MEV Limited

USB232/485 INSTRUCTION MANUAL

USB TO RS232 / RS485
SERIAL
COMMUNICATIONS
INTERFACE
WITH ISOLATION
OPTION

Issue 5

LIST OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

The USB232 and USB485 serial communications interfaces are a range of USB peripherals that provide legacy RS232 or RS485 serial communication interfaces to computers with USB support.

1.1 The Products Described in this Manual

There are three variants of USB232/485. Each supports a single serial communications interface that appears to operating system as a standard serial port.

USB232	A non-isolated RS232 interface.
USB485	A non-isolated RS485 interface.
USB485i	An isolated RS485 serial interface.

1.2 Features of the USB232/485 Series of Data Communications Interfaces

Each of the USB232/485 series of interfaces is designed to meet stringent performance requirements and ease of use while maintaining compatibility with standard serial communications boards.

- USB 1.1 specification compliant
- Windows 98, ME, 2000, XP and Linux compatible
- Data rates selectable up to 920 k baud (RS232) and 1,500 k baud (RS485)
- FIFO modes supporting a 384 character receive buffer and 128 byte transmit buffers
- Three point isolated serial communications on isolated versions
- Full Duplex, Half Duplex, Multi-drop applications
- RS485 transmitter enabled automatically in Half Duplex mode
- Full specification signal levels
- Implementation of all RS-232 primary control lines
- Low power consumption

1.3 General Description

The USB232/485 are advanced RS232 / RS485 serial communications interfaces suitable for any IBM PC or compatible computer that supports USB 1.1.

The RS485 ports have a link selectable “Half Duplex” mode that causes the transmit buffer to be enabled automatically, by the UART, whenever data is waiting to be sent from the UART Transmit buffer.

All models are supported by 3rd party Windows and Linux drivers. Microsoft Windows drivers are distributed on the CD that accompanies this product, and are also available on the MEV website at http://www.mev.co.uk/download.htm. The Linux drivers are available as standard as part of the 2.4.0 kernel and above.

These drivers are a superset of the Microsoft serial drivers and allow the devices to operate as standard serial ports. These drivers also allow the advanced features of the devices to be fully utilised by the application software.

There are three models available in the range.

USB232 provides a 9 pin RS-232 port

USB485 provides a 9 pin RS-422/485 port, jumper configurable to be half-duplex.

USB485i provides an isolated 9 pin RS-422/485 port, jumper configurable to be half-duplex.

The USB485i is designed to isolate the serial communications from the computer power. The design is such that it will sustain common mode voltages up to 75Vdc, which is outside of the low voltage directive (73/23/EEC). However in fault conditions they are protected to sustain common mode voltages up to peaks of 1KVdc. It provides isolation of the data and can be used in serial communications systems where high integrity data transmission and reception are required in an electrically severe environment.

Each interface consists of a small self powered unit that connects to the USB interface via a standard USB interface cable and one serial port designed to meet one of the following standards:

RS-232 full duplex serial port furnished with a 9 pin D-type male connector conforming to IBM practice. The port is fully configured with two data, six control I/O lines and one signal return.

RS485 full duplex, half-duplex, multi-drop operation or RS422 full duplex without RTS-CTS control lines. Depending on the application, RS485 or RS422 operation is selected by making the appropriate connections. Each RS422 / 485 port is furnished with a 9 pin D-type male connector.

Each interface takes up to one unit load, 100mA, from the PC USB interface.

1.3.1 Enhanced Features

The USB232 supports data rates up to 920k baud. The USB485 and 485i support data rates up to 1.5M Baud. There is a 384 byte receive FIFO buffer and 128 byte transmit FIFO buffer associated with each port. This allows the processor to service the ports in a timely manner over the USB bus.

The range has another special feature if you have an RS485 Half Duplex or Multi-drop Application. There is a link selectable Half-Duplex mode. In this mode the RS485 transmit buffer is enabled automatically, by the UART, whenever data is waiting to be sent in the UART Transmit buffer. This feature makes efficient multi-drop communication simple to implement by removing the burden of the Transmit buffer enable control from the software.

1.4 What the Package Contains

The package as delivered contains:

1. The USB serial interface as ordered, in a protective bag. The model will be one of the following, and is identified by the type number printed on the PCB.

USB232	USB to RS-232 Serial Communications Controller
USB485	USB to RS-422/485 Serial Communications Controller
USB485i	USB to RS-422/485 Serial Communications Controller with I/O signal isolation

2. The included distribution software and manual on CD

3. Any additional accessories (mating connectors, software etc.) may be packed separately.

1.4.1 Contacting MEV Limited for Technical Support or Service

The USB Series of interfaces are designed and manufactured by MEV Ltd and maintenance is available throughout the supported life of the product.

1.4.2 Technical Support

Should the device appear defective, please check the information in this manual and any 'Help' or 'READ.ME' files appropriate to the program in use to ensure that the product is being correctly applied.

If an application problem persists, please request Technical Support in one of the following ways:

Telephone:	UK	0161 477 1898
	International	+44 161 477 1898
Fax:	UK	0161 718 3587
	International	+44 161 718 3587
Email:	cooperd@mev.co.uk	
Web:	www.mev.co.uk	

2 GETTING STARTED

2.1 General Information

All of the USB232/485 series are Plug and Play and come complete with all the software to install and operate the device in any USB version 1.1 compliant host PC running under Windows or Linux and allow execution of normal serial communications programs.

Each device connects to the USB port with a standard USB Type B cable and does not need an external power supply.

When installing one or more USB232/485 Series Data Communications interfaces, ensure that the host computer has sufficient capacity. The USB 1.1 standard has support for up to 127 physical devices attached to the bus, however the bandwidth and performance of the port will be affected by bus loading, especially if high bandwidth devices are used as well.

The USB serial communications interfaces are suitable for use in any PC compatible computer that can provide a single USB 1.1 compliant interface.

The computer must run under a one of the following operating systems: Windows 98, Windows ME, Windows 2000, Windows XP or Linux.

2.2 Installing the Interface

Connect a USB Type B cable between the USB232/485 serial communications device and the host computer.

The USB232/485 interfaces are Plug and Play devices. The installation software supplied will handle all configuration of the device.

When the device is physically connected to the PC the Windows operating system will discover new hardware. From then on respond to the questions asked. When prompted for a disk use the disk supplied. Exact installation instructions are operating system dependent.

2.2.1 Windows 98/ME Installation

Please refer to “Installing FT8U232/245 devices under Windows 98” (AN232-03.pdf) which can be found on the associated CD or at http://www.mev.co.uk/download.htm.

2.2.2 Windows 2000/XP Installation

Please refer to “Installing FT8U232/245 devices under Windows 2000” (AN232-05.pdf) which can be found on the associated CD or at http://www.mev.co.uk/download.htm.

2.2.3 Linux Installation

Linux Drivers for FT8U232/485 devices have been added to Linux Kernel 2.4.0 and above. The devices will be detected automatically and will typically be configured as /dev/ttyUSBn devices.

2.3 USB232/485 Configuration Jumper Settings

Most configuration settings on the USB232/485 are performed by the plug and play installation program. However the USB485 and USB485i have some jumpers and these need to be set before connecting the unit to the host. The functions of the jumpers on the USB485 and USB485i control whether the unit operates in Full Duplex or Half Duplex mode and whether or not the RS485 port is terminated. The USB232 does not have jumpers.

2.3.1 RS-485 Full Duplex / Half Duplex Operation

The RS-485 port on a USB485 or USB485i can be used in either full duplex (simultaneous transmission and reception over two independent wire pairs) or half duplex (sequential transmission or reception over a single wire pair).

In full duplex operation the transmitter can be left in its enabled state at all times. In half duplex receive operation, the transmitter must be disabled by switching to its high impedance state. This allows reception of data over the same serial lines.

2.3.1.1 Jumper Selection For Full Duplex Operation

Link	Function
JP2 2-3 JP3 2-3	Full Duplex (4 wire) operation
JP4 1-2	Receiver enabled when device is awake
JP5 2-3	Transmitter enabled when device awake

Figure 2.1 Jumper Settings For Full Duplex Operation

2.3.1.2 Jumper Selection For Half Duplex Operation

Link	Function
JP2 1-2 JP3 1-2	2 wire operation TxA is connected to RxA' and TxB is connected to RxB'
JP5 1-2	Transmitter only enabled when device is transmitting

Figure 2.2 Jumper settings for Half Duplex Operation

2.3.1.3 Selection of Local Echo On/Off in Half Duplex Operation

Normally in half duplex operation it is not desirable to see the characters being transmitted. JP4 controls the operation of the receiver during half-duplex operation.

Link	Function
JP4 2-3	LOCAL ECHO OFF Receiver disabled when device is transmitting
JP4 1-2	LOCAL ECHO ON Receiver enabled when device is transmitting

Figure 2.3 Jumper settings for Local Echo On/Off in Half Duplex Operation

2.3.2 Transmission Line Termination

2.3.2.1 Termination Resistors for RS-422/485 Receivers

Operation of RS-422/485 systems requires that the lines be terminated at the final receiver. The simplest termination is by a line-to-line resistor, and provision is made to connect this 120Ω terminator on the data of each RS-422/485 channel.

The data input terminator resistors can be configured using jumper, JP1, which is factory fitted.

Link	Function
JP1 1-2	Data line is terminated
JP1 2-3	Data line is NOT terminated

Figure 2.4 Jumper Settings for Termination Resistor Selection

Correct termination is built into the RS-232 receivers.

2.3.3 Jumper Factory Settings Summary

The USB485 and USB485i interfaces can be reset to their factory defaults by re-configuring the device according to the following tables. These settings allow the device to be used in full or half duplex with local echo without changing the jumpers.

Link	Function
JP1 1-2	Data Line Terminated
JP2 2-3 JP3 2-3	Full Duplex (4 wire) operation
JP4 1-2	Receiver enabled when device is awake
JP5 1-2	Transmitter only enabled when device is transmitting

Figure 2.5 Factory Jumper Setting Summary

2.4 Application Software

The 'HyperTerminal' program supplied with Windows is compatible with the USB232/485 interfaces and is useful for testing and operation on COM1 to COM4 channels.

The device will operate in conjunction with all commercially available communications and data acquisition packages that support Windows 98, ME, 2000 & XP serial ports.

The device will operate with DOS programs that use the standard serial ports and will run inside a DOS window under Windows 98, ME, 2000 or XP.

Install the required application software in accordance with the vendor's instructions, assigning communications to the required COM port.

Source code and executable versions of a simple terminal application for Windows and Linux written in Delphi/Kylix is available for download from the MEV web site http://www.mev.co.uk/download.htm.

2.4.1 Installation Testing

Many applications packages include a self-test feature, and when the hardware and software have been satisfactorily installed, any such test should be performed to check correct operation.

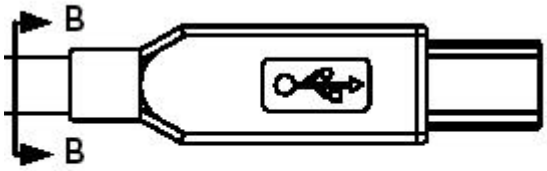
3 MAKING THE CONNECTIONS

This chapter describes the signal and control connections that the user must make between the USB232/485 interfaces and any external serial communications devices.

3.1 External Connections

3.1.1 USB Connector

Connection to the USB port is made using a standard type B cable.



Overmolded Series "B" Plug
(Always downstream towards the USB Device.)

Contact Number	Signal Name	Typical Wiring Assignment
1	VBUS	Red
2	D-	White
3	D+	Green
4	GND	Black
Shell	Shield Drain Wire	

Figure 3.1 USB Connector Termination Assignment

3.1.2 RS-232 9 way Port

Connections to the RS-232 are made via 9 pin D type connectors on the interface. The on-board connectors are male and the mating sockets are available as accessories. Provision is made for securing by screw jacks.

The 9 pin D connector pin-out conforms to the industry standard and will support commercially available cables and adapters.

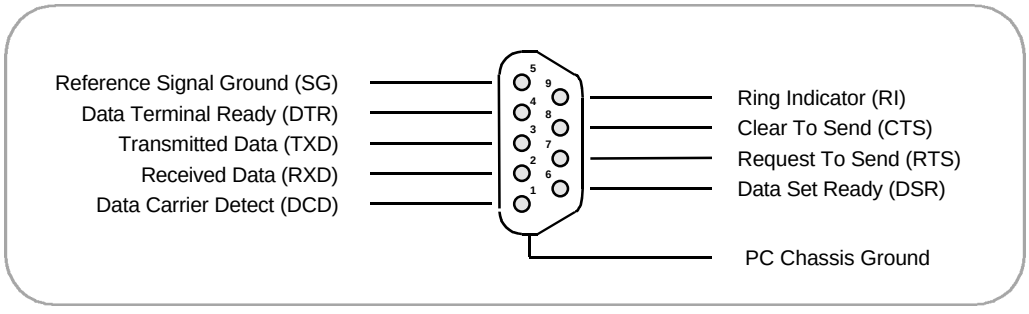


Figure 3.2 RS-232 9 way Port Pin Designations

3.1.3 RS-422/485 9 way Port

Connections to the RS-485 are made via 9 pin D type connectors on the interface. The on-board connectors are male and the mating sockets are available as accessories. Provision is made for securing by screw jacks. The 9 pin D connector is pin-out compatible with the default pin-out of the Amplicon PC248/PC249(i) series cards.

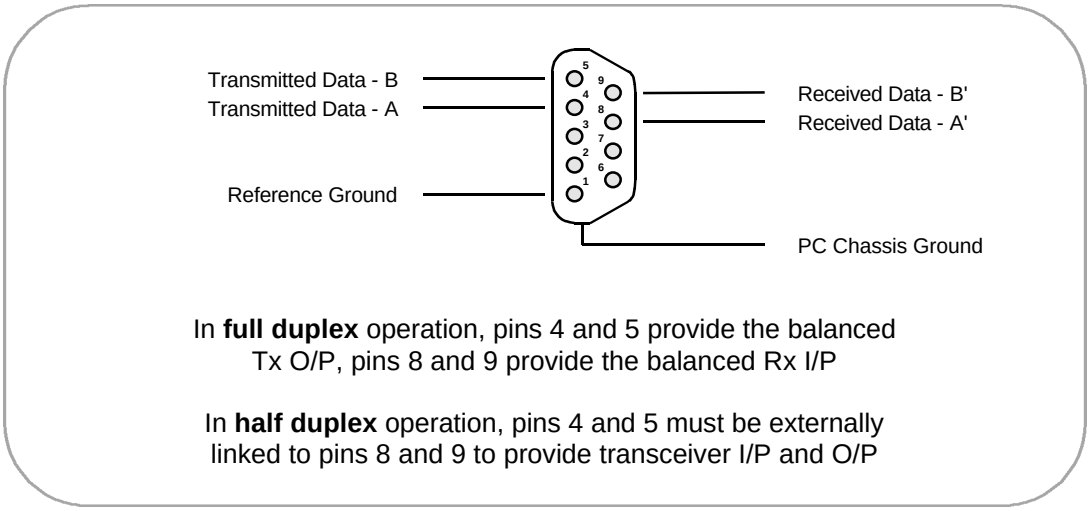


Figure 3.3 RS-422/485 Amplicon Standard Port Pin Designations

3.2 The Ground Connections

Each connector is equipped with two or more different ground connections and care must be taken in the use of these grounds and the cable design to ensure that the EMC requirements are met, and that isolation integrity is maintained in the case of the devices with isolated input/output.

The connector pin-out is such that commercially available cables and adapters are normally usable without modification, but the user must be aware of the requirements to maintain isolation when the devices at each end are not at nominal earth potential. The choice of proper, screened cables is also important for the system to maintain Electro-Magnetic Compatibility.

3.2.1 USB 232 Ground Connections

Reference Signal Ground (pin 5 of 9 way) is internally connected to the PC USB signal ground and should be externally connected to the Signal Ground pin of the RS-232 device at the other end of the link.

The **Connector Shell** is internally connected to the PC USB chassis ground. Protective ground should be externally connected to the protective ground pin of the RS-232 device at the other end of the link. To maintain shield integrity, metal connector hoods should be used, preferably at both ends. These hoods make contact with the connector shell and the cable screen so maintaining an overall shield.

3.2.2 USB485 Ground Connections

Reference Ground is internally connected to the PC USB signal ground that is not normally required for the differential operation of RS-422/485 line pairs. This pin may be left unconnected.

Connector Shell is internally connected to the PC USB chassis ground. To maintain shield integrity, metal connector hoods should be used, preferably at both ends. These hoods make contact with the connector shell and the cable screen so maintaining an overall shield.

3.2.3 USB485i Ground Connections

Reference Ground is internally connected to the isolated signal ground that must be connected to the signal ground of the remote RS-422/485 device. Any voltage appearing between this reference ground and the host PC USB ground is common mode and must not exceed 250 V peak. The internal resistance between these grounds is 1 MΩ.

Connector Shell is not connected. To maintain shield integrity, a metal connector hood should be used which must be connected to the cable screen at the remote device.

3.3 Choice of Cable

As speeds and distances of communication increase the choice of cable over which the communication is to take place becomes critical.

Belden Cable, part no. 8132 is recommended for use in long distance high speed RS422 & RS485 networks.

This is multi-shielded twisted pair cable. It has a capacitance of 20pF/m and characteristic impedance of 120 ohms.
In order to maintain compliance with the EMC directive, 89/336/EEC, it is mandatory that the final system integrator uses good quality screened cables for external connections. It is up to the final system integrator to ensure that compliance with the Directive is maintained. Please contact Technical Support (paragraph 1.4.2) for further information.

4 PROGRAMMING

The USB232/485 interfaces are supplied with Windows 98, ME, 2000, XP and Linux specific drivers. Programming for use under other operating systems is beyond the scope of this manual.

4.1 Programming with Windows 98, ME, 2000 and XP Device drivers.

Application programmers writing programs to run under these operating systems will simply treat the port as a standard COM port. All Programs written to run under these operating systems will be able to use the advanced features of the device.

4.2 Half Duplex Transmission Turnaround

In a multiple RS-485 transmitter installation, the application program controls the data communication turnaround and the selection of the bus 'talker'. Two common ways of providing program control are the 'Master/Slave' and 'Token Ring' methods. The 'Master/Slave' method designates one device on the network as Master, and this device supervises all transmissions by communicating with each of the Slaves in turn and offering it a transmission slot. In token ring operation, each device knows its ID neighbour and only talks directly to this next device. Thus communication only occurs between adjacent pairs of devices and this makes for a flexible network but can be a more difficult method to implement.

In half duplex mode the RS485 transmit buffer is enabled automatically, by the FT8U232AM UART, whenever data is waiting to be sent in the UART Transmit buffer. This feature makes efficient multi-drop communication simple to implement by removing the burden of the Transmit buffer enable control from the software. Programmers may find this feature useful when trying to implement multi-drop systems using Application software that does not support control of the transmitter. The port can simply be configured as a Half-Duplex port using jumpers. The application software will then treat the port as it would any other. Transmit buffer enabling and disabling will then take place automatically.

Appendix A - TECHNICAL SPECIFICATIONS

Figures given in the specification are typical at 25° C, except where otherwise stated.

A.1 HARDWARE SPECIFICATION

There are three interfaces available in the range:

USB232	Communications	RS-232
	I/O Connector	9 way male D
USB485	Communications	RS-485
	I/O Connector	9 way male D
USB485i	Communications	Isolated RS-485
	I/O Connector	9 way male D

A.1.1 USB

A.1.1.1 Series B connector

4 way series B connector, Pinout to USB 1.1 input/output standard. The connector shell is connected to the USB chassis ground.

A.1.1.2 Power (VBus)

	Min	Typ	Max
High power port(V)	4.75		5.25
Low power port(V)	4.40		5.25

A.1.1.3 Input Levels

	Min	Typ	Max
High driven(V)	2.00		
High floating (V)	2.7		3.6
Low(V)			0.8
Differential input sensitivity(V)	0.2		
Differential common mode range(V)	0.8		2.5

A.1.1.4 Output Levels

	Min	Typ	Max
High driven(V)	2.8		3.6
Low(V)	0.0		0.3
Output signal crossover(V)	1.3		2.0

A.1.2 USB232 RS-232 Port

A.1.2.1 9 way Connector

9 way, male D connector with metal shell. Pinouts to IBM input/output standard. The connector shell is connected to the local PC chassis ground.

A.1.2.2 Configuration

USB232 ports is configured as Data Terminal Equipment (DTE)

A.1.2.3 Rx Voltage Levels

RS-232 receivers - RXD, DCD, DSR, CTS and RI

	Min	Typ	Max
Input threshold low (V)	0.8	1.3	
Input threshold high (V)		1.7	2.4
Input hysteresis (V)	0.1	0.4	1.0
Input resistance (kΩ)	3	5	7

A.1.2.4 Tx Voltage Levels

RS-232 drivers - TxD, DTR and RTS

		Min	Typ	Max
Output voltage swing (Loaded 3 kΩ to Gnd)	Pos (V)	+5.0	+7.3	
	Neg (V)		–6.5	–5.0
Output short circuit current (mA)			±17	

A.1.2.5 Data Rate

The port is capable of error free transmission at data rates up to 920 k Baud.

A.1.2.6 I/O Protection

Driver outputs and receiver inputs can be shorted beyond the RS-232 fault limits to ±30 V without damage.

A.1.2.7 ESD Protection

The RS-232 line input/outputs have on-chip protection from ESD transients up to ±8 kV for human body model discharges.

A.1.3 USB485 and USB485i RS-422/485 Port

A.1.3.1 9 way Connector

9 way, male D connector with metal shell. For the isolated versions, all signals are referred to the remote device signal ground.

A.1.3.2 Rx Voltage Levels

RS-422/485 receiver - RXD

	Min	Typ	Max
Differential threshold voltage (V) (–7 ≤ Vcm ≤ 12 V)	–0.2		0.2
Receiver input hysteresis (mV) (Vcm = 0 V)		70	
Receiver input resistance (kΩ) (–7 ≤ Vcm ≤ 12 V)		12	

A.1.3.3 Rx I/P Termination

120 Ω resistor across differential input terminals of both Rx Data and CTS receivers. For multi-drop applications, the Rx data line termination resistor can be disconnected by removing a jumper.

A.1.3.4 Tx Voltage Levels

RS-422/485 driver - TXD

		Min	Typ	Max
Differential driver output (no load)				5 V
Differential driver output (with load)	Load = 50 Ω (RS-422)	2 V		5 V
	Load = 27 Ω (RS-485)	1.5 V		5 V
Driver common mode output voltage			3 V	
Differential output load resistance				27 Ω

A.1.3.5 Tx O/P Protection

Excessive output current and power dissipation caused by faults or bus contention are prevented by two mechanisms. A fold-back current limit provides immediate protection against short circuits and thermal protection forces the driver into a high impedance state if the die temperature exceeds the limits.

A.1.3.6 I/O Isolation

For the isolated versions, each RS-485 interface is electrically isolated, with no common connections to the other port. Signal isolation is by opto-couplers on the data lines and power to the drivers/receivers is supplied through an isolated DC-DC converter.

Isolation specifications measured between Reference Signal Ground of the external device and Chassis Ground of the USB are:

Maximum test voltage	±400 Vpk
Maximum user applied voltage (Short duration)	±250 Vpk
Maximum user applied voltage DC (Sustained)	±75 VDC
Maximum user applied voltage AC (Sustained)	50 VAC
Typical on-board common mode Impedance	1 MΩ in parallel with 1 nF

A.1.3.7 ESD Protection

The RS-422/485 line input/outputs have on-chip protection from ESD transients up to ±8 kV for human body model discharges.

A.1.3.8 Modes

Full Duplex, Half Duplex, Multi-drop, Broadcast. The mode of operation is jumper selectable see 2.3.1.1 and 2.3.1.2.

A.1.3.9 Transmit Turnaround

Transmission turn around is internal to the device. When in half duplex mode, the transmitter is automatically enabled when there is data to transmit.

A.1.4 UART

One FDTI FT8U232AM USB UltraBaud Data Transfer IC.

A.1.4.1 Baud Rates

All standard rates from 50 baud to 1.5Mbaud can be generated.

A.1.4.2 Data Bits

Programmable 5, 6, 7 or 8.

A.1.4.3 Stop Bits

Programmable 1 or 2.

A.1.4.4 Parity

Programmable Even, Odd or None.

A.1.5 PC INTERFACE

A.1.5.1 Compatibility

USB Bus revision 1.1 compatible.

A.1.5.2 Host resources

Fully plug and play configurable.

A.1.5.3 USB Frame Rate

1 millisecond.

A.1.5.4 USB packet size

64 bytes.

A.2 SOFTWARE

The distribution software is supplied on a CD-ROM.

Windows 98, ME, 2000 and XP Driver Software provides Application level access to all the advanced features of the device from these operating systems.

A.3 ENVIRONMENTAL CONDITIONS

A.3.1 Specific conditions

A.3.1.1 Dimensions

Length	87 mm plus edge connectors.
Width	43 mm.
Height	26 mm.

A.3.1.2 Temperature Range

Operating	0° C to +50° C.
Storage	–20 to +60° C.

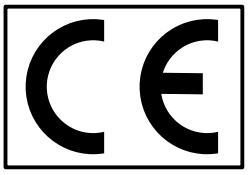
A.3.1.3 Power Requirements

+5 VDC from USB. Current required is less than one load unit, < 100 mA.

A.3.1.4 Dissipation

Each device will dissipate less than 0.5 Watts of heat.

A.3.1.5 Electro Magnetic Compatibility



(89/336/EEC)
Electro-Magnetic Compatibility

All devices in the USB232/485 Series comply with the European directive 89/336/EEC.