Future Technology Devices Intl Ltd.

Application Note

FT232BM and FT245BM
Power Control and Pin States

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1 FT232BM and FT245BM Power Control

1.1 Introduction

FT232BM and FT245BM Power Control / Pin States

Background

USB Bus Powered peripherals (ones that get their power from the USB bus) have a number of restrictions that can make it difficult for a design to meet the mandatory USB 2.0 requirements. Failure to meet these requirements can result in unreliable operation under certain conditions, also a peripheral that does not meet these requirements will fail the USB certification process and will not be eligible to use the USB Certified logo on the product packaging and marketing. The requirements in question are -

- In USB suspend mode, a Bus Powered USB peripheral must draw no more than 0.5mA (500uA) from the USB bus

  NOTE : The 500uA suspend current limit includes the 200uA current draw of the 1.5k pull-up on the USB D+ . This leaves only 300uA (0.3mA) to power the FT232BM / FT245BM **and** the external peripheral circuitry.

- On power-up a Bus Powered USB peripheral may draw no more than 100mA from the USB bus until the device has been successfully enumerated (drivers loaded and ready to go) by the Host PC.

  NOTE : USB Bus Powered peripherals may draw up to 500mA current from the USB bus after enumeration, unless they are plugged into a Bus Powered USB Hub in which case the limit is 100mA only.

In order to substantially reduce the effort and cost of meeting these requirements, FTDI have incorporated two new features in their BM series devices which if used correctly make designing such USB Bus Powered peripheral designs straight forward.

Firstly, the BM series devices have a PWREN# pin which can be used to control the power to external logic using a low cost power P-Channel MOSFET. Examples of how to implement such a circuit are provided in the FT232BM / FT245BM version 2.0 schematics and designer guides which can be downloaded from the FTDI site.

Secondly, the BM series devices have a pull-down mode (PDEN) where the peripheral interface pins are pulled down when the PWREN# pin is high (power = off). The pull-down resistors are used to bleed any residual voltages in the external circuitry to GND and to eliminate any stray leakage from the external circuitry through to the USB supply

voltage, thus reducing supply current from the USB bus to a minimum during USB suspend. To enable this mode, the BM series device must have an external configuration EEPROM connected and the Pull-Down mode <u>must</u> be set in the EEPROM configuration data.

NOTE : The FT232BM and FT245BM devices have <u>both</u> pull-up and pull-down resistors on their peripheral interface pins. These default to pulling input pins high unless pull-down mode is enabled in the configuration EEPROM and PWREN# is high.

PWREN# states

The PWREN# signal will be high (power = off) under the following conditions -

- The FT232BM / FT245BM device is in reset

OR

- The FT232BM / FT245BM device is not yet configured by USB enumeration, or the USB enumeration sequence has failed

OR

- The host PC system is in the USB suspend state

Pull Up / Pull Down Values

The Pull Up and Pull Down resistors have a nominal value of 200 KOhm with a tolerance of +/- 50%. This gives possible values of 100-300 K Ohm.

Interface Pins - IO Voltage

All the peripheral interface IO pins are powered from the VCCIO pin 13 of the FT232BM and FT245BM. If the VCCIO pin is
connected to 3.3 volts then these pins will drive to 3.3 volts. This makes it simple to connect to 3.3 volt logic.

The interface pins powered by VCCIO are...
FT232BM - TXD, RXD, RTS#, CTS#, DTR#, DSR#, DCD#, RI#, TXDEN, PWREN#, PWRCTL, TXLED, RXLED, SLEEP#
FT245BM - D[0...7], RD#, WR, TXE, RXF#, SI/WU, PWREN#

EEPROM Interface Pins

The pins EESK, EECS, and EEDATA operate at 5 volt levels only. These pins will be tri-state, but pulled high via an internal 200 K Ohm (+/-50%) resistor during device reset.

RESET#, RSTOUT# and TEST

TEST, RESET#, and RSTOUT# operate at 5 volt levels only. RSTOUT# is driven low during device reset.

Interface Pins - Bit Bang Mode

In addition to the usual pin states, the FT232BM and FT245BM peripheral interfaces can be configured (via a USB command) into a further mode known as Bit Bang mode - effectively acting as a general purpose IO port until switched back into the native mode of the device. The behaviour of the pull-up/ pull-down resistors in Bit Bang mode may differ from the native mode of the device, so the pins states for this mode are also defined in this document.

2 Pin States

2.1 FT232BM Pin States

Pin	*int PDEN off* PWREN# off	PWREN# on	*int PDEN on* PWREN# off	PWREN# on	Bit Bang Mode
TXD	O/P	O/P	I/P with PD	O/P	PU if I/P
RXD	I/P with PU	I/P with PU	I/P with PD	I/P with PU	PU if I/P
RTS#	O/P	O/P	I/P with PD	O/P	PU if I/P
CTS#	I/P with PU	I/P with PU	I/P with PD	I/P with PU	PU if I/P
DTR#	O/P	O/P	I/P with PD	O/P	PU if I/P
DSR#	I/P with PU	I/P with PU	I/P with PD	I/P with PU	PU if I/P
DCD#	I/P with PU	I/P with PU	I/P with PD	I/P with PU	PU if I/P
RI#	I/P with PU	I/P with PU	I/P with PD	I/P with PU	PU if I/P
TXDEN	O/P	O/P	O/P	O/P	O/P '0'
PWREN#	O/P '1'	O/P '0'	O/P '1'	O/P '0'	I/P PWREN#
PWRCTL	I/P with PU	I/P with PU	I/P with PU	I/P with PU	I/P with PU
TXLED	I/P no PU	I/P no PU (1)	I/P with PU	I/P no PU (1)	I/P with PU
RXLED	I/P no PU	I/P no PU (1)	I/P with PU	I/P no PU (1)	I/P with PU
SLEEP#	O/P	O/P	O/P	O/P	O/P SLEEP#

(1) :- These are input unless they are signalling an RX or TX character. When they are signalling they switch to output driving '0'.

key :

PD - Pull Down resistor
PU - Pull Up resistor
O/P - Output with no pull up or pull down resistor
I/P - Input
I/O - input or output depending on FT245BM RD# line
int PDEN - bit held in EEPROM set using FTD2XXST.exe programmer.
PWREN# off - off if chip is held reset OR it is NOT configured OR it is in suspend.
PWREN# on - on if chip is NOT held reset AND it is configured AND it is NOT in suspend.
Bit Bang Mode - this overrides the 'int PDEN ' bit set by the EEPROM.

2.2   **FT245BM Pin States**

Pin	*int PDEN off*		*int PDEN on*		Bit Bang Mode
	PWREN# off	PWREN# on	PWREN# off	PWREN# on	
D0	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D1	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D2	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D3	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D4	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D5	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D6	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
D7	I/O with PU	I/O with PU	I/P with PD	I/O with PU	PU if I/P
RD#	I/P with PU	I/P with PU	I/P with PD	I/P with PU	I/P with PU
WR	I/P with PU	I/P with PU	I/P with PD	I/P with PU	I/P with PU
TXE#	O/P (2)	O/P (2)	I/P with PD	O/P	O/P '1' (2)
RXF#	O/P (2)	O/P (2)	I/P with PD	O/P	O/P '1' (2)
SND/Wake	I/P with PU	I/P with PU	I/P with PD	I/P with PU (2)	I/P with PU
PWREN#	O/P '1'	O/P '0'	O/P '1'	O/P '0'	O/P '0'

(2) :- These become I/P with PU if the chip is in suspend.

key :

PD - Pull Down resistor
PU - Pull Up resistor
O/P - Output with no pull up or pull down resistor
I/P - Input
I/O - input or output depending on FT245BM RD# line
int PDEN - bit held in EEPROM set using FTD2XXST.exe programmer.
PWREN# off - off if chip is held reset OR it is NOT configured OR it is in suspend.
PWREN# on - on if chip is NOT held reset AND it is configured AND it is NOT in suspend.
Bit Bang Mode - this overrides the 'int PDEN ' bit set by the EEPROM.

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