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# **Future Technology Devices International Ltd**

## **USB to RS422 Serial Converter Cable**

CE FCC

## **Datasheet**

**Document Reference No.: FT\_000116**

**Version 1.2**

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## 1 Description

The **USB-RS422** cable is a USB to RS422 levels serial UART converter cable incorporating FTDI's FT232RQ USB to serial UART interface IC device which handles all the USB signalling and protocols. The cable provides a fast, simple way to connect devices with a RS422 interface to USB.

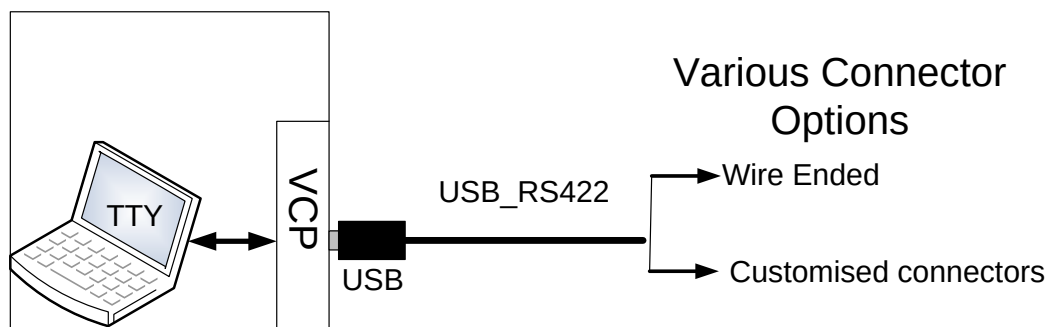
Each USB-RS422 cable contains a small internal electronic circuit board, utilising the FT232R, which is encapsulated into the USB connector end of the cable. The FT232R datasheet, [DS\\_FT232R](http://www.ftdichip.com), is available at <http://www.ftdichip.com>. The integrated electronics also include the RS422 transceiver plus Tx and Rx LEDs which give a visual indication of traffic on the cable (if transparent USB connector mould specified).

The other end of the cable is bare, tinned wire ended connections by default, but can be customised using different connectors to support various applications.

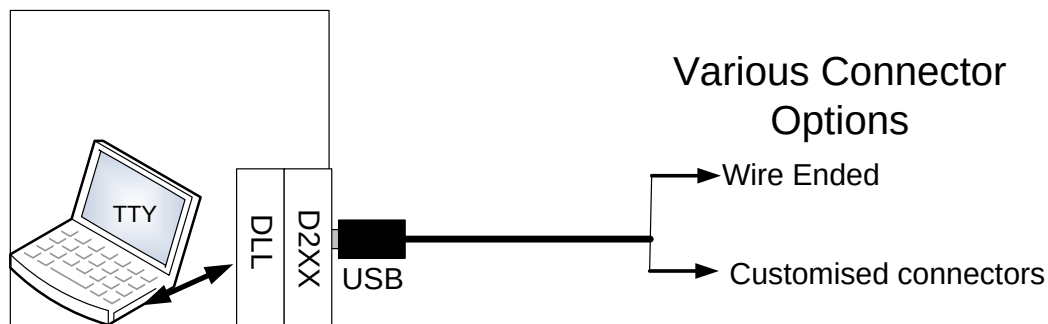
Cables are FCC, CE, RoHS compliant.

The USB side of the cable is USB powered and USB 2.0 full speed compatible. Each cable is 1.8m long and supports a data transfer rate up to 3 Mbaud. Each cable 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 cable. Further information and examples on this feature are available at <http://www.ftdichip.com> under [FTDIChip-ID Projects](#).

The USB-RS422 cables require USB drivers, available free from <http://www.ftdichip.com>, which are used to make the FT232R in the cable 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 cable through a DLL. This is illustrated in the Figure 1.1



Virtual COM Port



Software application access to USB via D2XX Driver

**Figure 1.1 Using the USB-RS422 Cable**



## 2 Cable Part Numbers

The following table gives details of the available USB-RS422 cables.

Table 2.1 Available USB-RS422 cables.

| Part Number               | Description                                                                                                                                                                                                               | End Connector*                     | Cable details                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------------|
| USB-RS422-WE-1800-BT      | <b>USB</b> to UART cable with <b>RS422</b> level UART signals. <b>B</b> black cable, <b>T</b> ransparent USB connector                                                                                                    | <b>Wire E</b> nded (no connector)  | <b>1.8m</b> cable,9 core, UL2464 24 AWG, diam=5mm |
| *<br>USB-RS422-CC-LLLL-CU | <b>USB</b> to UART cable with <b>RS422</b> level UART signals.<br><br><b>C</b> = cable colour ( <b>B</b> black or <b>T</b> transparent),<br><br><b>U</b> = USB connector colour ( <b>T</b> transparent or <b>B</b> black) | <b>CC</b> = Connector description. | LLLL = Length of cable.                           |

Table 2.1 USB-RS422 Cables Descriptions and Part Numbers

\* FTDI supports customised end connector designs. For more information, please contact FTDI Sales Team ([sales1@ftdichip.com](mailto:sales1@ftdichip.com))

### 2.1 Certifications

FTDI USB-RS422 cable is fully RoHs compliant as well as CE and FCC certified.





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### 3 Typical Applications

- USB to serial RS422 level converter.
- Upgrading legacy peripherals to USB.
- Interface Microcontroller UART or I/O to USB.
- Interface FPGA or PLD to USB.
- USB Instrumentation PC interface.
- USB industrial control.
- USB password protected file transfers.

#### 3.1 Driver Support

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

- Windows 7 64-bit
- 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 7 64-bit
- 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 3rd Party Drivers are also available for other operating systems - see **[www.ftdichip.com](http://www.ftdichip.com)** for details.



## 3.2 Features

- USB-RS422 converter cable provides a USB to RS422 serial interface with customised end connectors.
- Entire USB protocol handled by the electronics in the cable.
- EIA/TIA-422 communication 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.
- 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.
- Visual indication of Tx and Rx traffic via LEDs in the transparent USB connector.
- X-On / X-Off software handshaking.
- Data transfer rates from 300 baud to 3 Mbaud.
- Support for FT232R FTDIChip-ID™ feature for improved security.
- Low USB bandwidth consumption.
- UHCI / OHCI / EHCI host controller compatible.
- USB 2.0 Full Speed compatible.
- -40°C to +85°C operating temperature range.
- Cable length is 1.80m (6 feet).
- ESD Protection for RS-422 I/O's
  - ±15kV Human Body Model (HBM)
  - ±15kV EN61000-4-2 Air Gap Discharge
  - ±8kV EN61000-4-2 Contact Discharge
- FCC and CE compliant.
- Custom versions available on request (subject to MOQ).
- RoHS Compliant



## 4 Features of FT232R applicable to USB-RS422 Cable

The USB-RS422 cable uses FTDI's FT232RQ USB to serial UART IC device. This section summarises the key features of the FT232RQ which apply to the USB-RS422 USB to serial RS422 converter cables. 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 in each cable is used to store USB Vendor ID (VID), Product ID (PID), device serial number, product description string and various other USB configuration descriptors. Each cable is supplied with the internal EEPROM pre-programmed as described in **Appendix A – Cable 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 software called MPROG, which can be downloaded from FTDI Utilities on the FTDI website ([www.ftdichip.com](http://www.ftdichip.com)). 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 MPROG).

**Lower Operating and Suspend Current.** The FT232R has a low 15mA operating supply current and a very low USB suspend current of approximately 70µA. (Note that during suspend mode, the current drawn by any customised cable application which uses the USB supply, should not exceed 2.5mA to remain USB compliant)

**Low USB Bandwidth Consumption.** The USB interface of the FT232R, and therefore the USB-RS422 cables 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 cable 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-RS422 cables 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.

**Improved EMI Performance.** The USB-RS422 cables are FCC and CE certified.

**Extended Operating Temperature Range -** The USB-RS422 cables are capable of operating over an extended temperature range of -40° to +85° C thus allowing them to be used in commercial or industrial applications.





## 5 USB-RS422-WE-LLLL-CU

The USB-RS422-WE cable is un-terminated; it has bare and tinned wires.

The LLLL specifies the length of the cable in cm. The CU specifies the colour of the cable and the colour of the USB connector. The cable can be either Black or transparent. The USB connector comes with transparent plug because of the LED implemented inside but can be sold in black colour as well. For simplicity, the LLLL and CU have been dropped from the following descriptions.

### 5.1 USB-RS422-WE Connections and Mechanical Details

The following Figure 5.1 shows the cable signals and the wire colours for the signals on the USB-RS422-WE cable. The Figure 5.2 shows dimensions in millimetres.

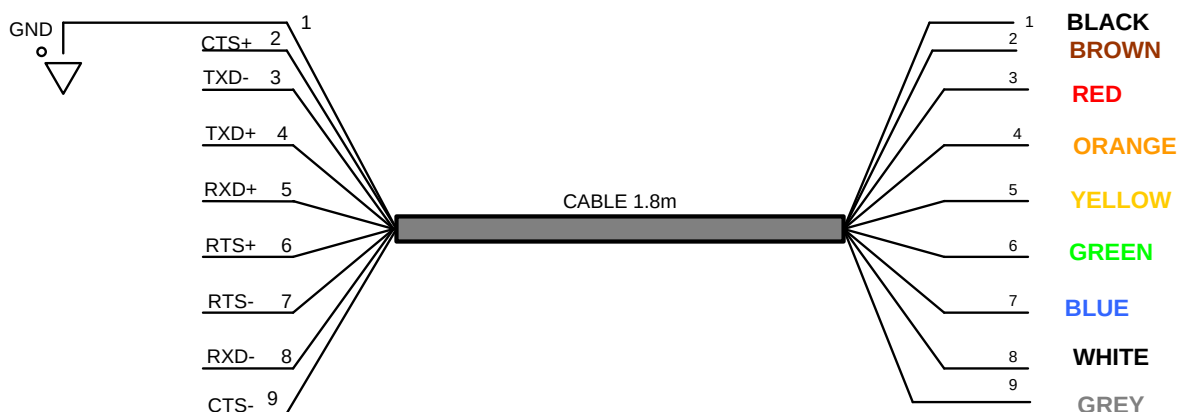


Figure 5.1 USB-RS422-WE Connections

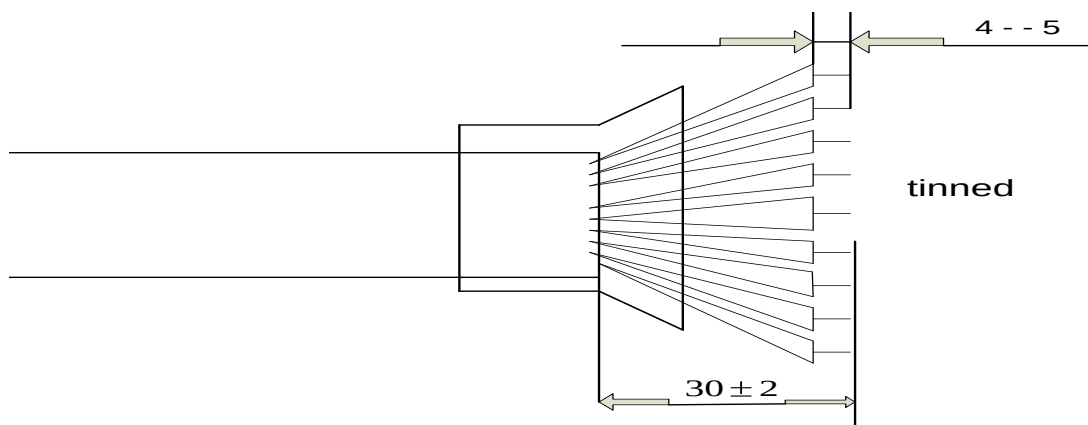


Figure 5.2 USB-RS422-WE Mechanical Details (dimensions in mm)



Figure 5.3 USB-RS422-WE Cable images



## 5.2 USB-RS422-WE Cable Signal Descriptions

| Colour | Name | Type   | Description                              |
|--------|------|--------|------------------------------------------|
| Black  | GND  | GND    | Device ground supply pin.                |
| Brown  | CTS+ | Input  | Clear to Send Control + (B), Input       |
| Red    | TXD- | Output | Data - (A) Output                        |
| Orange | TXD+ | Output | Data + (B) Output                        |
| Yellow | RXD+ | Input  | Data + (B) Input                         |
| Green  | RTS+ | Output | Request To Send Control + (B), Output    |
| Blue   | RTS- | Output | Request To Send Control - (A), Output    |
| White  | RXD- | Input  | Data - (A) Input                         |
| Grey   | CTS- | Input  | Clear to Send Control input - (A), Input |

Table 5.1 USB-RS422-WE Cable Signal Descriptions

## 5.3 USB-RS422-WE Electrical Parameters

| 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 5.2 USB-RS422-WE I/O 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.



| Description                 | Conditions                | Minimum | Typical | Maximum |
|-----------------------------|---------------------------|---------|---------|---------|
| ESD HBM                     | RS-422 Inputs and Outputs |         | ±15 kV  |         |
| EN61000-4-2ContactDischarge | RS-422 Inputs and Outputs |         | ±8 kV   |         |
| EN61000-4-2AirGapDischarge  | RS-422 Inputs and Outputs |         | ±15 kV  |         |

**Table 5.3 USB-RS422-WE ESD Tolerance**



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## 6 Cable PCB Block Diagram

The block diagram for the small internal electronic circuit board, utilising the FTDI FT232R, which is encapsulated into the USB connector end of the cable, is shown in Figure 6.1.

Customised versions of the cable are also available. Users interested in customised versions of these cables should contact FTDI sales ([sales1@ftdichip.com](mailto:sales1@ftdichip.com)).

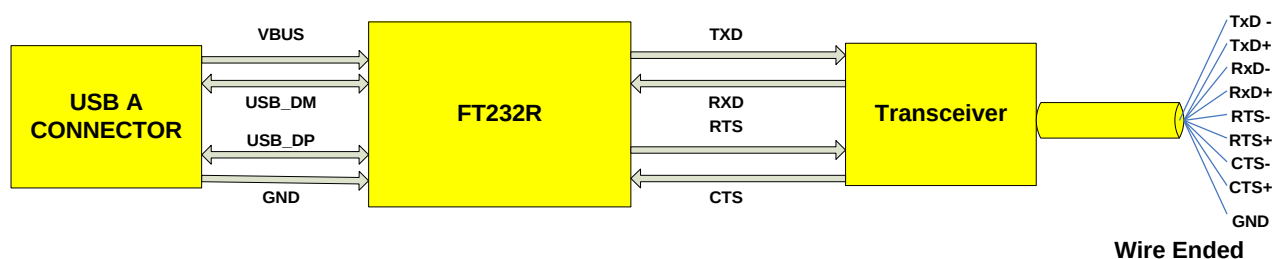


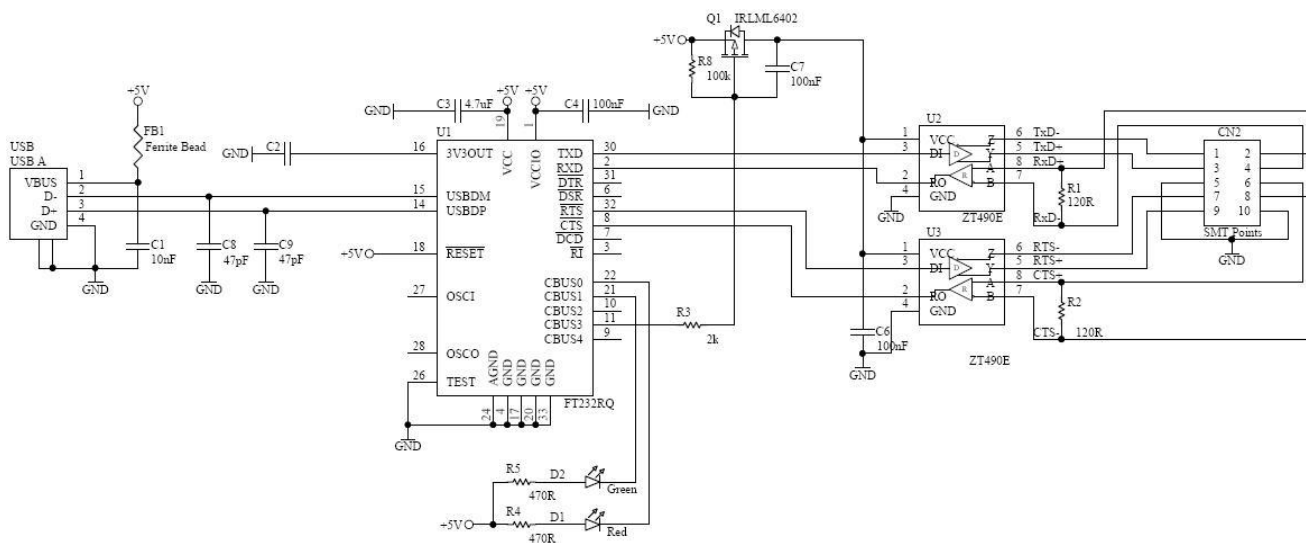
Figure 6.1 Block diagram of PCB Used in the USB to RS422 Serial Converter Cable



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## 7 USB-RS422 Schematic

The detailed schematic of Converter Cable USB-RS422 is shown on figure 7.1



### Figure 7.1 Schematic for USB-RS422 Converter Cable



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**Version 1.2**  
**Clearance No.: FTDI# 74**

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## Appendix A - Cable EEPROM Configuration

Each USB-RS422 cable is controlled by the FTDI FT232R IC. This FT232R device contains an EEPROM which contains the USB configuration descriptors for that device. When the cable 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

| Parameter                         | Value       | Notes                                                                                                                                                            |
|-----------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| USB Vendor ID (VID)               | 0403h       | FTDI default VID (hex)                                                                                                                                           |
| USB Product UD (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-RS422-WE                                                                                                                                                     |
| Max Bus Power Current             | 90mA        |                                                                                                                                                                  |
| Power Source                      | Bus Powered |                                                                                                                                                                  |
| Device Type                       | FT232R      |                                                                                                                                                                  |
| USB Version                       | 0200        | Returns USB 2.0 device description to the host.<br>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                    | 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 in the cable can be re-programmed over USB using the utility program MPROG. MPROG can be downloaded from the [www.ftdichip.com](http://www.ftdichip.com). Version 2.8a or later is required for the FT232R chip. 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 C - Revision History**

|               |                                                                          |                               |
|---------------|--------------------------------------------------------------------------|-------------------------------|
| Version Draft | First Draft                                                              | Jan 2009                      |
| Version 1.0   |                                                                          | 11 <sup>th</sup> Feb 2009     |
| Version 1.1   | Added and corrected images                                               | 14 <sup>th</sup> May 2009     |
| Version 1.2   | Changed TT to BT (Transparent to Black cable).<br>Added Window 7 support | 18 <sup>th</sup> January 2010 |