ACCES I/O PRODUCTS, INC.
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PCI-104 SERIAL COMMUNICATION BOARDS

104i-COM-8SM
104i-COM-4SM
104i-COM-8S
104i-COM-4S

USER MANUAL

FILE: m104i-COM-8SM.A1o

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Table of Contents

Chapter 1: INTRODUCTION

This communications card interfaces to the CPU through a 32bit PCI bus. It is a PCI-104 card, with no ISA bus connector.

- High Performance Octal PCI UART
- 16550 Compatible Register Set
- Up to 921.6kbps Serial Data Rate in all modes
- Global Interrupt Source Register
- Data Transfer in Byte, Word, and Double-Word
- 64-Byte Transmit and Receive FIFOs per each of eight UARTs
- Transmit and Receive FIFO Level Counters
- Programmable Transmit and Receive FIFO Trigger Level

Factory Options

- Extended Temperature Operation of -40˚ to +85˚C
- RoHS Compliance

The 104i-COM-8SM and 104i-COM-4SM (PCI-104) multi-port multi-protocol serial communication cards deliver eight or four high-speed serial communication ports for use in a wide variety of applications. The cards were developed for use by system integrators and manufacturers in the design of industrial and commercial systems. Based on the XR17D158, the boards have eight enhanced 16550 UARTs, each with a set of modem signals (CTS, RTS, RI, DTR, DSR, CD) in RS-232 mode. Each UART has both a 64 byte transmit and a 64 byte receive FIFO.

The provided Windows drivers are 100% compatible with the normal Microsoft-provided Serial Application Programming Interface. This means every program you've ever used with a standard serial port in Windows will also work with these ports, no problem. In addition, we provide several utility and sample programs to help you write your own code, if you're not using something off-the-shelf.

This serial Interface board contains eight independent ports and provides RS-232, RS-422 and RS-485 multipoint communication. The -4SM board contains four such ports. Each channel may be configured to any protocol using jumpers on the board, including termination.

In RS-232, RS-422 or RS-485 modes, the board can achieve speeds up to 921.6kbps per port. Use a high-quality cable for best results and to achieve higher baud rates.

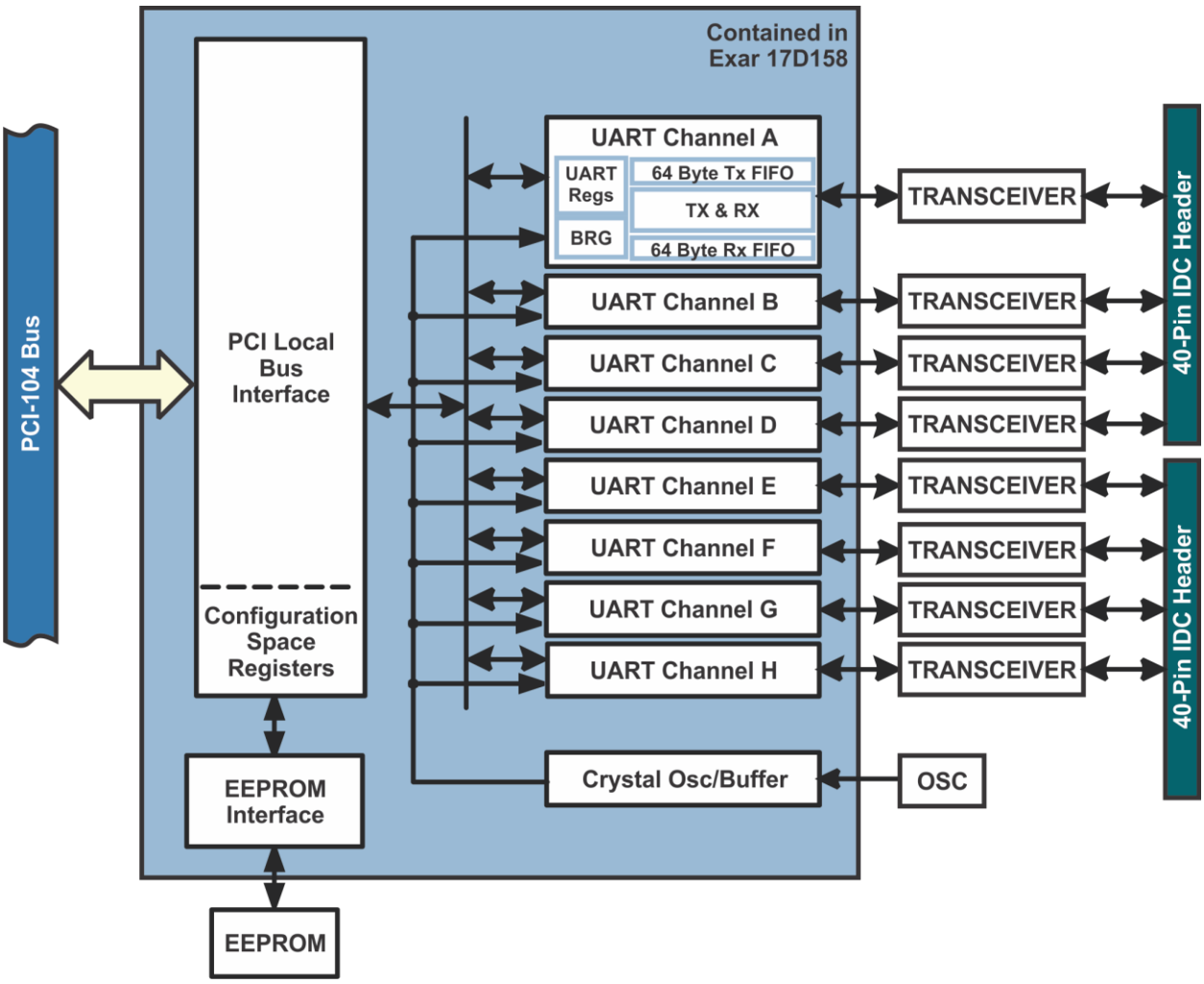


Figure 1-1: Block Diagram

Ordering Guide

104i-COM-8SM	PCI-104 Eight Port RS-232/422/485 Serial Communication Board
104i-COM-4SM	PCI-104 Four Port RS-232/422/485 Serial Communication Board
104i-COM-8S	PCI-104 Eight Port RS-422/485 Serial Communication Board
104i-COM-4S	PCI-104 Four Port RS-422/485 Serial Communication Board

Model Options

- -T Extended temperature operation of -40˚C to +85˚C
- -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

Contact factory with your special requirement. Examples of special orders would be conformal coating, latching I/O headers, custom baud rates, 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.

- PCI/104 Board
- Software Master CD
- Printed Quick-Start-Guide

Optional Accessories

• PCI-P104-ADAP	Develop & test software and hardware in a desktop PCI slot	
• C104-40F-D9M	40 pin ribbon cable with female header to four DB9M connectors, 12" long	
• C104-40F/D37F	40 pin ribbon cable with female header to DB37F connector, 9” long	
• C104-D37M/D9M	This 3' round-wire external serial breakout cable provides four male DB9 connectors from a male DB37 connector. Useful for system cabling and can be mated with C104-40F/D37F for various PC/104 serial requirements.	
• CAB40F-X	Ribbon cable assembly with 40-pin female header connectors (X = length in feet)	
• STB-40	Screw terminal board, typically ships with standoffs but can also mount on DIN-SNAP	
• DIN-SNAP-6	Six inch length of SNAP-TRACK with two clips, for mounting one STB-40 screw terminal board on a DIN rail	
• DIN-SNAP	One foot length of SNAP-TRACK with four clips, for mounting up to two STB-40 screw terminal boards on a DIN rail	
• 104-HDW-KIT(X)	Hardware kit for ACCES PC/104 boards; includes 4 screws, nuts and standoffs. Specify metric (M) or standard (S) hardware kit.	

Chapter 2: INSTALLATION

A printed Quick-Start Guide (QSG) is packed with the board 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 PC/104 Board is on CD and must be installed onto your hard disk prior to use. To do this, follow the steps below as appropriate for your operating system. Substitute the CD-ROM drive letter where you see d: in the examples below.

CD Installation

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

Windows

1. Place the CD into your CD-ROM drive.
2. The system should automatically run the install program. If it does not run promptly, 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.

Installing the Hardware

Before installing the board, please run setup.exe. The SETUP Program can be used to assist in configuring the switches and jumpers on the board. The setup program does not set the options on the board, these must be set manually by the user.

To Install the Card

1. Install jumpers for selected options and position the slide switches to select the position in the stack.
2. Remove power from the PC/104 stack.
3. Assemble standoff hardware (optionally available) to stack and secure the boards.
4. Carefully plug the board onto the PCI/104 connector on the CPU or onto the stack, ensuring proper alignment of the pins before completely seating the connectors.
5. Install I/O cables onto the board's I/O connectors and proceed to secure the stack together or repeat steps 3-5 until all boards are installed.
6. Verify all connections in the PCI/104 stack and secure then power up the system.
7. With the CD you received with your shipment in the drive, install the software for the card, following the printed QuickstartGuide.pdf you also received.
   a. In Windows, each COM port is assigned a number, which will correlate to a COM letter (COMA/COM5, COMH/COM12).
8. Run one of the provided sample programs appropriate for your operating system that was installed from the CD to test and validate your installation.

If a 104i-COM-8SM channel is configured for RS-485 the Properties dialog box must be used to enable auto-RTS. You can find this dialog box in the Device Manager program for the ports involved.

To gain a better understanding of the XR17D158 register set, refer to the chip datasheet located in the ChipSpecs directory on the ACCES I/O Software Master CD.

Chapter 3: OPTION SELECTION

To help you locate the jumpers described in this section, refer to the OPTION SELECTION MAP in **Figure 3-2**, as well as running the SETUP.EXE utility program installed from the Software Master CD with the software package for this board.

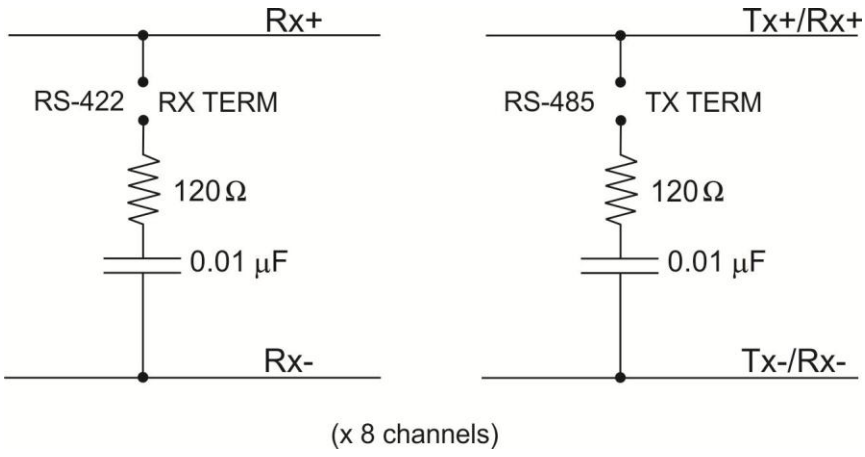


Figure 3-1: Simplified Dynamic Termination Schematic

Line Terminations

A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the location labeled TX TERM or RX TERM applies a 120Ω load in series with a small capacitor across the transmit/receive input/output for RS-485 operation or input for RS-422 operation respectively.

In RS-485 operations where there are multiple terminals, only the RS-485 ports at each end of the network should have terminating resistors as described above. Also, for RS-485 operation, there must be a bias on the TX+/RX+ and TX-/RX- lines. If the board is not to provide that bias, contact the factory technical support.

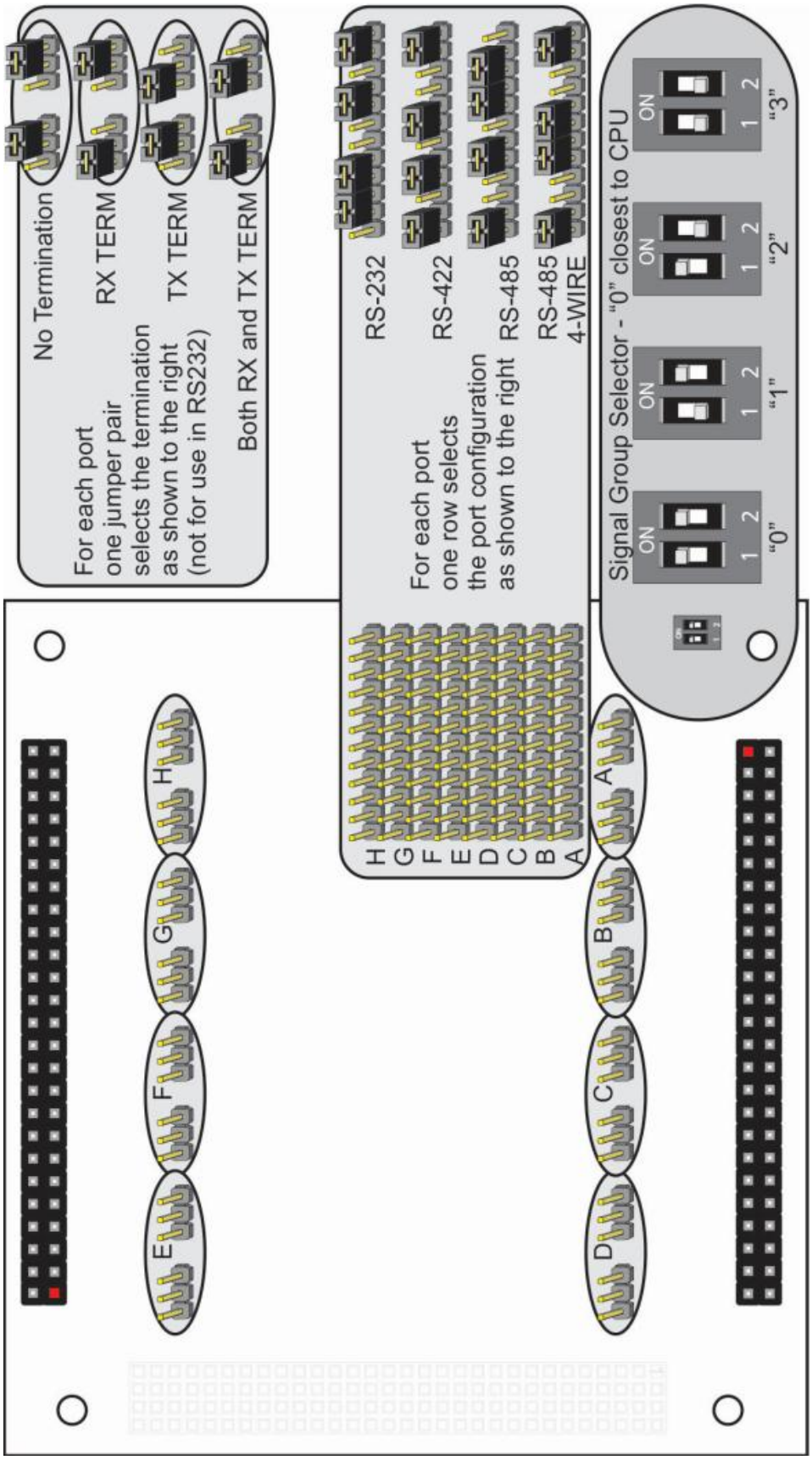


Figure 3-2: Option Selection Map

Most PCI bus signals are common to all four cards in the PCI stack. However, there are four unique signal groups, one for each card. The slide switches select which signal group goes to each card. The card in the stack closest to the CPU board must get signal group 0.

Only four PCI boards are allowed in a PC/104-Plus stack, each board must get a specific set of signals. These signals are selected with two slide switches, labeled SEL-1 and SEL-2, which form a binary value to control the mux (SEL-1 is the least significant bit and SEL-2 is the most significant bit). If this card is furthest from the CPU, slide both switches to the OFF STATE. This will select the signal with the longest trace on the CPU board (signal group 3). If this card is closest to the CPU, slide both switches to the ON STATE. This will select the signal with the shortest trace on the CPU board (signal group 0). Place the SEL-1 switch to ON and SEL-2 to OFF to select signal group 2, place the SEL-1 switch to OFF and SEL-2 to OFF to select signal group 1.

Jumper Function

(refer to option selection map)
Each communication channel (COM A through COM H) has four configuration jumpers. Four modes are possible: RS-232, RS-422 (also 4 wire RS-485 Master), 2 wire RS-485, and 4 wire RS-485 Slave. The communication modes are implemented with an RS-232 transceiver, a differential signal half-duplex transceiver (auto-RS-485 mode Tx/Rx and RS-422 Tx), and a differential signal receiver (RS-422 Rx).

- The first jumper enables the RS-232 transceiver.
- The second jumper connects the auto-RTS signal from the UART to the transmit-enable pin on the half-duplex differential transceiver or it connects either a permanent ON (for RS-422) or a permanent OFF signal (for RS-232) to the transmit-enable pin.
- The third jumper enables the RS-422 receiver and sends a permanent ON signal (for RS-422 Tx) to the transmit-enable pin on the half-duplex differential transceiver.
- The fourth jumper either disables the half-duplex differential transceiver's receiver (not used for RS-422, 4 wire RS-485, or RS-232) or connects the auto-RTS signal to the receiver's enable pin (2 wire RS-485).

RS-485 Balanced Mode Operation

The board supports RS-485 modes that use differential bus transceivers for increased range and noise immunity. The RS-485 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”.

The board also has the capability to add load resistors to terminate the communications lines. RS-485 communications requires that one transceiver supply a bias voltage to ensure a known state (an “idle one”) when all transmitters are off. 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 board. If your application requires the transmitter to be un-biased, please contact the factory.

The driver/receiver used, type 75176B, 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.

Chapter 4: ADDRESS SELECTION

The system BIOS or operating system will assign the address. The card occupies 4K bytes of memory space.

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.

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

Chapter 5: PROGRAMMING

Sample Programs

There are sample programs with source-code provided with the card in a variety of common languages. DOS samples are located in the DOS directory and Windows samples are located in the WIN32 directory.

Windows COM Utility Program

WinRISC is a COM utility program provided on CD with the installation package for this card that is very useful when working with any serial ports and serial devices. If you haven't used this program yet, do yourself a favor and run this program to test your COM ports.

Windows Programming

The card installs into Windows as COM ports so standard API functions can be used. See the documentation for your chosen language for details.

Chapter 6: CONNECTOR PIN ASSIGNMENTS

Pin	Ch	RS-485 Functions	Ch	RS-422 Functions	Ch	RS-232 Functions
1					A	CD
2					A	DSR
3	A	TX/RX+	A	TX+	A	RX
4	A	TX/RX-	A	TX-	A	RTS
5					A	TX
6			A	RX-	A	CTS
7			A	RX+	A	DTR
8					A	RI
9	A	Ground	A	Ground	A	Ground
10						
11					B	CD
12					B	DSR
13	B	TX/RX+	B	TX+	B	RX
14	B	TX/RX-	B	TX-	B	RTS
15					B	TX
16			B	RX-	B	CTS
17			B	RX+	B	DTR
18					B	RI
19	B	Ground	B	Ground	B	Ground
20						
21					C	CD
22					C	DSR
23	C	TX/RX+	C	TX+	C	RX
24	C	TX/RX-	C	TX-	C	RTS
25					C	TX
26			C	RX-	C	CTS
27			C	RX+	C	DTR
28					C	RI
29	C	Ground	C	Ground	C	Ground
30						
31					D	CD
32					D	DSR
33	D	TX/RX+	D	TX+	D	RX
34	D	TX/RX-	D	TX-	D	RTS
35					D	TX
36			D	RX-	D	CTS
37			D	RX+	D	DTR
38					D	RI
39	D	Ground	D	Ground	D	Ground
40						

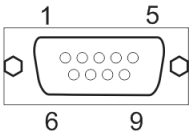
Table 6-1: P1 Connector Pin Assignment (8-port and 4-port boards)

Pin	Ch	RS-485 Functions	Ch	RS-422 Functions	Ch	RS-232 Functions
1					E	CD
2					E	DSR
3	E	TX/RX+	E	TX+	E	RX
4	E	TX/RX-	E	TX-	E	RTS
5					E	TX
6			E	RX-	E	CTS
7			E	RX+	E	DTR
8					E	RI
9	E	Ground	E	Ground	E	Ground
10						
11					F	CD
12					F	DSR
13	F	TX/RX+	F	TX+	F	RX
14	F	TX/RX-	F	TX-	F	RTS
15					F	TX
16			F	RX-	F	CTS
17			F	RX+	F	DTR
18					F	RI
19	F	Ground	F	Ground	F	Ground
20						
21					G	CD
22					G	DSR
23	G	TX/RX+	G	TX+	G	RX
24	G	TX/RX-	G	TX-	G	RTS
25					G	TX
26			G	RX-	G	CTS
27			G	RX+	G	DTR
28					G	RI
29	G	Ground	G	Ground	G	Ground
30						
31					H	CD
32					H	HSR
33	H	TX/RX+	H	TX+	H	RX
34	H	TX/RX-	H	TX-	H	RTS
35					H	TX
36			H	RX-	H	CTS
37			H	RX+	H	HTR
38					H	RI
39	H	Ground	H	Ground	H	Ground
40						

Table 6-2: P2 Connector Pin Assignment (8-port board only)

Cable accessories are available to provide interface to the 40-Pin headers on this board, connecting to a 40 pin screw terminal board, a DB37 for panel or enclosure mounting (an external / system cable is optionally available to mate with that DB37 and breaks it out to four DB9M's) or to four DB9M connectors.

DB9 Male



DB-9 Male Pin for each of Ch A-H	RS-232 Signals (DTE Standard)	RS-232 Signal Descriptions
Ch x - 1	DCD	Data Carrier Detected
Ch x - 2	RX	Receive Data
Ch x - 3	TX	Transmit Data
Ch x - 4	DTR	Data Terminal Ready
Ch x - 5	GND	Signal Ground
Ch x - 6	DSR	Data Set Ready
Ch x - 7	RTS	Request To Send
Ch x - 8	CTS	Clear to Send
Ch x - 9	RI	Ring Indicator

Table 6-3: DB9M Accessory Cable RS-232 Pin Assignment

DB-9 Male Pin for each of Ch A-H	RS-422 Signals	RS-422 Signal Descriptions
Ch x - 2	TX+	Transmit Data +
Ch x - 4	RX+	Receive Data +
Ch x - 5	GND	Signal Ground
Ch x - 7	TX-	Transmit Data -
Ch x - 8	RX-	Receive Data -

Table 6-4: DB9M Accessory Cable RS-422 Pin Assignment

DB-9 Male Pin for each of Ch A-H	RS-485 Signals (2 Wire)	RS-485 Signal Descriptions
Ch x - 2	TX/RX +	Transmit / Receive +
Ch x - 4	TX/RX -	Transmit / Receive -
Ch x - 5	GND	Signal Ground

Table 6-5: DB9M Accessory Cable RS-485 Pin Assignment

Port to Port Cable Wiring

The following connections are used to communicate between two ports (usually on different devices), depending on the communication mode:

Note that the user cable MUST include a ground to ground connection for RS-232, RS-422 *and* RS-485 as high common mode between external devices will burn out the transceiver IC's.

Mode	Cable Pins		
	Port 1	to	Port 2
RS-232	RX	to	TX
	TX	to	RX
	Ground	to	Ground
RS-422 Full-Duplex[1]	RX+	to	TX+
	RX-	to	TX-
	TX+	to	RX+
	TX-	to	RX-
	Ground	to	Ground
RS-422 Simplex Receive Only	RX+	to	TX+
	RX-	to	TX-
	Ground	to	Ground
RS-422 Simplex Transmit Only	TX+	to	RX+
	TX-	to	RX-
	Ground	to	Ground
RS-485 Half-Duplex	TX+/RX+	to	TX+/RX+
	TX-/RX-	to	TX-/RX-
	Ground	to	Ground
[1] RS-485 4-Wire *(not a TIA/EIA standard)*	Port 1 designates the Master, should be an RS-422 (TX not shared) Port 2 designates the Slaves, must be an RS-485 (TX shared)		

Table 6-6: Port to Port Cable Wiring

Chapter 7: SPECIFICATION

PCI Bus:	Rev. 2.3
Memory Space:	Requires 4k

16550 Compatible

Data Size:	5, 6, 7 or 8 bits
Stop bit length:	1, 1.5 or 2 bits
Parity:	Odd, even, none, mark, or space
Break condition:	On or off
Maximum Baud Rate:	921.6kbps (RS-232, RS-422 & 485 modes)

Full Duplex Operation
Eight 64 Byte Transmit FIFO, 64 Byte Receive FIFO (16C550 FIFO = 16 Bytes)
S/W programmable FIFO trigger levels (16C550 trigger levels are fixed)
12 standard registers for UART monitoring and control plus special registers
Loop-back mode
Scratch pad register

Transceiver I/O Characteristics

RS-232 Mode:

Receiver Input Resistance:	3K to 7K ohm
Receiver Input Sensitivity:	±3V
Receiver Input Range:	±15V
Driver Slew Rate:	24V/μS minimum
Driver Load Impedance:	3K to 7K ohm
Driver Output Signal Level:	Loaded ±5.4V typical

RS-422/485 Mode:

Receiver Input Sensitivity:	±200 mV differential input
Common Mode Range:	+12V to -7V
Transmitter Output Drive:	60 mA with thermal shutdown
Input Impedance:	12 K ohm Min
Input Hysteresis:	50 mV typical
ESD:	±15KV Human Body Model ±15KV Air Discharge ±8KV Contact Discharge

Communications Interface:

Eight channels split between two 40 pin male headers
Meets or exceeds the IEEE RS-232 standard

Environmental

Operating Temperature:	0˚C to +70˚C -40˚C to +85˚C (Extended temp version)
Humidity:	5% to 95%, non-condensing
Storage Temperature:	-65 ˚C to +125 ˚C
Power Required:	5V @ 50mA quiescent, 150mA maximum (nothing connected on I/O connectors)
Size:	PC/104-Plus format, 3.5" x 3.75"

Appendix A: APPLICATION CONSIDERATIONS

INTRODUCTION

Working with RS-485 devices is not much different from working with standard RS-232 serial devices and this standard overcomes deficiencies in the RS-232 standard. First, the cable length between two RS-232 devices must be short; less than 50 feet. Second, many RS-232 errors are the result of noise induced on the cables. The RS-485 standard permits cable lengths up to 4000 feet and, because it operates in differential mode, it is more immune to induced noise.

A third deficiency of RS-232 is that more than two devices cannot share the same cable. This is also true for RS422 *but RS-485 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 RS-485 devices can drive longer lines with more noise immunity than RS-232 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. RS-485 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.

Table A-1: RS-422 Specification Summary

Parameter	Conditions	Min.	Max.
Driver Output Voltage (unloaded)		4V -4V	6V -6V
Driver Output Voltage (loaded)	120Ω Termination	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

To prevent signal reflections in the cable and to improve noise rejection in both the RS422 and RS-485 mode, the receiver end of the cable should be terminated with a resistance equal to the characteristic impedance of the cable. (The exception is when 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.)

RS-485 DATA TRANSMISSION

The RS-485 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.

RS-485 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.

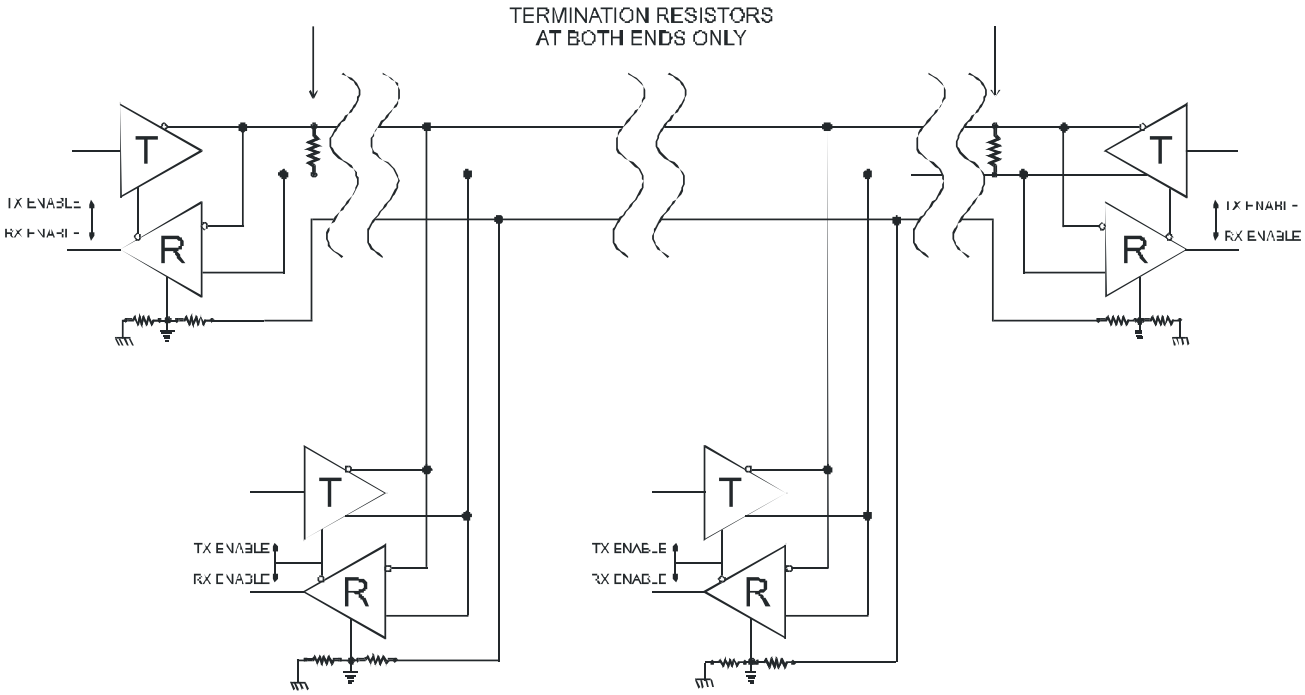


Figure A-1: Typical RS-485 Two-Wire Multidrop Network

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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