

***IC485™***  
***USER MANUAL***



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**Part # 1101**

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## Introduction

### Overview

The Sealevel Systems **IC485** is a 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** is self-powered allowing it to correctly drive multi-drop RS-485 networks.

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 each port to automate your data collection.

In RS-422 mode, the card works seamlessly with the standard operating system serial driver. In RS-485 mode, two methods are provided to control the communication line. 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 is the preferred method of controlling the communication line and requires the Sealevel Systems’ serial driver.

### What’s Included

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

- **IC485** Serial I/O Adapter
- Sealevel Software

### Factory Default Settings

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

Port #	Electrical Specification
Port 1	RS-422

To install the **IC485** using factory default settings, refer to **Installation**. For your reference, record installed **IC485** 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.

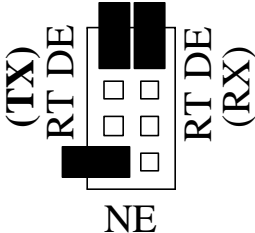
Header E2 is used to control the RS-485 mode functions for the driver circuit. The selections are:

'Data' enable (silk-screen 'DE'). 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 can not 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 Sealevel Systems' serial driver.

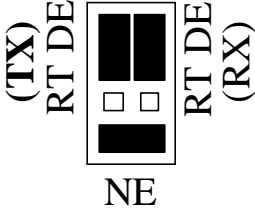
'RTS' enable (silk-screen 'RT'). The 'RTS' enable mode uses the 'RTS' modem control signal to enable the RS-485 interface and provides backward compatibility with existing software products. Sealevel Systems' serial driver should be used and configured for 'RTS' control providing a robust RS-485 solution.

'No Echo' (silk-screen 'NE'). 'No Echo' is 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. To select the 'No Echo' mode select silk-screen position 'NE'.

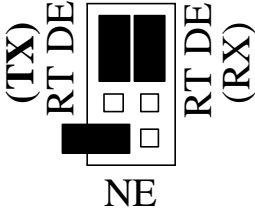
**RS-485 Mode Examples (Header E2)**



*Figure 1- Header E2, RS-422*

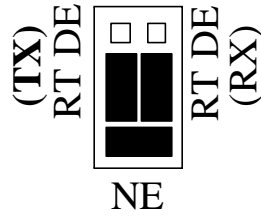


*Figure 2 – Header E2, RS-485 'Data' Enabled, with 'No Echo'*

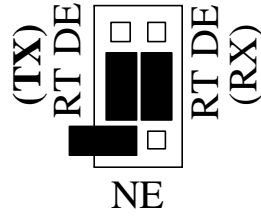


*Figure 3 - Header E2, RS-485 'Data' Enabled, with 'Echo'*

**RS-485 Mode Examples (Header E2) continued**



*Figure 4 - Header E2, RS-485 'RTS' Enabled, with 'No Echo'*



*Figure 5 – Header E2, RS-485 'RTS' Enabled, with 'Echo'*

### Line Termination

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. Header E1 allows customization of this interface to specific requirements. Each jumper position corresponds to a specific portion of the interface. If multiple **IC485** adapters are configured in an RS-485 network, only the adapters on each end should have the T jumper installed. One adapter should have the P & P jumpers installed. . Refer to the following table for each position's operation:

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

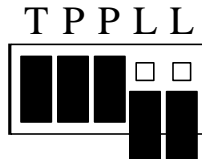


Figure 6 - Header E1, Line Termination

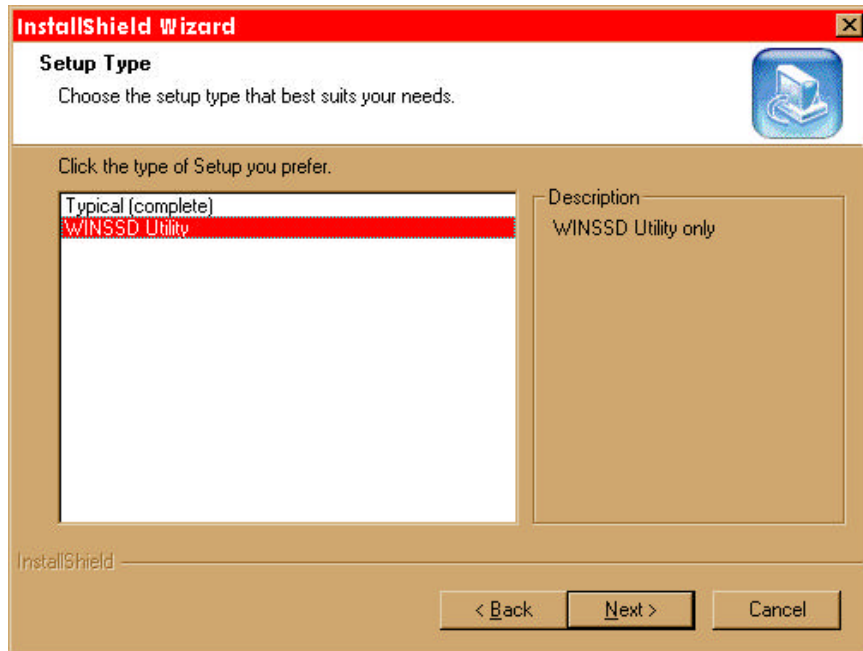


## Operating System Installation (For Windows Users)

### RS-422/RS-485 Four Wire Master. 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, simply connect the **IC485** 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 Sealevels' 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.



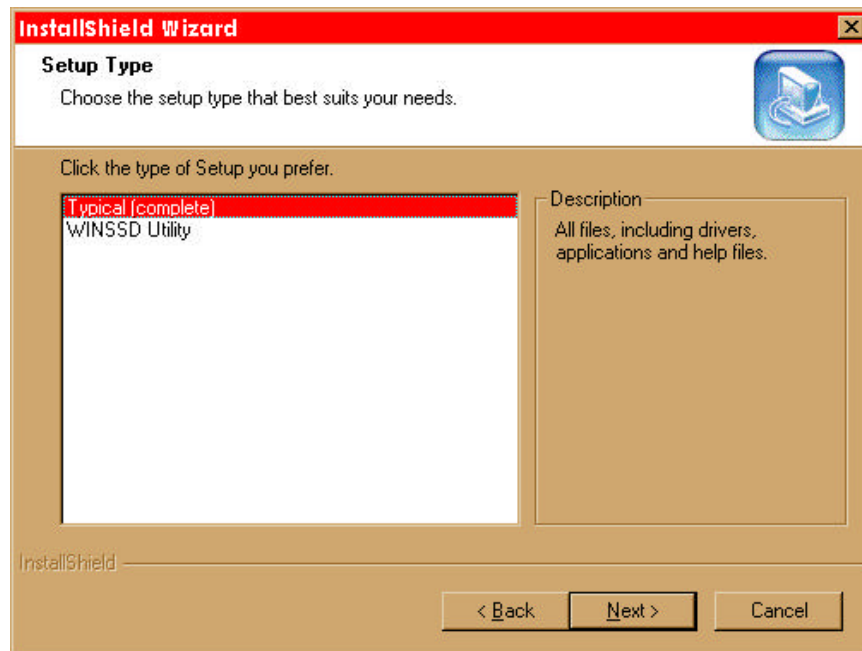
### **RS-485 Two-Wire and RS-485 Four Wire Slave Installation**

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 provides 2 methods of control. The first 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 second and preferred method is **'RTS Enable'** which uses Sealevels' 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 this 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 choice of which method to use is simple. If using the **IC485** in a Windows based system, always setup the transmitter control for **'RTS Enable'** and install Sealevels' **SeaCOM** software. If your system is not Windows based or if the port you are converting is not PC based, use **'Data Enable'**.

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 9X, ME, and Windows 2000. The port that the **IC485** is attached to must be selected under **Ports (COM & LPT)**. Access the '**RTS Enable**' checkbox via the '**Advanced**' dialog. In Windows NT, Sealevels' '**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 '**Data Enable**' mode can also be used. Refer to your operating system documentation for specifics.

## System Installation

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

1. Locate an existing RS-232 COM: port and connect the **IC485**.
2. With the **IC485** case open, configure headers **E1** and **E2** 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 silk screen. 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** case and connect the included AC adaptor.
6. If the **IC485** is in RS-422 mode, the **EN** led should now be on since the transmitter is always enabled.

Installation is complete.

## Technical Description

The Sealevel Systems **IC485** converts an existing RS-232 serial port into a field selectable RS-422/485 port for industrial automation and control applications.

### 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	

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## Specifications

### Environmental Specifications

Specification	Operating	Storage
Temperature Range	0° to 50° C (32° to 122° F)	-20° to 70° C (-4° to 158° 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 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.

### Mean Time Between Failures (MTBF)

Greater than 150,000 hours. (Calculated)

### 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 will be used in the troubleshooting procedures. By using this software and following these simple steps, most common problems can be eliminated without the need to call Technical Support.

1. The **IC485** is a level converter and therefore requires no system resources such as I/O ports or IRQ's. 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 Sealevels' **WinSSD** utility to perform a loopback test. If you can not open the host port, ensure that it is enabled in the System BIOS. If using a Plug 'n' Play operating system, verify that it appears in the Device Manager under Ports (COM & LPT).
3. If the host RS-232 port is working properly, verify that the **IC485** is configured correctly for your application based on the '**Card Setup**' section earlier in this manual. After attaching the **IC485**, 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 the '**NE**' jumper installed on '**E2**'. For loopback purposes, always have '**NE**' removed 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 card.

## Appendix B - How To Get Assistance

Please refer to Appendix A - Troubleshooting prior to calling Technical Support.

1. Read this manual thoroughly before attempting to install the adapter in your system.
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 maintains a Home page on the Internet. Our home page address is [www.sealevel.com](http://www.sealevel.com). The latest software updates, and newest manuals are available via our FTP site that can be accessed from our home page.
4. Technical support is available Monday to Friday from 8:00 a.m. thru 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** 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 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.

## 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.

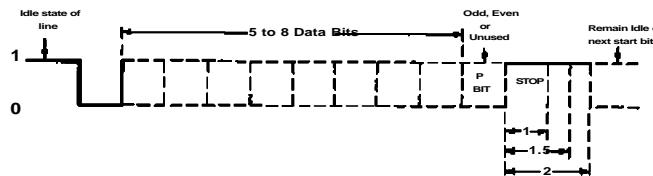


Figure 7 - Asynchronous Communications Bit Diagram

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 - Silk-Screen

2.688 in

## Appendix F - 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 his own 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.**

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 Systems, Inc. provides a lifetime warranty for this product. Should this product fail to be in good working order at any time during this period, Sealevel Systems will, at its option, replace or repair it at no additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster.

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.

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email: support@sealevel.com

Technical Support is available from 8 a.m. to 5 p.m. Eastern time.  
Monday - Friday

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**IC485** is a trademark of Sealevel Systems, Incorporated.