SRS-1 (Ship Recognition System)

The SRS-1 is an electronic instrument which should assist you with watch keeping and navigating in shipping lanes. It can be likened to a sophisticated radar device, except that far more information is obtained and its ability to detect AIS equipped ships depends only upon the ability to pick up an automatic VHF signal from those ships. The typical range can therefore extend out to 40NM or more if using a mast head antenna on a yacht. The unit can be set to provide an audible alarm if any AIS equipped ship is detected within 5, 10, 15 or 20 nautical miles. The alarm can also be disabled or set to sound if a ship is detected within any distance. Much more information about the "target" is available from AIS than from radar. The unit contains software which calculates the closest point of approach (based on current positions, speeds and distances). Alarms can be enabled which work with CPA to alert you if the SRS-1 "thinks" a collision or close approach is possible.

The SRS-1 is contains a state of the art VHF receiver, capable of operating on either of the two available AIS channels. (Ships transmit alternately on two separate transmitters. If a ship does not seem to be transmitting, you can change the AIS channel manually on the SRS-1 in case the ship is transmitting only on one of its two transmitters. This would be a very rare situation). The SRS-1 includes a sophisticated microprocessor based AIS decoder with its own display plus optional NMEA output to a chart plotter. The SRS-1 is quite capable of running by itself. However, attaching an AIS-capable chart plotter also allows you to see other vessels on the chart along with extra information such as beam, length, draft and destination which are not displayed directly by the SRS-1.

The SRS-1 uses only 0.15 amps while operating. This rises to 0.35 amps (due to the the back light) if a ship is detected or any button pressed. The back light then turns off again after two minutes. Average power consumption is approximately 5 amp hours per day on a

12 volt system, allowing the SRS-1 to be operated around the clock with minimal battery drain on a cruising yacht where power is normally at a premium.

The SRS-1 can also be configured to automatically track the nearest ship or a particular nominated ship. You can also have it display all information about the most recently detected ten ships over the past 2 hours.

1.0 What is AIS?
AIS stands for "Automatic Identification of Shipping". Since January 2005, it has been mandatory for all vessels over 300 tonnes to operate AIS systems while a ship is under way, drifting, moored or anchored. AIS is high speed telemetry, transmitted over VHF radio links. A typical transmission occurs via two separate radio transmitters, on two different channels and is completed within approximately a thirtieth of a second. The data is identical on each of the two AIS channels. Ships and shore stations automatically cooperate in the sharing of the channels, much like a terrestrial mobile telephone system. AIS contains much useful information about the ship. The rate of transmission of AIS data depends upon the speed of the ship and whether it is sailing or anchored/berthed. Position, heading and speed information is transmitted more frequently than the ship's name, call sign and dimensions.

2.0 Description of the SRS-1
The SRS-1 is 222Wx146Hx55Dmm and is designed for bulkhead mounting (i.e. on a wall or panel.) It is not designed for flush mounting. The electronics are enclosed in a sealed die cast box with a very large 120mmx45mm 4line 20char display. It can connect to its own antenna (which is how ships are configured) or optionally to your existing VHF antenna if you prefer to share it and avoid changes to your boat's wiring and other hardware. If you opt for this facility, an additional small (about 25mm square) die cast box is provided, called a "Coaxial Relay". This must be connected in series with your existing VHF antenna cable. This can be done at the VHF receiver or at the base of the mast if you have a PL-259 connector at that position to facilitate mast removal. Alternatively, you can cut the existing cable at any point and insert two male PL-259 plugs which connect to matching female sockets on the coaxial relay. The SRS-1 antenna connection is achieved by a cable (supplied) which comes out the side of the coaxial relay and plugs into the SRS-1. When the SRS-1 is on, power flows via the antenna cable to the coaxial relay, which keeps a relay closed allowing the AIS to tap into the antenna circuit. If the coaxial relay detects you are transmitting, it cuts the connection to the SRS-1 so that there is no impediment to your transmission and no damage to the SRS-1 unit. When SRS-1 power is off, the coaxial relay automatically disconnects it from the antenna. If the supplied BNC cable is too short, any competent radio or electronics shop should be able to make you a 50ohm BNC to BNC cable using RG58U cable.

The SRS-1 decodes Latitude, Longitude, vessel status, ID (MMSI), call sign, rate of turn, Course Over Ground (COG), heading, ship name and Speed Over Ground (SOG). Range and bearing from your current GPS position are also calculated and displayed. Other information such as ship length, beam, draft and destination are sent to a chart plotter but not displayed on the SRS-1 itself. The SRS-1 also computes time to Closest Point of Approach (CPA) and distance apart at that CPA.

The following two pictures show the two screens used most often on the SRS-1. When an AIS signal is detected, it is checked for integrity and if good, the screen shown below is displayed, the alarm sounded (if enabled) and the red LED flashes. If the Time to Closest Point of Approach is less than one hour AND the estimated distance apart at Closest Point

of Approach is less than 1NM, the alarm (if enabled) will beep seven times in a distinctive pattern.

The above display shows the first ship (numbering starts at zero). Its course over ground is 113degT and Heading is 26degT. The estimated CPA is 4NM and this point (TCPA or Time to CPA) was two hours previous at the current speed and course of the target and our own vessel. Range to the target is 7.2NM and it is at 80degT from us. The Rate of Turn of the target is 0 degrees per minute (+ve values are clockwise and -ve values are counter-clockwise). Speed over ground of the target is 0.3kts. This display toggles with the display below when the "Display" button is depressed. This shows the name of the target, the call sign, the status (anchored in this example) along with the latitude/longitude and the MMSI (Mobile Maritime Ship Identity- which can be used for VHF or HF Selective Calling).

Note that if the data is no longer valid (i.e. The last AIS signal was more than 30 mins ago, the first character on each screen will become an "X".

At the press of a button, the SRS-1 displays all ships detected and their vital statistics. It can track a maximum of 10 ships at once with only the latest ones displayed. You can select and track any one ship or track the nearest ship or just the default of the most recent ship's data.

The SRS-1 can be operated with a minimum of a 12 volt power connection and an antenna. However, GPS enables it to calculate the range and bearing [TRUE] to any detected target. The input is NMEA for use with good quality NMEA/Marine instruments. It can also handle RS232 from PCs and the like. The output is PC-compatible RS232 data in NMEA format. This is for feeding to a PC chart plotting program or a real hardware based chart plotter. The output is a blend of the GPS data plus AIS data. All data from the GPS is passed through.

3.0 Controls and displays
Front Panel: There is a power led (green), an on/off switch, a buzzer and a red "message" LED. The interaction between the operator and the SRS-1 is performed by a "mode" button and a "display" button. These are described in a later chapter.

Right Hand Side: On the right hand side of the SRS-1 are the input for the antenna, the GPS input and RS232 output. There is a fuse (1 amp) and power input plus a toggle switch to change between the two AIS channels. You rarely, if ever, need to change channels as the same information is transmitted on each channel. Exceptions could occur if you are in an area congested with hundreds or thousands of ships or one of a ship's two transmitters has failed. A 3.5mm socket is provided which is wired to the demodulated AIS audio data. It is unlikely you will ever use this. However, if you connect an earpiece, you should ear a hiss with brief clicks or "phut" sounds which are AIS signals. This facility is provided for techno-masochists or those who would like to feed an external AIS decoder such as Shipplotter software. However, PC based demodulators are not as good as the specialised internal AIS decoding hardware.
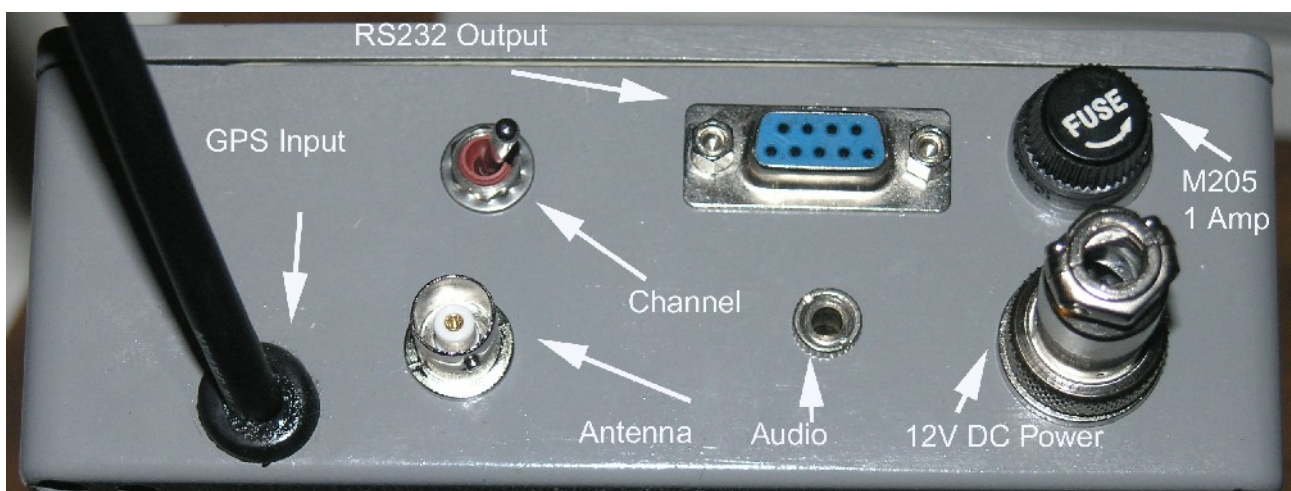
When any ship is detected, the red led always flashes. As well, you can program the

buzzer to always sound or only if the ship is under a certain range. When the alarm buzzer is turned "off" (by the mode menu), the alarm for failed GPS input is also disabled. The unit remembers the range even when powered off. However, the Alarm is always enabled when the power is first turned on. The SRS-1 can record data from 400 ships simultaneously (as long as most are anchored) and pass this onto the chart plotter for real time display. It also has a local memory for 10 ships- usually the 10 most recent. You can also "lock onto" any particular ship or track the closest ship.

When a valid AIS data sequence is received, the SRS-1 always displays the most useful data relating to the target. If you press the display button, you also get ship's name, call sign and position . If you press the Display button again, you get the first screen of data again. The latest data is always displayed during normal operation. Ship names and call signs are transmitted less frequently than the other information so this second display screen may have some blanks. You can also scroll through the 10 most recently detected ships. After 2 hours without a valid AIS message, the data is automatically removed from SRS-1 memory, which also occurs if the power is turned off.

4.0 Contacting other ships
If you are worried about a ship's intentions or simply want to establish contact, the SRS-1 makes this easy because each display screen shows the ship's ID (otherwise known as the MMSI- Mobile Maritime Ship's Identity). You can use this 9 digit code to digitally call another ship either on VHF-DSC or using the ship-ship HF DSC call channel in the two megahertz band. If you have been tracking the other ship for more than about five minutes on the SRS-1, you should also have the call sign and ship's name. There's a difference being able to name a ship rather than "calling the ship at approximately X, Y..." I. It'd be hard for them to ignore the beeping/clanging on the bridge from a DSC call or a voice call naming the ship.

5.0 Controls & Display
Ship data is stored for the ten most recently received ships. Ship numbers go from zero through nine. The ship number is displayed on the screen when AIS data is received. You can choose to monitor a particular ship using its number- this is the only real external use for SRS-1 ship numbers.

5.1 Display Button:
If you press this button during normal operation, a second screen of information about the latest or current ship is displayed. Pressing again will return to the previous screen.

5.2 Mode Button:
Pressing the mode button during normal operation brings up the main menu .

The Display button is used to scroll through these menu items. Pressing Mode again, selects the item. If you press Mode twice in a row, you first bring up the menu and then reset anything specific that you have set (such as "Watch Nearest Ship" or "List all ships" or "Monitor a particular ship".) It is important to node that this is a "Command" menu and not a "Status" menu. That means that the indicated letter or number is a command that you are issuing to the unit. For instance, "Set Alarms Y" means "Yes, Set the Alarms". It does NOT mean that "Yes, Alarms are set". The menu items are shown below:

'Reset': See above. Pressing Mode twice resets all the display options. Useful if you've got yourself "in a pickle" and want to restore normality.

'Set Alarms': If you scroll to this item using the Display button, the cursor will display a "Y" if alarms are previously off and a "N" if alarms are currently on. Pressing Mode will set the alarm mode appropriately.

'Watch nearest ship': Selecting this item will display the closest ship. The calculation is performed once per minute. This display mode can be reset using the Reset function described above. In this mode, pressing the Display button will toggle to the second screen of data or back to the first.

'List all ships': This causes the SRS-1 to scroll through the two pages of information for each ship. Each time you press the Display button, the display advances to the next screen. At the end, it returns to the normal operating mode. The SRS-1 still receives and transmits AIS data to the output port during this operation but it is not displayed. There is a 60 second time-out on this operation so that the SRS-1 returns to normal operation if no button is pressed for 60 seconds. A special page is displayed to advise the user how to advance the pages, that there is a 60 second time-out and also to show how many ships are about to be displayed. It looks like this:

'Monitor Ship': The cursor cycles through the ship numbers, from 0-9, upon pressing the Display button. After 9, the cursor goes back to the Reset menu item at the top of the screen. When you have the desired ship number, press Mode and the SRS-1 will monitor that ship, much like the monitoring of the closest ship. Reset using the Reset option.

A considerable amount of status information is available from the SRS-1. This is not normally displayed in operational mode but is easily available for debugging or other testing. Status mode can be enabled by one of the following two methods:

(a) While operating, press and hold the display button and while holding it, briefly depress "Mode" and release both buttons; or

(b) When power is off, hold down the Display button, turn on the power and release the Display button.

In either case, Status mode is ceased by pressing the Mode button twice (i.e. the first push brings up the menu wherein the first item is "Reset". Pressing 'Mode' again resets the unit back to operational mode.

The Status first Screen looks like this:
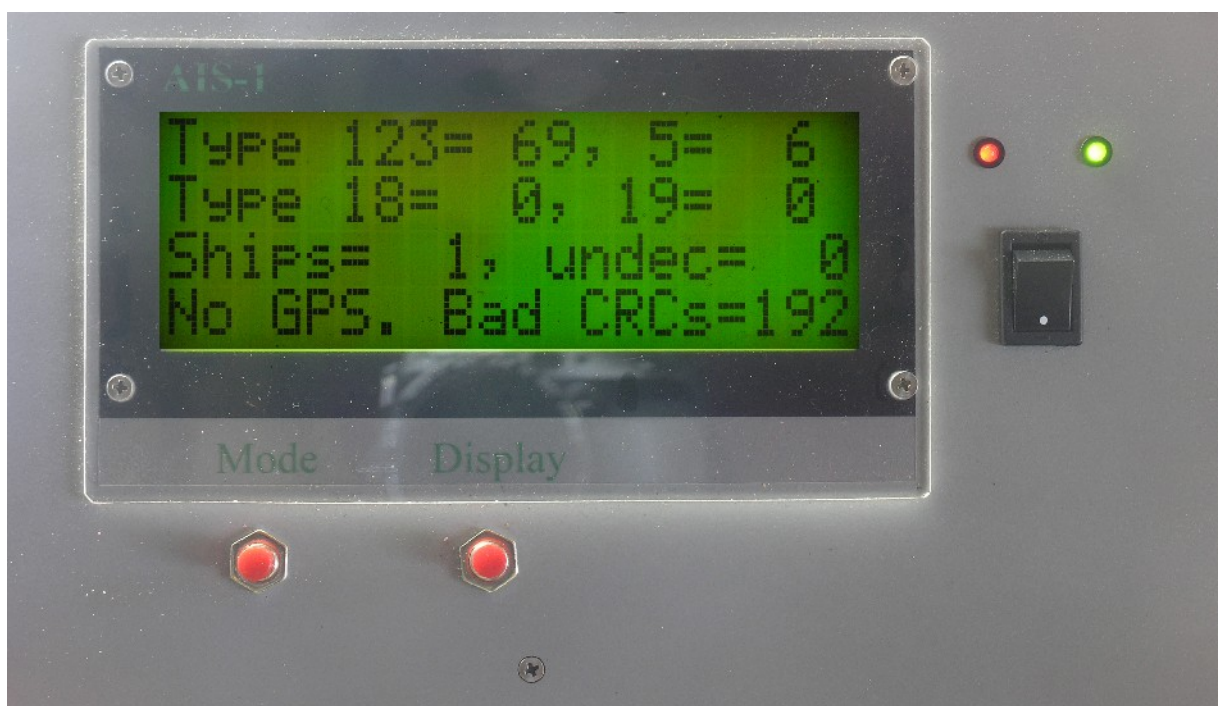
Type 1, 2 or 3 messages are those containing Lat/Lon information. This counter shows the number received. It rolls over at 256. The above screen shows that 69 of these messages have been received. Type 5 messages are those containing ship names, call signs and dimensions. Type 18 messages are less common and pertain to special "Class B" AIS vessels and are analogous to stripped-down 1,2,3 messages for "normal" ships. Type 19 messages are the Class B equivalent of Type 5 messages. Undec is the count of messages undecoded by the SRS-1 but passed on to the Chart Plotter. These are typically network status messages. Bad CRCs are the number of messages that failed the Cyclic Redundancy check. These messages are not used in any way, nor are they forwarded to a Chart Plotter. Bad CRCs are usually caused by very faint signals.

Ships are the number of ships currently filled. In the screen shot above, one ship.

The GPS field contains either "No GPS" or "GPS OK" depending upon whether or not valid GPS data is decoded from the GPS input. If no GPS data is detected, the SRS-1 will sound

the alarm (if enabled) and display a message on the screen every 10 minutes. The SRS-1 needs to be fed by valid $GPRMC GPS data in order to validly compute range, bearing and CPA information.

The second status screen (accessed by pressing the Display button) is as follows.
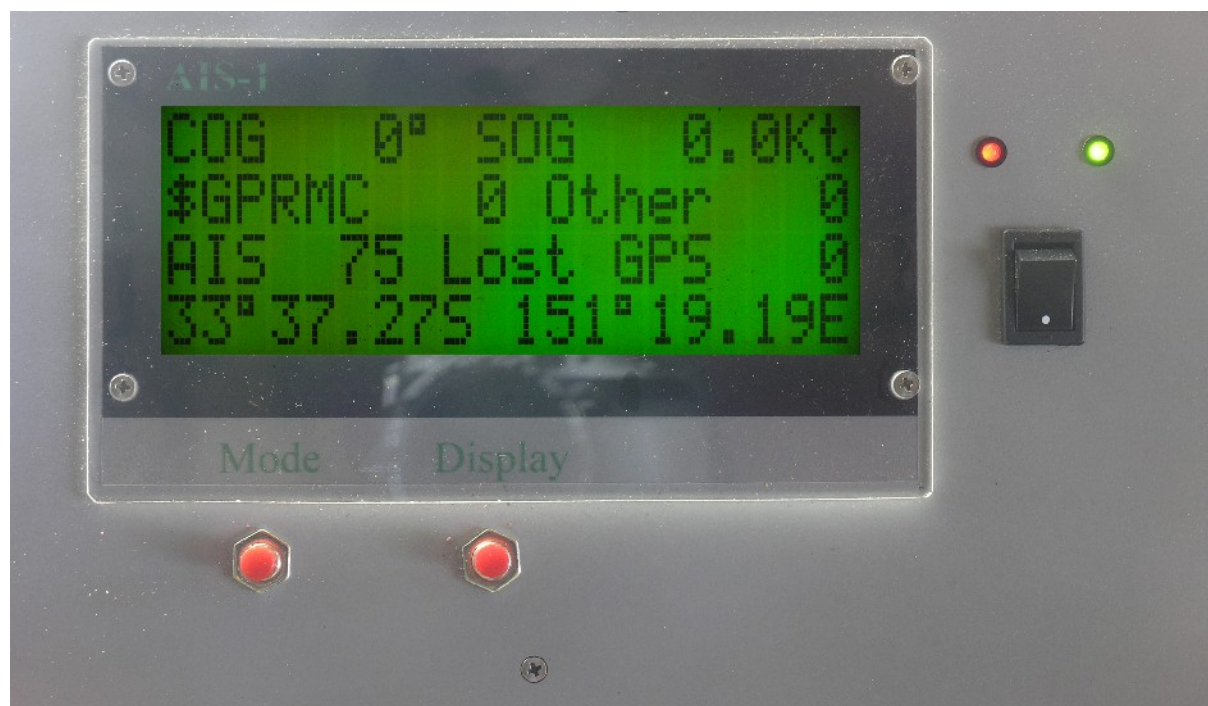
COG, SOG and position are all for our own vessel and derived from the GPS input. The data is only updated with the Display button or when ship data is received. $GPRMC counts the number of such sentences received from the GPS. 'Other' is a count of all other GPS sentences received. Note that the line starting "AIS" is only relevant to Revision 1.4 and 1.5 and is a count of the number of AIS sentences sent to a chart plotter. It should equal the number of AIS input messages displayed on the first status screen. If the SRS-1 becomes overloaded with AIS+GPS data, it will start "dumping" occasional GPS sentences rather than passing them through to the chart plotter. This is not normally a problem because GPS sentences come every couple of seconds. 'Lost GPS' is a count of how many GPS sentences have been discarded. This should be zero or only a very small number which hardly increases with time. Anything else indicates a huge amount of AIS traffic or (more likely) electrical noise on your ship's systems.

Please note that as of Rev 1.6, this line has been replaced with diagnostic information relating to the high speed processing of the AIS data and it is not relevant to normal users.

6.0 Chart Plotters
Chart Plotters and Chart Plotting software are increasingly being provided with AIS NMEA input and display facilities. This can enhance the capabilities of the SRS-1 further by providing a graphical display of the AIS equipped ships in your vicinity.
To give you an idea of the typical facilities provided, the free chart plotting software "Seaclear" or cheap but comprehensive "SOBvMax" provide the following.

They plot the ships on the chart with vector arrows for HDG, COG and an arrow length

proportional to SOG and pointing in the direction of Speed over Ground. There's also a menu by ship name & you can click & get more info on each ship (such as draft, destination, beam, length). A "find" button is provided so that you can go directly to the ship, choosing the best chart in the process.

7.0 Installation
Choose a suitable location where you will be able to see the SRS-1 display, operate the control buttons (infrequent) and hear the warning buzzer. The unit is sealed with a flexible sealing washer between the lid and box. The channel switch is waterproof. However, screw holes, push buttons and the display are not waterproof; so, the SRS-1 will be able to sustain light splashing. However, do your best to avoid any water.

Mounting is by two screw holes which are only accessible after carefully removing the lid. This is secured by six stainless steel screws in the front. The photograph shows the position of one mounting hole and the other is diagonally opposite.
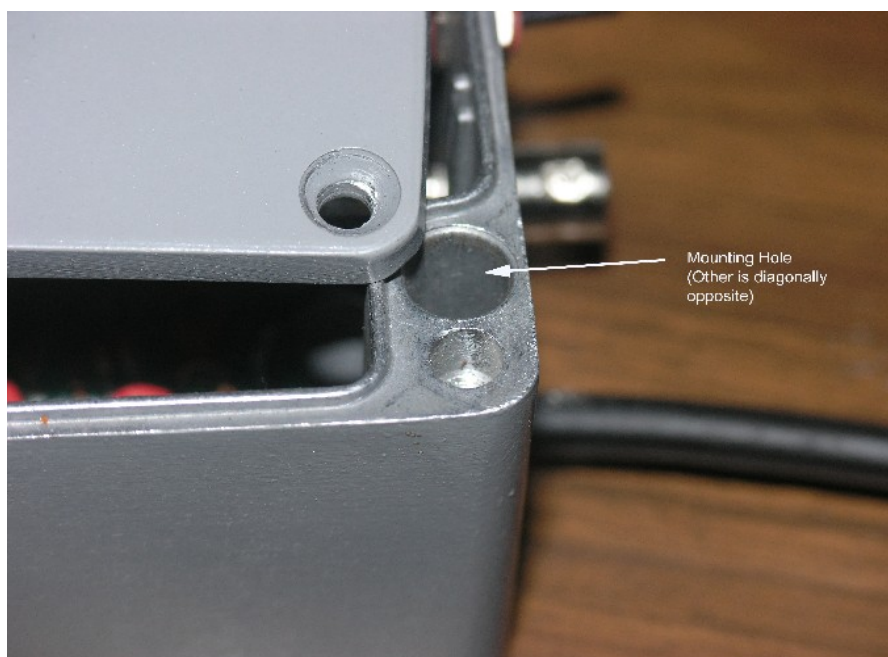

Be careful not to strain wires when the front cover is removed and make sure power is removed. DO NOT make any adjustments to items on either of the printed circuit boards. You can use self tappers or machine thread screws to mount the box. Some units have been mounted using M40 CS machine thread screws through a bulkhead with the M40 nuts inside the mounting holes accessed from the front.

When the unit has been secured, carefully re-attach the front panel being careful not to pinch or break any wires and ensuring the rubber seal has not come out of its channel.

A standalone antenna can be attached to the BNC connector on the SRS-1. Alternatively, use a BNC-BNC cable to attach the SRS-1 to a supplied coaxial relay. This coaxial relay is then inserted in series with the boat's mast head VHF antenna. Note that there are two female PL259 connectors on the coaxial relay and it does not matter which goes to the antenna and which goes to the VHF radio.

Next, attach a feed from a GPS. A mini-DIN line socket is provided. Pin connections are shown in the diagram below. This is looking INTO the plug attached to the SRS-1. The

designations +ve and -ve are for NMEA+ and NMEA-. If connecting to RS232, +ve goes to ground and -ve to the data connection.
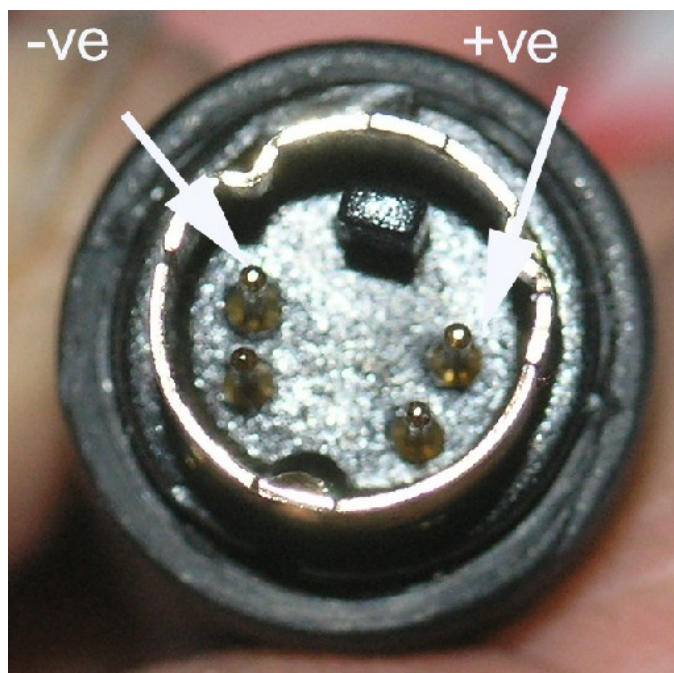
If the distance exceeds 50cm, use screened cable. Screened twin core microphone cable is ideal for longer runs. Ideally, your boat is equipped with a balanced RS422 NMEA GPS feed. However, some manufacturers compromise and the feed is actually RS232. The SRS-1 will still accommodate this, but noise immunity will not be as good as the more correct balanced feed provided by RS422.

Once you turn on the SRS-1, check the status screen via the menu. If you see the message "No GPS" in the bottom left hand corner, try interchanging the input leads as there is sometimes confusion in how these leads are labelled.

Optionally, a chart plotter or PC may be connected to the standard RS232 9 pin socket on the SRS-1. Only ground and data are provided. The SRS-1 does have the ability to receive PC data, but this is not enabled in current SRS-1 versions.

Connect power to the screw on connector which is provided. DO NOT reverse the polarity or severe, expensive damage will be caused to the SRS-1. If the supplied power cable length is insufficient, disassemble the connector and connect your own power leads to the plug.

Alarm Setup.
The alarm distance can only be set up as follows. The SRS-1 remembers the setting even when power is off.

Turn off the unit. Hold down the Mode button and turn on the power. Then release the mode button. You should then have a screen showing the alarm range as Any, 5, 10, 15 or 20NM. Use the Display button to select the correct one, then press Mode to memorise the setting. The unit will beep once in confirmation and then restart.

NMEA GPS input speed

The input and output communications speeds from the GPS and to the PC can be set to standard values between 4800baud (the NMEA standard) and 57,600baud. It is set by holding down the mode button (with the power off), turning on the power and then releasing the Mode button. Simply scroll through to the selected speed using the display button and select with the mode button. Speed will be stored in non-volatile memory. Please note that at this stage, the input and output speeds are the same. This is a limitation of the microprocessor which only has a single EUSART and Baud Rate Generator.

8.0 Specifications
Receiver sensitivity 0.18uV RMS for 12dB Sinad
AIS Bit Error Rate 1 in 10,000 at 12dB above noise
Decodes both Class A and Class B AIS signals rtransmitted over VHF
Microprocessor controlled VHF receiver.
Receiver double conversion super heterodyne 10.7MHz & 455KHz. 8 element bandpass filter with dual tank front end and image notch filter.
Construction Die Cast Aluminium Box with all Stainless Steel screws (except RS232 connector).
Display is high quality array-backlit 4*20 lines protected by Perspex front panel.
GPS Input RS422 or RS232.
PC Output RS232.
Input 9 to 15.9VDC
Input Current 150mA without back light. 350mA with back light.
Audio output for monitoring or external AIS decoding.
Antenna input BNC. 50 ohm available as an option.
Comes with quality Coaxial relay.
This manual relates to Version 1.4 of the SRS-1 microcode/firmware. This revision number is displayed along with the Copyright notice upon powering up the SRS-1.

9.0 Watchdog Timer
The SRS-1 is equipped with a Watch Dog timer. This timer, independent of the main microprocessor monitors that processor and restarts the whole system should there be in "bug" or latch up in the software. In many months of running, this has never occurred, but it's good to know that even if there is a software bug lurking inside, the SRS-1 software will restart itself within a few seconds.

(c) 2005, 2006, 2007, 2008 David W Kerr