UT232R

USB to RS232 Adapter cable

Data Sheet

The USB-RS232 adaptor cables are a family of communication devices from Connective Peripherals. This model, UT232R, provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports by incorporating the FT232R bridge chip.

The UT232R cable is available in two lengths of 2m length (UT232R-200) and 5m (UT232R-500) with thumb screws for locking the DB9 connector to the mating half.

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Table of Contents

1 Introduction

1.1 Functional Description

The USB-RS232 adaptor cables are a family of communication devices. This model, UT232R, provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports.

Each UT232R adapter contains a small internal electronic circuit board which utilises the FT232R, mounted inside a rugged plastic enclosure capable of withstanding industrial temperature ranges. The integrated electronics also include RS232 line drivers to provide true RS232 signal levels.

Figure 1-1 - UT232R -200-500

The Cable incorporates a standard USB-A device connector for connection to an upstream host or hub port. RS232-level signals, including modem handshake signals, are available on an industry-standard DE-9P connector. The connector moulding also includes thumb screws for locking the DB9 connector to the mating half when assembled. The maximum RS232-level data rate is 1MBaud.

The UT232R adapter cable requires USB device drivers, available free from Windows Update or from https://connectiveperipherals.com, which are used to make the UT232R appear as a Virtual COM Port (VCP). This allows existing serial communications software, such as HyperTerminal, to exchange data through the UT232R to a legacy RS232 peripheral device.

1.2 Typical Applications

- USB to RS232 Converter
- Upgrading Legacy Peripherals to USB
- PDA to USB data transfer
- USB Smart Card Readers
- USB Instrumentation
- USB Industrial Control
- USB MP3 Player Interface
- USB FLASH Card Reader / Writers
- Set Top Box PC - USB interface
- USB Digital Camera Interface
- USB Hardware Modems
- USB Wireless Modems
- USB Bar Code Readers
- USB Software / Hardware Encryption Dongles

1.3 Driver Support

- Windows 11, 10, 8.x, 7
- Windows XP (legacy)
- Windows CE 4.2, 5.0 and 6.0 (Legacy)
- macOS 10.9 and above
- Linux 2.4 and greater

The drivers listed above are all available to download for free from https://connectiveperipherals.com and from the FTDI website.

1.4 Driver Installation

For driver installation and troubleshooting, please refer to the **Connective Peripherals USB to Serial Converters Driver Installation Guide (CP_000084)** which is available from www.connectiveperipherals.com.

1.5 Block Diagram
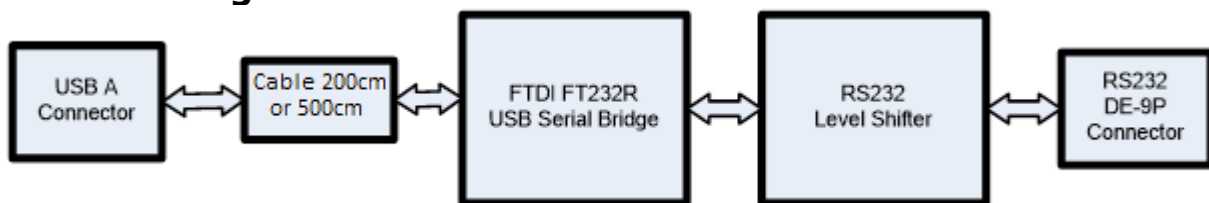
Figure 1-2 Block diagram

1.5.1 Block description

USB A Connector

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

Cable

The UT232R cable is available in two lengths 2m – Part number UT232R-200 and 5m - Part number UT232R-500.

FT232R

The FT232R provides the USB-to-Serial conversion. Operating system device drivers are required in order to work 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 RS232 devices.

DE-9P Connector (Male)

The DE-9P connector is configured in an industry standard (TIA/EIA-574) pin-out to provide connection to RS232 peripherals through standard cables. See section 4.1.2

1.6 Cable Features

- Adds one RS-232 serial port by connecting to USB

- Special high gloss white finish enclosure design

- Enhanced RS232 transceiver gives serial port speed of up to 1MBaud.

- Integral 2m (UT232R-200) or 5m (UT232R-500) USB cable with moulded strain relief

- Quality 4-layer PCB design

- Easy plug & play installation and RS-232 device connection

- Works with USB 1.1, USB 2.0 and USB 3 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

- COM port number can be changed to any available COM port number, including COM1 to COM4, to support HyperTerminal, or any other serial communications software application running in Windows

- FIFO: 128 bytes transmit buffer, 256 bytes 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 Communication Parameters
    - Parity: None, Even, Odd
    - Data bits: 7, 8
    - Flow control: RTS/CTS, DSR/DTR, X-ON/X-OFF, None
    - Stop bits 1,2

- Operating temperature of -20°C to +80°C

1.7 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. Refer to Application Note: Aliasing VCP Baud Rates

Table 1.1 Performance Figures

1.8 Ordering Information

Part Number	Description
UT232R-200	USB-RS232 Adapter Cable – 2m cable length
UT232R-500	USB-RS232 Adapter Cable – 5m cable length

Table 1.2 Ordering Information

2 FT232R Key features

This section summarises the key features and enhancements of the FT232R IC device which is used on the UT232R USB to RS232 converter cable. For further details, refer to FT232R datasheet for more information.

2.1 Integrated EEPROM

Previous generations of FTDI's USB UART devices required an external EEPROM if the device were to use USB Vendor ID (VID), Product ID (PID), serial number and product description strings other than the default values in the device itself. This external EEPROM has now been integrated onto the FT232R chip meaning that all designs have the option to change the product description strings. A user area of the internal EEPROM is available for storing additional data. The internal EEPROM is programmable in circuit, over USB without any additional voltage requirement.

2.2 Pre-programmed EEPROM

The FT232R is supplied with its internal EEPROM pre-programmed with a serial number which is unique to each individual device. This, in most cases, will remove the need to program the device EEPROM.

2.3 Lower Operating and Suspend Current

The device operating supply current has been further reduced to 15mA, and the suspend current has been reduced to around 70µA. This allows greater margin for peripheral designs to meet the USB suspend current limit.

2.4 Low USB Bandwidth Consumption

The operation of the USB interface to the FT232R has been designed to use as little as possible of the total USB bandwidth available from the USB host controller.

2.5 UART Pin Signal Inversion

The sense of each of the eight UART signals can be individually inverted by setting options in the internal EEPROM. Thus, CTS# (active low) can be changed to CTS (active high), or TXD can be changed to TXD#.

2.6 FTDIChip-ID™

Each FT232R is assigned a unique number which is burnt into the device at manufacture. This ID number cannot be reprogrammed by product manufacturers or end-users. This allows the possibility of using FT232R based dongles 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. Refer to the FT232R datasheet and the Chip-ID examples for more information.

2.7 Improved EMI Performance

The reduced operating current and improved on-chip VCC decoupling significantly improves the ease of PCB design requirements in order to meet FCC, CE and other EMI related specifications.

2.8 Programmable Receive Buffer Timeout

The receive buffer timeout is used to flush remaining data from the receive buffer. This time defaults to 16ms, but is programmable over USB in 1ms increments from 1ms to 255ms, thus allowing the device to be optimised for protocols that require fast response times from short data packets. Note that for full speed USB devices such as the UT232R, a latency timer value of 2ms or higher should be used (between 2ms and 255ms).

2.9 Baud Rates

The FT232R supports all standard baud rates and non-standard baud rates from 300 Baud up to 3 Mbaud. Achievable non-standard baud rates are calculated as follows -

Baud Rate = 3000000 / (n + x)

Where n can be any integer between 2 and 16,384 ($= 2^{14}$) and x can be a sub-integer of the value 0, 0.125, 0.25, 0.375, 0.5, 0.625, 0.75, or 0.875. When n = 1, x = 0, i.e., baud rate divisors with values between 1 and 2 are not possible.

This gives achievable baud rates in the range 183.1 baud to 3,000,000 baud. When a non-standard baud rate is required simply pass the required baud rate value to the driver as normal, and the driver will calculate the required divisor, and set the baud rate. Refer to application note AN 120 for more details.

The UT232R cable is limited to a maximum of 1 Mbaud because of the line driver within the circuit.

3 Installation

3.1 RS232 Connection Pin Out
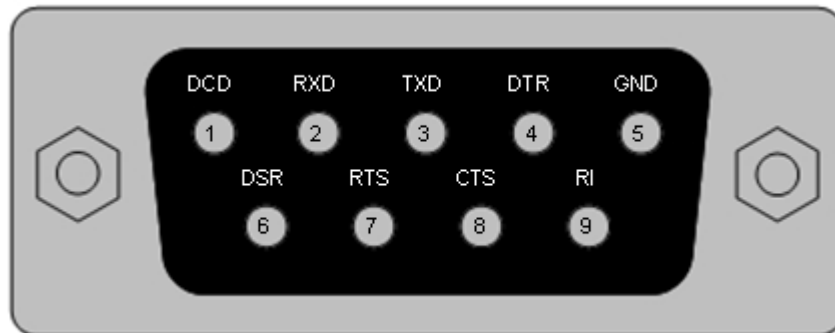
Figure 3-1 RS232 DB9 Pin Out

DB9 Pin No.	Name	Type	Description
1	DCD	Input	Data Carrier Detect control input
2	RXDATA	Input	Receive Asynchronous Data input.
3	TXDATA	Output	Transmit Asynchronous Data output.
4	DTR	Output	Data Terminal Ready control output / Handshake signal
5	GND	Gnd	Device ground supply pin.
6	DSR	Input	Data Set Ready control input / Handshake signal
7	RTS	Output	Request To Send Control Output / Handshake signal
8	CTS	Input	Clear to Send Control input / Handshake signal.
9	RI	Input	Ring Indicator control input. When remote wakeup is enabled in the FT232RL's internal EEPROM taking RI# low can be used to resume the PC USB host controller from suspend.

4 Connections

4.1 External Connectors

4.1.1 USB

The UT232R is a downstream USB 2.0 Device. A standard USB Series "A" connector is mounted inside the USB-F-1001 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	Ground	GND = USB signal ground
Shield	Case Ground	Drain = typically connected to the host PC case

Table 4.1 USB "A" Connector Pin-Out

4.1.2 RS232

The RS232 port is configured as Data Terminal Equipment (DTE), with a 9-contact D-Sub Pin connector. Pin assignments are according to TIA/EIA-574 which formally defines the assignments for a COM port found on many personal computers.

Pin Number	Pin Type	Description
1	Input	DCD = Data Carrier Detect
2	Input	RXD = Receive Data
3	Output	TXD = Transmit Data
4	Output	DTR = Data Terminal Ready
5	Ground	GND = RS232 signal ground
6	Input	DSR = Data Set Ready
7	Output	RTS = Request To Send
8	Input	CTS = Clear To Send
9	Input / Power	RI = Ring Indicator
Shield	Case Ground	Drain = typically connected to the host PC case

Table 4.2 DE-9P RS232 Pin-Out

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 Physical Environment Details

6.1 Operating Temperature

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
T	Operating Temperature Range	−20		+80	^{o}C	5% to 95% RH, non condensing

Table 6.1 Operating Temperature

7 Environmental Approvals & Declarations

7.1 EMI Compatibility

FCC and CE

The UT232R has been tested to be compliant with both FCC Part 15 Subpart B and European EMC Directive.

$C \epsilon$

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.

FC

Note: This equipment has been tested and found 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.

7.2 Safety

The UT232R is defined as Limited Power Supply (LPS) device, with operating voltages under 60VDC.

7.3 Environmental

The UT232R is a lead-free device that complies with the following environmental directives: RoHS, WEEE, REACH, PFOS and DecaBDE.

7.4 Reliability

The UT232R is designed as a robust USB-Serial adapter for use in many environments. There are no user-serviceable parts. Any failure will require a replacement of the unit.

8 Contact Information

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Appendix A - References

Document References

DS_FT232R

AN 120

Acronyms and Abbreviations

Terms	Description
COM	General Purpose Input/output
DLL	Dynamic Link Library
EEPROM	Serial Peripheral Interconnect
EHCI	Enhanced Host Controller Interface
FPGA	Field Programmable Gate Array
HBM	Human Body Model
LED	Light Emitting Diode
OHCI	Open Host Controller Interface
RoHS	Restriction of Hazardous Substance Directive
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver Transmitter
UHCI	Universal Host Controller Interface
VCP	Virtual COM Port

Appendix B - List of Figures and Tables

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Appendix C - Revision History

Revision	Changes	Date
Version 1.0	Transferred from FTDI to CP	29-12-2020
Version 1.1	Added driver install section and other minor updates	30-01-2023