TMS320C6000 DSP/BIOS Application Programming Interface (API) Reference Guide

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Preface

Read This First

About This Manual

DSP/BIOS gives developers of mainstream applications on Texas Instruments TMS320C6000^{TM} 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, 62 represents the two-digit numeric appropriate to your specific DSP platform. For example, DSP/BIOS assembly language API header files for the C6000 platform are described as having a suffix of .h62. For the C64x or C67x DSP platform, substitute either 64 or 67 for each occurrence of 62.
- ❏ Information specific to a particular device is designated with one of the following icons:

  C62x C64x

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.

TMS320C6000 Assembly Language Tools User's Guide (literature number SPRU186) 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 C6000 generation of devices.

TMS320C6000 Optimizing C Compiler User's Guide (literature number SPRU187) describes the c6000 C/C++ compiler and the assembly optimizer. This C/C++ compiler accepts ANSI standard C/C++ source code and produces assembly language source code for the C6000 generation of devices. The assembly optimizer helps you optimize your assembly code.

TMS320C6000 Programmer's Guide (literature number SPRU189) describes the c6000 CPU architecture, instruction set, pipeline, and interrupts for these digital signal processors.

TMS320c6000 Peripherals Reference Guide (literature number SPRU190) describes common peripherals available on the TMS320C6000 family of digital signal processors. This book includes information on the internal data and program memories, the external memory interface (EMIF), the host port, multichannel buffered serial ports, direct memory access (DMA), clocking and phase-locked loop (PLL), and the power-down modes.

TMS320C6000 Code Composer Studio Tutorial Online Help (literature number SPRH125) introduces the Code Composer Studio integrated development environment and software tools. Of special interest to DSP/BIOS users are the *Using DSP/BIOS* lessons.

TMS320C6000 Chip Support LIbrary API Reference Guide (literature number SPRU401) contains a reference for the Chip Support Library (CSL) application programming interfaces (APIs). The CSL is a set of APIs used to configure and control all on-chip peripherals.

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)

Trademarks

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Chapter 1

API Functional Overview

This chapter provides an overview to the TMS320C6000 DSP/BIOS API functions.

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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
C62 and C64 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.

1.3 Assembly Language Interface Overview

When calling DSP/BIOS APIs from assembly source code, you should include the module.h62 or module.h64 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

Syntax SWI_getpri

Preconditions	a4 = address of the SWI object b14 = address of start of .bss
Postconditions	a4 = SWI object's priority mask
Modifies	a4

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 *TMS320C6000 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 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.

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 and CSL 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 'C62x and 'C67x. Memory segment defaults are different for 'C64x. 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.
- ❏ **Int16.** Integer properties hold 16-bit unsigned integer values. The value range accepted for a property may have additional limits.
- ❏ **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.
- ❏ **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

a. 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

b. C62 operations

Function	Operation
C62_disableIER C64_disableIER	Disable certain maskable interrupts
C62_enableIER C64_enableIER	Enable certain maskable interrupts
C62_plug C64_plug	C function to plug an interrupt vector

c. 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

d. DEV module operations

Function	Operation
DEV_match	Match a device name with a driver

Function	Operation
Dxx_close	Close device
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

i. 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_init	Initialize GIO module
GIO_read	Synchronous read command

Function	Operation
GIO_submit	Submit a GIO packet to the mini-driver
GIO_write	Synchronous write command

e. 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

f. HST module operations

Function	Operation
HST_getpipe	Get corresponding pipe object

g. 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

h. IDL module operations

Function	Operation
IDL_run	Make one pass through idle functions

j. LCK module operations

Function	Operation
LCK_create	Create a resource lock
LCK_delete	Delete a resource lock

Function	Operation
LCK_pend	Acquire ownership of a resource lock
LCK_post	Relinquish ownership of a resource lock

k. 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

l. 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

m. 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

n. 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

o. 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

p. 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)

q. 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

r. 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

s. 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

t. 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

u. 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

v. 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

w. 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

x. 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)
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

y. 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

z.) 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 TMS320C6000 DSP/BIOS API functions, which are alphabetized by name. In addition, there are reference sections that 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 C62 and C64 Modules

The C62 and C64 modules include target-specific functions for the TMS320C6000 family.

Functions

- ❏ C62_disableIER. ASM macro to disable selected interrupts in the IER
- ❏ C62_enableIER. ASM macro to enable selected interrupts in the IER
- ❏ C62_plug. Plug interrupt vector
- ❏ C64_disableIER. ASM macro to disable selected interrupts in the IER
- ❏ C64_enableIER. ASM macro to enable selected interrupts in the IER
- ❏ C64_plug. Plug interrupt vector

Description

The C62 and C64 modules provide certain target-specific functions and definitions for the TMS320C6000 family of processors.

See the c62.h or c64.h files for a complete list of definitions for hardware flags for C. The c62.h and c64.h files contain C language macros, #defines for various TMS320C6000 registers, and structure definitions. The c62.h62 and c64.h64 files also contain assembly language macros for saving and restoring registers in interrupt service routines.

C62_disableIER *Disable certain maskable interrupts*

C Interface

Syntax	oldmask = C62_disableIER(mask);
Parameters	Uns mask; /* disable mask */
Return Value	Uns oldmask; /* actual bits cleared by disable mask */

Assembly Interface

Syntax C62_disableIER IEMASK, REG0, REG1

Preconditions

```
IEMASK      ; interrupt disable mask
REG0        ; temporary register that can be modified
REG1        ; temporary register that can be modified
```

Postconditions none

Description C62_disableIER disables interrupts by clearing the bits specified by mask in the Interrupt Enable Register (IER).

The C version of C62_disableIER returns a mask of bits actually cleared. This return value should be passed to C62_enableIER to re-enable interrupts.

See C62_enableIER for a description and code examples for safely protecting a critical section of code from interrupts.

See Also C62_enableIER

C64_disableIER *Disable certain maskable interrupts*

C Interface

Syntax	oldmask = C64_disableIER(mask);		
Parameters	Uns	mask;	/* disable mask */
Return Value	Uns	oldmask;	/* actual bits cleared by disable mask */

Assembly Interface

Syntax	C64_disableIER IEMASK, REG0, REG1	
Preconditions	IEMASK	; interrupt disable mask
	REG0	; temporary register that can be modified
	REG1	; temporary register that can be modified
Postconditions	none	

Description

C64_disableIER disables interrupts by clearing the bits specified by mask in the Interrupt Enable Register (IER).

The C version of C64_disableIER returns a mask of bits actually cleared. This return value should be passed to C64_enableIER to re-enable interrupts.

See C64_enableIER for a description and code examples for safely protecting a critical section of code from interrupts.

See Also

C64_enableIER

C62_enableIER *Enable certain maskable interrupts*

C Interface

Syntax	C62_enableIER(oldmask);
Parameters	Uns oldmask; /* enable mask */
Return Value	Void

Assembly Interface

Syntax	C62_enableIER IEMASK, REG0, REG1
Preconditions	IEMASK ; interrupt enable mask REG0 ; temporary register that can be modified REG1 ; temporary register that can be modified
Postconditions	none

Description

C62_disableIER and C62_enableIER disable and enable specific internal interrupts by modifying the Interrupt Enable Register (IER). C62_disableIER clears the bits specified by the mask parameter in the IER and returns a mask of the bits it cleared. C62_enableIER sets the bits specified by the oldmask parameter in the IER.

C62_disableIER and C62_enableIER are usually used in tandem to protect a critical section of code from interrupts. The following code examples show a region protected from all interrupts:

```
; ASM example

.include c62.h62
...

; disable interrupts specified by IEMASK
C62_disableIER IEMASK, b0, b1

`do some critical operation`

; enable interrupts specified by IEMASK
C62_enableIER IEMASK, b0, b1

/* C example */
Uns    oldmask;

oldmask = C62_disableIER(~0);
  `do some critical operation; `
  `do not call TSK_sleep, SEM_post, etc.`
C62_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 C62_disableIER / C62_enableIER 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 / TSK_enable. You can also use C62_disableIER / C62_enableIER 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 = C62_disableIER(INTMASK);
  `do some critical operation;`
  `NOT OK to call TSK_sleep, SEM_post, etc.`
C62_enableIER(oldmask);
TSK_enable();
```

Note:

If you use C_disableIER / C62_enableIER 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 C62_disableIER

C64_enableIER

Enable certain maskable interrupts

C Interface

Syntax C64_enableIER(oldmask);

Parameters Uns oldmask; /* enable mask */

Return Value Void

Assembly Interface

Syntax C64_enableIER IEMASK, REG0, REG1

Preconditions

IEMASK	; interrupt enable mask
REG0	; temporary register that can be modified
REG1	; temporary register that can be modified

Postconditions none

Description

C64_disableIER and C64_enableIER are used to disable and enable specific internal interrupts by modifying the Interrupt Enable Register (IER). C64_disableIER clears the bits specified by the mask parameter in the Interrupt Mask Register and returns a mask of the bits it cleared. C64_enableIER sets the bits specified by the oldmask parameter in the Interrupt Mask Register.

C64_disableIER and C64_enableIER 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 c64.h64
...

; disable interrupts specified by IEMASK
C64_disableIER IEMASK, b0, b1

`do some critical operation`

; enable interrupts specified by IEMASK
C64_enableIER IEMASK, b0, b1
```

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

oldmask = C64_disableIMR(~0);
  `do some critical operation; `
  `do not call TSK_sleep, SEM_post, etc.`
C64_enableIMR(oldmask);
```

Note:

DSP/BIOS kernel calls that can cause a task switch (for example, SEM_post and TSK_sleep) should be avoided within a C64_disableIER and C64_enableIER 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 / TSK_enable. You can also use C64_disableIER and C64_enableIER 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 = C64_disableIER(INTMASK);
  `do some critical operation;`
  `NOT OK to call TSK_sleep, SEM_post, etc.`
C64_enableIER(oldmask);
TSK_enable();
```

Note:

If you use C64_disableIER and C64_enableIER 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 C64_disableIER

C62_plug

C function to plug an interrupt vector

C Interface

Syntax

C62_plug(vecid, fxn, dmachan);

Parameters

```
Int      vecid;     /* interrupt id */
Fxn      fxn;       /* pointer to HWI function */
Int      dmachan;   /* DMA channel to use for performing plug */
```

Return Value

Void

Assembly Interface

none

Description

C62_plug writes an Interrupt Service Fetch Packet (ISFP) into the Interrupt Service Table (IST), at the address corresponding to vecid. The op-codes written in the ISFP create a branch to the function entry point specified by fxn:

```
stw    b0, *SP--[1]
mvk    fxn, b0
mvkh   fxn, b0
b      b0
ldw    *++SP[1],b0
nop    4
```

For ’C6x0x devices, if the IST is stored in external RAM, a DMA channel is not necessary and the dmachan parameter can be set to -1 to cause a CPU copy instead. A DMA channel can still be used to plug a vector in external RAM. A DMA channel must be used to plug a vector in internal program RAM.

For ’C6x11 devices, the dmachan should be set to -1, regardless of where the IST is stored.

If a DMA channel is specified by the dmachan parameter, C62_plug assumes that the DMA channel is available for use, and stops the DMA channel before programming it. If the DMA channel is shared with other code, a sempahore or other DSP/BIOS signaling method should be used to provide mutual exclusion before calling C62_plug.

C62_plug does not enable the interrupt. Use C62_enableIER to enable specific interrupts.

Constraints and Calling Context

- ❏ vecid must be a valid interrupt ID in the range of 0-15.
- ❏ dmachan must be 0, 1, 2, or 3 if the IST is in internal program memory and the device is a ’C6x0x.

See Also

C62_enableIER
HWI_dispatchPlug

C64_plug

C function to plug an interrupt vector

C Interface

Syntax

C64_plug(vecid, fxn);

Parameters

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

Return Value

Void

Assembly Interface

none

Description

C64_plug writes an Interrupt Service Fetch Packet (ISFP) into the Interrupt Service Table (IST), at the address corresponding to vecid. The op-codes written in the ISFP create a branch to the function entry point specified by fxn:

```
stw    b0, *SP--[1]
mvk    fxn, b0
mvkh   fxn, b0
b      b0
ldw    *++SP[1],b0
nop    4
```

For ’C6x0x devices, if the IST is stored in external RAM, a DMA channel is not necessary and the dmachan parameter can be set to -1 to cause a CPU copy instead. A DMA channel can still be used to plug a vector in external RAM. A DMA channel must be used to plug a vector in internal program RAM.

For ’C6x11 devices, the dmachan should be set to -1, regardless of where the IST is stored.

If a DMA channel is specified by the dmachan parameter, C64_plug assumes that the DMA channel is available for use, and stops the DMA channel before programming it. If the DMA channel is shared with other code, a sempahore or other DSP/BIOS signaling method should be used to provide mutual exclusion before calling C64_plug.

C64_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. C64_plug does not enable the interrupt. Use or C64_enableIER to enable specific interrupts.

Constraints and Calling Context

- ❏ vecid must be a valid interrupt ID in the range of 0-15.
- ❏ dmachan must be 0, 1, 2, or 3 if the IST is in internal program memory and the device is a ’C6x0x.

See Also

C64_enableIER

2.3 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 1-4.

Module Configuration Parameters

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")
TIMERSELECT	String	"Timer 0"
ENABLECLK	Bool	true
HIRESTIME	Bool	true
MICROSECONDS	Int16	1000
CONFIGURETIMER	Bool	false
PRD	Int16	33250

Instance Configuration Parameters

Name	Type	Default
comment	String	"<add comments here>"
fxn	Extern	prog.extern("FXN_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 0 when the maximum value is reached.

If the Clock Manager is enabled in the Configuration Tool, the timer counter register is incremented every four CPU cycles.

When this register reaches the value set for the period register, the counter is reset to 0 and a timer interrupt occurs. When a timer interrupt occurs, the HWI object for the selected 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

Note: Specifying On-device Timer

The Configuration Tool allows you to specify which on-device timer you want to use. DSP/BIOS requires the default setting in the interrupt selector register for the selected timer. For example, interrupt 14 must be configured for timer 0, interrupt 15 must be configured for timer 1, and interrupt 11 must be configured for timer 2.

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 incremented (number of instruction cycles divided by 4). 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 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 the HWI dispatcher 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.

The HWI object that runs the CLK_F_isr function is configured to use the HWI dispatcher. You can modify the dispatcher-specific properties of this HWI object. For example, you can change the interrupt mask value and the cache control value. See the HWI Module, page 2–114, for a description of the HWI dispatcher and these HWI properties. *You may not* disable the use of the HWI dispatcher for the HWI object that runs the CLK_F_isr function.

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 Configuration Tool.

TextConf Name: OBJMEMSEG Type: Ref

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: Int

  Example: `CLK.MICROSECONDS = 1000;`

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

  TextConf Name: CONFIGURETIMER Type: Bool

  Example: `CLK.CONFIGURETIMER = false;`

- **PRD Register**. This value is written to the PRD register.

  TextConf Name: PRD Type: Int

  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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code, which must use leading underscores when referencing C functions or labels.)

  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: Int

  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

Syntax	CLK_countspms
Preconditions	amr = 0
Postconditions	a4 = the number of hardware timer register ticks per millisecond
Modifies	a4

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 counts. For example, the following code returns the number of milliseconds since the 32-bit high-resolution time last wrapped back to 0:

```
timeAbs = (CLK_getltime() * (CLK_getprd())) /
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

Syntax CLK_gethtime

Preconditions interrupts are disabled
b14 = pointer to the start of .bss
amr = 0

Postconditions a4 = high-resolution time value

Modifies a2, a3, a4, a5, b1, b2, b3, b4, b5

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 incremented. When the CLK manager is enabled in the Configuration Tool, the timer counter register is incremented every four CPU cycles.

When this register reaches the value set for the period register, the counter is reset to 0 and a timer interrupt occurs. When a timer interrupt occurs, the HWI object for the selected 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 the value set for the period register property of the CLK module, the counter is reset to 0 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 current value of the timer counter register. 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

Syntax	CLK_getltime
Preconditions	b14 = pointer to the start of .bss amr = 0
Postconditions	a4 = low-resolution time value
Modifies	a4

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 incremented every four CPU cycles. When this register reaches the value set for the period register property of the CLK module, the counter is reset to 0 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 the value set for the period register property of the CLK module, the counter is reset to 0 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 200 MHz, and you use the default period register value of 50000, the CLK_gethtime value wraps back to 0 approximately every 86 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", 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	amr = 0
Postconditions	a4
Modifies	a4

Reentrant yes

Description CLK_getprd returns the value set for the period register property of the CLK Manager in the Configuration Tool. CLK_getprd can be used to compute an absolute length of time from the number of hardware timer counts. For example, the following code returns the number of milliseconds since the 32-bit high-resolution time last wrapped back to 0:

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

See Also CLK_countspms
CLK_gethtime
STS_delta

2.4 DEV Module

The DEV module is the device driver interface.

Functions

- ❑ 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

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 */
   Int      devid;   /* device ID */
   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 */
   DEV_Fxns *fxns;   /* device function table*/
   Int      devid;   /* device ID */
   Ptr       params; /* device parameters */
   Uns       type;   /* type of the device */
   Ptr       devp;   /* pointer to device handle */
} DEV_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 DEV Manager Properties and DEV Object Properties headings. For descriptions of data types, see Section 1.4, *DSP/BIOS TextConf Overview*, page 1-4.

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", "other")
deviceId	Arg	0x00000000
params	Arg	0x00000000
deviceGlobalDataPtr	Arg	0x00000000

Description

Using generic functions provided by the SIO Module, programs indirectly invoke corresponding functions which manage the particular device attached to the stream. Unlike other modules, your application programs do not issue direct calls to driver functions that manipulate individual device objects managed by the module. Instead, each driver module exports a distinguished structure of type DEV_Fxns, which is used by the SIO module to route generic function calls to the proper driver function.

The Dxx functions are templates for driver functions. To ensure that all driver functions present an identical interface to DEV, the driver functions must follow these templates.

DEV Manager Properties

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

❏ DGN Driver (software generator driver). A 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). A driver that uses the HST interface to send data to and from the DSP/BIOS Host Channel Control Analysis Tool.

❏ DIO Adapter (class driver). A driver used with the device driver model.

❏ DPI Driver (pipe driver). A software device used to stream data between DSP/BIOS tasks.

To configure devices for other drivers, use the 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.

  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. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.)

  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. The "other" option is for use with custom drivers.

  TextConf Name: fxnTableType Type: EnumString

  Options: "DEV_Fxns", "IOM_Fxns", "other"

  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.

  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_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 1-4.

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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.)

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 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 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

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 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 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: Ref

  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: Ref

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 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.** GIO_Fxns
- ❑ **device id.** Type 0 (zero).
- ❑ **device params ptr.** Type 0 (zero).

Once there are UDEV objects with the GIO_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 1-4.

Module Configuration Parameters

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")
STATICCREATE	Bool	false

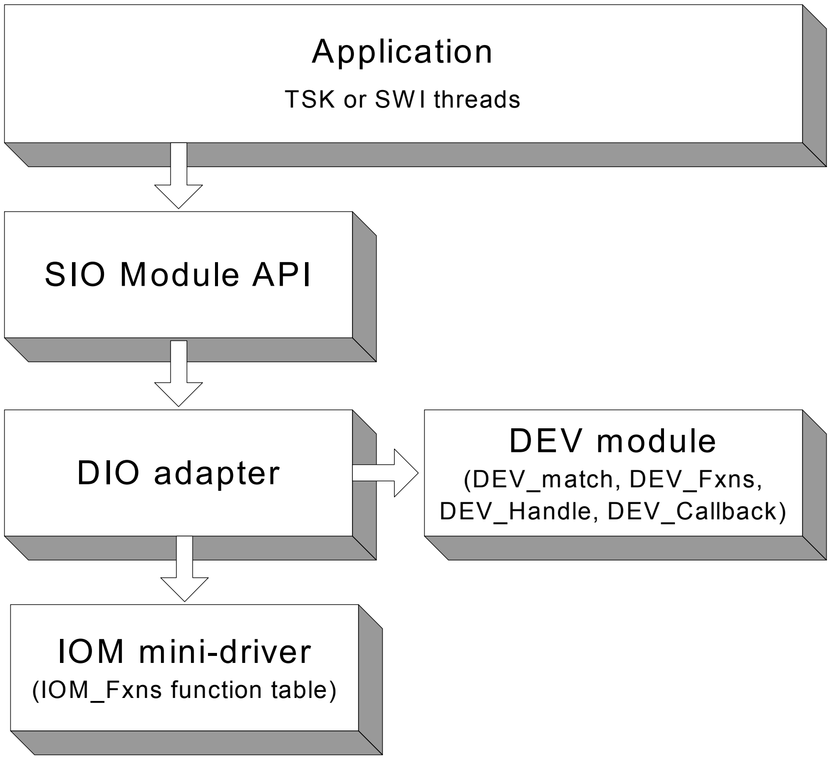
Instance Configuration Parameters.

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: Ref

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: Ref

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 optArgs 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 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 8-bit word in the data address space of the processor on C6x platforms.

Configuring a DOV Device

To add a DOV device, right-click on the User-defined Devices icon in the 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 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 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 Configuration Tool and enter 16 as the Device ID property, leave the Device Control String blank.

In addition to the 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 Configuration Tool (rather than dynamically with SIO_create), add SIO objects with the 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 1-4.

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 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 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\c6000\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 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 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 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 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 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 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 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 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.

2.5 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 an 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_init. Initializes GIO module.
- ❏ 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 */

/* Command codes */
#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 */
```

```
/* 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;   /* pointer 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 synchronization 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 1-4.

Module Configuration Parameters.

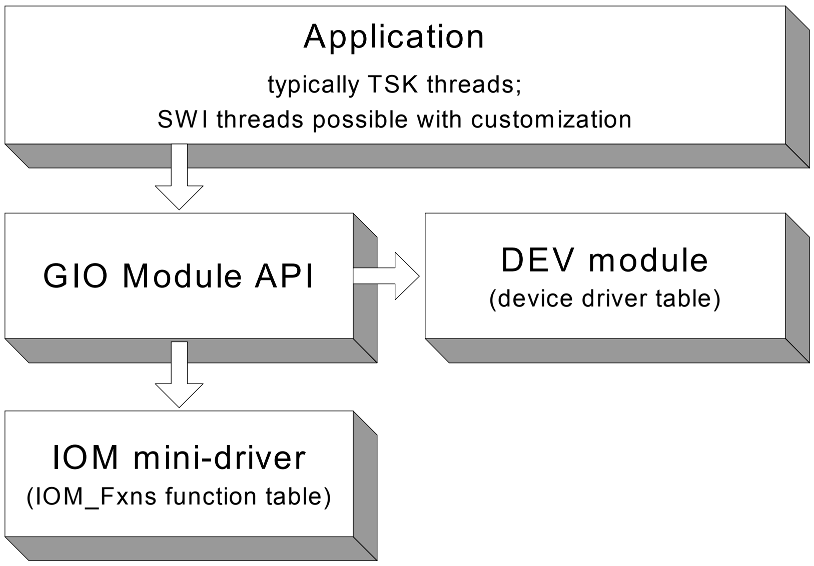
Name	Type	Default
ENABLEGIO	Bool	false
CREATEFXN	Extern	prog.extern("FXN_F_nop")
DELETEFXN	Extern	prog.extern("FXN_F_nop")
PENDFXN	Extern	prog.extern("FXN_F_nop"
POSTFXN	Extern	prog.extern("FXN_F_nop")

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.

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 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 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 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 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 77.

A call to GIO_abort results in a call to the mdSubmit function of the associated mini-driver. The GIO_ABORT command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_abort 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_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 77. 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 77.

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 an GIO object

C Interface

Syntax

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

Parameters

String	name	/* name of the device to open */
Int	mode	/* mode in which the device is to be opened */
Int	*status	/* address location to place driver return status */
Ptr	optArgs	/* optional domain/device-specific arguments */
GIO_Attrs	*attrs	/* pointer to an 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 an 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 optArgs 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;
```

The GIO_create call allocates a list of GIO_Packet items as specified by the nPackets member of the GIO_Attrs structure and stores them in the GIO_Obj object is 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,
                    &IopAttrs);
```

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 77.

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 GIO_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 77.

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

Initialize GIO module

C Interface

Syntax

GIO_init();

Parameters

Void

Return Value

Void

Assembly Interface

none

Description

The application calls GIO_init to initialize the GIO module, which manages the GIO objects. Mini-drivers used via the GIO module have their own separate initialization functions.

Constraints and Calling Context

❑ This function should be called with interrupts disabled.

Example

```
/* initialize GIO module */
GIO_init();
```

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 */
LgUns       *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 R, G, B 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 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 77.

A call to GIO_read results in a call to the mdSubmit function of the associated mini-driver. The GIO_READ command is passed to the mdSubmit function. The mdSubmit call is typically a blocking call, so calling GIO_read 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_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*/
GIO_read(gioChan, &ReadStruct, sizeof (ReadStruct));
```

GIO_submit

Submit an 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 */
LgUns       *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 77. 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 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 is invoked, if specified.

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 77.

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*/
GIO_submit(gioChan, &userStruct, sizeof(userStruct),
&callbackStruct);

/* write synchronously to the device */
GIO_submit(gioChan, &userStruct, sizeof(userStruct),
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 */
LgUns       *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 R, G, B 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 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 77.

A call to GIO_write results in a call to the mdSubmit function of the associated mini-driver. The GIO_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*/
GIO_write(gioChan, &WriteStrct, sizeof(WriteStrct));
```

2.6 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 1-4.

Module Configuration Parameters

Name	Type	Default (Enum Options)
BOARDNAME	String	"c6xxx"
CLKOUT	Int16	133.0000
DSPTYPE	Int16	62
CHIPTYPE	EnumString	"6201" ("6201", "6202", "6203", "6204", "6205", "6211", "6701", "6711", "6712", "other")
ENDIANMODE	EnumString	"little" ("big")
ALLUSERINITFXN	Bool	false
USERINITFXN	Extern	prog.extern("FXN_F_nop")
ENABLEINST	Bool	true
ENABLEALLTRC	Bool	true
CDBRELATIVEPATH	String	""
CSRPCC	EnumString	"mapped" ("cache enable", "cache freeze", "cache bypass")
C621XCONFIGUREL2	Bool	false
C641XCONFIGUREL2	Bool	false
C621XCCFGL2MODE	EnumString	"SRAM" ("1-way cache", "2-way cache", "3-way cache", "4-way cache")
C641XCCFGL2MODE	EnumString	"SRAM" ("1-way cache", "2-way cache", "3-way cache", "4-way cache")
C621XMAR	Numeric	0x0000
C641XMAREMIFB	Numeric	0x0000

Name	Type	Default (Enum Options)
C641XMARCE0	Numeric	0x0000
C641XMARCE1	Numeric	0x0000
C641XMARCE2	Numeric	0x0000
C641XMARCE3	Numeric	0x0000
C641XCCFGP	EnumString	"urgent" ("high", "medium", "low")
C641XSETL2ALLOC	Bool	false
C641XL2ALLOC0	EnumInt	6
C641XL2ALLOC1	EnumInt	2 (0 to 7)
C641XL2ALLOC2	EnumInt	2 (0 to 7)
C641XL2ALLOC3	EnumInt	2 (0 to 7)

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:

❑ **Target Board Name**. The type of board on which your target device is mounted.

TextConf Name: BOARDNAME Type: String

Example: `GBL.BOARDNAME = "c6xxx";`

❑ **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: Int

Example: `GBL.CLKOUT = 133.0000`

❑ **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. This value determines which DSP family tab in the Properties dialog contains writable fields.

TextConf Name: DSPTYPE Type: Int

Example: `GBL.DSPTYPE = 62;`

❏ **Chip Support Library (CSL).** Specifies the specific chip type, such as 6201, 6711, 6400, 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: "6201", "6202", "6203", "6204", "6205", "6211", "6701", "6711", "6712", "other"

Example: `GBL.CHIPTYPE = "6201";`

❏ **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

❏ **DSP Endian Mode**. 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. This field must match the setting in the DSP's CSR register.

TextConf Name: ENDIANMODE Type: EnumString

Options: "little", "big"

Example: `GBL.ENDIANMODE = "little";`

❏ **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";
  ```

- ❑ **Program Cache Control - CSR(PCC)**. This field in the DSP family tabs specifies the cache mode for the DSP at program initiation.

  TextConf Name: CSRPCC Type: EnumString

  Options: "mapped", "cache enable", "cache freeze", "cache bypass"

  Example: `GBL.CSRPCC = "mapped";`

- ❑ **Configure L2 Memory Settings**. (621x/671x and 641x tabs) You can check this box for DSPs that have a L1/L2 cache (for example, the c6211). The following fields are available if this box is checked.

  TextConf Name: C621XCONFIGUREL2 Type: Bool

  TextConf Name: C641XCONFIGUREL2 Type: Bool

  Example: `GBL.C621XCONFIGUREL2 = false;`

❑ **L2 Mode - CCFG(L2MODE)**. (621x/671x and 641x tabs) Sets the L2 cache mode. See the *c6000 Peripherals Manual* for details.

TextConf Name: C621XCCFGL2MODE Type: EnumString

TextConf Name: C641XCCFGL2MODE Type: EnumString

Options: "SRAM", "1-way cache", "2-way cache", "3-way cache", "4-way cache"

Example: `GBL.C621XCCFGL2MODE = "SRAM";`

❑ **L2 MAR 0-15 - bitmask used to initialize MARs**. (621x/671x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the 16 modifiable bits in registers MAR0 through MAR15.

TextConf Name: C621XMAR Type: Numeric

Example: `GBL.C621XMAR = 0x0000;`

❑ **MAR96-101 - bitmask controls EMIFB CE space**. (641x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the modifiable bits in registers MAR96 through MAR101.

TextConf Name: C641XMAREMIFB Type: Numeric

Example: `GBL.C641XMAREMIFB = 0x0000;`

❑ **MAR128-143 - bitmask controls EMIFA CE0 space**. (641x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the modifiable bits in registers MAR128 through MAR143.

TextConf Name: C641XMARCE0 Type: Numeric

Example: `GBL.C641XMARCE0 = 0x0000;`

❑ **MAR144-159 - bitmask controls EMIFA CE1 space**. (641x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the modifiable bits in registers MAR144 through MAR159.

TextConf Name: C641XMARCE1 Type: Numeric

Example: `GBL.C641XMARCE1 = 0x0000;`

❑ **MAR160-175 - bitmask controls EMIFA CE2 space**. (641x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the modifiable bits in registers MAR160 through MAR175.

TextConf Name: C641XMARCE2 Type: Numeric

Example: `GBL.C641XMARCE2 = 0x0000;`

- **MAR176-191 - bitmask controls EMIFA CE3 space**. (641x tab) Only bit 0 of each of these 32-bit registers is modifiable by the user. All other bits are reserved. Specify a bitmask for the modifiable bits in registers MAR176 through MAR191.

  TextConf Name: C641XMARCE3 Type: Numeric

  Example: `GBL.C641XMARCE3 = 0x0000;`

- **L2 Requestor Priority - CCFG(P)**. (641x tab) Specifies the CPU/DMA cache priority. See the *c6000 Peripherals Manual* for details.

  TextConf Name: C641XCCFGP Type: EnumString

  Options: "urgent", "high", "medium", "low"

  Example: `GBL.C641XCCFGP = "urgent";`

- **Configure Priority Queues**. (641x tab) Put a checkmark in this box if you want to configure the maximum number of transfer requests on the L2 priority queues.

  TextConf Name: C641XSETL2ALLOC Type: Bool

  Example: `GBL.C641XSETL2ALLOC = false;`

- **Max L2 Transfer Requests on URGENT Queue (L2ALLOC0)**. (641x tab) Select a number from 0 to 7 for the maximum number of L2 transfer requests permitted on the URGENT queue.

  TextConf Name: C641XL2ALLOC0 Type: EnumInt

  Options: 0 to 7

  Example: `GBL.C641XL2ALLOC0 = 6;`

- **Max L2 Transfer Requests on HIGH Queue (L2ALLOC1)**. (641x tab) Select a number from 0 to 7 for the maximum number of L2 transfer requests permitted on the HIGH priority queue.

  TextConf Name: C641XL2ALLOC1 Type: EnumInt

  Options: 0 to 7

  Example: `GBL.C641XL2ALLOC1 = 2;`

- **Max L2 Transfer Requests on MEDIUM Queue (L2ALLOC2)**. (641x tab) Select a number from 0 to 7 for the maximum number of L2 transfer requests permitted on the MEDIUM priority queue.

  TextConf Name: C641XL2ALLOC2 Type: EnumInt

  Options: 0 to 7

  Example: `GBL.C641XL2ALLOC2 = 2;`

- ❑ **Max L2 Transfer Requests on LOW Queue (L2ALLOC3)**. (641x tab) Select a number from 0 to 7 for the maximum number of L2 transfer requests permitted on the LOW priority queue.

TextConf Name:	C641XL2ALLOC3	Type: EnumInt
Options:	0 to 7	
Example:	`GBL.C641XL2ALLOC3 = 2;`	

2.7 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 1-4.

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")

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 needs to call the 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 a few of the 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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.) The TSK_create topic describes the Create function.

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, 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, 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, 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, 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");
  ```

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

2.8 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 1-4.

Module Configuration Parameters.

Name	Type	Default (Enum Options)
OBJMEMSEG	Reference	prog.get("IDRAM")
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("IDRAM")
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: Ref

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

❏ **bufalign.** The alignment (in words) of the buffer allocated within the specified memory segment.

TextConf Name:	bufAlign	Type: Int
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: Int
Example:	`myHst.frameSize = 128;`	

❏ **numframes.** The number of frames

TextConf Name:	numFrames	Type: Int
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 32-bit arguments passed to the notify function. They can be either unsigned 32-bit constants or symbolic labels.

  TextConf Name: arg0 Type: Arg

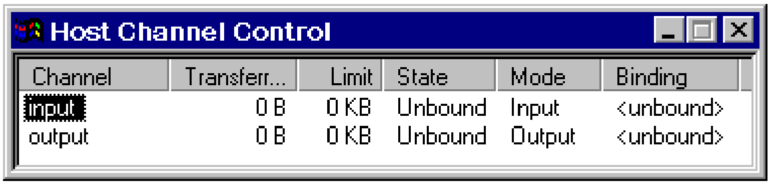
  TextConf Name: arg1 Type: Arg

  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.



Channel	Transferr...	Limit	State	Mode	Binding
input	0 B	0 KB	Unbound	Input	<unbound>
output	0 B	0 KB	Unbound	Output	<unbound>

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

Syntax HST_getpipe

Preconditions a4 = HST channel object pointer
amr = 0

Postconditions a4 = address of the pipe object

Modifies a4

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

2.9 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 1-4.

Module Configuration Parameters.

Name	Type	Default (Enum Options)
RESETVECTOR	Bool	false
EXTPIN4POLARITY	EnumString	"low-to-high" ("high-to-low")
EXTPIN5POLARITY	EnumString	"low-to-high" ("high-to-low")
EXTPIN6POLARITY	EnumString	"low-to-high" ("high-to-low")
EXTPIN7POLARITY	EnumString	"low-to-high" ("high-to-low")

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.

Name	Type	Default (Enum Options)
comment	String	"<add comments here>"

Name	Type	Default (Enum Options)
interruptSource	EnumString	"Reset" (Non_Maskable", "Reserved", "Timer 0", "Timer 1", "Host_Port_Host_to_DSP", "EMIF_SDRAM_Timer", "PCI_WAKEUP", "AUX_DMA_HALT", "External_Pin_4", "External_Pin_5", "External_Pin_6", "External_Pin_7", "DMA_Channel_0", "DMA_Channel_1", "DMA_Channel_2", "DMA_Channel_3", "MCSP_0_Transmit", "MCSP_0_Receive", "MCSP_1_Transmit", "MCSP_2_Receive", "MCSP_2_Transmit", "MCSP_2_Receive")
fxn	Extern	prog.extern("HWI_unused,"asm")
monitor	EnumString	"Nothing" ("Data Value", "Stack Pointer", "Top of SW Stack", "A0" ... "A15", "B0" ..."B15")
addr	Arg	0x00000000
dataType	EnumString	"signed" ("unsigned")
operation	EnumString	"STS_add(*addr)" ("STS_delta(*addr)", "STS_add(-*addr)", "STS_delta(-*addr)", "STS_add(|*addr|)", "STS_delta(|*addr|)")
useDispatcher	Bool	false
arg	Arg	3
interruptMask	EnumString	"self" ("all", "none", "bitmask")
interruptBitMask	Numeric	0x0010
cacheControl	Bool	true
progCacheMask	EnumString	"mapped" ("cache enable", "cache freeze", "cache bypass")
dataCacheMask	EnumString	"mapped" ("cache enable", "cache freeze", "cache bypass")

Description

The HWI module manages hardware interrupts. Using the 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 C62_plug or C64_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.

The HWI dispatcher is the preferred method for handling an interrupt. When enabled, the HWI objects that run functions for the CLK and RTDX modules use the dispatcher.

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 the HWI dispatcher 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 IEMASK and the cache control field.

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. You can use the IEMASK parameter for the HWI_enter API 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.

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

❏ **Generate RESET vector at address 0.** Check this box in order to place the interrupt vector table at address 0. This option is available only if address 0 currently exists within the memory configuration.

TextConf Name:	RESETVECTOR	Type: Bool
Example:	`HWI.RESETVECTOR = false;`	

❏ **External Interrupt Pin 4-7 Polarity**. Choose whether the device connected to this pin causes an interrupt when a high-to-low transition occurs, or when a low-to-high transition occurs.

TextConf Name:	EXTPIN4POLARITY	Type: EnumString
TextConf Name:	EXTPIN5POLARITY	Type: EnumString
TextConf Name:	EXTPIN6POLARITY	Type: EnumString
TextConf Name:	EXTPIN7POLARITY	Type: EnumString
Options:	"low-to-high", "high-to-low"	

Example:
```
HWI.EXTPIN4POLARITY =
    "low-to-high";
```

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_INT4.comment = "myISR";`

❑ **interrupt source**. Select the pin, DMA channel, timer, or other source of the interrupt.

TextConf Name: interruptSource   Type: EnumString

Options: "Reset", "Non_Maskable", "Reserved", "Timer 0", "Timer 1", "Host_Port_Host_to_DSP", "EMIF_SDRAM_Timer", "PCI_WAKEUP", "AUX_DMA_HALT", "External_Pin_4", "External_Pin_5", "External_Pin_6", "External_Pin_7", "DMA_Channel_0", "DMA_Channel_1", "DMA_Channel_2", "DMA_Channel_3", "MCSP_0_Transmit", "MCSP_0_Receive", "MCSP_1_Transmit", "MCSP_2_Receive", "MCSP_2_Transmit", "MCSP_2_Receive"

Example:
```
HWI_INT4.interruptSource =
    "External_Pin_4";
```

❑ **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_INT4.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", "A0" ... "A15", "B0" ..."B15"

  Example: `HWI_INT4.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_INT4.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_INT4.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_INT4.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_INT4.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_INT4.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.

  TextConf Name: interruptMask Type: EnumString

  Options: "self", "all", "none", "bitmask"

  Example: `HWI_INT4.interruptMask = "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.

  TextConf Name: interruptBitMask Type: Numeric

  Example: `HWI_INT4.interruptBitMask = 0x0010;`

- **Don't modify cache control**. A check box that chooses between not modifying the cache at all or enabling the individual drop-down menus for program and data cache control masks. This property is available only when using the HWI dispatcher.

  TextConf Name: cacheControl Type: Bool

  Example: `HWI_INT4.cacheControl = true;`

- **Program Cache Control Mask**. A drop-down menu that becomes writable when the "don't modify cache control" box is not checked. The choices (mapped, cache enable, cache bypass, cache freeze) are the same choices available from the GBL properties.

  TextConf Name: progCacheMask Type: EnumString

  Options: "mapped", "cache enable", "cache freeze", "cache bypass"

  Example: `HWI_INT4.progCacheMask = "mapped";`

- **Data Cache Control Mask**. A drop-down menu that becomes writable when the "don't modify cache control" box is not checked. The choices (mapped, cache enable, cache bypass, cache freeze) are the same choices available from the "program cache control mask" menu.

  TextConf Name: dataCacheMask Type: EnumString

  Options: "mapped", "cache enable", "cache freeze", "cache bypass"

  Example: `HWI_INT4.dataCacheMask = "mapped";`

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 that uses the dispatcher. As a result, you can modify the dispatcher's parameters for the CLK HWI, such as the cache setting or the interrupt mask. However, you cannot disable use of the dispatcher for the CLK HWI.

Table 2-1 lists 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 TMS320C6000

Name	Default Interrupt Source
HWI_RESET	Reset
HWI_NMI	NMI
HWI_INT4	INT4
HWI_INT5	INT5
HWI_INT6	INT6
HWI_INT7	INT7
HWI_INT8	INT8
HWI_INT9	INT9
HWI_INT10	INT10
HWI_INT11	INT11
HWI_INT12	INT12
HWI_INT13	INT13
HWI_INT14	INT14
HWI_INT15	INT15

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	oldCSR = HWI_disable();
Parameters	Void
Return Value	Uns oldCSR;

Assembly Interface

Syntax	HWI_disable
Preconditions	amr = 0

Postconditions	GIE = 0
	a4 = csr when HWI_disable was invoked

Modifies	a4, b0, csr

Reentrant

yes

Description

HWI_disable disables hardware interrupts by clearing the GIE bit in the Control Status Register (CSR). 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.

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, dmachan, attrs);
```

Parameters

```
Int         vecid;    /* interrupt id */
Fxn         fxn;      /* pointer to HWI function */
Int         dmachan;  /* DMA channel to use for performing plug */
HWI_Attrs   *attrs    /*pointer to HWI dispatcher attributes */
```

Return Value

Void

Assembly Interface

none

Reentrant

yes

Description

HWI_dispatchPlug writes an Interrupt Service Fetch Packet (ISFP) into the Interrupt Service Table (IST), at the address corresponding to vecid. The op-codes written in the ISFP create a branch 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.

For 'C6x0x devices, if the IST is stored in external RAM, a DMA (Direct Memory Access) channel is not necessary and the dmachan parameter can be set to -1 to cause a CPU copy instead. A DMA channel can still be used to plug a vector in external RAM. A DMA channel must be used to plug a vector in internal program RAM.

For 'C6x11 devices, the dmachan should be set to -1, regardless of where the IST is stored.

If a DMA channel is specified by the dmachan parameter, HWI_dispatchPlug assumes that the DMA channel is available for use, and stops the DMA channel before programming it. If the DMA channel is shared with other code, a semaphore or other DSP/BIOS signaling method should be used to provide mutual exclusion before calling C62_plug, C64_plug or HWI_dispatchPlug.

HWI_dispatchPlug does not enable the interrupt. Use C62_enableIER or C64_enableIER 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:

```
typedef struct HWI_Attrs {
   Uns   intrMask; /* IER bitmask, 1="self" (default) */
   Uns   ccMask    /* CSR CC bitmask, 1="leave alone" */
   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 IER. A value of 1 indicates an interrupt is being plugged. The default value is 1.

The ccMask element is a bitfield that corresponds to the cache control bitfield in the CSR. A value of 1 indicates that the HWI dispatcher should not modify the cache control settings at all. The default value is 1.

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 0-15.
- ❏ dmachan must be 0, 1, 2, or 3 if the IST is in internal program memory and the device is a ’C6x0x.

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

Syntax	HWI_enable
Preconditions	amr = 0
Postconditions	GIE = 1
Modifies	b0, csr

Reentrant yes

Description

HWI_enable enables hardware interrupts by setting the GIE bit in the Control Status Register (CSR).

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 ABMASK, CMASK, IEMASK, CCMASK
Preconditions	interrupts are globally disabled (that is, GIE == 0)

Postconditions	amr = 0
	GIE = 1
	dp (b14) = .bss

Modifies	a0, a1, a2, a3, amr, b0, b1, b2, b3, b14, b15, csr, ier

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.

Note:

For the C64 device, substitute 64 in each instance where 62 appears below unless otherwise specified.

Common masks are defined in the device-specific assembly macro files, c62.h62 and c64.h64. The c62.h62 file defines C62_ABTEMPS and C62_CTEMPS. The c64.h64 file defines C64_ATEMPS, C64_BTEMPS, and C64_CTEMPS. These masks specify the C temporary registers and should be used when saving the context for an ISR that is written in C.

The input parameter CCMASK specifies the program cache control (PCC) and data cache control (DCC) codes you need to use in the context of the ISR. Some typical values for this mask are defined in c62.h62 (or c64.h64). The PCC code and DCC code can be ORed together (for example, C62_PCC_ENABLE | C62_PCC_DISABLE) to generate CCMASK. If you use 0 as CCMASK, C62_CCDEFAULT is used. C62_CCDEFAULT is defined in c62.h62 as C62_PCC_DISABLE | C62_PCC_DISABLE. You set this value in the Global Settings Properties in the Configuration Tool. The following parameters and constants are available for HWI_enter:

- **ABMASK**. Register mask specifying A, B registers to save
  - **C62_ABTEMPS**. Mask to use if calling C function from within ISR; defined in c62.h62
  - **C62_A0 - C62_A15, C62_B0 - C62_B15**. Individual register constants; can be ORed together for more precise control than using C62_ABTEMPS
  - **C64_A0 - C64_A31, C64_B0 - C64_B31**. Individual register constants; can be ORed together for more precise control than using C64_ATEMPS and C64_BTEMPS
- **CMASK**. Register mask specifying control registers to save
  - **C62_CTEMPS**. Mask to use if calling C function from within ISR; defined in c62.h62
  - **C62_AMR**, **C62_CSR**, **C62_IER**, **C62_IST**, **C62_IRP**, **C62_NRP**. Individual register constants; can be ORed together for more precise control than using C62_CTEMPS
- **IEMASK**. Bit mask specifying IER bits to disable. Any bit mask can be specified, with bits having a one-to-one correspondence with the assigned values in the IER. The following convenience macros can be ORed together to specify the mask of interrupts to disable
  - **C62_NMIE**
  - **C62_IE4 - C62_IE15**

- ❏ **CCMASK**. Bit mask specifying cache control bits in the CSR. The following macros directly correspond to the possible modes of the program cache specified in the CSR.
  - ■ **C62_PCC_DISABLE**
  - ■ **C62_PCC_ENABLE**
  - ■ **C62_PCC_FREEZE**
  - ■ **C62_PCC_BYPASS**

Note that if HWI_enter modifies CSR bits, those changes are lost when interrupt processing is complete. HWI_exit restores the CSR to its value when interrupt processing began no matter what the value of CCMASK.

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.

Example

CLK_isr:

```
HWI_enter C62_ABTEMPS, C62_CTEMPS, 0XF0,
C62_PCC_ENABLE|C62_PCC_DISABLE
PRD_tick
HWI_exit C62_ABTEMPS, C62_CTEMPS, 0XF0,
C62_PCC_ENABLE|C62_PCC_DISABLE
```

See Also

HWI_exit

HWI_exit *Hardware ISR epilog*

C Interface

Syntax none

Parameters none

Return Value none

Assembly Interface

Syntax HWI_exit ABMASK CMASK IERRESTOREMASK CCMASK

Preconditions b14 = pointer to the start of .bss
amr = 0

Postconditions none

Modifies a0, a1, amr, b0, b1, b2, b3, b14, b15, csr, ier, irp

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 ABMASK and CMASK. These masks are 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 IERRESTOREMASK, HWI_exit only restores those enabled upon entering the ISR. HWI_exit does not affect the status of interrupt bits that are not in IERRESTOREMASK. 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 IERRESTOREMASK 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 IER register. (Including a bit in IER in the IERRESTOREMASK of HWI_exit does not enable the interrupt if it was disabled when the ISR was entered.)

Note:

For the C64 device, substitute 64 in each instance where 62 appears below unless otherwise specified.

The following parameters and constants are available for HWI_exit:

❑ **ABMASK**. Register mask specifying A, B registers to restore.

- **C62_ABTEMPS**. Mask to use if calling C function from within ISR; defined in c62.h62.
- **C62_A0 - C62_A15, C62_B0 - C62_B15**. Individual register constants; can be ORed together for more precise control than using C62_ABTEMPS.
- **C64_A0 - C64_A31, C64_B0 - C64_B31**. Individual register constants; can be ORed together for more precise control than using C64_ATEMPS and C64_BTEMPS

❑ **CMASK**. Register mask specifying control registers to restore.

- **C62_CTEMPS**. Mask to use if calling C function from within ISR; defined in c62.h62.
- **C62_AMR**, **C62_CSR**, **C62_IER**, **C62_IST**, **C62_IRP**, **C62_NRP**. Individual register constants; can be ORed together for more precise control than using C62_CTEMPS.

❑ **IERRESTOREMASK**. Bit mask specifying IER bits to restore. Any bit mask can be specified, with bits having a one-to-one correspondence with the assigned values in the IER. The following convenience macros can be ORed together to specify the mask of interrupts to restore.

- **C62_NMIE**
- **C62_IE4 - C62_IE15**

- ❏ **CCMASK**. Bit mask specifying cache control bits in CSR. The following macros directly correspond to the possible modes of the program cache specified in the CSR.
  - ■ **C62_PCC_DISABLE**
  - ■ **C62_PCC_ENABLE**
  - ■ **C62_PCC_FREEZE**
  - ■ **C62_PCC_BYPASS**

To be symmetrical, even though CCMASK has no effect on HWI_exit, you should use the same CCMASK that is used in HWI_enter for HWI_exit. HWI_exit restores the CSR to its value when interrupt processing began no matter what the value of CCMASK.

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.
- ❏ The ABMASK and CMASK 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.

Example

CLK_isr:

```
HWI_enter C62_ABTEMPS, C62_CTEMPS, 0XF0,
C62_PCC_ENABLE|C62_PCC_DISABLE
PRD_tick
HWI_exit C62_ABTEMPS, C62_CTEMPS, 0XF0,
C62_PCC_ENABLE|C62_PCC_DISABLE
```

See Also

HWI_enter

HWI_restore *Restore global interrupt enable state*

C Interface

Syntax HWI_restore(oldCSR);

Parameters Uns oldCSR;

Returns Void

Assembly Interface

Syntax HWI_restore

Preconditions a4 = mask (GIE is set to the value of bit 0)
GIE = 0
amr = 0

Postconditions none

Modifies a1, b0, csr

Reentrant yes

Description HWI_restore sets the global interrupt enable (GIE) bit in the Control Status Register (CSR) using the least significant bit of the oldCSR parameter. If bit 0 is 0, the GIE bit is not modified. If bit 0 is 1, the GIE bit is set to 1, which enables interrupts.

When you call HWI_disable, the previous contents of the 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

```
oldCSR = HWI_disable(); /* disable interrupts */
   'do some critical operation'
HWI_restore(oldCSR);
      /* re-enable interrupts if they
         were enabled at the start of the
         critical section */
```

See Also HWI_enable
HWI_disable

2.10 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 1-4.
Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")
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

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 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 2–97), 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: Ref

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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.)

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;`

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.

2.11 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 1-4.

Module Configuration Parameter.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

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: Ref

  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 2–170.

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 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 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.

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 only be used outside the context of SWI and HWI threads.

To determine whether a particular RTS function uses LCK_pend or LCK_post, refer to the source code for that function shipped with CCStudio. The following table shows some of the RTS functions that call LCK_pend and LCK_post in certain versions of CCStudio:

fprintf	printf	vfprintf	sprintf
vprintf	vsprintf	clock	strftime
minit	malloc	realloc	free
calloc	rand	srand	getenv

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

2.12 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

Instance Configuration Parameters.

Name	Type	Default (Enum Options)
comment	String	"<add comments here>"
bufSeg	Reference	prog.get("IDRAM")
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 2–349, 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.

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: Ref
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: Ref

  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 2–155, and LOG_event, page 2–152, for information about the structure of a log record.

TextConf Name: format Type: String

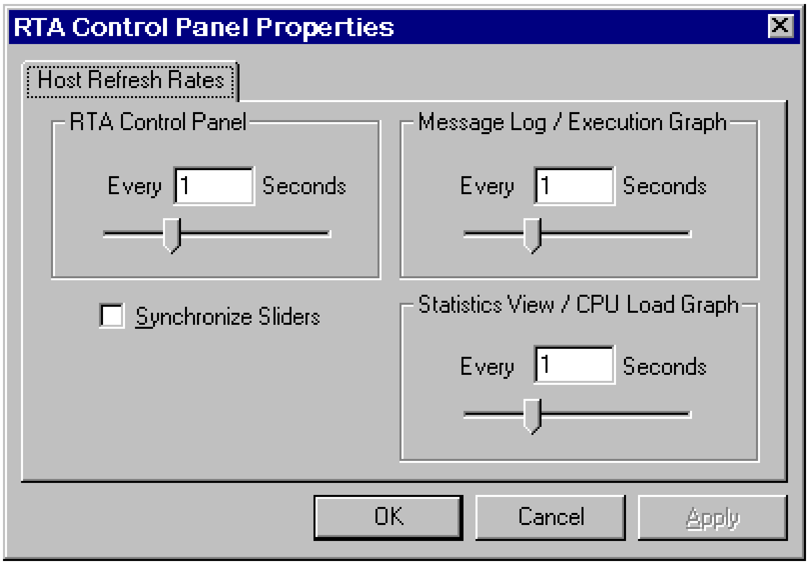
Example: `myLog.format = "0x%x, 0x%x, 0x%x";`

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



RTA Control Panel: Every 1 Seconds

Message Log / Execution Graph: Every 1 Seconds

Statistics View / CPU Load Graph: Every 1 Seconds

LOG_disable *Disable a message log*

C Interface

Syntax	LOG_disable(log);
Parameters	LOG_Handle log; /* log object handle */
Return Value	Void

Assembly Interface

Syntax	LOG_disable

Preconditions	a4 = address of the LOG object
	amr = 0

Postconditions	none
Modifies	a0

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	a4 = address of the LOG object
	amr = 0

Postconditions	none
Modifies	a0

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

Syntax LOG_error format [section]

Preconditions
a4 = format
b4 = arg0
b14 = address of the start of .bss
amr = 0

Postconditions none (see the description of the section argument below)

Modifies a0, a1, a2, a3, a4, a6, a7, b0, b2, b3, b5, b6, b7

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

a4 = address of the LOG object
b4 = val1
a6 = val2
b6 = val3
amr = 0

Postconditions

none

Modifies

a0, a1, a2, a3, a7, b0, b2, b3, b5, b7

Reentrant

yes

Description

LOG_event copies a sequence number and three arguments to the specified log buffer. Each log message uses four words. 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 Configuration Tool to choose raw data for the datatype property of this LOG object and typing a format string for the format property.

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

Syntax

LOG_message format [section]

Preconditions

a4 = format
b4 = arg0
b14 = address of the start of .bss
amr = 0

Postconditions

none (see the description of the section argument below)

Modifies

a0, a1, a2, a3, a4, a6, a7, b0, b2, b3, b5, b6, b7

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 2–155, 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

a4 = address of the LOG object
b4 = arg0
a6 = arg1
amr = 0

Postconditions none (see the description of the section parameter below)

Modifies a0, a1, a2, a3, a7, b0, b2, b3, b5, b6, b7

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).

The format string can use any of the conversion characters found in Table 2-2.

Table 2-2. Conversion Characters for LOG_printf

Conversion Character	Description
%d	Signed integer
%x	Unsigned hexadecimal integer
%o	Unsigned octal integer

%s	Character string
	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:
	`char *msg = "Hello world!";`
	`LOG_printf(&trace, "%s", msg);`
	However, the following example is not supported:
	`char msg[100];`
	`strcpy(msg, "Hello world!");`
	`LOG_printf(&trace, "%s", msg);`
	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.
	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.

%r	Symbol from symbol table
	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:
	`Int testval = 17;`
	`LOG_printf("%r = %d", &testval, testval);`
	displays:
	`testval = 17`
	If no symbol is found for the value passed to %r, the Event Log uses the string <unknown symbol>.

%p	pointer

If you want the Event Log to apply the same printf-style format string to all records in the log, use the 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. 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 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.
- ❏ The format string address is put in b6 as the third value for LOG_event.

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

Syntax	LOG_reset

Preconditions	a4 = address of the LOG object
	amr = 0

Postconditions	none
Modifies	a0, a1

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

2.13 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

Instance Configuration Parameters.

Name	Type	Default
comment	String	"<add comments here>"
messageSize	Int16	1
length	Int16	1
elementSeg	Reference	prog.get("IDRAM")

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 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 Configuration Tool.

TextConf Name: OBJMEMSEG Type: Ref

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, 8-bit bytes) 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: Ref
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 2–170.

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 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 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

2.14 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. The defaults shown are for ’C62x and ’C67x. The memory segment defaults are different for ’C64x. 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 1-4.

Module Configuration Parameters.

Name	Type	Default (Enum Options)
REUSECODESPACE	Bool	"false"

Name	Type	Default (Enum Options)
MAPMODE	EnumString	"Map 1" ("Map 0")
ARGSSIZE	Numeric	0x0004
STACKSIZE	Numeric	0x0100
NOMEMORYHEAPS	Bool	"false"
BIOSOBJSEG	Reference	prog.get("IDRAM")
MALLOCSEG	Reference	prog.get("IDRAM")
ARGSSEG	Reference	prog.get("IDRAM")
STACKSEG	Reference	prog.get("IDRAM")
GBLINITSEG	Reference	prog.get("IDRAM")
TRCDATASEG	Reference	prog.get("IDRAM")
SYSDATASEG	Reference	prog.get("IDRAM")
OBJSEG	Reference	prog.get("IDRAM")
BIOSSEG	Reference	prog.get("IPRAM")
SYSINITSEG	Reference	prog.get("IPRAM")
HWISEG	Reference	prog.get("IPRAM")
HWIVECSEG	Reference	prog.get("IPRAM")
RTDXTEXTSEG	Reference	prog.get("IPRAM")
USERCOMMANDFILE	Bool	"false"
TEXTSEG	Reference	prog.get("IPRAM")
SWITCHSEG	Reference	prog.get("IDRAM")
BSSSEG	Reference	prog.get("IDRAM")
FARSEG	Reference	prog.get("IDRAM")
CINITSEG	Reference	prog.get("IDRAM")
PINITSEG	Reference	prog.get("IDRAM")
CONSTSEG	Reference	prog.get("IDRAM")
DATASEG	Reference	prog.get("IDRAM")
CIOSEG	Reference	prog.get("IDRAM")
ENABLELOADADDR	Bool	"false"
LOADBIOSSEG	Reference	prog.get("IPRAM")
LOADSYSINITSEG	Reference	prog.get("IPRAM")
LOADGBLINITSEG	Reference	prog.get("IDRAM")
LOADTRCDATASEG	Reference	prog.get("IDRAM")
LOADTEXTSEG	Reference	prog.get("IPRAM")
LOADSWITCHSEG	Reference	prog.get("IDRAM")
LOADCINITSEG	Reference	prog.get("IDRAM")

Name	Type	Default (Enum Options)
LOADPINITSEG	Reference	prog.get("IDRAM")
LOADCONSTSEG	Reference	prog.get("IDRAM")
LOADHWISEG	Reference	prog.get("IPRAM")
LOADHWIVECSEG	Reference	prog.get("IPRAM")
LOADRTDXTEXTSEG	Reference	prog.get("IPRAM")

Instance Configuration Parameters.

Name	Type	Default (Enum Options)
comment	String	"<add comments here>"
base	Numeric	0x00000000
len	Numeric	0x00000000
createHeap	Bool	"true"
heapSize	Numeric	0x08000
enableHeapLabel	Bool	"false"
heapLabel	Extern	prog.extern("segment_name","asm")
space	EnumString	"data" ("code", "code/data")

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 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 Configuration Tool. You can also use the 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 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 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";`

❏ **Map Mode**. Select c6000 Memory Map 0 or Memory Map 1. Changing this property affects the base address for some pre-defined memory segments.

TextConf Name: MAPMODE Type: EnumString

Options: "Map 0", "Map 1"

Example: `MEM.MAPMODE = "Map 1";`

- ❑ **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 in MADUs. The upper-left corner of the 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 c6000 this is an 8-bit byte.

  TextConf Name: STACKSIZE Type: Numeric

  Example: `MEM.STACKSIZE = 0x0400;`

- ❑ **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: Ref

  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: Ref

  Example: `MEM.MALLOCSEG = prog.get("myMEM");`

BIOS Data tab

- **Argument Buffer Section (.args)**. The memory segment containing the .args section.

  TextConf Name: ARGSSEG Type: Ref

  Example: `MEM.ARGSSEG = prog.get("myMEM");`

- **Stack Section (.stack)**. The memory segment containing the global stack. This segment should be located in RAM.

  TextConf Name: STACKSEG Type: Ref

  Example: `MEM.STACKSEG = prog.get("myMEM");`

- **DSP/BIOS Init Tables (.gblinit)**. The memory segment containing the DSP/BIOS global initialization tables.

  TextConf Name: GBLINITSEG Type: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  Example: `MEM.BIOSSEG = 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: Ref

  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: Ref

  Example: `MEM.HWISEG = prog.get("myMEM");`

- **Interrupt Service Table Memory (.hwi_vec)**. The memory segment containing the Interrupt Service Table (IST). The IST can be placed anywhere on the memory map, but a copy of the RESET vector always remains at address 0x00000000.

  TextConf Name: HWIVECSEG Type: Ref

  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: Ref

  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 Configuration Tool. Your linker command file should then assign memory for the items normally handled by the following properties. See the *TMS320C6000 Optimizing Compiler User's Guide* 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: Ref

  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: Ref

  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: Ref

  Example: `MEM.BSSSEG = prog.get("myMEM");`

- ❑ **C Variables Section (.far)**. The memory segment containing global and static variables declared as far variables.

  TextConf Name: FARSEG Type: Ref

  Example: `MEM.FARSEG = 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: Ref

  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: Ref

  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: Ref

  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: Ref

  Example: `MEM.DATASEG = prog.get("myMEM");`

- **Data Section (.cio)**. This memory segment contains C standard I/O buffers.

  TextConf Name: CIOSEG Type: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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: Ref

  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 (IST).

  TextConf Name: LOADHWIVECSEG Type: Ref

  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: Ref

  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 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 = 0x00000000;`

- **len**. The length of this memory segment in MADUs. This value is shown in hex.

  TextConf Name: len Type: Numeric

  Example: `myMem.len = 0x00000000;`

- **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.

  TextConf Name: heapSize Type: Numeric

  Example: `myMem.heapSize = 0x08000;`

- **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", "code/data"

  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 2-3 and Table 2-4 list segments that can be defined for the c6000:

Table 2-3. Typical Memory Segments for c6x EVM Boards

Name	Memory Segment Type
IPRAM	Internal (on-device) program memory
IDRAM	Internal (on-device) data memory
SBSRAM	External SBSRAM on CE0
SDRAM0	External SDRAM on CE2
SDRAM1	External SDRAM on CE3

Table 2-4. Typical Memory Segment for c6711 DSK Boards

Name	Memory Segment Type
SDRAM	External SDRAM

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 Configuration Tool. The files created by the 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.

Memory management functions require that the caller obtain 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

❏ segid must identify a valid memory segment.

❏ MEM_alloc cannot be called from a SWI or HWI.

❏ 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 Configuration Tool. The files created by the 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.

Memory management functions require that the caller obtain 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

❏ segid must identify a valid memory segment.

❏ MEM_calloc cannot be called from a SWI or HWI.

❏ 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 Configuration Tool

Memory management functions require that the caller obtain 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

❏ 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.

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.

Memory management functions require that the caller obtain 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

❏ MEM_stat cannot be called from a SWI or HWI.

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 Configuration Tool. The files created by the 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.

Memory management functions require that the caller obtain 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

❏ segid must identify a valid memory segment.

❏ MEM_valloc cannot be called from a SWI or HWI.

❏ 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

2.15 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

Instance Configuration Parameters.

Name	Type	Default (Enum Options)
comment	String	"<add comments here>"
bufSeg	Reference	prog.get("IDRAM")
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

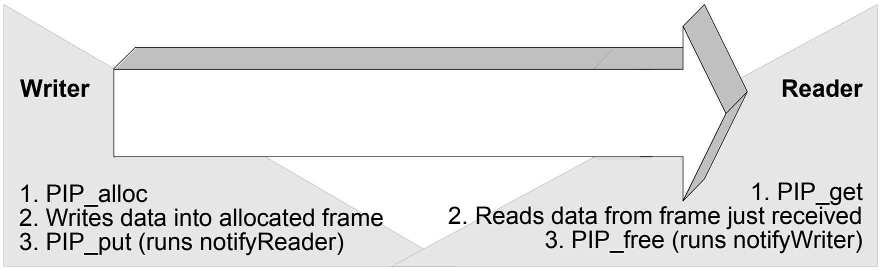
Description

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 2-2. 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 2-2. Pipe Schematic


Writer
Reader
1. PIP_alloc
2. Writes data into allocated frame
3. PIP_put (runs notifyReader)
1. PIP_get
2. Reads data from frame just received
3. PIP_free (runs notifyWriter)

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: Ref
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: Ref

  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
a4 = address of the pipe object
pipe.writerNumFrames > 0
amr = 0

Postconditions none

Modifies a0, a1, a2, a3, a4, a5, a6, a7, a8, a9, b0, b1, b2, b3, b4, b5, b6, b7, b8, b9

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.

Note:

Registers used by notifyWriter functions might also be modified.

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 2–112, 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

Syntax PIP_free

Preconditions a4 = address of the pipe object
amr = 0

Postconditions none

Modifies a1, a2, a3, a4, a5, b0, b1, b2, b3, b4

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.

Note:

Registers used by notifyWriter functions might also be modified.

Example See the example for PIP_alloc, page 2–192. The example for HST_getpipe, page 2–112, 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

Syntax	PIP_get
Preconditions	a4 = address of the pipe object pipe.readerNumFrames > 0 amr = 0
Postconditions	none
Modifies	a0, a1, a2, a3, a4, a5, a6, a7, a8, a9, b0, b1, b2, b3, b4, b5, b6, b7, b8, b9

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.

Note:

Registers used by notifyReader functions might also be modified.

Example See the example for PIP_alloc, page 2–192. The example for HST_getpipe, page 2–112, 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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_READPTR), a4;
nop    4
```

Preconditions

amr = 0

Postconditions

none

Modifies

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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_FULLBUFS), a4;
nop    4
```

Preconditions amr = 0

Postconditions none

Modifies 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 2–197.

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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_READCNT), a4;
nop    4
```

Preconditions amr = 0

Postconditions none

Modifies 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 2–197.

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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_WRITEPTR), a4;
nop    4
```

Preconditions amr = 0

Postconditions none

Modifies 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 2–197.

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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_EMPTYBUFS), a4;
nop    4
```

Preconditions amr = 0

Postconditions none

Modifies 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 2–197.

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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
ldw    *+a4(PIP_WRITECNT), a4;
nop    4
```

Preconditions amr = 0

Postconditions none

Modifies 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

Syntax PIP_put

Preconditions a4 = address of the pipe object
amr = 0

Postconditions none

Modifies a0, a1, a2, a3, a4, a5, b0, b1, b2, b3, b4

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.

Note:

Registers used by notifyReader functions might also be modified.

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 2–192. The example for HST_getpipe, page 2–112, 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

Syntax

```
mvk    pipe, a4;
mvkh   pipe, a4;
mvk    SIZE, b4;
mvkh   SIZE, b4;
stw    b4, *+a4(PIP_WRITECNT);
```

Preconditions amr = 0

Postconditions none

Modifies 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 2–197.

2.16 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 1-4.

Module Configuration Parameters

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")
USECLK	Bool	"true"
MICROSECONDS	Bool	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

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 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 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: Ref

  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: Numeric

  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

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 b14 = pointer to the start of .bss
amr = 0

Postconditions a4 = PRD_D_tick

Modifies a4

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 2–24, 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	a4 = address of the PRD object
	amr = 0

Postconditions	none
Modifies	a1, b1

Reentrant no

Description

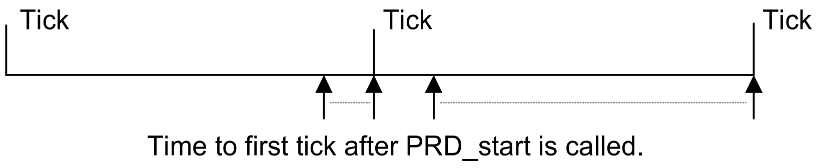
PRD_start starts a period object that has its mode property set to one-shot in the Configuration Tool.

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 2-3 shows, PRD ticks occur at a fixed rate and the call to PRD_start can occur at any point between ticks

Figure 2-3. PRD Tick Cycles



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

Syntax	PRD_stop

Preconditions	a4 = address of the PRD object
	amr = 0

Postconditions	none
Modifies	a1, b1

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 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

Syntax PRD_tick

Preconditions GIE = 0 (interrupts are disabled)
amr = 0

Postconditions none

Modifies a0, a1, a2, a3, a4, a5, a6, a7, a8, a9, b0, b1, b2, b3, b4, b5, b6, b7, b8, csr

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

2.17 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

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: Ref

  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 2–170.

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 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 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.

Note:

QUE_get must be used instead of QUE_dequeue if queue is shared by multiple tasks, or tasks and SWIs or HWIs (unless another mutual exclusion mechanism is used). QUE_get runs atomically and is never interrupted; QUE_dequeue performs the same action but runs non-atomically. While QUE_dequeue is somewhat faster than QUE_get, 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:

QUE_put must be used instead of QUE_enqueue if queue is shared by multiple tasks, or tasks and SWIs or HWIs (unless another mutual exclusion mechanism is used). QUE_put runs atomically and is never interrupted; QUE_enqueue performs the same action but runs non-atomically. While QUE_enqueue is somewhat faster than QUE_put, 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 `
```

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.

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

2.18 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 1-4.

Module Configuration Parameters.

Name	Type	Default (Enum Options)
ENABLERTDX	Bool	true
MODE	EnumString	"JTAG" ("HSRTDX", "Simulator")
RTDXDATASEG	Reference	prog.get("IDRAM")
BUFSIZE	Int16	1032
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", "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: Ref

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 = 1032;`

❑ **RTDX Interrupt Mask**. This mask identifies RTDX clients and protects RTDX critical sections. The mask specifies the interrupts to be temporarily disabled inside RTDX critical sections. This also temporarily disables other RTDX clients and prevents another RTDX function call. See the RTDX on-line help 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 `c:\ti\examples\hostapps\rtdx` folder. (If you installed in a path other than `c:\ti`, substitute your appropriate path.) 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 Use C function calling standards.

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 Use C function calling standards.

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 Use C function calling standards.

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 Use C function calling standards.

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
RTDX_enableInput
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 Use C function calling standards.

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 Use C function calling standards.

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

Use C function calling standards.

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 Use C function calling standards.

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 Use C function calling standards.

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 Use C function calling standards.

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

Use C function calling standards.

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 Use C function calling standards.

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 Use C function calling standards.

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

2.19 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

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 Configuration Tool.

TextConf Name: OBJMEMSEG Type: Ref

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 Configuration Tool rather than using the 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 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.

❏ SEM_post cannot be called from within a TSK_disable/TSK_enable block.

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

2.20 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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")
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("IDRAM")
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 at any point 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 Configuration Tool.

TextConf Name: OBJMEMSEG Type: Ref

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

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: Ref

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: Ref

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 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 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.

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 Configuration Tool.
- You can reduce the size of your application program by creating objects with the 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 object's Flush property in the Configuration Tool or 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 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.

Constraints and Calling Context

❑ SIO_flush cannot be called from a SWI or HWI.

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 an HWI.
- ❑ If SIO_get is called from a SWI, no action is performed.

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.

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 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 an HWI.
- ❏ If SIO_put is called from a SWI, no action is performed.

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 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 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 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

2.21 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 */
}
```

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 1-4.

Module Configuration Parameters.

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

Instance Configuration Parameters.

Name	Type	Default (Enum Options)
comment	String	"<add comments here>"
previousVal	Int32	0
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

Name	Type	Default (Enum Options)
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
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 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.

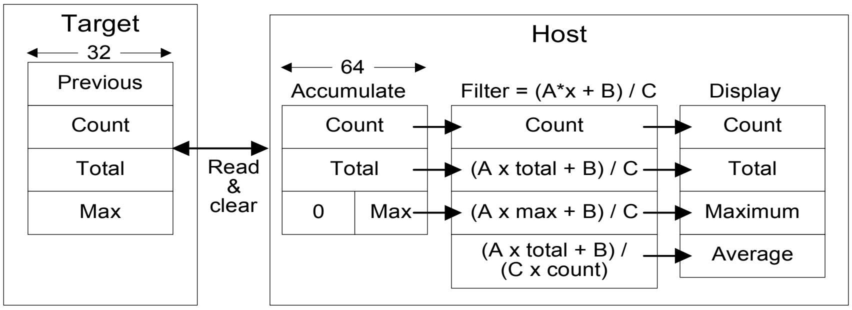
Statistics Data Gathering by the Statistics View Analysis Tool

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 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 2-4 shows the effects of the (A x X + B) / C operation.

Figure 2-4. 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: Ref

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";`

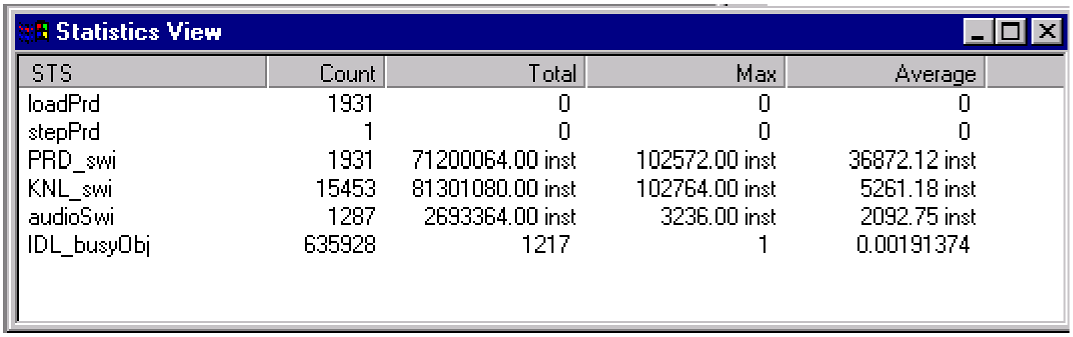
❑ **A, B, C**. The integer parameters used by the expression specified by the Host Operation field above.

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.

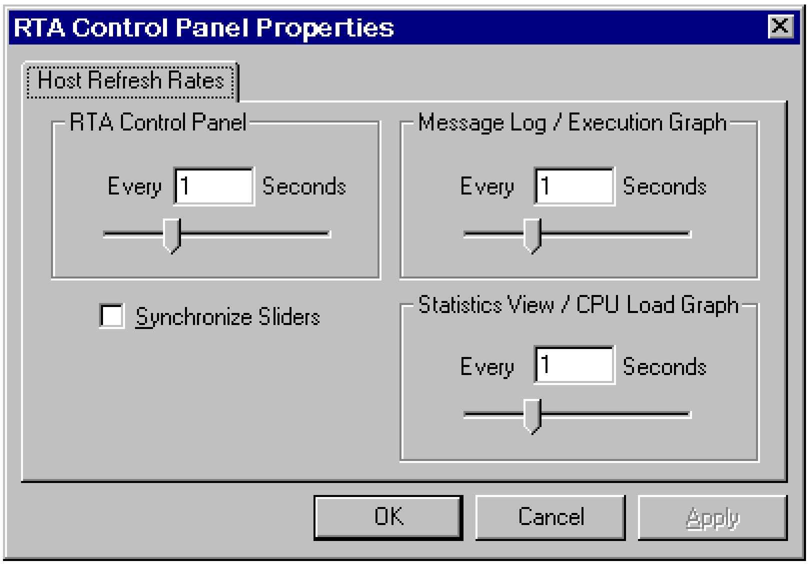
TSK statistics are handled differently than other statistics because TSK functions typically run an infinite loop that blocks when waiting for other threads. In contrast, HWI and SWI functions run to completion without blocking. Because of this difference, DSP/BIOS allows programs to identify the “beginning” 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 2-5. 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 2-5. RTA Control Panel Properties Page


RTA Control Panel Properties

Host Refresh Rates

RTA Control Panel: Every 1 Seconds

Message Log / Execution Graph: Every 1 Seconds

Statistics View / CPU Load Graph: Every 1 Seconds

☐ Synchronize Sliders

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	a4 = STS object handle
	b4 = 32-bit sample
	amr = 0

Postconditions	none
Modifies	a1, a3, b1, b2, b3

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

Syntax

STS_delta

Preconditions

a4 = STS object handle
b4 = 32-bit sample
amr = 0

Postconditions

none

Modifies

a1, a3, b1, b2, b3, b4, b5

Reentrant

no

Description

Each STS object contains a previous value that can be initialized with the 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 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

Syntax STS_reset

Preconditions a4 = STS object handle
amr = 0

Postconditions none

Modifies a1

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

a4 = STS object handle
b4 = new 32-bit value to store as previous
amr = 0

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 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

2.22 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.
- ❏ 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.

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 1-4.

Module Configuration Parameters

Name	Type	Default
OBJMEMSEG	Reference	prog.get("IDRAM")

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.

The processor registers that are saved before SWI functions are called include a0-a9 and b0-b9. These registers are the parent-preserved registers mentioned in the *TMS320C6000 Optimizing Compiler User's Guide*. The child-preserved registers, a10-a15 and b10-b15, are not saved.

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 32-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 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: Ref

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.

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 32-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

Syntax

SWI_andn

Preconditions

a4 = address of the SWI object
b4 = mask
amr = 0

Postconditions

none

Modifies

a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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.

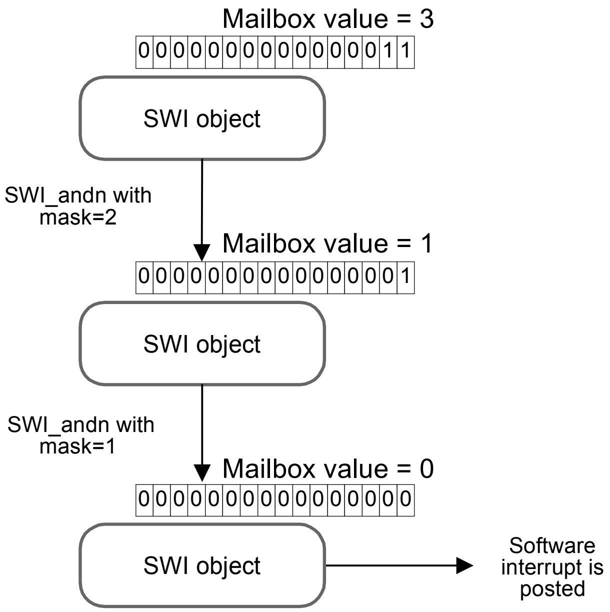
SWI_andn results in a context switch if the SWI's mailbox becomes zero and the SWI has higher priority than the currently executing thread.

You specify a software interrupt's initial mailbox value in the 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

Syntax SWI_andnHook

Preconditions a4 = address of the SWI object
b4 = mask
amr = 0

Postconditions none

Modifies a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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_andn(&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. 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;
   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 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 2–170.

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 a4 = address of the SWI object
amr = 0

Postconditions none

Modifies a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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 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 b14 = address of the start of .bss
GIE = 1 (interrupts must be enabled)
amr = 0

Postconditions none

Modifies a4

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

Syntax	SWI_enable
Preconditions	SWI_D_lock>= 0 (SWI execution is disabled; that is, locked) GIE = 1 (interrupts must be enabled) amr = 0
Postconditions	none
Modifies	a1, a4, b0, b1, b3, b4, csr

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;
   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 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	b14 = address of the start of .bss amr = 0
Postconditions	al4 = current software interrupt's mailbox value
Modifies	a4

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 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.

Constraints and Calling Context

❏ SWI_getmbox cannot be called from an HWI or TSK level.

❏ 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 a4 = address of the SWI object
b14 = address of start of .bss

Postconditions a4 = SWI object's priority mask

Modifies a4

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

C Interface

Syntax	SWI_inc(swi);
Parameters	SWI_Handle swi; /* SWI object handle*/
Return Value	Void

Assembly Interface

Syntax	SWI_inc

Preconditions	a4 = address of the SWI object
	amr = 0

Postconditions	none
Modifies	a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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

Syntax

SWI_or

Preconditions

a4 = address of the SWI object
b4 = mask
amr = 0

Postconditions

none

Modifies

a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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

Syntax

SWI_orHook

Preconditions

a4 = address of the SWI object
b4 = mask
amr = 0

Postconditions

none

Modifies

a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 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

Syntax	SWI_post

Preconditions	a4 = address of the SWI object
	amr = 0

Postconditions	none
Modifies	a0, a1, a2, a3, a4, a5, a6, a7, a9, b0, b1, b2, b3, b4, b5, b6, b7, csr

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 b14 = address of start of .bss
a4 = priority mask of desired priority level

Postconditions a4 = key for use with SWI_restorepri

Modifies a1, a2, a4

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 b14 = address of start of .bss
a4 = return value from the SWI_raisepri call

Postconditions none

Modifies a1, a2, a4, b0,csr

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

Syntax SWI_self

Preconditions b14 = address of the start of .bss
amr = 0

Postconditions a4 = address of the current SWI object

Modifies a4, b4

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;
   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 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

2.23 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 1-4.

Module Configuration Parameters.

Name	Type	Default
TRACESIZE	Numeric	512
TRACESEG	Reference	prog.get("IDRAM")
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: `TRC.TRACESIZE = 512;`

❏ **Trace Buffer Memory**. The memory segment that contains system trace information.

  TextConf Name: TRACESEG Type: Ref

  Example: `TRC.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, use a leading underscore before the C

function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.)

TextConf Name: ABORTFXN Type: Extern

Example: `TRC.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, use a leading underscore before the C function name.

  TextConf Name: ERRORFXN Type: Extern

  Example: `TRC.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, use a leading underscore before the C function name.

  TextConf Name: EXITFXN Type: Extern

  Example: `TRC.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, use a leading underscore before the C function name.

  TextConf Name: PUTCFXN Type: Extern

  Example: `TRC.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.

❏ The string passed to SYS_error must be non-NULL.

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	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 40-bit long integer. If the argument is a 32-bit long integer (LgInt or LgUns), the l modifier should not be used.

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

❏ On a DSP with floating-point support, SYS_printf prints an error for floating point numbers whose absolute value is greater than the maximum long int (defined as LONG_MAX in the <limits.h> ANSI header). This is because the integer part is computed by simply casting the float parameter to a long int local variable.

❏ On a DSP with floating-point support, SYS_printf only prints four digits after the decimal point for floating point numbers. Since SYS_printf does not support %e, floating point numbers have to be scaled approximately before being passed to SYS_printf.

❏ 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	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 40-bit long integer. If the argument is a 32-bit long integer (LgInt or LgUns), the l modifier should not be used.

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

❏ On a DSP with floating-point support, SYS_printf prints an error for floating point numbers whose absolute value is greater than the maximum long int (defined as LONG_MAX in the <limits.h> ANSI header). This is because the integer part is computed by simply casting the float parameter to a long int local variable.

❏ On a DSP with floating-point support, SYS_printf only prints four digits after the decimal point for floating point numbers. Since SYS_printf does not support %e, floating point numbers have to be scaled approximately before being passed to SYS_printf.

❏ 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	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 40-bit long integer. If the argument is a 32-bit long integer (LgInt or LgUns), the l modifier should not be used.

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

❏ On a DSP with floating-point support, SYS_printf prints an error for floating point numbers whose absolute value is greater than the maximum long int (defined as LONG_MAX in the <limits.h> ANSI header). This is because the integer part is computed by simply casting the float parameter to a long int local variable.

❏ On a DSP with floating-point support, SYS_printf only prints four digits after the decimal point for floating point numbers. Since SYS_printf does not support %e, floating point numbers have to be scaled approximately before being passed to SYS_printf.

❏ 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	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 40-bit long integer. If the argument is a 32-bit long integer (LgInt or LgUns), the l modifier should not be used.

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

❏ On a DSP with floating-point support, SYS_printf prints an error for floating point numbers whose absolute value is greater than the maximum long int (defined as LONG_MAX in the <limits.h> ANSI header). This is because the integer part is computed by simply casting the float parameter to a long int local variable.

❏ On a DSP with floating-point support, SYS_printf only prints four digits after the decimal point for floating point numbers. Since SYS_printf does not support %e, floating point numbers have to be scaled approximately before being passed to SYS_printf.

❏ 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

2.24 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.h62, and trc.h64are shown in the left column.

Table 2-10. Events and Statistics Traced by TRC

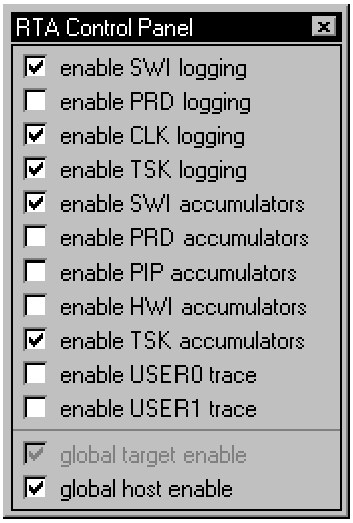
Constant	Tracing Enabled/Disabled	Default
TRC_LOGCLK	Log timer interrupts	off
TRC_LOGPRD	Log periodic ticks and start of periodic functions	off
TRC_LOGSWI	Log events when a software interrupt is posted and completes	off
TRC_LOGTSK	Log events when a task is made ready, starts, becomes blocked, resumes	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.



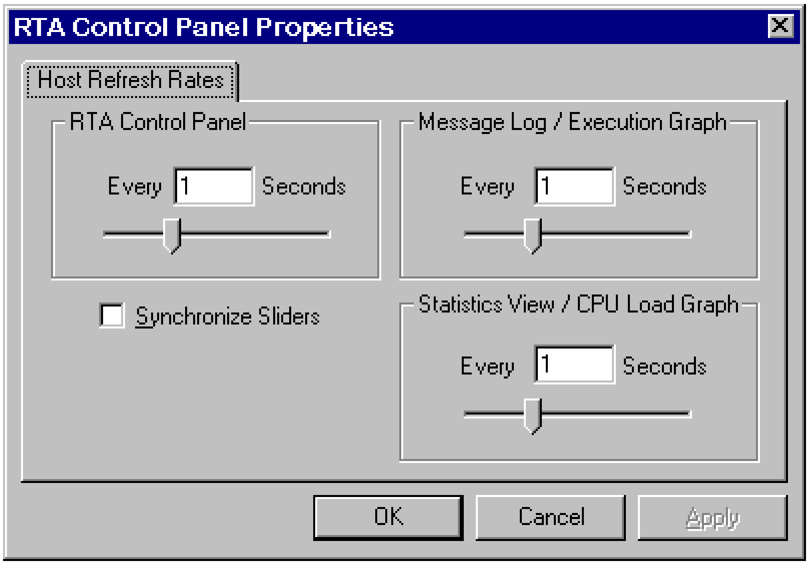
RTA Control Panel

- [✓] enable SWI logging
- [ ] enable PRD logging
- [✓] enable CLK logging
- [✓] enable TSK logging
- [✓] enable SWI accumulators
- [ ] enable PRD accumulators
- [ ] enable PIP accumulators
- [ ] enable HWI accumulators
- [✓] enable TSK accumulators
- [ ] enable USER0 trace
- [ ] enable USER1 trace
- [✓] global target enable
- [✓] global host enable

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 2-6. 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 2-6. RTA Control Panel Properties Page



RTA Control Panel Properties

Host Refresh Rates

RTA Control Panel

Every 1 Seconds

Message Log / Execution Graph

Every 1 Seconds

Synchronize Sliders

Statistics View / CPU Load Graph

Every 1 Seconds

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, ...)
b14 = address of the start of .bss
amr = 0

Postconditions none

Modifies a2, a4

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

Syntax	TRC_enable mask
Inputs	mask
Preconditions	constant - mask for trace types (TRC_LOGSWI, TRC_LOGPRD, ...) b14 = address of the start of .bss amr = 0
Postconditions	none
Modifies	a2, a4

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
b14 = address of the start of .bss
amr = 0

Postconditions
a4 == 0 if all trace types in the mask are enabled
a4 != 0 if any trace type in the mask is disabled

Modifies a2, a4

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 32-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

2.25 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
    Uns   sysstacksize;  system stack in MADUs */
#endif
    Int   stackseg; /* memory seg for stack allocation */
    Ptr    environ;  /* global environment data structure */
    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;  /* maximum 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 TRG_STACKSTAMP =  0xBEBEBEBE
TSK_Attrs TSK_ATTRS = { /* default attribute values */
    TSK->PRIORITY,      /* priority */
    NULL,               /* stack */
    TSK->STACKSIZE,     /* stacksize */
#ifdef
    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 1-4.

Module Configuration Parameters.

Name	Type	Default (Enum Options)
ENABLETSK	Bool	true
OBJMEMSEG	Reference	prog.get("IDRAM")
STACKSIZE	Int16	1024
STACKSEG	Reference	prog.get("IDRAM")
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	1024
stackMemSeg	Reference	prog.get("IDRAM")
priority	EnumInt	0 (-1, 0, 1 to 15)
fxn	Extern	prog.extern("FXN_F_nop")
arg0	Arg	0
arg7	Arg	0
envPointer	Arg	0x00000000
exitFlag	Bool	true
allocateTaskName	Bool	false

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 TRG_STACKSTAMP value is used to initialize the run-time stack. 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 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 and Error Tables, 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 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 Configuration Tool.

  TextConf Name: OBJMEMSEG Type: Ref

  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 Configuration Tool or TSK_create. The estimated minimum task size is shown in the status bar of the Configuration Tool.
  This property applies to TSK objects created both with the Configuration Tool and with TSK_create.

  TextConf Name: STACKSIZE Type: Int

  Example: `TSK.STACKSIZE = 1024;`

- **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: Ref

  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 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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.) 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, 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, 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, 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, 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, add a leading underscore before the stack name.

  TextConf Name: manualStack Type: Extern

  Example:
  ```
  myTsk.manualStack =
      prog.extern("myStack");
  ```

- ❏ **Stack size**. If you checked the box to Automatically allocate stack, enter the size (in MADUs) of the stack space to allocate for this task. 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: Int

  Example: `myTsk.stackSize = 1024;`

- ❏ **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: Ref

  Example:
  ```
  myTsk.stackMemSeg =
      prog.get("myMEM");
  ```

- ❏ **Priority**. The priority level for this task.

  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, use a leading underscore before the C function name. (The Configuration Tool generates assembly code which must use the leading underscore when referencing C functions or labels.)

  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. For labels defined in a C program, 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, 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;`

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 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 2–387 and TSK_deltatime on page 2–372, 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 TRG_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 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
    /* system stack size in MADUs*/
    Uns sysstacksize;
#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, task is barred from execution until its priority is raised at a later time by another task. 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 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 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 2–170.

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.

❏ Task arguments passed to TSK_create cannot be greater than 32 bits in length; that is, 40-bit integers and Double or Long Double data types cannot be passed as arguments to the TSK_create function.

❏ You can reduce the size of your application program by creating objects with the 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 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 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

❏ No kernel operations that can cause the current task to block can be made from within a TSK_disable/TSK_enable block. This includes SEM_pend (unless timeout is 0), TSK_sleep, and TSK_yield.

❏ TSK_yield cannot be called within a TSK_disable/TSK_enable block.

❏ 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

- ❏ No kernel operations that can cause the current task to block can be made from within a TSK_disable/TSK_enable block. This includes SEM_pend (unless timeout is 0), TSK_sleep, and TSK_yield.
- ❏ 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 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 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, 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 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.

❑ TSK_yield should not be called from within a TSK_disable/TSK_enable block.

See Also

TSK_sleep

2.26 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.*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.

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 unless the timeout is 0. As a result, RTS functions that call LCK_pend must only be used outside the context of SWI and HWI threads.

To determine whether a particular RTS function uses LCK_pend, refer to the source code for that function shipped with CCStudio. The following table shows some of the RTS functions that call LCK_pend in certain versions of CCStudio:

fprintf	printf	vfprintf	sprintf
vprintf	vsprintf	clock	strftime
minit	malloc	realloc	free
calloc	rand	srand	getenv

Chapter 3

Utility Programs

This chapter provides documentation for TMS320C6000 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.

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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 test62.cdb to the default configuration provided with DSP/BIOS:

```
cdbprint ../../include/bios62.cdb > original.txt
cdbprint test62.cdb > test62.txt
diff original.txt test62.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 target configuration files that are linked with the rest of the application code.

When you save a configuration file, the following files are created.

❑ **program.cdb.** Stores configuration settings for use by the Configuration Tool

❑ **programcfg.cmd.** Linker command file

❑ **programcfg.h62.** Assembly language header file included by hellocfg.s62

❑ **programcfg.s62.** Assembly language source file

❑ **programcfg_c.c.** Source file to define Chip Support Library (CSL) structures and properties. See the CSL documentation for more information.

❑ **programcfg.h.** Header file to include CSL header files and declare external variables for CSL objects. See the CSL documentation for more information.

The .h62 and .s62 extensions are generated for C62, C64, and C67 devices.

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. The following naming conventions
* are used by this makefile:

* <prog>.asm  - C62 assembly language source file
* <prog>.obj  - C62 object file (compiled/assembled)
* <prog>.out  - C62 executable (fully linked program)
* <prog>cfg.s62 - configuration assembly source file
                  generated by Configuration Tool
* <prog>cfg.h62 - 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)/c6000/bios/include/c62rules.mak

*
*  Compiler, assembler, and linker options.
*
* -g enable symbolic debugging

CC62OPTS = -g
AS62OPTS =
* -q quiet run

LD62OPTS = -q     * -q quiet run
*  Every BIOS program must be linked with:
*  $(PROG)cfg.o62 - from assembling $(PROG)cfg.s62
*  $(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.h62
$(PROG).obj:
$(PROG)cfg.s62 $(PROG)cfg.h62  $(PROG)cfg.cmd ::
$(PROG).cdb $(TI_DIR)/plugins/bios/gconfgen
$(PROG).cdb
.clean clean::
   @ echo removing generated configuration files ...
   @$(REMOVE) -f $(PROG)cfg.s62 $(PROG)cfg.h62
$(PROG)cfg.cmd
   @ echo removing object files and binaries ...
   @$(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.

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 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 are included as part of the value reported by the sizeti utility.

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.a62 file in the lib sub-directory.

```
..\bin\vers bios.a62
bios.a62:
    *** 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 TMS320C6000 errors and function callability.

Topic **Page**

A.1 Function Callability Table

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
C62_disableIER	C, assembly	Yes	Yes	Yes	No
C62_enableIER	C, assembly	Yes	Yes	Yes	No
C62_plug	C	Yes	Yes	Yes	No
C64_disableIER	C, assembly	Yes	Yes	Yes	No
C64_enableIER	C, assembly	Yes	Yes	Yes	No
C64_plug	C	Yes	Yes	Yes	No
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_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_init	C	Yes	No	No	No
GIO_read	C	Yes	No*	No*	Yes
GIO_submit	C	Yes	Yes*	Yes*	Yes

Function	Interface (C and/or Assembly)	Callable by Tasks?	Callable by SWI Handlers?	Callable by Hardware ISRs?	Possible Context Switch?
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
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

Function	Interface (C and/or Assembly)	Callable by Tasks?	Callable by SWI Handlers?	Callable by Hardware ISRs?	Possible Context Switch?
PIP_free	C, assembly	Yes	Yes	Yes	Yes
PIP_get	C, assembly	Yes	Yes	Yes	Yes
PIP_getReaderAddr	C, assembly	Yes	Yes	Yes	No
PIP_getReaderNumFrames	C, assembly	Yes	Yes	Yes	No
PIP_getReaderSize	C, assembly	Yes	Yes	Yes	No
PIP_getWriterAddr	C, assembly	Yes	Yes	Yes	No
PIP_getWriterNumFrames	C, assembly	Yes	Yes	Yes	No
PIP_getWriterSize	C, assembly	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, assembly	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
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	Yes	Yes	No	No
RTDX_CreateInputChannel	C	Yes	Yes	No	No
RTDX_CreateOutputChannel	C	Yes	Yes	No	No
RTDX_disableInput	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?
RTDX_disableOutput	C	Yes	Yes	No	No
RTDX_enableInput	C	Yes	Yes	No	No
RTDX_enableOutput	C	Yes	Yes	No	No
RTDX_isInputEnabled	C	Yes	Yes	No	No
RTDX_isOutputEnabled	C	Yes	Yes	No	No
RTDX_read	C	Yes	Yes	No	No
RTDX_readNB	C	Yes	Yes	No	No
RTDX_sizeofInput	C	Yes	Yes	No	No
RTDX_write	C	Yes	Yes	No	No
SEM_count	C	Yes	Yes	Yes	No
SEM_create	C	Yes	No	No	Yes*
SEM_delete	C	Yes	No	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
SIO_delete	C	Yes	No	No	Yes*
SIO_flush	C	Yes	No	No	No
SIO_get	C	Yes	No	No	Yes*
SIO_idle	C	Yes	No	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

Function	Interface (C and/or Assembly)	Callable by Tasks?	Callable by SWI Handlers?	Callable by Hardware ISRs?	Possible Context Switch?
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
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*

Function	Interface (C and/or Assembly)	Callable by Tasks?	Callable by SWI Handlers?	Callable by Hardware ISRs?	Possible Context Switch?
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.

A.2 DSP/BIOS Error Codes

Name	Value	SYS_Errors[Value]
SYS_OK	0	`"(SYS_OK)"`
SYS_EALLOC	1	`"(SYS_EALLOC): segid = %d, size = %u, align = %u"` Memory allocation error.
SYS_EFREE	2	`"(SYS_EFREE): segid = %d, ptr = ox%x, size = %u"` 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"` The device being opened is not configured into the system.
SYS_EBUSY	4	`"(SYS_EBUSY): device in use"` The device is already opened by the maximum number of users.
SYS_EINVAL	5	`"(SYS_EINVAL): invalid parameter"` An invalid parameter was passed to the device.
SYS_EBADIO	6	`"(SYS_EBADIO): device failure"` The device was unable to support the I/O operation.
SYS_EMODE	7	`"(SYS_EMODE): invalid mode"` 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"` Used by SPOX-MATH when type of operation does not match vector or filter type.
SYS_ETIMEOUT	9	`"(SYS_ETIMEOUT): timeout error"` Used by device drivers to indicate that reclaim timed out.
SYS_EEOF	10	`"(SYS_EEOF): end-of-file error"` Used by device drivers to indicate the end of a file.
SYS_EDEAD	11	`"(SYS_EDEAD): previously deleted object"` An attempt was made to use an object that has been deleted.
SYS_EBADOBJ	12	`"(SYS_EBADOBJ): invalid object"` An attempt was made to use an object that does not exist.
SYS_EUSER	>=256	`"(SYS EUSER): <user-defined string>"` User-defined error.

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