



DS_ES-U-1001-C10 (C100)

Premier USB-RS232 Adapter cable

Data Sheet

Document Reference No.: CP_000055

Version 1.1

Issue Date: 2019-03-27

The USB-RS232 adaptor cables are a family of communication devices from Connective Peripherals Pte Ltd. This model, ES-U-1001, provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports by incorporating the FTDI FT232BL bridge chip.

This cable is available in two lengths 10cm (ES-U-1001-C10) and 100cm (ES-U-1001-C100). Indicator LEDs provide status of Transmit (TXD) and Receive (RXD)

**Connective Peripherals Pte Ltd
178 Paya Lebar Road, #07-03 Singapore 409030
Tel.: +65 67430980 Fax: +65 68416071**

E-Mail (Support): support@connectiveperipherals.com Web: www.connectiveperipherals.com/products

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. Connective Peripherals Pte 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. Connective Peripherals Pte Ltd, 178 Paya Lebar Road, #07-03 Singapore 409030. Registered Number: 201617872E

Table of Contents

1	Introduction	4
1.1	Functional Description	4
1.2	Typical Applications	4
1.3	Driver Support	5
1.4	Block Diagram	5
1.4.1	Block description	5
1.5	Cable Features	6
1.6	Performance Figures	6
1.7	Ordering Information	7
2	FT232BL Key features	8
2.1	Low Suspend Current	8
2.2	Low USB Bandwidth Consumption	8
2.3	Improved EMI Performance	8
2.4	Programmable Receive Buffer Timeout	8
2.5	Baud Rates	8
3	Installation	9
3.1	RS232 Connection Pin Out	9
3.2	Device Driver Installation	9
3.2.1	Microsoft Windows	9
3.2.2	Mac OS X, Linux, Windows CE	13
4	Connections	14
4.1	External Connectors	14
4.1.1	USB	14
4.1.2	RS232	14
5	Electrical details	15
5.1	USB	15
5.2	RS232	15
6	Mechanical Details	16
6.1	Module Mechanical Dimensions	16
7	Physical Environment Details	17
7.1	Operating Temperature	17

8 Environmental Approvals & Declarations	18
8.1 EMI Compatibility.....	18
8.2 Safety	18
8.3 Environmental.....	18
8.4 Reliability.....	18
9 Troubleshooting	19
9.1 Hardware.....	19
9.2 Device Driver	19
9.3 Technical Support	20
10 Contact Information.....	21
Appendix A - List of Figures and Tables	22
List of Figures	22
List of Tables.....	22
Appendix B - Revision History.....	23

1 Introduction

1.1 Functional Description

The USB-RS232 adaptor cables are a family of communication devices. This model, ES-U-1001-C10 (C100), provides a simple method of adapting legacy serial devices with RS232 interfaces to modern USB ports.

Each ES-U-1001-C10 (C100) adapter contains a small internal electronic circuit board which utilises the FTDI FT232BL. The integrated electronics also include RS232 level shifters and TXD/RXD LEDs to provide a visual indication of data traffic through the adapter.



Figure 1-1 ES-U-1001-C10



Figure 1-2 ES-U-1001-C100

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 ES-U-1001-C10 (C100) adapter cable requires USB device drivers, available free from [Connective Peripherals](http://www.connectiveperipherals.com) website, which are used to make the ES-U-1001-C10 (C100) appear as a Virtual COM Port (VCP). This allows existing serial communications software, such as HyperTerminal, to exchange data through the ES-U-1001-C10 (C100) to a legacy RS232 peripheral device.

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

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 [Connective Peripherals](http://www.connectiveperipherals.com) website. Various 3rd Party Drivers are also available for various other operating systems - see the [Connective Peripherals](http://www.connectiveperipherals.com) website for details.

1.4 Block Diagram

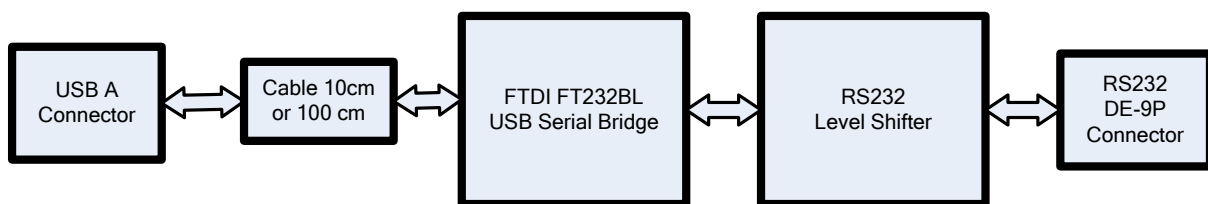


Figure 1-1-3 Block diagram

1.4.1 Block description

USB A Connector

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

Cable

The ES-U-1001-C10 (C100) cable is available in two lengths 10cm – Part number ES-U-1001-C10 and 100cm - Part number ES-U-1001-C100.

FTDI FT232BL

The FTDI FT232BL provides the USB-to-Serial conversion. Operating system device drivers are required in order to work with the FT232BL to provide the Virtual COM Port serial functionality.

RS232 Level Shifter

The RS232 level shifter converts the signals provided by the FT232BL RS232 signal levels.

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

1.5 Cable Features

- Adds one RS-232 serial port by connecting to USB
- Attractive translucent plastic design
- RXD (Green), TXD (Red) LEDs for monitoring port status & easy diagnostics
- Enhanced RS232 transceiver gives serial port speed of up to 1MBaud.
- Integral 10cm (ES-U-1001-C10) or 100cm (ES-U-1001-C100) USB cable with moulded strain relief
- 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, 384 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

1.6 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 Figures

1.7 Ordering Information

Part Number	Description
ES-U-1001-C10	Premier USB-RS232 Adapter Cable – 10cm cable
ES-U-1001-C100	Premier USB-RS232 Adapter Cable – 100cm cable

Table 1.2 Ordering Information

2 FT232BL Key features

This section summarises the key features and enhancements of the FT232BL IC device which is used on the ES-U-1001-C10 (C100) USB to RS232 converter cable. For further details, consult the FT232BL datasheet, which is available from the FTDI website.

2.1 Low Suspend Current

Integration of RCCLK within the device and internal design improvements reduce the suspend current of the FT232BL to under 200uA (excluding the 1.5k pull-up on USBDP) in USB suspend mode. This allows greater margin for peripherals to meet the USB Suspend current limit of 500uA.

2.2 Low USB Bandwidth Consumption

The operation of the USB interface to the FT232BL has been designed to use as little as possible of the total USB bandwidth available from the USB host controller.

2.3 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.

2.4 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.

2.5 Baud Rates

The FT232BL 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 -

$$\text{Baud Rate} = 3000000 / (n + x)$$

where n can be any integer between 2 and 16,384 (= 2¹⁴) 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 ES-U-1001-C10 (C100) 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

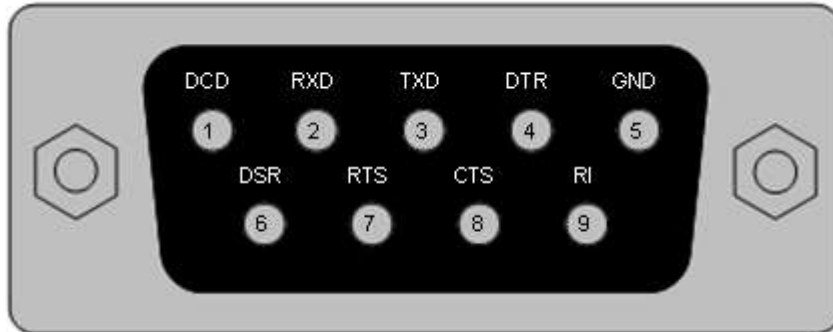


Figure 3-1 RS232 DB9 Pin Out

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.

3.2 Device Driver Installation

The ES-U-1001-C10 (C100) adaptor drivers are available for download from:

<https://www.connectiveperipherals.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 ES-U-1001-C10 (C100) 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 ES-U-1001-C10 (C100) to the USB Host or Hub port, download the latest device driver version from <https://www.connectiveperipherals.com>.
- 3) Run this executable to install the device drivers.
- 4) Connect the ES-U-1001-C10 (C100) 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 ES-U-1001-C10 (C100) 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:



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.

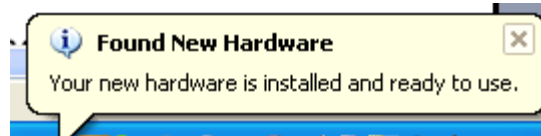


Figure 3-6 Hardware Ready

COM Port Assignment

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

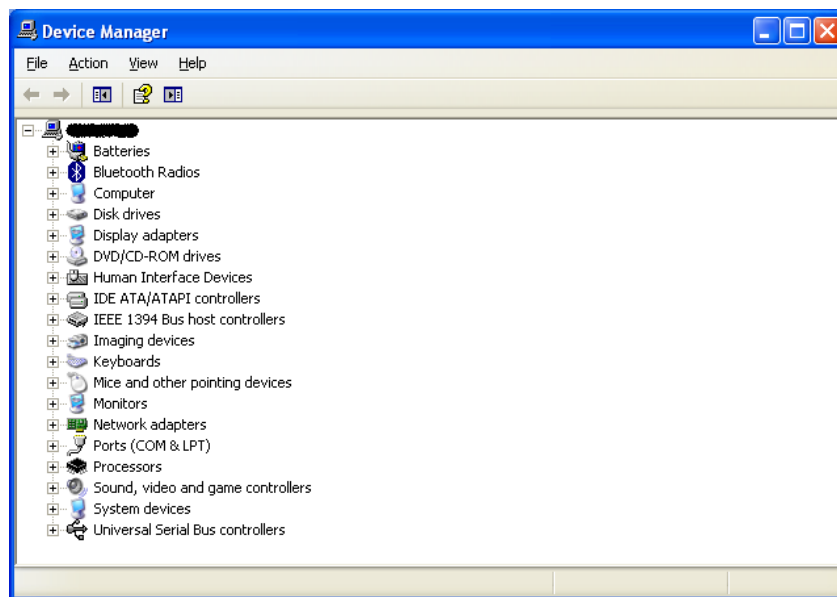


Figure 3-7 Device Manager

Click on the Plus "+" sign next to the Ports tree to list the available COM port. You will see "Connective Peripherals USB COM Port", followed by a COMn assignment. In the figure below, the ES-U-1001-C10 (C100) is assigned to COM3.



Figure 3-8 COM Port Assignment

Use this COM port number with your application software in order to access the ES-U-1001-C10 (C100).

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 Connective Peripherals 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 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.

4 Connections

4.1 External Connectors

4.1.1 USB

The USB-U-1001 is a downstream USB 2.0 Device. A standard USB Series "A" connector is mounted within the USB-U-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" Receptacle 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 3.2 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		25		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

6.1 Module Mechanical Dimensions

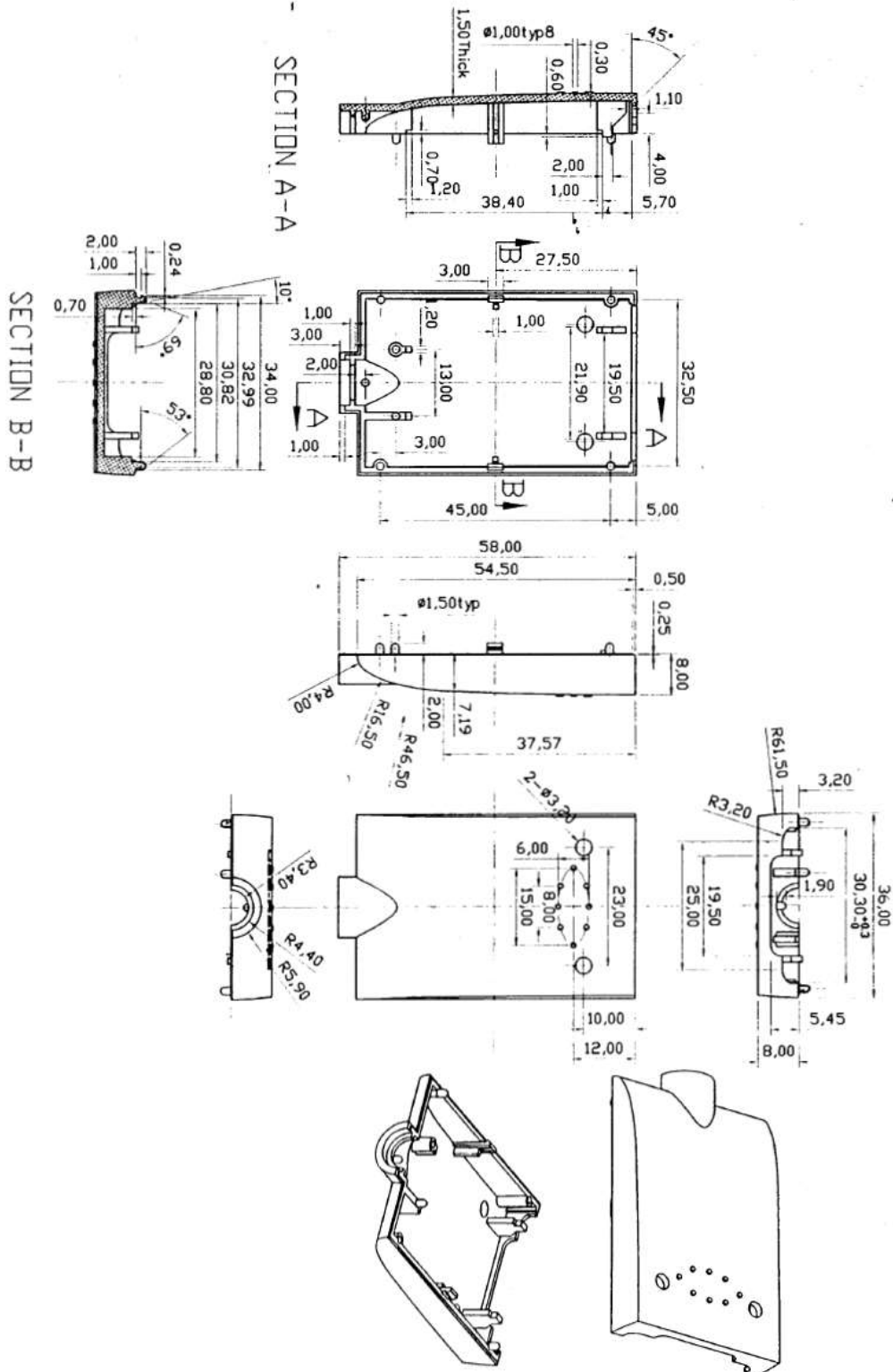


Figure 6-1 Case dimensions

7 Physical Environment Details

7.1 Operating Temperature

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

Table 7.1 Operating Temperature

8 Environmental Approvals & Declarations

8.1 EMI Compatibility

FCC and CE

The ES-U-1001-C10 (C100) has been tested 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 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.

8.2 Safety

The ES-U-1001-C10 (C100) is defined as Limited Power Supply (LPS) device, with operating voltages under 60VDC.

8.3 Environmental

The ES-U-1001-C10 (C100) is a lead-free device that complies with the following environmental directives: RoHS, WEEE, REACH, PFOS and DecaBDE.

8.4 Reliability

The ES-U-1001-C10 (C100) 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.

9 Troubleshooting

9.1 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.

9.2 Device Driver

Ensure the latest device driver is in use. See <https://www.connectiveperipherals.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 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's 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 Connective Peripherals 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>.

9.3 Technical Support

Technical support may be obtained from your nearest Connective Peripherals Office:

support@connectiveperipherals.com

<https://www.connectiveperipherals.com>

10 Contact Information

Global Headquarters – Singapore

Connective Peripherals Pte Ltd
178 Paya Lebar Road
#07-03
Singapore 409030

Tel: +65 67430980
Fax: +65 68416071

E-Mail (Sales)	sales@connectiveperipherals.com
E-Mail (Support)	support@connectiveperipherals.com
Web Site URL	http://www.connectiveperipherals.com
Web Shop URL	http://www.connectiveperipherals.com

Appendix A - List of Figures and Tables

List of Figures

Figure 1-1 ES-U-1001-C10.....	4
Figure 1-2 ES-U-1001-C100.....	4
Figure 1-0-1 Block diagram.....	5
Figure 3-1 RS232 DB9 Pin Out	9
Figure 3-2 Hardware Ready	9
Figure 3-3 Found New Hardware Wizard	10
Figure 3-4 Automatic Install.....	10
Figure 3-5 Complete Hardware Installation	10
Figure 3-6 Hardware Ready	11
Figure 3-7 Device Manager	11
Figure 3-8 COM Port Assignment	11
Figure 3-9 Access COM Port Properties	12
Figure 3-10 Settings Tab	12
Figure 3-11 Advanced Options.....	12
Figure 5-1 Case dimensions	16

List of Tables

Table 1.1 Performance Figures	6
Table 1.2 Ordering Information	7
Table 3.1 USB "A" Receptacle Pin-Out	14
Table 3.2 DE-9P RS232 Pin-Out.....	14
Table 4.1 USB Electrical Details	15
Table 4.2 RS232 Electrical Details.....	15
Table 6.1 Operating Temperature	17

Appendix B - Revision History

Revision	Changes	Date
1.0	Initial release	2009-08-04
1.1	Re-branding to reflect the migration of the product from EasySync to Connective Peripherals name – logo change, copyright changed, contact information Changed, all internal hyperlinks changed.	2019-03-27

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А