# FTDI Ltd

# DS_US232R-10(R-100)

# USB to RS232 Adapter cable

# Data Sheet

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The USB-RS232 adaptor cables are a family of communication devices from FTDI Ltd. This model, US232R, provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports by incorporating the FTDI FT232R bridge chip.

**The US232R cable is available in two lengths 10cm (US232R-10) and 100cm (US232R-100). Indicator LEDs provide status of Transmit (TX) and Receive (Rx)**

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# 1 Introduction

## 1.1 Functional Description

The USB-RS232 adaptor cables are a family of communication devices. This model, US232R, provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports.

Each US232R adapter contains a small internal electronic circuit board which utilises the FTDI FT232R, mounted inside a rugged plastic enclosure capable of withstanding industrial temperature ranges. The integrated electronics also include RS232 level shifters and TXD/RXD LEDs to provide a visual indication of data traffic through the adapter.

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 maximum RS232-level data rate is 1MBaud.

The US232R adapter cable requires USB device drivers, available free from FTDI, which are used to make the US232R appear as a Virtual COM Port (VCP). This allows existing serial communications software, such as HyperTerminal, to exchange data through the US232R to a legacy RS232 peripheral device.

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## 1.2 Typical Applications

- USB to RS232 Converter
- Upgrading Legacy Peripherals to USB
- USB Audio and Low Bandwidth Video data transfer
- 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

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## 1.3 Driver Support

- Windows Vista x64
- Windows XP x64
- Windows Server 2003 x64
- Windows Vista
- Windows XP
- Windows Server 2003
- Windows 2000
- Windows ME
- Windows 98
- Linux
- Mac OS X
- Mac OS 9
- Mac OS 8
- Windows CE.NET (Version 4.2 and greater)

The drivers listed above are all available to download for free from the FTDI website. Various 3rd Party Drivers are also available for various other operating systems - see the FTDI website for details.

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## 1.4 Block Diagram

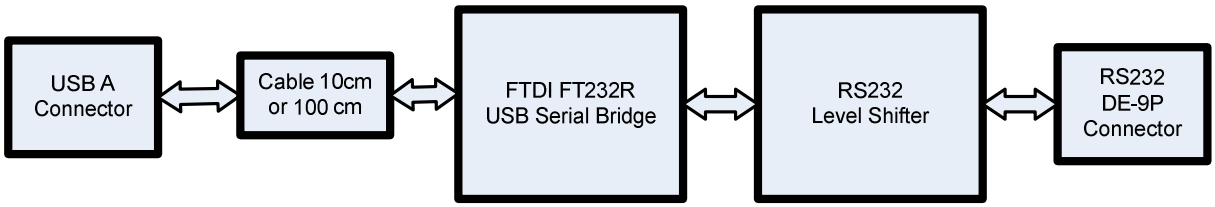


**Figure 1-1 Block diagram**

### 1.4.1 Block description

**USB A Connector**

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

**Cable**

The US232R cable is available in two lengths 10cm – Part number US232R-10 and 100cm - Part number US232R-100.

**FTDI FT232R**

The FTDI 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 3.3.2

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## 1.5 Cable Features

- Adds one RS-232 serial port by connecting to USB
- Special high gloss white finish enclosure design
- Side-lit blue RXD and TXD traffic indicators
- Enhanced RS232 transceiver gives serial port speed of up to 1MBaud.
- Gold plated USB and DB9 connectors for enhanced connection reliability
- Integral 10cm (US232R-10) or 100cm (US232R-100) 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 & 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
- 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 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 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

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## 1.6 Performance Figures

| Parameter | Performance |
|---|---|
| USB Interface | 12Mbps USB 2.0 Full-Speed |
| RS232 Interface | Standard Windows baud rates (300bps to 921.6Kbps)<br>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 Figures**

## 1.7 Ordering Information

| Part Number | Description |
|---|---|
| US232R-10 | USB-RS232 Adapter Cable – 10cm cable length |
| US232R-100 | USB-RS232 Adapter Cable – 100cm cable length |

**Table 1.2 Ordering Information**

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# 2 FT232R Key features

This section summarises the key features and enhancements of the FT232R IC device which is used on the US232R USB to RS232 converter cable. For further details, consult the FT232R datasheet, which is available from the FTDI website.

### 2.1.1 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.

### 2.1.2 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.

### 2.1.3 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 of 500µA.

### 2.1.4 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.

### 2.1.5 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#.

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### 2.1.6 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. Web based applications can be used to maintain product licensing this way. An application note describing this feature is available separately from the FTDI website.

### 2.1.7 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.

### 2.1.8 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.

### 2.1.9 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 FTDI driver will calculate the required divisor, and set the baud rate. See FTDI application note AN232B-05 for more details

The US232R cable is limited to a maximum of 1 Mbaud because of the line driver within the circuit.

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# 3 Installation

## 3.1 RS232 Connection Pin Out

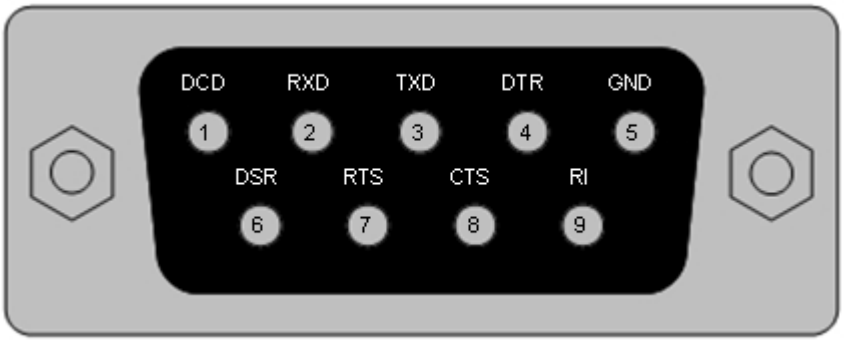


**Figure 3-1 RS232 DB9 Pin Out**

| 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 groud 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. |

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## 3.2 Device Driver Installation

The US232R adaptor drivers are available for download from:

www.ftdichip.com

### 3.2.1 Microsoft Windows

With the device drivers being Windows Hardware Quality Labs (WHQL) certified, they are also available through download directly from the Microsoft® Windows® Update service. This is the best choice when connecting the US232R to a computer running Windows Vista. Additional installation options are noted below:

**Installation Executable on Windows XP**

1) Login to your system as Administrator, or a user with Administrator rights.
2) Prior to connecting the US232R to the USB Host or Hub port, download the latest device driver version from the FTDI web site.
3) Run this executable to install the device drivers.
4) Connect the US232R 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.

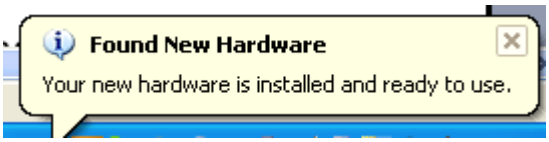


**Figure 3-2 Hardware Ready**

**Windows Update shown on Windows XP**

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

1) Connect the US232R 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 3-3 Found New Hardware Wizard**

3) Select one of the "Yes" choices and click "Next".
4) The following screen appears:

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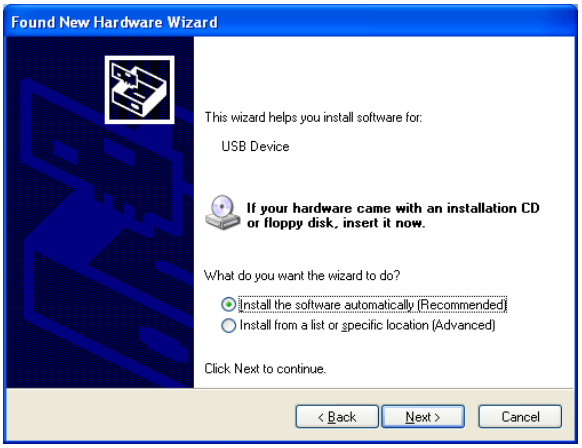


**Figure 3-4 Automatic Install**

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 3-5 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.

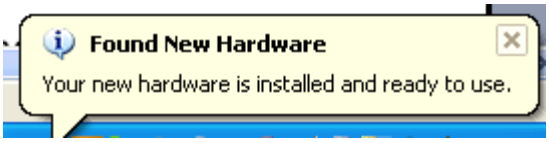


**Figure 3-6 Hardware Ready**

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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.

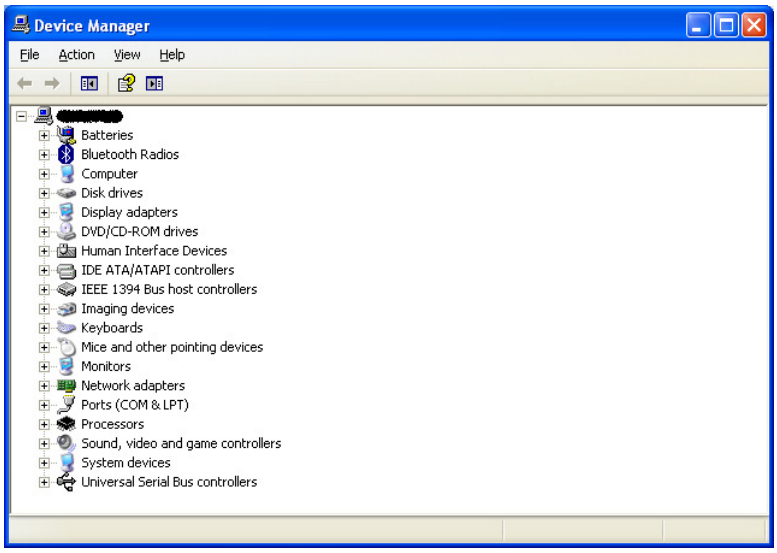


**Figure 3-7 Device Manager**

Click on the Plus "+" sign next to the Ports tree to list the available COM port. You will see "FTDI USB COM Port", followed by a COMn assignment. In the figure below, the US232R is assigned to COM3.

**Figure 3-8 COM Port Assignment**

Use this COM port number with your application software in order to access the US232R.

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 FTDI USB COM Port and select Properties.

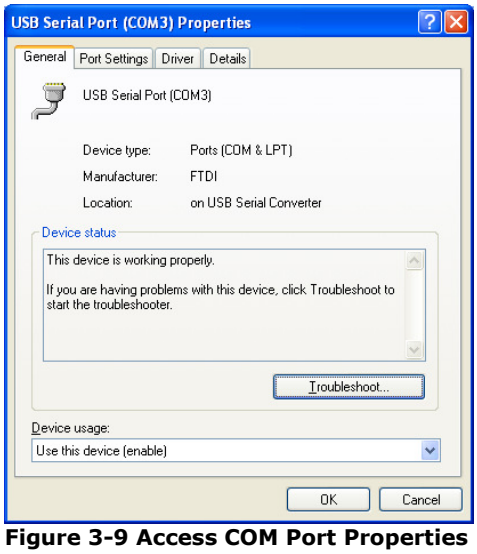


**Figure 3-9 Access COM Port Properties**

Next, click on the "Port Settings" tab.

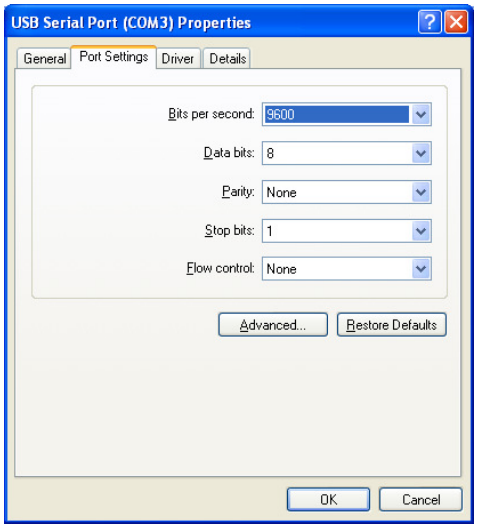


**Figure 3-10 Settings Tab**

Then click on the "Advanced…" button.

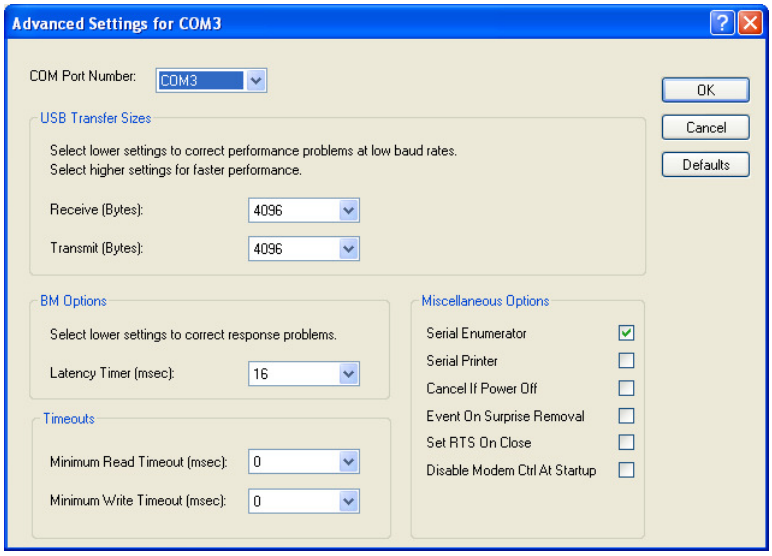


**Figure 3-11 Advanced Options**

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.

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

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# Connections

## 3.3 External Connectors

### 3.3.1 USB

The USB-F-1001 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 3.1 USB "A" Connector Pin-Out**

### 3.3.2 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 3.2 DE-9P RS232 Pin-Out**

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# 4 Electrical details

## 4.1 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 4.1 USB Electrical Details**

## 4.2 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 4.2 RS232 Electrical Details**

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# 5 Mechanical Details

## 5.1 Module Mechanical Dimensions

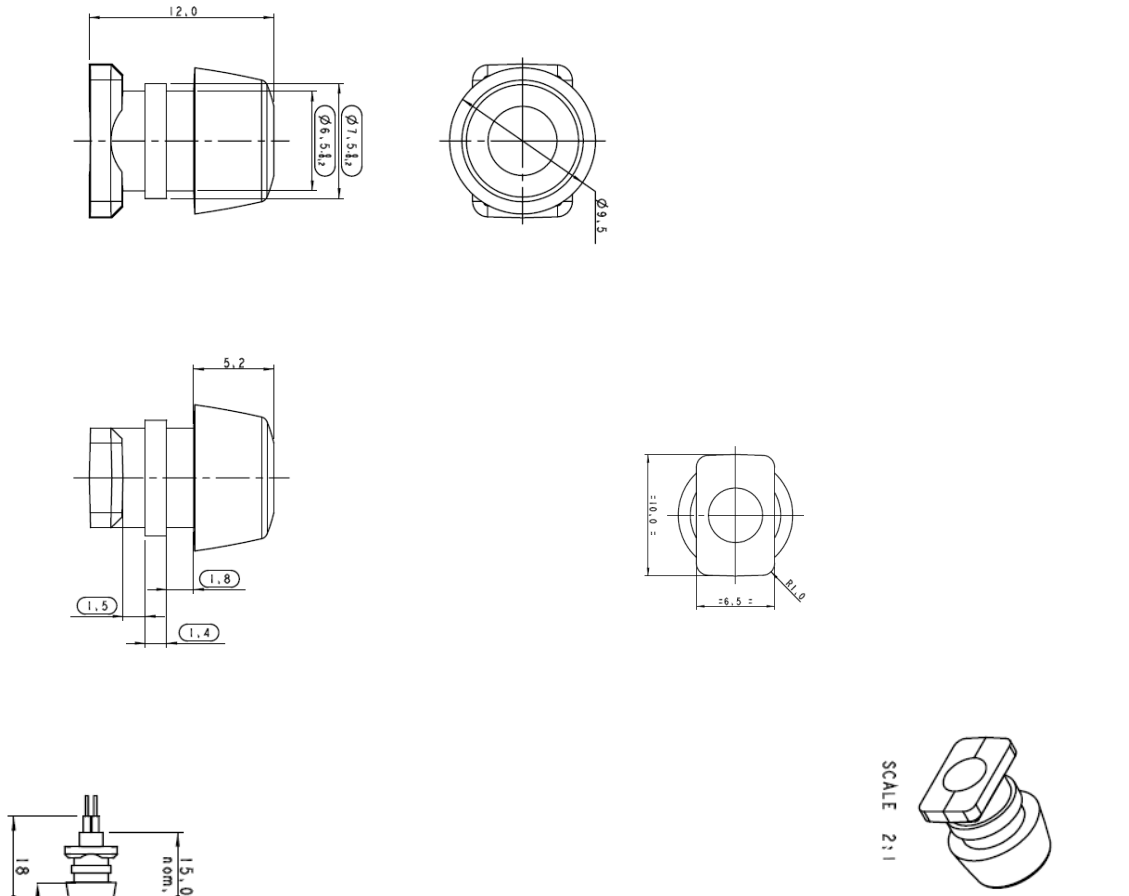


**Figure 5-1 Cable Dimensions**

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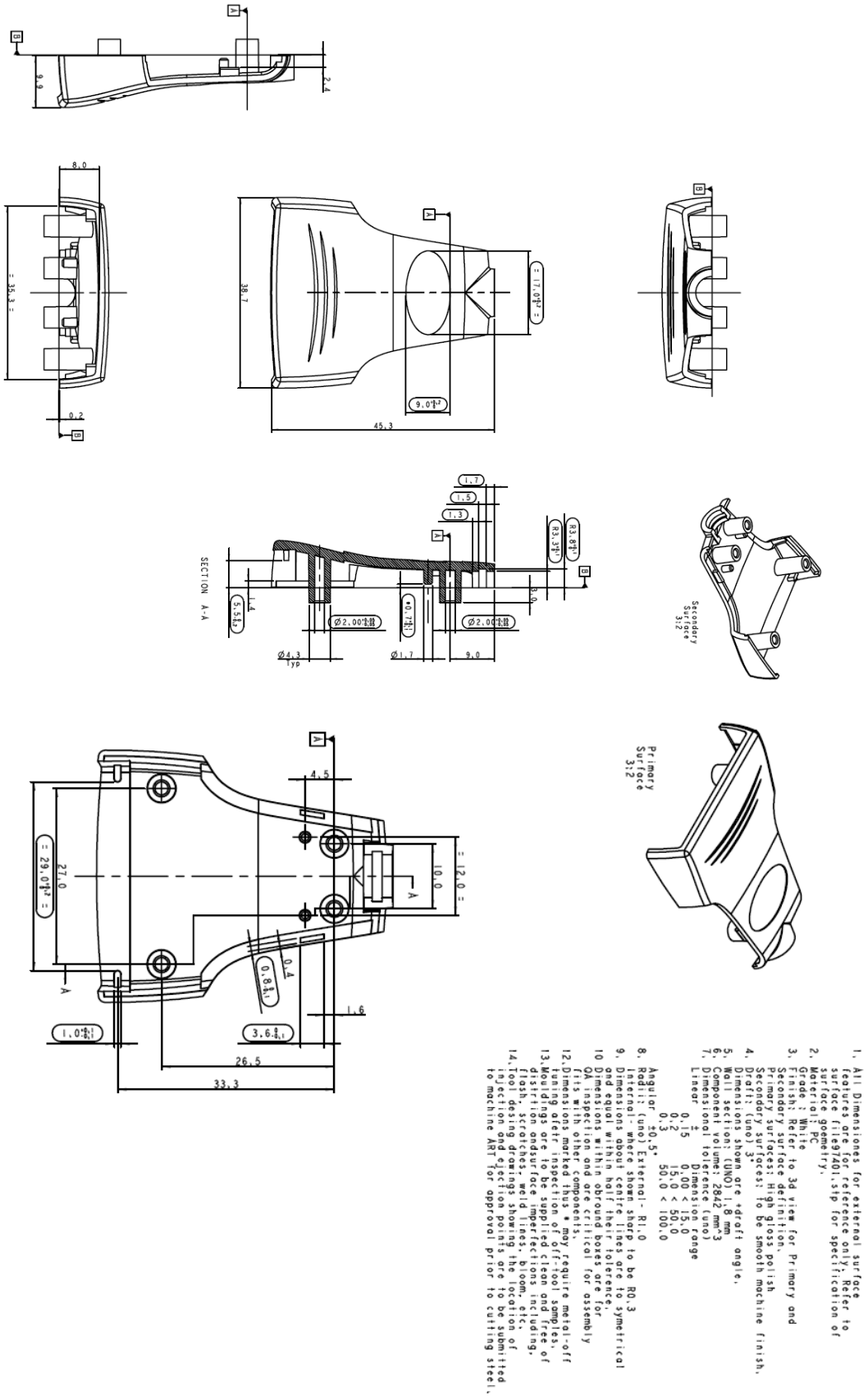


**Figure 5-2 Case top Dimensions**

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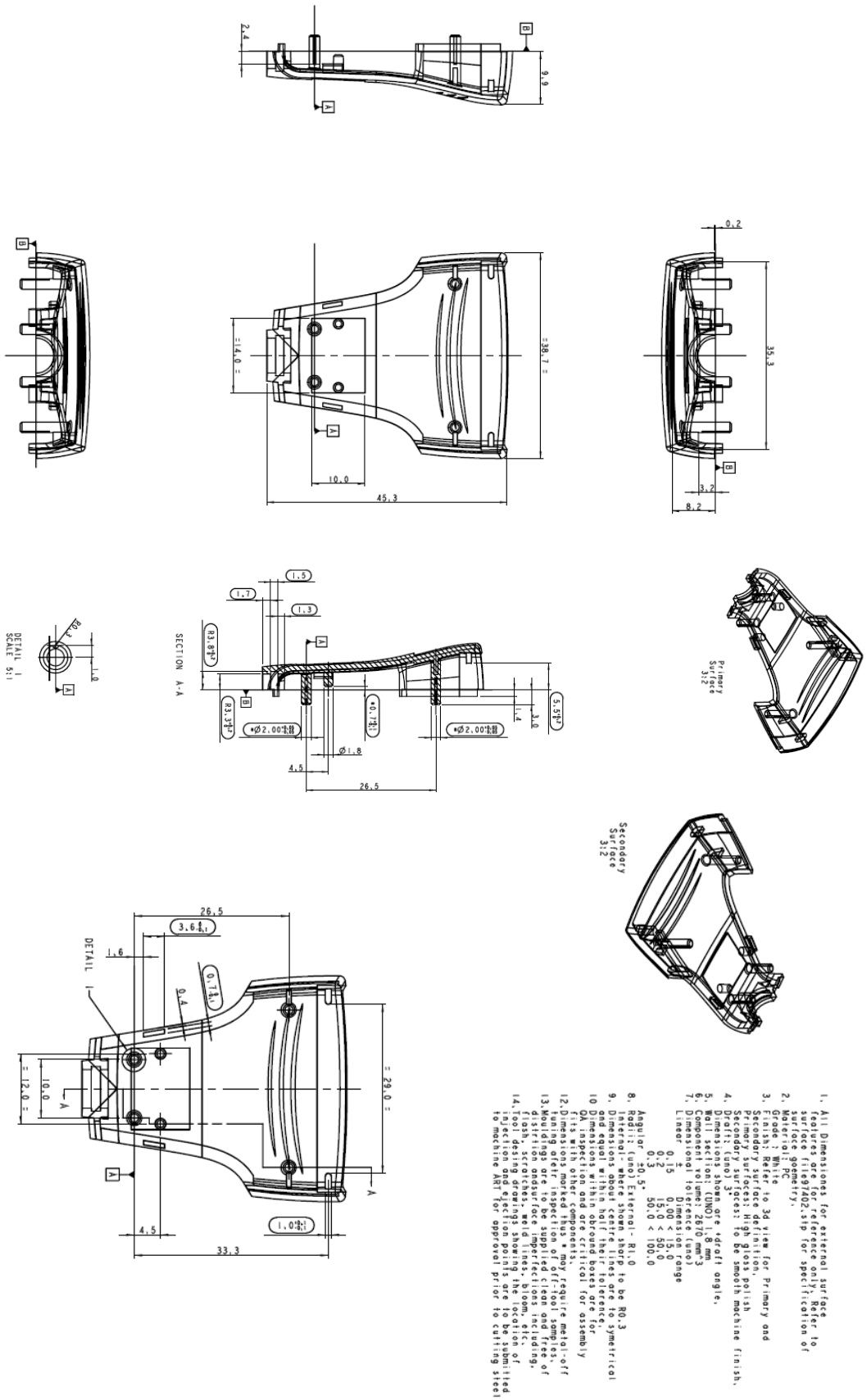


**Figure 5-3 Case Base Dimensions**

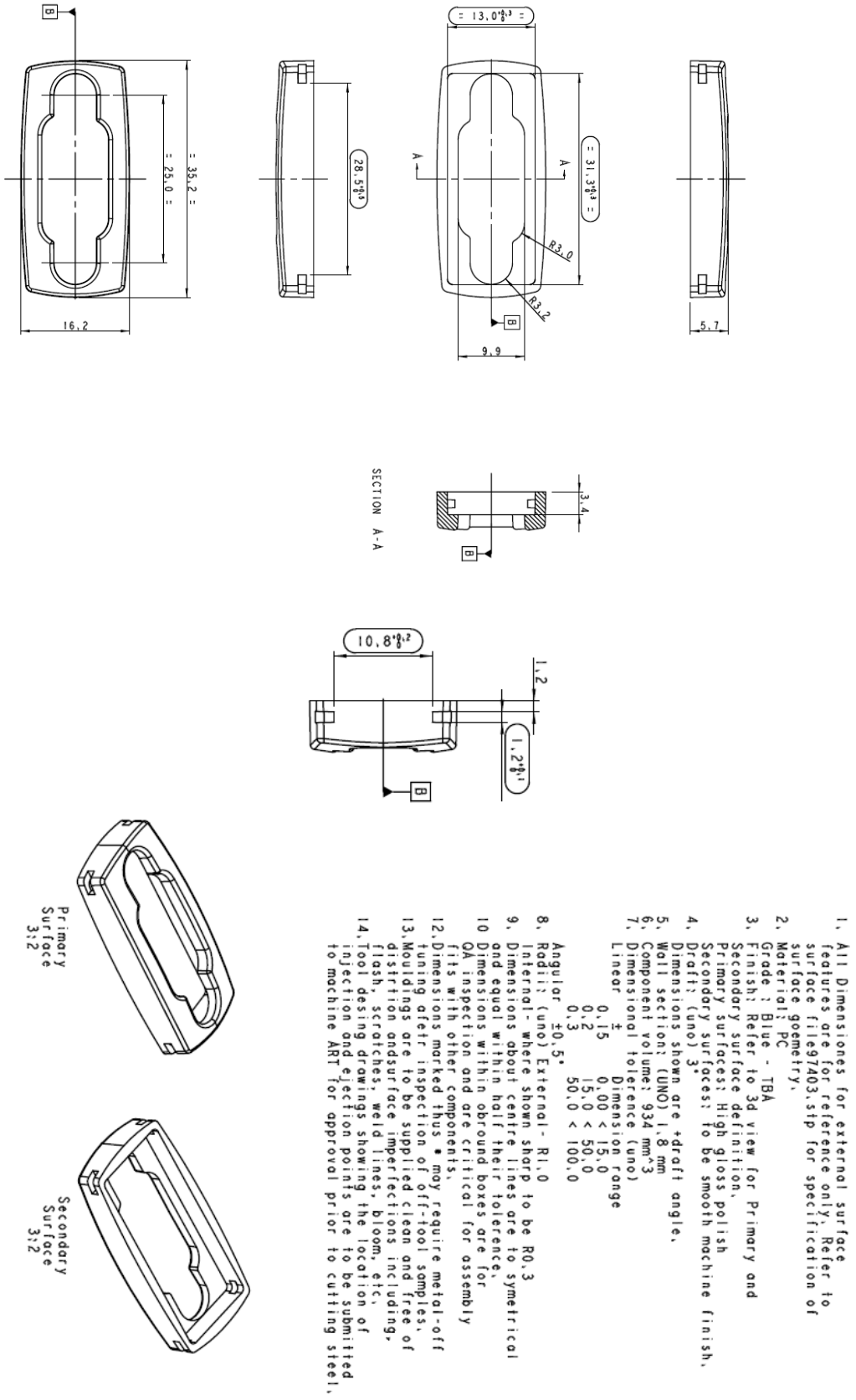


**Figure 5-4 Cap Dimensions**

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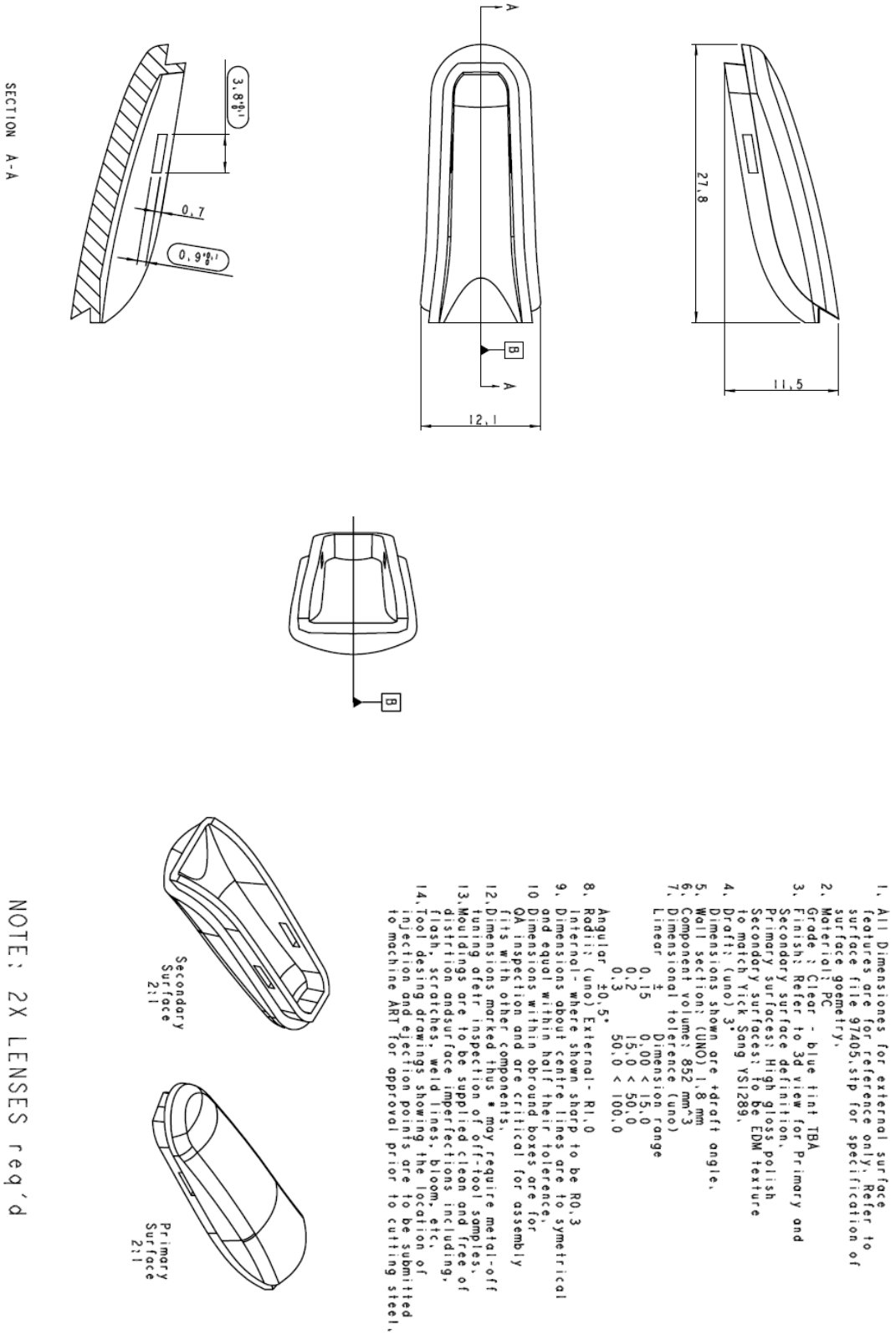


**Figure 5-5 Lens Dimensions**

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# 6 Physical Environment Details

## 6.1 Operating

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|---|---|---|---|---|---|---|
| T | Operating Temperature Range | –20 | | +80 | °C | 5% to 95% RH, non condensing |

**Table 6.1 Operating Temperature**

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# 7 Environmental Approvals & Declarations

## 7.1 EMI Compatibility

**FCC and CE**

The US232R has been tested to be compliant with both FCC Part 15 Subpart B and European EMC Directive.

CE

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 US232R is defined as Limited Power Supply (LPS) device, with operating voltages under 60VDC.

## 7.3 Environmental

The US232R is a lead-free device that complies with the following environmental directives: RoHS, WEEE, REACH, PFOS and DecaBDE.

## 7.4 Reliability

The US232R 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.

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# 8 Troubleshooting

## 8.1 Hardware

Cables are the most common sources of trouble with external devices.

Check the following:

- USB cable is properly inserted
- Computer power is ON
- Computer is not in Sleep or Standby
- If a USB Hub is used, be sure it is set for "Self-Powered" operation
- If a USB Hub is used, be sure all cables are properly inserted

RS232 cables – check the following:

- Output signals (TXD, RTS, DTR) are connected to the respective inputs (RXD, CTS, DSR) in each direction.
- Check for specific handshake requirements of your RS232 peripheral.
- If handshake signals are not used, ensure the application is set to "No Hardware Handshake", or equivalent.
- Test the port with a loop-back connector. Connect TXD to RXD, RTS to CTS and DTR to DSR. Use a simple terminal program (e.g. HyperTerminal) to check that data is transmitted and received.

## 8.2 Device Driver

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

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

See the FTDI installation guides for additional details: http://ftdichip.com/Documents/InstallGuides.htm

Common Windows Device Driver Troubles:

- DEVICE TIMES OUT: The default settings of the device driver assume typical data transfers of hundred 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 drivers buffer size and/or latency timer to smaller values. These values can be adjusted through the Advanced driver options as noted in Figure 2.13. 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.
- 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 screen in Figure 2.13.
- COM PORT IN USE: Windows keeps track of all COM port assignments. If multiple FTDI 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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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.

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## Appendix B - Revision History

| | | |
|---|---|---|
| Draft | Initial Draft – subject to change | 07-07-2009 |
| Rev 1.0 | Initial Release | 04-08-2009 |

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