MODELS
104I-COM-8SM, 104I-COM-8S
104I-COM-4SM, 104I-COM-4S
104I-COM-2SM, 104I-COM-2S

PCI-104 MULTI-PORT, MULTI-PROTOCOL RS-232, RS-422, RS-485 SERIAL COMMUNICATIONS BOARDS

USER MANUAL

FILE: 104I-COM-8SM.A1w

Notice

The information in this document is provided for reference only. ACCES does not assume any liability arising out of the application or use of the information or products described herein. This document may contain or reference information and products protected by copyrights or patents and does not convey any license under the patent rights of ACCES, nor the rights of others.

WARNING!!
ALWAYS CONNECT AND DISCONNECT YOUR FIELD CABLING WITH THE COMPUTER POWER OFF.
ALWAYS TURN COMPUTER POWER OFF BEFORE INSTALLING A BOARD.
CONNECTING AND DISCONNECTING CABLES, OR INSTALLING BOARDS INTO A SYSTEM WITH THE COMPUTER OR FIELD POWER ON MAY CAUSE DAMAGE TO THE I/O BOARD AND WILL VOID ALL WARRANTIES, IMPLIED OR EXPRESSED.

Warranty

Prior to shipment, ACCES equipment is thoroughly inspected and tested to applicable specifications.
However, should equipment failure occur, ACCES assures its customers that prompt service and support will be available.
All equipment originally manufactured by ACCES, found to be defective will be repaired or replaced subject to the following considerations:

Terms and Conditions

If a unit is suspected of failure, contact ACCES' Customer Service department.
Be prepared to give the unit model number, serial number, and a description of the failure symptom(s).
We may suggest some simple tests to confirm the failure.
We will assign a Return Material Authorization (RMA) number which must appear on the outer label of the return package.
All units/components should be properly packed for handling and returned with freight prepaid to the ACCES designated Service Center, and will be returned to the customer's/user's site freight prepaid and invoiced.

Coverage

First Three Years:
Returned unit/part will be repaired and/or replaced at ACCES option with no charge for labor or parts not excluded by warranty.
Warranty commences with equipment shipment.

Following Years:
Throughout your equipment's lifetime, ACCES stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry.

Equipment Not Manufactured by ACCES

Equipment provided but not manufactured by ACCES is warranted and will be repaired according to the terms and conditions of the respective equipment manufacturer's warranty.

General

Under this Warranty, liability of ACCES is limited to replacing, repairing or issuing credit (at ACCES discretion) for any products which are proved to be defective during the warranty period. In no case is ACCES liable for consequential or special damage arriving from use or misuse of our product. The customer is responsible for all charges caused by modifications or additions to ACCES equipment not approved in writing by ACCES or, if in ACCES opinion the equipment has been subjected to abnormal use. "Abnormal use" for purposes of this warranty is defined as any use to which the equipment is exposed other than that use specified or intended as evidenced by purchase or sales representation. Other than the above, no other warranty, expressed or implied, shall apply to any and all such equipment furnished or sold by ACCES.

Table of Contents

Chapter 1: Introduction

The 104I-COM-8SM family was designed for RS-232, RS-422 and RS-485 asynchronous communications for use in a wide variety of applications. These boards support both 3.3V and 5V Universal PCI Bus signaling designs. They follow the PCI-104 bus standard and are intended to be used by system integrators and manufacturers in the design of industrial and commercial communication systems. The board is available in 8, 4, and 2-port versions and is compatible with all popular operating systems.

Each COM port is capable of supporting data rates up to 1.8432Mbps and implements full RS-232 modem control signals to ensure compatibility with a wide range of serial peripherals. Existing serial peripherals can connect directly to industry standard DB9M connectors which are provided via an optionally available cable. The board features a 120 pin (4x30, 2mm) PCI bus stack-through connector which is used to connect the board to the 32-bit PCI bus.

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

Features

- Eight, four, or two-port PCI asynchronous serial communication.
- High performance Exar XR17D158 octal UART with 64-byte FIFO for each TX and RX with 16C550 compatible register set
- Serial protocol (RS-232/422/485) jumper configured per port
- PCI-104 standard form factor
- Supports communication rates up to 1.8432Mbps
  - (standard model RS-232 is 460.8kbps, fast RS-232 model 921.6kbps)
- ESD protection +/-15kV on all RS-232 signal pins
- Full modem control signals in RS-232 mode
- Software compatible with all operating systems
- Global Interrupt Source Register for all 8 UARTS
- Data Transfer in Byte, Word, and Double-Word
- Transmit and Receive FIFO Level Counters
- Programmable Transmit and Receive FIFO Trigger Level
- Jumper selectable termination for RS-485 applications
- Breakout cable available terminating with industry-standard DB9M connectors

Applications

- POS (Point-of-sale) Systems
- Gaming Machines
- Telecommunications
- Industrial Automation
- ATM (Automated Teller Machine) Systems
- Multiple terminal control
- Office Automation
- Data Collection Servers
- Systems Monitoring and Management
- Kiosks

Functional Description

The 104I-COM-8SM family of multi-port multi-protocol serial communication boards deliver eight, four, or two high-speed serial communication ports for use in a wide variety of applications. These boards feature a high performance Exar XR17D158 octal UART which supports the complete register set of the standard 16C550-type devices with a PCI local bus interface. Each port is capable of data communication in either RS-232, RS-422, or RS-485 configured via jumper selection, with speeds up to 1.8432Mbps (standard model up to 460.8kbps in RS-232 mode). Each UART has a 64-byte deep transmit and a 64-byte deep receive FIFO to protect against lost data in multitasking operating systems, to help reduce CPU utilization and to improve data throughput. When a port is configured in RS-232 mode, full modem control signals (CTS, RTS, RI, DTR, DSR, DCD) are supported.

A crystal oscillator is located on the board. This oscillator permits precise selection of standard baud rates. Custom baud rates are available upon request, please refer to the "Special Order" paragraph.

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. 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. Also, the boards are fully software compatible with all operating systems.

In addition, the PCI-104 standard form factor allows the board to be securely connected through the PCI-104 stack and hardware. PCI-104 is designed to be used in small rugged embedded systems. The board features a 120 pin (4x30, 2mm) PCI bus stack-through connector which is used to connect the board to the 32-bit PCI bus.

Existing serial peripherals can connect directly to the industry standard DB9M connectors which are provided via an available cable.

For more detailed information on the features supported by this chip please refer to the Exar XR17D158 datasheet found on the CD supplied with this board. Most users will be able to take advantage of these features automatically, without knowing about them, through the magic of software drivers.
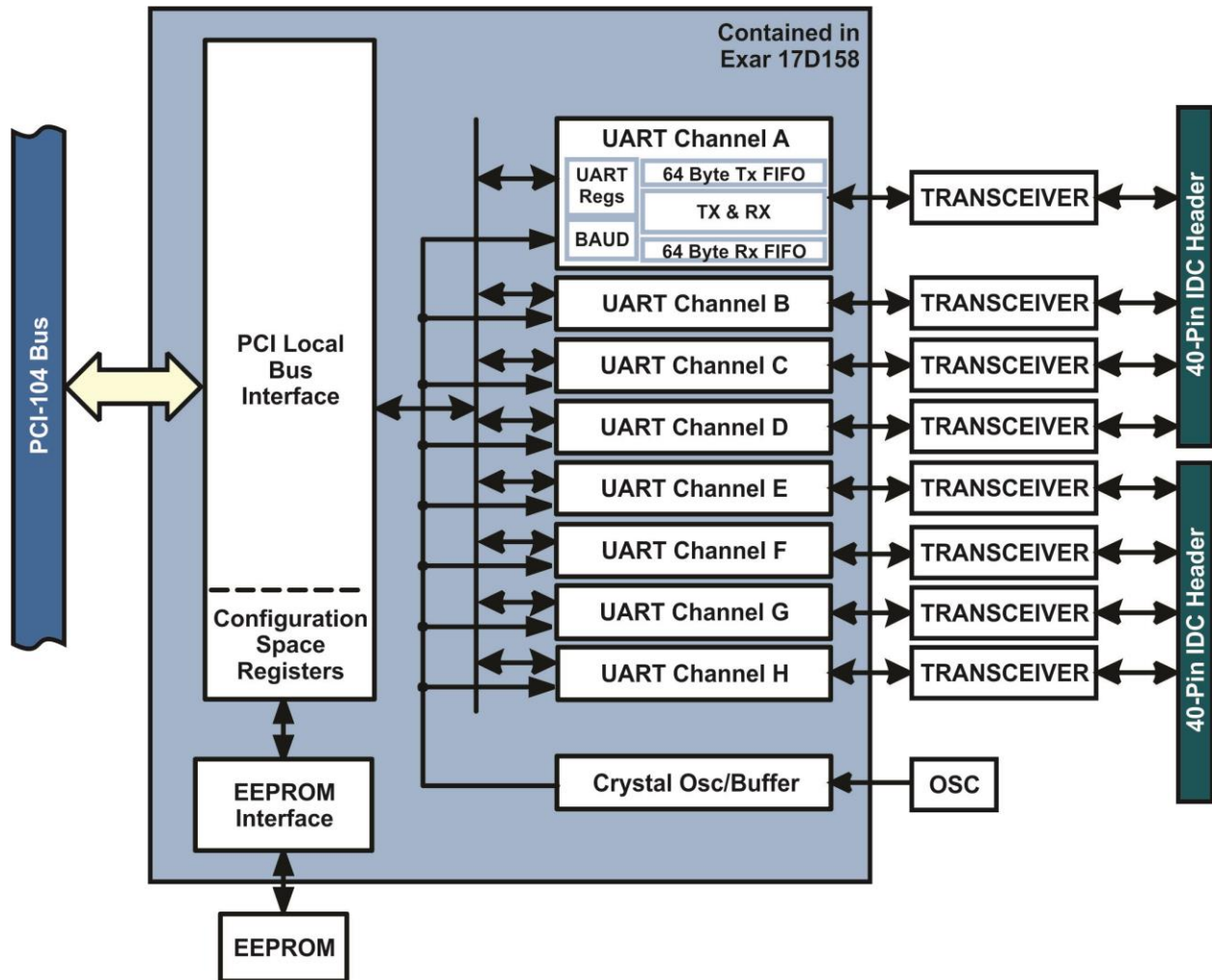
Figure 1-1: Block Diagram

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-2SM   PCI-104 Two 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
- 104I-COM-2S   PCI-104 Two Port RS-422/485 Serial Communication Board

Model Options

- -T   Extended temperature operation of -40˚C to +85˚C
- -F   Fast RS-232 transceivers (up to 921.6 Kbps)
- -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

- -S0x   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.

- 104I-COM Board

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 PCI-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 PCI-104 boards; includes 4 screws, nuts and standoffs. Specify metric (M) or standard (S) hardware kit.	

Chapter 2: Installation

The software provided with this PCI-104 Board is available for free download from the product webpage. It is also optionally available by request 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.

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 Settings program can be used to assist in configuring the switches and jumpers on the board. The settings program does not set the options on the board, these must be set manually by the user.

To Install the Board

1. Install jumpers for selected options and position the slide switches to select the position in the stack.
2. Remove power from the PCI-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 are secure then power up the system.
7. In Windows, each COM port is assigned a number, which will correlate to a COM letter (COMA/COM5, COMH/COM12). View these details in the Device Manager.
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 port 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: Hardware Details

Option Selections
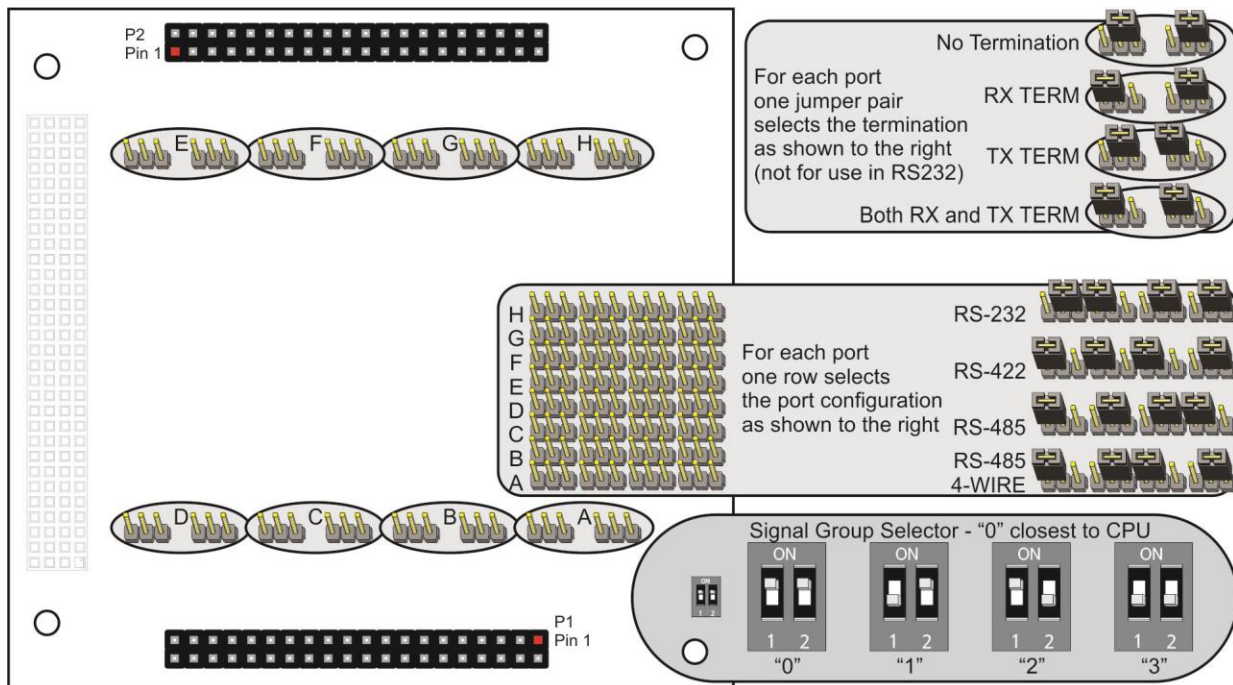
Figure 3-1: Option Selection Map

Run the Settings.exe utility program installed from the Software Master CD with the software package for this board for assistance in configuring jumper settings.

Communication Protocol / Mode Configuration

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).
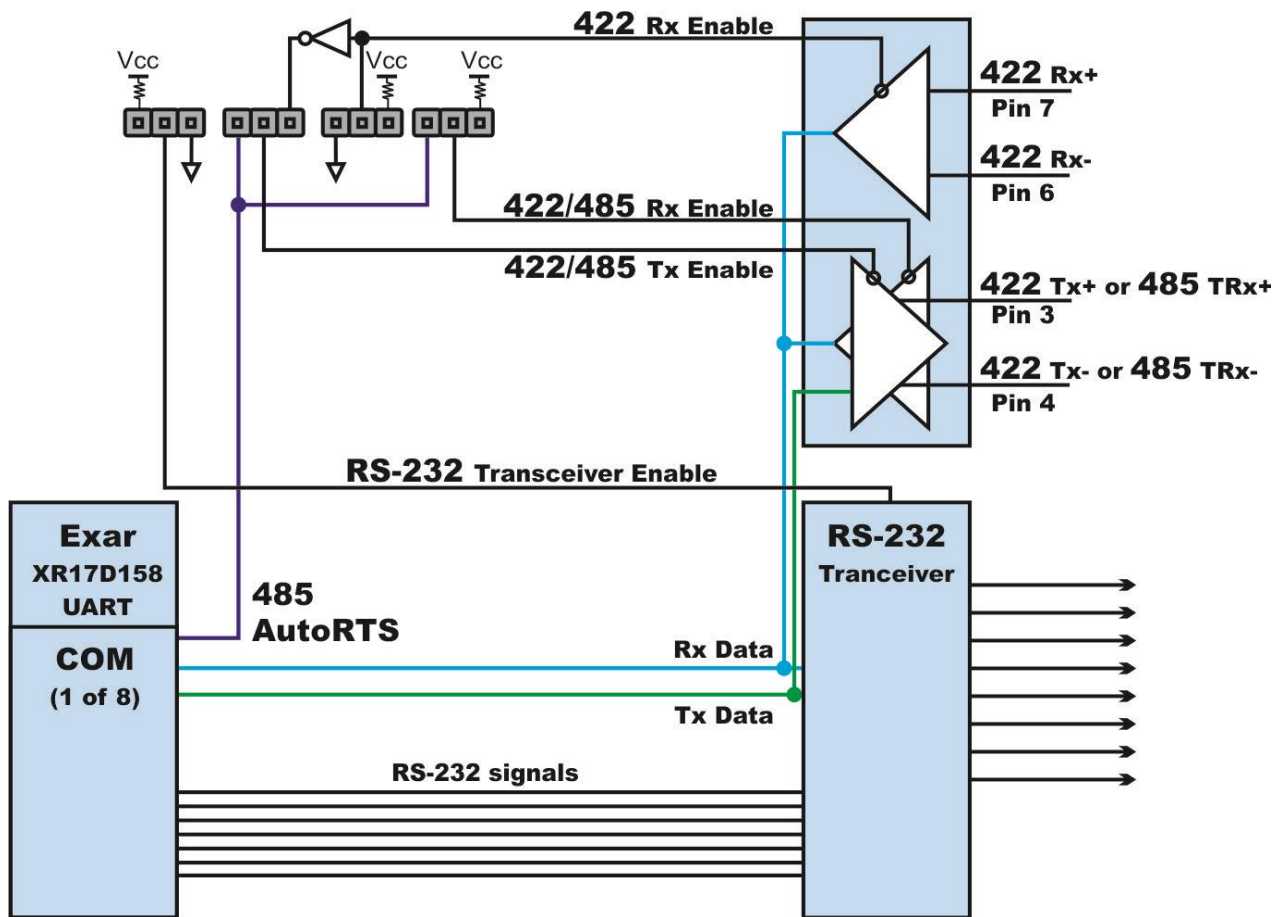
Figure 3-2: Jumper Settings Simplified Schematic

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.
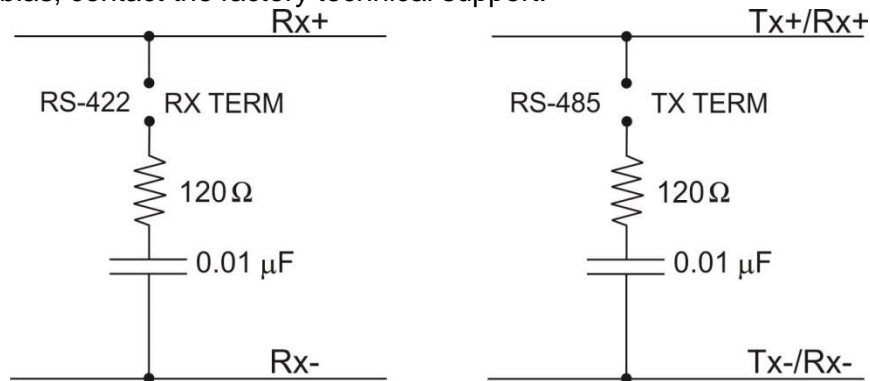
Figure 3-3: Simplified Dynamic Termination Schematic

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.

Stack Position DIP Switches

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

Only four PCI boards are allowed in a PCI-104 stack, and each board must get a specific set of signals. These signals are selected with two slide switches, labeled "1" and "2", which form a binary value to control the mux ("1" is the least significant bit and "2" is the most significant bit). If this board 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 board 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 "1" switch to ON and "2" to OFF to select signal group 2, place the "1" switch to OFF and "2" to ON to select signal group 1.

Chapter 4: Address Selection

The system BIOS or operating system will assign the address. The board 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 boards rather than you selecting those resources with switches or jumpers. As a result, you cannot set or change the board's base address. You can only determine what the system has assigned.

The Vendor ID for the board is 494F. (ASCII for "IO")
The Device ID for the "-8SM" board is 10EA
The Device ID for the "-4SM" board is 10DB
The Device ID for the "-2SM" board is 10D2
The Device ID for the "-8S" board is 106C
The Device ID for the "-4S" board is 105D
The Device ID for the "-2S" board is 1052

Chapter 5: Programming

Sample Programs

There are sample programs with source-code provided with the board 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 board 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 board installs into Windows as COM ports so standard API functions can be used. See the documentation for your chosen language for details.

The following information is of interest to advanced users only. If you are using the provided Windows or Linux drivers you can skip to Chapter 6: Connector Pin Assignments.

The following is an excerpt from the Exar XR17D158 datasheet on pages 30 and 31:

Programmable Baud Rate Generator

Each UART has its own Baud Rate Generator (BRG) with a prescaler for the transmitter and receiver. The prescaler is controlled by a software bit in the MCR register. The MCR register bit-7 sets the prescaler to divide the input crystal or external clock by 1 or 4. The output of the prescaler clocks to the BRG. The BRG further divides this clock by a programmable divisor between 1 and (2^{16} -1) to obtain a 16X or 8X sampling clock of the serial data rate. The sampling clock is used by the transmitter for data bit shifting and receiver for data sampling. The BRG divisor (DLL and DLM registers) defaults to a random value upon power up. Therefore, the BRG must be programmed during initialization to the operating data rate.
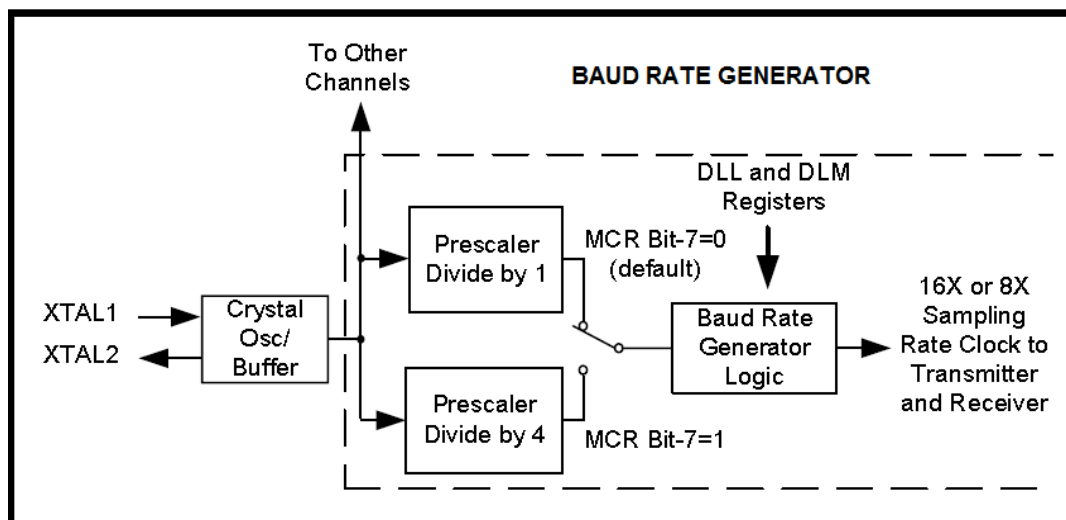
Figure 5-1: Programmable Baud Rate Generator

Programming the Baud Rate Generator Registers DLM and DLL provides the capability for selecting the operating data rate. Table 5-1 shows the standard data rates available with a 14.7456 MHz crystal or external clock at 16X clock rate. At 8X sampling rate, these data rates would double. When using a non-standard data rate crystal or external clock, the divisor value can be calculated with the following equation(s).

divisor (decimal) = (XTAL1 clock frequency / prescaler) / (serial data rate x 16), **WITH 8XMODE [7:0] IS 0**

divisor (decimal) = (XTAL1 clock frequency / prescaler / (serial data rate x 8), **WITH 8XMODE [7:0] IS 1**

OUTPUT Data Rate MCR Bit-7=1	OUTPUT Data Rate MCR Bit-7=0	DIVISOR FOR 16x Clock (Decimal)	DIVISOR FOR 16x Clock (HEX)	DLM PROGRAM VALUE (HEX)	DLL PROGRAM VALUE (HEX)	DATA RATE ERROR (%)
100	400	2304	900	09	00	0
600	2400	384	180	01	80	0
1200	4800	192	C0	00	C0	0
2400	9600	96	60	00	60	0
4800	19.2k	48	30	00	30	0
9600	38.4k	24	18	00	18	0
19.2k	76.8k	12	0C	00	0C	0
38.4k	153.6k	6	06	00	06	0
57.6k	230.4k	4	04	00	04	0
115.2k	460.8k	2	02	00	02	0
230.4k	921.6k	1	01	00	01	0

Table 5-1: Typical Data Rates with a 14.7456 MHz Crystal

End of excerpt from the Exar XR17D158 datasheet

Chapter 6: Connector Pin Assignments

IDC 40-Pin Header Male

```
2 □□□□□□□□□□□□□□□□□□□□ 40
1 □□□□□□□□□□□□□□□□□□□□ 39
```

Pin	Ch	RS-485 Functions	Ch	RS-422 Functions	Ch	RS-232 Functions	2-port versions
1						DCD	
2						DSR	
3		TX/RX+		TX+		RX	
4	PORT A	TX/RX-	PORT A	TX-	PORT A	RTS	
5						TX	
6				RX-		CTS	
7				RX+		DTR	Pins 1 through 20 only are populated on this 40-pin connector for 2-port versions
8						RI	
9		Ground		Ground		Ground	
10						N/C	
11						DCD	
12						DSR	
13		TX/RX+		TX+		RX	
14	PORT B	TX/RX-	PORT B	TX-	PORT B	RTS	
15						TX	
16				RX-		CTS	
17				RX+		DTR	
18						RI	
19		Ground		Ground		Ground	
20						N/C	
21						DCD	
22						DSR	
23		TX/RX+		TX+		RX	
24	PORT C	TX/RX-	PORT C	TX-	PORT C	RTS	
25						TX	
26				RX-		CTS	
27				RX+		DTR	Pins may not be populated for 2-port versions
28						RI	
29		Ground		Ground		Ground	
30						N/C	
31						DCD	
32						DSR	
33		TX/RX+		TX+		RX	
34	PORT D	TX/RX-	PORT D	TX-	PORT D	RTS	
35						TX	
36				RX-		CTS	
37				RX+		DTR	
38						RI	
39		Ground		Ground		Ground	
40						N/C	

Table 6-1: P1 Connector Pin Assignment (8-, 4-, and 2-port boards)

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

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.
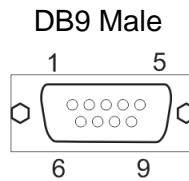
DB9 Male

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 - 7	TX/RX -	Transmit / Receive -
Ch x - 5	GND	Signal Ground

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

Manual 104I-COM-8SM

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

Bus type: PCI 32-bit, 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: 1.8432Mbps (RS-422 & 485 modes)
                         460.8kbps (RS-232 mode standard model)
                         921.6kbps (RS-232 -F factory option)

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
ESD: ±15kV Human Body Model
                             ±15kV Air Discharge
                             ±8kV Contact Discharge

RS-422/485 Mode:

Receiver Input Sensitivity: ±200mV differential input
Common Mode Range: +12V to -7V
Transmitter Output Drive: 60mA with thermal shutdown
Input Impedance: 12k ohm minimum
Input Hysteresis: 50mV typical

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: PCI-104-Plus format, 3.550" x 3.775"

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.
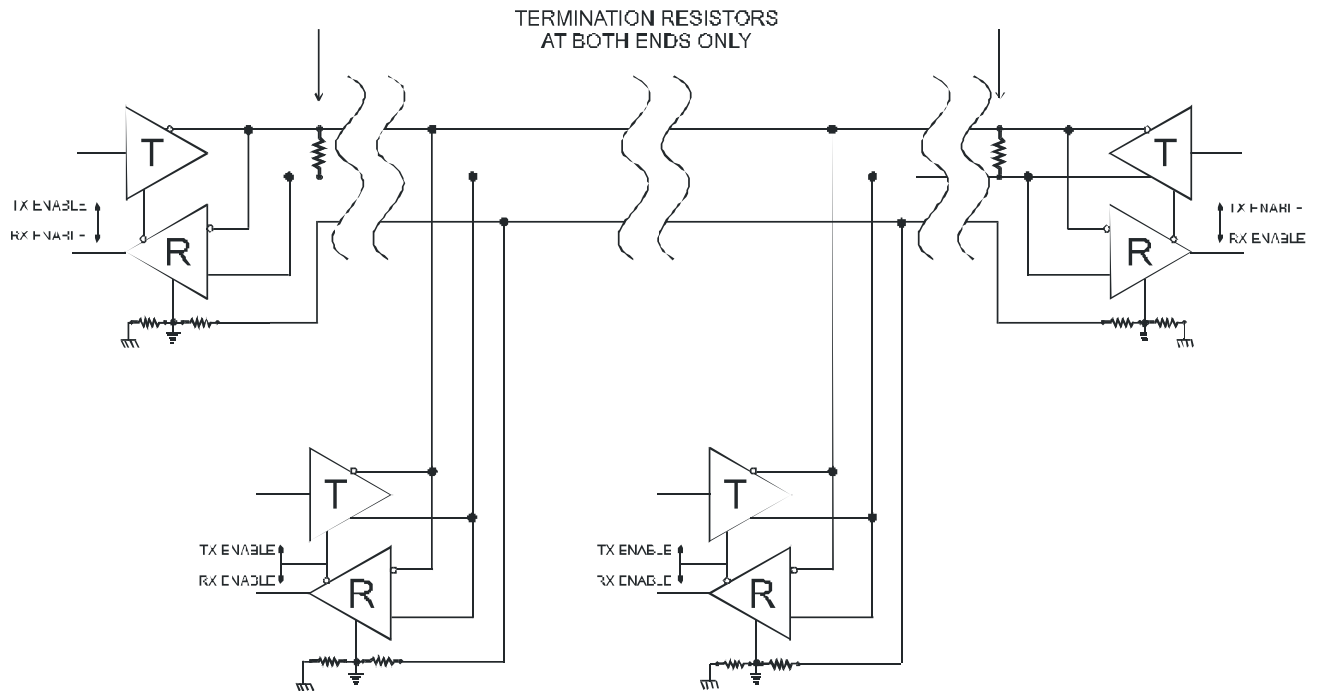

Figure A-1: Typical RS-485 Two-Wire Multidrop Network

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.