Future Technology Devices International Ltd

TTL-232RG

TTL to USB Serial Converter Generic Cables

Datasheet

1 Introduction

The **TTL-232RG** generic cables are a family of USB to TTL serial UART converter cables incorporating FTDI's FT232RQ USB to Serial UART interface IC device which handles all the USB signalling and protocols. The cables provide a fast, simple way to connect devices with a logic level serial interface to USB.

Each TTL-232RG generic cable contains a small internal electronic circuit board, utilising the FT232RQ, which is encapsulated into the USB connector end of the cable. The FT232RQ datasheet is available at https://ftdichip.com/document/usb-ic-data-sheets/. The other end of the cable is wire ended. The cables can be used for "TTL" or interface logic over a range to voltage levels.

Cables are FCC, CE, UKCA and RoHS compliant at TTL levels of + 5V to + 1.8V.

The USB side of the cable is USB powered and is 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 FT232RQ. 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 https://ftdichip.com/ under FTDIChip-ID Projects.

The TTL-232RG generic cables require USB drivers, available free from https://ftdichip.com/, which are used to make the FT232RQ 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 FT232RQ on the cable though a DLL. This is illustrated in the Figure 1.1

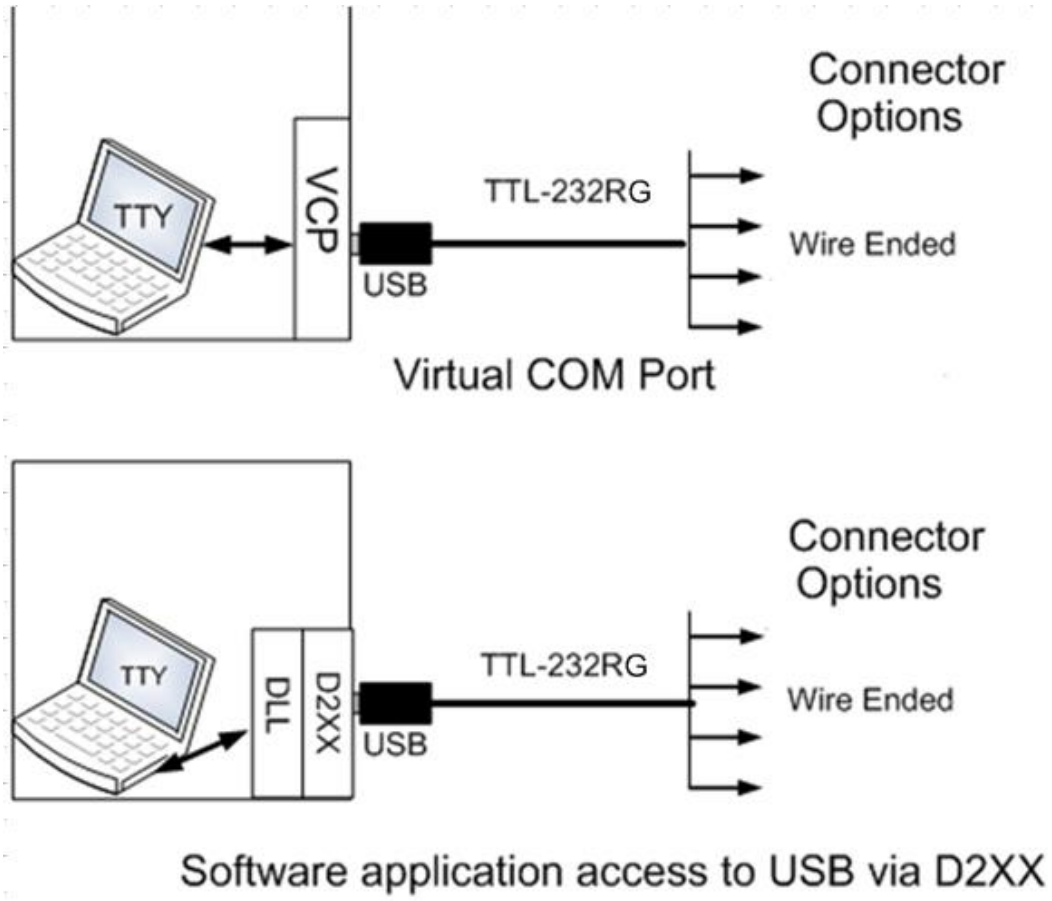

Figure 1.1 - Using the TTL-232RG Generic Cable

1.1 Available Cables and Part Numbers

The following Table 1.1 gives details of the available TTL-232RG generic cables.

Part Number	Description	End Connector*	Cable details
TTL-232RG-VSW3V3-WE	USB to UART cable with +3.3V TTL level UART signals. Maximum output of 50mA on VCC (see ***Note 1*** and ***Note 4***)	Wire Ended (no connector)	6 core, UL2464 24 AWG, diam=5mm
TTL-232RG-VSW3V3-PCB	USB to UART cable with +3.3V TTL level UART signals. Maximum output of 50mA on VCC (see ***Note 1*** and ***Note 4***)	N/A (no connector)	N/A (no cable) PCB Only
TTL-232RG-VREG3V3-WE	USB to UART cable with +3.3V TTL level UART signals. Maximum output of 250mA on VCC (see ***Note 2 and 5***)	Wire Ended (no connector)	6 core, UL2464 24 AWG, diam=5mm
TTL-232RG-VREG1V8-WE	USB to UART cable with +1.8V TTL level UART signals. Maximum output of 100mA on VCC (see ***Note 2 and 6***)	Wire Ended (no connector)	6 core, UL2464 24 AWG, diam=5mm
TTL-232RG-VSW5V-WE	USB to UART cable with up to 5V TTL level UART signals. Maximum output of 450mA on VCC (see ***Note 7***)	Wire Ended (no connector)	6 core, UL2464 24 AWG, diam=5mm
TTL-232RG-VIP-WE	USB to UART cable with TTL Voltage levels for the UART signals are supplied from the customers interface logic (see ***Note 3 and 8***)	Wire Ended (no connector)	6 core, UL2464 24 AWG, diam=5mm

Table 1.1 TTL-232RG Generic Cables Descriptions and Part Numbers

Note 1: Fixed 3.3V signals and supply.

Note 2: Any regulator from 1.8V to 5V can be used. 1.8V and 3.3V versions are standard products. Other values are customized at the factory.

Note 3: Any INPUT voltage can be supplied by the customer from 1.8V (min value of VCCIO) to +5.25V (Max value of VCCIO)

Note 4: The VCC power output signal (RED wire) is 3.3V. The source of 3.3V is the FT232RQ regulator output, which is switched onto the power output signal.

Note 5: The VCC power output signal (RED wire) is 3.3V. The source of 3.3V is on board 3.3V regulator output, which is switched onto the power output signal

Note 6: The VCC power output signal (RED wire) is 1.8V. The source of 1.8V is on board 1.8V regulator output, which is switched onto the power output signal

Note 7: The VCC power output signal (RED wire) is 5.0V. The source of 5.0V is the USB VBUS input, which is switched onto the power output signal. At the time of releasing these cables, this cable was not available. It will become available at a later date. Please contact FTDI Sales for further information.

Note 8: The VCC power input signal (RED wire) is an output from customer electronics, an input to the cable. This value=i/pV. The source of i/pV is from customer's interface logic and this is used to drive the VCCIO and hence the signal levels on the wires. This makes the generic cable customisable to whatever output voltage the customer interface is operating at 1.8V to 5.25V range.

FTDI supports customised end connector designs. For more information, please contact your local FTDI sales office (see section 6 Contact Information).

1.2 Certifications

The FTDI TTL-232RG range of generic cables are fully RoHS compliant and FCC/CE/UKCA approved.

Table of Contents

2 Typical Applications

- USB to Serial TTL Level Converter
- Upgrading Legacy Peripherals to USB
- Interface Microcontroller UART or I/O to USB
- Interface FPGA / PLD to USB
- Interface to FTDI VDRIVE2 or VMUSIC2 modules.
- Interface USB to none-standard (application dependant) logic levels.
- Replace MAX232 type level shifters allowing for direct connection of products to PC via USB
- USB Instrumentation PC interface
- USB Industrial Control
- USB Software / Hardware Encryption Dongles

2.1 Driver Support

Royalty free VIRTUAL COM PORT (VCP) and D2XX Direct Drivers are available for the following Operating Systems (OS):

- Windows
- Linux
- Mac
- Android (J2xx / D2xx only)

See the following website link for the full driver support list including OS versions and legacy OS.

https://ftdichip.com/drivers/

Virtual COM Port (VCP) drivers cause the USB device to appear as an additional COM port available to the PC. Application software can access the USB device in the same way as it would access a standard COM port.

D2XX Direct Drivers allow direct access to the USB device through a DLL. Application software can access the USB device through a series of DLL function calls. The functions available are listed in the D2XX Programmer's Guide document which is available from the Documents section of our website.

Please also refer to the Installation Guides webpage for details on how to install the drivers.

2.2 Features

- TTL-232RG generic converter cable provides a USB to TTL Serial interface with various logic levels.
- On board FT232RQ provides single chip USB to asynchronous serial data transfer interface.
- Entire USB protocol handled by the electronics in the cable USB.
- Connect directly to a microcontroller UART or I/O pins.
- UART interface support for 7 or 8 data bits, 1 or 2 stop bits and odd / even / mark / space / no parity.
- Fully assisted hardware (RTS#/CTS#) or X-On / X-Off software handshaking.
- Data transfer rates from 300 baud to 3 Mbaud at TTL levels.
- Internal EEPROM with user writeable area.
- Wide range of output drive voltages 1.8V to 5.0V safe TTL inputs makes the TTL-232RG easy to interface to 5.0V MCU's.
- FTDI's royalty-free VCP allow for communication as a standard emulated COM port and D2XX 'direct' drivers provide DLL application programming interface.
- Support for FT232RQ FTDIChip-ID™ feature for improved security.
- Voltage output power allows external logic to be powered from the USB port.
- Cable can be used to accept IO voltage from application interface logic allowing users to supply IO voltage levels.
- 6 way outputs provide Tx, Rx, RTS#, CTS#, VCC and GND.
- Low USB bandwidth consumption.
- UHCI / OHCI / EHCI host controller compatible.
- USB 2.0 (12Mb/s) Full Speed compatible.
- -40°C to +85°C operating temperature range.
- Cable length is 1.80m (6 feet).
- FCC, CE and UKCA compliant.
- Custom versions also available (subject to MOQ).

3 FT232RQ features applicable to TTL-232RG generic cables

The TTL-232RG generic cables use FTDI's FT232RQ USB to serial IC device. This section summarises the key features of the FT232RQ which apply to the TTL-232RG USB to serial TTL converter cables. For further details, and a full features and enhancements description consult the FT232R Datasheet, this is available from https://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**. A user area of the internal EEPROM is available to system designers to allow storing additional data. 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 FT_PROG, which can be downloaded from FTDI Utilities on the FTDI website (https://ftdichip.com/).

Lower Operating and Suspend Current. The FT232RQ 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 application should not exceed 2.5mA to remain USB compliant).

Low USB Bandwidth Consumption. The USB interface of the FT232RQ, and therefore the TTL-232RG cables has been designed to use as little as possible of the total USB bandwidth available from the USB host controller.

High Output Drive Option. The UART interface I/O pins on the TTL-232RG cables (RXD, TXD, RTS#, and CTS#) can be configured to use the FT232RQ's high output drive option. This option allows the FT232RQ I/O pins to drive up to three times the standard signal drive level. This allows multiple devices to be driven, or devices that require greater signal drive strength to be interfaced to the cables. This option is enabled in the internal EEPROM.

UART Pin Signal Inversion. The sense of each of the eight UART signals can be individually inverted by configuring options in the internal EEPROM. For example, CTS# (active low) can be changed to CTS (active high), or TXD can be changed to TXD#.

FTDIChip-ID™. The FT232RQ includes the 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 TTL-232RG 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 FT232RQ 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 (https://ftdichip.com/) describes this feature.

Improved EMI Performance. The TTL-232RG cables are FCC, CE an UKCA certified.

Extended Operating Temperature Range - The TTL-232RG generic cables are capable of operating over an extended temperature range of -40º to +85º C thus allowing them to be used in automotive or industrial applications.

4 TTL-232RG generic cable connection/mechanical details

The following Figure 4.1 shows the cable signals and the wire colours for these signals on the TTL-232RG generic cables.

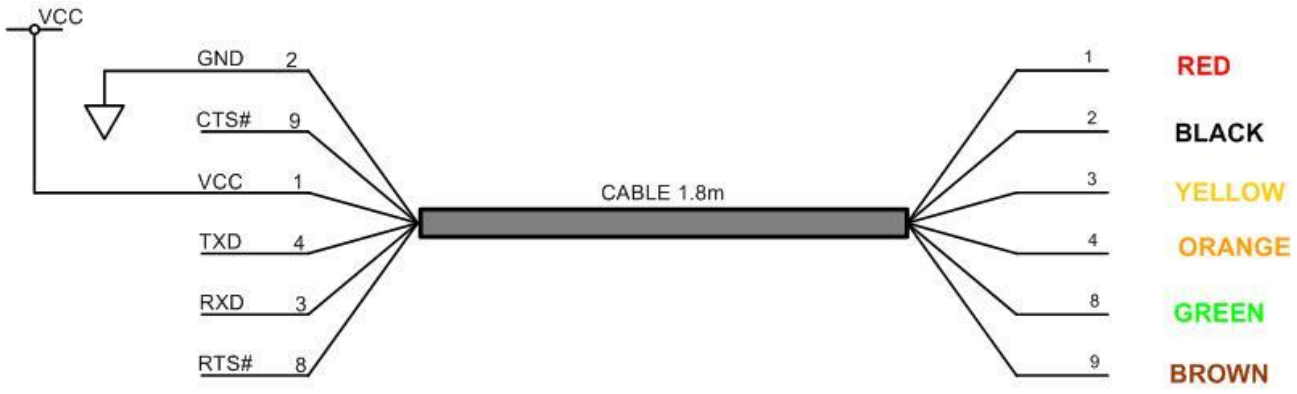

Figure 4.1 TTL-232RG Generic Cables Connections (numbers refer to pad numbers on the PCB)

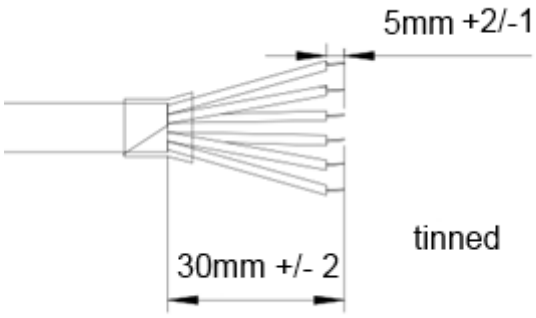

Figure 4.2 TTL-232RG Generic Cables Mechanical Details (dimensions in mm)

4.1 TTL-232RG Generic Cables Signal Descriptions

Colour	Name	Type	Description
Black	GND	GND	Device ground supply pin.
Brown	CTS#	Input	Clear to Send Control input / Handshake signal.
Red	VCC	Output or input	Power Supply Output except for the TTL-232RG-VIP-WE were this is an input and power is supplied by the application interface logic.
Orange	TXD	Output	Transmit Asynchronous Data output.
Yellow	RXD	Input	Receive Asynchronous Data input.
Green	RTS#	Output	Request To Send Control Output / Handshake signal.

Table 4.1 TTL-232RG Generic Cables Signal Descriptions

Figure 4.3 and Figure 4.4 shows the signals on the TTL-232RG-VSW3V3-PCB.

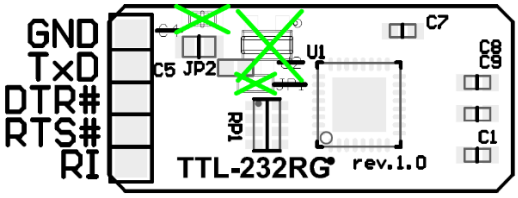

Figure 4.3 - TTL-232RG-VSW3V3-PCB Signals (Top)

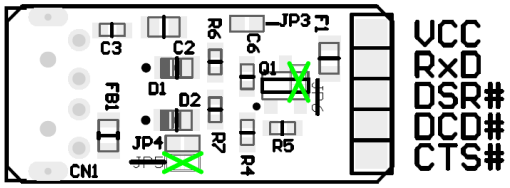

Figure 4.4 - TTL-232RG-VSW3V3-PCB Signals (Bottom)

4.2 TTL-232RG Generic Cables Electrical Parameters

4.2.1 TTL-232RG-VSW3V3-WE & TTL-232RG-VSW3V3-PCB Electrical Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
VCC	Output Power Voltage	3.2	3.3	3.4	V	
I_O	Output Power Current	-	50	-	mA	Must be less than 2.5mA during suspend.
T	Operating Temperature Range	-40		+85	°C	

Table 4.2 TTL-232RG-VSW3V3-WE & TTL-232RG-VSW3V3-PCB I/O Operating Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	2.2	2.8	3.2	V	I source = 1mA
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 4.3 TTL-232RG-VSW3V3-WE I/O Pin Characteristics

4.2.2 TTL-232RG-VREG3V3-WE Electrical Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
VCC	Output Power Voltage	3.2	3.3	3.4	V	
I_O	Output Power Current		250		mA	Must be less than 2.5mA during suspend.
T	Operating Temperature Range	-40		+85	°C	

Table 4.4 TTL-232RG-VREG3V3-WE I/O Operating Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	2.2	2.8	3.2	V	I source = 3mA
Vol	Output Voltage Low	0.3	0.4	0.6	V	I sink = 8mA
Vin	Input Switching Threshold	1.0	1.2	1.5	V	
VHys	Input Switching Hysteresis	20	25	30	mV	

Table 4.5 TTL-232RG-VREG3V3 Pin Characteristics

4.2.3 TTL-232RG-VREG1V8-WE Electrical Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
VCC	Output Power Voltage	1.32	1.62	1.8	V	
I_O	Output Power Current		100		mA	100mA for output power less than 3.0V
T	Operating Temperature Range	-40		+85	^oC	

Table 4.6 TTL-232RG-VREG1V8 I/O Operating Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	1.32	1.62	1.8	V	I source = 6mA
Vol	Output Voltage Low	0.06	0.1	0.18	V	I sink = 6mA
Vin	Input Switching Threshold	1.0	1.2	1.5	V	
VHys	Input Switching Hysteresis	20	25	30	mV	

Table 4.7 TTL-232RG-VREG1V8-WE I/O Pin Characteristics

4.2.4 TTL-232RG-VSW5V-WE Electrical Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
VCC	Output Power Voltage	4.25	5.0	5.25	V	
IO	Supply Current	-	450		mA	Must be less than 2.5mA during suspend.
T	Operating Temperature Range	-40		+85	oC	

Table 4.8 TTL-232RG-VSW5V-WE I/O Operating Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
Voh	Output Voltage High	3.2	4.1	4.9	V	I source = 6mA
Vol	Output Voltage Low	0.3	0.4	0.6	V	I sink = 6mA
Vin	Input Switching Threshold	1.0	1.2	1.5	V	
Vhys	Input Switching Hysteresis	20	25	30	mV	

Table 4.9 TTL-232RG-VSW5V-WE I/O Pin Characteristics

4.2.5 TTL-232RG-VIP-WE Electrical Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions
VCC	Power Input for I/O Buffer	1.8	INPUT i/p	5.25	V	
I_O	Supply Current	*	*	*	mA	Must be less than 2.5mA during suspend.
T	Operating Temperature Range	-40		+85	^oC	

Table 4.10 TTL-232RG-VIP-WE I/O Operating Parameters

Parameter	Description	Minimum	Typical	Maximum	Units	Conditions

Voh	Output Voltage High	*	*	*	V	I source = 6mA
Vol	Output Voltage Low	*	*	*	V	I sink = 6mA
Vin	Input Switching Threshold	*	*	*	V	
VHys	Input Switching Hysteresis	*	*	*	mV	

Table 4.11 TTL-232RG-VIP-WE I/O Pin Characteristics

*depends on supplied voltage

5 Cable PCB Circuit Schematic

The circuit schematic for the small internal electronic circuit board, utilising the FTDI FT232RQ, which is encapsulated into the USB connector end of the cable, is shown in Figure 5.1.

Customised versions of these cables are also available. Users interested in customised versions of these cables should contact FTDI sales (sales1@ftdichip.com).

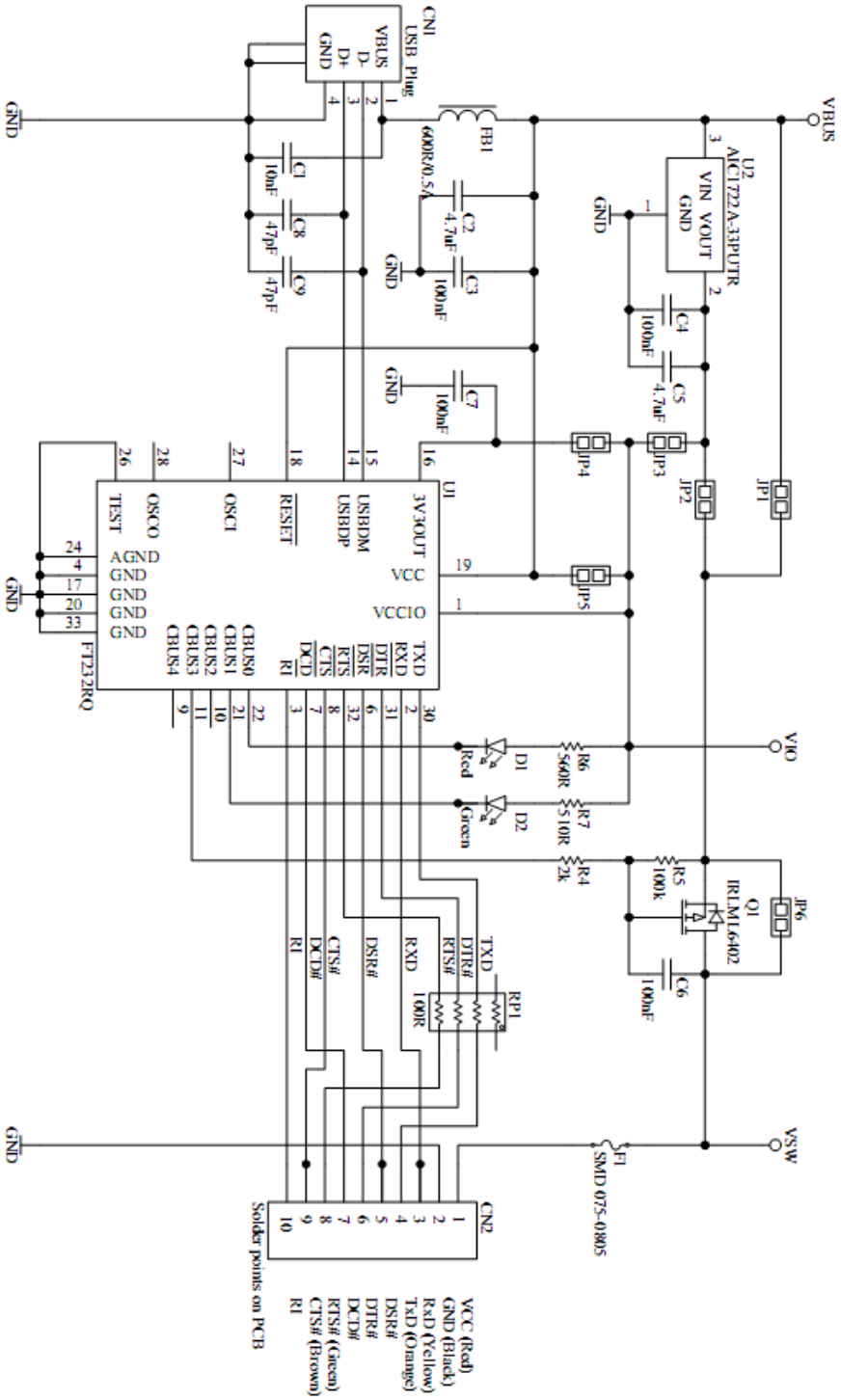

Figure 5.1 Circuit Schematic of PCB Used in the generic TTL to USB Serial Converter Cables

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Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI website for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A - Cable EEPROM Configuration

Each TTL-232RG cable is controlled by the FTDI FT232RQ IC. This FT232RQ 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 the following table. Note that these values can be changed using FT_PROG.

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	Product description depends on the cable. The following lists a few of the Product description for each different cable. TTL-232RG-VSW3V3 TTL-232RG-VREG3V3 TTL-232RG-VREG1V8 TTL-232RG-VREGxVx TTL-232RG-VIP
Max Bus Power Current	90mA	
Power Source	Bus Powered	
Device Type	FT232R	
USB Version	0200	Returns USB 2.0 device description to the host. Note: The device is a USB 2.0 Full Speed device (12Mb/s).
Remote Wake Up	Disabled	500uA suspend limit when in this state
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.

Default Internal EEPROM Configuration

Appendix B - References

Document References

FT232RQ Datasheet

FT_PROG

Acronyms and Abbreviations

Terms	Description
DLL	Dynamic Link Library
EEPROM	Electrically Erasable Programmable Read Only Memory
EHCI	Enhanced Host Controller Interface
FCC	Federal Communications Commission
FPGA	Field Programmable Gate Array
I/O	Input Output
MOQ	Minimum Order Quantity
OHCI	Open Host Controller Interface
PC	Personal Computer
PLD	Programmable Logic Device
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver Transmitter
UHCI	Universal Host Controller Interface
USB	Universal Serial Bus
VCP	Virtual COM Port

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Appendix C – Revision History

Document Title: TTL-232RG Datasheet

Document Reference No.: FT_000188

Clearance No.: FTDI# 129

Product Page: Cables

Document Feedback: Send Feedback

Revision	Changes	Date
Version 1.0	Initial Release	2009-11-17
Version 1.1	Updated release	2010-04-02
Version 1.2	A note added about the availability of the TTL_232RG-VSW5V-WE at the time of launch; Updated FCC/CE testing and approval status	2010-15-21
Version 1.3	Updated parametric value tables; update contact details; updated list of drivers supported	2015-08-11
Version 1.4	Changed the tolerance of wire length in 4.2	2016-05-23
Version 1.5	Updated table 4.2 and table 4.4	2018-05-04
Version 1.6	Added TTL-232RG-VSW3V3-PCB	04-05-2018
Version 1.7	Added UKCA and updated part number to FT232RQ. Updated driver support section and links.	12-07-2023

Mouser Electronics

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FTDI:

TTL-232RG-VSW3V3-PCB