

# **SIO4/8**

**Four/Eight Channel High Speed Serial I/O**

**All SIO4 and SIO8 Models  
All Form Factors  
All Standard Zilog Versions**

## **Isochronous Protocol Library Reference Manual**

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## Preface

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# 1. Introduction

This document provides information on the Isochronous Protocol Library, which is a library designed to facilitate use of the Isochronous serial protocol with an SIO4 or SIO8.

## 1.1. Purpose

The purpose of this document is twofold. First, it is intended to give a basic description of the Isochronous protocol. Second, it is intended to give a complete description of the Isochronous Protocol Library interface.

## 1.2. Acronyms

The following is a list of commonly occurring acronyms used throughout this document.

Acronyms	Description
DMA	Direct Memory Access
GSC	General Standards Corporation
PCI	Peripheral Component Interconnect
PMC	PCI Mezzanine Card
USC	Universal Serial Controller

## 1.3. Definitions

The following is a list of commonly occurring terms used throughout this document.

Term	Definition
Application	Application means the user mode process, which runs in user space with user mode privileges.
Driver	Driver means the executable providing the direct access to the SIO4 hardware.
ISOC	This refers to the Isochronous serial protocol.
Library	Depending on context, this is a general reference to the Isochronous Protocol Library.
SIO4	This is used as a general reference to any Zilog based board supported by this driver. This includes both SIO4 and SIO8 model boards. It is also used to refer to revisions of the board that do not include a suffix following the '4', such as SIO4A or SIO4B.

## 1.4. Software Overview

The Isochronous Protocol Library is a statically linked library providing an Isochronous centric interface to the SIO4 device driver. The library is provided in source form and must be built before being used. The library is a thin software layer that sits between an SIO4 application and the SIO4 API Library. The interface provided by the library is Isochronous specific and is a simplified rendition of the IOCTL services that are part of the overall driver interface. The library exists in parallel with the driver interface.

## 1.5. Hardware Overview

**NOTE:** The SIO8 boards appear to the system as two SIO4 boards.

The SIO4 is a four-channel high-speed serial interface I/O board. This board provides for bi-directional serial data transfers between two computers, or one computer and an external peripheral. Once the data link between the two devices is established, the desired transfers can be performed and will become transparent to the user. The SIO4 board includes two DMA controllers and comes with a maximum of 256K Bytes of FIFO storage, which is 32K per channel direction (32K \* 2 \* 4). Each DMA controller is capable of transferring data to and from host memory; whereas the FIFO help maintain continuous data transfer at the cable interface. The FIFO configuration can vary greatly from one SIO4 version to another (i.e. 32K \* 2 \* 4 to 1K \* 2 \* 1 to none at all). The SIO4 comes with

transceivers that are fixed as RS232 or RS485/422, or with transceivers that are configurable. The SIO4 comes in two basic varieties; SYNC models or Zilog models, which are based on two Z16C30 dual USC chips. Later model SIO4 boards support both models with the mode being software controlled on a per channel basis. The SIO4 also provides for interrupt generation for various states of the board like Sync Character detection, FIFO empty, FIFO full and DMA complete.

**NOTE:** Software selection of SYNC or Zilog mode of operation is not at this time explicitly supported by the Protocol Libraries, the SIO4 API Library or the device driver. The operating mode is controlled by the model ordered.

## 1.6. Reference Material

The following reference material may be of particular benefit in using the SIO4 and this driver. The specifications provide the information necessary for an in depth understanding of the specialized features implemented on this board.

- The applicable *SIO4/SIO8 User Manual* from General Standards Corporation.
- The applicable *SIO4/SIO8 Driver User Manual* from General Standards Corporation.
- The *PCI Bus Master Interface Chip* data handbook from PLX Technology, Inc.

PLX Technology Inc.  
870 Maude Avenue  
Sunnyvale, California 94085 USA  
Phone: 1-800-759-3735  
WEB: <http://www.plxtech.com/>

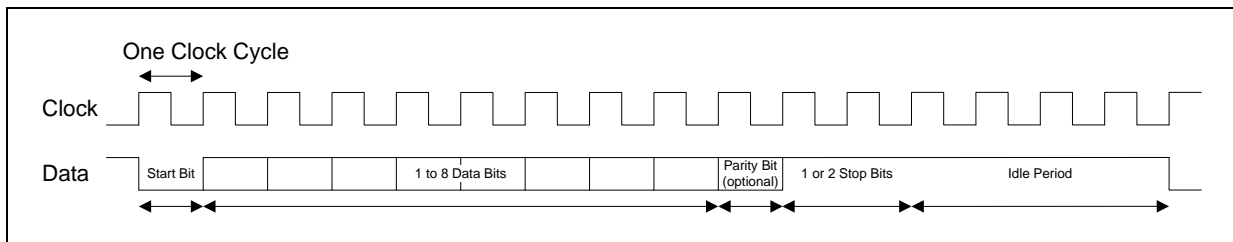
- The *Z16C30 USC User's Manual* from Zilog.

Zilog, Inc.  
910 E Hamilton Ave  
Campbell, California 95008 USA  
Phone: 1-408-558-8500  
WEB: <http://www.zilog.com/>

## 2. The Isochronous Serial Protocol

### 2.1. Description

The Isochronous Serial Protocol is an asynchronous, byte oriented serial transmission protocol synchronized by an accompanying clock. See Figure 1 below. All activity on the data line, both active and idle periods, is synchronized with the clock and is in intervals of the clock cycle. Each byte is transmitted with a single Start Bit, one to eight data bits, an optional Parity Bit, and one or more Stop Bits. A Start Bit is a logic zero on the data line for a single clock cycle. It begins on a clock boundary with a high to low transition on the data line. A Stop Bit is a logic one on the data line for a single clock cycle. They begin on a clock boundary immediately following the last data bit, or the Parity Bit, if it is present. All content in a given stream is the same size. Each byte includes the same number of data bits, either includes or excludes a Parity Bit, and closes with the same number of Stop Bits. The data bits and the Parity Bit use NRZ encoding. The idle period between consecutive bytes is an arbitrary number of clock cycles, including none. On the transmit side, data is clocked out on the clock's rising edge. On the receive side data is clocked in on the clock's falling edge. The data line is held high while the transmitter is idle.



**Figure 1** A depiction of an Isochronous data stream.



### 3. Library Interface Files

This section gives general information on the Isochronous Protocol Library interface files.

#### 3.1. Header File

The library's interface is defined via the header file shown below. To use the Isochronous Protocol Library applications must include this header file in their sources. Including this header file pulls in all other pertinent SIO4 specific header files. Therefore, sources may include only this one SIO4 header and make files may reference only this one SIO4 include directory.

File	Location
sio4_isoc.h	.../sio4/include

#### 3.2. Static Library Files

The executable code for the API defined for the Isochronous Protocol Library is contained in the static library file `sio4_isoc.a`, which is identified below. Using this library however, requires linking in other SIO4 specific static libraries. For this reason, and for ease of use, it is recommended that application make files link in the SIO4 Main Library instead of the Isochronous static library along with all of its dependencies. The result is that application make files reference only a single SIO4 static library and only a single SIO4 static library path.

Library	File	Location
Isochronous Protocol Library	sio4_isoc.a	.../sio4/lib
SIO4 Main Library	sio4_main.a *	.../sio4/lib

\* Refer to the SIO4 API Library Reference Manual for clarification when using multiple GSC product types in the same application.

## 4. Library Interface

The library interface is defined via the header file `sio4_isoc.h`, which is located in the `.../sio4/include/` directory.

### 4.1. High-level Functions

The library header defines the complete Isochronous interface offered by the library, which includes the following high-level function declarations.

#### 4.1.1. `sio4_isoc_close()`

This function is the entry point to close a connection previously opened to an SIO4 for Isochronous operation. All resources allocated by the library for the opened device are released as part of the close operation. This includes freeing allocated memory and closing access to the SIO4 serial channel.

Prototype

```
int sio4_isoc_close(int fd);
```

Argument	Description
<code>fd</code>	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

#### 4.1.2. `sio4_isoc_get()`

This function retrieves the current settings from the SIO4 for each of the referenced structure's fields. This function operates mostly by calling the low-level functions corresponding to each field of the `sio4_isoc_t` structure.

Prototype

```
int sio4_isoc_get(int fd, sio4_isoc_t* isoc, const char** err);
```

Argument	Description
<code>fd</code>	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
<code>isoc</code>	This is the structure where the current settings are recorded (section 4.3.1, page 16). Any field pertaining to an unsupported feature will be set to -1. The value -2 indicates a hardware setting that is invalid.
<code>err</code>	In the event of an error this will be set to identify the source of the error. The caller may provide a NULL pointer.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

#### 4.1.3. `sio4_isoc_init()`

This function initializes the Isochronous Protocol Library and must be the first call into the library.

**NOTE:** This service initializes the Isochronous Protocol Library as well as the SIO4 API Library.

**NOTE:** This function may be called more than once, but only the first successful call initializes the library. Any subsequent call has no effect.

## Prototype

```
int sio4_isoc_init(void);
```

Argument	Description
None	The function has no arguments.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

### 4.1.4. sio4\_isoc\_init\_data()

This function initializes an `sio4_isoc_t` structure according to the capabilities of the accessed device and some basic caller preferences. This function operates mostly by calling the low-level functions corresponding to each field of the `sio4_isoc_t` structure.

## Prototype

```
int sio4_isoc_init_data(
    int          fd,
    const sio4_isoc_init_t* init,
    sio4_isoc_t* isoc,
    const char** err);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
init	This structure provides the basic information needed prior to initializing the next argument. See below for more information.
isoc	This is the structure that the call will initialize (section 4.3.1, page 16).
err	In the event of an error this will be set to identify the source of the error. The caller may provide a NULL pointer.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

## Data Type

This structure contains information used to configure Isochronous clocking for the USC transmitter and receiver.

```
typedef struct
{
    s32 tx_bit_rate;
    s32 rx_bit_rate;
} sio4_isoc_init_t;
```

Field	Description
tx_bit_rate	This is the desired bit rate for the transmitter. This value must be greater than or equal to one, and less than or equal to 20,000,000.
rx_bit_rate	This is the desired bit rate for the receiver. This value must be greater than or equal to one, and less than or equal to 20,000,000. The Rx Bit Rate is provided for informational purposes only.

#### 4.1.5. sio4\_isoc\_ioctl()

This function is the entry point to performing IOCTL operations on the device. Refer to the driver reference manual for complete information on the driver's set of IOCTL services.

##### Prototype

```
int sio4_isoc_ioctl(int fd, int request, void* arg);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
request	This is an IOCTL macro contained in <code>sio4.h</code> or <code>sio4 usc.h</code> .
arg	This is the argument required for the above referenced IOCTL service.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

#### 4.1.6. sio4\_isoc\_open()

This function is the entry point to open a connection to an SIO4 serial channel for Isochronous operation. The handle returned by this call is used for all subsequent access to the specified channel. The file descriptor returned can be used for access the library's high-level functions, the library's low-level functions, and the driver interface.

**NOTE:** If the value of the index argument is specified as -1, then the function opens the file `/proc/sio4` for reading. In this case the share argument is ignored.

**NOTE:** If the value of the index argument is specified as -1, then the file descriptor returned can be used only with `sio4_isoc_read()` (section 4.1.6.1, page 13) and `sio4_isoc_close()` (section 4.1.1, page 10). It may also be used with the SIO4 API functions `sio4_read()` and `sio4_close()` (refer to the *SIO4 Reference Manual*). The file descriptor cannot be used with any other services.

##### Prototype

```
int sio4_isoc_open(int index, int share, int* fd);
```

Argument	Description						
index	This is the zero-based index of the SIO4 serial channel to access.						
share	Open the device in Shared Access Mode? If non-zero the device is opened in Shared Access Mode (see below). If zero the device is opened in Exclusive Access Mode (see below).						
fd	The device handle is returned here. The pointer cannot be NULL. Values returned are as follows.						
	<table><tr><th>Value</th><th>Description</th></tr><tr><td>&gt;= 0</td><td>This is the handle to use to access the device in subsequent calls.</td></tr><tr><td>-1</td><td>There was an error. The device is not accessible.</td></tr></table>	Value	Description	>= 0	This is the handle to use to access the device in subsequent calls.	-1	There was an error. The device is not accessible.
	Value	Description					
	>= 0	This is the handle to use to access the device in subsequent calls.					
-1	There was an error. The device is not accessible.						

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

#### 4.1.6.1. Access Modes

The value of the `share` argument determines the device access mode, as follows.

##### Shared Access Mode:

If the `share` argument is non-zero the device is opened in Shared Access Mode. The first such open request will succeed and return with the device in an initialized state. Subsequent such open requests will also succeed, but will not alter the device state. Once opened in Shared Access Mode, device access remains in this mode until all Shared Access Mode open requests release the device with a corresponding close request.

##### Exclusive Access Mode:

If the `share` argument is zero the device is opened in Exclusive Access Mode. In this mode, only one application at a time can access the device. The first such open request will succeed and return with the device in an initialized state. Subsequent open requests, regardless of the `share` argument value, will fail until the device is released with a corresponding close request.

#### 4.1.7. `sio4_isoc_read()`

This function requests that a buffer of data be read from the serial channel. The request will return either when it has been fulfilled or the read timeout expires, whichever occurs first. This is a blocking call.

**NOTE:** All read requests are serialized.

##### Prototype

```
int sio4_isoc_read(int fd, void* buf, size_t bytes);
```

Argument	Description
<code>fd</code>	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
<code>buf</code>	The data read is placed here.
<code>bytes</code>	Read up to this number of bytes.

Return Value	Description
0 to <code>bytes</code>	The operation succeeded. This is the number of bytes placed in the buffer. A value less than <code>bytes</code> generally indicates that the I/O timeout period lapsed before the entire request could be satisfied.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

#### 4.1.8. `sio4_isoc_set()`

This function configures an SIO4 channel according to the settings of the referenced `sio4_isoc_t` structure. All fields are validated before any settings are applied. This function operates mostly by calling the low-level functions corresponding to each field of the `sio4_isoc_t` structure.

**NOTE:** Before calling this function, the structure should, at minimum, be initialized by calling the `sio4_isoc_init_data()` function (section 4.1.3, page 10).

## Prototype

```
int sio4_isoc_set(
    int          fd,
    const sio4_isoc_t* isoc,
    const char**  err);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
isoc	This is the structure containing the settings to be applied (section 4.3.1, page 16).
err	In the event of an error this will be set to identify the source of the error. The caller may provide a NULL pointer.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

4.1.9. `sio4_isoc_show()`

This function displays the content of the referenced `sio4_isoc_t` structure to the screen. This is provided to assist debugging efforts. This function operates mostly by calling the low-level functions corresponding to each field of the `sio4_isoc_t` structure.

## Prototype

```
int sio4_isoc_show(
    int          fd,
    const sio4_isoc_t* isoc,
    const char**  err);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
isoc	This is the structure whose content will be displayed (section 4.3.1, page 16).
err	In the event of an error this will be set to identify the source of the error. The caller may provide a NULL pointer.

Return Value	Description
0	The operation completed successfully.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

4.1.10. `sio4_isoc_write()`

This function requests that a buffer of data be written to the serial channel. The request will return either when it has been fulfilled or the write timeout expires, whichever occurs first. This is a blocking call.

**NOTE:** All write requests are serialized.

## Prototype

```
int sio4_isoc_write(int fd, const void* buf, size_t bytes);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
buf	This is the source for the data to write.

<code>bytes</code>	Write at most this number of bytes.
--------------------	-------------------------------------

Return Value	Description
0 to <code>bytes</code>	The operation succeeded. This is the number of bytes written from the buffer. A value less than <code>bytes</code> generally indicates that the I/O timeout period lapsed before the entire request could be satisfied.
< 0	An error occurred. This is a negative <code>errno.h</code> value.

## 4.2. Low-level Functions

The low-level functions provide access to the board features reflected by the individual fields of the `sio4_isoc_t` structure (section 4.3.1, page 16). This structure is used to access all of the board features that are part of the Isochronous Protocol Library. For each structure field there is a corresponding board feature and an associated low-level function. When calling the high-level functions that use the `sio4_isoc_t` structure, the high-level functions perform their work by calling the low-level functions for each structure field. This is especially useful for activities such as structure initialization and board configuration. Following high-level configuration of the board though, there are times when an application may need to access features represented by only a subset of the `sio4_isoc_t` structure fields. This is where an application can make use of the low-level function. All of the low-level functions follow the prototype pattern shown below. The function naming convention includes the prefix “`sio4_isoc_t_`” followed by the C style field name, but with the periods (“.”) replaced by underscores (“\_”).

**NOTE:** The low-level functions do not accept NULL pointers.

### Prototype

```
void sio4_isoc_t_field_name(
    int          fd,
    s32*         arg,
    sio4_isoc_action_t action,
    const char** err);
```

Argument	Description
<code>fd</code>	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
<code>arg</code>	This refers to the feature specific value being passed in to the function. This pointer must not be NULL.
<code>action</code>	This identifies the specific action to be carried out in regards to the above feature specific value. See the <code>sio4_isoc_action_t</code> data type below.
<code>err</code>	If there is an error, then this field will be set to point to a string naming the <code>sio4_isoc_t</code> field for which the error pertains. An example is “ <code>isoc-&gt;cable.loopback.mode</code> ”. This pointer must not be NULL.

### Data Type

This enumeration identifies the specific action requested when a low-level function is called.

```
typedef enum
{
    SIO4_ISOC_ACTION_GET,
    SIO4_ISOC_ACTION_INIT,
    SIO4_ISOC_ACTION_SET,
    SIO4_ISOC_ACTION_SHOW,
    SIO4_ISOC_ACTION_VERIFY
}
```

```
} sio4_isoc_action_t;
```

Value	Description
SIO4_ISOC_ACTION_GET	This requests the current setting from the driver.
SIO4_ISOC_ACTION_INIT	This requests the initialization value from the library.
SIO4_ISOC_ACTION_SET	This requests that the supplied value be applied by the driver.
SIO4_ISOC_ACTION_SHOW	This requests that the supplied value be displayed to the screen.
SIO4_ISOC_ACTION_VERIFY	This requests that the supplied value be verified.

## Examples

For simplicity's sake a low-level function name can easily be derived given any field name, as shown in the below examples. The individual low-level function names are identified with the corresponding structure fields beginning in section 4.3.1, page 16.

Field	Function
sio4_isoc_t.cable.loopback.mode	sio4_isoc_t_cable_loopback_mode()
sio4_isoc_t.rx.encoding	sio4_isoc_t_rx_encoding()
sio4_isoc_t.tx.parity.enable	sio4_isoc_t_tx_parity_enable()

## 4.3. Data Structures

The library header file is `sio4_isoc.h`. Including this header in a source file gives that source the full library and driver interface. The library header defines the complete Isochronous interface offered by the library, which includes the following data structures and their associated macros and low-level function declarations.

### 4.3.1. sio4\_isoc\_t

This structure contains all of the parameters used to configure an SIO4 channel for Isochronous operation. The structure is initialized with default values by calling the `sio4_isoc_init_data()` function (section 4.1.3, page 10). Following this call, applications make changes to this structure's content according to their own requirements. Afterwards, the structure is passed to the `sio4_isoc_set()` function (section 4.1.6.1, page 13) where the settings are applied to the board.

```
typedef struct
{
    struct
    {
        s32    ref;
        s32    prog;
    } osc;

    Struct    // cable
    {
        s32    enable;        // PSRCR D31
        s32    mode;          // PSRCR D28, DCE or DTE
        s32    protocol;      // PSRSR D24-D27
        s32    txc;           // PSRCR D6-D8
        s32    txd;           // PSRCR D19-D20
        s32    txaux;         // PSRCR D17-D18
        s32    dcd;           // PSRCR D15-D16
        s32    dtr_dsr;       // PSRCR D21-D22
        s32    rts;           // PSRCR D13-D14
    }
};
```



```

struct
{
    s32 mode;          // PSRCR D23, D29
} loopback;

struct
{
    s32 enable;        // PSRCR D30
} term;

struct
{
    s32 txc;           // CCR 0x3333
    s32 txd_cts;       // CSR D2-D3
    s32 rxc;           // CCR 0xCCCC
    s32 rxd_dcd;       // CSR D4-D5
} legacy;

} cable;

Struct // tx
{
    s32 mode;          // USC CMR D8-D11
    s32 enable;        // USC TMR D0-D1
    s32 char_len;      // USC TMR D2-D4
    s32 encoding;      // USC TMR D13-D15
    s32 bit_rate;      // reflects sio4_isoc_init_t.tx_bit_rate
    s32 idle_cond;     // USC TCSR D8-D10

    struct
    {
        s32 enable;    // USC TMR D5
        s32 type;      // USC TMR D6-D7
    } parity;

    struct
    {
        s32 size;      // FSR D0-D15, read-only
        s32 ae;        // TAR D0-D15
        s32 af;        // TAR D16-D31
        s32 empty_cfg; // CSR D18, D26
        s32 space_cfg; // CSR D4-D5
    } fifo;

    struct
    {
        s32 dma_thresh; // Block Mode DMA only
        s32 mode;
        s32 pio_thresh;
        s32 timeout;
        s32 overrun;
    } io;
} tx;

Struct // rx

```

```

{
    s32    mode;          // USC CMR D0-D3
    s32    enable;        // USC RMR D0-D1
    s32    char_len;      // USC RMR D2-D4
    s32    encoding;      // USC RMR D13-D15
    s32    bit_rate;      // reflects sio4_isoc_init_t.rx_bit_rate
    s32    sync_byte;     // SBR D0-D7
    s32    status_word;   // CSR D3

    struct
    {
        s32 enable;       // USC RMR D5
        s32 type;         // USC RMR D6-D7
    } parity;

    struct
    {
        s32 size;         // FSR D16-D21, read-only
        s32 ae;           // RAR D0-D15
        s32 af;           // RAR D16-D31
        s32 full_cfg;     // BCR D8
    } fifo;

    struct
    {
        s32 dma_thresh;   // Block Mode DMA only
        s32 mode;
        s32 pio_thresh;
        s32 timeout;
        s32 overrun;
        s32 underrun;
    } io;

    struct
    {
        s32 enable;       // CSR D2
        s32 clk_src;      // BCR D22
    } time_stamp;
} rx;

Struct    // usc
{
    s32    mode;          // USC CCAR D8-D9
    s32    txd;           // USC IOCR D6-D7
    s32    cts;           // PSRCR D9-D10, USC IOCR D14-D15
    s32    cts_legacy;    // USC IOCR D14-D15
    s32    dcd;           // PSRCR D11-D12, USC IOCR D12-D13
    s32    dcd_legacy;    // USC IOCR D12-D13

    // All of the folling USC fields are initialized
    // by sio4_isoc_init_data() based on the content of the
    // sio4_isoc_init_t structure.

    struct
    {
        s32 clk_src;      // USC CMCR D3-D5

```

```

        s32 txc;          // PSRCR D0-D2, USC IOCR D3-D5
        s32 txc_legacy;  // USC IOCR D3-D5
        s32 stop_bits;   // USC CMR D14
    } tx;

    struct
    {
        s32 clk_src;      // USC CMCR D0-D2
        s32 rxc;          // PSRCR D3-D5, USC IOCR D0-D2
        s32 rxc_legacy;   // USC IOCR D0-D2
    } rx;

    struct
    {
        s32 enable;       // USC HCR D0
        s32 clk_src;      // USC CMCR D8-D9
        s32 divider;      // USC TC1R D0-D15
        s32 mode;         // USC HCR D1
    } brg0;

    struct
    {
        s32 enable;       // USC HCR D4
        s32 clk_src;      // USC CMCR D10-D11
        s32 divider;      // USC TC0R D0-D15
        s32 mode;         // USC HCR D5
    } brg1;

    struct
    {
        s32 clk_src;      // USC CMCR D12-D13
        s32 rate;         // USC HCR D14-D15
    } ctr0;

    struct
    {
        s32 clk_src;      // USC CMCR D14-D15
        s32 rate_src;     // USC HCR D13, ...
    } ctrl;

    } usc;

} sio4_isoc_t;

```

#### 4.3.1.1. sio4\_isoc\_t.osc

This section describes the structure's oscillator configuration fields.

Field	Description
osc	This structure configures the oscillator interface.
osc.ref	This field specifies the frequency of the fixed onboard reference oscillator. The default is 20MHz. The feature's low-level function is <code>sio4_isoc_t_osc_ref()</code> . This value is provided for informational purposes only.

osc. prog	This field specifies the desired programmable oscillator frequency. This is essentially the clock frequency provided by the onboard programmable oscillator to the USC. The default is 20MHz. The feature's low-level function is <code>sio4_isoc_t_osc_prog()</code> . The value provided is not recorded for later retrieval. Retrieval requests return one if oscillator programming is supported and zero if it isn't.
--------------	--

## 4.3.1.2. sio4\_isoc\_t.cable

This section describes the structure's cable configuration fields.

Field	Description																				
cable	This structure configures the cable interface.																				
cable. enable	<p>This field either enables or disables the cable transceivers. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_enable()</code>. Please also read Cable Configuration Modes (section 5.5, page 40).</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_CABLE_ENABLE_NO</td><td>Disable the cable transceivers.</td></tr> <tr> <td>SIO4_ISOC_CABLE_ENABLE_YES</td><td>Enable the cable transceivers. This is the default. This option disables all legacy cable related settings.</td></tr> </table>	Value	Description	SIO4_ISOC_CABLE_ENABLE_NO	Disable the cable transceivers.	SIO4_ISOC_CABLE_ENABLE_YES	Enable the cable transceivers. This is the default. This option disables all legacy cable related settings.														
Value	Description																				
SIO4_ISOC_CABLE_ENABLE_NO	Disable the cable transceivers.																				
SIO4_ISOC_CABLE_ENABLE_YES	Enable the cable transceivers. This is the default. This option disables all legacy cable related settings.																				
cable. mode	<p>This field specifies the arrangement of the signals on the cable interface. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_mode()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_CABLE_MODE_DCE</td><td>Select the DCE cable signal configuration.</td></tr> <tr> <td>SIO4_ISOC_CABLE_MODE_DTE</td><td>Select the DTE cable signal configuration. This is the default.</td></tr> </table>	Value	Description	SIO4_ISOC_CABLE_MODE_DCE	Select the DCE cable signal configuration.	SIO4_ISOC_CABLE_MODE_DTE	Select the DTE cable signal configuration. This is the default.														
Value	Description																				
SIO4_ISOC_CABLE_MODE_DCE	Select the DCE cable signal configuration.																				
SIO4_ISOC_CABLE_MODE_DTE	Select the DTE cable signal configuration. This is the default.																				
cable. Protocol	<p>This field specifies the cable transceiver configuration. The options available depend on the board's transceiver capabilities. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_protocol()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS232</td><td>This selects the RS232 protocol. This is the default.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS422_423_1</td><td>This selects the RS422/RS423 mixed protocol version 1.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS422_423_2</td><td>This selects the RS422/RS423 mixed protocol version 2.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS422_RS485</td><td>This selects the RS422/RS485 mixed protocol.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS423</td><td>This selects the RS423 protocol.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS530</td><td>This selects the RS530 protocol, version 1.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_RS530A</td><td>This selects the RS530 protocol, version 2.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_V35</td><td>This selects the V.35 protocol, version 1.</td></tr> <tr> <td>SIO4_ISOC_CABLE_PROTOCOL_V35A</td><td>This selects the V.35 protocol, version 2.</td></tr> </table>	Value	Description	SIO4_ISOC_CABLE_PROTOCOL_RS232	This selects the RS232 protocol. This is the default.	SIO4_ISOC_CABLE_PROTOCOL_RS422_423_1	This selects the RS422/RS423 mixed protocol version 1.	SIO4_ISOC_CABLE_PROTOCOL_RS422_423_2	This selects the RS422/RS423 mixed protocol version 2.	SIO4_ISOC_CABLE_PROTOCOL_RS422_RS485	This selects the RS422/RS485 mixed protocol.	SIO4_ISOC_CABLE_PROTOCOL_RS423	This selects the RS423 protocol.	SIO4_ISOC_CABLE_PROTOCOL_RS530	This selects the RS530 protocol, version 1.	SIO4_ISOC_CABLE_PROTOCOL_RS530A	This selects the RS530 protocol, version 2.	SIO4_ISOC_CABLE_PROTOCOL_V35	This selects the V.35 protocol, version 1.	SIO4_ISOC_CABLE_PROTOCOL_V35A	This selects the V.35 protocol, version 2.
Value	Description																				
SIO4_ISOC_CABLE_PROTOCOL_RS232	This selects the RS232 protocol. This is the default.																				
SIO4_ISOC_CABLE_PROTOCOL_RS422_423_1	This selects the RS422/RS423 mixed protocol version 1.																				
SIO4_ISOC_CABLE_PROTOCOL_RS422_423_2	This selects the RS422/RS423 mixed protocol version 2.																				
SIO4_ISOC_CABLE_PROTOCOL_RS422_RS485	This selects the RS422/RS485 mixed protocol.																				
SIO4_ISOC_CABLE_PROTOCOL_RS423	This selects the RS423 protocol.																				
SIO4_ISOC_CABLE_PROTOCOL_RS530	This selects the RS530 protocol, version 1.																				
SIO4_ISOC_CABLE_PROTOCOL_RS530A	This selects the RS530 protocol, version 2.																				
SIO4_ISOC_CABLE_PROTOCOL_V35	This selects the V.35 protocol, version 1.																				
SIO4_ISOC_CABLE_PROTOCOL_V35A	This selects the V.35 protocol, version 2.																				
cable. txc	<p>This field specifies the configuration of the cable's Tx Clock signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_txc()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_CABLE_TXC_OUT_0</td><td>This drives the signal low.</td></tr> <tr> <td>SIO4_ISOC_CABLE_TXC_OUT_1</td><td>This drives the signal high.</td></tr> <tr> <td>SIO4_ISOC_CABLE_TXC_OUT_CBL_RXA</td><td>This drives the signal from what appears at the</td></tr> </table>	Value	Description	SIO4_ISOC_CABLE_TXC_OUT_0	This drives the signal low.	SIO4_ISOC_CABLE_TXC_OUT_1	This drives the signal high.	SIO4_ISOC_CABLE_TXC_OUT_CBL_RXA	This drives the signal from what appears at the												
Value	Description																				
SIO4_ISOC_CABLE_TXC_OUT_0	This drives the signal low.																				
SIO4_ISOC_CABLE_TXC_OUT_1	This drives the signal high.																				
SIO4_ISOC_CABLE_TXC_OUT_CBL_RXA	This drives the signal from what appears at the																				

		cable's Rx Aux signal.
	SIO4_ISOC_CABLE_TXC_OUT_CBL_RXC	This drives the signal from what appears at the cable's Rx Clock signal.
	SIO4_ISOC_CABLE_TXC_OUT_OSC	This drives the signal from the onboard oscillator.
	SIO4_ISOC_CABLE_TXC_OUT_OSC_INV	This drives the signal from the inverted form of the onboard oscillator.
	SIO4_ISOC_CABLE_TXC_OUT_USC_RXC	This drives the signal from what appears at the USC's Rx Clock pin.
	SIO4_ISOC_CABLE_TXC_OUT_USC_TXC	This drives the signal from what appears at the USC's Tx Clock pin. This is the default.
cable. txd	This field specifies the configuration of the cable's Tx Data signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_txd()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_TXD_OUT_0	This drives the signal low.
	SIO4_ISOC_CABLE_TXD_OUT_1	This drives the signal high.
	SIO4_ISOC_CABLE_TXD_OUT_USC_TXD	This drives the signal from what appears at the USC's Tx Data pin. This is the default.
cable. txaux	This field specifies the configuration of the cable's Tx Aux signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_txaux()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_TXAUX_OUT_0	This drives the signal low.
	SIO4_ISOC_CABLE_TXAUX_OUT_1	This drives the signal high.
	SIO4_ISOC_CABLE_TXAUX_OUT_OSC	This drives the signal from the onboard oscillator.
	SIO4_ISOC_CABLE_TXAUX_TRI	This tri-states the drive segment of the transceivers. This is the default.
cable. dcd	This field specifies the cable DCD signal source when the cable signal is driven. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_dcd()</code> .  <b>NOTE:</b> Refer to the <code>usc.dcd</code> field (section 4.3.1.5, page 30) for affecting the cable signal's driven state.	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_DCD_OUT_0	This drives the signal low.
	SIO4_ISOC_CABLE_DCD_OUT_1	This drives the signal high.
	SIO4_ISOC_CABLE_DCD_OUT_RTS	This drives the signal from the Rx FIFO Almost Full status. This is the default.
	SIO4_ISOC_CABLE_DCD_OUT_USC_DCD	This drives the signal from what appears at the USC's DCD pin.
cable. dtr_dsr	This field specifies the configuration of the cable's DTR/DSR signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_dtr_dsr()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_DTR_DSR_OUT_0	This drives the signal low.
	SIO4_ISOC_CABLE_DTR_DSR_OUT_1	This drives the signal high.
	SIO4_ISOC_CABLE_DTR_DSR_IN	This configures the signal as an input.
	SIO4_ISOC_CABLE_DTR_DSR_TRI	This tri-states the drive segment of the transceivers. This is the default.
cable. rts	This field specifies the configuration of the cable's RTS signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_rts()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_RTS_OUT_0	This drives the signal low.

	SIO4_ISOC_CABLE_RTS_OUT_1	This drives the signal high.
	SIO4_ISOC_CABLE_RTS_OUT_CTS	This drives the signal from what appears at the USC's CTS pin.
	SIO4_ISOC_CABLE_RTS_OUT_RTS	This drives the signal from the Rx FIFO Almost Full status. This is the default.
cable. loopback	This structure configures the cable's loopback feature.	
cable. loopback. mode	This field specifies the loopback mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_loopback_mode()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_LOOPBACK_MODE_DISABLE	This disables loopback operation. This is the default.
	SIO4_ISOC_LOOPBACK_MODE_EXTERNAL	This selects the external loopback mode. *†
	SIO4_ISOC_LOOPBACK_MODE_INTERNAL	This selects the internal loopback mode. †
	* If external loopback mode is requested but not available, then the internal loopback mode is selected.	
	† Both loopback modes are performed onboard the SIO4; internal inside the USC, external at the cable interface. For external mode, enable the transceivers and disconnect cabling.	
cable. term	This structure configures the cable's termination feature. The operation of this feature depends on the active cable transceiver type.	
cable. term. enable	This field specifies the configuration of the transceiver's built-in termination feature. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_term_enable()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_TERM_ENABLE_NO	The built-in termination is disabled. This is the default.
	SIO4_ISOC_CABLE_TERM_ENABLE_YES	The built-in termination is enabled.
cable. legacy	This structure configures the cable's legacy interface feature. These fields are utilized if the board DCE/DTE cable configuration feature is unsupported by the board or is unused. Please also read Cable Configuration Modes (section 5.5, page 40).	
cable. legacy. txc	This field specifies the legacy configuration of the cable's Tx Clock signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_legacy_txc()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_LEGACY_TXC_DISABLE	This disables the Tx Clock signal.
	SIO4_ISOC_CABLE_LEGACY_TXC_BOTH	This drives the Tx Clock signal on both the upper and lower group of pins.
	SIO4_ISOC_CABLE_LEGACY_TXC_LOW	This drives the Tx Clock signal on the lower group of pins.
	SIO4_ISOC_CABLE_LEGACY_TXC_UP	This drives the Tx Clock signal on the upper group of pins. This is the default.
cable. legacy. txd_cts	This field specifies the legacy configuration of the cable's Tx Data and CTS signals. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_legacy_txd_cts()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_LEGACY_TXD_CTS_BOTH	This drives the signals on both the upper and lower group of pins.
	SIO4_ISOC_CABLE_LEGACY_TXD_CTS_LOW	This drives the signals on the lower group of pins.

	SIO4_ISOC_CABLE_LEGACY_TXD_CTS_TRI	This tri-states the signals.
	SIO4_ISOC_CABLE_LEGACY_TXD_CTS_UP	This drives the signals on the upper group of pins. This is the default.
cable. legacy. rxc	This field specifies the legacy configuration of the cable's Rx Clock signal. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_legacy_rxc()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_LEGACY_RXC_DISABLE	This disables the Rx Clock signal.
	SIO4_ISOC_CABLE_LEGACY_RXC_LOW	This drives the Rx Clock signal on the lower group of pins. This is the default.
	SIO4_ISOC_CABLE_LEGACY_RXC_UP	This drives the Rx Clock signal on the lower group of pins.
cable. legacy. rxd_dcd	This field specifies the legacy configuration of the cable's Rx Data and DCD signals. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_cable_legacy_rxd_dcd()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_CABLE_LEGACY_RXD_DCD_DISABLE	This disables the signals.
	SIO4_ISOC_CABLE_LEGACY_RXD_DCD_LOW	This uses the signals as inputs from the lower group of pins. This is the default.
	SIO4_ISOC_CABLE_LEGACY_RXD_DCD_UP	This uses the signals as inputs from the upper group of pins.

#### 4.3.1.3. sio4\_isoc\_t.tx

This section describes the structure's transmitter configuration fields.

Field	Description	
tx	This structure configures the transmitter portion of the channel.	
tx. mode	This field specifies the transmitter's operating mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_mode()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_MODE_ISOC	This selects the Isochronous operating mode. This is the default and the only valid option for this library.
tx. enable	This field specifies if the transmitter is to be enabled. When configuration is begun (see <code>sio4_isoc_set()</code> , section 4.1.6.1, page 13) the transmitter is initialized and disabled. The option in this field is applied towards the end of the configuration process. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_enable()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_ENABLE_NO_AFTER	This disables the transmitter after it has finished the transmission in progress.
	SIO4_ISOC_TX_ENABLE_NO_NOW	This disables the transmitter immediately.
	SIO4_ISOC_TX_ENABLE_YES_NOW	This enables the transmitter immediately. This is the default.
	SIO4_ISOC_TX_ENABLE_YES_W_AE	This enables the transmitter according to the state of any hardware flow control lines.

tx. char_len	<p>This field specifies if the size of transmitted characters. The length specified does not include the Parity Bit, if Parity is enabled. The data bits are the lower significant bits of the byte. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_char_len()</code>.</p> <table border="1"> <thead> <tr> <th>Value</th><th>Description</th></tr> </thead> <tbody> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_1</td><td>Characters are 1-bit in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_2</td><td>Characters are 2-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_3</td><td>Characters are 3-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_4</td><td>Characters are 4-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_5</td><td>Characters are 5-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_6</td><td>Characters are 6-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_7</td><td>Characters are 7-bits in length.</td></tr> <tr> <td>SIO4_ISOC_TX_CHAR_LEN_8</td><td>Characters are 8-bits in length. This is the default.</td></tr> </tbody> </table>	Value	Description	SIO4_ISOC_TX_CHAR_LEN_1	Characters are 1-bit in length.	SIO4_ISOC_TX_CHAR_LEN_2	Characters are 2-bits in length.	SIO4_ISOC_TX_CHAR_LEN_3	Characters are 3-bits in length.	SIO4_ISOC_TX_CHAR_LEN_4	Characters are 4-bits in length.	SIO4_ISOC_TX_CHAR_LEN_5	Characters are 5-bits in length.	SIO4_ISOC_TX_CHAR_LEN_6	Characters are 6-bits in length.	SIO4_ISOC_TX_CHAR_LEN_7	Characters are 7-bits in length.	SIO4_ISOC_TX_CHAR_LEN_8	Characters are 8-bits in length. This is the default.
Value	Description																		
SIO4_ISOC_TX_CHAR_LEN_1	Characters are 1-bit in length.																		
SIO4_ISOC_TX_CHAR_LEN_2	Characters are 2-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_3	Characters are 3-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_4	Characters are 4-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_5	Characters are 5-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_6	Characters are 6-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_7	Characters are 7-bits in length.																		
SIO4_ISOC_TX_CHAR_LEN_8	Characters are 8-bits in length. This is the default.																		
tx. encoding	<p>This field specifies the encoding of the transmitted data. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_encoding()</code>.</p> <table border="1"> <thead> <tr> <th>Value</th><th>Description</th></tr> </thead> <tbody> <tr> <td>SIO4_ISOC_TX_ENCODING_BI_MARK</td><td>This refers to Biphasic Mark encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_BI_LEVEL</td><td>This refers to Biphasic Level encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_BI_SPACE</td><td>This refers to Biphasic Space encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_D_BI_LEVEL</td><td>This refers to Differential Biphasic Level encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_NRZ</td><td>This refers to NRZ encoding. This is the default.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_NRZB</td><td>This refers to NRZB encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_NRZI_MARK</td><td>This refers to NRZI-Mark encoding.</td></tr> <tr> <td>SIO4_ISOC_TX_ENCODING_NRZI_SPACE</td><td>This refers to NRZI-Space encoding.</td></tr> </tbody> </table>	Value	Description	SIO4_ISOC_TX_ENCODING_BI_MARK	This refers to Biphasic Mark encoding.	SIO4_ISOC_TX_ENCODING_BI_LEVEL	This refers to Biphasic Level encoding.	SIO4_ISOC_TX_ENCODING_BI_SPACE	This refers to Biphasic Space encoding.	SIO4_ISOC_TX_ENCODING_D_BI_LEVEL	This refers to Differential Biphasic Level encoding.	SIO4_ISOC_TX_ENCODING_NRZ	This refers to NRZ encoding. This is the default.	SIO4_ISOC_TX_ENCODING_NRZB	This refers to NRZB encoding.	SIO4_ISOC_TX_ENCODING_NRZI_MARK	This refers to NRZI-Mark encoding.	SIO4_ISOC_TX_ENCODING_NRZI_SPACE	This refers to NRZI-Space encoding.
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SIO4_ISOC_TX_ENCODING_NRZI_SPACE	This refers to NRZI-Space encoding.																		
tx. bit_rate	<p>This specifies the desired transmission bit rate. During the <code>sio4_isoc_init_data()</code> call (section 4.1.3, page 10) this is set to the <code>sio4_isoc_init_t.tx_bit_rate</code> field value. The feature's low-level function is <code>sio4_isoc_t_tx_bit_rate()</code>. The Tx Bit Rate is used when the device is being configured, but the value is not recorded for later retrieval.</p>																		
tx. idle_cond	<p>This field specifies what appears on the Tx Data cable signal while no data is being transmitted. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_idle_cond()</code>.</p> <table border="1"> <thead> <tr> <th>Value</th><th>Description</th></tr> </thead> <tbody> <tr> <td>SIO4_ISOC_TX_IDLE_COND_0</td><td>The Tx Data signal outputs a continuous data "0" value.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_0_1</td><td>The Tx Data signal is alternately data "0" and data "1" values.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_1</td><td>The Tx Data signal outputs a continuous data "1" value.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_DEFAULT</td><td>The Tx Data signal is driven with the pattern that is the default for the selected serial protocol. This is the default.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_MARK</td><td>The Tx Data signal is held high.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_MARK_SPACE</td><td>The Tx Data signal is alternately driven with the high then low.</td></tr> <tr> <td>SIO4_ISOC_TX_IDLE_COND_SPACE</td><td>The Tx Data signal is held low.</td></tr> </tbody> </table>	Value	Description	SIO4_ISOC_TX_IDLE_COND_0	The Tx Data signal outputs a continuous data "0" value.	SIO4_ISOC_TX_IDLE_COND_0_1	The Tx Data signal is alternately data "0" and data "1" values.	SIO4_ISOC_TX_IDLE_COND_1	The Tx Data signal outputs a continuous data "1" value.	SIO4_ISOC_TX_IDLE_COND_DEFAULT	The Tx Data signal is driven with the pattern that is the default for the selected serial protocol. This is the default.	SIO4_ISOC_TX_IDLE_COND_MARK	The Tx Data signal is held high.	SIO4_ISOC_TX_IDLE_COND_MARK_SPACE	The Tx Data signal is alternately driven with the high then low.	SIO4_ISOC_TX_IDLE_COND_SPACE	The Tx Data signal is held low.		
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SIO4_ISOC_TX_IDLE_COND_SPACE	The Tx Data signal is held low.																		
tx. parity	<p>This structure configures the transmitter's use of Parity checking.</p>																		



tx. parity. enable	This field enables or disables the use of Parity. When used, the Parity Bit appears to the immediate left of the most significant data bit. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_parity_enable()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_PARITY_ENABLE_NO	Do <u>not</u> generate a Parity bit. This is the default.
	SIO4_ISOC_TX_PARITY_ENABLE_YES	Do generate a Parity bit.
tx. parity. type	This field specifies the type of Parity to use, when its use is enabled. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_parity_type()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_PARITY_TYPE_EVEN	This specifies Even Parity. This is the default.
	SIO4_ISOC_TX_PARITY_TYPE_ODD	This specifies Odd Parity.
	SIO4_ISOC_TX_PARITY_TYPE_ONE	This specifies One Parity (the parity bit is always set).
	SIO4_ISOC_TX_PARITY_TYPE_ZERO	This specifies Zero Parity (the parity bit is always clear).
tx. fifo	This structure configures the transmitter's FIFO parameters.	
tx. fifo. size	This field is filled in by the <code>sio4_isoc_init_data()</code> call (section 4.1.3, page 10) with the size of the channel's Tx FIFO. This is offered for informational purposes only. The feature's low-level function is <code>sio4_isoc_t_tx_fifo_size()</code> .	
tx. fifo. ae	This field specifies the Tx FIFO Almost Empty setting. The Tx FIFO Almost Empty status is asserted (goes low) when the Tx FIFO contains this number of values, or fewer. The valid value range is from zero to 0xFFFF. The default is 0x7. The feature's low-level function is <code>sio4_isoc_t_tx_fifo_ae()</code> .	
tx. fifo. af	This field specifies the Tx FIFO Almost Full setting. The Tx FIFO Almost Full status is asserted (goes low) when the Tx FIFO contains this number of free spaces, or fewer. The valid value range is from zero to 0xFFFF. The default is 0x7. The feature's low-level function is <code>sio4_isoc_t_tx_fifo_af()</code> .	
tx. fifo. empty_cfg	This field configures the transmitter's reaction to the Tx FIFO becoming empty. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_fifo_empty_cfg()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_FIFO_EMPTY_CFG_IGNORE	This specifies that the condition is to be ignored. This is the default.
	SIO4_ISOC_TX_FIFO_EMPTY_CFG_TX_OFF	This specifies that the transmitter be disabled when the condition occurs.
tx. fifo. space_cfg	This field configures the FIFO space allocation between the transmitter and the receiver when the Tx FIFO and Rx FIFO are of different sizes. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_fifo_space_cfg()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_TX_FIFO_SPACE_CFG_RX_2X	This specifies that the Rx FIFO be twice as large as the Tx FIFO. This is the default.
	SIO4_ISOC_TX_FIFO_SPACE_CFG_TX_2X	This specifies that the Tx FIFO be twice as large as the Rx FIFO.
tx. io	This structure configures the transmitter's software settings. These settings are used during <code>sio4_isoc_write()</code> calls (see section 4.1.10, page 14).	

tx. io. dma_thresh	This field configures the minimum size of Block Mode DMA transfers to be performed by the write service. If the Tx FIFO has less than the specified amount of available space, then the driver will wait a single system timer interval before trying again. However, if the Tx FIFO can accommodate what remains of the current request, or if the output stream appears to be idle, then the driver will perform a transfer rather than wait for more space. The valid range is any non-negative value up to the size of the Tx FIFO. The default is 0. The feature's low-level function is <code>sio4_isoc_t_tx_io_dma_thresh()</code> . Refer to the "Operating Information" section of the <i>SIO4 Reference Manual</i> for additional information.								
tx. io. mode	<p>This field selects the mechanism used to transfer data from host memory to the channel's Tx FIFO. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_io_mode()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_TX_IO_MODE_BMDMA</code></td><td>This selects Block Mode DMA mode transfers. *</td></tr> <tr> <td><code>SIO4_ISOC_TX_IO_MODE_DMDMA</code></td><td>This selects Demand Mode DMA mode transfers. *</td></tr> <tr> <td><code>SIO4_ISOC_TX_IO_MODE_PIO</code></td><td>This selects PIO mode transfers. This is the default.</td></tr> </table> <p>* The SIO4 has only two DMA engines. A BMDMA or DMDMA transfer request will fail if both DMA engines are already in use by other SIO4 channels.</p>	Value	Description	<code>SIO4_ISOC_TX_IO_MODE_BMDMA</code>	This selects Block Mode DMA mode transfers. *	<code>SIO4_ISOC_TX_IO_MODE_DMDMA</code>	This selects Demand Mode DMA mode transfers. *	<code>SIO4_ISOC_TX_IO_MODE_PIO</code>	This selects PIO mode transfers. This is the default.
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<code>SIO4_ISOC_TX_IO_MODE_PIO</code>	This selects PIO mode transfers. This is the default.								
tx. io. pio_thresh	This field specifies the threshold for write request sizes that force the use of PIO mode. If a write request is this size or smaller, then the transfer will automatically use PIO. The valid range is any non-negative value. The default is 44. The feature's low-level function is <code>sio4_isoc_t_tx_io_pio_thresh()</code> .								
tx. io. timeout	This field specifies the maximum duration of write requests to the driver. The valid range is from zero to 3600. The units are seconds. The default is 10 seconds. The value zero tells the driver to write as much data as possible to the Tx FIFO, but not to wait for additional free space when none is available. The feature's low-level function is <code>sio4_isoc_t_tx_io_timeout()</code> .								
tx. io. overrun	<p>This field tells the driver if it is to check for Tx FIFO overrun conditions before proceeding with write requests. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_tx_io_overrun()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_TX_IO_OVERRUN_CHECK</code></td><td>This specifies that the driver <u>should</u> check for overrun conditions. This is the default.</td></tr> <tr> <td><code>SIO4_ISOC_TX_IO_OVERRUN_IGNORE</code></td><td>This specifies that the driver should <u>not</u> check for overrun conditions.</td></tr> </table>	Value	Description	<code>SIO4_ISOC_TX_IO_OVERRUN_CHECK</code>	This specifies that the driver <u>should</u> check for overrun conditions. This is the default.	<code>SIO4_ISOC_TX_IO_OVERRUN_IGNORE</code>	This specifies that the driver should <u>not</u> check for overrun conditions.		
Value	Description								
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## 4.3.1.4. sio4\_isoc\_t.rx

This section describes the structure's receiver configuration fields.

Field	Description				
rx	This structure configures the receiver portion of the channel.				
rx. mode	<p>This field specifies the receiver's operating mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_mode()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_RX_MODE_ISOC</code></td><td>This selects the Isochronous operating mode. This is the default and the only valid option for this library.</td></tr> </table>	Value	Description	<code>SIO4_ISOC_RX_MODE_ISOC</code>	This selects the Isochronous operating mode. This is the default and the only valid option for this library.
Value	Description				
<code>SIO4_ISOC_RX_MODE_ISOC</code>	This selects the Isochronous operating mode. This is the default and the only valid option for this library.				
rx. enable	<p>This field specifies if the receiver is to be enabled. When configuration is begun (see <code>sio4_isoc_set()</code>, section 4.1.6.1, page 13) the receiver is initialized and disabled. The option in this field is applied towards the end of the configuration process. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_enable()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_RX_ENABLE_NO_AFTER</code></td><td>This disables the receiver after it has finished</td></tr> </table>	Value	Description	<code>SIO4_ISOC_RX_ENABLE_NO_AFTER</code>	This disables the receiver after it has finished
Value	Description				
<code>SIO4_ISOC_RX_ENABLE_NO_AFTER</code>	This disables the receiver after it has finished				

		the reception in progress.																		
	SIO4_ISOC_RX_ENABLE_NO_NOW	This disables the receiver immediately.																		
	SIO4_ISOC_RX_ENABLE_YES_NOW	This enables the receiver immediately. This is the default.																		
	SIO4_ISOC_RX_ENABLE_YES_W_AE	This enables the receiver according to the state of any hardware flow control lines.																		
rx. char_len	<p>This field specifies the size of received characters. The length specified does not include the Parity Bit, if Parity is enabled. The data bits are the lower significant bits of the byte. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_char_len()</code>.</p> <table><tr><th>Value</th><th>Description</th></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_1</td><td>Characters are 1-bit in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_2</td><td>Characters are 2-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_3</td><td>Characters are 3-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_4</td><td>Characters are 4-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_5</td><td>Characters are 5-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_6</td><td>Characters are 6-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_7</td><td>Characters are 7-bits in length.</td></tr><tr><td>SIO4_ISOC_RX_CHAR_LEN_8</td><td>Characters are 8-bits in length. This is the default.</td></tr></table>		Value	Description	SIO4_ISOC_RX_CHAR_LEN_1	Characters are 1-bit in length.	SIO4_ISOC_RX_CHAR_LEN_2	Characters are 2-bits in length.	SIO4_ISOC_RX_CHAR_LEN_3	Characters are 3-bits in length.	SIO4_ISOC_RX_CHAR_LEN_4	Characters are 4-bits in length.	SIO4_ISOC_RX_CHAR_LEN_5	Characters are 5-bits in length.	SIO4_ISOC_RX_CHAR_LEN_6	Characters are 6-bits in length.	SIO4_ISOC_RX_CHAR_LEN_7	Characters are 7-bits in length.	SIO4_ISOC_RX_CHAR_LEN_8	Characters are 8-bits in length. This is the default.
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rx. encoding	<p>This field specifies the encoding of the received data. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_encoding()</code>.</p> <table><tr><th>Value</th><th>Description</th></tr><tr><td>SIO4_ISOC_RX_ENCODING_BI_MARK</td><td>This refers to Biphasic Mark encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_BI_LEVEL</td><td>This refers to Biphasic Level encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_BI_SPACE</td><td>This refers to Biphasic Space encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_D_BI_LEVEL</td><td>This refers to Differential Biphasic Level encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_NRZ</td><td>This refers to NRZ encoding. This is the default.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_NRZB</td><td>This refers to NRZB encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_NRZI_MARK</td><td>This refers to NRZI-Mark encoding.</td></tr><tr><td>SIO4_ISOC_RX_ENCODING_NRZI_SPACE</td><td>This refers to NRZI-Space encoding.</td></tr></table>		Value	Description	SIO4_ISOC_RX_ENCODING_BI_MARK	This refers to Biphasic Mark encoding.	SIO4_ISOC_RX_ENCODING_BI_LEVEL	This refers to Biphasic Level encoding.	SIO4_ISOC_RX_ENCODING_BI_SPACE	This refers to Biphasic Space encoding.	SIO4_ISOC_RX_ENCODING_D_BI_LEVEL	This refers to Differential Biphasic Level encoding.	SIO4_ISOC_RX_ENCODING_NRZ	This refers to NRZ encoding. This is the default.	SIO4_ISOC_RX_ENCODING_NRZB	This refers to NRZB encoding.	SIO4_ISOC_RX_ENCODING_NRZI_MARK	This refers to NRZI-Mark encoding.	SIO4_ISOC_RX_ENCODING_NRZI_SPACE	This refers to NRZI-Space encoding.
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SIO4_ISOC_RX_ENCODING_NRZI_SPACE	This refers to NRZI-Space encoding.																			
rx. bit_rate	<p>This specifies the receive data bit rate. During the <code>sio4_isoc_init_data()</code> call (section 4.1.3, page 10) this is set to the <code>sio4_isoc_init_t.rx_bit_rate</code> field provided to the call. The feature's low-level function is <code>sio4_isoc_t_rx_bit_rate()</code>. The Rx Bit Rate is provided for informational purposes only and is not recorded for later retrieval.</p>																			
rx. sync_byte	<p>This specifies the value to be compared to received data as the data enters the Rx FIFO (the one outside the USC). This comparison can be used for interrupt generation. Valid values are from zero to 0xFF. The default is zero. The feature's low-level function is <code>sio4_isoc_t_rx_sync_byte()</code>.</p>																			
rx. status_word	<p>This field controls whether the firmware will place the USC Receive Control/Status Register in the Rx FIFO along with the received data. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_status_word()</code>.</p> <table><tr><th>Value</th><th>Description</th></tr><tr><td>SIO4_ISOC_RX_STATUS_WORD_DISABLE</td><td>The RCSR is <u>not</u> placed in the Rx FIFO. This is the default.</td></tr><tr><td>SIO4_ISOC_RX_STATUS_WORD_ENABLE</td><td>The RCSR <u>is</u> placed in the Rx FIFO.</td></tr></table>		Value	Description	SIO4_ISOC_RX_STATUS_WORD_DISABLE	The RCSR is <u>not</u> placed in the Rx FIFO. This is the default.	SIO4_ISOC_RX_STATUS_WORD_ENABLE	The RCSR <u>is</u> placed in the Rx FIFO.												
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rx. parity	<p>This structure configures the receiver's use of Parity checking.</p>																			

rx. parity. enable	<p>This field enables or disables the use of Parity. When enabled, the character size does not include the Parity Bit. When used, the Parity Bit appears to the immediate left of the most significant data bit. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_parity_enable()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_ENABLE_NO</code></td><td>Do <u>not</u> generate a Parity bit. This is the default.</td></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_ENABLE_YES</code></td><td>Do generate a Parity bit.</td></tr> </table>	Value	Description	<code>SIO4_ISOC_RX_PARITY_ENABLE_NO</code>	Do <u>not</u> generate a Parity bit. This is the default.	<code>SIO4_ISOC_RX_PARITY_ENABLE_YES</code>	Do generate a Parity bit.				
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<code>SIO4_ISOC_RX_PARITY_ENABLE_NO</code>	Do <u>not</u> generate a Parity bit. This is the default.										
<code>SIO4_ISOC_RX_PARITY_ENABLE_YES</code>	Do generate a Parity bit.										
rx. parity. type	<p>This field specifies the type of Parity to use, when its use is enabled. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_parity_type()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_TYPE_EVEN</code></td><td>This specifies Even Parity. This is the default.</td></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_TYPE_ODD</code></td><td>This specifies Odd Parity.</td></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_TYPE_ONE</code></td><td>This specifies One Parity (the parity bit is always set).</td></tr> <tr> <td><code>SIO4_ISOC_RX_PARITY_TYPE_ZERO</code></td><td>This specifies Zero Parity (the parity bit is always clear).</td></tr> </table>	Value	Description	<code>SIO4_ISOC_RX_PARITY_TYPE_EVEN</code>	This specifies Even Parity. This is the default.	<code>SIO4_ISOC_RX_PARITY_TYPE_ODD</code>	This specifies Odd Parity.	<code>SIO4_ISOC_RX_PARITY_TYPE_ONE</code>	This specifies One Parity (the parity bit is always set).	<code>SIO4_ISOC_RX_PARITY_TYPE_ZERO</code>	This specifies Zero Parity (the parity bit is always clear).
Value	Description										
<code>SIO4_ISOC_RX_PARITY_TYPE_EVEN</code>	This specifies Even Parity. This is the default.										
<code>SIO4_ISOC_RX_PARITY_TYPE_ODD</code>	This specifies Odd Parity.										
<code>SIO4_ISOC_RX_PARITY_TYPE_ONE</code>	This specifies One Parity (the parity bit is always set).										
<code>SIO4_ISOC_RX_PARITY_TYPE_ZERO</code>	This specifies Zero Parity (the parity bit is always clear).										
rx. fifo	This structure configures the receiver's FIFO parameters.										
rx. fifo. size	This field is filled in by the <code>sio4_isoc_init()</code> call (section 4.1.3, page 10) with the size of the channel's Rx FIFO. This is offered for informational purposes only. The feature's low-level function is <code>sio4_isoc_t_rx_fifo_size()</code> .										
rx. fifo. ae	This field specifies the Rx FIFO Almost Empty setting. The Rx FIFO Almost Empty status is asserted (goes low) when the Rx FIFO contain this number of values, or fewer. The valid value range is from zero to 0xFFFF. The default is 0x7. The feature's low-level function is <code>sio4_isoc_t_rx_fifo_ae()</code> .										
rx. fifo. af	This field specifies the Rx FIFO Almost Full setting. The Rx FIFO Almost Full status is asserted (goes low) when the Rx FIFO contain this number of values, or fewer. The valid value range is from zero to 0xFFFF. The default is 0x7. The feature's low-level function is <code>sio4_isoc_t_rx_fifo_af()</code> .										
rx. fifo. full_cfg	<p>This field configures the receiver's reaction to the Rx FIFO becoming full. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_fifo_full_cfg()</code>. This field refers to the channel specific setting, when supported. The corresponding global setting is not supported by the Isochronous Protocol Library because it affects channels other than the one being accessed. The global setting must be handled separately by the application.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td><code>SIO4_ISOC_RX_FIFO_FULL_CFG_DISABLE</code></td><td>This specifies that the receiver be disabled when the condition occurs.</td></tr> <tr> <td><code>SIO4_ISOC_RX_FIFO_FULL_CFG_OVER</code></td><td>This specifies that the condition produce an overflow. This is the default.</td></tr> </table>	Value	Description	<code>SIO4_ISOC_RX_FIFO_FULL_CFG_DISABLE</code>	This specifies that the receiver be disabled when the condition occurs.	<code>SIO4_ISOC_RX_FIFO_FULL_CFG_OVER</code>	This specifies that the condition produce an overflow. This is the default.				
Value	Description										
<code>SIO4_ISOC_RX_FIFO_FULL_CFG_DISABLE</code>	This specifies that the receiver be disabled when the condition occurs.										
<code>SIO4_ISOC_RX_FIFO_FULL_CFG_OVER</code>	This specifies that the condition produce an overflow. This is the default.										
rx. io	This structure configures the receiver's software settings. These settings are used during <code>sio4_isoc_read()</code> calls (section 4.1.6.1, page 13).										
rx. io. dma_thresh	This field specifies the minimum size of Block Mode DMA transfers when the driver needs to wait for additional data to become available in the Rx FIFO. If data is available in the Rx FIFO, but it is less than the specified threshold and won't fulfill the request, then the driver will wait for additional data become available. The wait period is one system timer tick. The valid range is any non-negative value up to the size of the Rx FIFO. The default is 0. The feature's low-level function is <code>sio4_isoc_t_rx_io_dma_thresh()</code> . Refer to the "Operating Information" section of the <i>SIO4 Reference Manual</i> for additional information.										

rx. io. mode	<p>This field selects the mechanism used to transfer data from the channel's Rx FIFO to host memory. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_io_mode()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_RX_IO_MODE_BMDMA</td><td>This selects Block Mode DMA mode transfers. *</td></tr> <tr> <td>SIO4_ISOC_RX_IO_MODE_DMDMA</td><td>This selects Demand Mode DMA mode transfers. *</td></tr> <tr> <td>SIO4_ISOC_RX_IO_MODE_PIO</td><td>This selects PIO mode transfers. This is the default.</td></tr> </table> <p>* The SIO4 has only two DMA engines. A BMDMA or DMDMA transfer request will fail if both DMA engines are already in use by other SIO4 channels.</p>	Value	Description	SIO4_ISOC_RX_IO_MODE_BMDMA	This selects Block Mode DMA mode transfers. *	SIO4_ISOC_RX_IO_MODE_DMDMA	This selects Demand Mode DMA mode transfers. *	SIO4_ISOC_RX_IO_MODE_PIO	This selects PIO mode transfers. This is the default.
Value	Description								
SIO4_ISOC_RX_IO_MODE_BMDMA	This selects Block Mode DMA mode transfers. *								
SIO4_ISOC_RX_IO_MODE_DMDMA	This selects Demand Mode DMA mode transfers. *								
SIO4_ISOC_RX_IO_MODE_PIO	This selects PIO mode transfers. This is the default.								
rx. io. pio_thresh	<p>This field specifies the threshold for read request sizes that force the use of PIO mode. If a read request is this size or smaller, then the transfer will automatically use PIO. The valid range is any non-negative value. The default is 44. The feature's low-level function is <code>sio4_isoc_t_rx_io_pio_thresh()</code>.</p>								
rx. io. timeout	<p>This field specifies the maximum duration of read requests to the driver. The valid range is from zero to 3600. The units are seconds. The default is 10 seconds. The value zero tells the driver to read as much data as possible from the Rx FIFO, but not to wait for additional data when none is available. The feature's low-level function is <code>sio4_isoc_t_rx_io_timeout()</code>.</p>								
rx. io. overrun	<p>This field tells the driver if it is to check for Rx FIFO overrun conditions before proceeding with read requests. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_io_overrun()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_RX_IO_OVERRUN_CHECK</td><td>This specifies that the driver check for overrun conditions. This is the default.</td></tr> <tr> <td>SIO4_ISOC_RX_IO_OVERRUN_IGNORE</td><td>This specifies that the driver <u>not</u> check for overrun conditions.</td></tr> </table>	Value	Description	SIO4_ISOC_RX_IO_OVERRUN_CHECK	This specifies that the driver check for overrun conditions. This is the default.	SIO4_ISOC_RX_IO_OVERRUN_IGNORE	This specifies that the driver <u>not</u> check for overrun conditions.		
Value	Description								
SIO4_ISOC_RX_IO_OVERRUN_CHECK	This specifies that the driver check for overrun conditions. This is the default.								
SIO4_ISOC_RX_IO_OVERRUN_IGNORE	This specifies that the driver <u>not</u> check for overrun conditions.								
rx. io. underrun	<p>This field tells the driver if it is to check for Rx FIFO underrun conditions before proceeding with read requests. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_io_underrun()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_RX_IO_UNDERRUN_CHECK</td><td>This specifies that the driver check for underrun conditions. This is the default.</td></tr> <tr> <td>SIO4_ISOC_RX_IO_UNDERRUN_IGNORE</td><td>This specifies that the driver <u>not</u> check for underrun conditions.</td></tr> </table>	Value	Description	SIO4_ISOC_RX_IO_UNDERRUN_CHECK	This specifies that the driver check for underrun conditions. This is the default.	SIO4_ISOC_RX_IO_UNDERRUN_IGNORE	This specifies that the driver <u>not</u> check for underrun conditions.		
Value	Description								
SIO4_ISOC_RX_IO_UNDERRUN_CHECK	This specifies that the driver check for underrun conditions. This is the default.								
SIO4_ISOC_RX_IO_UNDERRUN_IGNORE	This specifies that the driver <u>not</u> check for underrun conditions.								
rx. time_stamp	<p>This structure configures the receiver's Time Stamp settings.</p>								
rx. time_stamp. enable	<p>This field enables or disables the channel's use of the Time Stamp feature. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_time_stamp_enable()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_RX_TIME_STAMP_ENABLE_NO</td><td>Do <u>not</u> use the Time Stamp feature. This is the default.</td></tr> <tr> <td>SIO4_ISOC_RX_TIME_STAMP_ENABLE_YES</td><td><u>Do</u> use the Time Stamp feature.</td></tr> </table>	Value	Description	SIO4_ISOC_RX_TIME_STAMP_ENABLE_NO	Do <u>not</u> use the Time Stamp feature. This is the default.	SIO4_ISOC_RX_TIME_STAMP_ENABLE_YES	<u>Do</u> use the Time Stamp feature.		
Value	Description								
SIO4_ISOC_RX_TIME_STAMP_ENABLE_NO	Do <u>not</u> use the Time Stamp feature. This is the default.								
SIO4_ISOC_RX_TIME_STAMP_ENABLE_YES	<u>Do</u> use the Time Stamp feature.								
rx. time_stamp. clk_src	<p>This field selects the Time Stamp clock source. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_rx_time_stamp_clk_src()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_EXT</td><td>Use the board's external TTL clock source. *</td></tr> <tr> <td>SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_INT</td><td>Use the board's internal 1us clock. This is the default. *</td></tr> </table> <p>* All four channels on the SIO4 use the same clock source.</p>	Value	Description	SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_EXT	Use the board's external TTL clock source. *	SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_INT	Use the board's internal 1us clock. This is the default. *		
Value	Description								
SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_EXT	Use the board's external TTL clock source. *								
SIO4_ISOC_RX_TIME_STAMP_CLK_SRC_INT	Use the board's internal 1us clock. This is the default. *								

## 4.3.1.5. sio4\_isoc\_t.usc

This section describes the structure's USC configuration fields.

Field	Description										
usc	This structure configures the remaining USC portion of the channel.										
usc. mode	<p>This field specifies the USC's overall operating mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_mode()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_MODE_AUTO_ECHO</td><td>This is the USC's Auto Echo mode.</td></tr> <tr> <td>SIO4_ISOC_USC_MODE_LOOPBACK_EXT</td><td>This is the USC's external loopback mode.</td></tr> <tr> <td>SIO4_ISOC_USC_MODE_LOOPBACK_INT</td><td>This is the USC's internal loopback mode.</td></tr> <tr> <td>SIO4_ISOC_USC_MODE_NORMAL</td><td>This is the USC's normal operating mode. This is the default.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_MODE_AUTO_ECHO	This is the USC's Auto Echo mode.	SIO4_ISOC_USC_MODE_LOOPBACK_EXT	This is the USC's external loopback mode.	SIO4_ISOC_USC_MODE_LOOPBACK_INT	This is the USC's internal loopback mode.	SIO4_ISOC_USC_MODE_NORMAL	This is the USC's normal operating mode. This is the default.
Value	Description										
SIO4_ISOC_USC_MODE_AUTO_ECHO	This is the USC's Auto Echo mode.										
SIO4_ISOC_USC_MODE_LOOPBACK_EXT	This is the USC's external loopback mode.										
SIO4_ISOC_USC_MODE_LOOPBACK_INT	This is the USC's internal loopback mode.										
SIO4_ISOC_USC_MODE_NORMAL	This is the USC's normal operating mode. This is the default.										
usc. txd	<p>This field configures the operation of the USC's Tx Data pin. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_txd()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_TXD_OUT_0</td><td>The pin is driven low.</td></tr> <tr> <td>SIO4_ISOC_USC_TXD_OUT_1</td><td>The pin is driven high.</td></tr> <tr> <td>SIO4_ISOC_USC_TXD_OUT_TXD</td><td>The pin is driven from the transmitter's Tx Data signal. This is the default.</td></tr> <tr> <td>SIO4_ISOC_USC_TXD_TRI</td><td>The pin is tri-stated.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_TXD_OUT_0	The pin is driven low.	SIO4_ISOC_USC_TXD_OUT_1	The pin is driven high.	SIO4_ISOC_USC_TXD_OUT_TXD	The pin is driven from the transmitter's Tx Data signal. This is the default.	SIO4_ISOC_USC_TXD_TRI	The pin is tri-stated.
Value	Description										
SIO4_ISOC_USC_TXD_OUT_0	The pin is driven low.										
SIO4_ISOC_USC_TXD_OUT_1	The pin is driven high.										
SIO4_ISOC_USC_TXD_OUT_TXD	The pin is driven from the transmitter's Tx Data signal. This is the default.										
SIO4_ISOC_USC_TXD_TRI	The pin is tri-stated.										
usc. cts	<p>This field configures the operation of the USC's CTS pin. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_cts()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_CTS_OUT_0</td><td>The pin is driven low.</td></tr> <tr> <td>SIO4_ISOC_USC_CTS_OUT_1</td><td>The pin is driven high.</td></tr> <tr> <td>SIO4_ISOC_USC_CTS_IN_CBL_CTS</td><td>The pin is an input driver from the cable's CTS signal.</td></tr> <tr> <td>SIO4_ISOC_USC_CTS_TRI</td><td>The pin is tri-stated. This is the default.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_CTS_OUT_0	The pin is driven low.	SIO4_ISOC_USC_CTS_OUT_1	The pin is driven high.	SIO4_ISOC_USC_CTS_IN_CBL_CTS	The pin is an input driver from the cable's CTS signal.	SIO4_ISOC_USC_CTS_TRI	The pin is tri-stated. This is the default.
Value	Description										
SIO4_ISOC_USC_CTS_OUT_0	The pin is driven low.										
SIO4_ISOC_USC_CTS_OUT_1	The pin is driven high.										
SIO4_ISOC_USC_CTS_IN_CBL_CTS	The pin is an input driver from the cable's CTS signal.										
SIO4_ISOC_USC_CTS_TRI	The pin is tri-stated. This is the default.										
usc. cts_legacy	<p>This field configures the operation of the USC's CTS pin for legacy mode cable interface configurations. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_cts_legacy()</code>. Please also read Cable Configuration Modes (section 5.5, page 40).</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_TX_CTS_LEG_IN</td><td>The pin operates as an input. This is the default.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CTS_LEG_OUT_0</td><td>The pin operates as an output driven low.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CTS_LEG_OUT_1</td><td>The pin operates as an output driven high.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_TX_CTS_LEG_IN	The pin operates as an input. This is the default.	SIO4_ISOC_USC_TX_CTS_LEG_OUT_0	The pin operates as an output driven low.	SIO4_ISOC_USC_TX_CTS_LEG_OUT_1	The pin operates as an output driven high.		
Value	Description										
SIO4_ISOC_USC_TX_CTS_LEG_IN	The pin operates as an input. This is the default.										
SIO4_ISOC_USC_TX_CTS_LEG_OUT_0	The pin operates as an output driven low.										
SIO4_ISOC_USC_TX_CTS_LEG_OUT_1	The pin operates as an output driven high.										
usc. dcd	<p>This field configures the operation of the USC's DCD pin. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_dcd()</code>.</p> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_DCD_DISABLE</td><td>The pin is disabled. This is the default.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_IN_DCD_CBL_DCD</td><td>The pin is an input for the receiver's DCD function and is driven from the cable's DCD signal.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_IN_SYNC_CBL_DCD</td><td>The pin is an input for the receiver's SYNC function and is driven from the cable's DCD signal.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_OUT_0</td><td>The pin is driven low. *</td></tr> </table>	Value	Description	SIO4_ISOC_USC_DCD_DISABLE	The pin is disabled. This is the default.	SIO4_ISOC_USC_DCD_IN_DCD_CBL_DCD	The pin is an input for the receiver's DCD function and is driven from the cable's DCD signal.	SIO4_ISOC_USC_DCD_IN_SYNC_CBL_DCD	The pin is an input for the receiver's SYNC function and is driven from the cable's DCD signal.	SIO4_ISOC_USC_DCD_OUT_0	The pin is driven low. *
Value	Description										
SIO4_ISOC_USC_DCD_DISABLE	The pin is disabled. This is the default.										
SIO4_ISOC_USC_DCD_IN_DCD_CBL_DCD	The pin is an input for the receiver's DCD function and is driven from the cable's DCD signal.										
SIO4_ISOC_USC_DCD_IN_SYNC_CBL_DCD	The pin is an input for the receiver's SYNC function and is driven from the cable's DCD signal.										
SIO4_ISOC_USC_DCD_OUT_0	The pin is driven low. *										

	<div>SIO4_ISOC_USC_DCD_OUT_1</div> <div>The pin is driven high. *</div> <div>* This option enables the cable DCD signal to be driven, though the <code>cable.dcd</code> field (section 4.3.1.2, page 20) may configure the cable to output an alternate signal.</div>																										
usc. dcd_legacy	<div>This field configures the operation of the USC's DCD pin for legacy mode cable interface configurations. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_dcd_legacy()</code>. Please also read Cable Configuration Modes (section 5.5, page 40).</div> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_DCD_LEG_IN_DCD</td><td>The pin operates as a DCD input. This is the default.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_LEG_IN_SYNC</td><td>The pin operates as a SYNC input.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_LEG_OUT_0</td><td>The pin operates as an output driven low.</td></tr> <tr> <td>SIO4_ISOC_USC_DCD_LEG_OUT_1</td><td>The pin operates as an output driven high.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_DCD_LEG_IN_DCD	The pin operates as a DCD input. This is the default.	SIO4_ISOC_USC_DCD_LEG_IN_SYNC	The pin operates as a SYNC input.	SIO4_ISOC_USC_DCD_LEG_OUT_0	The pin operates as an output driven low.	SIO4_ISOC_USC_DCD_LEG_OUT_1	The pin operates as an output driven high.																
Value	Description																										
SIO4_ISOC_USC_DCD_LEG_IN_DCD	The pin operates as a DCD input. This is the default.																										
SIO4_ISOC_USC_DCD_LEG_IN_SYNC	The pin operates as a SYNC input.																										
SIO4_ISOC_USC_DCD_LEG_OUT_0	The pin operates as an output driven low.																										
SIO4_ISOC_USC_DCD_LEG_OUT_1	The pin operates as an output driven high.																										
usc. tx	This structure configures the remaining USC transmitter settings.																										
usc. tx. clk_src	<div>This field configures the source for the USC transmitter clock. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_tx_clk_src()</code>.</div> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_BRG0</td><td>Select Baud Rate Generator 0.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_BRG1</td><td>Select Baud Rate Generator 1.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_CTR0</td><td>Select Counter 0.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_CTR1</td><td>Select Counter 1.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_DISABLE</td><td>Disable the transmitter.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_DPLL</td><td>Select the DPLL.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_RXC_PIN</td><td>Select the Rx Clock pin.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_CLK_SRC_TXC_PIN</td><td>Select the Tx Clock pin. This is the default.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_TX_CLK_SRC_BRG0	Select Baud Rate Generator 0.	SIO4_ISOC_USC_TX_CLK_SRC_BRG1	Select Baud Rate Generator 1.	SIO4_ISOC_USC_TX_CLK_SRC_CTR0	Select Counter 0.	SIO4_ISOC_USC_TX_CLK_SRC_CTR1	Select Counter 1.	SIO4_ISOC_USC_TX_CLK_SRC_DISABLE	Disable the transmitter.	SIO4_ISOC_USC_TX_CLK_SRC_DPLL	Select the DPLL.	SIO4_ISOC_USC_TX_CLK_SRC_RXC_PIN	Select the Rx Clock pin.	SIO4_ISOC_USC_TX_CLK_SRC_TXC_PIN	Select the Tx Clock pin. This is the default.								
Value	Description																										
SIO4_ISOC_USC_TX_CLK_SRC_BRG0	Select Baud Rate Generator 0.																										
SIO4_ISOC_USC_TX_CLK_SRC_BRG1	Select Baud Rate Generator 1.																										
SIO4_ISOC_USC_TX_CLK_SRC_CTR0	Select Counter 0.																										
SIO4_ISOC_USC_TX_CLK_SRC_CTR1	Select Counter 1.																										
SIO4_ISOC_USC_TX_CLK_SRC_DISABLE	Disable the transmitter.																										
SIO4_ISOC_USC_TX_CLK_SRC_DPLL	Select the DPLL.																										
SIO4_ISOC_USC_TX_CLK_SRC_RXC_PIN	Select the Rx Clock pin.																										
SIO4_ISOC_USC_TX_CLK_SRC_TXC_PIN	Select the Tx Clock pin. This is the default.																										
usc. tx. txc	<div>This field configures the operation of the USC's Tx Clock pin. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_tx_txc()</code>.</div> <table> <tr> <th>Value</th><th>Description</th></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_0</td><td>The pin is an input driven low.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_1</td><td>The pin is an input driven high.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_CBL_RXAUX</td><td>The pin is an input driven from the cable's Rx Aux signal.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_CBL_RXC</td><td>The pin is an input driven from the cable's Rx Clock signal.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_OSC</td><td>The pin is an input driven from the onboard oscillator.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_IN_OSC_INV</td><td>The pin is an input driven from the inverted onboard oscillator.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_BRG0</td><td>The pin is an output driven from Baud Rate Generator 0.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_BRG1</td><td>The pin is an output driven from Baud Rate Generator 1.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_BYTE_CLK</td><td>The pin is an output driven from the transmitter's Byte Clock.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_CLK</td><td>The pin is an output driven from the transmit clock. This is the default.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_COMP</td><td>The pin is an output driven from the transmit complete signal.</td></tr> <tr> <td>SIO4_ISOC_USC_TX_TXC_OUT_CTR1</td><td>The pin is an output driven from Counter 1.</td></tr> </table>	Value	Description	SIO4_ISOC_USC_TX_TXC_IN_0	The pin is an input driven low.	SIO4_ISOC_USC_TX_TXC_IN_1	The pin is an input driven high.	SIO4_ISOC_USC_TX_TXC_IN_CBL_RXAUX	The pin is an input driven from the cable's Rx Aux signal.	SIO4_ISOC_USC_TX_TXC_IN_CBL_RXC	The pin is an input driven from the cable's Rx Clock signal.	SIO4_ISOC_USC_TX_TXC_IN_OSC	The pin is an input driven from the onboard oscillator.	SIO4_ISOC_USC_TX_TXC_IN_OSC_INV	The pin is an input driven from the inverted onboard oscillator.	SIO4_ISOC_USC_TX_TXC_OUT_BRG0	The pin is an output driven from Baud Rate Generator 0.	SIO4_ISOC_USC_TX_TXC_OUT_BRG1	The pin is an output driven from Baud Rate Generator 1.	SIO4_ISOC_USC_TX_TXC_OUT_BYTE_CLK	The pin is an output driven from the transmitter's Byte Clock.	SIO4_ISOC_USC_TX_TXC_OUT_CLK	The pin is an output driven from the transmit clock. This is the default.	SIO4_ISOC_USC_TX_TXC_OUT_COMP	The pin is an output driven from the transmit complete signal.	SIO4_ISOC_USC_TX_TXC_OUT_CTR1	The pin is an output driven from Counter 1.
Value	Description																										
SIO4_ISOC_USC_TX_TXC_IN_0	The pin is an input driven low.																										
SIO4_ISOC_USC_TX_TXC_IN_1	The pin is an input driven high.																										
SIO4_ISOC_USC_TX_TXC_IN_CBL_RXAUX	The pin is an input driven from the cable's Rx Aux signal.																										
SIO4_ISOC_USC_TX_TXC_IN_CBL_RXC	The pin is an input driven from the cable's Rx Clock signal.																										
SIO4_ISOC_USC_TX_TXC_IN_OSC	The pin is an input driven from the onboard oscillator.																										
SIO4_ISOC_USC_TX_TXC_IN_OSC_INV	The pin is an input driven from the inverted onboard oscillator.																										
SIO4_ISOC_USC_TX_TXC_OUT_BRG0	The pin is an output driven from Baud Rate Generator 0.																										
SIO4_ISOC_USC_TX_TXC_OUT_BRG1	The pin is an output driven from Baud Rate Generator 1.																										
SIO4_ISOC_USC_TX_TXC_OUT_BYTE_CLK	The pin is an output driven from the transmitter's Byte Clock.																										
SIO4_ISOC_USC_TX_TXC_OUT_CLK	The pin is an output driven from the transmit clock. This is the default.																										
SIO4_ISOC_USC_TX_TXC_OUT_COMP	The pin is an output driven from the transmit complete signal.																										
SIO4_ISOC_USC_TX_TXC_OUT_CTR1	The pin is an output driven from Counter 1.																										

	SIO4_ISOC_USC_TX_TXC_OUT_DPLL_TX	The pin is an output driven from the transmit clock from the DPLL.
usc. tx. txc_legacy	This field configures the operation of the USC's Tx Clock pin for legacy mode cable interface configurations. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_tx_txc_legacy()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	Value	Description
	SIO4_ISOC_USC_TX_TXC_LEG_IN	The pin operates as an input.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_BRG0	The pin is an output driven from Baud Rate Generator 0.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_BRG1	The pin is an output driven from Baud Rate Generator 1.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_BYTE_CLK	The pin is an output driven from the transmitter's Byte Clock.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_CLK	The pin is an output driven from the transmit clock. This is the default.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_COMP	The pin is an output driven from the transmit complete signal.
	SIO4_ISOC_USC_TX_TXC_LEG_OUT_CTR1	The pin is an output driven from Counter 1.
SIO4_ISOC_USC_TX_TXC_LEG_OUT_DPLL_TX	The pin is an output driven from the transmit clock from the DPLL.	
usc. tx. stop_bits	This field configures the number of Stop Bits injected by the transmitter after each data byte. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_tx_stop_bits()</code> .	
	Value	Description
	SIO4_ISOC_USC_TX_STOP_BITS_1	This refers to a single stop bit. This is the default.
SIO4_ISOC_USC_TX_STOP_BITS_2	This refers to two stop bits.	
usc. rx	This structure configures the remaining USC receiver settings.	
usc. rx. clk_src	This field configures the source for the USC receiver clock. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_rx_clk_src()</code> .	
	Value	Description
	SIO4_ISOC_USC_RX_CLK_SRC_BRG0	Select Baud Rate Generator 0.
	SIO4_ISOC_USC_RX_CLK_SRC_BRG1	Select Baud Rate Generator 1.
	SIO4_ISOC_USC_RX_CLK_SRC_CTR0	Select Counter 0.
	SIO4_ISOC_USC_RX_CLK_SRC_CTR1	Select Counter 1.
	SIO4_ISOC_USC_RX_CLK_SRC_DISABLE	Disable the receiver.
	SIO4_ISOC_USC_RX_CLK_SRC_DPLL	Select the DPLL.
	SIO4_ISOC_USC_RX_CLK_SRC_RXC_PIN	Select the Rx Clock pin. This is the default.
SIO4_ISOC_USC_RX_CLK_SRC_TXC_PIN	Select the Tx Clock pin.	
usc. rx. rxc	This field configures the operation of the USC's Rx Clock pin. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_rx_rxc()</code> .	
	Value	Description
	SIO4_ISOC_USC_RX_RXC_IN_0	The pin is an input driven low.
	SIO4_ISOC_USC_RX_RXC_IN_1	The pin is an input driven high.
	SIO4_ISOC_USC_RX_RXC_IN_CBL_RXAUX	The pin is an input driven from the cable's Rx Aux signal.
	SIO4_ISOC_USC_RX_RXC_IN_CBL_RXC	The pin is an input driven from the cable's Rx Clock signal. This is the default.
SIO4_ISOC_USC_RX_RXC_IN_OSC	The pin is an input driven from the	



		onboard oscillator.
	SIO4_ISOC_USC_RX_RXC_IN_OSC_INV	The pin is an input driven from the inverted onboard oscillator.
	SIO4_ISOC_USC_RX_RXC_OUT_BRG0	The pin is an output driven from Baud Rate Generator 0.
	SIO4_ISOC_USC_RX_RXC_OUT_BRG1	The pin is an output driven from Baud Rate Generator 1.
	SIO4_ISOC_USC_RX_RXC_OUT_BYTE_CLK	The pin is an output driven from the receiver's Byte Clock.
	SIO4_ISOC_USC_RX_RXC_OUT_CLK	The pin is an output driven from the receiver clock.
	SIO4_ISOC_USC_RX_RXC_OUT_CTR0	The pin is an output driven from Counter 0.
	SIO4_ISOC_USC_RX_RXC_OUT_DPLL_RX	The pin is an output driven from the DPLL receiver clock.
	SIO4_ISOC_USC_RX_RXC_OUT_SYNC	The pin is an output driven from the receiver's SYNC signal.
usc. rx. rxc_legacy	This field configures the operation of the USC's Rx Clock pin for legacy mode cable interface configurations. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_rx_rxc_legacy()</code> . Please also read Cable Configuration Modes (section 5.5, page 40).	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_RX_RXC_LEG_IN	The pin is an input. This is the default.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_BRG0	The pin is an output driven from Baud Rate Generator 0.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_BRG1	The pin is an output driven from Baud Rate Generator 1.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_BYTE_CLK	The pin is an output driven from the receiver's Byte Clock.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_CLK	The pin is an output driven from the receiver clock.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_CTR0	The pin is an output driven from Counter 0.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_DPLL_RX	The pin is an output driven from the DPLL receiver clock.
	SIO4_ISOC_USC_RX_RXC_LEG_OUT_SYNC	The pin is an output driven from the receiver's SYNC signal.
usc. brg0	This structure configures settings for Baud Rate Generator 0 (BRG0).	
usc. brg0. enable	This field enables or disabled Baud Rate Generator 0. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg0_enable()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG0_ENABLE_NO	This disables BRG0. This is the default.
	SIO4_ISOC_USC_BRG0_ENABLE_YES	This enables BRG0.
usc. brg0. clk_src	This field selects the clock source for Baud Rate Generator 0. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg0_clk_src()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG0_CLK_SRC_CTR0	This selects the output from Counter 0. This is the default.
	SIO4_ISOC_USC_BRG0_CLK_SRC_CTR1	This selects the output from Counter 1.
	SIO4_ISOC_USC_BRG0_CLK_SRC_RXC_PIN	This selects the signal present at the

		USC's Rx Clock pin.
	SIO4_ISOC_USC_BRG0_CLK_SRC_TXC_PIN	This selects the signal present at the USC's Tx Clock pin.
usc. brg0. divider	This field specifies the clock divider value for Baud Rate Generator 0. The valid value range is from zero to 0xFFFF. The default is zero. The feature's low-level function is <code>sio4_isoc_t_usc_brg0_divider()</code> .	
usc. brg0. mode	This field specifies the Baud Rate Generator 0 operating mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg0_mode()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG0_MODE_CONT	This selects continuous operation. This is the default.
	SIO4_ISOC_USC_BRG0_MODE_SINGLE	This selects single shot mode, in which clocking stops when the counter value reaches zero.
usc. brg1	This structure configures settings for Baud Rate Generator 1 (BRG1).	
usc. brg1. enable	This field enables or disabled Baud Rate Generator 1. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg1_enable()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG1_ENABLE_NO	This disables BRG1. This is the default.
	SIO4_ISOC_USC_BRG1_ENABLE_YES	This enables BRG1.
usc. brg1. clk_src	This field selects the clock source for Baud Rate Generator 1. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg1_clk_src()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG1_CLK_SRC_CTR0	This selects the output from Counter 0.
	SIO4_ISOC_USC_BRG1_CLK_SRC_CTR1	This selects the output from Counter 1. This is the default.
	SIO4_ISOC_USC_BRG1_CLK_SRC_RXC_PIN	This selects the signal present at the USC's Rx Clock pin.
	SIO4_ISOC_USC_BRG1_CLK_SRC_TXC_PIN	This selects the signal present at the USC's Tx Clock pin.
usc. brg1. divider	This field specifies the clock divider value for Baud Rate Generator 1. The valid value range is from zero to 0xFFFF. The default is zero. The feature's low-level function is <code>sio4_isoc_t_usc_brg1_divider()</code> .	
usc. brg1. mode	This field specifies the Baud Rate Generator 1 operating mode. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_brg1_mode()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_BRG1_MODE_CONT	This selects continuous operation. This is the default.
	SIO4_ISOC_USC_BRG1_MODE_SINGLE	This selects single shot mode, in which clocking stops when the counter value reaches zero.
usc. ctr0	This structure configures settings for Counter 0 (CTR0).	
usc. ctr0. clk_src	This field selects the clock source for Counter 0. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_ctr0_clk_src()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_CTR0_CLK_SRC_DISABLE	This disables Counter 0. This is the default.
	SIO4_ISOC_USC_CTR0_CLK_SRC_RXC_PIN	This selects the signal present at the

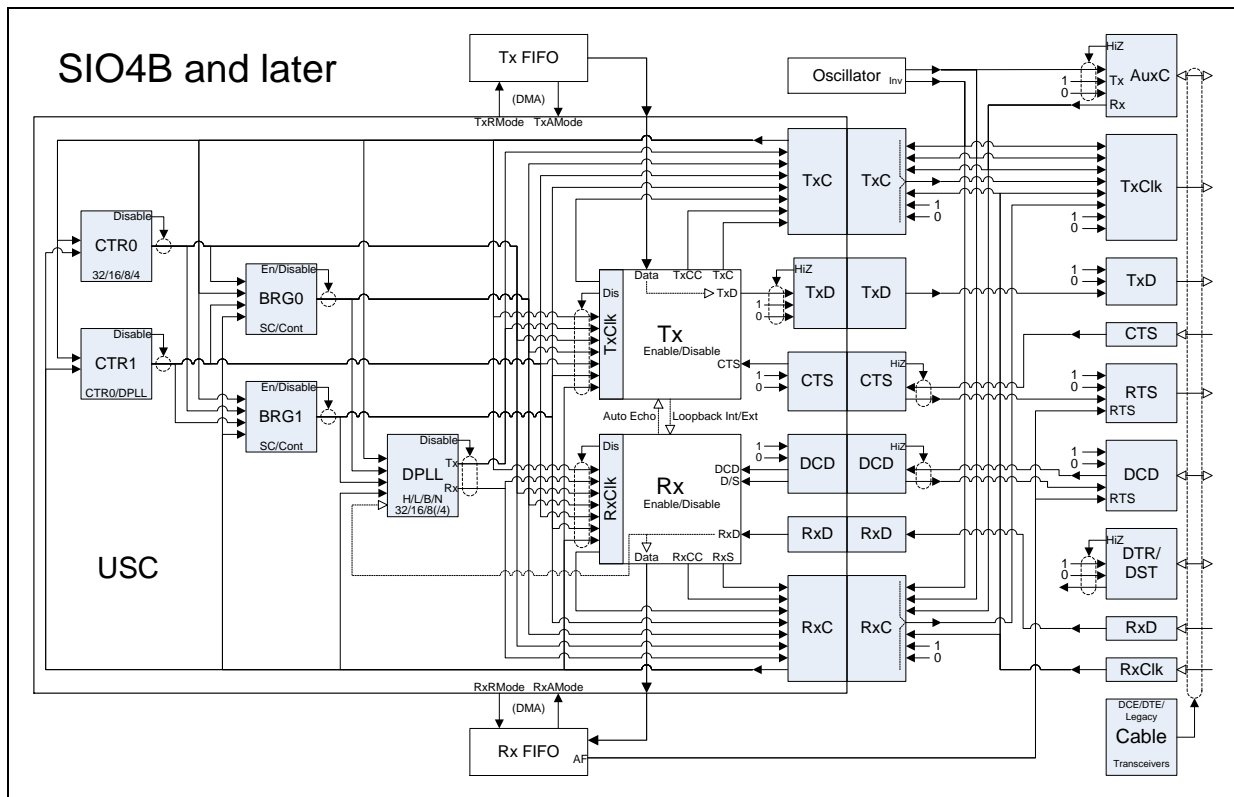
		USC's Rx Clock pin.
	SIO4_ISOC_USC_CTR0_CLK_SRC_TXC_PIN	This selects the signal present at the USC's Tx Clock pin.
usc. ctr0. rate	This field selects the divider rate for Counter 0. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_ctr0_rate()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_CTR0_RATE_4X	This sets the output as the input divided by four.
	SIO4_ISOC_USC_CTR0_RATE_8X	This sets the output as the input divided by eight.
	SIO4_ISOC_USC_CTR0_RATE_16X	This sets the output as the input divided by 16.
	SIO4_ISOC_USC_CTR0_RATE_32X	This sets the output as the input divided by 32. This is the default.
usc. ctrl	This structure configures settings for Counter 1 (CTR1).	
usc. ctrl. clk_src	This field selects the clock source for Counter 1. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_ctrl1_clk_src()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_CTR1_CLK_SRC_DISABLE	This disables Counter 1. This is the default.
	SIO4_ISOC_USC_CTR1_CLK_SRC_RXC_PIN	This selects the signal present at the USC's Rx Clock pin.
	SIO4_ISOC_USC_CTR1_CLK_SRC_TXC_PIN	This selects the signal present at the USC's Tx Clock pin.
usc. ctrl. rate_src	This field selects the source for the rate divider used by Counter 1. Valid values are given in the table below. The feature's low-level function is <code>sio4_isoc_t_usc_ctrl1_rate_src()</code> .	
	<b>Value</b>	<b>Description</b>
	SIO4_ISOC_USC_CTR1_RATE_SRC_CTR0	This selects the rate divider used by CTR0.
	SIO4_ISOC_USC_CTR1_RATE_SRC_DPLL	This selects the rate divider used by the DPLL. This is the default.

## 5. Operating Information

This section explains some basic operational procedures for using the SIO4 with the Isochronous Protocol Library. This is in no way intended to be a comprehensive guide. This is simply to address a very few issues relating to their use.

## 5.1. Basic Illustration

The below figure is included to assist individuals in the configuration of the SIO4. The figure illustrates boards with more recent firmware. The DMA references are handled automatically by the driver to facilitate movement of data between the USC and the on-board FIFOs.



**Figure 2** A functional illustration of an SIO4B or later model board.

## 5.2. Getting Started

To configure the SIO4 for HDLC operation meeting specific requirements, the recommended starting point is a local, customizable copy of the `hdlcc2c` sample application included with the driver. This application is designed to transfer bulk data between an SIO4 transmitter and an SIO4 receiver. The transmitter and receiver can be from two channels on different boards, two channels on the same board, or by loopback mode using the transmitter and receiver from the very same channel. There are two loopback configurations. Internal Loopback performs the transfer by routing signals totally onboard the SIO4 without driving the cable transceivers. External Loopback performs the transfer by routing the signals through the cable transceivers.

**NOTE:** When using Loopback operation, it is recommended that cabling and any remote equipment be disconnected from the SIO4. This is because External Loopback is the default when Internal Loopback is not supported by firmware.

### 5.2.1. Cable Validation

The first step in deriving a customized configuration is to verify cabling. This should be done using the application's default settings. It is recommended that one channel be used for loopback testing and that two other channels on the same board be connected by the cabling to be tested. A script with the below commands is a convenient means of repeating these tests until cabling has been verified successfully.

```
./hdlcc2c 0 0 -i
./hdlcc2c 0 0 -e
./hdlcc2c 1 2
```

### 5.2.2. Customizing the Configuration

The second step in deriving a customized configuration is to methodically modify the application code, one parameter at a time, until all necessary parameter changes have been accommodated. That is, choose a parameter from the documentation that must be changed from its default, modify the application so the required setting can be specified from the command line, then test the resulting changes. A script with the below commands is a convenient means of repeating these tests. In this example the “-X” represents the new command line argument for the parameter being altered from its default. This script tests all three cabling setups both without the change and with the change. This is done to verify that the default operation remains functional after the code modifications. In some cases, the script may need to be expanded to test each parameter addition to ensure prior changes remain functional. It is suggested that parameter changes be accommodated one at a time to ease the development and testing process.

```
./hdlcc2c 0 0 -I
./hdlcc2c 0 0 -e
./hdlcc2c 1 2 -I
./hdlcc2c 0 0 -I -X
./hdlcc2c 0 0 -e -X
./hdlcc2c 1 2 -X
```

**NOTE:** At times modifications for a parameter may need to be implemented on the transmitter or receiver first in order to facilitate validation. At other times the transmitter and receiver may temporarily be configured differently in order to verify that a change is implemented properly.

**NOTE:** It is best to initially test parameter additions separately, one at a time. Where there are parameter interactions, testing parameter combinations should be completed before moving on.

The general sequence for addition of a new parameter modification is as follows.

1. Add a field representing the parameter to the `args_t` structure defined in `main.h`.
2. Add command line support for the new parameter by updating the `_parse_args()` function at the top of `main.c`. At minimum, the `list[]` table must be updated to associate assignment of a setting with a command line argument. This may also mean assigning a default to the new field following the `memset()` function call.

**NOTE:** One may have to review multiple sample applications to get a feel for how to add specific command line argument types to the argument table.

3. Update the `_setup_apply()` function at the top of `setup.c` to apply the value from the new field to the `sio4_hdlc_t` structure prior to calling `sio4_hdlc_set()`.
4. Now update the script steps given above for the code changes just implemented. Continue adding support for other required parameter changes when testing is complete. Update the above script for each addition.

## 5.3. Debugging Aids

The SIO4 driver archive includes the following debugging aids appropriate for use with the Isochronous Protocol Library.

### 5.3.1. Device Identification

When communicating with technical support complete device identification is virtually always necessary. The *id* example application is provided for this specific purpose. This is a text only console application. The output can be piped to a file, which can then be emailed to GSC technical support when requested. Locate the application as follows.

Description	File	Location	OS
Application	id	.../id/	Linux
	id.rta	...\\id\\	INtime

### 5.3.2. `sio4_isoc_show()`

The function `sio4_isoc_show()` (section 4.1.9, page 14) is part of the protocol library interface. The purpose of the function is to produce a human readable report of all fields included in the `sio4_isoc_t` structure (section 4.3.1, page 16) passed in as a function argument. The function is best used to report the structure's content before it is passed to `sio4_isoc_set()` (section 4.1.8, page 13) or after it is passed to `sio4_isoc_get()` (section 4.1.2, page 10). The output can be used with Figure 2 to help visualize the channel configuration reflected by the structure content. When used in conjunction with `sio4_isoc_set()`, the `sio4_isoc_show()` output indicates the state that `sio4_isoc_set()` is expected to produce. When used in conjunction with `sio4_isoc_get()`, the `sio4_isoc_show()` output indicates the channel's current state. This may be beneficial after calling `sio4_isoc_set()` in order to verify the results achieved. The pair of calls may also be used before or after read or write requests in order to help explain the results of individual transfer requests.

### 5.3.3. Detailed Register Dump

The utility function `sio4_reg_list()` is included in the `sio4` utility library. The purpose of the function is to report the current content of registers for the referenced serial channel. The arguments control the set of registers included in the output and the detail with which the register content is reported. This function can be called at any time to report the device state, but it is most often called after completing board setup, or just before or after read or write requests in order to help explain the results of individual transfer requests.

#### Prototype

```
int sio4_reg_list(int fd, int gsc, int gsc_detail,
                 int usc, int usc_detail);
```

Argument	Description
fd	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
gsc	If non-zero, then the output will include a dump of all <code>GSC_SIO4_XXX</code> registers. Refer to <code>sio4.h</code> for a complete list of these registers.
gsc_detail	If non-zero, then the dump of the above registers will include detailed information about all register fields, including the field value and the meaning of the value.
usc	If non-zero, then the output will include a dump of all <code>GSC_USC_XXX</code> registers. Refer to <code>sio4.h</code> for a complete list of these registers.
usc_detail	If non-zero, then the dump of the above registers will include detailed information about all register fields, including the field value and the meaning of the value.

Return Value	Description
>= 0	This is the number of errors encountered during execution of the function.

## 5.4. Clocking Configurations

The Isochronous serial protocol requires an Rx Clock signal for data reception. This limits the clocking configuration options when using the SIO4 for full duplex data transfer. The SIO4 receiver clocks in data from the cable's Tx Data signal using the cable's Rx Clock signal. In this case both signals are routed directly from the cable interface to the USC. The SIO4 transmitter clocks out data to the cable's Tx Data signal using the clock driven on the cable's Tx Clock signal. In this case the origin of the cable's Tx Clock signal and the USC's transmit clock is the SIO4's programmable oscillator, which is programmed to the desired Tx bit rate. The Tx Data is routed directly from the USC to the cable interface. Clock and data signal routing for SIO4B and later model boards is illustrated in Figure 3. This signal routing pictured is the configuration produced by the `sio4_isoc_init_data()` function, which initializes the `sio4_isoc_t` structure given as an argument.

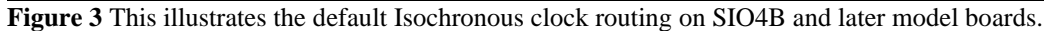
**NOTE:** On SIO4A model boards, full duplex operation requires either that the driver be updated to support programming of the SIO4A's programmable oscillator or an alternate signal routing configuration which may require an Rx Clock cable signal that is active full time.

**NOTE:** On SIO4 model boards (with no 'A' or 'B' suffix) full duplex operation requires either that the board's fixed frequency oscillator be replaced to match the desired transmit bit rate or an alternate signal routing configuration which may require an Rx Clock cable signal that is active full time.

The below code sample illustrates the minimum required steps to configure an SIO4 for Isochronous operation. Error checking is omitted for brevity.

```
void config_sample(int fd)
{
    const char*      err      = NULL;
    sio4_isoc_init_t  init;
    sio4_isoc_t       isoc;

    init.tx_bit_rate  = 1000000L;
    init.rx_bit_rate  = 1000000L;
    sio4_isoc_init_data(fd, &init, &isoc, &err);
    sio4_isoc_set(fd, &isoc, &err);
}
```



The SIO4 supports two cable interfacing modes; DCE/DTE mode and Legacy mode. Older boards support only Legacy mode. More recent boards support only DCE/DTE mode. Intermediate boards support both modes. When both are available selection of the active mode is governed by enabling or disabling the transceivers. This is done through the `sio4_isoc_t.cable.enable` field, which is described under section 4.3.1.2 beginning on page 20.

The DCE/DTE Mode controls cable signaling according to the DCE or DTE selection, as described in the board user manual. When available in firmware this mode is enabled by enabling the cable transceivers (see paragraph above). The Isochronous Protocol Library passes all DCE/DTE mode settings to the driver unconditionally. DCE/DTE mode settings received by the driver are applied only if this mode is supported by the board. The driver otherwise ignores these settings.

The Legacy More of operation controls signal routing for the cable interface, according to the Upper and Lower settings, and the USC, as described in the board user manual. When available in firmware this is the default mode of operation. When selectable this mode is activated by disabling the cable transceivers (see paragraph above). The Isochronous Protocol Library's `sio4_isoc_set()` function (section 4.1.8, page 13) applies Legacy mode settings only if the Legacy mode will be active when the function exits. The library otherwise ignores the Legacy settings. All other library functions process their settings unconditionally. Legacy mode settings received by the driver are applied only if this mode is supported by the board. The driver otherwise ignores these settings.



## 5.6. Simple Data Transfer

The steps needed to transmit or receive data using the Isochronous protocol can be minimal, and are as follows. These minimal steps are illustrated in the `simple_xfer` sample application under the `sio4/isoc` subdirectory.

1. Initialize the Isochronous library as follows.

```
int ret;

ret = sio4_isoc_init();

if (ret)
{
    printf("ERROR: sio4_isoc_init(): errno %d\n", -ret);
    return(ret);
}
```

2. Gain access to the desired SIO4. The argument “index” refers to the zero-based index of the board to access.

```
int fd;

fd = sio4_isoc_open(index);

if (fd < 0)
{
    printf("ERROR: sio4_isoc_open(): errno %d\n", -fd);
    return(fd);
}
```

3. Initialize an `sio4_isoc_init_t` structure. This simply requires that the transmit and receive bit rates be identified. This can be done simply as follows.

```
sio4_isoc_init_t    init;

init.tx_bit_rate    = 1000000L;
init.rx_bit_rate    = 1000000L;
```

4. Pass the initialized `sio4_isoc_init_t` structure to the `sio4_isoc_init_data()` function, along with the other required arguments. This will initialize the passed in `sio4_isoc_t` structure, using the `sio4_isoc_init_t` structure’s content where necessary.

```
const char* err    = NULL;
sio4_isoc_t isoc;

ret = sio4_isoc_init_data(fd, &init, &isoc, &err);

if ((ret) || (err))
{
    printf("ERROR: sio4_isoc_init_data(): field '%s'\n", err);
    return(ret);
}
```

5. Just for development purposes, print the structure’s content to the console. Again, this is for development purposes and should be removed from production code.

```
ret = sio4_isoc_show(fd, &isoc, &err);

if ((ret) || (err))
{
    printf("ERROR: sio4_isoc_show(): field '%s'\n", err);
    return(ret);
}
```

- Review both the output produced from the above step and the documentation for the `sio4_isoc_t` structure to determine what settings, if any, need changing for your particular application. Depending on the SIO4 model board in use, it may be that the DCE/DTE and transceiver settings are the only settings that need changing. Review the board user manual and documentation for your equipment to determine if the SIO4 should be configured as DCE or DTE.

```
isoc.cable.mode      = SIO4_ISOC_CABLE_MODE_DCE;
isoc.cable.protocol = SIO4_ISOC_CABLE_PROTOCOL_RS422_RS485;
```

- Apply the settings to the SIO4 in order to configure the device according to the content of the `sio4_isoc_t` structure.

```
ret = sio4_isoc_set(fd, &isoc, &err);

if ((ret) || (err))
{
    printf("ERROR: sio4_isoc_set(): field '%s'\n", err);
    return(ret);
}
```

- The SIO4 is now ready to transmit and/or receive data using the API's write and/or read calls.

## 5.7. Error and Status Detection

The serial controller used on the SIO4 incorporates the ability to detect a number of error and other conditions for both the transmit and the receive data streams.

### 5.7.1. Interrupt Events

The most efficient means of detecting the various conditions, especially errors, is by use of interrupts. The basic steps for this are to enable the interrupts of interest then have a thread wait for a corresponding interrupt event. (See the Interrupt and the Wait Event services in the driver reference manual.) This is illustrated in the following code fragments.

Thread A	Thread B
<pre>For (;;) {     ...     read SIO4 data      if (error recorded)     {         Error exists in         1) Read buffer, or         2) SIO4 Rx FIFO         Resync data stream.     } }</pre>	<pre>For (;;) {     ...     Enable desired interrupts.     Wait for an interrupt.      if (error interrupt occurred)     {         Record the error.     }     ... }</pre>

<pre> else {     Read buffer is error free. } ... } </pre>	
--	--

### 5.7.2. Rx Status Word

The SIO4 can also provide status in the Rx data stream on a per byte basis. This is done by enabling the Rx Status Word feature (`sio4_isoc_t.rx.status_word`, section 4.3.1.4, page 26). When enabled, the SIO4 places the lower eight bits of the USC's Receive Command/Status Register in the Rx FIFO immediately after the data itself. This allows an application to identify the precise location in the data stream where some Rx related conditions occur. The downside of this is that it doubles the volume of data going through the Rx FIFO and effectively reduces its size by 1/2. Refer to the *Z16C30 Data Handbook* for information on the USC's Receive Command/Status Register.

## 5.8. Debugging Aids

The SIO4 driver archive includes two debugging aids appropriate for use with the Isochronous Protocol Library. The aids are described below.

### 5.8.1. `sio4_isoc_show()`

The function `sio4_isoc_show()` (section 4.1.9, page 14) is part of the protocol library interface. The purpose of the function is to produce a human readable report of all fields included in the `sio4_isoc_t` structure (section 4.3.1, page 16) passed in as a function argument. The function is best used to report the structure's content before it is passed to `sio4_isoc_set()` (section 4.1.6.1, page 13) or after it is passed to `sio4_isoc_get()` (section 4.1.2, page 10). The output can be used with Figure 2 to help visualize the channel configuration reflected by the structure content. When used in conjunction with `sio4_isoc_set()`, the `sio4_isoc_show()` output indicates the state that `sio4_isoc_set()` is expected to produce. When used in conjunction with `sio4_isoc_get()`, the `sio4_isoc_show()` output indicates the channel's current state. This may be beneficial after calling `sio4_isoc_set()` in order to verify the results achieved. The pair of calls may also be used before or after the API's read or write calls in order to help explain the results of individual transfer requests.

### 5.8.2. `sio4_reg_list()`

The function `sio4_reg_list()` is included in the SIO4 utility library. The purpose of the function is to report the current content of registers for the referenced serial channel. The arguments control the set of registers included in the output and the detail with which the register content is reported. This function can be called at any time to report the device state, but it is most often called after completing board setup, or just before or after `sio4_isoc_read()` or `sio4_isoc_write()` calls in order to help explain the results of individual transfer requests.

#### Prototype

```
int sio4_reg_list(int fd, int gsc, int gsc_detail,
                 int usc, int usc_detail);
```

Argument	Description
<code>fd</code>	This is a file descriptor obtained from <code>sio4_isoc_open()</code> (section 4.1.6, page 12).
<code>gsc</code>	If non-zero, then the output will include a dump of all <code>GSC_SIO4_XXX</code> registers. Refer to <code>sio4.h</code> for a complete list of these registers.

<code>gsc_detail</code>	If non-zero, then the dump of the GSC registers will include detailed information about all register fields, including the field value and the meaning of the value.
<code>usc</code>	If non-zero, then the output will include a dump of all <code>GSC_USC_XXX</code> registers. Refer to <code>sio4_usc.h</code> for a complete list of these registers.
<code>usc_detail</code>	If non-zero, then the dump of the USC registers will include detailed information about all register fields, including the field value and the meaning of the value.

<b>Return Value</b>	<b>Description</b>
<code>&gt;= 0</code>	This is the number of errors encountered during execution of the function.

## 5.9. Exclusions

### 5.9.1. Global Rx FIFO Full Configuration

The global Rx FIFO Full Configuration setting (see `SIO4_IOCTL_RX_FIFO_FULL_CFG_GLB` in `sio4.h`) is not included as part of the Isochronous Protocol Library. It is excluded because the setting can override the channel specific settings for all four channels. If an application is to access this feature it must be done in parallel with use of the Isochronous Protocol Library.

## Document History

Revision	Description
March 24, 2025	Updated release date. Minor editorial changes.
May 20, 2024	Updated release date.
March 19, 2024	Updated release date. Added comment about use of the static libraries. Removed the Cable Protocol Disable option as it is unsupported by hardware.
November 16, 2023	Updated release date.
June 15, 2023	Updated release date. Minor editorial modifications.
December 13, 2022	Updated release date. Minor editorial modifications.
June 2, 2022	Updated release date. Updated the description of the Tx Idle Line conditions.
February 8, 2022	Updated release date. Reorganized the Operating Information section (section 5, page 36). Added a Getting Started section (section 5.2, page 36). Updated the Debugging Aids section (section 5.3, page 38).
August 9, 2021	Updated release date. Updated the I/O timeout field descriptions. Updated the descriptions of the I/O return values. Changed some argument and field names for consistency and clarity. Added a note about read requests being serialized. Added a note about write requests being serialized. Added statements about the read and write services being blocking calls.
May 5, 2021	Updated release date.
February 26, 2021	Updated release date.
February 18, 2021	Updated release date.
October 12, 2020	Updated release date.
July 30, 2019	Updated release date.
March 24, 2019	Updated release date.
March 15, 2019	Updated release date.
October 18, 2018	Updated the default PIO threshold values based on testing. Updated the inside cover page. Added Tx and Rx I/O DMA Threshold fields.
October 31, 2017	Added information on the Cable Configuration Modes. Updated some legacy setting information.
October 17, 2017	Removed library versioning. Added information on opening device index -1. Added section on library interface files. Updated return status information for high-level services. Added support for device index -1. Numerous editorial changes throughout.
December 7, 2016	Modified for updated driver release.
November 18, 2016	Intermediate release. Updated the “simple” example. Updated information on loopback mode.
November 11, 2016	Intermediate release. Updated the operating information section. Made various miscellaneous updates. Added information on minimal setup for data transfer.
September 16, 2016	Updated to version 1.4. Changed the defaults for several settings.
April 13, 2016	Updated to version 1.3.
September 7, 2015	Updated to version 1.2.
December 9, 2014	Updated to version 1.1. Added retrieval information for the oscillator programming field.
December 4, 2014	Initial release, version 1.0.