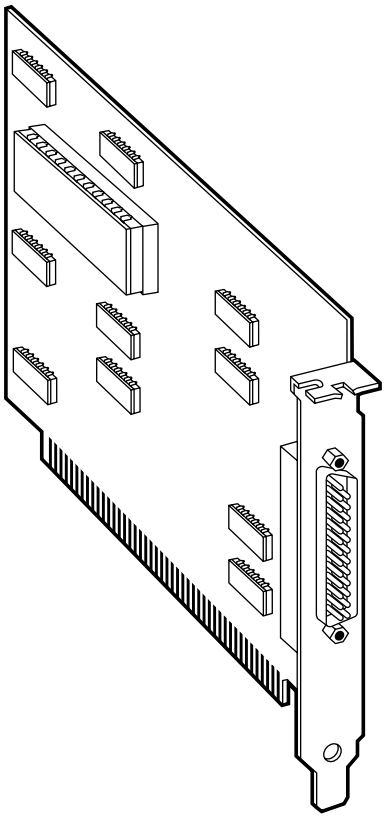
BLACK BOX®
NETWORK SERVICES

MARCH 2000
IC601C
IC172C

Single Channel RS-232/530/422/485/20mA Current Loop Interface



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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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de
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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 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 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 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.

Table of Contents

Chapter **Page**

1. Specifications

Number of Ports	Single port
Maximum Data Distance	Up to 50 feet (15.2 m) on RS-232; Up to 4000 feet (1219 m) on RS-530/422/485; Up to 10,000 feet (3048 m) on 20mA
Speed	19.2 Kbps (RS-232), IC601C: 115.2 kbps (RS-422/485), IC172C: 460.8 kbps and above (RS-422/485); Maximum data rate is dependent on software, CPU, and cable length
Protocol	Asynchronous only
Connectors	(1) DB25 male
RS-485 Operation	Two- or four-wire
Communications Chip	IC601C: 16550 UART; IC172C: 16950 UART
System Requirements	ISA Bus
Operating Temperature	32 to 122°F (0 to 50°C)
Storage Temperature	-4 to 158°F (-20 to 70°C)
Relative Humidity	90%, noncondensing
MTBF	> 150,000 hours
MTTR	< 0.25 hour

Manufacturing IPC 610-A CLASS-III standards adhered to with a 0.1 visual A.Q.L. and 100% Functional Testing; Boards are built to UL® 94V0 rating and are 100% electrically tested. Boards are solder mask over bare copper or solder mask over tin nickel.

Board Size Half card

Shipping Weight 2 lb. (0.9 kg)

Power

Supply Line	+12 VDC	-12 VDC	+5 VDC
Rating (mA)	50	50	270

2. Introduction

The Single Channel RS-232/530/422/485/20mA Current Loop Interface provides one async serial port that can interface to RS-232, RS-530, RS-422, RS-485, and 20 mA Current Loop.

The Current Loop Interface is designed for asynchronous-only operation: It implements only those signals associated with async operation. The DTE mode for RS-530 is assumed.

The Current Loop Interface board (part number IC601C) uses the 16550 UART chip. This chip features programmable baud rate, data format, and interrupt control, and has a 16-byte transmit and receive FIFO. Part number IC172C uses the 16950 UART chip, which features a 128-byte FIFO. The Current Loop Interface can be addressed as COM1:, COM2:, or any other I/O address up to 3FF Hex, providing total compatibility with most communications software and languages. Drivers and receivers for RS-232, RS-530/422/485, and 20mA Current Loop are provided on the serial port.

2.1 Features

- DB25 male connector mounted on board bracket. Port can be addressed as COM1:, COM2:, COM3: (3E8 Hex), COM4: (2E8 Hex) or any other I/O address up to 3FF Hex.
- Interrupt Request (IRQ) lines are jumper selected for IRQ 9/2, 3, 4, 5, and 7
- Interrupt can be shared with other sharable interrupts.
- RS-232C Interface with all standard PC signals (TD, RD, RTS, CTS, DSR, DCD, DTR, RI) or RS-530/422 interface.
- Serial-port interface (RS-232, RS-530/422/485, 20mA Current Loop) is determined by jumper selection.
- Utility software is included for diagnostics.
- No additional line driver or converter is needed.

2.2 Asynchronous Communications

Asynchronous communications is the standard means of serial data communication for IBM compatible PCs.

Serial data communications implies that individual bits of a character are transmitted consecutively to a receiver that assembles the bits back into a character (see Figure 2-1). Data rate, error checking, handshaking, and character framing (start and stop bits) are pre-defined and must correspond at both the transmitting and receiving ends.

Serial asynchronous communications is typically implemented with a Recommended Standard (RS). The standard usually defines signal levels, maximum bandwidth, connector pinout, supported handshaking signals, drive capabilities, and electrical characteristics of the serial lines.

The following sections briefly describe some of the more common communication standards. Voltage levels that are stated are typical and may vary with line characteristics. All interfaces accept a range of acceptable electrical and physical parameters and may even operate in excess to the specified standard under certain line characteristics. The full specification for each standard is available from almost any dealer of engineering documents. For a more detailed explanation of asynchronous serial communications, refer to the book *Technical Aspects of Data Communications* by John E. McNamara, published by Digital Press (DEC) 1982.

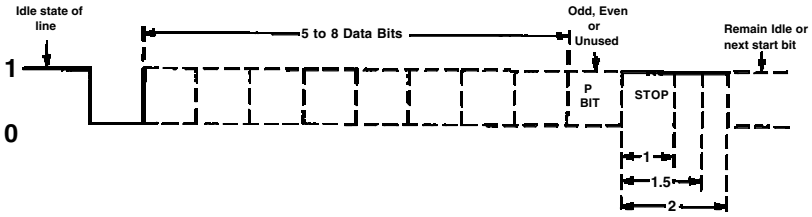


Figure 2-1. Asynchronous Timing Diagram.

2.3 RS-232

Probably the most widely used communication standard is RS-232. This implementation has been defined and revised several times and is often referred to as RS-232C or EIA-232. RS-232 most commonly uses either a DB25 or a DB9 connector. It is capable of operating at data rates up to 20 Kbps for a distance of up to 50 feet (15.2 m). The absolute maximum data rate may vary due to line conditions and cable lengths. RS-232 often operates at 38.4 Kbps at very short distances. The voltage levels defined by RS-232 range from -12 to +12 volts.

RS-232 is a single-ended interface. This means that a single electrical signal is compared to a common signal (ground) to determine binary logic states. A voltage of +12 volts (usually +8 to +10 volts) represents a binary 0, and -12 volts (-8 to 10 volts) denotes a binary 1.

Table 2-1. RS-232 Connector Pinouts

Signal	Name	Pin #	Mode
GND	Ground	7	
RD	Receive Data	3	Input RS-232
CTS	Clear To Send	5	Input RS-232
DSR	Data Set Ready	6	Input RS-232
DCD	Data Carrier Detect	8	Input RS-232
RI	Ring Indicator	22	Input RS-232
DTR	Data Terminal Ready	20	Output RS-232
TD	Transmit Data	2	Output RS-232
RTS	Request To Send	4	Output RS-232

2.4 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 4000 feet long. RS-422 also defines driver and receiver electrical characteristics that will allow one 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.

2.5 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 4000 feet 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's 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 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) controls the state of the driver. Some communication software packages refer to RS-485 as RTS enable or RTS block-mode transfer.

RS-485 can be cabled in two ways: two-wire and four-wire mode. Two-wire mode does not allow for full-duplex communication. Two-wire mode requires that data be transferred in only one direction at a time and the two transmit pins should 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 physical connector, a connector pinout, or a set of modem control signals.

2.6 RS-530 and RS-449

RS-530 and RS-449 (a.k.a. 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 pinout 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 DB37 connector; RS-530 is backward-compatible and is replacing RS-449. RS-530 is defined on a DB25 connector. These two interfaces do not define an electrical specification, but they do provide a means of selecting a standard cabling interface.

Table 2-2. RS-530/422/485 Connector Pinouts

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

2.7 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 1-Kohm pull-up/pull-down combination that biases the receiver inputs.

The RS-530 specification calls for a 100-ohm 1/2-watt resistor between the signal ground and the chassis ground. On the IBM PC, these two grounds are already connected together, so this resistor is omitted.

2.8 Current Loop

This communication specification is based on the absence or presence of current, not voltage levels, over the communication lines. The logic of a Current-Loop communications circuit is determined by the polarity of the current path (typically + or - 20mA). When referring to the specification, the current value is usually stated (for example, 20mA Current Loop). Current Loop is used for point-to-point communication and there are typically two current sources, one for transmit and one for receive. These two current sources may be located at either end of the communication line. To ensure a proper current path to ground, or loop, the cabling of two current loop communication ports will depend on the location of the current sources. Current Loop is normally good for data rates up to 19.2 Kbps. This limitation is due to the fact that the drivers and receivers are usually optically isolated circuits that are inherently slower than non-isolated equivalent circuits.

Table 2-2. 20mA Current Loop Pinouts

Signal	Name	Pin #
	Current Source #1	21
TD+	Transmit Data Positive	25
RD+	Receive Data Positive	12
	Current Source #2	9
TD-	Transmit Data Negative	24
RD-	Receive Data Negative	11
	Ground	7

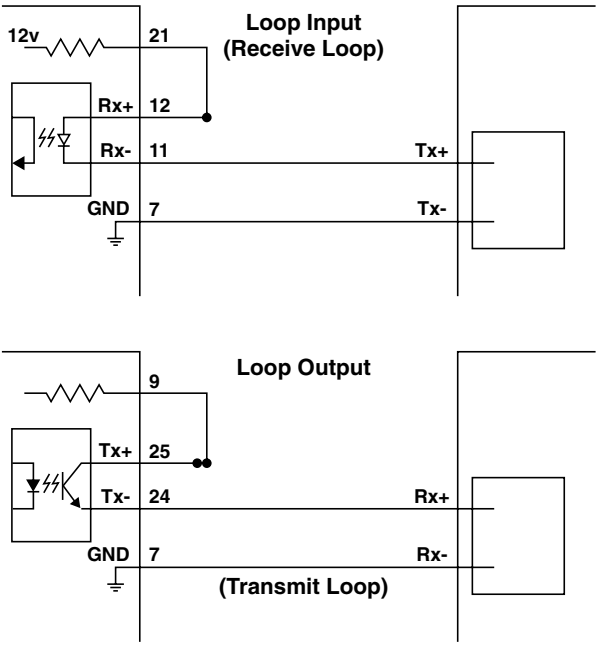
To perform a loopback test in Current Loop, connect pins 21 to 25, 24 to 12, and 11 to 7.

CURRENT-LOOP CONNECTIONS

Passive Connection

Loop Input:	12 RD+	⇐	Customer Current Source
	11 RD-	⇒	Customer TD+ output
Loop Output:	25 TD+	⇐	Customer Current Source
	24 TD-	⇒	Customer RD+ Input

Active Connection



3. Address Selection

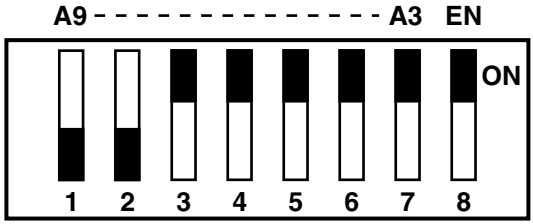
The Single Channel RS-232/530/422/485/20mA Current Loop Interface occupies 8 consecutive I/O locations. DIP-switch SW1 sets the base address for the Current Loop Interface. Be careful when selecting the base address, since some selections conflict with existing PC ports. The following table shows several examples that usually do not cause a conflict.

Table 3-1. Address Selection

Address	Binary	Switch Setting						
Hex	A9 A0	1	2	3	4	5	6	7
280-287	1010000XXX	OFF	ON	OFF	ON	ON	ON	ON
2A0-2A7	1010100XXX	OFF	ON	OFF	ON	OFF	ON	ON
2E8-2EF	1011101XXX	OFF	ON	OFF	OFF	OFF	ON	OFF
2F8-2FF	1011111XXX	OFF	ON	OFF	OFF	OFF	OFF	OFF
3E8-3EF	1111101XXX	OFF	OFF	OFF	OFF	OFF	ON	OFF
300-307	1100000XXX	OFF	OFF	ON	ON	ON	ON	ON
328-32F	1100101XXX	OFF	OFF	ON	ON	OFF	ON	OFF
3F8-3FF	1111111XXX	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Typically COM1: = 3F8h; COM2: = 2F8h; COM3: = 3E8h; COM4: = 2E8h.

The following illustration shows the correlation between the DIP-switch setting and the address bits used to determine the base address.



In this example, the address 300 hex through 307 hex is selected. 300 hex equals 11 0000 0XXX in binary representation.

NOTE

Setting the switch "On" or "Closed" corresponds to a "0" in the address, while leaving it "Off" or "Open" corresponds to a "1".

Port Enable/Disable

Each port on the Current Loop Interface can be enabled or disabled with switch position 8 on the DIP switch. The port is enabled with the switch "On" or "Closed" and disabled when "Off" or "Open." If any port is disabled, be sure to also disable the interrupt request for that port by removing the IRQ jumper (see Figure 4-6).

4. Interface Selection

The board contains several jumper straps for each port which must be set for proper operation.

E2 connects the DB25 connector (P1) to either RS-232 interface drivers and receivers, or RS-422/485 interface drivers and receivers, or the Current Loop receiver interface. Figure 4-1 shows the two settings for each port.

IMPORTANT!

On E2 you must move all eight push-on jumpers. **This is required to completely isolate RS-232 signals from RS-422/485 and vice-versa. On E1, however, there are several jumper options.**

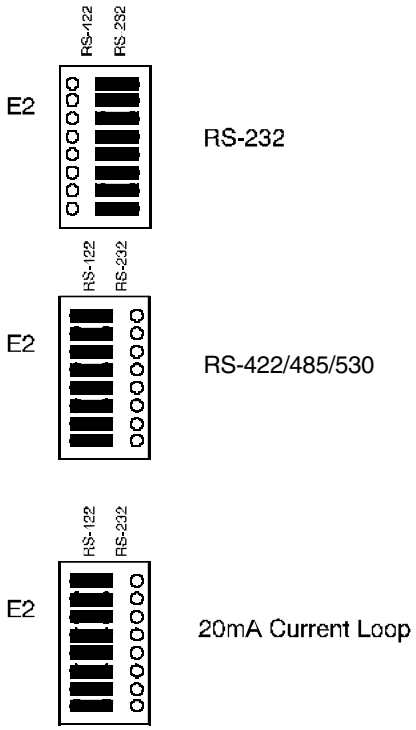


Figure 4-1. Header E2 options.

E1 jumper setting for RS-232 interface option:

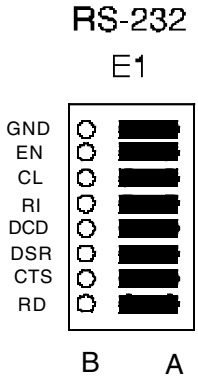


Figure 4-2. Header E1 (RS-232 Interface Option).

GND	Ground	"A" selects normal ground for RS-232.
EN	Enable	"A" (not applicable to RS-232).
CL	Current Loop	"A" selects RS-232 Receive Data.
RI	Ring Indicator	"A" enables RI, "B" sets it true.
DCD	Data Carrier Detect	"A" selects RS-232.
DSR	Data Set Ready	"A" selects RS-232.
CTS	Clear To Send	"A" selects RS-232.
RD	Receive Data	"A" selects RS-232.

E1 Jumper setting for RS-530 and RS-422:

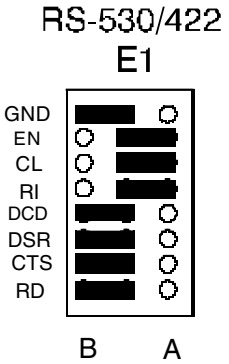


Figure 4-3. Header E1 (RS-530/422 Interface Option).

GND	Ground	"B" selects 100-ohm ground for RS-530/422.
EN	Enable	"A" position for RS-530.
CL	Current Loop	"A" selects RS-530 Receive Data.
RI	Ring Indicator	(not used on RS-530) "B" sets it true.
DCD	Data Carrier Detect	"B" selects RS-530.
DSR	Data Set Ready	"B" selects RS-530.
CTS	Clear To Send	"B" selects RS-530.
RD	Receive Data	"B" selects RS-530.

E1 Jumper setting for RS-485:

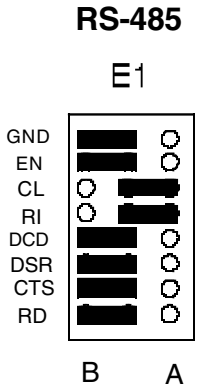


Figure 4-4. Header E1 (RS-485 Interface Option).

GND	Ground	"B" selects 100-ohm ground for RS-485.
EN	Enable driver with RTS "B"	"A" is always enabled.
CL	Current Loop	"A" selects RS-485 Receive Data.
RI	Ring Indicator	(not used on RS-485) "B" sets it true.
DCD	Data Carrier Detect	"B" selects RS-485.
DSR	Data Set Ready	"B" selects RS-485.
CTS	Clear To Send	"B" selects RS-485.
RD	Receive Data	"B" selects RS-485.

E1 position "EN" is used to enable the driver with RTS. To permanently enable the driver (normal RS-422 point-to-point mode), remove jumper "EN" at E1. ***Failure to correctly set this jumper can cause transmitter contention problems, preventing operation by any nodes on the network.***

E1 position "GND" determines whether the board provides a direct ground connection (as in RS-232 and most RS-422), or a 100-ohm high-impedance ground. The 100-ohm high-impedance ground is normally used in RS-485 (and some RS-422) to avoid ground-loop currents with long cables.

E1 Jumper setting for 20 mA Current Loop:

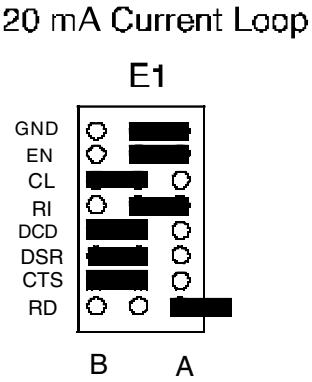


Figure 4-5. Header E1 (20 mA Current Loop Interface Option).

GND	Ground	"A" selects normal ground for Current Loop.
EN	N/A	
CL	Current Loop	"B" selects Current Loop receive data.
RI	Ring Indicator	(not used),"B" sets it true.
DCD	N/A	
DSR	N/A	
CTS	N/A	
RD	Receive Data.	Remove or "Float" on one pin for Current Loop.

E3 selects the interrupt request for the serial port. If COM1: is selected, this jumper must be on the IRQ4 setting. If COM2: is selected, this jumper must be on IRQ3. Consult your particular software for IRQ selection. If no interrupt is desired, remove the jumper.

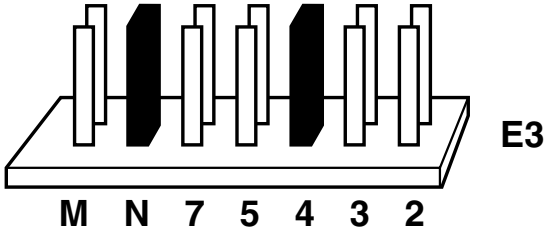


Figure 4-6. Header E3 IRQ Selection.

Positions “M” and “N” allow the user to select a single interrupt per port mode or a shared interrupt mode. The “N” selects the single-interrupt-per port mode, which is the typical DOS, OS/2, and Windows 3.1 mode of operation.

The “M” selects the shared interrupt mode, which allows more than one port to access a single IRQ, and indicates the inclusion of a 1K ohm pull-down resistor required on one port when sharing interrupts. This mode is used by software that requires COM3: and COM4: to share interrupts with COM1: and COM2: or in an OEM configuration to support a specific software application.

NOTE

IRQ2 on AT class machines is not available. IRQ9 is substituted in place of IRQ2. To select IRQ9, place the jumper on the IRQ2 position.

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.

5.1.2 WINDOWS 95/98 USERS

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.

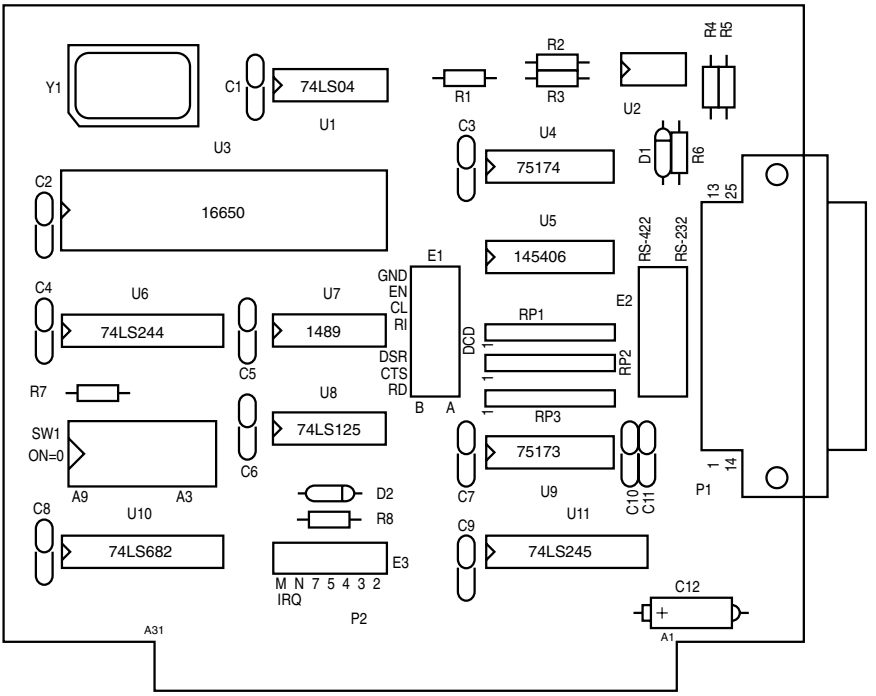
5.2 Hardware Installation

To install the card:

- Remove the PC case.
- Remove the screw holding the blank metal slot cover.
- Remove the blank metal slot cover.
- Gently insert the board.
- Replace the blank metal slot cover.
- Replace the screw.
- Replace the PC case.

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.

Appendix. Block Diagram



For in-depth schematic detail, call for technical support.

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