



Future Technology Devices International Ltd

DB9-USB-RS232 Module

Male & Female

Datasheet

Document Reference No.: FT_000204

Version 1.3

Issue Date: 2010-11-05

Future Technology Devices International Ltd (FTDI)

Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow, G41 1HH, United Kingdom

Tel.: +44 (0) 141 429 2777 Fax: + 44 (0) 141 429 2758

E-Mail (Support): support1@ftdichip.com Web: <http://www.ftdichip.com>

Neither the whole nor any part of the information contained in, or the product described in this manual, may be adapted or reproduced in any material or electronic form without the prior written consent of the copyright holder. This product and its documentation are supplied on an as-is basis and no warranty as to their suitability for any particular purpose is either made or implied. Future Technology Devices International Ltd will not accept any claim for damages howsoever arising as a result of use or failure of this product. Your statutory rights are not affected. This product or any variant of it is not intended for use in any medical appliance, device or system in which the failure of the product might reasonably be expected to result in personal injury. This document provides preliminary information that may be subject to change without notice. No freedom to use patents or other intellectual property rights is implied by the publication of this document. Future Technology Devices International Ltd, Unit1, 2 Seaward Place, Centurion Business Park, Glasgow, G41 1HH, United Kingdom. Scotland Registered Number: SC136640

1 Introduction

1.1 Functional Description

The DB9-USB-RS232 connectors can be used to upgrade an RS232 port to an active USB port without the need to redesign the PCB. These active connectors contain all the USB to RS232 (and vice-versa) conversion electronics and are designed to fit directly into the same PCB footprint as a PC compatible RS232DB9 connector.

The FTDI DB9-USB-RS232 connectors come in two types DB9-USB-RS232-M and DB9-USB-RS232-F.

A DB9-USB-RS232-M can be used to replace a male DB9 connector that is wired in a PC compatible RS232manner.

A DB9-USB-RS232-F can be used to replace a female DB9 connector that is wired in a PC compatible RS232manner.

The purposes of the modules is to provide a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports by replacing the DB9 connector with this miniaturised module which closely resembles a DB9 connector. This is accomplished by incorporating the industry standard FTDI FT232R USB-Serial Bridge IC plus the required level shifters inside the module.



Figure 1.1 – DB9-USB-RS232

The module uses a standard USB-MINI-B connector for connection to an upstream host or hub port. RS232-level signals, including modem handshake signals, can transmit data at rates up to 1 Mega Baud.

The DB9-USB-RS232 module requires USB device drivers, available free from www.ftdichip.com, which are used to make the DB9-USB-RS232 appear as a Virtual COM Port (VCP). This allows existing serial communications software, such as HyperTerminal, to exchange data through the DB9-USB-RS232 to a legacy RS232 peripheral device.

Note: The connector is referred as a DB9 connector since DE9 is often referred to by this name.

1.2 Background

In the long distant past, there was no standard defined for the connections on a DB9 connector when it was used as an RS232 interface. That changed when IBM introduced the PC-AT. This introduced a *generally accepted* DB9 RS232 standard and PC peripherals adopted the same pin-out using a 1-to-1 cable connection between the PC and the peripheral. The FTDI DB9-USB-RS232 have adopted this standard. The DB9 connector used is either male or female.

Note that **NOT ALL** peripheral adopted this standard so it is important for the user to check against the pin-out used for the male and female FTDI DB9-USB-RS232 connectors.

1.3 Block Diagram

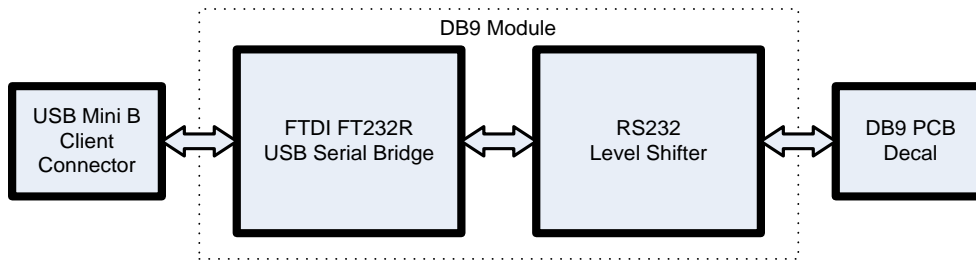


Figure 1.2 – DB9-USB-RS232 Block Diagram

1.3.1 Block description

USB Mini B Client Connector

This connector provides the interface for connection to a USB Host or Hub port.

FTDI FT232R

The FTDI FT232R provides the USB-to-Serial conversion. Operating system device drivers are required in order to operate with the FT232R to provide the Virtual COM Port serial functionality.

RS232 Level Shifter

The RS232 level shifter converts the signals provided by the FT232R into the voltage levels required by application RS232 interface.

DB9 PCB Footprint

The DB9 pin-out configured in an industry standard (TIA/EIA-574) pin-out to provide connection to RS232 peripherals through a standard DB9 footprint . See section 3

1.4 Features

- Adds one USB serial port by connecting to the RS232 DB9 footprint of a device
- Easy placement for an standard Male and Female RS232 DB9 footprint of a device
- Works with USB 1.1 & 2.0 Host and Hub ports
- Industry Standard FTDI chip set & device drivers for maximum compatibility
- Microsoft Windows® WHQL-certified, Mac OS X, Linux and Windows CE device drivers
- Installs as a standard Windows COM port
- Supports Windows Server 2008, 2003, Vista, XP 2000, Linux, Mac OS X
- 128 byte transmit buffer, 256 byte receive buffer
- RS-232 data signals: TxD, RxD, RTS, CTS, DSR, DTR, DCD, RI, GND
- Powered by USB port. No external power adapter required.
- Serial port speed up to 1Mbps
- Serial Communication Parameters
 - Parity: None, Even, Odd
 - Data bits: 7, 8
 - Flow control: RTS/CTS , DSR/DTR, X-ON/X-OFF, None
- Operating temperature of -40°C to +85°C

1.5 Performance Figures

| Parameter | Performance |
|-----------------|---|
| USB Interface | 12Mbps USB 2.0 Full-Speed |
| RS232 Interface | Standard Windows baud rates (300bps to 921.6Kbps) Custom baud rates (300bps to 1Mbps) through baud rate aliasing. See FTDI Application Note: Configuring FT232R, FT2232 and FT232BM Baud Rates |

Table 1.1 – Performance Specifications

| Part Number | Description |
|-------------|---|
| DB9-USB-M | Full Speed USB to 1-Port RS232 module to replace RS232 DB9 male connector |
| DB9-USB-F | Full Speed USB to 1-Port RS232 module to replace RS232 DB9 female connector |

Table 1.2 – Ordering Information

| | | |
|-----------|---|-----------|
| 1 | Introduction | 1 |
| 1.1 | Functional Description | 1 |
| 1.2 | Background | 1 |
| 1.3 | Block Diagram | 2 |
| 1.3.1 | Block description | 2 |
| 1.4 | Features | 3 |
| 1.5 | Performance Figures | 3 |
| 2 | USB Connections | 5 |
| 3 | RS232 Connections | 6 |
| 3.1.1 | RS232 DB9 MALE Connector | 8 |
| 3.1.2 | RS232 DB9 FEMALE Connector | 9 |
| 4 | Installation | 10 |
| 4.1 | Device Driver Installation | 10 |
| 4.1.1 | Microsoft Windows Installation | 10 |
| 4.1.2 | Mac OS X, Linux, Windows CE | 14 |
| 5 | Electrical details | 15 |
| 5.1 | USB | 15 |
| 5.2 | RS232 | 15 |
| 6 | Mechanical Details | 16 |
| 7 | Physical Environment Details | 17 |
| 7.1 | Storage | 17 |
| 7.2 | Operating | 17 |
| 8 | Environmental Approvals & Declarations | 18 |
| 8.1 | EMI Compatibility | 18 |
| 8.2 | Safety | 18 |
| 8.3 | Environmental | 18 |
| 8.4 | Reliability | 18 |
| 8.4.1 | MTTF | 18 |
| 8.5 | Import / Export Information | 19 |
| 9 | Troubleshooting | 20 |
| 10 | Contact Information | 21 |
| | Appendix A – References | 23 |
| | Appendix B – Revision History | 24 |

2 USB Connections

The DB9-USB-RS232 module is a downstream USB 2.0 Device. A “USB mini B” receptacle is mounted inside the module to facilitate connection to an upstream USB Host or Hub.

| Pin Number | Pin Type | Description |
|------------|---------------|---|
| 1 | Power | VBUS – USB Power provided from upstream USB Host or Hub |
| 2 | Bidirectional | D- = USB data signal, negative polarity |
| 3 | Bidirectional | D+ = USB data signal, positive polarity |
| 4 | ID | Not Connected |
| 5 | Ground | GND = USB signal ground |
| Shield | Case Ground | Drain = typically connected to the host PC case |

Table 2.1 – USB “mini-B” Receptacle Pin-Out

3 RS232 Connections

DB9 connectors used for RS232 communication are either male or female type connectors.

The PC compatible accepted electrical connections for male and female RS232 DB9 connectors are illustrated in Figure 3.1 where the structure on the left is the top view of a male RS232 DB9 connector and the structure on the right is the top view of a Female RS232 DB9 connector.

Assuming a design follows these connection conventions, then an FTDI male or female DB9-RS232-USB connector can be used to replace this RS232 DB9 and turn the connection into an active USB interface.

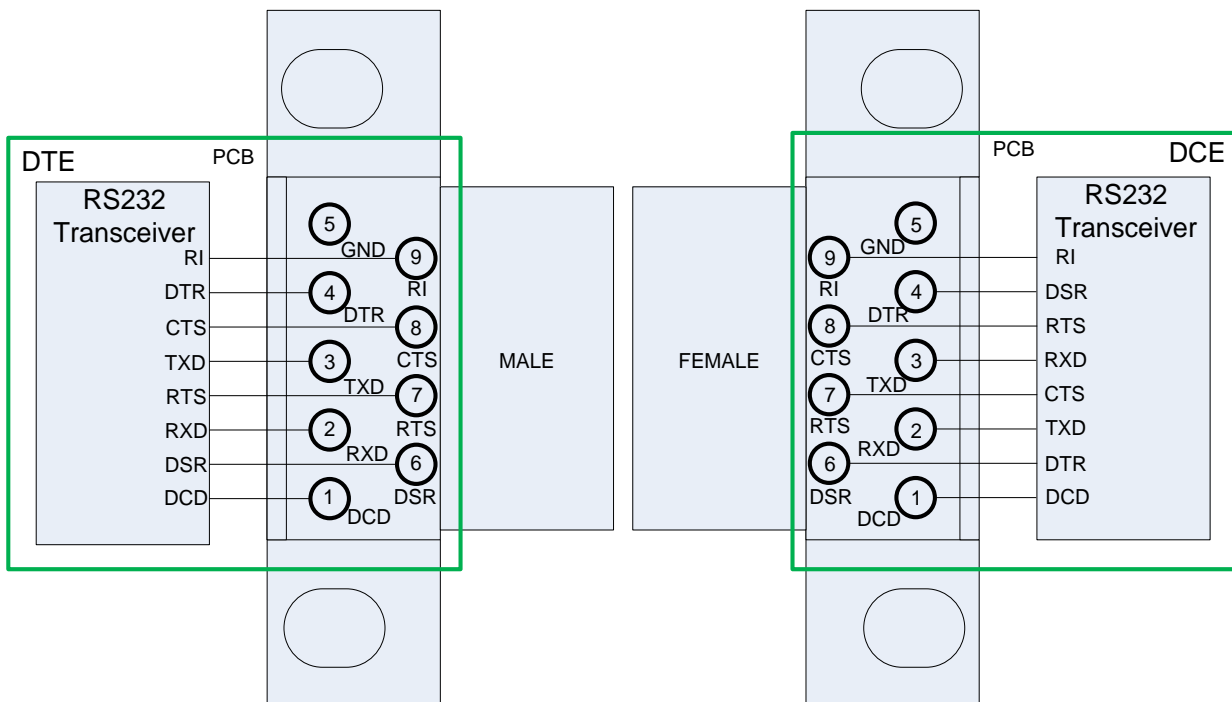


Figure 3.1 – Male and Female DB9-USB-RS232 PCB connections (top view looking through the module)

Examples and signal directions are shown in Figure 3.2 and Figure 3.3

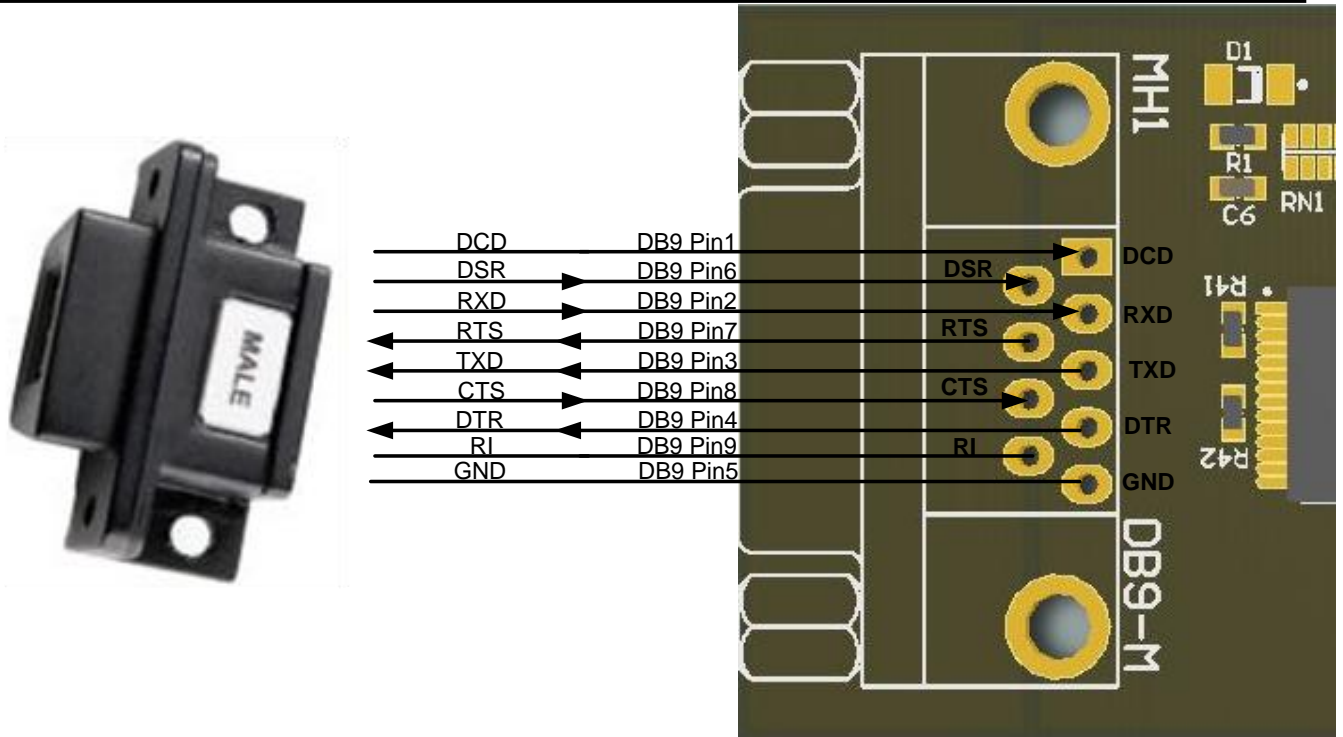


Figure 3.2 – DB9-USB-RS232-M Connection illustration

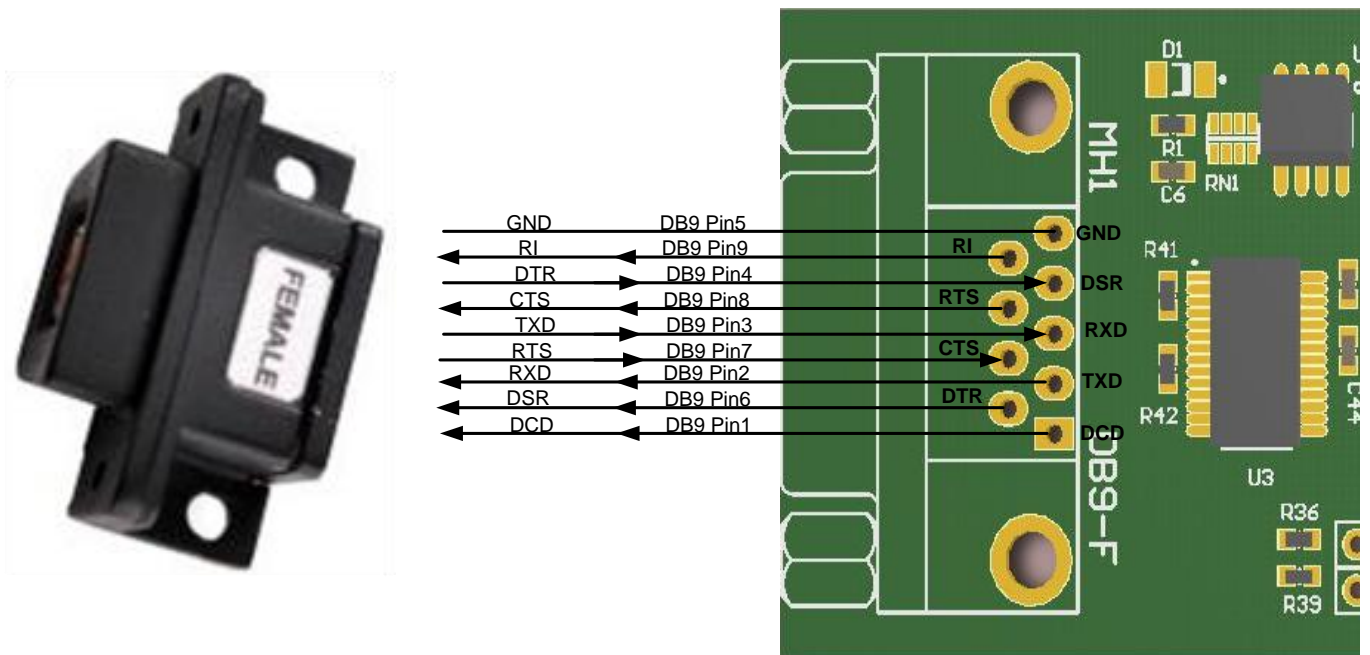


Figure 3.3 – DB9-USB-RS232-F Connection illustration

3.1.1 RS232 DB9 MALE Connector

The DB9-USB-RS232-M can be used to replace a male DB9 connector used for transmitting RS232 protocol.

Table 2.1 gives the pin out description of each pad of an RS232 footprint.

| Pin Number | Pin Type of DB9-USB-RS232 module | Pin Type at application PCB | Description |
|------------|----------------------------------|-----------------------------|--|
| 1 | Input (note1) | Input | DCD = Data Carrier Detect |
| 2 | Output | Input | RXD = Receive Data (this is an output from the DB9-USB-RS232-M to the application Rx input) |
| 3 | Input | Output | TXD = Transmit Data (this is an input to the DB9-USB-RS232-M from the application Tx output) |
| 4 | Input | Output | DTR = Data Terminal Ready (this is an input to the DB9-USB-RS232-M from the application DTR output) |
| 5 | Ground | Ground | GND = RS232 signal ground |
| 6 | Output | Input | DSR = Data Set Ready (this is an output from the DB9-USB-RS232-M to the application DSR input) |
| 7 | Input | Output | RTS = Request To Send (this is an input to the DB9-USB-RS232-M from the application RTS output) |
| 8 | Output | Input | CTS = Clear To Send (this is an output from the DB9-USB-RS232-M to the application CTS input) |
| 9 | Input (note1) | Input | RI = Ring Indicator |
| Shield | Ground | Case Ground | Drain = typically connected to the host PC case |

Table 2.1 – A Male RS232 DB9 footprint Pin-Out

Note 1: A conflict in an DTE to DTE connection application may occur with the RI and the DCD pins. This conflict is dependent on the application board. The user should check that the inputs and outputs match the table above.

3.1.2 RS232 DB9 FEMALE Connector

The DB9-USB-RS232-F can be used to replace a female DB9 connector used for transmitting RS232 protocol.

Table 2.2 gives the pin out description of each pad of an RS232 footprint..

| Pin Number | Pin Type of DB9-USB-RS232 module | Pin Type at application PCB | Description |
|------------|----------------------------------|-----------------------------|---|
| 1 | Input | Output | DCD = Data Carrier Detect (this is an input to the DB9-USB-RS232-F from the application DCD output) |
| 2 | Input | Output | RXD = Receive Data (this is an input to the DB9-USB-RS232-F from the application Tx output, normally labelled RXD in DCE convention) |
| 3 | Output | Input | TXD = Transmit Data (this is an output to the DB9-USB-RS232-F from the application Rx input, normally labelled TXD in DCE convention) |
| 4 | Output | Input | DTR = Data Terminal Ready (this is an output to the DB9-USB-RS232-F from the application DSR input, normally labelled DTR in DCE convention) |
| 5 | Ground | Ground | GND = RS232 signal ground |
| 6 | Input | Output | DSR = Data Set Ready (this is an input to the DB9-USB-RS232-F from the application DTR output, normally labelled DSR in DCE convention) |
| 7 | Output | Input | RTS = Request To Send (this is an output to the DB9-USB-RS232-F from the application CTS input, normally labelled RTS in DCE convention) |
| 8 | Input | Output | CTS = Clear To Send (this is an input to the DB9-USB-RS232-F from the application RTS output, normally labelled CTS in DCE convention) |
| 9 | Input | Output | RI = Ring Indicator (this is an input to the DB9-USB-RS232-F from the application RI output) |
| Shield | Ground | Case Ground | Drain = typically connected to the host PC case |

Table 2.2 – A Female RS232 DB9 footprint Pin-Out

4 Installation

4.1 Device Driver Installation

The drivers for the DB9-USB-RS232 modules are available for download from:

www.ftdichip.com

The following section illustrates an example installation on the Windows OS.

4.1.1 Microsoft Windows Installation

With the device drivers being Windows Hardware Quality Labs (WHQL) certified, they are also available through download directly from the Microsoft® Windows® Update service. Additional installation options are noted below:

Installation Executable shown on Windows XP

- 1) Login to the system as Administrator, or a user with Administrator rights.
- 2) Prior to connecting the DB9-USB-RS232 module to the USB Host or Hub port, download the latest device driver version from the FTDIChip web site.
- 3) Run this executable to install the device drivers.
- 4) Connect the DB9-USB-RS232 module to your computer. A notification will appear near the task bar indicating that new hardware has been installed and is ready for use. It is normal if this notice appears twice.

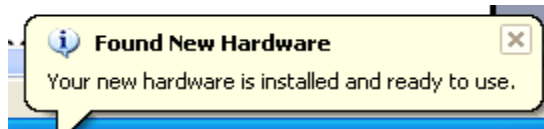


Figure 3.1 – Hardware Ready

Windows Update shown on Windows XP

You must have an active Internet connection and the Windows Update Service enabled.

- 1) Connect the DB9-USB-RS232 module to your USB Host or Hub.
- 2) The “Found New Hardware” Wizard will appear. The first dialog should ask whether it is acceptable to use the Windows Update Service to find the device driver.



Figure 3.2 – Found New Hardware Wizard

- 3) Select one of the “Yes” choices and click “Next”.

4) The following screen appears:

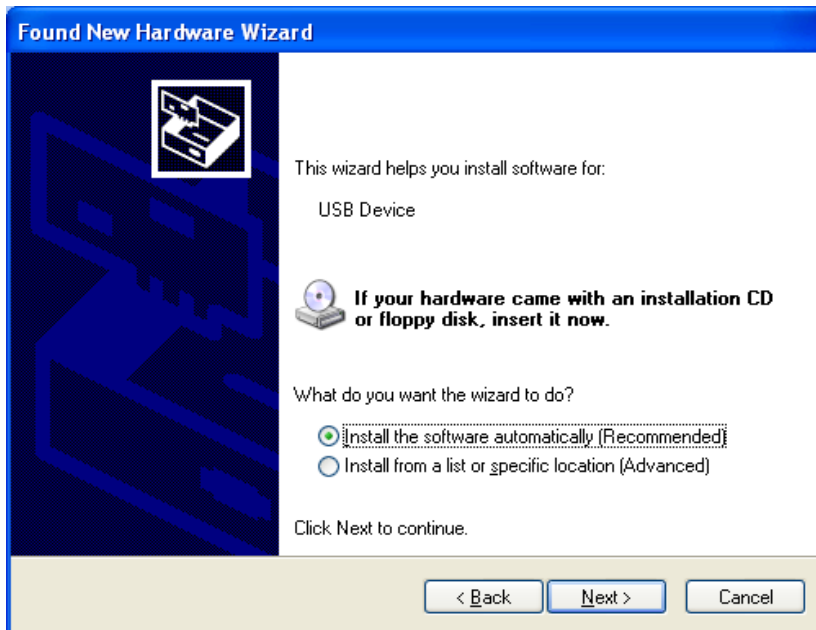


Figure 3.3 – Automatic Install

- 5) Wait while the driver is found, downloaded, and installed. This step may take a couple minutes depending on the Internet speed.
- 6) After the files are found and installed, click "Finish" to complete the installation.



Figure 3.4 – Complete Hardware Installation

- 7) Steps 2 through 6 will repeat. The first time installs the basic USB Serial Converter in the USB device tree. The second time installs the Virtual COM Port layer in the Ports tree and assigns the COM port number.
- 8) When both portions of the device driver have been installed successfully, the following message will appear, indicating that the device is ready.

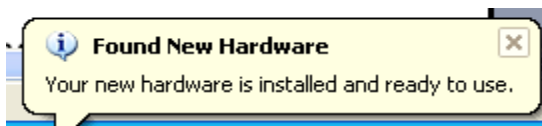


Figure 3.5 – Hardware Ready

COM Port Assignment

Next, to determine which COM port has been assigned, open the Windows Device Manager from the System Control Panel.

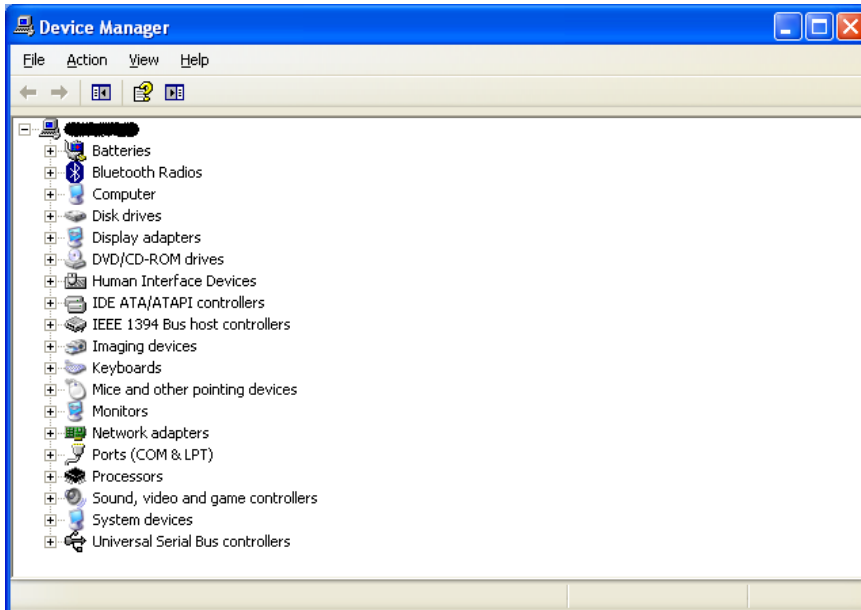


Figure 3.6 – Device Manager

Click on the Plus "+" sign next to the Ports tree to list the available COM port. You will see "USB Serial Port", followed by a COMn assignment. In the figure below, the DB9-USB-RS232 module is assigned to COM3.



Figure 3.7 – COM Port Assignment

Use this COM port number with your application software in order to access the DB9-USB-RS232 module.

If an application requires use of a different COM port number, the assignment may be changed through the Advanced Driver Options settings.

From the Device Manager listing above, right-click on the USB Serial Port and select Properties.

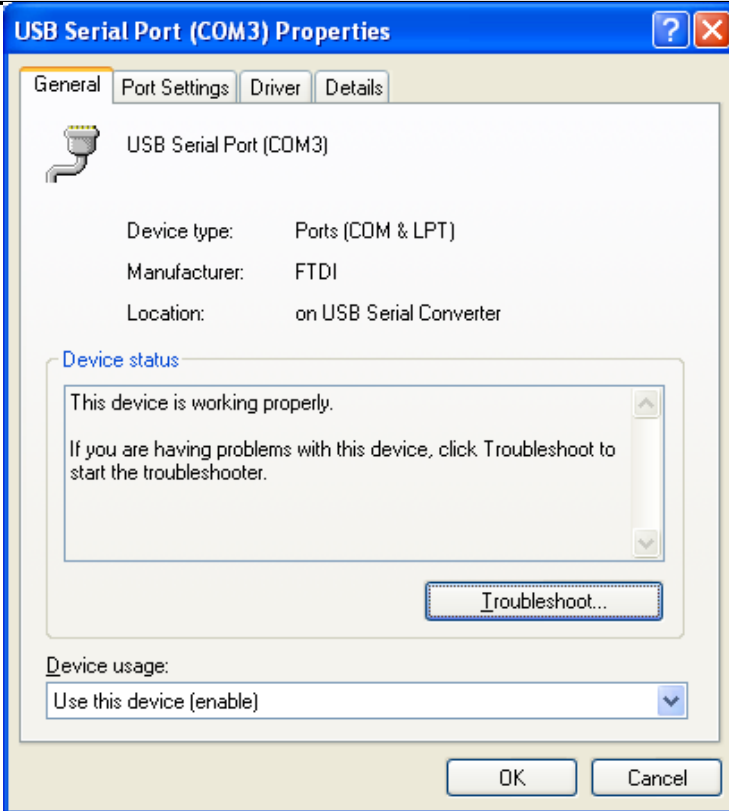


Figure 3.8 – Access COM Port Properties

Next, click on the "Port Settings" tab.

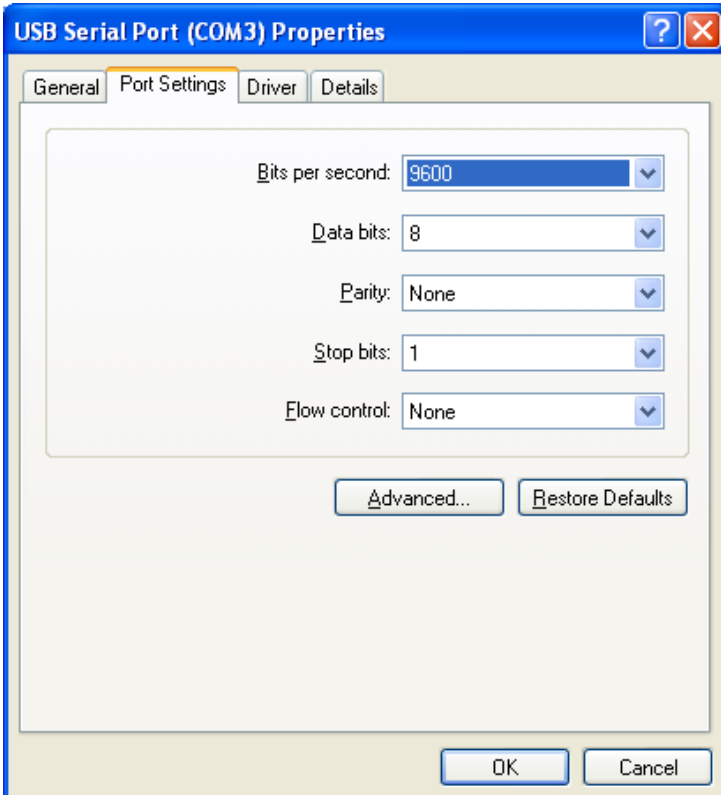


Figure 3.9 – Settings Tab

Then click on the "Advanced..." button.

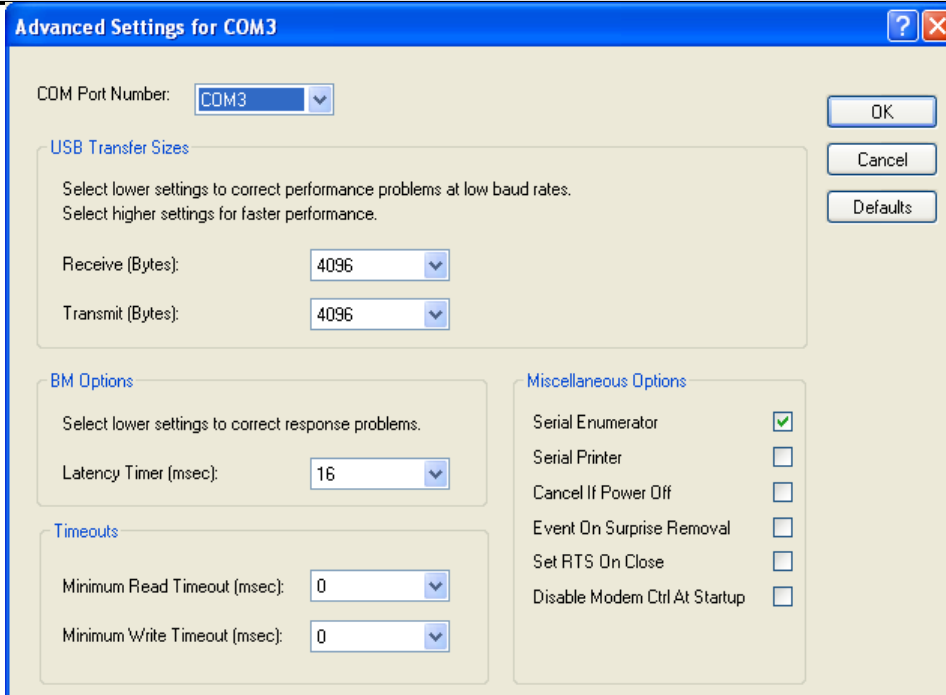


Figure 3.10 – Advanced Options

This will display the various advanced settings. Note the COM port assignment in the upper left. Clicking on the drop-down list will display the available port numbers. Select one that is not in use and click OK on each dialog box to activate the selection. Windows will remember this COM port number.

4.1.2 Mac OS X, Linux, Windows CE

Device drivers and FTDI installation guides for Mac OS X, Linux and Windows CE are available for download on the FTDIChip web sites. Follow the respective FTDI installation guides for the chosen operating system.

5 Electrical details

5.1 USB

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|-----------------|----------------------|---------|---------|---------|-------|--|
| USB_VCC | Input Power Voltage* | 4.25 | 5.0* | 5.25 | V | *Present when USB cable is attached and USB Host or Hub powered. |
| I _{cc} | USB current | | 30 | 50 | mA | |

Table 5.1 – USB Electrical Details

5.2 RS232

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|--------------------|----------------------------------|---------|---------|---------|-------|-------------------------------|
| V _{trans} | Transmitter output voltage swing | ± 5 | | | V | RL = 3KΩ |
| V _{rec} | Receiver input voltage range | ±2.4 | | ±25 | V | Input resistance = 3KΩ to 7KΩ |
| | ESD HBM | | ±15 | | KV | RS-232 Inputs and Outputs |

Table 5.2 – RS232 Electrical Details

6 Mechanical Details

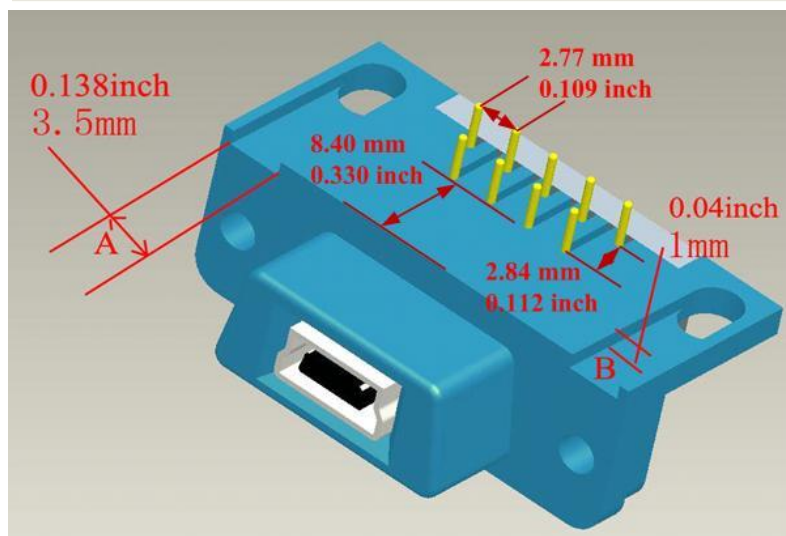
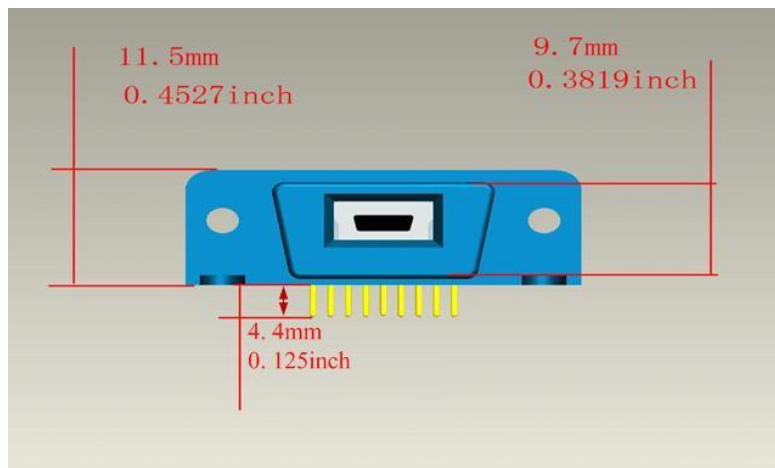
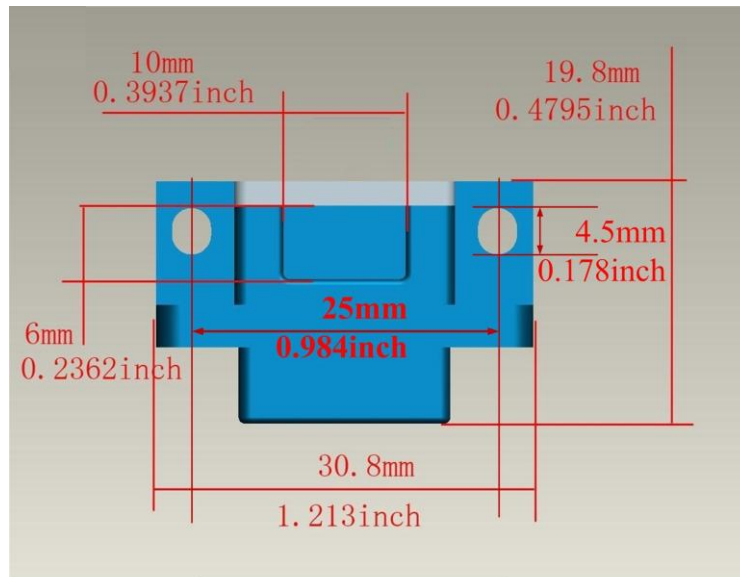


Figure 5.1 – DB9-USB-RS232-M/F module Dimensions

7 Physical Environment Details

7.1 Storage

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|-----------|---------------------------|---------|---------|---------|-------|------------|
| T | Storage Temperature Range | TBD | | TBD | °C | |

Table 7.1 – Storage Temperature

7.2 Operating

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|-----------|-----------------------------|---------|---------|---------|-------|---------------------------------|
| T | Operating Temperature Range | -40 | | +85 | °C | 5% to 95% RH, non condensing |

Table 7.2 – Operating Temperature

8 Environmental Approvals & Declarations

8.1 EMI Compatibility

FCC and CE

At the time of launch, the DB9-USB-RS232 is undergoing testing to be compliant with both FCC Part 15 Subpart B and European EMC Directive.



NOTE: This is a Class B product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.



NOTE: This equipment is currently undergoing testing to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

8.2 Safety

The DB9-USB-RS232 is defined as Limited Power Supply (LPS) device, with operating voltages under 60VDC.

8.3 Environmental

The DB9-USB-RS232 is a lead-free device that complies with the following environmental directives: RoHS, WEEE, REACH, PFOS and DecaBDE.

8.4 Reliability

The DB9-USB-RS232 is designed as a robust USB-Serial module for use in many environments. There are no user-serviceable parts. Any failure will require a replacement of the unit.

8.4.1 MTF

The Mean Time To Failure is calculated at TBD hours.

8.5 Import / Export Information

| Import / Export Information | |
|-----------------------------|---|
| Country of Origin | China |
| Harmonized Code | 8.5.1.1 8471.80.4000 |
| Product Description | USB to RS232 Connector Adapter, Single Port |
| USA ECCN | EAR99 – No License Required |

Table 8.1 – Import / Export Information

9 Troubleshooting

Ensure the latest device driver is in use. See www.ftdichip.com

If USB devices other than FTDI chips are installed in the system, then check with all manufacturers of these devices for the latest device drivers.

Section 3 details driver installation. If the user continues to have driver installation issues, then please refer to the FTDI installation guides <http://ftdichip.com/Documents/InstallGuides.htm> for additional details.

Common Windows Device Driver Troubles:

- **DEVICE TIMES OUT:** The default settings of the device driver assume typical data transfers of hundreds to thousands or more bytes at a given time. Some applications, such as a GPS device, only send data in short packets, often only a few bytes. If this is the case, it may be necessary to adjust the driver buffer size and/or latency timer to smaller values. These values can be adjusted through the Advanced driver options. The buffer size can be reduced to 64 bytes. The latency timer can be set as low as 2ms. A setting of 1ms will cause unnecessary USB traffic and could adversely affect data transmission. Advanced driver options are described in http://www.ftdichip.com/Documents/AppNotes/AN_107_AdvancedDriverOptions_AN_000073.pdf
- **ERRATIC MOUSE POINTER:** The device driver defaults to query an attached device to find out whether it is a mouse or modem, consistent with native COM port operation. Some RS232 peripherals constantly send short packets of data, causing the host system to “think” a mouse or modem has been attached. These short packets will interfere with normal mouse operation causing the pointer to jump around the screen. If this happens, disconnect the RS232 device and *uncheck the Serial Enumerator* option, also found on the Advanced driver options.
- **COM PORT IN USE:** Windows keeps track of all COM port assignments. If multiple FTDIChip products have been connected to a single system, the COM port number will increase, even if the other devices are not attached. If the higher COM port assignments are not acceptable for the application, known unused COM port numbers should be uninstalled according to the FTDI installation guide: <http://ftdichip.com/Documents/InstallGuides.htm>.

10 Contact Information

Head Office – Glasgow, UK

Future Technology Devices International Limited
Unit 1, 2 Seaward Place
Centurion Business Park
Glasgow, G41 1HH
United Kingdom
Tel: +44 (0) 141 429 2777
Fax: +44 (0) 141 429 2758

E-mail (Sales) sales1@ftdichip.com
E-mail (Support) support1@ftdichip.com
E-mail (General Enquiries) admin1@ftdichip.com
Web Site URL <http://www.ftdichip.com>
Web Shop URL <http://www.ftdichip.com>

Branch Office – Shanghai, China

Future Technology Devices International Limited (China)
Room 408, 317 Xianxia Road,
ChangNing District,
ShangHai, China

Tel: +86 (21) 62351596
Fax: +86(21) 62351595

E-Mail (Sales): cn.sales@ftdichip.com
E-Mail (Support): cn.support@ftdichip.com
E-Mail (General Enquiries): cn.admin1@ftdichip.com
Web Site URL: <http://www.ftdichip.com>

Branch Office – Taipei, Taiwan

Future Technology Devices International Limited (Taiwan)
2F, No 516, Sec. 1 NeiHu Road
Taipei 114
Taiwan, R.O.C.

Tel: +886 (0) 2 8791 3570
Fax: +886 (0) 2 8791 3576

E-mail (Sales) tw.sales1@ftdichip.com
E-mail (Support) tw.support1@ftdichip.com
E-mail (General Enquiries) tw.admin1@ftdichip.com
Web Site URL <http://www.ftdichip.com>

Branch Office – Hillsboro, Oregon, USA

Future Technology Devices International Limited (USA)
7235 NW Evergreen Parkway, Suite 600
Hillsboro, OR 97123-5803
USA

Tel: +1 (503) 547 0988
Fax: +1 (503) 547 0987

E-Mail (Sales) us.sales@ftdichip.com
E-Mail (Support) us.support@ftdichip.com
E-mail (General Enquiries) us.admin@ftdichip.com

Distributor and Sales Representatives

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.

Vinculum is part of Future Technology Devices International Ltd. Neither the whole nor any part of the information contained in, or the product described in this manual, may be adapted or reproduced in any material or electronic form without the prior written consent of the copyright holder. This product and its documentation are supplied on an as-is basis and no warranty as to their suitability for any particular purpose is either made or implied. Future Technology Devices International Ltd will not accept any claim for damages howsoever arising as a result of use or failure of this product. Your statutory rights are not affected. This product or any variant of it is not intended for use in any medical appliance, device or system in which the failure of the product might reasonably be expected to result in personal injury. This document provides preliminary information that may be subject to change without notice. No freedom to use patents or other intellectual property rights is implied by the publication of this document. Future Technology Devices International Ltd, Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow G41 1HH United Kingdom. Scotland Registered Number: SC136640

Appendix A – References

AN_149_Upgrading a DB9 RS232 Interface to USB using an FTDI DB9-USB-RS232 Module_

http://ftdichip.com/Support/Documents/AppNotes/AN_149_Upgrading%20a%20DB9%20RS232%20Interface%20to%20USB%20Using%20an%20FTDI%20DB9-USB-RS232%20Module.pdf

Appendix B – Revision History

| | | |
|---------------|---|--------------------------------|
| Version Draft | First Draft | October 2009 |
| Version 1.0 | First release | 18 th November 2009 |
| Version 1.1 | Updated part numbers | 19 th February 2010 |
| Version 1.2 | Added Figures 2.2 and 2.4. Updated tables 2.2 and 2.3 | 1 st June 2010 |
| | Added note 1 to Table 2.2 | |
| Version 1.3 | Simplified datasheet | 5 th November 2010 |