. For a stream opened in SIO_OUTPUT mode, the logical size of the buffer indicates the number of valid MADUs of data it contains. For a stream opened in SIO_INPUT mode, the logical length of a buffer indicates the number of MADUs being requested by the client. In either case, the logical size of the buffer must be less than or equal to the physical size of the buffer.

The argument arg is not interpreted by DSP/BIOS, but is offered as a service to the stream client. DSP/BIOS and all DSP/BIOS-compliant device drivers preserve the value of arg and maintain its association with the data that it was issued with. arg provides a user argument as a method for a client to associate additional information with a particular buffer of data.

SIO_issue is used in conjunction with SIO_reclaim to operate a stream opened in SIO_ISSUERECLAIM mode. The SIO_issue call sends a buffer to a stream, and SIO_reclaim retrieves a buffer from a stream. In normal operation each SIO_issue call is followed by an SIO_reclaim call. Short bursts of multiple SIO_issue calls can be made without an intervening SIO_reclaim call, but over the life of the stream SIO_issue and SIO_reclaim must be called the same number of times.

At any given point in the life of a stream, the number of SIO_issue calls can exceed the number of SIO_reclaim calls by a maximum of nbufs. The value of nbufs is determined by the SIO_create call or by setting the Number of buffers property for the object in the DSP/BIOS Configuration Tool.

**Note:**

An SIO_reclaim call should not be made without at least one outstanding SIO_issue call. Calling SIO_reclaim with no outstanding SIO_issue calls has undefined results.

**Constraints and Calling Context**

- The stream must be created with attrs.model set to SIO_ISSUERECLAIM.
- SIO_issue cannot be called from an HWI.

**See Also**

Dxx_issue
SIO_create
SIO_reclaim

## SIO_put

*Put a buffer to a stream*

### C Interface

**Syntax**

nmadus = SIO_put(stream, bufp, nmadus);

**Parameters**

```
SIO_Handle  stream;   /* stream handle */
Ptr         *bufp;    /* pointer to a buffer */
Uns         nmadus;   /* number of MADUs in the buffer */
```

**Return Value**

```
Int         nmadus;   /* number of MADUs, negative if error */
```

### Assembly Interface

none

### Description

SIO_put exchanges a non-empty buffer with an empty buffer. The bufp parameter is an input/output parameter that points to a non-empty buffer when SIO_put is called. When SIO_put returns, bufp points to a new (different) buffer, and nmadus indicates success or failure of the call.

SIO_put blocks until a buffer can be returned to the caller, or until the stream's timeout attribute expires (see SIO_create). If a timeout occurs, the value (-1 * SYS_ETIMEOUT) is returned. If timeout is not equal to SYS_FOREVER or 0, the task suspension time can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

To indicate success, SIO_put returns a positive value for nmadus. As a success indicator, nmadus is the number of valid MADUs in the buffer returned by the stream (usually zero). To indicate failure, SIO_put returns a negative value (the actual error code multiplied by -1).

Since this operation is generally accomplished by redirection rather than by copying data, references to the contents of the buffer pointed to by bufp must be recomputed after the call to SIO_put.

A task switch occurs when calling SIO_put if there are no empty data buffers in the stream.

Internally, SIO_put calls Dxx_issue and Dxx_reclaim for the device.

### Constraints and Calling Context

- ❏ The stream must not be created with attrs.model set to SIO_ISSUERECLAIM. The results of calling SIO_put on a stream created for the issue/reclaim model are undefined.
- ❏ SIO_put cannot be called from a SWI or HWI.

### See Also

Dxx_issue
Dxx_reclaim
SIO_get

## SIO_ready

*Determine if device for stream is ready*

### C Interface

**Syntax** status = SIO_ready(stream);

**Parameters** SIO_Handle stream;

**Return Value** Int status; /* result of operation */

### Assembly Interface

none

### Description

SIO_ready returns TRUE if a stream is ready for input or output.

If you are using SIO objects with SWI threads, you may want to use SIO_ready to avoid calling SIO_reclaim when it may fail because no buffers are available.

SIO_ready is similar to SIO_select, except that it does not block. You can prevent SIO_select from blocking by setting the timeout to zero, however, SIO_ready is more efficient because SIO_select performs SEM_pend with a timeout of zero. SIO_ready simply polls the stream to see if the device is ready.

### See Also

SIO_select

## SIO_reclaim

*Request a buffer back from a stream*

### C Interface

**Syntax**

nmadus = SIO_reclaim(stream, pbufp, parg);

**Parameters**

```
SIO_Handle  stream;   /* stream handle */
Ptr         *pbufp;   /* pointer to the buffer */
Arg         *parg;    /* pointer to a user argument */
```

**Return Value**

```
Int         nmadus;   /* number of MADUs or error if negative */
```

### Assembly Interface

none

### Description

SIO_reclaim is used to request a buffer back from a stream. It returns a pointer to the buffer, the number of valid MADUs in the buffer, and a user argument (parg). After the SIO_reclaim call parg points to the same value that was passed in with this buffer using the SIO_issue call.

Internally, SIO_reclaim calls Dxx_reclaim, then it gets the frame from the driver's device->fromdevice queue.

If a stream was created in SIO_OUTPUT mode, then SIO_reclaim returns an empty buffer, and nmadus is zero, since the buffer is empty. If a stream was opened in SIO_INPUT mode, SIO_reclaim returns a non-empty buffer, and nmadus is the number of valid MADUs of data in the buffer.

If SIO_reclaim is called from a TSK thread, it blocks (in either mode) until a buffer can be returned to the caller, or until the stream's timeout attribute expires (see SIO_create), and it returns a positive number or zero (indicating success), or a negative number (indicating an error condition). If timeout is not equal to SYS_FOREVER or 0, the task suspension time can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

If SIO_reclaim is called from a SWI thread, it returns an error if it is called when no buffer is available. SIO_reclaim never blocks when called from a SWI.

To indicate success, SIO_reclaim returns a positive value for nmadus. As a success indicator, nmadus is the number of valid MADUs in the buffer. To indicate failure, SIO_reclaim returns a negative value for nmadus. As a failure indicator, nmadus is the actual error code multiplied by -1.

Failure of SIO_reclaim indicates that no buffer was returned to the client. Therefore, if SIO_reclaim fails, the client should not attempt to de-reference pbufp, since it is not guaranteed to contain a valid buffer pointer.

SIO_reclaim is used in conjunction with SIO_issue to operate a stream opened in SIO_ISSUERECLAIM mode. The SIO_issue call sends a buffer to a stream, and SIO_reclaim retrieves a buffer from a stream. In normal operation each SIO_issue call is followed by an SIO_reclaim call. Short bursts of multiple SIO_issue calls can be made without an intervening SIO_reclaim call, but over the life of the stream SIO_issue and SIO_reclaim must be called the same number of times. The number of SIO_issue calls can exceed the number of SIO_reclaim calls by a maximum of nbufs at any given time. The value of nbufs is determined by the SIO_create call or by setting the Number of buffers property for the object in the DSP/BIOS Configuration Tool.

**Note:**

An SIO_reclaim call should not be made without at least one outstanding SIO_issue call. Calling SIO_reclaim with no outstanding SIO_issue calls has undefined results.

SIO_reclaim only returns buffers that were passed in using SIO_issue. It also returns the buffers in the same order that they were issued.

A task switch occurs when calling SIO_reclaim if timeout is not set to 0, and there are no data buffers available to be returned.

**Constraints and Calling Context**

- ❏ The stream must be created with attrs.model set to SIO_ISSUERECLAIM.
- ❏ There must be at least one outstanding SIO_issue when an SIO_reclaim call is made.
- ❏ SIO_reclaim returns an error if it is called from a SWI when no buffer is available. SIO_reclaim does not block if called from a SWI.
- ❏ All frames issued to a stream must be reclaimed before closing the stream.
- ❏ SIO_reclaim cannot be called from a HWI.

**See Also**

Dxx_reclaim
SIO_issue
SIO_create

## SIO_segid

*Return the memory segment used by the stream*

**C Interface**

**Syntax**

segid = SIO_segid(stream);

**Parameters**

SIO_Handle stream;

**Return Value**

Int segid; /* memory segment ID */

**Assembly Interface**

none

**Description**

SIO_segid returns the identifier of the memory segment that stream uses for buffers.

**See Also**

SIO_bufsize

## SIO_select

*Select a ready device*

### C Interface

**Syntax**

```
mask = SIO_select(streamtab, nstreams, timeout);
```

**Parameters**

```
SIO_Handle  streamtab; /* stream table */
Int         nstreams;  /* number of streams */
Uns         timeout;   /* return after this many system clock ticks */
```

**Return Value**

```
Uns         mask;      /* stream ready mask */
```

### Assembly Interface

none

### Description

SIO_select waits until one or more of the streams in the streamtab[] array is ready for I/O (that is, it does not block when an I/O operation is attempted).

streamtab[] is an array of streams where nstreams < 16. The timeout parameter indicates the number of system clock ticks to wait before a stream becomes ready. If timeout is 0, SIO_select returns immediately. If timeout is SYS_FOREVER, SIO_select waits until one of the streams is ready. Otherwise, SIO_select waits for up to 1 system clock tick less than timeout due to granularity in system timekeeping.

The return value is a mask indicating which streams are ready for I/O. A 1 in bit position j indicates the stream streamtab[j] is ready.

SIO_select results in a context switch if no streams are ready for I/O.

Internally, SIO_select calls Dxx_ready to determine if the device is ready for an I/O operation.

SIO_ready is similar to SIO_select, except that it does not block. You can prevent SIO_select from blocking by setting the timeout to zero, however, SIO_ready is more efficient in this situation because SIO_select performs SEM_pend with a timeout of zero. SIO_ready simply polls the stream to see if the device is ready.

For the SIO_STANDARD model in SIO_INPUT mode only, if stream I/O has not been started (that is, if SIO_get has not been called), SIO_select calls Dxx_issue for all empty frames to start the device.

### Constraints and Calling Context

- ❏ streamtab must contain handles of type SIO_Handle returned from prior calls to SIO_create.
- ❏ streamtab[] is an array of streams; streamtab[i] corresponds to bit position i in mask.

- SIO_select cannot be called from an HWI.
- SIO_select can only be called from a SWI if the timeout value is zero.

**See Also**

Dxx_ready
SIO_get
SIO_put
SIO_ready
SIO_reclaim

## SIO_staticbuf

*Acquire static buffer from stream*

### C Interface

**Syntax**

```
nmadus = SIO_staticbuf(stream, bufp);
```

**Parameters**

```
SIO_Handle  stream;    /* stream handle */
Ptr         *bufp;     /* pointer to a buffer */
```

**Return Value**

```
Int         nmadus;    /* number of MADUs in buffer */
```

### Assembly Interface

none

### Description

SIO_staticbuf returns buffers for static streams that were configured using the DSP/BIOS Configuration Tool. Buffers are allocated for static streams by checking the Allocate Static Buffer(s) check box for the related SIO object.

SIO_staticbuf returns the size of the buffer or 0 if no more buffers are available from the stream.

SIO_staticbuf can be called multiple times for SIO_ISSUERECLAIM model streams.

SIO_staticbuf must be called to acquire all static buffers before calling SIO_get, SIO_put, SIO_issue or SIO_reclaim.

### Constraints and Calling Context

- SIO_staticbuf should only be called for streams that are defined statically using the DSP/BIOS Configuration Tool.
- SIO_staticbuf should only be called for static streams whose Allocate Static Buffer(s) check box has been checked.
- SIO_staticbuf cannot be called after SIO_get, SIO_put, SIO_issue or SIO_reclaim have been called for the given stream.
- SIO_staticbuf cannot be called from an HWI.

### See Also

SIO_get

## 2.22 STS Module

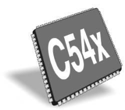
The STS module is the statistics objects manager.

**Functions**

- ❏ STS_add. Update statistics using provided value
- ❏ STS_delta. Update statistics using difference between provided value and setpoint
- ❏ STS_reset. Reset values stored in STS object
- ❏ STS_set. Save a setpoint value

**Constants, Types, and Structures**

```
struct STS_Obj {
    LgInt    num;     /* count */
    LgInt    acc;     /* total value */
    LgInt    max;     /* maximum value */
}
typedef struct STS_Obj {
    Int   numh;
    Int   numl;
    Int   acch;
    Int   accl;s
    Int   maxh;
    Int   maxl;
} STS_Obj;
```




**Note:**

STS objects should not be shared across threads. Therefore, STS_add, STS_delta, STS_reset, and STS_set are not reentrant.

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the STS Manager Properties and STS Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| previousVal | Int32 | 0 |

| Name | Type | Default (Enum Options) |
|---|---|---|
| unitType | EnumString | "Not time based" ("High resolution time based", "Low resolution time based") |
| operation | EnumString | "Nothing" ("A * x", "A * x + B", "(A * x + B) / C") |
| numA | Int32 | 1 |
| numB | Int32 | 0 |
| numC | Int32 | 1 |

**Description**

The STS module manages objects called statistics accumulators. Each STS object accumulates the following statistical information about an arbitrary 32-bit wide data series:

- **Count**. The number of values in an application-supplied data series
- **Total**. The sum of the individual data values in this series
- **Maximum**. The largest value already encountered in this series

Using the count and total, the Statistics View analysis tool calculates the average on the host.

Statistics are accumulated in 32-bit variables on the target and in 64-bit variables on the host. When the host polls the target for real-time statistics, it resets the variables on the target. This minimizes space requirements on the target while allowing you to keep statistics for long test runs.

**Default STS Tracing**

In the RTA Control Panel, you can enable statistics tracing for the following modules by marking the appropriate checkbox. You can also set the HWI Object Properties to perform various STS operations on registers, addresses, or pointers.

Except for tracing TSK execution, your program does not need to include any calls to STS functions in order to gather these statistics. The default units for the statistics values are shown in Table 2-5.

*Table 2-5. Statistics Units for HWI, PIP, PRD, and SWI Modules*

| Module | Units |
|---|---|
| HWI | Gather statistics on monitored values within HWIs |
| PIP | Number of frames read from or written to data pipe (count only) |
| PRD | Number of ticks elapsed from time that the PRD object is ready to run to end of execution |

| Module | Units |
|---|---|
| SWI | Instruction cycles elapsed from time posted to completion |
| TSK | Instruction cycles elapsed from time TSK is made ready to run until the application calls TSK_deltatime. |

**Custom STS Objects**

You can create custom STS objects using the DSP/BIOS Configuration Tool. The STS_add operation updates the count, total, and maximum using the value you provide. The STS_set operation sets a previous value. The STS_delta operation accumulates the difference between the value you pass and the previous value and updates the previous value to the value you pass.

By using custom STS objects and the STS operations, you can do the following:

- ❑ **Count the number of occurrences of an event**. You can pass a value of 0 to STS_add. The count statistic tracks how many times your program calls STS_add for this STS object.
- ❑ **Track the maximum and average values for a variable in your program**. For example, suppose you pass amplitude values to STS_add. The count tracks how many times your program calls STS_add for this STS object. The total is the sum of all the amplitudes. The maximum is the largest value. The Statistics View calculates the average amplitude.
- ❑ **Track the minimum value for a variable in your program**. Negate the values you are monitoring and pass them to STS_add. The maximum is the negative of the minimum value.
- ❑ **Time events or monitor incremental differences in a value**. For example, suppose you want to measure the time between hardware interrupts. You would call STS_set when the program begins running and STS_delta each time the interrupt routine runs, passing the result of CLK_gethtime each time. STS_delta subtracts the previous value from the current value. The count tracks how many times the interrupt routine was performed. The maximum is the largest number of clock counts between interrupt routines. The Statistics View also calculates the average number of clock counts.
- ❑ **Monitor differences between actual values and desired values**. For example, suppose you want to make sure a value stays within a certain range. Subtract the midpoint of the range from the value and pass the absolute value of the result to STS_add. The count tracks how many times your program calls STS_add for this STS object. The total is the sum of all deviations from the middle of the range. The maximum is the largest deviation. The Statistics View calculates the average deviation.

You can further customize the statistics data by setting the STS Object Properties to apply a printf format to the Total, Max, and Average fields in the Statistics View window and choosing a formula to apply to the data values on the host.

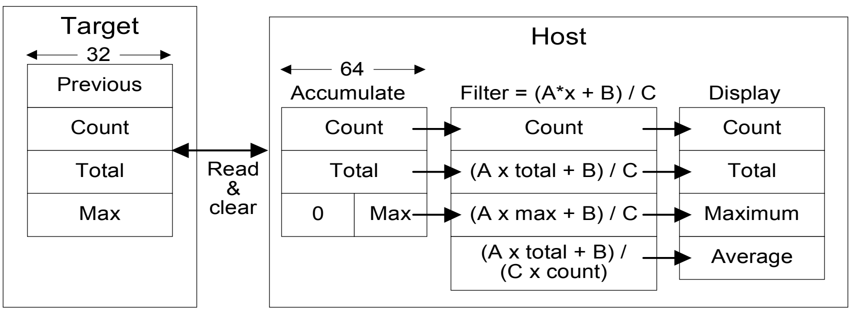
**Statistics Data Gathering by the Statistics View Analysis Tool**

The statistics manager allows the creation of any number of statistics objects, which in turn can be used by the application to accumulate simple statistics about a time series. This information includes the 32-bit maximum value, the last 32-bit value passed to the object, the number of samples (up to $2^{32}$ - 1 samples), and the 32-bit sum of all samples.

These statistics are accumulated on the target in real-time until the host reads and clears these values on the target. The host, however, continues to accumulate the values read from the target in a host buffer which is displayed by the Statistics View real-time analysis tool. Provided that the host reads and clears the target statistics objects faster than the target can overflow the 32-bit wide values being accumulated, no information loss occurs.

Using the DSP/BIOS Configuration Tool, you can select a Host Operation for an STS object. The statistics are filtered on the host using the operation and variables you specify. Figure 2-7 shows the effects of the (A x X + B) / C operation.

*Figure 2-7. Statistics Accumulation on the Host*




**STS Manager Properties**

The following global property can be set for the STS module in the STS Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❏ **Object Memory**. The memory segment that contains the STS objects.

TextConf Name: OBJMEMSEG Type: Reference

Example: `STS.OBJMEMSEG = prog.get("myMEM");`

**STS Object Properties**

To create an STS object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var mySts = STS.create("mySts");
```

The following properties can be set for an STS object in the STS Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❑ **comment**. Type a comment to identify this STS object.

TextConf Name: comment Type: String

Example: `mySts.comment = "my STS";`

❑ **prev**. The initial 32-bit history value to use in this object.

TextConf Name: previousVal Type: Int32

Example: `mySts.previousVal = 0;`

❑ **unit type**. The unit type property enables you to choose the type of time base units.

- Not time based. When you select this unit type, the values are displayed in the Statistics View without applying any conversion.
- High-resolution time based. When you select this unit type, the Statistics View, by default, presents the results in units of instruction cycles.
- Low-resolution time based. When you select this unit type, the Statistics View, by default, presents the results in units of timer interrupts.

TextConf Name: unitType Type: EnumString

Options: "Not time based", "High resolution time based", "Low resolution time based"

Example: `mySts.unitType = "Not time based";`

❑ **host operation**. The expression evaluated (by the host) on the data for this object before it is displayed by the Statistics View real-time analysis tool. The operation can be:

- A x X
- A x X + B
- (A x X + B) / C

TextConf Name: operation Type: EnumString

Options: "Nothing", "A * x", "A * x + B", "(A * x + B) / C"

Example: `mySts.operation = "Nothing";`

- ❑ **A, B, C**. The integer parameters used by the expression specified by the Host Operation field above.

  TextConf Name: numA Type: Int32

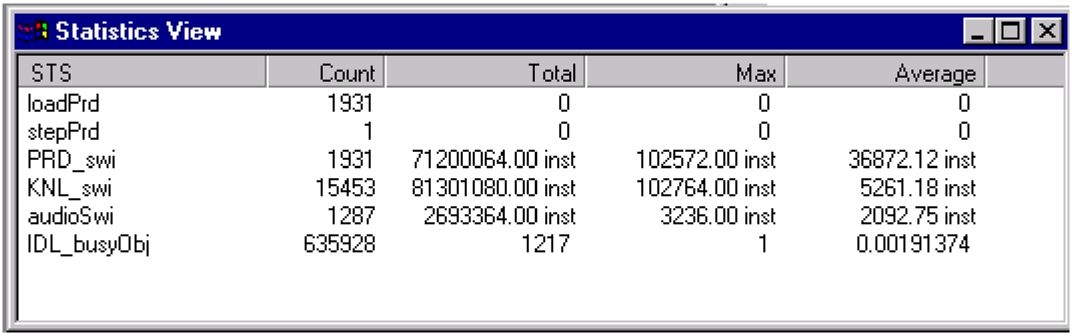
  TextConf Name: numB Type: Int32

  TextConf Name: numC Type: Int32

  Example:
```
mySts.numA = 1;
mySts.numB = 0;
mySts.numC = 1;
```

**STS - Statistics View Interface**

You can view statistics in real-time with the Statistics View analysis tool by choosing the DSP/BIOS→Statistics View menu item.




| STS | Count | Total | Max | Average |
|---|---|---|---|---|
| loadPrd | 1931 | 0 | 0 | 0 |
| stepPrd | 1 | 0 | 0 | 0 |
| PRD_swi | 1931 | 71200064.00 inst | 102572.00 inst | 36872.12 inst |
| KNL_swi | 15453 | 81301080.00 inst | 102764.00 inst | 5261.18 inst |
| audioSwi | 1287 | 2693364.00 inst | 3236.00 inst | 2092.75 inst |
| IDL_busyObj | 635928 | 1217 | 1 | 0.00191374 |

By default, the Statistics View displays all STS objects available. To limit the list of STS objects, right-click on the Statistics View and select Property Page from the pop-up menu. This presents a list of all STS objects. Hold down the control key while selecting the STS object that you wish to observe in the Statistics View. To copy data from the Statistics View, right-click on the Statistics View and select Copy from the pop-up menu. This places the window data in tab-delimited format to the clipboard.

**Note: Updating Task Statistics**

If TSK_deltatime is not called by a task, its STS object is never updated in the Statistics View, even if TSK accumulators are enabled in the RTA Control Panel.

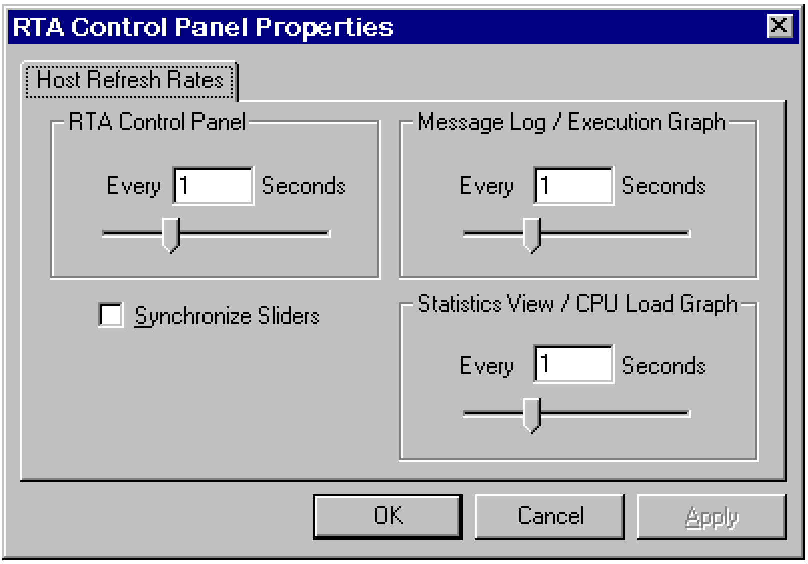
TSK statistics are handled differently than other statistics because TSK functions typically run an infinite loop that blocks when waiting for other threads. In contrast, HWI and SWI functions run to completion without blocking. Because of this difference, DSP/BIOS allows programs to identify the “beginning” of a TSK function’s processing loop by calling TSK_settime and the “end” of the loop by calling TSK_deltatime.

To modify the units of time-based STS objects or to provide unit labels for STS objects that are not time based, select the Units tab from the Statistics View Property Page. Select an STS object from the list of STS objects available. The unit options displayed on the right are the unit options for the selected STS object. If the STS object is high-resolution based, you can choose instruction cycles, microseconds, or milliseconds. If your STS object is low-resolution time based, you can choose interrupts, microseconds, or milliseconds. If your STS object is not time based, you can provide a unit label.

When you run your program, the Statistics View displays the Count, Total, Max and Average statistic values for the STS objects. To pause the display, right-click on this window and choose Pause from the pop-up menu. To reset the values to 0, right-click on this window and choose Clear from the pop-up menu.

You can also control how frequently the host polls the target for statistics information. Right-click on the RTA Control Panel and choose the Property Page to set the refresh rate as seen in Figure 2-8. If you set the refresh rate to 0, the host does not poll the target unless you right-click on the Statistics View window and choose Refresh Window from the pop-up menu

*Figure 2-8. RTA Control Panel Properties Page*




See the *Code Composer Studio* online tutorial for more information on how to monitor statistics with the Statistics View analysis tool.

## STS_add

*Update statistics using the provided value*

### C Interface

**Syntax** STS_add(sts, value);

**Parameters**

```
STS_Handle  sts;     /* statistics object handle */
LgInt       value;   /* new value to update statistics object */
```

**Return Value** Void

### Assembly Interface

**Syntax** STS_add

**Preconditions** ar2 = address of the STS object
a = 32-bit value
sxm = 1

**Postconditions** none

**Modifies** ag, ah, al, ar2, bg, bh, bl, c, ovb

### Assembly Interface

**Syntax** STS_add

**Preconditions** xar0 = address of the STS object;
ac0 = 32-bit value
SXMD = 1

**Postconditions** none

**Modifies** ac1, xar0

**Reentrant** no

**Description** STS_add updates a custom STS object's Total, Count, and Max fields using the data value you provide.

For example, suppose your program passes 32-bit amplitude values to STS_add. The Count field tracks how many times your program calls STS_add for this STS object. The Total field tracks the total of all the amplitudes. The Max field holds the largest value passed to this point. The Statistics View analysis tool calculates the average amplitude.

You can count the occurrences of an event by passing a dummy value (such as 0) to STS_add and watching the Count field.

You can view the statistics values with the Statistics View analysis tool by enabling statistics in the DSP/BIOS→RTA Control Panel window and choosing your custom STS object in the DSP/BIOS→Statistics View window.

**See Also**

STS_delta
STS_reset
STS_set
TRC_disable
TRC_enable

## STS_delta

*Update statistics using the difference between the provided value and the setpoint*

### C Interface

**Syntax** STS_delta(sts,value);

**Parameters**

```
STS_Handle sts;      /* statistics object handle */
LgInt      value;    /* new value to update statistics object */
```

**Return Value** Void

### Assembly Interface

C54x

**Syntax** STS_delta

**Preconditions** ar2 = address of the STS object
a = 32-bit value
sxm = 1

**Postconditions** none

**Modifies** ag, ah, al, ar2, bg, bh, bl, c, ovb

### Assembly Interface

C55x

**Syntax** STS_delta

**Preconditions** xar0 = address of the STS object;
ac0 = 32-bit value
SXMD = 1

**Postconditions** none

**Modifies** ac1, xar0

**Reentrant** no

**Description** Each STS object contains a previous value that can be initialized with the DSP/BIOS Configuration Tool or with a call to STS_set. A call to STS_delta subtracts the previous value from the value it is passed and then invokes STS_add with the result to update the statistics. STS_delta also updates the previous value with the value it is passed.

STS_delta can be used in conjunction with STS_set to monitor the difference between a variable and a desired value or to benchmark program performance.

You can benchmark your code by using paired calls to STS_set and STS_delta that pass the value provided by CLK_gethtime.

```
STS_set(&sts, CLK_gethtime());
  "processing to be benchmarked"
STS_delta(&sts, CLK_gethtime());
```

**Constraints and Calling Context**

- ❏ Before the first call to STS_delta is made, the previous value of the STS object should be initialized either with a call to STS_set or by setting the prev property of the STS object using the DSP/BIOS Configuration Tool.

**Example**

```
STS_set(&sts, targetValue);
  "processing"
STS_delta(&sts, currentValue);
  "processing"
STS_delta(&sts, currentValue);
  "processing"
STS_delta(&sts, currentValue);
```

**See Also**

STS_add
STS_reset
STS_set
CLK_gethtime
CLK_getltime
PRD_getticks
TRC_disable
TRC_enable

## STS_reset

*Reset the values stored in an STS object*

### C Interface

**Syntax** STS_reset(sts);

**Parameters** STS_Handle sts; /* statistics object handle */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** STS_reset

**Preconditions** ar2 = address of the STS object

**Postconditions** none

**Modifies** ag, ah, al, ar2, c

### Assembly Interface

C55x

**Syntax** STS_reset

**Preconditions** xar0 = address of the STS object

**Postconditions** none

**Modifies** xar0, csr

**Reentrant** no

**Description** STS_reset resets the values stored in an STS object. The Count and Total fields are set to 0 and the Max field is set to the largest negative number. STS_reset does not modify the value set by STS_set.

After the Statistics View analysis tool polls statistics data on the target, it performs STS_reset internally. This keeps the 32-bit total and count values from wrapping back to 0 on the target. The host accumulates these values as 64-bit numbers to allow a much larger range than can be stored on the target.

**Example**

```
STS_reset(&sts);
STS_set(&sts, value);
```

**See Also**

STS_add
STS_delta
STS_set
TRC_disable
TRC_enable

## STS_set

*Save a value for STS_delta*

### C Interface

**Syntax**

STS_set(sts, value);

**Parameters**

```
STS_Handle  sts;      /* statistics object handle */
LgInt       value;    /* new value to update statistics object */
```

**Return Value**

Void

### Assembly Interface

**Syntax**

STS_set

**Preconditions**

ar2 = address of the STS object
a = 32-bit value

**Postconditions**

none

**Modifies**

none

### Assembly Interface

**Syntax**

STS_set

**Preconditions**

xar0 = address of the STS object,
ac0 = 32-bit value

**Postconditions**

none

**Modifies**

none

### Reentrant

no

### Description

STS_set can be used in conjunction with STS_delta to monitor the difference between a variable and a desired value or to benchmark program performance. STS_set saves a value as the previous value in an STS object. STS_delta subtracts this saved value from the value it is passed and invokes STS_add with the result.

STS_delta also updates the previous value with the value it was passed. Depending on what you are measuring, you can need to use STS_set to reset the previous value before the next call to STS_delta.

You can also set a previous value for an STS object in the DSP/BIOS Configuration Tool. STS_set changes this value.

See STS_delta for details on how to use the value you set with STS_set.

**Example**

This example gathers performance information for the processing between STS_set and STS_delta.

```
STS_set(&sts, CLK_getltime());
  "processing to be benchmarked"
STS_delta(&sts, CLK_getltime());
```

This example gathers information about a value's deviation from the desired value.

```
STS_set(&sts, targetValue);
   "processing"
STS_delta(&sts, currentValue);
   "processing"
STS_delta(&sts, currentValue);
   "processing"
STS_delta(&sts, currentValue);
```

This example gathers information about a value's difference from a base value.

```
STS_set(&sts, baseValue);
   "processing"
STS_delta(&sts, currentValue);
STS_set(&sts, baseValue);
   "processing"
STS_delta(&sts, currentValue);
STS_set(&sts, baseValue);
```

**See Also**

STS_add
STS_delta
STS_reset
TRC_disable
TRC_enable

## 2.23 SWI Module

The SWI module is the software interrupt manager.

**Functions**

- ❏ SWI_andn. Clear bits from SWI's mailbox; post if becomes 0.
- ❏ SWI_andnHook. Specialized version of SWI_andn for use as hook function for configured DSP/BIOS objects. Both its arguments are of type (Arg).
- ❏ SWI_create. Create a software interrupt.
- ❏ SWI_dec. Decrement SWI's mailbox value; post if becomes 0.
- ❏ SWI_delete. Delete a software interrupt.
- ❏ SWI_disable. Disable software interrupts.
- ❏ SWI_enable. Enable software interrupts.
- ❏ SWI_getattrs. Get attributes of a software interrupt.
- ❏ SWI_getmbox. Return the mailbox value of the SWI when it started running.
- ❏ SWI_getpri. Return a SWI’s priority mask.
- ❏ SWI_inc. Increment SWI's mailbox value and post the SWI.
- ❏ SWI_or. Or mask with value contained in SWI's mailbox field and post the SWI.
- ❏ SWI_orHook. Specialized version of SWI_or for use as hook function for configured DSP/BIOS objects. Both its arguments are of type (Arg).
- ❏ SWI_post. Post a software interrupt.
- ❏ SWI_raisepri. Raise a SWI’s priority.
- ❏ SWI_restorepri. Restore a SWI’s priority.
- ❏ SWI_self. Return address of currently executing SWI object.
- ❏ SWI_setattrs. Set attributes of a software interrupt.

**Constants, Types, and Structures**

```
typedef struct SWI_Obj SWI_Handle;

SWI_MINPRI  = 1;  /* Minimum execution priority */
SWI_MAXPRI = 14   /* Maximum execution priority */
```

```
struct SWI_Attrs {     /* SWI attributes */
   SWI_Fxn  fxn;       /* address of SWI function */
   Arg      arg0;      /* first arg to function */
   Arg      arg1;      /* second arg to function */
#if defined(_54_)
   Bool     iscfxn;    /* C54x only, TRUE if C fxn */
#endif
   Int      priority;  /* Priority of SWI object */
   Uns      mailbox;   /* check for SWI posting */
};

SWI_Attrs SWI_ATTRS = {  /* Default attribute values */
    (SWI_Fxn)FXN_F_nop,      /* SWI function */
    0,                       /* arg0 */
    0,                       /* arg1 */
#if defined(_54_)
    TRUE,                    /* iscfxn */
#endif
    1,                       /* priority */
    0                        /* mailbox */
 };
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the SWI Manager Properties and SWI Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

**Module Configuration Parameters**

| Name | Type | Default |
|---|---|---|
| OBJMEMSEG | Reference | prog.get("IDATA") |

**Instance Configuration Parameters**

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| fxn | Extern | prog.extern("FXN_F_nop") |
| priority | EnumInt | 1 (0 to 14) |
| mailbox | Int16 | 0 |
| arg0 | Arg | 0 |
| arg1 | Arg | 0 |

**Description**

The SWI module manages software interrupt service routines, which are patterned after HWI hardware interrupt service routines.

DSP/BIOS manages four distinct levels of execution threads: hardware interrupt service routines, software interrupt routines, tasks, and background idle functions. A software interrupt is an object that encapsulates a function to be executed and a priority. Software interrupts are prioritized, preempt tasks, and are preempted by hardware interrupt service routines.

**Note:**

SWI functions are called after the processor register state has been saved. SWI functions can be written in C or assembly and must follow the C calling conventions described in the compiler manual.

**Note: RTS Functions Callable from TSK Threads Only**

Many runtime support (RTS) functions use lock and unlock functions to prevent reentrancy. However, DSP/BIOS SWI and HWI threads cannot call LCK_pend and LCK_post. As a result, RTS functions that call LCK_pend or LCK_post *must not be called in the context of a SWI or HWI thread*. For a list or RTS functions that should not be called from a SWI or an HWI function, see “LCK_pend” on page 2-167.

The C++ new operator calls malloc, which in turn calls LCK_pend. As a result, the new operator cannot be used in the context of a SWI or HWI thread.

**Note:**

All processor registers are saved before calling SWI functions. This includes st0, st1, a, b, ar0-ar7, the T registers, bk, brc, rsa, rea, and pmst. The following status register bits are set to 0 before calling the user function: ARP, C16, CMPT, CPL, FRCT, BRAF and OVM. If the function is a C function, specified with a leading underscore in the DSP/BIOS Configuration Tool, CPL is set to 1 before calling the function.

Each software interrupt has a priority level. A software interrupt preempts any lower-priority software interrupt currently executing.

A target program uses an API call to post a SWI object. This causes the SWI module to schedule execution of the software interrupt’s function. When a software interrupt is posted by an API call, the SWI object’s function is not executed immediately. Instead, the function is scheduled for execution. DSP/BIOS uses the software interrupt's priority to determine whether to preempt the thread currently running. Note that if a software interrupt is posted several times before it begins running, (because HWIs and higher priority interrupts are running,) when the software interrupt does eventually run, it will run only one time.

Software interrupts can be posted for execution with a call to SWI_post or a number of other SWI functions. Each SWI object has a 16-bit mailbox which is used either to determine whether to post the software interrupt or as a value that can be evaluated within the software interrupt's function. SWI_andn and SWI_dec post the software interrupt if the mailbox value transitions to 0. SWI_or and SWI_inc also modify the mailbox value. (SWI_or sets bits, and SWI_andn clears bits.)

| | Treat mailbox as bitmask | Treat mailbox as counter | Does not modify mailbox |
|---|---|---|---|
| Always post | SWI_or | SWI_inc | SWI_post |
| Post if becomes 0 | SWI_andn | SWI_dec | |

The SWI_disable and SWI_enable operations allow you to post several software interrupts and enable them all for execution at the same time. The software interrupt priorities then determine which software interrupt runs first.

All software interrupts run to completion; you cannot suspend a software interrupt while it waits for something (for example, a device) to be ready. So, you can use the mailbox to tell the software interrupt when all the devices and other conditions it relies on are ready. Within a software interrupt processing function, a call to SWI_getmbox returns the value of the mailbox when the software interrupt started running. Note that the mailbox is automatically reset to its original value when a software interrupt runs; however, SWI_getmbox will return the saved mailbox value from when the SWI started execution.

Software interrupts can have up to 15 priority levels. The highest level is SWI_MAXPRI (14). The lowest is SWI_MINPRI (0). The priority level of 0 is reserved for the KNL_swi object, which runs the task (TSK) scheduler.

A software interrupt preempts any currently running software interrupt with a lower priority. If two software interrupts with the same priority level have been posted, the software interrupt that was posted first runs first. Hardware interrupts in turn preempt any currently running software interrupt, allowing the target to respond quickly to hardware peripherals. For information about setting software interrupt priorities, choose Help–>Help Topics in the DSP/BIOS Configuration Tool, and type priority in the Index tab.

Interrupt threads (including hardware interrupts and software interrupts) are all executed using the same stack. A context switch is performed when a new thread is added to the top of the stack. The SWI module automatically saves the processor's registers before running a higher-priority software interrupt that preempts a lower-priority software interrupt. After the higher-priority software interrupt finishes running, the registers are restored and the lower-priority software interrupt can run if no other higher-priority software interrupts have been posted. (A separate task stack is used by each task thread.)

See the *Code Composer Studio* online tutorial for more information on how to post software interrupts and scheduling issues for the Software Interrupt manager.

**SWI Manager Properties**

The following global property can be set for the SWI module in the SWI Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **Object Memory**. The memory segment that contains the SWI objects.

  TextConf Name: OBJMEMSEG Type: Reference

  Example: `SWI.OBJMEMSEG = prog.get("myMEM");`

**SWI Object Properties**

To create a SWI object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var mySwi = SWI.create("mySwi");
```

If you cannot create a new SWI object (an error occurs or the Insert SWI item is inactive in the Configuration Tool), try increasing the Stack Size property in the MEM Manager Properties dialog before adding a SWI object or a SWI priority level.

The following properties can be set for a SWI object in the SWI Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

- **comment**. Type a comment to identify this SWI object.

  TextConf Name: comment Type: String

  Example: `mySwi.comment = "my SWI";`

- **function**. The function to execute.

If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. (The DSP/BIOS Configuration Tool generates assembly code, which must use leading underscores when referencing C functions or labels.) If you are using TextConf scripts, do not add an underscore, because TextConf adds the underscore internally.

TextConf Name: fxn Type: Extern

Example: `mySwi.fxn = prog.extern("swiFxn");`

- **priority**. This field shows the numeric priority level for this SWI object. Software interrupts can have up to 15 priority levels. The highest level is SWI_MAXPRI (14). The lowest is SWI_MINPRI (0). The priority level of 0 is reserved for the KNL_swi object, which runs the task scheduler. Instead of typing a number in the DSP/BIOS Configuration Tool, you change the relative priority levels of SWI objects by dragging the objects in the ordered collection view.

  TextConf Name: priority Type: EnumInt

  Options: 0 to 14

  Example: `mySwi.priority = 1;`

- **mailbox**. The initial value of the 16-bit word used to determine if this software interrupt should be posted.

  TextConf Name: mailbox Type: Int16

  Example: `mySwi.mailbox = 7;`

- **arg0, arg1**. Two arbitrary pointer type (Arg) arguments to the above configured user function.

  TextConf Name: arg0 Type: Arg

  TextConf Name: arg1 Type: Arg

  Example: `mySwi.arg0 = 0;`

**SWI - Code Composer Studio Interface**

The SWI tab of the Kernel/Object View shows information about software interrupt objects.

To enable SWI logging, choose DSP/BIOS→RTA Control Panel and put a check in the appropriate box. To view a graph of activity that includes SWI function execution, choose DSP/BIOS→Execution Graph.

You can also enable SWI accumulators in the RTA Control Panel. Then you can choose DSP/BIOS→Statistics View, which lets you select objects for which you want to see statistics. If you choose a SWI object, you see statistics about the number of instruction cycles elapsed from the time the SWI was posted to the SWI function's completion.

**Note:**

Static SWIs have an STS object associated with them, while dynamic SWIs do not. The STS pointer is located in the SWI object structure for static SWIs only. Therefore, they may be accessed by the user and used for STS operations.

## SWI_andn

*Clear bits from SWI's mailbox and post if mailbox becomes 0*

**C Interface**

**Syntax** SWI_andn(swi, mask);

**Parameters**

```
SWI_Handle  swi;     /* SWI object handle*/
Uns         mask     /* inverse value to be ANDed */
```

**Return Value** Void

**Assembly Interface**

C54x

**Syntax** SWI_andn

**Preconditions**
cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
al = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

**Assembly Interface**

C55x

**Syntax** SWI_andn

**Preconditions**
xar0 = address of the SWI object
t0 = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

**Reentrant** yes

**Description** SWI_andn is used to conditionally post a software interrupt. SWI_andn clears the bits specified by a mask from SWI's internal mailbox. If SWI's mailbox becomes 0, SWI_andn posts the software interrupt. The bitwise logical operation performed is:

```
mailbox = mailbox AND (NOT MASK)
```

For example, if multiple conditions that all be met before a software interrupt can run, you should use a different bit in the mailbox for each condition. When a condition is met, clear the bit for that condition.

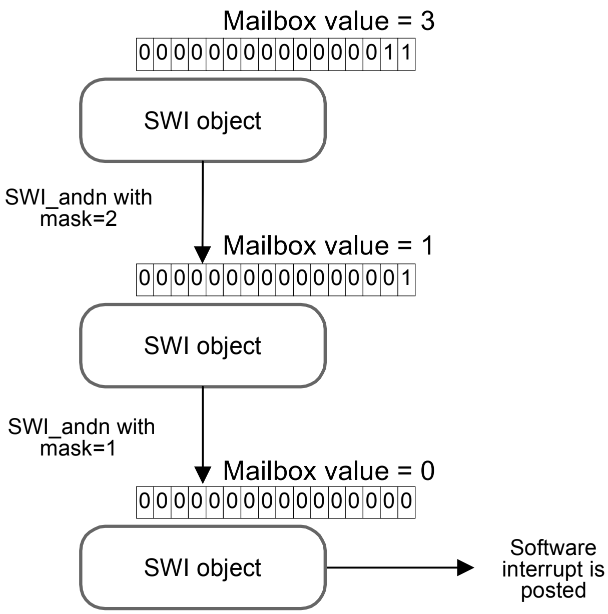
SWI_andn results in a context switch if the SWI's mailbox becomes zero and the SWI has higher priority than the currently executing thread.

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes.

**Note:**

Use the specialized version, SWI_andnHook, when SWI_andn functionality is required for a DSP/BIOS object hook function.

The following figure shows an example of how a mailbox with an initial value of 3 can be cleared by two calls to SWI_andn with values of 2 and 1. The entire mailbox could also be cleared with a single call to SWI_andn with a value of 3.




**Constraints and Calling Context**

❏ If this function is invoked outside the context of an interrupt service routine, interrupts must be enabled.

- ❑ When called within an HWI ISR, the code sequence calling SWI_andn must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

```
/* ======== ioReady ======== */

   Void ioReady(unsigned int mask)
   {
      /* clear bits of "ready mask" */
      SWI_andn(&copySWI, mask);
   }
```

**See Also**

SWI_andnHook
SWI_dec
SWI_getmbox
SWI_inc
SWI_or
SWI_orHook
SWI_post
SWI_self

## SWI_andnHook

*Clear bits from SWI's mailbox and post if mailbox becomes 0*

### C Interface

**Syntax** SWI_andnHook(swi, mask);

**Parameters**

| | | |
|---|---|---|
| Arg | swi; | /* SWI object handle*/ |
| Arg | mask | /* value to be ANDed */ |

**Return Value** Void

### Assembly Interface

C54x

**Syntax** SWI_andnHook

**Preconditions**
cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
al = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface

C55x

**Syntax** SWI_andn

**Preconditions**
xar0 = address of the SWI object
t0 = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

### Reentrant

yes

### Description

SWI_andnHook is a specialized version of SWI_andn for use as hook function for configured DSP/BIOS objects. SWI_andnHook clears the bits specified by a mask from SWI's internal mailbox and also moves the arguments to the correct registers for proper interface with low level DSP/BIOS assembly code. If SWI's mailbox becomes 0, SWI_andnHook posts the software interrupt. The bitwise logical operation performed is:

```
mailbox = mailbox AND (NOT MASK)
```

For example, if there are multiple conditions that must all be met before a software interrupt can run, you should use a different bit in the mailbox for each condition. When a condition is met, clear the bit for that condition.

SWI_andnHook results in a context switch if the SWI's mailbox becomes zero and the SWI has higher priority than the currently executing thread.

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes.

**Constraints and Calling Context**

- If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.
- When called within an HWI ISR, the code sequence calling SWI_andnHook must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

```
/* ======== ioReady ======== */

   Void ioReady(unsigned int mask)
   {
      /* clear bits of "ready mask" */
      SWI_andnHook(&copySWI, mask);
   }
```

**See Also**

SWI_andn
SWI_dec
SWI_getmbox
SWI_inc
SWI_or
SWI_orHook
SWI_post
SWI_self

## SWI_create

*Create a software interrupt*

### C Interface

**Syntax** swi = SWI_create(attrs);

**Parameters** SWI_Attrs *attrs; /* pointer to swi attributes */

**Return Value** SWI_Handle swi; /* handle for new swi object */

### Assembly Interface

none

### Description

SWI_create creates a new SWI object. If successful, SWI_create returns the handle of the new SWI object. If unsuccessful, SWI_create returns NULL unless it aborts. For example, SWI_create can abort if it directly or indirectly calls SYS_error, and SYS_error is configured to abort.

The attrs parameter, which can be either NULL or a pointer to a structure that contains attributes for the object to be created, facilitates setting the SWI object's attributes. The SWI object's attributes are specified through a structure of type SWI_attrs defined as follows:

```
struct SWI_Attrs {
   SWI_Fxn  fxn;
   Arg      arg0;
   Arg      arg1;
   Bool     iscfxn; /* C54x only */
   Int      priority;
   Uns      mailbox;
};
```

If attrs is NULL, the new SWI object is assigned the following default attributes.

```
SWI_Attrs SWI_ATTRS = {  /* Default attribute values */
    (SWI_Fxn)FXN_F_nop,      /* SWI function */
    0,                       /* arg0 */
    0,                       /* arg1 */
    TRUE,                    /* iscfxn, C54x only */
    1,                       /* priority */
    0                        /* mailbox */
 };
```

The fxn attribute, which is the address of the SWI function, serves as the entry point of the software interrupt service routine.

The arg0 and arg1 attributes specify the arguments passed to the SWI function, fxn.

The iscfxn attribute (used for C54x only) must be TRUE if the fxn attribute references a C function (or an assembly function that expects the C run-time environment). This causes the C preconditions to be applied by the SWI scheduler before calling fxn.

The priority attribute specifies the SWI object's execution priority and must range from 0 to 14. The highest level is SWI_MAXPRI (14). The lowest is SWI_MINPRI (0). The priority level of 0 is reserved for the KNL_swi object, which runs the task scheduler.

The mailbox attribute is used either to determine whether to post the SWI or as a value that can be evaluated within the SWI function.

All default attribute values are contained in the constant SWI_ATTRS, which can be assigned to a variable of type SWI_Attrs prior to calling SWI_create.

SWI_create calls MEM_alloc to dynamically create the object's data structure. MEM_alloc must acquire a lock to the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module, page 2–200.

**Constraints and Calling Context**

- SWI_create cannot be called from a SWI or HWI.
- The fxn attribute cannot be NULL.
- The priority attribute must be less than or equal to 14 and greater than or equal to 1.

**See Also**

SWI_delete
SWI_getattrs
SWI_setattrs
SYS_error

## SWI_dec

*Decrement SWI's mailbox value and post if mailbox becomes 0*

### C Interface

**Syntax** SWI_dec(swi);

**Parameters** SWI_Handle swi; /* SWI object handle*/

**Return Value** Void

### Assembly Interface

**Syntax** SWI_dec

**Preconditions**
cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface

**Syntax** SWI_dec

**Preconditions**
xar0 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

### Reentrant

yes

### Description

SWI_dec is used to conditionally post a software interrupt. SWI_dec decrements the value in SWI's mailbox by 1. If SWI's mailbox value becomes 0, SWI_dec posts the software interrupt. You can increment a mailbox value by using SWI_inc, which always posts the software interrupt.

For example, you would use SWI_dec if you wanted to post a software interrupt after a number of occurrences of an event.

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes.

SWI_dec results in a context switch if the SWI's mailbox becomes zero and the SWI has higher priority than the currently executing thread.

**Constraints and Calling Context**

- ❏ If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.
- ❏ When called within an HWI ISR, the code sequence calling SWI_dec must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

```
/* ======== strikeOrBall ======== */

   Void strikeOrBall(unsigned int call)
   {
      if (call == 1) {
         /* initial mailbox value is 3 */
         SWI_dec(&strikeoutSwi);
      }
      if (call == 2) {
         /* initial mailbox value is 4 */
         SWI_dec(&walkSwi);
      }
   }
```

**See Also**

SWI_delete
SWI_getmbox
SWI_inc
SWI_or
SWI_post
SWI_self

## SWI_delete

*Delete a software interrupt*

### C Interface

**Syntax**

SWI_delete(swi);

**Parameters**

SWI_Handle swi; /* SWI object handle */

**Return Value**

Void

### Assembly Interface

none

### Description

SWI_delete uses MEM_free to free the SWI object referenced by swi.

SWI_delete calls MEM_free to delete the SWI object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

### Constraints and Calling Context

- ❏ swi cannot be the currently executing SWI object (SWI_self)
- ❏ SWI_delete cannot be called from a SWI or HWI.
- ❏ SWI_delete must not be used to delete a statically-created SWI object. No check is performed to prevent SWI_delete from being used on a statically-created object. If a program attempts to delete a SWI object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

### See Also

SWI_create
SWI_getattrs
SWI_setattrs
SYS_error

## SWI_disable

*Disable software interrupts*

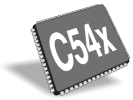
### C Interface

**Syntax** SWI_disable();

**Parameters** Void

**Return Value** Void

### Assembly Interface



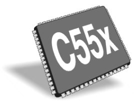

**Syntax** SWI_disable

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** none

**Modifies** c

### Assembly Interface




**Syntax** SWI_disable

**Preconditions** intm = 0

**Postconditions** none

**Modifies** none

### Reentrant

yes

### Description

SWI_disable and SWI_enable control SWI software interrupt processing. SWI_disable disables all other SWI functions from running until SWI_enable is called. Hardware interrupts can still run.

SWI_disable and SWI_enable allow you to ensure that statements that must be performed together during critical processing are not interrupted. In the following example, the critical section is not preempted by any software interrupts.

```
SWI_disable();
   `critical section`
SWI_enable();
```

You can also use SWI_disable and SWI_enable to post several software interrupts and allow them to be performed in priority order. See the example that follows.

SWI_disable calls can be nested. The number of nesting levels is stored internally. Software interrupt handling is not reenabled until SWI_enable has been called as many times as SWI_disable.

**Constraints and Calling Context**

- ❏ The calls to HWI_enter and HWI_exit required in any hardware ISRs that schedules software interrupts automatically disable and reenable software interrupt handling. You should not call SWI_disable or SWI_enable within a hardware ISR.
- ❏ SWI_disable cannot be called from the program's main function.

**Example**

```
/* ======== postEm ======== */
   Void postEm
   {
      SWI_disable();

      SWI_post(&encoderSwi);
      SWI_andn(&copySwi, mask);
      SWI_dec(&strikeoutSwi);

      SWI_enable();
   }
```

**See Also**

HWI_disable
HWI_enable
SWI_enable

## SWI_enable

*Enable software interrupts*

### C Interface

**Syntax** SWI_enable();

**Parameters** Void

**Return Value** Void

### Assembly Interface

C54x

**Syntax** SWI_enable

**Preconditions** can only be called if SWI_disable was called before
cpl = 0
dp = GBL_A_SYSPAGE
intm = 0 (interrupts globally enabled)

**Postconditions** none

**Modifies** ag, ah, al, c

### Assembly Interface

C55x

**Syntax** SWI_enable

**Preconditions** can only be called if SWI_disable was called before
intm = 0 (interrupts globally enabled)

**Postconditions** none

**Modifies** tc!, xar1, t0, intm

**Reentrant** yes

**Description** SWI_disable and SWI_enable control SWI software interrupt processing. SWI_disable disables all other software interrupt functions from running until SWI_enable is called. Hardware interrupts can still run. See the SWI_disable section for details.

SWI_disable calls can be nested. The number of nesting levels is stored internally. Software interrupt handling is not be reenabled until SWI_enable has been called as many times as SWI_disable.

SWI_enable results in a context switch if a higher-priority SWI is ready to run.

**Constraints and Calling Context**

- ❏ The calls to HWI_enter and HWI_exit required in any hardware ISRs that schedules software interrupts automatically disable and reenable software interrupt handling. You should not call SWI_disable or SWI_enable within a hardware ISR.
- ❏ SWI_enable cannot be called from the program's main function.

**See Also**

HWI_disable
HWI_enable
SWI_disable

## SWI_getattrs

*Get attributes of a software interrupt*

### C Interface

**Syntax**

SWI_getattrs(swi, attrs);

**Parameters**

```
SWI_Handle  swi;      /* handle of the swi */
SWI_Attrs   *attrs;   /* pointer to swi attributes */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SWI_getattrs retrieves attributes of an existing SWI object.

The swi parameter specifies the address of the SWI object whose attributes are to be retrieved. The attrs parameter, which is the pointer to a structure that contains the retrieved attributes for the SWI object, facilitates retrieval of the attributes of the SWI object.

The SWI object's attributes are specified through a structure of type SWI_attrs defined as follows:

```
struct SWI_Attrs {
   SWI_Fxn  fxn;
   Arg      arg0;
   Arg      arg1;
   Bool     iscfxn; /* C54x only */
   Int      priority;
   Uns      mailbox;
};
```

The fxn attribute, which is the address of the SWI function, serves as the entry point of the software interrupt service routine.

The arg0 and arg1 attributes specify the arguments passed to the SWI function, fxn.

The iscfxn attribute (used for C54x only) is TRUE if the fxn attribute references a C function (or an assembly function that expects the C run-time environment).

The priority attribute specifies the SWI object's execution priority and ranges from 0 to 14. The highest level is SWI_MAXPRI (14). The lowest is SWI_MINPRI (0). The priority level of 0 is reserved for the KNL_swi object, which runs the task scheduler.

The mailbox attribute is used either to determine whether to post the SWI or as a value that can be evaluated within the SWI function.

The following example uses SWI_getattrs:

```
extern  SWI_Handle swi;
SWI_Attrs attrs;

SWI_getattrs(swi, &attrs);
attrs.priority = 5;
SWI_setattrs(swi, &attrs);
```

**Constraints and Calling Context**

- ❏ SWI_getattrs cannot be called from a SWI or HWI.
- ❏ The attrs parameter cannot be NULL.

**See Also**

SWI_create
SWI_delete
SWI_setattrs

## SWI_getmbox *Return a SWI's mailbox value*

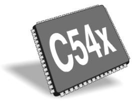
### C Interface

**Syntax** num = Uns SWI_getmbox();

**Parameters** Void

**Return Value** Uns num /* mailbox value */

### Assembly Interface



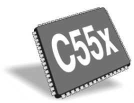

**Syntax** SWI_getmbox

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** al = current software interrupt's mailbox value

**Modifies** ag, ah, al, c

### Assembly Interface




**Syntax** SWI_getmbox

**Preconditions** none

**Postconditions** t0 = current software interrupt's mailbox value

**Modifies** t0

### Reentrant

yes

### Description

SWI_getmbox returns the value that SWI's mailbox had when the software interrupt started running. DSP/BIOS saves the mailbox value internally so that SWI_getmbox can access it at any point within a SWI object's function. DSP/BIOS then automatically resets the mailbox to its initial value (defined with the DSP/BIOS Configuration Tool) so that other threads can continue to use the software interrupt's mailbox.

SWI_getmbox should only be called within a function run by a SWI object.

When called from with the context of a SWI, the value returned by SWI_getmbox is zero if the SWI was posted by a call to SWI_andn, SWI_andnHook, or SWI_dec. Therefore, SWI_getmbox provides relevant information only if the SWI was posted by a call to SWI_inc, SWI_or, SWI_orHook, or SWI_post.

**Constraints and Calling Context**

- ❏ SWI_getmbox cannot be called from the context of an HWI or TSK.
- ❏ SWI_getmbox cannot be called from the program's main function.

**Example**

This call could be used within a SWI object's function to use the mailbox value within the function. For example, if you use SWI_or or SWI_inc to post a software interrupt, different mailbox values can require different processing.

```
swicount = SWI_getmbox();
```

**See Also**

SWI_andn
SWI_andnHook
SWI_dec
SWI_inc
SWI_or
SWI_orHook
SWI_post
SWI_self

## SWI_getpri

*Return a SWI's priority mask*

### C Interface

**Syntax** key = SWI_getpri(swi);

**Parameters** SWI_Handle swi; /* SWI object handle*/

**Return Value** Uns key /* Priority mask of swi */

### Assembly Interface

**Syntax** SWI_getpri

**Preconditions** ar2 = address of the SWI object

**Postconditions** a = SWI object's priority mask

**Modifies** ag, ah, al, c

### Assembly Interface

**Syntax** SWI_getpri

**Preconditions** xar0 = address of the SWI object

**Postconditions** t0 = SWI object's priority mask

**Modifies** t0

**Reentrant** yes

**Description** SWI_getpri returns the priority mask of the SWI passed in as the argument.

**Example**

```
/* Get the priority key of swi1 */
key = SWI_getpri(&swi1);

/* Get the priorities of swi1 and swi3 */
key = SWI_getpri(&swi1) | SWI_getpri(&swi3);
```

**See Also**
SWI_raisepri
SWI_restorepri

## SWI_inc

*Increment SWI's mailbox value and post the SWI*

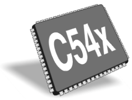
### C Interface

**Syntax** SWI_inc(swi);

**Parameters** SWI_Handle swi; /* SWI object handle*/

**Return Value** Void

### Assembly Interface



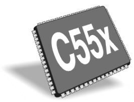

**Syntax** SWI_inc

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface




**Syntax** SWI_inc

**Preconditions** xar0 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

**Reentrant** no

**Description** SWI_inc increments the value in SWI's mailbox by 1 and posts the software interrupt regardless of the resulting mailbox value. You can decrement a mailbox value by using SWI_dec, which only posts the software interrupt if the mailbox value is 0.

If a software interrupt is posted several times before it has a chance to begin executing, because HWIs and higher priority software interrupts are running, the software interrupt only runs one time. If this situation occurs, you can use SWI_inc to post the software interrupt. Within the software interrupt's function, you could then use SWI_getmbox to find out how many times this software interrupt has been posted since the last time it was executed.

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes. To get the mailbox value, use SWI_getmbox.

SWI_inc results in a context switch if the SWI is higher priority than the currently executing thread.

**Constraints and Calling Context**

- ❏ If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.
- ❏ When called within an HWI ISR, the code sequence calling SWI_inc must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**Example**

```
extern SWI_ObjMySwi;
/* ======== AddAndProcess ======== */

   Void AddAndProcess(int count)
   {
      int i;

      for (i = 1; I <= count; ++i)
          SWI_inc(&MySwi);
   }
```

**See Also**

SWI_andn
SWI_dec
SWI_getmbox
SWI_or
SWI_post
SWI_self

## SWI_or

*OR mask with the value contained in SWI's mailbox field*

### C Interface

**Syntax** SWI_or(swi, mask);

**Parameters**

```
SWI_Handle  swi;     /* SWI object handle*/
Uns         mask;    /* value to be ORed */
```

**Return Value** Void

### Assembly Interface

C54x

**Syntax** SWI_or

**Preconditions**

cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
al = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface

C55x

**Syntax** SWI_or

**Preconditions**

xar0 = address of the SWI object
t0 = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

### Reentrant

no

### Description

SWI_or is used to post a software interrupt. SWI_or sets the bits specified by a mask in SWI's mailbox. SWI_or posts the software interrupt regardless of the resulting mailbox value. The bitwise logical operation performed on the mailbox value is:

```
mailbox = mailbox OR mask
```

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes. To get the mailbox value, use SWI_getmbox.

For example, you might use SWI_or to post a software interrupt if any of three events should cause a software interrupt to be executed, but you want the software interrupt's function to be able to tell which event occurred. Each event would correspond to a different bit in the mailbox.

SWI_or results in a context switch if the SWI is higher priority than the currently executing thread.

**Note:**

Use the specialized version, SWI_orHook, when SWI_or functionality is required for a DSP/BIOS object hook function.

**Constraints and Calling Context**

❏ If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.

❏ When called within an HWI ISR, the code sequence calling SWI_or must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**See Also**

SWI_andn
SWI_andnHook
SWI_dec
SWI_getmbox
SWI_inc
SWI_orHook
SWI_post
SWI_self

## SWI_orHook

*OR mask with the value contained in SWI's mailbox field*

### C Interface

**Syntax** SWI_orHook(swi, mask);

**Parameters**

```
Arg     swi;    /* SWI object handle*/
Arg     mask;   /* value to be ORed */
```

**Return Value** Void

### Assembly Interface

C54x

**Syntax** SWI_orHook

**Preconditions**
cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
al = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface

C55x

**Syntax** SWI_orHook

**Preconditions**
xar0 = address of the SWI object
t0 = mask
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

### Reentrant

no

### Description

SWI_orHook is used to post a software interrupt, and should be used when hook functionality is required for DSP/BIOS hook objects. SWI_orHook sets the bits specified by a mask in SWI's mailbox and also moves the arguments to the correct registers for interfacing with low level DSP/BIOS assembly code. SWI_orHook posts the software interrupt regardless of the resulting mailbox value. The bitwise logical operation performed on the mailbox value is:

```
mailbox = mailbox OR mask
```

You specify a software interrupt's initial mailbox value in the DSP/BIOS Configuration Tool. The mailbox value is automatically reset when the software interrupt executes. To get the mailbox value, use SWI_getmbox.

For example, you might use SWI_orHook to post a software interrupt if any of three events should cause a software interrupt to be executed, but you want the software interrupt's function to be able to tell which event occurred. Each event would correspond to a different bit in the mailbox.

SWI_orHook results in a context switch if the SWI is higher priority than the currently executing thread.

**Note:**

Use the specialized version, SWI_orHook, when SWI_or functionality is required for a DSP/BIOS object hook function.

**Constraints and Calling Context**

- If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.
- When called within an HWI ISR, the code sequence calling SWI_orHook must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**See Also**

SWI_andn
SWI_andnHook
SWI_dec
SWI_getmbox
SWI_inc
SWI_or
SWI_post
SWI_self

## SWI_post

*Post a software interrupt*

### C Interface

**Syntax** SWI_post(swi);

**Parameters** SWI_Handle swi; /* SWI object handle*/

**Return Value** Void

### Assembly Interface

C54x

**Syntax** SWI_post

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE
ar2 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** ag, ah, al, ar0, ar2, ar3, ar4, ar5, bg, bh, bl, c, dp, t, tc

### Assembly Interface

C55x

**Syntax** SWI_post

**Preconditions** xar0 = address of the SWI object
intm = 0 (if called outside the context of an ISR)

**Postconditions** none

**Modifies** tc1, tc2, t0, t1, xar0, xar1, xar2, xar3, xar4, ac0, ac1

### Reentrant

yes

### Description

SWI_post is used to post a software interrupt regardless of the mailbox value. No change is made to the SWI object's mailbox value.

To have a PRD object post a SWI object's function, you can set _SWI_post as the function property of a PRD object and the name of the software interrupt object you want to post its function as the arg0 property.

SWI_post results in a context switch if the SWI is higher priority than the currently executing thread.

**Constraints and Calling Context**

- ❏ If this macro (API) is invoked outside the context of an interrupt service routine, interrupts must be enabled.
- ❏ When called within an HWI ISR, the code sequence calling SWI_post must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**See Also**

SWI_andn
SWI_dec
SWI_getmbox
SWI_inc
SWI_or
SWI_self

## SWI_raisepri *Raise a SWI's priority*

### C Interface

**Syntax** key = SWI_raisepri(mask);

**Parameters** Uns mask; /* mask of desired priority level */

**Return Value** Uns key; /* key for use with SWI_restorepri */

### Assembly Interface

**Syntax** SWI_raisepri

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE
a = priority mask of desired priority level

**Postconditions** a = old priority mask

**Modifies** ag, ah, al, bg, bh, bl, c

### Assembly Interface

**Syntax** SWI_raisepri

**Preconditions** t0 = priority mask of desired priority level

**Postconditions** t0 = old priority mask

**Modifies** ac0, t0, t1

### Reentrant

yes

### Description

SWI_raisepri is used to raise the priority of the currently running SWI to the priority mask passed in as the argument. SWI_raisepri can be used in conjunction with SWI_restorepri to provide a mutual exclusion mechanism without disabling software interrupts.

SWI_raisepri should be called before a shared resource is accessed, and SWI_restorepri should be called after the access to the shared resource.

A call to SWI_raisepri not followed by a SWI_restorepri keeps the SWI's priority for the rest of the processing at the raised level. A SWI_post of the SWI posts the SWI at its original priority level.

A SWI object's execution priority must range from 0 to 14. The highest level is SWI_MAXPRI (14). The lowest is SWI_MINPRI (0). Priority zero (0) is reserved for the KNL_swi object, which runs the task scheduler.

SWI_raisepri never lowers the current SWI priority.

**Constraints and Calling Context**

- SWI_raisepri cannot be called from an HWI or TSK level.

**Example**

```
/* raise priority to the priority of swi_1 */
key = SWI_raisepri(SWI_getpri(&swi_1));
---  access shared resource ---
SWI_restore(key);
```

**See Also**

SWI_getpri
SWI_restorepri

## SWI_restorepri *Restore a SWI's priority*

### C Interface

**Syntax** SWI_restorepri(key);

**Parameters** Uns key; /* key to restore original priority level */

**Return Value** Void

### Assembly Interface

**Syntax** SWI_restorepri

**Preconditions**
cpl = 0
dp = GBL_A_SYSPAGE
a = old priority mask
intm = 0
SWI_D_lock < 0
not in an ISR

**Postconditions** none

**Modifies** ag, ah, al, c, intm, tc

### Assembly Interface

**Syntax** SWI_restorepri

**Preconditions**
t0 = old priority mask
intm = 0
SWI_D_lock<0
not in an ISR

**Postconditions** none

**Modifies** t0, intm

**Reentrant** yes

**Description** SWI_restorepri restores the priority to the SWI's priority prior to the SWI_raisepri call returning the key. SWI_restorepri can be used in conjunction with SWI_raisepri to provide a mutual exclusion mechanism without disabling all software interrupts.

SWI_raisepri should be called right before the shared resource is referenced, and SWI_restorepri should be called after the reference to the shared resource.

**Constraints and Calling Context**

- ❑ SWI_restorepri cannot be called from an HWI or TSK level.
- ❑ SWI_restorepri cannot be called from the program's main function.

**Example**

```
/* raise priority to the priority of swi_1 */
key = SWI_raisepri(SWI_getpri(&swi_1));
---  access shared resource ---
SWI_restore(key);
```

**See Also**

SWI_getpri
SWI_raisepri

## SWI_self

*Return address of currently executing SWI object*

### C Interface

**Syntax** curswi = SWI_self();

**Parameters** Void

**Return Value** SWI_Handle swi; /* handle for current swi object */

### Assembly Interface

C54x

**Syntax** SWI_self

**Preconditions** cpl = 0
dp = GBL_A_SYSPAGE

**Postconditions** al = address of the current SWI object

**Modifies** ag, ah, al, c

### Assembly Interface

C55x

**Syntax** SWI_self

**Preconditions** none

**Postconditions** xar0 = address of the current SWI object

**Modifies** xar0

**Reentrant** yes

**Description** SWI_self returns the address of the currently executing software interrupt.

**Constraints and Calling Context**

- ❏ SWI_self cannot be called from an HWI or TSK level.
- ❏ SWI_self cannot be called from the program's main function.

**Example** You can use SWI_self if you want a software interrupt to repost itself:

```
SWI_post(SWI_self());
```

**See Also** SWI_andn
SWI_getmbox
SWI_post

## SWI_setattrs

*Set attributes of a software interrupt*

### C Interface

**Syntax**

SWI_setattrs(swi, attrs);

**Parameters**

```
SWI_Handle  swi;        /* handle of the swi */
SWI_Attrs   *attrs;     /* pointer to swi attributes */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SWI_setattrs sets attributes of an existing SWI object.

The swi parameter specifies the address of the SWI object whose attributes are to be set.

The attrs parameter, which can be either NULL or a pointer to a structure that contains attributes for the SWI object, facilitates setting the attributes of the SWI object. If attrs is NULL, the new SWI object is assigned a default set of attributes. Otherwise, the SWI object's attributes are specified through a structure of type SWI_attrs defined as follows:

```
struct SWI_Attrs {
   SWI_Fxn  fxn;
   Arg      arg0;
   Arg      arg1;
   Bool     iscfxn; /* C54x only */
   Int      priority;
   Uns      mailbox;
};
```

The fxn attribute, which is the address of the swi function, serves as the entry point of the software interrupt service routine.

The arg0 and arg1 attributes specify the arguments passed to the swi function, fxn.

The iscfxn attribute (used for C54x only) must be TRUE if the fxn attribute references a C function (or an assembly function that expects the C run-time environment). This causes the C preconditions to be applied by the SWI scheduler before calling fxn.

The priority attribute specifies the SWI object's execution priority and must range from 1 to 14. Priority 14 is the highest priority. You cannot use a priority of 0; that priority is reserved for the system SWI that runs the TSK scheduler.

The mailbox attribute is used either to determine whether to post the SWI or as a value that can be evaluated within the SWI function.

All default attribute values are contained in the constant SWI_ATTRS, which can be assigned to a variable of type SWI_Attrs prior to calling SWI_setattrs.

The following example uses SWI_setattrs:

```
extern  SWI_Handle swi;
SWI_Attrs attrs;

SWI_getattrs(swi, &attrs);
attrs.priority = 5;
SWI_setattrs(swi, &attrs);
```

**Constraints and Calling Context**

- ❑ SWI_setattrs must not be used to set the attributes of a SWI that is preempted or is ready to run.
- ❑ The fxn attribute cannot be NULL.
- ❑ The priority attribute must be less than or equal to 14 and greater than or equal to 1.

**See Also**

SWI_create
SWI_delete
SWI_getattrs

## 2.24 SYS Module

The SYS modules manages system settings.

**Functions**

- SYS_abort. Abort program execution
- SYS_atexit. Stack an exit handler
- SYS_error. Flag error condition
- SYS_exit. Terminate program execution
- SYS_printf. Formatted output
- SYS_putchar. Output a single character
- SYS_sprintf. Formatted output to string buffer
- SYS_vprintf. Formatted output, variable argument list
- SYS_vsprintf. Output formatted data

**Constants, Types, and Structures**

```
#define SYS_FOREVER  (Uns)-1 /* wait forever */
#define SYS_POLL     (Uns)0  /* don't wait */

#define SYS_OK       0  /* no error */
#define SYS_EALLOC   1  /* memory allocation error */
#define SYS_EFREE    2  /* memory free error */
#define SYS_ENODEV   3  /* device driver not found */
#define SYS_EBUSY    4  /* device driver busy */
#define SYS_EINVAL   5  /* invalid device parameter */
#define SYS_EBADIO   6  /* I/O failure */
#define SYS_EMODE    7  /* bad mode for device driver */
#define SYS_EDOMAIN  8  /* domain error */
#define SYS_ETIMEOUT 9  /* call timed out */
#define SYS_EE0F     10 /* end-of-file */
#define SYS_EDEAD    11 /* previously deleted obj */
#define SYS_EBADOBJ  12 /* invalid object */
#define SYS_EUSER  256  /* user errors start here */


#define SYS_NUMHANDLERS  8 /* # of atexit handlers */

extern String SYS_errors[]; /* array of error strings
*/
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the SYS Manager Properties heading. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| Name | Type | Default |
|---|---|---|
| TRACESIZE | Numeric | 512 |
| TRACESEG | Reference | prog.get("IDATA") |
| ABORTFXN | Extern | prog.extern("UTL_doAbort") |
| ERRORFXN | Extern | prog.extern("UTL_doError") |
| EXITFXN | Extern | prog.extern("UTL_halt") |
| PUTCFXN | Extern | prog.extern("UTL_doPutc") |

### Description

The SYS module makes available a set of general-purpose functions that provide basic system services, such as halting program execution and printing formatted text. In general, each SYS function is patterned after a similar function normally found in the standard C library.

SYS does not directly use the services of any other DSP/BIOS module and therefore resides at the bottom of the system. Other DSP/BIOS modules use the services provided by SYS in lieu of similar C library functions. The SYS module provides hooks for binding system-specific code. This allows programs to gain control wherever other DSP/BIOS modules call one of the SYS functions.

### SYS Manager Properties

The following global properties can be set for the SYS module in the SYS Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script.

- **Trace Buffer Size**. The size of the buffer that contains system trace information. This system trace buffer can be viewed only by looking for the SYS_PUTCBEG symbol in the Code Composer Studio memory view. For example, by default the Putc function writes to the trace buffer.

  TextConf Name: TRACESIZE Type: Numeric

  Example: `SYS.TRACESIZE = 512;`

- **Trace Buffer Memory**. The memory segment that contains system trace information.

  TextConf Name: TRACESEG Type: Reference

  Example: `SYS.TRACESEG = prog.get("myMEM");`

- **Abort Function**. The function to run if the application aborts by calling SYS_abort. The default function is _UTL_doAbort, which logs an error message and calls _halt.

If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name.

TextConf Name: ABORTFXN Type: Extern

Example: `SYS.ABORTFXN = prog.extern("abort");`

- **Error Function**. The function to run if an error flagged by SYS_error occurs. The default function is _UTL_doError, which logs an error message and returns. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name.

  TextConf Name: ERRORFXN Type: Extern

  Example: `SYS.ERRORFXN = prog.extern("error");`

- **Exit Function**. The function to run when the application exits by calling SYS_exit. The default function is UTL_halt, which loops forever with interrupts disabled and prevents other processing. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name.

  TextConf Name: EXITFXN Type: Extern

  Example: `SYS.EXITFXN = prog.extern("exit");`

- **Putc Function**. The function to run if the application calls SYS_putchar, SYS_printf, or SYS_vprintf. The default function is _UTL_doPutc, which writes a character to the system trace buffer. This system trace buffer can be viewed only by looking for the SYS_PUTCBEG symbol in the Code Composer Studio memory view. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name.

  TextConf Name: PUTCFXN Type: Extern

  Example: `SYS.PUTCFXN = prog.extern("myPutc");`

**SYS Object Properties** The SYS module does not support the creation of individual SYS objects.

## SYS_abort

*Abort program execution*

**C Interface**

**Syntax**

SYS_abort(format, [arg,] ...);

**Parameters**

```
String    format;   /* format specification string */
Arg       arg;      /* optional argument */
```

**Return Value**

Void

**Assembly Interface**

none

**Description**

SYS_abort aborts program execution by calling the function bound to the configuration parameter Abort function, where vargs is of type va_list and represents the sequence of arg parameters originally passed to SYS_abort.

```
(*(Abort_function))(format, vargs)
```

The function bound to Abort function can elect to pass the format and vargs parameters directly to SYS_vprintf or SYS_vsprintf prior to terminating program execution.

The default Abort function for the SYS manager is _UTL_doAbort, which logs an error message and calls UTL _halt, which is defined in the boot.c file. The UTL_halt function performs an infinite loop with all processor interrupts disabled.

**Constraints and Calling Context**

- ❏ If the function bound to Abort function is not reentrant, SYS_abort must be called atomically.

**See Also**

SYS_exit
SYS_printf

## SYS_atexit

*Stack an exit handler*

### C Interface

**Syntax** success = SYS_atexit(handler);

**Parameters** Fxn handler /* exit handler function */

**Return Value** Bool success /* handler successfully stacked */

### Assembly Interface

none

### Description

SYS_atexit pushes handler onto an internal stack of functions to be executed when SYS_exit is called. Up to SYS_NUMHANDLERS(8) functions can be specified in this manner. SYS_exit pops the internal stack until empty and calls each function as follows, where status is the parameter passed to SYS_exit:

```
(*handler)(status)
```

SYS_atexit returns TRUE if handler has been successfully stacked; FALSE if the internal stack is full.

The handlers on the stack are called only if either of the following happens:

- ❏ SYS_exit is called.
- ❏ All tasks for which the Don’t shut down system while this task is still running property is TRUE have exited. (By default, this includes the TSK_idle task, which manages communication between the target and analysis tools.)

### Constraints and Calling Context

- ❏ handler cannot be NULL.

## SYS_error

*Flag error condition*

### C Interface

**Syntax**

SYS_error(s, errno, [arg], ...);

**Parameters**

```
String  s;      /* error string */
Int     errno;  /* error code */
Arg     arg;    /* optional argument */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SYS_error is used to flag DSP/BIOS error conditions. Application programs as well as internal functions use SYS_error to handle program errors.

SYS_error calls the function bound to Error function to handle errors.

The default Error function for the SYS manager is _UTL_doError, which logs an error message and returns.

### Constraints and Calling Context

- The only valid error numbers are the error constants defined in sys.h (SYS_E*) or numbers greater than or equal to SYS_EUSER. Passing any other error values to SYS_error can cause DSP/BIOS to crash.

## SYS_exit

*Terminate program execution*

### C Interface

**Syntax** SYS_exit(status);

**Parameters** Int status; /* termination status code */

**Return Value** Void

### Assembly Interface

none

### Description

SYS_exit first pops a stack of handlers registered through the function SYS_atexit, and then terminates program execution by calling the function bound to the configuration parameter Exit function, passing on its original status parameter.

```
(*handlerN)(status)
     ...
(*handler2)(status)
(*handler1)(status)

(*(Exit_function))(status)
```

The default Exit function for the SYS manager is UTL_halt, which performs an infinite loop with all processor interrupts disabled.

### Constraints and Calling Context

- If the function bound to Exit function or any of the handler functions is not reentrant, SYS_exit must be called atomically.

### See Also

SYS_abort
SYS_atexit

## SYS_printf

*Output formatted data*

### C Interface

**Syntax**

SYS_printf(format, [arg,] ...);

**Parameters**

| | | |
|---|---|---|
| String | format; | /* format specification string */ |
| Arg | arg; | /* optional argument */ |

**Return Value**

Void

### Assembly Interface

none

### Description

SYS_printf provides a subset of the capabilities found in the standard C library function printf.

> **Note:**
>
> SYS_printf and the related functions are code-intensive. If possible, applications should use the LOG Module functions to reduce code size and execution time.

Conversion specifications begin with a % and end with a conversion character. The conversion characters recognized by SYS_printf are limited to the characters shown in Table 2-6.

*Table 2-6. Conversion Characters Recognized by SYS_printf*

| Character | Corresponding Output Format |
|---|---|
| d | signed decimal integer |
| u | unsigned decimal integer |
| f | decimal floating point |
| o | octal integer |
| x | hexadecimal integer |
| c | single character |
| s | NULL-terminated string |
| p | data pointer |

Between the % and the conversion character, the following symbols or specifiers contained in square brackets can appear, in the order shown.

```
%[-][0][width]type
```

A dash (-) symbol causes the converted argument to be left-justified within a field of width characters with blanks following. A 0 (zero) causes the converted argument to be right-justified within a field of size width with leading 0s. If neither a dash nor 0 are given, the converted argument is right-justified in a field of size width, with leading blanks. The width is a decimal integer. The converted argument is not modified if it has more than width characters, or if width is not given.

The length modifier l can precede %d, %u, %o, and %x if the corresponding argument is a long integer.

SYS_vprintf is equivalent to SYS_printf, except that the optional set of arguments is replaced by a va_list on which the standard C macro va_start has already been applied. SYS_sprintf and SYS_vsprintf are counterparts of SYS_printf and SYS_vprintf, respectively, in which output is placed in a specified buffer.

Both SYS_printf and SYS_vprintf internally call the function SYS_putchar to output individual characters via the Putc function configured in the SYS Manager Properties. The default Putc function is _UTL_doPutc, which writes a character to the system trace buffer. The size and memory segment for the system trace buffer can also be set in the SYS Manager Properties. This system trace buffer can be viewed only by looking for the SYS_PUTCBEG symbol in the Code Composer Studio memory view.

**Constraints and Calling Context**

- The function bound to Exit function or any of the handler functions are not reentrant; SYS_exit must be called atomically.

**See Also**

SYS_sprintf
SYS_vprintf
SYS_vsprintf

# SYS_sprintf

*Output formatted data*

## C Interface

### Syntax

SYS_sprintf (buffer, format, [arg,] ...);

### Parameters

```
String    buffer;   /* output buffer */
String    format;   /* format specification string */
Arg       arg;      /* optional argument */
```

### Return Value

Void

## Assembly Interface

none

## Description

SYS_sprintf provides a subset of the capabilities found in the standard C library function printf.

**Note:**

SYS_sprintf and the related functions are code-intensive. If possible, applications should use LOG Module module functions to reduce code size and execution time.

Conversion specifications begin with a % and end with a conversion character. The conversion characters recognized by SYS_sprintf are limited to the characters in Table 2-7.

*Table 2-7. Conversion Characters Recognized by SYS_sprintf*

| Character | Corresponding Output Format |
|---|---|
| d | signed decimal integer |
| u | unsigned decimal integer |
| f | decimal floating point |
| o | octal integer |
| x | hexadecimal integer |
| c | single character |
| s | NULL-terminated string |
| p | data pointer |

Between the % and the conversion character, the following symbols or specifiers contained within square brackets can appear, in the order shown.

```
%[-][0][width]type
```

A dash (-) symbol causes the converted argument to be left-justified within a field of width characters with blanks following. A 0 (zero) causes the converted argument to be right-justified within a field of size width with leading 0s. If neither a dash nor 0 are given, the converted argument is right-justified in a field of size width, with leading blanks. The width is a decimal integer. The converted argument is not modified if it has more than width characters, or if width is not given.

The length modifier l can precede %d, %u, %o, and %x if the corresponding argument is a long integer.

SYS_vprintf is equivalent to SYS_printf, except that the optional set of arguments is replaced by a va_list on which the standard C macro va_start has already been applied. SYS_sprintf and SYS_vsprintf are counterparts of SYS_printf and SYS_vprintf, respectively, in which output is placed in a specified buffer.

Both SYS_printf and SYS_vprintf internally call the function SYS_putchar to output individual characters in a system-dependent fashion via the configuration parameter Putc function. This parameter is bound to a function that displays output on a debugger if one is running, or places output in an output buffer between PUTCEND and PUTCBEG.

**Constraints and Calling Context**

❏ The function bound to Exit function or any of the handler functions are not reentrant; SYS_exit must be called atomically.

**See Also**

SYS_printf
SYS_vprintf
SYS_vsprintf

## SYS_vprintf

*Output formatted data*

### C Interface

**Syntax**

SYS_vprintf(format, vargs);

**Parameters**

```
String    format;  /* format specification string */
va_list   vargs;   /* variable argument list reference */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SYS_vprintf provides a subset of the capabilities found in the standard C library function printf.

> **Note:**
>
> SYS_vprintf and the related functions are code-intensive. If possible, applications should use LOG Module functions to reduce code size and execution time.

Conversion specifications begin with a % and end with a conversion character. The conversion characters recognized by SYS_vprintf are limited to the characters in Table 2-8.

*Table 2-8. Conversion Characters Recognized by SYS_vprintf*

| Character | Corresponding Output Format |
|---|---|
| d | signed decimal integer |
| u | unsigned decimal integer |
| f | decimal floating point |
| o | octal integer |
| x | hexadecimal integer |
| c | single character |
| s | NULL-terminated string |
| p | data pointer |

Between the % and the conversion character, the following symbols or specifiers contained within square brackets can appear, in the order shown.

```
%[-][0][width]type
```

A dash (-) symbol causes the converted argument to be left-justified within a field of width characters with blanks following. A 0 (zero) causes the converted argument to be right-justified within a field of size width with leading 0s. If neither a dash nor 0 are given, the converted argument is right-justified in a field of size width, with leading blanks. The width is a decimal integer. The converted argument is not modified if it has more than width characters, or if width is not given.

The length modifier l can precede %d, %u, %o, and %x if the corresponding argument is a long integer.

SYS_vprintf is equivalent to SYS_printf, except that the optional set of arguments is replaced by a va_list on which the standard C macro va_start has already been applied. SYS_sprintf and SYS_vsprintf are counterparts of SYS_printf and SYS_vprintf, respectively, in which output is placed in a specified buffer.

Both SYS_printf and SYS_vprintf internally call the function SYS_putchar to output individual characters via the Putc function configured in the SYS Manager Properties. The default Putc function is _UTL_doPutc, which writes a character to the system trace buffer. The size and memory segment for the system trace buffer can also be set in the SYS Manager Properties. This system trace buffer can be viewed only by looking for the SYS_PUTCBEG symbol in the Code Composer Studio memory view.

**Constraints and Calling Context**

❏ The function bound to Exit function or any of the handler functions are not reentrant; SYS_exit must be called atomically.

**See Also**

SYS_printf
SYS_sprintf
SYS_vsprintf

## SYS_vsprintf

*Output formatted data*

### C Interface

**Syntax**

SYS_vsprintf(buffer, format, vargs);

**Parameters**

```
String    buffer;   /* output buffer */
String    format;   /* format specification string */
va_list   vargs;    /* variable argument list reference */
```

**Return Value**

Void

### Assembly Interface

none

### Description

SYS_vsprintf provides a subset of the capabilities found in the standard C library function printf.

**Note:**

SYS_vsprintf and the related functions are code-intensive. If possible, applications should use LOG Module functions to reduce code size and execution time.

Conversion specifications begin with a % and end with a conversion character. The conversion characters recognized by SYS_vsprintf are limited to the characters in Table 2-9.

*Table 2-9. Conversion Characters Recognized by SYS_vsprintf*

| Character | Corresponding Output Format |
|---|---|
| d | signed decimal integer |
| u | unsigned decimal integer |
| f | decimal floating point |
| o | octal integer |
| x | hexadecimal integer |
| c | single character |
| s | NULL-terminated string |
| p | data pointer |

Between the % and the conversion character, the following symbols or specifiers contained within square brackets can appear, in the order shown.

`%[-][0][width]type`

A dash (-) symbol causes the converted argument to be left-justified within a field of width characters with blanks following. A 0 (zero) causes the converted argument to be right-justified within a field of size width with leading 0s. If neither a dash nor 0 are given, the converted argument is right-justified in a field of size width, with leading blanks. The width is a decimal integer. The converted argument is not modified if it has more than width characters, or if width is not given.

The length modifier l can precede %d, %u, %o, and %x if the corresponding argument is a long integer.

SYS_vprintf is equivalent to SYS_printf, except that the optional set of arguments is replaced by a va_list on which the standard C macro va_start has already been applied. SYS_sprintf and SYS_vsprintf are counterparts of SYS_printf and SYS_vprintf, respectively, in which output is placed in a specified buffer.

Both SYS_printf and SYS_vprintf internally call the function SYS_putchar to output individual characters in a system-dependent fashion via the configuration parameter Putc function. This parameter is bound to a function that displays output on a debugger if one is running, or places output in an output buffer between PUTCEND and PUTCBEG.

**Constraints and Calling Context**

❑ The function bound to Exit function or any of the handler functions are not reentrant; SYS_exit must be called atomically.

**See Also**

SYS_printf
SYS_sprintf
SYS_vprintf

## SYS_putchar

*Output a single character*

**C Interface**

**Syntax** SYS_putchar(c);

**Parameters** Char c; /* next output character */

**Return Value** Void

**Assembly Interface** none

**Description** SYS_putchar outputs the character c by calling the system-dependent function bound to the configuration parameter Putc function.

```
((Putc function))(c)
```

For systems with limited I/O capabilities, the function bound to Putc function might simply place c into a global buffer that can be examined after program termination.

The default Putc function for the SYS manager is _UTL_doPutc, which writes a character to the system trace buffer. The size and memory segment for the system trace buffer can be set in the SYS Manager Properties. This system trace buffer can be viewed only by looking for the SYS_PUTCBEG symbol in the Code Composer Studio memory view.

SYS_putchar is also used internally by SYS_printf and SYS_vprintf when generating their output.

**Constraints and Calling Context**

- ❏ If the function bound to Putc function is not reentrant, SYS_putchar must be called atomically.

**See Also** SYS_printf

## 2.25 TRC Module

The TRC module is the trace manager.

**Functions**

- ❏ TRC_disable. Disable trace class(es)
- ❏ TRC_enable. Enable trace type(s)
- ❏ TRC_query. Query trace class(es)

**Description**

The TRC module manages a set of trace control bits which control the real-time capture of program information through event logs and statistics accumulators. For greater efficiency, the target does not store log or statistics information unless tracing is enabled.

Table 2-10 lists events and statistics that can be traced. The constants defined in trc.h, trc.h54, and trc.h55 are shown in the left column.

*Table 2-10. Events and Statistics Traced by TRC*

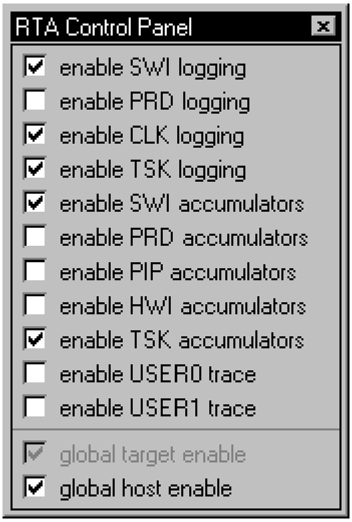
| Constant | Tracing Enabled/Disabled | Default |
|---|---|---|
| TRC_LOGCLK | Log timer interrupts | off |
| TRC_LOGPRD | Log periodic ticks and start of periodic functions | off |
| TRC_LOGSWI | Log events when a software interrupt is posted and completes | off |
| TRC_LOGTSK | Log events when a task is made ready, starts, becomes blocked, resumes | off |
| TRC_STSHWI | Gather statistics on monitored values within HWIs | off |
| TRC_STSPIP | Count number of frames read from or written to data pipe | off |
| TRC_STSPRD | Gather statistics on number of ticks elapsed during execution | off |
| TRC_STSSWI | Gather statistics on length of SWI execution | off |
| TRC_STSTSK | Gather statistics on length of TSK execution. Statistics are gathered from the time TSK is made ready to run until the application calls TSK_deltatime. | off |
| TRC_USER0 and TRC_USER1 | Your program can use these bits to enable or disable sets of explicit instrumentation actions. You can use TRC_query to check the settings of these bits and either perform or omit instrumentation calls based on the result. | off |
| TRC_GBLHOST | This bit must be set in order for any implicit instrumentation to be performed. Simultaneously starts or stops gathering of all enabled types of tracing. This can be important if you are trying to correlate events of different types. This | off |
| TRC_GBLTARG | This bit must also be set for any implicit instrumentation to be performed. This bit can only be set by the target program and is enabled by default. | on |
| TRC_STSSWI | Gather statistics on length of SWI execution | off |

All trace constants except TRC_GBLTARG are switched off initially. To enable tracing you can use calls to TRC_enable or the DSP/BIOS→RTA Control Panel, which uses the TRC module internally. You do not need to enable tracing for messages written with LOG_printf or LOG_event and statistics added with STS_add or STS_delta.

Your program can call the TRC_enable and TRC_disable operations to explicitly start and stop event logging or statistics accumulation in response to conditions encountered during real-time execution. This enables you to preserve the specific log or statistics information you need to see.

**TRC - Code Composer Studio Interface**

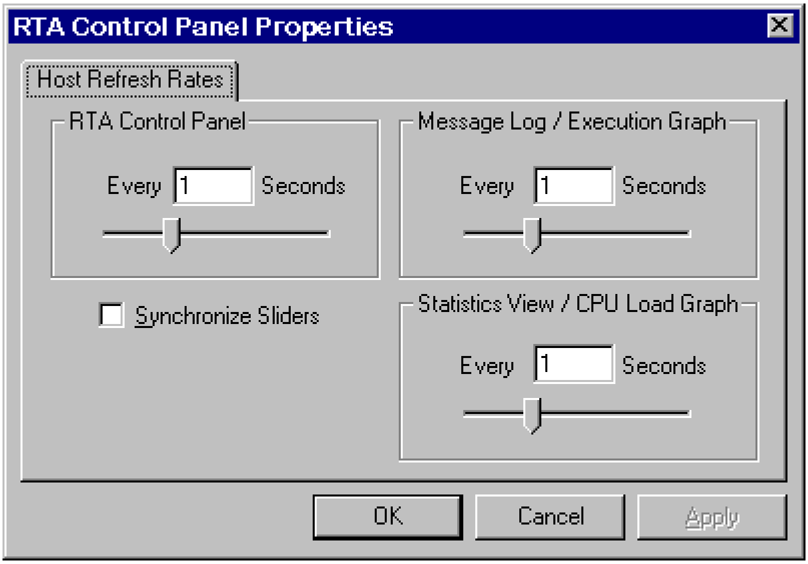
You can choose DSP/BIOS→RTA Control Panel to open a window that allows you to control run-time tracing.




Once you have enabled tracing, you can use DSP/BIOS→Execution Graph and DSP/BIOS→Event Log to see log information, and DSP/BIOS→Statistics View to see statistical information.

You can also control how frequently the host polls the target for trace information. Right-click on the RTA Control Panel and choose the Property Page to set the refresh rate as seen in Figure 2-9. If you set the refresh rate to 0, the host does not poll the target unless you right-click on the RTA Control Panel and choose Refresh Window from the pop-up menu

*Figure 2-9. RTA Control Panel Properties Page*




See the *Code Composer Studio* online tutorial for more information on how to enable tracing in the RTA Control Panel.

## TRC_disable
*Disable trace class(es)*

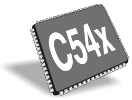
### C Interface

**Syntax** TRC_disable(mask);

**Parameters** Uns mask; /* trace type constant mask */

**Return Value** Void

### Assembly Interface




**Syntax** TRC_disable mask

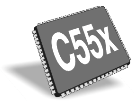
**Inputs** mask

**Preconditions** constant - mask for trace types (TRC_LOGSWI, TRC_LOGPRD, ...)

**Postconditions** none

**Modifies** c

### Assembly Interface




**Syntax** TRC_disable mask

**Inputs** mask

**Preconditions** constant - mask for trace types (TRC_LOGSWI, TRC_LOGPRD, ...)

**Postconditions** none

**Modifies** none

### Reentrant

no

### Description

TRC_disable disables tracing of one or more trace types. Trace types are specified with a 32-bit mask. (See the TRC Module topic for a list of constants to use in the mask.)

The following C code would disable tracing of statistics for software interrupts and periodic functions:

```
TRC_disable(TRC_LOGSWI | TRC_LOGPRD);
```

Internally, DSP/BIOS uses a bitwise AND NOT operation to disable multiple trace types.

For example, you might want to use TRC_disable with a circular log and disable tracing when an unwanted condition occurs. This allows test equipment to retrieve the log events that happened just before this condition started.

**See Also**

TRC_enable
TRC_query
LOG_printf
LOG_event
STS_add
STS_delta

## TRC_enable

*Enable trace type(s)*

### C Interface

**Syntax** TRC_enable(mask);

**Parameters** Uns mask; /* trace type constant mask */

**Return Value** Void

### Assembly Interface

C54x

**Syntax** TRC_enable mask

**Inputs** mask

**Preconditions** constant - mask for trace types (TRC_LOGSWI, TRC_LOGPRD, ...)

**Postconditions** none

**Modifies** c

### Assembly Interface

C55x

**Syntax** TRC_enable mask

**Inputs** mask

**Preconditions** constant - mask for trace types (TRC_LOGSWI, TRC_LOGPRD, ...)

**Postconditions** none

**Modifies** none

### Reentrant

no

### Description

TRC_enable enables tracing of one or more trace types. Trace types are specified with a 32-bit mask. (See the TRC Module topic for a list of constants to use in the mask.)

The following C code would enable tracing of statistics for software interrupts and periodic functions:

```
TRC_enable(TRC_STSSWI | TRC_STSPRD);
```

Internally, DSP/BIOS uses a bitwise OR operation to enable multiple trace types.

For example, you might want to use TRC_enable with a fixed log to enable tracing when a specific condition occurs. This allows test equipment to retrieve the log events that happened just after this condition occurred.

**See Also**

TRC_disable
TRC_query
LOG_printf
LOG_event
STS_add
STS_delta

## TRC_query — *Query trace class(es)*

### C Interface

**Syntax** result = TRC_query(mask);

**Parameters** Uns mask; /* trace type constant mask */

**Return Value** Int result /* indicates whether all trace types enabled */

### Assembly Interface

**Syntax** TRC_query mask

**Inputs** mask

**Preconditions** constant - mask for trace types

**Postconditions** a == 0 if all trace types in the mask are enabled
a != 0 if any trace type in the mask is disabled

**Modifies** ag, ah, al, c

### Assembly Interface

**Syntax** TRC_query mask

**Inputs** mask

**Preconditions** constant - mask for trace types

**Postconditions** t0 == 0 if all trace types in the mask are enabled
t0 != 0 if any trace type in the mask is disabled

**Modifies** t0

### Reentrant

yes

### Description

TRC_query determines whether particular trace types are enabled. TRC_query returns 0 if all trace types in the mask are enabled. If any trace types in the mask are disabled, TRC_query returns a value with a bit set for each trace type in the mask that is disabled. (See the TRC Module topic for a list of constants to use in the mask.)

Trace types are specified with a 16-bit mask. The full list of constants you can use is included in the description of the TRC module.

For example, the following C code returns 0 if statistics tracing for the PRD class is enabled:

```
result = TRC_query(TRC_STSPRD);
```

The following C code returns 0 if both logging and statistics tracing for the SWI class are enabled:

```
result = TRC_query(TRC_LOGSWI | TRC_STSSWI);
```

Note that TRC_query does not return 0 unless the bits you are querying and the TRC_GBLHOST and TRC_GBLTARG bits are set. TRC_query returns non-zero if either TRC_GBLHOST or TRC_GBLTARG are disabled. This is because no tracing is done unless these bits are set.

For example, if the TRC_GBLHOST, TRC_GBLTARG, and TRC_LOGSWI bits are set, the following C code returns the results shown:

```
result = TRC_query(TRC_LOGSWI)    /* returns 0 */
result = TRC_query(TRC_LOGPRD)    /* returns non-zero
*/
```

However, if only the TRC_GBLHOST and TRC_LOGSWI bits are set, the same C code returns the results shown:

```
result = TRC_query(TRC_LOGSWI)    /* returns non-zero
*/
result = TRC_query(TRC_LOGPRD)    /* returns non-zero
*/
```

**See Also**

TRC_enable
TRC_disable

## 2.26 TSK Module

The TSK module is the task manager.

**Functions**

- TSK_checkstacks. Check for stack overflow
- TSK_create. Create a task ready for execution
- TSK_delete. Delete a task
- TSK_deltatime. Update task STS with time difference
- TSK_disable. Disable DSP/BIOS task scheduler
- TSK_enable. Enable DSP/BIOS task scheduler
- TSK_exit. Terminate execution of the current task
- TSK_getenv. Get task environment
- TSK_geterr. Get task error number
- TSK_getname. Get task name
- TSK_getpri. Get task priority
- TSK_getsts. Get task STS object
- TSK_itick. Advance system alarm clock (interrupt only)
- TSK_self. Get handle of currently executing task
- TSK_setenv. Set task environment
- TSK_seterr. Set task error number
- TSK_setpri. Set a task's execution priority
- TSK_settime. Set task STS previous time
- TSK_sleep. Delay execution of the current task
- TSK_stat. Retrieve the status of a task
- TSK_tick. Advance system alarm clock
- TSK_time. Return current value of system clock
- TSK_yield. Yield processor to equal priority task

**Task Hook Functions**

```
Void TSK_createFxn(TSK_Handle task);

Void TSK_deleteFxn(TSK_Handle task);

Void TSK_exitFxn(Void);

Void TSK_readyFxn(TSK_Handle newtask);

Void TSK_switchFxn(TSK_Handle oldtask,
                   TSK_Handle newtask);
```

## Constants, Types, and Structures

```
typedef struct TSK_OBJ *TSK_Handle;
                /* handle for task object */

struct TSK_Attrs {     /* task attributes */
   Int   priority;     /* execution priority */
   Ptr    stack;       /* pre-allocated stack */
   Uns    stacksize;   /* stack size in MADUs */
#ifdef _55_
   Uns   sysstacksize; /*C55x system stack in MADUs */
#endif
   Int   stackseg;     /* mem seg for stack allocation */
   Ptr    environ;     /* global environment data struct */
   String name;        /* printable name */
   Bool   exitflag;    /* program termination requires */
                       /* this task to terminate */
   TSK_DBG_Mode debug /* indicates enum type TSK_DBG_YES */
                       /* TSK_DBG_NO or TSK_DBG_MAYBE */
};

Int TSK_pid;           /* MP processor ID */

Int TSK_MAXARGS = 8;   /* max number of task arguments */
Int TSK_IDLEPRI = 0;   /* used for idle task */
Int TSK_MINPRI = 1;    /* minimum execution priority */
Int TSK_MAXPRI = 15;   /* maximum execution priority */
Int TSK_STACKSTAMP =
TSK_Attrs TSK_ATTRS = { /* default attribute values */
    TSK->PRIORITY,      /* priority */
    NULL,               /* stack */
    TSK->STACKSIZE,     /* stacksize */
#ifdef _55_
    TSK->SYSSTACKSIZE,  /* system stacksize in MADUs */
#endif
    TSK->STACKSEG,      /* stackseg */
    NULL,               /* environ */
    "",                 /* name */
     TRUE,              /* exitflag */
};

enum TSK_Mode {        /* task execution modes */
   TSK_RUNNING,        /* task is currently executing */
   TSK_READY,          /* task is scheduled for execution */
   TSK_BLOCKED,        /* task is suspended from execution */
   TSK_TERMINATED,     /* task is terminated from execution */
};

struct TSK_Stat {      /* task status structure */
    TSK_Attrs  attrs;  /* task attributes */
    TSK_Mode   mode;   /* task execution mode */
    Ptr        sp;     /* task stack pointer */
    Uns        used;   /* task stack used */
};
```

**Configuration Properties**

The following list shows the properties that can be configured in a DSP/BIOS TextConf script, along with their types and default values. For details, see the TSK Manager Properties and TSK Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-5.

### Module Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| ENABLETSK | Bool | true |
| OBJMEMSEG | Reference | prog.get("IDATA") |
| STACKSIZE | Int16 | 256 |
| SYSSTACKSIZE ('C55x only) | Int16 | 256 |
| STACKSEG | Reference | prog.get("IDATA") |
| PRIORITY | EnumInt | 1 (1 to 15) |
| DRIVETSKTICK | EnumString | "PRD" ("User") |
| CREATEFXN | Extern | prog.extern("FXN_F_nop") |
| DELETEFXN | Extern | prog.extern("FXN_F_nop") |
| EXITFXN | Extern | prog.extern("FXN_F_nop") |
| CALLSWITCHFXN | Bool | false |
| SWITCHFXN | Extern | prog.extern("FXN_F_nop") |
| CALLREADYFXN | Bool | false |
| READYFXN | Extern | prog.extern("FXN_F_nop") |

### Instance Configuration Parameters

| Name | Type | Default (Enum Options) |
|---|---|---|
| comment | String | "<add comments here>" |
| autoAllocateStack | Bool | true |
| manualStack | Extern | prog.extern("null","asm") |
| stackSize | Int16 | 256 |
| sysStackSize ('C55x only) | Int16 | 256 |
| stackMemSeg | Reference | prog.get("IDATA") |
| priority | EnumInt | 0 (-1, 0, 1 to 15) |
| fxn | Extern | prog.extern("FXN_F_nop") |
| arg0 | Arg | 0 |
| arg7 | Arg | 0 |

| Name | Type | Default (Enum Options) |
|---|---|---|
| envPointer | Arg | 0x00000000 |
| exitFlag | Bool | true |
| allocateTaskName | Bool | false |
| order | Int16 | 0 |

**Description**

The TSK module makes available a set of functions that manipulate task objects accessed through handles of type TSK_Handle. Tasks represent independent threads of control that conceptually execute functions in parallel within a single C program; in reality, concurrency is achieved by switching the processor from one task to the next.

When you create a task, it is provided with its own run-time stack, used for storing local variables as well as for further nesting of function calls. The TSK_STACKSTAMP value is used to initialize the run-time stack. When creating a task dynamically, you need to initialize the stack with TSK_STACKSTAMP only if the stack is allocated manually and TSK_checkstacks or TSK_stat is to be called. Each stack must be large enough to handle normal subroutine calls as well as a single task preemption context. A task preemption context is the context that gets saved when one task preempts another as a result of an interrupt thread readying a higher-priority task. All tasks executing within a single program share a common set of global variables, accessed according to the standard rules of scope defined for C functions.

Each task is in one of four modes of execution at any point in time: running, ready, blocked, or terminated. By design, there is always one (and only one) task currently running, even if it is a dummy idle task managed internally by TSK. The current task can be suspended from execution by calling certain TSK functions, as well as functions provided by other modules like the SEM Module and the SIO Module; the current task can also terminate its own execution. In either case, the processor is switched to the next task that is ready to run.

You can assign numeric priorities to tasks through TSK. Tasks are readied for execution in strict priority order; tasks of the same priority are scheduled on a first-come, first-served basis. As a rule, the priority of the currently running task is never lower than the priority of any ready task. Conversely, the running task is preempted and re-scheduled for execution whenever there exists some ready task of higher priority.

You can use the DSP/BIOS DSP/BIOS Configuration Tool to specify one or more sets of application-wide hook functions that run whenever a task state changes in a particular way. For the TSK module, these functions are the Create, Delete, Exit, Switch, and Ready functions. The HOOK module adds an additional Initialization function.

A single set of hook functions can be specified for the TSK module itself. To create additional sets of hook functions, use the HOOK Module. When you create the first HOOK object, any TSK module hook functions you have specified are automatically placed in a HOOK object called HOOK_KNL. To set any properties of this object other than the Initialization function, use the TSK module properties. To set the Initialization function property of the HOOK_KNL object, use the HOOK object properties. If you configure only a single set of hook functions using the TSK module, the HOOK module is not used.

The TSK_create topic describes the Create function. The TSK_delete topic describes the Delete function. The TSK_exit topic describes the Exit function.

If a Switch function is specified, it is invoked when a new task becomes the TSK_RUNNING task. The Switch function gives the application access to both the current and next task handles at task switch time. The function should use these argument types:

```
Void mySwitchFxn(TSK_Handle currTask,
                 TSK_Handle nextTask);
```

This function can be used to save/restore additional task context (for example, external hardware registers), to check for task stack overflow, to monitor the time used by each task, etc.

If a Ready function is specified, it is invoked whenever a task is made ready to run. Even if a higher-priority thread is running, the Ready function runs. The Ready function is called with a handle to the task being made ready to run as its argument. This example function prints the name of both the task that is ready to run and the task that is currently running:

```
Void myReadyFxn(TSK_Handle task)
{
   String      nextName, currName;
   TSK_Handle  currTask = TSK_self();

   nextName = TSK_getname(task);
   LOG_printf(&trace, "Task %s Ready", nextName);

   currName = TSK_getname(currTask);
   LOG_printf(&trace, "Task %s Running", currName);
}
```

The Switch function and Ready function are called in such a way that they can use only functions allowed within a software interrupt handler. See Appendix A, Function Callability Table, for a list of functions that can be called by SWI handlers. There are no real constraints on what functions are called via the Create function, Delete function, or Exit function.

**TSK Manager Properties**

The following global properties can be set for the TSK module in the TSK Manager Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

❑ **Enable TSK Manager**. If no tasks are used by the program other than TSK_idle, you can optimize the program by disabling the task manager. The program must then not use TSK objects created with either the DSP/BIOS Configuration Tool or the TSK_create function. If the task manager is disabled, the idle loop still runs and uses the system stack instead of a task stack.

TextConf Name: ENABLETSK Type: Bool

Example: `TSK.ENABLETSK = true;`

❑ **Object Memory**. The memory segment that contains the TSK objects created with the DSP/BIOS Configuration Tool.

TextConf Name: OBJMEMSEG Type: Reference

Example: `TSK.OBJMEMSEG = prog.get("myMEM");`

❑ **Default stack size**. The default size of the stack (in MADUs) used by tasks. You can override this value for an individual task you create with the DSP/BIOS Configuration Tool or TSK_create. The estimated minimum task size is shown in the status bar of the DSP/BIOS Configuration Tool.
This property applies to TSK objects created both with the DSP/BIOS Configuration Tool and with TSK_create.

TextConf Name: STACKSIZE Type: Int16

Example: `TSK.STACKSIZE = 256;`

❏ **Default systack size**. This property defines the size (in MADUs) of the system stack.

TextConf Name: SYSSTACKSIZE Type: Int16

Example: `TSK.SYSSTACKSIZE = 256;`

❏ **Stack segment for dynamic tasks**. The default memory segment to contain task objects created at run-time with the TSK_create function. The TSK_Attrs structure passed to the TSK_create function can override this default. If you select MEM_NULL for this property, creation of task objects at run-time is disabled.

TextConf Name: STACKSEG Type: Reference

Example: `TSK.STACKSEG = prog.get("myMEM");`

❏ **Default task priority**. The default priority level for tasks that are created dynamically with TSK_create.
This property applies to TSK objects created both with the DSP/BIOS Configuration Tool and with TSK_create.

TextConf Name: PRIORITY Type: EnumInt

Options: 1 to 15

Example: `TSK.PRIORITY = 1;`

❏ **TSK tick driven by**. Choose whether you want the system clock to be driven by the PRD module or by calls to TSK_tick and TSK_itick. This clock is used by TSK_sleep and functions such as SEM_pend that accept a timeout argument.

TextConf Name: DRIVETSKTICK Type: EnumString

Options: "PRD", "User"

Example: `TSK.DRIVETSKTICK = "PRD";`

❏ **Create function**. The name of a function to call when any task is created. This includes tasks that are created statically in the DSP/BIOS Configuration Tool and those created dynamically using TSK_create. If the Create function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_create topic describes the Create function.

TextConf Name: CREATEFXN Type: Extern

Example:
```
TSK.CREATEFXN =
    prog.extern("tskCreate");
```

- **Delete function**. The name of a function to call when any task is deleted at run-time with TSK_delete. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_delete topic describes the Delete function.

  TextConf Name: DELETEFXN    Type: Extern

  Example:
  ```
  TSK.DELETEFXN =
      prog.extern("tskDelete");
  ```

- **Exit function**. The name of a function to call when any task exits. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK_exit topic describes the Exit function.

  TextConf Name: EXITFXN    Type: Extern

  Example:
  ```
  TSK.EXITFXN =
      prog.extern("tskExit");
  ```

- **Call switch function**. Check this box if you want a function to be called when any task switch occurs.

  TextConf Name: CALLSWITCHFXN    Type: Bool

  Example:
  ```
  TSK.CALLSWITCHFXN = false;
  ```

- **Switch function**. The name of a function to call when any task switch occurs. This function can give the application access to both the current and next task handles. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK Module topic describes the Switch function.

  TextConf Name: SWITCHFXN    Type: Extern

  Example:
  ```
  TSK.SWITCHFXN =
      prog.extern("tskSwitch");
  ```

- **Call ready function**. Check this box if you want a function to be called when any task becomes ready to run.

  TextConf Name: CALLREADYFXN    Type: Bool

  Example:
  ```
  TSK.CALLREADYFXN = false;
  ```

- **Ready function**. The name of a function to call when any task becomes ready to run. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. The TSK Module topic describes the Ready function.

  TextConf Name: READYFXN    Type: Extern

  Example:
  ```
  TSK.READYFXN =
      prog.extern("tskReady");
  ```

**TSK Object Properties**

To create a TSK object in a configuration script, use the following syntax. The DSP/BIOS TextConf examples that follow assume the object has been created as shown here.

```
var myTsk = TSK.create("myTsk");
```

The following properties can be set for a TSK object in the TSK Object Properties dialog of the Configuration Tool or in a DSP/BIOS TextConf script:

**General tab**

- **comment**. Type a comment to identify this TSK object.

  TextConf Name: comment  Type: String

  Example: `myTsk.comment = "my TSK";`

- **Automatically allocate stack**. Check this box if you want the task's private stack space to be allocated automatically when this task is created. The task's context is saved in this stack before any higher-priority task is allowed to block this task and run.

  TextConf Name: autoAllocateStack  Type: Bool

  Example: `myTsk.autoAllocateStack = true;`

- **Manually allocated stack**. If you did not check the box to Automatically allocate stack, type the name of the manually allocated stack to use for this task. If the stack is defined in a C program and you are using the DSP/BIOS Configuration Tool, add a leading underscore before the stack name.

  TextConf Name: manualStack  Type: Extern

  Example:
  ```
  myTsk.manualStack =
      prog.extern("myStack");
  ```

- **Stack size**. Enter the size (in MADUs) of the stack space to allocate for this task. You must enter the size whether the application allocates the stack manually or automatically. Each stack must be large enough to handle normal subroutine calls as well as a single task preemption context. A task preemption context is the context that gets saved when one task preempts another as a result of an interrupt thread readying a higher priority task.

  TextConf Name: stackSize  Type: Int16

  Example: `myTsk.stackSize = 256;`

- **System stack size.** This specifies the size (in MADUs) of the task's system stack

  TextConf Name: sysStackSize  Type: Int16

  Example: `myTsk.sysStackSize = 256;`

- ❑ **Stack Memory Segment**. If you checked the box to Automatically allocate stack, select the memory segment to contain the stack space for this task.

  TextConf Name: stackMemSeg Type: Reference

  Example:
  ```
  myTsk.stackMemSeg =
      prog.get("myMEM");
  ```

- ❑ **Priority**. The priority level for this task. A priority of -1 causes a task to be suspended until its priority is raised programmatically.

  TextConf Name: priority Type: EnumInt

  Options: -1, 0, 1 to 15

  Example: `myTsk.priority = 1;`

**Function tab**

- ❑ **Task function**. The function to be executed when the task runs. If this function is written in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the C function name. (The DSP/BIOS Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.) If you compile C programs with the -pm or -op2 options, you should precede C functions called by task threads with the FUNC_EXT_CALLED pragma. See the online help for the C compiler for details.

  TextConf Name: fxn Type: Extern

  Example: `myTsk.fxn = prog.extern("tskFxn");`

- ❑ **Task function argument 0-7**. The arguments to pass to the task function. Arguments can be integers or labels. If a label is defined in a C program and you are using the DSP/BIOS Configuration Tool, add a leading underscore before the label name.

  TextConf Name: arg0 to arg7 Type: Arg

  Example: `myTsk.arg0 = 0;`

**Advanced tab**

- ❑ **Environment pointer**. A pointer to a globally-defined data structure this task can access. The task can get and set the task environment pointer with the TSK_getenv and TSK_setenv functions. If this structure is defined in C and you are using the DSP/BIOS Configuration Tool, use a leading underscore before the structure name. If your program uses multiple HOOK objects, HOOK_setenv allows you to set individual environment pointers for each HOOK and TSK object combination.

  TextConf Name: envPointer Type: Arg

  Example: `myTsk.envPointer = 0;`

- ❑ **Don't shut down system while this task is still running**. Check this box if you do not want the application to be able to end if this task is still running. The application can still abort. For example, you might clear this box for a monitor task that collects data whenever all other tasks are blocked. The application does not need to explicitly shut down this task.

  TextConf Name: exitFlag Type: Bool

  Example: `myTsk.exitFlag = true;`

- ❑ **Allocate Task Name on Target**. Check this box if you want the name of this TSK object to be retrievable by the TSK_getname function. Clearing this box saves a small amount of memory. The task name is available in analysis tools in either case.

  TextConf Name: allocateTaskName Type: Bool

  Example: `myTsk.allocateTaskName = false;`

- ❑ **order**. This field is not shown in the TSK Object Properties dialog. You can change the sequence in which TSK functions are executed by selecting the TSK Manager and dragging the TSK objects shown in the second pane up and down.

  TextConf Name: order Type: Int16

  Example: `myTsk.order = 2;`

**TSK - DSP/BIOS Analysis Tool Interface**

The TSK tab of the Kernel/Object View shows information about task objects.

To enable TSK logging, choosing DSP/BIOS→RTA Control Panel and check the appropriate box. Then you can open the system log by choosing View–>System Log. You see a graph of activity that includes TSK function execution states.

Only TSK objects created with the DSP/BIOS Configuration Tool are traced. The System Log graph includes time spent performing dynamically created TSK functions in the Other Threads row.

You can also enable TSK accumulators in the RTA Control Panel. Then you can choose DSP/BIOS→Statistics View, which lets you select objects for which you want to see statistics. If you choose a TSK object, you see statistics about the time elapsed from the time the TSK was posted (made ready to run) until TSK_deltatime is called by the application. See TSK_settime on page 2–441 and TSK_deltatime on page 2–426, for more information on gathering statistics on TSK objects.

## TSK_checkstacks *Check for stack overflow*

### C Interface

**Syntax** TSK_checkstacks(oldtask, newtask);

**Parameters**

```
TSK_Handle oldtask;    /* handle of task switched from */
TSK_Handle newtask;    /* handle of task switched to */
```

**Return Value** Void

### Assembly Interface

none

### Description

TSK_checkstacks calls SYS_abort with an error message if either oldtask or newtask has a stack in which the last location no longer contains the initial value TSK_STACKSTAMP. The presumption in one case is that oldtask's stack overflowed, and in the other that an invalid store has corrupted newtask's stack.

You can call TSK_checkstacks directly from your application. For example, you can check the current task's stack integrity at any time with a call like the following:

```
TSK_checkstacks(TSK_self(), TSK_self());
```

However, it is more typical to call TSK_checkstacks in the task Switch function specified for the TSK manager in your configuration file. This provides stack checking at every context switch, with no alterations to your source code.

If you want to perform other operations in the Switch function, you can do so by writing your own function (myswitchfxn) and then calling TSK_checkstacks from it.

```
Void myswitchfxn(TSK_Handle oldtask,
                 TSK_Handle newtask)
{
    `your additional context switch operations`
    TSK_checkstacks(oldtask, newtask);
    ...
}
```

### Constraints and Calling Context

- ❏ TSK_checkstacks cannot be called from an HWI or SWI.

## TSK_create

*Create a task ready for execution*

### C Interface

**Syntax**

task = TSK_create(fxn, attrs, [arg,] ...);

**Parameters**

```
Fxn         fxn;     /* pointer to task function */
TSK_Attrs   *attrs;  /* pointer to task attributes */
Arg         arg;     /* task arguments */
```

**Return Value**

```
TSK_Handle  task;    /* task object handle */
```

### Assembly Interface

none

### Description

TSK_create creates a new task object. If successful, TSK_create returns the handle of the new task object. If unsuccessful, TSK_create returns NULL unless it aborts (for example, because it directly or indirectly calls SYS_error, and SYS_error is configured to abort).

The fxn parameter uses the Fxn type to pass a pointer to the function the TSK object should run. For example, if myFxn is a function in your program, you can create a TSK object to call that function as follows:

```
task = TSK_create((Fxn)myFxn, NULL);
```

You can use the DSP/BIOS DSP/BIOS Configuration Tool to specify an application-wide Create function that runs whenever a task is created. This includes tasks that are created statically in the Configuration Tool and those created dynamically using TSK_create. The default Create function is a no-op function.

For TSK objects created statically, the Create function is called during the BIOS_start portion of the program startup process, which runs after the main() function and before the program drops into the idle loop.

For TSK objects created dynamically, the Create function is called after the task handle has been initialized but before the task has been placed on its ready queue.

Any DSP/BIOS function can be called from the Create function. DSP/BIOS passes the task handle of the task being created to your Create function. Your Create function declaration should be similar to the following:

```
Void myCreateFxn(TSK_Handle task);
```

The new task is placed in TSK_READY mode, and is scheduled to begin concurrent execution of the following function call:

```
(*fxn)(arg1, arg2, ... argN) /* N = TSK_MAXARGS = 8 */
```

As a result of being made ready to run, the task runs the application-wide Ready function if one has been specified.

TSK_exit is automatically called if and when the task returns from fxn.

If attrs is NULL, the new task is assigned a default set of attributes. Otherwise, the task's attributes are specified through a structure of type TSK_Attrs defined as follows:

```
struct TSK_Attrs {
    Int      priority;
    Ptr      stack;
    Uns      stacksize;
#ifdef _55_
    Uns sysstacksize; /* system stack size in MADUs*/
#endif
    Uns      stackseg;
    Ptr      environ;
    String   name;
    Bool     exitflag;
};
```

The priority attribute specifies the task's execution priority and must be less than or equal to TSK_MAXPRI (15); this attribute defaults to the value of the configuration parameter Default task priority (preset to TSK_MINPRI). If priority is less than 0,the task is barred from execution until its priority is raised at a later time by TSK_setpri. A priority value of 0 is reserved for the TSK_idle task defined in the default configuration. You should not use a priority of 0 for any other tasks.

The stack attribute specifies a pre-allocated block of stacksize MADUs to be used for the task's private stack; this attribute defaults to NULL, in which case the task's stack is automatically allocated using MEM_alloc from the memory segment given by the stackseg attribute.

The stacksize attribute specifies the number of MADUs to be allocated for the task's private stack; this attribute defaults to the value of the configuration parameter Default stack size (preset to 1024). Each stack must be large enough to handle normal subroutine calls as well as a single task preemption context. A task preemption context is the context that gets saved when one task preempts another as a result of an interrupt thread readying a higher priority task.

The stackseg attribute specifies the memory segment to use when allocating the task stack with MEM_alloc; this attribute defaults to the value of the configuration parameter Default stack segment.

The system stack attribute specifies a pre-allocated block of sysstacksize MADUs to be used for the task's private system stack. This attribute defaults to NULL, in which case the task's system stack is automatically allocated using MEM_alloc from the memory segment given by the stackseg attribute. The sysstacksize attribute specifies the number of MADUs to be allocated for the task's private system stack. This attribute defaults to the value of the configuration parameter Default system stack size (preset to 256).

The environ attribute specifies the task's global environment through a generic pointer that references an arbitrary application-defined data structure; this attribute defaults to NULL.

The name attribute specifies the task's printable name, which is a NULL-terminated character string; this attribute defaults to the empty string "". This name can be returned by TSK_getname.

The exitflag attribute specifies whether or not the task must terminate before the program as a whole can terminate; this attribute defaults to TRUE.

All default attribute values are contained in the constant TSK_ATTRS, which can be assigned to a variable of type TSK_Attrs prior to calling TSK_create.

A task switch occurs when calling TSK_create if the priority of the new task is greater than the priority of the current task.

TSK_create calls MEM_alloc to dynamically create an object's data structure. MEM_alloc must lock the memory before proceeding. If another thread already holds a lock to the memory, then there is a context switch. The segment from which the object is allocated is described by the DSP/BIOS objects property in the MEM Module, page 2–200.

**Constraints and Calling Context**

- TSK_create cannot be called from a SWI or HWI.
- The fxn parameter and the name attribute cannot be NULL.
- The priority attribute must be less than or equal to TSK_MAXPRI and greater than or equal to TSK_MINPRI. The priority can be less than zero (0) for tasks that should not execute.
- The string referenced through the name attribute cannot be allocated locally.
- The stackseg attribute must identify a valid memory segment.
- You can reduce the size of your application program by creating objects with the DSP/BIOS Configuration Tool rather than using the XXX_create functions.

**See Also**

MEM_alloc
SYS_error
TSK_delete
TSK_exit

## TSK_delete

*Delete a task*

**C Interface**

**Syntax** TSK_delete(task);

**Parameters** TSK_Handle task; /* task object handle */

**Return Value** Void

**Assembly Interface** none

**Description**

TSK_delete removes the task from all internal queues and calls MEM_free to free the task object and stack. task should be in a state that does not violate any of the listed constraints.

If all remaining tasks have their exitflag attribute set to FALSE, DSP/BIOS terminates the program as a whole by calling SYS_exit with a status code of 0.

You can use the DSP/BIOS DSP/BIOS Configuration Tool to specify an application-wide Delete function that runs whenever a task is deleted. The default Delete function is a no-op function. The Delete function is called before the task object has been removed from any internal queues and its object and stack are freed. Any DSP/BIOS function can be called from the Delete function. DSP/BIOS passes the task handle of the task being deleted to your Delete function. Your Delete function declaration should be similar to the following:

```
Void myDeleteFxn(TSK_Handle task);
```

TSK_delete calls MEM_free to delete the TSK object. MEM_free must acquire a lock to the memory before proceeding. If another task already holds a lock to the memory, then there is a context switch.

> **Note:**
>
> Unless the mode of the deleted task is TSK_TERMINATED, TSK_delete should be called with care. For example, if the task has obtained exclusive access to a resource, deleting the task makes the resource unavailable.

**Constraints and Calling Context**

- ❏ The task cannot be the currently executing task (TSK_self).
- ❏ TSK_delete cannot be called from a SWI or HWI.

- ❏ No check is performed to prevent TSK_delete from being used on a statically-created object. If a program attempts to delete a task object that was created using the DSP/BIOS Configuration Tool, SYS_error is called.

**See Also**

MEM_free
TSK_create

## TSK_deltatime

*Update task statistics with difference between current time and time task was made ready*

### C Interface

**Syntax** TSK_deltatime(task);

**Parameters** TSK_Handle task; /* task object handle */

**Return Value** Void

### Assembly Interface

none

### Description

This function accumulates the time difference from when a task is made ready to the time TSK_deltatime is called. These time differences are accumulated in the task's internal STS object and can be used to determine whether or not a task misses real-time deadlines.

If TSK_deltatime is not called by a task, its STS object is never updated in the Statistics View, even if TSK accumulators are enabled in the RTA Control Panel.

TSK statistics are handled differently than other statistics because TSK functions typically run an infinite loop that blocks when waiting for other threads. In contrast, HWI and SWI functions run to completion without blocking. Because of this difference, DSP/BIOS allows programs to identify the “beginning” of a TSK function's processing loop by calling TSK_settime and the “end” of the loop by calling TSK_deltatime.

For example, if a task waits for data and then processes the data, you want to ensure that the time from when the data is made available until the processing is complete is always less than a certain value. A loop within the task can look something like the following:

```
Void task
{
  'do some startup work'

  /* Initialize time in task's
     STS object to current time */
  TSK_settime(TSK_self);

  for (;;) {
    /* Get data */
    SIO_get(...);

    'process data'
```

```
        /* Get time difference and
           add it to task's STS object */
        TSK_deltatime(TSK_self);
    }
}
```

In the example above, the task blocks on SIO_get and the device driver posts a semaphore that readies the task. DSP/BIOS sets the task's statistics object with the current time when the semaphore becomes available and the task is made ready to run. Thus, the call to TSK_deltatime effectively measures the processing time of the task.

**Constraints and Calling Context**

- ❑ The results of calls to TSK_deltatime and TSK_settime are displayed in the Statistics View only if Enable TSK accumulators is selected in the RTA Control Panel.

**See Also**

TSK_getsts
TSK_settime

## TSK_disable

*Disable DSP/BIOS task scheduler*

**C Interface**

**Syntax** TSK_disable();

**Parameters** Void

**Return Value** Void

**Assembly Interface** none

**Description**

TSK_disable disables the DSP/BIOS task scheduler. The current task continues to execute (even if a higher priority task can become ready to run) until TSK_enable is called.

TSK_disable does not disable interrupts, but is instead used before disabling interrupts to make sure a context switch to another task does not occur when interrupts are disabled.

TSK_disable maintains a count which allows nested calls to TSK_disable. Task switching is not reenabled until TSK_enable has been called as many times as TSK_disable. Calls to TSK_disable can be nested.

Since TSK_disable can prohibit ready tasks of higher priority from running it should not be used as a general means of mutual exclusion. SEM Module semaphores should be used for mutual exclusion when possible.

**Constraints and Calling Context**

- Do not call any function that can cause the current task to block within a TSK_disable/TSK_enable block. For example, SEM_pend (if timeout is 0), TSK_sleep, TSK_yield, and MEM_alloc can all cause blocking. For a complete list, see Section A.1, *Function Callability Table*, page A-2.
- TSK_disable cannot be called from a SWI or HWI.
- TSK_disable cannot be called from the program's main function.

**See Also**

SEM Module
TSK_enable

## TSK_enable

*Enable DSP/BIOS task scheduler*

**C Interface**

**Syntax**

TSK_enable();

**Parameters**

Void

**Return Value**

Void

**Assembly Interface**

none

**Description**

TSK_enable is used to reenable the DSP/BIOS task scheduler after TSK_disable has been called. Since TSK_disable calls can be nested, the task scheduler is not enabled until TSK_enable is called the same number of times as TSK_disable.

A task switch occurs when calling TSK_enable only if there exists a TSK_READY task whose priority is greater than the currently executing task.

**Constraints and Calling Context**

- Do not call any function that can cause the current task to block within a TSK_disable/TSK_enable block. For example, SEM_pend (if timeout is 0), TSK_sleep, TSK_yield, and MEM_alloc can all cause blocking. For a complete list, see Section A.1, *Function Callability Table*, page A-2.
- TSK_enable cannot be called from a SWI or HWI.
- TSK_enable cannot be called from the program's main function.

**See Also**

SEM Module
TSK_disable

## TSK_exit

*Terminate execution of the current task*

**C Interface**

**Syntax**

TSK_exit();

**Parameters**

Void

**Return Value**

Void

**Assembly Interface**

none

**Description**

TSK_exit terminates execution of the current task, changing its mode from TSK_RUNNING to TSK_TERMINATED. If all tasks have been terminated, or if all remaining tasks have their exitflag attribute set to FALSE, then DSP/BIOS terminates the program as a whole by calling the function SYS_exit with a status code of 0.

TSK_exit is automatically called whenever a task returns from its top-level function.

You can use the DSP/BIOS DSP/BIOS Configuration Tool to specify an application-wide Exit function that runs whenever a task is terminated. The default Exit function is a no-op function. The Exit function is called before the task has been blocked and marked TSK_TERMINATED. Any DSP/BIOS function can be called from an Exit function. Calling TSK_self within an Exit function returns the task being exited. Your Exit function declaration should be similar to the following:

```
Void myExitFxn(Void);
```

A task switch occurs when calling TSK_exit unless the program as a whole is terminated.

**Constraints and Calling Context**

- ❏ TSK_exit cannot be called from a SWI or HWI.
- ❏ TSK_exit cannot be called from the program's main function.

**See Also**

MEM_free
TSK_create
TSK_delete

## TSK_getenv
*Get task environment pointer*

**C Interface**

**Syntax** environ = TSK_getenv(task);

**Parameters** TSK_Handle task; /* task object handle */

**Return Value** Ptr environ; /* task environment pointer */

**Assembly Interface** none

**Description** TSK_getenv returns the environment pointer of the specified task. The environment pointer, environ, references an arbitrary application-defined data structure.

If your program uses multiple HOOK objects, HOOK_getenv allows you to get environment pointers you have set for a particular HOOK and TSK object combination.

**See Also** HOOK_getenv
HOOK_setenv
TSK_setenv
TSK_seterr
TSK_setpri

## TSK_geterr

*Get task error number*

**C Interface**

**Syntax**

errno = TSK_geterr(task);

**Parameters**

```
TSK_Handle  task;      /* task object handle */
```

**Return Value**

```
Int         errno;     /* error number */
```

**Assembly Interface**

none

**Description**

Each task carries a task-specific error number. This number is initially SYS_OK, but it can be changed by TSK_seterr. TSK_geterr returns the current value of this number.

**See Also**

SYS_error
TSK_setenv
TSK_seterr
TSK_setpri

## TSK_getname

*Get task name*

**C Interface**

**Syntax**

name = TSK_getname(task);

**Parameters**

TSK_Handle task; /* task object handle */

**Return Value**

String name; /* task name */

**Assembly Interface**

none

**Description**

TSK_getname returns the task's name.

For tasks created with the DSP/BIOS Configuration Tool, the name is available to this function only if the Allocate Task Name on Target box is checked in the properties for this task. For tasks created with TSK_create, TSK_getname returns the attrs.name field value, or an empty string if this attribute was not specified.

**See Also**

TSK_setenv
TSK_seterr
TSK_setpri

## TSK_getpri
*Get task priority*

**C Interface**

**Syntax**
priority = TSK_getpri(task);

**Parameters**
TSK_Handle task; /* task object handle */

**Return Value**
Int priority; /* task priority */

**Assembly Interface**
none

**Description**
TSK_getpri returns the priority of task.

**See Also**
TSK_setenv
TSK_seterr
TSK_setpri

## TSK_getsts

*Get the handle of the task's STS object*

**C Interface**

**Syntax** sts = TSK_getsts(task);

**Parameters** TSK_Handle task; /* task object handle */

**Return Value** STS_Handle sts; /* statistics object handle */

**Assembly Interface** none

**Description** This function provides access to the task's internal STS object. For example, you can want the program to check the maximum value to see if it has exceeded some value.

**See Also** TSK_deltatime
TSK_settime

## TSK_itick

*Advance the system alarm clock (interrupt use only)*

**C Interface**

**Syntax** TSK_itick();

**Parameters** Void

**Return Value** Void

**Assembly Interface** none

**Description** TSK_itick increments the system alarm clock, and readies any tasks blocked on TSK_sleep or SEM_pend whose timeout intervals have expired.

**Constraints and Calling Context**

- ❏ TSK_itick cannot be called by a TSK object.
- ❏ TSK_itick cannot be called from the program's main function.
- ❏ When called within an HWI ISR, the code sequence calling TSK_itick must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

**See Also**

SEM_pend
TSK_sleep
TSK_tick

## TSK_self

*Returns handle to the currently executing task*

**C Interface**

**Syntax** curtask = TSK_self();

**Parameters** Void

**Return Value** TSK_Handle curtask; /* handle for current task object */

**Assembly Interface** none

**Description** TSK_self returns the object handle for the currently executing task. This function is useful when inspecting the object or when the current task changes its own priority through TSK_setpri.

No task switch occurs when calling TSK_self.

**See Also** TSK_setpri

## TSK_setenv

*Set task environment*

### C Interface

**Syntax**

TSK_setenv(task, environ);

**Parameters**

| | | |
|---|---|---|
| TSK_Handle | task; | /* task object handle */ |
| Ptr | environ; | /* task environment pointer */ |

**Return Value**

Void

### Assembly Interface

none

### Description

TSK_setenv sets the task environment pointer to environ. The environment pointer, environ, references an arbitrary application-defined data structure.

If your program uses multiple HOOK objects, HOOK_setenv allows you to set individual environment pointers for each HOOK and TSK object combination.

### See Also

HOOK_getenv
HOOK_setenv
TSK_getenv
TSK_geterr

## TSK_seterr

*Set task error number*

### C Interface

**Syntax**

TSK_seterr(task, errno);

**Parameters**

```
TSK_Handle  task;    /* task object handle */
Int         errno;   /* error number */
```

**Return Value**

Void

### Assembly Interface

none

### Description

Each task carries a task-specific error number. This number is initially SYS_OK, but can be changed to errno by calling TSK_seterr. TSK_geterr returns the current value of this number.

### See Also

TSK_getenv
TSK_geterr

## TSK_setpri

*Set a task's execution priority*

**C Interface**

**Syntax**

```
oldpri = TSK_setpri(task, newpri);
```

**Parameters**

```
TSK_Handle  task;      /* task object handle */
Int         newpri;    /* task's new priority */
```

**Return Value**

```
Int         oldpri;    /* task's old priority */
```

**Assembly Interface**

none

**Description**

TSK_setpri sets the execution priority of task to newpri, and returns that task's old priority value. Raising or lowering a task's priority does not necessarily force preemption and re-scheduling of the caller: tasks in the TSK_BLOCKED mode remain suspended despite a change in priority; and tasks in the TSK_READY mode gain control only if their (new) priority is greater than that of the currently executing task.

The maximum value of newpri is TSK_MAXPRI(15). If the minimum value of newpri is TSK_MINPRI(0). If newpri is less than 0, the task is barred from further execution until its priority is raised at a later time by another task; if newpri equals TSK_MAXPRI, execution of the task effectively locks out all other program activity, except for the handling of interrupts.

The current task can change its own priority (and possibly preempt its execution) by passing the output of TSK_self as the value of the task parameter.

A context switch occurs when calling TSK_setpri if a task makes its own priority lower than the priority of another currently ready task, or if the currently executing task makes a ready task's priority higher than its own priority. TSK_setpri can be used for mutual exclusion.

**Constraints and Calling Context**

❏ newpri must be less than or equal to TSK_MAXPRI.

❏ The task cannot be TSK_TERMINATED.

❏ The new priority should not be zero (0). This priority level is reserved for the TSK_idle task.

**See Also**

TSK_self
TSK_sleep

## TSK_settime

*Reset task statistics previous value to current time*

**C Interface**

**Syntax** TSK_settime(task);

**Parameters** TSK_Handle task; /* task object handle */

**Return Value** Void

**Assembly Interface** none

**Description**

Your application can call TSK_settime before a task enters its processing loop in order to ensure your first call to TSK_deltatime is as accurate as possible and doesn't reflect the time difference since the time the task was created. However, it is only necessary to call TSK_settime once for initialization purposes. After initialization, DSP/BIOS sets the time value of the task's STS object every time the task is made ready to run.

TSK statistics are handled differently than other statistics because TSK functions typically run an infinite loop that blocks when waiting for other threads. In contrast, HWI and SWI functions run to completion without blocking. Because of this difference, DSP/BIOS allows programs to identify the "beginning" of a TSK function's processing loop by calling TSK_settime and the "end" of the loop by calling TSK_deltatime.

For example, a loop within the task can look something like the following:

```
Void task
{
  'do some startup work'

  /* Initialize task's STS object to current time */
  TSK_settime(TSK_self());

  for (;;) {
    /* Get data */
    SIO_get(...);

    'process data'

    /* Get time difference and
       add it to task's STS object */
    TSK_deltatime(TSK_self());
  }
}
```

In the previous example, the task blocks on SIO_get and the device driver posts a semaphore that readies the task. DSP/BIOS sets the task's statistics object with the current time when the semaphore becomes available and the task is made ready to run. Thus, the call to TSK_deltatime effectively measures the processing time of the task.

**Constraints and Calling Context**

- ❑ TSK_settime cannot be called from the program's main function.
- ❑ The results of calls to TSK_deltatime and TSK_settime are displayed in the Statistics View only if Enable TSK accumulators is selected within the RTA Control Panel.

**See Also**

TSK_deltatime
TSK_getsts

## TSK_sleep

*Delay execution of the current task*

**C Interface**

**Syntax** TSK_sleep(nticks);

**Parameters** Uns nticks; /* number of system clock ticks to sleep */

**Return Value** Void

**Assembly Interface** none

**Description**

TSK_sleep changes the current task's mode from TSK_RUNNING to TSK_BLOCKED, and delays its execution for nticks increments of the system clock. The actual time delayed can be up to 1 system clock tick less than timeout due to granularity in system timekeeping.

After the specified period of time has elapsed, the task reverts to the TSK_READY mode and is scheduled for execution.

A task switch always occurs when calling TSK_sleep if nticks > 0.

**Constraints and Calling Context**

- TSK_sleep cannot be called from a SWI or HWI, or within a TSK_disable / TSK_enable block.
- TSK_sleep cannot be called from the program's main function.
- TSK_sleep should not be called from within an IDL function. Doing so prevents analysis tools from gathering run-time information.
- nticks cannot be SYS_FOREVER.

## TSK_stat

*Retrieve the status of a task*

### C Interface

**Syntax**

TSK_stat(task, statbuf);

**Parameters**

TSK_Handle task; /* task object handle */
TSK_Stat *statbuf; /* pointer to task status structure */

**Return Value**

Void

### Assembly Interface

none

### Description

TSK_stat retrieves attribute values and status information about task; the current task can inquire about itself by passing the output of TSK_self as the first argument to TSK_stat.

Status information is returned through statbuf, which references a structure of type TSK_Stat defined as follows:

```
struct TSK_Stat {     /* task status structure */
    TSK_Attrs attrs; /* task attributes */
    TSK_Mode  mode;  /* task execution mode */
    Ptr      sp;    /* task's current stack pointer */
    Uns      used;  /* max number of words ever */
                    /* used on the task stack */
};
```

When a task is preempted by a software or hardware interrupt, the task execution mode returned for that task by TSK_stat is still TSK_RUNNING because the task runs when the preemption ends.

TSK_stat has a non-deterministic execution time. As such, it is not recommended to call this API from SWIs or HWIs.

### Constraints and Calling Context

- ❏ statbuf cannot be NULL.

### See Also

TSK_create

## TSK_tick

*Advance the system alarm clock*

### C Interface

**Syntax**

TSK_tick();

**Parameters**

Void

**Return Value**

Void

### Assembly Interface

none

### Description

TSK_tick increments the system clock, and readies any tasks blocked on TSK_sleep or SEM_pend whose timeout intervals have expired. TSK_tick can be invoked by an ISR or by the currently executing task. The latter is particularly useful for testing timeouts in a controlled environment.

A task switch occurs when calling TSK_tick if the priority of any of the readied tasks is greater than the priority of the currently executing task.

### Constraints and Calling Context

- When called within an HWI ISR, the code sequence calling TSK_tick must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.

### See Also

CLK Module
SEM_pend
TSK_itick
TSK_sleep

## TSK_time

*Return current value of system clock*

**C Interface**

**Syntax** curtime = TSK_time();

**Parameters** Void

**Return Value** Uns curtime; /* current time */

**Assembly Interface** none

**Description** TSK_time returns the current value of the system alarm clock.

Note that since the system clock is usually updated asynchronously by an interrupt service routine (via TSK_itick or TSK_tick), curtime can lag behind the actual system time. This lag can be even greater if a higher priority task preempts the current task between the call to TSK_time and when its return value is used. Nevertheless, TSK_time is useful for getting a rough idea of the current system time.

## TSK_yield

*Yield processor to equal priority task*

**C Interface**

**Syntax**

TSK_yield();

**Parameters**

Void

**Return Value**

Void

**Assembly Interface**

none

**Description**

TSK_yield yields the processor to another task of equal priority.

A task switch occurs when you call TSK_yield if there is an equal priority task ready to run.

**Constraints and Calling Context**

- ❏ When called within an HWI ISR, the code sequence calling TSK_yield must be either wrapped within an HWI_enter/HWI_exit pair or invoked by the HWI dispatcher.
- ❏ TSK_yield cannot be called from the program's main function.

**See Also**

TSK_sleep

## 2.27 std.h and stdlib.h functions

This section contains descriptions of special utility macros found in std.h and DSP/BIOS standard library functions found in stdlib.h.

**Macros**

- **ArgToInt.** Cast an Arg type parameter as an integer type.
- **ArgToPtr.** Cast an Arg type parameter as a pointer type.

**Functions**

- **atexit.** Register an exit function.
- ***calloc.** Allocate and clear memory.
- **exit.** Call the exit functions registered by atexit.
- **free.** Free memory.
- ***getenv.** Get environmental variable.
- ***malloc.** Allocate memory.
- ***realloc.** Reallocate a memory packet.

**Syntax**

```
#include <std.h>
ArgToInt(arg)
ArgToPtr(arg)


#include <stdlib.h>
int  atexit(void (*fcn)(void));
void *calloc(size_t nobj, size_t size);
void exit(int status);
void free(void *p);
char *getenv(char *name);
void *malloc(size_t size);
void *realloc(void *p, size_t size);
```

**Description**

The DSP/BIOS library contains some C standard library functions which supersede the library functions bundled with the C compiler. These functions follow the ANSI C specification for parameters and return values. Consult Kernighan and Ritchie for a complete description of these functions.

The functions calloc, free, malloc, and realloc use MEM_alloc and MEM_free (with segid = Segment for malloc/free) to allocate and free memory.

getenv uses the _environ variable defined and initialized in the boot file to search for a matching environment string.

exit calls the exit functions registered by atexit before calling SYS_exit.

**Note: RTS Functions Callable from TSK Threads Only**

Many runtime support (RTS) functions use lock and unlock functions to prevent reentrancy. However, DSP/BIOS SWI and HWI threads cannot call LCK_pend and LCK_post. As a result, RTS functions that call LCK_pend or LCK_post *must not be called in the context of a SWI or HWI thread*. For a list or RTS functions that should not be called from a SWI or an HWI function, see “LCK_pend” on page 2-167.

To determine whether a particular RTS function uses LCK_pend, refer to the source code for that function shipped with Code Composer Studio. The following table shows some of the RTS functions that call LCK_pend in certain versions of Code Composer Studio:

| | | | |
|---|---|---|---|
| fprintf | printf | vfprintf | sprintf |
| vprintf | vsprintf | clock | strftime |
| minit | malloc | realloc | free |
| calloc | rand | srand | getenv |

The C++ new operator calls malloc, which in turn calls LCK_pend. As a result, the new operator cannot be used in the context of a SWI or HWI thread.

Chapter 3

# Utility Programs

This chapter provides documentation for TMS320C5000 utilities that can be used to examine various files from the MS-DOS command line. These programs are provided with DSP/BIOS in the bin subdirectory. Any other utilities that may occasionally reside in the bin subdirectory and not documented here are for internal Texas Instruments' use only.

**Topic** **Page**

## cdbcmp

*Prints a listing of all parameters defined in a configuration file*

**Syntax**

cdbcmp projname.cdb > projname.tcf

cdbcmp proj1.cdb proj2.cdb > proj_diffs.tcf

**Description**

The cdbcmp utility either compares one CDB file to the CDB template used to create it or compares two CDB files.

On Solaris, the cdbcmp.exe file is installed in the <ccs_base_dir>/bin/utilities/tconf directory. On Windows, it is installed in the <ccs_base_dir>\bin\utilities\tconf folder. You may want to add this directory to your PATH variable so that you can run cdbcmp without specifying the full path to the utility each time.

When used to compare a CDB file to its template, you do not need to specify the template; cdbcmp finds the template automatically. The cdbcmp utility generates a TCONF script that loads the template file, modifies the configuration to match the CDB file, and saves the resulting configuration as a CDB file.

When used to compare two CDB files, cdbcmp generates the script commands necessary to convert the settings in the first CDB file to the settings in the second CDB file. The cdbcmp utility generates a TCONF script that loads the first CDB file, modifies the configuration to match the second CDB file, and saves the resulting configuration as a CDB file.

If you have an existing CDB file, you can convert that file to a TCONF script using a command like the following:

```
cdbcmp demo.cdb > demo.tcf
```

**Note: Order Dependencies in Generated Scripts**

Some object classes have order dependencies, and you may need to modify the sequence of statements in the output script to get the script to run without errors. For example, an object may be referenced in a statement before it is created. Such errors are usually fairly easy to diagnose based on the JavaScript error and a visual inspection of the script. To correct such errors, move the statement that creates the object before the statement that references the object.

To view changes made between two versions of a CDB file or to compare CDB files for two applications, use a command like the following:

```
cdbcmp v1/demo.cdb v2/demo.cdb
```

This command compares the two CDB file and creates a script with statements that would convert the first configuration to the second.

To merge changes to CDB files made by two developers, use commands like the following:

```
cdbcmp a/demo.cdb > demo_a.tcf
cdbcmp b/demo.cdb > demo_b.tcf
sdiff -o demo.tcf demo_a.tcf demo_b.tcf
```

These commands create two script files that define differences between the configurations and their templates. The sdiff UNIX command (and similar commands on UNIX and other platforms) allows you to merge the statements in the two TCONF script files without including duplications.

For example, configurations may need to be merged if one developer is working on a driver while another is working on thread scheduling.

## cdbprint

*Prints a listing of all parameters defined in a configuration file*

**Syntax**

cdbprint [-a] [-l] [-w] cdb-file

**Description**

This utility reads a .cdb file created with the Configuration Tool and creates a list of all the objects and parameters. This tool can be used to compare two configuration files or to simply review the values of a single configuration file.

The -a flag causes cdbprint to list all objects and fields including those that are normally not visible (i.e., unconfigured objects and hidden fields). Without this flag, cdbprint ignores unconfigured objects or modules as well as any fields that are hidden.

The -l flag causes cdbprint to list the internal parameter names instead of the labels used by the Configuration Tool. Without this flag, cdbprint lists the labels used by the Configuration Tool.

The -w flag causes cdbprint to list only those parameters that can also be modified in the Configuration Tool. Without this flag, cdbprint lists both read-only and read-write parameters.

**Example**

The following sequence of commands can be used to compare a configuration file called test54.cdb to the default configuration provided with DSP/BIOS:

```
cdbprint ../../include/bios54.cdb > original.txt
cdbprint test54.cdb > test54.txt
diff original.txt test54.txt
```

## gconfgen

*Reads a reads a .cdb file created with the Configuration Tool*

**Syntax**

gconfgen cdb-file

**Description**

This command line utility reads a .cdb file (e.g. program.cdb) created with the Configuration Tool, where program is the name of your project, or program. The utility generates the corresponding source, header, and linker command files to be used when building your application.

On Solaris, the gconfgen.exe file is installed in the <ccs_base_dir>/plugins/bios directory. On Windows, it is installed in the <ccs_base_dir>\plugins\bios folder.

If your TCONF script uses prog.gen(), you do not need to use this utility to generate files.

The gconfgen utility generates the following files:

- ❏ **program.cdb.** Stores configuration settings for use by the Configuration Tool
- ❏ **programcfg.cmd.** Linker command file
- ❏ **programcfg.h54.** Assembly language header file included by hellocfg.s54
- ❏ **programcfg.h55.** Assembly language header file included by hellocfg.s55
- ❏ **programcfg.s54.** Assembly language source file
- ❏ **programcfg.s55.** Assembly language source file
- ❏ **programcfg_c.c.** Source file to define various structures and properties.
- ❏ **programcfg.h.** Header file to include various header files and declare external variables.

This utility is useful when the build process is controlled by a scripted mechanism, such as a make file, to generate the configuration source files from the configuration database file (.cdb file). Caution should be used, however, following product upgrades, since gconfgen does not detect revision changes. After a product update, use the graphical Configuration Tool to update your .cdb files to the new version. Once updated, gconfgen can be used again to generate the target configuration files.

**Example**

You can use gconfgen from the makefiles provided with the DSP/BIOS examples in the product distribution. To use gconfgen from the command line or makefiles, use its full path (TI_DIR\plugins\bios\gconfgen) or add its folder (TI_DIR\plugins\bios) to your PATH environment variable. (Note that TI_DIR is the root directory of the product distribution).

```
*
* Makefile for creation of program named by the
* PROG variable
*
* These conventions are used in this makefile:
* <prog>.asm - C54 assembly language source file
* <prog>.obj - C54 object file (compiled/assembled)
* <prog>.out  - C54 executable (fully linked program)
* <prog>cfg.s54 - configuration assembly source file
*                 generated by Configuration Tool
* <prog>cfg.h54 - configuration assembly header file
*                 generated by Configuration Tool
* <prog>cfg.cmd - configuration linker command file
*                 generated by Configuration Tool
*

TI_DIR  := $(subst \,/,$(TI_DIR))
include $(TI_DIR)/c5400/bios/include/c54rules.mak
*
*  Compiler, assembler, and linker options.
*
* -g enable symbolic debugging

CC54OPTS = -g
AS54OPTS =
* -q quiet run
LD54OPTS = -q      * -q quiet run
*
* Every BIOS program must be linked with:
* $(PROG)cfg.o54 - from assembling $(PROG)cfg.s54
* $(PROG)cfg.cmd - linker command file generated by
*  Configuration Tool. If additional linker command
*  files exist, $(PROG)cfg.cmd must appear first.
*
PROG   = tsktest
OBJS   = $(PROG)cfg.obj
LIBS   =
CMDS   = $(PROG)cfg.cmd
```

```
*
*  Targets:
*
all:: $(PROG).out
$(PROG).out: $(OBJS) $(CMDS)
$(PROG)cfg.obj: $(PROG)cfg.h54
$(PROG).obj:
$(PROG)cfg.s54 $(PROG)cfg.h54  $(PROG)cfg.cmd ::
$(PROG).cdb    $(TI_DIR)/plugins/bios/gconfgen
$(PROG).cdb
.clean clean::
   @ echo removing generated configuration files ...
   @$(REMOVE) -f $(PROG)cfg.s54 $(PROG)cfg.h54
$(PROG)cfg.cmd
   @ echo removing object files and binaries ...
   @$(REMOVE) -f *.obj *.out *.lst *.map
```

```
*
* Makefile for creation of program named by the
* PROG variable
*
* These naming conventions are used by this makefile:
*  <prog>.asm  - C55 assembly language source file
*  <prog>.obj  - C55 object file (compiled/assembled)
*  <prog>.out  - C55 executable (fully linked program)
*  <prog>cfg.s55 - configuration assembly source file
*                  generated by Configuration Tool
*  <prog>cfg.h55 - configuration assembly header file
*                  generated by Configuration Tool
*  <prog>cfg.cmd - configuration linker command file
*                  generated by Configuration Tool
*

TI_DIR  := $(subst \,/,$(TI_DIR))
include $(TI_DIR)/c5500/bios/include/c55rules.mak
*
*  Compiler, assembler, and linker options.
*
* -g enable symbolic debugging

CC55OPTS = -g
AS55OPTS =
* -q quiet run
LD55OPTS = -q      * -q quiet run
```

```
*
*  Every BIOS program must be linked with:
*  $(PROG)cfg.o55 - from assembling $(PROG)cfg.s55
*  $(PROG)cfg.cmd - linker command file generated by
*   Configuration Tool. If additional linker command
*   files exist, $(PROG)cfg.cmd must appear first.
*
PROG   = tsktest
OBJS   = $(PROG)cfg.obj
LIBS   =
CMDS   = $(PROG)cfg.cmd
*
*  Targets:
*
all:: $(PROG).out
$(PROG).out: $(OBJS) $(CMDS)
$(PROG)cfg.obj: $(PROG)cfg.h55
$(PROG).obj:
$(PROG)cfg.s55 $(PROG)cfg.h55  $(PROG)cfg.cmd ::
$(PROG).cdb    $(TI_DIR)/plugins/bios/gconfgen
$(PROG).cdb
.clean clean::
   @ echo removing generated configuration files ...
   @$(REMOVE) -f $(PROG)cfg.s55 $(PROG)cfg.h55
$(PROG)cfg.cmd
   @ echo removing object files and binaries ...
   @$(REMOVE) -f *.obj *.out *.lst *.map
```

## nmti

*Display symbols and values in a TI COFF file*

**Syntax**

nmti [file1 file2 ...]

**Description**

nmti prints the symbol table (name list) for each TI executable file listed on the command line. Executable files must be stored as COFF (Common Object File Format) files.

If no files are listed, the file a.out is searched. The output is sent to stdout. Note that both linked (executable) and unlinked (object) files can be examined with nmti.

Each symbol name is preceded by its value (blanks if undefined) and one of the following letters:

| | |
|---|---|
| A | absolute symbol |
| B | bss segment symbol |
| D | data segment symbol |
| E | external symbol |
| S | section name symbol |
| T | text segment symbol |
| U | undefined symbol |

The letter is upper case if the symbol is external, and lower case if it is local.

## sectti

*Display information about sections in TI COFF files*

**Syntax**

sectti [-a] [file1 file2 ...]

**Description**

sectti displays location and size information for all the sections in a TI executable file. Executable files must be stored as COFF (Common Object File Format) files.

Sizes are reported in MADUs (16-bit units for C54x) or MAPUs (8-bit units for C55x). All values are in hexadecimal. If no file names are given, a.out is assumed. Note that both linked (executable) and unlinked (object) files can be examined with sectti.

Using the -a flag causes sectti to display all program sections, including sections used only on the target by the DSP/BIOS plug-ins. If you omit the -a flag, sectti displays only the program sections that are loaded on the target.

## sizeti

*Display the section sizes of an object file*

**Syntax**

sizeti[file1 file2 ...]

**Description**

This utility prints the decimal number of MADUs (16-bit units for C54x) or MAPUs (8-bit units for C55x) required by all code sections, all data sections, and the .bss and .stack sections for each COFF file argument. If no file is specified, a.out is used. Note that both linked (executable) and unlinked (object) files can be examined with this utility.

All sections that are located in program memory, including the .cinit data initialization section, are included as part of the value reported by the sizeti utility. Depending on how the executable is built, the .cinit section may not require space on the DSP.

Here is example output from the sizeti utility:

```
>cd \ti\tutorial\dsk5402\hello2\Debug
>c:\ti\bin\sizeti hello.out
   code    data    bss+stack   total
   6357    3311    591         10259     hello.out

>cd \ti\tutorial\evm5510\hello2\Debug
>c:\ti\bin\sizeti hello.out
   code    data    bss+stack   total
   82653   468     2622        85743     hello.out
```

## vers

*Display version information for a DSP/BIOS source or library file*

**Syntax**

vers [file1 file2 ...]

**Description**

The vers utility displays the version number of DSP/BIOS files installed in your system. For example, the following command checks the version number of the bios.a54 or bios.a55 file in the lib sub-directory.

```
..\bin\vers bios.a54
bios.a54:
    *** library
    *** "date and time"
    *** bios-c06
    *** "version number"
```

or

```
..\bin\vers bios.a55
bios.a55:
    *** library
    *** "date and time"
    *** bios-c06
    *** "version number"
```

The actual output from vers may contain additional lines of information. To identify your software version number to Technical Support, use the version number shown.

Note that both libraries and source files can be examined with vers.

Appendix A

# Function Callability and Error Tables

This appendix provides tables describing TMS320C5000 errors and function callability.

| Topic | Page |
|---|---|

## A.1 Function Callability Table

The following table indicates what types of threads can call each of the DSP/BIOS functions. The Possible Context Switch column indicates whether another thread may be run as a result of this function. For example, the function may block on a resource or it may make another thread ready to run. The Possible Context Switch column does not indicate whether the function disables interrupts that might schedule higher-priority threads.

*Table A-1 Function Callability*

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| ATM_andi | C | Yes | Yes | Yes | No |
| ATM_andu | C | Yes | Yes | Yes | No |
| ATM_cleari | C | Yes | Yes | Yes | No |
| ATM_clearu | C | Yes | Yes | Yes | No |
| ATM_deci | C | Yes | Yes | Yes | No |
| ATM_decu | C | Yes | Yes | Yes | No |
| ATM_inci | C | Yes | Yes | Yes | No |
| ATM_incu | C | Yes | Yes | Yes | No |
| ATM_ori | C | Yes | Yes | Yes | No |
| ATM_oru | C | Yes | Yes | Yes | No |
| ATM_seti | C | Yes | Yes | Yes | No |
| ATM_setu | C | Yes | Yes | Yes | No |
| BUF_alloc | C | Yes | Yes | Yes | No |
| BUF_create | C | Yes | No | No | Yes |
| BUF_delete | C | Yes | No | No | Yes |
| BUF_free | C | Yes | Yes | Yes | No |
| BUF_maxbuff | C | Yes | No | No | No |
| BUF_stat | C | Yes | Yes | Yes | No |
| C54_disableIMR | C | Yes | Yes | Yes | No |
| C54_enableIMR | C | Yes | Yes | Yes | No |
| C54_plug | C | Yes | Yes | Yes | No |
| C55_disableIER0, C55_disableIER1 | C, assembly | Yes | Yes | Yes | No |
| C55_enableIER0, C55_enableIER1 | C, assembly | Yes | Yes | Yes | No |
| C55_plug | C | Yes | Yes | Yes | No |

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| CLK_countspms | C, assembly | Yes | Yes | Yes | No |
| CLK_gethtime | C, assembly | Yes | Yes | Yes | No |
| CLK_getltime | C, assembly | Yes | Yes | Yes | No |
| CLK_getprd | C, assembly | Yes | Yes | Yes | No |
| DEV_createDevice | C | Yes | No | No | Yes* |
| DEV_deleteDevice | C | Yes | No | No | Yes* |
| DEV_match | C | Yes | Yes | Yes | No |
| GIO_abort | C | Yes | No* | No* | Yes |
| GIO_control | C | Yes | No* | No* | Yes |
| GIO_create | C | Yes | No | No | No |
| GIO_delete | C | Yes | No | No | Yes |
| GIO_flush | C | Yes | No* | No* | Yes |
| GIO_read | C | Yes | No* | No* | Yes |
| GIO_submit | C | Yes | Yes* | Yes* | Yes |
| GIO_write | C | Yes | No* | No* | Yes |
| HOOK_getenv | C | Yes | Yes | Yes | No |
| HOOK_setenv | C | Yes | Yes | Yes | No |
| HST_getpipe | C, assembly | Yes | Yes | Yes | No |
| HWI_disable | C, assembly | Yes | Yes | Yes | No |
| HWI_dispatchPlug | none | Yes | Yes | Yes | No |
| HWI_enable | C, assembly | Yes | Yes | Yes | Yes* |
| HWI_enter | assembly | No | No | Yes | No |
| HWI_exit | assembly | No | No | Yes | Yes |
| HWI_restore | C, assembly | Yes | Yes | Yes | Yes* |
| IDL_run | C | Yes | No | No | No |
| LCK_create | C | Yes | No | No | Yes* |
| LCK_delete | C | Yes | No | No | Yes* |
| LCK_pend | C | Yes | No | No | Yes* |
| LCK_post | C | Yes | No | No | Yes* |
| LOG_disable | C, assembly | Yes | Yes | Yes | No |
| LOG_enable | C, assembly | Yes | Yes | Yes | No |
| LOG_error | C, assembly | Yes | Yes | Yes | No |
| LOG_event | C, assembly | Yes | Yes | Yes | No |
| LOG_message | C, assembly | Yes | Yes | Yes | No |

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| LOG_printf | C, assembly | Yes | Yes | Yes | No |
| LOG_reset | C, assembly | Yes | Yes | Yes | No |
| MBX_create | C | Yes | No | No | Yes* |
| MBX_delete | C | Yes | No | No | Yes* |
| MBX_pend | C | Yes | Yes* | Yes* | Yes* |
| MBX_post | C | Yes | Yes* | Yes* | Yes* |
| MEM_alloc | C | Yes | No | No | Yes* |
| MEM_calloc | C | Yes | No | No | Yes* |
| MEM_define | C | No | No | No | No* |
| MEM_free | C | Yes | No | No | Yes* |
| MEM_redefine | C | No | No | No | No* |
| MEM_stat | C | Yes | No | No | Yes* |
| MEM_valloc | C | Yes | No | No | Yes* |
| PIP_alloc | C, assembly | Yes | Yes | Yes | Yes |
| PIP_free | C, assembly | Yes | Yes | Yes | Yes |
| PIP_get | C, assembly | Yes | Yes | Yes | Yes |
| PIP_getReaderAddr | C | Yes | Yes | Yes | No |
| PIP_getReaderNumFrames | C | Yes | Yes | Yes | No |
| PIP_getReaderSize | C | Yes | Yes | Yes | No |
| PIP_getWriterAddr | C | Yes | Yes | Yes | No |
| PIP_getWriterNumFrames | C | Yes | Yes | Yes | No |
| PIP_getWriterSize | C | Yes | Yes | Yes | No |
| PIP_peek | C | Yes | Yes | Yes | No |
| PIP_get | C, assembly | Yes | Yes | Yes | Yes |
| PIP_put | C, assembly | Yes | Yes | Yes | Yes |
| PIP_reset | C | Yes | Yes | Yes | Yes |
| PIP_setWriterSize | C | Yes | Yes | Yes | No |
| PRD_getticks | C, assembly | Yes | Yes | Yes | No |
| PRD_start | C, assembly | Yes | Yes | Yes | No |
| PRD_stop | C, assembly | Yes | Yes | Yes | No |
| PRD_tick | C, assembly | Yes | Yes | Yes | Yes |
| QUE_create | C | Yes | No | No | Yes* |
| QUE_delete | C | Yes | No | No | Yes* |
| QUE_dequeue | C | Yes | Yes | Yes | No |

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| QUE_empty | C | Yes | Yes | Yes | No |
| QUE_enqueue | C | Yes | Yes | Yes | No |
| QUE_get | C | Yes | Yes | Yes | No |
| QUE_head | C | Yes | Yes | Yes | No |
| QUE_insert | C | Yes | Yes | Yes | No |
| QUE_new | C | Yes | Yes | Yes | No |
| QUE_next | C | Yes | Yes | Yes | No |
| QUE_prev | C | Yes | Yes | Yes | No |
| QUE_put | C | Yes | Yes | Yes | No |
| QUE_remove | C | Yes | Yes | Yes | No |
| RTDX_channelBusy | C, assembly | Yes | Yes | No | No |
| RTDX_CreateInputChannel | C, assembly | Yes | Yes | No | No |
| RTDX_CreateOutputChannel | C, assembly | Yes | Yes | No | No |
| RTDX_disableInput | C, assembly | Yes | Yes | No | No |
| RTDX_disableOutput | C, assembly | Yes | Yes | No | No |
| RTDX_enableInput | C, assembly | Yes | Yes | No | No |
| RTDX_enableOutput | C, assembly | Yes | Yes | No | No |
| RTDX_isInputEnabled | C, assembly | Yes | Yes | No | No |
| RTDX_isOutputEnabled | C, assembly | Yes | Yes | No | No |
| RTDX_read | C, assembly | Yes | Yes | No | No |
| RTDX_readNB | C, assembly | Yes | Yes | No | No |
| RTDX_sizeofInput | C, assembly | Yes | Yes | No | No |
| RTDX_write | C, assembly | Yes | Yes | No | No |
| SEM_count | C | Yes | Yes | Yes | No |
| SEM_create | C | Yes | No | No | Yes* |
| SEM_delete | C | Yes | Yes* | No | Yes* |
| SEM_ipost | C | No | Yes | Yes | No |
| SEM_new | C | Yes | Yes | Yes | No |
| SEM_pend | C | Yes | Yes* | Yes* | Yes* |
| SEM_post | C | Yes | Yes | Yes | Yes* |
| SEM_reset | C | Yes | No | No | No |
| SIO_bufsize | C | Yes | Yes | Yes | No |
| SIO_create | C | Yes | No | No | Yes* |
| SIO_ctrl | C | Yes | Yes | No | No |

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| SIO_delete | C | Yes | No | No | Yes* |
| SIO_flush | C | Yes | Yes* | No | No |
| SIO_get | C | Yes | No | No | Yes* |
| SIO_idle | C | Yes | Yes* | No | Yes* |
| SIO_issue | C | Yes | Yes | No | No |
| SIO_put | C | Yes | No | No | Yes* |
| SIO_ready | C | Yes | Yes | Yes | No |
| SIO_reclaim | C | Yes | Yes* | No | Yes* |
| SIO_segid | C | Yes | Yes | Yes | No |
| SIO_select | C | Yes | Yes* | No | Yes* |
| SIO_staticbuf | C | Yes | Yes | No | No |
| STS_add | C, assembly | Yes | Yes | Yes | No |
| STS_delta | C, assembly | Yes | Yes | Yes | No |
| STS_reset | C, assembly | Yes | Yes | Yes | No |
| STS_set | C, assembly | Yes | Yes | Yes | No |
| SWI_andn | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_andnHook | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_create | C | Yes | No | No | Yes* |
| SWI_dec | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_delete | C | Yes | No | No | Yes* |
| SWI_disable | C, assembly | Yes | Yes | No | No |
| SWI_enable | C, assembly | Yes | Yes | No | Yes* |
| SWI_getattrs | C | Yes | Yes | Yes | No |
| SWI_getmbox | C, assembly | No | Yes | No | No |
| SWI_getpri | C, assembly | Yes | Yes | Yes | No |
| SWI_inc | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_or | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_orHook | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_post | C, assembly | Yes | Yes | Yes | Yes* |
| SWI_raisepri | C, assembly | No | Yes | No | No |
| SWI_restorepri | C, assembly | No | Yes | No | Yes |
| SWI_self | C, assembly | No | Yes | No | No |
| SWI_setattrs | C | Yes | Yes | Yes | No |
| SYS_abort | C | Yes | Yes | Yes | No |

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| SYS_atexit | C | Yes | Yes | Yes | No |
| SYS_error | C | Yes | Yes | Yes | No |
| SYS_exit | C | Yes | Yes | Yes | No |
| SYS_printf | C | Yes | Yes | Yes | No |
| SYS_putchar | C | Yes | Yes | Yes | No |
| SYS_sprintf | C | Yes | Yes | Yes | No |
| SYS_vprintf | C | Yes | Yes | Yes | No |
| SYS_vsprintf | C | Yes | Yes | Yes | No |
| TRC_disable | C, assembly | Yes | Yes | Yes | No |
| TRC_enable | C, assembly | Yes | Yes | Yes | No |
| TRC_query | C, assembly | Yes | Yes | Yes | No |
| TSK_checkstacks | C | Yes | No | No | No |
| TSK_create | C | Yes | No | No | Yes* |
| TSK_delete | C | Yes | No | No | Yes* |
| TSK_deltatime | C | Yes | Yes | Yes | No |
| TSK_disable | C | Yes | No | No | No |
| TSK_enable | C | Yes | No | No | Yes* |
| TSK_exit | C | Yes | No | No | Yes* |
| TSK_getenv | C | Yes | Yes | Yes | No |
| TSK_geterr | C | Yes | Yes | Yes | No |
| TSK_getname | C | Yes | Yes | Yes | No |
| TSK_getpri | C | Yes | Yes | Yes | No |
| TSK_getsts | C | Yes | Yes | Yes | No |
| TSK_itick | C | No | Yes | Yes | Yes |
| TSK_self | C | Yes | Yes | Yes | No |
| TSK_setenv | C | Yes | Yes | Yes | No |
| TSK_seterr | C | Yes | Yes | Yes | No |
| TSK_setpri | C | Yes | Yes | Yes | Yes* |
| TSK_settime | C | Yes | Yes | Yes | No |
| TSK_sleep | C | Yes | No | No | Yes* |
| TSK_stat | C | Yes | Yes* | Yes* | No |
| TSK_tick | C | Yes | Yes | Yes | Yes* |
| TSK_time | C | Yes | Yes | Yes | No |
| TSK_yield | C | Yes | Yes | Yes | Yes* |

Note: *See the appropriate API reference page for more information.

*Table A-2 RTS Function Calls*

| Function | Interface (C and/or Assembly) | Callable by Tasks? | Callable by SWI Handlers? | Callable by Hardware ISRs? | Possible Context Switch? |
|---|---|---|---|---|---|
| calloc | C | Yes | No | No | Yes* |
| clock | C | Yes | No | No | Yes* |
| fprintf | C | Yes | No | No | Yes* |
| free | C | Yes | No | No | Yes* |
| getenv | C | Yes | No | No | Yes* |
| malloc | C | Yes | No | No | Yes* |
| minit | C | Yes | No | No | Yes* |
| printf | C | Yes | No | No | Yes* |
| rand | C | Yes | No | No | Yes* |
| realloc | C | Yes | No | No | Yes* |
| sprintf | C | Yes | No | No | Yes* |
| srand | C | Yes | No | No | Yes* |
| strftime | C | Yes | No | No | Yes* |
| vfprintf | C | Yes | No | No | Yes* |
| vprintf | C | Yes | No | No | Yes* |
| vsprintf | C | Yes | No | No | Yes* |

Note: *See section 2.27, *std.h and stdlib.h functions*, page 2-448 for more information.

## A.2 DSP/BIOS Error Codes

*Table A-3 Error Codes*

| Name | Value | SYS_Errors[Value] |
|---|---|---|
| SYS_OK | 0 | "(SYS_OK)” |
| SYS_EALLOC | 1 | "(SYS_EALLOC): segid = %d, size = %u, align = %u"<br>Memory allocation error. |
| SYS_EFREE | 2 | "(SYS_EFREE): segid = %d, ptr = ox%x, size = %u"<br>The memory free function associated with the indicated memory segment was unable to free the indicated size of memory at the address indicated by ptr. |
| SYS_ENODEV | 3 | "(SYS_ENODEV): device not found"<br>The device being opened is not configured into the system. |
| SYS_EBUSY | 4 | "(SYS_EBUSY): device in use"<br>The device is already opened by the maximum number of users. |
| SYS_EINVAL | 5 | "(SYS_EINVAL): invalid parameter"<br>An invalid parameter was passed to the device. |
| SYS_EBADIO | 6 | "(SYS_EBADIO): device failure"<br>The device was unable to support the I/O operation. |
| SYS_EMODE | 7 | "(SYS_EMODE): invalid mode"<br>An attempt was made to open a device in an improper mode; e.g., an attempt to open an input device for output. |
| SYS_EDOMAIN | 8 | "(SYS_EDOMAIN): domain error"<br>Used by SPOX-MATH when type of operation does not match vector or filter type. |
| SYS_ETIMEOUT | 9 | "(SYS_ETIMEOUT): timeout error"<br>Used by device drivers to indicate that reclaim timed out. |
| SYS_EEOF | 10 | "(SYS_EEOF): end-of-file error"<br>Used by device drivers to indicate the end of a file. |
| SYS_EDEAD | 11 | "(SYS_EDEAD): previously deleted object"<br>An attempt was made to use an object that has been deleted. |
| SYS_EBADOBJ | 12 | "(SYS_EBADOBJ): invalid object"<br>An attempt was made to use an object that does not exist. |
| SYS_EUSER | >=256 | "(SYS EUSER): <user-defined string>"<br>User-defined error. |

## Appendix B

# C55x DSP/BIOS Preservation and Preconditions

This appendix provides tables describing the TMS320C55x™ register conventions in terms of preservation across multi-threaded context switching and preconditions.

## B.1 Register Preservation During Context Switches

When a thread context switches in an application, DSP/BIOS preserves the contents of certain data and status registers. To list which registers are preserved, we need to divide context switching into several categories.

- The type of thread to which context switches is important. That is, the thread type that runs after the context switch is a factor. DSP/BIOS has two thread scheduling models—TSK and SWI. Each model has its own scheduler. (Switching to HWI threads is not considered in this appendix because DSP/BIOS API mechanisms are provided to control which registers are saved.)
- The type of thread that posted the SWI of TSK is important. (In this case, “posting a TSK” means an action such as posting a SEM, LCK, or MBX object that frees a resource on which a TSK was blocked.) If an HWI posted the thread, it is posted *asynchronously*. If an SWI or TSK posted the thread, it is posted *synchronously*.

Table B-1 gives examples of the four types of context switch considered in this appendix.

*Table B-1 Examples of Context Switching Types*

| | Asynchronous Switch to SWI1 | Synchronous Switch to SWI1 | Asynchronous Switch to TSK1 | Synchronous Switch to TSK1 |
|---|---|---|---|---|
| **Switch from SWI0** | An interrupt occurs and calls SWI_post for SWI1, leading to a context switch. | SWI0 calls SWI_post for SWI1, which has a higher priority then SWI0. | SWIs have higher priority than TSKs, so a SWI to TSK transition cannot occur. | SWIs have higher priority than TSKs, so a SWI to TSK transition cannot occur. |
| **Switch from TSK0** | An interrupt occurs and calls SWI_post for SWI1, leading to a context switch. | TSK0 calls SWI_post for SWI1. | An interrupt occurs and calls SEM_post for a SEM used by TSK1. | TSK0 calls SEM_post for a SEM used by TSK1, causing a context switch to TSK1. |

Although this table gives examples of both types of context switches, the set of registers preserved is the same whether the switch was *from* a SWI or a TSK. The important consideration is *to* which type of thread context switches.

## B.2 Data Register Preservation Model

The following terms are used in Table B-2 to describe what happens to data registers after a context switch:

- ❏ **Preserved.** These registers are preserved as part of the thread by the scheduler. Each thread has its own copy of the register.

  For example, both the TSK and SWI schedulers preserve the AC0 register when an asynchronous switch occurs. Suppose swi_a has a value of 7 in register ac0, and an interrupt posts swi_b. If swi_b sets this value to 10, the value in register ac0 is guaranteed to be 7 when control returns to swi_a.

- ❏ **Not Preserved.** These registers are not preserved as part of the thread by the scheduler. When control returns to a thread after a context switch, these registers cannot be assumed to contain the same values.

  For example, both the TSK and SWI schedulers do not preserve the AC0 register when a synchronous switch occurs. Suppose swi_a has a value of 7 in register ac0, and swi_a posts swi_b, which has a higher priority. If swi_b sets this value to 10, the value in register ac0 cannot be predicted when control returns to swi_a.

The general rules for which data registers are preserved during a context switch are as follows:

- ❏ For synchronous switches to a SWI, no data registers are preserved.
- ❏ For synchronous switches to a TSK, the child-preserved registers (as specified by the C compiler) are preserved.
- ❏ For asynchronous switches to a SWI or TSK, parent-preserved registers and certain data registers that the compiler does not specify as child-preserved or parent-preserved (e.g., BK03 and BK47) are preserved.
- ❏ Control registers related to interrupts (IER0, IER1, IFR0, IFR1, IVPD, IVPH, DBGIER0, and DBGIER1) and control registers related to IDLE mode (ISTR, ICR) are not preserved for any type of SWI or TSK context switch.

*Table B-2 Data Register Preservation Model*

| Data Register | Synchronous Switch to SWI | Synchronous Switch to TSK | Asynchronous Switch to SWI | Asynchronous Switch to TSK |
|---|---|---|---|---|
| AC0 | Not Preserved | Not Preserved | Preserved | Preserved |

| Data Register | Synchronous Switch to SWI | Synchronous Switch to TSK | Asynchronous Switch to SWI | Asynchronous Switch to TSK |
|---|---|---|---|---|
| AC1 | Not Preserved | Not Preserved | Preserved | Preserved |
| AC2 | Not Preserved | Not Preserved | Preserved | Preserved |
| AC3 | Not Preserved | Not Preserved | Preserved | Preserved |
| BK03 | Not Preserved | Not Preserved | Preserved | Preserved |
| BK47 | Not Preserved | Not Preserved | Preserved | Preserved |
| BKC | Not Preserved | Not Preserved | Preserved | Preserved |
| BRC0 | Not Preserved | Not Preserved | Preserved | Preserved |
| BRC1 | Not Preserved | Not Preserved | Preserved | Preserved |
| BRS1 | Not Preserved | Not Preserved | Preserved | Preserved |
| BSA01 | Not Preserved | Not Preserved | Preserved | Preserved |
| BSA23 | Not Preserved | Not Preserved | Preserved | Preserved |
| BSA45 | Not Preserved | Not Preserved | Preserved | Preserved |
| BSA67 | Not Preserved | Not Preserved | Preserved | Preserved |
| BSAC | Not Preserved | Not Preserved | Preserved | Preserved |
| CDP | Not Preserved | Not Preserved | Preserved | Preserved |
| CFCT | Preserved* | Preserved* | Preserved* | Preserved* |
| CSR | Not Preserved | Not Preserved | Preserved | Preserved |
| DP | Not Preserved | Not Preserved | Preserved | Preserved |
| DBIER0 | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| DBIER1 | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| ISTR | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| ICR | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| IER0 | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| IER1 | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| IFR0 | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| IVPD | Not Preserved | Not Preserved | Not Preserved | Not Preserved |

| Data Register | Synchronous Switch to SWI | Synchronous Switch to TSK | Asynchronous Switch to SWI | Asynchronous Switch to TSK |
|---|---|---|---|---|
| IVPH | Not Preserved | Not Preserved | Not Preserved | Not Preserved |
| PDP | Not Preserved | Not Preserved | Preserved | Preserved |
| REA0 | Not Preserved | Not Preserved | Preserved | Preserved |
| REA1 | Not Preserved | Not Preserved | Preserved | Preserved |
| RETA | Preserved* | Preserved* | Preserved* | Preserved* |
| RPTC | Not Preserved | Not Preserved | Preserved | Preserved |
| RSA0 | Not Preserved | Not Preserved | Preserved | Preserved |
| RSA1 | Not Preserved | Not Preserved | Preserved | Preserved |
| T0 | Not Preserved | Not Preserved | Preserved | Preserved |
| T1 | Not Preserved | Not Preserved | Preserved | Preserved |
| T2 | Not Preserved | Preserved | Not Preserved | Preserved |
| T3 | Not Preserved | Preserved | Not Preserved | Preserved |
| TRN0 | Not Preserved | Not Preserved | Preserved | Preserved |
| TRN1 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR0 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR1 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR2 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR3 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR4 | Not Preserved | Not Preserved | Preserved | Preserved |
| XAR5 | Not Preserved | Preserved | Not Preserved | Preserved |
| XAR6 | Not Preserved | Preserved | Not Preserved | Preserved |
| XAR7 | Not Preserved | Preserved | Not Preserved | Preserved |

* The CFCT and RETA control registers affect the control flow of an application. RETA (used in the USE_RETA stack model) and CFCT are preserved for all context switch types. Application threads should not operate directly on these registers. Writing directly to these registers can cause incorrect control flow. (In the NO_RETA and C54X_STK stack models, an application can operate on the RETA register.)

## B.3 Status Register Preservation Model

The TMS320C55x processor has four status registers, ST0-ST3, which hold status and mode bits. The following terms are used in Table B-3 to describe what happens to the status bits after a context switch:

- **Preserved.** These status bits are preserved as part of the thread by the scheduler. Each thread has its own copy of the register.

  For example, the TSK and SWI schedulers preserve the AC0_OV2 bit (in the ST0 register) when an asynchronous switch occurs. Suppose swi_a has a value of 1 in status bit AC0_OV2, and an interrupt posts swi_b. If swi_b sets this value to 0, the value in status bit AC0_OV2 is guaranteed to be 1 when control returns to swi_a.

- **Not Preserved.** These status bits are not preserved as part of the thread by the scheduler. When control returns to a thread after a context switch, these status bits cannot be assumed to contain the same values.

  For example, both the TSK and SWI schedulers do not preserve the AC0_OV2 bit when a synchronous switch occurs. Suppose swi_a has a value of 1 in status bit AC0_OV2, and swi_a posts swi_b, which has a higher priority. If swi_b sets this value to 0, the value in the AC0_OV2 bit cannot be predicted when control returns to swi_a.

- **Propagated.** These status bits always contain the last value set by any thread. If a thread changes this bit value, the new value is visible to all threads until the value is changed again.

  For example the _HINT bit (in the ST3 register) is propagated for all types of context switches. Suppose swi_a has a value of 1 in status bit _HINT, and an interrupt posts swi_b. If swi_b sets this value to 0, the value in status bit _HINT is guaranteed to be 0 when control returns to swi_a unless another thread changes its value before swi_a regains control.

- **Untouched.** These status bits are not touched by DSP/BIOS. These bits are related to emulation; DSP/BIOS does not operate on them.

*Table B-3 Status Register Preservation Model*

| Status Register | Status Bit | Synchronous Switch to SWI | Synchronous Switch to TSK | Asynchronous Switch to SWI | Asynchronous Switch to TSK |
|---|---|---|---|---|---|
| ST0 | AC0V2 | Not Preserved | Not Preserved | Preserved | Preserved |
| | AC0V3 | Not Preserved | Not Preserved | Preserved | Preserved |
| | TC1 | Not Preserved | Not Preserved | Preserved | Preserved |
| | TC2 | Not Preserved | Not Preserved | Preserved | Preserved |

| Status Register | Status Bit | Synchronous Switch to SWI | Synchronous Switch to TSK | Asynchronous Switch to SWI | Asynchronous Switch to TSK |
|---|---|---|---|---|---|
| | CARRY | Not Preserved | Not Preserved | Preserved | Preserved |
| | AC0V0 | Not Preserved | Not Preserved | Preserved | Preserved |
| | ACOV1 | Not Preserved | Not Preserved | Preserved | Preserved |
| | DP | Not Preserved | Not Preserved | Preserved | Preserved |
| ST1 | BRAF | Not Preserved | Not Preserved | Preserved | Preserved |
| | CPL | Not Preserved | Not Preserved | Preserved | Preserved |
| | XF | Propagated | Propagated | Propagated | Propagated |
| | HM | Propagated | Propagated | Propagated | Propagated |
| | INTM | Preserved | Preserved | Preserved | Preserved |
| | M40 | Not Preserved | Not Preserved | Preserved | Preserved |
| | SATD | Not Preserved | Not Preserved | Preserved | Preserved |
| | SXMD | Not Preserved | Not Preserved | Preserved | Preserved |
| | C16 | Not Preserved | Not Preserved | Preserved | Preserved |
| | FRCT | Not Preserved | Not Preserved | Preserved | Preserved |
| | C54CM | Not Preserved | Not Preserved | Preserved | Preserved |
| ST2 | _ARMS | Not Preserved | Not Preserved | Preserved | Preserved |
| | _DBGM | Untouched | Untouched | Untouched | Untouched |
| | _EALLOW | Untouched | Untouched | Untouched | Untouched |
| | _RDM | Not Preserved | Not Preserved | Preserved | Preserved |
| | _CDPLC | Not Preserved | Not Preserved | Preserved | Preserved |
| | _AR0-7LC | Not Preserved | Not Preserved | Preserved | Preserved |
| ST3 | CARFRZ | Propagated | Propagated | Propagated | Propagated |
| | CAEN | Propagated | Propagated | Propagated | Propagated |
| | CACLR | Propagated | Propagated | Propagated | Propagated |
| | _HINT | Propagated | Propagated | Propagated | Propagated |
| | CBERR | Propagated | Propagated | Propagated | Propagated |
| | MPNMC | Propagated | Propagated | Propagated | Propagated |
| | SATA | Not Preserved | Not Preserved | Preserved | Preserved |
| | CLKOFF | Propagated | Propagated | Propagated | Propagated |
| | SMUL | Not Preserved | Not Preserved | Preserved | Preserved |
| | SST | Not Preserved | Not Preserved | Preserved | Preserved |

## B.4 Preconditions for Synchronous DSP/BIOS APIs

The DSP/BIOS APIs requires certain values in certain status register bits as a precondition. Table B-4 lists these required values, which are in compliance with C compiler conventions. These preconditions are the same as those described by the C compiler for C function calls. These settings are made in boot code, by HWI_enter before running a user ISR, and by HWI_exit before calling the DSP/BIOS scheduler.

Thread scheduling objects (such as TSK, SWI, IDL, PRD, and CLK) and data objects (such as PIP) call user functions. Within such functions, these bit settings can be changed. However, user functions must ensure that these bits are reset to their assumed values before a user function calls any DSP/BIOS function, calls any C-callable function, exits any C-callable function, or exits the function itself. For example, C54CM can be set to 1 to do some operation, but it must be reset to 0.

*Table B-4 Status Bit Values Required by DSP/BIOS APIs*

| Status Register | Register Bit Pair | Assumed Value |
|---|---|---|
| ST1 | CPL | 1 |
| | M40 | 0 |
| | SATD | 0 |
| | SXMD | 1 |
| | C16 | 0 |
| | FRCT | 0 |
| | C54CM | 0 |
| ST2 | ARMS | 1 |
| | RDM | 0 |
| | CDPLC | 0 |
| | AR0-7LC | 0 |
| ST3 | SATA | 0 |
| | SMUL | 0 |

HWI_enter sets the ASM bit of the ST1 register and the SST bit of the ST3 register to 0. Similarly HWI_exit sets these two bits to zero before passing control to the DSP/BIOS scheduler.

*Table B-5 Additional Bit Settings by HWI_enter and HWI_exit*

| Status Register | Register Bit Pair | Set Value |
|---|---|---|
| ST1 | ASM | 0 |
| ST3 | SST | 0 |

# Index

# D

# E

# F



# G



# H



# I

## L



## M



## N

# O



# P

# Q



# R



# S