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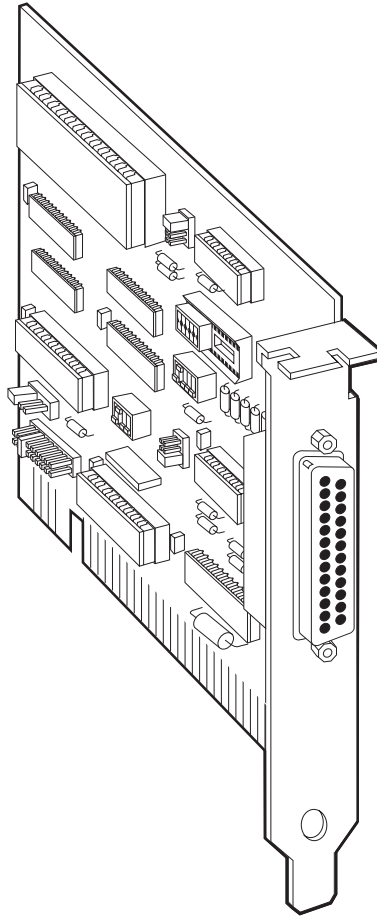**MARCH 2000**
IC050C
IC171C

RS422/485 Serial Interface Plus

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This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

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Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

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ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El parato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equio eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

   A: El cable de poder o el contacto ha sido dañado; u

   B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

   C: El aparato ha sido expuesto a la lluvia; o

   D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

   E: El aparato ha sido tirado o su cubierta ha sido dañada.

Contents

1. Specifications

Number of Ports — Single RS-485/422

Speed — IC050C: 115.2 Kbps; IC171C: 460.8 kbps and higher

RS-485 Operation — 2- or 4-wire

Connectors — DB25P

Maximum Distance — Up to 5000 ft. (1524 m)

Communications Chip — IC050C: 16550 UART; IC171C: 16950 UART

MTBF — >150,000 hours

MTTR — <0.25 hours

Materials — Boards are solder mask over bare copper or tin nickel

Operating Temperature — 32° to 122°F (0° to 50°C)

Storage Temperature — -4° to 158°F (-20° to 70°C)

Humidity — 0 to 90% relative humidity, noncondensing

Power — +5 VDC @ 160 mA

2. Introduction

2.1 Overview

The RS422/485 Serial Interface Plus is an easy-to-use RS-485 interface for your PC. It incorporates unique hardware circuitry that enables the RS-485 interface to appear to be an RS-232 interface, requiring no additional software drivers.

Previous RS-485 interfaces required the software to "turn on" RTS to transmit and then "turn off" RTS at the end of the character. This required overhead and special interrupt processing. Newer operating systems such as Windows™, Windows NT™, OS/2®, and other multi-tasking operating systems typically will not allow the user access to the low-level registers of the UART chip without writing a specialized driver. Since the RS422/485 Serial Interface Plus emulates an RS-232 port, installation is as easy as picking an address and interrupt level.

The README file on the serial utility disk contains information about the latest changes and revisions. To view this file, insert the diskette into drive A or B and type `A:TYPE READ.ME|MORE [ENTER]` or `B:TYPE READ.ME¦MORE [ENTER]`.

2.2 What's Included

Your Serial Interface Plus should come with the following items. If any of these items are missing or damaged, contact Black Box.

    (1) RS422/485 Serial Interface Plus card

    (2) 3.5" serial utility diskettes

    This manual

2.3 Features

Listed below are the special features your Serial Interface Plus offers.

- Single-channel RS-485/422 adapter for Windows, OS/2, Windows NT, and DOS communications.

- Addressable as COM1: through COM4: or twelve other pre-selected address options.

- Automatic RS-485 protocol control allows card to appear to be RS-232; therefore, no special drivers or additional software is required.

- "PAL" allows for unique OEM address selection.

- Individually selectable addresses and extended AT interrupts allow for seamless integration into OS/2 and Windows systems.

- IRQs 2–7, 10–12, and 15 supported.

- IRQs can be shared or individually set for each port.

- 16-bit address decode allows for easy integration.

- Selectable termination, echo mode, and two- and four-wire operation.

2.4 Technical Description

The RS422/485 Serial Interface Plus (IC050C) provides one RS-422/485 serial port utilizing the 16550 UART. This chip features programmable baud rate, data format, and interrupt control, and a 16-byte input and output FIFO. The IC171C uses a 16950 UART, and has a 128-byte FIFO.

RS-422
RS-422, unlike RS-232, is a differential interface that defines voltage levels, and driver/receiver electrical specifications. On a differential interface, logic levels are defined by the difference in voltage between a pair of outputs or inputs. In contrast, a single-ended interface, for example RS-232, defines the logic levels as the difference in voltage between a single signal and a common ground connection. Differential interfaces are typically more immune to noise or voltage spikes that may occur on the communication lines. Differential interfaces also have greater drive capabilities that allow for longer cable lengths. RS-422 is rated up to 10 Mbps and can have cabling 5000 feet (1524 m) long. RS-422 also defines driver and receiver electrical characteristics that will allow 1 driver and up to 32 receivers on the line at once. RS-422 signal levels range from 0 to +5 volts. RS-422 does not define a physical connector.

RS-530 and RS-449

RS-530 and RS-449 (EIA-530 and EIA-449) are similar to RS-422 and RS-485 in the fact that they are differential interfaces, but these two standards provide a specified pin-out that defines a full set of modem control signals that can be used for regulating flow control and line status. RS-449 is defined on a standard 37-pin D sub-connector, while RS-530 is backward-compatible and is replacing RS-449. RS-530 is defined on a 25-pin D sub-connector.
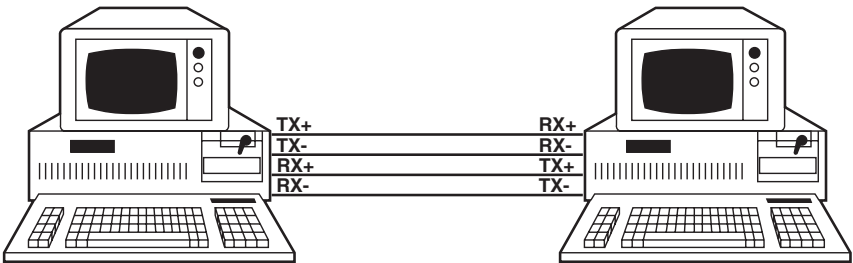

TX+   RX+
TX-   RX-
RX+   TX+
RX-   TX-

Figure 2-1. RS-422/530 Connection.

RS-485

This interface is very similar to RS-422 is several ways. RS-485 is a differential interface that allows cable lengths up to 5000 feet (1524 m) and data rates up to 10 Mbps. The signal levels for RS-485 are the same as those defined by RS-422. RS-485 has electrical characteristics that allow for 32 drivers and 32 receivers to be connected to one line.

This interface is ideal for multi-drop or network environments. The RS-485 tri-state driver (not dual-state) will allow the electrical presence of the driver to be removed from the line. The driver is in a tri-state or high-impedance condition when not active. Only one driver may be active at a time and the other driver(s) must be tri-stated.

Some communication software packages refer to RS-485 as RTS enable or RTS block mode transfer.

RS-485 can be cabled in two ways, 2- and 4-wire mode. Two-wire mode does not allow for full-duplex communication. It requires that data be transferred in only one direction at a time and the two transmit pins be connected to the two receive pins (Tx+ to Rx+ and Tx- to Rx-). Four-wire mode will allow full-duplex data transfers. RS-485 does not define a connector pin-out, modem control signals, or a physical connector.
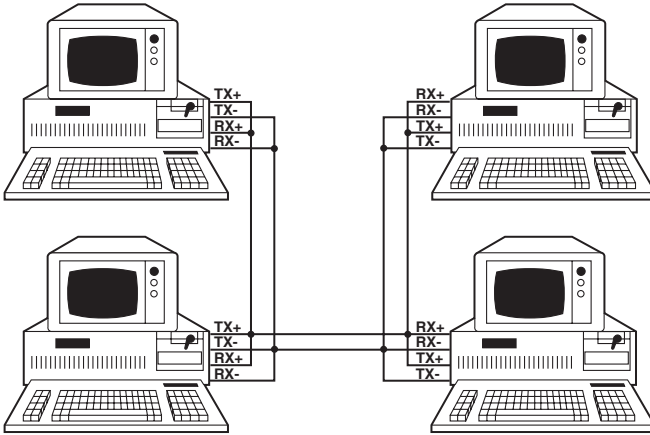

Figure 2-2. RS-485 Two-Wire Connection.

3. Address Selection

NOTE

Be sure to set the address selections and jumper options _before_ installation.

The RS422/485 Serial Interface Plus occupies 8 consecutive I/O locations, and looks to the PC as a standard serial port. DIP switch SW1 sets the port address options. Be careful when selecting the port address, since some selections conflict with existing PC ports. The following table shows the addressing options available with the standard PAL. If you don't see an address option that suits your needs, call Black Box about a custom PAL option.

Port 1 J2	SW1 1	SW1 2	SW1 3	SW1 4
Disabled	ON	ON	ON	ON
3F8	ON	ON	ON	OFF
2F8	ON	ON	OFF	ON
3E8	ON	ON	OFF	OFF
2E8	ON	OFF	ON	ON
3220	ON	OFF	ON	OFF
3228	ON	OFF	OFF	ON
4220	ON	OFF	OFF	OFF
4228	OFF	ON	ON	ON
238	OFF	ON	ON	OFF
300	OFF	ON	OFF	ON
308	OFF	ON	OFF	OFF
280	OFF	OFF	ON	ON
288	OFF	OFF	ON	OFF
290	OFF	OFF	OFF	ON
298	OFF	OFF	OFF	OFF

Each COM port in your system should have a unique address. Typically COM1: through COM4: addresses are 3F8, 2F8, 3E8, and 2E8 Hex.
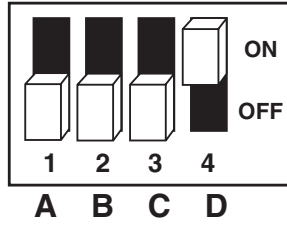
Figure 3-1. DIP Switch SW1. Address 3F8 Hex.

4. Option Selection

NOTE

Be sure to set the address selections and jumper options *before* installation.

The RS422/485 Serial Interface Plus contains several jumpers that must be set for proper operation.

E1: This header selects the interrupt request for the RS422/485 Serial Interface Plus. If COM1: is selected, this jumper must be on the IRQ4 setting. If COM2: is selected, this jumper must be on IRQ3. Any two or more ports can share a common IRQ by placing the jumpers on the same IRQ setting, and setting the appropriate selections at E3. Consult your particular software for IRQ selection. If no interrupt is desired, remove the jumper.

NOTE

Most communications-software applications default COM3: to IRQ4 and COM4: to IRQ3. This requires the sharing of interrupts between COM1: and COM3:, and between COM2: and COM4:. While this is the default, it is not always the preferred setting. Windows 3.1, OS/2, and UNIX® applications typically require a separate IRQ setting for each address. Check your software configuration instructions to determine the most appropriate.
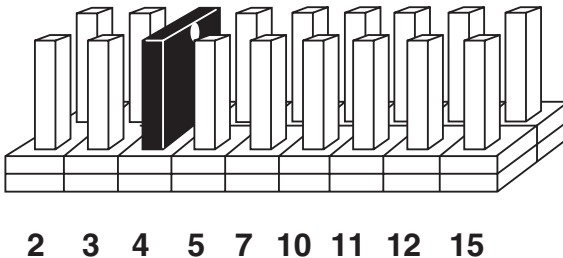

2   3   4   5   7   10 11 12 15

Figure 4-1. Header E1 (Factory Default). IRQ 4 Selected.

Figure 4-2. Header E1 Optional Windows 3.1 Configuration. IRQ 10 selected. (Refer to Chapter 6 for more information.)

NOTE

IRQ 2 on AT class machines is not available. IRQ 9 is substituted in place of IRQ 2. To select IRQ 9, place the jumper on the IRQ 2 position.

E2: "N" indicates the (N)ormal, single-interrupt-per-port mode. The "S" indicates the (S)hared interrupt mode, which allows more than one port to access a single IRQ. This is the preferred Windows and OS/2 setting.

Figure 4-3. Header E2 in Normal Mode.

Set jumpers to "N" for single interrupt mode. This setting is the normal setting for most applications.

Set jumpers to "S" for shared interrupt mode for all ports sharing an IRQ except for one. Set one of the ports sharing an IRQ to "M." This provides the pull-down resistor circuit that makes sharing of IRQs possible.
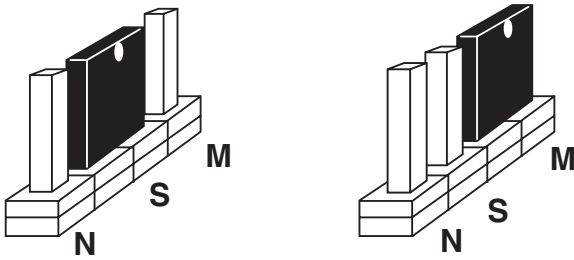
Figure 4-4. Header E2 in Shared Mode.

Header E5 is used to control the RS-485 enable/disable functions for the driver circuit. One of the unique features of the RS422/485 Serial Interface Plus is its ability to be RS-485 compatible without the need for special software or drivers. This is especially useful in Windows, Windows NT, and OS/2 environments where the lower level I/O control is abstracted from the application program. This means that the user can effectively use the RS422/485 Serial Interface Plus in a RS-485 application with existing software drivers.
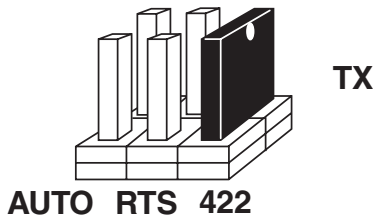

Figure 4-5. This jumper is in the "422" position. Note that the modem control outputs are only valid when Header E5 is in the 422 mode.

AUTO	Driver automatically Enabled/Disabled
RTS	Driver Enabled by UART RTS signal
422	Driver always Enabled

Figure 4-6. Header E5.

Header E3 is used to control the RS-485 enable/disable functions for the receiver circuit. The RS-485 "Echo" is the result of connecting the board's receiver inputs to the transmitter outputs. Every time a character is transmitted it is also received by the board. This can be beneficial if your software can handle it (using received characters to throttle the transmitter), or it can confuse your system if your software cannot handle it. The RS422/485 Serial Interface Plus provides a jumper block (E3) to enable or disable this function.

RX

AUTO RTS 422

Figure 4-7. This should follow the selection made at E5 if "No Echo" is desired. If Echo suppression is not desired, then leave the jumper in the "422" position. The modem control outputs are only valid when Header E3 is in the 422 mode.

AUTO	Receiver automatically Enabled/Disabled
RTS	Receiver Enabled by UART RTS signal
422	Receiver always Enabled

Figure 4-8. Header E3.

EIA-530

SIO-485

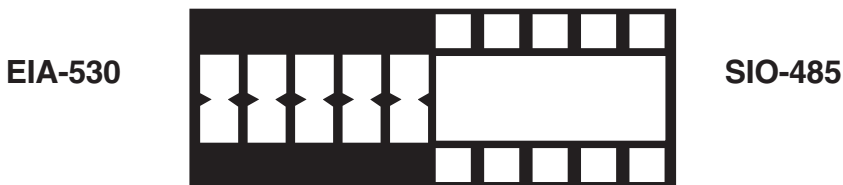**Figure 4-9. DIP Shunt E4 (EIA-530 Mode).**

DIP shunt E4 selects the pin out for the DB25 connector P3. With the 5-position shunt in the EIA-530 mode, the RS422/485 Serial Interface Plus complies with the EIA-530 pinout with the following signals supported:

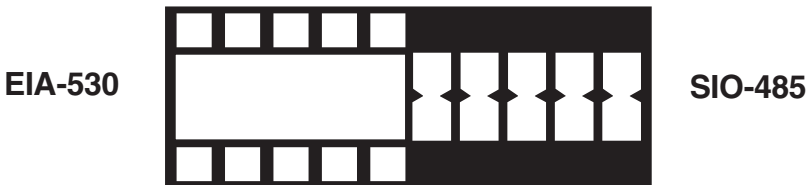| Signal		Name	Pin #	Mode
GND		Ground	7	
RDB	RX+	Receive Positive	16	Input RS-422
RDA	RX	Receive Negative	3	Input RS-422
CTSB	CTS+	Clear To Send Positive	13	Input RS-422
CTSA	CTS-	Clear To Send Negative	5	Input RS-422
DSRB	DSR+	Data Set Ready Positive	22	Input RS-422
DSRA	DSR-	Data Set Ready Negative	6	Input RS-422
DCDB	DCD+	Data Carrier Detect Positive	10	Input RS-422
DCDA	DCD-	Data Carrier Detect Negative	8	Input RS-422
TDB	TX+	Transmit Positive	14	Output RS-422
TDA	TX-	Transmit Negative	2	Output RS-422
RTSB	RTS+	Request To Send Positive	19	Output RS-422
RTSA	RTS-	Request To Send Negative	4	Output RS-422
DTRB	DTR+	Data Terminal Ready Positive	23	Output RS-422
DTRA	DTR-	Data Terminal Ready Negative	20	Output RS-422

EIA-530 SIO-485

Figure 4-10. DIP Shunt E4 (SIO-485 Mode).

With the 5-position shunt in the SIO-485 mode, the RS422/485 Serial Interface Plus converts to 4-wire or 2-wire RS-422/485 with the following signals supported:

Signal		Name	Pin #	Mode
GND		Ground	7	
TDB	TX+	Transmit Positive	24	Output RS-422
TDA	TX-	Transmit Negative	25	Output RS-422
RDB	RX+	Receive Positive	12	Input RS-422
RDA	RX-	Receive Negative	13	Input RS-422

RS-530/422/485 Line Termination

Typically, each end of the RS-530/422/485 bus must have line-terminating resistors. A 100-ohm resistor is across each RS-530/422/485 input, in addition to a 1K ohm pull-up/pull-down combination that biases the receiver inputs. DIP switch SW2 allows you to customize this interface to your specific requirements. Each switch corresponds to a specific portion of the interface. If multiple RS422/485 Serial Interface Plus adapters are configured in a network, only the boards on each end should have switches 1, 2, and 3 ON. Refer to the following table for each switch's operation:

| Name	Function
T	Adds or removes the 100-ohm termination. Switch 1 ON adds the termination, and OFF removes the termination.
P	Adds or removes the 1K ohm pull-up resistor in the RS-422/RS-485 receiver circuit (Receive data only). Switch 2 ON adds the 1K pull-up resistor and OFF removes the pull-up resistor.
P	Adds or removes the 1K ohm pull-down resistor in the RS-422/RS-485 receiver circuit (Receive data only). Switch 3 ON adds the 1K pull-down resistor, and OFF removes the pull-down resistor.
L	Connects the TX+ to RX+ for RS-485 two-wire operation.
L	Connects the TX- to RX- for RS-485 two-wire operation.
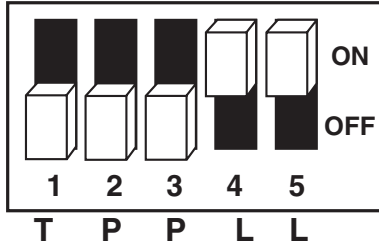
Figure 4-11. DIP Switch SW2.

5. Installation

IMPORTANT

You MUST set up the operating system BEFORE you physically install the Card.

5.1 Software Installation

If you are installing an ISA adapter in DOS, OS/2®, or QNX, please refer to the appropriate directory on one of the Serial Utilities Disks for instructions.

5.1.1 WINDOWS 3.1X

Please refer to the /WINDOWS sub-directory on the Serial Utilities Diskette for help files and current information on the installation of the Card in this operating environment. **Chapter 6** also contains detailed installation instructions.

5.1.2 WINDOWS 95/98

For the ISA card, run setup on disk two of the Serial Utilities Diskettes before installing the card. Make note of the resources that Windows assigns the adapter, and set the adapter to match those resources. Power down the computer and install the adapter as described in **Section 5.2**. If you wish to change any resources assigned to the adapter, refer to the help file installed in the Black Box folder in the **Start, Programs** menu.

5.1.3 WINDOWS NT

For the ISA card, run setup on disk two of the Serial Utilities Diskettes before installing the card. After installing the software, refer to the help file that automatically comes up for installation instructions.

5.2 Hardware Installation

The RS422/485 Serial Interface Plus can be installed in any of the PC expansion slots, except J8 on the original IBM® PC/XT™ and Portable. The Card contains several jumper straps for each port that you must set for proper operation.

NOTE

Be sure to set the address selections and jumper options *before* installation.

1. Turn off PC power. Disconnect the power cord.

2. Remove the PC case cover.

3. Locate an available slot and remove the blank metal slot cover.

4. Gently insert the Card into the slot. Make sure that the Card is seated properly.

5. Replace the screw.

6. Replace the cover.

7. Connect the power cord.

   Installation is complete.

6. Windows 3.1 Configuration

To configure the RS422/485 Serial Interface Plus under Windows 3.1, open the "Control Panel," which is typically found in the "Main" Program Group. Next, open the "Ports" selection under the Control Panel.
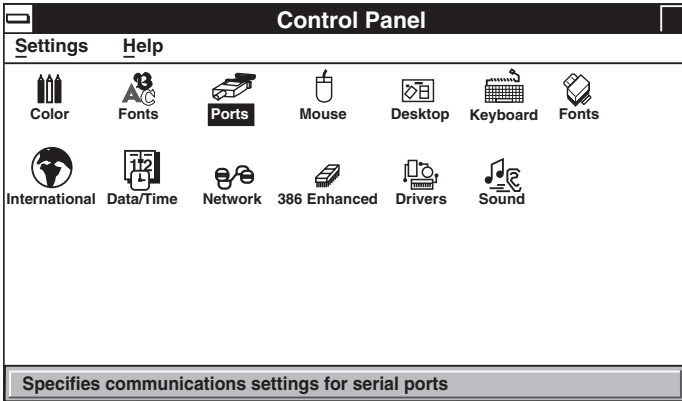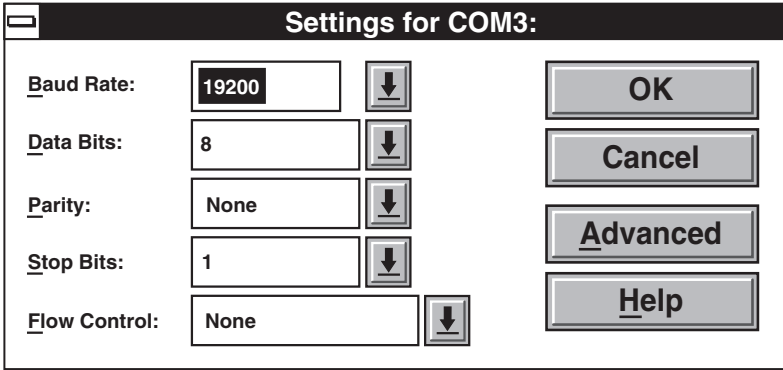

Select the port you wish to configure. Once you have selected the port, click on the "Settings" button.
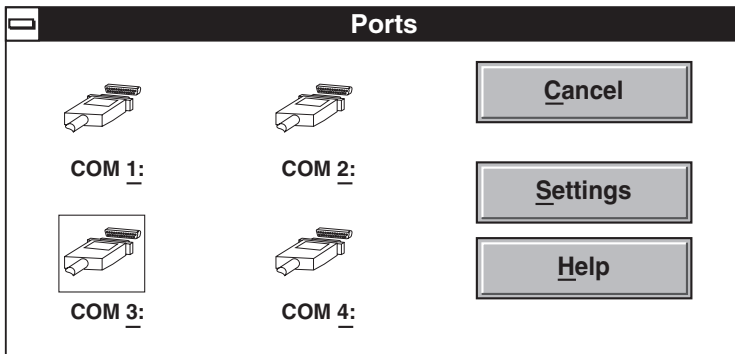
The next step is to select the appropriate Baud Rate, Data Bits, Parity, Stop Bits, and Flow Control.

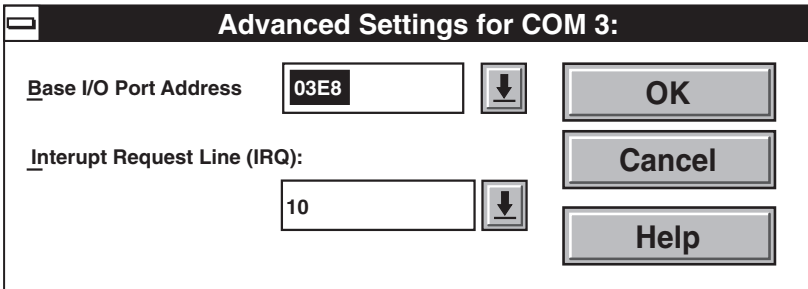| Settings for COM3:		
Baud Rate:	19200 ⬇	**OK**
Data Bits:	8 ⬇	**Cancel**
Parity:	None ⬇	**Advanced**
Stop Bits:	1 ⬇	
Flow Control:	None ⬇	**Help**

If you wish to select an IRQ or address different from the default, click on the "Advanced" button.

Advanced Settings for COM 3:		
Base I/O Port Address	03E8 ⬇	**OK**
Interupt Request Line (IRQ):		**Cancel**
	10 ⬇	**Help**

Select "OK" for all windows after you have made your selection. The following message should appear:

System Setting Change
(!)   **Your COM Port settings have changed:**
You will need to quit and restart Windows so that the new setting(s) can take effect.
D̲on't Restart Now   **R̲estart Now**
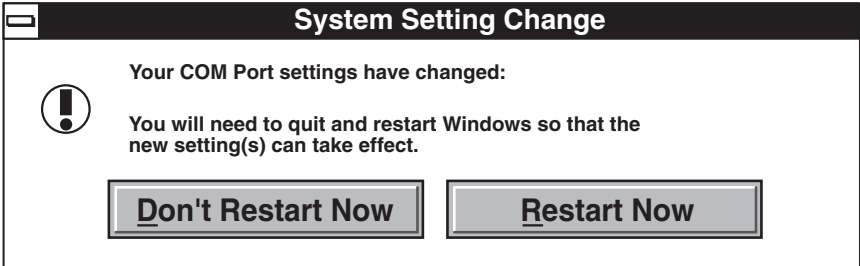
If you wish to configure another COM Port setting, select the "Don't Restart Now" button and repeat this procedure until you have configured all new ports. To make the changes take effect immediately, select the "Restart Now" button.

7. Troubleshooting

Computer does not recognize any COM ports, or the system is "dead" or non-responsive.

How to identify the problem: Use the SSD.COM Program (found on your utility diskette).

Solution: Identify all COM ports installed on you computer and address the RS422/485 Serial Interface Plus at a different address from those already present.

Reason: Only one device can occupy an address location. If more than one device tries to share an address space, a conflict will occur, preventing either device from working.

The RS422/485 Serial Interface Plus's address is not recognized by the system.

How to identify the problem: Use the SSD.COM Program (found on your utility diskette).

Solution: Verify that the RS422/485 Serial Interface Plus addresses are correctly set.

Reason: If the board is incorrectly addressed, your application will not respond.

The RS422/485 Serial Interface Plus transmits but does not receive. The other side appears to receive, but you do not receive any characters in your application.

How to identify the problem: Verify that the IRQ is set properly on your RS422/485 Serial Interface Plus and is correctly set in your application program.

Solution: Change the IRQs so that they are correct.
Reason: Most DOS application programs are "interrupt-driven" on receive. If the IRQ is not set on the card to match those required by your application, it will not receive characters, because the interrupt for the first character cannot be serviced.

When using Windows 3.1, only two ports at any time are functional.

How to identify the problem: Verify that all ports have a separate interrupt, or if sharing interrupts, only one device is using the IRQ at a time.

Solution: Change the IRQs so that each port has its own unique interrupt (the preferred setting) or close each port before trying to open the next.

Reason: The Windows communication driver does not support simultaneous operation of shared interrupts.

In Windows 3.1, the mouse hangs or moves erratically.

How to identify the problem: Verify that the mouse is not sharing an interrupt with any other port or device.

Solution: Change the IRQ of your mouse port so that it does not share an interrupt. Most mice only operate on either COM1 or COM2 using IRQ 4 and 3 respectively. This is a limitation of the mouse driver.

Reason: A mouse is an interrupt "hog." Any movement or button-pressing on the mouse causes an interrupt.

The application requires that the Modem Control signals be "on" or "active," but they aren't connected in my cable.

How to identify the problem: Check the pinout of your cable and the device you are connected to.

Solution: The unused modem control signals are biased ON on the board.

MSD (Microsoft® Diagnostics) doesn't report the ports on the RS422/485 Serial Interface Plus.

How to identify the problem: Verify that the RS422/485 Serial Interface Plus addresses are correctly set.
Solution: Use the program SETCOM (found on your utility diskette) to install your additional ports.

Reason: MSD only reports the serial ports found by the BIOS. Older BIOS install only COM1 or COM2. Newer BIOSs will install up to four ports, but only if the traditional COM port addresses are used.

The RS422/485 Serial Interface Plus is setup to use the AT interrupts, but there's no interrupt response.

<u>How to identify the problem:</u> Verify that the interrupt jumpers are correctly set. Verify that the card is inserted into a 16-bit or AT slot.

<u>Solution:</u> Use the program SLT (found on your utility diskette) to verify that the interrupts are set correctly. (Note that SLT requires that the transmit and receive signals on the connector be "looped back" or connected together. This can be accomplished by setting SW2 4 and 5 ON.)

<u>Reason:</u> AT IRQs are not found on the 8-bit slots only on 16-bit slots. The higher level interrupts can never be used in a PC/XT compatible system or if the board is installed in an 8-bit slot.

7.1 Calling Black Box

If you determine that your RS422/485 Serial Interface Plus is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact Black Box Technical Support at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:
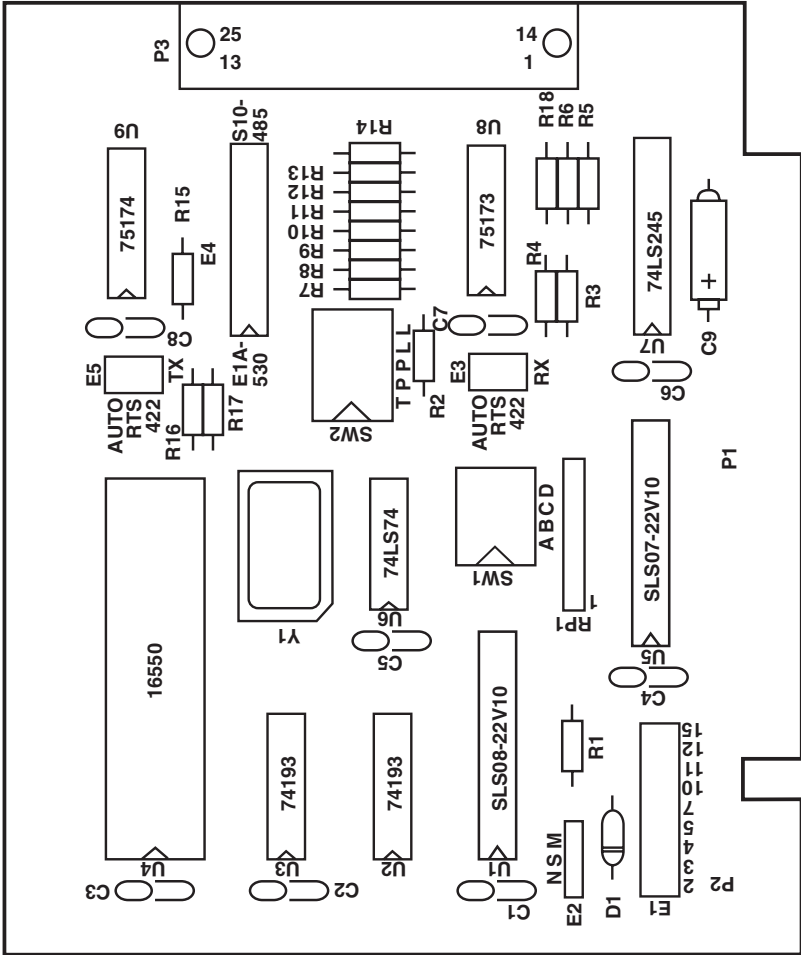
- the nature and duration of the problem.

- when the problem occurs.

- the components involved in the problem.

- any particular application that, when used, appears to create the problem or make it worse.

7.2 Shipping and Packaging

If you need to transport or ship your RS422/485 Serial Interface Plus:

- Package it carefully. We recommend that you use the original container.

- If you are shipping the Serial Interface Plus for repair, make sure you include its power supply. If you are returning the Serial Interface Plus, make sure you include this manual as well. Before you ship, contact Black Box to get a Return Materials Authorization (RMA) number.

Appendix: Circuit-Board Design

BLACK BOX®
NETWORK SERVICES