SSRadio™

Operations Manual

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FCC Statement

FCC (CFR 47, Part 15.105),BS EN 55022: 1995

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to FCC, CFR 47, Part 15 Rules, and Class A ITE (Information Technology Equipment), pursuant to the European Standard EN 55022: 1995. 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. Manufacturer provided or recommended shielded input/output cables must be used for this equipment to comply with the regulation limits tested.

Operation of this equipment in a residential area is likely to cause harmful interference in which case user's will be required to correct the interference at their own expense.

Changes or modifications to this product or its accessories which is not approved in writing by the manufacturer may void the user's authority to operate this equipment.

FCC ID L87-SSR-1

Canadian Certification Number 2416 102 518

Declaration of Conformity

(according to 47 CFR 2.1077)

Ashtech, Inc.
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declares that the product:

Spread Spectrum Radio
Model #: 800210

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.

Gary Sapia
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Introduction

Ashtech's SSRadio (SSR) is a spread spectrum radio-modem designed to provide reliable wireless data communication between two or more points. The design is optimized for use in GPS differential application in that a compact, receive-only version of the SSR is offered which can be installed within most of Ashtech's Z and GG receivers. This eliminates at least one box and one cable from the list of equipment normally required for Differential GPS applications. An internal SSR can be programmed to receive data from a transmitter or a repeater, but it does not support duplex mode.

The other component of the system, the transceiver, is housed in a compact enclosure. It can be programmed as a transmitter for the base station, as an external receiver for the rover, or as a repeater to get around obstacles and extend communication range. Two transceivers can be used in "duplex" mode, wherein data packets sent by the master can be acknowledged by the slave. The duplex mode can also be used for two-way communication. In this mode the data sent by the slave is also acknowledged by the master. Only the transceiver box can be set as a transmitter, a repeater, or a master or slave in duplex mode. The transceiver box has a single connector that is used for both power and data. Used with most Ashtech receivers, this feature eliminates the need for an extra power cable for the radio.

Another optimal feature is variable link speed. Link speed refers to the data rate from radio to radio. Different link speeds can be selected to maximize communication range or to increase data throughput. The available link speeds are 4800, 9600, and 19200 bits per second (bps). A rate of 4800 bps is suitable for longer range DGPS applications such as vehicle or vessel tracking, while rates of 9600 or 19200 bps are better for throughput-intensive applications such as Real-time Kinematic (RTK) GPS surveying (higher accuracy). Transmission range for RTK can be as high as 20km, depending on the local terrain and obstructions. The range can be extended by using additional transceivers as repeaters.

In the US and some other countries, the SSRadio can be used license-free, as it operates in the unregulated 902-928 MHz band. The SSRadio has been designed in accordance with the United States Code of Federal Regulations (CFR) 47 Telecommunications Part 15.247.

The repeater capability and the duplex mode are supported in the following firmware and software versions:

Transceiver firmware version 2.00 or higher.

Configuration software for windows version 5.00 or higher.

Configuration software for hand-held version 2.0 or higher.

Throughout this manual the term GPS is used generically to refer to receivers with GPS-only capability as well as receivers with GPS+GLONASS capability.

Equipment Supplied

The SSRadio is available in three distinct system packages. Standard accessories for a given system package are indicated by an “x” in Table 1.1. Please note that the internal remote can only be ordered as an option for certain Ashtech GPS receivers. Details on SSRadio accessories are provided in Figure 1.1.

Table 1.1. Equipment Supplied

Component	Description	SYSTEMS		
		Base/ External Remote	Internal Remote	Repeater
SSRadio Transceiver	Spread spectrum transceiver 902-928 MHz	x		x
Receiver Board	Spread spectrum receiver 902-928 MHz (installed internal to the GPS receiver)		x	
Antenna	Spread spectrum antenna	x	x	x
Mount	Antenna mounting bracket, 8.5 in	x		x
Mount & Cable	Antenna mounting bracket and cable		x	
Cable	Cable, RF coax, 5 meter, N to inverted TNC connector	x		x
Cable	Cable, power/serial data, coiled	x		
Cable	Cable, Power/ Serial Data, w/ power connector			x
Software	3½-inch disk containing configuration software	x	x	x

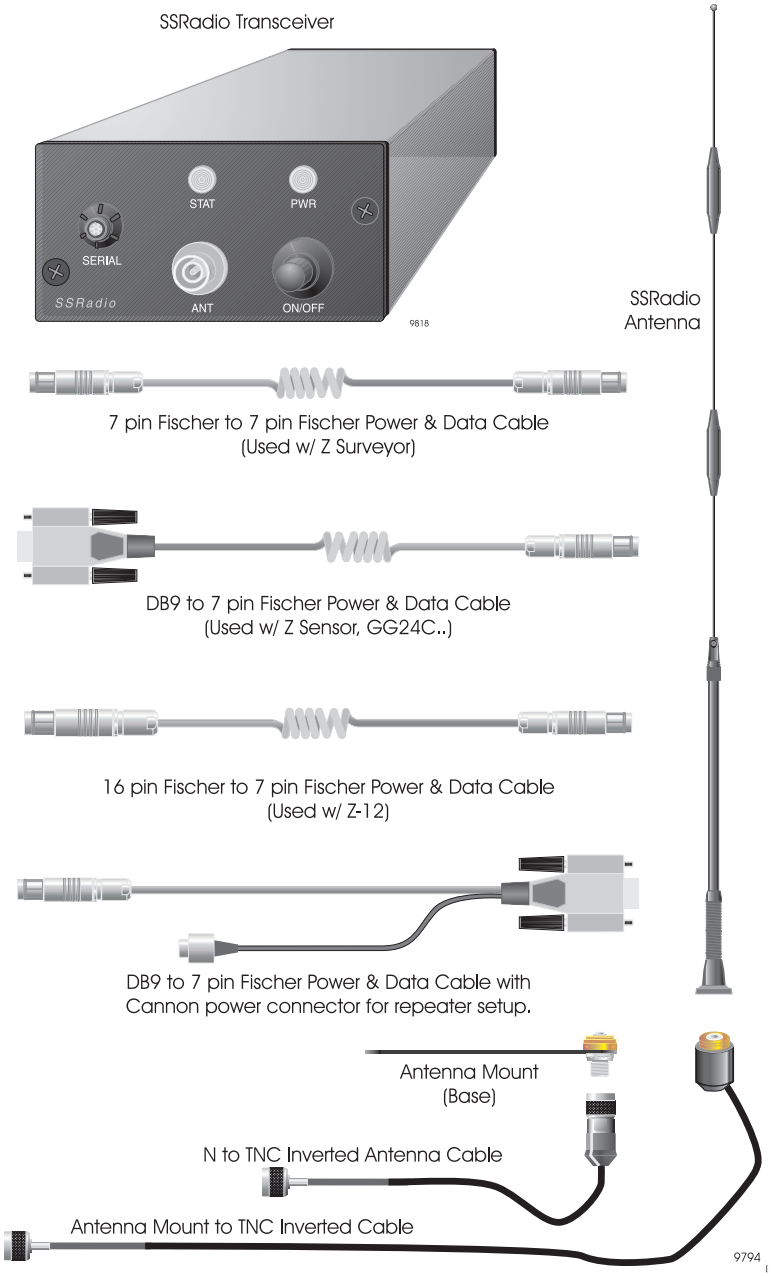

Figure 1.1: SSRadio Components

Receiver Board

Some receivers can be ordered with a receive-only version of the SSRadio installed inside. This version of the SSRadio, which is captured on a small printed circuit board, is not available as a separate stand-alone item. Details are presented in “Station Configurations” on page 7.

Other Equipment

In order to set the operating parameters of the SSRadio, you will need the following equipment, not supplied with the SSRadio.

1. GPS Receiver - Z-Surveyor, Z Sensor, GG24 Surveyor, GG24 Sensor, or Z-12 Sensor
2. IBM-compatible personal computer (PC) or handheld controller (Husky FS/2)

Physical Description

The SSRadio (figure 1.2), transceiver is housed in an extruded aluminium case, with all controls, indicators, and connectors located on the front panel. Table 1.2 describes the items on the front panel.

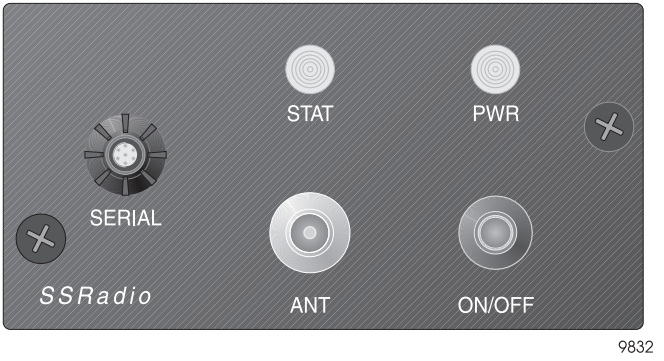

Figure 1.2: Front Panel

Table 1.2. SSR Front Panel

Item	Function
SERIAL	7-pin Fischer connector. Input for power, and interface for RS-232 serial data communication with other equipment
STAT	Three-color (Red, Yellow, Green) light-emitting diode (LED) indicates operating status
PWR	Red LED indicates power on
ANT	Inverted TNC connector, RF input/output
ON/OFF	Push-button power switch turns SSRadio on or off

Specifications

Table 1.3 lists major specifications for the transceiver and the receiver board. The receiver board is listed for information only; as noted previously, the receiver board is not available separately.

Table 1.3. Specifications

Parameter	Transceiver	Receiver Board
DATA COMMUNICATIONS		
Link speed	4800, 9600, 19200 bps, software-selectable by user	
Data link rate RS-232	9600	
Error correction	FEC, 16-bit CRC interleaved CCITT X.25	
Topologies supported	Broadcast, Broadcast w/ repeater and Duplex	
RADIO		
Type	Spread spectrum, compliant with FCC Part 15	
Modulation	Frequency-hopping spread spectrum	
Frequency steps	50 KHz, 100 KHz	
Hopping cycle	50	
Sensitivity @ 10^{-5} BER (Bit Error Rate)	-105 dBm @ 19200 bps -110 dBm @ 9600 bps -113 dBm @ 4800 bps	-107 dBm @ 19200 bps -112 dBm @ 9600 bps -115 dBm @ 4800 bps
Frequency range	902-928 MHz	
RF transmit power	1 watt (+30 dBm)	N/A
Range	5 km urban; 3-15 km rural >15 km line-of-sight depending upon antenna and data rate Range can be extended by using repeater(s)	
Voltage input	6-16 VDC	
Power requirements	Transmit: 4 W Receive: 0.8 W	0.6 W
Antenna connector	Inverted TNC	
PHYSICAL CHARACTERISTICS		
Width	3 5/8“(9.4 cm)	5 ¼ “ (13.3 cm)
Height	1 7/8” (4.8 cm)	1 5/8” (4.1 cm)
Depth	6 ¼” (16.5 cm)	½” (1.3 cm)
Weight	19 oz	3 oz
ENVIRONMENT		
Operating temperature	-25 to +60°C	
Case sealing	MIL-STD-810E for wind-driven rain and dust	N/A
Humidity	95% non-condensing	
Vibration	5g each orthogonal axis for 20 hours	

Station Configurations

The SSRadio transceiver can be used at base, repeater, and remote stations. Figure 1.3 shows the possible configurations. In the base station, the SSRadio transceiver is used in conjunction with any of several receivers. In the remote station, Configuration A may be used, comprising an SSRadio transceiver and a GPS receiver, or Configuration B, as shown, internally fitted with an SSRadio receiver board. When programmed as a repeater the SSRadio transceiver operates in stand-alone mode.

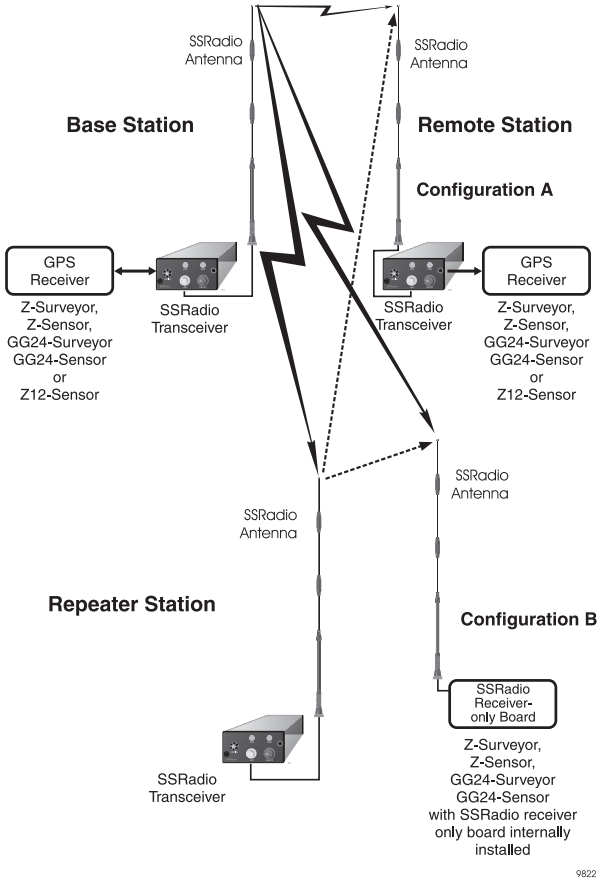

Figure 1.3: Base and Remote Station Configurations

The SSRadio transceiver, when programmed as a repeater, will also ouput the repeated data out of the serial port.

If the GPS receiver has an internal SSR receiver board installed, this configuration can be identified by the presence of a inverted TNC connector on the connector panel of the surveyor/sensor marked as Radio or SSRadio.

Connector Pinout

Figure 1.4 shows the pin configuration for the 7-pin Fischer serial data connector. Table 1.4 defines the signals on the various pins.

Figure 1.4: SERIAL Data Connector Pin Configuration

Table 1.4. SERIAL Data Connector Signal Designations

Pin	Signal	Signal Description
1	Power	6-16 VDC
2	Ground	System ground
3	CTS	Clear to send*
4	RTS	Ready to send*
5	RXD	Receive data
6	TXD	Transmit data
7	1PPS In	One-pulse-per-second input
* Pin 3 CTS and pin 4 RTS are internally jumpered together.		

Serial Data Cable Configurations

Your serial data cable configuration will depend upon the option(s) you purchased and the station configuration you plan to use. The various cable configurations are listed below and shown in the following illustrations.

1. Fischer 7-pin to Fischer 7-pin: Used to connect SSRadio to Z Surveyor.
2. Fischer 7-pin to DB9: Used to connect SSRadio to GG24 Sensor, GG24 Surveyor, or Z12 Sensor
3. Fischer 7-pin to Fischer 16-pin: Used to connect SSRadio to Z-12.
4. Fischer 7-pin to DB9 and Cannon 3-pin. Used to connect SSRadio to a PC directly and a power supply. Also used in Repeater Setup.

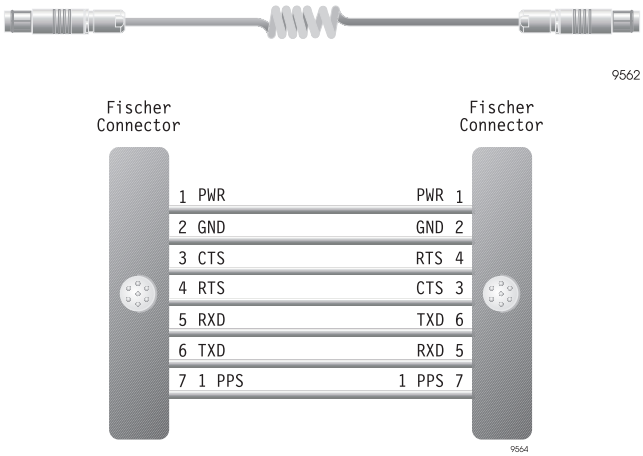

Figure 1.5: Fischer 7-Pin to Fischer 7-Pin

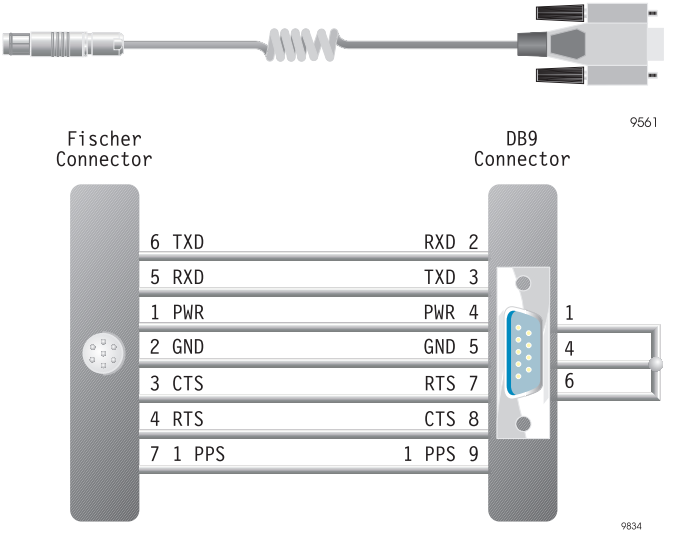

Figure 1.6: Fischer 7-Pin to DB9

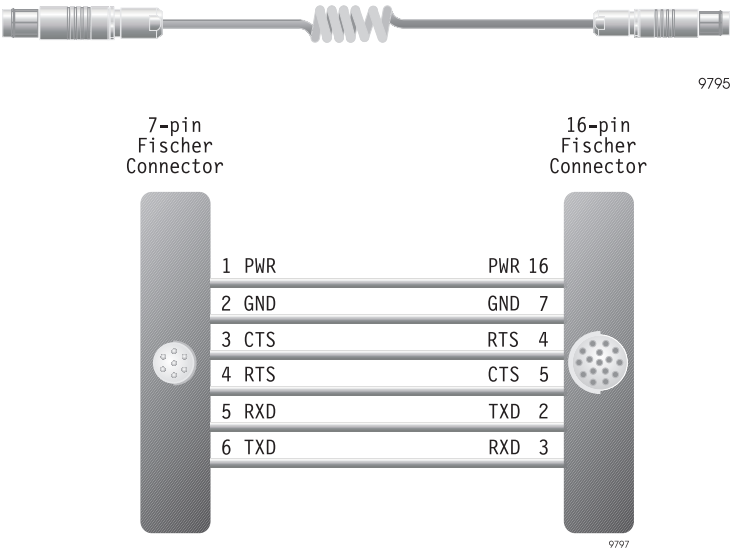

Figure 1.7: Fischer 7-pin to Fischer 16-pin

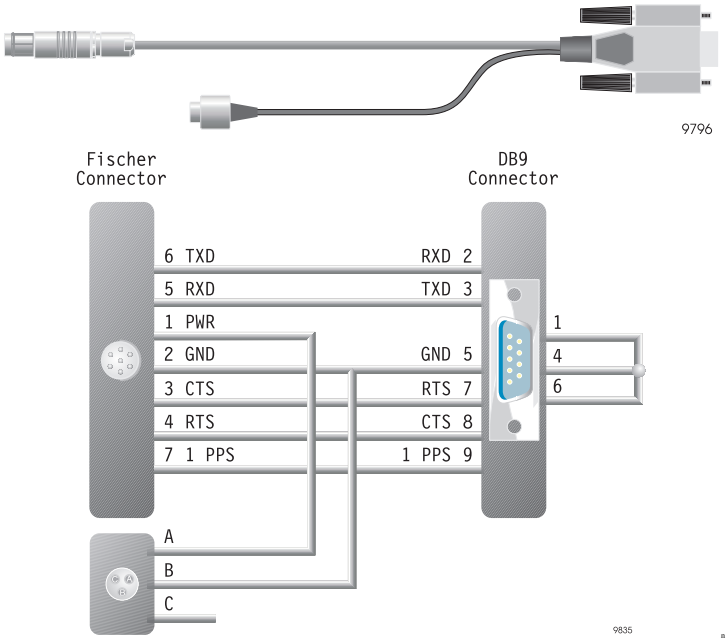

Figure 1.8: Fischer 7-pin to DB9 and Cannon 3 pin

Getting Started

This chapter provides instructions for setting up the SSRadio and configuring the unit for optimum performance.

Antenna Location

For reliable communication, the SSRadio antenna and the GPS receiver antenna should be located as high as feasible and away from obstructions, particularly metal objects such as towers, bridges, and buildings; multipath reflections from such objects can cause errors in data transmission. The GPS antenna should have a clear view of the sky above 10° elevation. Mount the SSRadio spread spectrum antenna on the same structure as the GPS antenna, using the supplied mounting bracket.

SSRadio and GPS Receiver Location

The SSRadio and the GPS receiver should be located as far as feasible from electrical devices which can cause interference, such as computers, motors, power buses, transformers, etc.

Equipment Connections

Connect the equipment as shown in Figure 2.1.

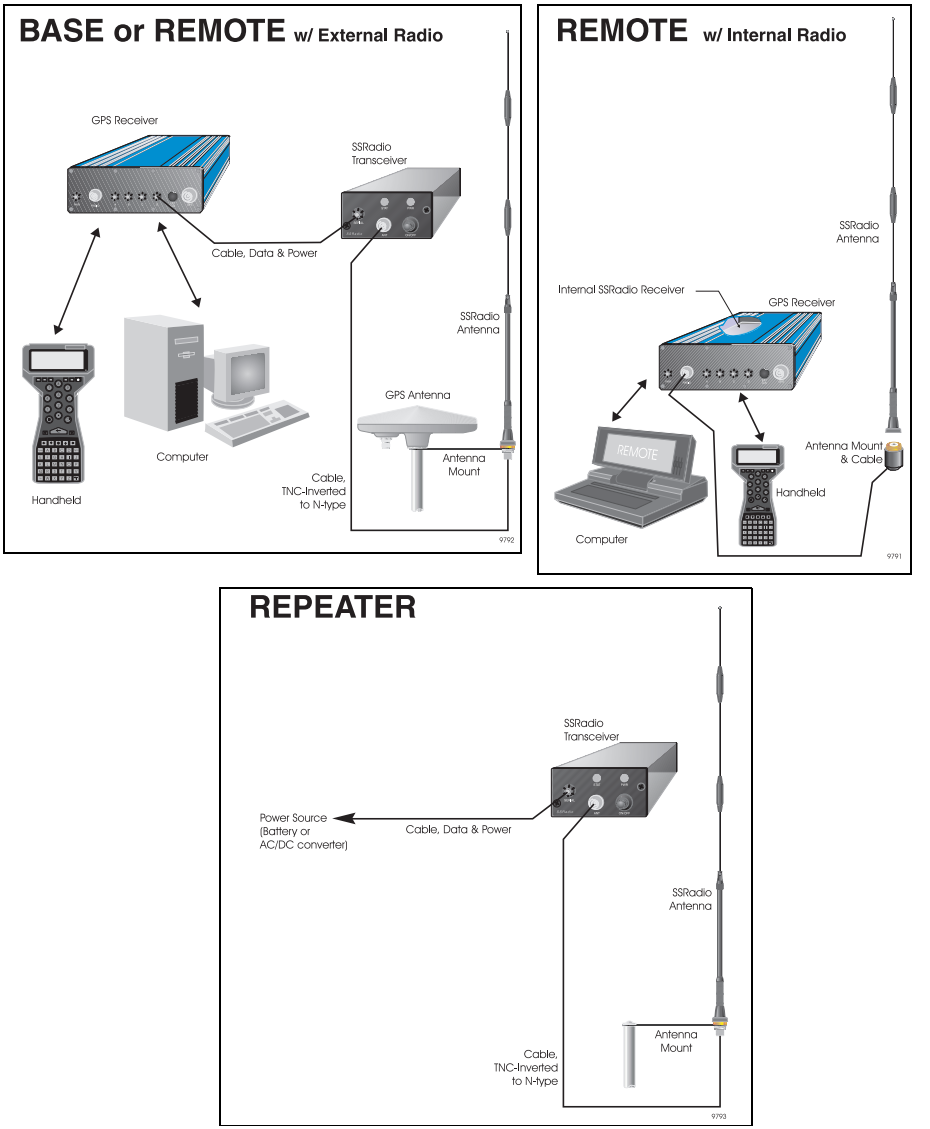

Figure 2.1: Equipment Connections

For all Base or Remote set-ups

Connect the GPS antenna to the ANT connector on the GPS receiver using the coaxial cable supplied with the GPS receiver. Make necessary power and data connections to the GPS receiver as specified in the receiver manual.

For a Base station or a Remote station with external SSRadio

1. Connect the SSRadio spread spectrum antenna to the ANT connector on the SSRadio using the supplied 5-meter coaxial cable.
2. Connect one end of the supplied serial data cable to the SERIAL connector on the SSRadio.
3. Connect the other end of the appropriate serial data cable to the GPS receiver DB9, 7-pin Fischer, or 16-pin Fischer connector.
4. Turn on the GPS receiver.

For remote stations with internal radios

1. Connect the SSR's antenna to the Radio connector on the GPS receiver using the supplied 1.2-meter cable and antenna mount assembly.
2. Turn on the GPS receiver.

For repeater stations

1. Connect the SSR's antenna to the ANT connector on the transceiver using the supplied 5-meter cable and antenna mount assembly.
2. Connect the SSRadio to a power source using the provided cable.
3. Turn on the SSRadio.

The SSR transceiver must be configured as a repeater before being used in that mode. The factory default setting is Broadcast/Receiver. See chapter 3 or 4 for the procedure to program the radios.

Equipment Operation

The following section applies to firmware version 2.00 and higher. If your SSR contains a version of firmware lower than 2.00, you need to upload the latest firmware version into your radio. Refer to chapter 3 (Configuration) for instructions on how to install PC configuration software, and also how to update the radio firmware with your PC. You should also refer to chapter 3 if you are not sure what version of firmware is in your radio.

The SSRadio Transceiver

On power-up, an SSR transceiver will go into **configuration** mode. In this mode it waits for special commands from any of the configuration software packages supplied

by Ashtech. If it is contacted by the software it will stay in configuration mode. If no commands are received for 30 seconds the transceiver will exit the configuration mode, and will enter **transparent** mode. Transparent mode is discussed later in this section.

During Configuration mode the "Status" LED will blink approximately once per second. The blinking patterns and the colors used indicate the function and mode that is programmed in the radio. Table 2.1 shows what patterns and colors are associated with a given mode. For a more detailed description of these modes refer to chapter 3.

The illegal mode, shown by a continuous yellow, means that incompatible parameters are programmed into the radio. This will not occur if you use the provided programs to set the modes. Use of a non-standard program, (e.g., a program that you developed), may cause the radio to go into an illegal state.

Table 2.1. Transceiver Blinking Pattern Definition

Mode	Color(s)	Pattern
Receiver	Green	Flash at 0.6s intervals
Transmitter	Red	Flash at 0.6s intervals
Transmitter (to Repeater)	Red/Yellow	Each color flashes in turn for 0.6s
Receiver (from Repeater)	Yellow/Green	Each color flashes in turn for 0.6s
1st Repeater	Yellow	Flash at 0.6s intervals
Next Repeater	Yellow/Yellow	Each color flashes in turn for 0.6s followed by a 3.0s pause, and the sequence is repeated
Master Duplex	Red/Red	Each color flashes in turn for 0.6s followed by a 3.0s pause, and the sequence is repeated
Slave Duplex	Green/Green	Each color flashes in turn for 0.6s followed by a 3.0s pause, and the sequence is repeated
Illegal Mode	Yellow	Stays on continuously

When the configuration mode times out due to no activity, or when the configuration session is exited, the radio enters transparent mode. In this mode a transmitter will begin transmitting data it receives through its I/O port, a repeater will begin receiving and re-transmitting data from a transmitter, and a receiver will begin receiving data from a transmitter or repeater.

An SSR transceiver set in broadcast mode as a receiver can automatically configure itself to become a receiver or a transmitter. If it enters transparent mode and receives the first data packet through its I/O port, it will configure itself as a transmitter. If it receives the first data packet through its RF port, it will configure itself as a receiver.

Each SSR transceiver leaves the factory configured as a receiver in broadcast mode.

The SSRadio Receiver

On power-up, the SSR goes into configuration mode. If it is contacted by any of the configuration software packages provided by Ashtech, it will stay in configuration mode. If it is not contacted by the configuration software within 30 seconds, the receiver will exit the configuration mode and enter transparent mode.

A status LED for an internal SSR is provided only on the Z-Surveyor. It is a miniature green LED located on the left side of the front panel below the power LED. During Configuration mode this LED will blink approximately once per second

Refer to Chapter 4, **Troubleshooting** if after power-up the SSR transceiver's Status LED is showing continuous yellow or is exhibiting a non-standard pattern. Refer to your GPS equipment documentation for guidelines on using a radio data link between the base and rover stations.

Refer to Chapter 3, **Configuration** for a detailed discussion of the operation of the SSR's different modes.

Transparent Mode Indications

When an SSR exits configuration mode it enters transparent mode. Table 2.2 outlines the Status LED's flashing patterns when the SSR is in transparent mode and the information conveyed for different situations.

Table 2.2. Status LED patterns in transparent mode

Situation	LED Behavior		
	Transmitter	**Repeater**	**Receiver**
No Synchronization frame is received from a transmitter	N/A	Solid Green	
Synchronization frame is received and/or transmitted, but there is no data. The flashes in this mode are one or two quick blinks every 10 seconds.	Flash Yellow	Flash Green & Yellow	Flash Green
Data is received and/or transmitted. These flashes appear to be intermittent; they are more rapid than in both previous cases, and are in sync with the data transmitted and/or received.	Flash Red	Flash Green & Red	Flash Green

Configuration

If the factory defaults are not satisfactory, the SSRadio can be optimized for better performance in your particular application. The set of operating parameters is called the configuration and is stored in non-volatile memory. Every time the SSRadio is turned on, the internal firmware reads the configuration from memory and configures the internal modem.

Installing the SSR Configuration Tools

Configuration settings can be adjusted with software that is supplied with the SSRadio. The software allows you to view, edit, and program the SSRadio configuration parameters quickly and efficiently.

For Windows 3.x and Windows NT 3.xx or lower, do the following:

1. Turn your computer on and start Windows.
2. If an old version of SSR configuration software is installed on your PC, it's a good idea to remove it before loading the new SSR configuration software. Click on the **Uninstall** icon in the **SSR Configuration Tools** window and follow instructions to remove the old software (Figure 3.1).
3. Insert the new SSRadio Configuration Programs for Windows disk into your floppy drive. The following assumes that this is drive **A** on your computer. If not, modify the command line accordingly.
4. Click on **File** on the program manager tool bar, and select **Run...**
5. In the dialog box that pops up type **A:\setup** and click on **OK**.
6. Follow instructions given by the Install Shield.

Figure 3.1: SSR Tools icons for Windows 3.x and Windows NT 3.xx

For Windows 95 and Windows NT 4.00 or higher, do the following:

1. Turn your computer on and start Windows.

2. If an old version of SSR configuration software is installed on your PC, we recommend that you remove it before loading the new version. Click on the **Uninstall** icon in the **Start->Programs->SSR Configuration Tools** folder to remove the old software (Figure 3.2).
3. Insert the new SSRadio Configuration Programs for Windows disk into your floppy drive. The following assumes that this is drive **A** on your computer. If not, modify the command line accordingly.
4. Click on **Start** and select **Run....** from the menu.
5. In the dialog box that pops up type **A:\setup** and click on **OK**.
6. Follow instructions given by Install Shield.

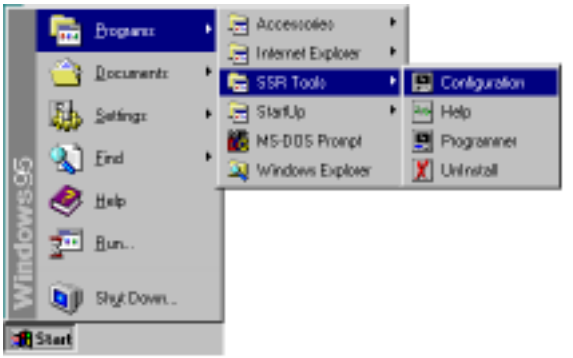

Figure 3.2: Selection of SSR Tool Icons for Windows 95/NT 4.0 and up

Running the SSR Configuration Tools

1. Connect the SSRadio transceiver to any port on the GPS receiver. If you have an internal SSRadio receiver installed, it will already be connected to port D internally.
2. Connect another port of your GPS receiver to a COM port on your PC.
3. Turn on the PC if it is not already on.
4. Turn on the SSRadio and the GPS receiver
5. For Windows 3.x and Windows NT 3.xx, on the PC display, start the SSR Configuration utility by opening the SSR Tools program group and double-clicking on the **Configuration** icon (see Figure 3.1). For Windows 95 and Windows NT 4.00 and higher, start the SSR Configuration utility by

clicking once on the **Configuration** icon in the **Start->Programs->SSR Tools** menu.

6. The SSRadio Modem Configuration Tools window appears, as shown in Figure 3.3.

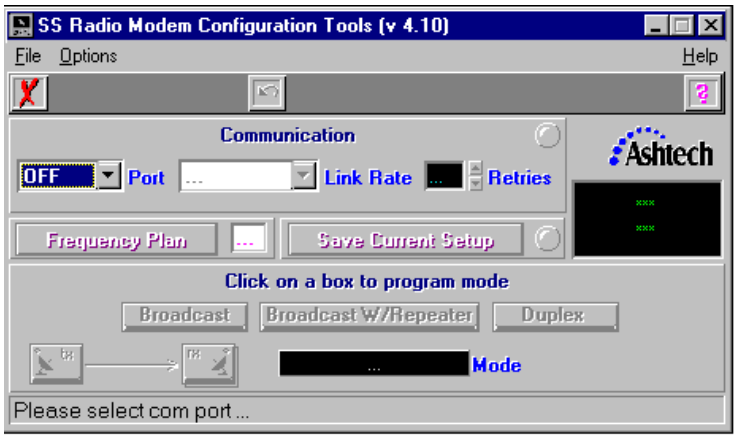

Figure 3.3: SSRadio Modem Configuration Tools Window

7. In the Communication field, select the COM port to which the SSRadio is attached. The round indicator at the top right corner of the communication field will blink yellow to show that contact with SSR is not established.
8. Select “GPS/GLONASS Receiver Port for SSR” in the Options menu and pick the GPS serial port that is connected to the radio. (Port D for the internal radio). If you are connecting directly to the SSRadio, it is not necessary to select a GPS serial port.

9. When the software is connected to SSRadio, the display will change as shown in Figure 3.4

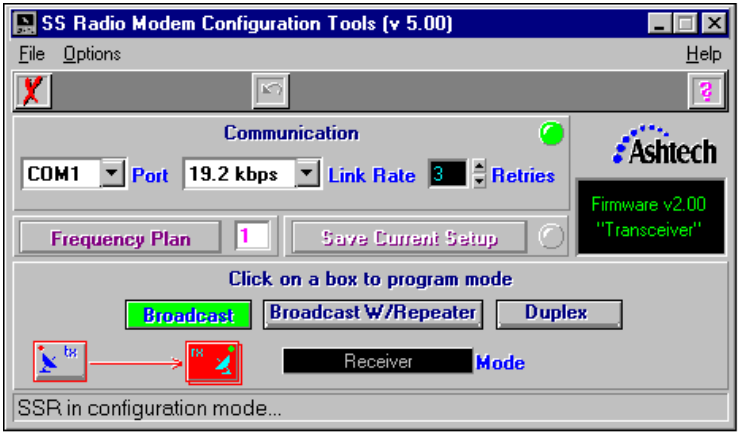

Figure 3.4: Successful SSRadio Connection

The window appears as shown after the software has successfully interfaced to the SSRadio. The status indicator in the communication field will be green when the interface to the SSRadio is successful and will blink yellow if unsuccessful. The settings shown are from an SSRadio transceiver with factory default settings. The settings you see may be different depending on whether your radio's parameters have been changed.

The software allows you to change parameters such as link speed, mode, number of retries, and frequency plan. Once any of these fields has been modified, an indicator by the **Save Current Setup** button will start blinking yellow. This signifies that the parameters on the screen are different from those stored in the radio and need to be saved. Once you have made all changes necessary, you can save them by clicking the **Save Current Setup** button. You will be asked to confirm that you want to save the settings shown on the display. Choose **Yes**. Your changes will be programmed into the SSRadio, and the indicator by the **Save Current Setup** button will stop blinking. Once the changes have been saved, the new settings will be in effect. If at any time after making changes, and before saving them, you change your mind, click on the icon below:

This will cause the settings to revert to those that were last saved in the radio.

Programming the Latest Firmware

The SSRadio's firmware version number is displayed in a box beneath the Ashtech logo. If this number is lower than the version number referenced on the diskette you received with this manual, then you will need to upgrade the firmware in the radio.

1. Connect the radio to the PC, either directly or through a GPS receiver. You may need to cycle power on an SSR transceiver to put it into configuration mode.
2. Run the **Programmer** software by double clicking on the associated icon. The SSR Programming Tool window will appear as shown in Figure 3.5.

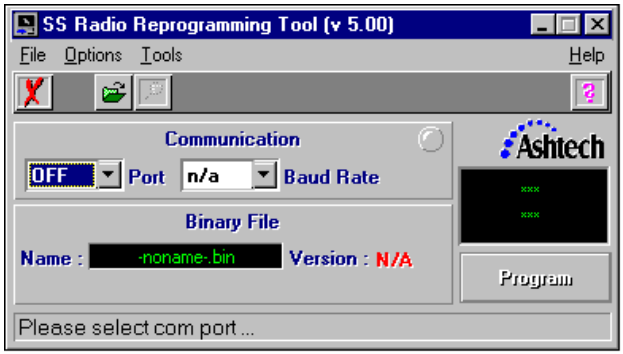

Figure 3.5: SSR Programming Tool

3. Select the appropriate COM port in the communication field.
4. Under the option menu, select the port that the radio is connected to on the GPS receiver (port D for internal radio). You should see some of the fields change, and the indicator in the top right corner of the communication field will turn green, signifying that the program has successfully contacted the radio.
5. To select the most recent version of the firmware pick "Open" from the file menu. A file selection window will pop up with two types of files to select from. SSR_R*nnn*.BIN is used for an internal SSR; SSR_T*nnn*.BIN is used for SSR transceivers. The 3 digit number (nnn) is the firmware version number.
6. Select the latest version (the highest nnn) and click on OK. The name of the file you selected should appear in the Name box in the center of the window.

7. Click on “Program” button. A progress window will appear, and after a few seconds a confirmation message should appear to notify you that programming was successful.
8. Select “exit” from the file menu to leave the program.

Configuration Parameters

Communication Field

The **Communication** field is shown in Figure 3.6.

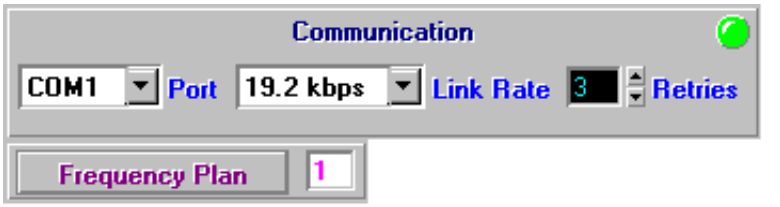

Figure 3.6: Communication Field

In the **Communication** field, you can set the following configuration parameters:

- COM Port
- Link Rate
- Frequency Plan

Use **COM Port** to select the corresponding port.

The **Link Rate** field allows you to select the rate at which data is transmitted over the RF link. Possible selections are 19200, 9600, or 4800 bps. The real rate at which data is transmitted through SSRadios will be less than the selected link rate because the SSRadio adds service data into the received data stream.

The approximate real link speeds, (R) for zero retries, are listed below:

~10000 bps for 19200 bps link rate

~4700 bps for 9600 bps link rate

~2300 bps for 4800 bps link rate

When the retries count is not zero, the link rates must be divided by (N+1), where N is the retries count.

This calculation for the case of Master/Slave operation is not valid. The actual number will vary and depend on the link quality. It will be at best R, and at worst R/(N+1).

A link rate of 19200 bps is recommended. You may need to use a lower rate, 9600 or 4800 bps, in difficult transmission conditions such as long range or heavy fade.

To communicate with the SSRadio, your equipment should use a baud rate of 9600, 8 data bits, 1 stop bit, and no parity.

Avoiding Buffer Overflow

The SSRadio buffers input and output data. The size of each data buffer is 10k (10240 bytes). Buffer overflow must be avoided. If your data rate is more than the real link data rate, data will be lost. The only way to avoid data loss is to keep the average data rate below the real link speed.

Frequency Plan Selection

The SSRadio can be set to any one of ten “Frequency Plans.” Each frequency plan is a collection of settings for a number of parameters that define the communication channel properties. The average user may not want to know the details of these parameters; users interested in this information will find it in Appendix A. When the “Frequency Plan” button is clicked, the window shown in Figure 3.7 will pop up.

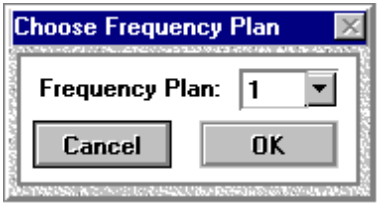

Figure 3.7: Frequency Plan Selection Window

To change the plan, click on the drop-down button to make a selection from the list.

Retries Field

This field is not used when the SSRadio is in the receiver mode.

This option designates how many times the transceiver will repeat information. The possible selections are 0, 1, 2, or 3. For networks with reliable RF links, this parameter would be set to 0. If the network has some weak or marginal links, the value would be set higher. If an SSRadio receives a packet from a transmitter more than once, it discards the repeated packets. Refer to the section "The Duplex Mode", on page 29 for more information on the function of the retries setting.

Operation Mode Selection

Figure 3.8 shows the mode selection window. The parameters shown were read from an SSRadio transceiver with factory default settings. The parameters you see may be different.

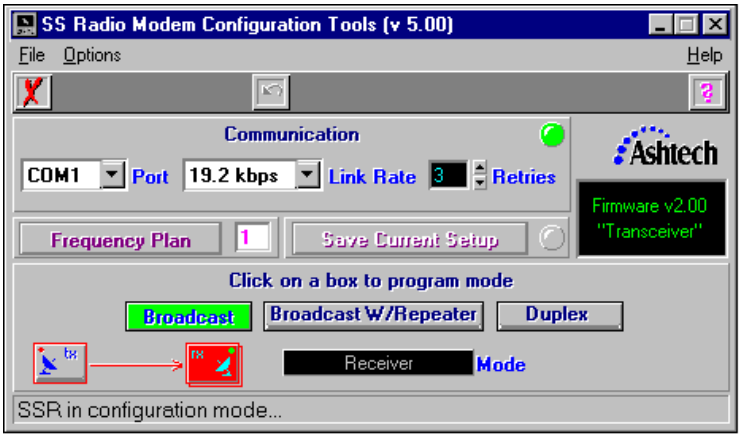

Figure 3.8: Mode selection window, Broadcast

The following sections describe the different modes in which an SSRadio can be programmed.

Broadcast Mode

This is the most commonly used mode. It is also known as point-to-multipoint mode. In this mode, one transceiver is programmed as a transmitter with an SSR transceiver (programmed as a receiver) or an internal SSR receiving data directly from the transmitter. A virtually unlimited number of SSRs can receive data from a single transmitter. In broadcast mode, data is sent in only one direction; no acknowledges are sent back by the receivers. The transmitter and the receivers need to be programmed with the same link rate and frequency plan.

Click on the **Broadcast** button to set the radio in broadcast mode. Next, click on one of the dish antenna icons labelled with **tx** or **rx**. The icon chosen will be highlighted in red, and the mode selected will be shown in the mode box. Remember that this change will actually be programmed into the radio when you click the “Save Current Setup” button and choose “Yes” in the subsequent pop-up box.

Please note that a transceiver programmed as a receiver can change “automatically” to a transmitter. The conditions required for this to happen are described in "Equipment Operation", on page 15.

Broadcast With Repeater Mode

Click **Broadcast W/ Repeater**. Your Mode selection window will resemble Figure 3.9.

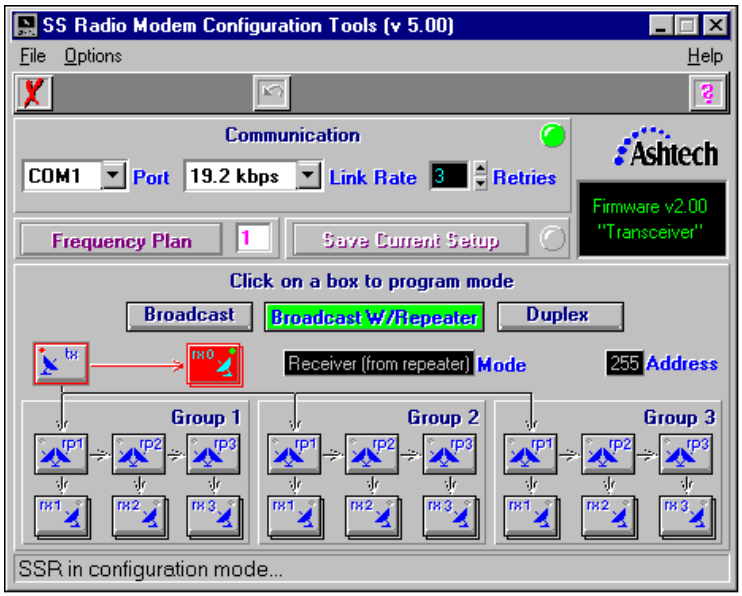

Figure 3.9: Mode selection window, Broadcast W/ Repeater

This mode is similar to the broadcast mode in that one transmitter transmits to multiple receivers, and the communication is only in one direction (i.e., no acknowledges are sent by the receivers). Repeaters are used in this mode to increase the range of transmission or to get around obstacles that cut off line of sight. An SSRadio transceiver programmed as a repeater retransmits data from the transmitter. The first repeater will reduce data throughput by approximately 50%. There is no throughput penalty for additional repeaters, but a 400 milli-second delay is incurred for each repeater in the link between the transmitter and the receiver.

If you plan to use repeaters, all of the components of the network must be programmed in this Broadcast W/ Repeater window. An SSRadio programmed in the broadcast mode or duplex mode will not function in a repeater network.

Use the topology shown in this window as a guide for programming your radios. To program any component of the network, click on the “tx”, “rp*i*”, or “rx*i*” icons. The selected icon will be highlighted in red and the other components required for the system (everything between the highlighted component and the transmitter) will be outlined in red.

Use one group, say group one, if you are setting up a repeater network with only one branch. If you need to set up repeaters going in different directions, do it using different groups. Through the use of unique addressing, a receiver from one group will not receive from repeaters from a different group; that is, receiver (i) in group N will only receive from repeater (i) in group N.

The receiver icon (rx0) that appears next to the transmitter icon (tx) is useful if you are in the field, and you are not sure whether you will need a repeater at some point in your excursion. Set the transmitter from within the Broadcast W/Repeater window. The text in the mode box reads, “Transmitter to Repeater”. Since you are not sure whether you need a repeater, bring two SSRs to the field. For one of them you have accessories required for setting a receiver; for the other you have accessories relevant to setting a repeater. Set your receiver to rx0, attach it to the GPS receiver, and go out in the field receiving data directly from the transmitter - no repeater in between. Now, if you come to an obstacle which blocks the line of sight between the transmitter and the receiver, cutting off communications, you can set your extra SSR as a repeater using one of the repeater group panes, and post it on one side of the obstacle. Next, take our SSR receiver, change its mode to repeater from the receiver, using the same pane as you used for setting the repeater. Now your SSR receiver is getting data from the repeater, and the problem imposed by the obstacle is negated. The advantage here is that if you were using the Broadcast mode, you would have to trek back to the transmitter and change to Broadcast W/Repeater mode. By using the rx0 setting, you can use a simple broadcast topology and you are still able to switch to a repeater topology without having to go back to the transmitter and reset it.

See Figure 3.10 for an example where the rx2 in group 2 is selected. Notice that the tx, rp1, and rp2 icons are all highlighted with red boundaries and all links in that path are also highlighted.

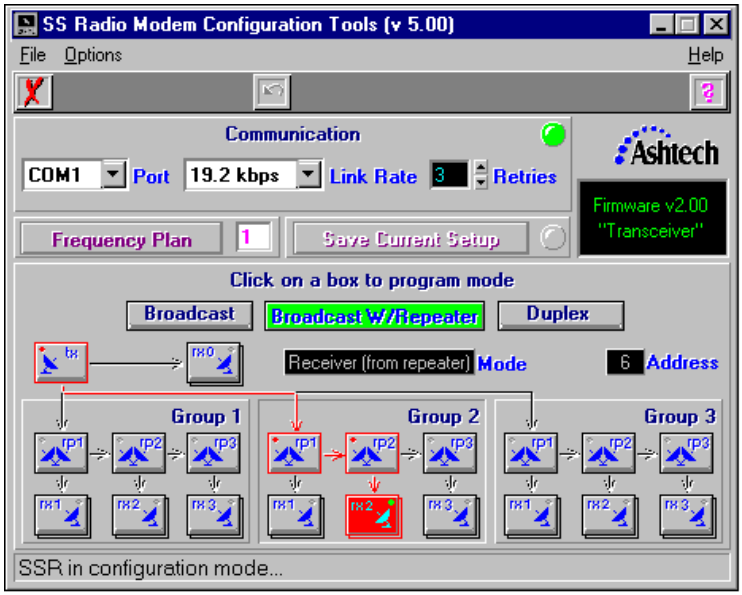

Figure 3.10: Broadcast W/ Repeater, example

Remember that the selected mode will actually be programmed in the radio when you click the "Save Current Setup" button and choose "Yes" in the subsequent pop-up box.

You can select up to 3 repeaters in each branch.

The Duplex Mode

Click the "Duplex" button. You will see a window similar to Figure 3.11. This mode allows bi-directional communication between two SSR transceivers, one set as a "master", the other set as a "slave". Only one receiver can be used in this mode. This is also known as point-to-point communication. You can set the function in this mode by clicking the "md" or "sd" icons in any of the four master/slave pairs shown. Note that the transceivers must be set in pairs. A transceiver set as sd3 will not receive data from a transceiver set as md1.

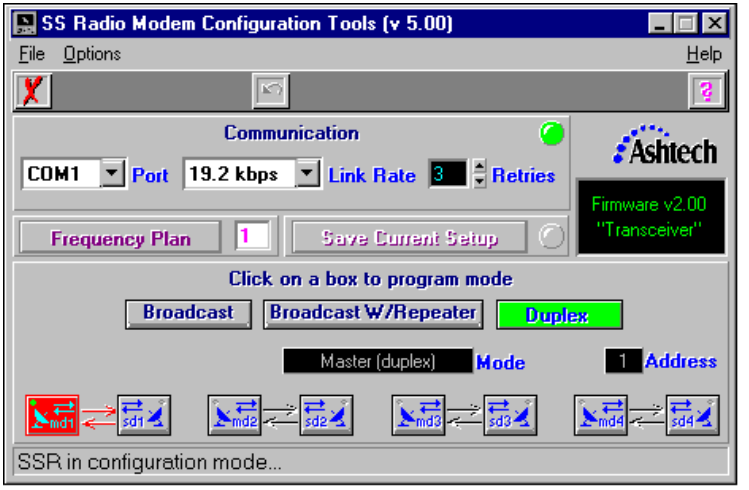

Figure 3.11: Mode selection window, Duplex

The transmissions from the slave device can be an acknowledge or can contain actual data. If the slave device is not being used to send data to the master the acknowledges are used to optimize range and throughput. Specifically, if the repeat rate is set at 3, the master will retransmit the data up to 3 times, but only until it receives an acknowledge. If it receives an acknowledge after the first try, it will not attempt a retry. When conditions are ideal, the throughput is at maximum for the given link speed. As conditions deteriorate, the number of retries goes up and throughput will decrease. This happens automatically; there is no need for a manual adjustment.

Configuring the SSRadio with Handheld Controller

Most of the parameters that can be configured with a PC can also be configured with a handheld controller such as the Husky FS/2 or Hewlett Packard HP200.

You will need to load the radio configuration program into your handheld device. If you have a Husky, use FSRADIO.EXE; if you have an HP palm-top, use HPRADIO.EXE. These programs are supplied in the diskette marked “SSRadio Configuration Programs for Handhelds”. To load these programs into your handheld, follow the procedure in the user’s manual for your specific handheld.

To access either of these radio configuration programs, type FSRADIO or HPRADIO at the prompt. If you are connecting directly to the SSRadio, type FSRADIO /D or

HPRADIO /D at the prompt. Please note that a space must be inserted between the last letter of the first word (“O”) and the forward slash (“/”).

This section describes the procedures for configuring the SSRadio using a handheld controller. The handheld controller configuration program menu is character-based, requiring you to select items from menus. The handheld controller can program the following parameters:

- Daisy Chain mode
- Channel
- Link Speed
- Frequency Plan (1 of 10)
- Mode

To program a particular parameter, you must find the parameter in one of the handheld conroller screens. The screens are:

Table 3.1. Controller Screens

Screen	Page
Daisy Chain Through Screen	33
Connect to Screen	34
SSRadio Status Screen	35
Change Parameters Screen	36
Mode of Operation Screen	37
Broadcast Mode Screen	38
Broadcast with Repeater Mode Screen	39
Mode Selection within a Group Screen	40
Receiver from Repeater Selection Screen	41
Repeater Selection Screen	42
Duplex Mode Selection Screen	43
Master Selection Screen	44
Slave Selection Screen	45
Select Frequency Plan Screen	46
Retries Screen	47
Select Link Speed Screen	48

The first part of Chapter 3 contains detailed descriptions of all modes.

Figure 3.12 shows you how to navigate through the handheld controller screens. The pages following Figure 3.12 present detailed descriptions of each screen.

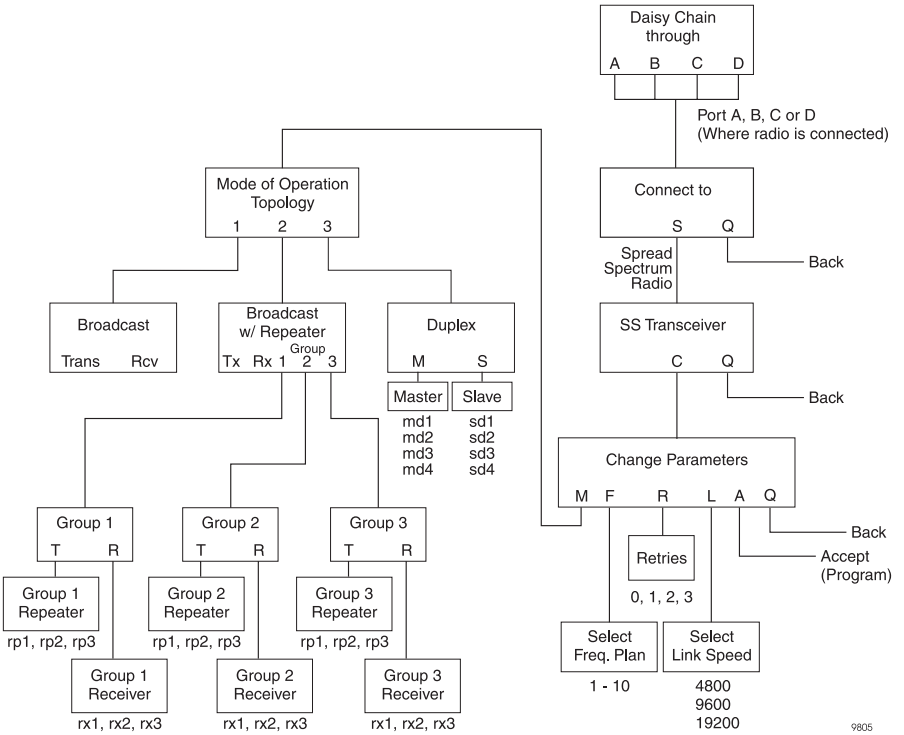

Figure 3.12: Map of Handheld Controller Screens

Daisy Chain Through Screen

The **Daisy Chain Through** screen (Figure 3.13), lets you connect your handheld controller to the SSRadio through a receiver serial port.

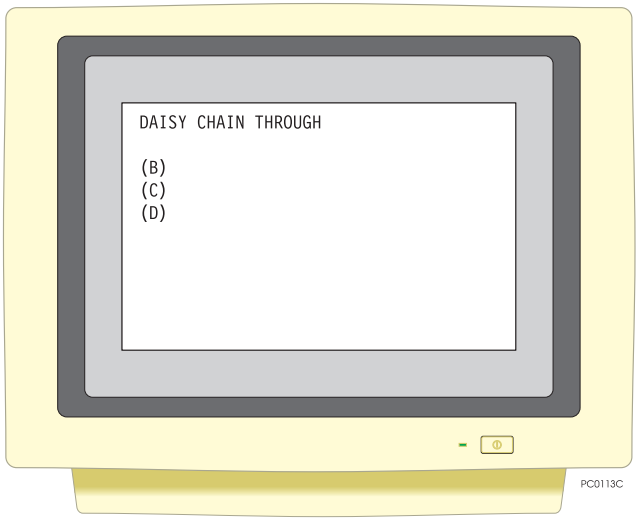

Figure 3.13: Daisy Chain Through Screen

The selections on this screen are B, C, and D. These are the serial ports on the GPS receiver. Port A (or whatever port the handheld controller is connected to) on the receiver is not available, as it is used by the handheld controller.

A valid port selection calls the **Connect To** screen, and the program then activates the daisy chain mode in the receiver using the selected port.

If your satellite receiver has an SSRadio installed within, Port D should be selected.

Connect To Screen

The **Connect To** screen (Figure 3.14), lets you configure a Pacific Crest radio (not covered in this manual) or an SSRadio.

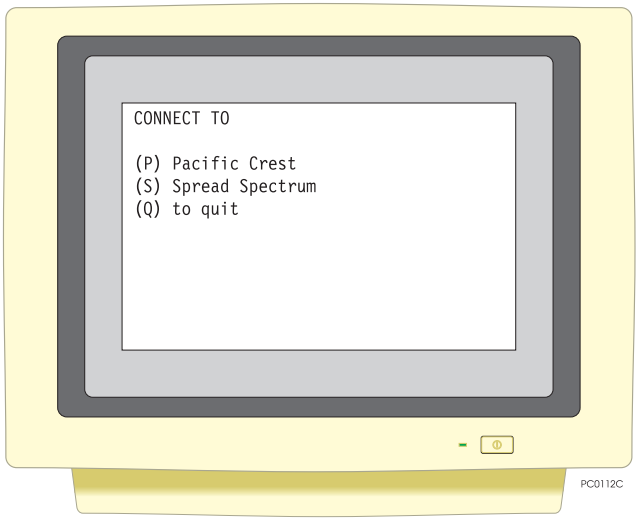

Figure 3.14: Connect To Screen

The selections in this screen are:

P — Calls the Pacific Crest radio configuration screen; not supported in this version of the software.

S — Calls the "SSRadio Status Screen", on page 35.

Q — Quits the program.

Press the appropriate key to make the desired connection.

SSRadio Status Screen

The **SSRadio Status** screen (Figure 3.15), allows you to view the SSRadio's current configuration, return to the "Connect to Screen" or advance to the "Change Parameters Screen".

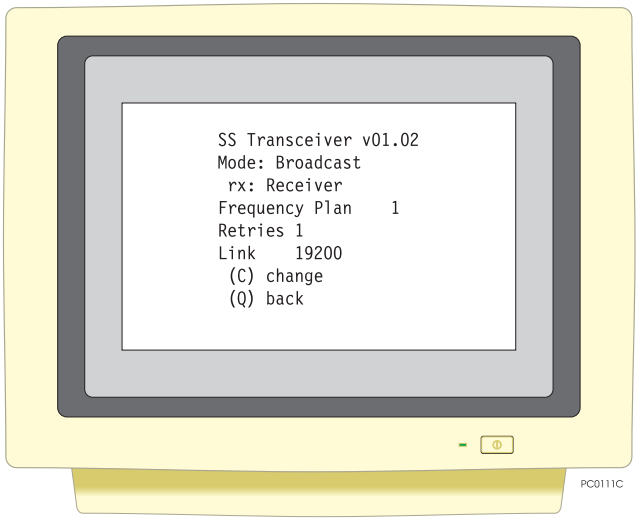

Figure 3.15: SS Transceiver Screen

The selections in this screen are:

C — Change parameters of the SS Transceiver. This selection calls the "Change Parameters Screen", on page 36.

Q — Return to the "Connect To Screen", on page 34.

Change Parameters Screen

The **Change Parameters** screen (Figure 3.16), lets you change settings of the SSRadio.

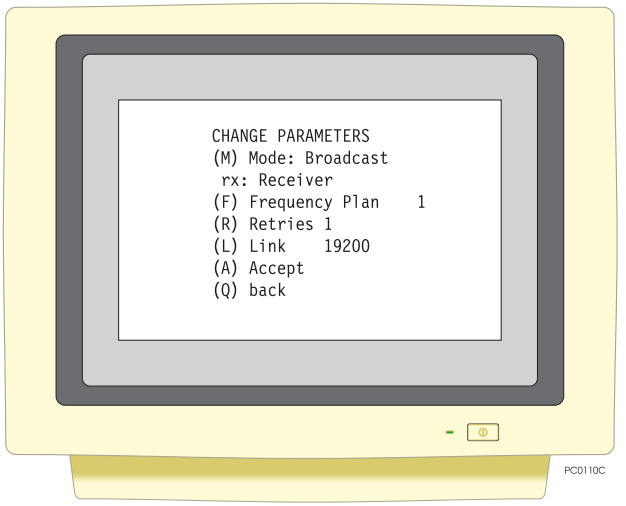

Figure 3.16: Change Parameters Screen

The selections on this screen are:

M — Calls the "Mode of Operation Screen", on page 37, to change the operating mode. The default mode is Broadcast Receiver.

F — Calls the "Select Frequency Plan Screen", on page 46, to select a preset Frequency Plan. Default is 1.

R — Calls the "Retries Screen", on page 47, to select the number of retries.

L — Calls the "Select Link Speed Screen", on page 48, to set link speed.

A — Accepts selected parameters and programs the SSRadio.

Q — Returns to the "SSRadio Status Screen", on page 35.

Mode of Operation Screen

The **Mode of Operation** screen (Figure 3.17), lets you select one of 3 topologies of operation for the SSRadio.

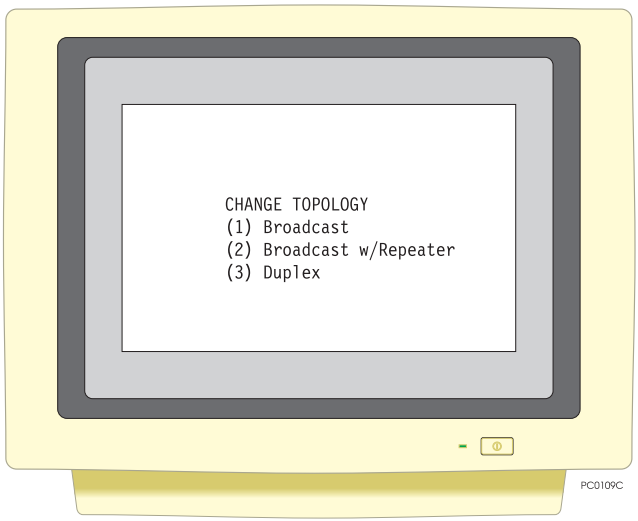

Figure 3.17: Mode of Operation Screen

The selections on this screen are:

Broadcast —This will take you to "Broadcast Mode Screen", on page 38.

Broadcast w/Repeater—This will take you to "Broadcast with Repeater Mode Screen", on page 39.

Duplex—This will take you to "Duplex Mode Selection Screen", on page 43.

Broadcast Mode Screen

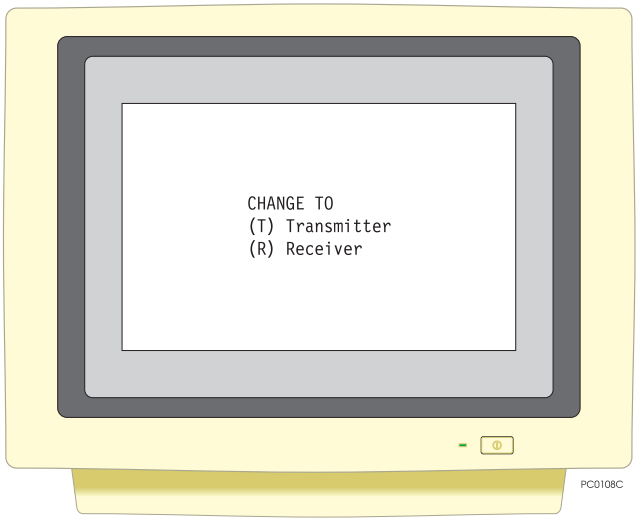

Figure 3.18: Broadcast Mode Screen

The selections on this screen are:

Receiver — This setting is used if you want to use the radio as a receiver.

Transmitter — This setting is used if you want to operate the SSRadio as a transmitter. This mode can only be set on the transceiver.

After you make a selection, the program returns to the "Change Parameters Screen", on page 36.

Broadcast with Repeater Mode Screen

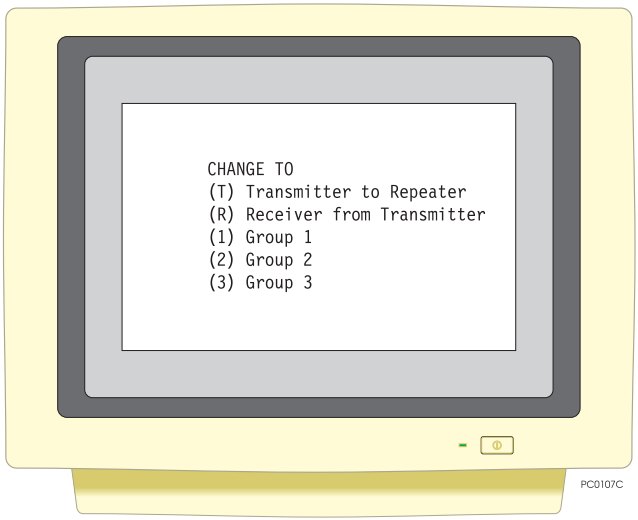

Figure 3.19: Broadcast with Repeater Mode Screen

Use this screen to select “Transmitter to Repeater” or “Receiver from Transmitter”, after which the program will return to “Change Parameters Screen”. Choose one of the three groups to access additional selections for “Repeater” or “Receiver from Repeater” settings. This will take you to "Mode Selection within a Group Screen", on page 40.

Mode Selection within a Group Screen

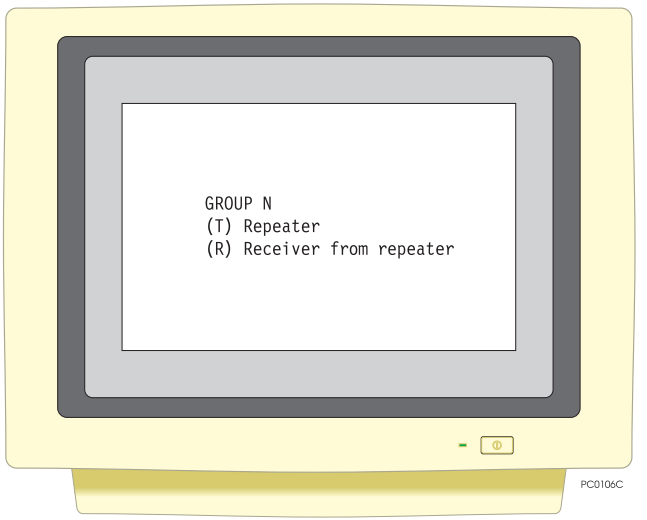

Figure 3.20: Mode Selection within a Group Screen

Repeater—This will take you to "Repeater Selection Screen", on page 42.

Receiver—This selection will take you to "Receiver from Repeater Selection Screen", on page 41.

Receiver from Repeater Selection Screen

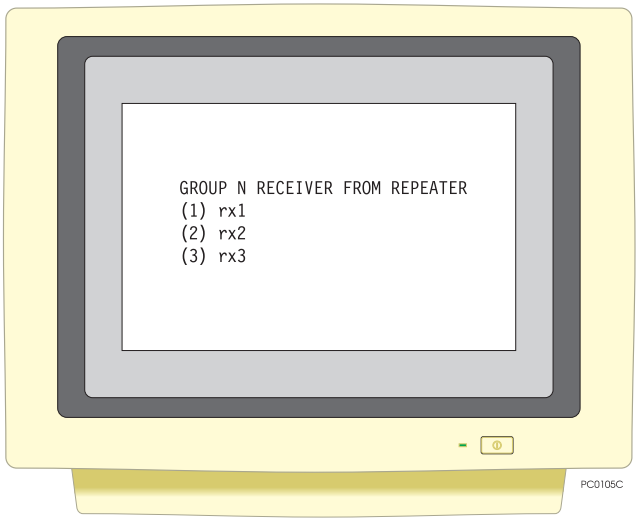

Figure 3.21: Receiver from Repeater Selection Screen

This screen sets the mode for Receiver from Repeater 1, 2, or 3. After selection the program will return to "Change Parameters Screen", on page 36.

Repeater Selection Screen

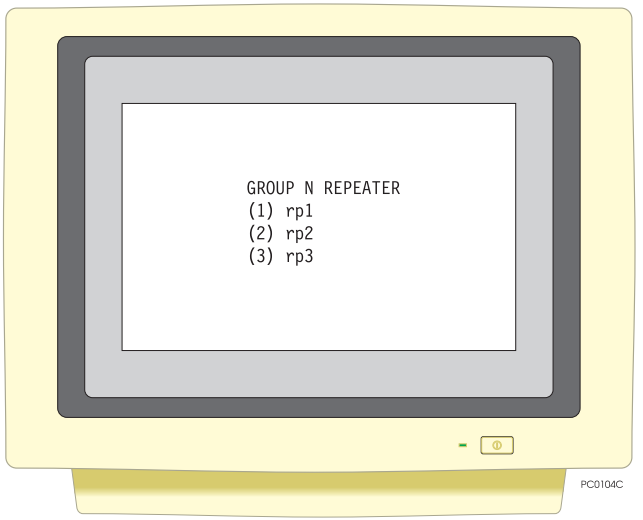

Figure 3.22: Repeater Selection Screen

Use this screen to set repeater 1, 2, or 3. After selection the program will return to "Change Parameters Screen", on page 36.

Duplex Mode Selection Screen

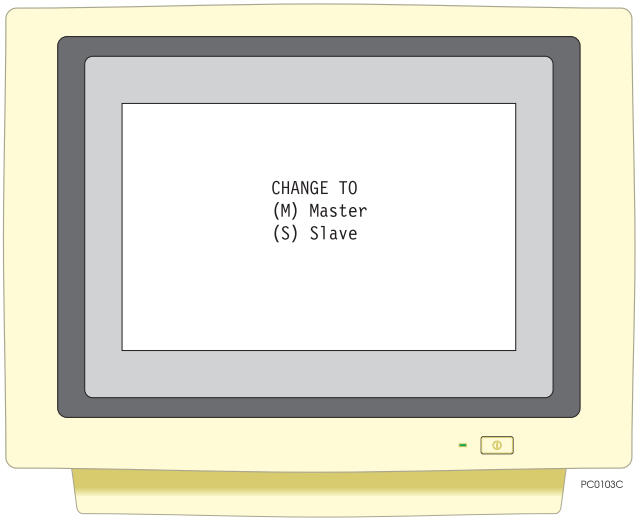

Figure 3.23: Duplex Mode Selection Screen

Master — This will take you to the "Master Selection Screen", on page 44.

Slave — This will take you to "Slave Selection Screen", on page 45.

Master Selection Screen

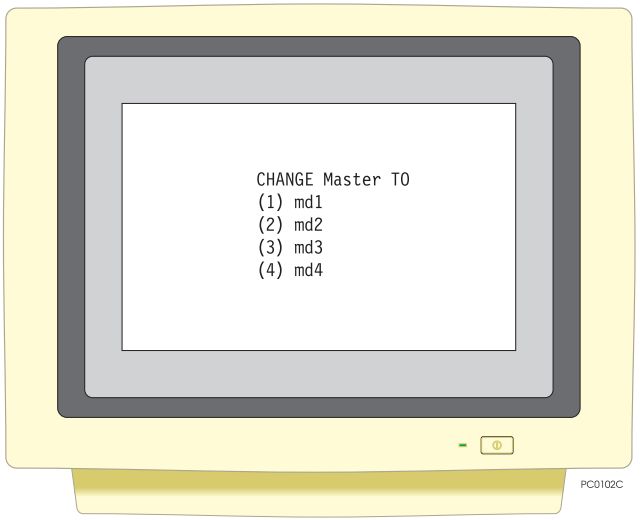

Figure 3.24: Master Selection Screen

Use this screen to select one of four master modes: md 1, 2, 3, or 4. After selection the program will return to "Change Parameters Screen", on page 36.

Slave Selection Screen

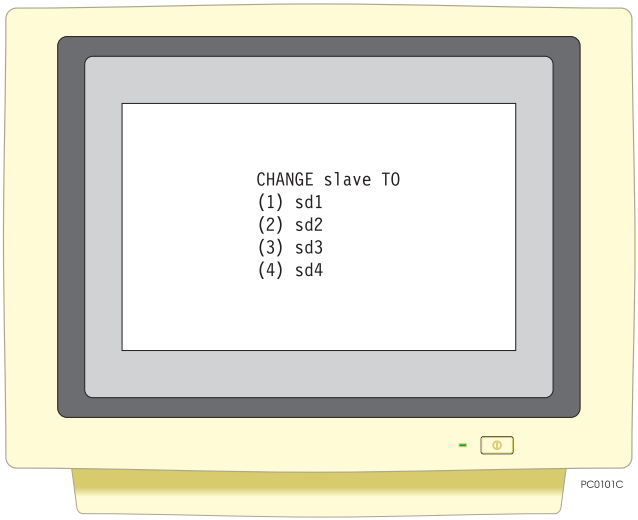

Figure 3.25: Slave Selection Screen

Use this screen to select one of four slave modes: sd 1, 2, 3, or 4. After selection the program will return to "Change Parameters Screen", on page 36.

Select Frequency Plan Screen

The **Select Frequency Plan** screen (Figure 3.26), lets you select one of 10 preset banks of link parameters and algorithms stored in memory. To select a Plan, type a number from 1 through 10 and press the **Enter** key P.

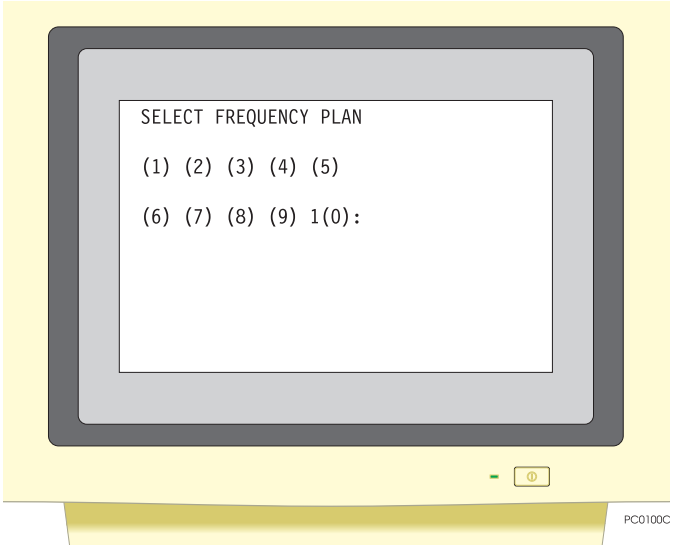

Figure 3.26: Select Frequency Screen

Use this screen to choose one of four possible retry settings: 0, 1, 2, or 3. After selection the program will return to "Change Parameters Screen", on page 36.

Retries Screen

The **Retries** Screen (Figure 3.27), lets you set the number of retries.

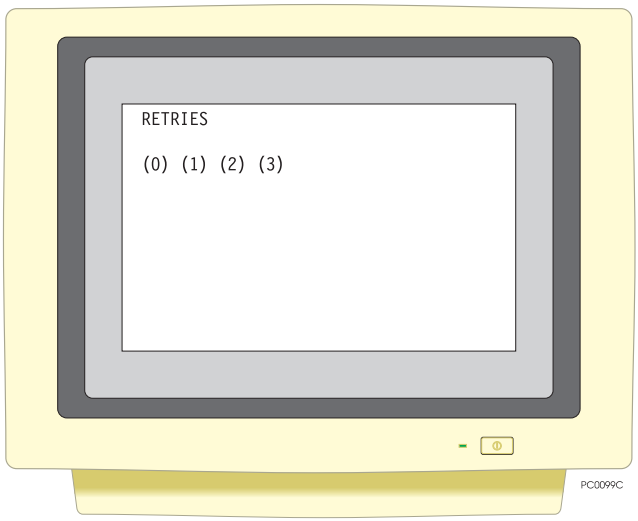

Figure 3.27: Number of Retries Screen

Use this screen to choose one of four possible retry settings: 0, 1, 2, or 3. After selections the program will return to "Change Parameters Screen", on page 36.

Select Link Speed Screen

The **Select Link Speed** screen (Figure 3.28), lets you select the rate at which data is transmitted over the RF link.

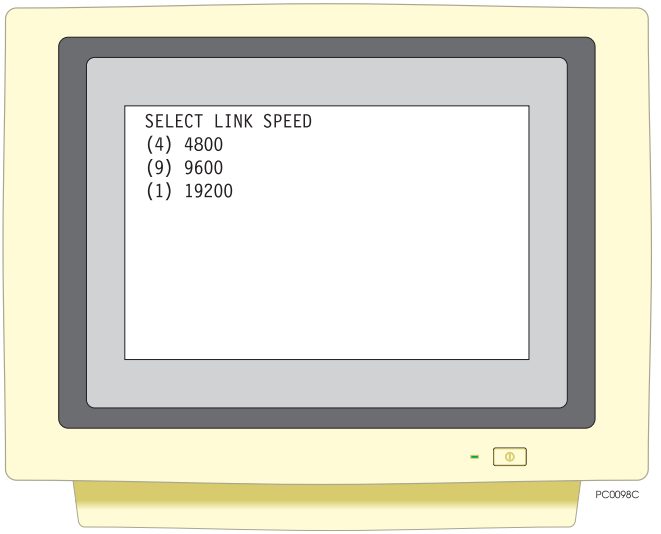

Figure 3.28: Select Link Speed Screen

Select the rate by typing 4, 9, or 1 as appropriate. The program returns to the "Change Parameters Screen", on page 36.

4

Troubleshooting

This chapter provides some solutions to problems you may encounter when using the SSRadio.

1. **An SSR transceiver set as a transmitter is in transparent mode but the STAT LED does not indicate data transmission.**
   - The transceiver may be configured as a receiver or repeater. Cycle power on the SSR and verify that the STAT LED's color(s) and blinking pattern indicate a transmitter mode. If not, use the SSR Configuration Tools to set the SSR to the appropriate transmitter mode.
   - The baud rate of the output device to which the SSR is connected may not be set to 9600. If it isn't, set the device's baud rate to 9600.
   - The device to which the SSR is connected is not turned on. Make sure the device is turned on and has adequate power.
2. **I observe a periodic loss of data of as much as 10 KB, even when the distance between the radios is only a few meters.**
   - Data reception can be interrupted by RF interference. Try switching to another frequency plan to alleviate the problem.
   - This may also occur when the SSR's data buffer is overflowing. This can happen when the size of the packets in conjunction with the 9600 baud input rate are filling the SSR's buffer faster than the link rate is clearing it. Try setting the radios to a higher link rate. If the SSRs are already set at the fastest link rate, try reducing the number of retries at the transmitter.
   - An SSR set as a receiver can become overloaded when its antenna is too close to the antenna of a transmitter or repeater. Try increasing the distance between the antennas.
3. **An SSR set as a receiver does not receive data, even when it is in line of sight with the transmitter.**
   - Configuration parameters such as link rate and frequency plan must be identical from radio to radio in order for communication to occur. The mode must also be set correctly. For example, an SSR set as a receiver in Broadcast mode will not be able to receive data from an SSR set as a transmitter in duplex mode even if the link rate and frequency plan are the same, nor can an SSR set as a receiver in group 2 receive data from a repeater in group 1. Make sure that the parameters have been set correctly. If you are reconfiguring the SSR often, it's a good practice to attach a label to it which lists the settings.

4. **Data reception is frequently interrupted.**
    - As mentioned above, data reception can be interrupted by RF interference. Try switching to another frequency plan.
    - Reception can be interrupted by obstacles blocking the line of sight between the SSRs. Operating the transmitter on high ground can help overcome obstructions to the line of sight.
    - Interruptions to reception will become more frequent as the distance between the reciever and transmitter increases. Try using one or more repeaters to reduce interruptions while extending communication range. As with the transmitter, it is best to locate repeaters on high ground.
5. **The application I am running is not transmitting or receiving data correctly.**
    - In a situation like this, try to get the application working with a hardwire connection. In the case of a differential GPS application, connect the port on the base unit which is outputting corrections directly to the port on the remote unit which is set to receive corrections and verify that the system is functioning normally. The SSR functions essentially as a null-modem connection. If the system works while using the hardwire connection but doesn't work once the SSRs are deployed, there may be a mismatch in serial port connections. Try using a null modem connector to enable communications between the SSRs and the input and output devices to which they are attached.

Data Banks

Table A.1. Data Banks for Standard Configurations

Bank	Start Freq MHz	Hopping Cycle	Freq Step KHz	Start Phase	Freq Change Rule	Sync	Protocol	EOT
1	902.05	50	50	0	0	Internal	EOT timeout, start time enable	10 ms
2	908.00	50	50	0	0	Internal	EOT timeout, start time enable	10 ms
3	915.00	50	50	0	0	Internal	EOT timeout, start time enable	10 ms
4	920.00	50	50	0	0	Internal	EOT timeout, start time enable	10 ms
5	925.00	50	50	0	0	Internal	EOT timeout, start time enable	10 ms
6	902.05	50	100	0	0	Internal	EOT timeout, start time enable	10 ms
7	908.00	50	100	0	0	Internal	EOT timeout, start time enable	10 ms
8	915.00	50	100	0	0	Internal	EOT timeout, start time enable	10 ms
9	920.00	50	100	0	0	Internal	EOT timeout, start time enable	10 ms
10	915.00	50	100	0	2	Internal	EOT timeout, start time enable	10 ms

Global Product Support

If you have any problems or require further assistance, the Customer Support team can be reached through the following media:

- telephone
- email
- Ashtech BBS system
- Internet

Please refer to the documentation before contacting Customer Support. Many common problems are identified within the documentation along with suggestions for solving them.

Ashtech customer support:

Sunnyvale, California, USA

800 Number: 1-800-229-2400

Local Voice Line: (408) 524-1680

FAX Line: (408) 524-1500

Email: support@ashtech.com

Ashtech Europe Ltd. Oxfordshire UK

TEL: 44 1 993 883 533

FAX: 44 1 993 883 977

Solutions for Common Problems

- Check cables and power supplies. Many hardware problems are related to these simple problems.
- If the problem seems to be with your computer, re-boot it to clear the system's RAM memory.
- If you are experiencing receiver problems, power cycle the receiver or try a different port.
- Verify that the batteries are charged.
- If a session does not download properly, exit and restart the download software and reconnect to the receiver at a lower baud rate.

If none of these suggestions solves the problem, contact the Customer Support team. To assist the Customer Support team, please have the following information available:

Table B.1: GPS Product Information

Information Category	Your Actual Numbers
Receiver model	
Receiver serial #	
Software version #	
Software key serial #	
Firmware version #	
Options*	
A clear, concise description of the problem.	
* The firmware version # and options can be obtained using the $PASHQ,RID (receiver identification) command.	

Corporate Web Page

You can obtain data sheets, GPS information, application notes, and a variety of useful information from Ashtech's Internet web page. In addition, you can access the BBS through the web site, and locate additional support areas such as frequently asked questions and training previews. The Internet address is:

http://www.ashtech.com

Training Courses

Ashtech provides a full range of GPS training courses for the novice and advanced user. Arrangements can be made for customized, on-site training to fit your specific needs.

Ashtech training courses:

- Conventional GPS Surveying
- Resolving Problem Data Sets
- Real-Time Z Applications
- Reliance for GPS/GIS

For detailed information, call or email Ashtech, or contact your local Ashtech dealer. The Ashtech www pages contains information on course dates, costs, and content.

Repair Centers

In addition to repair centers in California and England, authorized distributors in 27 countries can assist you with your service needs.

Ashtech Inc., Sunnyvale, California
Voice: (408) 524-1680
or (800) 229-2400
FAX: (408) 524-1500
Ashtech Europe Ltd. Oxfordshire UK
TEL: 44 1 993 883 533
FAX: 44 1 993 883 977

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