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## **MODEL USB-FLEXCOM4**

# **USB to Four RS-232/422/485 Serial Ports and MODEL USB-COM232-4A USB to Four RS-232 Serial Ports**

## **USER MANUAL**

FILE: MUSB-FLEXCOM4.B1f

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## Chapter 1: Introduction

This flexible serial communications adapter was designed for effective multipoint transmission in any one of three modes on each channel. These modes are RS232, RS422 and RS485 (EIA485) protocol.

### Features

- Four-port serial communications adapter for USB 1.1 and USB 2.0 host ports
- Supports field selectable RS-232, RS-422 or RS-485 protocols, per port
- Includes type FT232BM UART with 384-byte receive/128-byte transmit FIFO buffers
- Speeds up to 921.6kbps simultaneously
- Power LED and individual port activity LEDs visible next to the USB and each COM connector
- All required power drawn from USB port, no external power adapter required
- Compact, low profile enclosure

### Applications

Multiple peripherals such as POS, barcode scanners, scales, date-entry terminals, data acquisition modules, and automation equipment will benefit from the small size, low cost, reliability and simplicity of this product.

### Functional Description

#### RS422 Balanced Mode Operation

The board supports RS422 communications and uses differential balanced drivers for long range and noise immunity. The board also has the capability to add load resistors to terminate the communications lines. RS422 communications requires that a transmitter supply a bias voltage to ensure a known "zero" state. Also, receiver inputs at each end of the network should be terminated to eliminate "ringing". The board supports biasing by default and supports termination by jumpers on the card. If your application requires the transmitter to be un-biased, please call us.

#### RS485 Balanced Mode Operation

The board supports RS485 communications and uses differential balanced drivers for long range and noise immunity. RS485 operation involves switchable transceivers and the ability to support multiple devices on a single "party line". The RS485 specification defines a maximum of 32 devices on a single line. The number of devices served on a single line can be expanded by use of "repeaters".

This board also has the capability to add load resistors to terminate the communications lines. RS485 communications requires that one transmitter supply a bias voltage to ensure a known "zero" state when all transmitters are off. Also, receiver inputs at each end of the network should be terminated to eliminate "ringing". The card supports biasing by default and supports termination by jumpers on the card. If your application requires the transmitter to be un-biased, please call us.

## COM Port Compatibility

The FT232BM UARTs are used as Asynchronous Communication Elements (ACE). These include 128-byte transmit & 384-byte receive buffers to protect against lost data in multitasking operating systems, while maintaining 100 percent compatibility with the original IBM serial port. The system assigns the COM numbers automatically.

The driver/receiver used (SP491 in non-RS232 modes) is capable of driving extremely long communication lines at high baud rates. It can drive up to +60 mA on balanced lines and receive inputs as low as 200 mV differential signal superimposed on common mode noise of +12 V to -7 V. In case of communication conflict, the driver/receivers feature thermal shutdown.

The driver/receiver used in RS232 mode is the ICL3243.

## Communication Mode

The board supports Half-Duplex communications with a 2-wire cable connection. Half-Duplex allows traffic to travel in both directions, but only one way at a time. RS485 communications commonly use the Half-Duplex mode since they share only a single pair of wires.

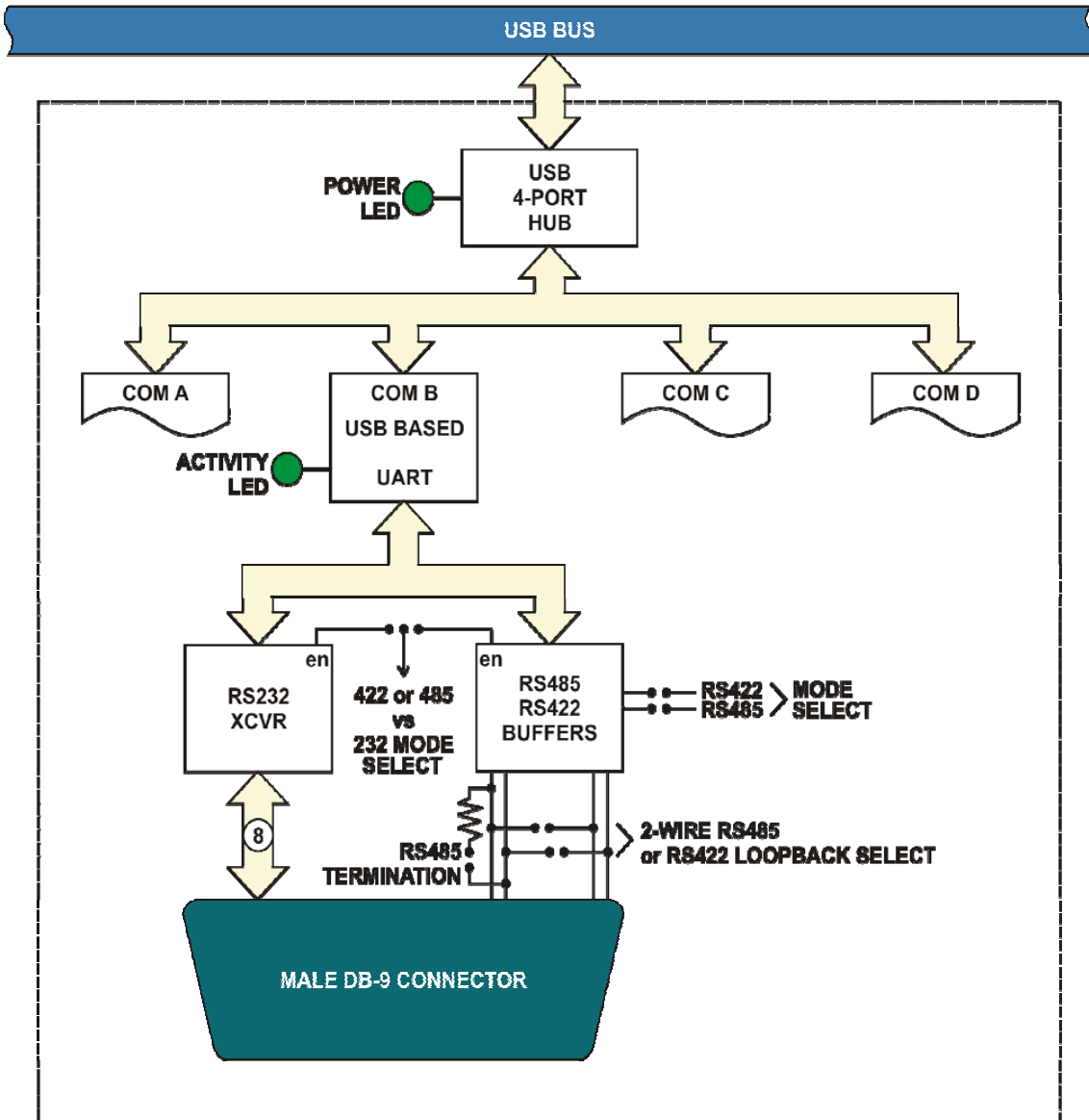


Figure 1-1: Block Diagram (Only one full serial channel shown)

### Baud Rates

Baud rates up to 921.6kbps are supported in RS-422 and RS-485 modes while RS-232 has a limit of 230.4kbps.

## Ordering Guide

USB-FLEXCOM4	USB to four port RS-232/422/485 serial adapter
USB-COM232-4A	USB to four port RS-232 serial adapter

## Model Options

- -OEM Board only version with no enclosure
- -HDR 10-pin male headers onboard instead of DB9 connectors (only available on OEM version)
- -DIN DIN rail mounting bracket for integrating into legacy and industrial environments
- -RoHS This product is available in a RoHS compliant version. Please call for specific pricing then be sure to add this suffix to the model number on any hard-copy or verbal purchase orders.

## Special Order

Custom baud rates are achievable by using a different crystal oscillator. Contact factory with your requirement. Other examples of special orders would be conformal coating, un-biased transmitter lines, etc.

## Included with your board

The following components are included with your shipment, depending on options ordered. Please take the time now to ensure that no items are damaged or missing.

- USB Module in labeled enclosure with an anti-skid bottom
- 6' USB 2.0 cable
- Software Master CD
- USB I/O Quick-Start Guide

## Optional Accessories

- C104-10F-12 Ribbon Cable Assembly, 12" with 10 pin female headers on each end
- STB-10 Screw Terminal Board, 10 pin male header
- DIN-SNAP6 DIN-rail mounting for one STB-10
- ADAP9 Screw Terminal Adaptor board with a Male DB9 connector and 9 screw terminals



**Figure 1-2:** ADAP9 Screw Terminal Accessory



## Chapter 2: Installation

A printed USB I/O Quickstart Guide is normally included and packed with your hardware for shipment. It provides all the straight-forward steps necessary to complete your software and hardware installation.

### Software CD Installation

The software provided with this board is contained on one CD and **must be installed onto your hard disk prior to use**. To do this, perform the following steps as appropriate for your operating system. Substitute the appropriate drive letter for your drive where you see d: in the examples below.

#### WIN98/Me/2000/XP/2003

1. Place the CD into your CD-ROM drive.
2. The install program should automatically run. If not click START | RUN and type `D:\INSTALL`, click OK or press `Enter`.
3. Follow the on-screen prompts to install the software for this board.
4. Leave the CD in the drive as it may be needed for driver installation once you plug the hardware into the USB port.

### Installing the Adapter

Before installing the adapter, carefully read the OPTION SELECTION section of this manual and configure the adapter according to your requirements. In Windows, the SETUP.EXE program will lead you through the process of setting the options on the board. The setup program does not set the options. These must be set manually by jumpers on the board, within the case of the adapter.

#### To Install the Adapter

1. Remove the four screws on the sides of the enclosure. Slide the lid to one side then pull the side of the lid out to clear the DB9 connectors. Once cleared, pull the cleared side of the lid upward to remove it.
2. Print the Option Selection Map to make notes on. Determine what protocol each port (A-D) will communicate in (RS232, RS422 or RS485 etc.). Record these details on your printout.
3. Install jumpers for each port following either the Option Selection section of this manual or the suggestions of the SETUP.EXE software program.
4. Re-install the lid and four screws.
5. Plug the USB cable into the device and the USB port then follow the new hardware wizard to complete driver installation.

## Chapter 3: Hardware Details

### Option Selection

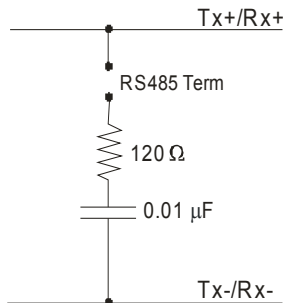
To help you locate the jumpers described in this section, refer to the Option Selection Map at the end of this section. Operation of the serial communications is determined by jumper installation as described in the following paragraphs. For the convenience of the user, the jumpers are clearly labeled as follows:



**Figure 3-1:** Jumper Labels

### Terminations

A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the locations labeled TERM applies a 120Ω load across the receive input for RS-422 and the transmit/receive input/output for RS485 operation.

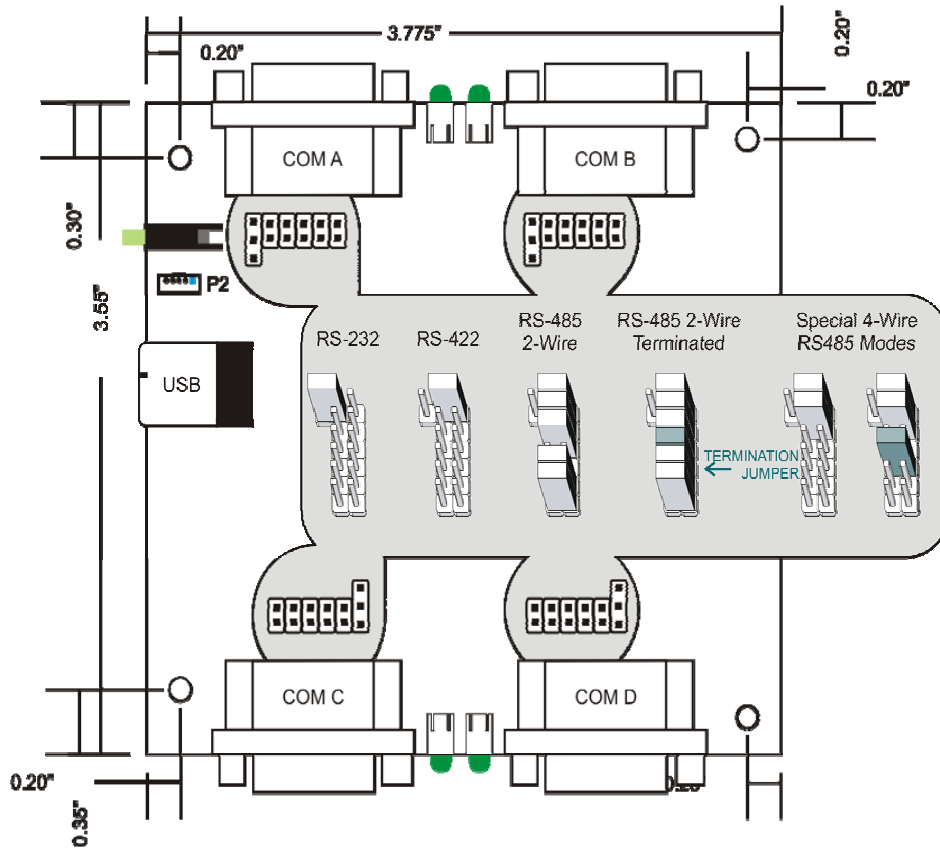


**Figure 3-2:** Simplified Termination Schematic

In RS485 operations where there are typically multiple terminals, only the RS485 devices at each end of the network (the serial COM port at one end and an RS-485 device at the other end) should have terminating impedance as described above. Refer to Appendix A: Application Considerations for further explanations and diagrams of typical RS-485 networks.

To terminate the COM A port, place a jumper at the location labeled TERM in the jumper cluster near J1. To terminate the COM B, COM C or COM D ports, place jumpers at locations labeled TERM near J2 (COM B), J3 (COM C) or J4 (COM D) respectively.

Also, for RS485 operation, there must be a bias on the TRX+ and TRX- lines which this adapter provides. If the adapter is not to provide that bias, contact the factory for technical support.



**Figure 3-3: Option Selection Map**

The board has 4 separate channels which are individually configured. Each channel can be used in one of four modes. Install jumpers referring to the Option Selection Map above for guidance.

- 1) RS232 - Install the 2-position jumper in the 232 position.
- 2) RS422 - Install the 2-position jumper in the 422/485 position.
- 3) RS485 (4 wire) – It is assumed that this unit will function as the “Master” in 4-wire RS485 mode. In this case configure the jumpers for RS422. It is also possible to use it as a “Slave”. In this case, install the 2-position jumper in the 422/485 position and install the 485TX jumper.
- 4) RS485 (2 wire) - Install the 2-position jumper in the 422/485 position, install the 485TX and 485RX jumpers, and install both the TxRx+ jumper and the TxRx- jumper.
- 5) To provide a termination load for RS422 or RS485, install the TERM jumper for that channel.

**Note:** Any unneeded jumpers that are installed can cause the adapter to function incorrectly.

### Default Shipping Configuration

This communications adapter ships with each port configured for RS485 two-wire mode. If you need to communicate in any other of the supported modes, you’ll need to remove the lid and configure the jumpers for that port.

### Connectors and Indicator Functions

<b>USB Connector</b>	Type B, high-retention design
<b>Embedded USB Connector</b>	Mini 5-pin header in parallel with type B connector
<b>LED near USB connector</b>	Indicates power and activity
<b>LEDs and DB9 Connectors</b>	COM activity indicator next to each COM port connector

## Chapter 4: USB Address Information

Use the provided driver to access the USB board. This driver will allow you to determine how many supported USB devices are currently installed, and each device's type.

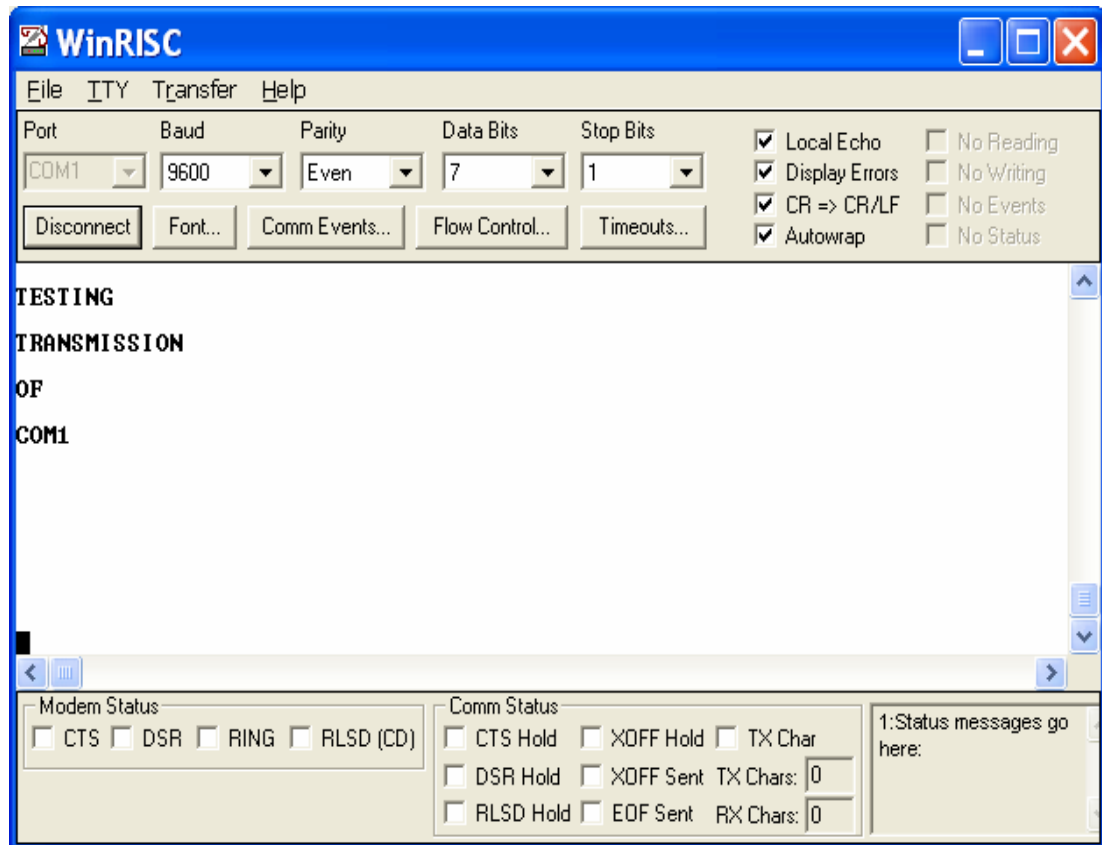
### Address Map

The core of the UART function is supplied by the FTDI FT232BM chip.

## Chapter 5: Programming

### Sample Programs

There are sample programs provided with the board in several Windows languages. Windows samples are located in the WIN32 directory.



**Figure 5-1:** WinRISC Windows Terminal Program Screen Shot

### Windows Programming

The board installs into Windows as COM ports. Thus the Windows standard API functions can be used. In particular:

- ▶ CreateFile() and CloseHandle() for opening and closing a port.
- ▶ SetupComm(), SetCommTimeouts(), GetCommState(), and SetCommState() to set and change a port's settings.
- ▶ ReadFile() and WriteFile() for accessing a port.

See the documentation for your chosen programming language for details.

## Chapter 6: Connector Pin Assignments

### Input/Output Connections

The Serial Communications board uses four individual DB9 connectors. The –OEM version is available with an option for 10-pin headers as the –HDR. The second table lists pin connections for the –HDR version.

Proper EMI cabling techniques include using shielded twisted-pair wiring for the input/output wiring. Anywhere there is no signal listed means “make no connection”.

DB-9 Male Pin for each of Ch A-D	RS-232 Signals (Industry Standard)	RS-485 Signals (2 Wire)	RS-422 Signals (Also 4wire RS485)
Ch x - 1	DCD		RX-
Ch x - 2	RX	TX+/RX+	TX+
Ch x - 3	TX	TX-/RX-	TX-
Ch x - 4	DTR		
Ch x - 5	Gnd	Gnd	Gnd
Ch x - 6	DSR		
Ch x - 7	RTS		
Ch x - 8	CTS		
Ch x - 9	RI		RX+

**Table 6-1:** DB9M Connector Pin Assignments

10-Pin header for each of Ch A-D	RS-232 Signals (Industry Standard)	RS-485 Signals (2 Wire)	RS-422 Signals (Also 4wire RS485)
Ch x - 1	DCD		RX-
Ch x - 3	RX	TX+/RX+	TX+
Ch x - 5	TX	TX-/RX-	TX-
Ch x - 7	DTR		
Ch x - 9	Gnd	Gnd	Gnd
Ch x - 2	DSR		
Ch x - 4	RTS		
Ch x - 6	CTS		
Ch x - 8	RI		RX+
Ch x - 10			

**Table 6-2:** 10-Pin Header Connector Pin Assignments

## Chapter 7: Specifications

### Communications Interface

- Serial Ports: COM A through COM D via four male DB9 connectors
- Character length: 5, 6, 7, or 8 bits
- Parity: Even, odd or none
- Stop Interval: 1, 1.5, or 2 bits
- Serial Data Rates: Up to 921.6k for RS-422 and RS-485 modes, asynchronous  
RS-232 speeds up to 230.4kbps.
- Receiver Input Sensitivity: +200 mV, differential input
- Common Mode Rejection: +12V to -7V
- Transmitter Output Drive: Up to 60 mA, with thermal shutdown

### Bus Type

- USB Connector: Type B, high-retention
- Embedded USB Connector 5-pin header, Molex part number 53047  
Mating connector housing is Molex part number 51021 0500

### Environmental

- Operating Temperature: 0 °C. to +60 °C
- Storage temperature: -50 °C. to +120 °C
- Humidity: 5% to 95%, non-condensing
- Power Required: 5VDC at approximately 110 mA (plus loads up to an additional 240 mA) from USB bus
- Size: Board Dimension: 3.550 x 3.775 inches (PC/104 size & mounting)  
Box Dimension: 4.00 x 4.00 x 1.25 inches

## Appendix A: Application Considerations

### Introduction

Working with RS422 and RS485 devices is not much different from working with standard RS232 serial devices and these two standards overcome deficiencies in the RS232 standard. First, the cable length between two RS232 devices must be short; less than 50 feet at 9600 baud. Second, many RS232 errors are the result of noise induced on the cables. The RS422 and RS485 standards permit cabling up to 5000 feet and since it operates in differential mode, is more immune to induced noise.

Connections between two RS422 devices (with CTS ignored) should be as follows:

Device #1		Device #2	
Signal	Pin No.	Signal	Pin No.
Gnd	5	Gnd	5
TX <sup>+</sup>	2	RX <sup>+</sup>	9
TX <sup>-</sup>	3	RX <sup>-</sup>	1
RX <sup>+</sup>	9	TX <sup>+</sup>	2
RX <sup>-</sup>	1	TX <sup>-</sup>	3

**Table A-1:** Connections Between Two RS422 Devices

A third deficiency of RS232 is that more than two devices cannot share the same cable. This is also true for RS422 but RS485 offers all the benefits of RS422 plus allows up to 32 devices to share the same twisted pairs. An exception to the foregoing is that multiple RS422 devices can share a single cable if only one will talk and the others will all receive.

SERIAL PORT CONNECTOR		CABLE TO RS-485 DEVICE	
Signal	Pin No.	Signal	Pin No.
Tx/Rx+	2	Tx/Rx +	2
Tx/Rx -	3	Tx/Rx -	3
100 Ω to Ground	5	100 Ω to Ground	5

**Table A-2:** RS485 Data Cable Wiring

### Balanced Differential Signals

The reason that RS422 and RS485 devices can drive longer lines with more noise immunity than RS232 devices is that a balanced differential drive method is used. In a balanced differential system, the voltage produced by the driver appears across a pair of wires. A balanced line driver will produce a differential voltage from +2 to +6 volts across its output terminals. A balanced line driver can also have an input "enable" signal that connects the driver to its output terminals. If the "enable" signal is



OFF, the driver is disconnected from the transmission line. This disconnected or disabled condition is usually referred to as the "tristate" condition and represents a high impedance. RS485 drivers must have this control capability. RS422 drivers may have this control but it is not always required.

A balanced differential line receiver senses the voltage state of the transmission line across the two signal input lines. If the differential input voltage is greater than +200 mV, the receiver will provide a specific logic state on its output. If the differential voltage input is less than -200 mV, the receiver will provide the opposite logic state on its output. A maximum operating voltage range is from +6V to -6V allows for voltage attenuation that can occur on long transmission cables.

A maximum common mode voltage rating of +7V provides good noise immunity from voltages induced on twisted pair lines. A signal ground connection is necessary to keep common mode voltage within that range. The circuit may operate without the ground connection but may not be reliable.

Parameter	Conditions	Min.	Max.
Driver Output Voltage (unloaded)		4V	6V
		-4V	-6V
Driver Output Voltage (loaded)	TERM jumper in	2V	
		-2V	
Driver Output Resistance			50Ω
Driver Output Short-Circuit Current			+150 mA
Driver Output Rise Time			10% unit interval
Receiver Sensitivity			+200 mV
Receiver Common Mode Voltage Range			+7V
Receiver Input Resistance			4KΩ

**Table A-2:** RS422/485 Specification Summary

To prevent signal reflections in the cable and to improve noise rejection in both the RS422 and RS485 mode, the receiver end of the cable should be terminated with a resistance equal to the characteristic impedance of the cable. (An exception to this is the case where the line is driven by an RS422 driver that is never "tristated" or disconnected from the line. In this case, the driver provides a low internal impedance that terminates the line at that end.)

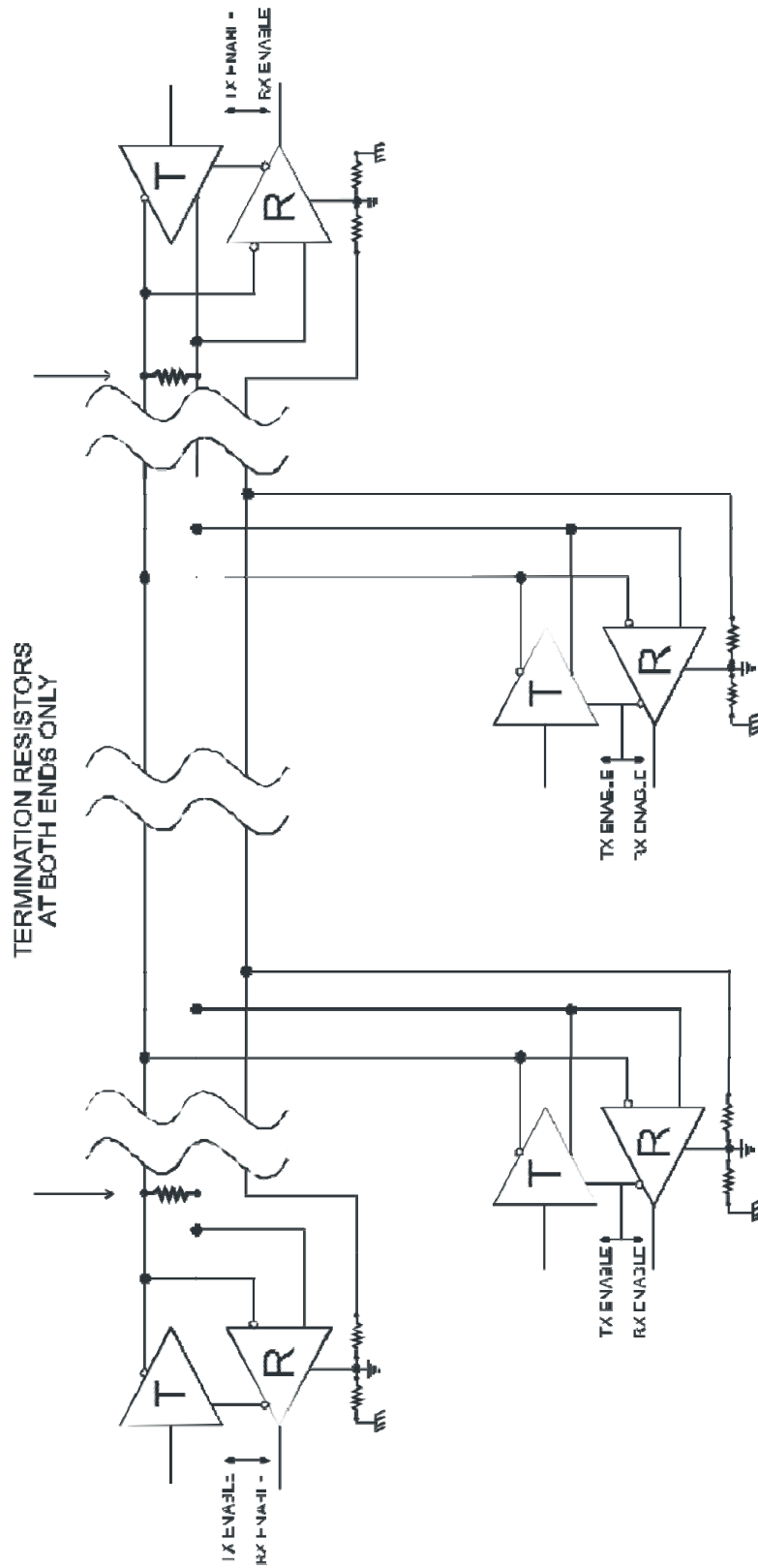
**Note**

You do not have to add a terminator resistor to your cables when you use the adapter. Termination resistors for the RX+ and RX- lines are provided on the card and are placed in the circuit when you install the RS 485 jumpers. (See the Option Selection section of this manual.)

**RS485 Data Transmission**

The RS485 Standard allows a balanced transmission line to be shared in a party-line mode. As many as 32 driver/receiver pairs can share a two-wire party line network. Many characteristics of the drivers and receivers are the same as in the RS422 Standard. One difference is that the common mode voltage limit is extended and is +12V to -7V. Since any driver can be disconnected (or tristated) from the line, it must withstand this common mode voltage range while in the tristate condition.

The following illustration shows a typical multidrop or party line network. Note that the transmission line is terminated on both ends of the line but not at drop points in the middle of the line.



**Figure A-1:** Typical RS485 Two-Wire Multidrop Network

## **RS485 Four-Wire Multidrop Network**

An RS485 network can also be connected in a four-wire mode. In a four-wire network it's necessary that one node be a master node and all others be slaves. The network is connected so that the master transmits to all slaves and all slaves transmit to the master. This has advantages in equipment that uses mixed protocol communications. Since the slave nodes never listen to another slave's response to the master, a slave node cannot reply incorrectly.

## Customer Comments

If you experience any problems with this manual or just want to give us some feedback, please email us at: ***manuals@acesio.com***. Please detail any errors you find and include your mailing address so that we can send you any manual updates.

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