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MODEL COM-2S

USER MANUAL

FILE: MCOM-2S.C3d

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Chapter 1: Introduction

The COM-2S Serial Interface Card was designed for effective multipoint transmission. The COM-2S is 6.5 inches long and may be installed in 8 or 16-bit 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 COM-2S.

Multi-Protocol Operation

The COM-2S 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 COM-2S also supports RS422 and RS485 modes which use differential balanced drivers for increased range and noise immunity. COM-2S 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 COM-2S supports these options by means of jumpers on the card. See Chapter 3, Option Selection for more details.

COM Port Compatibility

Type 16550 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% compatibility with the original IBM serial port. However, the COM-2S 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 COM-2S without conflict with other computer resources.

A crystal oscillator is located on the card. This oscillator ensures 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 COM-2S 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 COM-2S card. The LEDs blink to indicate activity on the transmitting and receiving lines and are useful for problem diagnosis.

Communication Modes

COM-2S 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. COM-2S 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 COM-2S 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 COM-2S automatically adjusts its timing to the baud rate of the data. (Note: For use with Windows programs, COM-2S 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 Chapter 3, Option Selection 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.

CE Marking

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

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 3F8 (hex) range of AT I/O bus addresses.

Caution

The OUT2 bit of the UART must be set low for proper interrupt driven communication. This bit enables or disables the interrupts and the card will not communicate if the bit is pulled high.

RS232 Drivers

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

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 °C. to +60 °C.
- Storage Temperature Range: -50 °C. to +120 °C.
- Humidity: 5% to 95%, non-condensing.
- 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 IRQs 10-15 will be unavailable.

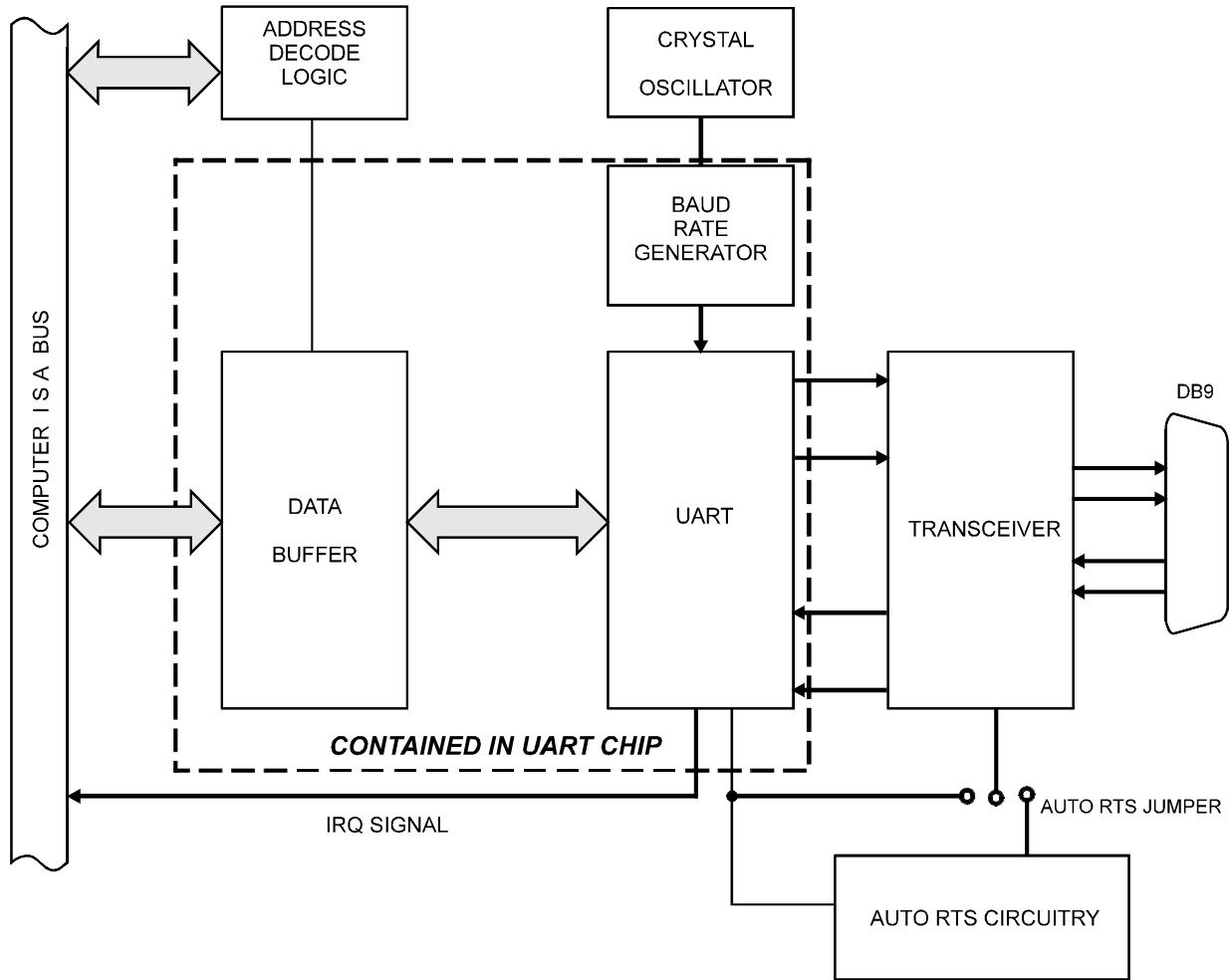


Figure 1-1: COM-2S Block Diagram
 (Only one serial channel shown)

Chapter 2: Installation

A printed Quick-Start Guide (QSG) is packed with the board for your convenience. If you've already performed the steps from the QSG, you may find this chapter to be redundant and may skip forward to begin developing your application.

The software provided with this ISA Board is on CD and must be installed onto your hard disk prior to use. To do this, perform the following steps as appropriate for your operating system.

CD Installation

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

DOS

1. Place the CD into your CD-ROM drive.
2. Type `D: Enter` to change the active drive to the CD-ROM drive.
3. Type `INSTALL Enter` to run the install program.
4. Follow the on-screen prompts to install the software for this board.

WINDOWS

1. Place the CD into your CD-ROM drive.
2. The system should automatically run the install program. If the install program does not run promptly, click START | RUN and type `D:INSTALL`, click OK or press `Enter`.
3. Follow the on-screen prompts to install the software for this board.

LINUX

1. Please refer to linux.htm on the CD-ROM for information on installing serial ports under linux.

Installing the Hardware

Before installing the board, carefully read Chapter 3 and Chapter 4 of this manual and configure the board according to your requirements. The SETUP Program can be used to assist in configuring jumpers on the board. Be especially careful with Address Selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. To help avoid this problem, refer to the FINDBASE.EXE program installed from the CD. The setup program does not set the options on the board, these must be set by jumpers.

To Install the Board

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 setup software program.
5. Select the base address on the card using either the Address Selection section of this manual or the suggestions for COM-2S in 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 board 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.

Note

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

Two DB9 connectors are 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 the input/output wiring.

Installing COM Ports in Windows Operating Systems

***NOTE:** COM boards can be installed in virtually any operating system and we do support installation in earlier versions of Windows, and are very likely to support future version as well. For use in WinCE, contact the factory for specific instructions.

Windows NT4.0

To install the COM ports in Windows NT4 you'll need to change one entry in the registry. This entry enables IRQ sharing on multi-port COM boards. The key is

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Serial. The name of the value is **PermitShare** and the data should be set to **1**.

You'll then add the board's ports as COM ports, setting the base addresses and IRQs to match your board's settings.

To change the registry value, run RegEdit from the START|RUN menu option (by typing REGEDIT [ENTER] in the space provided). Navigate down the tree view on the left to find the key, and double click on the name of the value to open a dialog allowing you to set the new data value.



To add a COM port, use START|CONTROL PANEL|PORTS applet and click ADD, then enter the correct UART address and Interrupt number.

When the "Add New Port" dialog is configured click OK, but answer "Don't Restart Now" when prompted, until you've added any other ports as well. Then restart the system normally, or by selecting "Restart Now."

Windows XP

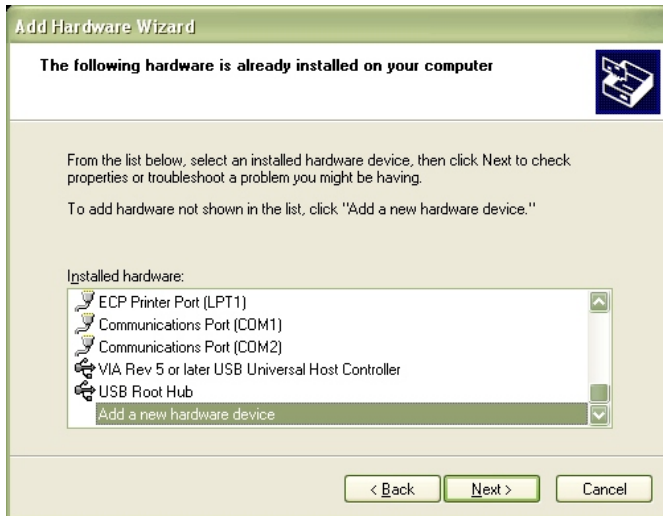
To install the COM ports in Windows XP you will be manually installing "standard" communications ports, then changing the settings for resources used by the ports to match the hardware.

Run the "Add Hardware" applet from the Control Panel.

Click "Next" at the "Welcome to the Add New Hardware Wizard" dialog.

You'll briefly see a "...searching..." message, then

Select "Yes, I have already connected the hardware" and Click "Next"



Select “Add a new hardware device” from the bottom of the list presented and Click “Next.”

Select “Install the hardware that I manually select from a list” and Click “Next.”

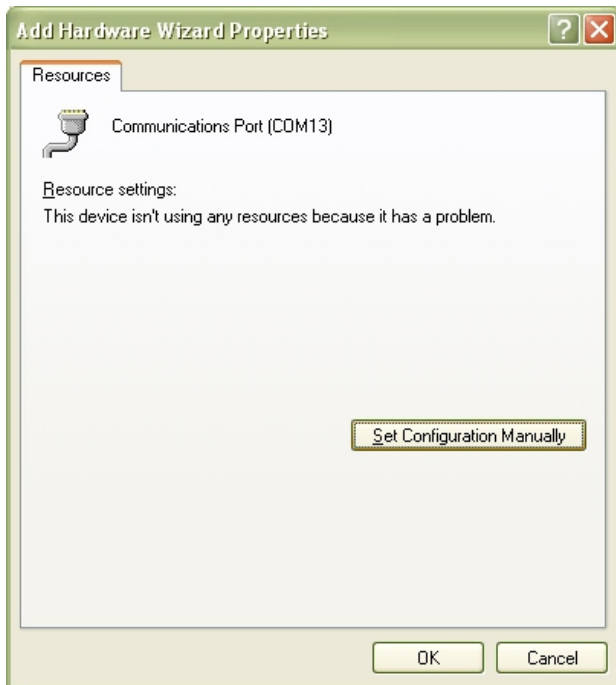
Select “Ports (COM & LPT) and Click “Next”

Select “(Standard Port Types)” and “Communications Port” (the defaults), Click “Next.”

Click “Next.”



Click the “View or change resources for this hardware (Advanced)” link.

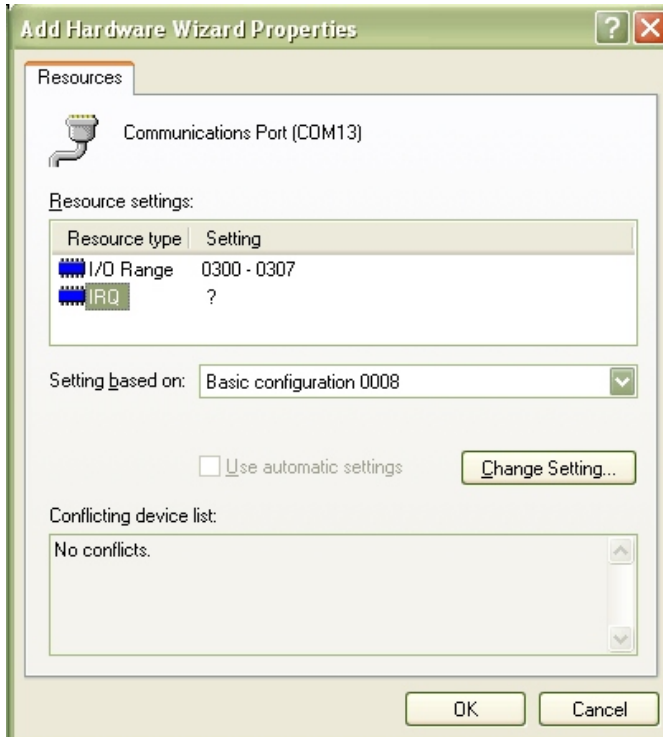


Click the "Set Configuration Manually" button.

Select "Basic Configuration 8" from the "Settings Based on:" drop-down list.

Select "I/O Range" in the "Resource Settings" box and Click the "Change Settings..." button.

Enter the base address of the board, and Click "OK"



Select "IRQ" in the "Resource Settings" box and Click the "Change Settings" button.

Enter the IRQ of the board and Click "OK".

Close the "Set Configuration Manually" dialog and Click "Finish."

Click "Do Not Reboot" if you wish to install more ports. Repeat all of the above steps, entering the same IRQ but using the configured Base address for each additional UART.

When you are done installing ports, reboot the system normally.

Chapter 3: Option Selection

To help you locate the jumpers described in this section, refer to the Option Selection Map at the end of this chapter. 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 RS232 communications or differential RS422/485 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 may be installed for two-wire half-duplex RS485 mode.

Auto or RTS

Only one jumper may be installed for each COM port. These jumpers select either the Automatic or RTS line control modes for RS485 operation. To operate with Windows programs, select Automatic.

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 120Ω load across the input for RS422 mode and across the transmit/receive input/output for RS485 operation.

In RS485 operations, where there are multiple terminals, only the RS485 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 COM-2S card is to provide that bias, install jumpers at the locations labeled BIAS.

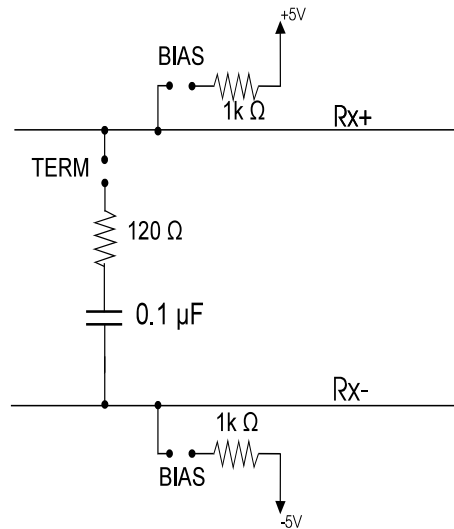
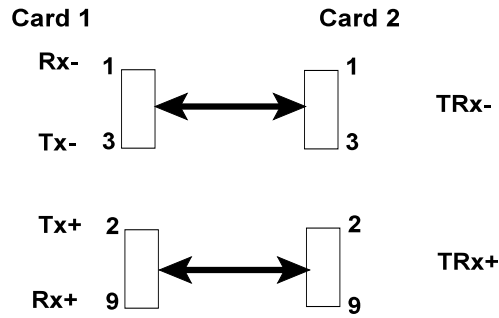


Figure 3-1: Simplified Termination Schematic

Data Cable Wiring

| When two pin numbers are joined together with a "&", those pins are wired together in the external cable. | | | Cable | |
|---|----------------------------|-----------|--------|--------|
| Mode | Jumpers | Signal | Card 1 | Card 2 |
| RS232 | 232 (x5) | DCD | 1 | 7&8 |
| | | RX | 2 | 3 |
| | | TX | 3 | 2 |
| | | DTR | 4 | 6 |
| | | Ground | 5 | 5 |
| | | DSR | 6 | 4 |
| | | RTS | 7 | 1 |
| | | CTS | 8 | 1 |
| | | RI | 9 | open |
| RS422/485 | | | | |
| Simplex (2-wire Receive Only) | 422 (x5) | Rx+ | 9 | 2 |
| | | Rx- | 1 | 3 |
| Simplex (2-wire Transmit Only) | 422 (x5) | Tx+ | 2 | 9 |
| | | Tx- | 3 | 1 |
| Half-Duplex (2-Wire no echo*) | 422 (x5) AUTO or RTS | Rx- & Tx- | 1 & 3 | 1 & 3 |
| | | Tx+ & Rx+ | 2 & 9 | 2 & 9 |
| Half-Duplex (2-Wire with echo) | 422 (x5) ECHO, AUTO or RTS | | 1 & 3 | 1 & 3 |
| | | | 2 & 9 | 2 & 9 |
| Full-Duplex (4-Wire) | 422 (x5) | Tx+ | 2 | 9 |
| | | Tx- | 3 | 1 |
| | | Rx+ | 9 | 2 |
| | | Rx- | 1 | 3 |

* Preferred RS485 mode.



Interrupts

In addition to standard interrupt levels IRQ2 through IRQ7, the COM-2S also supports higher interrupts IRQ10 through IRQ15 (Except IRQ 13 reserved by other hardware). Select the desired level by installing a jumper in one of these locations. If the COM-2S is installed in a short eight-bit slot, the higher interrupts (IRQ10 through IRQ15) will be unavailable to the card.

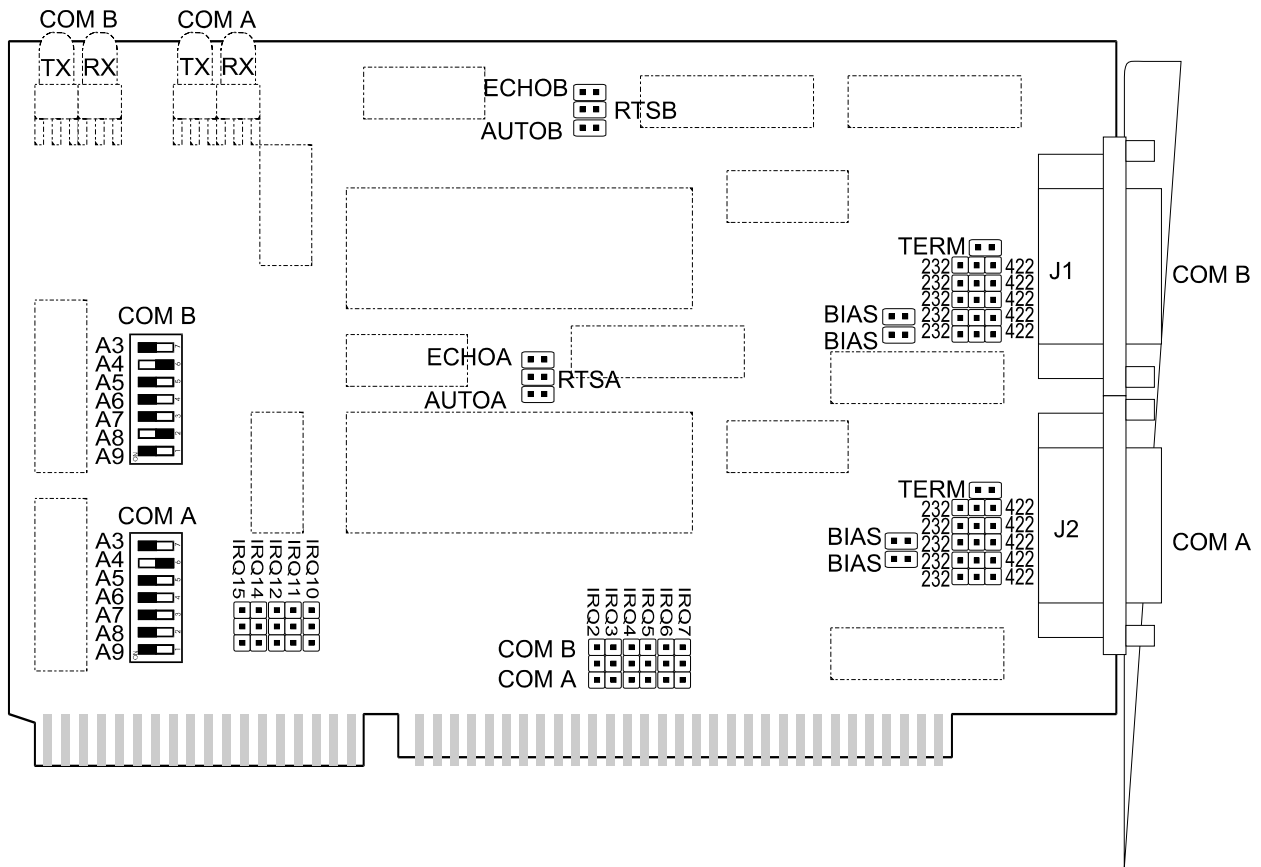


Figure 3-2: COM-2S Option Selection Map

Switches

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

Jumpers

- JP16, JP20 = COM-2S IRQ
- 232,422 = Select communications mode; Single ended (RS232) or Differential (RS422/485)
- TERM = Terminate receiver lines in RS422 and/or 485 mode
- BIAS = Apply bias to receiver lines in RS485 mode
- 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 (2-wire RS485 only) (For port A or B)

Chapter 4: Address Selection

The COM-2S 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 with your card will assist you to select a base address that will avoid this conflict.

| HEX RANGE | USAGE |
|-----------|----------------------------------|
| 000-00F | 8237 DMA Controller 1 |
| 020-021 | 8259 Interrupt |
| 040-043 | 8253 Timer |
| 060-06F | 8042 Keyboard Controller |
| 070-07F | CMOS RAM, NMI Mask Reg, RT Clock |
| 080-09F | DMA Page Register |
| 0A0-0BF | 8259 Slave Interrupt Controller |
| 0C0-0DF | 8237 DMA Controller 2 |
| 0F0-0F1 | Math Coprocessor |
| 0F8-0FF | Math Coprocessor |
| 170-177 | Fixed Disk Controller 2 |
| 1F0-1F8 | Fixed Disk Controller 1 |
| 200-207 | Game Port |
| 238-23B | Bus Mouse |
| 23C-23F | Alt. Bus Mouse |
| 278-27F | Parallel Printer |
| 2B0-2BF | EGA |
| 2C0-2CF | EGA |
| 2D0-2DF | EGA |
| 2E0-2E7 | GPIB (AT) |
| 2E8-2EF | Serial Port |
| 2F8-2FF | Serial Port |
| 300-30F | |
| 310-31F | |
| 320-32F | Hard Disk (XT) |
| 370-377 | Floppy Controller 2 |
| 378-37F | Parallel Printer |
| 380-38F | SDLC |
| 3A0-3AF | SDLC |
| 3B0-3BB | MDA |
| 3BC-3BF | Parallel Printer |
| 3C0-3CF | VGA EGA |
| 3D0-3DF | CGA |
| 3E8-3EF | Serial Port |
| 3F0-3F7 | Floppy Controller 1 |
| 3F8-3FF | Serial Port |

Table 4-1: Standard Address Assignments for Computers

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

| Address Switch Settings | 1st Digit | | 2nd Digit | | | | 3rd Digit |
|-------------------------|-----------|-----|-----------|----|----|----|-----------|
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Switch Label | 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: COM-2S 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 Chapter 5, Programming.

| | | | | | | | |
|--------------------|-----|----|-----|-----|----|-----|-----|
| 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 | 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 circuits 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.

Chapter 5: Programming

Sample Programs

There are sample programs provided with the COM-2S 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 COM-2S 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:

$$\text{desired baud rate} = (\text{crystal frequency}) / (32 * \text{divisor})$$

On the COM-2S card, a crystal frequency of 3.6864 MHz is divided by 2 before application to the UART. Below is a table for the popular divisor frequencies:

| Baud Rate | Divisor | Notes: | Max Diff. Cable Length * |
|-----------|---------|--------|--------------------------|
| 115200 | 1 | | 2200 ft |
| 57600 | 2 | | 4000 ft |
| 38400 | 3 | | 4000 ft |
| 28800 | 4 | | 4000 ft |
| 19200 | 6 | | 4000 ft |
| 14400 | 8 | | 4000 ft |
| 9600 | 12 | | 4000 ft |
| 4800 | 24 | | 4000 ft |
| 2400 | 48 | | 4000 ft |
| 1200 | 96 | | 4000 ft |

*These are theoretical maximums based on typical conditions and good quality cables based on the EIA 485 and EIA 422 standard for balanced differential drivers. RS-232 communication lines have a maximum length of 50 feet, regardless of speed.

Table 5-1: Baud Rate Divisor Values

In C, the code to set the chip to 9600 baud is:

```
outportb(BASEADDR, 0x0C);
outportb(BASEADDR +1, 0);
```

The second initializing step is to set the Line Control Register at Base Address +3. This register defines word length, stop bits, parity, and the DLAB.

Bits 0 and 1 control word length and allow word lengths from 5 to 8 bits. Bit settings are extracted by subtracting 5 from the desired word length.

Bit 2 determines the number of stop bits. There can be either one or two stop bits. If Bit 2 is set to 0, there will be one stop bit. If Bit 2 is set to 1, there will be two stop bits.

Bits 3 through 6 control parity and break enable. They are not commonly used for communications and should be set to zeroes.

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

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

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

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 COM-2S 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*/
```

Caution

The OUT2 bit of the UART must be set low for proper interrupt driven communication. This bit enables or disables the interrupts and the card will not communicate if the bit is pulled high.

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. | RS232 Functions | RS422/485 Functions |
|---------|----------------------------------|---------------------|
| 1 | DCD Data Carrier Detect (Input) | Rx- Receive Data |
| 2 | RD Receive Data (input) | Tx+ Transmit Data |
| 3 | TD Transmit Data (output) | Tx- Transmit Data |
| 4 | DTR Data Terminal Ready (output) | |
| 5 | Gnd Signal Ground | GND Ground |
| 6 | DSR Data Set Ready (input) | |
| 7 | RTS Request to Send (output) | |
| 8 | CTS Clear to Send (input) | |
| 9 | RI Ring Indicator (input) | Rx+ Receive Data |

Table 6-1: Connector Pin Assignments

Note

For Simplex, Half-Duplex, and Full-Duplex operation, see Chapter 3, Option Selection in this manual for pin connection information.

Note

If connections are to be made to a COM-2S (CE-marked version), then CE-certifiable cabling and breakout methodology (Cable shields connected to ground at the mounting bracket 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. 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 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 | COM-2S 9 pin | 25 pin | Signal | COM-2S 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 |

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

| Parameter | Condition | Min. | Max. |
|-------------------------------------|------------|------|-------------------|
| Driver Output Voltage (unloaded) | | 4V | 6V |
| | | -4V | -6V |
| Driver Output Voltage (loaded) | TERM | 2V | |
| | jumpers in | -2V | |
| Driver Output Resistance | | | 50 Ω |
| Driver Output Short-Circuit Current | | | ± 150 mA |
| Driver Output Rise Time | | | 10% unit interval |
| Receiver Sensitivity | | | ± 200 mV |
| Receiver Common Mode Voltage Range | | | $\pm 7V$ |
| Receiver Input Resistance | | | 4K Ω |

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. (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.

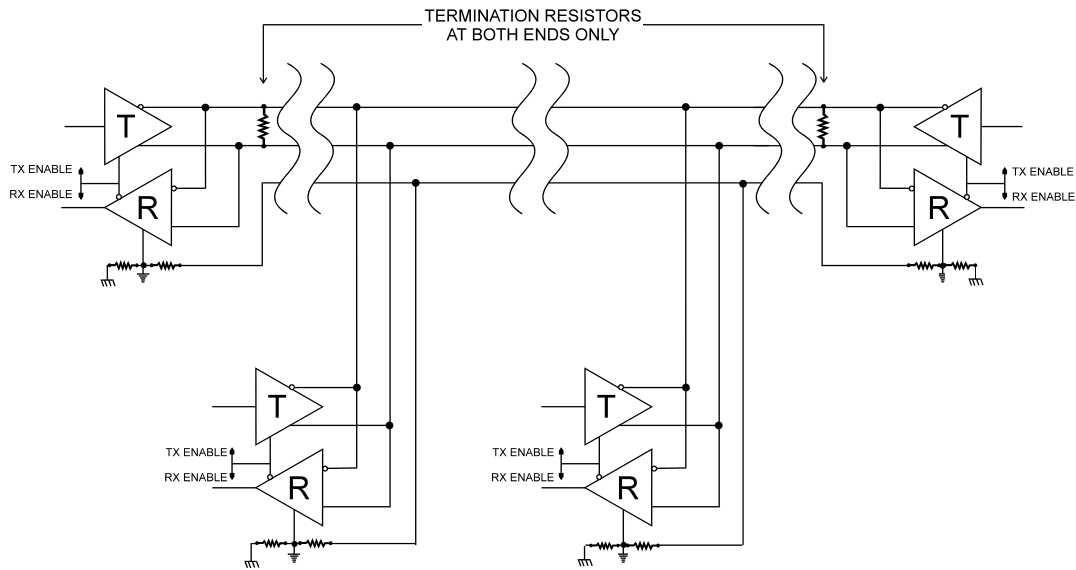


Figure A-1: Typical RS485 Two-Wire Multidrop Network

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.

Customer Comments

If you experience any problems with this manual or just want to give us some feedback, please email us at: **manuals@acesio.com**. Please detail any errors you find and include your mailing address so that we can send you any manual updates.



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