

SEALEVEL[®]

SYSTEMS INCORPORATED

IC485+I

Users Manual



Part Number 1103

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Contents

INTRODUCTION	1
OVERVIEW.....	1
WHAT'S INCLUDED.....	1
FACTORY DEFAULT SETTINGS	1
CARD SETUP.....	2
RS-485 ENABLE MODES	2
LINE TERMINATION AND RECEIVER ECHO OFF/ON.....	4
<i>Electrical Interface Examples (DIP switch SW2)</i>	5
OPERATING SYSTEM INSTALLATION (FOR WINDOWS USERS)	6
RS-422/RS-485 FOUR WIRE MASTER/RS-485 TWO WIRE AUTO MODE INSTALLATION.....	6
RS-485 TWO-WIRE AND RS-485 FOUR-WIRE SLAVE INSTALLATION.....	6
OTHER OPERATING SYSTEMS	8
PHYSICAL INSTALLATION.....	8
TECHNICAL DESCRIPTION.....	9
CONNECTOR PIN ASSIGNMENTS	9
<i>RS-232 Signals (DB-25 Female)</i>	9
<i>RS-422/485 Pin Assignments (6 Position Screw Terminal)</i>	9
SPECIFICATIONS	10
ENVIRONMENTAL SPECIFICATIONS	10
MANUFACTURING.....	10
PHYSICAL DIMENSIONS	10
APPENDIX A - TROUBLESHOOTING	11
APPENDIX B - HOW TO GET ASSISTANCE.....	12
APPENDIX C - ELECTRICAL INTERFACE.....	13
RS-232	13
RS-422	13
RS-485	13
APPENDIX D - ASYNCHRONOUS COMMUNICATIONS.....	14
APPENDIX E - GROUND LOOP PHENOMENON	15
WHAT IS GROUND LOOP?.....	15
CABLING RECOMMENDATIONS	15
APPENDIX F - SILK-SCREEN	16
APPENDIX G - COMPLIANCE NOTICES.....	17
FEDERAL COMMUNICATIONS COMMISSION STATEMENT	17
EMC DIRECTIVE STATEMENT	17
WARRANTY	18

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Introduction

Overview

The Sealevel Systems **IC485+I** is an isolated single channel RS-232 to RS-422/485 asynchronous converter. It provides one field selectable RS-422/485 serial port supporting asynchronous data rates up to 115.2K bps. The **IC485+I** is self-powered allowing it to correctly drive multi-drop RS-485 networks.

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 phenomenon that leads to data loss and the destruction of communications interfaces.

Configure the port as RS-422 for long distance device connections up to 4000ft. where noise immunity and high data integrity are essential. Select RS-485 and capture data from multiple peripherals in an RS-485 multi-drop network. Up to 31 RS-485 devices can be connected to automate your data collection.

In RS-422 and RS-485 Auto modes, the card works seamlessly with the standard operating system serial driver. Two additional methods are provided to control the communication line in RS-485 mode. The “Data Enable” mode uses the transmitted data to enable the transmitter and requires no software drivers. This mode has limitations that will be discussed in more detail later. The “RTS Enable” mode uses the UART modem control signal RTS to control the communication line and requires the Sealevel Systems’ serial driver.

What’s Included

The **IC485+I** is shipped with the following items. If any of these items is missing or damaged, contact the supplier.

- **IC485+I** Serial I/O Adapter
- Sealevel Software CD
- Power Supply

Factory Default Settings

The **IC485+I** factory default settings are as follows:

Port #	Electrical Specification
Port 1	RS-422

To install the **IC485+I** using factory default settings, refer to **Installation**.

For your reference, record installed **IC485+I** settings below:

Port #	Electrical Specification
Port 1	

Card Setup

RS-485 Enable Modes

RS-485 is ideal for multi-drop or network environments. RS-485 requires a tri-state driver 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.

DIP-switch SW1 is used to control the RS-485 mode functions for the driver circuit. The selections are:

‘RS-422 Mode’ (Always). This is the factory default mode that ensures the transmitter is always enabled. This mode is intended for Full Duplex applications such as RS-422 or RS-485 4-wire Master mode where tri-state control of the transmitter is not required.

‘RS-485 Auto Mode’. This mode uses an onboard MicroChip PIC microcontroller to sense the baud rate and control the transmitter enable signal based on the detected baud rate. The logic assumes a minimum baud rate of 1200bps and a word length of 10 bits (1 start bit, 8 data bits, and 1 stop bit). For baud rates of 38.4K or less, line turnaround should not exceed 4 bit times, 57.6K should not exceed 10 bit times, and 115.2K should not exceed 20 bit times after successfully autobauding.

‘RS-485 RTS Enable Mode’. The ‘RTS’ enable mode uses the ‘RTS’ modem control signal to enable the RS-485 interface and provides backward compatibility with existing software products. Sealevel Systems’ serial driver should be used and configured for ‘RTS’ control providing a robust RS-485 solution.

‘RS-485 Data Enable Mode’. The ‘Data’ enable mode uses the transmit data stream to enable/disable the transmitter. When the data bit is High (logic 1), the transmitter will be tri-stated and relies on the line biasing resistors to place the line in the proper state. For this reason, line termination cannot be used thus reducing the data rate and maximum cable length. This mode should only be used in applications that prevent the use of the RS-485 Auto Mode or Sealevel Systems’ serial driver.

Communication Mode Examples (Dip switch SW1)

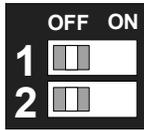


Figure 1- Dip switch SW1, RS-422

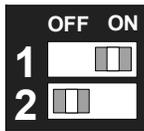


Figure 2 – Dip switch SW1, RS-485 'Auto' Enable

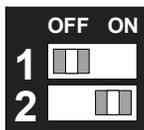


Figure 3 – Dip switch SW1, RS-485 'RTS' Enable

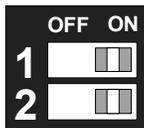


Figure 4 – Dip switch SW1, RS-485 'Data' Enable

Line Termination and Receiver Echo Off/On

Typically, each end of the RS-485 bus must have a line-terminating resistor (RS-422 terminates at the receive end only). A 120-ohm resistor is across each RS-422/485 input in addition to a 1K-ohm pull-up/pull-down combination that biases the receiver inputs. DIP-switch SW2 allows customization of this interface to specific requirements. Each DIP-switch position corresponds to a specific portion of the interface. If multiple **IC485+I** adapters are configured in an RS-485 network, only the adapters on each end should have DIP-switch SW2 position 1 on. One adapter should have DIP-switch SW2 positions 2 and 3 on. Refer to the table below for each position's operation.

DIP-switch SW2 position 6 is used to control the RS-485 enable/disable functions for the receiver circuit and determines 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. To enable the 'No Echo' mode DIP-switch SW2 position 6 should be on.

SW2	Function
1	Adds or removes the 120-ohm termination
2	Adds or removes the 1K-ohm pull-up resistor in the RS-422/RS-485 receiver circuit (Receive data only)
3	Adds or removes the 1K-ohm pull-down resistor in the RS-422/RS-485 receiver circuit (Receive data only)
4	Connects TX+ to RX+ for RS-485 two-wire operation
5	Connects TX- to RX- for RS-485 two-wire operation
6	Receiver Echo Off/On (On = Echo Off)

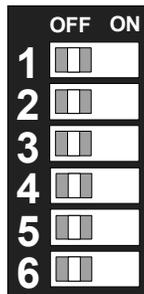


Figure 5 – DIP-switch SW2, Line Termination and Echo Off/On

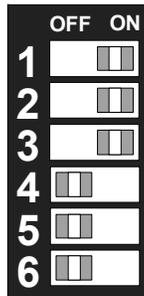
Electrical Interface Examples (DIP switch SW2)

Figure 6 – RS-422 with Termination and Receiver Echo

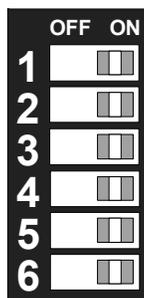


Figure 7 – RS-485 2-wire with Termination and Receiver No Echo

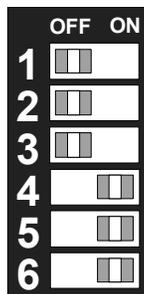


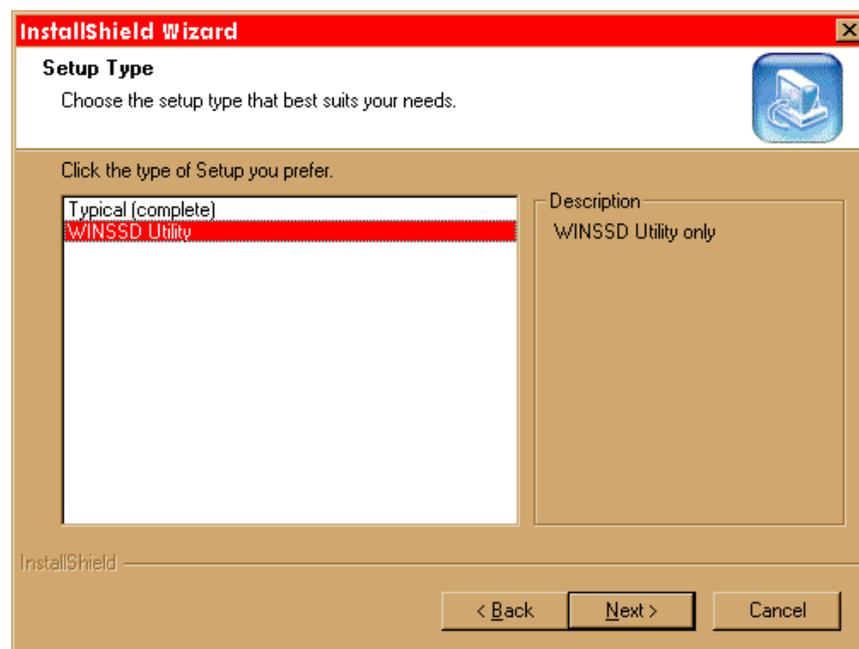
Figure 8 – RS-485 2-wire no Termination and Receiver No Echo

Operating System Installation (For Windows Users)

RS-422/RS-485 Four Wire Master/RS-485 Two Wire Auto Mode Installation

If your application is 4-wire Full Duplex RS-422 or 4-Wire RS-485 Master, where control of the transmitter is not required, or 2-wire RS-485 and you intend to use the Auto Mode to control the transmitter, simply connect the **IC485+I** to an existing RS-232 COM: port. This will utilize the Operating System Serial Driver to control the COM: port. You will want to install Sealevel's diagnostic utility, **WinSSD**, to test and verify proper operation of the port.

Start by choosing **Install Software** at the beginning of the CD. Choose **Asynchronous COM: Port Software, SeaCOM**. Continue with the installation until the "Setup Type" dialog, as shown below, appears. Choose "**WinSSD Utility**" to install just the diagnostic tool. A Start Menu Program Group, "**SeaCOM**" will be created and **WinSSD** can be started from there.



RS-485 Two-Wire and RS-485 Four-Wire Slave Installation

If your application is 2-wire Half-Duplex RS-485 or 4-Wire Full-Duplex RS-485 Slave that requires control of the transmitter, the **IC485+I** provides 3 methods of control.

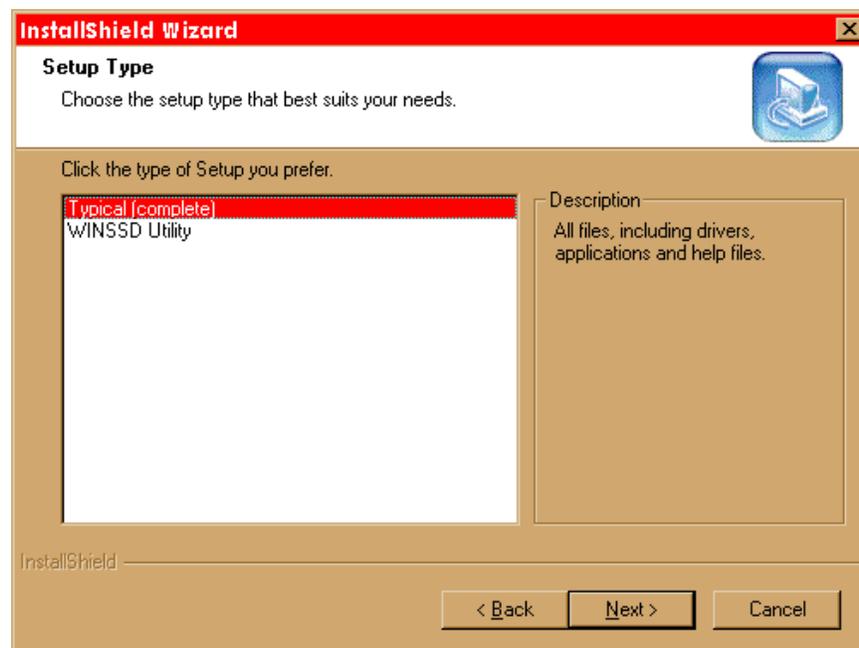
The first method is '**Auto Enable**' which uses an onboard microcontroller to sense the baud rate and control the transmitter enable. This mode assumes a minimum baud rate of 1200bps and a word length of 10 bits. This would be the preferred method, as it requires no software in order to work. This mode should be used with line termination since the transmitter is driving the line during transmission.

The second method is '**RTS Enable**' which uses Sealevel's Windows based serial drivers to control the UART modem control signal RTS. RTS is connected to the transmitter enable circuit and thru software control, provides an efficient method of line-turnaround. This abstracts the application from the low level control and simplifies application development. This mode should be used with line termination since the transmitter is driving the line during transmission.

The last method is '**Data Enable**' which uses the transmitted data stream to enable the transmitter and requires no special software drivers. When the transmitted data is a low (0), the transmitter will be enabled to drive the line. When the transmitted data is a high (1), the transmitter will be tri-stated relying on the line biasing resistors to pull the line to the proper state. Due to this, termination must not be used and thus data rate and cable length are reduced accordingly.

The choice of which method to use is simple. If your data stream permits the use of the '**Auto Enable**' mode always use this option as it permits the simplest installation. If '**Auto Enable**' is not an option and you are using the **IC485+I** in a Windows based system, setup the transmitter control for '**RTS Enable**' and install Sealevel's **SeaCOM** software. Again, if '**Auto Enable**' is not an option, and your system is not Windows based or if the port you are converting is not PC based, use '**Data Enable**'.

If '**RTS Enable**' mode is chosen, start by choosing **Install Software** at the beginning of the CD. Choose **Asynchronous COM: Port Software, SeaCOM**. Continue with the installation until the "**Setup Type**" dialog, as shown below, appears. Choose "**Typical (complete)**" to install the software including drivers and applications. A Start Menu Program Group, "**SeaCOM**" will be created and **WinSSD** can be started from there.



Once the software installation is complete, the port must be configured for '**RTS Enable**'. This is accomplished by using the Device Manager in Windows (except NT). The port that the **IC485+I** is attached must be selected under **Ports (COM & LPT)**. Access the '**RTS Enable**' checkbox via the '**Advanced**' dialog. In Windows NT, Sealevel's '**Advanced Ports**' applet should be used for configuration.

Other Operating Systems

Linux includes a full-featured serial driver that includes support not found in Microsoft's serial driver. Most serial drivers offer a mechanism to control **RTS** from the application layer. While this is not as efficient and normally means using 'Echo' to know when to turn off the transmitter, for most applications this is adequate. The '**Auto Enable**' and '**Data Enable**' modes can also be used. Refer to your operating system documentation for specifics.

Physical Installation

The **IC485+I** can be connected to any existing RS-232 port. A cable such as Sealevel's' **CA-177** can be used to attach the **IC485+I** DB-25F to the PC's DB-9M connector.

1. Locate an existing RS-232 COM: port and connect the **IC485+I**.
2. With the **IC485+I** case open, configure DIP-switches SW1 and SW2 for your application.
3. Connect the wiring to your external device via the provided 6-position screw terminal. The signals are labeled on the board's silkscreen. From the included hardware, select the strain relief clamp that best fits your cable.
4. Make sure all connections are secure and that strain relief is correctly installed.
5. Close the **IC485+I** case and connect the included AC adaptor.
6. If the **IC485+I** is in RS-422 mode, the **EN** led should now be on since the transmitter is always enabled.

Installation is complete.

Please Note:

On power-up, the **IC485+I** scans the Mode Select DIP-switch (SW1) one time to determine the communication mode and then branches to the selected control logic. No attempt is made to periodically check the switch for a mode change. This is done for two reasons. First, our experience shows that a device such as this is configured for the required application and the mode is not changed after this. Due to this reason, the product is not burdened with the overhead of always checking this switch. At higher baud rates this becomes especially critical due to the speed of the onboard microcontroller. The utmost priority is given to sampling the incoming data.

Why is this important? If the **IC485+I** has been configured for a particular mode, and for some reason it has become necessary to change the communication mode, remove power, reconfigure the Mode Select DIP-switch (SW1) for the new mode, and reapply power.

Technical Description

The Sealevel Systems **IC485+I** converts an existing RS-232 serial port into an isolated, field selectable, RS-422/485 port for industrial automation and control applications. 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 phenomenon that leads to data loss and the destruction of communications interfaces.

Connector Pin Assignments

RS-232 Signals (DB-25 Female)

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

Note: These assignments meet EIA/TIA/ANSI-232E DTE

Technical Note: The modem control signals are biased in the following fashion: RTS and CTS are connected, DTR is connected to DCD and DSR, and RI is tied inactive.

RS-422/485 Pin Assignments (6 Position Screw Terminal)

Signal		Name	Pin #	Mode
RDB	RX+	Receive Data Positive	1	Input
RDA	RX-	Receive Data Negative	2	Input
TDB	TX+	Transmit Data Positive	3	Output
TDA	TX-	Transmit Data Negative	4	Output
GND	GND	Ground	5	
SHIELD	SH	Shield	6	

Specifications

Environmental Specifications

Specification	Operating	Storage
Temperature Range	0° to 70° C (32° to 158° F)	-50° to 105° C (-58° to 221° F)
Humidity Range	10 to 90% R.H. Non-Condensing	10 to 90% R.H. Non-Condensing

Manufacturing

All Sealevel Systems Printed Circuit 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.

Physical Dimensions

Package Length	3.8 inches	(9.66 cm)
Package Width	2.3 inches	(5.84 cm)
Package Height	1.0 inches	(2.54 cm)

Appendix A - Troubleshooting

Serial Utility test software is supplied with the Sealevel Systems adapter and should be used in the troubleshooting procedures. Using this software and following these simple steps, most common problems can be eliminated without the need to call Technical Support.

1. The **IC485+I** is a level converter and therefore requires no system resources such as I/O ports or IRQs. The I/O resources of the host RS-232 COM: port will be used to access the port.
2. If you are experiencing problems, a good starting point is to verify proper operation of the host RS-232 COM: port. Connect the host port TX and RX lines and use Sealevel's **WinSSD** utility to perform a loopback test. If you cannot open the host port, ensure that it is enabled in the System BIOS. If using a Plug 'n' Play operating system, verify that it is recognized by the system.
3. If the host RS-232 port is working properly, verify that the **IC485+I** is configured correctly for your application based on the '**Card Setup**' section earlier in this manual. After attaching the **IC485+I**, you may perform a loopback test by connecting TX+ to RX+ and TX- to RX-. Keep in mind that this test will fail should you have DIP-switch SW2 position 6 on. This forces the **IC485+I** into 'No Echo' mode and will prevent the loopback test from passing. For loopback purposes, always have DIP-switch SW2 position 6 off even if you will use No Echo in your actual application.
4. During the loopback test, pay attention to the TX and RX LEDs, as both of these should be on. Failure of one or both of these to be on would indicate a hardware problem on the adapter.

Appendix B - How To Get Assistance

Please refer to Troubleshooting Guide prior to calling Technical Support.

1. Begin by reading through the Trouble Shooting Guide in Appendix A. If assistance is still needed please see below.
2. When calling for technical assistance, please have your user manual and current adapter settings. If possible, please have the adapter installed in a computer ready to run diagnostics.
3. Sealevel Systems provides an FAQ section on its web site. Please refer to this to answer many common questions. This section can be found at <http://www.sealevel.com/faq.asp>.
4. Sealevel Systems maintains a web page on the Internet. Our home page address is www.sealevel.com. The latest software updates, and newest manuals are available via our web site.
5. Technical support is available Monday to Friday from 8:00 a.m. to 5:00 p.m. eastern time. Technical support can be reached at (864) 843-4343.

Return Authorization Must Be Obtained From Sealevel Systems Before Returned Merchandise Will Be Accepted. Authorization Can Be Obtained By Calling Sealevel Systems And Requesting A Return Merchandise Authorization (RMA) Number.

Appendix C - Electrical Interface

RS-232

Quite possibly 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-232 or EIA/TIA-232. The IBM PC computer defined the RS-232 port on a 9 pin D sub connector and subsequently the EIA/TIA approved this implementation as the EIA/TIA-574 standard. This standard is defined as the *9-Position Non-Synchronous Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*. Both implementations are in wide spread use and will be referred to as RS-232 in this document. RS-232 is capable of operating at data rates up to 20 Kbps at distances less than 50 ft. The absolute maximum data rate may vary due to line conditions and cable lengths. RS-232 is a single ended or unbalanced interface, meaning that a single electrical signal is compared to a common signal (ground) to determine binary logic states. The RS-232 and the EIA/TIA-574 specification define two types of interface circuits, Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE). The **IC485-I** is a DCE device.

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.

RS-485

RS-485 is backwardly compatible with RS-422; however, it is optimized 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 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.

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. A start bit, followed by a pre-defined number of data bits (5, 6, 7, or 8) defines character boundaries for asynchronous communications. The end of the character is defined by the transmission of a pre-defined number of stop bits (usually 1, 1.5 or 2). An extra bit used for error detection is often appended before the stop bits.

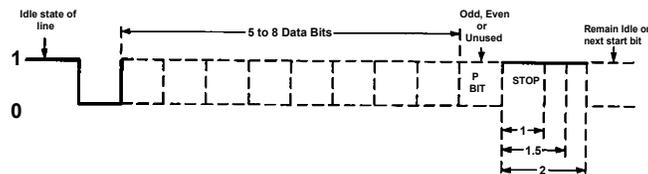


Figure 9 - Asynchronous Communications Bit Diagram

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

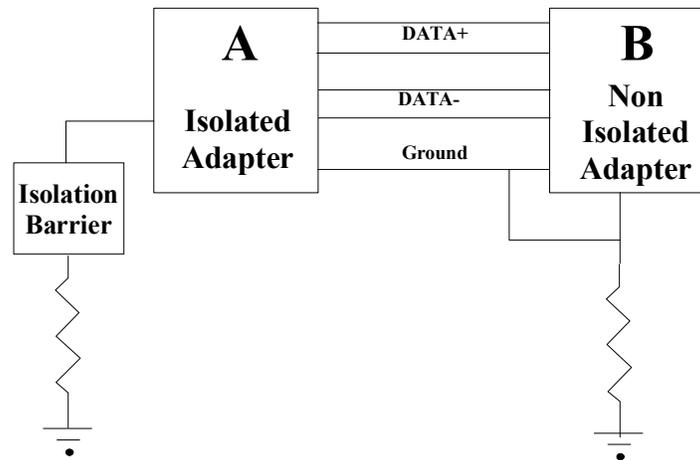
Appendix E - Ground Loop Phenomenon

What is Ground Loop?

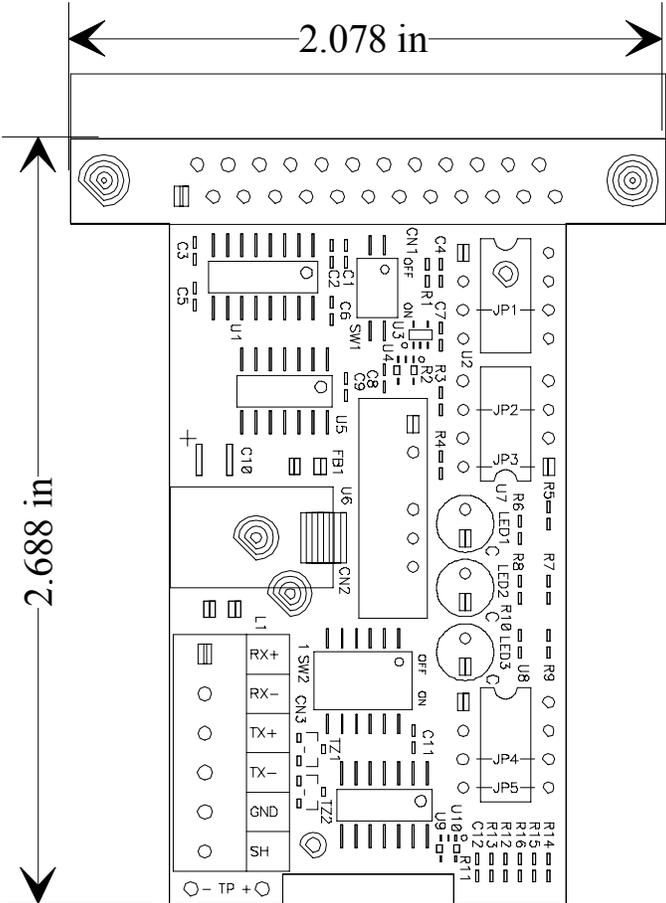
Ground loop Phenomenon occurs when two (or more) pieces of equipment are connected together with a common ground and a different ground potential exists at each location. This current can cause the connected equipment to experience noise that in turn causes data transmission errors. In the extreme this ground current can cause equipment malfunction or even destruction.

Cabling Recommendations

When connecting the **IC485+II** in a RS-485 network, care should be taken that both ends of the network are not isolated from ground (see Figure 8). 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.



Appendix F - Silk-Screen



Appendix G - Compliance Notices

Federal Communications Commission Statement

FCC - This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in such case the user will be required to correct the interference at the users expense.

EMC Directive Statement



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"

EN55024 - "Information technology equipment Immunity characteristics Limits and methods of measurement".

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 in which case the user may be required to take adequate measures to prevent or correct the interference.

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/EMC directives.

Warranty



Sealevel's commitment to providing the best I/O solutions is reflected in the Lifetime Warranty that is standard on all Sealevel manufactured products. We are able to offer this warranty due to our control of manufacturing quality and the historically high reliability of our products in the field. Sealevel products are designed and manufactured at its Liberty, South Carolina facility, allowing direct control over product development, production, burn-in and testing.

Sealevel Systems, Inc. (hereafter "Sealevel") warrants that the Product shall conform to and perform in accordance with published technical specifications and shall be free of defects in materials and workmanship for life. In the event of failure, Sealevel will repair or replace the product at Sealevel's sole discretion. Failures resulting from misapplication or misuse of the Product, failure to adhere to any specifications or instructions, or failure resulting from neglect or abuse are not covered under this warranty.

Warranty service is obtained by delivering the Product to Sealevel and providing proof of purchase. **Return authorization must be obtained from Sealevel Systems before returned merchandise will be accepted. Authorization is obtained by calling Sealevel Systems and requesting a Return Merchandise Authorization (RMA) number.** The Customer agrees to insure the Product or assume the risk of loss or damage in transit, to prepay shipping charges to Sealevel, and to use the original shipping container or equivalent. Warranty is valid only for original purchaser and is not transferable.

Sealevel Systems assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use, misuse of, or inability to use this product. Sealevel Systems will not be liable for any claim made by any other related party.

This warranty applies to Sealevel manufactured Product. Product purchased through Sealevel but manufactured by a third party will retain the original manufacturer's warranty.

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