Future Technology Devices International Ltd

The DB9-USB Family of

UART Converter Modules

Datasheet

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1 Introduction

1.1 The DB9-USB Family of UART Converter Modules

The DB9-USB connector modules can be used to upgrade an RS232 port to an active USB port without the need to redesign the PCB.

The DB9-USB family consist of 6 modules. Two of these operate at RS232 voltage levels, while four of them operate at digital voltage levels (a choice of 5V or 3.3V). Each is available to replace either a male or a female DB9.

1.2 Functional Description

DB9-USB modules can be used to upgrade a UART port of a device to an active USB port without the need for redesigning the device's PCB. These active connectors contain all the USB to UART (and vice-versa) conversion electronics and are designed to fit directly into the same PCB footprint as a PC compatible UART DB9 connector.

The FTDI DB9-USB-RS232 modules are available 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 RS232 manner. This module operates at **RS232** signal levels.

A **DB9-USB-RS232-F** can be used to replace a female DB9 connector that is wired in a PC compatible RS232 manner. This module operates at **RS232** signal levels.

The FTDI DB9-USB-D3 modules are available in two types DB9-USB-D3-M and DB9-USB-D3-F.

A **DB9-USB-D3-M** can be used to replace a male DB9 connector that is wired in a PC compatible RS232 manner. This module operates at **3.3V** signal levels.

A **DB9-USB-D3-F** can be used to replace a female DB9 connector that is wired in a PC compatible RS232 manner. This module operates at **3.3V** signal levels.

The FTDI DB9-USB-D5 modules are available in two types DB9-USB-D5-M and DB9-USB-D5-F.

A **DB9-USB-D5-M** can be used to replace a male DB9 connector that is wired in a PC compatible RS232 manner. This module operates at **5.0V** signal levels.

A **DB9-USB-D5-F** can be used to replace a female DB9 connector that is wired in a PC compatible RS232 manner. This module operates at **5.0V** signal levels.

The purposes of these modules is to provide a simple method of adapting legacy serial devices with UART 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. The RS232 level DB9-USB modules include an RS232 level transceiver.

Figure 1.1 – DB9-USB Family

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DB9-USB modules use a standard USB-MINI-B connector for connection to an upstream host or hub port.

RS232 Level: RS232 level signals, includes modem handshake signals, and capable of transmitting data at rates up to 1 Mega Baud.

Digital Level: 3.3V or 5V level signals, includes modem handshake signals, and capable of transmitting data at rates up to 3 Mega Baud.

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

1.3 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.

DB9-USB modules have adopted this standard. The DB9 connector wire schemes used by this module either the standard male or standard female wire configuration.

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 DB9-USB connectors.

Note: DB9 connectors are also known as DE9 connector since it consists of 9 pins in a size E shell. However DE9 connectors are more commonly referred to as DB9 connector.

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1.4 Block Diagrams

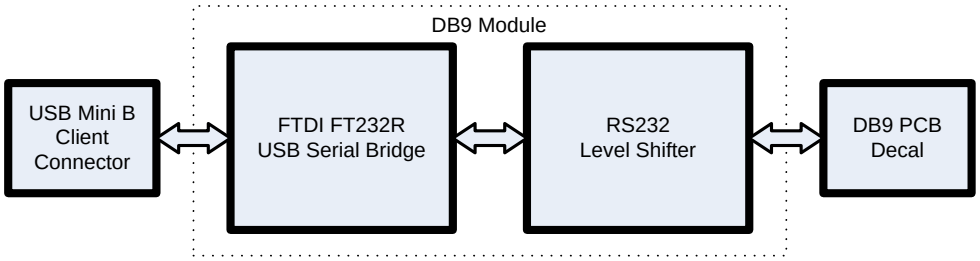

Figure 1.2 – DB9-USB-RS232 Block Diagram

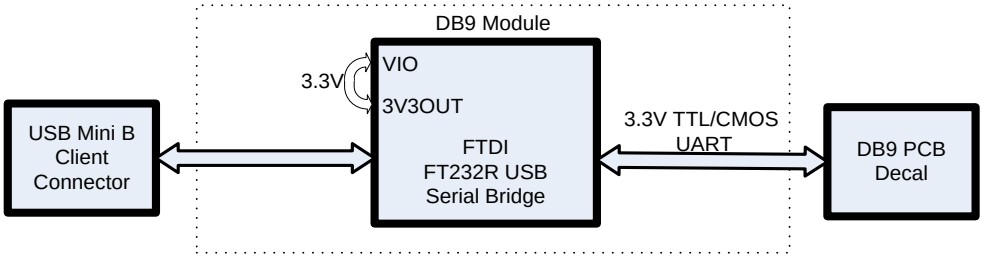

Figure 1.3 – DB9-USB-D3 Block Diagram

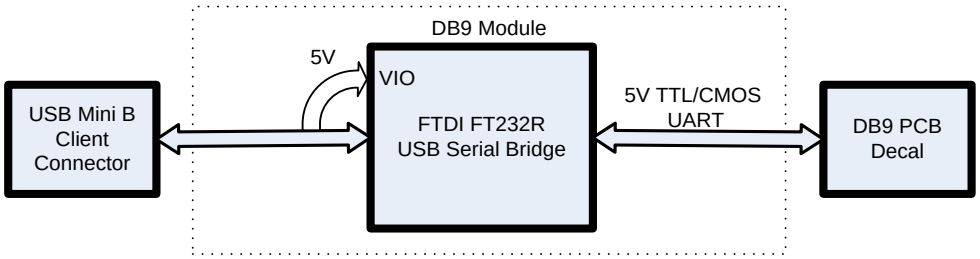

Figure 1.4 – DB9-USB-D5 Block Diagram

1.4.1 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-USB PCB Footprint

The DB9-USB pin-out is configured to match the industry standard DB9 footprint. See section 3.

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1.5 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
- A selection of RS232, 3.3V or 5V UART signal levels.
- 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
- 128 byte transmit buffer, 256 byte receive buffer
- UART 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 (RS232 levels) or 3Mbps (3.3V/5V levels)
- 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

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1.6 Technical Specification & Ordering Information

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
UART	Standard Windows baud rates (300bps to 921.6Kbps) Custom baud rates (300bps to 3Mbps) through baud rate aliasing.

Table 1.1 – Performance Specifications

Product Name	Part Number	Description
DB9-USB-RS232-M	DB9-USB-M	Full Speed USB to 1-Port RS232 level UART module that can replace an RS232 Level UART DB9 male connector
DB9-USB-RS232-F	DB9-USB-F	Full Speed USB to 1-Port RS232 level UART module that can replace an RS232 level UART DB9 female connector
DB9-USB-D3-M	DB9-USB-D3-M	Full Speed USB to 1-Port 3.3V level UART module that can replace 3.3V level UART DB9 male connector
DB9-USB-D3-F	DB9-USB-D3-F	Full Speed USB to 1-Port 3.3V level UART module that can replace 3.3V level UART DB9 female connector
DB9-USB-D5-M	DB9-USB-D5-M	Full Speed USB to 1-Port 5V level UART module that can replace 5V UART DB9 male connector
DB9-USB-D5-F	DB9-USB-D5-F	Full Speed USB to 1-Port 5V level UART module that can replace 5V UART DB9 female connector

Table 1.2 – Ordering Information

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2 USB Connections

DB9-USB modules are downstream USB 2.0 Devices. A "USB mini B" receptacle is mounted inside the modules 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

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3 UART Connections

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

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

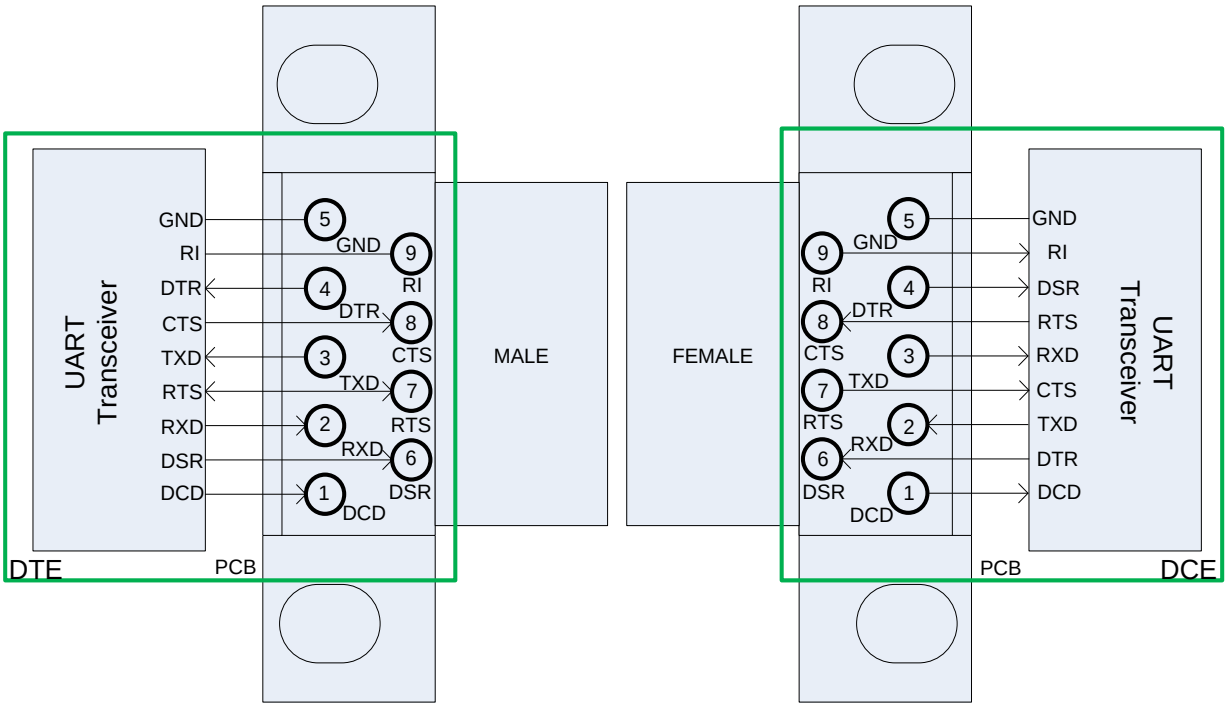

Figure 3.1 – Male and Female DB9-USB internal connections (top view looking through the module)

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

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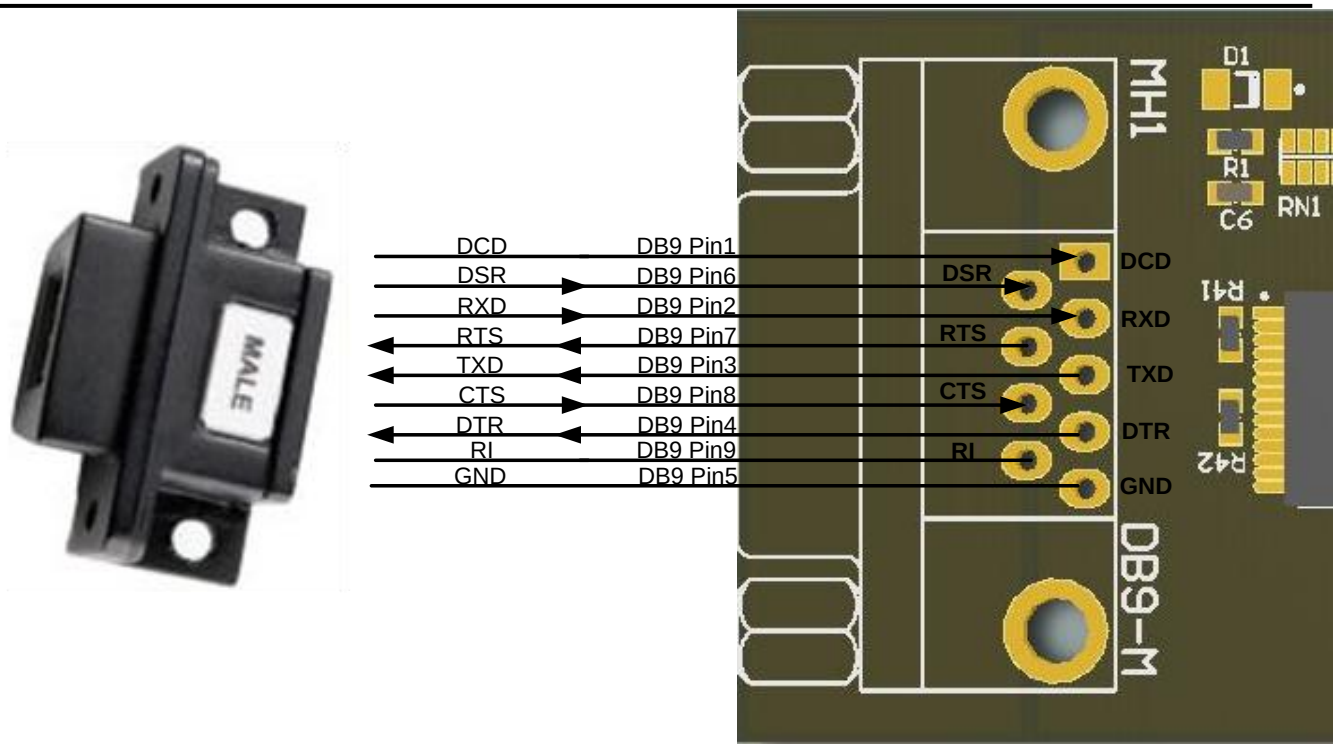

Figure 3.2 – DB9-USB-RS232-M Connection illustration

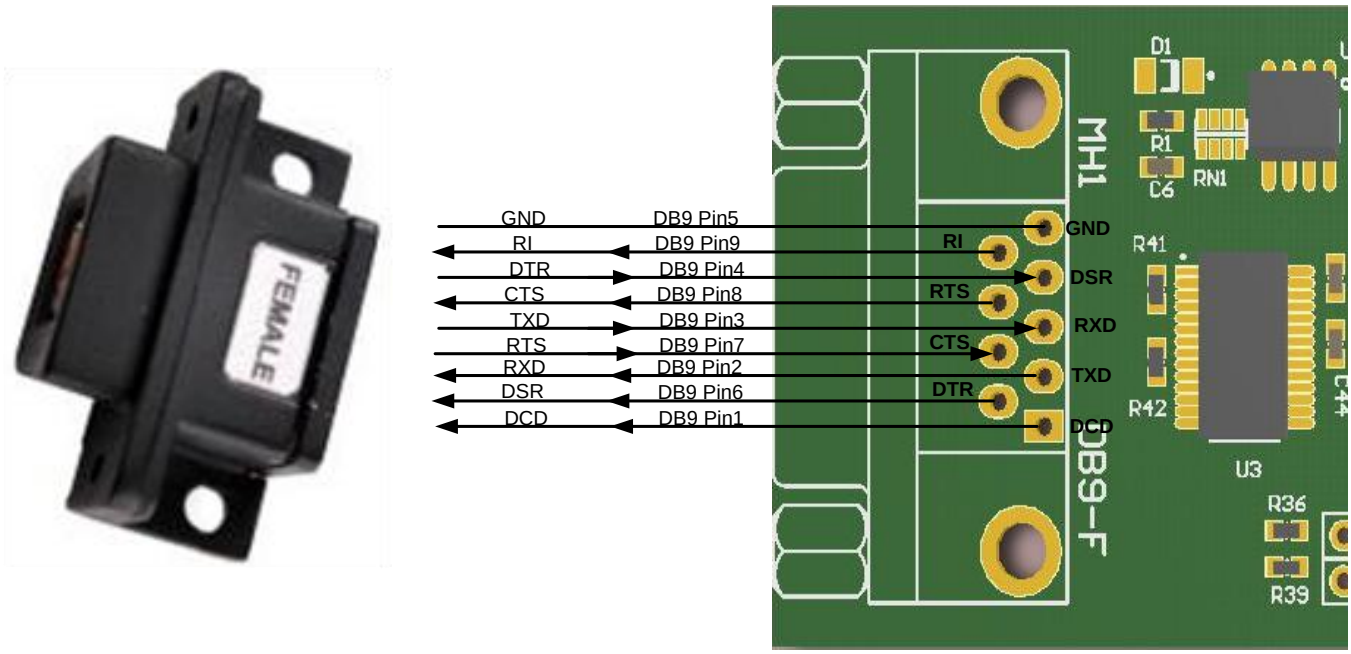

Figure 3.3 – DB9-USB-RS232-F Connection illustration

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3.1.1 Male DB9 UART Connector Signals

The DB9-USB-X-M can be used to replace a male DB9 connector used for transmitting UART signals.

Table 2.1 gives the pin out description of each pin/pad of a UART connector/footprint.

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

Table 2.1 – Male DB9 UART Signal Description

Note 1: These signals are irrelevant for DTE to DTE connections.

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3.1.2 FEMALE DB9 UART Connector Signals

The DB9-USB-X-F can be used to replace a female DB9 connector used for transmitting UART signals. Table 2.2 gives the pin out description of each pin/pad of an UART connector/footprint.

Pin Number	Pin Type of DB9-USB module	Pad Type at application PCB	Description
1	Input	Output	DCD = Data Carrier Detect (this is an input to the DB9-USB-X-F from the application DCD output)
2	Input	Output	RXD = Receive Data (this is an input to the DB9-USB-X-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-X-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-X-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-X-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-X-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-X-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-X-F from the application RI output)
Shield	Ground	Case Ground	Drain = typically connected to the host PC case

Table 2.2 – Female DB9 UART Signal Description

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4 Installation

4.1 Device Driver Installation

The drivers for the DB9-USB 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 module to the USB Host or Hub port, download the latest device driver version from the FTDI Chip web site.
3) Run this executable to install the device drivers.
4) Connect the DB9-USB 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.

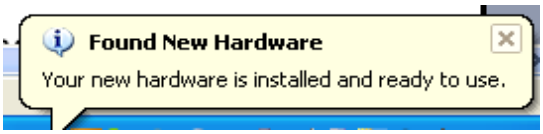

Figure 3.1 – Hardware Ready

Windows Update shown on Windows XP

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

1) Connect the DB9-USB 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".

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4) The following screen appears:

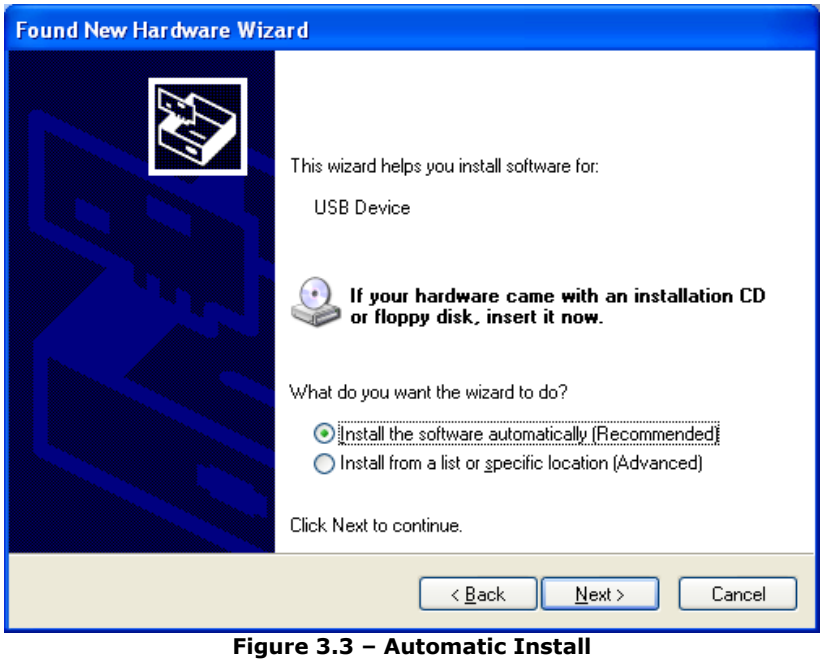

Figure 3.3 – Automatic Install

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.

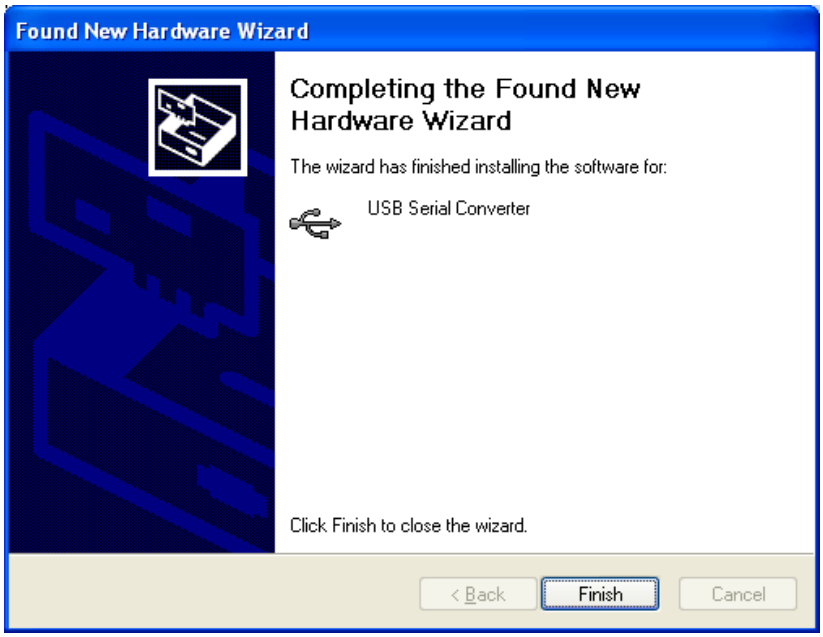

Figure 3.4 – Complete Hardware Installation

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.

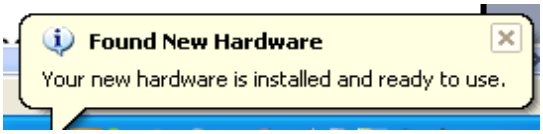

Figure 3.5 – Hardware Ready

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COM Port Assignment

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

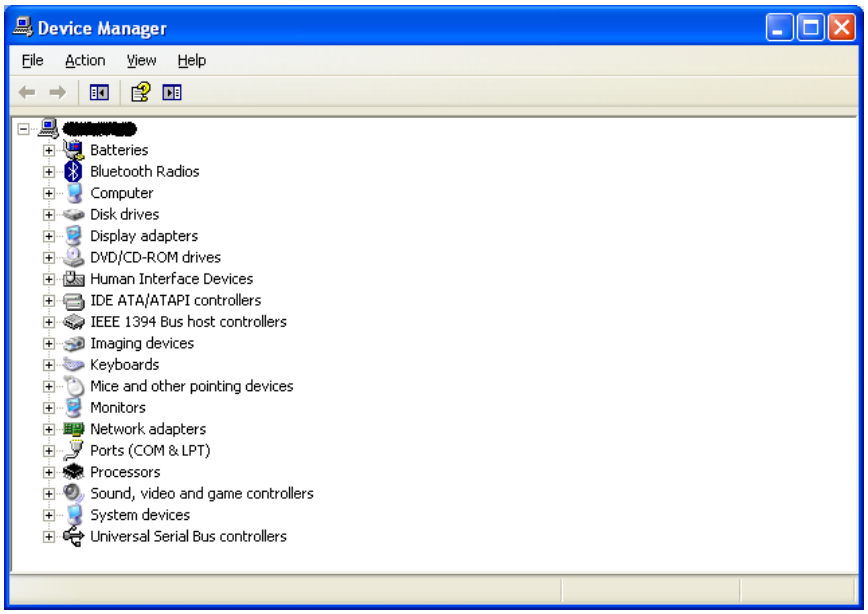

Figure 3.6 – Device Manager

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 COM 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 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.

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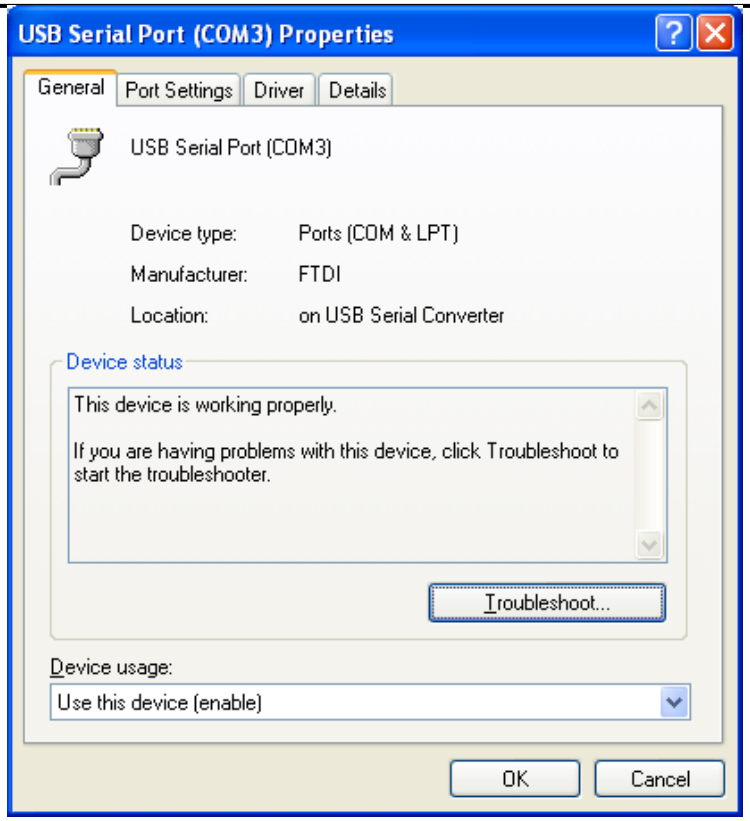

Figure 3.8 – Access COM Port Properties

Next, click on the "Port Settings" tab.

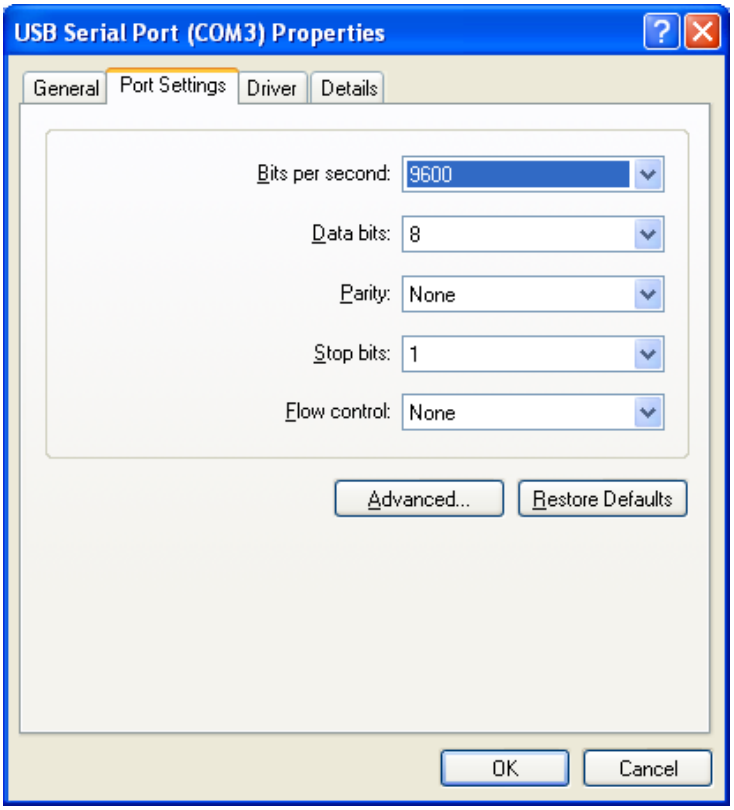

Figure 3.9 – Settings Tab

Then click on the "Advanced…" button.

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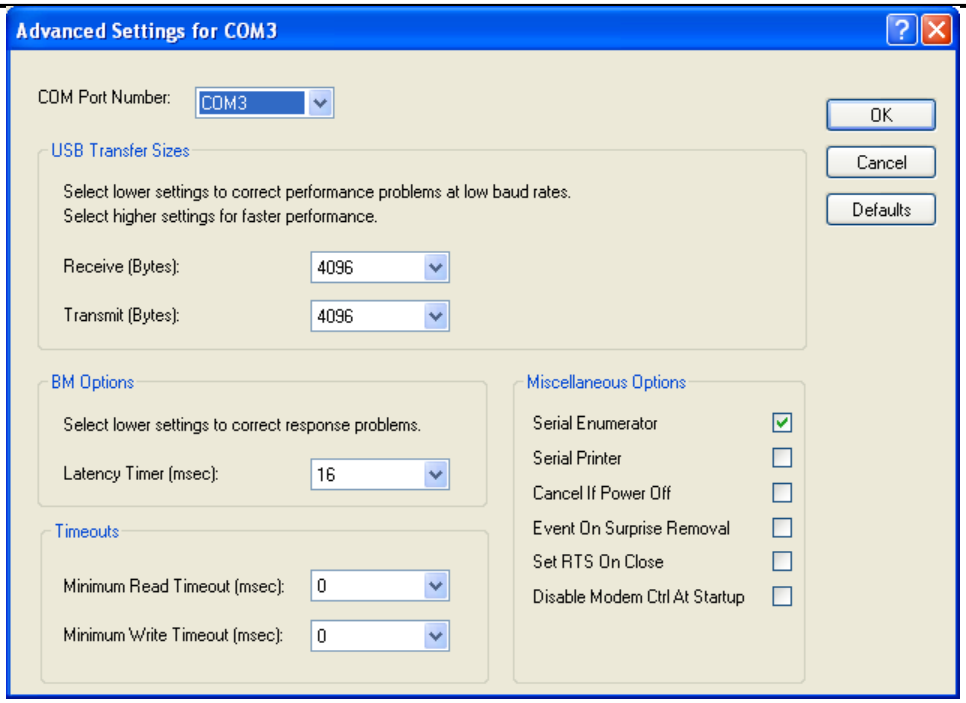

Figure 3.10 – Advanced Options

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 FTDI Chip web site. Follow the respective FTDI installation guides for the chosen operating system.

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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.
Icc	USB current		30	50	mA	

Table 5.1 – USB Electrical Details

5.2 RS232

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Vtrans	Transmitter output voltage swing	± 5			V	RL = 3KΩ
Vrec	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

5.3 3.3V Level UART

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	2.2	2.7	3.2	V	I source = 1mA
Vol	Output Voltage Low	0.3	0.4	0.5	V	I sink = 2mA
Vin	Input Switching Threshold	1.0	1.2	1.5	V	**
Vhys	Input Switching Hysteresis	20	25	30	mV	**

Table 5.3 – 3.3V Level UART Electrical Details

5.4 5V Level UART

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	3.2	4.1	4.9	V	I source = 2mA
Vol	Output Voltage Low	0.3	0.4	0.6	V	I sink = 2mA
Vin	Input Switching Threshold	1.0	1.2	1.5	V	**
Vhys	Input Switching Hysteresis	20	25	30	mV	**

Table 5.4 – 5V Level UART Electrical Details

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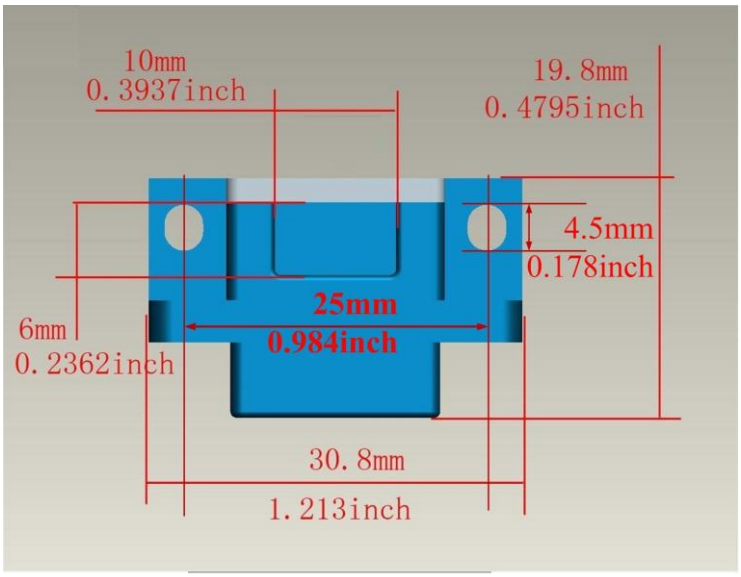
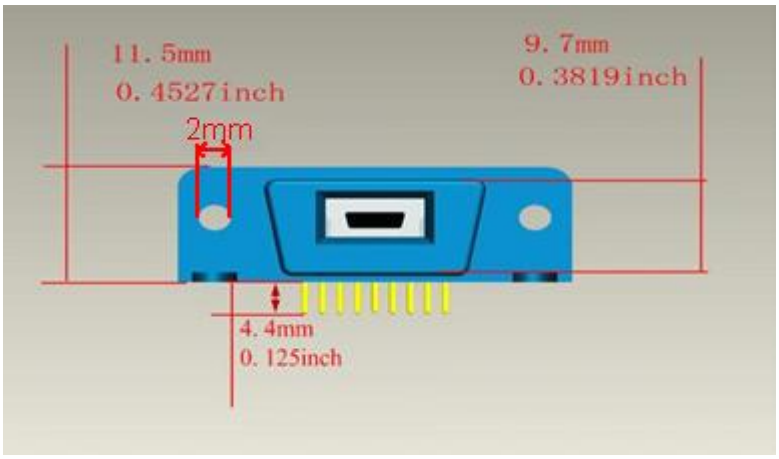
6 Mechanical Details





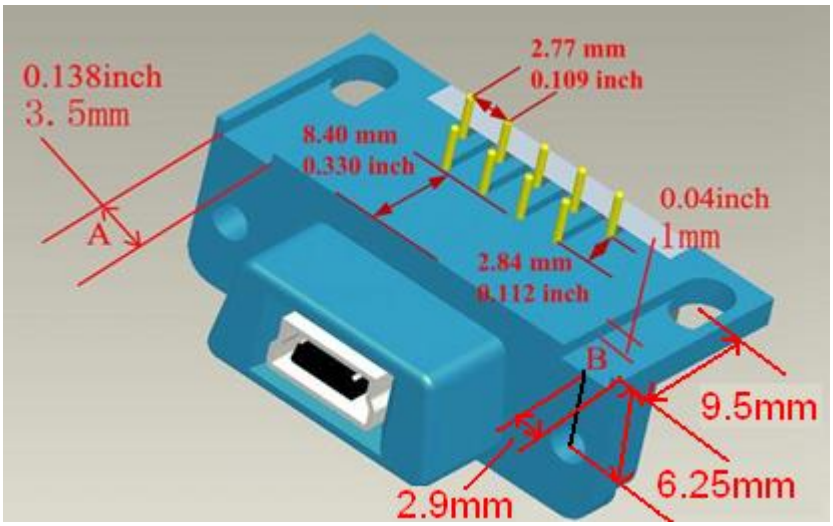


Figure 5.1 – DB9-USB dimensions

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7 Physical Environment Details

7.1 Storage

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
T	Storage Temperature Range	-65		+85	°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

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8 Environmental Approvals & Declarations

8.1 EMI Compatibility

FCC and CE

DB9-USB modules are certified for 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 modules are defined as Limited Power Supply (LPS) device, with operating voltages under 60VDC.

8.3 Environmental

The DB9-USB modules are lead-free devices that comply with the following environmental directives: RoHS, WEEE, REACH, PFOS and DecaBDE.

8.4 Reliability

The DB9-USB modules are designed to be 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.

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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 Connector Adapter, Single Port
USA ECCN	EAR99 – No License Required

Table 8.1 – Import / Export Information

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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 4 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.

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Appendix A – References

AN_149 Upgrading a DB9 RS232 Interface to USB using an FTDI DB9-USB-RS232 Module

Appendix B – Revision History

Version Draft	First Draft	October 2009
Version 1.0	First release	18th November 2009
Version 1.1	Updated part numbers	19th February 2010
Version 1.2	Added Figures 2.2 and 2.4. Updated tables 2.2 and 2.3 Added note 1 to Table 2.2	1st June 2010
Version 1.3	Simplified datasheet	5th November 2010
Version 2.0	Added details on Digital 3.3V and Digital 5V modules Edited descriptions	31st August 2011

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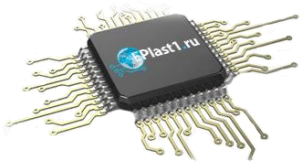

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