

F2837xD Peripheral Driver Library (Deprecated)

USER'S GUIDE



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Texas Instruments
13905 University Boulevard
Sugar Land, TX 77479
<http://www.ti.com/c2000>



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1 Introduction

The Texas Instruments® F2837xD Peripheral Driver Library (Deprecated) is a set of drivers for accessing peripherals found on the Delfino family of C2000 microcontrollers. While they are not drivers in the pure operating system sense (that is, they do not have a common interface and do not connect into a global device driver infrastructure), they do provide a mechanism that makes it easy to use the device's peripherals.

The capabilities and organization of the drivers are governed by the following design goals:

They are written entirely in C except where absolutely not possible.

They demonstrate how to use the peripheral in its common mode of operation.

They are easy to understand.

They are reasonably efficient in terms of memory and processor usage.

They are as self-contained as possible.

Where possible, computations that can be performed at compile time are done there instead of at run time.

Some consequences of these design goals are:

The drivers are not necessarily as efficient as they could be (from a code size and/or execution speed point of view). While the most efficient piece of code for operating a peripheral would be written in assembly and custom tailored to the specific requirements of the application, further size optimizations of the drivers would make them more difficult to understand.

The drivers do not support the full capabilities of the hardware. Some of the peripherals provide complex capabilities which cannot be utilized by the drivers in this library, though the existing code can be used as a reference upon which to add support for the additional capabilities.

The APIs have a means of removing all error checking code. Because the error checking is usually only useful during initial program development, it can be removed to improve code size and speed.

For many applications, the drivers can be used as is. But in some cases, the drivers will have to be enhanced or rewritten in order to meet the functionality, memory, or processing requirements of the application. If so, the existing driver can be used as a reference on how to operate the peripheral.

Source Code Overview

The following is an overview of the organization of the peripheral driver library source code located within the "common/deprecated" directory.

`driverlib/` This directory contains the source code for the drivers.

`inc/` This directory holds the part specific header files used for the direct register access programming model.

`inc/hw_*.h`

Header files, one per peripheral, that describe all the registers and the bit fields within those registers for each peripheral. These header files are used by the drivers to directly access a peripheral, and can be used by application code to bypass the peripheral driver library API.

2 Programming Model

Introduction	??
Direct Register Access Model	??
Software Driver Model	??
Combining The Models	??

The peripheral driver library provides support for two programming models: the direct register access model and the software driver model. Each model can be used independently or combined, based on the needs of the application or the programming environment desired by the developer.

Each programming model has advantages and disadvantages. Use of the direct register access model generally results in smaller and more efficient code than using the software driver model. However, the direct register access model requires detailed knowledge of the operation of each register and bit field, as well as their interactions and any sequencing required for proper operation of the peripheral; the developer is insulated from these details by the software driver model, generally requiring less time to develop applications. In the direct register access model, the peripherals are programmed by the application by writing values directly into the peripheral's registers. A set of macros is provided that simplifies this process. These macros are stored in several header files contained in the `inc` directory. By including the header files `inc/hw_types.h` and `inc/hw_memmap.h`, macros are available for accessing all registers on the Delfino devices. Individual bitfield access can easily be added by simply including the `inc/hw_peripheral.h` header file for the desired peripheral.

The defines used by the direct register access model follow a naming convention that makes it easier to know how to use a particular macro. The rules are as follows:

Values that end in `_R` are used to access the value of a register. For example, `SSI0_CR0_R` is used to access the `CR0` register in the `SSI0` module.

Values that end in `_M` represent the mask for a multi-bit field in a register. If the value placed in the multi-bit field is a number, there is a macro with the same base name but ending with `_S` (for example, `SSI_CR0_SCR_M` and `SSI_CR0_SCR_S`). If the value placed into the multi-bit field is an enumeration, then there are a set of macros with the same base name but ending with identifiers for the various enumeration values (for example, the `SSI_CR0_FRF_M` macro defines the bit field, and the `SSI_CR0_FRF_NMW`, `SSI_CR0_FRF_TI`, and `SSI_CR0_FRF_MOTO` macros provide the enumerations for the bit field).

Values that end in `_S` represent the number of bits to shift a value in order to align it with a multi-bit field. These values match the macro with the same base name but ending with `_M`.

All other macros represent the value of a bit field.

All register name macros start with the module name and instance number (for example, `SSI0` for the first SSI module) and are followed by the name of the register as it appears in the data sheet (for example, the `CR0` register in the data sheet results in `SSI0_CR0_R`).

All register bit fields start with the module name, followed by the register name, and then followed by the bit field name as it appears in the data sheet. For example, the `SCR` bit field in the `CR0` register in the `SSI` module will be identified by `SSI_CR0_SCR`. . . . In the case where the bit field is a single bit, there will be nothing further (for example, `SSI_CR0_SPH` is a single bit in the `CR0` register). If the bit field is more than a single bit, there will be a mask value (`_M`) and either a shift (`_S`) if the bit field contains a number or a set of enumerations if not.

Given these definitions, the `CR0` register can be programmed as follows:

$SSI0_{CR0_R} = ((5 << SSI_{CR0_S}CR_S) | SSI_{CR0_S}PH | SSI_{CR0_S}PO | SSI_{CR0_F}RF_{MOTO} | SSI_{CR0_D}SS_8);$

Alternatively, the following has the same effect (although it is not as easy to understand):

$SSI0_{CR0_R} = 0x000005c7;$

Extracting the value of the `SCR` field from the `CR0` register is as follows:

$ulValue = (SSI0_{CR0_R}SSI_{CR0_S}CR_M) >> SSI0_{CR0_S}CR_S;$

The GPIO modules have many registers that do not have bit field definitions. For these registers, the register bits represent the individual GPIO pins; so bit zero in these registers corresponds to the **Px0** pin on the part (where **x** is replaced by a GPIO module letter), bit one corresponds to the **Px1** pin, and so on. In the software driver model, the API provided by the peripheral driver library is used by applications to control the peripherals. Because these drivers provide complete control of the peripherals in their normal mode of operation, it is possible to write an entire application without direct access to the hardware. This method provides for rapid development of the application without requiring detailed knowledge of how to program the peripherals.

Corresponding to the direct register access model example, the following call also programs the `CR0` register in the SSI module (though the register name is hidden by the API):

`SSIConfigSetExpClk(SSI0_BASE, 50000000, SSI_FRF_MOTO_MODE_3, SSI_MODE_MASTER, 1000000, 8);`

The resulting value in the `CR0` register might not be exactly the same because `SSIConfigSetExpClk()` may compute a different value for the `SCR` bit field than what was used in the direct register access model example.

The drivers in the peripheral driver library are described in the remaining chapters in this document. They combine to form the software driver model. The direct register access model and software driver model can be used together in a single application, allowing the most appropriate model to be applied as needed to any particular situation within the application. For example, the software driver model can be used to configure the peripherals (because this is not performance critical) and the direct register access model can be used for operation of the peripheral (which may be more performance critical). Or, the software driver model can be used for peripherals that are not performance critical (such as a UART used for data logging) and the direct register access model for performance critical peripherals.

3 Controller Area Network (CAN)

Introduction	??
API Functions	9
CAN Message Objects	??
Programming Example	??

?? The Controller Area Network (CAN) APIs provide a set of functions for accessing the Delfino CAN modules. Functions are provided to configure the CAN controllers, configure message objects, and manage CAN interrupts.

The Delfino CAN module provides hardware processing of the CAN data link layer. It can be configured with message filters and preloaded message data so that it can autonomously send and receive messages on the bus, and notify the application accordingly. It automatically handles generation and checking of CRCs, error processing, and retransmission of CAN messages.

The message objects are stored in the CAN controller and provide the main interface for the CAN module on the CAN bus. There are 32 message objects that can each be programmed to handle a separate message ID, or can be chained together for a sequence of frames with the same ID. The message identifier filters provide masking that can be programmed to match any or all of the message ID bits, and frame types.

This driver is contained in `driverlib/can.c`, with `driverlib/can.h` containing the API definitions for use by applications.

3.1 API Functions

Data Structures

[tCANBitClkParms](#)

[tCANMsgObject](#)

Macros

[CAN_CLK_AUXCLKIN](#)

[CAN_CLK_CPU_SYSCLKOUT](#)

[CAN_CLK_EXT_OSC](#)

[CAN_INT_ERROR](#)

[CAN_INT_IE0](#)

[CAN_INT_IE1](#)

[CAN_INT_STATUS](#)

[CAN_STATUS_BUS_OFF](#)

[CAN_STATUS_EPASS](#)

CAN_STATUS_EWARN
CAN_STATUS_LEC_ACK
CAN_STATUS_LEC_BIT0
CAN_STATUS_LEC_BIT1
CAN_STATUS_LEC_CRC
CAN_STATUS_LEC_FORM
CAN_STATUS_LEC_MSK
CAN_STATUS_LEC_NONE
CAN_STATUS_LEC_STUFF
CAN_STATUS_PDA
CAN_STATUS_PERR
CAN_STATUS_RXOK
CAN_STATUS_TXOK
CAN_STATUS_WAKE_UP
MSG_OBJ_DATA_LOST
MSG_OBJ_EXTENDED_ID
MSG_OBJ_FIFO
MSG_OBJ_NEW_DATA
MSG_OBJ_NO_FLAGS
MSG_OBJ_REMOTE_FRAME
MSG_OBJ_RX_INT_ENABLE
MSG_OBJ_STATUS_MASK
MSG_OBJ_TX_INT_ENABLE
MSG_OBJ_USE_DIR_FILTER
MSG_OBJ_USE_EXT_FILTER
MSG_OBJ_USE_ID_FILTER

Enumerations

tCANIntStsReg

[tCANStsReg](#)

[tMsgObjType](#)

Functions

uint32_t [CANBitRateSet](#) (uint32_t ui32Base, uint32_t ui32SourceClock, uint32_t ui32BitRate)

void [CANBitTimingGet](#) (uint32_t ui32Base, [tCANBitClkParms](#) *pClkParms)

void [CANBitTimingSet](#) (uint32_t ui32Base, [tCANBitClkParms](#) *pClkParms)

void [CANCkSourceSelect](#) (uint32_t ui32Base, uint16_t ui16Source)

void [CANDisable](#) (uint32_t ui32Base)

void [CANEnable](#) (uint32_t ui32Base)

bool [CANErrCntrGet](#) (uint32_t ui32Base, uint32_t *pui32RxCount, uint32_t *pui32TxCount)

void [CANGlobalIntClear](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

void [CANGlobalIntDisable](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

void [CANGlobalIntEnable](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

bool [CANGlobalIntstatusGet](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

void [CANInit](#) (uint32_t ui32Base)

void [CANIntClear](#) (uint32_t ui32Base, uint32_t ui32IntClr)

void [CANIntDisable](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

void [CANIntEnable](#) (uint32_t ui32Base, uint32_t ui32IntFlags)

void [CANIntRegister](#) (uint32_t ui32Base, unsigned char ucIntNumber, void (*pfnHandler)(void))

uint32_t [CANIntStatus](#) (uint32_t ui32Base, [tCANIntStsReg](#) eIntStsReg)

void [CANIntUnregister](#) (uint32_t ui32Base, unsigned char ucIntNumber)

void [CANMessageClear](#) (uint32_t ui32Base, uint32_t ui32ObjID)

void [CANMessageGet](#) (uint32_t ui32Base, uint32_t ui32ObjID, [tCANMsgObject](#) *pMsgObject, bool bClrPendingInt)

void [CANMessageSet](#) (uint32_t ui32Base, uint32_t ui32ObjID, [tCANMsgObject](#) *pMsgObject, [tMsgObjType](#) eMsgType)

bool [CANRetryGet](#) (uint32_t ui32Base)

void [CANRetrySet](#) (uint32_t ui32Base, bool bAutoRetry)

uint32_t [CANStatusGet](#) (uint32_t ui32Base, [tCANStsReg](#) eStatusReg)

3.1.1 Detailed Description

The CAN APIs provide all of the functions needed by the application to implement an interrupt-driven CAN stack. These functions may be used to control any of the available CAN ports on a Delfino microcontroller, and can be used with one port without causing conflicts with the other port.

The CAN module is disabled by default, so the [CANInit\(\)](#) function must be called before any other CAN functions are called. This call initializes the message objects to a safe state prior to enabling the controller on the CAN bus. Also, the bit timing values must be programmed prior to enabling the CAN controller. The [CANBitTimingSet\(\)](#) function should be called with the appropriate bit timing values for the CAN bus. Once these two functions have been called, a CAN controller can be enabled using the [CANEnable\(\)](#), and later disabled using [CANDisable\(\)](#) if needed. Calling [CANDisable\(\)](#) does not reinitialize a CAN controller, so it can be used to temporarily remove a CAN controller from the bus.

The CAN controller is highly configurable and contains 32 message objects that can be programmed to automatically transmit and receive CAN messages under certain conditions. Message objects allow the application to perform some actions automatically without interaction from the microcontroller. Some examples of these actions are the following:

Send a data frame immediately

Send a data frame when a matching remote frame is seen on the CAN bus

Receive a specific data frame

Receive data frames that match a certain identifier pattern

To configure message objects to perform any of these actions, the application must first set up one of the 32 message objects using [CANMessageSet\(\)](#). This function must be used to configure a message object to send data, or to configure a message object to receive data. Each message object can be configured to generate interrupts on transmission or reception of CAN messages.

When data is received from the CAN bus, the application can use the [CANMessageGet\(\)](#) function to read the received message. This function can also be used to read a message object that is already configured in order to populate a message structure prior to making changes to the configuration of a message object. Reading the message object using this function will also clear any pending interrupt on the message object.

Once a message object has been configured using [CANMessageSet\(\)](#), it has allocated the message object and will continue to perform its programmed function unless it is released with a call to [CANMessageClear\(\)](#). The application is not required to clear out a message object before setting it with a new configuration, because each time [CANMessageSet\(\)](#) is called, it will overwrite any previously programmed configuration.

The 32 message objects are identical except for priority. The lowest numbered message objects have the highest priority. Priority affects operation in two ways. First, if multiple actions are ready at the same time, the one with the highest priority message object will occur first. And second, when multiple message objects have interrupts pending, the highest priority will be presented first when reading the interrupt status. It is up to the application to manage the 32 message objects as a resource, and determine the best method for allocating and releasing them.

The CAN controller can generate interrupts on several conditions:

When any message object transmits a message

When any message object receives a message

On warning conditions such as an error counter reaching a limit or occurrence of various bus errors

On controller error conditions such as entering the bus-off state

An interrupt handler must be installed in order to process CAN interrupts. If dynamic interrupt configuration is desired, the [CANIntRegister\(\)](#) can be used to register the interrupt handler. This will place the vector in a RAM-based vector table. However, if the application uses a pre-loaded vector table in flash, then the CAN controller handler should be entered in the appropriate slot in the vector table. In this case, [CANIntRegister\(\)](#) is not needed, but the interrupt will need to be enabled on the host processor master interrupt controller using the [IntEnable\(\)](#) function. The CAN module interrupts are enabled using the [CANIntEnable\(\)](#) function. They can be disabled by using the [CANIntDisable\(\)](#) function.

Once CAN interrupts are enabled, the handler will be invoked whenever a CAN interrupt is triggered. The handler can determine which condition caused the interrupt by using the [CANIntStatus\(\)](#) function. Multiple conditions can be pending when an interrupt occurs, so the handler must be designed to process all pending interrupt conditions before exiting. Each interrupt condition must be cleared before exiting the handler. There are two ways to do this. The [CANIntClear\(\)](#) function will clear a specific interrupt condition without further action required by the handler. However, the handler can also clear the condition by performing certain actions. If the interrupt is a status interrupt, the interrupt can be cleared by reading the status register with [CANStatusGet\(\)](#). If the interrupt is caused by one of the message objects, then it can be cleared by reading the message object using [CANMessageGet\(\)](#).

There are several status registers that can be used to help the application manage the controller. The status registers are read using the [CANStatusGet\(\)](#) function. There is a controller status register that provides general status information such as error or warning conditions. There are also several status registers that provide information about all of the message objects at once using a 32-bit bit map of the status, with one bit representing each message object. These status registers can be used to determine:

Which message objects have unprocessed received data

Which message objects have pending transmission requests

Which message objects are allocated for use

3.1.2 Macro Definition Documentation

3.1.2.1

This flag is used to clock the CAN controller with the clock from AUXCLKIN (from GPIO)

3.1.2.2

This flag is used to clock the CAN controller Selected CPU SYSCLKOUT (CPU1.Sysclk or CPU2.Sysclk).

3.1.2.3

This flag is used to clock the CAN controller with the X1/X2 oscillator clock.

3.1.2.4

This flag is used to allow a CAN controller to generate error interrupts.
Referenced by CANIntDisable(), and CANIntEnable().

3.1.2.5

This flag is used to allow a CAN controller to generate interrupts on interrupt line 0
Referenced by CANIntDisable(), and CANIntEnable().

3.1.2.6

This flag is used to allow a CAN controller to generate interrupts on interrupt line 1
Referenced by CANIntDisable(), and CANIntEnable().

3.1.2.7

This flag is used to allow a CAN controller to generate status interrupts.
Referenced by CANIntDisable(), and CANIntEnable().

3.1.2.8

A message was transmitted successfully since the last read of this status.

3.1.2.9

This indicates that data was lost since this message object was last read.
Referenced by CANMessageGet().

3.1.2.10

This indicates that a message object will use or is using an extended identifier.
Referenced by CANMessageGet(), and CANMessageSet().

3.1.2.11

This indicates that this message object is part of a FIFO structure and not the final message object in a FIFO.
Referenced by CANMessageSet().

3.1.2.12

This indicates that receive interrupts should be enabled, or are enabled.

Referenced by CANMessageGet(), and CANMessageSet().

3.1.2.13

This define is used with the flag values to allow checking only status flags and not configuration flags.

3.1.2.14

This definition is used with the [tCANMsgObject](#) ui32Flags value and indicates that transmit interrupts should be enabled, or are enabled.

Referenced by CANMessageGet(), and CANMessageSet().

3.1.2.15

This indicates that a message object will use or is using filtering based on the direction of the transfer. If the direction filtering is used, then ID filtering must also be enabled.

Referenced by CANMessageGet(), and CANMessageSet().

3.1.2.16

This indicates that a message object will use or is using message identifier filtering based on the extended identifier. If the extended identifier filtering is used, then ID filtering must also be enabled.

Referenced by CANMessageGet(), and CANMessageSet().

3.1.2.17

This indicates that a message object will use or is using filtering based on the object's message identifier.

Referenced by CANMessageGet(), and CANMessageSet().

3.1.3 Data Structure Documentation

3.1.3.1 tCANBitClkParms

Definition:

```
typedef struct
{
    uint16_t uSyncPropPhase1Seg;
```

```
uint16_t uPhase2Seg;  
uint16_t uSJW;  
uint16_t uQuantumPrescaler;  
}  
tCANBitClkParms
```

Members:

uSyncPropPhase1Seg This value holds the sum of the Synchronization, Propagation, and Phase Buffer 1 segments, measured in time quanta. The valid values for this setting range from 2 to 16.

uPhase2Seg This value holds the Phase Buffer 2 segment in time quanta. The valid values for this setting range from 1 to 8.

uSJW This value holds the Resynchronization Jump Width in time quanta. The valid values for this setting range from 1 to 4.

uQuantumPrescaler This value holds the CAN_CLK divider used to determine time quanta. The valid values for this setting range from 1 to 1023.

Description:

This structure is used for encapsulating the values associated with setting up the bit timing for a CAN controller. The structure is used when calling the CANGetBitTiming and CANSetBitTiming functions.

3.1.3.2 tCANMsgObject

Definition:

```
typedef struct  
{  
    uint32_t ui32MsgID;  
    uint32_t ui32MsgIDMask;  
    uint32_t ui32Flags;  
    uint32_t ui32MsgLen;  
    unsigned char *pucMsgData;  
}  
tCANMsgObject
```

Members:

ui32MsgID The CAN message identifier used for 11 or 29 bit identifiers.

ui32MsgIDMask The message identifier mask used when identifier filtering is enabled.

ui32Flags This value holds various status flags and settings specified by tCANObjFlags.

ui32MsgLen This value is the number of bytes of data in the message object.

pucMsgData This is a pointer to the message object's data.

Description:

The structure used for encapsulating all the items associated with a CAN message object in the CAN controller.

This section will explain how to configure the CAN message objects in various modes using the [CANMessageSet\(\)](#) and [CANMessageGet\(\)](#) APIs. The configuration of a message object is determined by two parameters that are passed into the [CANMessageSet\(\)](#) API. These are the [tCANMsgObject](#) structure and the [tMsgObjType](#) type field. It is important to note that the uObjID parameter is the index of one of the 32 message objects that are available and is not the message object's identifier.

Message objects can be defined as one of five types based on the needs of the application. They are defined in the [tMsgObjType](#) enumeration and can only be one of those values. The simplest of the message object types are MSG_OBJ_TYPE_TX and MSG_OBJ_TYPE_RX which are used to send or receive messages for a given message identifier or a range of identifiers. The message type MSG_OBJ_TYPE_TX_REMOTE is used to transmit a remote request for data from another CAN node on the network. These message objects do not transmit any data but once they send the request will automatically turn into receive message object and wait for data from a remote CAN device. The message type MSG_OBJ_TYPE_RX_REMOTE is the receiving end of a remote request, and receive remote requests for data and generate an interrupt to let the application know when to supply and transmit data back to the CAN controller that issued the remote request for data. The message type MSG_OBJ_TYPE_RXTX_REMOTE is similar to the MSG_OBJ_TYPE_RX_REMOTE except that it automatically responds with data that the application placed in the message object.

The remaining information used to configure a CAN message object is contained in the [tCANMsgObject](#) structure which is used when calling [CANMessageSet\(\)](#) or will be filled by data read from the message object when calling [CANMessageGet\(\)](#). The CAN message identifier is simply stored into the ulMsgID member of the [tCANMsgObject](#) structure and is the 11 or 20 bit CAN identifier for this message object. The ulMsgIDMask is the mask is used in combination with the ulMsgID value to determine a match when the MSG_OBJ_USE_ID_FILTER flag is set for a message object. The ulMsgIDMask is ignored if MSG_OBJ_USE_ID_FILTER flag is not set. The last of the configuration parameters are specified in the ulFlags which are defined as a combination of the MSG_OBJ_* values. The MSG_OBJ_TX_INT_ENABLE and MSG_OBJ_RX_INT_ENABLE flags will enable transmit complete or receive data interrupts. If the CAN network is only using extended(20 bit) identifiers then the MSG_OBJ_EXTENDED_ID flag should be specified. The [CANMessageSet\(\)](#) function will force this flag set if the identifier is greater than an 11 bit identifier can hold. The MSG_OBJ_USE_ID_FILTER is used to enable filtering based on the message identifiers as message are seen by the CAN controller. The combination of ulMsgID and ulMsgIDMask will determine if a message is accepted for a given message object. In some cases it may be necessary to add a filter based on the direction of the message, so in these cases the MSG_OBJ_USE_DIR_FILTER is used to only accept the direction specified in the message type. Another additional filter flag is MSG_OBJ_USE_EXT_FILTER which will filter on only extended identifiers. In a mixed 11 bit and 20 bit identifier system, this will prevent an 11 bit identifier being confused with a 20 bit identifier of the same value. It is not necessary to specify this if there are only extended identifiers being used in the system. To determine if the incoming message identifier matches a given message object, the incoming message identifier is ANDed with ulMsgIDMask and compared with ulMsgID. The "C" logic would be the following:

```
if((IncomingID & ulMsgIDMask) == ulMsgID) { // Accept the message. } else { // Ignore the message.
}
```

The last of the flags to affect [CANMessageSet\(\)](#) is the MSG_OBJ_FIFO flag. This flag is used when combining multiple message objects in a FIFO. This is useful when an application needs to receive more than the 8 bytes of data that can be received by a single CAN message object. It can also be used to reduce the likelihood of causing an overrun of data on a single message object that may be receiving data faster than the application can handle when using a single message object. If multiple message objects are going to be used in a FIFO they must be read in sequential order based on the message object number and have the exact same message identifiers and filtering values. All but the last of the message objects in a FIFO should have the MSG_OBJ_FIFO and the last message object in the FIFO should not have the MSG_OBJ_FIFO flag set to specify that is the last entry in the FIFO. See the CAN FIFO configuration example in the Programming Examples section of this document.

The remaining flags are all used when calling [CANMessageGet\(\)](#) when reading data or checking

the status of a message object. If the MSG_OBJ_NEW_DATA flag is set in the `tCANMsgObject` `ulFlags` variable then the data returned was new and not stale data from a previous call to `CANMessageGet()`. If the MSG_OBJ_DATA_LOST flag is set then data was lost since this message object was last read with `CANMessageGet()`. The MSG_OBJ_REMOTE_FRAME flag will be set if the message object was configured as a remote message object and a remote request was received.

When sending or receiving data, the last two variables define the size and a pointer to the data used by `CANMessageGet()` and `CANMessageSet()`. The `ulMsgLen` variable in `tCANMsgObject` specifies the number of bytes to send when calling `CANMessageSet()` and the number of bytes to read when calling `CANMessageGet()`. The `pucMsgData` variable in `tCANMsgObject` is the pointer to the data to send `ulMsgLen` bytes, or the pointer to the buffer to read `ulMsgLen` bytes into. This example code will send out data from CAN controller 0 to be received by CAN controller 1. In order to actually receive the data, an external cable must be connected between the two ports. In this example, both controllers are configured for 1 Mbit operation.

```
tCANBitClkParms CANBitClk; tCANMsgObject sMsgObjectRx; tCANMsgObject sMsgObjectTx;
unsigned char ucBufferIn[8]; unsigned char ucBufferOut[8];

// Reset the state of all the message objects and the state of the CAN // module to a known state.
CANInit(CAN0_BASE); CANInit(CAN1_BASE);

// Configure the controller for 1 Mbit operation. CANSetBitTiming(CAN1_BASE, CANBitClk);

// Take the CAN0 device out of INIT state. CANEnable(CAN0_BASE); CANEnable(CAN1_BASE);

// Configure a receive object. sMsgObjectRx.ulMsgID = (0x400); sMsgObjectRx.ulMsgIDMask =
0x7f8; sMsgObjectRx.ulFlags = MSG_OBJ_USE_ID_FILTER | MSG_OBJ_FIFO;

// The first three message objects have the MSG_OBJ_FIFO set to // indicate that they are part of
a FIFO. CANMessageSet(CAN0_BASE, 1, sMsgObjectRx, MSG_OBJ_TYPE_RX); CANMessage-
Set(CAN0_BASE, 2, sMsgObjectRx, MSG_OBJ_TYPE_RX); CANMessageSet(CAN0_BASE, 3,
sMsgObjectRx, MSG_OBJ_TYPE_RX);

// Last message object does not have the MSG_OBJ_FIFO set to // indicate that this is the last
message. sMsgObjectRx.ulFlags = MSG_OBJ_USE_ID_FILTER; CANMessageSet(CAN0_BASE,
4, sMsgObjectRx, MSG_OBJ_TYPE_RX);

// Configure and start transmit of message object. sMsgObjectTx.ulMsgID = 0x400; sMsgOb-
jectTx.ulFlags = 0; sMsgObjectTx.ulMsgLen = 8; sMsgObjectTx.pucMsgData = ucBufferOut; CAN-
MessageSet(CAN0_BASE, 2, sMsgObjectTx, MSG_OBJ_TYPE_TX);

// Wait for new data to become available. while((CANStatusGet(CAN1_BASE,
CAN_STS_NEWDAT) 1) == 0) { // Read the message out of the message object. CAN-
MessageGet(CAN1_BASE, 1, sMsgObjectRx, true); }

// Process new data in sMsgObjectRx.pucMsgData. ...
```

This example code will configure a set of CAN message objects in FIFO mode, using CAN controller 0.

```
tCANBitClkParms CANBitClk; tCANMsgObject sMsgObjectRx; unsigned char ucBufferIn[8]; un-
signed char ucBufferOut[8];

// Reset the state of all the message objects and the state of // the CAN module to a known state.
CANInit(CAN0_BASE);

// Configure the controller for 1 Mbit operation. CANBitRateSet(CAN0_BASE, 8000000, 1000000);

// Take the CAN0 device out of INIT state. CANEnable(CAN0_BASE);
```

```
// Configure a receive object this CAN FIFO to receive message // objects with message ID
0x400-0x407. sMsgObjectRx.ulMsgID = (0x400); sMsgObjectRx.ulMsgIDMask = 0x7f8; sMsgOb-
jectRx.ulFlags = MSG_OBJ_USE_ID_FILTER | MSG_OBJ_FIFO;
```

```
// The first three message objects have the MSG_OBJ_FIFO set // to indicate that they are part of
a FIFO. CANMessageSet(CAN0_BASE, 1, sMsgObjectRx, MSG_OBJ_TYPE_RX); CANMessage-
Set(CAN0_BASE, 2, sMsgObjectRx, MSG_OBJ_TYPE_RX); CANMessageSet(CAN0_BASE, 3,
sMsgObjectRx, MSG_OBJ_TYPE_RX);
```

```
// Last message object does not have the MSG_OBJ_FIFO set to // indicate that this is the last
message. sMsgObjectRx.ulFlags = MSG_OBJ_USE_ID_FILTER; CANMessageSet(CAN0_BASE,
4, sMsgObjectRx, MSG_OBJ_TYPE_RX);
```

```
...
```


4 Interrupt Controller (PIE)

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The interrupt controller API provides a set of functions for dealing with the Peripheral Interrupt Expansion Controller (PIE). Functions are provided to enable and disable interrupts, and register interrupt handlers.

The PIE provides global interrupt maskin, prioritization, and handler dispatching. Individual interrupt sources can be masked, and the processor interrupt can be globally masked as well (without affecting the individual source masks).

The PIE is tightly coupled with the C28x microprocessor. When the processor responds to an interrupt, PIE will supply the address of the function to handle the interrupt directly to the processor. This eliminates the need for a global interrupt handler that queries the interrupt controller to determine the cause of the interrupt and branch to the appropriate handler, reducing interrupt response time.

Interrupt handlers can be configured in two ways; statically at compile time and dynamically at run time. Static configuration of interrupt handlers is accomplished by editing the interrupt handler table in the application's startup code. When statically configured, the interrupts must be explicitly enabled in PIE via `IntEnable()` before the processor will respond to the interrupt (in addition to any interrupt enabling required within the peripheral itself). Alternatively, interrupts can be configured at run-time using `IntRegister()`. When using `IntRegister()`, the interrupt must also be enabled as before.

Correct operation of the PIE controller requires that the vector table be placed at 0xD00 in RAM. Failure to do so will result in an incorrect vector address being fetched in response to an interrupt. The vector table is in a section called "PieVectTableFile" and should be placed appropriately with a linker script.

This driver is contained in `driverlib/interrupt.c`, with `driverlib/interrupt.h` containing the API definitions for use by applications.

4.1 API Functions

Functions

```
void IntDisable (uint32_t ui32Interrupt)
void IntEnable (uint32_t ui32Interrupt)
bool IntMasterDisable (void)
bool IntMasterEnable (void)
void IntRegister (uint32_t ui32Interrupt, void(*pfnHandler)(void))
void IntUnregister (uint32_t ui32Interrupt)
```

4.1.1 Detailed Description

The primary function of the interrupt controller API is to manage the interrupt vector table used by the PIE to dispatch interrupt requests. Registering an interrupt handler is a simple matter of inserting the handler address into the table. By default, the table is filled with pointers to an internal handler that loops forever; it is an error for an interrupt to occur when there is no interrupt handler registered to process it. Therefore, interrupt sources should not be enabled before a handler has been registered, and interrupt sources should be disabled before a handler is unregistered. Interrupt handlers are managed with [IntRegister\(\)](#) and [IntUnregister\(\)](#).

Each interrupt source can be individually enabled and disabled via [IntEnable\(\)](#) and [IntDisable\(\)](#). The processor interrupt can be enabled and disabled via [IntMasterEnable\(\)](#) and [IntMasterDisable\(\)](#); this does not affect the individual interrupt enable states. Masking of the processor interrupt can be utilized as a simple critical section (only NMI will interrupt the processor while the processor interrupt is disabled), though this will have adverse effects on the interrupt response time.

4.1.2 Function Documentation

4.1.2.1 void IntDisable (uint32_t ui32Interrupt)

Disables an interrupt.

Parameters *ui32Interrupt* specifies the interrupt to be disabled.

The specified interrupt is disabled in the interrupt controller. Other enables for the interrupt (such as at the peripheral level) are unaffected by this function.

Returns None.

References [IntMasterDisable\(\)](#), and [IntMasterEnable\(\)](#).

Referenced by [CANIntUnregister\(\)](#), [SysTickIntDisable\(\)](#), [SysTickIntUnregister\(\)](#), [UARTRXIntUnregister\(\)](#), [UARTTXIntUnregister\(\)](#), and [USBIntUnregister\(\)](#).

4.1.2.2 void IntEnable (uint32_t ui32Interrupt)

Enables an interrupt.

Parameters *ui32Interrupt* specifies the interrupt to be enabled.

The specified interrupt is enabled in the interrupt controller. Other enables for the interrupt (such as at the peripheral level) are unaffected by this function.

Returns None.

References [IntMasterDisable\(\)](#), and [IntMasterEnable\(\)](#).

Referenced by [CANIntRegister\(\)](#), [SysTickIntEnable\(\)](#), [SysTickIntRegister\(\)](#), [UARTRXIntRegister\(\)](#), [UARTTXIntRegister\(\)](#), and [USBIntRegister\(\)](#).

4.1.2.3 `bool IntMasterDisable (` `)`

Disables the processor interrupt.

Prevents the processor from receiving interrupts. This does not affect the set of interrupts enabled in the interrupt controller; it just gates the single interrupt from the controller to the processor.

Note Previously, this function had no return value. As such, it was possible to include `interrupt.h` and call this function without having included `hw_types.h`. Now that the return is a `bool`, a compiler error will occur in this case. The solution is to include `hw_types.h` before including `interrupt.h`. Returns **true** if interrupts were already disabled when the function was called or **false** if they were initially enabled.

Referenced by `IntDisable()`, and `IntEnable()`.

4.1.2.4 `bool IntMasterEnable (` `)`

Enables the processor interrupt.

Allows the processor to respond to interrupts. This does not affect the set of interrupts enabled in the interrupt controller; it just gates the single interrupt from the controller to the processor.

Note Previously, this function had no return value. As such, it was possible to include `interrupt.h` and call this function without having included `hw_types.h`. Now that the return is a `bool`, a compiler error will occur in this case. The solution is to include `hw_types.h` before including `interrupt.h`. Returns **true** if interrupts were disabled when the function was called or **false** if they were initially enabled.

Referenced by `IntDisable()`, and `IntEnable()`.

4.1.2.5 `void IntRegister (` `void ui32_t ui32Interrupt,` `void(*)(void) pfnHandler)`

Registers a function to be called when an interrupt occurs.

Assumes PIE is enabled

Parameters *ui32Interrupt* specifies the interrupt in question.

pfnHandler is a pointer to the function to be called.

This function is used to specify the handler function to be called when the given interrupt is asserted to the processor. When the interrupt occurs, if it is enabled (via [IntEnable\(\)](#)), the handler function will be called in interrupt context. Since the handler function can pre-empt other code, care must be taken to protect memory or peripherals that are accessed by the handler and other non-handler code.

Returns None.

Referenced by `CANIntRegister()`, `SysTickIntRegister()`, `UARTRXIntRegister()`, `UARTTXIntRegister()`, and `USBIntRegister()`.

4.1.2.6 void IntUnregister (uint32_t ui32Interrupt)

Unregisters the function to be called when an interrupt occurs.

Parameters *ui32Interrupt* specifies the interrupt in question.

This function is used to indicate that no handler should be called when the given interrupt is asserted to the processor. The interrupt source will be automatically disabled (via [IntDisable\(\)](#)) if necessary.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

Referenced by `CANIntUnregister()`, `SysTickIntUnregister()`, `UARTRXIntUnregister()`, `UARTTXIntUnregister()`, and `USBIntUnregister()`.

The following example shows how to use the Interrupt Controller API to register an interrupt handler and enable the interrupt.

```
// // The interrupt handler function. // extern void IntHandler(void);  
// // Register the interrupt handler function for interrupt 5. // IntRegister(5, IntHandler);  
// // Enable interrupt 5. // IntEnable(5);  
// // Enable interrupt 5. // IntMasterEnable();
```


5 System Control

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System control determines the overall operation of the device. It controls the clocking of the device, the set of peripherals that are enabled, configuration of the device and its resets, and provides information about the device.

The members of the Delfino family have a varying peripheral set and memory sizes. The device has a set of read-only registers that indicate the size of the memories and the peripherals that are present. This information can be used to write adaptive software that will run on more than one member of the Delfino family.

The device can be clocked from one of four sources: an external oscillator, one of the two internal oscillators, or an external single ended clock source. The main PLL can be used with any of the three oscillators as its input, excluding the external single ended clock source.

This driver is contained in `driverlib/sysctl.c`, with `driverlib/sysctl.h` containing the API definitions for use by applications.

5.1 API Functions

Macros

```
#define SYSTEM_CLOCK_SPEED
```

Functions

```
void SysCtlAuxClockSet (uint32_t ui32Config)
uint32_t SysCtlClockGet (uint32_t ui32ClockIn)
void SysCtlClockSet (uint32_t ui32Config)
uint32_t SysCtlLowSpeedClockGet (uint32_t ui32ClockIn)
void SysCtlPeripheralDisable (uint32_t ui32Peripheral)
void SysCtlPeripheralEnable (uint32_t ui32Peripheral)
bool SysCtlPeripheralPresent (uint32_t ui32Peripheral)
bool SysCtlPeripheralReady (uint32_t ui32Peripheral)
void SysCtlPeripheralReset (uint32_t ui32Peripheral)
void SysCtlReset (void)
void SysCtlUSBPLLDisable (void)
void SysCtlUSBPLLEnable (void)
```

5.1.1 Detailed Description

The SysCtl API is broken up into three groups of functions: those that provide device information, those that deal with device clocking, and those that provide peripheral control.

Information about the device is provided by [SysCtlSRAMSizeGet\(\)](#), [SysCtlFlashSizeGet\(\)](#), and [SysCtlPeripheralPresent\(\)](#).

Clocking of the device is configured with [SysCtlClockSet\(\)](#) and [SysCtlAuxClockSet\(\)](#). Information about device clocking is provided by [SysCtlClockGet\(\)](#) and [SysCtlLowSpeedClockGet\(\)](#).

Peripheral enabling and reset are controlled with [SysCtlPeripheralReset\(\)](#), [SysCtlPeripheralEnable\(\)](#), and [SysCtlPeripheralDisable\(\)](#).

5.1.2 Macro Definition Documentation

5.1.2.1 #define SYSTEM_CLOCK_SPEED

Defined system clock oscillator source speed. Adjust this to reflect your actual clock speed.

5.1.3 Function Documentation

5.1.3.1 void SysCtlAuxClockSet (uint32_t ui32Config)

Sets the clocking of the device.

Parameters *ui32Config* is the required configuration of the device clocking.

This function configures the clocking of the device. The input crystal frequency, oscillator to be used, use of the PLL, and the system clock divider are all configured with this function.

The *ui32Config* parameter is the logical OR of several different values, many of which are grouped into sets where only one can be chosen.

The system clock divider is chosen with one of the following values: **SYSCCTL_SYSDIV_1**, **SYSCCTL_SYSDIV_2**, **SYSCCTL_SYSDIV_3**, ... **SYSCCTL_SYSDIV_64**.

The use of the PLL is chosen with either **SYSCCTL_USE_PLL** or **SYSCCTL_USE_OSC**.

The external crystal frequency is chosen with one of the following values: **SYSCCTL_XTAL_4MHZ**, **SYSCCTL_XTAL_4_09MHZ**, **SYSCCTL_XTAL_4_91MHZ**, **SYSCCTL_XTAL_5MHZ**, **SYSCCTL_XTAL_5_12MHZ**, **SYSCCTL_XTAL_6MHZ**, **SYSCCTL_XTAL_6_14MHZ**, **SYSCCTL_XTAL_7_37MHZ**, **SYSCCTL_XTAL_8MHZ**, **SYSCCTL_XTAL_8_19MHZ**, **SYSCCTL_XTAL_10MHZ**, **SYSCCTL_XTAL_12MHZ**, **SYSCCTL_XTAL_12_2MHZ**, **SYSCCTL_XTAL_13_5MHZ**, **SYSCCTL_XTAL_14_3MHZ**, **SYSCCTL_XTAL_16MHZ**, **SYSCCTL_XTAL_16_3MHZ**, **SYSCCTL_XTAL_18MHZ**, **SYSCCTL_XTAL_20MHZ**, **SYSCCTL_XTAL_24MHZ**, or **SYSCCTL_XTAL_25MHZ**. Values below **SYSCCTL_XTAL_5MHZ** are not valid when the PLL is in operation.

The oscillator source is chosen with one of the following values: **SYSCCTL_OSC_MAIN**, **SYSCCTL_OSC_INT**, **SYSCCTL_OSC_INT4**, **SYSCCTL_OSC_INT30**, or **SYSCCTL_OSC_EXT32**.

SYSCTL_OSC_EXT32 is only available on devices with the hibernate module, and then only when the hibernate module has been enabled.

The internal and main oscillators are disabled with the **SYSCTL_INT_OSC_DIS** and **SYSCTL_MAIN_OSC_DIS** flags, respectively. The external oscillator must be enabled in order to use an external clock source. Note that attempts to disable the oscillator used to clock the device is prevented by the hardware.

To clock the system from an external source (such as an external crystal oscillator), use **SYSCTL_USE_OSC | SYSCTL_OSC_MAIN**. To clock the system from the main oscillator, use **SYSCTL_USE_OSC | SYSCTL_OSC_MAIN**. To clock the system from the PLL, use **SYSCTL_USE_PLL | SYSCTL_OSC_MAIN**, and select the appropriate crystal with one of the **SYSCTL_XTAL_xxx** values.

Note If selecting the PLL as the system clock source (that is, via **SYSCTL_USE_PLL**), this function polls the PLL lock interrupt to determine when the PLL has locked. If an interrupt handler for the system control interrupt is in place, and it responds to and clears the PLL lock interrupt, this function delays until its timeout has occurred instead of completing as soon as PLL lock is achieved. Returns None.

5.1.3.2 uint32_t SysCtlClockGet (uint32_t u32ClockIn)

Provides a small delay.

Parameters *u1Count* is the number of delay loop iterations to perform.

This function provides a means of generating a constant length delay. It is written in assembly to keep the delay consistent across tool chains, avoiding the need to tune the delay based on the tool chain in use.

The loop takes 5 cycles/loop + 9.

Returns None. Gets the processor clock rate. This function determines the clock rate of the processor clock.

Note Because of the many different clocking options available, this function cannot determine the clock speed of the processor. This function should be modified to return the actual clock speed of the processor in your specific application. Returns The processor clock rate.

Referenced by SysCtlLowSpeedClockGet().

5.1.3.3 void SysCtlClockSet (uint32_t ui32Config)

Sets the clocking of the device.

Parameters *ui32Config* is the required configuration of the device clocking.

This function configures the clocking of the device. The oscillator to be used, SYSPLL fractional and integer multiplier, and the system clock divider are all configured with this function.

The *ui32Config* parameter is the logical OR of four values: Clock divider, Integer multiplier, Fractional multiplier, and oscillator source.

The system clock divider is chosen with using the following macro: **SYSCTL_SYSDIV(x)** - "x" is an integer of value 1 or any even value up to 126

The System PLL fractional multiplier is chosen with one of the following values: **SYSCTL_FMULT_0, SYSCTL_FMULT_1_4, SYSCTL_FMULT_1_2, SYSCTL_FMULT_3_4**

The System PLL integer multiplier is chosen with using the following macro: **SYSCTL_IMULT(x)** - "x" is an integer from 0 to 127

The oscillator source is chosen with one of the following values: **SYSCTL_OSCSRC_OSC2, SYSCTL_OSCSRC_XTAL, SYSCTL_OSCSRC_OSC1**

Note The external oscillator must be enabled in order to use an external clock source. Note that attempts to disable the oscillator used to clock the device is prevented by the hardware. Returns None.

5.1.3.4 `uint32_t SysCtlLowSpeedClockGet (` `uint32_t u32ClockIn)`

Gets the low speed peripheral clock rate.

This function determines the clock rate of the low speed peripherals.

Note Because of the many different clocking options available, this function cannot determine the clock speed of the processor. This function should be modified to return the actual clock speed of the processor in your specific application. Returns The low speed peripheral clock rate.

References `SysCtlClockGet()`.

5.1.3.5 `void SysCtlPeripheralDisable (` `uint32_t ui32Peripheral)`

Disables a peripheral.

Parameters *ui32Peripheral* is the peripheral to disable.

Peripherals are disabled with this function. Once disabled, they will not operate or respond to register reads/writes.

The *ui32Peripheral* parameter must be only one of the following values:
SYSCTL_PERIPH_UART_A, SYSCTL_PERIPH_UART_B, SYSCTL_PERIPH_UART_C,
SYSCTL_PERIPH_UART_D, SYSCTL_PERIPH_SPI_A, SYSCTL_PERIPH_SPI_B,
SYSCTL_PERIPH_SPI_C, SYSCTL_PERIPH_MCBSP_A, SYSCTL_PERIPH_MCBSP_B,
SYSCTL_PERIPH_DMA, SYSCTL_PERIPH_USB_A

Returns None.

5.1.3.6 `void SysCtlPeripheralEnable (`

```
uint32_t ui32Peripheral (
```

Enables a peripheral.

Parameters *ui32Peripheral* is the peripheral to enable.

Peripherals are enabled with this function. At power-up, all peripherals are disabled; they must be enabled in order to operate or respond to register reads/writes.

The *ui32Peripheral* parameter must be only one of the following values:
SYSCTL_PERIPH_UART_A, **SYSCTL_PERIPH_UART_B**, **SYSCTL_PERIPH_UART_C**,
SYSCTL_PERIPH_UART_D, **SYSCTL_PERIPH_SPI_A**, **SYSCTL_PERIPH_SPI_B**,
SYSCTL_PERIPH_SPI_C, **SYSCTL_PERIPH_MCBSP_A**, **SYSCTL_PERIPH_MCBSP_B**,
SYSCTL_PERIPH_DMA, **SYSCTL_PERIPH_USB_A**

Returns None.

```
5.1.3.7 bool SysCtlPeripheralPresent (
```

```
uint32_t ui32Peripheral )
```

Determines if a peripheral is present.

Parameters *ui32Peripheral* is the peripheral in question.

This function determines if a particular peripheral is present in the device. Each member of the family has a different peripheral set; this function determines which peripherals are present on this device.

Returns Returns **true** if the specified peripheral is present and **false** if it is not.

```
5.1.3.8 bool SysCtlPeripheralReady (
```

```
uint32_t ui32Peripheral )
```

Determines if a peripheral is ready.

Parameters *ui32Peripheral* is the peripheral in question.

This function determines if a particular peripheral is ready to be accessed. The peripheral may be in a non-ready state if it is not enabled, is being held in reset, or is in the process of becoming ready after being enabled or taken out of reset.

Note The ability to check for a peripheral being ready varies based on the part in use. Please consult the data sheet for the part you are using to determine if this feature is available. Returns Returns **true** if the specified peripheral is ready and **false** if it is not.

```
5.1.3.9 void SysCtlPeripheralReset (
```

```
uint32_t ui32Peripheral )
```

Resets a peripheral

Parameters *ui32Peripheral* is the peripheral to reset.

The f2837x devices do not have a means of resetting peripherals via software. This is a dummy function that does nothing.

Returns None.

5.1.3.10 void SysCtlReset ()

Resets the device.

This function performs a software reset of the entire device. The processor and all peripherals are reset and all device registers are returned to their default values (with the exception of the reset cause register, which maintains its current value but has the software reset bit set as well).

Returns This function does not return.

5.1.3.11 void SysCtlUSBPLLDisable ()

Powers down the USB PLL.

This function will disable the USB controller's PLL. The USB registers are still accessible, but the physical layer will no longer function.

Returns None.

5.1.3.12 void SysCtlUSBPLLEnable ()

Powers up the USB PLL.

This function will enable the USB controller's PLL.

Note Because every application is different, the user will likely have to modify this function to ensure the PLL multiplier is set correctly to achieve the 60 MHz required by the USB controller. Returns None. The following example shows how to use the SysCtl API to enable device peripherals.

```
// Enable the EPWM1 and I2C1. SysCtlPeripheralEnable(SYSCTL_PERIPH_EPWM1); SysCtlPeripheralEnable(SYSCTL_PERIPH_I2C1);
```

6 System Tick (SysTick)

Introduction ??
 API Functions 31
 Programming Example ?? SysTick is a simple timer that makes use of the CPU Timer0 module within the C28x core. Its intended purpose is to provide a periodic interrupt for a RTOS, but it can be used for other simple timing purposes.

This driver is contained in `driverlib/systick.c`, with `driverlib/systick.h` containing the API definitions for use by applications.

6.1 API Functions

Functions

~~void~~ void `SysTickDisable` (void)
 void `SysTickEnable` (void)
 void `SysTickInit` (void)
 void `SysTickIntDisable` (void)
 void `SysTickIntEnable` (void)
 void `SysTickIntRegister` (void(*pfnHandler)(void))
 void `SysTickIntUnregister` (void)
 uint32_t `SysTickPeriodGet` (void)
 void `SysTickPeriodSet` (uint32_t ui32Period)
 uint32_t `SysTickValueGet` (void)

6.1.1 Detailed Description

The SysTick API is fairly simple, like SysTick itself. There are functions for configuring and enabling SysTick (`SysTickInit()`, `SysTickEnable()`, `SysTickDisable()`, `SysTickPeriodSet()`, `SysTickPeriodGet()`, and `SysTickValueGet()`) and functions for dealing with an interrupt handler for SysTick (`SysTickIntRegister()`, `SysTickIntUnregister()`, `SysTickIntEnable()`, and `SysTickIntDisable()`).

6.1.2 Function Documentation

6.1.2.1 void SysTickDisable (

)

Disables the SysTick counter.

This will stop the SysTick counter. If an interrupt handler has been registered, it will no longer be called until SysTick is restarted.

Returns None.

6.1.2.2 void SysTickEnable (

)

Enables the SysTick counter.

This will start the SysTick counter. If an interrupt handler has been registered, it will be called when the SysTick counter rolls over.

Note Calling this function will cause the SysTick counter to (re)commence counting from its current value. The counter is not automatically reloaded with the period as specified in a previous call to [SysTickPeriodSet\(\)](#). If an immediate reload is required, the **NVIC_ST_CURRENT** register must be written to force this. Any write to this register clears the SysTick counter to 0 and will cause a reload with the supplied period on the next clock. Returns None.

6.1.2.3 void SysTickInit (

)

Initializes the Timer0 Module to act as a system tick

Returns None.

6.1.2.4 void SysTickIntDisable (

)

Disables the SysTick interrupt.

This function will disable the SysTick interrupt, preventing it from being reflected to the processor.

Returns None.

References IntDisable().

6.1.2.5 void SysTickIntEnable (

)

Enables the SysTick interrupt.

This function will enable the SysTick interrupt, allowing it to be reflected to the processor.

Note The SysTick interrupt handler does not need to clear the SysTick interrupt source as this is done automatically by NVIC when the interrupt handler is called. Returns None.

References IntEnable().

6.1.2.6 void SysTickIntRegister (
void (*)(void) pfnHandler)

Registers an interrupt handler for the SysTick interrupt.

Parameters *pfnHandler* is a pointer to the function to be called when the SysTick interrupt occurs.

This sets the handler to be called when a SysTick interrupt occurs.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References IntEnable(), and IntRegister().

6.1.2.7 void SysTickIntUnregister (
)

Unregisters the interrupt handler for the SysTick interrupt.

This function will clear the handler to be called when a SysTick interrupt occurs.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References IntDisable(), and IntUnregister().

6.1.2.8 uint32_t SysTickPeriodGet (
)

Gets the period of the SysTick counter.

This function returns the rate at which the SysTick counter wraps; this equates to the number of processor clocks between interrupts.

Returns Returns the period of the SysTick counter.

6.1.2.9 void SysTickPeriodSet (
uint32_t ui32Period)

Sets the period of the SysTick counter.

Parameters *ui32Period* is the number of clock ticks in each period of the SysTick counter; must be between 1 and 16, 777, 216, inclusive.

This function sets the rate at which the SysTick counter wraps; this equates to the number of processor clocks between interrupts.

Note Calling this function does not cause the SysTick counter to reload immediately. If an immediate reload is required, the **NVIC_ST_CURRENT** register must be written. Any write to this register clears the SysTick counter to 0 and will cause a reload with the *ui32Period* supplied here on the next clock after the SysTick is enabled. Returns None.

6.1.2.10 uint32_t SysTickValueGet ()

Gets the current value of the SysTick counter.

This function returns the current value of the SysTick counter; this will be a value between the period - 1 and zero, inclusive.

Returns Returns the current value of the SysTick counter. The following example shows how to use the SysTick API to configure the SysTick counter and read its value.

```
unsigned long ulValue;
```

```
// // Configure and enable the SysTick counter. // SysTickInit(); SysTickPeriodSet(1000); SysTick-  
Enable();
```

```
// // Delay for some time... //
```

```
// // Read the current SysTick value. // ulValue = SysTickValueGet();
```

7 UART

[Introduction](#) ??
[API Functions](#) 35
[Programming Example](#) ?? The Universal Asynchronous Receiver/Transmitter (UART) API provides a set of functions for using the Delfino UART modules. Functions are provided to configure and control the UART modules, to send and receive data, and to manage interrupts for the UART modules.

The Delfino UART performs the functions of parallel-to-serial and serial-to-parallel conversions. It is very similar in functionality to a 16C550 UART, but is not register-compatible.

Some of the features of the Delfino UART are:

`void` A 16x12 bit receive FIFO and a 16x8 bit transmit FIFO.

Programmable baud rate generator.

Automatic generation and stripping of start, stop, and parity bits.

Line break generation and detection.

Programmable serial interface

5, 6, 7, or 8 data bits

even, odd, stick, or no parity bit generation and detection

1 or 2 stop bit generation

baud rate generation, from DC to processor clock/16

Modem control/flow control

IrDA serial-IR (SIR) encoder/decoder.

DMA interface

This driver is contained in `driverlib/uart.c`, with `driverlib/uart.h` containing the API definitions for use by applications.

7.1 API Functions

Functions

`bool` [UARTBusy](#) (`uint32_t ui32Base`)

`int32_t` [UARTCharGet](#) (`uint32_t ui32Base`)

`int32_t` [UARTCharGetNonBlocking](#) (`uint32_t ui32Base`)

`void` [UARTCharPut](#) (`uint32_t ui32Base`, `unsigned char ucData`)

```
bool UARTCharPutNonBlocking (uint32_t ui32Base, unsigned char ucData)

bool UARTCharsAvail (uint32_t ui32Base)

void UARTConfigGetExpClk (uint32_t ui32Base, uint32_t ui32UARTClk, uint32_t *pui32Baud,
uint32_t *pui32Config)

void UARTConfigSetExpClk (uint32_t ui32Base, uint32_t ui32UARTClk, uint32_t ui32Baud,
uint32_t ui32Config)

void UARTDisable (uint32_t ui32Base)

void UARTEnable (uint32_t ui32Base)

void UARTFIFODisable (uint32_t ui32Base)

void UARTFIFOEnable (uint32_t ui32Base)

void UARTFIFOIntLevelGet (uint32_t ui32Base, uint32_t *pui32TxLevel, uint32_t *pui32RxLevel)

void UARTFIFOIntLevelSet (uint32_t ui32Base, uint32_t ui32TxLevel, uint32_t ui32RxLevel)

void UARTFIFOLevelGet (uint32_t ui32Base, uint32_t *pui32TxLevel, uint32_t *pui32RxLevel)

void UARTIntClear (uint32_t ui32Base, uint32_t ui32IntFlags)

void UARTIntDisable (uint32_t ui32Base, uint32_t ui32IntFlags)

void UARTIntEnable (uint32_t ui32Base, uint32_t ui32IntFlags)

uint32_t UARTIntStatus (uint32_t ui32Base, bool bMasked)

uint32_t UARTParityModeGet (uint32_t ui32Base)

void UARTParityModeSet (uint32_t ui32Base, uint32_t ui32Parity)

void UARTRxErrorClear (uint32_t ui32Base)

uint32_t UARTRxErrorGet (uint32_t ui32Base)

void UARTRXIntRegister (uint32_t ui32Base, void(*pfnHandler)(void))

void UARTRXIntUnregister (uint32_t ui32Base)

void UARTsetLoopBack (uint32_t ui32Base, bool enable)

bool UARTSpaceAvail (uint32_t ui32Base)

uint32_t UARTTxIntModeGet (uint32_t ui32Base)

void UARTTxIntModeSet (uint32_t ui32Base, uint32_t ui32Mode)

void UARTTXIntRegister (uint32_t ui32Base, void(*pfnHandler)(void))

void UARTTXIntUnregister (uint32_t ui32Base)
```

7.1.1 Detailed Description

The UART API provides the set of functions required to implement an interrupt driven UART driver. These functions may be used to control any of the available UART ports on a Delfino microcontroller, and can be used with one port without causing conflicts with the other port.

The UART API is broken into three groups of functions: those that deal with configuration and control of the UART modules, those used to send and receive data, and those that deal with interrupt handling.

Configuration and control of the UART are handled by the [UARTConfigGetExpClk\(\)](#), [UARTConfigSetExpClk\(\)](#), [UARTDisable\(\)](#), [UARTEnable\(\)](#), [UARTParityModeGet\(\)](#), and [UARTParityModeSet\(\)](#) functions. The DMA interface can be enabled or disabled by the [UARTDMAEnable\(\)](#) and [UARTDMADisable\(\)](#) functions.

Sending and receiving data via the UART is handled by the [UARTCharGet\(\)](#), [UARTCharGetNonBlocking\(\)](#), [UARTCharPut\(\)](#), [UARTCharPutNonBlocking\(\)](#), [UARTBreakCtl\(\)](#), [UARTCharsAvail\(\)](#), and [UARTSpaceAvail\(\)](#) functions.

Managing the UART interrupts is handled by the [UARTIntClear\(\)](#), [UARTIntDisable\(\)](#), [UARTIntEnable\(\)](#), [UARTIntRegister\(\)](#), [UARTIntStatus\(\)](#), and [UARTIntUnregister\(\)](#) functions.

7.1.2 Function Documentation

7.1.2.1 `bool UARTBusy (uint32_t ui32Base)`

Determines whether the UART transmitter is busy or not.

Parameters *ui32Base* is the base address of the UART port.

Allows the caller to determine whether all transmitted bytes have cleared the transmitter hardware. If **false** is returned, the transmit FIFO is empty and all bits of the last transmitted character, including all stop bits, have left the hardware shift register.

Returns Returns **true** if the UART is transmitting or **false** if all transmissions are complete.

7.1.2.2 `int32_t UARTCharGet (uint32_t ui32Base)`

Waits for a character from the specified port.

Parameters *ui32Base* is the base address of the UART port.

Gets a character from the receive FIFO for the specified port. If there are no characters available, this function waits until a character is received before returning.

Returns Returns the character read from the specified port, cast as a *long*.

7.1.2.3 `int32_t UARTCharGetNonBlocking (`

uint32_t ui32Base)

Receives a character from the specified port.

Parameters *ui32Base* is the base address of the UART port.

Gets a character from the receive FIFO for the specified port.

This function replaces the original UARTCharNonBlockingGet() API and performs the same actions. A macro is provided in `uart.h` to map the original API to this API.

Returns Returns the character read from the specified port, cast as a *long*. A **-1** is returned if there are no characters present in the receive FIFO. The [UARTCharsAvail\(\)](#) function should be called before attempting to call this function.

7.1.2.4 void UARTCharPut (

uint32_t ui32Base,

unsigned char ucData)

Waits to send a character from the specified port.

Parameters *ui32Base* is the base address of the UART port.

ucData is the character to be transmitted.

Sends the character *ucData* to the transmit FIFO for the specified port. If there is no space available in the transmit FIFO, this function waits until there is space available before returning.

Returns None.

7.1.2.5 bool UARTCharPutNonBlocking (

uint32_t ui32Base,

unsigned char ucData)

Sends a character to the specified port.

Parameters *ui32Base* is the base address of the UART port.

ucData is the character to be transmitted.

Writes the character *ucData* to the transmit FIFO for the specified port. This function does not block, so if there is no space available, then a **false** is returned, and the application must retry the function later.

This function replaces the original UARTCharNonBlockingPut() API and performs the same actions. A macro is provided in `uart.h` to map the original API to this API.

Returns Returns **true** if the character was successfully placed in the transmit FIFO or **false** if there was no space available in the transmit FIFO.

7.1.2.6 `bool UARTCharsAvail (`
 `uint32_t ui32Base)`

Determines if there are any characters in the receive FIFO.

Parameters *ui32Base* is the base address of the UART port.

This function returns a flag indicating whether or not there is data available in the receive FIFO.

Returns **true** if there is data in the receive FIFO or **false** if there is no data in the receive FIFO.

7.1.2.7 `void UARTConfigGetExpClk (`
 `uint32_t ui32Base,`
 `uint32_t ui32UARTClk,`
 `uint32_t * pui32Baud,`
 `uint32_t * pui32Config)`

Gets the current configuration of a UART.

Parameters *ui32Base* is the base address of the UART port.

ui32UARTClk is the rate of the clock supplied to the UART module.

pui32Baud is a pointer to storage for the baud rate.

pui32Config is a pointer to storage for the data format.

The baud rate and data format for the UART is determined, given an explicitly provided peripheral clock (hence the ExpClk suffix). The returned baud rate is the actual baud rate; it may not be the exact baud rate requested or an “official” baud rate. The data format returned in *pui32Config* is enumerated the same as the *ui32Config* parameter of [UARTConfigSetExpClk\(\)](#).

The peripheral clock will be the same as the processor clock. This will be the value returned by [SysCtlClockGet\(\)](#), or it can be explicitly hard coded if it is constant and known (to save the code/execution overhead of a call to [SysCtlClockGet\(\)](#)).

This function replaces the original UARTConfigGet() API and performs the same actions. A macro is provided in `uart.h` to map the original API to this API.

Returns None.

7.1.2.8 `void UARTConfigSetExpClk (`
 `uint32_t ui32Base,`
 `uint32_t ui32UARTClk,`

```
uint32_t ui32Baud,  
uint32_t ui32Config )
```

Sets the configuration of a UART.

Parameters *ui32Base* is the base address of the UART port.

ui32UARTClk is the rate of the clock supplied to the UART module.

ui32Baud is the desired baud rate.

ui32Config is the data format for the port (number of data bits, number of stop bits, and parity).

This function configures the UART for operation in the specified data format. The baud rate is provided in the *ui32Baud* parameter and the data format in the *ui32Config* parameter.

The *ui32Config* parameter is the logical OR of three values: the number of data bits, the number of stop bits, and the parity. **UART_CONFIG_WLEN_8**, **UART_CONFIG_WLEN_7**, **UART_CONFIG_WLEN_6**, and **UART_CONFIG_WLEN_5** select from eight to five data bits per byte (respectively). **UART_CONFIG_STOP_ONE** and **UART_CONFIG_STOP_TWO** select one or two stop bits (respectively). **UART_CONFIG_PAR_NONE**, **UART_CONFIG_PAR_EVEN**, **UART_CONFIG_PAR_ODD**, **UART_CONFIG_PAR_ONE**, and **UART_CONFIG_PAR_ZERO** select the parity mode (no parity bit, even parity bit, odd parity bit, parity bit always one, and parity bit always zero, respectively).

The peripheral clock will be the same as the processor clock. This will be the value returned by [SysCtlClockGet\(\)](#), or it can be explicitly hard coded if it is constant and known (to save the code/execution overhead of a call to [SysCtlClockGet\(\)](#)).

This function replaces the original UARTConfigSet() API and performs the same actions. A macro is provided in `uart.h` to map the original API to this API.

Returns None.

References UARTDisable(), and UARTEnable().

7.1.2.9 void UARTDisable (

```
uint32_t ui32Base )
```

Disables transmitting and receiving.

Parameters *ui32Base* is the base address of the UART port.

Clears the UARTEN, TXE, and RXE bits, then waits for the end of transmission of the current character, and flushes the transmit FIFO.

Returns None.

Referenced by UARTConfigSetExpClk().

7.1.2.10 void UARTEnable (

pui32RxLevel is a pointer to storage for the receive FIFO level, returned as one of **UART_FIFO_RX1_8**, **UART_FIFO_RX2_8**, **UART_FIFO_RX4_8**, **UART_FIFO_RX6_8**, or **UART_FIFO_RX7_8**.

This function gets the FIFO level at which transmit and receive interrupts are generated.
Returns None.

7.1.2.14 void UARTFIFOIntLevelSet (

uint32_t ui32Base,
uint32_t ui32TxLevel,
uint32_t ui32RxLevel)

Sets the FIFO level at which interrupts are generated.
Parameters *ui32Base* is the base address of the UART port.

ui32TxLevel is the transmit FIFO interrupt level, specified as one of **UART_FIFO_TX1_8**, **UART_FIFO_TX2_8**, **UART_FIFO_TX4_8**, **UART_FIFO_TX6_8**, or **UART_FIFO_TX7_8**.

ui32RxLevel is the receive FIFO interrupt level, specified as one of **UART_FIFO_RX1_8**, **UART_FIFO_RX2_8**, **UART_FIFO_RX4_8**, **UART_FIFO_RX6_8**, or **UART_FIFO_RX7_8**.

This function sets the FIFO level at which transmit and receive interrupts are generated.
Returns None.

7.1.2.15 void UARTFIFOLevelGet (

uint32_t ui32Base,
uint32_t * pui32TxLevel,
uint32_t * pui32RxLevel)

Gets the FIFO level at which interrupts are generated.
Parameters *ui32Base* is the base address of the UART port.

pui32TxLevel is a pointer to storage for the transmit FIFO level, returned as one of **UART_FIFO_TX1_8**, **UART_FIFO_TX2_8**, **UART_FIFO_TX4_8**, **UART_FIFO_TX6_8**, or **UART_FIFO_TX7_8**.

pui32RxLevel is a pointer to storage for the receive FIFO level, returned as one of **UART_FIFO_RX1_8**, **UART_FIFO_RX2_8**, **UART_FIFO_RX4_8**, **UART_FIFO_RX6_8**, or **UART_FIFO_RX7_8**.

This function gets the FIFO level at which transmit and receive interrupts are generated.
Returns None.

7.1.2.16 void UARTIntClear (
 uint32_t ui32Base,
 uint32_t ui32IntFlags)

Clears UART interrupt sources.

Parameters *ui32Base* is the base address of the UART port.

ui32IntFlags is a bit mask of the interrupt sources to be cleared.

The specified UART interrupt sources are cleared, so that they no longer assert. This function must be called in the interrupt handler to keep the interrupt from being recognized again immediately upon exit.

The *ui32IntFlags* parameter has the same definition as the *ui32IntFlags* parameter to [UARTIntEnable\(\)](#).

Returns None.

7.1.2.17 void UARTIntDisable (
 uint32_t ui32Base,
 uint32_t ui32IntFlags)

Disables individual UART interrupt sources.

Parameters *ui32Base* is the base address of the UART port.

ui32IntFlags is the bit mask of the interrupt sources to be disabled.

Disables the indicated UART interrupt sources. Only the sources that are enabled can be reflected to the processor interrupt; disabled sources have no effect on the processor.

The *ui32IntFlags* parameter has the same definition as the *ui32IntFlags* parameter to [UARTIntEnable\(\)](#).

Returns None.

7.1.2.18 void UARTIntEnable (
 uint32_t ui32Base,
 uint32_t ui32IntFlags)

Enables individual UART interrupt sources.

Parameters *ui32Base* is the base address of the UART port.

ui32IntFlags is the bit mask of the interrupt sources to be enabled.

Enables the indicated UART interrupt sources. Only the sources that are enabled can be reflected to the processor interrupt; disabled sources have no effect on the processor.

The *ui32IntFlags* parameter is the logical OR of any of the following:

UART_INT_OE - Overrun Error interrupt

UART_INT_BE - Break Error interrupt

UART_INT_PE - Parity Error interrupt

UART_INT_FE - Framing Error interrupt

UART_INT_RT - Receive Timeout interrupt

UART_INT_TX - Transmit interrupt

UART_INT_RX - Receive interrupt

UART_INT_DSR - DSR interrupt

UART_INT_DCD - DCD interrupt

UART_INT_CTS - CTS interrupt

UART_INT_RI - RI interrupt

Returns None.

7.1.2.19 uint32_t UARTIntStatus (

uint32_t ui32Base,

bool bMasked)

Gets the current interrupt status.

Parameters *ui32Base* is the base address of the UART port.

bMasked is **false** if the raw interrupt status is required and **true** if the masked interrupt status is required.

This returns the interrupt status for the specified UART. Either the raw interrupt status or the status of interrupts that are allowed to reflect to the processor can be returned.

Returns Returns the current interrupt status, enumerated as a bit field of values described in [UARTIntEnable\(\)](#).

7.1.2.20 uint32_t UARTParityModeGet (

uint32_t ui32Base)

Gets the type of parity currently being used.

Parameters *ui32Base* is the base address of the UART port.

This function gets the type of parity used for transmitting data and expected when receiving data.

Returns Returns the current parity settings, specified as one of **UART_CONFIG_PAR_NONE**, **UART_CONFIG_PAR_EVEN**, **UART_CONFIG_PAR_ODD**, **UART_CONFIG_PAR_ONE**, or **UART_CONFIG_PAR_ZERO**.

7.1.2.21 void UARTParityModeSet (

uint32_t ui32Base,

uint32_t ui32Parity)

Sets the type of parity.

Parameters *ui32Base* is the base address of the UART port.

ui32Parity specifies the type of parity to use.

Sets the type of parity to use for transmitting and expect when receiving. The *ui32Parity* parameter must be one of **UART_CONFIG_PAR_NONE**, **UART_CONFIG_PAR_EVEN**, **UART_CONFIG_PAR_ODD**, **UART_CONFIG_PAR_ONE**, or **UART_CONFIG_PAR_ZERO**. The last two allow direct control of the parity bit; it is always either one or zero based on the mode.

Returns None.

7.1.2.22 void UARTRxErrorClear (

uint32_t ui32Base)

Clears all reported receiver errors.

Parameters *ui32Base* is the base address of the UART port.

This function is used to clear all receiver error conditions reported via [UARTRxErrorGet\(\)](#). If using the overrun, framing error, parity error or break interrupts, this function must be called after clearing the interrupt to ensure that later errors of the same type trigger another interrupt.

Returns None.

7.1.2.23 uint32_t UARTRxErrorGet (

uint32_t ui32Base)

Gets current receiver errors.

Parameters *ui32Base* is the base address of the UART port.

This function returns the current state of each of the 4 receiver error sources. The returned errors are equivalent to the four error bits returned via the previous call to [UARTCharGet\(\)](#) or [UARTCharGetNonBlocking\(\)](#) with the exception that the overrun error is set immediately the overrun occurs rather than when a character is next read.

Returns Returns a logical OR combination of the receiver error flags, **UART_RXERROR_FRAMING**, **UART_RXERROR_PARITY**, **UART_RXERROR_BREAK** and **UART_RXERROR_OVERRUN**.

7.1.2.24 void UARTRXIntRegister (

uint32_t ui32Base,

void(*)(void) pfnHandler)

Registers an interrupt handler for a UART RX interrupt.

Parameters *ui32Base* is the base address of the UART port.

pfnHandler is a pointer to the function to be called when the UART interrupt occurs.

This function does the actual registering of the interrupt handler. This will enable the global interrupt in the interrupt controller; specific UART interrupts must be enabled via [UARTIntEnable\(\)](#). It is the interrupt handler's responsibility to clear the interrupt source.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References [IntEnable\(\)](#), and [IntRegister\(\)](#).

7.1.2.25 void UARTRXIntUnregister (

uint32_t ui32Base)

Unregisters an interrupt handler for a UART RX interrupt.

Parameters *ui32Base* is the base address of the UART port.

This function does the actual unregistering of the interrupt handler. It will clear the handler to be called when a UART interrupt occurs. This will also mask off the interrupt in the interrupt controller so that the interrupt handler no longer is called.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References [IntDisable\(\)](#), and [IntUnregister\(\)](#).

7.1.2.26 void UARTsetLoopBack (

uint32_t ui32Base,

bool enable)

Enables Loop Back Test Mode.

Parameters *ui32Base* is the base address of the UART port.

Sets the SCICCR.LOOPBKENA to enable

Returns None.

7.1.2.27 bool UARTSpaceAvail (

uint32_t ui32Base)

Determines if there is any space in the transmit FIFO.

Parameters *ui32Base* is the base address of the UART port.

This function returns a flag indicating whether or not there is space available in the transmit FIFO.

Returns Returns **true** if there is space available in the transmit FIFO or **false** if there is no space available in the transmit FIFO.

7.1.2.28 uint32_t UARTTxIntModeGet (

uint32_t ui32Base)

Returns the current operating mode for the UART transmit interrupt.

Parameters *ui32Base* is the base address of the UART port.

This function returns the current operating mode for the UART transmit interrupt. The return value will be **UART_TXINT_MODE_EOT** if the transmit interrupt is currently set to be asserted once the transmitter is completely idle - the transmit FIFO is empty and all bits, including any stop bits, have cleared the transmitter. The return value will be **UART_TXINT_MODE_FIFO** if the interrupt is set to be asserted based upon the level of the transmit FIFO.

Returns Returns **UART_TXINT_MODE_FIFO** or **UART_TXINT_MODE_EOT**.

7.1.2.29 void UARTTxIntModeSet (

uint32_t ui32Base,

uint32_t ui32Mode)

Sets the operating mode for the UART transmit interrupt.

Parameters *ui32Base* is the base address of the UART port.

ui32Mode is the operating mode for the transmit interrupt. It may be **UART_TXINT_MODE_EOT** to trigger interrupts when the transmitter is idle or **UART_TXINT_MODE_FIFO** to trigger based on

the current transmit FIFO level.

This function allows the mode of the UART transmit interrupt to be set. By default, the transmit interrupt is asserted when the FIFO level falls past a threshold set via a call to `UARTFIFOLevelSet()`. Alternatively, if this function is called with *ui32Mode* set to **UART_TXINT_MODE_EOT**, the transmit interrupt will only be asserted once the transmitter is completely idle - the transmit FIFO is empty and all bits, including any stop bits, have cleared the transmitter.

Returns None.

7.1.2.30 void UARTTXIntRegister (

uint32_t ui32Base,

void(*)(void) pfnHandler)

Registers an interrupt handler for a UART TX interrupt.

Parameters *ui32Base* is the base address of the UART port.

pfnHandler is a pointer to the function to be called when the UART interrupt occurs.

This function does the actual registering of the interrupt handler. This will enable the global interrupt in the interrupt controller; specific UART interrupts must be enabled via [UARTIntEnable\(\)](#). It is the interrupt handler's responsibility to clear the interrupt source.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References [IntEnable\(\)](#), and [IntRegister\(\)](#).

7.1.2.31 void UARTTXIntUnregister (

uint32_t ui32Base)

Unregisters an interrupt handler for a UART TX interrupt.

Parameters *ui32Base* is the base address of the UART port.

This function does the actual unregistering of the interrupt handler. It will clear the handler to be called when a UART interrupt occurs. This will also mask off the interrupt in the interrupt controller so that the interrupt handler no longer is called.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References [IntDisable\(\)](#), and [IntUnregister\(\)](#).

The following example shows how to use the UART API to initialize the UART, transmit characters, and receive characters.

```
// Initialize the UART. Set the baud rate, number of data bits, // turn off parity, number
of stop bits, and stick mode. UARTConfigSetExpCik(UART0_BASE, SysCtlClockGet(), 38400,
(UART_CONFIG_WLEN_8 | UART_CONFIG_STOP_ONE | UART_CONFIG_PAR_NONE));
```



```
// Enable the UART. UARTEnable(UART0_BASE);  
// Check for characters. This will spin here until a character // is placed into the receive FIFO.  
while(!UARTCharsAvail(UART0_BASE)) { }  
// Get the character(s) in the receive FIFO. while(UARTCharGetNonBlocking(UART0_BASE)) { }  
// Put a character in the output buffer. UARTCharPut(UART0_BASE, 'c');  
// Disable the UART. UARTDisable(UART0_BASE);
```


8 USB Controller

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The USB APIs provide a set of functions that are used to access the Delfino USB device or host controllers. The APIs are split into groups according to the functionality provided by the USB controller present in the microcontroller. Because of this, the driver has to handle microcontrollers that have only a USB device interface, a host and/or device interface, or microcontrollers that have an OTG interface. The groups are the following: USBDev, USBHost, USBOTG, USBEndpoint, and USBFIFO. The APIs in the USBDev group are only used with microcontrollers that have a USB device controller. The APIs in the USBHost group can only be used with microcontrollers that have a USB host controller. The USBOTG APIs are used by microcontrollers with an OTG interface. With USB OTG controllers, once the mode of the USB controller is configured, the device or host APIs should be used. The remainder of the APIs are used for both USB host and USB device controllers. The USBEndpoint APIs are used to configure and access the endpoints while the USBFIFO APIs are used to configure the size and location of the FIFOs.

8.1 API Functions

Functions

uint32_t [USBDevAddrGet](#) (uint32_t ui32Base)

void [USBDevAddrSet](#) (uint32_t ui32Base, uint32_t ui32Address)

void [USBDevConnect](#) (uint32_t ui32Base)

void [USBDevDisconnect](#) (uint32_t ui32Base)

void [USBDevEndpointConfigGet](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t *pui32MaxPacketSize, uint32_t *pui32Flags)

void [USBDevEndpointConfigSet](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32MaxPacketSize, uint32_t ui32Flags)

void [USBDevEndpointDataAck](#) (uint32_t ui32Base, uint32_t ui32Endpoint, bool blsLastPacket)

void [USBDevEndpointStall](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void [USBDevEndpointStallClear](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void [USBDevEndpointStatusClear](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void [USBDevMode](#) (uint32_t ui32Base)

uint32_t [USBEndpointDataAvail](#) (uint32_t ui32Base, uint32_t ui32Endpoint)

int32_t [USBEndpointDataGet](#) (uint32_t ui32Base, uint32_t ui32Endpoint, uint8_t *pui8Data, uint32_t *pui32Size)

```
int32_t USBEndpointDataPut (uint32_t ui32Base, uint32_t ui32Endpoint, uint8_t *pui8Data,
uint32_t ui32Size)

int32_t USBEndpointDataSend (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32TransType)

void USBEndpointDataToggleClear (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void USBEndpointDMAChannel (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Channel)

void USBEndpointDMAConfigSet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Config)

void USBEndpointDMADisable (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void USBEndpointDMAEnable (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void USBEndpointPacketCountSet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Count)

uint32_t USBEndpointStatus (uint32_t ui32Base, uint32_t ui32Endpoint)

uint32_t USBFIFOAddrGet (uint32_t ui32Base, uint32_t ui32Endpoint)

void USBFIFOConfigGet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t *pui32FIFOAddress,
uint32_t *pui32FIFOSize, uint32_t ui32Flags)

void USBFIFOConfigSet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32FIFOAddress,
uint32_t ui32FIFOSize, uint32_t ui32Flags)

void USBFIFOFlush (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

uint32_t USBFrameNumberGet (uint32_t ui32Base)

uint32_t USBHostAddrGet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void USBHostAddrSet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Addr, uint32_t
ui32Flags)

void USBHostEndpointConfig (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t
ui32MaxPayload, uint32_t ui32NAKPollInterval, uint32_t ui32TargetEndpoint, uint32_t ui32Flags)

void USBHostEndpointDataAck (uint32_t ui32Base, uint32_t ui32Endpoint)

void USBHostEndpointDataToggle (uint32_t ui32Base, uint32_t ui32Endpoint, bool bDataToggle,
uint32_t ui32Flags)

void USBHostEndpointStatusClear (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

uint32_t USBHostHubAddrGet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Flags)

void USBHostHubAddrSet (uint32_t ui32Base, uint32_t ui32Endpoint, uint32_t ui32Addr, uint32_t
ui32Flags)

void USBHostMode (uint32_t ui32Base)

void USBHostPwrConfig (uint32_t ui32Base, uint32_t ui32Flags)

void USBHostPwrDisable (uint32_t ui32Base)
```

```
void USBHostPwrEnable (uint32_t ui32Base)
void USBHostPwrFaultDisable (uint32_t ui32Base)
void USBHostPwrFaultEnable (uint32_t ui32Base)
void USBHostRequestIN (uint32_t ui32Base, uint32_t ui32Endpoint)
void USBHostRequestINClear (uint32_t ui32Base, uint32_t ui32Endpoint)
void USBHostRequestStatus (uint32_t ui32Base)
void USBHostReset (uint32_t ui32Base, bool bStart)
void USBHostResume (uint32_t ui32Base, bool bStart)
uint32_t USBHostSpeedGet (uint32_t ui32Base)
void USBHostSuspend (uint32_t ui32Base)
void USBIntDisableControl (uint32_t ui32Base, uint32_t ui32Flags)
void USBIntDisableEndpoint (uint32_t ui32Base, uint32_t ui32Flags)
void USBIntEnableControl (uint32_t ui32Base, uint32_t ui32Flags)
void USBIntEnableEndpoint (uint32_t ui32Base, uint32_t ui32Flags)
void USBIntRegister (uint32_t ui32Base, void(*pfnHandler)(void))
uint32_t USBIntStatus (uint32_t ui32Base, uint32_t *pui32IntStatusEP)
uint32_t USBIntStatusControl (uint32_t ui32Base)
uint32_t USBIntStatusEndpoint (uint32_t ui32Base)
void USBIntUnregister (uint32_t ui32Base)
uint32_t USBModeGet (uint32_t ui32Base)
uint32_t USBNumEndpointsGet (uint32_t ui32Base)
void USBOTGMode (uint32_t ui32Base)
void USBOTGSessionRequest (uint32_t ui32Base, bool bStart)
void USBPHYPowerOff (uint32_t ui32Base)
void USBPHYPowerOn (uint32_t ui32Base)
```

8.1.1 Detailed Description

The USB APIs provide all of the functions needed by an application to implement a USB device or USB host stack. The APIs abstract the IN/OUT nature of endpoints based on the type of USB controller that is in use. Any API that uses the IN/OUT terminology will comply with the standard

USB interpretation of these terms. For example, an OUT endpoint on a microcontroller that has only a device interface will actually receive data on this endpoint, while a microcontroller that has a host interface will actually transmit data on an OUT endpoint.

Another important fact to understand is that all endpoints in the USB controller, whether host or device, have two "sides" to them. This allows each endpoint to both transmit and receive data. An application can use a single endpoint for both IN and OUT transactions. For example: In device mode, endpoint 1 could be configured to have BULK IN and BULK OUT handled by endpoint 1. It is important to note that the endpoint number used is the endpoint number reported to the host. For microcontrollers with host controllers, the application can use an endpoint to communicate with both IN and OUT endpoints of different types as well. For example: Endpoint 2 could be used to communicate with one device's interrupt IN endpoint and another device's bulk OUT endpoint at the same time. This effectively gives the application one dedicated control endpoint for IN or OUT control transactions on endpoint 0, and three IN endpoints and three OUT endpoints.

The USB controller has a configurable FIFOs in devices that have a USB device controller as well as those that have a host controller. The overall size of the FIFO RAM is 4096 bytes. It is important to note that the first 64 bytes of this memory are dedicated to endpoint 0 for control transactions. The remaining 4032 bytes are configurable however the application desires. The FIFO configuration is usually set at the beginning of the application and not modified once the USB controller is in use. The FIFO configuration uses the USBFIFOConfig() API to set the starting address and the size of the FIFOs that are dedicated to each endpoint.

Example: FIFO Configuration

0-64 - endpoint 0 IN/OUT (64 bytes).

64-576 - endpoint 1 IN (512 bytes).

576-1088 - endpoint 1 OUT (512 bytes).

1088-1600 - endpoint 2 IN (512 bytes). // FIFO for endpoint 1 IN starts at address 64 and is 512 bytes in size. USBFIFOConfig(USB0_BASE, USB_EP_1, 64, USB_FIFO_SZ_512, USB_EP_DEV_IN);

// FIFO for endpoint 1 OUT starts at address 576 and is 512 bytes in size. USBFIFOConfig(USB0_BASE, USB_EP_1, 576, USB_FIFO_SZ_512, USB_EP_DEV_OUT);

// FIFO for endpoint 2 IN starts at address 1088 and is 512 bytes in size. USBFIFOConfig(USB0_BASE, USB_EP_2, 1088, USB_FIFO_SZ_512, USB_EP_DEV_IN);

8.1.2 Function Documentation

8.1.2.1 uint32_t USBDevAddrGet (

uint32_t ui32Base)

Returns the current device address in device mode.

Parameters *ui32Base* specifies the USB module base address.

This function returns the current device address. This address was set by a call to [USBDevAddrSet\(\)](#).

Note This function must only be called in device mode. Returns The current device address.

8.1.2.2 void USBDevAddrSet (

uint32_t ui32Base,

uint32_t ui32Address)

Sets the address in device mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Address is the address to use for a device.

This function configures the device address on the USB bus. This address was likely received via a SET ADDRESS command from the host controller.

Note This function must only be called in device mode. Returns None.

8.1.2.3 void USBDevConnect (

uint32_t ui32Base)

Connects the USB controller to the bus in device mode.

Parameters *ui32Base* specifies the USB module base address.

This function causes the soft connect feature of the USB controller to be enabled. Call [USBDevDisconnect\(\)](#) to remove the USB device from the bus.

Note This function must only be called in device mode. Returns None.

8.1.2.4 void USBDevDisconnect (

uint32_t ui32Base)

Removes the USB controller from the bus in device mode.

Parameters *ui32Base* specifies the USB module base address.

This function causes the soft connect feature of the USB controller to remove the device from the USB bus. A call to [USBDevConnect\(\)](#) is needed to reconnect to the bus.

Note This function must only be called in device mode. Returns None.

8.1.2.5 void USBDevEndpointConfigGet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t * pui32MaxPacketSize,

uint32_t * pui32Flags)

Gets the current configuration for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

pui32MaxPacketSize is a pointer which is written with the maximum packet size for this endpoint.

pui32Flags is a pointer which is written with the current endpoint settings. On entry to the function, this pointer must contain either **USB_EP_DEV_IN** or **USB_EP_DEV_OUT** to indicate whether the IN or OUT endpoint is to be queried.

This function returns the basic configuration for an endpoint in device mode. The values returned in **pui32MaxPacketSize* and **pui32Flags* are equivalent to the *ui32MaxPacketSize* and *ui32Flags* previously passed to [USBDevEndpointConfigSet\(\)](#) for this endpoint.

Note This function must only be called in device mode. Returns None.

8.1.2.6 void USBDevEndpointConfigSet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32MaxPacketSize,

uint32_t ui32Flags)

Sets the configuration for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32MaxPacketSize is the maximum packet size for this endpoint.

ui32Flags are used to configure other endpoint settings.

This function sets the basic configuration for an endpoint in device mode. Endpoint zero does not have a dynamic configuration, so this function must not be called for endpoint zero. The *ui32Flags* parameter determines some of the configuration while the other parameters provide the rest.

The **USB_EP_MODE_** flags define what the type is for the given endpoint.

USB_EP_MODE_CTRL is a control endpoint.

USB_EP_MODE_ISOC is an isochronous endpoint.

USB_EP_MODE_BULK is a bulk endpoint.

USB_EP_MODE_INT is an interrupt endpoint.

The **USB_EP_DMA_MODE** flags determine the type of DMA access to the endpoint data FIFOs. The choice of the DMA mode depends on how the DMA controller is configured and how it is being used. See the “Using USB with the uDMA Controller” section for more information on DMA configuration.

When configuring an IN endpoint, the **USB_EP_AUTO_SET** bit can be specified to cause the automatic transmission of data on the USB bus as soon as *ui32MaxPacketSize* bytes of data are written into the FIFO for this endpoint. This option is commonly used with DMA as no interaction is required to start the transmission of data.

When configuring an OUT endpoint, the **USB_EP_AUTO_REQUEST** bit is specified to trigger the request for more data once the FIFO has been drained enough to receive *ui32MaxPacketSize* more bytes of data. Also for OUT endpoints, the **USB_EP_AUTO_CLEAR** bit can be used to clear the data packet ready flag automatically once the data has been read from the FIFO. If this option is not used, this flag must be manually cleared via a call to [USBDevEndpointStatusClear\(\)](#). Both of these settings can be used to remove the need for extra calls when using the controller in DMA mode.

Note This function must only be called in device mode. Returns None.

8.1.2.7 void USBDevEndpointDataAck (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
bool bIsLastPacket )
```

Acknowledge that data was read from the given endpoint's FIFO in device mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

bIsLastPacket indicates if this packet is the last one.

This function acknowledges that the data was read from the endpoint's FIFO. The *bIsLastPacket* parameter is set to a **true** value if this is the last in a series of data packets on endpoint zero. The *bIsLastPacket* parameter is not used for endpoints other than endpoint zero. This call can be used if processing is required between reading the data and acknowledging that the data has been read.

Note This function must only be called in device mode. Returns None.

8.1.2.8 void USBDevEndpointStall (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Flags )
```

Stalls the specified endpoint in device mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies the endpoint to stall.

ui32Flags specifies whether to stall the IN or OUT endpoint.

This function causes the endpoint number passed in to go into a stall condition. If the *ui32Flags* parameter is **USB_EP_DEV_IN**, then the stall is issued on the IN portion of this endpoint. If the *ui32Flags* parameter is **USB_EP_DEV_OUT**, then the stall is issued on the OUT portion of this endpoint.

Note This function must only be called in device mode. Returns None.

8.1.2.9 void USBDevEndpointStallClear (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32Flags)

Clears the stall condition on the specified endpoint in device mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies which endpoint to remove the stall condition.

ui32Flags specifies whether to remove the stall condition from the IN or the OUT portion of this endpoint.

This function causes the endpoint number passed in to exit the stall condition. If the *ui32Flags* parameter is **USB_EP_DEV_IN**, then the stall is cleared on the IN portion of this endpoint. If the *ui32Flags* parameter is **USB_EP_DEV_OUT**, then the stall is cleared on the OUT portion of this endpoint.

Note This function must only be called in device mode. Returns None.

8.1.2.10 void USBDevEndpointStatusClear (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32Flags)

Clears the status bits in this endpoint in device mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags are the status bits that are cleared.

This function clears the status of any bits that are passed in the *ui32Flags* parameter. The *ui32Flags* parameter can take the value returned from the [USBEndpointStatus\(\)](#) call.

Note This function must only be called in device mode. Returns None.

8.1.2.11 void USBDevMode (uint32_t ui32Base)

Change the mode of the USB controller to device.

Parameters *ui32Base* specifies the USB module base address.

This function changes the mode of the USB controller to device mode.

Note This function must only be called on microcontrollers that support OTG operation and have the DEVMODOTG bit in the USBGPCS register. Returns None.

8.1.2.12 uint32_t USBEndpointDataAvail (uint32_t ui32Base, uint32_t ui32Endpoint)

Determine the number of bytes of data available in a given endpoint's FIFO.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

This function returns the number of bytes of data currently available in the FIFO for the given receive (OUT) endpoint. It may be used prior to calling [USBEndpointDataGet\(\)](#) to determine the size of buffer required to hold the newly-received packet.

Returns This call returns the number of bytes available in a given endpoint FIFO.

8.1.2.13 int32_t USBEndpointDataGet (uint32_t ui32Base, uint32_t ui32Endpoint, uint8_t * pui8Data, uint32_t * pui32Size)

Retrieves data from the given endpoint's FIFO.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

pui8Data is a pointer to the data area used to return the data from the FIFO.

pui32Size is initially the size of the buffer passed into this call via the *pui8Data* parameter. It is set to the amount of data returned in the buffer.

This function returns the data from the FIFO for the given endpoint. The *pui32Size* parameter indicates the size of the buffer passed in the *pui32Data* parameter. The data in the *pui32Size* parameter is changed to match the amount of data returned in the *pui8Data* parameter. If a zero-byte packet is received, this call does not return an error but instead just returns a zero in the *pui32Size* parameter. The only error case occurs when there is no data packet available.

Returns This call returns 0, or -1 if no packet was received.

8.1.2.14 int32_t USBEndpointDataPut (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint8_t * pui8Data,

uint32_t ui32Size)

Puts data into the given endpoint's FIFO.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

pui8Data is a pointer to the data area used as the source for the data to put into the FIFO.

ui32Size is the amount of data to put into the FIFO.

This function puts the data from the *pui8Data* parameter into the FIFO for this endpoint. If a packet is already pending for transmission, then this call does not put any of the data into the FIFO and returns -1. Care must be taken to not write more data than can fit into the FIFO allocated by the call to [USBFIFOConfigSet\(\)](#).

Returns This call returns 0 on success, or -1 to indicate that the FIFO is in use and cannot be written.

8.1.2.15 int32_t USBEndpointDataSend (

uint32_t ui32Base,

uint32_t ui32Endpoint,

```
uint32_t ui32TransType )
```

Starts the transfer of data from an endpoint's FIFO.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32TransType is set to indicate what type of data is being sent.

This function starts the transfer of data from the FIFO for a given endpoint. This function is called if the **USB_EP_AUTO_SET** bit was not enabled for the endpoint. Setting the *ui32TransType* parameter allows the appropriate signaling on the USB bus for the type of transaction being requested. The *ui32TransType* parameter must be one of the following:

USB_TRANS_OUT for OUT transaction on any endpoint in host mode.

USB_TRANS_IN for IN transaction on any endpoint in device mode.

USB_TRANS_IN_LAST for the last IN transaction on endpoint zero in a sequence of IN transactions.

USB_TRANS_SETUP for setup transactions on endpoint zero.

USB_TRANS_STATUS for status results on endpoint zero.

Returns This call returns 0 on success, or -1 if a transmission is already in progress.

8.1.2.16 void USBEndpointDataToggleClear (

```
uint32_t ui32Base,
```

```
uint32_t ui32Endpoint,
```

```
uint32_t ui32Flags )
```

Sets the data toggle on an endpoint to zero.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies the endpoint to reset the data toggle.

ui32Flags specifies whether to access the IN or OUT endpoint.

This function causes the USB controller to clear the data toggle for an endpoint. This call is not valid for endpoint zero and can be made with host or device controllers.

The *ui32Flags* parameter must be one of **USB_EP_HOST_OUT**, **USB_EP_HOST_IN**, **USB_EP_DEV_OUT**, or **USB_EP_DEV_IN**.

Returns None.

8.1.2.17 void USBEndpointDMAChannel (

```
uint32_t ui32Base,  
uint32_t ui32Endpoint,  
uint32_t ui32Channel )
```

Sets the DMA channel to use for a given endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies which endpoint's FIFO address to return.

ui32Channel specifies which DMA channel to use for which endpoint.

This function is used to configure which DMA channel to use with a given endpoint. Receive DMA channels can only be used with receive endpoints and transmit DMA channels can only be used with transmit endpoints. As a result, the 3 receive and 3 transmit DMA channels can be mapped to any endpoint other than 0. The values that are passed into the *ui32Channel* value are the UDMA_CHANNEL_USBEP* values defined in *udma.h*.

Note This function only has an effect on microcontrollers that have the ability to change the DMA channel for an endpoint. Calling this function on other devices has no effect. Returns None.

8.1.2.18 void USBEndpointDMAConfigSet (

```
uint32_t ui32Base,  
uint32_t ui32Endpoint,  
uint32_t ui32Config )
```

Configure the DMA settings for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Config specifies the configuration options for an endpoint. This function configures the DMA settings for a given endpoint without changing other options that may already be configured. In order for the DMA transfer to be enabled, the *USBEndpointDMAEnable()* function must be called before starting the DMA transfer. The configuration options are passed in the *ui32Config* parameter and can have the values described below.

One of the following values to specify direction: - *USB_EP_HOST_OUT* or *USB_EP_DEV_IN* – This setting is used with DMA transfers from memory to the USB controller. –
USB_EP_HOST_IN or *USB_EP_DEV_OUT* – This setting is used with DMA transfers from the USB controller to memory.

One of the following values: - *USB_EP_DMA_MODE_0* (default) – This setting is typically used for transfer that do not span multiple *USB_EP_DMA_MODE_1* – This setting is typically used for transfer that span multiple packets and do not require interrupts between packets.

Values only used with *USB_EP_HOST_OUT* or *USB_EP_DEV_IN* : – *USB_EP_AUTOSET* – This setting is used to allow transmit DMA transfers to automatically be sent when a full packet is loaded into a FIFO. This is needed for full-speed devices.

Values only used with `USB_EP_HOST_IN` or `USB_EP_DEV_OUT` : `~USB_EP_AUTO_CLEAR` –
This setting is used to allow receive DMA transfer to automatically be acknowledged as they are received. This is needed with `USB_EP_HOST_IN`.

Values only used with `USB_EP_HOST_IN` : `~USB_EP_AUTO_REQUEST` –
This setting is used to allow receive DMA transfer to automatically request a new IN transaction when the previous transfer has ended.

Example: Set endpoint 1 receive endpoint to automatically acknowledge request and automatically generate a new IN request in host mode.

```

//! // !! // Configure endpoint 1 for receiving multiple packets using DMA. //! // !!
USBEndpointDMAConfigSet(USB0_BASE, USB_EP1, USB_EP_HOST_IN | ~USB_EP_DMA_MODE1 | ~USB_EP_AUTO_REQUEST);
Example: Set endpoint 2 transmit endpoint to automatically send each packet in host mode when
spanning multiple packets.

```

```

//! // !! // Configure endpoint 1 for transmitting multiple packets using DMA. //! // !!
USBEndpointDMAConfigSet(USB0_BASE, USB_EP2, USB_EP_HOST_OUT | ~USB_EP_DMA_MODE1 | ~USB_EP_AUTO_REQUEST);
Returns None.

```

8.1.2.19 void USBEndpointDMADisable (

```

uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Flags )

```

Disable DMA on a given endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags specifies which direction to disable.

This function disables DMA on a given endpoint to allow non-DMA USB transactions to generate interrupts normally. The *ui32Flags* parameter must be `USB_EP_DEV_IN` or `USB_EP_DEV_OUT`; all other bits are ignored.

Returns None.

8.1.2.20 void USBEndpointDMAEnable (

```

uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Flags )

```

Enable DMA on a given endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags specifies which direction and what mode to use when enabling DMA.

This function enables DMA on a given endpoint and configures the mode according to the values in the *ui32Flags* parameter. The *ui32Flags* parameter must have **USB_EP_DEV_IN** or **USB_EP_DEV_OUT** set. Once this function is called the only DMA or error interrupts are generated by the USB controller.

Note If this function is called when an endpoint is configured in DMA mode 0 the USB controller does not generate an interrupt. Returns None.

8.1.2.21 void USBEndpointPacketCountSet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32Count)

Sets the number of packets to request when transferring multiple bulk packets.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint index to target for this write.

ui32Count is the number of packets to request.

This function sets the number of consecutive bulk packets to request when transferring multiple bulk packets with DMA.

Note This feature is not available on all Tiva devices. Please check the data sheet to determine if the USB controller has a DMA controller or if it must use the uDMA controller for DMA transfers. Returns None.

8.1.2.22 uint32_t USBEndpointStatus (

uint32_t ui32Base,

uint32_t ui32Endpoint)

Returns the current status of an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

This function returns the status of a given endpoint. If any of these status bits must be cleared, then the [USBDevEndpointStatusClear\(\)](#) or the [USBHostEndpointStatusClear\(\)](#) functions must be called.

The following are the status flags for host mode:

USB_HOST_IN_PID_ERROR - PID error on the given endpoint.

USB_HOST_IN_NOT_COMP - The device failed to respond to an IN request.

USB_HOST_IN_STALL - A stall was received on an IN endpoint.

USB_HOST_IN_DATA_ERROR - There was a CRC or bit-stuff error on an IN endpoint in Isochronous mode.

USB_HOST_IN_NAK_TO - NAKs received on this IN endpoint for more than the specified timeout period.

USB_HOST_IN_ERROR - Failed to communicate with a device using this IN endpoint.

USB_HOST_IN_FIFO_FULL - This IN endpoint's FIFO is full.

USB_HOST_IN_PKTRDY - Data packet ready on this IN endpoint.

USB_HOST_OUT_NAK_TO - NAKs received on this OUT endpoint for more than the specified timeout period.

USB_HOST_OUT_NOT_COMP - The device failed to respond to an OUT request.

USB_HOST_OUT_STALL - A stall was received on this OUT endpoint.

USB_HOST_OUT_ERROR - Failed to communicate with a device using this OUT endpoint.

USB_HOST_OUT_FIFO_NE - This endpoint's OUT FIFO is not empty.

USB_HOST_OUT_PKTEND - The data transfer on this OUT endpoint has not completed.

USB_HOST_EP0_NAK_TO - NAKs received on endpoint zero for more than the specified timeout period.

USB_HOST_EP0_ERROR - The device failed to respond to a request on endpoint zero.

USB_HOST_EP0_IN_STALL - A stall was received on endpoint zero for an IN transaction.

USB_HOST_EP0_IN_PKTRDY - Data packet ready on endpoint zero for an IN transaction.

The following are the status flags for device mode:

USB_DEV_OUT_SENT_STALL - A stall was sent on this OUT endpoint.

USB_DEV_OUT_DATA_ERROR - There was a CRC or bit-stuff error on an OUT endpoint.

USB_DEV_OUT_OVERRUN - An OUT packet was not loaded due to a full FIFO.

USB_DEV_OUT_FIFO_FULL - The OUT endpoint's FIFO is full.

USB_DEV_OUT_PKTRDY - There is a data packet ready in the OUT endpoint's FIFO.

USB_DEV_IN_NOT_COMP - A larger packet was split up, more data to come.

USB_DEV_IN_SENT_STALL - A stall was sent on this IN endpoint.

USB_DEV_IN_UNDERRUN - Data was requested on the IN endpoint and no data was ready.

USB_DEV_IN_FIFO_NE - The IN endpoint's FIFO is not empty.

USB_DEV_IN_PKTEND - The data transfer on this IN endpoint has not completed.

USB_DEV_EP0_SETUP_END - A control transaction ended before Data End condition was sent.

USB_DEV_EP0_SENT_STALL - A stall was sent on endpoint zero.

USB_DEV_EP0_IN_PKTEND - The data transfer on endpoint zero has not completed.

USB_DEV_EP0_OUT_PKTRDY - There is a data packet ready in endpoint zero's OUT FIFO.

Returns The current status flags for the endpoint depending on mode.

8.1.2.23 uint32_t USBFIFOAddrGet (

uint32_t ui32Base,

uint32_t ui32Endpoint)

Returns the absolute FIFO address for a given endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies which endpoint's FIFO address to return.

This function returns the actual physical address of the FIFO. This address is needed when the USB is going to be used with the uDMA controller and the source or destination address must be set to the physical FIFO address for a given endpoint.

Returns None.

8.1.2.24 void USBFIFOConfigGet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t * pui32FIFOAddress,

uint32_t * pui32FIFOSize,

uint32_t ui32Flags)

Returns the FIFO configuration for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

pui32FIFOAddress is the starting address for the FIFO.

ui32FIFOSize is the size of the FIFO as specified by one of the `USB_FIFO_SZ_` values.

ui32Flags specifies what information to retrieve from the FIFO configuration.

This function returns the starting address and size of the FIFO for a given endpoint. Endpoint zero does not have a dynamically configurable FIFO, so this function must not be called for endpoint zero. The *ui32Flags* parameter specifies whether the endpoint's OUT or IN FIFO must be read. If in host mode, the *ui32Flags* parameter must be **USB_EP_HOST_OUT** or **USB_EP_HOST_IN**, and if in device mode, the *ui32Flags* parameter must be either **USB_EP_DEV_OUT** or **USB_EP_DEV_IN**.

Returns None.

8.1.2.25 void USBFIFOConfigSet (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32FIFOAddress,
uint32_t ui32FIFOSize,
uint32_t ui32Flags )
```

Sets the FIFO configuration for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32FIFOAddress is the starting address for the FIFO.

ui32FIFOSize is the size of the FIFO specified by one of the `USB_FIFO_SZ_` values.

ui32Flags specifies what information to set in the FIFO configuration.

This function configures the starting FIFO RAM address and size of the FIFO for a given endpoint. Endpoint zero does not have a dynamically configurable FIFO, so this function must not be called for endpoint zero. The *ui32FIFOSize* parameter must be one of the values in the **USB_FIFO_SZ_** values.

The *ui32FIFOAddress* value must be a multiple of 8 bytes and directly indicates the starting address in the USB controller's FIFO RAM. For example, a value of 64 indicates that the FIFO starts 64 bytes into the USB controller's FIFO memory. The *ui32Flags* value specifies whether the endpoint's OUT or IN FIFO must be configured. If in host mode, use **USB_EP_HOST_OUT** or **USB_EP_HOST_IN**, and if in device mode, use **USB_EP_DEV_OUT** or **USB_EP_DEV_IN**.

Returns None.

8.1.2.26 void USBFIFOFlush (

```
uint32_t ui32Base,
```

uint32_t ui32Endpoint,
uint32_t ui32Flags)

Forces a flush of an endpoint's FIFO.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags specifies if the IN or OUT endpoint is accessed.

This function forces the USB controller to flush out the data in the FIFO. The function can be called with either host or device controllers and requires the *ui32Flags* parameter be one of **USB_EP_HOST_OUT**, **USB_EP_HOST_IN**, **USB_EP_DEV_OUT**, or **USB_EP_DEV_IN**.

Returns None.

8.1.2.27 uint32_t USBFrameNumberGet (
uint32_t ui32Base)

Get the current frame number.

Parameters *ui32Base* specifies the USB module base address.

This function returns the last frame number received.

Returns The last frame number received.

8.1.2.28 uint32_t USBHostAddrGet (
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Flags)

Gets the current functional device address for an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags determines if this is an IN or an OUT endpoint.

This function returns the current functional address that an endpoint is using to communicate with a device. The *ui32Flags* parameter determines if the IN or OUT endpoint's device address is returned.

Note This function must only be called in host mode. Returns Returns the current function address being used by an endpoint.

8.1.2.29 void USBHostAddrSet (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Addr,
uint32_t ui32Flags )
```

Sets the functional address for the device that is connected to an endpoint in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Addr is the functional address for the controller to use for this endpoint.

ui32Flags determines if this is an IN or an OUT endpoint.

This function configures the functional address for a device that is using this endpoint for communication. This *ui32Addr* parameter is the address of the target device that this endpoint is communicating with. The *ui32Flags* parameter indicates if the IN or OUT endpoint is set.

Note This function must only be called in host mode. Returns None.

8.1.2.30 void USBHostEndpointConfig (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32MaxPayload,
uint32_t ui32NAKPollInterval,
uint32_t ui32TargetEndpoint,
uint32_t ui32Flags )
```

Sets the base configuration for a host endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32MaxPayload is the maximum payload for this endpoint.

ui32NAKPollInterval is the either the NAK timeout limit or the polling interval, depending on the type of endpoint.

ui32TargetEndpoint is the endpoint that the host endpoint is targeting.

ui32Flags are used to configure other endpoint settings.

This function sets the basic configuration for the transmit or receive portion of an endpoint in host mode. The *ui32Flags* parameter determines some of the configuration while the other parameters provide the rest. The *ui32Flags* parameter determines whether this is an IN endpoint (**USB_EP_HOST_IN** or **USB_EP_DEV_IN**) or an OUT endpoint (**USB_EP_HOST_OUT** or **USB_EP_DEV_OUT**), whether this is a Full speed endpoint (**USB_EP_SPEED_FULL**) or a Low speed endpoint (**USB_EP_SPEED_LOW**).

The **USB_EP_MODE_** flags control the type of the endpoint.

USB_EP_MODE_CTRL is a control endpoint.

USB_EP_MODE_ISOC is an isochronous endpoint.

USB_EP_MODE_BULK is a bulk endpoint.

USB_EP_MODE_INT is an interrupt endpoint.

The *ui32NAKPollInterval* parameter has different meanings based on the **USB_EP_MODE** value and whether or not this call is being made for endpoint zero or another endpoint. For endpoint zero or any Bulk endpoints, this value always indicates the number of frames to allow a device to NAK before considering it a timeout. If this endpoint is an isochronous or interrupt endpoint, this value is the polling interval for this endpoint.

For interrupt endpoints, the polling interval is the number of frames between interrupt IN requests to an endpoint and has a range of 1 to 255. For isochronous endpoints this value represents a polling interval of $2^{(ui32NAKPollInterval - 1)}$ frames. When used as a NAK timeout, the *ui32NAKPollInterval* value specifies $2^{(ui32NAKPollInterval - 1)}$ frames before issuing a time out.

There are two special time out values that can be specified when setting the *ui32NAKPollInterval* value. The first is **MAX_NAK_LIMIT**, which is the maximum value that can be passed in this variable. The other is **DISABLE_NAK_LIMIT**, which indicates that there is no limit on the number of NAKs.

The **USB_EP_DMA_MODE_** flags enable the type of DMA used to access the endpoint's data FIFOs. The choice of the DMA mode depends on how the DMA controller is configured and how it is being used. See the "Using USB with the uDMA Controller" section for more information on DMA configuration.

When configuring the OUT portion of an endpoint, the **USB_EP_AUTO_SET** bit is specified to cause the transmission of data on the USB bus to start as soon as the number of bytes specified by *ui32MaxPayload* has been written into the OUT FIFO for this endpoint.

When configuring the IN portion of an endpoint, the **USB_EP_AUTO_REQUEST** bit can be specified to trigger the request for more data once the FIFO has been drained enough to fit *ui32MaxPayload* bytes. The **USB_EP_AUTO_CLEAR** bit can be used to clear the data packet ready flag automatically once the data has been read from the FIFO. If this option is not used, this flag must be manually cleared via a call to [USBDevEndpointStatusClear\(\)](#) or [USBHostEndpointStatusClear\(\)](#).

Note This function must only be called in host mode. Returns None.

8.1.2.31 void USBHostEndpointDataAck (

```
uint32_t ui32Base,
uint32_t ui32Endpoint )
```

Acknowledge that data was read from the given endpoint's FIFO in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

This function acknowledges that the data was read from the endpoint's FIFO. This call is used if processing is required between reading the data and acknowledging that the data has been read.

Note This function must only be called in host mode. Returns None.

8.1.2.32 void USBHostEndpointDataToggle (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
bool bDataToggle,
uint32_t ui32Flags )
```

Sets the value data toggle on an endpoint in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint specifies the endpoint to reset the data toggle.

bDataToggle specifies whether to set the state to DATA0 or DATA1.

ui32Flags specifies whether to set the IN or OUT endpoint.

This function is used to force the state of the data toggle in host mode. If the value passed in the *bDataToggle* parameter is **false**, then the data toggle is set to the DATA0 state, and if it is **true** it is set to the DATA1 state. The *ui32Flags* parameter can be **USB_EP_HOST_IN** or **USB_EP_HOST_OUT** to access the desired portion of this endpoint. The *ui32Flags* parameter is ignored for endpoint zero.

Note This function must only be called in host mode. Returns None.

8.1.2.33 void USBHostEndpointStatusClear (

```
uint32_t ui32Base,
uint32_t ui32Endpoint,
uint32_t ui32Flags )
```

Clears the status bits in this endpoint in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags are the status bits that are cleared.

This function clears the status of any bits that are passed in the *ui32Flags* parameter. The *ui32Flags* parameter can take the value returned from the [USBEndpointStatus\(\)](#) call.

Note This function must only be called in host mode. Returns None.

8.1.2.34 uint32_t USBHostHubAddrGet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32Flags)

Gets the current device hub address for this endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Flags determines if this is an IN or an OUT endpoint.

This function returns the current hub address that an endpoint is using to communicate with a device. The *ui32Flags* parameter determines if the device address for the IN or OUT endpoint is returned.

Note This function must only be called in host mode. Returns This function returns the current hub address being used by an endpoint.

8.1.2.35 void USBHostHubAddrSet (

uint32_t ui32Base,

uint32_t ui32Endpoint,

uint32_t ui32Addr,

uint32_t ui32Flags)

Sets the hub address for the device that is connected to an endpoint.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

ui32Addr is the hub address and port for the device using this endpoint. The hub address must be defined in bits 0 through 6 with the port number in bits 8 through 14.

ui32Flags determines if this is an IN or an OUT endpoint.

This function configures the hub address for a device that is using this endpoint for communication. The *ui32Flags* parameter determines if the device address for the IN or the OUT endpoint is configured by this call and sets the speed of the downstream device. Valid values are one of **USB_EP_HOST_OUT** or **USB_EP_HOST_IN** optionally ORed with **USB_EP_SPEED_LOW**.

Note This function must only be called in host mode. Returns None.

8.1.2.36 void USBHostMode (uint32_t ui32Base)

Change the mode of the USB controller to host.

Parameters *ui32Base* specifies the USB module base address.

This function changes the mode of the USB controller to host mode.

Note This function must only be called on microcontrollers that support OTG operation and have the DEVMODOTG bit in the USBGPCS register. Returns None.

8.1.2.37 void USBHostPwrConfig (uint32_t ui32Base, uint32_t ui32Flags)

Sets the configuration for USB power fault.

Parameters *ui32Base* specifies the USB module base address.

ui32Flags specifies the configuration of the power fault.

This function controls how the USB controller uses its external power control pins (USBnPFILT and USBnEPEN). The flags specify the power fault level sensitivity, the power fault action, and the power enable level and source.

One of the following can be selected as the power fault level sensitivity:

USB_HOST_PWRFLT_LOW - An external power fault is indicated by the pin being driven low.

USB_HOST_PWRFLT_HIGH - An external power fault is indicated by the pin being driven high.

One of the following can be selected as the power fault action:

USB_HOST_PWRFLT_EP_NONE - No automatic action when power fault detected.

USB_HOST_PWRFLT_EP_TRI - Automatically tri-state the USBnEPEN pin on a power fault.

USB_HOST_PWRFLT_EP_LOW - Automatically drive USBnEPEN pin low on a power fault.

USB_HOST_PWRFLT_EP_HIGH - Automatically drive USBnEPEN pin high on a power fault.

One of the following can be selected as the power enable level and source:

USB_HOST_PWREN_MAN_LOW - USBnEPEN is driven low by the USB controller when [USB-HostPwrEnable\(\)](#) is called.

USB_HOST_PWREN_MAN_HIGH - USBnEPEN is driven high by the USB controller when [USB-HostPwrEnable\(\)](#) is called.

USB_HOST_PWREN_AUTOLOW - USBnEPEN is driven low by the USB controller automatically if [USBOTGSessionRequest\(\)](#) has enabled a session.

USB_HOST_PWREN_AUTOHIGH - USBnEPEN is driven high by the USB controller automatically if [USBOTGSessionRequest\(\)](#) has enabled a session.

On devices that support the VBUS glitch filter, the **USB_HOST_PWREN_FILTER** can be added to ignore small, short drops in VBUS level caused by high power consumption. This feature is mainly used to avoid causing VBUS errors caused by devices with high in-rush current.

Note This function must only be called on microcontrollers that support host mode or OTG operation. Returns None.

8.1.2.38 void USBHostPwrDisable (
uint32_t ui32Base)

Disables the external power pin.

Parameters *ui32Base* specifies the USB module base address.

This function disables the USBnEPEN signal, which disables an external power supply in host mode operation.

Note This function must only be called in host mode. Returns None.

8.1.2.39 void USBHostPwrEnable (
uint32_t ui32Base)

Enables the external power pin.

Parameters *ui32Base* specifies the USB module base address.

This function enables the USBnEPEN signal, which enables an external power supply in host mode operation.

Note This function must only be called in host mode. Returns None.

8.1.2.40 void USBHostPwrFaultDisable (

```
uint32_t ui32Base )
```

Disables power fault detection.

Parameters *ui32Base* specifies the USB module base address.

This function disables power fault detection in the USB controller.

Note This function must only be called in host mode. Returns None.

8.1.2.41 void USBHostPwrFaultEnable (

```
uint32_t ui32Base )
```

Enables power fault detection.

Parameters *ui32Base* specifies the USB module base address.

This function enables power fault detection in the USB controller. If the USBnPFLT pin is not in use, this function must not be used.

Note This function must only be called in host mode. Returns None.

8.1.2.42 void USBHostRequestIN (

```
uint32_t ui32Base,
```

```
uint32_t ui32Endpoint )
```

Schedules a request for an IN transaction on an endpoint in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

This function schedules a request for an IN transaction. When the USB device being communicated with responds with the data, the data can be retrieved by calling [USBEndpointDataGet\(\)](#) or via a DMA transfer.

Note This function must only be called in host mode and only for IN endpoints. Returns None.

8.1.2.43 void USBHostRequestINClear (

```
uint32_t ui32Base,
```

```
uint32_t ui32Endpoint )
```

Clears a scheduled IN transaction for an endpoint in host mode.

Parameters *ui32Base* specifies the USB module base address.

ui32Endpoint is the endpoint to access.

This function clears a previously scheduled IN transaction if it is still pending. This function is used to safely disable any scheduled IN transactions if the endpoint specified by *ui32Endpoint* is reconfigured for communications with other devices.

Note This function must only be called in host mode and only for IN endpoints. Returns None.

8.1.2.44 void USBHostRequestStatus (

uint32_t ui32Base)

Issues a request for a status IN transaction on endpoint zero.

Parameters *ui32Base* specifies the USB module base address.

This function is used to cause a request for a status IN transaction from a device on endpoint zero. This function can only be used with endpoint zero as that is the only control endpoint that supports this ability. This function is used to complete the last phase of a control transaction to a device and an interrupt is signaled when the status packet has been received.

Returns None.

8.1.2.45 void USBHostReset (

uint32_t ui32Base,

bool bStart)

Handles the USB bus reset condition.

Parameters *ui32Base* specifies the USB module base address.

bStart specifies whether to start or stop signaling reset on the USB bus.

When this function is called with the *bStart* parameter set to **true**, this function causes the start of a reset condition on the USB bus. The caller must then delay at least 20ms before calling this function again with the *bStart* parameter set to **false**.

Note This function must only be called in host mode. Returns None.

8.1.2.46 void USBHostResume (

uint32_t ui32Base,

bool bStart)

Handles the USB bus resume condition.

Parameters *ui32Base* specifies the USB module base address.

bStart specifies if the USB controller is entering or leaving the resume signaling state.

When in device mode, this function brings the USB controller out of the suspend state. This call must first be made with the *bStart* parameter set to **true** to start resume signaling. The device application must then delay at least 10ms but not more than 15ms before calling this function with the *bStart* parameter set to **false**.

When in host mode, this function signals devices to leave the suspend state. This call must first be made with the *bStart* parameter set to **true** to start resume signaling. The host application must then delay at least 20ms before calling this function with the *bStart* parameter set to **false**. This action causes the controller to complete the resume signaling on the USB bus.

Returns None.

8.1.2.47 uint32_t USBHostSpeedGet (

uint32_t ui32Base)

Returns the current speed of the USB device connected.

Parameters *ui32Base* specifies the USB module base address. This function returns the current speed of the USB bus in host mode.

Example: Get the USB connection speed.

```
/*! // !!! // Get the connection speed of the device connected to the USB controller. //! // !!!
USBHostSpeedGet(USB0_BASE); //!
```

Note This function must only be called in host mode. Returns one of the following: **USB_LOW_SPEED**, **USB_FULL_SPEED**, or **USB_UNDEF_SPEED**.

8.1.2.48 void USBHostSuspend (

uint32_t ui32Base)

Puts the USB bus in a suspended state.

Parameters *ui32Base* specifies the USB module base address.

When used in host mode, this function puts the USB bus in the suspended state.

Note This function must only be called in host mode. Returns None.

8.1.2.49 void USBIntDisableControl (

uint32_t ui32Base,

uint32_t ui32Flags)

Disables control interrupts on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

ui32Flags specifies which control interrupts to disable.

This function disables the control interrupts for the USB controller specified by the *ui32Base* parameter. The *ui32Flags* parameter specifies which control interrupts to disable. The flags passed in the *ui32Flags* parameters must be the definitions that start with **USB_INTCTRL_*** and not any other **USB_INT** flags.

Returns None.

8.1.2.50 void USBIntDisableEndpoint (

uint32_t ui32Base,

uint32_t ui32Flags)

Disables endpoint interrupts on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

ui32Flags specifies which endpoint interrupts to disable.

This function disables endpoint interrupts for the USB controller specified by the *ui32Base* parameter. The *ui32Flags* parameter specifies which endpoint interrupts to disable. The flags passed in the *ui32Flags* parameters must be the definitions that start with **USB_INTEP_*** and not any other **USB_INT** flags.

Returns None.

8.1.2.51 void USBIntEnableControl (

uint32_t ui32Base,

uint32_t ui32Flags)

Enables control interrupts on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

ui32Flags specifies which control interrupts to enable.

This function enables the control interrupts for the USB controller specified by the *ui32Base* parameter. The *ui32Flags* parameter specifies which control interrupts to enable. The flags passed in the *ui32Flags* parameters must be the definitions that start with **USB_INTCTRL_*** and not any other **USB_INT** flags.

Returns None.

8.1.2.52 void USBIntEnableEndpoint (

uint32_t ui32Base,

```
uint32_t ui32Flags )
```

Enables endpoint interrupts on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

ui32Flags specifies which endpoint interrupts to enable.

This function enables endpoint interrupts for the USB controller specified by the *ui32Base* parameter. The *ui32Flags* parameter specifies which endpoint interrupts to enable. The flags passed in the *ui32Flags* parameters must be the definitions that start with **USB_INTEP_*** and not any other **USB_INT** flags.

Returns None.

8.1.2.53 void USBIntRegister (

```
uint32_t ui32Base,
```

```
void(*)(void) pfnHandler )
```

Registers an interrupt handler for the USB controller.

Parameters *ui32Base* specifies the USB module base address.

pfnHandler is a pointer to the function to be called when a USB interrupt occurs.

This function registers the handler to be called when a USB interrupt occurs and enables the global USB interrupt in the interrupt controller. The specific desired USB interrupts must be enabled via a separate call to `USBIntEnable()`. It is the interrupt handler's responsibility to clear the interrupt sources via calls to `USBIntStatusControl()` and `USBIntStatusEndpoint()`.

See Also [IntRegister\(\)](#) for important information about registering interrupt handlers. Returns None.

References `IntEnable()`, and `IntRegister()`.

8.1.2.54 uint32_t USBIntStatus (

```
uint32_t ui32Base,
```

```
uint32_t * pui32IntStatusEP )
```

Returns the control interrupt status on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

ui32IntStatusEP is a pointer to the variable which holds the endpoint interrupt status from RXIS And TXIS.

This function reads control interrupt status for a USB controller. This call returns the current status

for control interrupts only, the endpoint interrupt status is retrieved by calling [USBIntStatusEndpoint\(\)](#). The bit values returned are compared against the **USB_INTCTRL_*** values.

The following are the meanings of all **USB_INTCTRL_*** flags and the modes for which they are valid. These values apply to any calls to [USBIntStatusControl\(\)](#), [USBIntEnableControl\(\)](#), and [USBIntDisableControl\(\)](#). Some of these flags are only valid in the following modes as indicated in the parentheses: Host, Device, and OTG.

USB_INTCTRL_ALL - A full mask of all control interrupt sources.

USB_INTCTRL_VBUS_ERR - A VBUS error has occurred (Host Only).

USB_INTCTRL_SESSION - Session Start Detected on A-side of cable (OTG Only).

USB_INTCTRL_SESSION_END - Session End Detected (Device Only)

USB_INTCTRL_DISCONNECT - Device Disconnect Detected (Host Only)

USB_INTCTRL_CONNECT - Device Connect Detected (Host Only)

USB_INTCTRL_SOF - Start of Frame Detected.

USB_INTCTRL_BABBLE - USB controller detected a device signaling past the end of a frame (Host Only)

USB_INTCTRL_RESET - Reset signaling detected by device (Device Only)

USB_INTCTRL_RESUME - Resume signaling detected.

USB_INTCTRL_SUSPEND - Suspend signaling detected by device (Device Only)

USB_INTCTRL_MODE_DETECT - OTG cable mode detection has completed (OTG Only)

USB_INTCTRL_POWER_FAULT - Power Fault detected (Host Only)

Note This call clears the source of all of the control status interrupts. Returns Returns the status of the control interrupts for a USB controller. This is the value of USBIS.

8.1.2.55 uint32_t USBIntStatusControl (

uint32_t ui32Base)

Returns the control interrupt status on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

This function reads control interrupt status for a USB controller. This call returns the current status for control interrupts only, the endpoint interrupt status is retrieved by calling [USBIntStatusEndpoint\(\)](#). The bit values returned are compared against the **USB_INTCTRL_*** values.

The following are the meanings of all **USB_INTCTRL_*** flags and the modes for which they are valid. These values apply to any calls to [USBIntStatusControl\(\)](#), [USBIntEnableControl\(\)](#), and [USBIntDisableControl\(\)](#). Some of these flags are only valid in the following modes as indicated in the parentheses: Host, Device, and OTG.

USB_INTCTRL_ALL - A full mask of all control interrupt sources.

USB_INTCTRL_VBUS_ERR - A VBUS error has occurred (Host Only).

USB_INTCTRL_SESSION - Session Start Detected on A-side of cable (OTG Only).

USB_INTCTRL_SESSION_END - Session End Detected (Device Only)

USB_INTCTRL_DISCONNECT - Device Disconnect Detected (Host Only)

USB_INTCTRL_CONNECT - Device Connect Detected (Host Only)

USB_INTCTRL_SOF - Start of Frame Detected.

USB_INTCTRL_BABBLE - USB controller detected a device signaling past the end of a frame (Host Only)

USB_INTCTRL_RESET - Reset signaling detected by device (Device Only)

USB_INTCTRL_RESUME - Resume signaling detected.

USB_INTCTRL_SUSPEND - Suspend signaling detected by device (Device Only)

USB_INTCTRL_MODE_DETECT - OTG cable mode detection has completed (OTG Only)

USB_INTCTRL_POWER_FAULT - Power Fault detected (Host Only)

Note This call clears the source of all of the control status interrupts. Returns Returns the status of the control interrupts for a USB controller.

8.1.2.56 uint32_t USBIntStatusEndpoint (

uint32_t ui32Base)

Returns the endpoint interrupt status on a given USB controller.

Parameters *ui32Base* specifies the USB module base address.

This function reads endpoint interrupt status for a USB controller. This call returns the current status for endpoint interrupts only, the control interrupt status is retrieved by calling [USBIntStatusControl\(\)](#). The bit values returned are compared against the **USB_INTEP_*** values. These values are grouped into classes for **USB_INTEP_HOST_*** and **USB_INTEP_DEV_*** values to handle both host and device modes with all endpoints.

Note This call clears the source of all of the endpoint interrupts. Returns Returns the status of the endpoint interrupts for a USB controller.

8.1.2.57 void USBIntUnregister (

uint32_t ui32Base)

Unregisters an interrupt handler for the USB controller.

Parameters *ui32Base* specifies the USB module base address.

This function unregisters the interrupt handler. This function also disables the USB interrupt in the interrupt controller.

See Also [IntRegister\(\)](#) for important information about registering or unregistering interrupt handlers. Returns None.

References [IntDisable\(\)](#), and [IntUnregister\(\)](#).

8.1.2.58 uint32_t USBModeGet (uint32_t ui32Base)

Returns the current operating mode of the controller.

Parameters *ui32Base* specifies the USB module base address.

This function returns the current operating mode on USB controllers with OTG or Dual mode functionality.

For OTG controllers:

The function returns one of the following values on OTG controllers: **USB_OTG_MODE_ASIDE_HOST**, **USB_OTG_MODE_ASIDE_DEV**, **USB_OTG_MODE_BSIDE_HOST**, **USB_OTG_MODE_BSIDE_DEV**, **USB_OTG_MODE_NONE**.

USB_OTG_MODE_ASIDE_HOST indicates that the controller is in host mode on the A-side of the cable.

USB_OTG_MODE_ASIDE_DEV indicates that the controller is in device mode on the A-side of the cable.

USB_OTG_MODE_BSIDE_HOST indicates that the controller is in host mode on the B-side of the cable.

USB_OTG_MODE_BSIDE_DEV indicates that the controller is in device mode on the B-side of the cable. If an OTG session request is started with no cable in place, this mode is the default.

USB_OTG_MODE_NONE indicates that the controller is not attempting to determine its role in the system.

For Dual Mode controllers:

The function returns one of the following values: **USB_DUAL_MODE_HOST**, **USB_DUAL_MODE_DEVICE**, or **USB_DUAL_MODE_NONE**.

USB_DUAL_MODE_HOST indicates that the controller is acting as a host.

USB_DUAL_MODE_DEVICE indicates that the controller acting as a device.

USB_DUAL_MODE_NONE indicates that the controller is not active as either a host or device.

Returns Returns **USB_OTG_MODE_ASIDE_HOST**, **USB_OTG_MODE_ASIDE_DEV**, **USB_OTG_MODE_BSIDE_HOST**, **USB_OTG_MODE_BSIDE_DEV**, **USB_OTG_MODE_NONE**, **USB_DUAL_MODE_HOST**, **USB_DUAL_MODE_DEVICE**, or **USB_DUAL_MODE_NONE**.

8.1.2.59 uint32_t USBNumEndpointsGet (

```
uint32_t ui32Base )
```

Returns the number of USB endpoint pairs on the device.

Parameters *ui32Base* specifies the USB module base address.

This function returns the number of endpoint pairs supported by the USB controller corresponding to the passed base address. The value returned is the number of IN or OUT endpoints available and does not include endpoint 0 (the control endpoint). For example, if 15 is returned, there are 15 IN and 15 OUT endpoints available in addition to endpoint 0.

Returns Returns the number of IN or OUT endpoints available.

8.1.2.60 void USBOTGMode (

```
uint32_t ui32Base )
```

Change the mode of the USB controller to OTG.

Parameters *ui32Base* specifies the USB module base address.

This function changes the mode of the USB controller to OTG mode. This function is only valid on microcontrollers that have the OTG capabilities.

Returns None.

8.1.2.61 void USBOTGSessionRequest (

```
uint32_t ui32Base,
```

```
bool bStart )
```

Starts or ends a session.

Parameters *ui32Base* specifies the USB module base address.

bStart specifies if this call starts or ends a session.

This function is used in OTG mode to start a session request or end a session. If the *bStart* parameter is set to **true**, then this function starts a session and if it is **false** it ends a session.

Returns None.

8.1.2.62 void USBPHYPowerOff (

```
uint32_t ui32Base )
```

Powers off the USB PHY.

Parameters *ui32Base* specifies the USB module base address.

This function powers off the USB PHY, reducing the current consumption of the device. While in the powered-off state, the USB controller is unable to operate.

Returns None.

8.1.2.63 void USBPHYPowerOn (uint32_t ui32Base)

Powers on the USB PHY.

Parameters *ui32Base* specifies the USB module base address.

This function powers on the USB PHY, enabling it return to normal operation. By default, the PHY is powered on, so this function must only be called if [USBPHYPowerOff\(\)](#) has previously been called.

Returns None. This example code makes the calls necessary to configure end point 1, in device mode, as a bulk IN end point. The first call configures end point 1 to have a maximum packet size of 64 bytes and makes it a bulk IN end point. The call to [USBFIFOConfigSet\(\)](#) sets the starting address to 64 bytes in and 64 bytes long. It specifies **USB_EP_DEV_IN** to indicate that this is a device mode IN endpoint. The next two calls demonstrate how to fill the data FIFO for this endpoint and then have it scheduled for transmission on the USB bus. The [USBEndpointDataPut\(\)](#) call puts data into the FIFO but does not actually start the data transmission. The [USBEndpointDataSend\(\)](#) call will schedule the transmission to go out the next time the host controller requests data on this endpoint.

```
// Configure Endpoint 1. USBDevEndpointConfigSet(USB0_BASE, USB_EP_1, 64, DIS-  
ABLE_NAK_LIMIT, USB_EP_MODE_BULK | USB_EP_DEV_IN);
```

```
// Configure FIFO as a device IN endpoint FIFO starting at address 64 // and is 64 bytes in size.  
USBFIFOConfig(USB0_BASE, USB_EP_1, 64, USB_FIFO_SZ_64, USB_EP_DEV_IN);
```

```
...
```

```
// Put the data in the FIFO. USBEndpointDataPut(USB0_BASE, USB_EP_1, pucData, 64);
```

```
// Start the transmission of data. USBEndpointDataSend(USB0_BASE, USB_EP_1,  
USB_TRANS_IN);
```

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