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MODEL PCI-COM-1S

USER MANUAL

FILE: MPCI-COM-1S.Ca

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Chapter 1: Introduction

This Serial Communications Card was designed for use in PCI-Bus computers and provides effective communication in either RS422 (EIA422) or RS485 (EIA485) over long communication lines. The card is 4.80 inches long (122 mm) and may be installed in any 5-volt PCI slot in IBM or compatible computers. A type 16550 buffered UART is used and, for Windows compatibility, automatic control is included to transparently enable/disable the transmission drivers.

Balanced Mode Operation and Load Termination

In RS422 mode, the card uses differential (or balanced) line drivers for noise immunity and to increase the maximum distance to 4000 feet. The RS485 mode improves on RS422 with switchable transceivers and the ability to support multiple devices on a single “party line”. The number of devices served on a single line can be expanded by using “repeaters”.

RS422 operation permits multiple receivers on the communications lines and RS485 operation permits up to 32 transmitters and receivers on the same set of data lines. Devices at the ends of these networks should be terminated to avoid “ringing”. The user has the option to terminate the transmitter and/or the receiver lines.

RS485 communications requires that a transmitter supply a bias voltage to ensure a known “zero” state when no device is transmitting. This card supports biasing by default. If your application requires the transmitter to be un-biased, please contact the factory.

COM Port Compatibility

A 16550 UART is used as the Asynchronous Communication Element (ACE). It includes 16-byte transmit/receive FIFO buffers to protect against lost data in multitasking operating systems, while maintaining 100 percent compatibility with the original IBM serial port. PCI bus architecture allows addresses between 0000 and FFF8 hex to be assigned to the cards.

The crystal oscillator on the card permits precise selection of baud rates up to 115,200 or, by changing a jumper, up to 460,800 baud with the standard crystal oscillator. Baud rate is program selected and rates available are listed in a table in the Programming section of this manual.

The driver/receiver used, the 75ALS176, 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 or -7 V. In case of communication conflict, the driver/receivers feature thermal shutdown.

Communication Modes

The cards support Simplex, Half-Duplex, and Full-Duplex communications in a variety of two and four-wire cable connections. Simplex is the simplest form of communications with transmission occurring only in one direction. Half-Duplex allows traffic to travel in both directions, but only one way at a time. In Full-Duplex operation, data travels in both directions at the same time. Most RS485 communications use the Half-Duplex mode because only a single pair of wires need to be used and installation costs are dramatically reduced.

Auto-RTS Transceiver Control

In Windows applications the driver must be enabled and disabled as needed, allowing all cards to share a two-wire or four-wire cable. This card controls the driver automatically. With automatic control, the driver is enabled when data are ready to be transmitted. The driver remains enabled for the transmission time of one additional character after data transfer is complete and then is disabled. The receiver is normally enabled but is disabled during transmission and then re-enabled after transmission is completed. The card automatically adjusts its timing to the baud rate of the data.

Specifications

Communications Interface

- I/O Connection: Shielded male D-sub 9-pin IBM AT style connector compatible with RS422 and RS485 specifications.
- 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 115,200 baud, Asynchronous. Faster rates, up to 460,800 baud, are achieved by jumper selection on the card. Type 16550 buffered UART.

RS422/RS485 Differential Communication Mode

- Receiver Input Sensitivity: +200 mV, differential input.
- Common Mode Rejection: +12V to -7V
- Drive Capability: 60 mA transmit output with thermal shutdown.
- Multipoint: Compatible with RS422 and RS485 specifications.

Note

Up to 32 drivers and receivers allowed on line. Serial communications ACE used is type 16550. Driver/Receivers used are type 75ALS176.

Environmental

- Operating Temperature Range: 0 to +60 °C
- Humidity: 5% to 95%, non-condensing.
- Storage Temperature Range: -50 to +120 °C
- Size: 4.80" long (122mm) by 1.80" high (46 mm).
- Power Required: +5VDC at 175 mA typical

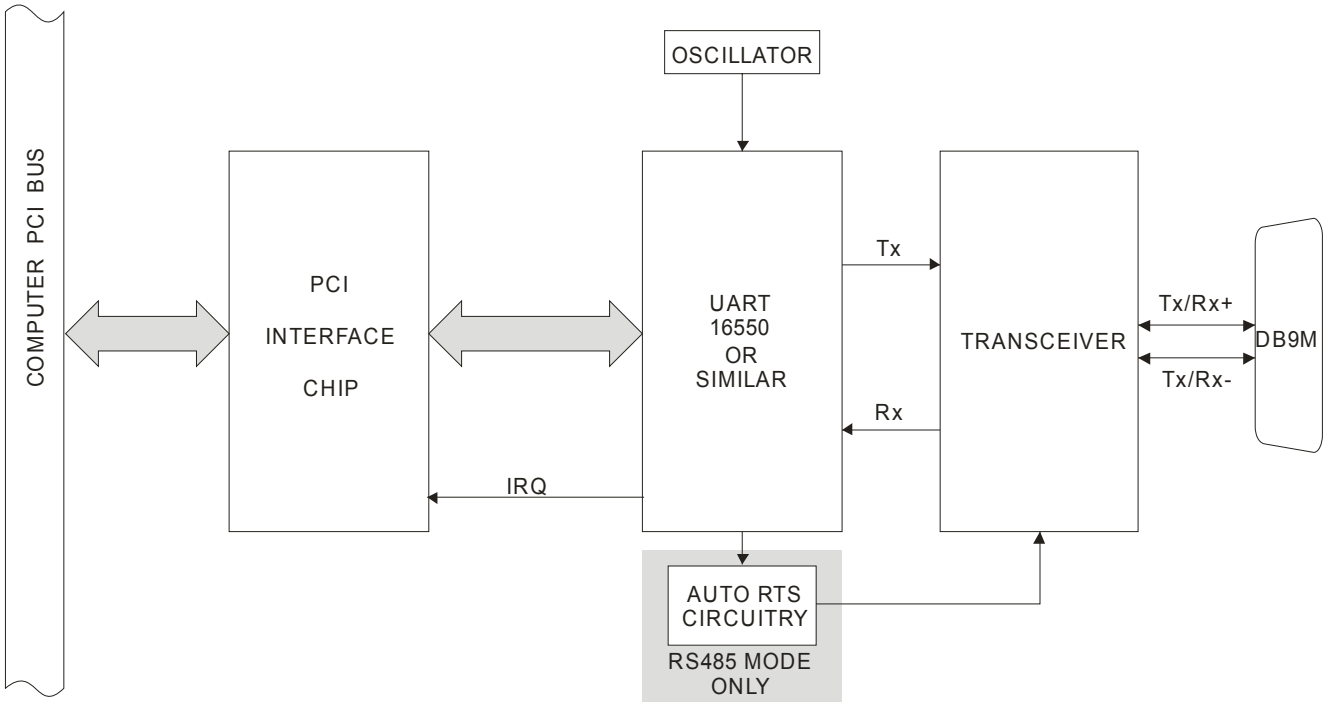


Figure 1-1: Block Diagram

Chapter 2: Installation

A printed Quick-Start Guide (QSG) is packed with the card for your convenience. If you've already performed the steps from the QSG, you may find this chapter to be redundant and may skip forward to begin developing your application.

The software provided with this card is on 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.

Configure Card Options via Jumper Selection
Before installing the card into your computer, carefully read Chapter 3: Option Selection of this manual, then configure the card according to your requirements and protocol (RS-232, RS-422, RS-485, 4-wire 485, etc.). Our Windows based setup program can be used in conjunction with Chapter 3 to assist in configuring jumpers on the card, as well as provide additional descriptions for usage of the various card options (such as termination, bias, baud rate range, RS-232, RS-422, RS-485, etc.).

CD Software Installation

The following instructions assume the CD-ROM drive is drive "D". Please substitute the appropriate drive letter for your system as necessary.

DOS
1. Place the CD into your CD-ROM drive.
2. Type D : Enter to change the active drive to the CD-ROM drive.
3. Type I N S T A L L Enter to run the install program.
4. Follow the on-screen prompts to install the software for this board.

WINDOWS
1. Place the CD into your CD-ROM drive.
2. The system should automatically run the install program. If the install program does not run promptly, click START | RUN and type D : I N S T A L L, click OK or press Enter.
3. Follow the on-screen prompts to install the software for this board.

LINUX
1. Please refer to linux.htm on the CD-ROM for information on installing under linux.

Note: COM boards can be installed in virtually any operating system. We do support installation in earlier versions of Windows, and are very likely to support future versions as well.

Caution! * ESD A single static discharge can damage your card and cause premature failure! Please follow all reasonable precautions to prevent a static discharge such as grounding yourself by touching any grounded surface prior to touching the card.

Hardware Installation

1. Make sure to set switches and jumpers from either the Option Selection section of this manual or from the suggestions of SETUP.EXE.
2. Do not install card into the computer until the software has been fully installed.
3. Turn OFF computer power AND unplug AC power from the system.
4. Remove the computer cover.
5. Carefully install the card in an available 5V or 3.3V PCI expansion slot (you may need to remove a backplate first).
6. Inspect for proper fit of the card and tighten screws. Make sure that the card mounting bracket is properly screwed into place and that there is a positive chassis ground.
7. Install an I/O cable onto the card's bracket mounted connector.
8. Replace the computer cover and turn ON the computer. Enter the CMOS setup program of your system and verify that the PCI plug-and-play option is set appropriately for your system. Systems running Windows 95/98/2000/XP/2003 (or any other PNP-compliant operating system) should set the CMOS option to OS. Systems running under DOS, Windows NT, Windows 3.1, or any other non-PNP-compliant operating system should set the PNP CMOS option to BIOS or Motherboard. Save the option and continue booting the system.
9. Most computers should auto-detect the card (depending on the operating system) and automatically finish installing the drivers.
10. Run PCIfind.exe to complete installing the card into the registry (for Windows only) and to determine the assigned resources.
11. Run one of the provided sample programs that was copied to the newly created card directory (from the CD) to test and validate your installation.

Chapter 3: Option Selection

Four configuration options are determined by jumper position as described in the following paragraphs. Locations of the jumpers are shown in Figure 3-1, Option Selection Map.

422/485

This jumper selects either RS422 or RS485 communications mode.

Termination and Bias

A transmission line should be terminated at the receiving end in its characteristic impedance in order to avoid “ringing”. Installing a jumper at the location labeled TERMIN applies a 120Ω load across the input for RS422 mode. Similarly, installing a jumper at the location labeled TERMOUT applies 120Ω across the transmit/receive input/output for RS485 operation.

In RS485 operations, where there are multiple terminals, only the RS485 ports at each end of the network should have terminating resistors as described above. Also, for RS485 operation, there must be a bias on the RX+ and RX- lines. The 422/485 feature provides this bias.

Baud Rate

The x1/x4 jumper selects either the standard 1.8432MHz clock or 7.3728MHz clock for input to the UART. The x4 position provides capability for baud rates up to 460,800 KHz.

Interrupts

The IRQ number is assigned by the system. Use PCIFind.EXE to determine the IRQ that was assigned to the card by the BIOS or Operating System. Alternately, in Windows 95/98/NT the Device Manager can be used. The cardis listed under the Data Acquisition class. Selecting the card, clicking *Properties*, then selecting the *Resources* tab will show the base address and IRQ assigned to the card.

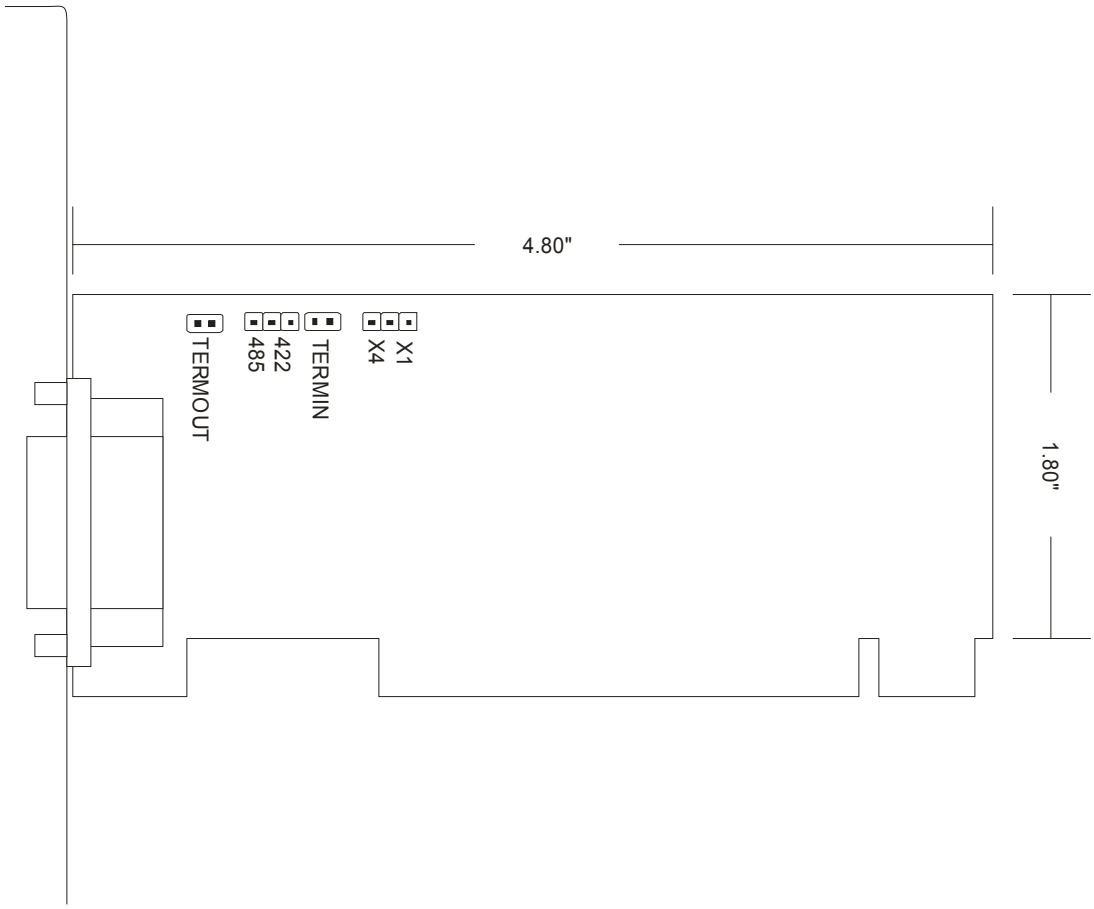


Figure 3-1: Option Selection Map

Chapter 4: Address Selection

The PCI architecture is Plug-and-Play. This means the BIOS or Operating System determines the resources assigned to PCI cards, rather than the user selecting these resources with switches or jumpers. As a result, the card's base address cannot be changed, it can only be determined. It's possible to use the Windows95/98/NT device manager to specify system resources but that method is beyond the scope of this manual.

To determine the base address that has been assigned to the card, run the provided PCIFind.EXE utility program. This utility will display a list of all of the cards detected on the PCI bus, the addresses assigned to each function on each of the cards, and the respective IRQs and DMAs (if any) allotted.

Alternately, some operating systems (Windows 95/98/2000) can be queried to determine which resources were assigned. In these operating systems, you can use either PCIFind or the Device Manager utility from the System Properties Applet of the control panel. These cards are installed in the Data Acquisition class of the Device Manager list. Selecting the card then clicking *Properties*, then selecting the Resources Tab will display a list of the resources allocated to the card.

The PCI bus supports a minimum of 64K of I/O space, your card's address may be located anywhere in the 0400 to FFF8 hex range. PCIFind uses the Vendor ID and the Device ID to search for your card then reads the base address and IRQ assigned. If you want to determine the base address and IRQ assigned, use the following information:

The Vendor ID code for the card is 494F (ASCII for "IO").
The Device ID code for the card is 10C9.

Chapter 5: Programming

Sample Programs

There are sample programs provided with the card in C, Pascal, QuickBASIC, and several Windows languages. DOS samples are located in the DOS directory and Windows samples are located in the WIN32 directory.

Windows Programming

The card 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 language for details.

Under DOS, the process is very different. The remainder of this chapter describes DOS programming.

Initialization

Initializing the chip requires knowledge of the UART's register set. The first step is to set the baud rate divisor. You do this by first setting the DLAB (Divisor Latch Access Bit) high. This bit is Bit 7 at Base Address +3. In C code, the call would be:

```
outportb(BASEADDR +3,0x80);
```

You then load the divisor into Base Address +0 (low byte) and Base Address +1 (high byte). The following equation defines the relationship between baud rate and divisor:

Desired Baud Rate = (UART clock frequency) ÷ (32 * divisor)

When the Baud jumper is in the X1 position, the UART clock frequency is 1.8432 Mhz. When the jumper is in the X4 position, the clock frequency is 7.3728 Mhz. The following table lists popular divisor frequencies. Note that there are two columns to consider depending on the position of the Baud jumper.

Baud Rate	Divisor x1	Divisor x4	Max Diff. Cable Length*
460800	-	1	550 ft
230400	-	2	1400 ft
153600	-	3	2500 ft
115200	1	4	3000 ft
57600	2	8	4000 ft
38400	3	12	4000 ft
28800	4	16	4000 ft
19200	6	24	4000 ft
14400	8	32	4000 ft
9600	12	48 – Most Common	4000 ft
4800	24	96	4000 ft
2400	48	192	4000 ft
1200	96	384	4000 ft

* Recommended maximum distances for differentially driven data cables (RS422 or RS485) are for typical conditions.

Table 5-1: Baud Rate Divisor Values

In C, the code to set the chip to 9600 baud is:

```
outportb(BASEADDR, 0x0C);
outportb(BASEADDR +1,0);
```

The second initializing step is to set the Line Control Register at Base Address + 3. This register defines word length, stop bits, parity, and the DLAB. Bits 0 and 1 control word length and allow word lengths from 5 to 8 bits. Bit settings are extracted by subtracting 5 from the desired word length. Bit 2 determines the number of stop bits. There can be either one or two stop bits. If Bit 2 is set to 0, there will be one stop bit. If Bit 2 is set to 1, there will be two stop bits. Bits 3 through 6 control parity and break enable. They are not commonly used for communications and should be set to zero. Bit 7 is the DLAB discussed earlier. It must be set to zero after the divisor is loaded or else there will be no communication.

The C command to set the UART for an 8-bit word, no parity, and one stop bit is:

```
outportb(BASEADDR +3, 0x03)
```

The final initialization step is to flush the receiver buffers. You do this with two reads from the receiver buffer at Base Address +0. When done, the UART is ready to use.

Reception

Reception can be handled in two ways: polling and interrupt-driven. When polling, reception is accomplished by constantly reading the Line Status Register at Base Address +5. Bit 0 of this register is set high whenever data are ready to be read from the chip. A simple polling loop must continuously check this bit and read in data as it becomes available. The following code fragment implements a polling loop and uses a value of 13, (ASCII Carriage Return) as an end-of-transmission marker:

```
do
{
while (!(inportb(BASEADDR +5) & 1));        /*Wait until data ready*/
data[i++]= inportb(BASEADDR);
}while (data[i]!=13);                       /*Reads the line until null character rec'd*/
```

Interrupt-driven communications should be used whenever possible and is required for high data rates. Writing an interrupt-driven receiver is not much more complex than writing a polled receiver but care should be taken when installing or removing your interrupt handler to avoid writing the wrong interrupt, disabling the wrong interrupt, or turning interrupts off for too long a period.

The handler would first read the Interrupt Identification Register at Base Address +2. If the interrupt is for Received Data Available, the handler then reads the data. If no interrupt is pending, control exits the routine. A sample handler, written in C, is as follows:

```
readback = inportb(BASEADDR +2);
if (readback & 4)                   /*Readback will be set to 4 if data are available*/
data[i++]=inportb(BASEADDR);
outportb(0x20,0x20);                /*Write EOI to 8259 Interrupt Controller*/
return;
```

Transmission

RS485 transmission is simple to implement. The AUTO feature in RS485 mode automatically enables the transmitter when data are ready to send, so no software enabling is required. The following software example is for non-AUTO operation in RS422 mode. First the RTS line should be set high by writing a 1 to Bit 1 of the Modem Control Register at Base Address +4. The RTS line is used to toggle the transceiver from receive mode to transmit mode and vice versa..

After the above is done, the card is ready to send data. To transmit a string of data, the transmitter must first check Bit 5 of the Line Status Register at Base Address +5. That bit is the transmitter-holding-register-empty flag. If it is high, the transmitter has sent the data. The process of checking the bit until it goes high followed by a write is repeated until no data remains. After all data has been transmitted, the RTS bit should be reset by writing a 0 to Bit 1 of the Modem Control Register.

The following C code fragment demonstrates this process:

```
outportb(BASEADDR +4, inportb(BASEADDR +4)|0x02);
                        /*Set RTS bit without altering states of other bits*/
while(data[i]);         /*While there is data to send*/
{
while(!(inportb(BASEADDR +5)&0x20));       /*Wait until transmitter is empty*/
outportb(BASEADDR,data[i]);
i++;
}
outportb(BASEADDR +4, inportb(BASEADDR +4)&0xFD);
                        /*Reset RTS bit without altering states of other bits*/
```

Caution

The OUT2 bit of the UART must be set ‘TRUE’ for proper interrupt driven communication. Legacy software uses this bit to gate interrupts and the card may not communicate if bit 3 of register 4 (Modem Control Register) is not set.

Chapter 6: Connector Pin Assignments

The popular 9-pin D subminiature connector is used for interfacing to communication lines. The connector is equipped with 4-40 threaded standoffs (female screw lock) to provide strain relief.

Pin No.	Assignment
1	Rx^- (Receive Data)
2	Tx^+ (Transmit Data)
3	Tx^- (Transmit Data)
4	
5	GND (Signal Ground)
6	
7	
8	
9	Rx^+ (Receive Data)

Table 6-1: Connector Pin Assignments

Data Cable Wiring

The following table shows pin connections between two devices for Simplex, Half -Duplex and Full-Duplex operations.

Mode	Card 1	Card 2
Simplex, 2-wire, receive only, RS422	Rx+ pin 9	Tx+ pin 2
	Rx- pin 1	Tx- pin 3
Simplex, 2-wire, transmit only, RS422	Tx+ pin 2	Rx+ pin 9
	Tx- pin 3	Rx- pin 1
Half-Duplex, 2-wire, RS485	Tx+ pin 2	Tx+ pin 2
	Tx- pin 3	Tx- pin 3
Full-Duplex, 4-wire, RS422	Tx+ pin 2	Rx+ pin 9
	Tx- pin 3	Rx- pin 1
	Rx+ pin 9	Tx+ pin 2
	Rx- pin 1	Tx- pin 3

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. Second, many RS232 errors are the result of noise induced on the cables. The RS422 standard permits cable lengths up to 5000 feet and, because it operates in differential mode, it is more immune to induced noise.

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

Device #1			**Device #2**		
Signal	9 pin	25 pin	Signal	9 pin	25 pin
Gnd	5	7	Gnd	5	7
TX^+	2	24	RX^+	9	12
TX^-	3	25	RX^-	1	13
RX^+	9	12	TX^+	2	24
RX^-	1	1	TX^-	3	25

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 always receive.

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. The maximum operating voltage range is from +6V to -6V allowing 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 the twisted pair lines. The signal ground line connection is necessary in order to keep the 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	2V	
	jumpers in	-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 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.

Note

You do not have to add a terminator resistor to your cables when you use the card. Termination resistors for the RX^+ and RX^- lines are provided on the card and are placed in the circuit when you install the TERM 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.

RS485 Two-Wire Multidrop Network

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.

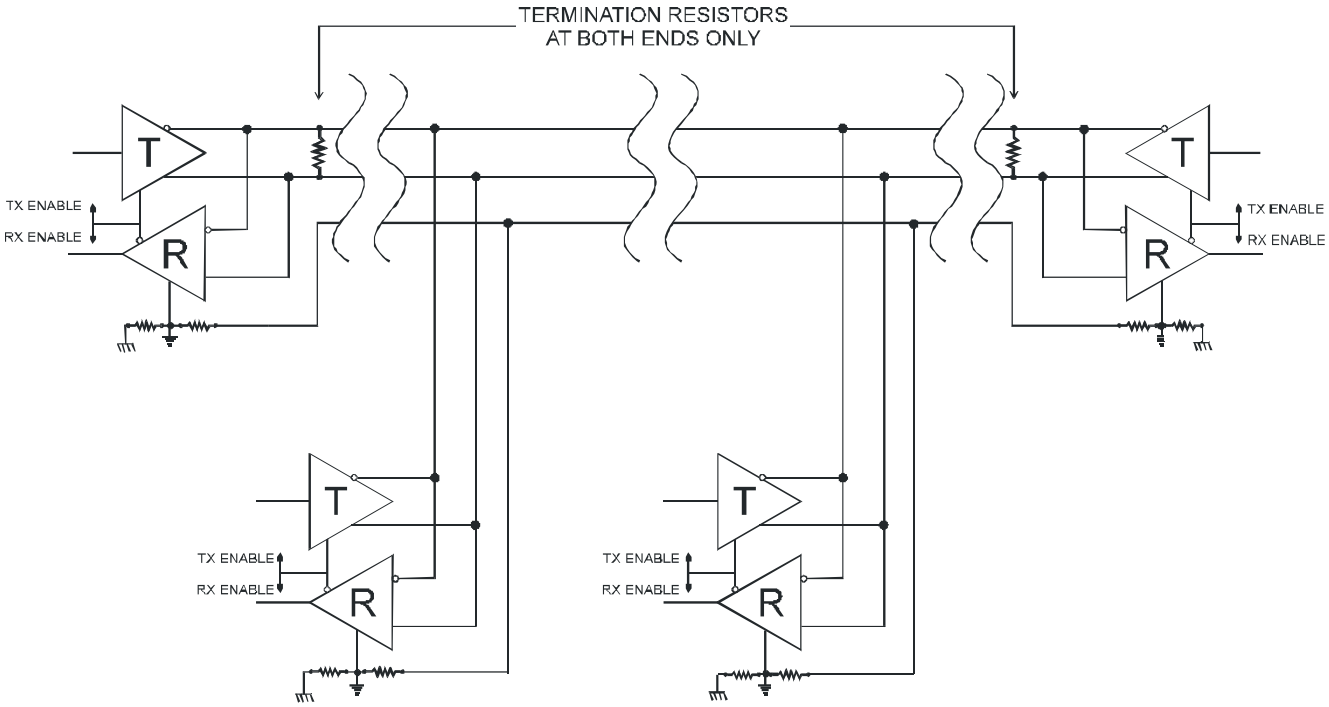


Figure A-1: Typical RS485 Two-Wire Multidrop Network

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 communicates to all slaves and all slaves communicate only with 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@accesio.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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