INDUSTRIAL COMPUTER SOURCE®

Model ULTRA-485/2 & ULTRA-485/2ISO Product Manual

MANUAL NUMBER :   00750-119-4B

FOREWARD

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

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

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

Guarantee

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

Refunds

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

Restocking Charges

Product returned _after_ 30 days, and _before_ 90 days, of the purchase will be subject to a **minimum** 20% restocking charge and any charges for damaged or missing parts.

Products not returned within 90 days of purchase, or products which are not in as-new and re-saleable condition, are not eligible for credit return and will be returned to the customer.

Limited Warranty

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

The **Return Procedure** must be followed to assure repair or replacement. Industrial Computer Source will normally return your replacement or repaired item via UPS Blue. _Overnight delivery or delivery via other carriers is available at additional charge._

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

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

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

Return Procedure

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

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

Limitation of Liability

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

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

Advisories

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

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

 CAUTION!

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

 WARNING!

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

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

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

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

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Current Revision 4B

September 1997

Chapter 1: Introduction

Overview

The Model ULTRA-485/2ISO provides the PC with two additional ground isolated RS-422/485. ULTRA-485/2 provides two non-isolated RS-422/485 serial ports for terminals, modems, printers, etc. Isolation is important in installations where the 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 phenomena that leads to data loss and the possible destruction of communications interfaces. The isolated ULTRA-485/2ISO provides up to 500 volts DC of isolation.

What's Included

The ULTRA-485/2ISO "isolated or non-isolated" is shipped with the following items. If any of these items are missing or damaged, contact the supplier.

- ULTRA-485/2ISO Serial I/O Adapter
- 3.5" Serial Utility Diskette
- User Manual

Factory Default Settings

The ULTRA-485/2ISO factory default settings are as follows:

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

For your reference, record installed ULTRA-485/2ISO settings below:

Port #	Base Address	IRQ	Electrical Specification

How to remain CE Compliant

In order for machines to remain CE compliant, only CE compliant parts may be used. To keep a chassis compliant it must contain only compliant cards, and for cards to remain compliant they must be used in compliant chassis. Any modifications made to the equipment may affect the CE compliance standards and should not be done unless approved in writing by Industrial Computer Source.

The Models ULTRA-485/2 & ULTRA-485/2ISO are designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

Chapter 2: Card Setup

The ULTRA-485/2ISO contains several jumper straps which must be set for proper operation.

Address Selection

Each port on the ULTRA-485/2ISO 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 following table shows the addressing options available.

	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

Table 1: Address Selection Table

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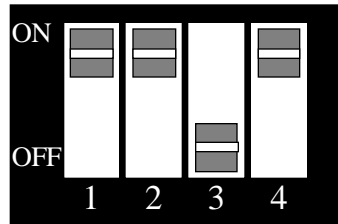

Figure 1: DIP-switch=2F8 Illustration

Refer to Appendix A for common address contentions.

Port Enable / Disable

Each port on the ULTRA-485/2ISO 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.

IRQ Selection

Headers E11 corresponds with Port 1 and E12 corresponds with Port 2 select the interrupt request for each serial port. 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.
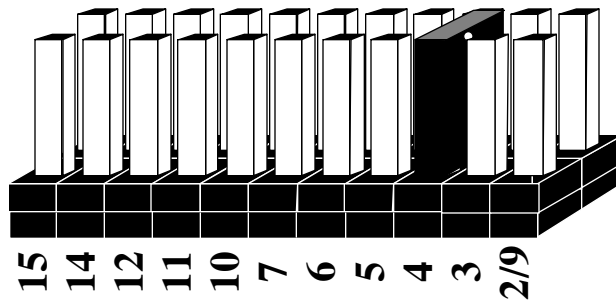
Figure 2: Header E11 and E12, IRQ Selection

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 particular software for IRQ selection. If no interrupt is desired, remove the jumper.

Interrupt Modes

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

'**N**' indicates the (**N**)ormal, single interrupt per port mode. '**S**' Indicates the (**S**)hared 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 1K ohm pull-down resistor required on one port when sharing interrupts.
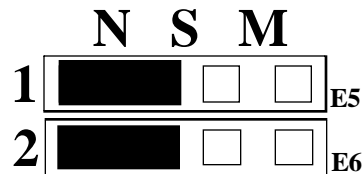
Figure 3: Header E5 & E6, Normal IRQ Mode

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 IRQs possible. If you are using more than one ULTRA-485/2ISO or a compatible adapter in a bus you should only have one port set to '**M**'. The following example shows both ports sharing a single IRQ.

Figure 4: Header E5 & E6, Shared IRQ Mode

Set the jumper to '**S**' if you are using more than one ULTRA-485/2ISO in a bus or 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 5: Header E5 & E6, Sharing IRQ's with another adapter

RS-485 Enable Modes

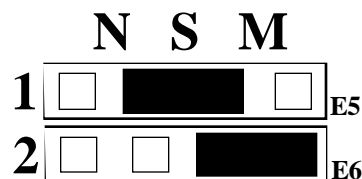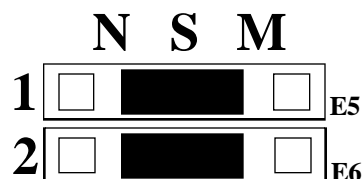RS-485 is ideal for multi-drop or network environments. RS-485 requires a tri-state driver (not dual-state) that will allow the electrical presence of the driver to be removed from the line. The driver is in a tri-state or high impedance condition when this occurs. Only one driver may be active at a time and the other driver(s) must be tri-stated. The output modem control signal **R**equest **T**o **S**end (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 unique features of the ULTRA-485/2ISO 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 ULTRA-485/2ISO in a RS-485 application with existing (i.e. 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 (i.e. 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:

Echo	**No Echo**	**422**	**485**

E3 = Port 1
E9 = Port 2
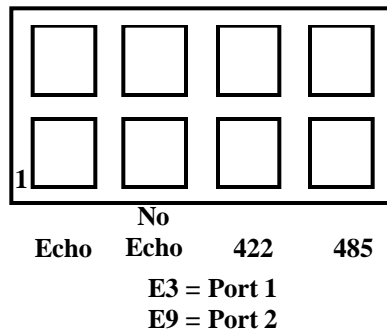
Figure 5A: Header Blocks Illustration

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 DB-9 connector.
Position 4 '485'	RS-422/485 Driver enabled by RTS or 'Auto' enabled. Modem control signal not available on DB-9 connector.

Interface Mode Examples

RTS
Auto

E8 & E10   **E3 & E9**
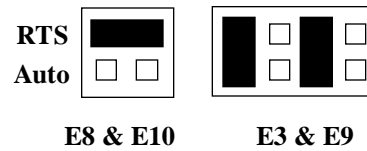
Figure 6: RS-422 'Auto' Enabled, with 'No Echo'

RTS
Auto

E8 & E10   **E3 & E9**
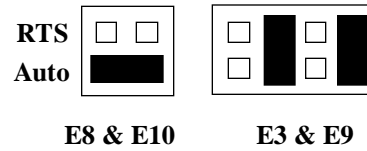
Figure 7: RS-485 'Auto' Enabled, with 'No Echo'

RTS
Auto

E8 & E10   **E3 & E9**
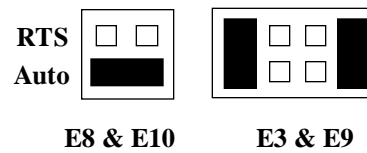
Figure 8: RS-485 'Auto' Enabled, with 'Echo'

RTS
Auto

E8 & E10   **E3 & E9**

Figure 9: RS-485 'RTS' Enabled, with 'No Echo'

Line Termination

Typically, each end of the RS-485 bus must have line terminating resistors (RS-422 terminates at the receive end only). A 120 ohm resistor is across each RS-530/422/485 input in addition to a 1K ohm pull-up/pull-down combination that bias 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 ULTRA-485/2ISO adapters are configured in a RS-485 network, only the boards on each end should have jumpers T, P & P **ON.** Refer to the following table 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 1K ohm pull-down resistor in the RS-422/RS-485 receiver circuit (Receive data only).
P	Adds or removes the 1K ohm pull-up resistor in the RS-422/RS-485 receiver circuit (Receive data only).

Figure 10: Headers E1 and E4= 422 with BIAS , Line Termination

Chapter 3: Installation

The ULTRA-485/2ISO can be installed in any of the PC expansion slots. The ULTRA-485/2ISO contains several jumper straps for each port which must be set for proper operation.

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. Choose configuration options (see chapter 2).
5. Gently insert the ULTRA-485/2ISO into the slot. Make sure that the adapter is seated properly.
6. Replace the screw.
7. Replace the cover.
8. Connect the power cord.

Installation is complete.

Windows 3.x (including WFW 3.11) Installation

To configure the ULTRA-485/2ISO under Windows 3.1 start by opening the '**Control Panel**'. The Control Panel is typically found in the '**Main**' Program Group. The next step is to open the '**Ports**' selection under the **Control Panel**.
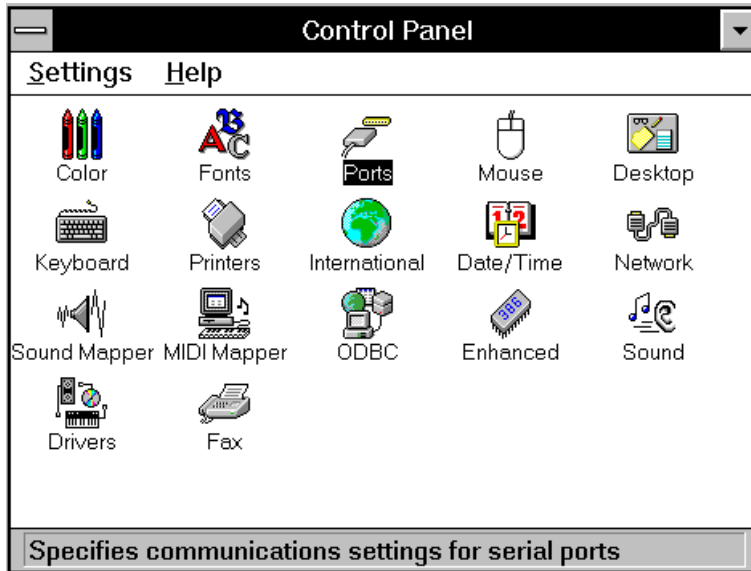
Select the port you wish to configure. Once you have selected the port, click on the '**Settings**' button.
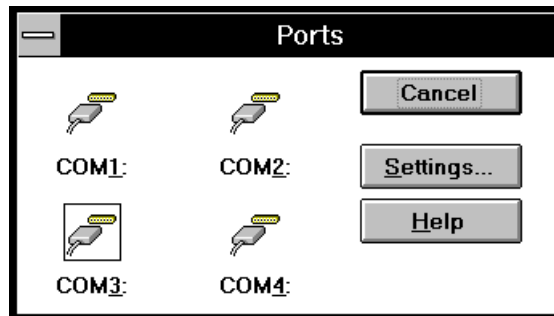
The next step is to select the appropriate Baud rate, Data Bits, Parity, Stop Bits and Flow control.
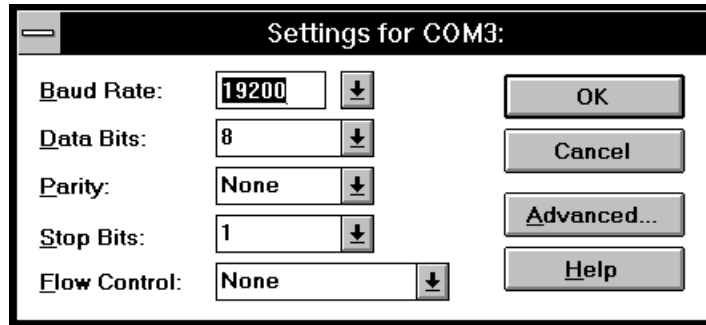
If you wish to select an IRQ or address different than the default click on the '**Advanced**' button.
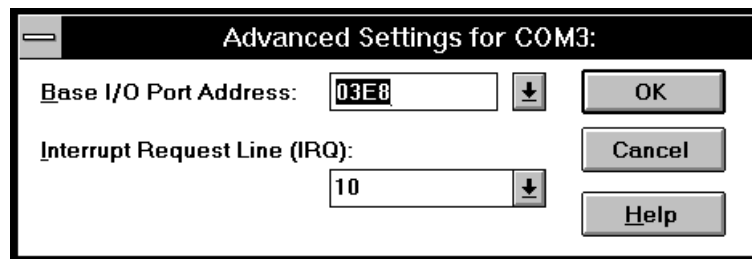
Select 'OK' for all windows after you have made your selection. The following message should appear:
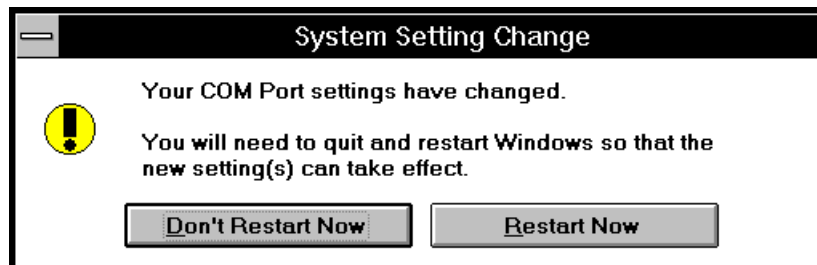
If you wish to configure another COM: port setting, select the 'Don't Restart Now' button and repeat this procedure until you have configured all new ports. To make the changes take effect immediately select the 'Restart Now' button.

Windows 95 and Windows NT Installation

Please refer to the Application Notes section of the Serial Utilities Diskette for current information on the installation of the ULTRA-485/2ISO in these operating systems.

ULTRA-485/2ISO Software Drivers

Refer to the accompanying diskette for included drivers, installation, and setup.

Chapter 4: Technical Description

The Model ULTRA-485/2ISO provides the PC with two additional ground isolated RS-422/485 or two non-isolated RS-422/485 serial ports for Model ULTRA-485/2 terminals, modems, printers, etc. Isolation is important in installations where the 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 phenomena that leads to data loss and the destruction of communications interfaces. The ULTRA-485/2ISO isolated boards provide up to 500 volts DC of isolation.

The ULTRA-485/2ISO utilizes the 16550 UART. This chip features programmable baud rate, data format, interrupt control and a 16 byte input and output FIFO.

Features

- Automatic RS-485 driver enable/disable allows card to appear to be RS-232 requiring no additional drivers
- 'PAL' option allows for unique OEM address selection
- 'Shareable' IRQs allow more than one port to share a single IRQ
- IRQs 2/9-7, 10, 11, 12, 14, 15 supported
- 16550 buffered UARTs Standard
- 16 Bit address decode allows for easier integration

Connector Pin Assignments

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

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Chapter 5: Specifications

Environmental Specifications

Specification	Operating	Storage
Temperature Range	0º to 50º C (32º to 122º F)	-20º to 70º C (-4º to 158º F)
Humidity Range	10 to 90% R.H. Non-Condensing	10 to 90% R.H. Non-Condensing

Manufacturing

- IPC 610-A Class-III standards are adhered to with a 0.1 visual A.Q.L. and 100% Functional Testing.
- All the printed circuit boards are built to U.L. 94V0 rating and are 100% electrically tested. These printed circuit boards are solder mask over bare copper or solder mask over tin nickel.

Power Consumption

Supply line: +5 VDC

Rating: 600 mA

Mean Time Between Failures (MTBF)

Greater than 150,000 hours. (Calculated)

Physical Dimensions

Board length: 7.35 inches   (18.67 cm)

Board Height including Goldfingers: 4.2 inches   (10.66 cm)

Board Height excluding Goldfingers: 3.9 inches   (9.91 cm)

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Appendix A: Troubleshooting

A Serial Utility Diskette is supplied with the adapter and will be used in the troubleshooting proce-
dures. By using this diskette and following these simple steps, most common problems can be
eliminated without the need to call Technical Support.

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 adapter so that there is no conflict with currently installed adapters. No two
    adapters can occupy the same I/O address.

3. Make sure the adapter is using a unique IRQ. While the adapter does allow the sharing of IRQs,
    many other adapters (i.e. SCSI adapters & on-board serial ports) <u>do not</u>. The IRQ is selected
    via an on-board header block. Refer to the section on Card Setup for help in choosing an I/O
    address and IRQ.

4. Make sure the adapter is securely installed in a motherboard slot.

5. Use the supplied diskette and User Manual to verify that the adapter is configured correctly.
    The supplied diskette contains a diagnostic program 'SSD' that will verify if an adapter is
    configured properly. This diagnostic program is written with the user in mind and is easy to
    use. 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. This will eliminate the
    software issue from the equation.

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Appendix B: Electrical Interface

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 Megabits per second and can have cabling 4000 feet 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.
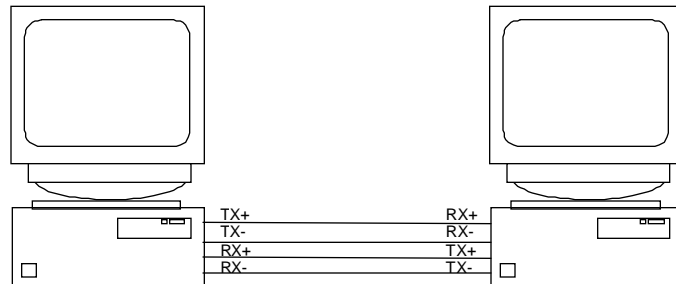

Figure 4-1: RS-422/530 Example

RS-485

RS-485 is backwardly compatible with RS-422; however, it is optimized for partyline or multi-drop applications. The output of the RS-422/485 driver is capable of being **Active** (enabled) or **Tri-State** (disabled). This capability allows multiple ports to be connected in a multi-drop bus and selectively polled. RS-485 allows cable lengths up to 4000 feet and data rates up to 10 Megabits per second. 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 wire 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 data transfers. RS-485 does not define a connector pin-out or a set of modem control signals. RS-485 does not define a physical connector.
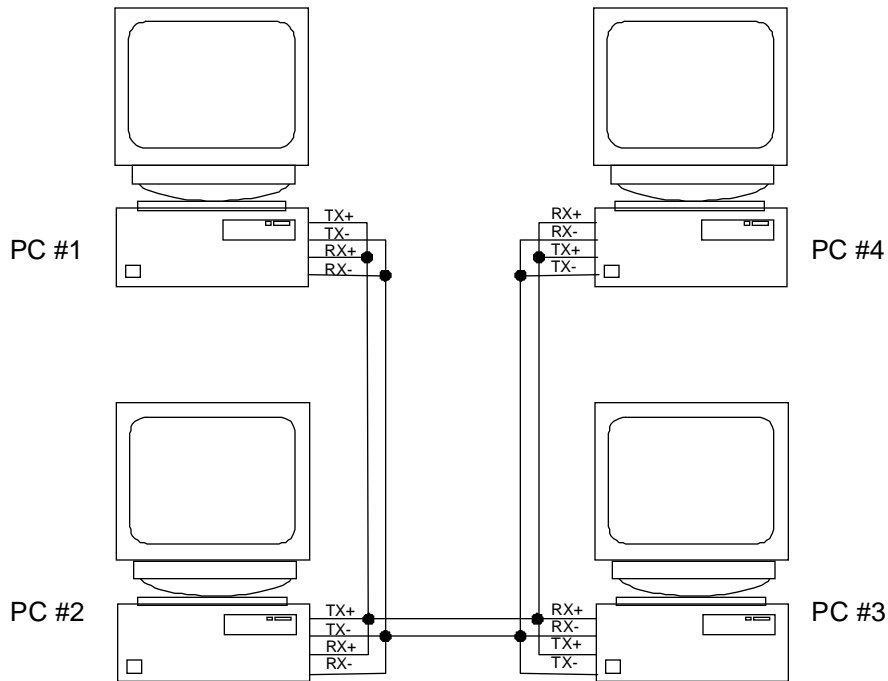

Figure 4-2: RS-485 Two wire Example

Appendix C: Ground Loop Phenomenon

What is Ground Loop?

Ground loop phenomenon 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 equipment to experience noise that in turn causes data transmission errors. In the extreme this ground current can cause equipment malfunction or even destruction.

Cabling Recommendations

When connecting the ULTRA-485/2ISO in a RS-485 network, care should be taken that both ends of the network are not isolated from ground (see Figure 12). 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 destruction of the receiver circuit.
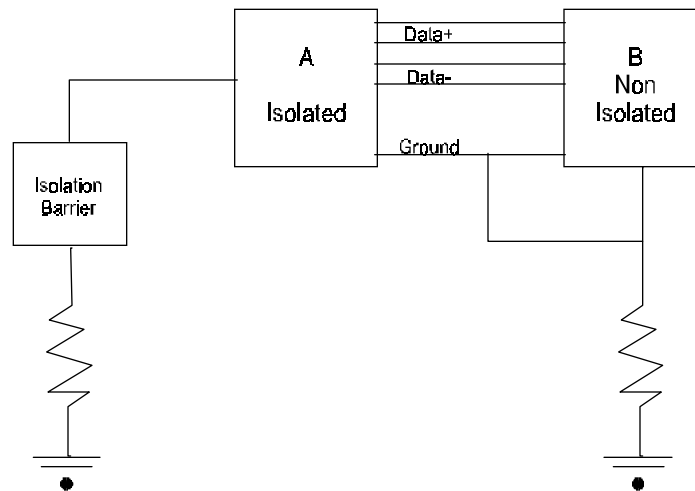

Figure 11: ULTRA-485/2ISO cabling example

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Appendix D: 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.
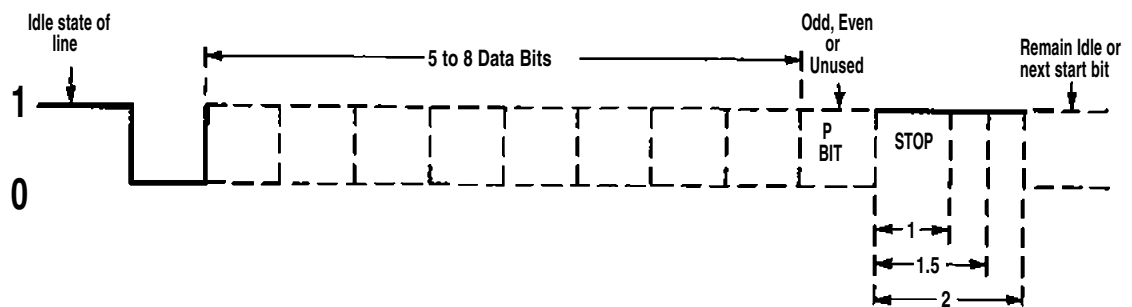

Figure 12: Asynchronous Communications Bit Diagram

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 refereed 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 (i.e. 9600,N,8,1).

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Appendix E: Silk-Screen
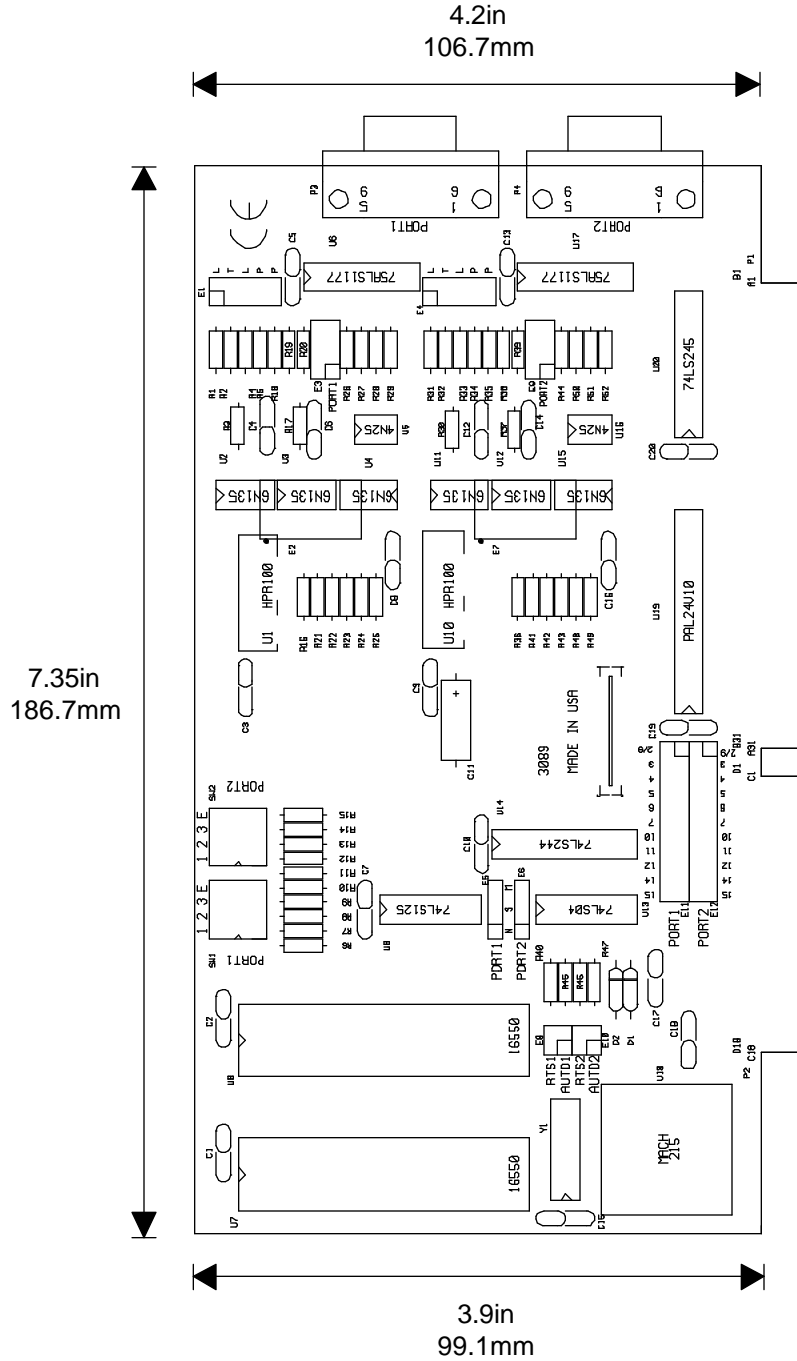
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September 11, 1997
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Mr. Steven R. Peltier
President & Chief Executive Officer

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