MODEL ICOM422/485A

USER MANUAL

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Chapter 1: Introduction

The card is five inches long and should be installed in either long or short slots of IBM PC/XT/AT or compatible computers. If installed in an eight-bit slot, the high interrupts (IRQ 10-15) will not be available to the ICOM422/485A.

Multipoint Opto-isolated Communications

The ICOM422/485A serial communications card was designed for multipoint transmission on long communication lines in noisy environments using RS422 or RS485 differential line drivers. The data lines are opto-isolated from the computer and from each other to assure communication when large common mode noise are superimposed.   An on-board DC-DC converter provides isolated power for the line driver circuits.

A crystal oscillator is located on the card. This oscillator permits precise selection of baud rate from 50 to 115,200 in the 1X mode. In the 4X mode, baud rates up to 460,800 baud may be selected. The Programming section of this manual contains a table to use when selecting baud rate.

The output transceiver used, type 75176B, is capable of driving extremely long communication lines at high baud rates. It can drive up to ±60mA on balanced lines and receive inputs as low as ±200mV differential signal. Opto-isolators on the card provide protection to maximum 500 V. In case of communication conflict, the transceivers feature thermal shutdown.

COM Port Compatibility

Type ST16C550 UARTs are used as the Asynchronous Communication Element (ACE) which include a 16-byte transmit/receive buffer to protect against lost data in multitasking operating systems, while maintaining 100 percent compatibility with the original IBM serial port.

ICOM422/485A card is not restricted to the standard DOS addresses of COM1 - COM4. You can select a base address anywhere within the I/O address range 000 to 3F8 hex and the FINDBASE program will help you choose from available addresses.

Line Bias and Termination

For increased noise immunity, the communication lines may be loaded at the receiver and biased at the transmitter. RS485 communications requires that one transmitter supply a bias voltage to ensure a known "zero" state when all transmitters are off, and the last receiver input at each end of the network be terminated to prevent "ringing". The ICOM422/485A supports these options with jumpers on the card. See Chapter 3, Option Selection for more details.

Auto and Manual Transceiver Control

RS485 communications requires the transmitter driver to be enabled and disabled as needed, to allow all cards to share the communications line. The ICOM422/485A card has automatic driver control. When the card is not transmitting, the receiver is enabled and the transmitter driver is disabled. Under automatic control, when data are to be transmitted, the receiver is disabled and the driver is enabled. After data transfer is complete, the driver remains enabled for the transmission time of one additional character and then disabled. The ICOM422/485A automatically adjusts it's timing to the baud rate of the data.

Communication Modes

Model ICOM422/485A supports Half-Duplex, and Full-Duplex communications in a variety of 2-wire and 4-wire cable connections. Half-Duplex allows traffic to travel in both directions, but only one direction at a time. In Full-Duplex mode data travels in both directions at the same time.

CE Marking

If your card is marked CE-marked it meets requirements of EN50081-1:1992 (Emissions), EN50082-1:1992 (Immunity), and EN60950:1992 (Safety).

Specification

Communications Interface

- **Serial Ports:** A shielded male D-sub 9-pin IBM AT style connector compatible with RS422 and RS485 specifications. Serial communications ACE used is type ST16C550. Transceivers used are type 75176.

- **Serial Data Rates:** 50 to 115,200 baud in the 1X mode and up to 460,800 in the 4X mode. The mode is jumper selectable. Asynchronous,Type 16550 buffered UART.

- **Address:** Continuously mappable within 000 to 3FF (hex) range of AT I/O bus addresses.

- **Multipoint:** Compatible with RS422 and RS485 specifications. Up to 32 drivers and receivers allowed on line.

- **Input Isolation:** 500 Volts, from computer and between ports.

- **Receiver Input Sensitivity:** ±200 mV, differential input.

- **Transmitter Output Drive Capability:** 60 mA (100 mA short-circuit current capability).

Environmental

- **Operating Temperature Range:** 0 to +60 ℃

- **Storage Temperature Range:** -50 to +120 ℃

- **Humidity:** 5% to 95%, non-condensing.

- **Power Required:** +5VDC at 150 mA typical, +12 VDC at 200 mA typical. 3 W total power consumption.

- **Size:** 5" long. (127 mm) Although designed for a full-length slot, if the card is installed in a eight-bit XT-style slot the card will work but higher order IRQ's 10-15 will be unavailable.
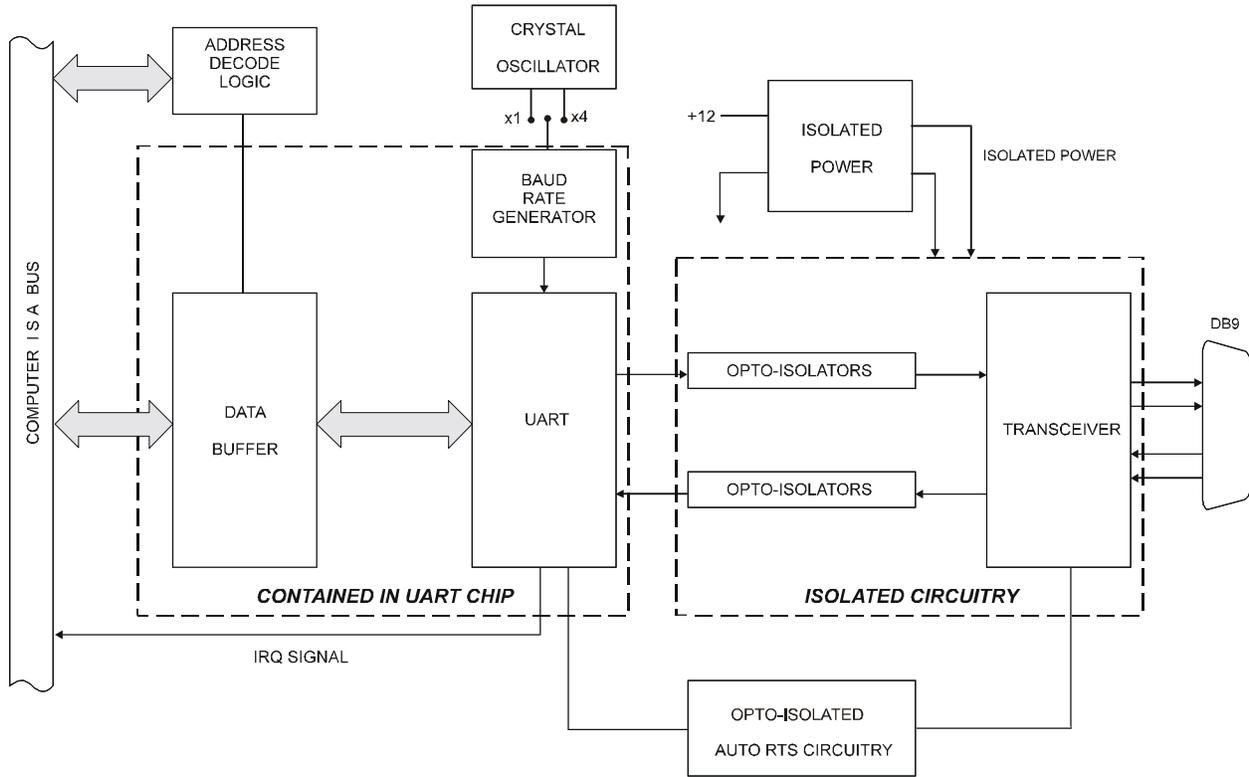
Figure 1-1: ICOM422/485A Block Diagram

Chapter 2: Installation

The software provided with this card is contained on either one CD or multiple diskettes and must be installed onto your hard disk prior to use. To do this, perform the following steps as appropriate for your software format and operating system. Substitute the appropriate drive letter for your CD-ROM or disk drive where you see d: or a: respectively in the examples below.

CD Installation

DOS/WIN3.x
1.   Place the CD into your CD-ROM drive.
2.   Type ⍰⍰⍰ to change the active drive to the CD-ROM drive.
3.   Type ⍰⍰⍰⍰⍰⍰⍰⍰⍰ to run the install program.
4.   Follow the on-screen prompts to install the software for this card.

WIN95/98/NT/2000
1.   Place the CD into your CD-ROM drive.
2.   The CD should automatically run the install program after 30 seconds. If the install program does not run, click START | RUN and type d:install, click OK or press ⍰ .
3.   Follow the on-screen prompts to install the software for this card.

3.5-Inch Diskette Installation

As with any software package, you should make backup copies for everyday use and store your original master diskettes in a safe location. The easiest way to make a backup copy is to use the DOS DISKCOPY utility.

In a single-drive system, the command is:

⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰

You will need to swap disks as requested by the system.
In a two-disk system, the command is:

⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰

This will copy the contents of the master disk in drive A to the backup disk in drive B.

To copy the files on the master diskette to your hard disk, perform the following steps.
1.   Place the master diskette into a floppy drive.
2.   Change the active drive to the drive that has the diskette installed. For example, if the diskette is in drive A, type ⬚⬚⬚ .
3.   Type ⬚⬚⬚⬚⬚⬚⬚⬚ and follow the on-screen prompts.

Directories Created on the Hard Disk

The installation process will create several directories on your hard disk. If you accept the installation defaults, the following structure will exist.

[CARDNAME]

Root or base directory containing the SETUP.EXE setup program used to help you configure jumpers and calibrate the card.

DOS\PSAMPLES:	A subdirectory of [CARDNAME] that contains Pascal samples.
DOS\CSAMPLES:	A subdirectory of [CARDNAME] that contains "C" samples.
Win32\language:	Subdirectories containing samples for Win95/98 and NT.

WinRISC.exe

A Windows dumb-terminal type communication program designed for RS422/485 operation. Used primarily with Remote Data Acquisition Pods and our RS422/485 serial communication product line. Can be used to say hello to an installed modem.

ACCES32

This directory contains the Windows 95/98/NT driver used to provide access to the hardware registers when writing 32-bit Windows software. Several samples are provided in a variety of languages to demonstrate how to use this driver. The DLL provides four functions (InPortB, OutPortB, InPort, and OutPort) to access the hardware.

This directory also contains the device driver for Windows NT, ACCESNT.SYS. This device driver provides register-level hardware access in Windows NT. Two methods of using the driver are available, through ACCES32.DLL (recommended) and through the DeviceIOControl handles provided by ACCESNT.SYS (slightly faster).

SAMPLES

Samples for using ACCES32.DLL are provided in this directory. Using this DLL not only makes the hardware programming easier (MUCH easier), but also one source file can be used for both Windows 95/98 and WindowsNT. One executable can run under both operating systems and still have full access to the hardware registers. The DLL is used exactly like any other DLL, so it is compatible with any language capable of using 32-bit DLLs. Consult the manuals provided with your language's compiler for information on using DLLs in your specific environment.

VBACCES

This directory contains sixteen-bit DLL drivers for use with VisualBASIC 3.0 and Windows 3.1 only. These drivers provide four functions, similar to the ACCES32.DLL. However, this DLL is only compatible with 16-bit executables. Migration from 16-bit to 32-bit is simplified because of the similarity between VBACCES and ACCES32.

PCI

This directory contains PCI-bus specific programs and information. If you are not using a PCI card, this directory will not be installed.

SOURCE

A utility program is provided with source code you can use to determine allocated resources at run-time from your own programs in DOS.

PCIFind.exe

A utility for DOS and Windows to determine what base addresses and IRQs are allocated to installed PCI cards. This program runs two versions, depending on the operating system. Windows 95/98/NT displays a GUI interface, and modifies the registry. When run from DOS or Windows3.x, a text interface is used. For information about the format of the registry key, consult the card-specific samples provided with the hardware. In Windows NT, NTioPCI.SYS runs each time the computer is booted, thereby refreshing the registry as PCI hardware is added or removed. In Windows 95/98/NT PCIFind.EXE places itself in the boot-sequence of the OS to refresh the registry on each power-up.

This program also provides some COM configuration when used with PCI COM ports. Specifically, it will configure compatible COM cards for IRQ sharing and multiple port issues.

WIN32IRQ

This directory provides a generic interface for IRQ handling in Windows 95/98/NT. Source code is provided for the driver, greatly simplifying the creation of custom drivers for specific needs. Samples are provided to demonstrate the use of the generic driver. Note that the use of IRQs in near-real-time data acquisition programs requires multi-threaded application programming techniques and must be considered an intermediate to advanced programming topic. Delphi, C++ Builder, and Visual C++ samples are provided.

Findbase.exe

DOS utility to determine an available base address for ISA bus , non-Plug-n-Play cards. Run this program once, before the hardware is installed in the computer, to determine an available address to give the card. Once the address has been determined, run the setup program provided with the hardware to see instructions on setting the address switch and various option selections.

Poly.exe

A generic utility to convert a table of data into an nth order polynomial. Useful for calculating linearization polynomial coefficients for thermocouples and other non-linear sensors.

Risc.bat

A batch file demonstrating the command line parameters of RISCTerm.exe.

RISCTerm.exe

A dumb-terminal type communication program designed for RS422/485 operation. Used primarily with Remote Data Acquisition Pods and our RS422/485 serial communication product line. Can be used to say hello to an installed modem. RISCTerm stands for Really Incredibly Simple Communications TERMinal.

Installing the Card

The ICOM422/485A card can be installed in a long slot of an IBM PC/XT/AT or compatible computer. Before installing the card carefully read Chapter 3, Option Selection and Chapter 4, Address Selection and configure the card according to your requirements. You can find an unused base address with the FINDBASE program provided on the CD (or diskettes) that came with your card. Finally, our setup program will lead you through the process of setting the options on the ICOM422/485A. The setup program does not set the options on the card, these must be set by jumpers on the card.

Be especially careful with address selection. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

To Install the Card

1. Turn off computer power.
2. Remove the computer cover.
3. Remove the blank I/O backplate.
4. Install jumpers for selected options from either Chapter 3, Option Selection of this manual or the suggestions of our software SETUP program.
5. Select the base address on the card for either Chapter 4, Address Selection of this manual or the suggestions of our FINDBASE setup software program.
6. Install the card in an I/O expansion slot.
7. Install the I/O cable.
8. Inspect for proper fit of the card and cable and tighten screws. Make sure that the card mounting bracket is properly screwed into place and that there is a positive chassis ground.
9. Turn the computer ON and observe the LED indicators. The LED's will blink when there is any activity on the communication lines.
10. Turn the computer OFF and replace the computer cover.

Note

If installed in an eight-bit slot, IRQs 10-15 will be unavailable.

A DB9 connector is provided on the mounting bracket for input/output connections. 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.) be used for input/output wiring.

Chapter 3: Option Selection

The following paragraphs describe the functions of the various jumpers on the ICOM422/485A card. Refer to Figure 3-1, Option Selection Map for the locations of these jumpers on the card.

Address Selection

DIP switches A3 through A9 set the card's base address on the I/O bus. See the Address Selection section of this manual to follow.

IRQ2 Through IRQ15

Place a jumper at the location that corresponds to the IRQ level that you desire. If the card is installed in a short, eight-bit slot, the higher interrupts IRQ10 through IRQ15 will not be usable.
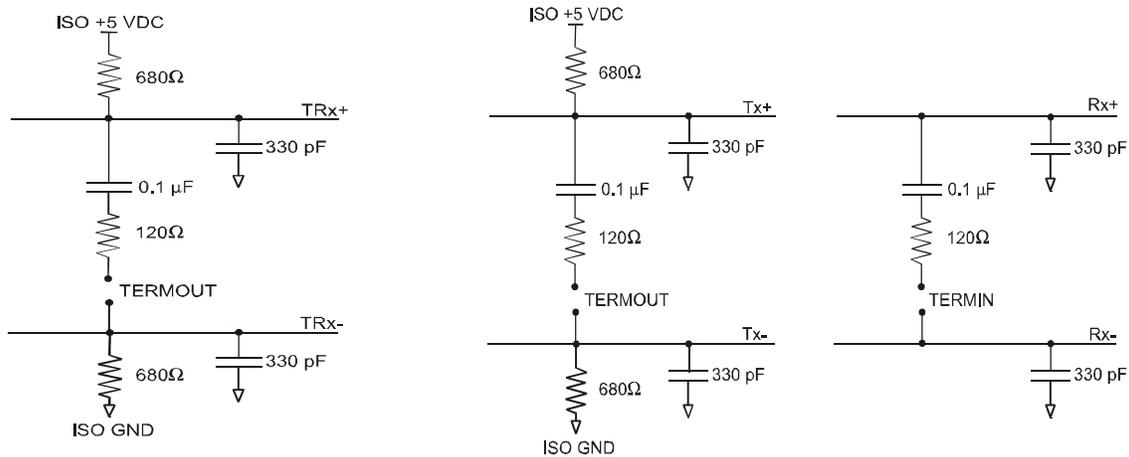
485 and 422

A jumper at the "485" location sets the card in RS485, Half-Duplex, automatic RTS mode. A jumper at the "422" location sets the card in RS422, Full-Duplex mode.

Baud x1 and Baud x4

Placement of this jumper controls baud rate. The "x1" position permits baud rates up to 115.2Kbaud and the "x4" position permits baud rates up to 460.8Kbaud.

Terminations and Bias

A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the location labeled TERMOUT applies a 120? load in series with a 0.1?F capacitor across the output (if desired) for RS422 mode and across the transmit/receive input/output for RS485 operation. A jumper at the TERMIN location applies a load on RS422 inputs.

```
ISO +5 VDC                    ISO +5 VDC
   680Ω                          680Ω                           Rx+
                  TRx+                      Tx+          330 pF
           330 pF                   330 pF
   0.1 µF                        0.1 µF                  0.1 µF
   120Ω                          120Ω                    120Ω
 TERMOUT                       TERMOUT                  TERMIN
                  TRx-                      Tx-                   Rx-
           330 pF                   330 pF          330 pF
   680Ω                          680Ω
ISO GND                        ISO GND
```

Two-Wire Connection   Four-Wire Connection

Figure 3-1: Simplified Schematic - Two-Wire and Four-Wire Connection

Full or Half-Duplex

Full-Duplex allows simultaneous bi-directional communications. Half-Duplex allows bi-directional transmit and receiver communication but only one at a time, and is required for RS485 communications. Proper selection depends on the wire connections used to connect the two serial ports. The following table shows how two serial communication cards would be interconnected for the various modes. Tx designates the transmit wires and Rx designates the receive wires.

Communication Modes and Cabling Options

Mode				Cable		
					Card A	**Card B**
Simplex	2-wire Receive Only		Rx-	1	. . . . . .	2
			Rx+	9	. . . . . .	3
Simplex	2-wire Transmit Only		Tx+	2	. . . . . .	9
			Tx-	3	. . . . . .	1
Half-Duplex	2-wire with local echo		TRx+	2	. . . . . .	2
			TRx-	3	. . . . . .	3
Half-Duplex	2-wire w/o local echo		TRx+	2	. . . . . .	2
			TRx-	3	. . . . . .	3
Full-Duplex	4-wire w/o local echo		Tx+	2	. . . . . .	9
			Tx-	3	. . . . . .	1
			Rx-	1	. . . . . .	3
			Rx+	9	. . . . . .	2
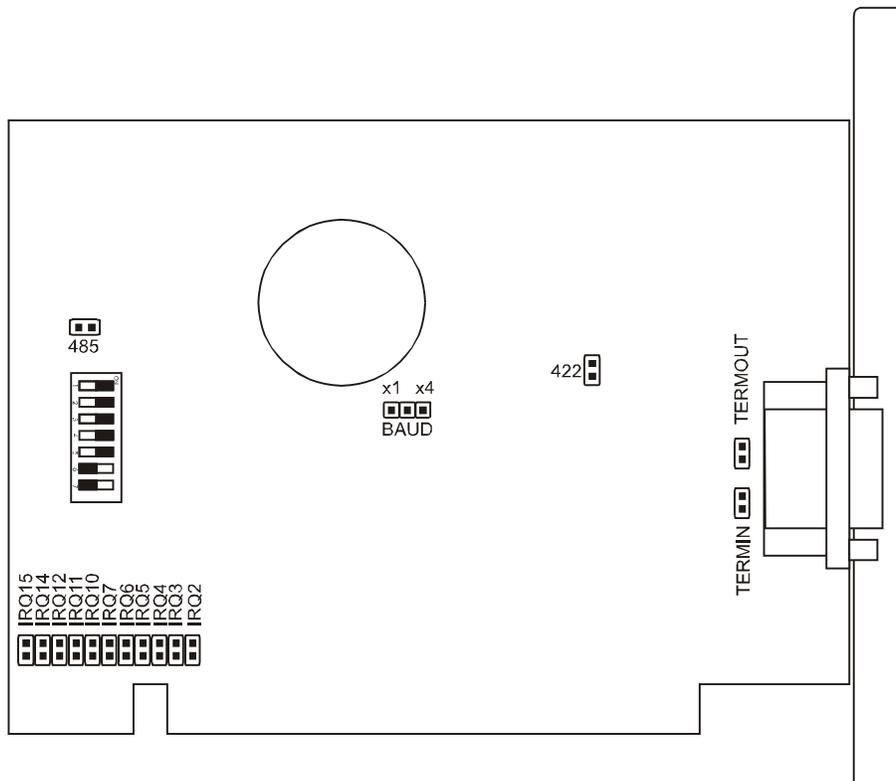
Figure 3-2: ICOM422/485A Option Selection Map

Switches
- S1=COM Address (This illustration has COM at the COM 3 address.)

Jumpers
- 485 Selects RS485 with automatic-RTS mode.
- 422 Selects RS422 Full duplex mode.
- TERMOUT   Load for RS485 mode or output load for RS422 mode.
- TERMIN   Input load for RS422 mode.
- Baud x1   Selects baud rate range 50 to 115,200 baud.
- Baud x4   Selects baud rate range 200 to 460,800 baud.

Chapter 4: Address Selection

The ICOM422/485A base address can be selected anywhere within the I/O bus address range 100-3F8 hex, providing that the address does not overlap with other functions. If in doubt, refer to the table below for a list of standard address assignments. (The primary and secondary binary synchronous communication ports are supported by the Operating System.) The base address locator program FINDBASE provided on CD (or diskettes) will assist you to select a base address that will avoid conflict with other installed computer resources. Then, the SETUP program will show you how to position the address switches when you have selected a base address.

The following provides background information to help you better understand this process.

Hex Range	Usage
000-01F	DMA Controller 1
020-03F	INT Controller 1, Master
040-05F	Timer
060-06F	8042 (Keyboard)
070-07F	Real Time Clock, NMI Mask
080-09F	DMA Page Register
0A0-0BF	INT Controller 2
0C0-0DF	DMA Controller 2
0F0	Clear Math Coprocessor Busy
0F1	Reset Coprocessor
0F8-0FF	Arithmetic Processor
1F0-1F8	IDE Fixed Disk
200-207	Game I/O
278-27F	Parallel Printer Port 2
2F8-2FF	Asynchronous Comm'n (Secondary)
300-31F	Prototype Card
360-36F	Reserved
378-37F	Parallel Printer Port 1
380-38F	SDLC or Binary Synchronous Comm'n 2
3A0-3AF	Binary Synchronous Comm'n 1
3B0-3BF	Monochrome Display/Printer
3C0-3CE	Local Area Network
3D0-3DF	Color/Graphic Monitor
3F0-3F7	Floppy Diskette Controller
3F8-3FF	Asynchronous Comm'n (Primary)

Table 4-1: Standard Address Assignments for 286/386/486 Computers

I/O bus address switches are marked A3-A9. The following table lists switch label vs. the address line controlled and the relative weights of each.

Address Switch Settings	1st Digit		2nd Digit				3rd
Switch Label	7	6	5	4	3	2	1
Address Line Controlled	A9	A8	A7	A6	A5	A4	A3
Decimal Weight	512	256	128	64	32	16	8
Hexadecimal Weight	200	100	80	40	20	10	8

Table 4-2: Address Switch Setup

In order to read the address switch setup, assign a binary "1" to switches that are turned OFF and a binary "0" to switches in the ON position. For example, as illustrated in the following table, switch selection corresponds to binary 10 1101 1xxx (hex 2D8). The "xxx" represents address lines A2, A1, and A0 used on the card to select individual registers. See Chapter 5, Programming in this manual.

Switch Label	A9	A8	A7	A6	A5	A4	A3
Setup	OFF	ON	OFF	OFF	ON	OFF	OFF
Binary Representation	1	0	1	1	0	1	1
Conversion Factors	2	1	8	4	2	1	8
HEX Representation	2		D				8

Table 4-3: Example Address Setup

Review the Address Selection Table carefully before selecting the card address. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

The following table lists standard DOS COM Port addresses.

Serial COM Port	IRQ	Base Hex Address	Address Switch Settings						
			A9	A8	A7	A6	A5	A4	A3
COM1	IRQ 4	3F8	1	1	1	1	1	1	1
COM2	IRQ 3	2F8	1	0	1	1	1	1	1
COM3	IRQ 4	3E8	1	1	1	1	1	0	1
COM4	IRQ 3	2E8	1	0	1	1	1	0	1

Table 4-4: Standard DOS COM Port Addresses

Notice that only two interrupts are assigned to four serial ports. "Sharing" interrupts is not a good idea if both ports are used at the same time.

Chapter 5: Programming

Sample Programs

There are sample programs provided with the ICOM422/485A 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 ICOM422/485A 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 = (crystal frequency) / (32 * divisor)

When the BAUD jumper is in the X1 position, the UART clock frequency is 1.8432MHz. 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	Divisor	Divisor	Max. Diff'l.
460800	N/A	1	500 ft
230400	N/A	2	800 ft
153600	N/A	3	1300 ft
115200	1	4	2200 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	4000 ft.
4800	24	96	4000 ft.
2400	48	192	4000 ft.
1200	96	384	4000 ft.

*These are theoretical maximums based on typical conditions and good quality cables.

Table 5-1: Baud Rate Divisors

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)
```

The third step of the initialization sequence is to set the Modem Control Register at Base Address +4. This register controls functions on some cards. Bit 1 is the Request to Send (RTS) control bit. This bit should be left low until transmission time. (Note: When operating in the automatic RS485 mode, the state of this bit is not significant.) Bits 2 and 3 are user-designated outputs. Bit 2 may be ignored on this card. Bit 3 is used to enable interrupts and should be set high if an interrupt-driven receiver is to be used.

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. Polling is not effective at high data rates above because the program cannot do anything else when it is polling or data could be missed. 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 automatically enables the transmitter when data is ready to send so no software enabling procedure is needed.

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.	RS422 Four-Wire	RS485 Two-Wire
1	Rx- Receive Data	
2	Tx+ Transmit Data (Output)	TRx+
3	Tx- Transmit Data	TRx-
4	Not Used	
5	Gnd Isolated Common (Ground)	Ground
6	Not Used	
7	Not Used	
8	Not Used	
9	Rx+ Receive Data (Input)	

Table 6-1: Connector Pin Assignments

Note

If the unit is CE-marked, then CE-certifiable cabling and breakout methodology (cable shields grounded at the connector, shielded twisted-pair wiring, etc) must be used.

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. 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	**9-pin Connector**	**Signal**	**9-pin Connector**
Gnd	5	Gnd	5
TX^+	2	RX^+	9
TX^-	3	RX^-	1
RX^+	9	TX^+	2
RX^-	1	TX^-	3

Table A-1: Connections Between Two RS422 Devices

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

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.

The maximum common mode voltage rating 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			50?
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			4K?

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.)

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.
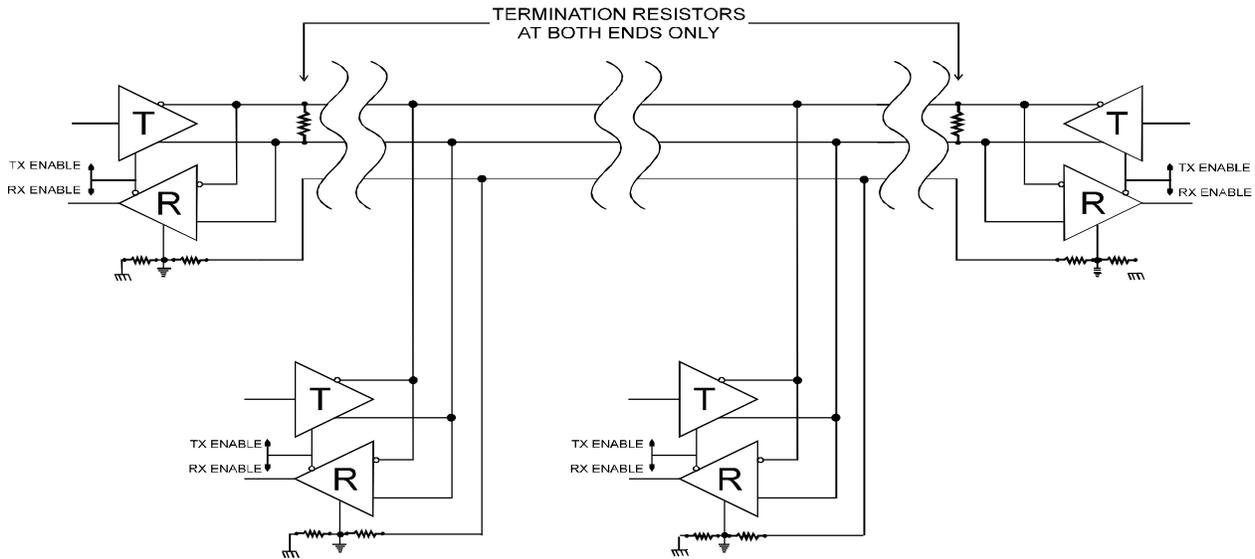

Figure A-1: Typical RS485 Two-Wire Multidrop Network

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@accesioproducts.com.*. Please detail any errors you find and include your mailing address so that we can send you any manual updates.