



API Definitions for FTDI FT232 and FT245 USB Interface Chips

Vendor Request Interface

This section contains a list of requests for the FTDI FT232BM / FT245BM and FT232R / FT245R USB interface devices.

Request Table

Request	Value	Description
FTDI_RESET	0	Reset the port
FTDI_MODEM_CTRL	1	Set the modem control register
FTDI_SET_FLOW_CTRL	2	Set flow control options
FTDI_SET_BAUD_RATE	3	Set the baud rate
FTDI_SET_DATA	4	Set the data characteristics of the port
FTDI_GET_MODEM_STATUS	5	Retrieve current value of modem status register
FTDI_SET_EVENT_CHAR	6	Set the event character
FTDI_SET_ERROR_CHAR	7	Set the error character
FT_SET_LATENCY-TIMER	9	Set the latency timer
FT_GET_LATENCY_TIMER	A	Return the latency timer
FT_SET_BIT_MODE	B	Set special bit mode or turn on a special function
FT_GET_BIT_MODE	C	Return the current values on the DBUS pins

Port Identifier Table

Port	Value
Default (SIOA)	0
SIOA	1
SIOB	2

FTDI_RESET

Reset the communications port.

BmRequestType	bRequest	wValue	wIndex	wLength	Data
0100000B	FTDI_RESET	Control Value	Port	0	None

The control value is contained in the IValue field and is defined as follows :-

- 0 = Reset SIO (Resets both RX and TX Buffer)
- 1 = Purge RX buffer
- 2 = Purge TX buffer

FTDI_SET_BAUD_RATE

Set the baud rate of the communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_BAUD_RATE	Baud Rate Value	Port	0	None

Baud rate values correspond to actual baud rates as shown in the following tables.

For 48MHz :-

Baud RateValue	Actual Baud Rate
0x2710	300
0x1388	600
0x09C4	1200
0x04E2	2400
0x0271	4800
0x4138	9600
0x809C	19200
0xC04E	38400
0x0034	57600
0x001A	115200
0x000D	230400
0x4006	460800
0x8003	921600

FTDI_SET_DATA

Set the data characteristics of the communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
0100000B	FTDI_SET_DATA	Data Characteristics	Port	0	None

Data characteristics are mapped into wValue as shown in the following table.

Offset	Data Characteristics
B0..7	Number of data bits
B8..10	Parity... 0 = None 1 = Odd 2 = Even 3 = Mark 4 = Space
B11..13	Number of stop bits... 0 = 1 1 = 1.5 2 = 2
B14	1 = Send Break 0 = Stop Break
B15	Reserved

To send break set bit 14 high. To stop break set bit 14 low. Alternatively change baud rate to half of present rate and send '00' character. This will pulse break at receiver instead of keeping it on.

FTDI_MODEM_CTRL

Set the modem control register of the communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
0100000B	FTDI_MODEM_CTRL	Control Value	Port	0	None

Contents of the wValue field are shown in the following table.

Offset	Data Characteristics
B0	DTR State 0 = reset 1 = set
B1	RTS State 0 = reset 1 = set
B2..7	Reserved
B8	DTR State 0 = ignore 1 = use DTR state
B9	RTS state enable 0 = ignore 1 = use RTS state
B10..B15	Reserved

FTDI_SET_FLOW_CTRL

Set the flow control handshaking for the communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_FLOW_CTRL	Xoff/Xon	Protocol/Port	0	None

Index specifies the port.

The hIndex field contains the protocol and its possible values are shown in the following table.

Offset	Description
B0	Output handshaking using RTS/CTS 0 = disabled 1 = enabled
B1	Output handshaking using DTR/DSR 0 = disabled 1 = enabled
B2	Xon/Xoff handshaking 0 = disabled 1 = enabled

A value of zero in the hIndex field selects no handshaking.

If Xon/Xoff handshaking is specified, the hValue field contains the Xoff character and the lValue field contains the Xon character.

FTDI_SET_EVENT_CHAR

Set the special event character for the specified communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_EVENT_CHAR	Event Char	Port	0	None

Contents of the wValue field are shown in the following table.

Offset	Description
B0..7	Event Character
B8	Event Character Processing 0 = disabled 1 = enabled
B9..15	Reserved

FTDI_SET_ERROR_CHAR

Set the parity error replacement character for the specified communications port.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_ERROR_CHAR	Error Char	Port	0	None

Contents of the wValue field are shown in the following table.

Offset	Description
B0..7	Error Character
B8	Error Character Processing 0 = disabled 1 = enabled
B9..15	Reserved

FTDI_GET_MODEM_STATUS

Retrieve the current value of the modem status register.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
11000000B	FTDI_GET_MODEM_STATUS	Zero	Port	2	Status

Two bytes of data are returned and their formats are shown in the following tables.

Offset	Description
B0..3	0
B4	Clear to Send (CTS) 0 = inactive 1 = active
B5	Data Set Ready (DSR) 0 = inactive 1 = active
B6	Ring Indicator (RI) 0 = inactive 1 = active
B7	Receive Line Signal Detect (RLSD) 0 = inactive 1 = active

Offset	Description
B0	Data Ready (DR)
B1	Overrun Error (OE)
B2	Parity Error (PE)
B3	Framing Error (FE)
B4	Break Interrupt (BI)
B5	Transmitter Holding Register (THRE)
B6	Transmitter Empty (TEMT)
B7	Error in RCVR FIFO

FTDI_SET_LATENCY_TIMER

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_LATENCY_TIMER	Latency	Port	0	None

lValue = latency
hValue = 00h

FTDI_GET_LATENCY_TIMER

Retrieve the current latency timer value.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
11000000B	FTDI_GET_LATENCY_TIMER	Zero	Port	1	current latency value

FTDI_SET_BIT_MODE

SPECIAL COMMANDS For Bit-Bang Mode

The Devices from BM series onwards have special I/O modes that can be set on the pins

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_SET_BIT_MODE	Function	Port	0	None

Function (hValue)

Offset Description

B0	Async Bit Bang 232/245BM,2232C,232R,245R
B1	MPSSE 2232C
B2	Sync Bit Bang 2232C,232R,245R
B3	CPU Emulation 2232C
B4	Fast Serial 2232C
B5	CBUS Bit Bang 232R
B6	0
B7	0

LValue

Data Direction 1 = output
00h
Data Direction 1 = output
00h
00h
3 - 0 = data value, 7 - 4 Enables (1 = output)

When using the CBUS bit mode commands the main UART function is still available for the IN and OUT endpoints.

Note that the CBUS pins 0 to 3 must be selected to be IO mode using MPROG to program the on-chip eeprom.

FTDI_GET_BIT_MODE

Retrieve the current value of the pins on the DBUS if in Aysnc or Sync bit bang mode.
If in CBus Bit Bang mode then return the value of the CBUS pins.

BmRequestType	BRequest	wValue	wIndex	wLength	Data
01000000B	FTDI_GET_BIT_MODE	Zero	Port	1	Current Pin State

DESCRIPTORS

This section contains the descriptors returned by the FTDI USB to High Speed Serial Converter.

Device Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x12	Size of descriptor in bytes
1	bDescriptorType	1	0x01	DEVICE Descriptor Type
2	bcdUSB	2	0x0110	USB Spec Release Number
4	bDeviceClass	1	0x00	Class Code
5	bDeviceSubClass	1	0x00	Subclass Code
6	bDeviceProtocol	1	0x00	Protocol Code
7	bMaxPacketSize0	1	0x08	Maximum packet size for endpoint 0
8	idVendor	2	0x0403	Vendor ID
10	idProduct	2	0x6001	Product ID
12	bcdDevice	2	0x0200	Device release number
14	iManufacturer	1	0x01	Index of manufacturer string descriptor
15	iProduct	1	0x02	Index of product string descriptor
16	iSerialNumber	1	0x03	Index of serial number string descriptor
17	bNumConfigurations	1	0x01	Number of possible configurations

Configuration Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of descriptor in bytes
1	bDescriptorType	1	0x02	CONFIGURATION Descriptor Type
2	wTotalLength	2	0x0020	Total length of data
4	bNumInterfaces	1	0x01	Number of interfaces supported
5	bConfigurationValue	1	0x01	Argument for SetConfiguration() req.
6	iConfiguration	1	0x00	Index of configuration string descriptor
7	bmAttributes	1	0x20	Configuration characteristics Remote Wakeup
8	MaxPower	1	0x2D	Maximum power consumption

Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of descriptor in bytes
1	bDescriptorType	1	0x04	INTERFACE Descriptor Type
2	bInterfaceNumber	1	0x00	Number of interface
3	bAlternateSetting	1	0x00	Value used to select alternate setting
4	bNumEndpoints	1	0x02	Number of endpoints
5	bInterfaceClass	1	0xFF	Class Code
6	bInterfaceSubClass	1	0xFF	Subclass Code
7	bInterfaceProtocol	1	0xFF	Protocol code
8	iInterface	1	0x02	Index of interface string descriptor

IN Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of descriptor in bytes
1	bDescriptorType	1	0x05	ENDPOINT Descriptor Type
2	bEndpointAddress	1	0x81	Address of endpoint
3	bmAttributes	1	0x02	Endpoint attributes - Bulk
4	bNumEndpoints	2	0x0040	maximum packet size
5	bInterval	1	0x00	Interval for polling endpoint

OUT Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of descriptor in bytes
1	bDescriptorType	1	0x05	ENDPOINT Descriptor Type
2	bEndpointAddress	1	0x02	Address of endpoint
3	bmAttributes	1	0x02	Endpoint attributes - Bulk
4	bNumEndpoints	2	0x0040	maximum packet size
5	bInterval	1	0x00	Interval for polling endpoint

DATA FORMAT

This section describes the data format used by the FTDI FT232BM / FT245BM USB interface devices.

IN Endpoint

The device reserves the first two bytes of data on this endpoint to contain the current values of the modem and line status registers. In the absence of data, the device generates a message consisting of these two status bytes every 16 milliseconds.

Byte 0 : Modem Status

Offset	Description
B0	Reserved - MUST BE 1
B1	Reserved - MUST BE 0
B2	Reserved - MUST BE 0
B3	Reserved - MUST BE 0
B4	Clear to Send (CTS)
B5	Data Set Ready (DSR)
B6	Ring Indicator (RI)
B7	Receive Line Signal Detect (RLSD)

Byte 1 : Line Status

Offset	Description
B0	Data Ready (DR)
B1	Overrun Error (OE)
B2	Parity Error (PE)
B3	Framing Error (FE)
B4	Break Interrupt (BI)
B5	Transmitter Holding Register (THRE)
B6	Transmitter Empty (TEMT)
B7	Error in RCVR FIFO

OUT Endpoint

The OUT packet consists solely of data. I.E. there are no reserved bytes on this endpoint.

FT232/245 BM DEVICES ADDITIONAL API COMMANDS

The following API applies to FTDI's second generation BM devices only

Extended Baud Rate Command

The following USB Setup command is used to program the Baud rate:

Working out the baud rate :

lIndex bit 0, hValue bit 7, 6

0 0 0	don't add anything
0 0 1	add 4/8 clock
0 1 0	add 2/8 clock
0 1 1	add 1/8 clock
1 0 0	add 3/8 clock
1 0 1	add 5/8 clock
1 1 0	add 6/8 clock
1 1 1	add 7/8 clock

hValue 5-0 and lValue 7-0 are the divisor

Program Baud Rate

40	bmRequestType
03	bmRequest
low Baud	lValue
High Baud	hValue
modifier	lIndex
00	hIndex
00	lLength
00	hLength

Notes :

A value of lIndex = 0, hValue = 0 and lValue = 0 will give 3 MegaBaud.

A value of lIndex = 0, hValue = 0 and lValue = 1 will give 2 MegaBaud.

The other values of lIndex = 2 or more will give the values associated with the formula :

Baud Rate = 3,000,000 DIV (Divisor + fractions)

i.e.

A value of lIndex = 0, hValue = 0 and lValue = 2 will give 1.5 MegaBaud.

A value of lIndex = 1, hValue = 80h and lValue = 4 will give a divisor of 4.75 => Baud Rate = 3,000,000 DIV 4.75 = 631,578 Baud

Write Latency Timer

Write Latency timer

40 | bmRequestType
 09 | bmRequest
 Value | IValue
 00 | hValue
 00 | lIndex
 00 | hIndex
 00 | lLength
 00 | hLength

Value is the time in milliseconds between sending data back to the PC when there is less than a full buffer. It should be in the range 1 -> 255 D. The default value is 16 Dec for backwards compatibility.

Read Latency Timer

Read Latency timer

C0 | bmRequestType
 0A | bmRequest
 00 | IValue
 00 | hValue
 00 | lIndex
 00 | hIndex
 01 | lLength
 00 | hLength

This returns the current value of the latency timer in 1 byte.

Bit Bang Mode

Definition

The FT232BM and FT245BM chips can be set up in a special mode where the normal function of the chips are replaced. This mode changes the 8 data lines on the FT245BM or the RS232 data and control lines of the FT232BM to an 8 bit bi-directional bus. The purpose of this mode was intended to be used to program FPGA devices. It may also be used to talk to serial EEPROMs or load a data latch.

Pin Definitions

FT245BM	FT232BM	Bit-Bang Data bit
Data0	TXD	Data0
Data1	RXD	Data1
Data2	RTS	Data2
Data3	CTS	Data3
Data4	DTR	Data4
Data5	DSR	Data5
Data6	DCD	Data6
Data7	RI	Data7

Mode of Operation

Any data written to the device in the normal manner will be self clocked onto the data pins (for the pins that have been programmed as outputs). Each pin can be set as an input or an output independant of the other pins. The rate of clocking out the data is controlled by the baud rate generator. This exists in both the FT245BM as well as the FT232BM.

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device then the pins will hold the last value written.

The commands of interest are :

1) Set Baud Rate

This co□
and transferring the result back to the Read path of the chip. The maximum baud rate is 3 MegaBaud. The clock for the Bit Bang mode is actually 16 times the baudrate. A value of 9600 baud would transfer the data at (9600 x 16) = 153600 bytes per second or 1 every 6.5 uS.

2) Set Bit Bang Mode

40		bmRequestType
0B		bmRequest
Bit Mask		lValue
Enable		hValue
00		lIndex
00		hIndex
00		lLength
00		hLength

This sets up which bits are input and which are output. The Bit Mask byte sets the direction. A '1' means the corresponding bit is to be an output. A '0' means the corresponding bit is to be an input. When read data is passed back to the PC, the current pin state for both inputs and outputs will be used. The Enable byte will turn the bit bang mode off and on. Setting bit 0 to '1' turns it on. Clearing bit 0 to '0' turns it off.

3) Read Data pins

C0		bmRequestType
0C		bmRequest
00		lValue
00		hValue
00		lIndex
00		hIndex
01		lLength
00		hLength

This function does an immediate read of the 8 pins and passes back the value. This is useful to see what the pins are doing now. The normal Read pipe will contain the same result but it has also been sampling the pins continuously (up until its buffers become full). Therefore the data in the Read pipe will be old.

Document Revision History

Version 0.9 – Initial document August 2000. First released revision

Version 0.91 – Updated April 2001

- FTDI_SET_DATA, page 4
Offset table changed
B14...15 Reserved
corrected to
B14 1 = Send Break, 0 = Stop Break; B15 Reserved
- FTDI_GET_MODEM_STATUS, page 6
wLength changed from 1 to 2
One byte of data is returned corrected to two bytes of data are returned
Second table added describing second byte of data

Version 1.0 – Updated December 2002

- Separate BM API extensions document generated

Version 1.1 – Updated March 2004

- FTDI Address Updated
- Original API and BM Extensions documents merged
- FTDI_SET_ERROR_CHAR, page 5
bRequest corrected from FTDI_SET_EVENT_CHAR to FTDI_SET_ERROR_CHAR
- DATA FORMAT, IN Endpoint
Two status bytes are generated every 16 ms, not every 40 ms as document originally stated.
- Parallel Port removed from Port Identifier table
- 12 MHz FPGA Baud rate table removed
- Read Latency Timer, page 10
bmRequest should be 0A, and not 09.

Version 1.2 – Updated June 2004

- FTDI_SET_BAUD_RATE, page 2. BmRequestType and wValue were reversed.
- FTDI_RESET, page 1. Reset SIO clarified.

Version 1.3 – Updated May 2006

- FT232R / FT245R data added

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