Future Technology Devices International Ltd

Datasheet

UMFT231XC USB to UART with Battery Charger Support

UMFT231XC is a USB to UART development module with battery charging support.

1   Introduction

UMFT231XC is a development module designed primarily for evaluating the battery charging feature of FTDI's X-Chip range of USB-interface bridging ICs. This module is suitable for charging single cell lithium-ion batteries.

UMFT231XC utilises an FT231XS and a battery charging IC. FT231XS is one of the devices from FTDI's range of USB interface bridging IC devices. FT231X is a USB to UART interface with a battery charger detection feature, which can allow batteries to be charged with a higher current from a dedicated charger port (without the FT231X being enumerated).

The module includes a LTC4053EDD, which is a lithium-ion battery charger with thermal regulation. FTDI X-Chips are designed to operate with battery charger chips, such as the LTC4053EDD, to facilitate charging a battery of a device via USB slave port, with either 1 Amp of current from a dedicated charger port or with up to 500mA from a USB host without violating USB compliance regulations. The X-Chip family are designed to implement this feature without the requirement of external MOSFET or controller chips to regulate the current divider network of the LTC4053 chip.

The on-chip MTP ROM of the FT231XS is programmed by default to support this specific battery charging application. The MTP ROM can be reconfigured to allow for adjustments using FT_Prog. FT_Prog is available for free download from the FTDI website.

1.1   Features

The UMFT231XC is fitted with a FT231XS. For a full list of the FT231X's features please see the FT231X datasheet which can be found at the FTDI website.
In addition to the features listed in the FT231X datasheet, the UMFT231XC has the following features:

- Configured with a LTC4053EDD lithium-ion battery charger

- 3 way 3.5mm screw terminal for connecting a battery to the module

- Thermal regulation safety feature

- 10 pin 0.1" female header used for UART signals, 12 pin 0.1" female header for Power and control

- Status LEDs

- Mini USB-B connector

- Power MOSFET for suspending power supplied to an external circuit from USB bus when in USB suspend mode

Applications include

- Prototyping and evaluating battery charging of a device via a USB port

- USB to UART communications

Table of Contents

2 Driver Support

Royalty-Free VIRTUAL COM PORT Drivers (VCP) for:

- Windows 7 32,64-bit
- Windows Vista
- Windows XP 32,64-bit
- Windows XP Embedded
- Windows CE.NET 4.2 , 5.0 and 6.0
- MAC OS OS-X
- Linux 3.0and greater
- Android

Royalty-Free D2XX Direct Drivers (USB Drivers + DLL S/W Interface) for:

- Windows 7 32,64-bit
- Windows Vista
- Windows XP 32,64-bit
- Windows XP Embedded
- Windows CE.NET 4.2, 5.0 and 6.0
- MAC OS OS-X
- Linux 3.0 and greater
- Android

The drivers listed above are all available to download for free from www.ftdichip.com. Various 3rd Party Drivers are also available for various other operating systems - visit www.ftdichip.com for details.

3 Ordering Information

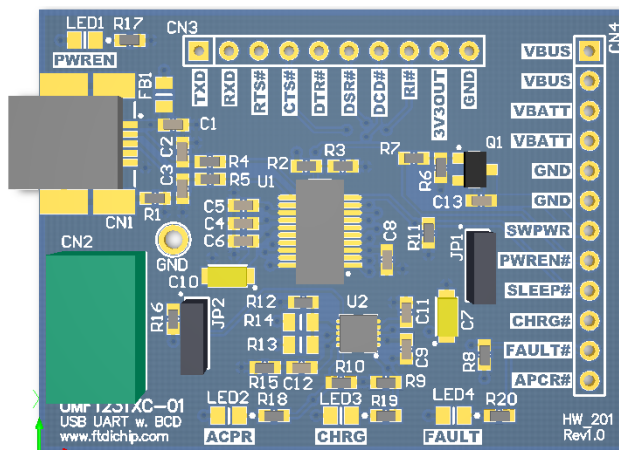| Module Code	Utilised IC Code	Description
UMFT231XC-01	FT231XS	USB to UART evaluation module with battery charger support.

4 UMFT231XC Signals and Configurations

4.1 UMFT231XC Pin Out

Pin	CN3	CN4
1	TXD	VBUS
2	RXD	VBATT
3	RTS#	VBATT
4	CTS#	GND
5	DTR#	GND
6	DSR#	SWPWR
7	DCD#	PWREN#
8	RI#	SLEEP#
9	3V3OUT	CHRG#
10	GND	FAULT#
11		ACPR#
12		GND

Table 4.1 – UMFT231XC Pin-Out

4.2 CN3 Signal Descriptions

Pin No.	Name	Type	Description
1	TXD	Output	Transmit asynchronous data output.
2	RXD	Input	Receiving asynchronous data input.
3	RTS#	Output	Request to send control output / handshake signal.
4	CTS#	Input	Clear to send control input / handshake signal.
5	DTR#	Output	Data terminal ready control output / handshake signal.
6	DSR#	Input	Data set ready control input / handshake signal.
7	DCD#	Input	Data carrier detect control input.
8	RI#	Input	Ring indicator control input. When remote wake up is enabled in the internal MTP ROM taking RI# low >20ms can be used to resume the PC USB host controller from suspend.
9	3V3OUT	Power Output	3.3V output with a current limit of 50mA from the on chip LDO regulator. This pin is decoupled with a 100nF capacitor to ground on the PCB module. The prime purpose of this pin is to provide the 3.3V supply that can be used internally. 3.3V will always be present when power is supplied to VBUS.
10	GND	Ground	Module ground supply pins

Table 4.2 – CN3 Pin-Out Description

4.3 CN4 Signal Descriptions

Pin No.	Name	Type	Description
1	VBUS	Power Output	5V power output USB port. For a low power USB bus powered design, up to 100mA can be sourced from the USB host/hub and applied to the USB bus. A maximum of 500mA can be sourced from the USB host/hub and applied to the USB bus in a high power USB designs. A current draw up to 1A can be sourced from a dedicated charger and applied to the USB bus. VBUS is an input for the USB connector CN1.
2	VBATT	Power Output	Connection to the battery's positive terminal and LTC4053EDD regulated power output used for charging the battery.
3	VBATT	Power Output	Connection to the battery's positive terminal and LTC4053EDD regulated power output used for charging the battery.
4	GND	Ground	Module ground supply pins
5	GND	Ground	Module ground supply pins
6	SWPWR	Power Output	Switchable power sourced from VBUS, when utilised VBUS shorted to SWPWR when the FT231X is enumerated.
7	PWREN#	Output	Output is low after the device has been configured by USB, then high during USB suspend mode. This is the default configuration, reprogramming the MTP ROM can change this setup.
8	SLEEP#	Output	Low during USB suspend mode. This is the default configuration, reprogramming the MTP ROM can change this setup.
9	CHRG#	Output	Low when battery is being charged. This is the default configuration, reprogramming the MTP ROM can change this setup.
10	FAULT#	Output	Low when VBATT or NCT is out of range. This is the default configuration, reprogramming the MTP ROM can change this setup.
11	ACPR#	Output	Low when VBUS is out of voltage range required to charge the battery. This is the default configuration, reprogramming the MTP ROM can change this setup.
12	GND	Ground	Module ground supply pins

Table 4.3 – CN4 Pin-Out Description

4.4 CN2 Signal Descriptions

The CN2 connector is a screw terminal. This connector can be used to connect the wires of a battery the UMFT231XC module.

Pin No.	Name	Type	Description
1	+	Power	Positive power connection to the battery. Power is output from this pin when charging; power is input through this pin when powering a load from the battery.
2	NTC	Safety Feature	Negative Temperature Coefficient, a safety feature used to monitor the batteries temperature, suspends charging when temperature falls out of the temperature range of 0°C – 50°C (with a 2°C hysteresis at both thresholds).
3	-	Ground	Ground connection for the negative supply of the battery.

Table 4.4 – CN4 Pin Out Description

4.5 Jumper Configurations

JP1 is used to reconfigure the power sourced by the switched power net controlled by the CBUS1 line connected to a MOSFET.

Jumper No.	Shorted Pins	Factory Settings	Description
JP1	Pin1-2	Default Setting	Source switchable power from USB VBUS input. With a default configuration SWPWR power is shutdown when the FT231X has not enumerated. This function supports limiting the current flow through the USB bus while in suspend to meet USB compliancy regulations.
JP1	Pin2-3	-	Source switchable power from battery.

Table 4.5 – Solder Links JP1 Pin Description

JP2 is used to adjust the UMFT231XC to facilitate for a battery with or without an NTC line. If a battery has an NTC line, pin 2 of CN2 should be connected to the NTC pin of the battery charger, however if there is no LTC line available the NTC pin of the battery charger should be tired to ground using this jumper.

Jumper No.	Shorted Pins	Factory Settings	Description
JP2	Pin1-2	-	If the charged battery has an NTC line. Connect the line to CN2 pin 2 and configure JP2 to this mode. NTC is a temperature sensing safety feature used to prevent the battery overheating.
JP2	Pin2-3	Default Setting	If there is no NTC line available, then configure JP2 to this jumper setting. This setting shorts the UMFT231XC's NCT line to ground. This indicates that NCT is not available, and allows the battery charger to function without this function.

Table 4.6 – Solder Links JP2 Pin Description

4.6 LEDS

The SWPWR LED illuminates when the SWPWR net is powered up. With the default MTP ROM configuration power to SWPWR is switched on and off by PWREN# to the MOSFET Q1. Q1 will be on when enumerated and off when not enumerated. SWPWR can be sourced from either VBUS or VBATT depending on the setting of JP1.

The ACPR# LED illuminates when voltage supplied to VBUS is above the under-voltage lockout threshold and at least 35mV above VBATT (which means the voltage supplied is suitable for charging).

The CHRG# LED illuminates when the battery is being charged.

The FAULT# LED illuminates when a fault is detected. These detected faults can be either NTC being out of range and a timeout occurring under trickle charge conditions.

5 Battery Charging using an X-Chip

An illustration of an X-Chip being used for battery charging functions is shown in Figure 5.1. The PROG pin of the LTC4053 holds a current detection function that maintains a voltage of 1.5V to this pin and is used to detect the current flowing from V_{PROG} (1.5V) at this pin through a resistor network to Ground. The amount of current from V_{PROG} through the resistor network to Ground is directly proportion the amount of current permitted to flow from VBUS to the battery. The battery charging current is defined by $I_{CHG} = (I_{PROG}).1000$, where I_{CHG} is the current charging the battery, I_{PROG} is $1.5V/R_{PROG}$ and R_{PROG} is the resistance between V_{PROG} and Ground.

It is important that there is no other current source to the PROG pin other than V_{PROG} to prevent an offset in the battery charging current. The FTDI FT231X uses open drain outputs with no internal pull-ups for BCD# and PWREN# to support this requirement. The X-Chip will allow the same CBUS function to be reused with more than one pin, so if BCD# or PWREN# are needed elsewhere in the circuit a second assignment of the required function should be made to a second pin and this pin can be routed elsewhere.

The SHDN# pin of the LTC4053 is an active low input and when a logic low is applied to SHDN# the current supply to the battery is suspended.
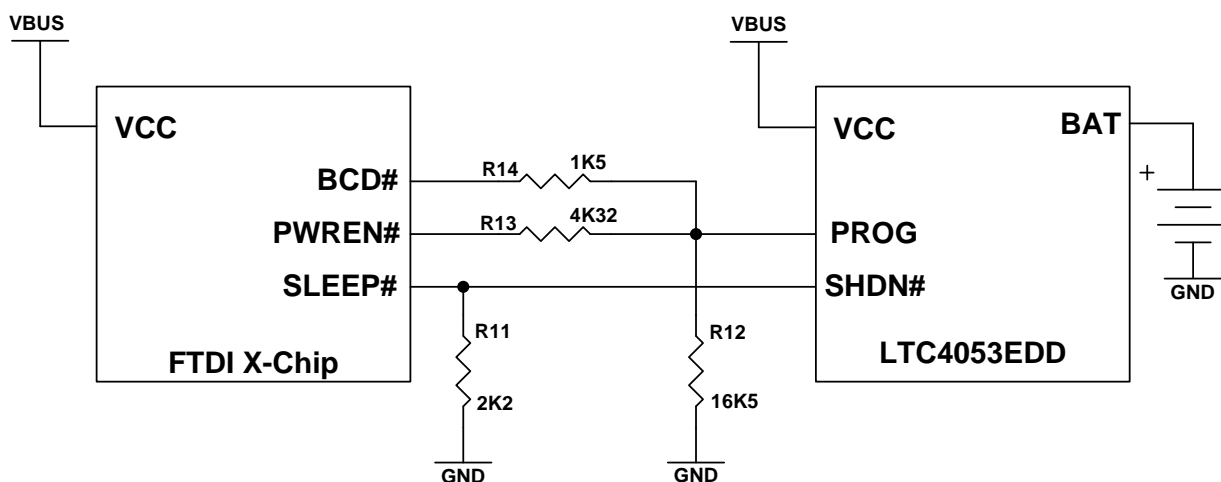
Figure 5.1 – Simplified X-Chip - Battery Charger interface

The required configuration of the BCD# Options of the MTP ROM for this application are given in Table 5.1.

A list of all the different current limits of the UMFT231XC is given in Table 5.2. If the BCD Options of the MTP ROM is configured as shown in Table 5.1, when connected to dedicated charger port BCD# will be tied to ground, PWERN# will be floating and SLEEP will be driven high. The current values give in Table 5.2 can be altered by changing the values of R12, R13 or R14 of the UMFT231XC. The default values of these resistors are given in Figure 5.1.

A description of the signals used to control the limit of the current to battery is given in Table 5.3.

BCD Options:			BCD# Options:
(1) Battery Charger Enable	Enable	Enables the use of BCD_Charger# function, allows for BCD_Charger# to be driven low when a dedicated charger port is connected.	(1) Battery Charger Enable
(2) Force Power Enable	Disable	Disables the option of forcing PWREN# to be driven low when a dedicated charger port is connected.	(2) Force Power Enable
(3) De-activate Sleep	Enable	Prevents SLEEP# pin from driving low when a dedicated charger port is connected.	(3) De-activate Sleep

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Table 5.1 – Configuration of the BCD Options for the UMFT231XC

BCD# Logic State	PWREN# Logic State	SLEEP# Logic State	Current Limits
X	X	0	0mA
Floating	Floating	1	70mA
Floating	0	1	400mA
0	Floating	1	1000mA

Table 5.2 – Truth Table for the Charging Current

Signal	Signal Description	Signal Function for this Application
BCD#	Battery Charger Detected (Active Low) An open drain to ground function that shorts to ground when a dedicated charger port is detected.	When the embedded MTP ROM of the FT231X is configured correctly, BCD# can be used to allow the supply a current greater than 500mA to the battery when a dedicated charged is connected to the USB bus. This module will charge a battery with up to 1A when connected to a dedicated charger port. Details on the default MTP ROM configuration (which is suitable for this application) are given in Section 6.
PWREN#	Power Enable (Active Low) An open drain to ground function that shorts to ground when the X-Chip has enumerated.	PWREN# can be used to allow the supply a current up to 500mA to the battery when the X-Chip is enumerated or up to 100mA when the X-Chip is not enumerated and not suspended. This module charges a battery with a 400mA current limit when in enumerated. When the chip is not enumerated, not connected to a dedicated charger port and not in sleep mode the battery is charged with a limit of 70mA. The "Force Power Enable" option should be disabled to prevent driving the PWREN# signal low and influencing the batteries current limit when connected to a dedicated charger port. For other application enabling this option can be a benefit. Details on the default MTP ROM configuration (which is suitable for this application) are given in Section 6.
SLEEP#	USB suspend (Active Low Output) An open drain with an internal pull-up to VCCIO (3.3V for this module). Shorts to Ground when in USB suspend mode.	SLEEP# can stop the supply of current to the battery when in USB suspend mode and otherwise not interfere. For this application, the SLEEP# function needs to be configured to be disabled (i.e. driven high) when connected to a dedicated charger port. This is done by enabling "De-activate Sleep" option. Details on the default MTP ROM configuration (which is suitable for this application) are given in Section 6.
PROG	Charge Current Program pin. The LTC4053 maintains a voltage of 1.5V to this pin and measures the current flow through the resistor network to ground. The measured current flow is proportional to the limit of the charging current allowed by this chip.	This pin functions with the BCD# and PWREN#. The combined resistance from PROG to ground of the three resistors R13, R14 and R12 change with the status of BCD# and PWREN#. When either of these pins are logic Low, the pin becomes shorted to ground. No additional current is applied to these pins, thus no offset occurs for the PROG current reading.
SHDN#	Charger Shutdown (Active Low Input) Shuts down charger current.	This line is used when in USB suspend mode, in this mode current flow through the USB bus must be less than 500uA. The SHDN# function limits the charger current to less than 25uA when active.

Table 5.3 – Battery Charging Supporting Functions Table

6 MTP ROM Configuration

Following a power-on reset or a USB reset the FT231X will scan its internal MTP ROM and read the USB configuration descriptors stored there. The default values programmed into the internal MTP ROM in the FT231XQ used on the UMFT231XC are shown in Table 6.1.

Parameter	Value	Notes
USB Vendor ID (VID)	0403h	FTDI default VID (hex)
USB Product UD (PID)	6015h	FTDI default PID (hex)
Serial Number Enabled?	Yes	
Serial Number	See Note	A unique serial number is generated and programmed into the MTP ROM during final test of the FT231XC module.
Pull down I/O Pins in USB Suspend	Disabled	Enabling this option will make the device pull down on the UART interface lines when the power is shut off (PWREN# is high).
Manufacturer Name	FTDI	
Product Description	UMFT231XC	
Max Bus Power Current	500mA	
Power Source	Bus Powered	
Device Type	FT231X	
USB Version	0200	Returns USB 2.0 device description to the host. Note: The device is a USB 2.0 Full Speed device (12Mb/s) as opposed to a USB 2.0 High Speed device (480Mb/s).
Remote Wake Up	Enabled	Taking RI# low will wake up the USB host controller from suspend.
High Current I/Os	Disabled	Enables the high drive level on the UART and CBUS I/O pins.
Load VCP Driver	Enabled	Makes the device load the CVP driver interface for the device.
CBUS0	BCD_Charger#	Default configuration of CBUS0 – Drives low when a dedicated charger port is connected the USB bus. Otherwise a floating output pin.
BCD Options:		
(1) Battery Charger Enable	Enable	Enables the use of BCD_Charger# function, allows for BCD_Charger# to be driven low when a dedicated charger port is connected.
(2) Force Power Enable	Disable	Disables the option of forcing PWREN# to be driven low when a dedicated charger port is connected.
(3) De-activate Sleep	Enable	Prevents SLEEP# pin from driving low when a dedicated charger port is connected.
CBUS1	PWREN#	Default configuration of CBUS1 – Power enable (used to switch SWPWR).
CBUS2	SLEEP#	Default configuration of CBUS2 – Drives low when in USB suspend mode. Configured to be disabled (ties high by internal pull-up) when using a dedicated charger port.
CBUS3	PWREN#	Default configuration of CBUS3 – Power enable. Low after USB enumeration, high when the FT231X is connected to a USB host/hub and not enumerated. Configured to be disabled (floating output) when a dedicated charger port is connected to the device.
Invert UART	Disabled	Inverts the UART signals.

Table 6.1 – Default Internal MTP ROM Configuration

The internal MTP ROM in the FT231X can be programmed over USB using the utility program FT_PROG. FT_PROG can be downloaded from the www.ftdichip.com. Users who do not have their own USB vendor

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ID but who would like to use a unique Product ID in their design can apply to FTDI for a free block of unique PIDs. Contact FTDI Support (support1@ftdichip.com) for this service, also see TN_100 and TN_101.
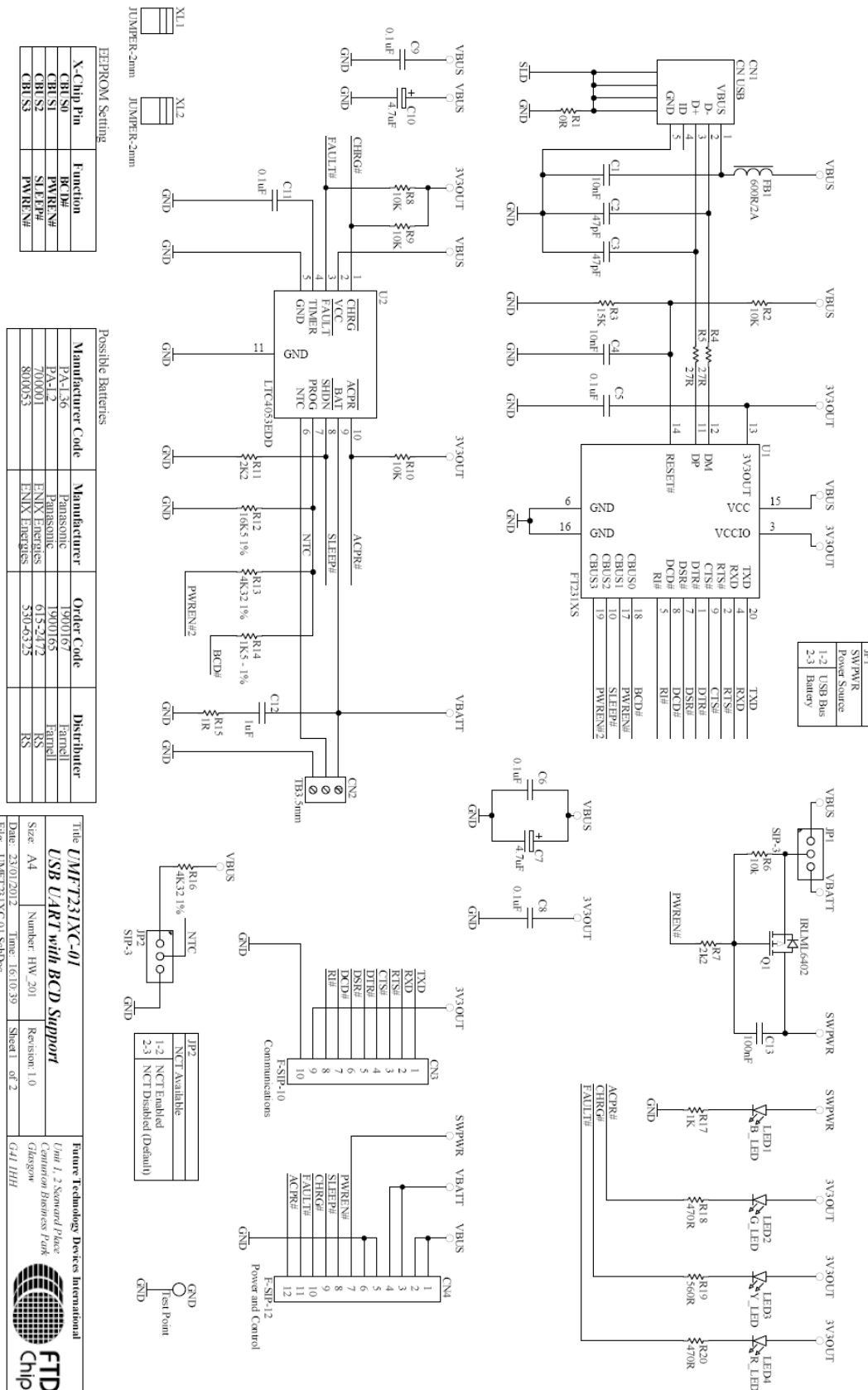
7 Module Dimensions
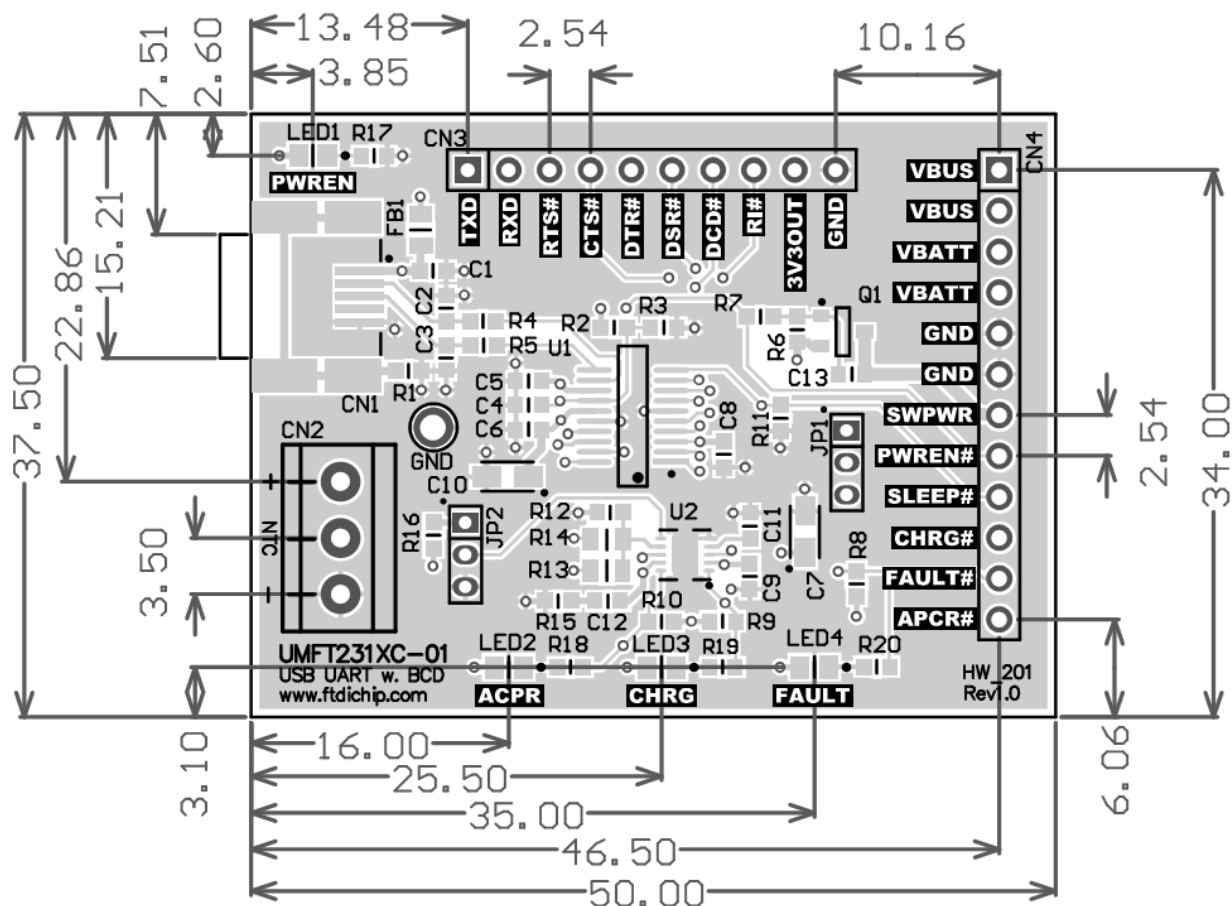
Figure 7.1 – UMFT231XC Module Dimensions

All dimensions are given in millimetres.

The UMFT231XC module exclusively uses lead free components, and is fully compliant with European Union directive 2002/95/EC.

8 UMFT231XA Module Circuit Schematic

Figure 8.1 – Module Circuit Schematic

9 Contact Information

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Appendix A - List of Figures and Tables