

# **Future Technology Devices International Ltd**

## **USB TO RS485 UART SERIAL CONVERTER PCB**

### **Datasheet**

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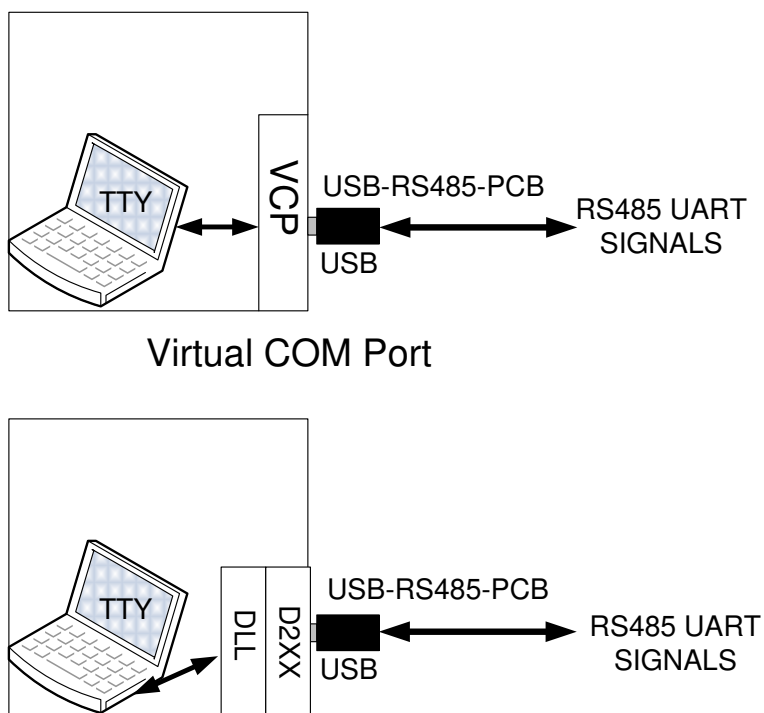
## 1 Description

The **USB-RS485-PCB** is a USB to RS485 level serial UART converter PCB incorporating FTDI's FT232RQ USB to Serial UART interface IC device which handles all the USB signalling and protocols. The PCB provides a fast, simple way to connect devices with a RS485 interface to USB.

Each USB-RS485-PCB contains a small internal electronic circuit board, utilising the FT232R plus a USB type-A connector. The FT232R datasheet, DS\_FT232R, is available at <http://www.ftdichip.com>. The integrated electronics also include an RS485 transceiver plus Tx and Rx LEDs which give a visual indication of UART traffic.

The PCB is USB powered and USB 2.0 full speed compatible. Each PCB supports a data transfer rate up to 3 Mbaud and supports the FTDIChip-ID™, with a unique USB serial number programmed into the FT232R. This feature can be used to create a security or password protected file transfer access using the PCB. Further information and examples on this feature are available at <http://www.ftdichip.com> under FTDIChip-ID Projects.

The USB-RS485-PCB requires USB drivers, available free from <http://www.ftdichip.com>, which are used to make the FT232R on the PCB appear as a virtual COM port (VCP). This then allows the user to communicate with the USB interface via a standard PC serial emulation port (for example TTY). Another FTDI USB driver, the D2XX driver, can also be used with application software to directly access the FT232R on the PCB through a DLL. This is illustrated in the Figure 1.1.



### Software application access to USB via D2XX

Figure 1.1 Using the USB-RS485-PCB

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## 1.1 Part Number

The following Table 1.1 gives details of the USB-RS485-PCB.

| Part Number   | Description                 |
|---------------|-----------------------------|
| USB-RS485-PCB | USB to RS485 level UART PCB |

**Table 1.1 USB-RS485-PCB Part Number**

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## 2 Typical Applications

- USB to Serial RS485 Level Converter.
- Upgrading Legacy Peripherals to USB.
- Interface Microcontroller UART or I/O to USB.
- Interface FPGA / PLD to USB.
- USB Instrumentation PC interface.
- USB Industrial Control.
- USB password protected file transfers.

### 2.1 Driver Support

#### Royalty free VIRTUAL COM PORT (VCP) DRIVERS for...

- Windows 98, 98SE, ME, 2000, Server 2003 and Server 2008
- Windows XP and XP 64-bit
- Windows Vista and Vista 64-bit
- Windows XP Embedded
- Windows CE 4.2, 5.0 and 6.0
- Mac OS 8/9, OS-X
- Linux 2.4 and greater

#### Royalty free D2XX Direct Drivers (USB Drivers + DLL S/W Interface)

- Windows 98, 98SE, ME, 2000, Server 2003 and Server 2008
- Windows XP and XP 64-bit
- Windows Vista and Vista 64-bit
- Windows XP Embedded
- Windows CE 4.2, 5.0 and 6.0
- Linux 2.4 and greater
- Mac OS-X

The drivers listed above are all available to download for free from [www.ftdichip.com](http://www.ftdichip.com). Various 3<sup>rd</sup> Party Drivers are also available for various other operating systems – see [www.ftdichip.com](http://www.ftdichip.com) for details.

### 2.2 Features

- USB-RS485-PCB provides a USB to RS485 Serial UART interface.
- Entire USB protocol handled by the electronics on the PCB.
- EIA/TIA-485 interface with low power requirements.
- UART interface support for 7 or 8 data bits, 1 or 2 stop bits and odd / even / mark / space / no parity.
- Data transfer rates up from 300 baud to 3 Mbaud.
- Internal EEPROM with user writeable area.
- FTDI's royalty-free VCP allow for communication as a standard emulated COM port and D2XX 'direct' drivers provide DLL application programming interface.
- Support for FT232R FTDIChip-ID™ feature for improved security.
- PCB is USB Powered – no external supply required.
- X-On / X-Off software handshaking
- Low USB bandwidth consumption.
- UHCI / OHCI / EHCI host controller compatible.
- USB 2.0 Full Speed compatible.
- -40°C to +85°C operating temperature range.
- RoHS compliant
- ESD Protection for RS-485 I/O's
  - ±15kV Human Body Model (HBM)
  - ±15kV EN61000-4-2 Air Gap Discharge
  - ±8kV EN61000-4-2 Contact Discharge

### 3 Features of FT232R applicable to USB-RS485-PCB

The USB-RS485-PCB uses FTDI's FT232RQ USB to serial IC device. This section summarises the key features of the FT232RQ which apply to the USB-RS485-PCB. For further details, and a full features and enhancements description consult the FT232R datasheet, this is available from [www.ftdichip.com](http://www.ftdichip.com).

**Internal EEPROM.** The internal EEPROM is used to store USB Vendor ID (VID), Product ID (PID), device serial number, product description string and various other USB configuration descriptors. Each USB-RS485-PCB is supplied with the internal EEPROM pre-programmed as described in **Appendix A – PCB EEPROM Configuration**. The internal EEPROM descriptors can be programmed in circuit, over USB without any additional voltage requirement. It can be programmed using the FTDI utility called FT\_Prog, which can be downloaded from the FTDI website (<http://www.ftdichip.com/Support/Utilities.htm>). Additionally, there is a user area of the internal EEPROM available to system designers to allow storing of data (note that this is not modified by FT\_Prog).

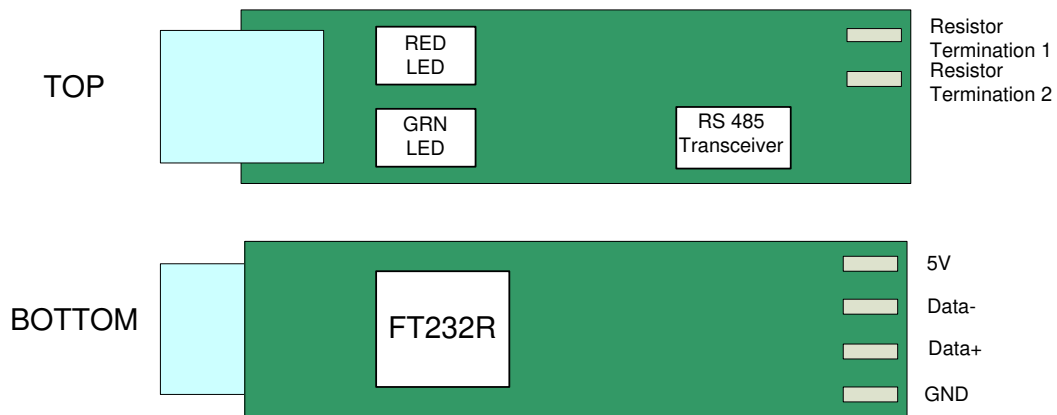
**Lower Operating and Suspend Current.** The FT232R has a low 15mA operating supply current and a very low USB suspend current of approximately 70µA.

**Low USB Bandwidth Consumption.** The USB interface of the FT232R, and therefore the USB-RS485-PCB has been designed to use as little as possible of the total USB bandwidth available from the USB host controller.

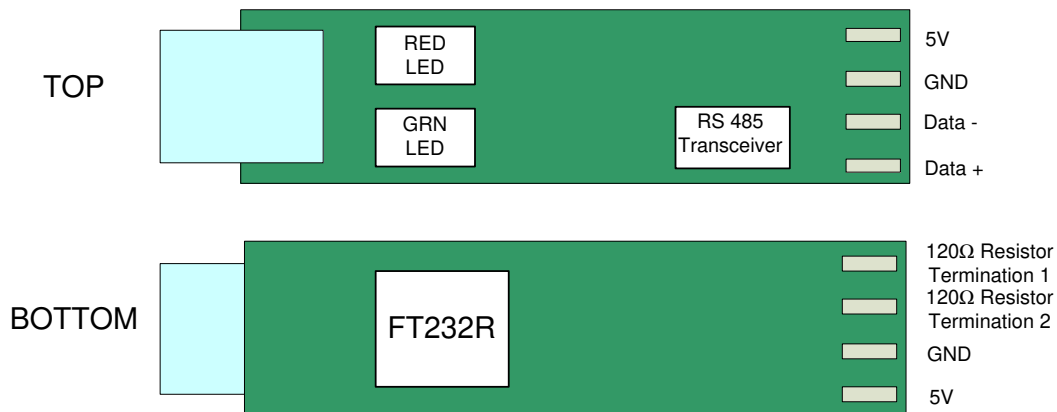
**FTDICHIP-ID™.** The FT232R includes the new FTDICHIP-ID™ security dongle feature. This FTDICHIP-ID™ feature allows a unique number to be burnt into each FT\_232RQ during manufacture. This number cannot be reprogrammed. This number is only readable over USB can be used to form the basis of a security dongle which can be used to protect any customer application software being copied. This allows the possibility of using the USB-RS485-PCB as a dongle for software licensing. Further to this, a renewable license scheme can be implemented based on the FTDICHIP-ID™ number when encrypted with other information. This encrypted number can be stored in the user area of the FT232R internal EEPROM, and can be decrypted, then compared with the protected FTDICHIP-ID™ to verify that a license is valid. Web based applications can be used to maintain product licensing this way. An application note, AN232R-02, available from FTDI website ([www.ftdichip.com](http://www.ftdichip.com)) describes this feature.

**Extended Operating Temperature Range –** The USB-RS485-PCB is capable of operating over an extended temperature range of -40° to +85°C thus allowing it to be used in automotive or industrial applications.

#### 4 USB-RS485-PCB Connector Pin Out and Mechanical details



USB-RS485-PCB Rev 1

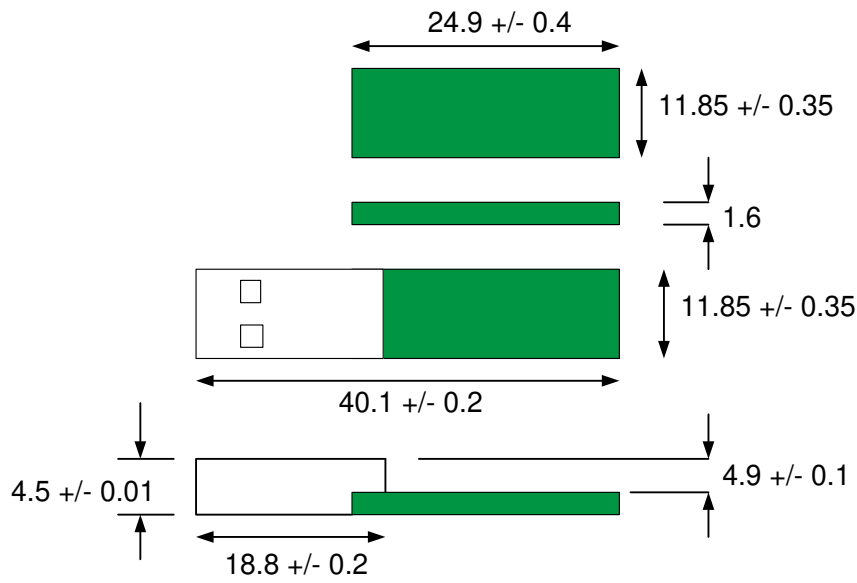


USB-RS485-PCB Rev 2

**Figure 4.1 USB-RS485-PCB Pin Out (Top is TOP View, Bottom is BOTTOM View)**

The mechanical details of the PCB are shown in the following diagram Figure 4.2

Additional pads were added to the PCB to allow for easier wiring which resulted in a Rev 2 PCB. There were no other changes between Rev 1 and Rev 2.



Dimensions in mm

**Figure 4.2 USB-RS485-PCB, Mechanical Details**



## 4.1 USB-RS485-PCB Signal Descriptions

| Name         | Type         | Description  |
|--------------|--------------|--|
| GND          | GND          | Device ground supply pin.  |
| Terminator 1 | Input        | Pin 1 of 120R Terminating Resistor. Only Required if the USB-RS485-PCB is the first or last device in a multi-drop RS485 System, to meet RS485 Termination Requirements.                           |
| POWER        | Output       | Power output. Default output is +5V when active, 0V during suspend. If required, contact FTDI Sales Team (sales1@ftdichip.com). Switchable power to external device, 250mA max. OFF during suspend |
| Data +       | Bi-Direction | Data + Signal  |
| Data -       | Bi-Direction | Data - Signal  |
| Terminator 2 | Input        | Pin 2 of 120R Terminating Resistor. Only Required if the USB-RS485-PCB is the first or last device in a multi-drop RS485 System, to meet RS485 Termination Requirements.                           |

**Table 4.1 USB-RS485-PCB Signal Descriptions**

Note: In some cases when termination is enabled, unexpected zero bytes can be received at the beginning or end of a message. To resolve this, biasing resistors can be added to the Data + and Data - lines to ensure that the lines go to an idle state when no node is driving data onto the bus.

Typical values for these resistors would be:

- 750 ohms between Data + and +5V (POWER)
- 750 ohms between Data - and ground (GND)

The resistors would be fitted externally to the USB-RS485-PCB as the board does not have footprints for them.

Only one set of biasing resistors should only be used on the bus. They should not be added to the USB-RS485-PCB node if another node on the bus is already providing biasing.

## 4.2 USB-RS485-PCB Electrical Parameters

| Parameter      | Description                 | Minimum | Typical | Maximum | Units | Conditions   |
|----------------|-----------------------------|---------|---------|---------|-------|--|
| VCC_5V         | Output Power Voltage        | 4.25    | 5.0     | 5.25    | V     | The range is dependent on the USB port that the USB-RS485-PCB is connected to. |
| I <sub>o</sub> | Output Power Current        | -       |         | 250     | mA    | Must be less than 2.5mA during suspend.  |
| T              | Operating Temperature Range | -40     |         | +85     | °C    |  |

**Table 4.2 USB-RS485-PCB**

| Parameter                 | Description                         | Minimum | Typical | Maximum | Units | Conditions                 |
|---------------------------|-------------------------------------|---------|---------|---------|-------|----------------------------|
| <b>Receiver Input</b>     |                                     |         |         |         |       |                            |
| VCM                       | Common-mode input voltage range     | -7      |         | +12     | V     |                            |
| IN                        | Input Current                       |         |         | 1.0     | mA    | VIN = +12V                 |
|                           |                                     |         |         | -0.8    |       | VIN = -7V                  |
| VTH                       | Differential Threshold Voltage, VTH | -0.2    |         | +0.2    | V     |                            |
| VIHYST                    | Input Hysteresis                    |         | 20      |         | mV    |                            |
| RIN                       | Input Resistance, RIN               | 12      | 15      |         | kΩ    |                            |
| <b>Transmitter Output</b> |                                     |         |         |         |       |                            |
| VOD                       | Differential Output Voltage, dVOD   | 1.5     |         | 5       | V     | With RL = 54Ω. CL = 50pF * |

**Table 4.4 USB-RS485-PCB I/O Pin Characteristics**

\* - The 54 ohms is the equivalent of two 120 ohm termination resistors placed on each side of the transmission line and the input impedance of 32 receivers on the line.

Note: The VCC\_5V output is switched by a transistor on the USB-RS485-PCB. This transistor will enable the VCC\_5V output when the device is enumerated (it will disable the VCC\_5V output when in USB suspend mode).

| Description                 | Conditions                | Minimum | Typical | Maximum |
|-----------------------------|---------------------------|---------|---------|---------|
| ESD HBM                     | RS-485 Inputs and Outputs |         | ±15 kV  |         |
| EN61000-4-2ContactDischarge | RS-485 Inputs and Outputs |         | ±8 kV   |         |
| EN61000-4-2AirGapDischarge  | RS-485 Inputs and Outputs |         | ±15 kV  |         |

**Table 4.3 USB-RS485-WE ESD Tolerance**

### 4.3 Local Echo

RS485 systems often have local echo enabled. This means any data transmitted by a device is echoed back to itself.

The USB-RS485-PCB allows for local echo to be enabled/disabled by changing a bit in the FT232R EEPROM. If CBUS4 in the EEPROM is set for "PWRON#", local echo is enabled. If CBUS4 in the EEPROM is set for "TXDEN", local echo is disabled.

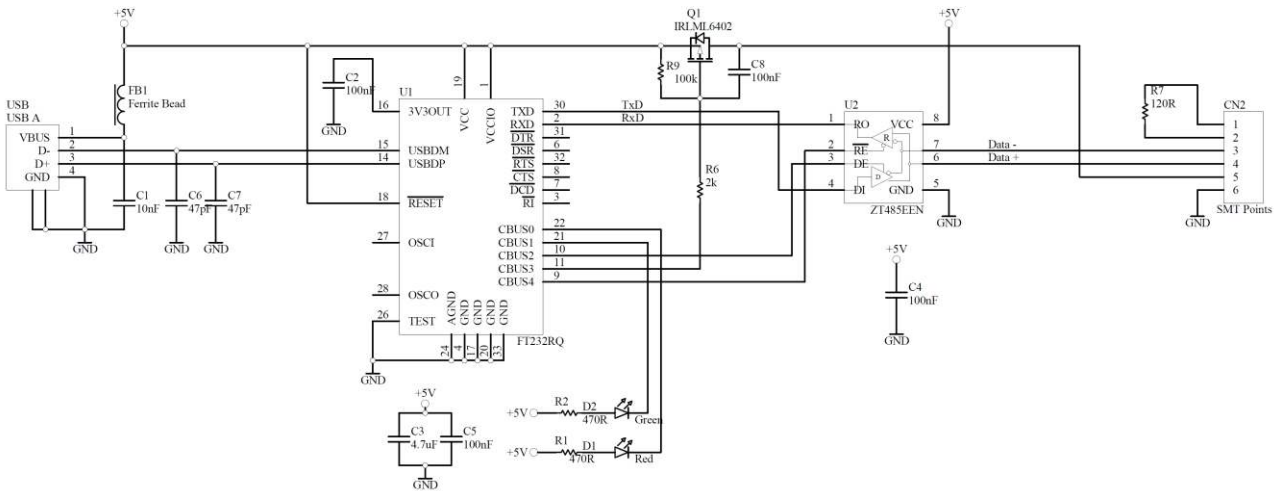
Users can enable/disable the local echo setting with the Echo Configuration Utility from <http://www.ftdichip.com/Support/Utilities/USB-485%20Echo%20Configuration%20Utility.zip>

If required, other EEPROM settings (including local echo) can also be configured with the FT\_Prog utility from <http://www.ftdichip.com/Support/Utilities.htm>

The default for the local echo is disabled (CBUS4 set for "TXDEN").

## 5 USB-RS485-PCB Circuit Schematic

The circuit schematic of the USB-RS485-PCB, utilising the FTDI FT232R, is shown in Figure 5.1



**Figure 5.1 Circuit Schematic of USB-RS485-PCB.**

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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 – PCB EEPROM Configuration

Each USB-RS485-PCB is controlled by the FTDI FT232R IC. This FT232R device contains an EEPROM which contains the USB configuration descriptors for that device. When the PCB is plugged into a PC or a USB reset is performed, the PC will read these descriptors. The default values stored into the internal EEPROM are defined in Table 0.1 Default Internal EEPROM Configuration

| Parameter                         | Value       | Notes  |
|-----------------------------------|-------------|--|
| USB Vendor ID (VID)               | 0403h       | FTDI default VID (hex)   |
| USB Product ID (PID)              | 6001h       | FTDI default PID (hex)   |
| Serial Number Enabled?            | Yes         |  |
| Serial Number                     | See Note    | A unique serial number is generated and programmed into the EEPROM during device final test.   |
| 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               | See note    | USB-RS485-PCB  |
| Max Bus Power Current             | 90mA        |  |
| Power Source                      | Bus Powered |  |
| Device Type                       | FT232R      |  |
| USB Version                       | 0200        | Returns USB 2.0 device description to the host. Note: The device is be a USB 2.0 Full Speed device (12Mb/s) as opposed to a USB 2.0 High Speed device (480Mb/s). |
| Remote Wake Up                    | Disabled    |  |
| High Current I/Os                 | Enabled     | Enables the high drive level on the UART and CBUS I/O pins.  |
| Load VCP Driver                   | Enabled     | Makes the device load the VCP driver interface for the device.   |
| Invert TXD                        | Disabled    | Signal on this pin becomes TXD# if enable.   |
| Invert RXD                        | Disabled    | Signal on this pin becomes RXD# if enable.   |
| Invert RTS#                       | Disabled    | Signal on this pin becomes RTS if enable.  |
| Invert CTS#                       | Disabled    | Signal on this pin becomes CTS if enable.  |

**Table 0.1 Default Internal EEPROM Configuration**

The internal EEPROM on the PCB can be re-programmed over USB using the utility program FT\_Prog, which can be downloaded from <http://www.ftdichip.com/Support/Utilities.htm>. Users who do not have their own USB Vendor 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 for this service.

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## Appendix B – List of Figures and Tables

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## Appendix C – Revision History

|               |  |                                 |
|---------------|--|---------------------------------|
| Version Draft | First Draft  | January, 2009                   |
| Version 1.0   | First Release  | 21 <sup>st</sup> January, 2009  |
| Version 1.01  | Corrected the PCB diagram and TW address   | 09 <sup>th</sup> February, 2009 |
| Version 1.02  | Added Rev 1 and Rev 2 mechanical diagrams  | 10 <sup>th</sup> March, 2009    |
| Version 1.1   | Edited Figure 4.1 and table 4.1, signals A Data+ and B Data-<br>Added section 1.2 USB compliant Logo   | 29 <sup>th</sup> July 2010      |
| Version 1.2   | Removed section 1.2<br>All diagram/schematic pins now labelled as 'Data +' and 'Data -'<br>Added links to FT_Prog utility which replaces MPROG<br>Added link to echo configuration utility<br>Updated table 4.2 as 5V output is available on standard PCB<br>Added details of external biasing resistors | 27 <sup>th</sup> May 2011       |