

**General Standards Corporation**  
**SIO4 Application Interface**  
**User Manual version 1.6.10.1**

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## Introduction

This document describes the Application Programmers Interface (API) for the General Standards Corporation I/O Interface boards. Some API functions apply only to certain hardware. Each function contains the list of boards that it supports. For examples of how to use the API functions, refer to the source code included in the API examples. These examples are located in the sub-directories named `samples/SIO4B_Test` on Win32 systems and in `/usr/local/gsc_api/PlxSdk/Linux/Samples/` on Linux systems.

This API was written using Microsoft Visual Studio .NET 2003 and is compatible with C#.Net and VB.Net as well as Win32 console and MFC applications, both “managed” and “unmanaged”. Microsoft Visual C++ 6.0 is supported as well. The API also supports the Linux platform and the GNU C compiler.

## Win32 Installation

The API support files are installed during the standard installation of the driver. The API support files are placed, by default, into the `C:\Program Files\General Standards Corporation\GscApi\` directory and subdirectories and consist of the following files:

`GscApi.h` – This is the header file that should be included in any source files that utilize the API. This file contains the function prototypes and constant definitions needed to access the API.

`GscApi.lib` – This is the import library file that should be included in your project so that the linker can find the API functions.

`GscApi.dll` – This is the dynamically linked library file that contains the actual API code. It should be located in the same directory as your executable or in your system path so that your application can access the API functions. This file will also be installed to your system32 directory during installation.

It is recommended that you install the driver/API before installing the SIO4B card. After the installation completes, shut the system down and install the SIO4B card.

Under Windows XP, you may get the following warning during the Hardware Wizard’s installation of the card. You can safely choose Continue Anyway to install the driver.



## Linux Installation

On the Linux platform, the General Standards Corp API support files are packaged in an autotools tarball file called `gsc_api.linux.x.x.x.tar.gz`. To install the API support files follow the below installation process.

**NOTE:** The “x.x.x” sequence refers to the current release version number.

**NOTE:** The default installation destination is given as `/usr/local/`, though the software may be installed elsewhere.

1. All of the scripts for building the GSC API archive content are designed for execution under a Bourne shell. Open a Bourne shell by entering the command below.

```
sh
```

2. Change the current directory to the desired installation location, such as `/usr/local/`. Copy the tarball file into the current directory so it can be accessed. Extract the files from the archive with the following command.

```
tar -xzf gsc_api.linux.x.x.x.tar.gz
```

This will create a subdirectory called `gsc_api` containing the installation files. One of the files in this directory is the `INSTALL` text file, which contains instructions for installing the GSC API.

3. Without changing directories, create a new directory named `buildGsc` from which the installation process will be run. The Linux command to do this is as follows.

```
mkdir buildGsc
```

4. Change directories to the `buildGsc` directory by entering the command below.

```
cd buildGsc
```

5. Run the command given below, which will perform a series of checks of the Linux platform to make sure the libraries and header files needed by the API are present. If the `configure` command fails any of its checks, install the missing software and rerun the `configure` command.

```
../gsc_api/configure
```

6. Next, issue the following command to build the GSC API library and samples.

```
make
```

7. To install the newly built API files, type the below command at the command line.

```
make install
```

This completes the installation process. The API support files are placed, by default, into the `/usr/local/include/GscApi/` and `/usr/local/lib/` directories and consist of the following files:

`GscApi.h` – This is the header file that should be included in any source files that utilize the API. This file contains the function prototypes and constant definitions needed to access the API.

`libGscApi.so` – This is the shared library that contains the actual API code. It should be located in the same directory as your executable or in your system path so that your application can access the API functions.

The driver sources are installed under the `gsc_api` directory tree in the subdirectory `PlxSdk/Linux/Driver/`. The driver must be manually built and loaded as a module. Currently, the PLX Linux driver is not available on kernel.org, so it is not built into any distributed Linux kernels. To build a driver perform the following steps.

1. Make sure the environment variable `PLX_SDK_DIR` is defined and exported. This should be done by adding the following line to the `.profile` file in the user's home directory:

```
export PLX_SDK_DIR=/usr/local/gsc_api/PlxSdk/
```

2. To build the PCI9056 and PXI9080 drivers enter the following commands.

```
cd $PLX_SDK_DIR/Linux/Driver/  
./builddriver 9056  
./builddriver 9080
```

Both drivers should build successfully.

3. To load each of these drivers enter the following commands. Each driver will load successfully only if a corresponding board is installed.

```
cd $PLX_SDK_DIR/Bin
./Plx_load 9056
./Plx_load 9080
```

4. Once the drivers are installed, any of the GSC or PLX sample applications can be executed. All the sample applications are built during installation and then installed in the `/usr/local/bin/` directory. This directory should be in the `PATH` environment variable on your Linux system, so the samples can be executed from any directory.

The source code of each sample application may also be built with the supplied makefiles. However, one more step is required before attempting to build any of the sample code. In order to use the GSC API and PLX API shared libraries, the text file `/etc/ld.so.conf` must include the following line.

```
/usr/local/lib/
```

If the file does not contain this line, edit the file and add the line. The next time the Linux system is booted, the Linux dynamic linker run-time bindings will be updated to include the GSC and PLX libraries. The command `ldconfig` may be used to update the linker run-time bindings if a system reboot is undesirable.

To build a sample application, change directories to the desired application and type `make` from a shell prompt. The sample applications are located in `/usr/local/gsc_api/Linux/Samples/`. The resulting binary executables are written to the `App` subdirectory of the sample source directory. For example, to build and run the `DisplayBoards` sample application, type the following from a shell command prompt.

```
cd /usr/local/gsc_api/Linux/Samples/DisplayBoards/
make
cd App
./DisplayBoards
```

Note that there is an environment variable called `PLX_DEBUG` that is recognized by the sample application makefiles. This variable may be defined in the sample application makefiles by uncommenting the following line in the desired make file.

```
#PLX_DEBUG = 1
```

If this variable is defined, then a debug executable will be built, with the text `“_dbg”` suffixed to the filename. In the example above, if the `DisplayBoards` application is built for debugging, the name of the executable generated would be `DisplayBoards_dbg`. It will be written to the `App` subdirectory, just as it is for the non-debug version of the application.

The API installation also includes the source code for the GSC API library. It is located in `/usr/local/gsc_api/GscApi/`. The library can be built from the source code with the



make file provided along with the source code. To build the GSC API library, change directories to that given above and type “make” from the command line. This will build a static library and place it in the “Library” subdirectory. To link this library with applications instead of the provided shared library, modify the application make file as appropriate.

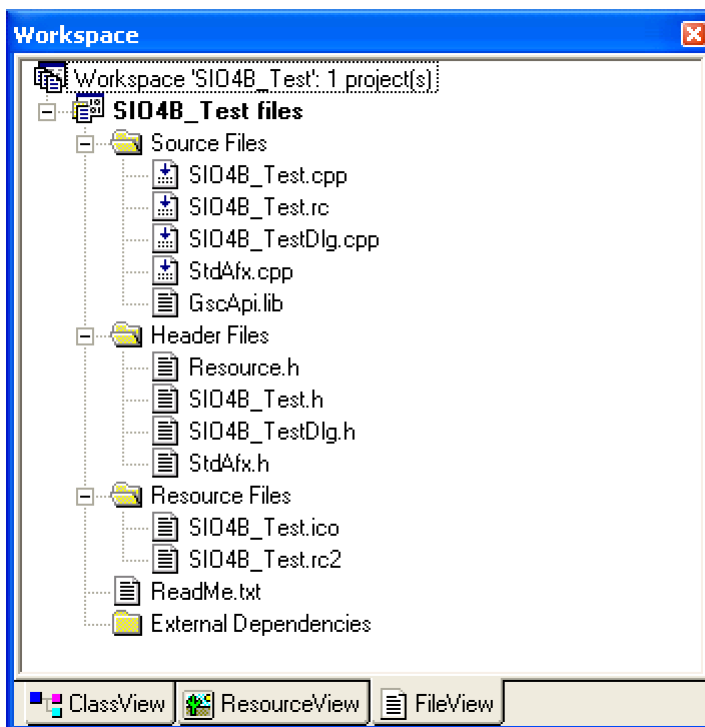
## Win32 Project Setup

To utilize the SIO4B-API in your software application, you should include the GscApi.h header file and the GscApi.lib static library file in your project. The details of adding these files to your project will differ from compiler to compiler. We will concentrate on the Microsoft® Visual Studio .NET 2003 IDE. Support for other compilers may be added in future releases of the SIO4B-API.

First, be sure that your source code file that will make use of the SIO4B-API has the GscApi.h header file included as follows:

```
#include "GscApi.h"
```

Next, be sure that your project has the GscApi.lib static library file included to be compiled as part of your project as follows (here is a sample of the workspace for the SIO4B\_Test included with the SIO4B-API in the Samples directory):



Lastly, the GscApi.dll file should be made available to your final executable program – either by having this file in the same directory or making it available via your system's path.

## Linux Project Setup

The standard GNU compiler is supported on Linux. To utilize the SIO4B-API in your software application, you should include the `GscApi.h` header file in any source code files that reference API functions or data types just as you would.

The only other requirement for writing application code to use the API is to add the GSC API and PLX API libraries to the GNU linker in your makefile. A makefile that builds a sample application called `MyApp`, consisting of one C source file called `MyApp.c`, would contain linker-related script that looks like the following:

```
# definition of linker
LINK = libtool -mode=link $(LDFLAGS) -o $@

# definition of linker flags
# here is where the libraries are added to the build.
LDFLAGS =
LIBS = -lGscApi -lPlxApi

# suffix rule to invoke linker
MyApp : MyApp.o $(DEPENDENCIES)
$(LINK) $(LDFLAGS) MyApp.o $(LIBS)
```

## System Level Routines

The System Level Routines perform functions that either apply to all SIO4 boards in the system, or are not board specific. These routines are used to gather information about the current system setup. All of these functions return zero if successful or a non-zero error code if a failure occurs.

### ***GscFindBoards***

`GscFindBoards(...)` is used to report the number of GSC SIO4 boards in the system as well as some board specific information. An application may call this function at any time.

#### **Supported Hardware:**

All

#### **Prototype:**

```
int GscFindBoards(
    int *boardCount,
    GSC_DEVICES_STRUCT *results);
```

#### **Parameters:**

*boardCount* – a pointer to the location to save the number of boards detected. This value will be zero if no boards are found.

*results* – a pointer to the devices structure that will be filled in with the information from the boards found. If this parameter is NULL, no board specific information will be returned. The boardCount will, however, still be returned. The devices structure is defined as follows:

```
typedef struct
{
    int    busNumber;        // Identifies the bus that contains the board
    int    slotNumber;       // Identifies the slot that contains the board
    int    vendorId;         // Identifies the board Vendor
    int    deviceId;         // Identifies the device
    char   serialNumber[25]; // A unique board serial number
} GSC_DEVICES_STRUCT;
```

## ***GscGetErrorString***

`GscGetErrorString(...)` is used to translate the error codes that are returned by the various API functions into meaningful null-terminated strings. The strings returned by this function are guaranteed to be less than 80 characters in length.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscGetErrorString(  
                        int errorCode,  
                        char *errorString);
```

### **Parameters:**

*errorCode* – the error code returned by an API function.

*errorString* – a pointer to a character string that will be filled with the text that corresponds to the `errorCode`.

## Board Level Routines

The Board Level Routines perform functions that apply to a single SIO4 board. These functions affect all channels of the SIO4 board. Each of these routines requires the board number (*boardNumber*) as the first argument. The board numbers run from 1 up to the number that is returned from the call to GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

These routines can be called at any time. All of these functions return zero if successful or a non-zero error code if a failure occurs.

### ***GscOpen***

GscOpen(...) is used to “open” the SIO4 board for operation. It should be called before any other Board or Channel Level routines and should only be called once. In the process of opening a board, all four channels are reset and the clock outputs are disabled.

#### **Supported Hardware:**

All

#### **Prototype:**

```
int GscOpen( int boardNumber, int headerVersion);
```

#### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*headerVersion* – The version of the api being used by the application. The value GSC\_API\_VERSION, from the GscApi.h header file, should always be passed in for this parameter.

## **GscClose**

GscClose(...) is used to “close” the SIO4 board. It should be the last API function called before the application terminates. This function releases the resources that are used by the API and driver.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscClose( int boardNumber);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

## **GscGetInfo**

GscGetInfo(...) returns general information about an SIO4 board. The information is returned in a board info structure.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscGetInfo(  
                int boardNumber,  
                PBOARD_INFO info);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*PBOARD\_INFO info* – a pointer to the BOARD\_INFO structure that holds the retrieved board information. The BOARD\_INFO structure is defined as follows:

```
typedef struct  
{  
    char    apiVersion[20];    // The installed GscApi library version  
    char    driverVersion[20]; // The installed PLX driver version  
    char    fpgaVersion[20];  // The fpga version  
    char    boardType[50];    // The board type, retrieved from the fpga.  
} BOARD_INFO, *PBOARD_INFO;
```



## **GscGetVersions**

GscGetVersions(...) returns the various version numbers associated with the API, the low level driver, and the SIO4 board's FPGA. The Library and Driver version numbers are returned in the form: 0xMMmmee where MM is the major release number, mm is the minor release number, and ee is the engineering release number. The entire version is defined as MM.mm.ee for example 1.02.05 is returned as 0x00010205. The FPGA version number has several encoded fields. The low byte contains the actual version number. Refer to the hardware users manual for details on the other encoded fields.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscGetVersions(  
    int boardNumber,  
    int *libVersion,  
    int *driverVersion,  
    int *fpgaVersion);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*libVersion* – A pointer to the location that will receive the library (API) version number. If this value is NULL, no value will be returned.

*driverVersion* – A pointer to the location that will receive the low level driver version number. If this value is NULL, no value will be returned.

*fpgaVersion* – A pointer to the location that will receive the FPGA firmware version number. If this value is NULL, no value will be returned.

## ***GscLocalRegisterRead***

`GscLocalRegisterRead(...)` is used to read the local board registers. These registers reside within the board's FPGA. It is not recommended that a user application directly access these registers. This function is included for diagnostic purposes only.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscLocalRegisterRead(  
                           int boardNumber,  
                           int reg,  
                           int *value);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*reg* – The address of the register to be read. Macros for these addresses are described in the section titled “Local Register Definitions”.

*value* – A pointer to the location that will receive the results of the read operation.

## ***GscLocalRegisterWrite***

`GscLocalRegisterWrite(...)` is used to write to the local board registers. These registers reside within the board's FPGA. It is not recommended that a user application directly access these registers. This function is included for diagnostic purposes only.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscLocalRegisterWrite(  
                           int boardNumber,  
                           int reg,  
                           int value);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*reg* – The address of the register to be written. Macros for these addresses are described in the section titled “Local Register Definitions”.

*value* – The value that is to be written to the local register.

## ***GscAllocPhysicalMemory***

`GscAllocPhysicalMemory(...)` is used to attempt to allocate a physically contiguous, page-locked buffer which is safe for use with DMA operations.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscAllocPhysicalMemory(  
    int boardNumber,  
    PLX_PHYSICAL_MEM *pciMem);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*pcimem* – A pointer to a `PLX_PHYSICAL_MEM` structure that will contain the buffer information.

## ***GscMapPhysicalMemory***

`GscMapPhysicalMemory(...)` is used to map into user virtual space a buffer previously allocated with `GscAllocPhysicalMemory`.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscMapPhysicalMemory(  
    int boardNumber,  
    PLX_PHYSICAL_MEM *pciMem);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*pcimem* – A pointer to a `PLX_PHYSICAL_MEM` structure that will contain the buffer information.

## ***GscUnmapPhysicalMemory***

`GscUnmapPhysicalMemory(...)` is used to unmap a buffer previously mapped into user virtual space with `GscAllocPhysicalMemory`.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscUnmapPhysicalMemory(  
    int boardNumber,  
    PLX_PHYSICAL_MEM *pciMem);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*pcimem* – A pointer to a `PLX_PHYSICAL_MEM` structure that will contain the buffer information.

## Channel Level Routines

The Channel Level Routines perform functions that apply to a single channel on an SIO4 board. Each of these routines requires the board number (`boardNumber`) as the first parameter and the channel number (`channel`) as the second parameter. The board number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system. The channel number will always be 1, 2, 3, or 4.

These routines can be called at any time. All of these functions return zero if successful or a non-zero error code if a failure occurs.

### ***GscSio4ChannelReset***

`GscSio4ChannelReset(...)` resets a single channel on the SIO4 board. In addition to disabling the serial channel, this function sets the “Almost Empty” and “Almost Full” FIFO flags to 16.

#### **Supported Hardware:**

All

#### **Prototype:**

```
int GscSio4ChannelReset(  
                        int boardNumber,  
                        int channel);
```

#### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

## ***GscSio4ChannelResetRxFifo***

`GscSio4ChannelResetRxFifo(...)` resets the Rx FIFO for a single channel. After the reset, the FIFO will contain no data.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelResetRxFifo (  
                                int boardNumber,  
                                int channel);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.



## ***GscSio4ChannelResetTxFifo***

`GscSio4ChannelResetTxFifo(...)` resets the Tx FIFO for a single channel. After the reset, the FIFO will contain no data.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelResetTxFifo (  
                                int boardNumber,  
                                int channel);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

## ***GscSio4ChannelRegisterRead***

`GscSio4ChannelRegisterRead(...)` is used to read the registers in the Universal Serial Chip that controls the specified channel. It is not recommended that a user application directly access these registers. This function is included for diagnostic purposes only.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelRegisterRead(  
                                int boardNumber,  
                                int channel,  
                                int reg,  
                                int *value);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*reg* – The address of the register to be read. Macros for these addresses are described in the section titled “Channel Register Definitions”.

*value* – A pointer to the location that will receive the results of the read operation.

## ***GscSio4ChannelRegisterWrite***

`GscSio4ChannelRegisterWrite(...)` is used to write to the registers in the Universal Serial Chip that controls the specified channel. It is not recommended that a user application directly access these registers. This function is included for diagnostic purposes only.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelRegisterWrite(  
                                int boardNumber,  
                                int channel,  
                                int reg,  
                                int value);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*reg* – The address of the register to be written. Macros for these addresses are described in the section titled “Channel Register Definitions”.

*value* – The value that is to be written to the register.

## **GscSio4GetLastError**

GscSio4GetLastError(...) is used to retrieve the error description text of the last channel-level api call made for the specified channel.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4GetLastError(  
    int boardNumber,  
    int channel,  
    int errorCode,  
    char *errorString  
    char *errorDetail);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*errorCode* – The integer error code

*errorString* – The error description text

*errorDetail* – More verbose and detailed error description text

## ***GscSio4ChannelSetMode / GscSio4ChannelGetMode***

`GscSio4ChannelSetMode(...)` sets a single channel of the SIO4 board to the desired serial format and bit rate.

Each mode has its own defaults, as described below, which can be altered by calling the appropriate Channel Level Routines after this function returns.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelSetMode(  
    int boardNumber,  
    int channel,  
    int mode,  
    int bitRate);
```

```
int GscSio4ChannelGetMode(  
    int boardNumber,  
    int channel,  
    int *mode,  
    int *bitRate);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*mode* – The desired/current serial mode for this channel. The value should be one of the following:

`GSC_MODE_ASYNC` – Sets the channel to standard asynchronous mode. The channel defaults to 8 data bits, no Parity, and one stop bit. It also uses a 16x sampling clock.

`GSC_MODE_ISO` – Sets the channel to isochronous mode. Uses the same defaults as `GSC_MODE_ASYNC` except the sampling clock, which is set to 1x.

`GSC_MODE_HDLC` – Sets the channel to HDLC mode. The Transmit clock is derived from the on-board source at the rate specified (*bitRate*) and is also driven onto the cable for use by the receiving end. The receiver clock is connected to the cable and should be supplied by the transmitter at the other end.

GSC\_MODE\_SYNC -  
GSC\_MODE\_SYNC\_ENV – (SIO4-SYNC boards only)  
GSC\_MODE\_ASYNC\_CV -  
GSC\_MODE\_MONOSYNC -  
GSC\_MODE\_BISYNC -  
GSC\_MODE\_TRANS\_BISYNC –

GSC\_MODE\_NBIF -  
GSC\_MODE\_802\_3 -

*bitRate* – The desired/current serial bit (baud) rate for this channel. This value can range from 250 to 10,000,000 for synchronous modes and 50 to 1,000,000 for asynchronous modes.

## ***GscSio4GetOption/GscSio4SetOption***

`GscSio4SetOption(...)` sets the value of a protocol configuration option for a channel. The available options are defined by the `GSC_OPTION_NAME` enumerated type.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4SetOption(
    int boardNumber,
    int channel,
    enum GSC_OPTION_NAME option,
    int value);

int GscSio4GetOption(
    int boardNumber,
    int channel,
    enum GSC_OPTION_NAME option,
    int value[]);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*option* – The protocol option to set or retrieve. The available options are defined in the `GSC_OPTION_NAME` enumerated type. They are listed in the table below.

*value* – The value or values set or retrieved. When calling `GscSio4SetOption`, in some cases *value* will actually contain a pair of 16 bit values, such as when configuring the `GSC_SIO_PROTOCOL` option. In this case *value* will contain a protocol option in the upper 16 bits and a termination option in the lower 16 bits. When retrieving the value of this option using `GscSio4GetOption`, the protocol and termination options will be returned as two elements in the `value[]` array. The majority of the available options are represented by a single value. The options that are represented as a pair of values are listed below:

The table below lists the available options and valid settings for each option. The `GscSio4SetOption()` function requires a 32-bit parameter value for all options. For some of the options, this parameter value represents two 16-bit option settings rather than one 32-bit setting. For these options, the table includes descriptions of the format each 16-bit

parameter and its valid values. Likewise, for the GscSio4GetOption() function, which returns two array entries in the case of the options composed of two 16-bit values, the table describes each entry returned in the parameter array along with its set of valid values.

<i>Option Name</i>	<i>Description</i>	<i>Set Value Parameter Format</i>	<i>Get Value Parameter Format</i>	<i>Valid Values</i>
GSC_SIO_DATASIZE	The size of the transmitted and received data for a single channel of the SIO4 board.	[31..0]: datasize	value[0]: datasize	1..8 for standard SIO4 boards. 0..65535 for -SYNC boards
GSC_SIO_GAPSIZE	The size of the gap between transmitted data words for a single channel of the SIO4 board. The gap size can be set to any value between 0 and 65535.	[31..0]: gapsize	value[0]: gapsize	0..65535 for -SYNC boards only.
GSC_SIO_MSBSLBORDER	The byte ordering of both transmitted and received data words for a single channel of the SIO4 board. The order can be set to transmit or receive either the most significant byte first or the least significant byte first.	[31..16]: Tx Order  [15..0]: Rx Order	value[0]: Tx Order value[1]: RxOrder	GSC_MSB_FIRST GSC_LSB_FIRST
GSC_SIO_PARITY	The type of parity that will be used on a single channel of the SIO4 board.	[31..0]: parity	value[0]: parity	GSC_PARITY_NONE GSC_PARITY_EVEN GSC_PARITY_ODD GSC_PARITY_MARK GSC_PARITY_SPACE
GSC_SIO_STOPBITS	The number of stop bits to use for a single channel of the SIO4 board.	[31..0]: stopbits	value[0]: stopbits	GSC_STOP_BITS_0 GSC_STOP_BITS_1 GSC_STOP_BITS_1_5 GSC_STOP_BITS_2
GSC_SIO_ENCODING	The encoding type for a single channel of the SIO4 board.	[31..0] encoding	value[0]: encoding	The macros defined in the section "Channel Encoding Definitions".



<i>Option Name</i>	<i>Description</i>	<i>Set Value Parameter Format</i>	<i>Get Value Parameter Format</i>	<i>Valid Values</i>
GSC_SIO_PROTOCOL	The physical interface protocol and termination options. The protocol on the standard SIO4B card is fixed at RS422/RS485 or RS232 depending on the configuration set at the factory.  Only the –BX cards allow this value to be changed.	[31..16]: protocol [15..0]: termination	value[0]: protocol value[1]: termination	Protocol: GSC_PROTOCOL_RS422_RS485 GSC_PROTOCOL_RS423 GSC_PROTOCOL_RS232 GSC_PROTOCOL_RS530_1 GSC_PROTOCOL_RS530_2 GSC_PROTOCOL_V35_1 GSC_PROTOCOL_V35_2 GSC_PROTOCOL_RS422_RS423_1 GSC_PROTOCOL_RS422_RS423_2 Termination: GSC_TERMINATION_ENABLED GSC_TERMINATION_DISABLED
GSC_SIO_DTEDCE	Sets a single channel of the SIO4 board to either DTE or DCE mode. Each channel defaults to DTE mode when it is configured. Setting this option is only necessary if DCE mode is required, or to switch back to DTE mode after a previous change to DCE mode. The pin-outs for both DTE and DCE modes are available in the Hardware User Manual.	[31..0]: mode	value[0]: mode	GSC_PIN_DTE GSC_PIN_DCE
GSC_SIO_LOOPBACK	The loopback mode of a channel on the SIO4 board.	[31..0] loop mode	value[0]: loop mode	GSC_LOOP_NONE GSC_LOOP_EXTERNAL
GSC_SIO_RECEIVER	Used for enabling or disabling the receiver for a single channel on the SIO4 board..	[31..0]: mode	value[0]: mode	GSC_ENABLED GSC_DISABLED
GSC_SIO_TRANSMITTER	Used for enabling or disabling the transmitter for a single channel on the SIO4 board.	[31..0]: mode	value[0]: mode	GSC_ENABLED GSC_DISABLED
GSC_SIO_TXDATAPINMODE	Used to enable the TxD pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO
GSC_SIO_RXDATAPINMODE	Used to enable the RxD pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO
GSC_SIO_TXCLOCKPINMODE	Used to enable the TxC pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO
GSC_SIO_RXCLOCKPINMODE	Used to enable the RxC pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO

<i>Option Name</i>	<i>Description</i>	<i>Set Value Parameter Format</i>	<i>Get Value Parameter Format</i>	<i>Valid Values</i>
GSC_SIO_CTSPINMODE	Used to enable the CTS pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO
GSC_SIO_RTSPINMODE	Used to enable the RTS pin of a channel to be used for general purpose i/o.	[31..0]: mode	value[0]: mode	GSC_PIN_AUTO GSC_PIN_GPIO
GSC_SIO_CLOCKSOURCE	Used to set the clock pin sources of the transmitter and receiver. This option provides for the transmitter and receiver to be configured with an internal or an external clock source.	[31..16]: Tx source	N/A	GSC_CLOCK_INTERNAL GSC_CLOCK_EXTERNAL
		[15..0]: Rx Source		
GSC_SIO_CRCMODE	Used for setting the CRC generation/detection mode for a single channel. This routine is also used to set the initial value of the CRC register.	[31..16] crc mode	value[0]: rc mode	crc mode: GSC_CRC_NONE GSC_CRC_16 GSC_CRC_32 GSC_CRC_CCITT  initial value: GSC_CRC_INIT_0 GSC_CRC_INIT_1
		[15..0] crc initial value	value[1]: crc initial value	
GSC_SIO_SYNCWORD	Used to set the sync word used on a channel.	[31..16]: Tx sync word	value[0]: Tx sync word	Integer value between 0..65535.
		[15..0]: Rx sync word	value[1]: Rx sync word	
GSC_SIO_TXUNDERRUN	Sets the data pattern to be transmitted under a Tx underrun condition.	[31..0]: Tx Underrun pattern	value[0]: Tx underrun pattern	GSC_SYN1 GSC_SYN0_SYN1 GSC_CRC_SYN1 GSC_CRC_SYN0_SYN1
GSC_SIO_TXPREAMBLE	Used to enable or disable the Tx preamble for a channel.	[31..0]: preamble state	value[0]: preamble state	GSC_ENABLED GSC_DISABLED
GSC_SIO_TXSHORTSYNC	Used set the Tx sync length (short or 8 bit) for a channel.	[31..0]: Tx sync length	value[0]: Tx sync length	GSC_ENABLED GSC_DISABLED
GSC_SIO_RXSYNCSTRIP	Set the Rx sync strip mode for a channel.	[31..0]: Rx sync strip mode	value[0]: Rx sync strip mode	GSC_ENABLED GSC_DISABLED
GSC_SIO_RXSHORTSYNC	Used to set the Rx sync length (short or 8 bit) for a channel.	[31..0]: Rx short sync length	value[0]: Rx short sync length	GSC_ENABLED GSC_DISABLED

<i>Option Name</i>	<i>Description</i>	<i>Set Value Parameter Format</i>	<i>Get Value Parameter Format</i>	<i>Valid Values</i>
GSC_SIO_TXPREAMBLELENGTH	Used to set the Tx preamble length for a channel	[31..0]: Tx preamble length	value[0]: Tx preamble length	GSC_PREAMBLE_8BITS GSC_PREAMBLE_16BITS GSC_PREAMBLE_32BITS GSC_PREAMBLE_64BITS
GSC_SIO_TXPREAMBLEPATTERN	Used to set the Tx preamble pattern for a channel.	[31..0]: Tx preamble pattern	value[0]: Tx preamble value	GSC_PREAMBLE_ALL_0 GSC_PREAMBLE_ALL_1 GSC_PREAMBLE_ALL_0_1 GSC_PREAMBLE_ALL_1_0
GSC_SIO_ORDERING	Used to set the byte and bit order used in bisync16 mode on a channel.	[31..16]: byte order [15..0] bit order	value[0]: byte order value[1]: bit order	byte and bit order: GSC_MSB_FIRST GSC_LSB_FIRST
GSC_SIO_MAXRXCOUNT	Used to set the maximum Rx count allowed	[31..0]: Max Rx Count	value[0]: Max Rx count	Integer value

## ***GscSio4ChannelSetPinMode / GscSio4ChannelGetPinMode***

`GscSio4ChannelSetPinMode(...)` configures the specified pin for general purpose I/O. The function can also set the specified pin for normal use.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelSetPinMode (  
                                int boardNumber,  
                                int channel,  
                                int pinName,  
                                int mode);  
  
int GscSio4ChannelGetPinMode (  
                                int boardNumber,  
                                int channel,  
                                int pinName,  
                                int *mode);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*pinName* – Identifier for the pin to be configured.

*mode* – The desired/current mode of operation for the specified pin. Valid values are defined in the `GSC_TOKENS` enumeration as follows:

```
GSC_PIN_AUTO  
GSC_PIN_GPIO
```

## ***GscSio4ChannelSetPinValue / GscSio4ChannelGetPinValue***

`GscSio4ChannelSetPinValue(...)` sets the current value of the specified programmable PIN if it is configured as GPIO.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelSetPinValue (  
                                int boardNumber,  
                                int channel,  
                                int pinName,  
                                int value);
```

```
int GscSio4ChannelGetPinValue (  
                                int boardNumber,  
                                int channel,  
                                int pinName,  
                                int *value);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*pinName* - Identifier for the pin to be configured.

*value* – The desired/current value of the specified pin. Accepted values are 0 and 1.

## ***GscSio4ChannelFifoSizes***

`GscSio4ChannelFifoSizes(...)` returns the size, in bytes, of the channel's Transmit and Receive FIFOs. The size of the Receive FIFO is returned in the upper 16 bits and the size of the Transmit FIFO is returned in the lower 16 bits of the result (*sizes*).

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelFifoSizes(  
    int boardNumber,  
    int channel,  
    int *sizes);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*sizes* – A pointer to the location that will receive the size (in bytes) of the Receive (upper 16 bits) and the Transmit (lower 16 bits) FIFOs

## **GscSio4ChannelFifoCounts**

GscSio4ChannelFifoCounts(...) returns the current number of bytes in the channel's Transmit and Receive FIFOs. The number of bytes in the Receive FIFO are returned in the upper 16 bits and the number of bytes in the Transmit FIFO are returned in the lower 16 bits of the result (*counts*).

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelFifoCounts(  
                                int boardNumber,  
                                int channel,  
                                int *counts);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*counts* – A pointer to the location that will receive the number of bytes currently in the Receive (upper 16 bits) and the Transmit (lower 16 bits) FIFOs.

## ***GscSio4ChannelSetTxAlmost / GscSio4ChannelGetTxAlmost***

`GscSio4ChannelSetTxAlmost(...)` programs the “Almost Full” and “Almost Empty” registers in the Transmit FIFO for a single channel. Once the values are programmed, the FIFO will be reset to force the change to take effect. This will also clear the contents of the FIFO, so this command should be done before any data transfers occur.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelSetTxAlmost(  
                                int boardNumber,  
                                int channel,  
                                int almostValue);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*almostValue* – The 32bit value that will be programmed into the Transmitter FIFO’s Almost Full (upper 16 bits) and Almost Empty (lower 16 bits) registers.



## ***GscSio4ChannelSetRxAlmost / GscSio4ChannelGetRxAlmost***

`GscSio4ChannelSetRxAlmost(...)` programs the “Almost Full” and “Almost Empty” registers in the Receive FIFO for a single channel. Once the values are programmed, the FIFO will be reset to force the change to take effect. This will also clear the contents of the FIFO, so this command should be done before any data transfers occur.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4ChannelSetRxAlmost(  
                                int boardNumber,  
                                int channel,  
                                int almostValue);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*almostValue* – The 32bit value that will be programmed into the Receiver FIFO’s Almost Full (upper 16 bits) and Almost Empty (lower 16 bits) registers.

## ***GscSio4ChannelCheckForData***

`GscSio4ChannelCheckForData(...)` determines whether a packet has been received on the specified channel. If a packet has been received, a dma transfer is initiated to return the data. The data received on the channel is transferred into the memory buffer pointed to by *buffer*. A number of bytes transferred is indicated by the value of *count*. This function may return before the transfer completes.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelCheckForData(  
                                int boardNumber,  
                                int channel,  
                                char *buffer,  
                                int *count);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will receive the data. The buffer should be large enough to hold a packet of data.

*count* – The number of bytes transferred.

## ***GscSio4ChannelReceivePacket***

`GscSio4ChannelReceivePacket(...)` determines whether a packet has been received on the specified channel. If a packet has been received, a dma transfer is initiated to return the data. The data received on the channel is transferred into the memory buffer pointed to by *buffer*. A number of bytes transferred is indicated by the value of *count*. This function may return before the transfer completes.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelReceivePacket(  
                                int boardNumber,  
                                int channel,  
                                char *buffer,  
                                int *count,  
                                int *transferStatus);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will receive the data. The buffer should be large enough to hold a packet of data.

*count* – The number of bytes that are to be transferred. Must be set to this value prior to making the function call.

*transferStatus* – Indicates the status of the transfer. The value will be non-zero if there are errors, such as a CRC error or an abort error, with the transfer. The status returned in this parameter will be a mask of any error bits in the UART RCSR register. Otherwise the value will be zero.

## **GscSio4ChannelReceiveData**

GscSio4ChannelReceiveData(...) starts the reception of data on the specified channel. The data received on the channel is transferred into the memory buffer pointed to by *buffer*. A total of *count* bytes will be transferred. This function may return before the transfer completes. When this function returns, the value pointed to by *id* will contain a unique identifier that can be used to determine the progress of the transfer.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelReceiveData(  
                                int boardNumber,  
                                int channel,  
                                char *buffer,  
                                int count,  
                                int *id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will receive the data. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*id* – A pointer to the location that will hold the unique transfer identifier that is assigned to this transfer. This value can be used to determine when the transfer has completed.

## ***GscSio4ChannelReceiveDataAndWait***

*GscSio4ChannelReceiveDataAndWait*(...) starts the reception of data on the specified channel. The data received on the channel is transferred into the memory buffer pointed to by *buffer*. A total of *count* bytes will be transferred. This function will not return until the entire transfer has completed or the timeout period has expired. If a timeout occurs, the value in *bytesTransferred* will specify the number of bytes that were actually received. (Note that if no timeout occurs, the *bytesTransferred* value is undefined.)

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelReceiveDataAndWait(  
    int boardNumber,  
    int channel,  
    char *buffer,  
    int count,  
    int timeout,  
    int *bytesTransferred);
```

### **Return value:**

The function returns a zero if the packet transfer completes. Otherwise it returns a non-zero error code.

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the *GscFindBoards*(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will receive the data. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*timeout* – The desired timeout period (in milliseconds) for the transfer.

*bytesTransferred* – If a timeout occurs, this value will specify the total number of bytes that were actually received. If no timeout occurs, this value is undefined.

## ***GscSio4ChannelReceivePlxPhysData***

`GscSio4ChannelReceivePlxPhysData(...)` starts the reception of data on the specified channel. The data received on the channel is transferred into the physically contiguous memory buffer pointed to by *buffer*. The memory for this buffer must be allocated with the `GscAllocPhysicalMemory` function and mapped into user virtual space using the `GscMapPhysicalMemory` function. A total of *count* bytes will be transferred. This function may return before the transfer completes. When this function returns, the value pointed to by *id* will contain a unique identifier that can be used to determine the progress of the transfer.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelReceivePlxPhysData(  
                                     int boardNumber,  
                                     int channel,  
                                     PLX_PHYSICAL_MEM *buffer,  
                                     int count,  
                                     int *id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the physically contiguous data buffer that will receive the data. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*id* – A pointer to the location that will hold the unique transfer identifier that is assigned to this transfer. This value can be used to determine when the transfer has completed.

## ***GscSio4ChannelTransmitData***

`GscSio4ChannelTransmitData(...)` starts the transmission of data on the specified channel. The data to be transmitted on the channel is transferred from the memory buffer pointed to by *buffer*. A total of *count* bytes will be transferred. This function may return before the transfer completes. When this function returns, the value pointed to by *id* will contain a unique identifier that can be used to determine the progress of the transfer.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelTransmitData(  
                                int boardNumber,  
                                int channel,  
                                char *buffer,  
                                int count,  
                                int *id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will be transmitted. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*id* – A pointer to the location that will hold the unique transfer identifier that is assigned to this transfer. This value can be used to determine when the transfer has completed.

## ***GscSio4ChannelTransmitDataAndWait***

`GscSio4ChannelTransmitDataAndWait(...)` starts the transmission of data on the specified channel. The data to be transmitted on the channel is transferred from the memory buffer pointed to by *buffer*. A total of *count* bytes will be transferred. This function will not return until the entire transfer has completed or the timeout period has expired. If a timeout occurs, the value in *bytesTransferred* will specify the number of bytes that were actually transmitted. (Note that if no timeout occurs, the *bytesTransferred* value is undefined.)

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelTransmitDataAndWait(  
                                     int boardNumber,  
                                     int channel,  
                                     char *buffer,  
                                     int count,  
                                     int timeout  
                                     int *bytesTransferred);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the data buffer that will be transmitted. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*timeout* – The desired timeout period (in milliseconds) for the transfer.

*bytesTransferred* – If a timeout occurs, this value will specify the total number of bytes that were actually transmitted. If no timeout occurs, this value is undefined.



## ***GscSio4ChannelTransmitPlxPhysData***

`GscSio4ChannelTransmitPlxPhysData(...)` starts the transmission of data on the specified channel. The data to be transmitted on the channel is transferred from the physically contiguous memory buffer pointed to by *buffer*. This buffer must be allocated using the `GscAllocPhysicalMemory` function and mapped to user virtual space using the `GscMapPhysicalMemory` function. A total of *count* bytes will be transferred. This function may return before the transfer completes. When this function returns, the value pointed to by *id* will contain a unique identifier that can be used to determine the progress of the transfer.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelTransmitPlxPhysData(  
    int boardNumber,  
    int channel,  
    PLX_PHYSICAL_MEM *buffer,  
    int count,  
    int *id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*buffer* – A pointer to the start of the physically contiguous data buffer that will be transmitted. The buffer should be at least *count* bytes long.

*count* – The number of bytes to transfer.

*id* – A pointer to the location that will hold the unique transfer identifier that is assigned to this transfer. This value can be used to determine when the transfer has completed.

## ***GscSio4ChannelQueryTransfer***

`GscSio4ChannelQueryTransfer(...)` is used to determine the status of a transfer that was initiated by a call to either `GscSio4ChannelReceiveData (...)` or `GscSio4ChannelTransmitData (...)`. The result is returned in *stat* and will be 0 if the transfer has completed or non-zero if it has not completed.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelQueryTransfer(  
                                int boardNumber,  
                                int channel,  
                                int *stat,  
                                int id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*stat* – A pointer to the location that will hold the returned status of the transfer. The *stat* will be 0 if the transfer has completed. Otherwise, it will hold the number of bytes left to transfer.

*id* – The unique ID that was assigned to the transfer by the call to either `GscSio4ChannelReceiveData(...)` or `GscSio4ChannelTransmitData(...)`

## **GscSio4ChannelWaitForTransfer**

GscSio4ChannelWaitForTransfer (...) is used to wait for the completion of a transfer that was initiated by a call to either GscSio4ChannelReceiveData (...) or GscSio4ChannelTransmitData (...). The routine will return when either the transfer completes or the timeout period expires. If the timeout period expires, the *bytesTransferred* parameter will be updated with the number of bytes that were successfully transferred. If the transfer completes, or another type of error occurs, the *bytesTransferred* parameter will be -1.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelWaitForTransfer(  
                                int boardNumber,  
                                int channel,  
                                int timeout,  
                                int id,  
                                int *bytesTransferred);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*timeout* – The desired amount of time in milliseconds that the routine will wait for the transfer to complete.

*id* – The unique ID that was assigned to the transfer by the call to either GscSio4ChannelReceiveData(...) or GscSio4ChannelTransmitData(...)

*bytesTransferred* - A pointer to the location that will hold the number of bytes that were actually transferred if the timeout period expires. This value will be -1 if the transfer completes or an error occurs.

## ***GscSio4ChannelFlushTransfer***

`GscSio4ChannelFlushTransfer (...)` is used to force any data that is in the Rx FIFO to be transferred via DMA to memory. For a Tx channel, data is transferred to the Tx FIFO until it is full. Calling this routine is only necessary when a transfer did not complete on its own, or when aborting a transfer that has not completed.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelFlushTransfer(  
                                int boardNumber,  
                                int channel,  
                                int id);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*id* – The unique ID that was assigned to the transfer by the call to either `GscSio4ChannelReceiveData(...)` or `GscSio4ChannelTransmitData(...)`

## ***GscSio4ChannelRemoveTransfer***

`GscSio4ChannelRemoveTransfer (...)` is used to remove a pending transfer from the transfer queue. Calling this routine is only necessary when a transfer did not complete on its own, or when aborting a transfer that has not completed. If a transfer ID of -1 is passed to the routine, all pending transfers will be removed.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelRemoveTransfer(  
    int boardNumber,  
    int channel,  
    int id,  
    int *bytesTransferred);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*id* – The unique ID that was assigned to the transfer by the call to either `GscSio4ChannelReceiveData(...)` or `GscSio4ChannelTransmitData(...)`

*bytesTransferred* - A pointer to the location that will hold the number of bytes that were actually transferred before the call to `GscSio4ChannelRemoveTransfer ()`. This value will be -1 if the transfer had already completed or an error occurs.

## ***GscFindBoardsGscSio4ChannelRegisterInterrupt***

`GscSio4ChannelRegisterInterrupt (...)` is used register a callback routine with the interrupt handler. There are several interrupt sources associated with each interrupt. This routine allows any or all of the interrupt sources to be associated with a callback function. The callback function can be shared between interrupt sources or a different callback can be used for each source. This routine also determines whether the interrupt occurs on the Rising Edge (High True) or Falling Edge (Low True).

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelRegisterInterrupt(  
                                     int boardNumber,  
                                     int channel,  
                                     int interrupt,  
                                     int type,  
                                     GSC_CB_FUNCTION *function);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*interrupt* – This value determines which interrupts are associated with the provided callback function. This value should be the logical OR of one or more of the following:

`GSC_INTR_SYNC_DETECT` – Triggers an interrupt when the SYNC byte is received on the channel. (This source is not available on the –Sync boards)

`GSC_INTR_USC` – Triggers an interrupt when the on board USC has an interrupt pending. Refer to the USC data sheet for details of its possible interrupt sources. (This source is not available on the –Sync boards)

`GSC_INTR_TX_FIFO_EMPTY` – Triggers an interrupt when the Transmit FIFO for the channel is empty.

`GSC_INTR_TX_FIFO_FULL` – Triggers an interrupt when the Transmit FIFO for the channel is full.

`GSC_INTR_TX_FIFO_ALMOST_EMPTY` – Triggers an interrupt when the Transmit FIFO for the channel is almost empty. The level at which this

interrupt will occur is set by calling the `GscSio4ChannelSetTxAlmost(...)` routine.

`GSC_INTR_RX_FIFO_EMPTY` – Triggers an interrupt when the Receive FIFO for the channel is empty.

`GSC_INTR_RX_FIFO_FULL` – Triggers an interrupt when the Receive FIFO for the channel is full.

`GSC_INTR_RX_FIFO_ALMOST_FULL` – Triggers an interrupt when the Receive FIFO for the channel is almost full. The level at which this interrupt will occur is set by calling the `GscSio4ChannelSetRxAlmost(...)` routine.

`GSC_INTR_RX_ENVELOPE` – Triggers an interrupt when the RX Envelope signal changes. (This source is only available on the –Sync boards)

*type* – This value determines whether the interrupt occurs on the rising or falling edge. It should be one of the following:

`GSC_RISING_EDGE` – The interrupt will occur on the rising edge of the interrupt signal (i.e. when the condition becomes true.)

`GSC_FALLING_EDGE` – The interrupt will occur on the falling edge of the interrupt signal (i.e. when the condition becomes not true.)

*function* – This is the address of the interrupt callback function. If this value is set to `NULL`, the callback for the current “interrupt” parameter will be cleared, otherwise this routine will be called for each of the conditions specified in the “interrupt” parameter. The prototype for the callback function is:

```
void CALLBACK callback_function(  
                                int boardNumber,  
                                int channel,  
                                int interrupt);
```

The parameters to the callback specify the board and channel number on which the interrupt occurred as well as the source of the interrupt (as defined above.) If multiple interrupt sources are mapped to the same callback routine, the “interrupt” parameter can be used to determine the source of the interrupt.

## ***GscSio4ChannelSetClock***

`GscSio4ChannelSetClock(...)` is used to set the serial bit rate (baud rate) for a specific channel. Under normal conditions, this routine will not be used since the `GscSio4ChannelSetMode(...)` function sets the bit rate of the channel when the channel's mode is set. This function is provided to allow the bit rate to be changed without re-configuring the channel.

### **Supported Hardware:**

All

### **Prototype:**

```
int GscSio4ChannelSetClock(  
                                int boardNumber,  
                                int channel,  
                                int frequency);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*frequency* – The desired bit rate for this channel. This value is specified in Hz and can range from 100 to 10000000 (1000000 for async channels).



## Protocol Level Routines

The Protocol Level Routines perform functions that apply to a specific protocol on a single channel on an SIO4 board. Each of these routines requires the board number (`boardNumber`) as the first parameter and the channel number (`channel`) as the second parameter. The board number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system. The channel number will always be 1, 2, 3, or 4.

These routines can be called at any time. All of these functions return zero if successful or a non-zero error code if a failure occurs.

### ***GscSio4HdlcGetDefaults***

`GscSio4HdlcGetDefaults(...)` returns the default HDLC configuration structure.

#### **Supported Hardware:**

PCI-SIO4B

#### **Prototype:**

```
int GscSio4HdlcGetDefaults(  
                                PGSC_HDLC_CONFIG config);
```

#### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## ***GscSio4HdlcSetConfig / GscSio4HdlcGetConfig***

`GscSio4HdlcSetConfig(...)` sets the mode of the specified channel to HDLC and sets the current configuration to the values specified in the *config* parameter.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4HdlcSetConfig(  
    int boardNumber,  
    int channel,  
    GSC_HDLC_CONFIG config);  
  
int GscSio4HdlcGetConfig(  
    int boardNumber,  
    int channel,  
    PGSC_HDLC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The desired/current configuration structure for the channel.

## ***GscSio4AsyncGetDefaults***

`GscSio4AsyncGetDefaults(...)` returns the default Async configuration structure.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4AsyncGetDefaults(  
                                PGSC_ASYNC_CONFIG config);
```

### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## ***GscSio4AsyncSetConfig / GscSio4AsyncGetConfig***

`GscSio4AsyncSetConfig(...)` sets the mode of the specified channel to Async and sets the current configuration to the values specified in the *config* parameter.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4AsyncSetConfig(  
    int boardNumber,  
    int channel,  
    GSC_ASYNC_CONFIG config);  
  
int GscSio4AsyncGetConfig(  
    int boardNumber,  
    int channel,  
    PGSC_ASYNC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The desired/current configuration structure for the channel.

## ***GscSio4BiSyncGetDefaults***

`GscSio4BiSyncGetDefaults(...)` returns the default BiSync configuration structure.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4BiSyncGetDefaults(  
                                PGSC_BISYNC_CONFIG config);
```

### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## ***GscSio4BiSyncSetConfig / GscSio4BiSyncGetConfig***

`GscSio4BiSyncSetConfig(...)` sets the mode of the specified channel to bisync and sets the current configuration to the values specified in the *config* parameter.

### **Supported Hardware:**

PCI-SIO4B

### **Prototype:**

```
int GscSio4BiSyncSetConfig(  
  
                           int boardNumber,  
                           int channel,  
                           GSC_BISYNC_CONFIG config);  
  
int GscSio4BiSyncGetConfig(  
  
                           int boardNumber,  
                           int channel,  
                           PGSC_BISYNC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The desired/current configuration structure for the channel.

## ***GscSio4SyncGetDefaults***

`GscSio4SyncGetDefaults(...)` returns the default Sync configuration structure.

### **Supported Hardware:**

PCI-SIO4B-SYNC

### **Prototype:**

```
int GscSio4SyncGetDefaults(  
                                PGSC_SYNC_CONFIG config);
```

### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## ***GscSio4SyncSetConfig / GscSio4SyncGetConfig***

`GscSio4SyncSetConfig(...)` sets the mode of the specified channel to Sync and sets the current configuration to the values specified in the *config* parameter.

### **Supported Hardware:**

PCI-SIO4B-SYNC

### **Prototype:**

```
int GscSio4SyncSetConfig(  
    int boardNumber,  
    int channel,  
    GSC_SYNC_CONFIG config);
```

```
int GscSio4SyncGetConfig(  
    int boardNumber,  
    int channel,  
    PGSC_SYNC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The desired/current configuration structure for the channel.



## ***GscSio4BiSync16GetDefaults***

`GscSio4BiSync16GetDefaults(...)` returns the default bisync16 configuration structure.

### **Supported Hardware:**

PCI-SIO4B-BISYNC

### **Prototype:**

```
int GscSio4BiSync16GetDefaults(  
                                PGSC_BISYNC16_CONFIG config);
```

### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## ***GscSio4BiSync16SetConfig / GscSio4BiSync16GetConfig***

`GscSio4BiSync16SetConfig(...)` sets the mode of the specified channel to `bisync16` and sets the current configuration to the values specified in the `config` parameter.

### **Supported Hardware:**

PCI-SIO4B-BISYNC

### **Prototype:**

```
int GscSio4BiSync16SetConfig(  
                                int boardNumber,  
                                int channel,  
                                GSC_BISYNC16_CONFIG config);  
  
int GscSio4BiSync16GetConfig(  
                                int boardNumber,  
                                int channel,  
                                PGSC_BISYNC16_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The desired/current configuration structure for the channel.

## **GscSio4BiSync16GetTxCounts**

GscSio4BiSync16GetTxCounts(...) is used to retrieve the initial and remaining Tx counts for a channel configured in bisync16 mode.

### **Supported Hardware:**

PCI-SIO4B-BISYNC

### **Prototype:**

```
int GscSio4BiSync16GetTxCounts(  
                                int boardNumber,  
                                int channel,  
                                int *remaining,  
                                int *initial);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*remaining* – The remaining Tx counts value.

*initial* – The initial Tx Counts value.

## ***GscSio4BiSync16GetRxCounts***

`GscSio4BiSync16GetRxCounts(...)` is used to retrieve the initial and remaining Rx counts for a channel configured in `bisync16` mode.

### **Supported Hardware:**

PCI-SIO4B-BISYNC

### **Prototype:**

```
int GscSio4BiSync16GetRxCounts(  
                                int boardNumber,  
                                int channel,  
                                int *remaining,  
                                int *initial);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*remaining* – The remaining Rx counts value.

*initial* – The initial Rx Counts value.

## ***GscSio4BiSync16EnterHuntMode***

`GscSio4BiSync16EnterHuntMode(...)` is used to cause a channel configured in `bisync16` mode to enter hunt mode.

### **Supported Hardware:**

PCI-SIO4B-BISYNC16??

### **Prototype:**

```
int GscSio4BiSync16EnterHuntMode(  
                                int boardNumber,  
                                int channel)
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

## ***GscSio4BiSync16AbortTx***

*GscSio4BiSync16AbortTx(...)* is used to cause a channel configured in *bisync16* mode to abort the current transmission.

### **Supported Hardware:**

PCI-SIO4B-BISYNC16??

### **Prototype:**

```
int GscSio4BiSync16AbortTx(  
                                int boardNumber,  
                                int channel)
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the *GscFindBoards(...)* function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

## ***GscSio4BiSync16Pause***

`GscSio4BiSync16Pause(...)` is used to cause a channel configured in `bisync16` mode to pause the current transmission.

### **Supported Hardware:**

PCI-SIO4B-BISYNC16??

### **Prototype:**

```
int GscSio4BiSync16Pause(  
                           int boardNumber,  
                           int channel)
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

## ***GscSio4BiSync16Resume***

`GscSio4BiSync16Resume(...)` is used to cause a channel configured in `bisync16` mode to pause the current transmission.

### **Supported Hardware:**

PCI-SIO4B-BISYNC16??

### **Prototype:**

```
int GscSio4BiSync16Resume(  
                           int boardNumber,  
                           int channel)
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.



## CTC Protocol Routines

### ***GscSio4CTCAddMajorFrame***

*GscSio4CTCAddMajorFrame(...)* adds a CTC major frame to the TX SRAM for the specified channel.

#### **Supported Hardware:**

SIO4BXR

#### **Prototype:**

```
int GscSio4CTCAddMajorFrame(  
                                int boardNumber,  
                                int channel,  
                                CTC_MAJOR_FRAME *frame,  
                                int framesize);
```

#### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the *GscFindBoards(...)* function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*frame* – A pointer to the start of the CTC major frame that will be transmitted.

*framesize* – The major frame size expressed as the number of minor frames

## ***GscSio4CTCAddMinorFrame***

`GscSio4CTCAddMinorFrame(...)` adds a CTC minor frame to the TX SRAM for the specified channel.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCAddMinorFrame(  
                                int boardNumber,  
                                int channel,  
                                CTC_MINOR_FRAME *frame);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*frame* – A pointer to the CTC minor frame that will be written to TX SRAM.

## ***GscSio4CTCGetActiveMajorFrame***

*GscSio4CTCGetActiveMajorFrame(...)* returns the frame number of the CTC major frame actively being transmitted.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCGetActiveMajorFrame(  
                                     int boardNumber,  
                                     int channel,  
                                     int *frameNumber);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the *GscFindBoards(...)* function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*\*frameNumber* – A pointer to the returned active major frame number

## ***GscSio4CTCGetConfig***

`GscSio4GetActiveMajorFrame(...)` returns the current configuration structure for a single channel that is set to CTC mode.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCGetConfig(  
                        int boardNumber,  
                        int channel,  
                        PGSC_CTC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – A pointer to the board configuration structure. The details of this structure are documented in the section “CTC Data Structures”

## ***GscSio4CTCGetDefaults***

`GscSio4CTCGetDefaults(...)` returns the default CTC configuration structure.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCGetDefaults(  
                                PGSC_CTC_CONFIG config);
```

### **Parameters:**

*config* – A pointer to a configuration structure that will be filled in with default configuration values.

## **GscSio4CTCReceiveFrames**

GscSio4CTCReceiveFrames(...) returns the frame number of the CTC major frame actively being transmitted.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCReceiveFRames(  
                                int boardNumber,  
                                int channel,  
                                int *nFrames,  
                                char *buffer,  
                                int *nErrors);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*\*nFrames* – On input, this parameter specifies the maximum number of frames to retrieve. On output, the actual number of frames retrieved is returned.

*\*buffer* – The minor frames received are returned in this parameter.

*\*nErrors* – The count of errors associated with frames in the FIFO.

## ***GscSio4CTCResetTimer***

GscSio4CTCResetTimer(...) resets the CTC timer value.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCResetTimer(  
                           int boardNumber);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

## ***GscSio4CTCSetConfig***

`GscSio4CTCSetConfig(...)` sets the current configuration structure for a single CTC channel. The details of the configuration structure are documented in the section “CTC Data Structures”.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCSetConfig(  
    int boardNumber,  
    int channel,  
    GSC_CTC_CONFIG config);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*config* – The board configuration structure populated with the desired settings for the CTC board.



## ***GscSio4CTCSetTimer***

`GscSio4CTCSetTimer(...)` sets the CTC timer BCD or binary value.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCSetTimer(  
    int boardNumber,  
    unsigned short usecs,  
    unsigned int hilo  
    int timerMode);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*usecs* – Value for the CTC timer usec register

*hilo* – Value for the CTC timer hilo register

*timerMode* – BCD or binary.

## **GscSio4CTCSwitchMajorFrame**

GscSio4CTCSwitchMajorFrame(...) adds a CTC major frame to TX SRAM for the specified channel and hands off active CTC transmission to the added major frame, causing the previously transmitting major frame to go dormant.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCSwitchMajorFrame(  
                                int boardNumber,  
                                int channel,  
                                CTC_MAJOR_FRAME *frame  
                                int frameSize);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the GscFindBoards(...) function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*\*frame* – A pointer to the new major frame to start transmitting

*frameSize* – The major frame size expressed as the number of minor frames contained in the major frame.

## ***GscSio4CTCTransmitFrames***

`GscSio4CTCTransmitFrames(...)` transmits a loop of CTC minor frames on the specified channel.

### **Supported Hardware:**

SIO4BXR

### **Prototype:**

```
int GscSio4CTCTransmitFrames(  
                                int boardNumber,  
                                int channel,  
                                int frameNumber);
```

### **Parameters:**

*boardNumber* – The number of the desired board. This number corresponds to the results of the `GscFindBoards(...)` function. Note that this number will always be 1 in a single board system.

*channel* – The desired channel number. This number will be 1, 2, 3, or 4.

*frameNumber* – The starting minor frame number of the loop.

## CTC Data Structures and Macro Definitions

### GSC\_CTC\_CONFIG Structure

```
typedef struct _GSC_CTC_CONFIG
{
    // Channel Configuration Variables
    int  bitRate;           // Bit rate for the channel.
    int  protocol;         // Bus Protocol - RS485, RS232, etc.
    int  termination;      // Termination Resistors enabled/disabled
    int  majorFrameSize;   // Maximum number of minor frames
                                // allowable in a major frame
    int  minorFrameSize;   // Minor frame size in bytes.
    int  timerMode;        // Binary or BCD
    int  timerValue;       // 32-bit binary or bcd timer value

    // Transmitter Configuration Variables
    int  txStatus;         // Transmitter Enabled/Disabled
    int  txFrameCount;     // Enable/disable inclusion of frame
                                // count in tx frame.
    int  txFrameTimer;     // Enable/disable inclusion of timestamp
                                // in tx frame.

    // Receiver Configuration Variables
    int  rxStatus;         // Receiver Enabled/Disabled
    int  rx;               // Clock source for the receiver

    // Pin Configuration Variables
    int  interfaceMode;    // DTE or DCE interface
    int  loopbackMode;     // None, internal, or external loop back
} GSC_CTC_CONFIG, *PGSC_CTC_CONFIG;
```

### CTC\_MINOR\_FRAME Structure

```
typedef struct _CTC_MINOR_FRAME
{
    int  frameNumber;
    int  lastFrame;
    int  framingErrEnable;
    int  timerInsertEnable;
    int  frameCountInsertEnable;
    int  nextFrame;
    int  size;
    char *data;
} CTC_MINOR_FRAME;
```

## CTC\_MAJOR\_FRAME Structure

```
typedef struct _CTC_MAJOR_FRAME
{
    int majorFrameNumber;
    CTC_MINOR_FRAME frames[256];
} CTC_MAJOR_FRAME;
```

## CTC Local Registers

Macro	Value
CTC_TIMER_CONTROL_REG	0x0800
CTC_TIMER_HILO_REG	0x0804
CTC_TIMER_USEC_REG	0x0808
CTC_CONTROL_REG	0x0000
CTC_FRAME_SIZE_REG	0x0018
CTC_TX_FRAME_START_REG	0x001c
CTC_TX_HEADER_OFFSET_REG	0x0030
CTC_TX_HEADER_DATA_REG	0x0034
CTC_TX_BUFFER_OFFSET_REG	0x0038
CTC_TX_BUFFER_DATA_REG	0x003c
CTC_TX_HEADER_CURRENT_REG	0x0040
CTC_TX_MAX_FRAMESIZE_REG	0x0044
CTC_RX_HEADER_FIFOCOUNT_REG	0x0058
CTC_RX_FRAME_FIFOCOUNT_REG	0x005c
CTC_RX_FRAME_ERRORCOUNT_REG	0x0060
CTC_TEST_REG	0x0810

## CTC Interrupt Definitions

GSC_INTR_CTC_RX_FIFO_OVF	0x0001
GSC_INTR_CTC_RX_FRAME_RECV	0x0002
GSC_INTR_CTC_RX_FRAME_ERR	0x0010
GSC_INTR_CTC_RX_HEADER_OVERFLOW	0x0020

## Structures and Macro Definitions

This section contains the descriptions of the various structures and macro definitions available to users of the API.

### *Devices Structure*

```
typedef struct
{
    int    busNumber;        // Identifies the bus that contains the board
    int    slotNumber;      // Identifies the slot that contains the board
    int    vendorId;        // Identifies the board Vendor
    int    deviceId;        // Identifies the device
    char   serialNumber[25]; // A unique board serial number
} GSC_DEVICES_STRUCT;
```

### ***Interrupt Callback Prototype***

```
typedef void
((CALLBACK *GSC_CB_FUNCTION)(int boardNumber, int channel, int interrupt));
```

For the Linux platform, the macro `CALLBACK` is null. On the Win32 platform, this macro declares the function calling convention as `_stdcall`, which is required by Microsoft .Net 2003 applications.

## Channel Mode Definitions

The Channel Mode Definitions are used to set the current operating protocol for each channel of the SIO4 board. These definitions are passed as a parameter of the GscSio4ChannelSetMode(...) command.

<b>Macro</b>	<b>Protocol</b>	<b>Defaults</b>
GSC_MODE_ASYNC	Asynchronous Mode	8 Data Bits No Parity 1 Stop Bit 16x Clock NRZ Encoding
GSC_MODE_HDLC	HDLC/SDLC Mode	8 Data Bits NRZ Encoding
GSC_MODE_SYNC	Synchronous Mode*	8 Data Bits 0 Gap Bits NRZ Encoding
GSC_MODE_SYNC_ENV	Synchronous Mode w/ Envelope*	8 Data Bits 0 Gap Bits NRZ Encoding
GSC_MODE_ISO	Isochronous Mode	8 Data Bits NRZ Encoding
GSC_MODE_MONOSYNC	Monosync Mode	8 Data Bits NRZ Encoding
GSC_MODE_BISYNC	BiSync Mode	8 Data Bits NRZ Encoding
GSC_MODE_TRANS_BISYNC	Transparent BiSync Mode	8 Data Bits NRZ Encoding
GSC_MODE_802_3	IEEE 802.3 Ethernet Mode	8 Data Bits NRZ Encoding

\* These are the only modes that are available on the –SYNC card. They are not available on the standard card.

## Channel Mode Configuration Structures

The Channel Mode Configuration structures are used by the GscApi mode configuration functions that correspond with each mode. For example, the structure GSC\_HDLC\_CONFIG is used by the GscApi configuration functions as follows:

```
GSC_HDLC_CONFIG cfg; // declare a configuration variable

GscSio4HdlcGetDefaults(&cfg); // get the default settings for Hdlc
mode

GscSio4HdlcSetConfig(board, channel, cfg); // configure a channel in Hdlc mode
GscSio4HdlcGetConfig(board, channel, &cfg); // retrieve current configuration
```

The GSC\_HDLC\_CONFIG structure definition, along with the structures corresponding to the Async, BiSync, Sync and BiSync16 modes are listed below.

### GSC\_ASYNC\_CONFIG Structure

```
typedef struct _GSC_ASYNC_CONFIG
{
    // Channel Configuration Variables
    int    bitRate; // Baud rate for the channel.
    int    encoding; // Encoding - NRZ, BiPhase, etc.
    int    protocol; // Bus Protocol - RS485, RS232, V.35, etc.
    int    termination; // Termination Resistors enabled/disabled
    int    parity; // Parity mode - None, Even, Odd, etc.
    int    stopBits; // Stop bits - 0, 1, 1.5, 2

    // Transmitter Configuration Variables
    int    txStatus; // Transmitter Enabled/Disabled
    int    txCharacterLength; // Bits per Tx character
    int    txClockSource; // Clock source for the transmitter

    // Receiver Configuration Variables
    int    rxStatus; // Receiver Enabled/Disabled
    int    rxCharacterLength; // Bits per Rx character
    int    rxClockSource; // Clock source for the receiver

    // Pin Configuration Variables
    int    interfaceMode; // DTE or DCE interface
    int    txDataPinMode; // Auto (system use) or GPIO
    int    rxDataPinMode; // Auto (system use) or GPIO
    int    txClockPinMode; // Auto (system use) or GPIO
    int    rxClockPinMode; // Auto (system use) or GPIO
    int    ctsPinMode; // Auto (system use) or GPIO
    int    rtsPinMode; // Auto (system use) or GPIO
    int    loopbackMode; // None, internal, or external loop back
} GSC_ASYNC_CONFIG, *PGSC_ASYNC_CONFIG;
```



## GSC\_HDLC\_CONFIG Structure

```
typedef struct _GSC_HDLC_CONFIG
{
    // Channel Configuration Variables
    int bitRate; // Baud rate for the channel.
    int encoding; // Encoding - NRZ, BiPhase, etc.
    int protocol; // Bus Protocol - RS485, RS232, V.35, etc.
    int termination; // Termination Resistors enabled/disabled
    int parity; // Parity mode - None, Even, Odd, etc.
    int crcMode; // CRC Type - Disabled, CCITT, etc.
    int crcInitialValue; // Initial CRC - All 1 or 0

    // Transmitter Configuration Variables
    int txStatus; // Transmitter Enabled/Disabled
    int txCharacterLength; // Bits per Tx character

    int txUnderRun; // What to do on a Tx underrun
    int txPreamble; // Length of Preamble
    int txPreamblePattern; // Type of Preamble
    int txSharedZero; // Share 0s in adjacent flags?
    int txClockSource; // Clock source for the transmitter
    int txIdleCondition; // What to transmit when the line is idle

    // Receiver Configuration Variables
    int rxStatus; // Receiver Enabled/Disabled
    int rxCharacterLength; // Bits per Rx character
    int rxAddrSearchMode; // Rx address search mode
    int rxAddress; // Address to search for
    int rxClockSource; // Clock source for the receiver
    int rxReceiveStatusBlocks; // Enable/disable 16 bit receive
    // status blocks in RX FIFO

    // Pin Configuration Variables
    int interfaceMode; // DTE or DCE interface
    int txDataPinMode; // Auto (system use) or GPIO
    int rxDataPinMode; // Auto (system use) or GPIO
    int txClockPinMode; // Auto (system use) or GPIO
    int rxClockPinMode; // Auto (system use) or GPIO
    int ctsPinMode; // Auto (system use) or GPIO
    int rtsPinMode; // Auto (system use) or GPIO
    int loopbackMode; // None, internal, or external loop back

    // Misc Configuration Variables
    int packetFraming; // Internal use only, leave enabled
} GSC_HDLC_CONFIG, *PGSC_HDLC_CONFIG;
```

## GSC\_BISYNC\_CONFIG Structure

```
typedef struct _GSC_BISYNC_CONFIG
{
    // Channel Configuration Variables
    int bitRate; // Baud rate for the channel.
    int encoding; // Encoding - NRZ, BiPhase, etc.
    int protocol; // Bus Protocol - RS485, RS232, V.35, etc.
    int termination; // Termination Resistors enabled/disabled
    int parity; // Parity mode - None, Even, Odd, etc.
    int crcMode; // CRC Type - Disabled, CCITT, etc.
    int crcInitialValue; // Initial CRC - All 1 or 0

    // Transmitter Configuration Variables
    int txStatus; // Transmitter Enabled/Disabled
    int txCharacterLength; // Bits per Tx character
    int txClockSource; // Clock source for the transmitter
    int txIdleCondition; // What to transmit when the line is idle
    int txSyncWord; // Two character sync pattern
    int txUnderRun; // What to do on a Tx underrun
    int txPreamble; // Enable/disable preamble before sync open
    int txPreambleLength; // Preamble length - 8,16,32,64 bits
    int txPreamblePattern; // Preamble pattern - all zeros, all
    // ones, etc.
    int txShortSync; // Length of sync character -
    // 8 bits or same as txCharacterLength

    // Receiver Configuration Variables
    int rxStatus; // Receiver Enabled/Disabled
    int rxClockSource; // Clock source for the receiver
    int rxCharacterLength; // Bits per Rx character
    int rxSyncWord; // Two character sync pattern
    int rxSyncStrip; // Sync character stripping enable/disable
    int rxShortSync; // Length of sync character - 8 bits or same
    // as rxCharacterLength

    // Pin Configuration Variables
    int interfaceMode; // DTE or DCE interface
    int txDataPinMode; // Auto (system use) or GPIO
    int rxDataPinMode; // Auto (system use) or GPIO
    int txClockPinMode; // Auto (system use) or GPIO
    int rxClockPinMode; // Auto (system use) or GPIO
    int ctsPinMode; // Auto (system use) or GPIO
    int rtsPinMode; // Auto (system use) or GPIO
    int loopbackMode; // None, internal, or external loop back

    // Misc Configuration Variables
    int packetFraming; // Internal use only, leave disabled
} GSC_BISYNC_CONFIG, *PGSC_BISYNC_CONFIG;
```

## GSC\_SYNC\_CONFIG Structure

```
typedef struct _GSC_SYNC_CONFIG
{
    // Channel Configuration Variables
    int bitRate; // Baud rate for the channel.
    int encoding; // Encoding - NRZ, NRZB
    int protocol; // Bus Protocol - RS485, RS232, V.35, etc.
    int termination; // Termination Resistors enabled/disabled

    // Transmitter Configuration Variables
    int txStatus; // Transmitter Enabled/Disabled
    int txCharacterLength; // Bits per Tx character
    int txGapLength; // Bits between Tx characters
    int txClockSource; // Clock source for the transmitter
    int txClockEdge; // Clock edge for the transmitter
    int txEnvPolarity; // Envelope polarity for the transmitter
    int txIdleCondition; // What to transmit when the line is idle
    int txClockIdleCondition; // What to do with the clock when line idle
    int txMsbLsb; // Bit order for transmitter

    // Receiver Configuration Variables
    int rxStatus; // Receiver Enabled/Disabled
    int rxClockSource; // Clock source for the receiver
    int rxClockEdge; // Clock edge for the receiver
    int rxEnvPolarity; // Envelope polarity for the receiver
    int rxMsbLsb; // Bit order for receiver

    // Pin Configuration Variables
    int interfaceMode; // DTE or DCE interface
    int txDataPinMode; // Auto (system use) or GPIO
    int rxDataPinMode; // Auto (system use) or GPIO
    int txClockPinMode; // Auto (system use) or GPIO
    int rxClockPinMode; // Auto (system use) or GPIO
    int txEnvPinMode; // Auto (system use) or GPIO
    int rxEnvPinMode; // Auto (system use) or GPIO
    int loopbackMode; // None, internal, or external loop back

    // Misc Configuration Variables
    int packetFraming; // Internal use only, leave disabled
} GSC_SYNC_CONFIG, *PGSC_SYNC_CONFIG;
```

## GSC\_BISYNC16\_CONFIG Structure

```
typedef struct _GSC_BISYNC16_CONFIG
{
    // Channel Configuration Variables
    int bitRate; // Baud rate for the channel.
    int encoding; // Encoding - NRZ, BiPhase, etc.
    int protocol; // Bus Protocol - RS485, RS232, V.35, etc.
    int termination; // Termination Resistors enabled/disabled

    // Transmitter Configuration Variables
    int txStatus; // Transmitter Enabled/Disabled
    int txIdleCondition; // What to transmit when the line is idle
    int txSyncWord; // Two character sync pattern
    int txBitOrder;
    int txByteOrder;

    // Receiver Configuration Variables
    int rxStatus; // Receiver Enabled/Disabled
    int rxSyncWord; // Two character sync pattern
    int maxRxCount;

    // Pin Configuration Variables
    int interfaceMode; // DTE or DCE interface
    int txDataPinMode; // Auto (system use) or GPIO
    int rxDataPinMode; // Auto (system use) or GPIO
    int txClockPinMode; // Auto (system use) or GPIO
    int rxClockPinMode; // Auto (system use) or GPIO
    int ctsPinMode; // Auto (system use) or GPIO
    int rtsPinMode; // Auto (system use) or GPIO
    int loopbackMode; // None, internal, or external loop back
} GSC_BISYNC16_CONFIG, *PGSC_BISYNC16_CONFIG;
```

## Channel Encoding Definitions

The Channel Encoding Definitions are used to set the desired channel encoding for each channel of the SIO4 board. These definitions are passed as a parameter of the GscSio4ChannelSetEncoding(...) command.

<b>Macro</b>	<b>Description</b>
GSC_ENCODING_NRZ	
GSC_ENCODING_NRZB	
GSC_ENCODING_NRZI_MARK	
GSC_ENCODING_NRZI_SPACE	
GSC_ENCODING_BIPHASE_MARK	
GSC_ENCODING_BIPHASE_SPACE	
GSC_ENCODING_BIPHASE_LEVEL	
GSC_ENCODING_DIFF_BIPHASE_LEVEL	

## Channel Protocol and Termination Definitions

GSC\_PROTOCOL\_RS422\_RS485,  
GSC\_PROTOCOL\_RS423,  
GSC\_PROTOCOL\_RS232,  
GSC\_PROTOCOL\_RS530\_1,  
GSC\_PROTOCOL\_RS530\_2,  
GSC\_PROTOCOL\_V35\_1,  
GSC\_PROTOCOL\_V35\_2,  
GSC\_PROTOCOL\_RS422\_RS423\_1,  
GSC\_PROTOCOL\_RS422\_RS423\_2,

GSC\_TERMINATION\_ENABLED,  
GSC\_TERMINATION\_DISABLED,

## Channel Interrupt Definitions

```
GSC_INTR_RISING_EDGE,  
GSC_INTR_FALLING_EDGE,  
GSC_INTR_HIGH_TRUE,  
GSC_INTR_LOW_TRUE,  
  
GSC_INTR_SYNC_DETECT           = 0x0001,  
GSC_INTR_USC                   = 0x0002,  
GSC_INTR_TX_FIFO_EMPTY        = 0x0004,  
GSC_INTR_TX_FIFO_FULL         = 0x0008,  
GSC_INTR_TX_FIFO_ALMOST_EMPTY = 0x0010,  
GSC_INTR_RX_FIFO_EMPTY        = 0x0020,  
GSC_INTR_RX_FIFO_FULL         = 0x0040,  
GSC_INTR_RX_FIFO_ALMOST_FULL  = 0x0080,  
GSC_INTR_TX_TRANSFER_COMPLETE = 0x0100,  
GSC_INTR_RX_TRANSFER_COMPLETE = 0x0200,  
GSC_INTR_RX_ENVELOPE          = GSC_INTR_SYNC_DETECT,  
// -Sync card definition
```

## Channel Pin Definitions

```
GSC_PIN_DTE,  
GSC_PIN_DCE,  
GSC_PIN_AUTO,  
GSC_PIN_GPIO,  
GSC_PIN_RX_CLOCK, // Keep these enums in order  
GSC_PIN_RX_DATA, //  
GSC_PIN_CTS, //  
GSC_PIN_DCD, //  
GSC_PIN_TX_CLOCK, //  
GSC_PIN_TX_DATA, //  
GSC_PIN_RTS, //  
GSC_PIN_AUXCLK, // Keep these enums in order  
GSC_PIN_RX_ENV,  
GSC_PIN_TX_ENV,
```



## Channel Parity Definitions

GSC\_PARITY\_NONE,  
GSC\_PARITY\_EVEN,  
GSC\_PARITY\_ODD,  
GSC\_PARITY\_MARK,  
GSC\_PARITY\_SPACE,

## **Channel Stop Bits Definition**

GSC\_STOP\_BITS\_0,  
GSC\_STOP\_BITS\_1,  
GSC\_STOP\_BITS\_1\_5,  
GSC\_STOP\_BITS\_2,

## **Loopback Definitions**

GSC\_LOOP\_NONE,  
GSC\_LOOP\_INTERNAL,  
GSC\_LOOP\_EXTERNAL,

## **HDLC CRC Definitions**

GSC\_CRC\_NONE,  
GSC\_CRC\_16,  
GSC\_CRC\_32,  
GSC\_CRC\_CCITT,  
GSC\_CRC\_INIT\_0,  
GSC\_CRC\_INIT\_1,

## Local Register Definitions

The Local Register Definitions are used to access the various registers that are contained in the on board FPGA. These registers should not be accessed during normal operation and are included only for diagnostic purposes. For detailed descriptions of the registers, refer to the SIO4 hardware user's manual.

<b>Macro</b>	<b>Value</b>	<b>Description</b>
FW_REVISION_REG	0x0000	Firmware Revision Register
BOARD_CONTROL_REG	0x0004	Board Control Register
BOARD_STATUS_REG	0x0008	Board Status Register
CLOCK_CONTROL_REG	0x000c	Clock Control Register
TX_ALMOST_BASE_REG	0x0010	Base value for the Tx Almost registers
RX_ALMOST_BASE_REG	0x0014	Base value for the Rx Almost registers
DATA_FIFO_BASE_REG	0x0018	Base value for the Tx and Rx Data FIFOs
CONTROL_STATUS_BASE_REG	0x001c	Base value for the Control/Status registers
SYNC_CHARACTER_BASE_REG	0x0050	Base value for the Sync Byte Registers
INTERRUPT_CONTROL_REG	0x0060	Interrupt Control Register
INTERRUPT_STATUS_REG	0x0064	Interrupt Status/Clear Register
INTERRUPT_EDGE_LEVEL_REG	0x0068	Interrupt Edge/Level Register (RO)
INTERRUPT_HI_LO_REG	0x006c	Interrupt High/Low, Rising/Falling register
PIN_SOURCE_BASE_REG	0x0080	Base value for the Pin Source Registers
PIN_STATUS_BASE_REG	0x0090	Base value for the Pin Status Registers
POSC_RAM_ADDRESS_REG	0x00a0	Programmable OSC Address Register
POSC_RAM_DATA_REG	0x00a4	Programmable OSC Data Register
POSC_CONTROL_STATUS_REG	0x00a8	Programmable OSC Control/Status Register
TX_COUNT_BASE_REG	0x00b0	
FIFO_COUNT_BASE_REG	0x00d0	Base value for the FIFO Count Registers
FIFO_SIZE_BASE_REG	0x00e0	Base value for the FIFO Size Registers
FEATURES_REG	0x00fc	Features Register

## Channel Register Definitions

The Channel Register Definitions are used to access the various registers that are contained in the Zilog USC chip for each channel. These registers should not be accessed during normal operation and are included only for diagnostic purposes. For detailed descriptions of the registers, refer to the Zilog USC hardware user's manual.

<b>Macro</b>	<b>Value</b>	<b>Description</b>
USC_CCAR	0x0000	Channel Command/Address Register
USC_CMR	0x0002	Channel Mode Register
USC_CCSR	0x0004	Channel Command/Status Register
USC_CCR	0x0006	Channel Control Register
USC_TMDR	0x000c	Test Mode Data Register
USC_TMCR	0x000e	Test Mode Control Register
USC_CMCR	0x0010	Clock Mode Control Register
USC_HCR	0x0012	Hardware Configuration Register
USC_IVR	0x0014	Interrupt Vector Register
USC_IOCR	0x0016	I/O Control Register
USC_ICR	0x0018	Interrupt Control Register
USC_DCCR	0x001a	Daisy Chain Control Register
USC_MISR	0x001c	Misc. Interrupt Status Register
USC_SICR	0x001e	Status Interrupt Control Register
USC_RDR	0x0020	Receive Data Register (RO)
USC_RMR	0x0022	Receive Mode Register
USC_RCSR	0x0024	Receive Command Status Register
USC_RICR	0x0026	Receive Interrupt Control Register
USC_RSR	0x0028	Receive Sync Register
USC_RCLR	0x002a	Receive Count Limit Register
USC_RCCR	0x002c	Receive Character Count Register
USC_TC0R	0x002e	Time Constant 0 Register
USC_TDR	0x0030	Transmit Data Register (WO)
USC_TMR	0x0032	Transmit Mode Register
USC_TCSR	0x0034	Transmit Command Status Register
USC_TICR	0x0036	Transmit Interrupt Control Register
USC_TSR	0x0038	Transmit Sync Register
USC_TCLR	0x003a	Transmit Count Limit Register
USC_TCCR	0x003c	Transmit Character Count Register
USC_TC1R	0x003e	Time Constant 1 Register

## Miscellaneous Token Definitions

GSC\_ENABLED,  
GSC\_DISABLED,

GSC\_CLOCK\_INTERNAL,  
GSC\_CLOCK\_EXTERNAL,

GSC\_LSB\_FIRST,  
GSC\_MSB\_FIRST,