



USB to Serial Gateway

User Manual

USG-1-B-485

For use with RS485 Industrial Interfaces and
Maritime IEC 61162-2 connections

Issue 1.04

- Create a safe serial port connection to an RS485 network or an IEC61162-2 compliant marine connection that may be on a different power circuit.
- Provide a fully compliant RS485 port from a USB port
- Receive low level differential signals that are too small to be received directly by a PC serial port

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Important Notices

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The **Actisense** USB to Serial Gateway (USG-1-485) is intended for use in a marine environment, but only below decks. If the unit is to be used in a more severe environment, such use may be considered misuse under the seller's warranty.

The **Actisense** USG-1-485 has been certified to comply with the European directive for Electro-Magnetic Compatibility (EN60945), and is appropriately CE marked. Operation of the unit should be in conjunction with appropriate CE approved shielded connectors and cabling used in accordance with the CE directive EN60945. Any EMC related issues should be reported to Active Research immediately to allow the company to rectify or resolve EMC related problems in accordance with its obligations under EN60945.

If the unit is connected such that compliance failure occurs beyond the company's control, the company shall not be held responsible for compliance failure until suitable EMC guidelines for connection are seen to have been taken.

Notices

When using this document, keep the following in mind:

The products described in this manual and the specifications thereof may be changed without prior notice. To obtain up-to-date information and/or specifications, contact Active Research Limited or visit the [Actisense website \(www.actisense.com\)](http://www.actisense.com).

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Active Research Limited will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user's unit according to this document.

Foreword

Actisense recognises that instructions are often skipped, so we have aimed to write this document in an informative, yet direct manner that will aid the user. We have tried to cover all the points a typical user may need to know. Please read all sections before installing and using the **Actisense** USB to Serial Gateway product.

Introduction

The **Actisense** USB to Serial Gateway (USG-1-485) product developed out of the requirement to solve three fundamental problems with interfacing the industry RS485 communications standard to a PC.

These are:

1. **Ground loops.** When the PC and the connected system have different ground potentials (or are totally different ground altogether), data can become corrupted and permanent damage can occur.
2. **Different standards.** When you buy a standard USB to serial converter, they normally provide PC standard RS232 port, whereas RS485 uses a differential bi-directional signalling system. This means that a standard USB to serial converter is incompatible with RS485 / IEC61162-2 that uses the RS485 electrical driver type.
3. **PC has no serial port.** Most modern PCs do not come with serial ports any more as these are being replaced by the new standard of USB. Furthermore, RS485 signals are not directly compatible with standard PC serial ports.

Full information on the complete **Actisense** product range can be found on the [Actisense website](http://www.actisense.com).

RS485 & IEC61162-2

The port provided by the USG-1-B-485 will be referred throughout the document as "RS485" although the IEC61162-2 marine standard uses the same interface, and the two terms are interchangeable.

The IEC61162-2 interface is not normally used in a bidirectional mode, however, and is generally referred to as a three-wire RS422 system. The differential signalling method and the output driver levels are compatible between the two systems.

USG-1 solutions

Solution #1 - Ground loops

The first problem encountered when using a standard USB to serial converter (or a standard RS232 port) is that the ground of the PC is then shared with the connected system ground.

PCs are often powered from a mains inverter, generator set or direct from mains supply when in dock, whereas the marine electronics are normally connected to the current marine battery set.

This means that when you connect the two systems together, you are joining two different power systems. This can result in no visible problems, but more often it results in one of three consequences:

1. Data corruption - the data becomes garbled as the electrical data signal now floats on a noisy ground current flowing between the two power systems.
2. The PC crashes intermittently as ground currents flow across its sensitive electronic circuitry. This can cause permanent damage.
3. In the case of large ground loop faults, some components can melt / catch fire / fuses blow or earth leakage devices trip.

The **USG-1-485** solves all these problems by providing a safe, opto-isolated barrier between the two systems. **Because the signal travels across this barrier as light**, the signals do not share the same ground, and safety is assured as no current can flow between the two power systems. In addition, a built-in power isolator completes the isolation.

Solution #2 - Different standards

PC serial or "COM" ports use the RS232 standard. This uses a ground and a receive pin to get data from a connected system. Data is sent as voltages referenced to ground on a single transmit line. This type of drive is known as "single-ended".

In contrast, RS485 systems use a "differential" system, where a "Positive" data line and a "Negative" data line move in opposition to each other.

Many installations without isolated outputs have been seen where the negative data line on a differential drive system has been connected to the ground of the PC. If you're lucky, this may work, but if not, you will either simply get no data, or at worst, damage your equipment.

The USG-1-485 solves this by using ingenious circuitry unique to Actisense in its bi-directional transmitter circuit. Please refer to the [Interfacing](#) section for more information.

Solution #3 - PC has no serial port

Many laptop and desktop PCs do not come equipped with RS232 type serial ports (which could be converted to an RS485 type using a simple converter) any more. The USG-1-485 solves this by creating a standard RS485 port from any PC USB port.

This port appears on the PC system as a regular "COM" port, and so can be used with all standard navigation and display software.

Features

Standard USB connection - Equipped with a type "A" USB connector to connect to a USB port or hub (USB v1.1 or v2.0 compliant).

Opto-isolated ISO-Drive transceiver technology creates a transceiver, unique to Actisense, that is isolated to 1500 volts - say goodbye to ground loop issues!

ISO-Drive allows a completely "floating" output to be created, making a safe connection to a PC an easy task. You can use the ISO-Drive output to safely transfer data to an RS485 device, or to another PC. The output automatically changes between differential and single ended drive depending upon the type of instrument it is connected to.

When not transmitting, the USG-1-485 automatically switches to receive mode. The output becomes a differential input fully compliant with the RS485 specification. This allows the USG-1-485 to work correctly with long cable runs and in a noisy environment. Typical operating voltage is 2.0v to 12.5v. The unit can withstand -8/+12.5v continuously, and +/- 40v transients. The input is also compatible with RS232 signal levels.

PC USB drivers supplied on disc - the drivers allow the USG-1 to appear as a standard "COM" port on the PC.

Low current consumption - the USG-1-485 is powered directly from the USB port on your PC, so no extra power cables are required.

Tough Polycarbonate case - certified to IP54 (Splash and dust proof) when used with both supplied cables.

Software updates

The USG-1 has no built-in firmware, but Actisense will be providing updates to the PC USB drivers free on our website, www.actisense.com when they become available.

RS485 Interfacing

The basics

RS485 interfaces are much like RS422 interfaces, but with the ability for the connection to be a listener or a talker depending upon port direction.

The USG-1 transceiver changes direction automatically. When installed on a PC, the USB driver sets up a virtual communications port "VCP" on the host PC. When data is sent to this port, the USG-1-485 transceiver automatically becomes a driver and sends data to the RS485 network. Once all data has been sent, the transceiver automatically switches back to receive mode.

In addition, an optional link on the USG-1-485 board can be set to "echo" mode, where data on the bus sent from the USG-1-485 returns back to the PC. This link is factory set to "no echo".

Actisense produces a full range of products to solve many marine and other interfacing requirements.

Please visit the [Actisense website](#) for full details on these and other **Actisense** interfacing products (NMEA Multiplexers, NMEA Buffers, and NMEA Autoswitches) as well as Depth sounders.

The RS485 signals

RS485 uses a "differential" signalling scheme, whereby two wires are used to transmit the data. These connections will be labelled as either "A" and "B" or "+" and "-" respectively, depending on the instrument and manufacturer.

When connecting between different manufacturers, there can be some confusion, but it is simple and easy to remember: "A" connects to "+" and "B" connects to "-".

Opening the USG-1

The USG-1 comes supplied with a factory installed connection cable with tinned solder wire ends. **Using this cable means that you will not need to open the USG-1-485 case to make your connections.**

If you need to use your own cable, Phoenix style connectors are provided within the USG-1-485 to allow you to connect it. A separate grommet is also provided for this purpose - simply slide it over your own cable before connecting it to the Phoenix style connectors.

To open the USG-1-485, remove the two screws in the base of the USG-1, then slide off the top of the case. The grommets need to be slid off the top of the case in order to access the internal connections. You will be left with the USG-1-485 circuitry attached to the base of the unit and the two supplied cables attached to their connectors.

Note: When opening the USG-1-485 case, be aware that the circuitry inside is not 100% protected against static electricity. Please ensure that, when opening the case, you use precautions against static damage - by only touching the connector block and by holding the unit by its base. In this way, the risks of static damage will be minimised.

USG-1 connections

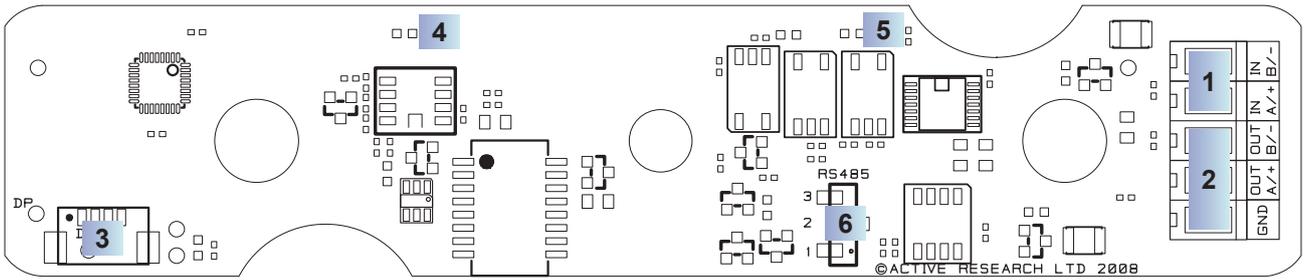


Figure 1 – Inside the USG-1 case

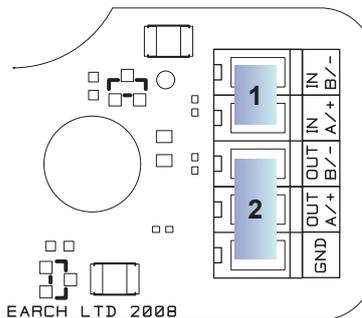
Figure 1 shows an internal view of the USG-1 Printed Circuit Board (PCB). The USG-1 has screw-terminal “Phoenix” type connectors with a pre-installed cable. This cable should be sufficient for most installations. The colour codes used for this cable are:

Wire colour	Function
Shield / Screen	ISO-Drive Ground
Blue	ISO-Drive RS485 B/-
White	ISO-Drive RS485 A/+
Black	ISO-Drive RS485 B/-
Red	ISO-Drive RS485 A/+

This cable also has a screen connection. This is not connected inside the USG-1: in most instances, simply connect this to ground at the instrument end, and this will provide correct screening of the signals on the USG-1-485 data cable.

1/2. An RS485 bidirectional connection.

Two sets of screw-terminal Phoenix-style connectors (1 & 2 in figure 1) are provided to connect the RS485 network. These connectors are provided for use



when the customer needs to use their own cable.

The bottom set of three screw-terminal Phoenix-style connectors provide a second set of connections to the RS485 network, along with a reference to the floating ground of the USG-1-485 driver circuitry to use where required.

Both sets of connections provide connections: ‘+ / A’, ‘- / B’. This allows the USG-1-485 to interface to various different devices that require any combination of these outputs. Both sets are connected in parallel on the board. This allows a network to be created, by allowing a connection in from the RS485 network, and the second set used to connect to further devices on the network.

Note: The connection marked “GND” on the connection block 3 is not USB or PC ground, it is connected to the isolated ground of the ISO-Drive circuit. In most installations, this GND should be left disconnected. It is only for use in special circumstances where an RS485 3-terminal type connection is required, and is reserved only for specialist installations. No damage will be caused by connecting to this GND in error, but it may result in missing or corrupted data if it is used incorrectly. Always follow the connection diagrams shown in this manual to ensure correct operation.

3. A micro-connector to connect to the supplied USB type A terminated cable.

This connector should not normally be removed: it is installed at the factory and is not customer serviceable.

4. An indicator LED - USB

This LED flashes when data is sent from or received from the USB side of the USG-1. It can be clearly seen through the USG-1’s translucent lid when the case is closed.

5. An indicator LED - RS485

This LED flashes when data is sent from or received from the RS485 side of the USG-1. It can be clearly seen through the USG-1’s translucent lid when the case is closed.

6. An echo-mode header

Connecting the supplied link between pins 1 and 2 sets the “echo” mode, which returns all data sent by the PC. Connecting pins 2 and 3, sets the “no echo”, mode, which is the factory default.

Connecting Devices

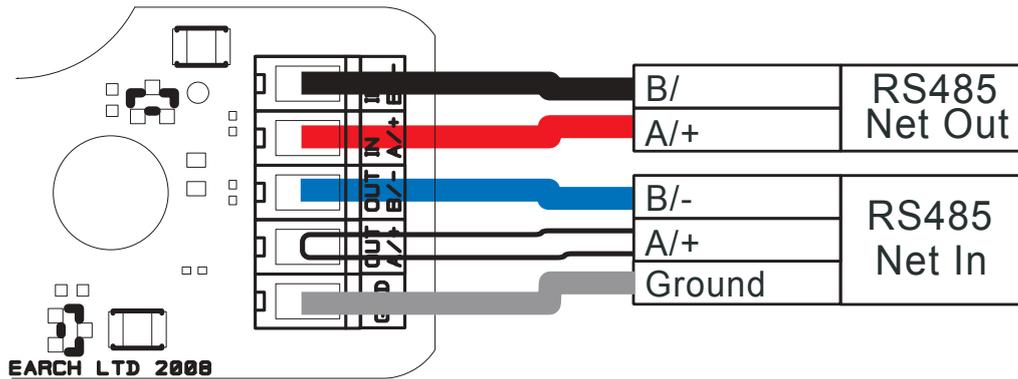


Figure 2 – RS485 connections

RS485 Connections

Figure 2 shows a typical installation with an RS485 network connected into the lower connections of the connector (connection 3 on Figure 1), and the network continuing on via the second set of connections above.

The USG-1-485 maintains full isolation of the PC from both ground and signal lines.

The ground (**GND**) connection may be connected to the network as a reference ground. This is not the same as the PC ground - it is the isolated ground used by the RS485 transceiver on the USG-1-485.

Notes:

1. It is recommended that all device interconnection cables used should meet the two-conductor, shielded, twisted pair configuration specification. The shield connection of these wires should be connected at the instrument end only to prevent ground loops.
2. Throughout these connection diagrams, the wire colours represent those actually used on the supplied Actisense USG-1-485 data cable. When using the supplied cable, simply use the colours indicated to connect to your network or instrument.
3. Refer to the [Specifications](#) section for the full details on input/output specifications.

Connecting to a 3-pin RS485 Listener or Talker (IEC 61162-2)

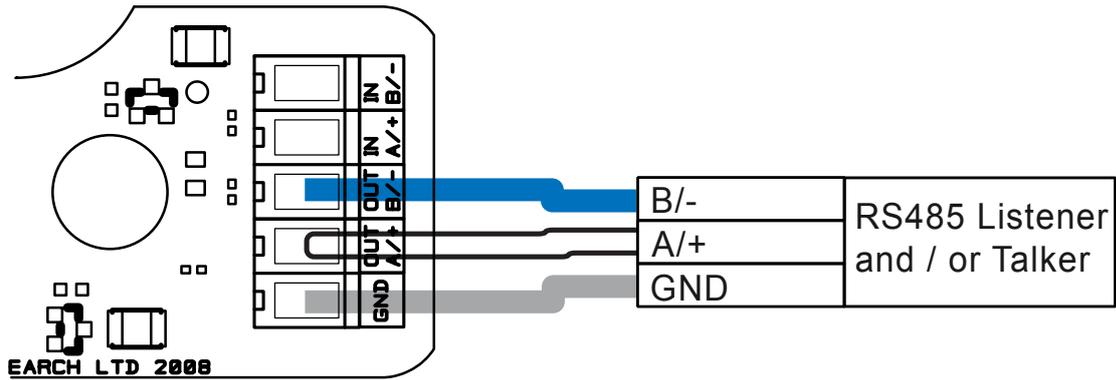


Figure 3 – RS485 / IEC 61162-2 port connections

The USG-1 transceiver can be connected to an IEC61162-2 Listener, and / or Talker that requires a differential drive plus ground as shown in figure 3, The USG-1 serial port will default automatically to listen mode when no data is being sent (from an 'RS485 Talker') to the virtual serial port representing the USG-1-485 on the PC.

Connecting to a Personal Computer RS232 port

It is possible to connect the USG-1-485 to a PC's serial communications (RS232) port, however, the resulting PC connection would not be bidirectional - as communication can only work one-way (either receive only, or transmit only, but not both).

It is therefore, highly recommend to use an Actisense USG-1-422 model instead, using the RS232 connections detailed in that user manual. This method will allow full bi-directional isolated connection to a PC RS232 port.

USB Driver Installation

The **Actisense** USG-1 makes use of a virtual serial port driver (known as the Virtual COM Port Driver) to interface between the USB port on the PC and the **Actisense** product. This driver allows software running on a PC to communicate with the **Actisense** USG-1 as if it was connected to a standard serial port on the PC, when in fact all communication is done over the USB connection.

The required driver installation comes in two separate packages. The first driver is called the 'Serial Converter' which converts the USB data packets to a serial data stream. The second driver, called the 'Actisense USB Serial Port', makes the USB connection appear as a COM port in the Windows Device Manager.

The USG-1 with USB connection has been extensively tested with both Windows XP and Windows 98 SE.

For the experienced Windows XP user who is used to installing drivers, this section will be very familiar. To all other Windows users, the required steps are detailed below to help with installation.

The steps for Windows 98 SE are very similar to those of Windows XP and so are not detailed here.

The **Actisense** CD also contains the USB drivers for Windows 2000. These drivers have not been tested by **Actisense**, but should operate in the same manner as the Windows 98 SE and XP drivers.

The required Linux drivers are already included in the Linux kernels from v2.4.20 and onwards. However, **Actisense** has not been able to test the compatibility of the USG-1 with USB and this driver.

For MAC OS 8, 9, and X please contact **Actisense** for details (refer to the [Company Information](#) section).

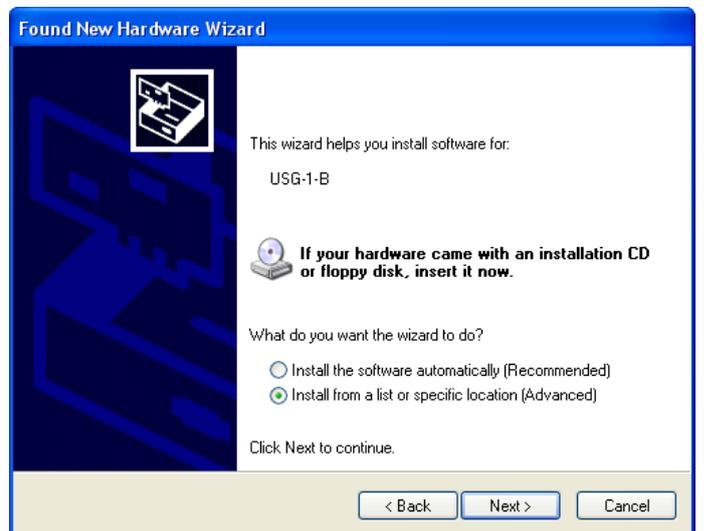
Step by step guide

1. Make sure the **Actisense** USG-1 is connected to an available USB port on the PC. The standard Windows 'Found New Hardware Wizard' window will then appear.

Select the '**No, not this time**' option, to allow driver installation from the **Actisense** CD which was supplied with your Actisense product.

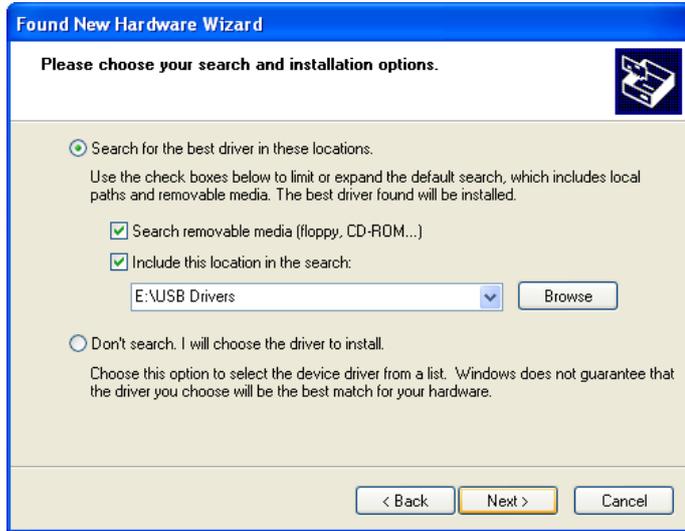


2. Insert the **Actisense** CD, choose the 'Install from a list or specific location' option, and click 'Next'.



USB to Serial Gateway - USG-1-B-485

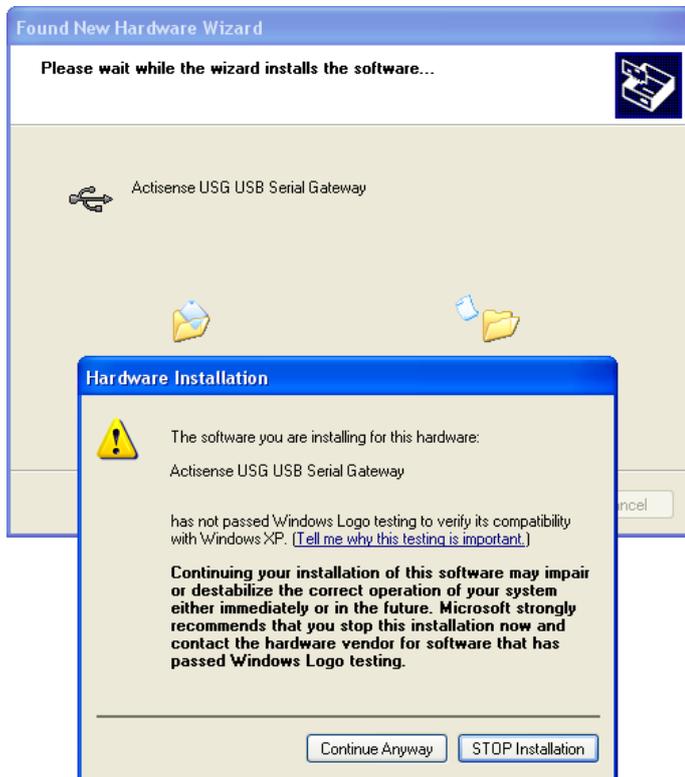
3. Make sure the 'Include this location in the search' option is ticked, and use the 'Browse' button to locate the 'USB Drivers' directory on the Actisense CD.



5. The 'USB Serial Converter' driver is now installed, click 'Finish' to complete the wizard, and wait for the 'Found New Hardware Wizard' to appear again.



4. The 'Actisense USB Serial Converter' driver is not Microsoft Windows certified, but it has been 'tried and tested' for stable and reliable operation with the Actisense USG-1. Click 'Continue Anyway' to carry on with the installation.



This second wizard will guide you through the 'USB Serial Port' driver installation.

6. Follow steps 1 to 5 above for the 'USB Serial Port' driver installation and click 'Finish' to complete.

'Your new hardware is installed and ready to use' will appear in the bottom right corner of your screen when the installation is complete. See the [USB Driver Configuration section](#) for details on how to find out which COM port number has been allocated to your Actisense device as well as how to change to a different COM port and configure the Baud rate.



USB Configuration

To communicate with the USG-1, the COM port number that Windows has allocated to the USB port needs to be determined. The following guide will walk the user through this standard operation.

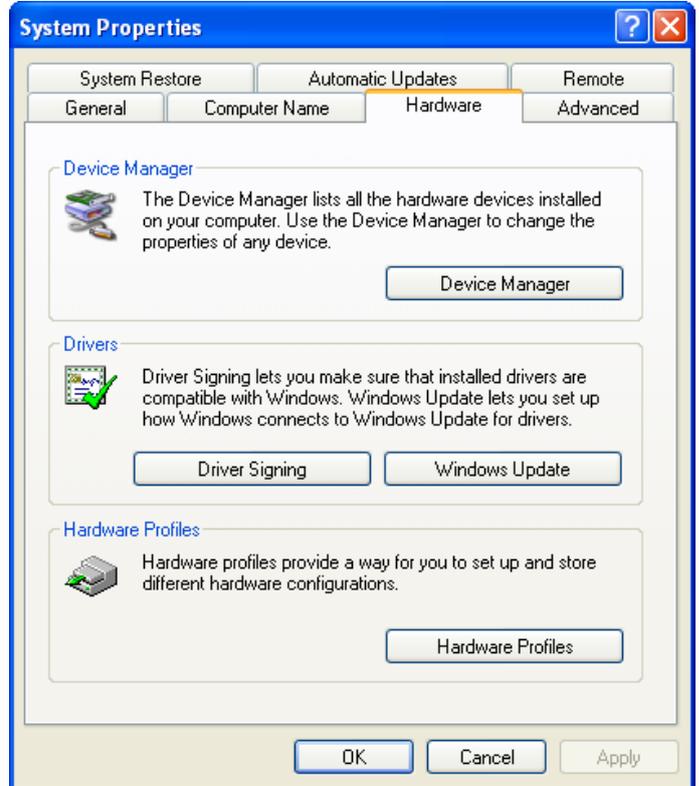
The **Actisense** USB to Serial Gateway, USG-1 is completely USB port independent: it can be easily unplugged from one USB port and connected to another available USB port on the same PC without the COM Port number changing.

To achieve this independent operation, plug the USG-1 into each required USB port that you require it to work with in turn, install the USB drivers and manually change the allocated COM port number to the same number for each USB port. Once configured, the COM port number will not change unless instructed to do so by the user.

This is very useful when the USG-1 is working in unison with a software program that is set up to use a particular COM port, as the user does not need to re select a different COM port every time the PC re boots, or the cable is swapped between two USB ports.

Step by step guide

1. Make sure the **Actisense** USG-1 is connected to an available USB port on the PC. From the Windows '**Control Panel**', open the '**System Properties**' window and click on the '**Hardware**' tab.



2. Click on '**Device Manager**' and expand the '**Ports (COM & LPT)**' list by clicking on the '+' sign next to it. You will find the '**Actisense USG**' in the list, followed by the allocated COM port number.

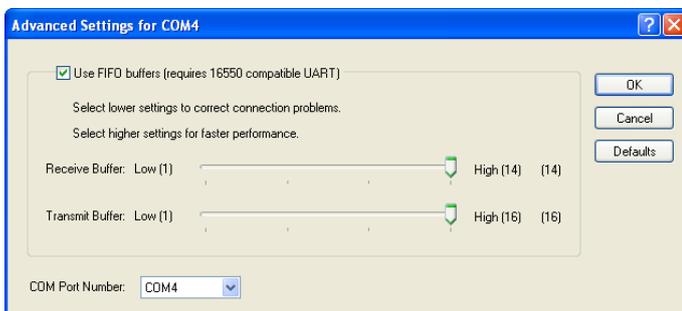


3. Double click on the port icon for the 'Actisense USG' and the port properties window will appear. Click on the 'Port Settings' tab. Here you can set the default settings for the USG-1 device. **It is not necessary to change the default settings here - as each software program will define these settings itself.**



4. Click on the 'Advanced' button and choose a different COM Port number if required (to make it compatible with the software requiring the USG-1 RS485 data).

The other settings are already optimised for the **Actisense** USG-1 and should be left in the default values. Click on 'OK' button to save the new settings.



Troubleshooting guide

This guide will concentrate on all relevant troubleshooting issues above simple cable connection faults. Therefore, the cables between the USG-1 hardware and any other devices should be checked as a matter of course, before continuing with this guide.

Diagnostic LED

The USG-1 hardware has a bright LED that can be seen through the case to indicate when data is **either** received **or** transmitted. It can be used to debug potential problems. If you have both a talker and a listener connected, then you can analyse which is working by disconnecting one of them or by stopping the PC from sending data.

Mode / Error condition	Required user response
LED does not flash when the PC is sending data	Check that the PC program is sending data and that it has opened the comms port assigned (by user) or allocated (by Windows Device Manager) to the USG-1
LED does not flash when the Talker is sending data	Check that the 'Talker' device is correctly connected to the USG-1-485, that it is powered on, and that it is sending data. In addition, the USB driver must be correctly installed and the PC software must have the assigned comms port open for the LED to flash
No data is being received by the Listener, but LED is flashing as PC is sending	Check that the 'Listener' device is correctly connected to the USG-1-485, that it is powered on, and that it is set to receive data at the Baud rate of the PC comms port. If there is a cable problem that has activated the short-circuit protection, the protective poly-fuses will have activated to protect the USG-1-485 from damage. In this case, remove the cable fault and wait 1 minute before reconnecting the USG-1 to the RS485 network.
	If the error persists, the USG-1-485 unit should be returned to Actisense (refer to the Company Information section). Please contact Actisense before returning the unit in order to obtain a Returns Number. Any returns sent without a Returns Number will incur a delay in being processed. Any returns that are not found to be faulty will incur the minimum servicing charge.

Table 1 – Diagnostic LED colours

Specifications

Parameter	Conditions	Min.	Max.	Unit
Supply				
Supply voltage	From USB port	4.75	5.25	V
Supply current drawn from USB port	Supply voltage = 5v (no load)	40	46	mA
	Supply voltage = 5v (output shorted)	75	80	mA
RS485 Transceiver Input / Output				
Input voltage between +/-	Logical '1'	2.0	15.0	V
	Logical '0'	-0.3	0.5	V
Input current		-	1.0	mA
Differential input voltage	Required level for data to be detected	-0.2	0.2	V
Output voltage between +/- and ground (under no load)	Logical '1'	0.0	0.5	V
	Logical '0'	4.5	5.0	V
Output current at max load of 100 ohm	At maximum load, differential drive voltage reduces to 1.4v	-	14	mA
Output short circuit current (note 1)	Due to short circuit protection	50	55	mA
Galvanic isolation	From USB ground		1500	V
Static discharge protection	Yes			
PC Communication settings				
Baud rate	Both input & output Baud rates are set by the PC software settings	300	115200	bps

General				
Ambient temperature		-20	+70	°C

Table 2 – USG-1-485 specifications

All specifications are taken with reference to an ambient temperature (T_A) of +25°C.

Note:

- Short circuit may be applied indefinitely. The RS485 transceiver input / output may be short-circuited directly to a 30 volt battery supply without damage. A maximum current of 50mA will flow due to “polyfuse” auto-resetting fuse technology being used.

Order codes:

USG-1-485	USG-1 for use with RS485 industrial interfaces
USG-1-422	USG-1 for use with NMEA 0183 and RS422 interfaces

Company Information

Active Research Limited
5, Wessex Trade Centre
Ringwood Road
Poole
Dorset
UK
BH12 3PF



Telephone: 01202 746682 (International : +44 1202 746682)
Fax: 01202 746683 (International : +44 1202 746683)

Actisense on the Web: For advice, support and product details

E-mail: support@actisense.com
Website: www.actisense.com

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