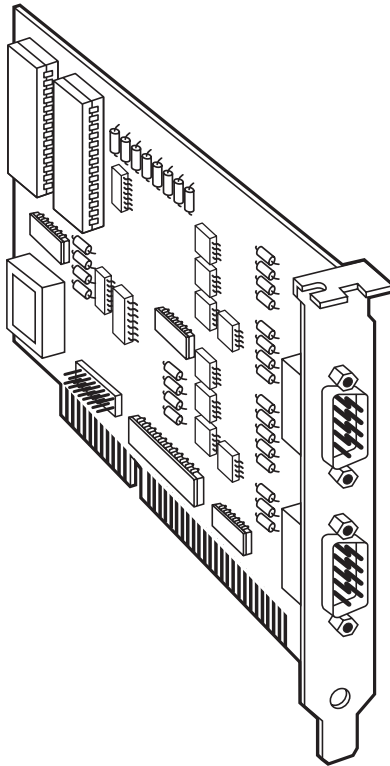




RS-422/485 Serial Interface Plus 2-Port RS-422/485 Serial Interface Plus 2-Port (with Optical Isolation)



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RADIO-FREQUENCY INTERFERENCE STATEMENTS**

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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This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

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

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**NORMAS OFICIALES MEXICANAS (NOM)
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 aparato 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 conectado 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 física 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 equipo 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 líneas de energía.
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 objetos líquidos 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: Objetos 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.

EUROPEAN UNION DECLARATION OF CONFORMITY

Products bearing the CE Label fulfill the requirements of the EMC directive (89/336/EEC) and of the low-voltage directive (73/23/EEC) issued by the European Commission. To obey these directives, the following European standards must be met:

- EN55022 Class A: “Limits and methods of measurement of radio interference characteristics of information technology equipment”
- EN50082-1: “Electromagnetic compatibility - Generic immunity standard: Part 1: Residential, commercial and light industry”
- EN60950 (IEC950): “Safety of information technology equipment, including electrical business equipment”

WARNING!

This is a Class A Product. In a domestic environment, this product may cause radio interference, and the user may be required to take adequate measures.

Always use cabling provided with this product if possible. If no cable is provided or if an alternate cable is required, use high-quality shielded cabling to maintain compliance with FCC and EMC directives.



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1. Specifications

Data Rate —	IC051C, IC057C: 115.2 Kbps; IC176C, IC178C: 460.8 kbps and higher
Communication Chip —	IC051C, IC057C: 16550 UART; IC176C, IC178C: 16850 UART
Max. Distance —	5000 feet (1524 m)
Connectors —	(2) DB9 M, (1) PC-card edge, 16-bit
Diagnostics —	(2) 3.5-inch asynchronous utility disks
Manufacturing —	IPC 610-A Class-III standards are adhered to with a 0.1 visual A.Q.L. and 100% functional testing. All boards are built to UL® 94V0 rating and are 100% electrically tested. These printed circuit boards are solder mask over bare copper or solder mask over tin nickel.
MTBF —	>150,000 hours
Operating Temperature —	32 to 122°F (0 to 50°C)
Storage Temperature —	-4 to +158°F (-20 to +70°C)
Relative Humidity Tolerance —	10 to 90%, noncondensing
Power Consumption —	+5 VDC @ 600 mA
Size —	4.2"H x 7.4"L (10.7 x 18.8 cm)

2. Introduction

2.1 Overview

The RS-422/485 Serial Interface Plus 2-Port provides the PC with two additional ground-isolated RS-422/485 (IC057C, IC178C) or two non-isolated RS-422/485 (IC051C, IC176C) serial ports for terminals, modems, printers, etc. Isolation is important in installations where equipment being connected to the PC is either far from the PC, or on a different power-transformer circuit. Ground-loop current is a commonly neglected and misunderstood phenomenon that leads to data loss and can even destroy your communications interfaces. The isolated RS-422/485 Serial Interface Plus 2-Port provides up to 500 volts DC of isolation.

The Serial Interface Plus (IC051C, IC057C) uses the 16550 UART chip, which features programmable baud rate, data format, interrupt control, and a 16-byte input and output FIFO. The IC176C and IC178C feature the 16850 UART, which has a 128-byte buffer.

In addition, the Serial Interface Plus supports IRQs 2/9–7, 10, 11, 12, 14, and 15. And shareable IRQs allow more than one port to share a single IRQ.

2.2 Package Contents

If any of the items listed below are missing or damaged, call Black Box at (724) 746-5500.

- RS-422/485 Serial Interface Plus 2-Port (with or without Optical Isolation)
- (2) 3.5-inch serial utility diskettes
- This user's manual

2.3 Factory-Default Settings

The Serial Interface Plus's factory-default settings are listed below.

Port #	Base Address	IRQ	Electrical Specification
1	3F8	4	RS-422
2	2F8	3	RS-422

If you want to install the Serial Interface Plus using the factory-default settings, you can skip the next two chapters. Turn to **Chapter 5**.

3. Connector Pin Assignments

NOTE

These assignments meet EIA/TIA/ANSI-574 DTE for DB9 connectors.

Signal	Name	Pin #	Mode
GND	Ground	5	—
TX+	Transmit Data Positive	4	Output
TX-	Transmit Data Negative	3	Output
RTS+	Request To Send Positive	6	Output
RTS-	Request To Send Negative	7	Output
RX+	Receive Data Positive	1	Input
RX-	Receive Data Negative	2	Input
CTS+	Clear To Send Positive	9	Input
CTS-	Clear To Send Negative	8	Input

4. Card Setup

For your reference, record the installed Serial Interface Plus's settings here.

Port #	Base Address	IRQ	Electrical Specification
1			
2			

The Serial Interface Plus contains several jumpers (straps) which must be set for proper operation. The factory-default settings are shown in **Section 2.3**.

4.1 Address Selection

Each serial port on the Serial Interface Plus occupies eight consecutive I/O locations. A DIP switch is used to set the base address for these locations. SW1 sets the I/O address for port 1 and SW2 sets port 2. The table below shows the addressing options available. If different address options are required, contact Black Box about a custom PAL® option.

	1	2	3	4
3F8	On	On	On	On
2F8	On	On	Off	On
3E8	On	Off	On	On
2E8	On	Off	Off	On
2A0	Off	On	On	On
300	Off	On	Off	On
328	Off	Off	On	On
Disabled	Off	Off	Off	Off

NOTE

Each COM: port in your system should have a unique address. Typically, COM1: through COM4: addresses are 3F8, 2F8, 3E8, and 2E8 Hex.

Refer to *Chapter 6, Troubleshooting*, for common address conflicts.

4.2 Port Enable/Disable

Port 2 on the Serial Interface Plus can be enabled or disabled with switch position 4 on the DIP switch. The port is enabled with the switch ON and disabled when OFF. If any port is disabled, be sure to disable the interrupt request for that port by removing the IRQ jumper.

4.3 IRQ Selection

Headers E11 and E12 select the interrupt request for each serial port (E11 for Port 1 and E12 for Port 2). If COM1: is selected, the corresponding jumper must be on the IRQ4 setting. If COM2: is selected, the corresponding jumper must be on IRQ3.

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. Check your software configuration instructions to determine the most appropriate IRQ selection.

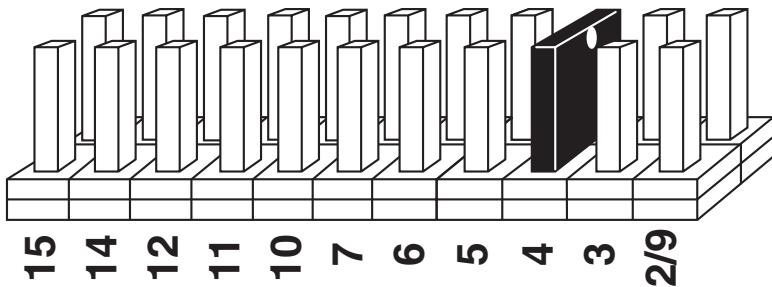


Figure 4-1. Header E11 and E12, IRQ Selection.

Any two or more ports can share a common IRQ by placing the jumpers on the same IRQ setting at header E11 and E12 and setting the appropriate selections at E5 and E6. Consult your software for IRQ selection. If no interrupt is desired, remove the jumper.

4.4 Interrupt Modes

Header E1 selects the interrupt mode for each port. Each port must be set in the correct mode to ensure proper installation.

N indicates the normal, single-interrupt-per-port mode. **S** indicates the shared-interrupt mode, which allows more than one port to access a single IRQ. 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 E1. Consult your particular software for IRQ selection. If no interrupt is desired, remove the jumper. **M** indicates the inclusion of a 1-Kohm pull-down resistor required on one port when sharing interrupts.

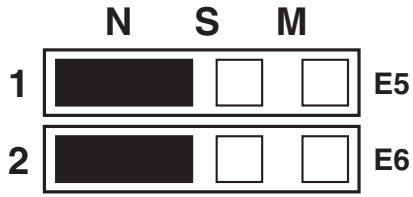


Figure 4-2. Header E5 and E6, Normal IRQ Mode.

Set the jumpers to **S** for shared-interrupt mode on all blocks sharing an IRQ except one. Set that port block for **M**. This provides the pull-down resistor circuit that makes sharing of IRQs possible. If you are using more than one Serial Interface Plus or a compatible adapter in a bus, only have one port set to **M**. The following example shows both ports sharing a single IRQ.

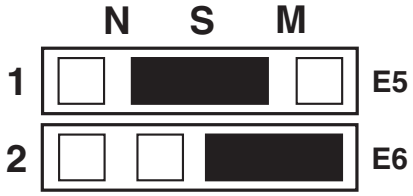


Figure 4-3. Header E5 and E6, Shared IRQ Mode.

Set the jumper to **S** if you are using more than one Serial Interface Plus in a bus or if you wish to completely remove the pull-down resistor for hardware compatibility. *Setting the adapter in this configuration when it is not accompanied by a pull-down resistor will prevent the ports from triggering an interrupt.*

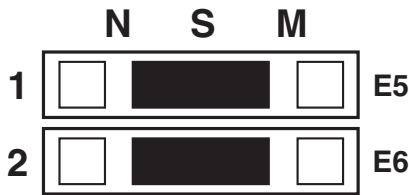


Figure 4-4. Header E5 and E6, Sharing IRQs with another adapter.

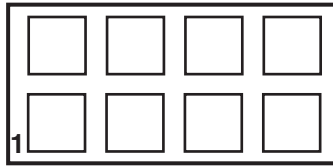
4.5 RS-485 Enable Modes

RS-485 is ideal for multi-drop or network environments. RS-485 requires a tri-state driver (not dual-state) that 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 this occurs. Only one driver may be active at a time and the other driver(s) must be tri-stated. The output modem control signal Request To Send (RTS) is typically used to control the state of the driver. Some communication software packages refer to RS-485 as “RTS enable” or “RTS block mode transfer.”

One of the Serial Interface Plus’s unique features is the ability to be RS-485 compatible without the need for special software or drivers. This ability 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 ability means that the user can effectively use the Serial Interface Plus in an RS-485 application with existing (for example, standard RS-232) software drivers.

Headers E8 (Port 1) and E10 (Port 2) are used to control the RS-485 mode functions for the driver circuit. The two selections are RTS enable or Auto enable. The Auto enable feature automatically enables/disables the RS-485 interface. The RTS mode uses the RTS modem control signal to enable the RS-485 interface and provides backward compatibility with existing software products.

Headers E3 (Port 1) and E9 (Port 2) are used to control the RS-485 enable/disable functions for the receiver circuit and determine the state of the RS-422/485 driver. The RS-485 Echo is the result of connecting the receiver inputs to the transmitter outputs. Every time a character is transmitted, it is also received. This can be beneficial if the software can handle echoing (that is, using received characters to throttle the transmitter) or it can confuse the system if the software does not. These header blocks are described in the illustration and table that follow.



No
Echo Echo 422 485
E3 = Port 1
E9 = Port 2

- Position 1 “Echo”** Echoes the data that is transmitted. All characters transmitted are received. (Only relevant in the two-wire RS-485 mode.)
- Position 2 “No Echo”** Inhibits the data that has been transmitted. Receiver is off when transmitter is on. (Only relevant in the two-wire RS-485 mode.)
- Position 3 “422”** RS-422/485 Driver always enabled (RS-422 mode).
RTS modem control signal available on DB9 connector.
- Position 4 “485”** RS-422/485 Driver enabled by RTS or Auto enabled.
Modem control signal not available on DB9 connector.

4.6 Interface Mode Examples

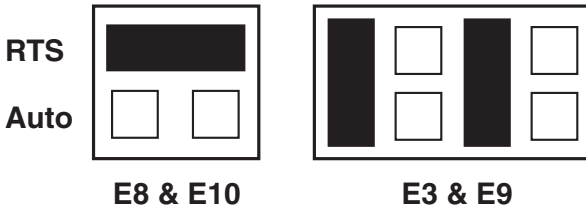


Figure 4-5. RS-422.

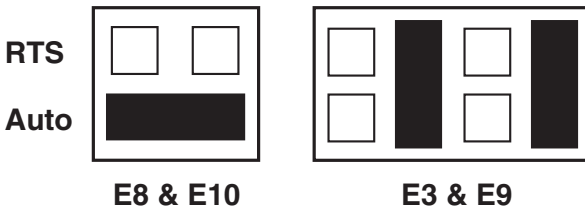


Figure 4-6. RS-485 Auto Enabled with No Echo.

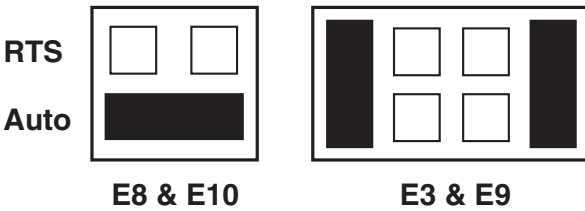


Figure 4-7. RS-485 Auto Enabled with Echo.

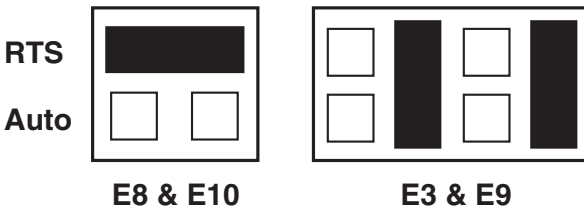


Figure 4-8. RS-485 RTS Enabled with No Echo.

4.7 Line Termination

Typically, each end of the RS-485 bus must have line-terminating resistors (RS-433 terminates at the receive end only). A 120-ohm resistor is across each RS-530/422/485 input in addition to a 1-Kohm pull-up/pull-down combination that biases the receiver inputs. Headers E1 and E4 allow the user to customize this interface to their specific requirements. Each jumper position corresponds to a specific portion of the interface. If multiple Serial Interface Plus adapters are configured in an RS-485 network, only the boards on each end should have jumpers T, P, and P **ON**. Refer to the table below for each position's operation.

Name	Function
L	Connects the TX+ to RX+ for RS-485 two-wire operation.
T	Adds or removes the 120-ohm termination.
L	Connects the TX- to RX- for RS-485 two-wire operation.
P	Adds or removes the 1-Kohm pull-down resistor in the RS-422/RS-485 receiver circuit (Receive data only).
P	Adds or removes the 1-Kohm pull-up resistor in the RS-422/RS-485 receiver circuit (Receive data only).

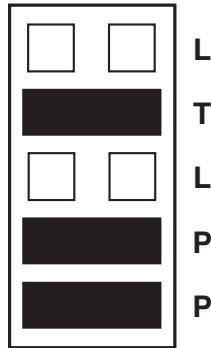


Figure 4-9. Headers E1 and E4, Line Termination.

5. Installation

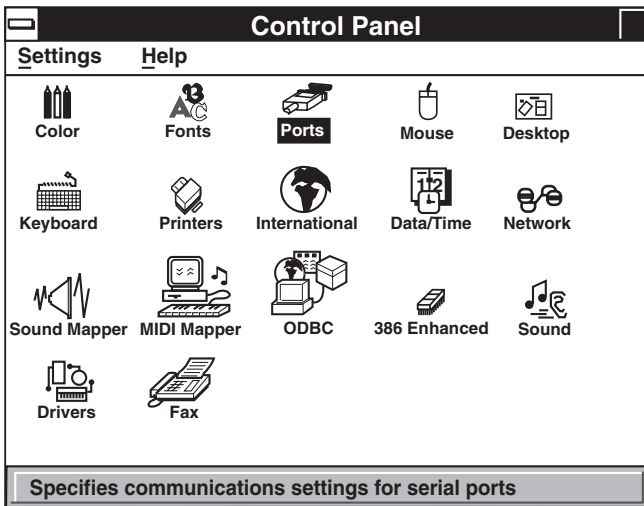
IMPORTANT

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

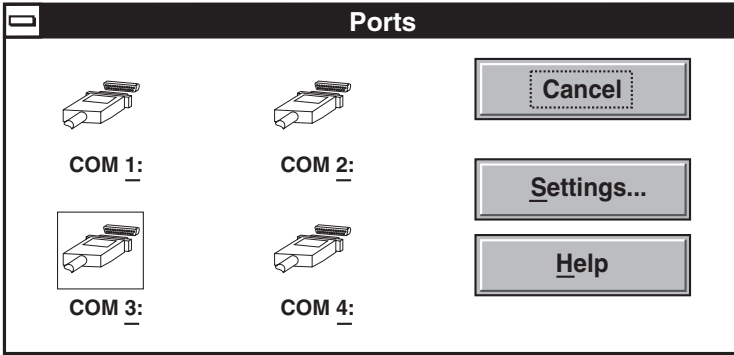
The Serial Interface Plus can be installed in any of the PC expansion slots. The Serial Interface Plus has several jumpers (straps) for each port which must be set for proper operation before you install it in the computer.

5.1 Windows® 3.x (Including Windows for Workgroups 3.11) Installation

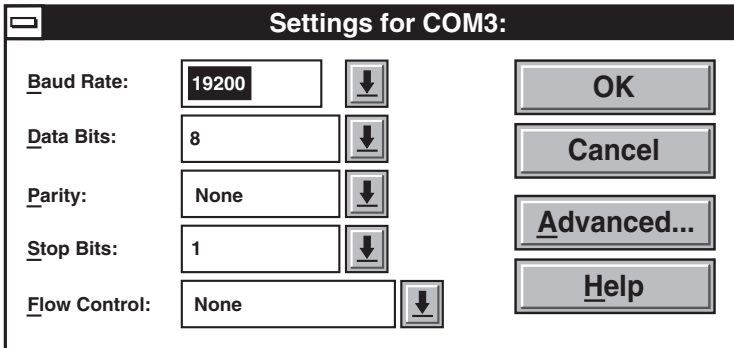
To configure the Serial Interface Plus under Windows 3.1, open the Control Panel, which is typically found in the Main Program Group. Next, open the **Ports** selection under the Control Panel.



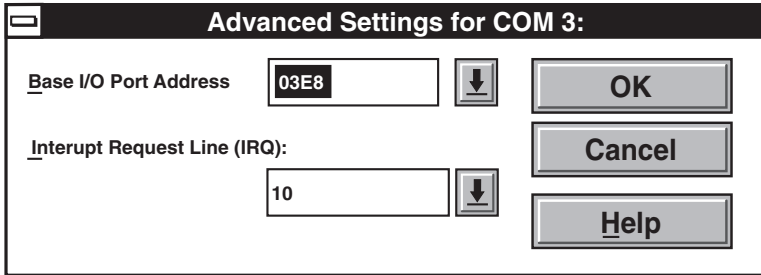
Select the port you want to configure. Once you have selected the port, click on the **Settings** button.



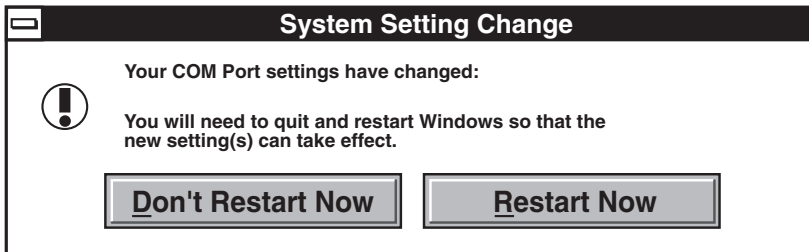
The next step is to select the appropriate Baud Rate, Data Bits, Parity, Stop Bits, and Flow Control.



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



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



If you want 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.

5.2 Installing the Interface using Other Operating Systems

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

WINDOWS 95/98 USERS

For the ISA card, run setup on the Serial Utilities Diskette 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.

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.

5.3 Installing the Hardware

1. Remove the PC case.
2. Remove the blank metal slot cover.
3. Gently insert the board.
4. Replace the screw.
5. Replace the cover.

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.

6. Troubleshooting

6.1 Solving Common Problems

A serial utility diskette, used for troubleshooting, is included with your Serial Interface Plus. By using this diskette and following these simple steps, most common problems can be eliminated.

1. Identify all I/O adapters currently installed in your system. This includes your on-board serial ports, controller cards, sound cards, etc. The I/O addresses used by these adapters, as well as the IRQ (if any) should be identified.
2. Configure your Serial Interface Plus so that there is no conflict with currently installed adapters. No two adapters can occupy the same I/O address.
3. Make sure the Serial Interface Plus is using a unique IRQ. While the Serial Interface Plus does allow the sharing of IRQs, many other adapters (such as SCSI adapters and on-board serial ports) do not. The IRQ is typically selected via an on-board header block. Refer to *Chapter 4, Card Setup*, for help in choosing an I/O address and IRQ.
4. Make sure the Serial Interface Plus is securely installed in a motherboard slot.
5. Use the supplied diskette and user manual to verify that the Serial Interface Plus is configured correctly. The supplied diskette contains a diagnostic program, “SSD,” that will verify if an adapter is configured properly. Refer to the “README” file on the supplied diskette for detailed instructions on using “SSD.”
6. The following are known I/O conflicts:
 - The 278 and 378 settings may conflict with your printer I/O adapter.
 - 3B0 cannot be used if a monochrome adapter is installed.
 - 3F8-3FF is typically reserved for COM1:.
 - 2F8-2FF is typically reserved for COM2:.
 - 3E8-3EF is typically reserved for COM3:.
 - 2E8-2EF is typically reserved for COM4:.
7. Please refer to your included diskette for any post-production manual updates and application-specific information.
8. Always use the diagnostic software when troubleshooting a problem, instead of trying to troubleshoot with some other application. That way you can be sure the problem isn't in your software.

6.2 Calling Black Box

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

Before you do, make a record of the history of the problem. We'll 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; and
- the results of any testing that you've already done.

6.3 Shipping and Packaging

If you need to transport or ship your 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 everything that came in the original package. Before you ship, contact Black Box to get a Return Materials Authorization (RMA) number.

Appendix A: Electrical Interfaces

A.1 RS-422

The RS-422 specification defines the electrical characteristics of balanced-voltage digital interface circuits. RS-422 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 4000 feet (1219 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.

A.2 RS-485

RS-485 is backward-compatible with RS-422; however, it is typically used for party-line or multi-drop applications. The output of the RS-422/485 driver is capable of being **Active** (enabled) or **Tri-State** (disabled). This allows multiple ports to be connected in a multi-drop bus and selectively polled. RS-485 allows cable lengths up to 4000 feet (1219 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. RS-485 tri-state driver (not dual-state) will allow the electrical presence of the driver to be removed from the line. Only one driver may be active at a time, and the other driver(s) must be “tri-stated.” RS-485 can be cabled in two ways: two- and four-wire mode. Two-wire mode does not allow for full-duplex communication, and requires that data be transferred in only one direction at a time. For half-duplex operation, the two transmit pins should be connected to the two receive pins (Tx+ to Rx+ and Tx- to Rx-). Four-wire mode allows full-duplex transfers. RS-485 does not define a connector pinout or a set of modem control signals. RS-485 does not define a physical connector.

Appendix B: Asynchronous Communications

Serial data communications implies that individual bits of a character are transmitted consecutively to a receiver that assembles the bits back into a character. Data rate, error checking, handshaking, and character framing (start/stop bits) are pre-defined and must correspond at both the transmitting and receiving ends.

Asynchronous communications is the standard means of serial data communication for PC compatibles and PS/2® computers. The original PC was equipped with a communication or COM: port that was designed around an 8250 Universal Asynchronous Receiver Transmitter (UART). This device allows asynchronous serial data to be transferred through a simple and straightforward programming interface. Character boundaries for asynchronous communications are defined by a starting bit followed by a pre-defined number of data bits (5, 6, 7, or 8). The end of the character is defined by the transmission of a pre-defined number of stop bits (usual 1, 1.5, or 2). An extra bit used for error detection is often appended before the stop bits.

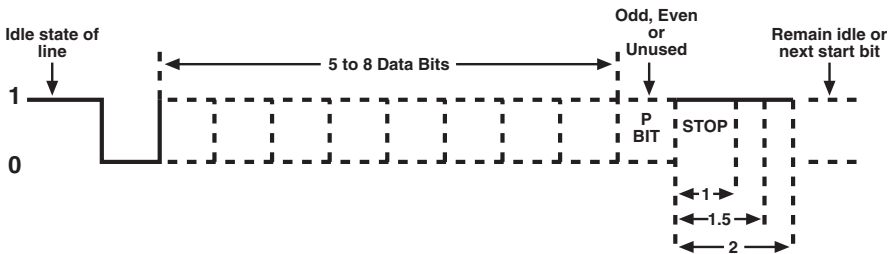


Figure B-1. Asynchronous Communications Bit.

This special bit is called the parity bit. Parity is a simple method of determining if a data bit has been lost or corrupted during transmission. There are several methods for implementing a parity check to guard against data corruption. Common methods are called (E)ven Parity or (O)dd Parity. Sometimes parity is not used to detect errors on the data stream; this is referred to as (N)o parity. Because each bit in asynchronous communications is sent consecutively, it is easy to generalize asynchronous communications by stating that each character is wrapped (framed) by pre-defined bits to mark the beginning and end of the serial transmission of the character. The data rate and communication parameters for asynchronous communications have to be the same at both the transmitting and receiving ends. The communication parameters are baud rate, parity, number of data bits per character, and stop bits (for example, 9600, N, 8, 1).

Appendix C: The Ground-Loop Phenomenon

C.1 What is a Ground Loop?

A ground loop occurs when two or more pieces of equipment are connected together with a common ground, and a different ground potential exists at each location. This current can cause the connected ground equipment to experience noise, which causes data-transmission errors. At its worst, this ground current can even destroy your equipment.

C.2 Cabling Recommendations

When connecting the RS-422/485 Serial Interface Plus 2-Port in an RS-485 network, make sure that both ends of the network are not isolated from ground (see Figure C-1). This “floating” ground condition could cause the capacitive or inductive coupling of voltages that will cause a break-down in the DC-to-DC converter circuit or in the opto-isolator circuit. This condition will cause data errors and possibly destroy the receiver circuit.

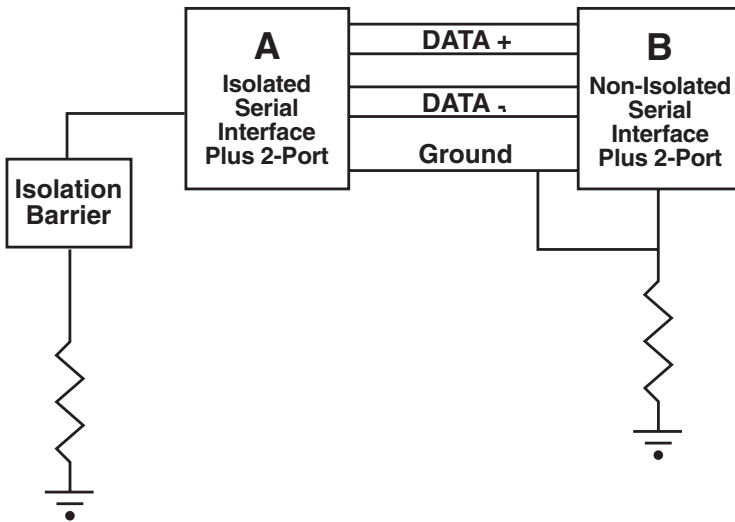
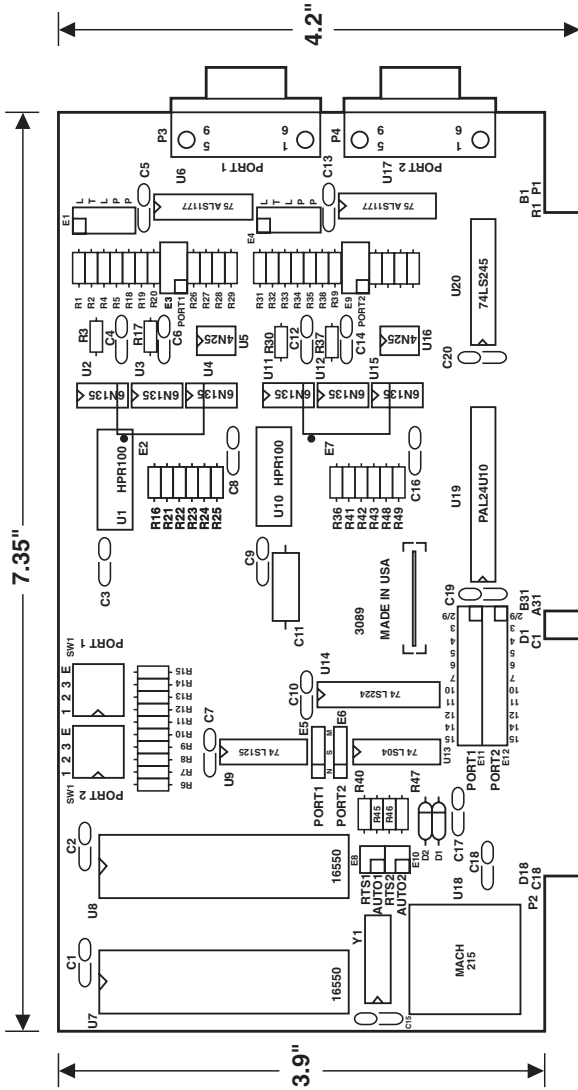


Figure C-1. Serial Interface Plus Cabling Example.

Appendix D: Board Layout





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