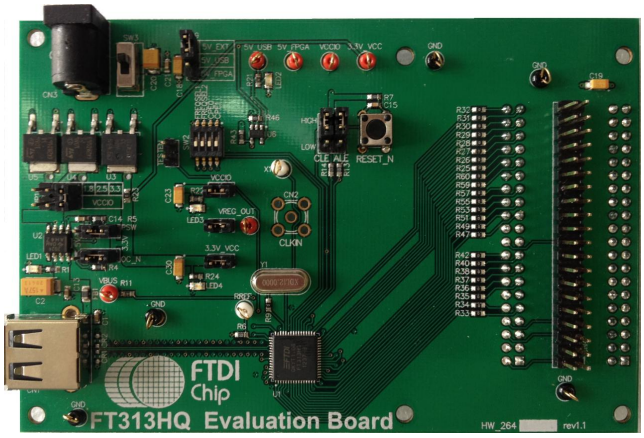
FTDI Chip

UMFT313EV Datasheet

USB2.0 Hi-Speed Host Development Module



General Purpose USB2.0 Hi-Speed USB Host Contoller

1 Introduction

The UMFT313EV is a development module for FTDI's FT313H, which is used to develop and demonstrate the functionality of the USB2.0 Hi-Speed Host Controller. This module can provide three kinds of asynchronous bus interface to connect with a microcontroller.

- 8-bit / 16-bit SRAM asynchronous bus interface
- 8-bit / 16-bit NOR Flash asynchronous bus interface
- 8-bit / 16-bit General Multiplex asynchronous bus interface

In addition, FT313H also supports a battery charger detection feature, which can allow batteries to be charged with a higher current from downstream ports with three kinds of configuration.

- Standard downstream port (SDP)
- Deducated charging port (DCP)
- Charging downstream port (CDP)

1.1 Features

The UMFT313EV utilises the FTDI FT313H QFN package. All the features of the FT313H can be accessed with the UMFT313EV. For a full list of the FT313H's features please see the FT313H datasheet.
In addition to the features listed in the FT313H datasheet, the UMFT313EV has the following features:

- Standard USB-A receptacle allows module to be connected to USB devices
- Supports self power or power from the microcontroller platform
- Provides configuration switch for module system frequency selection and BCD mode configuration
- Provides button for module hardware reset
- On board 2x20 pins 2.54mm (0.1") pitch female headers allowing easy connection to microcontroller platforms
- Provides probe header for customer debugging

2 Ordering Information

Part No.	Description
UMFT313EV	FT313H Hi-Speed USB host controller development module.

Table 2-1 – Ordering information

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3 Hardware Description

3.1 UMFT313EV board profile

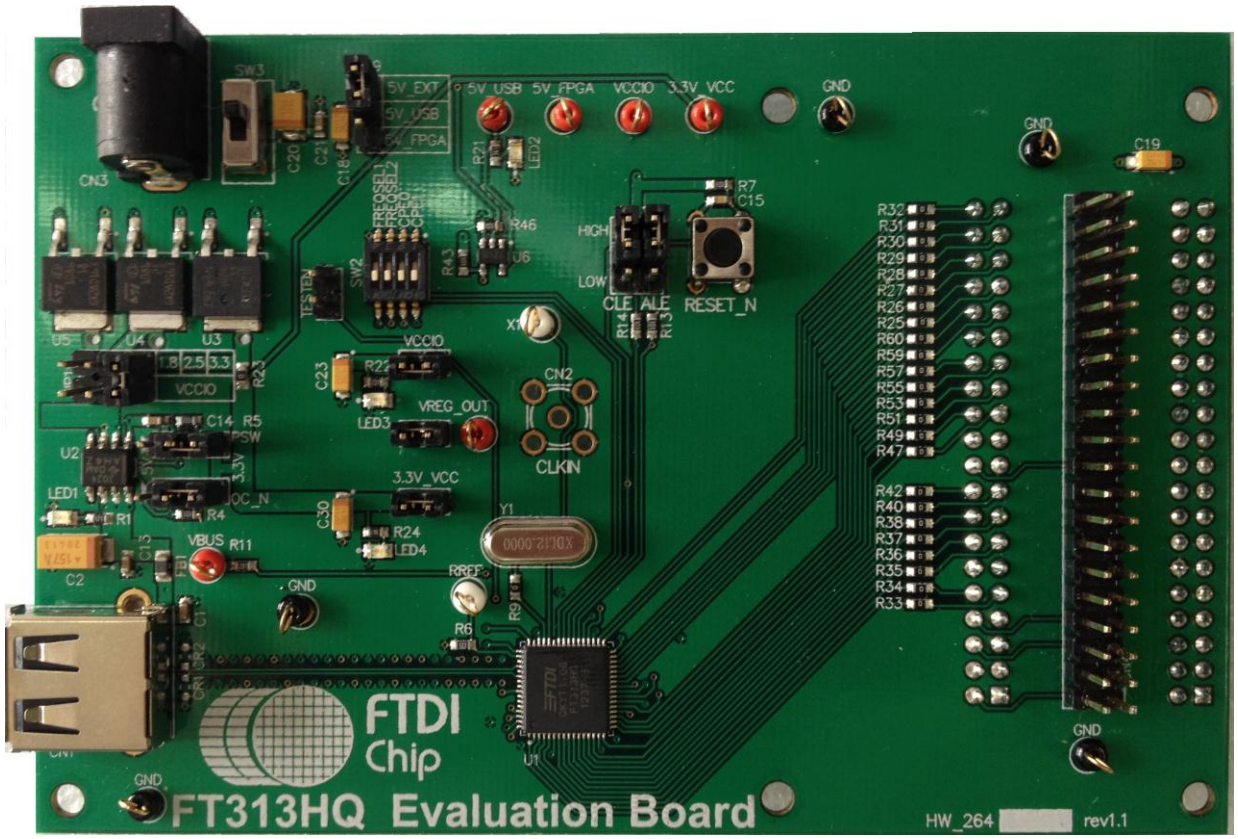

Figure 3.1 – UMFT313EV board profile

The UMFT313EV module is intended for use as a hardware platform to enable easy evaluation of FTDI's FT313H USB2.0 Hi-Speed host controller. This module is targeted at connecting with an external microcontroller platform to control its parallel I/O bus interface.

The board requires a 5V DC supply with LEDs to indicate VCC(I/O) and VCC(3V3). A 12MHz oscillator provides a clock to the FT313H. The reset button will perform a hardware reset and set the device to a default mode.

If a microcontroller platform has installed the FT313H USB host software in initialization, the UMFT313EV downstream port behaves as a general purpose USB2.0 Hi-Speed host controller, which is able to support high speed / full speed / low speed USB devices and support all USB transfer types.

3.2 Physical Descriptions

3.2.1 PCB layout

The UMFT313EV module is 120mm x 80mm four-layer printed circuit board. Board thickness is approximately 1.6mm.

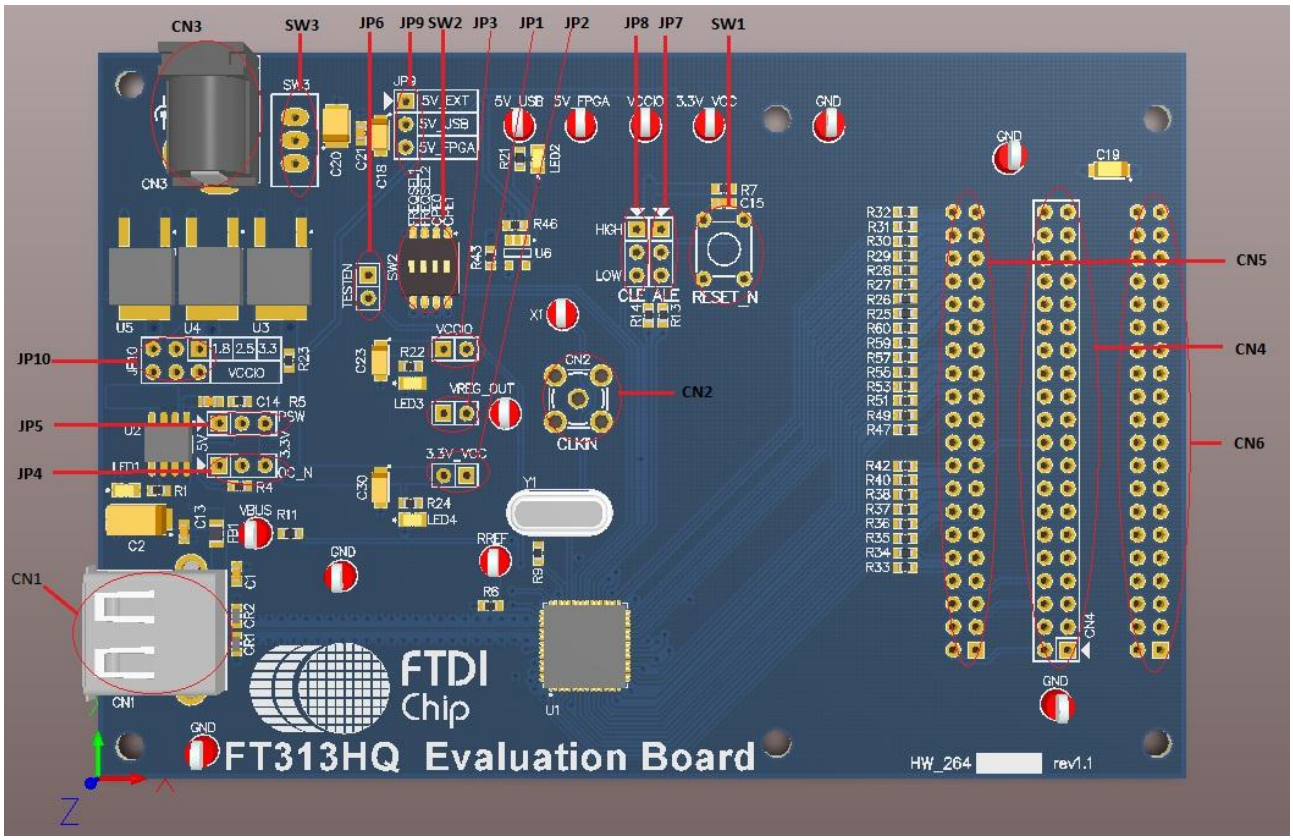

Figure 3.2 – UMFT313EV module top view

3.2.2 Connectors

Connectors and jumpers are described in the following sections.

Connector	Function
CN1	Standard-A USB host connector
CN2	Clock input, SMA connector; (Not populated)
CN3	+5V DC power connector
CN4	Prober connector, 2x20 pins male header; mounted on top
CN5	Bus interface connector, 2x20 pins female header; mounted on bottom
CN6	Power supply from platform connector, 2x20 pins female header; mounted on bottom

Connector	Function
SW1	Reset push button
SW2	Chip operating mode configuration switch
SW3	DC power switch
JP1	VCC(1V2) power supply jumper
JP2	VCC(3V3) power supply jumper
JP3	VCC(I/O) power supply jumper
JP4	OC_N signal configuration jumper
JP5	PSW_N signal configuration jumper
JP6	Chip entry test mode jumper
JP7	ALE signal configuration jumper
JP8	CLE singal configuration jumper
JP9	+5V power supply jumper
JP10	VCC(I/O) power supply resource jumper

Table 3-1 – Connectors and Jumpers

- **CN1- USB port**

  Standard USB-A receptacle for USB device connection.

- **CN2- Clock input connector**

  This is an option for the FT313H clock input. By default, this component is not populated on the PCB.

  To use CLKIN for a clock input, remove R9 0 ohm resistor on the board and select the correct frequency configuration on **SW2**.

- **CN3- DC power connector**

  Used for external power supply of +5V / 3A from DC power supply.

  As the FT313H supports high current battery charging in CDP and DCP mode, it is recommended to use an external power supply for charging. Note, the **SW3** power switch controls external power (on or off).

  By default, the UMFT313EV module uses the +5V voltage power supply from the host microcontroller platform.

- **CN4- Probe connector**

For customer debug when developing code for the UMFT313EV module on a specific platform. The table below lists the pinout description.

Pin No.	Name	Type	Description
1	PS_D	O	Power supply detector 1 -- Power supply from microctroller platform 0 -- Power supply from external wall adapter
2	RD#	I	Read enable, active low
3	Reserved	-	-
4	CS#	I	Chip select, active low
5	INTERRUPT	O	Interrupt output, default active low Polarity control by register
6	WR#	I	Write enable, active low
7	DMA_DACK	I	DMA acknowledge, default active low Polarity control by register
8	DMA_DREQ	O	DMA request, default active low Polarity control by register
9	DATA0	I/O	Address and data bus bit 0
10	DATA1	I/O	Address and data bus bit 1
11	Reserved	-	-
12	GND	P	Ground
13	DATA2	I/O	Address and data bus bit 2
14	DATA3	I/O	Address and data bus bit 3
15	DATA4	I/O	Address and data bus bit 4
16	DATA5	I/O	Address and data bus bit 5
17	DATA6	I/O	Address and data bus bit 6
18	DATA7	I/O	Address and data bus bit 7
19	RST#	I	Asynchronous reset, active low
20	ALE_T	I	Address latch enable
21	Reserved	-	-
22	CLE_T	I	Command latch enable
23	DATA8	I/O	Address and data bus bit 8
24	DATA9	I/O	Address and data bus bit 9
25	DATA10	I/O	Address and data bus bit 10
26	DATA11	I/O	Address and data bus bit 11
27	DATA12	I/O	Address and data bus bit 12
28	DATA13	I/O	Address and data bus bit 13
29	Reserved	-	-

Pin No.	Name	Type	Description
30	GND	P	Ground
31	DATA14	I/O	Address and data bus bit 14
32	DATA15	I/O	Address and data bus bit 15
33	ADDR0	I	Address bus bit 0
34	ADDR1	I	Address bus bit 1
35	ADDR2	I	Address bus bit 2
36	ADDR3	I	Address bus bit 3
37	ADDR4	I	Address bus bit 4
38	ADDR5	I	Address bus bit 5
39	ADDR6	I	Address bus bit 6
40	ADDR7	I	Address bus bit 7

Table 3-2 – CN4 probe pinout description

- **CN5- Bus interface connector**

This header connects to the external development platform which can access the FT313H chip by PIO mode or DMA mode. Also, provides +5V power supply to UMFT313EV module. The table below lists the pinout description.

Pin No.	Name	Type	Description
1	PS_D	O	Power supply detector 1 -- Power supply from microctroller platform 0 -- Power supply from external wall adapter
2	RD#	I	Read enable, active low
3	Reserved	-	-
4	CS#	I	Chip select, active low
5	INTERRUPT	O	Interrupt output, default active low Polarity control by register
6	WR#	I	Write enable, active low
7	DMA_DACK	I	DMA acknowledge, default active low Polarity control by register
8	DMA_DREQ	O	DMA request, default active low Polarity control by register
9	DATA0	I/O	Address and data bus bit 0
10	DATA1	I/O	Address and data bus bit 1
11	5V_FPGA	P	+5V power supply
12	GND	P	Ground
13	DATA2	I/O	Address and data bus bit 2

Pin No.	Name	Type	Description
14	DATA3	I/O	Address and data bus bit 3
15	DATA4	I/O	Address and data bus bit 4
16	DATA5	I/O	Address and data bus bit 5
17	DATA6	I/O	Address and data bus bit 6
18	DATA7	I/O	Address and data bus bit 7
19	RST#	I	Asynchronous reset, active low
20	ALE_T	I	Address latch enable
21	Reserved	-	-
22	CLE_T	I	Command latch enable
23	DATA8	I/O	Address and data bus bit 8
24	DATA9	I/O	Address and data bus bit 9
25	DATA10	I/O	Address and data bus bit 10
26	DATA11	I/O	Address and data bus bit 11
27	DATA12	I/O	Address and data bus bit 12
28	DATA13	I/O	Address and data bus bit 13
29	3.3V_FPGA	P	+3.3V power supply
30	GND	P	Ground
31	DATA14	I/O	Address and data bus bit 14
32	DATA15	I/O	Address and data bus bit 15
33	ADDR0	I	Address bus bit 0
34	ADDR1	I	Address bus bit 1
35	ADDR2	I	Address bus bit 2
36	ADDR3	I	Address bus bit 3
37	ADDR4	I	Address bus bit 4
38	ADDR5	I	Address bus bit 5
39	ADDR6	I	Address bus bit 6
40	ADDR7	I	Address bus bit 7

Table 3-3 – CN5 bus interface pinout description

- **CN6- Platform power connector**

  This header provides power and ground to UMFT313EV module. The table below lists the pinout description.

Pin No.	Name	Type	Description
1	Reserved	-	-
2	Reserved	-	-
3	Reserved	-	-
4	Reserved	-	-
5	Reserved	-	-
6	Reserved	-	-
7	Reserved	-	-
8	Reserved	-	-
9	Reserved	-	-
10	Reserved	-	-
11	5V_FPGA	P	+5V power supply
12	GND	P	Ground
13	Reserved	-	-
14	Reserved	-	-
15	Reserved	-	-
16	Reserved	-	-
17	Reserved	-	-
18	Reserved	-	-
19	Reserved	-	-
20	Reserved	-	-
21	Reserved	-	-
22	Reserved	-	-
23	Reserved	-	-
24	Reserved	-	-
25	Reserved	-	-
26	Reserved	-	-
27	Reserved	-	-
28	Reserved	-	-
29	3.3V_FPGA	P	+3.3V power supply
30	GND	P	Ground
31	Reserved	-	-
32	Reserved	-	-
33	Reserved	-	-
34	Reserved	-	-

Pin No.	Name	Type	Description
35	Reserved	-	-
36	Reserved	-	-
37	Reserved	-	-
38	Reserved	-	-
39	Reserved	-	-
40	Reserved	-	-

Table 3-4 – CN6 power and ground pinout description

- **SW1- Reset push button**

  Hardware reset button. Active low.

- **SW2- Chip configuration switch**

  This switch is provided for BCD mode configuration and system clock frequency selection. 12MHz Oscillator is the on-board default, and USB port is default setup to SDP.

  (SW2 ON position = '0'; OFF position = '1')

SW2	BCD MODE	Standard Downstream Port (SDP) –Default setting	Dedicated Charging Port (DCP)	Charging Downsteam Port (CDP)
SW2.1	CPE1	0	0	1
SW2.2	CPE0	0	1	1

Table 3-5 – BCD mode configuration

(SW2 ON position ='0'; OFF position = '1')

SW2	CLK FREQUENCE	12MHz (Default setting)	19.2MHz	24MHz
SW2.3	FREQSEL2	0	0	1
SW2.4	FREQSEL1	0	1	0

Table 3-6 – System clock frequence selection

- **SW3- DC power switch**

  The external power supply switch. Default is off.

- **JP1/JP2/JP3- power supply jumper**

  JP1 – VCC(1V2) power supply jumper, default is short.

  Chip core voltage output VOUT(1V2) connects to VCC(1V2) input with this jumper.User can utilize this header to measure power consumption for core power supply.

  JP2 – VCC(3V3) power supply jumper, default is short.

Utilize this header to measure power consumption for VCC(3V3) power supply.

JP3 – VCC(I/O) power supply jumper, default is short.

Utilize this header to measure power consumption for VCC(I/O) power supply.

- **JP4/JP5- OC_N/PSW_N signals jumper**

JP4 – +5V tolerant support, for debug.

By default, OC_N pin (Active low) connects to VCC(3V3) through a 10k ohm resistor.

Connect pin 1 and pin 2. OC_N pin connected to +5V.

Connect pin 2 and pin 3. OC_N pin connected to VCC(3V3).

JP5 – +5V tolerant support, for debug.

By default, PSW_N pin (Active low) connects to VCC(3V3) through a 10k ohm resistor.

Connect pin 1 and pin 2. PSW_N pin connected to +5V.

Connect pin 2 and pin 3. PSW_N pin connected to VCC(3V3).

- **JP6- Test mode jumper**

This jumper is only for factory test.

The header should be left open for normal operation.

- **JP7/JP8- ALE/CLE signals jumper**

ALE and CLE are provided to select the FT313H bus interface type.

JUMPER	SIGNAL	SRAM	NOR	General Multiplex
JP7	ALE	0 (JP7 2-3 short)	0 (JP7 2-3 short)	1 (JP7 1-2 short)
JP8	CLE	0 (JP8 2-3 short)	1 (JP8 1-2 short)	0 (JP8 2-3 short)

Table 3-7 – Bus interface configuration

- **JP9- +5V power supply jumper**

Connect 5V_USB to 5V_EXT, if using an external power supply through **CN3** connector.

Connect 5V_USB to 5V_FPGA, by default use microcontroller platform power supply through **CN5** and **CN6** connectors.

- **JP10- VCC(I/O) power resource jumper**

The FT313H chip supports bus interface I/O voltage from 1.62V to 3.63V. There are three selectable supplies on board which can provide the VCC(I/O) voltage. By default, +3.3V voltage is connected to VCC(I/O).

Connect VCC(I/O) to +3.3V, bus interface I/O signals support +3.3V tolerance.

Connect VCC(I/O) to +2.5V, bus interface I/O signals support +2.5V tolerance.

Connect VCC(I/O) to +1.8V, bus interface I/O signals support +1.8V tolerance.

3.2.3 LEDs

The UMFT313EV module has four LEDs that are located on the top side of the board.

LED	Use	Color
LED1	VBUS indicator	Red
LED2	+5V power indicator	Green
LED3	VCC(I/O) power indicator	Green
LED4	VCC(3V3) power indicator	Green

Table 3-8 – LEDs

3.3 How to Quick Start

This section explains how the UMFT313EV module may be setup for code development. For more information please refer to FT313H application notes.

3.3.1 Establishment of hardware environment

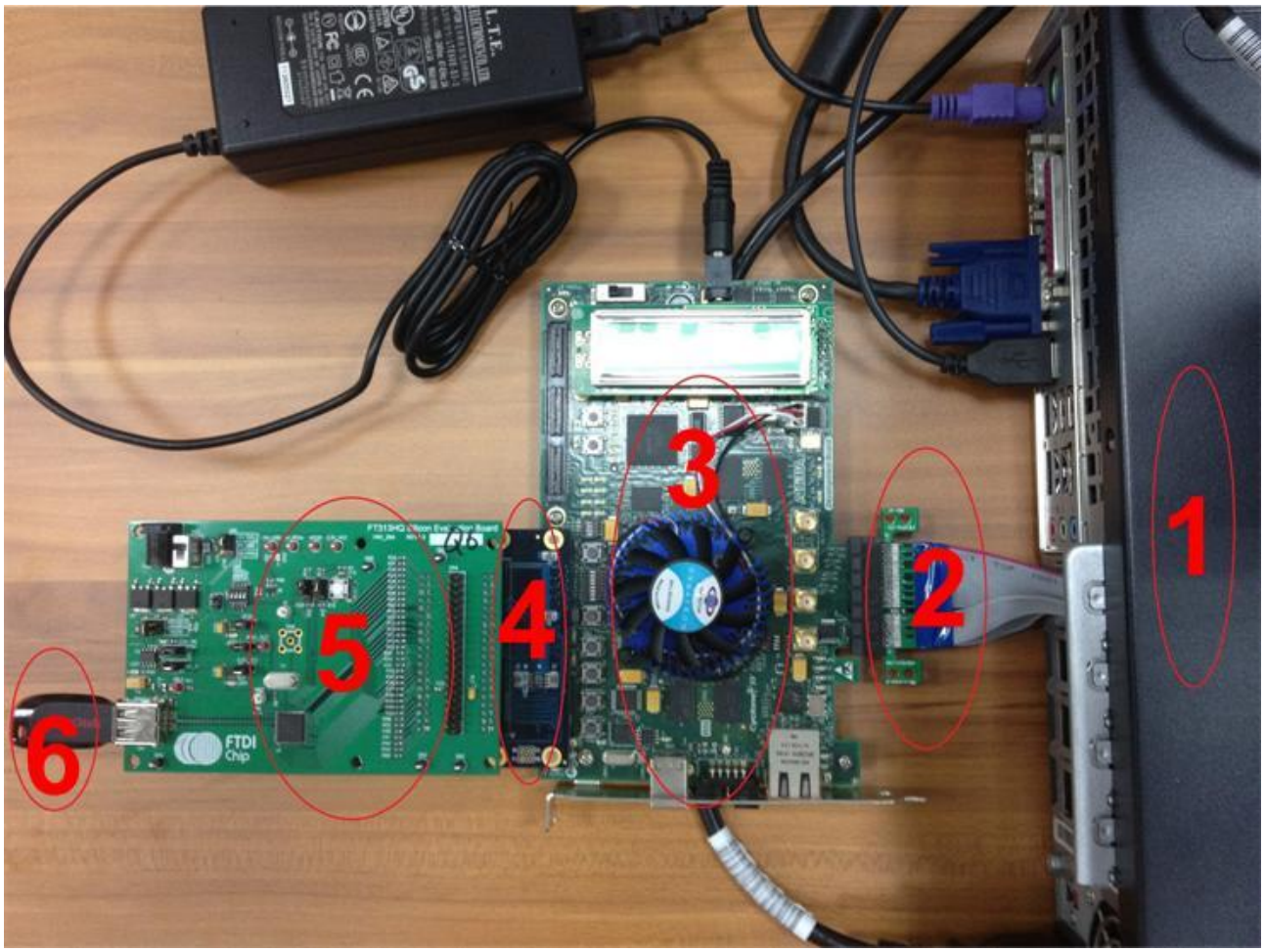

Figure 3.3 – PCI Express FPGA development setup

NOTE: This setup assumes the UMFT313EV is to be connected to a desktop PC for software development. Users with a standard processor board support package would not necessarily need the PCI bridge and may connect direct to the target processor.

1). X86-based PC that has PCI Express slot (minimum 4x connector) in motherboard

Installed Linux OS with CentOS 6.3.

http://mirror.nus.edu.sg/centos/6.3/isos/i386/

Rebuild Kernel version 3.0.4 with download from kernel.org.

http://www.kernel.org/pub/linux/kernel/v3.0/linux-3.0.4.tar.gz

2). PCI Express extender cable

The PCI Express provides a high-speed, high-performance, point-to-point, differential signaling link for interconnecting devices. Data is transmitted form a device on one set of signals, and received on another set of signals.

This PCI Express extender cable interconnect consisits of either a x1, x2, x4 point-to-point link.

Can be purchased from the Samtec website.

https://www.samtec.com/productinformation/technicalspecifications/overview.aspx?series=pciec

3). Altera Cyclone IV GX FPGA development kit

The Altera Cyclone IV GX FPGA development kit is a PCI-SIG compliant board which supports PCI Express Gen x1, x2, and x4 endpoint designs with using Cyclone IV GX PCI Express hard intellectual property(IP).

Download FPGA image .flash file into NAND flash memory on board. This image will be provided by FTDI.

Power on the FPGA platform after all the boards are connected, then power on PC with power button. The PCI Express system will do a hardware reset for UMFT313EV module.

Can be purchased from the Altera website.

http://www.altera.com/products/devkits/altera/kit-cyclone-iv-gx.html

4). Terasic GPIO-HSMC card

This board is designed to fan out the High Speed Mezzanine connector (HSMC) I/Os to three 40-pin expansion prototype connector. This board connects the Altera Cyclone IV GX FPGA development kit HSMC-A header to UMFT313EV module CN5 and CN6 headers.

Please note to short JP3 jumper on Altera FPGA development kit to provide +2.5V voltage on HSMC-A header.

Can be purchased from the Terasic website.

GPIO-HSMC Card:

http://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=67&No=218

GPIO-HSTC Card: (New model instead of GPIO-HSMC Card)

http://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=67&No=322

5). UMFT313EV development module

Please note to select JP9 jumper 5V_USB connect to 5V_FPGA, and select JP10 jumper VCC(I/O) to connect to +2.5V.

6). USB device

Any USB2.0 Hi-Speed , full-speed, low-speed devices or hubs.

3.3.2 Run software

The UMFT313EV module USB host controller driver software stack will be provided by FTDI Chip. For more information please refer to the FT313H software programming guide.

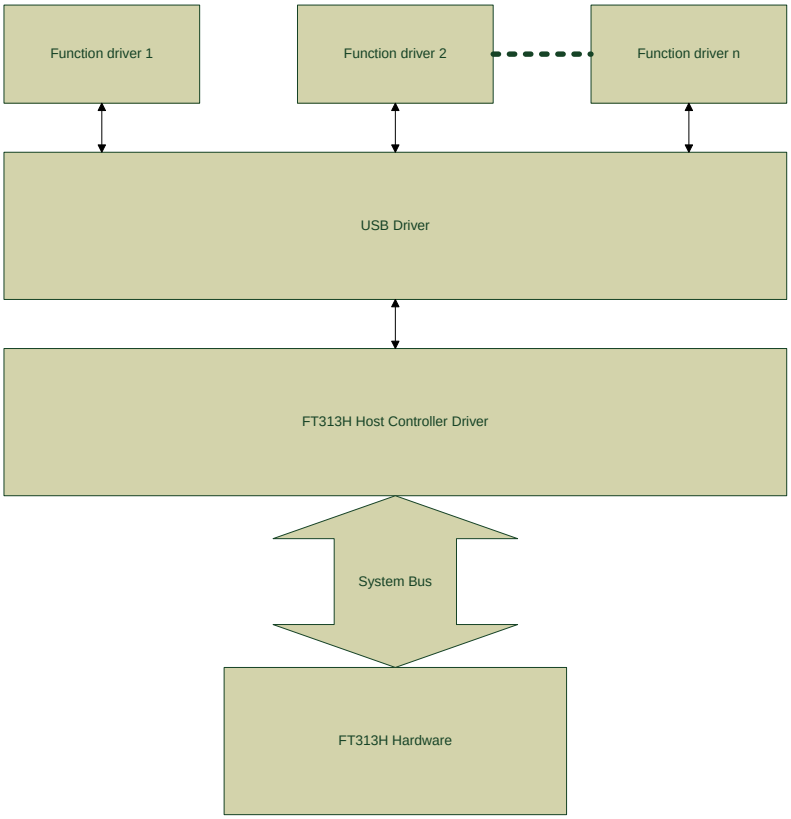

Figure 3.4 – USB host controller software architecture

1). Login PC, go to FT313H-hcd project folder.

2). Install FT313H host controller device driver in system by command:

> make

> insmod ft313-hcd.ko

3). Insert USB2.0 high speed thumb drive, and see the mass storage device on window, and then double-click the icon to access the memory.

4 Board Circuit Schematics and BoMs

4.1 UMFT313EV schematic

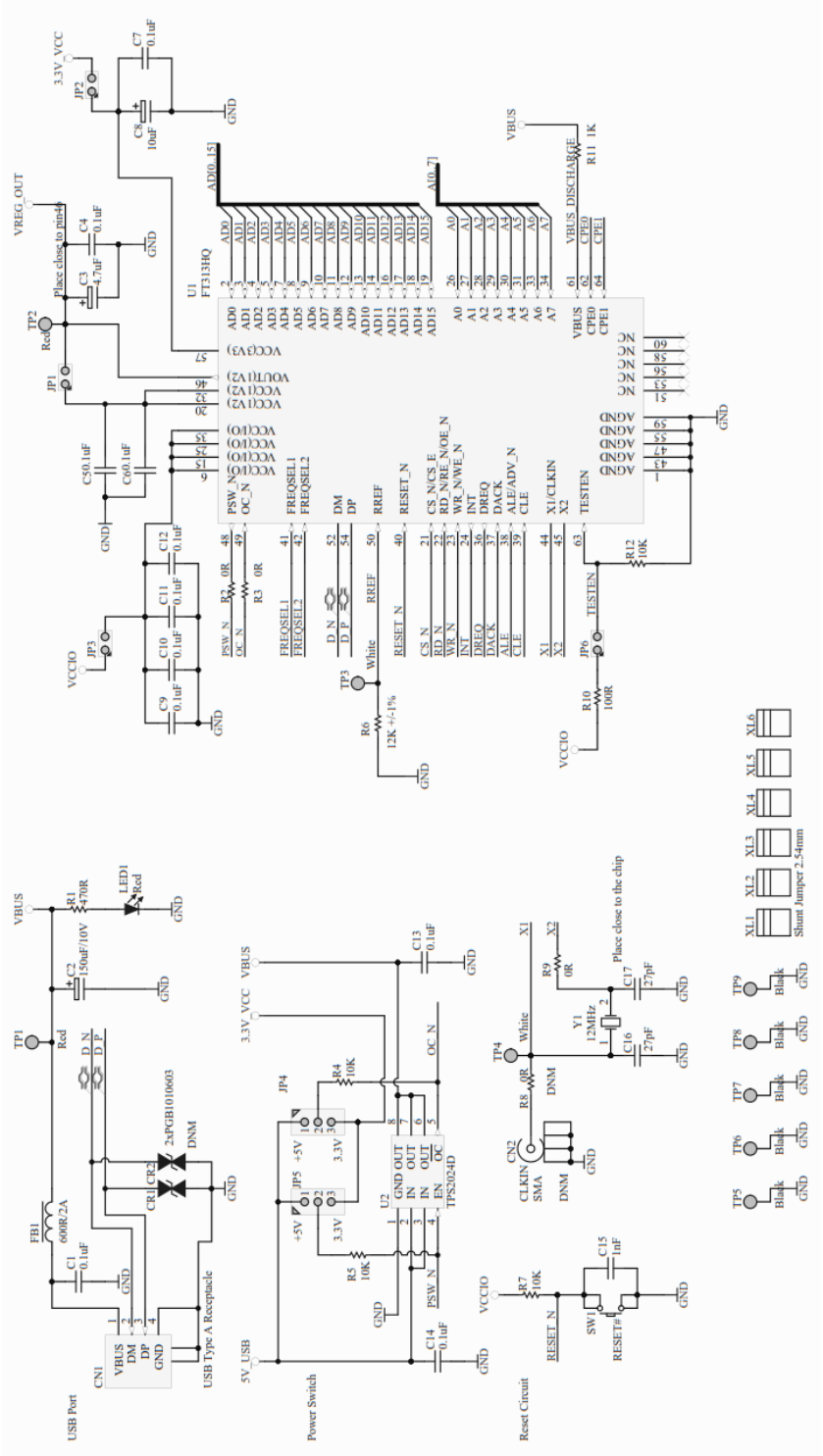

Figure 4.1 – FT313H Chip

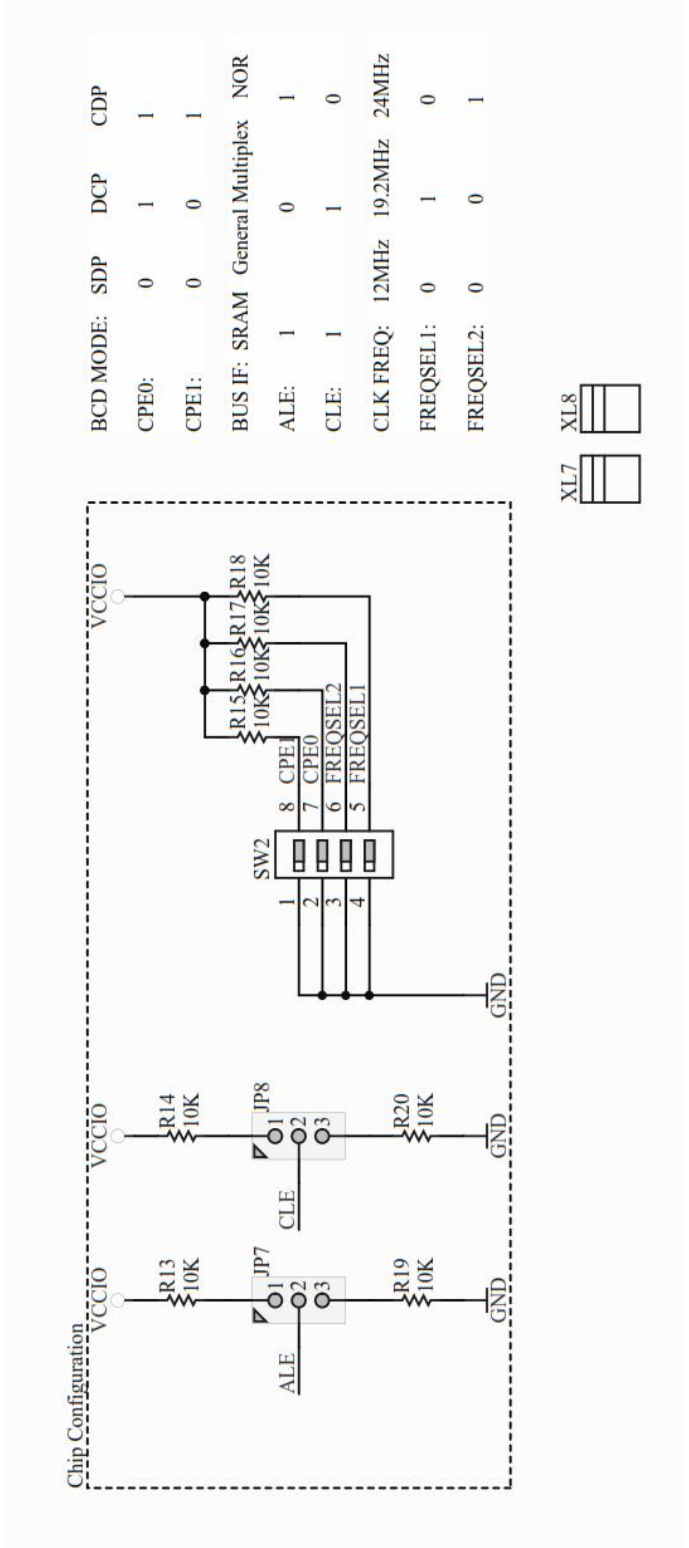

Figure 4.2 – Configuration

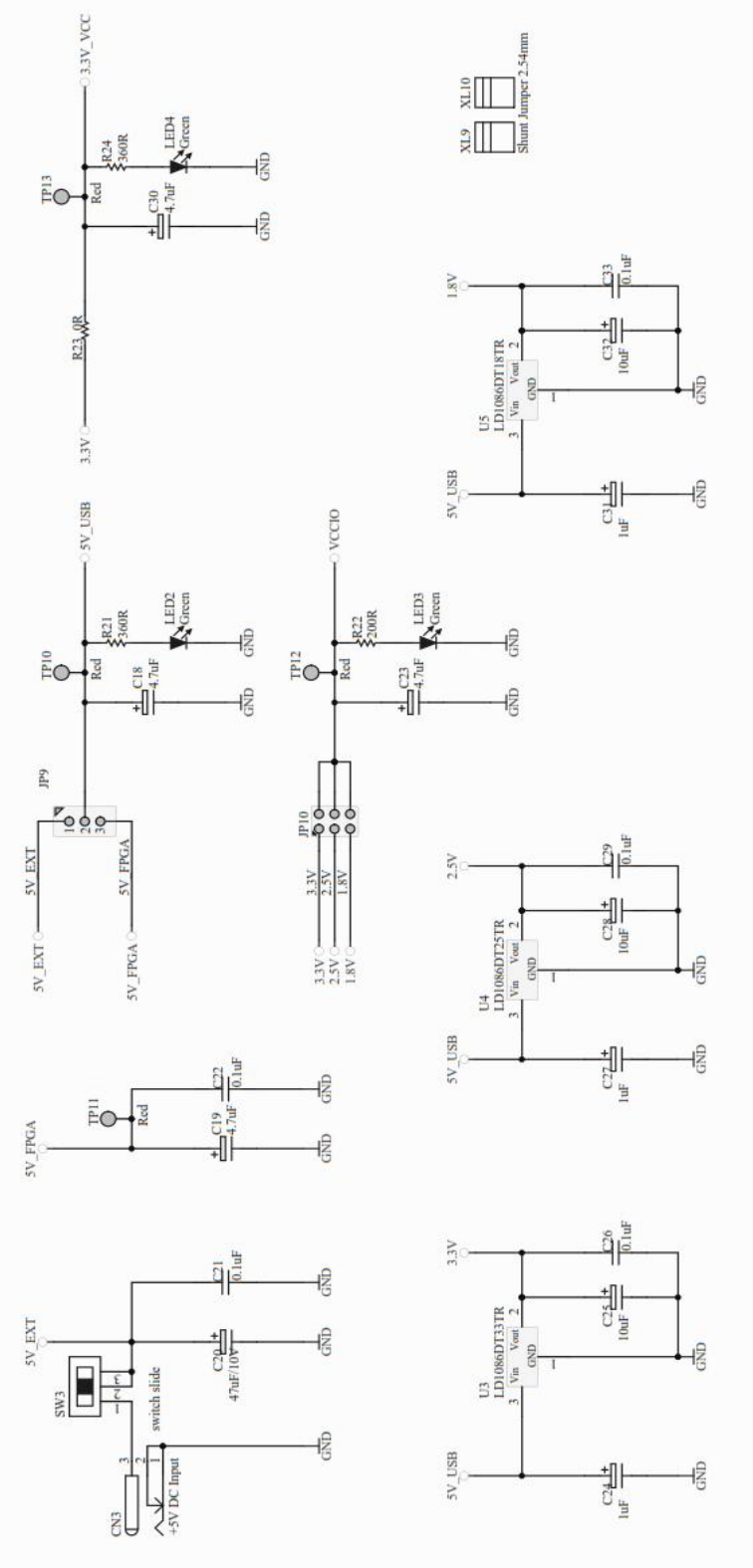

Figure 4.3 – Power

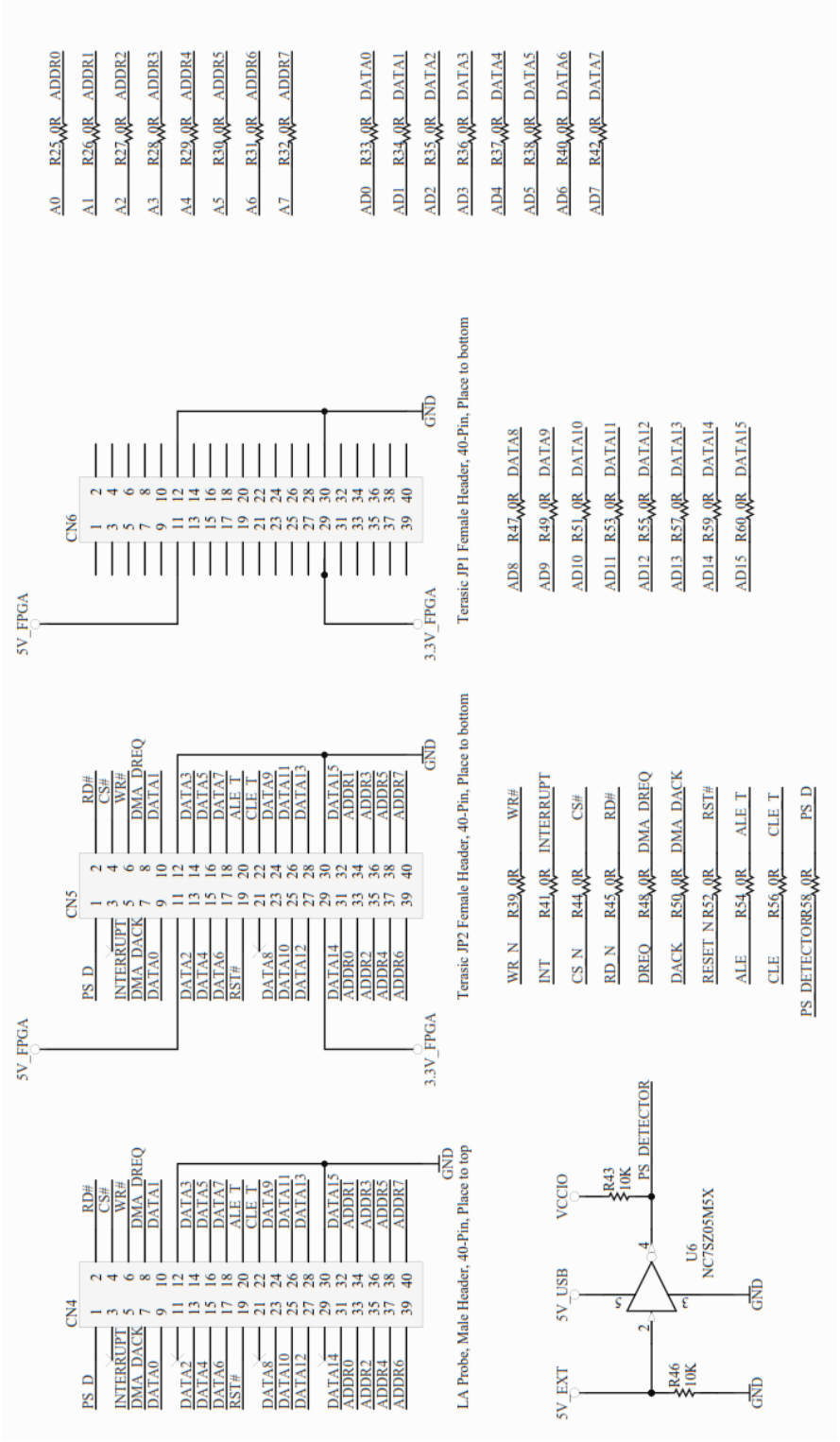

Figure 4.4 – Connector

4.2 Bill of Materials

#	Comment	Designator	Footprint	Description
1	0.1uF	C1, C4, C5, C6, C7, C9, C10, C11, C12, C13, C14, C21, C22, C26, C29, C33	CAPC1608-0603	Capacitor bipolar
2	150uF/10V	C2	CAPM-C-6032-28	CAP TANT 150UF 10V 10% 2312
3	4.7uF	C3, C18, C19, C23, C30	CAPM-A-3216-18	Polarized Capacitor
4	10uF	C8, C25, C28, C32	CAPM-B-3528-21	CAP TANT 10UF 25V 10% 1411
5	1nF	C15	CAPC1608-0603	Capacitor bipolar
6	27pF	C16, C17	CAPC1608-0603	Capacitor bipolar
7	47uF/10V	C20	CAPM-B-3528-21	Polarized Capacitor
8	1uF	C24, C27, C31	CAPM-A-3216-18	CAP TANT 10UF 25V 10% 1411
9	USB Type A Receptacle	CN1	CN_USB-SKT A	USB connector
10	2.1mm Power Jack	CN3	CN_2.1mm_POWER_SOCKET	Low Voltage Power Supply Connector
11	LA Probe, Male Header, 40-Pin, Place to top	CN4	CN_HDR2X20	CONN HEADER VERT DUAL 40POS GOLD
12	Terasic JP2 Female Header, 40-Pin, Place to bottom	CN5	CN_HDR2X20	Header, 40-Pin, Dual row
13	Terasic JP1 Female Header, 40-Pin, Place to bottom	CN6	CN_HDR2X20	Header, 40-Pin, Dual row
14	600R/2A	FB1	IND_C2012-0805	Chip Ferrite Bead 0805
15	Header1 x2	JP1, JP2, JP3, JP6	SIP-2	2 contact jumper
16	Header1 x3	JP4, JP5, JP7, JP8, JP9	SIP-3	3 contact jumper
17	Header2 x3	JP10	CN_HDR2X3	2 contact jumper
18	Red	LED1	LEDC2012-0805	Typical LED diode
19	Green	LED2, LED3, LED4	LEDC2012-0805	Typical LED diode
20	470R	R1	RESC1608-0603	Resistor
21	0R	R2, R3, R9, R23, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R44, R45, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60	RESC1608-0603	Resistor
22	10K	R4, R5, R7, R12, R13, R14, R15, R16, R17, R18, R43, R46	RESC1608-0603	Resistor
23	12K +/-1%	R6	RESC1608-0603	Resistor
24	100R	R10	RESC1608-0603	Resistor
25	1K	R11	RESC1608-0603	Resistor

#	Comment	Designator	Footprint	Description
26	360R	R21, R24	RESC1608-0603	Resistor
27	200R	R22	RESC1608-0603	Resistor
28	EVQPAC04	SW1	SW_PushButton	Push button momentary switch; 4.3 - 5.0mm height
29	Switch DIP	SW2	SW_DIP_TDA04H0SB1	SWITCH DIP 4POS HALF PITCH SMD
30	Switch slide	SW3	SW_500ASSP1M2	SWITCH SLIDE MINI SPDT PC MNT, LF
31	Red	TP1, TP2, TP10, TP11, TP12, TP13	TEST_PIN_PTH_COMPACT	Test pin
32	White	TP3, TP4	TEST_PIN_PTH_COMPACT	Test pin
33	Black	TP5, TP6, TP7, TP8, TP9	TEST_PIN_PTH_COMPACT	TEST POINT PC COMPACT .063"D BLK
34	FT313HQ	U1	QFN50P900X900-64N	HS USB Host Controller, Single USB Port, USB2.0 EHCI Compatible
35	TPS2024D	U2	SO-8N	Power distribution switches
36	LD1086DT33TR	U3	TO252P990X238-3N	1.5A Low Dropout Positive Voltage Regulator
37	LD1086DT25TR	U4	TO252P990X238-3N	1.5A Low Dropout Positive Voltage Regulator
38	LD1086DT18TR	U5	TO252P990X238-3N	1.5A Low Dropout Positive Voltage Regulator
39	NC7SZ05M5X	U6	SOT23-5AL	IC INVERT SGL OPEN DRAIN SOT23-5
40	Shunt Jumper 2.54mm	XL1, XL2, XL3, XL4, XL5, XL6, XL7, XL8, XL9, XL10	-	2.54mm Shorting Jumper
41	12MHz	Y1	CRYSTAL_HC49_3Pin	Crystal Oscillator

Table 4-1 – Bill of materials

5 FTDI Chip Contact Information

Head Office – Glasgow, UK

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Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A - List of Figures and Tables

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Appendix B – Abbreviations and References

Term	Description
BCD	Battery Charger Detect
CPE0	Charging Port Emulation 0
CPE1	Charging Port Emulation 1
CDP	Charging Downstream Port
DCP	Dedicated Charging Port
HSMC	High Speed Mezzanine Connector
HSTC	High Speed Terasic Connector
LED	Light Emitting Diode
OS	Operating System
PCI	Peripheral Component Interconnect
QFN	Quad Flat No Lead Package
SDP	Standard Downstream Port
USB	Universal Serial Bus

Table B-1 – Abbreviations

Title	Description
FT_000589	FT313H IC Datasheet
FT_000764	FT313H Software Programming Guide
USB_2.0	Universal Serial Bus Specification Revision 2.0
BCD Spec	Battery Charging Specification Revision 1.2
EHCI Spec	Enhanced Host Controller Interface Specification for Universal Serial Bus Revison 1.0
PCI Express Spec	PCI Express Base Specificaiton Revision 3.0
Altera Cyclone IV FPGA	Altera Cyclone IV GX FPGA Development Kit User Guide

Table B-2 – References

Appendix C – Revision History

Document Title:	UMFT313EV
Document Reference No.:	FT_000762
Clearance No.:	FTDI# 321
Product Page:	http://www.ftdichip.com/Products/Modules.htm
Document Feedback:	Send Feedback

Version 1.0	Initial Datasheet relased	31/10/12