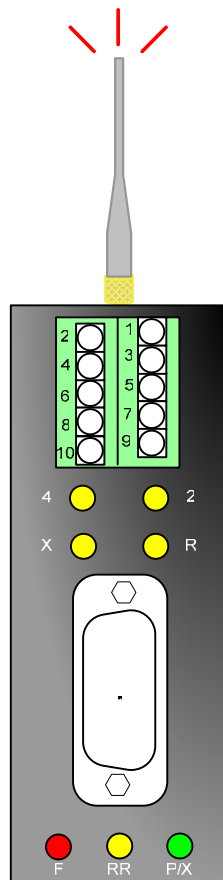


User Manual

SSR



Spread Spectrum Radio Modem

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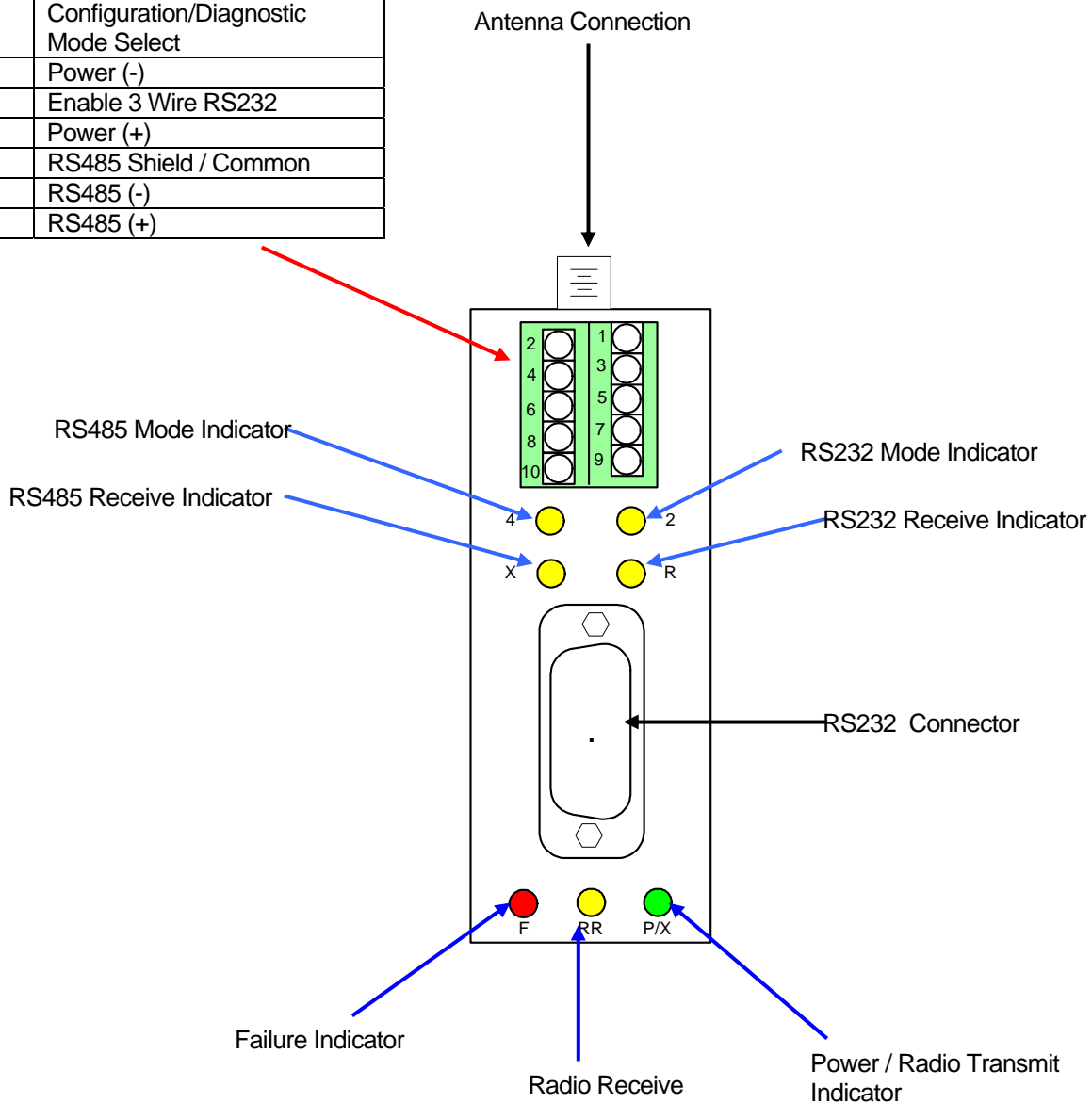
Introduction

Introduction

Thank you for purchasing the AGM Spread Spectrum Radio (SSR). The AGM Spread Spectrum Radio modem provides a variety of cost effective data communications possibilities. This manual covers installation and setup of the more commonly used configurations.

Screw Terminal Connections

Pin	Description
1	Configuration/Diagnostic Mode Select
2	Power (-)
3	Enable 3 Wire RS232
4	Power (+)
5,6	RS485 Shield / Common
7,8	RS485 (-)
9,10	RS485 (+)



Introduction

Overview

The AGM AUX/DIN 5017-1 SSR is a low cost radio modem using spread spectrum technology, operating in the 900 MHz band. The SSR complies with FCC Part 15 rules and may be operated without licensing. The SSR is intended for short range line of sight communications of up to 20 miles using external high gain antenna.

The SSR may be wired either for a RS485 or RS232 system. When used with RS485 the SSR will automatically switch to RS232 for configuration. Either full RS232 or 3 wire RS232 may be used.

The standard SSR communicates over the air waves at 9600 bps. 19200 and 1200 bps are available on special order.

Default communications is set for 9600 bps, 8 data bits, no parity and 1 stop bit. The SSR may also be configured for 1200, 2400, 4800, 19200, 38400, or 57600 bps. 7 bit and 8 bit parity options are also available through configuration.

Theory of Operation and Construction

The heart of the SSR is an industrial hardened radio modem that groups received characters into packets, adds error checking, and then transmits the packet using spread spectrum frequency hopping algorithms. Other SSR receive the transmitted packet, checks the packet for errors and then if no errors sends the received characters to the connected device. The use of spread spectrum frequency hopping algorithms allows multiple radios to share the same frequency band with minimal interference.

The SSR may be used with any protocol that uses 7 or 8 bit asynchronous data. This includes but is not limited to: ASCII Modbus, RTU Modbus, DF1, or DNP3. You do not need to own AGM Electronics Inc. equipment to use the SSR.

The SSR is configured by using a computer and any terminal emulation software such as Hyperterminal which is packaged with Microsoft Windows. The SSR may be configured in the field using a laptop computer and RS232 cable. A RS232 to RS485 adapter is not required to configure the SSR for RS485 installations.

In most installations, the SSR can be used right out of the box, however AGM Electronics Inc. will configure your SSR at the factory free of charge.

The hermetically sealed assembly minimizes installation costs.

Introduction

General Specifications

Ports – 1 RS232C, 1 RS485

Baud Rate – RS232C/RS485, 1200, 2400, 4800, 9600, 19200, 38400, or 57600 bps

Status Indicators - 7

Operating Temperature Range, -20/80 deg C

Adjustments – Operator configurable locally from a PC

Power – 11/26 vdc +/- 10%, nominal 3 Watts @ 12V.

Physical – 3 X 1.14 X 3.5 (DIN), 3 X 1.14 X 2.7 (AUX)

Frequency – 902 – 928 MHz, Frequency Hopping, Wide band FM modulator.

Network Topology – Peer-Peer, Point- Point, Point- Multipoint, Multi-drop

Channel Capacity – 7 Hop sequences, 25 frequencies

Antenna Connector – Reverse Polarity SMA (Adapter cable to N connector available for external antennas)

Indoor / Urban range – Up to 1500 feet.

Outdoor with Dipole Antenna range – Up to 7 miles, Line of sight

Outdoor with High Gain Antenna range – Up to 20 miles, Line of sight

Transmit Power – 140 mW

Receive Sensitivity - -110 dBm

FCC Certifications, Part 15.247 – OUR9XSTREAM

Industry Canada (IC) – 4214A-9XSTREAM

Hardware Installation

Hardware Installation

The SSR is available pre-configured to your application. When pre-configured, the SSR is ready for use and you only need to connect your equipment. If not pre-configured or if you need to modify the configuration you will need to connect the SSR to a computer containing a RS232 serial port and terminal emulation program. Hyperterminal is available on any Microsoft Windows 95/98/NT/2000/XP system.

Antenna Connection

The connector on the SSR is a reverse polarity SMA connector. As per FCC Part 15 regulations this is considered a non-standard connector. A reverse polarity SMA to a standard N adapter cable is available for fixed installations.

Short range antenna (Under 1500 feet)

Your SSR is shipped with a whip antenna. If you will not be installing the SSR in an enclosure and if operating over a short range, simply attach this whip antenna to the antenna connector on the SSR.

If installing the SSR in an enclosure you will need an extension cable from the SSR to the external antenna location. A reverse polarity SMA to reverse polarity SMA extension cable is available from AGM Electronics Inc. and other manufacturers. For this type of connection connect one end of the extension cable to the SSR and the whip antenna to the other end.

Long range external antenna

The SSR may be used with an approved external high gain antenna over several miles. The antenna and required cabling may be purchased separately from AGM Electronics Inc. or other manufacturers. As per FCC part 15 regulations only approved antennas may be used.

External antennas use an N connector and will require a reverse polarity SMA to N adapter cable. You may use either an adapter cable available from AGM Electronics Inc. or create your own.

The SSR only works over line of sight communications. This requires an unobstructed view of each SSR location for reliable communications. An external antenna installation will probably require a tower or other mast to meet this line of sight requirement.

Installation of the external antenna is beyond the scope of this manual and requires the expertise of a professional installer to insure all building codes are met. We recommend using a contractor with experience in radio installations.

We highly recommend the use of antenna surge suppressors to protect the SSR and connected equipment.

Hardware Installation

Power Connection

The SSR will operate from either a 12 VDC or 24 VDC supply that is capable of supplying 300 mA. Connect the minus lead of your power supply to pin 2 of the green connector and the positive lead to pin 4 of the green connector.

When power is applied the “P/X” light should be on. The “F” light indicates the supply voltage is too low or a failure of the SSR. If neither lights are on or if the “F” light is on check your input voltage. The SSR requires a minimum of 11 volts for operation.

Connecting to a Personal Computer

Use the following procedure to connect the SSR to your computer for either configuration changes or use.

You will need straight through cable to connect to the SSR. This cable should have a 9 or 25 pin female connector on one end to match the connector on your computer and a 9 pin male connector on the other end to mate with the SSR. Cables, adapters and gender changers designed for connecting a computer to a modem are available through many computer, electronic or office supply stores.

The SSR also supports RS232 using only 3 wires, Transmit, Receive and Ground. Typically 3 wire RS232 is only used with custom cables to reduce the wiring cost. If using 3 wire RS232 you will need to install a jumper between pins 3 and 5 on the green connector.

1. Plug one end of the RS232 cable into an available RS232 communications port your PC. This port is normally a 9 pin male D connector; however it may also be a 25 pin D connector in some cases. Consult with your PC documentation for the location of this connector.
2. Plug the other end of the RS232 cable from your PC into the 9 pin female D connectors on the top of the SSR.
3. Start Hyperterminal or other terminal emulator program. Select direct connect to the serial port connected to the SSR. Unless configured for another baud rate or data format select 9600 bps (baud), 8 data bits, no parity, and 1 stop bit. If connecting for configuration, turn off all handshaking.
4. If properly connected the “2” light on the SSR will be on. If not on check your cable connections and RS232 port on your computer. If using 3 wire RS232 you will need to add a jumper between pins 3 and 5 on the green connector before the “2” light will turn on.

NOTE: The SSR automatically switches to RS232 mode when a RS232 cable is plugged in and the DTR line is active. RS232 mode overrides RS485 mode, if connecting to configure a SSR for RS485 operation you will need to disconnect your RS232 cable before the SSR can communicate over RS485.

Hardware Installation

Connecting to RS485 devices

Connecting a SSR to any device using RS485 is the same regardless of the device connected. To connect one or more RS485 devices you will need a shielded twisted pair cable.

1. Connect one wire of the twisted pair cable to pin 9 or 10 of the green connector. The other end of the wire should be connected to +RS485 on the RS485 device.
2. Connect the other wire of the twisted pair cable to pin 7 or 8 of the green connector. The other end of the wire should be connected to -RS485 on the RS485 device.
3. If using shielded cable you may connect the shield to either pin 5 or 6 of the green connector. To prevent ground loops the shield of the cable should only be connected at one location when the SSR and RS485 device share the same power supply. If separate power supplies are used you may connect the shield to both locations, however watch for any ground loops that may be created.
4. If additional RS485 devices are to be used, connect the next device. Two terminals are provided on the SSR for daisy chaining the RS485 cable. Connect the next RS485 device with +RS485 to pin 9 or 10 and connect the -RS485 to pin 7 or 8 using the pin not connected to the other RS485 device.
5. When all devices are connected the RS485 buss may require termination resistors. If the SSR is the last device on the buss, install 120 – 150 ohm resistors across the pins 8 and 10 or pins 7 and 9 depending on which pair is open. Install these terminating resistors on the first and last device only. If the RS485 cable run is less than 100 feet, installed in the same enclosure, and you do not encounter any communications problems the terminating resistors may be omitted.
6. The SSR must be configured for use with RS485. If the “4” light is on then the SSR is configured for RS485, otherwise the SSR must be configured. You may configure the SSR for RS485 without removing the RS485 connections by plugging your computer into the RS232 connection. See the Connecting to Personal Computer and configuration sections for configuring the SSR.

Connecting to AGM Data Handler (DH) RS232

To connect a SSR to a RS232 Data Handler you will need a 9 pin female to 9 pin male null-modem cable.

1. Plug one end of the RS232 cable into the 9 pin male connector on the Data Handler.
2. Plug the other end of the RS232 cable into the 9 pin female D connector on top of the SSR.
3. Power up both the Data Handler and SSR. If properly connected the “2” light will be on. If not on then check your cable connections.

Hardware Installation

Connecting to AGM Integrated Control Station (ICS)

To connect a SSR to an ICS you will need a 9 pin male to 25 pin female straight through cable.

1. Plug the 25 pin end of the cable of the RS232 cable into the 25 pin D connector on the back of the ICS.
2. Plug the other end of the RS232 cable into the 9 pin female D connector on top of the SSR.
3. Power up both the ICS and SSR. If properly configured the “2” light should be on and the “4” light should be off. If the “2” light is not on check your cable connections. If the “4” light is on then the SSR is configured for RS485. The ICS will not work with a ICS if configured for RS485 operation.

Connecting to AGM Universal Web Station (UWS)

RS-232 connection

To connect a SSR to a UWS Data Handler you will need a 9 pin female to 9 pin male straight through cable.

1. Plug one end of the RS232 cable into one of the 9 pin male connector on the UWS. Select either “A” or “B” depending on which port will be used with the SSR.
2. Plug the other end of the RS232 cable into the 9 pin female D connector on top of the SSR.
3. Power up both the UWS and SSR. If properly connected the “2” light will be on. If not on then check your cable connections.

RS-485 connection

The SSR may also be used with the RS485 connection on the UWS. The connection for any RS485 device is the same. See the Connecting to RS485 Devices section for connection details.

Hardware Installation

Connecting to a 3rd Party PLC

The SSR supports any PLC that uses a protocol based on 7 or 8 data bit asynchronous serial communications. This includes ASCII Modbus, RTU Modbus, Allen-Bradley DF1 Half Duplex and DNP3 protocols. You must have the appropriate RS232 or RS485 interface installed. Consult with your PLC manufacture on the RS232 or RS485 interface to use.

If using RS485 see the Connecting to RS485 Devices section. The following are instruction for RS232.

You will need a cable to connect from your PLC to a Modem. If a cable of this type is not available you will need a Null-Modem adapter and possibly a gender changer to connect your PLC to the SSR. Null-Modem adapters and gender changers are typically available through many computer, electronic or office supply stores.

1. Plug one end of the RS232 cable into your PLC. See your PLC documentation for making this connection.
2. Plug the other end of the RS232 cable from the PLC into the 9 pin female D connector on the top of the SSR
3. Power up both the SSR and PLC. The "2" light should be on. If off then your PLC may be using either 3 wire RS232.
4. If using 3 wire RS232 connect a jumper between pins 3 and 5 of the green connector. This will force the SSR into the RS232 mode and turn the "2" light on.

Getting Started

Getting Started

The SSR be preconfigured at the factory. In this case your SSR should be ready to use after you have made all hardware connections.

In many cases the default configuration will work. The default configuration is for 9600 bps, 8 data bits, no parity and one stop bit. Networking is set up for Peer-Peer and the hopping channel is 0.

For best throughput we recommend you set up your system to match the SSR data rate of 9600 bps. If this is not practical then the SSR will need to be configured to match the data rate and data format used by your system.

When multiple SSR are used within the same geographic area you will need to change the hopping channel or possibly other networking settings to prevent interference between systems. You may also experience interference from other spread spectrum manufactures.

Once you have power and antennas connected to your system we recommend you test the radio connections before putting your system in full operation. This will insure you have solid communications, you're not being interfered with, and you're not interfering with anyone else.

Testing Your Installation

1. The very first step that should be done before attempting to transmit is to listen. Power up the SSR and observe the "RR" light. This light should remain off. If the "RR" light flashes, then there are other spread spectrum radios in the same locale using the same hop channel as your SSR. To avoid interfering with the other spread spectrum radio you must change your hop channel.
2. Repeat the above step with all sites. Just because one site passes, does not mean you're free of interference.
3. Start transmitting and check to determine if all sites are responding. The lights on the SSR are designed to assist in trouble shooting any connection problems. If the SSR is receiving, the "RR" and "X" lights will be flashing. If transmitting the "R" light will flash on and the "P/X" light off with each transmission.

Configuration

Configuration

To modify the configuration of a SSR the following will be required:

1. Computer with an available RS232 "COM" port.
2. Terminal Emulator such as Hyper Terminal.
3. Straight through RS232 cable to connect your computer to the SSR.
4. 12 to 24 volt power supply. The SSR typically draws 300 mA when transmitting.
5. The Spread Spectrum Radio (SSR).

The following instructions assume you are familiar with your terminal emulator program and how to connect the SSR to your computer. See the Hardware Installation section for instructions on connecting the SSR to your computer.

Assuming you do not have to change the SSR communications settings from their defaults, set your terminal emulator software to use 9600 bps, 8 data bits, no parity, and one stop bit. Turn off any handshaking. If you have changed the communications settings use those setting.

The SSR operates similar to dial up modems. It uses a command mode sequence and all commands are prefixed by AT. The AT command set however is not like modems and all commands must either be separated by commas or carriage returns.

All commands except the command to enter the command mode must be prefixed by "AT".

The following sections describe the commands you are most likely to need to modify. A complete list is available from AGM Electronics Inc.

Entering Command Mode

The command mode is entered by typing in "+++" then waiting for "OK" to be returned. The SSR has a built in adjustable time out that will automatically exit the command mode. Default setting is 20 seconds. If you wait 20 or more seconds after sending "+++" or a command the SSR will return to normal operating mode.

Exit Command Mode (CN)

The SSR will automatically exit the command mode after the default of 20 seconds without a AT command or to force an exit enter "ATCN".

Configuration

Save Changes (WR)

Enter "ATWR" to save the changes in the SSR non-volatile memory. On power up the SSR will revert to previously stored settings.

Baud Rate (BD)

Baud Rate	Command
1200	ATBD0
2400	ATBD1
4800	ATBD2
9600	ATBD3
19200	ATBD4
38400	ATBD5
57600	ATBD6

Parity (NB)

Parity	Command
8 bit No Parity or 7 bit Any Parity	ATNB0
8 bit Even Parity	ATNB1
8 bit Odd Parity	ATNB2
8 bit Mark Parity	ATNB3
8 bit Space Parity	ATNB4

Communications Mode (CS)

Mode	Command
RS232	ATCS0
RS485	ATCS1

Hopping Channel (HP)

Channel	Command
0	ATHP0
1	ATHP1
2y	ATHP2
3	ATHP3
4	ATHP4
5	ATHP5
6	ATHP6

SSR's as Repeaters

SSR's as Repeaters

Store and Forward

The modules can be configured as simple “store and forward” repeaters by attaching a hardware loopback (“repeater”) adapter that loops received data back into the module for retransmission. This mode allows the radio to store and forward up to 430 bytes.

Usage Guidelines

- Three wire RS232 must be enabled. Jumper pins 3 and 5 on screw terminal.
- Two loopback repeaters cannot be within transmission range of each other as they will continually repeat data back and forth to each other.
- The module initiating the communication will receive an echo of its own transmitted packet.
- The repeater will buffer incoming received data and retransmit it when there is a break in receiving of more data.
- In the absence of a loopback adapter, use a shorting strip to create a short between TXD and RXD, pins 2 & 3, of the DB9 female RS232 connector.

Streaming

Because of the great price value of the modules, it is cost effective to configure two modules (‘module 1’ & ‘module 2’) to act as a streaming repeater between a source and a destination module. To configure this repeater, assign the two modules each to a different channel (ATHP) and connect the serial ports using a null-modem connection. Module 1 should share a channel with the source module and module 2 should share a different channel with the destination module. The source module will transmit data to module 1 which passes through the null-modem connection to module 2 which forwards the data to the destination.

This configuration allows for less delay in the transmission as the repeater node can both receive and transmit at the same time. It allows for several repeaters in a row in order to reach a destination.

Usage Guidelines

- Two antennas must be used. Antennas must be a minimum of 8 inches apart. Additional antenna separation and use of directional antennas will reduce the possibility of interference between the two modules.
- Three wire RS232 must be enabled. Jumper pins 3 and 5 on screw terminal.

SSR's as Repeaters

- This system works best if either the packets are small or if modules can be configured with retries (ATRR) to overcome any interference the module may cause between them.
- Multiple streaming repeaters can be cascaded to extend the reach even further, each leg of the system should use a separate channel.
- Data travels through the repeater fastest using this method. May be used to transfer large files.
- A source radio can roam among several repeaters as long as the "module 1" in each repeater uses a common channel, i.e. ATHP=0 for all "module 1"s.

Application Specific

Because SSR modules operate in a peer-to-peer mode (no module must be designated a master of the network) a system designer can take advantage of flexible network topologies. Devices attached to each of the modules can accept data received by the attached module before using the same module to rebroadcast the data to a device further away. SSR customers have deployed self configuring and self healing networks by developing sophisticated algorithms that take advantage of this feature unique to SSR modules.

Usage Guidelines

- Devices attached to the modules must have their own addressing capability and either "store and forward" or routing capability.
- System designers may use a certain channel (ATHP) for discovery and configuring the network while using other channels for extended communication. This technique allows for more efficient data transfers while minimizing latency and interference.

Technical Support

Technical Support

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Diagnostics and Trouble Shooting

Indicator Lights

Seven indicator lights are included on the front of a SSR to aid in troubleshooting your SSR installation.

Light	Description
4	RS485 Mode
2	RS232 Mode
X	RS232/RS485 Transmit. Light flashes with each character transmitted from the SSR to connected device.
R	RS232/RS485 Receive. Light flashes with each character received from the connected device.
F	Failed. Indicates either the input power is below 11 volts or the SSR has failed.
RR	Radio Receive. Flashes when characters are received by the radio.
P/X	Power / Transmit. On when power is applied. Flashes when transmitting over the radio.

Diagnostic Indicator Lights 2 and 4

Light 2	Light 3	Description
Off	Off	No connection to the SSR. Configuration set to factory defaults.
Off	On flashing Off	RS485 mode. Light flashes when SSR transmits data to the RS485 devices.
On	Off	RS232 mode. Correct cable is connected to the SSR.
On	On	SSR is configured for RS485 mode but has a RS232 cable connected. In this mode the RS232 connection will override the RS485 connection.

Diagnostics and Trouble Shooting

Diagnostic / Configuration Jumper

The SSR contains a diagnostic mode which will allow you to enter the configuration settings regardless of the current configuration. This mode is entered by putting a jumper between pins 1 and 5 on the green connector and cycling the power.

When in this mode the SSR will continuously transmit to the RS232 or RS485 connection a count with each number followed by carriage return / line feed. The count will be transmitted at the current baud rate and data format. You may use this count to determine the baud rate of the SSR then match it with your terminal emulator program.

Entering “+++” will enter the configuration mode. You are in configuration mode when the count stops and “OK” is returned. Configure the SSR as you would normally.

For normal operation you must remove the jumper. The jumper is for diagnostics only.

Appendix A

Appendix A

FCC Compliance Information

FCC ID: **OUR9XSTREAM**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Appendix B

Wiring and Simplified Diagram

