Model COM485/2
Product Manual

MANUAL NUMBER : 00650-122-3B

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6260 SEQUENCE DRIVE, SAN DIEGO, CA 92121-4371 (619) 677-0877 (FAX) 619-677-0895

INDUSTRIAL COMPUTER SOURCE EUROPE *TEL 01.69.18.74.40 FAX 01.64.46.40.42* • ***INDUSTRIAL COMPUTER SOURCE (UK) LTD*** *TEL 01243-523500 FAX 01243-532949*

FOREWARD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by Industrial Computer Source. The following pages contain information regarding the warranty and repair policies.

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

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A thirty day money-back guarantee is provided on all **standard** products sold. **Special order products** are covered by our Limited Warranty, *however they may not be returned for refund or credit. EPROMs, RAM, Flash EPROMs or other forms of solid electronic media are not returnable for credit - but for replacement only. Extended Warranty available. Consult factory.*

Refunds

In order to receive refund on a product purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, software, cables, etc.) within 30 days of receipt and in as-new and resalable condition. The **Return Procedure** must be followed to assure prompt refund.

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One year limited warranty on all products sold with the exception of the "Performance Series" I/O products, which are warranted to the original purchaser, for as long as they own the product, subject to all other conditions below, including those regarding neglect, misuse and acts of God. Within one year of purchase, Industrial Computer Source will repair or replace, at our option, any defective product. At any time after one year, we will repair or replace, at our option, any defective "Performance Series" I/O product sold. This does not include products damaged in shipment, or damaged through customer neglect or misuse. Industrial Computer Source will service the warranty for all standard catalog products for the first year from the date of shipment. After the first year, for products not manufactured by Industrial Computer Source, the remainder of the manufacturer's warranty, if any, will be serviced by the manufacturer directly.

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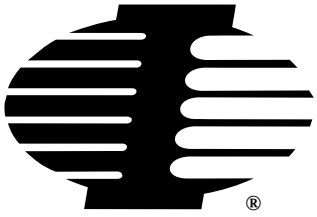
The limited warranty is void if the product has been subjected to alteration, neglect, misuse, or abuse; if any repairs have been attempted by anyone other than Industrial Computer Source or its authorized agent; or if the failure is caused by accident, acts of God, or other causes beyond the control of Industrial Computer Source or the manufacturer. Neglect, misuse, and abuse shall include any installation, operation, or maintenance of the product other than in accordance with the owners' manual.

No agent, dealer, distributor, service company, or other party is authorized to change, modify, or extend the terms of this Limited Warranty in any manner whatsoever. Industrial Computer Source reserves the right to make changes or improvements in any product without incurring any obligation to similarly alter products previously purchased.



Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by Industrial Computer Source.

Return Procedure

For any Limited Warranty or Guarantee return, please contact Industrial Computer Source's Customer Service at **1-800-480-0044** and obtain a Return Material Authorization (RMA) Number. All product(s) returned to Industrial Computer Source for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing date of purchase.

> To reduce risk of damage, returns of product must be in an Industrial Computer Source shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from Industrial Computer Source Customer Service at a nominal cost.

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In no event shall Industrial Computer Source be liable for any defect in hardware or software or loss or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. Industrial Computer Source liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by Industrial Computer Source or its authorized agent.

Some *Sales Items* and *Customized Systems* are **not** subject to the guarantee and limited warranty. However in these instances , any deviations will be disclosed prior to sales and noted in the original invoice. ***Industrial Computer Source reserves the right to refuse returns or credits on software or special order items.***

Advisories

Three types of advisories are used throughout the manual to stress important points or warn of potential hazards to the user or the system. They are the Note, the Caution, and the Warning. Following is an example of each type of advisory:

Note: The note is used to present special instruction, or to provide extra information which may help to simplify the use of the product.

CAUTION!

A Caution is used to alert you to a situation which if ignored may cause injury or damage equipment.

WARNING!

A Warning is used to alert you of a situation which if ignored will cause serious injury.

Cautions and Warnings are accented with triangular symbols. The exclamation symbol is used in all cautions and warnings to help alert you to the important instructions. The lightning flash symbol is used on the left hand side of a caution or a warning if the advisory relates to the presence of voltage which may be of sufficient magnitude to cause electrical shock.

Use caution when servicing any electrical component. We have tried to identify the areas which may pose a Caution or Warning condition in this manual; however, Industrial Computer Source does not claim to have covered all situations which might require the use of a Caution or Warning.

You must refer to the documentation for any component you install into a computer system to insure proper precautions and procedures are followed.

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Chapter 1: Installation

Backing up the Disk

The software provided with the COM485/2 card is in MS-DOS on diskette. As with any software package, you should make back-up copies for everyday use and place your original master diskette in a safe location.

The easiest way to make a back-up copy is to use the DOS DISKCOPY utility.

In a single-drive system the command is diskcopy a: a:

In a two-drive system the command is diskcopy a: b:

(This will copy the master disk in drive A to the back-up disk in drive B.)

Hard Disk Installation

The files contained on the master diskette may also be copied onto your hard disk. To do this perform the following:

1. Place the master diskette into a floppy drive.
2. Change the active drive to the drive that has the master diskette installed. For example, if the diskette is the A drive, type A:
3. Type install and follow the screen prompts.

Files contained on the disk are stored in separate directories as follows:

COM485/2:	Root or base directory containing the FINDBASE PROGRAM that will help you to decide what base address to use with the card. Also contains the COM485/2ET.EXE setup program.
PSAMPLES:	Contains Pascal samples.
CSAMPLES:	Contains “C” samples.
BSAMPLES:	Contains QuickBASIC samples.
VBACCES:	VisualBASIC utility driver that includes PEEK and POKE statements for reading and writing RAM as well as INPORT and OUTPORT for reading and writing I/O. The driver is in the form of a DLL and allows you to access hardware as if the language was designed for it when you use VisualBASIC for Windows 3.x (VB 4.0 support is provided separately.)

Installing the Card

The COM485/2 card can be installed in a short or long slot of an IBM PC/XT/AT or compatible computer. Before installing the card carefully read the **OPTION SELECTION** and **ADDRESS SELECTION** sections of this manual and configure the card according to your requirements. You can find an open base address with the FINDBASE program on the diskette provided with the card. Finally, our COM-SET setup program will lead you through the process of setting the options on the COM485/2. 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 the **Option Selection** section of this manual or the suggestions of our COM485/2ET setup software program.
5. Select the base address on the card using either the **Address Selection** section of this manual or the suggestions for COM485/2 in our FINDBASE setup software program.
6. Install the card in an I/O expansion slot.

Note: If installed in an eight-bit slot, IRQ's 10-15 will be unavailable.

7. Install the I/O cable.
8. Inspect for proper fit of the card and cable and tighten screws.
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.

How to remain CE Compliant

This device complies with CE Directives 72/23/EEC and EMC 89/336/EEC. CE compliance is based on the interaction of all the components of a system. Any modifications made to the equipment may affect the CE compliance and must be approved in writing by Industrial Computer Source. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to claim CE compliance.

The Model COM485/2 is designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

Chapter 2: Functional Description

The COM485/2 Serial Interface Card was designed for effective multipoint transmission in the most common protocols. For long-distance, or noisy environments, consider our ISO-COM485/2 with optically isolated line drivers. The COM485/2 is 6.5 inches long and may be installed in short or long 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 COM485/2.

Multi-Protocol Operation

The COM485/2 is a multi-protocol serial card supporting RS232, RS422 or RS485 communications. RS232 is the most common form of serial communication but is an unbalanced, single line system unsuitable for distances over 50 feet. RS422 is an extension of RS232 but uses differential (or balanced) line drivers to improve noise immunity and increase the maximum distance to 4000 feet. RS485 improves on RS422 with switchable transceivers and the ability to support multiple devices on a single "party line". The RS485 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".

RS485 and RS422 Balanced Mode Operation

In addition to RS232 mode, the COM485/2 also supports RS422 and RS485 modes which use differential balanced drivers for increased range and noise immunity. COM485/2 also has capability to add bias voltages and to add load resistors to terminate the communications lines. (RS485 communications requires that one transmitter supply a bias voltage to ensure a known "zero" state when all transmitters are off. Also, receiver inputs at each end of the network should be terminated to eliminate "ringing". The COM485/2 supports these options by means of jumpers on the card. See the "Option Selection" section for more details.

Com Port Compatibility

Type NS16550 UART's 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% compatibility with the original IBM serial port. However, the COM485/2 card is not restricted to the standard DOS addresses of COM1 - COM4. Continuous address selection is available anywhere within the I/O address range 000 to 3F8 hex and our FINDBASE program will scan I/O Bus memory-mapped addresses in your computer for available addresses that can be used by COM485/2 without conflict with other computer resources..

A crystal oscillator is located on the card. This oscillator permits precise selection of baud rate from 50 to 115,200 with the standard crystal oscillator. Other crystals for higher baud rate ability are available upon special order. If your COM485/2 is so modified, then there will be an "addendum" sheet in the front of this catalog.

The driver/receiver used, the 75ALS180, 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.

Two sets of LED indicators are provided on the COM485/2 card. The LED's blink to indicate activity on the transmitting and receiving lines and are useful for problem diagnosis.

Communication Modes

COM485/2 supports Simplex, Half-Duplex, and Full-Duplex communications in a variety of 2- and 4-wire cable connections. Simplex is the simplest form of communications with transmission occurring only in one direction. Half-Duplex allows traffic to travel in both directions, but only one way at a time. In Full-Duplex operation, data travels in both directions at the same time. RS485 communications commonly use the half-duplex mode since they share only a single pair of wires. COM485/2 also supports the option of locally echoing the characters back to the transmitter.

RTS AND Auto-RTS Transceiver CONTROL

In RS485 communications the driver must be enabled and disabled as needed, allowing all cards to share a two wire or four wire cable. The COM485/2 card has two methods of controlling the driver; automatic (AUTO) and request-to-send (RTS) control. With automatic control, the driver is enabled when data is ready to be transmitted. The driver remains enabled for the transmission time of one character after data transfer is complete and then is disabled. The COM485/2 automatically adjusts it's timing to the baud rate of the data. (Note: for use with Windows programs, COM485/2 must be operated in the AUTO-RTS mode.)

Under RTS control, your software must set the RTS bit to a logic 1 to enable the driver and logic 0 to disable the driver.

The receiver is also normally disabled during RS485 transmissions. See the **Option Selection** section for details on setting the AUTO and RTS modes, and for enabling or disabling local echoing of characters. In normal RS485 communication the echo is turned off to prevent data being echoed back.

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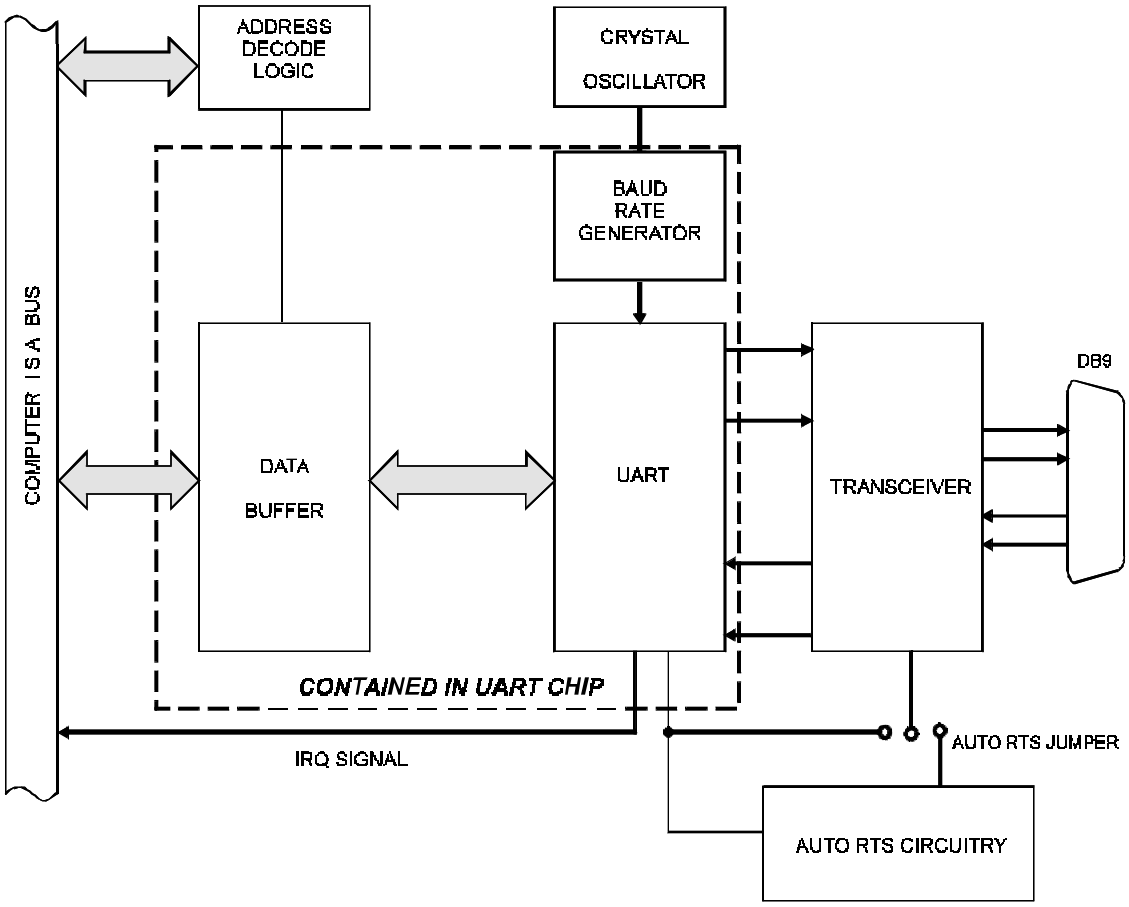

Figure 2-1: COM485/2 Block Diagram
(Only one serial channel shown)

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Chapter 3: RS232/422/485 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.

232/422: *Jumpers must be installed in these blocks for each COM port.* The function of the 232 and 422 jumpers are to configure the port for single-ended RS-232 communications or differential RS-422/485 mode communications.

ECHO: This jumper enables local echoing of transmitted characters back to the receiver. It is used to confirm (locally) that a character was transmitted and must be installed for full duplex RS-422 mode.

AUTO or RTS: *Only one jumper may be installed for each COM por*t. These jumpers select either the AUTOMATIC or RTS line control modes for RS485 operation. To operate with Windows programs, select AUTOMATIC.

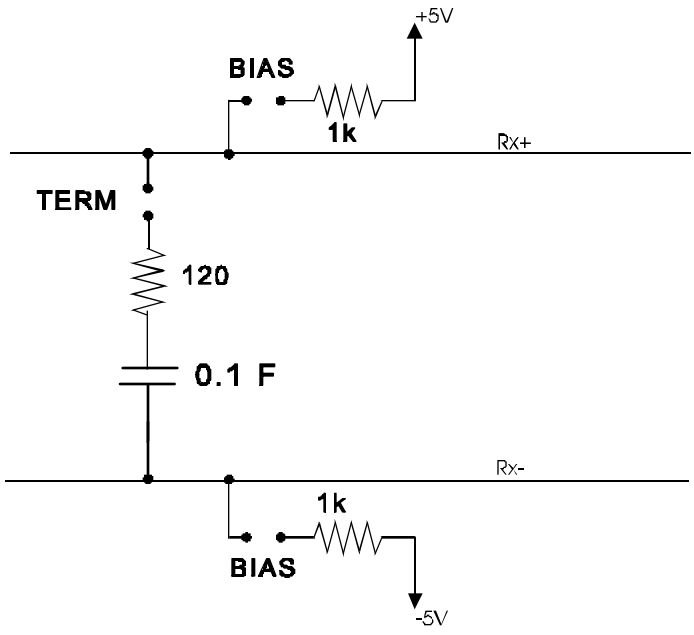


Figure 3-1: RS232/422/485 Option Selection

TERMINATIONS AND BIAS: A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the location labeled TERM applies a 120W load across the input for RS-422 mode and across the transmit/receive input/output for RS-485 operation.

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 RS485 operation, there must be a bias on the RX+ and RX- lines. *If the COM485/2 card is to provide that bias, install jumpers at the locations labeled BIAS.*

SIMPLEX or DUPLEX: The receiver can be set in either SIMPLEX or DUPLEX as set by the RS422 jumper as listed in the following table. SIMPLEX mode is intended for one-way communication able to transmit or receive. DUPLEX mode allows transmission or reception either simultaneous or alternatively as defined in the following paragraph.

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. Proper selection depends on the wire connections used to connect the two serial ports and the 422 and ECHO jumpers as defined in the following table.

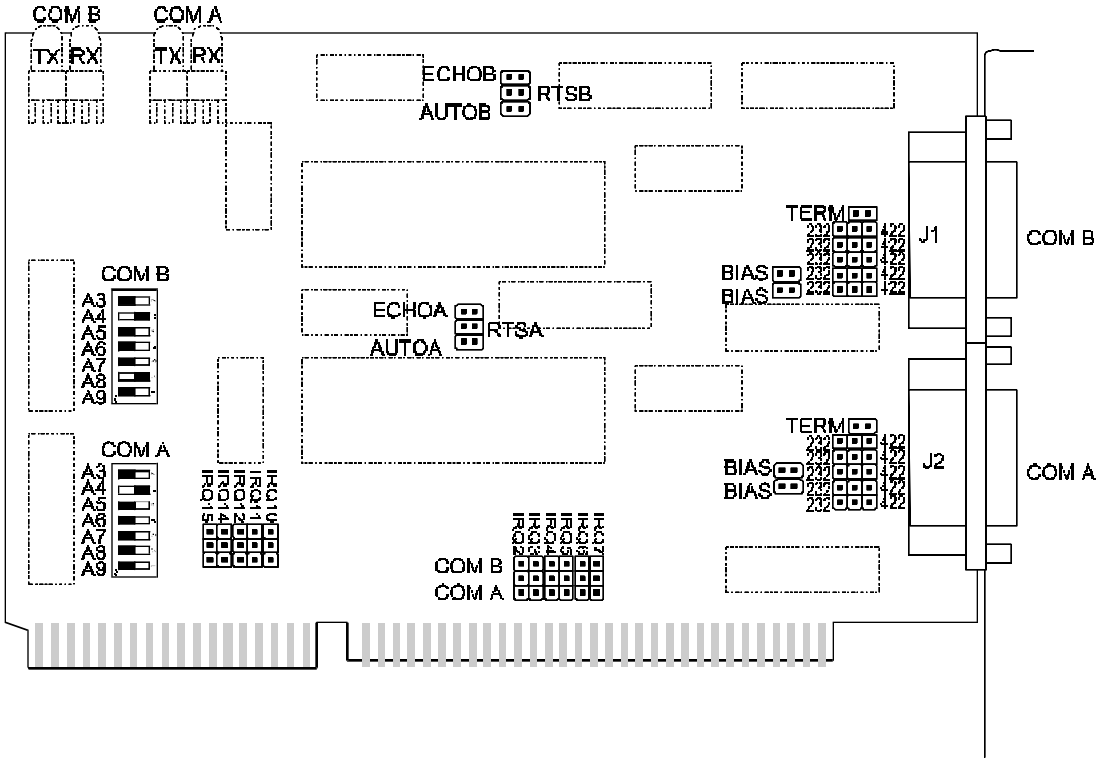
When two numbers are joined together with a "&" the two pins are jumpered together.

Data Cable Wiring

				CABLE	
Mode		**Jumpers**		**Card 1&Card 2**	
RS232		232		2	3
				3	2
		Ground		5	5
RS422/485					
Simplex	2-wire Receive Only	422	Rx	9	2
				1	3
Simplex	2-wire Transmit Only	422	Tx	2	9
				3	1
Half Duplex	2-wire without local echo *	422		1&3	1&3
				2&9	2&9
Half Duplex	2-wire with local echo	422, ECHO		1&3	1&3
				2&9	2&9
Full Duplex	4-wire with local echo	422,ECHO	Tx^+	2	9
				3	1
			Rx^+	9	2
				1	3

* Preferred RS485 mode.

INTERRUPTS: In addition to standard interrupt levels IRQ2 through IRQ7, the COM485/2 also supports higher interrupts IRQ10 through IRQ15 (Except IRQ13 and others reserved by other installed hardware). Select the desired level by installing a jumper in one of these locations. If the COM485/2 is installed in a short eight-bit slot, the higher interrupts (IRQ10 through IRQ15) will be unavailable to the card.



Switches

S1=COM-B Address Illustration above shows switches set to:
S2=COM-A Address COM-A = COM 3, COM-B = COM 4

Jumpers

JP16, JP20 = COM485/2 IRQ
232,422 = Select communications mode;
Single ended (RS232) or Differential (RS422/485)
TERM = Terminate RS485 receive lines
BIAS = Apply RS485 bias to transmitter lines
RTS (A/B) = Use manual RTS RS485 transceiver control (For port A or B)
AUTO (A/B) = Use automatic RTS RS485 transceiver control (For port A or B)
ECHO (A/B) = Locally echo characters (For port A or B)

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Chapter 4: Address Selection

The COM485/2 base address can be selected anywhere within an I/O 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 FINDBASE base address locator program provided on diskette with your card will assist you to select a base address that will avoid this conflict.

Hex Range	Usage
000-0FF	Internal System - Not Usable
1F0-1FF	AT Hard Disk
200-207	Game Control
278-27F	Parallel Port (LPT2)
238-23B	Bus Mouse
2E8-2EF	Asynchronous Communications (COM4)
2F8-2FF	Asynchronous Communications (COM2)
300-31F	Prototype Card
320-32F	XT Hard Disk
378-37F	Parallel Port (LPT1)
380-38F	SDLC Communications
3A0-3AF	SDLC Communications
3B0-3BB	MDA
3BC-3BF	Alt. Parrallel Port
3C0-3CF	EGA
3DO-3DF	CGA
3E8-3EF	Asynchronous Communications (COM3)
3F0-3F7	Floppy Disk
3F8-3FF	Asynchronous Communications (COM1)

Table 4-1: Standard Address Assignments for PC and PC/XT Computers

Address Switch Settings	1st Digit		2nd Digit				3rd Digit
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: COM485/2 Address Switches

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 **PROGRAMMING** section of this manual.

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

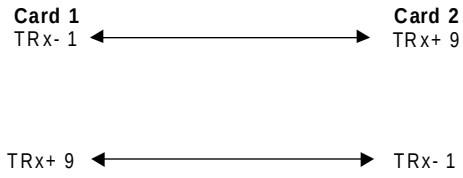
There are two sample programs installed with the diskette with the COM-2S card. These are:

Sample 1

This program is provided in C, Pascal, and QuickBASIC. It performs a test of the loopback feature of the UART. It requires no external hardware and no interrupts.

Sample 2

This program is provided in C only and demonstrates interrupt-driven RS485 half-duplex operation. The program requires at least two computers with one card in each and a two-wire cable interconnecting them. That cable must connect the Tx pins from card 1 to the Rx pins respectively of card 2 and the Tx pins from card 2 to the Rx pins at card 1.



RS232 Programming

RS232 programming is the simplest of all requiring only setup of the baud rate and data format. Remember to have the driver jumpers in the 232 position.

RS422 Programming

Programming for RS422 operation is a simplified version of RS485 communications without the overhead of multiple devices on the same line. RS422 also supports multiple devices but only if one port is limited to transmitting and all the other ports are always receivers. Remember to have the driver jumpers in the 422 position and to terminate one end of the RS422 line.

RS485 Programming

Programming the UART for RS485 communication can be divided into three distinct sections: initialization, reception, and transmission. Initialization deals with option setup on the chip including baud rate selection. Reception deals with incoming-character processing which can be done using either polling or interrupts. Transmission deals with the process of sending the data out. Remember to have the jumpers in the 422 position.

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)
```

On the COM-2S card, the crystal frequency is 3.6864 MHz. Below is a table for the popular divisor frequencies:

Baud Rate Divisor Values

Baud Rate	Divisor	Notes:	Max Diff. Cable Length *
115200	1		375 feet
57600	2		660 ft
38400	3		920 ft
28800	4		1165 ft
19200	6		1620 ft
14400	8		2050 ft
9600	12	Most common industrial speed	4000 ft
4800	24		4000 ft
2400	48		4000 ft
1200	96		4000 ft

* Recommended maximum distances for differentially driven data cables (RS422 or RS485) are for typical conditions. RS-232 communication lines have a maximum length of 50 feet, regardless of speed.

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. 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 RS-485 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. A simple polling loop must continuously check this bit and read in data as it becomes available. The following code fragment implements a polling loop and uses a value of 13, (ASCII Carriage Return) as an end-of-transmission marker:

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

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

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

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

Transmission

RS485 transmission is simple to implement. The AUTO feature of the COM485/2 card automatically enables the transmitter when data are ready to send so no software enabling is required. The following software example is for non-AUTO operation.

First the RTS line should be set high by writing a 1 to Bit 1 of the Modem Control Register at Base Address +4. The RTS line is used to toggle the transceiver from receive mode to transmit mode and vice versa. It is not carried out on the line in RS485 and is not used for handshaking. Similarly, the CTS line is not used in RS485 and should always be enabled by installing a jumper as described earlier.

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

The following C code fragment demonstrates this process:

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

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. Connector pin assignments are as follows:

Pin Connectors

		RS-232 Functions		RS-422/485 Functions	
Pin 1	-	DCD	Data Carrier Detect (Input)	Rx^-	Receive Data
Pin 2	-	RD	Receive Data (input)	Tx^+	Transmit Data
Pin 3	-	TD	Transmit Data (output)	Tx^-	Transmit Data
Pin 4	-	DTR	Data Terminal Ready (output)		
Pin 5	-	Gnd	Signal Ground	GND	Ground
Pin 6	-	DSR	Data Set Ready (input)		
Pin 7	-	RTS	Request to Send (output)		
Pin 8	-	CTS	Clear to Send (input)		
Pin 9	-	RI	Ring Indicator (input)	Rx^+	Receive Data

Note: For Simplex, Half Duplex, and Full Duplex operation, see the **OPTION SELECTION** section of this manual for pin connection information.

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Chapter 7: Specifications

Communications Interface

I/O Connection:	9-pin male D-sub connectors
Serial Ports:	Two shielded male D-sub 9-pin IBM AT style connectors compatible with RS-232, RS-422 and RS-485 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:	50 to 115,200 (Faster or custom rates available), Asynchronous, Type 16550 buffered UART.
Address:	Continuously mappable within 000 to 3FF (hex) range of AT I/O bus addresses.

RS232 Drivers

Device:	75C185 Quad Line Transceivers
Output Voltage:	± 6VDC minimum, current limited to 10 mA.
Receiver threshold:	1.5V high, 0.75 low, Maximum input ±30VDC

RS422/RS485 Differential Communication Mode

Multipoint:	Compatible with RS422 and RS485 specifications. Up to 32 drivers and receivers allowed on line. Serial communications ACE used is type NS16550. Driver/Receivers used are type 75ALS180.
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 to +60 ℃
Humidity:	5% to 95%, non-condensing.
Storage Temperature Range:	-50 to +120 °C
Power Required:	+5VDC at 125 mA typical, -12VDC at 5 mA typical, +12VDC at 5 mA typical, 750 mW total power consumption.
Size:	6 1/2" long (3/4 length) by 3 7/8" Although designed for a half-length slot, if the card is installed in an 8-bit XT-style slot, the card will work but higher order IRQ's 10-15 will be unavailable.)

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Appendix A: Application Considerations

Introduction

Working with RS-422 and RS-485 devices is not much different from working with standard RS232 serial devices and these two standards overcome deficiencies in the RS-232 standard. First, the cable length between two RS232 devices must be short; less than 50 feet. Second, many RS232 errors are the result of noise induced on the cables. The RS-422 standard permits cable lengths up to 5000 feet and, because it operates in differential mode, it is more immune to induced noise.

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

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

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

Balanced Differential Signals

The reason that RS422 and RS485 devices can drive longer lines with more noise immunity than RS232 devices is that a balanced differential drive method is used. In a balanced differential system, the voltage produced by the driver appears across a pair of wires. A balanced line driver will produce a differential voltage from ±2 to ±6 volts across its output terminals. A balanced line driver can also have an input “enable” signal that connects the driver to its output terminals. If the “enable” signal is OFF, the driver is disconnected from the transmission line. This disconnected or disabled condition is usually referred to as the “tristate” condition and represents a high impedance. RS485 drivers must have this control capability. RS422 drivers may have this control but it is not always required.

A balanced differential line receiver senses the voltage state of the transmission line across the two signal input lines. If the differential input voltage is greater than +200 mV, the receiver will provide a specific logic state on its output. If the differential voltage input is less than -200 mV, the receiver will provide the opposite logic state on its output. The maximum operating voltage range is from +6V to -6V allowing for voltage attenuation that can occur on long transmission cables.

A maximum common mode voltage rating of ±7V provides good noise immunity from voltages induced on the twisted pair lines. The signal ground line connection is necessary in order to keep the common mode voltage within that range. The circuit may operate without the ground connection but may not be reliable.

RS422 Specifications Summary

Parameter	Conditions	Min.	Max.
Driver Output Voltage (unloaded)		4V	6V
		-4V	-6V
Driver Output Voltage (loaded)	TERM jumpers in	2V	
		-2V	
Driver Output Resistance			50 Ohms
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 Ohms

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. (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.)

Note: You do not have to add a terminator resistor to your cables when you use the COM-2S card. Termination resistors for the RX^+ and RX^- lines are provided on the card and are placed in the circuit when you install the TERM jumpers. Moreover, installing the BIAS jumpers properly biases these lines. (See the **Option Selection** section of this manual.)

RS485 Data Transmission

The RS485 Standard allows a balanced transmission line to be shared in a party-line mode. As many as 32 driver/receiver pairs can share a two-wire party line network. Many characteristics of the drivers and receivers are the same as in the RS422 Standard. One difference is that the common mode voltage limit is extended and is +12V to -7V. Since any driver can be disconnected (or tristated) from the line, it must withstand this common mode voltage range while in the tristate condition.

RS485 Two-Wire Multidrop Network

The following illustration shows a typical multidrop or party line network. Note that the transmission line is terminated on both ends of the line but not at drop points in the middle of the line.

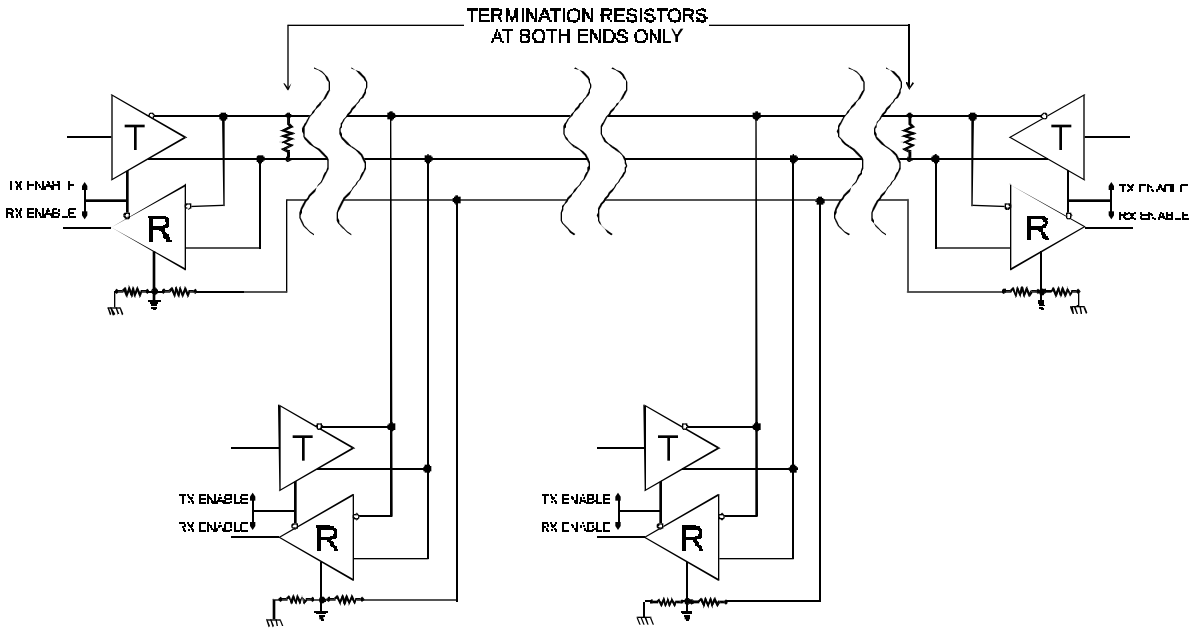

Figure A-1: Typical RS485 Two-Wire Multidrop Network

RS485 Four Wire Multidrop Network

An RS485 network can also be connected in a four-wire mode. In a four-wire network it's necessary that one node be a master node and all others be slaves. The network is connected so that the master communicates to all slaves and all slaves communicate only with the master. This has advantages in equipment that uses mixed protocol communications. Since the slave nodes never listen to another slave's response to the master, a slave node cannot reply incorrectly.

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August 28, 1997
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