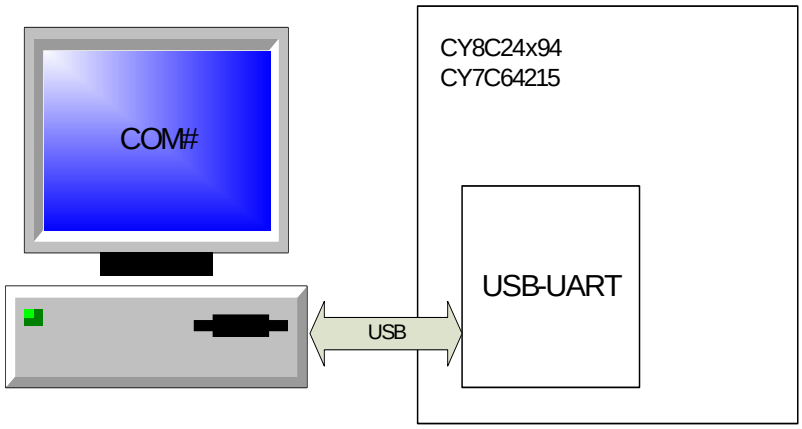
USBUART Device Data Sheet

USBUART vX.Y

Resources	PSoC® Blocks			API Memory (Bytes)		Pins (per External I/O)
	Digital	Analog CT	Analog SC	Flash	RAM	
CY8C24x94, CY8CLED04				1900	60	2
CY7C64215				1900	60	2

Features and Overview

- The USBUART Device uses a USB interface to emulate a COM port.
- UART-like high-level functions are available on the PSoC device side.



USBUART Device Block Diagrams

Functional Description

Many embedded applications use the RS-232 interface to communicate with external systems such as PCs, especially when debugging. But in the PC world, the RS-232 COM port is about to disappear from most new computers, leaving USB as the replacement for serial communication. The simplest way to migrate a device to USB is to emulate RS-232 over the USB bus. The primary advantage of this method is that PC applications will use the USB connection as an RS-232 COM connection, making it very simple to debug. This method uses a standard Windows® driver that is included with all versions Microsoft® Windows from Windows 98SE through Windows XP.

The USB Communication Device Class (CDC) specification defines many communication models, including an abstract control model for serial emulation over USB in Section 3.6.2.1. See the CDC specification version 1.1 for details. The Microsoft Windows USB modem driver, usbser.sys, conforms to this specification.

When a new device connects to a Windows PC the first time, Windows will ask the user to provide a driver. An INF file is required to install drivers on Windows 2000 and later. Microsoft Windows does not provide a standard INF file for the usbser.sys driver. In order to install a device that emulates RS-232 over USB, you must supply an INF file that maps the attached device to the Microsoft CDC drivers. The necessary INF file for USBUART projects is generated automatically and is located in the project LIB folder. After supplying the INF file, the driver allows the USB device to be enumerated as a COM port.

The settings in a terminal application (baud rate, data bits, parity, stop bits, and flow control) will not affect the performance of data transmissions because it is a USB device and the USB protocol is used to control data flow. However, the terminal settings with the exception of flow control can be retrieved with specific API calls to use with an RS-232 device if needed. The flow control setting cannot be retrieved because it is not supported by the CDC driver.

Use the following API calls to retrieve specific settings:

- USBUART_dwGetDTERate
- USBUART_bGetCharFormat
- USBUART_bGetParityType
- USBUART_bGetDataBits
- USBUART_bGetLineControlBitmap

USB Compliance

USB drivers may present various bus conditions to the device, including Bus Resets, and different timing requirements. Not all of these can be correctly illustrated in the examples provided. It is your responsibilty to design applications that conform to the USB spec.

USB Compliance for Self Powered Devices

In the *USB Compliance Checklist* there is a question that reads, “Is the device’s pull-up active only when V_{BUS} is high?”

The question lists Section 7.1.5 in the *Universal Serial Bus Specification Revision 2.0* as a reference. This section reads, in part, “The voltage source on the pull-up resistor must be derived from or controlled by the power supplied on the USB cable such that when V_{BUS} is removed, the pull-up resistor does not supply current on the data line to which it is attached.”

If the device that you are creating will be self-powered, you must connect a GPIO pin to V_{BUS} through a resistive network and write firmware to monitor the status of the GPIO. Application Note AN15813, *Monitoring the EZ-USB FX2LP VBUS*, explains the necessary hardware and software components required. You can use the USBFS_Start() and USBFS_Stop() API routines to control the D+ and D- pin pull-ups. The pull-up resistor does not supply power to the data line until you call USBFS_Start(). USBFS_Stop() disconnects the pull-up resistor from the data pin.

Section 9.1.1.2 in the *Universal Serial Bus Specification Revision 2.0* says, “Devices report their power source capability through the configuration descriptor. The current power source is reported as part of a device’s status. Devices may change their power source at any time, e.g., from self- to bus-powered.“ The device responds to GET_STATUS requests based on the status set with the USBFS_SetPowerStatus() function. To set the correct status, USBFS_SetPowerStatus() should be called at least once if your device is configured as self-powered. You should also call the USBFS_SetPowerStatus() function any time your device changes status.

Timing

The USBUART Device User Module supports USB 2.0 Full Speed operation on the CY8C24x94 and CY7C64215 devices.

Parameters

Vendor ID

Each USB product must have a unique combination of Vendor ID (VID) and Product ID (PID). This 2-byte string contains the Vendor ID. Vendor IDs are assigned by the USB Implementers Forum.

Product ID

Each USB product must have a unique combination of Vendor ID (VID) and Product ID (PID). This 2-byte string contains the Product ID. Product IDs are assigned by the manufacturer and must be unique to the product.

VendorString

A free form string describing the manufacturer of the product. Do not use apostrophes (‘) in the VendorString.

ProductString

A free form string describing the product. Do not use apostrophes (‘) in the ProductString.

SerialNumberType

Choose the type of Serial Number. The possible settings are given in the following table.

Parameter	Description
None	This device have no serial number. Value entered in SerialNumberString parameter is ignored.
Automatic	The serial number is automatically generated from PSoC device serialization number. Serial number is 24 hex characters. Value entered in SerialNumberString parameter is ignored.
Manual	Used value entered in the SerialNumberString parameter.

SerialNumberString

Sets the serial number for the device. Is reccommended to use numeric value. Applied only if SerialNumberType parameter is set to Manual.

DevicePower

Choose the device power source. The device can be self-powered or powered from the USB.

MaxPower

Set the power (in mA) consumed from the USB bus when the device is powered from the USB bus. If the device is self-powered this parameter is ignored. The minimum is 1 mA and the maximum is 500 mA. Normally you will set this to 100 mA for a low power device or 500 mA for a high power device.

Application Programming Interface

The Application Programming Interface (API) routines are provided as part of the user module to allow you to deal with the module at a higher level. This section specifies the interface to each function together with related constants provided by the include files.

Note In this, as in all user module APIs, the values of the A and X register may be altered by calling an API function. It is the responsibility of the calling function to preserve the values of A and X prior to the call if those values are required after the call. This “registers are volatile” policy was selected for efficiency reasons and has been in force since version 1.0 of PSoC Designer. The C compiler automatically takes care of this requirement. Assembly language programmers must ensure their code observes the policy, too. Though some user module API function may leave A and X unchanged, there is no guarantee they will do so in the future

The following tables list the USBUART supplied API functions.

USBUART API

Function	Description
void **USBUART_Start**(BYTE bVoltage)	Enable the user module for use with the device.
void **USBUART_Stop**(void)	Disable the user module.
BOOL **USBUART_Init**(void)	Initialize the USBUART module. Returns a nonzero value if the USBUART is successfully initialized.
void **USBUART_Write**(BYTE * pData, BYTE bLength)	Sends bLength bytes from pData array to the PC.
void **USBUART_CWrite**(const BYTE * pData, BYTE bLength)	Sends bLength bytes from constant (ROM) pData array to the PC.
void **USBUART_PutString**(BYTE * pStr)	Sends a NULL terminated string pStr to the PC.
void **USBUART_CPutString**(const BYTE * pStr)	Sends a constant (ROM) NULL terminated string pStr to the PC.
void **USBUART_PutChar**(BYTE bChar)	Sends one character to the PC
void **USBUART_PutCRLF**(void)	Sends a carriage return (0x0D) and a line feed (0x0A) to the PC.
void **USBUART_PutSHexByte**(BYTE bValue)	Sends a two character hex representation of bValue to the PC.
void **USBUART_PutSHexInt**(INT iValue)	Sends a four character hex representation of iValue to the PC.
BYTE **USBUART_bGetRxCount**(void)	Returns the current byte count ready for read.
BYTE **USBUART_bTxIsReady**(void)	Returns a nonzero value if USBUART is ready to send data.
BYTE **USBUART_Read**(BYTE * pData, BYTE bLength)	Reads the specified number of bytes from the RX buffer and places it in the RAM array specified by pData. The function returns the number of bytes remaining in RX buffer and operation status.
void **USBUART_ReadAll**(BYTE * pData)	Reads all available data from the RX buffer and places it in the RAM array specified by pData.
WORD **USBUART_ReadChar**(void)	Returns one byte from the RX buffer in the LSB of the return value. The function also returns the operations status and number of bytes remaining in the RX buffer in the MSB of the return value.
BYTE **USBUART_bCheckUSBActivity**(void)	Checks and clears the USB Bus Activity Flag. Returns a one if the USB was active since the last check, otherwise returns zero.
DWORD ***USBUART_dwGetDTERate**(DWORD * dwDTERate)	Returns the data terminal rate set for this port in bits per second.
BYTE **USBUART_bGetCharFormat**(void)	Returns the number of stop bits.
BYTE **USBUART_bGetParityType**(void)	Returns the parity type.

USBUART API *(continued)*

Function	Description
BYTE **USBUART_bGetDataBits**(void)	Returns the number of data bits.
BYTE **USBUART_bGetLineControlBitmap**(void)	Returns the DTE and RTS signal state.
void **USBUART_SendStateNotify**(BYTE bState)	Sends notification about the current UART state to the PC.
void **USUART_SetPowerStatus**(BYTE bPowerStatus)	Sets the device to self powered or bus powered

USBUART_Start

Description:

Performs all required operations to start the USBUART Device User Module.

C Prototype:

```
void USBUART_Start(BYTE bVoltage)
```

Assembly:

```
mov   A, USBUART_5V_OPERATION   ; Select the Voltage level
call  USBUART_Start             ; Call the Start Function
```

Parameters:

bVoltage is the operating voltage of the chip, passed in the Accumulator. This will determine whether the voltage regulator will be enabled for 5V operation or pass through mode will be used for 3.3V operation. Symbolic names are provided in C and assembly, and their associated values are given in the following table.

Mask	Value	Description
USBUART_3V_OPERATION	0x02	Disable the voltage regulator and pass-through Vcc for pull-up
USBUART_5V_OPERATION	0x03	Enable the voltage regulator and use the regulator for pull-up

Return Value:

None

Side Effects:

The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_Stop

Description:

Performs all necessary shutdown tasks required for the USBUART Device User Module.

C Prototype:

```
void  USBUART_Stop(void)
```

Assembly:

```
call  USBUART_Stop
```

Parameters:
None

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the CUR_PP page pointer register is modified.

USBUART_Init

Description:
Try to initialize the USBUART device and set up communication with the PC.

C Prototype:
```
BOOL  USBUART_Init(void)
```

Assembly:
```
call  USBUART_Init
```

Parameters:
None

Return Value:
Returns a nonzero value in the accumulator if the device initializes successfully. Returns a 0 if initialization failed. The user module can operate only after successful initialization.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and CUR_PP page pointer registers is modified.

USBUART_Write

Description:
Sends bLength characters from the location specified by (RAM) pointer pData to the PC.

C Prototype:
```
void  USBUART_Write(BYTE * pData, BYTE bLength)
```

Assembly:
```
mov   A,20              ; Load array count
push  A
mov   A,>pData          ; Load MSB part of pointer to RAM string
push  A
mov   A,<pData          ; Load LSB part of pointer to RAM string
push  A
call  USBUART_Write     ; Make call to function
add   SP,253            ; Reset stack pointer to original position
```

Parameters:
pData is a pointer to a data array. The maximum length of the data array is 32 bytes.

bLength is the number of bytes to be transferred from the array and sent to the PC. Valid values are between 0 and 32.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_CWrite

Description:
Sends bLength characters from the location specified by (ROM) pointer pData to the PC.

C Prototype:
```
void  USBUART_CWrite(const BYTE * pData, BYTE bLength)
```

Assembly:
```
mov   A,20              ; Load array count
push  A
mov   A,>pData          ; Load MSB part of pointer to ROM string
push  A
mov   A,<pData          ; Load LSB part of pointer to ROM string
push  A
call  USBUART_CWrite    ; Make call to function
add   SP,253            ; Reset stack pointer to original position
```

Parameters:
pData is a pointer to a data array in ROM. Maximum length of the data array is 32 bytes.

bLength is the number of bytes to be transferred from the array and sent to the PC. Valid values are between 0 and 32.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_PutString

Description:
Sends a null terminated (RAM) string to the PC.

C Prototype:
```
void USBUART_PutString(BYTE * pStr)
```

Assembler:
```
mov  A,>pStr            ; Load MSB part of pointer to RAM based null
                        ; terminated string
mov  X,<pStr            ; Load LSB part of pointer to RAM based null
                        ; terminated string
call USBUART_PutString  ; Call function to send string out
```

Parameters:
pStr: Pointer to the string to be sent to PC. The MSB is passed in the Accumulator and the LSB is

passed in the X register. The maximum string length is 32 bytes including the terminating null character.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_CPutString

Description:
Sends a null terminated (ROM) string to the PC.

C Prototype:
```
void USBUART_CPutString(const BYTE * pStr)
```

Assembler:
```
mov  A,>pStr            ; Load MSB part of pointer to ROM based null
                        ; terminated string
mov  X,<pStr            ; Load LSB part of pointer to ROM based null
                        ; terminated string
call USBUART_PutString  ; Call function to send string out
```

Parameters:
pStr: Pointer to the string to be sent to the PC. The MSB is passed in the Accumulator and the LSB is passed in the X register. The maximum string length is 32 bytes including the terminating null character.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_PutChar

Description:
Writes a single character to the PC.

C Prototype:
```
void USBUART_PutChar(BYTE bChar)
```

Assembler:
```
mov  A,0x33            ; Load ASCII character "3" in A
call USBUART_PutChar   ; Call function to send single character to PC
```

Parameters:
bChar: Character to be sent to the PC. Data is passed in the Accumulator.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is

true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_PutCRLF

Description:

Sends a carriage return (0x0D) and line feed (0x0A) to the PC.

C Prototype:

```
void USBUART_PutCRLF(void)
```

Assembler:

```
call USBUART_PutCRLF       ; Send a carriage return and line feed out
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_PutSHexByte

Description:

Sends a two byte ASCII Hex representation of the data to the PC.

C Prototype:

```
void USBUART_PutSHexByte(BYTE bValue)
```

Assembler:

```
mov  A,0x33               ; Load data to be sent
call USBUART_PutSHexByte  ; Call function to output hex representation of
                          ; data. The output for this value would be "33".
```

Parameters:

bValue: Byte to be converted to an ASCII string (hex representation). Data is passed in the Accumulator.

Return Value:

None

Side Effects:

The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_PutSHexInt

Description:

Sends a four byte ASCII hex representation of the data to the PC.

C Prototype:

```
void USBUART_PutSHexInt(INT iValue)
```

Assembler:

```
mov  A,0x34           ; Load LSB in A
mov  X,0x12           ; Load MSB in X
call UART_PutSHexInt  ; Call function to output hex representation of data.
                      ; The output for this value would be "1234".
```

Parameters:

iValue: Integer to be converted to ASCII string (hex representation). The MSB is passed in the X register and the LSB is passed in Accumulator

Return Value:

None

Side Effects:

The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_bGetRxCount

Description:

This function returns the number of bytes that were received from the PC and are waiting in the RX buffer.

C Prototype:

```
BYTE  USBUART_bGetRxCount(void)
```

Assembly:

```
call  USB_bGetEPCount
```

Parameters:

None

Return Value:

Returns the current byte count in A.

Side Effects:

The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP page pointer register are modified.

USBUART_bTxIsReady

Description:

Returns a nonzero value if the TX buffer is ready to send more data. Otherwise it returns zero.

C Prototype:

```
BYTE  USBUART_bTxIsReady(void)
```

Assembly:

```
call  USBUART_bTxIsready
```

Parameters:

None

Return Value:

If TX buffer can accept data then this function returns a nonzero value. Otherwise a zero is returned.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions.

USBUART_Read

Description:
Reads bLength bytes of received data from the RX Buffer and places it in a data array specified by pData.

C Prototype:
```
BYTE  USBUART_Read(BYTE * pData, BYTE bLength)
```

Assembly:
```
mov A, 25              ; Load count
push A
mov A, >pData          ; Load MSB part of pointer to RAM array
push A
mov A, <pData          ; Load LSB part of pointer to RAM array
push A
call  USBUART_Read
```

Parameters:
pData is a pointer to a data array. Maximum length of the data array is 32 bytes.

bLength is the number of bytes to be read to the array. Valid values are between 0 and 32.

Return Value:
Returns the number of bytes remaining in the RX buffer using bit 0..6 of the Accumulator and the MSb (bit 7) of the Accumulator indicates an error condition. Error conditions usually occur when you request more bytes than are available in the buffer. The data from the RX buffer is placed in the data array specified by pData.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_ReadAll

Description:
Reads all bytes of received data from the RX buffer and places it in a data array specified by pData.

C Prototype:
```
void  USBUART_ReadAll(BYTE * pData)
```

Assembly:
```
mov  A,>pData           ; Load MSB part of pointer to RAM buffer
mov  X,<pData           ; Load LSB part of pointer to RAM buffer
call  USBUART_ReadAll
```

Parameters:
pData is a pointer to a data array. The MSB is passed in the Accumulator and the LSB is passed in the X register. The maximum size of the data array is 32 bytes.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_ReadChar

Description:
Reads one byte of received data from the RX Buffer.

C Prototype:
```
WORD  USBUART_ReadChar(void)
```
Assembly:
```
call  USBUART_ReadChar
```
Parameters:
None

Return Value:
The MSB of the returned value (Accumulator) contains the number of bytes remaining in the RX buffer using bits 0..6. Bit 7 indicates error status. Bit 7 is set to one if the buffer is empty when the function is called. The LSB of the returned value (X) contains a character from buffer.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_bCheckUSBActivity

Description:
Checks for activity on the USB.

C Prototype:
```
BYTE  USBUART_bCheckUSBActivity(void)
```
Assembly:
```
call  USB_bCheckUSBActivity
```
Parameters:
None

Return Value:
Returns one in the Accumulator if the USB was active since the last check, otherwise returns zero.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions.

USBUART_dwGetDTERate

Description:
Returns the data terminal rate set for this port in bits per second. Pass the function a pointer to a DWORD. The function returns the DTE rate in the location referenced by the pointer.

C Prototype:
```
DWORD * USBUART_dwGetDTERate(DWORD * dwDTERate)
```
Assembly:
```
mov  A,>dwDTERate       ; Load MSB part of pointer
mov  X,<dwDTERate       ; Load LSB part of pointer
call  USBUART_dwGetDTERate
```
Parameters:
dwDTERate: A pointer to where the DTE rate will be stored when the function returns.

Return Value:
Stores the DTE rate DWORD value in the location referenced by the pointer it was passed, and then returns a pointer to that location.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the IDX_PP and the CUR_PP page pointer registers are modified.

USBUART_bGetCharFormat

Description:
Returns the number of stop bits.

C Prototype:
```
BYTE  USBUART_bGetCharFormat(void)
```
Assembly:
```
call  USBUART_bGetCharFormat
```
Parameters:
None

Return Value:
Returns number of stop bits in Accumulator. Symbolic names provided in C and assembly, and their associated values are given in the following table.

Mask	Value	Description
USBUART_1_STOPBITS	0x00	1 stop bit
USBUART_1_5_STOPBITS	0x01	1.5 stop bits
USBUART_2_STOPBITS	0x02	2 stop bits

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the CUR_PP page pointer registers are modified.

USBUART_bGetParityType

Description:
Returns the parity type.

C Prototype:
BYTE USBUART_bGetParityType(void)

Assembly:
call USBUART_bGetParityType

Parameters:
None

Return Value:
Returns the parity type in Accumulator. Symbolic names provided in C and assembly, and their associated values are given in the following table.

Mask	Value	Description
USBUART_PARITY_NONE	0x00	No parity
USBUART_PARITY_ODD	0x01	Parity odd
USBUART_PARITY_EVEN	0x02	Parity even
USBUART_PARITY_MARK	0x03	Mark parity
USBUART_PARITY_SPACE	0x04	Space parity

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the CUR_PP page pointer registers are modified.

USBUART_bGetDataBits

Description:
Returns the number of data bits.

C Prototype:
```
BYTE  USBUART_bGetDataBits(void)
```

Assembly:
```
call  USBUART_bGetDataBits
```

Parameters:
None

Return Value:
Returns the number of data bits in the Accumulator. The number can be 5, 6, 7, 8 or 16.

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the CUR_PP page pointer registers are modified.

USBUART_bGetLineControlBitmap

Description:
Returns a bitmap with the state of the RS-232 style control signal.

C Prototype:
```
BYTE  USBUART_bGetLineControlBitmap(void)
```

Assembly:
```
call  USBUART_bGetLineControlBitmap
```

Parameters:
None

Return Value:
Returns a bitmap with the state of the control signal in the Accumulator. Each bit of the bitmap can be treated individually. Bits D7..D2 are reserved. Symbolic names are provided in C and assembly, and their associated values are given in the following table.

Mask	Value	Description
USBUART_RTS	0x02	RTS (1 – activate carrier; 0 – deactivate carrier)
USBUART_DTR	0x01	DTR (1 – present; 0 – not present)

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the CUR_PP page pointer registers are modified.

USBUART_SendStateNotify

Description:
Sends notification to the PC about the UART status.

C Prototype:
```
void  USBUART_SendStateNotify(BYTE bState)
```

Assembly:
```
mov  A, (USBUART_DCD + USBUART_DSR)
call  USBUART_SendStateNotify
```

Parameters:
bState bitmap with the state of the control signal in Accumulator. Each of the bits in the bitmap can be treated individually. Symbolic names provided in C and assembly, and their associated values are given in the following table.

Mask	Value	Description
USBUART_DCD	0x01	RS-232 DCD signal
USBUART_DSR	0x02	RS-232 DSR signal
USBUART_BREAK	0x04	State of the break detection mechanism
USBUART_RING	0x08	State of the ring detection signal.
USBUART_FRAMING_ERR	0x10	A framing error has occurred.
USBUART_PARITY_ERR	0x20	A parity error has occurred.
USBUART_OVERRUN	0x40	Received data has been discarded due to an overrun.

Return Value:
None

Side Effects:
The A and X registers may be modified by this or future implementations of this function. The same is true for all RAM page pointer registers in the large memory model. When necessary, it is the calling function's responsibility to preserve the values across calls to fastcall16 functions. Currently only the

CUR_PP and IDX_PP page pointer registers are modified.

USBUART_SetPowerStatus

Description:

Sets the current power status. Set the power status to one for self powered or zero for bus powered. The device will reply to USB GET_STATUS requests based on this value. This allows the device to properly report its status for USB Chapter 9 compliance. Devices may change their power source from self powered to bus powered at any time and report their current power source as part of the device status. You should call this function any time your device changes from self powered to bus powered or vice versa, and set the status appropriately.

C Prototype:

```
void USBUART_SetPowerStatus(BYTE bPowerStaus);
```

Assembly:

```
MOV   A, USB_DEVICE_STATUS_SELF_POWERED      ; Select self powered
call  USBUART_SetPowerStatus
```

Parameters:

bPowerStatus contains the desired power status, one for self powered or zero for bus powered. Symbolic names are provided in C and assembly, and their associated values are given here:

State	Value	Description
USB_DEVICE_STATUS_BUS_POWERED	0x00	Set the device to bus powered.
USB_DEVICE_STATUS_SELF_POWERED	0x01	Set the device to self powered.

Return Value:

None

Side Effects:

The A and X registers may be modified by this or future implementations of this function. This is true for all RAM page pointer registers in the Large Memory Model. When necessary, it is the responsibility of the calling function to preserve the values across calls to fastcall16 functions.

Sample Code

The following code illustrates how to use the USBUART user module in a simple application. When a new device connects to a Windows PC for the first time, Windows will ask the user to provide a driver. An INF file is required to install drivers on Windows 2000 and later. Microsoft Windows does not provide a standard INF file for the usbser.sys driver supplied with Windows. In order to install a device that emulates RS-232 over USB, you must supply an INF file that maps the attached device to the Microsoft usbser.sys driver. The necessary INF file for USBUART projects is generated automatically and is located in the project LIB folder. Use this INF file to install the device. Once the driver is installed, this device enumerates as a COM port and simply echoes any received symbol back to the PC.

```
BYTE Len;
BYTE pData[32];
void main()
{
    M8C_EnableGInt;                          //Enable Global Interrupts
    USBUART_Start(USBUART_5V_OPERATION);     //Start USBUART 5V operation
    while(!USBUART_Init());                  //Wait for Device to initialize

    while(1)
    {
```

```
            Len = USBUART_bGetRxCount();       //Get count of ready data
            if (Len)
            {
                USBUART_ReadAll(pData);        //Read all data rom RX
                while (!USBUART_bTxIsReady()); //If TX is ready
                USBUART_Write(pData, Len);     //Echo
             }
        }
    }
```

The equivalent code, written in Assembly, is:

```
include "m8c.inc"       ; part specific constants and macros
include "memory.inc"    ; Constants & macros for SMM/LMM and Compiler
include "PSoCAPI.inc"   ; PSoC API definitions for all User Modules

AREA bss (RAM, REL)

Len: blk 1
pData: blk 32

export _main

AREA text (ROM, REL)

_main:

M8C_EnableGInt           ; Enable Global Interrupts

MOV   A, USBUART_5V_OPERATION
LCALL USBUART_Start      ; Start USBUART 5V operation

deviceInit:              ; Wait for Device to initialize
LCALL USBUART_Init
CMP   A,0
JZ    deviceInit

mainLoop:
LCALL USBUART_bGetRxCount
MOV   [Len],A            ; Get count of ready data

CMP   [Len],0            ; Check if Len is 0
JZ    mainLoop

mov   A,>pData           ; Load MSB part of pointer to RAM buffer
mov   X,<pData           ; Load LSB part of pointer to RAM buffer
call  USBUART_ReadAll    ; Read all data rom RX

txReady:
LCALL USBUART_bTxIsReady ; Check to see if TX is ready
CMP   A,0
JZ    txReady

                         ; Echo data
mov   A,[Len]            ; Load array count
push  A
mov   A,>pData          ; Load MSB part of pointer to RAM string
push  A
```

```
mov   A,<pData          ; Load LSB part of pointer to RAM string
push  A
call  USBUART_Write
add   SP,253            ; Reset stack pointer to original position

jmp   mainLoop
```

Configuration Registers

This section describes the PSoC Resource Registers used or modified by the USBUART Device User Module.

Resource EP0_CNTL: Bank 0 reg[56] Endpoint0 Control Register

Bit	7	6	5	4	3	2	1	0
Value	Setup Received	IN Received	OUT Received	ACK'd Transaction	Mode			

Setup Received: When this bit is one, it indicates a valid SETUP packet has been received and ACKed. This bit is forced high from the start of the data packet phase of the SETUP transaction, until the start of the ACK packet returned by the SIE. The CPU is prevented from clearing this bit during this interval. After this interval, the bit will remain set until cleared by firmware. While this bit is set to one, the CPU cannot write to the EP0_DRx registers. This prevents firmware from overwriting an incoming SETUP transaction before firmware has a chance to read the SETUP data. This bit is cleared by any nonlocked writes to the register.

IN Received: When this is one, it indicates a valid IN packet has been received. This bit is set to one after the host acknowledges an IN data packet. When zero, this bit indicates either that no IN has been received or that the host did not acknowledge the IN data by sending an ACK handshake. It is cleared to zero by any nonlocked writes to the register.

OUT Received: When this bit is one, it indicates a valid OUT packet has been received and ACKed. This bit is set to one after the last received packet in an OUT transaction. When zero this bit indicates no OUT packets have been received. It is cleared to zero by any nonlocked writes to the register.

ACK'd Transaction: This bit is one whenever the SIE engages in a transaction to the register's endpoint that completes with a ACK packet. This bit is zero by any nonlocked writes to the register.

Mode: The mode controls how the USB SIE responds to traffic and how the USB SIE will change the mode of that endpoint as a result of host packets to the endpoint.

Mode	Description	Mode	Description
1h	NAK IN/OUT Accept NAK NAK NAK IN and OUT token.	9h	ACK OUT (Stall = 0) Ignore Ignore ACK This mode is changed by the SIE to mode 8h on issuance of ACK handshake to an OUT.
2h	Status OUT Only Accept STALL Check For control endpoint, STALL IN and ACK zero byte OUT.	Ah	Reserved Ignore Ignore Ignore
3h	Status IN/ OUT Accept STALL STALL For control endpoint, STALL IN and OUT token.	Bh	ACK OUT – Status IN Accept TX 0 Byte ACK ACK the OUT token or send zero byte data for IN token.
4h	Reserved Ignore Ignore Ignore	Ch	NAK IN Ignore NAK Ignore Send NAK handshake for IN token.

Mode	Description	Mode	Description
5h	ISO OUT Ignore Ignore Always Isochronous OUT.	Dh	ACK IN (Stall = 0) Ignore TX Count Ignore The mode is changed by the SIE to mode Ch after receiving ACK handshake to an IN data.
6h	Status IN Only Accept TX 0 Byte STALL For control endpoint, STALL OUT and send zero byte data for IN token.	Eh	Reserved Ignore Ignore Ignore
7h	ISO IN Ignore TX Count Ignore Isochronous IN.	Fh	ACK IN – Status OUT Accept TX Count Check Respond to IN data or Status OUT.
8h	NAK OUT Ignore Ignore NAK Send NAK hand-shake to OUT token.		

Resource EPx_CNTL: Bank 1 reg[C4-C7] Endpoint1 – Endpoint4 Control Registers

Bit	7	6	5	4	3	2	1	0
Value	Stall0	Reserved	NakIntEnable	ACK'd Transaction	Mode			

Stall: When this bit is one, the SIE stalls an OUT packet if the Mode bits are set to ACK-OUT. The SIE stalls an IN packet if the mode bits are set to ACK-IN. This bit must be zero for all other modes.

NakIntEnable: When set to one, this bit causes an endpoint interrupt to be generated even when a transfer completes with a NAK.

ACK'd Transaction: This bit is one whenever the SIE engages in a transaction to the register's endpoint that completes with an ACK packet. This bit is zero after any writes to the register.

Mode: Same as EP0_CNTL above.

Resource EP0_CNT : Bank 0 reg[57] Enpoint0 Count Register

Bit	7	6	5	4	3	2	1	0
Value	Data Toggle	Data Valid	Reserved			Byte Count		

Data Toggle: This bit selects the DATA packet's toggle state. For IN transactions, firmware must set this bit. For OUT or SETUP transactions, the SIE hardware sets this bit to the state of the received Data Toggle bit.

Data Valid: This bit is used for OUT transactions only. It is cleared if CRC, bit stuff, or PID errors have occurred. This bit does not update for some endpoint mode settings. This bit may be cleared by writing a zero to it when the register is not locked.

Byte Count: These bits indicate the number of data bytes in a transaction. For IN transactions, firmware loads the count with the number of bytes to be transmitted to the host from the endpoint FIFO. Valid values are 0 to 8. For OUT or SETUP transactions, the count is updated by hardware to the number of data bytes received, plus two for the CRC bytes. Valid values are 2 to 10.

Resource EPx_CNT0: Bank 0 reg[4F,51,53,55] Endpoint1 - Endpoint4 Count0 Registers

Bit	7	6	5	4	3	2	1	0
Value	Count LSb							

These bits are the eight LSb of a 9-bit counter. The MSb is the Count MSb of the EPx_CNT1 register.

The 9-bit count indicates the number of data bytes in a transaction. For IN transactions, firmware loads the count with the number of bytes to be transmitted to the host. Valid values are 0 to 256.

The lower eight bits of endpoint count also sets the limit for the number of bytes that will be received for an out transaction. Before an OUT transaction can be received for an endpoint, this count value must be set to the maximum number of bytes that can be received where 0x01 is 1 byte and 0xff is 255 bytes. If this count value is set to a value greater than the number of bytes received, both the data from the USB packet and the two-byte CRC will be written to the USB's dedicated SRAM.

If the count value is less than the number of data bytes received, the SIE will mark the packet as invalid and not generate an interrupt. For example, an eight byte data packet will try to write eight data bytes and two CRC bytes. A count value of eight or greater will allow a good packet to generate an interrupt. A count value of seven or less will cause the SIE to mark the packet as bad.

Once the OUT transaction is complete, the full 9-bit count will be updated by the SIE to the actual number of data bytes received by the SIE plus two for the packet's CRC. Valid values are 2 to 258.

Resource EPx_CNT1: Bank 0 reg[4E,50,52,54] Endpoint1 - Endpoint4 Count1 Registers

Bit	7	6	5	4	3	2	1	0
Value	DataToggle	Data Valid	Reserved					Count MSb

Data Toggle: This bit selects the DATA packet's toggle state. For IN transactions, firmware must set this bit to the expected state. For OUT transactions, the hardware sets this bit to the state of the received Data Toggle bit.

Data Valid: This bit is used for OUT transactions only and is read only. It is 0 if CRC, bit stuffing, or PID errors occur. This bit does not update for some endpoint mode settings.

Count MSb: This bit is the most significant bit of a 9-bit counter. The least significant bits are the EPx Count[7:0] bits of the EPx_CNT register. Refer to the EPx_CNTx register for more information.

Resource EP0_DRx: Bank 0 reg[57-5F] Enpoint0 Data Register 0-7

Bit	7	6	5	4	3	2	1	0
Value	Data							

These registers are used to read and write data to the USB control endpoint. They are shared for both transmit and receive. The count in the EP0_CNT register determines the number of bytes received or to be transferred.

Resource USB_CNTL0: Bank 0 reg[4A] USB Control Register 0

Bit	7	6	5	4	3	2	1	0
Value	USB Enable	Device Address						

USB Enable: When this bit is one it enables the SIE for USB traffic and the USB transceiver. The device will not respond to USB traffic if this bit is zero.

Device Address: The SIE will respond to the USB device address specified by these bits. This address must be set by firmware and specified by the system with a SETUP command during USB enumeration.

Resource USB_CNTL1: Bank 1 reg[C1] USB Control Register 1

Bit	7	6	5	4	3	2	1	0
Value	Reserved					Bus Activity	EnableLock	RegEnable

Bus Activity: This is a sticky bit that detects any non-idle USB event that has occurred on the USB bus. Once set to high by the SIE to indicate the bus activity, this bit retains its logical high value until firmware clears it. Writing a zero to this bit clears it; writing a one preserves its value.

EnableLock: Set this bit to one to turn on the automatic frequency locking of the internal oscillator for USB traffic. Unless an external clock is being provided, this bit should remain set to one for proper USB operation.

RegEnable: This bit controls the operation of the internal USB regulator. For applications with PSoC supply voltages in the 5V range, set this bit high to enable the internal regulator. For device supply voltages in the 3.3V range, clear this bit to connect the transceiver directly to the supply.

Resource USBIO_CNTL0: Bank 0 reg[4B] USB IO Control Register 0

Bit	7	6	5	4	3	2	1	0
Value	TEN	TSE0	TD	Reserved				RD

TEN: Setting this bit allows the USB outputs to be driven manually. Normally, TEN is kept low so that the internal hardware can control traffic flow automatically. One application for manual USB mode is driving a resume signal (USB “K”) to wake the system from USB suspend.

TSE0: This bit is used to manually transmit a single ended zero (both D+ and D- low) on the USB pins. This bit has no effect if TEN = 0.

TD: This bit is used to manually drive a USB J or K state onto the USB pins. There is no effect if TEN = 0, and TSE0 overrides this bit.

RD: This read only bit gives the state of USB Received Data from the differential receiver. The USB Enable bit in the USB_CR0 register must be set to receive data. If the USB Enable bit is not set, this bit will read zero.

Resource USBIO_CNTL1: Bank 0 reg[4C] USB IO Control Register 1

Bit	7	6	5	4	3	2	1	0
Value	IO Mode	Drive Mode	DPI	DMI	PS2PUEN	USBPUEN	DPO	DMO

IO Mode: This bit allows the D+ and D- pins to be configured for either USB mode or bit banged modes. If this bit is one, the DMI and DPI bits are used to drive the D- and D+ pins.

Drive Mode: If the IOMode bit is one, this bit configures the D- and D+ pins for either CMOS drive or open-drain drive. If IOMode is zero, this bit has no effect. Note that in open drain mode 5 kΩ pull-up resistors can be connected internally with the PS2PUEN bit.

DPI: This bit is used to drive the D+ pin if IOMode = 1.

DMI: This bit is used to drive the D- pin if IOMode = 1.

PS2PUEN: This bit controls the connection of the two internal 5 kΩ pull-up resistors to the D+ and D- pins.

USBPUEN: This bit controls the connection of the internal 1.5 kΩ pull-up resistor on the D+ pin.

DPO: This read only bit gives the state of the D+ pin.

DMO: This read only bit gives the state of the D- pin.

Resource USB_SOFx: Bank 0 reg[48-49] USB Start of Frame Register 0 and 1

Bit	7	6	5	4	3	2	1	0
Value USB_SOF0	Frame Number							
Value USB_SOF1	Reserved					Frame Number		

Frame Number: The USB Start of Frame Registers (USB_SOF0 andUSB_SOF1) provide access to the 11-bit SOF frame number. The USB_SOF0 register has the lower 8 bits [7:0] and the USB_SOF1 register has the upper 3 bits [10:8] of the SOF frame number.