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MODEL LPCI-COM422/8

USER MANUAL

FILE: MLPCI-COM422-8.D1m

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Table of Contents

Chapter 1: Introduction 5
Specifications 6
Figure 1-1: Block Diagram (Only one serial channel shown) 7
Chapter 2: Installation 8
Chapter 3: Option Selection 11
Figure 3-1: Simplified Termination Schematic 11
Figure 3-2: Option Selection Map 12
Chapter 4: Address Selection 13
Chapter 5: Programming 14
Table 5-1: Baud Rate Divisor Values 15
Chapter 6: Connector Pin Assignments 18
Table 6-1: Connection Pin Assignments 18
Table 6-2: Data Cable Wiring (DB9M) 19
Appendix A: Application Considerations 20
Table A-1: Connections Between Two RS422 Devices 20
Table A-2: RS422 Specification Summary 21
Figure A-1: Typical RS485 Two-Wire Multidrop Network 22

Chapter 1: Introduction

The card was designed for effective multipoint transmission in RS422 (EIS422) protocol. The card is 6.60 inches long and may be installed in an available 5V or 3.3V PCI expansion slot. The card features eight independent, asynchronous RS422 serial ports and type 16550 buffered UARTs. The card meets Universal PCI and MD2 Low Profile PCI Bus Specifications.

RS422 Balanced Mode Operation

The card supports RS422 communications and uses differential balanced drivers for long range and noise immunity. It 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 card supports biasing by default and supports termination by jumpers on the card. If your application requires the transmitter to be un-biased, please contact the factory.

COM Port Compatibility

Type 16550 UARTs are used as the Asynchronous Communication Element (ACE). These include 16-byte transmit/receive buffers to protect against lost data in multitasking operating systems, while maintaining 100% compatibility with the original IBM serial port. The system assigns the address(es).

A crystal oscillator is located on the card. This oscillator permits precise selection of baud rates up to 115,200 or, by changing a jumper, up to 921,600 with the standard crystal oscillator.

The driver/receiver used, the SN75176B, 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 Mode

The card supports Full-Duplex and Half-Duplex communications with a 4-wire cable connection. Half-Duplex allows traffic to travel in both directions, but only one way at a time.

Baud Rate Ranges

The card has capability for two baud rate ranges and you can select which you wish to use on a port-by-port basis. One range is up to 115,200 baud applications and the other is up to 921,600 baud. Refer to Table 5-1, Baud Rate Divisor Values in chapter 5 of the manual.

Specifications

Communications Interface

- I/O Connection: 50-pin SCSI D-Connector
- Serial Ports: Eight cable terminated shielded male D-sub 9-pin with standard IBM AT Style connectors compatible with RS422 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, A faster range of rates, up to 921,600, is achieved by jumper selection on the card. Type 16550 buffered UART
- Address: Continuously mappable within 0000 to FFFF (hex) range of PCI bus addresses
- Receiver Input Sensitivity: +200 mV, differential input
- Common Mode Rejection: +12V to -7V
- Transmitter Output Drive Capability: 60 mA, with thermal shutdown

Environmental

- Operating Temperature Range: 0°C to +60°C
- Storage temperature Range: -50°C to +120°C
- Humidity: 5% to 95%, non-condensing

- Power Required: +5VDC at 200 mA typical
- Size: Low Profile Version: 6.6” long (167.64mm) by 2.21” tall (56.17mm) seated height.

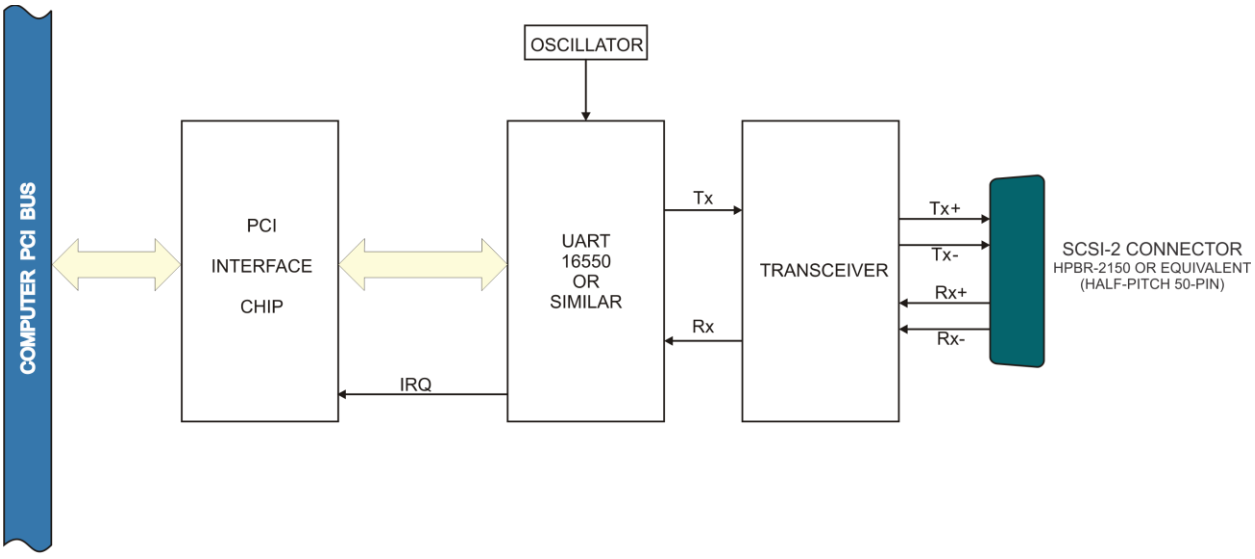


Figure 1-1: Block Diagram (Only one serial channel shown)

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.

The base address assigned by BIOS or the operating system can change each time new hardware is installed into or removed from the computer. Please recheck PCIFind or Device Manager if the hardware configuration is changed. Software you write can automatically determine the base address of the card using a variety of methods depending on the operating system. In DOS, the PCI\SOURCE directory shows the BIOS calls used to determine the address and IRQ assigned to installed PCI devices. In Windows, the Windows sample programs demonstrate querying the registry entries (created by PCIFind and NTIOPCI.SYS during boot-up) to determine this same information.

Interrupts
Please note that, in Windows NT, changes must be made to the system registry to support IRQ sharing. The following is excerpted from "Controlling Multiport Serial I/O Cards" provided by Microsoft in the MSDN library, documentid:mk:@ivt:nt40res/D15/S55FC.HTM, also available in the WindowsNT Resource Kit.

The Microsoft serial driver can be used to control many dumb multiport serial cards. Dumb indicates that the control includes no on-board processor. Each port of a multiport card has a separate subkey under the HKLM\CurrentControlSet\Services\Serial\Parameters subkey in the registry. In each of these subkeys, you must add values for DosDevices, Interrupt, InterruptStatus, PortAddress, and PortIndex because these are not detected by the Hardware Recognizer. (For descriptions and ranges for these values, see Regentry.hlp, the Registry help file on the WindowsNT Workstation Resource Kit CD.)

For example, if you have an eight-port card configured to use address 0xFC00 with an interrupt of 05, the values in the Registry are:

Serial##### Subkey: PortAddress = REG_DWORD 0xFC00 Interrupt = REG_WORD 5 DosDevices = REG_SZ COM5 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD 1	**Serial##### Subkey:** PortAddress = REG_DWORD 0xFC20 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM9 InterruptStatus = REG_DWORD 0xFC40 PortIndex - REG_DWORD 5
Serial##### Subkey: PortAddress = REG_DWORD 0xFC00 Interrupt = REG_WORD 5 DosDevices = REG_SZ COM5 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD 1	**Serial##### Subkey:** PortAddress = REG_DWORD 0xFC20 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM9 InterruptStatus = REG_DWORD 0xFC40 PortIndex - REG_DWORD 5
Serial##### Subkey: PortAddress = REG_DWORD 0xFC08 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM6 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD 2	**Serial##### Subkey:** PortAddress = REG_DWORD 0xFC28 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM10 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD 6
Serial##### Subkey: PortAddress =_DWORD 0xFC10 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM7 InterruptStatus = REG_DWORD 0xFC40 PortIndex - REG_DWORD 3	**Serial##### Subkey:** PortAddress = REG_DWORD 0xFC30 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM11 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD 7
Serial##### Subkey: PortAddress = REG_DWORD 0xFC18 Interrupt = REG_DWORD 5 Dos Devices = REG_SZ COM8 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD4	**Serial##### Subkey:** PortAddress = REG_DWORD 0xFC38 Interrupt = REG_DWORD 5 DosDevices = REG_SZ COM12 InterruptStatus = REG_DWORD 0xFC40 PortIndex = REG_DWORD8

As this example shows, the shared IRQ status Register is located at Base address + 0x40.

Chapter 3: 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 section is determined by jumper installation as described in the following paragraphs.

Terminations
A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the locations labeled LOAD INPUT apply a 120Ω load across the receive input for RS422 operation.

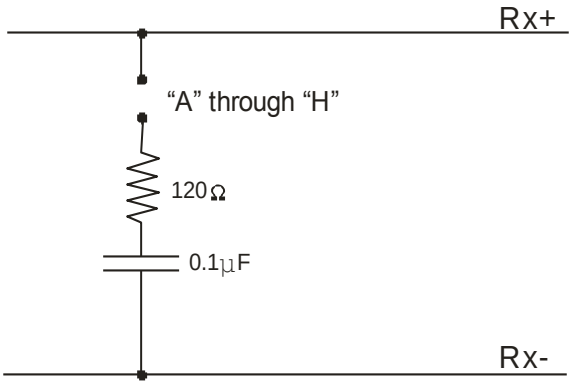


Figure 3-1: Simplified Termination Schematic

Data Cable Wiring

SignalPin Connection

Ain-	1
Aout+	2
Aout-	3
100 Ω to Ground	5
Ain+	9

Baud Rate Ranges
The jumper labeled X8CLK is provided to select baud rates in either of two ranges. When not installed, the baud rate range is up to 115,200 baud. When installed in the X8CLK, the baud rate range is 200 to 921,600 baud.

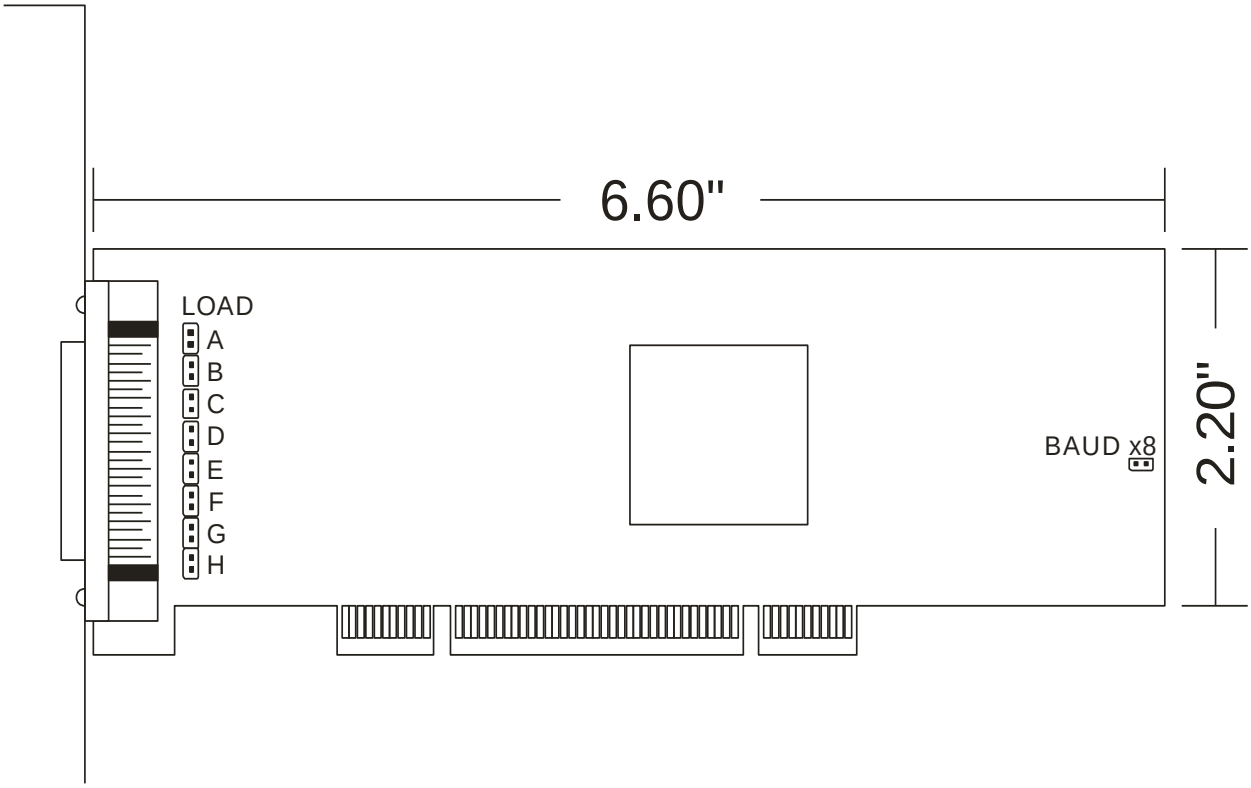


Figure 3-2: Option Selection Map

Chapter 4: Address Selection

The card uses one address space. COM A, COM B, COM C, COM D, COM E, COM F, COM G, and COM H each occupy eight consecutive register locations. The interrupt register which indicates which port or ports caused the interrupt is located at base address + 64.

PCI architecture is Plug and Play. This means that the BIOS or Operating System determines the resources assigned to PCI cards rather than you selecting those resources with switches or jumpers. As a result, you cannot set or change the card's base address. You can only determine what the system has assigned.

To determine the base address that has been assigned, run the PCIFind.EXE, or PCINT utility program provided. 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 (if any) allotted.

Alternatively, some operating systems (Plug and Play Windows) 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 Applet of the control panel. The card is installed in the Data Acquisition class of the Device Manager list. Selecting the card, clicking Properties, and then selecting the Resources Tab will display a list of the resources allocated to the card.

The PCI bus supports 64K of I/O space, so your card's addresses may be located anywhere in the 0000 to FFFF hex range.

Vendor ID code is 494F (ASCII for "I/O")
Device ID code is 1068

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)

On the card, the UART clock frequency is 1.8432 MHz. On the next page is a table for the popular divisor frequencies.

Baud Rate	Divisor x1	Divisor x8	Max Diff. Cable Length*
921600	-	1	250 ft
460800	-	2	550 ft
230400	-	4	1400 ft
153600	-	6	2500 ft
115200	1	8	3000 ft
57600	2	16	4000 ft
38400	3	24	4000 ft
28800	4	32	4000 ft
19200	6	48	4000 ft
14400	8	64	4000 ft
9600	12	96 – Most Common	4000 ft
4800	24	192	4000 ft
2400	48	384	4000 ft
1200	96	768	4000 ft

* These are theoretical maximums for typical conditions and good quality cables based on the EIA 485 and EIA 422 standard for balanced differential drivers.

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 zeroes.

Bit 7 is the DLAB discussed earlier. It must be set to zero after the divisor is loaded or else there will be no communications.

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

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

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

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.

The following C code fragment demonstrates this process:

```
while(data[i]);                          /*While there is data to send*/
{
while(!(inportb(BASEADDR +5)&0x20));     /*Wait until transmitter is empty*/
outportb(BASEADDR,data[i]);
i++;
}
```

Chapter 6: Connector Pin Assignments

Input/Output Connections

The card uses a 50-pin SCSI (Centronics type) D-connector to interface to a spider cable. The spider cable has eight individual DB9M connectors provided with it.

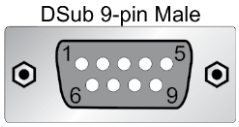
To ensure that there is minimum susceptibility to EMI and minimum radiation it is important that the card mounting bracket be properly screwed into place and that there be a positive chassis ground. Also, proper EMI cabling techniques (cable connect to chassis ground at the aperture, shielded twisted-pair wiring, etc) must be used for the input/output wiring.

Pin	RS-422 Signals	Pin	RS-422 Signals
1	GND Ground	26	GND Ground
2	Aout+	27	Eout+
3	Aout-	28	Eout-
4	Ground through 100 Ohm R	29	Ground through 100 Ohm R
5	Ain+	30	Ein+
6	Ain-	31	Ein-
7	GND Ground	32	GND Ground
8	Bout+	33	Fout+
9	Bout-	34	Fout-
10	Ground through 100 Ohm R	35	Ground through 100 Ohm R
11	Bin+	36	Fin+
12	Bout-	37	Fout-
13	GND Ground	38	GND Ground
14	Cout+	39	Gout+
15	Cout-	40	Gout-
16	Ground through 100 Ohm R	41	Ground through 100 Ohm R
17	Cin+	42	Gin+
18	Cin-	43	Gin-
19	GND Ground	44	GND Ground
20	Dout+	45	Hout+
21	Dout-	46	Hout-
22	Ground through 100 Ohm R	47	Ground through 100 Ohm R
23	Din+	48	Hin+
24	Din-	49	Hin-
25	GND Ground	50	GND Ground

Table 6-1: Connection Pin Assignments

Signal	Connector Pin
Ain-	Pin 1
Aout+	Pin 2
Aout-	Pin 3
100 Ohm to Ground	Pin 5
Ain+	Pin 9

Table 6-2: Data Cable Wiring (DB9M)



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 standard permits cable lengths up to 5000 feet and, because it operates in the 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	Pin No.	Signal	Pin No.
Gnd	7	Gnd	7
TX^+	24	RX^+	12
TX^-	25	RX^-	13
RX^+	12	TX^+	24
RX^-	13	TX^-	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 all 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. 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 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)	LD and LDGND	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. (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 card. Termination resistors for the RX+ and RX- lines are provided on the card and are placed in the circuit when you install the LD and LDGND 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.

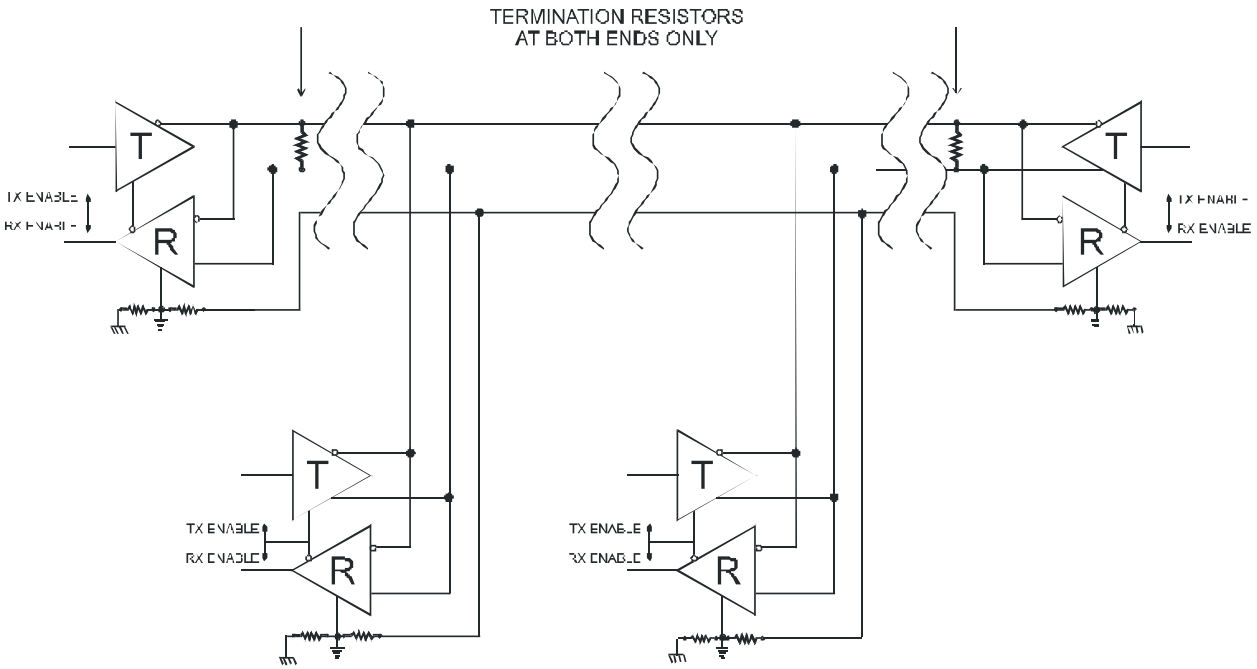


Figure A-1: Typical RS485 Two-Wire Multidrop Network

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 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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