OPERATION AND MAINTENANCE MANUAL
FOR THE
RADIO FREQUENCY
REMOTE FIRING DEVICE (RFD)

Manufactured by:

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SUPPLEMENTAL TOOLS AND EQUIPMENT

This publication may reference specific supplemental tools and equipment. Engineering Technology, Inc. (ETI) does not intend to, nor does it have any obligation to, provide any tools or equipment to the users of this device and publication.

REPORTING ERRORS AND/OR RECOMMENDING IMPROVEMENTS

You can help to improve this manual. If you find any errors or if you would like to recommend an improvement, please let us know by submitting a Radio Frequency Remote Firing Device Malfunction Report. The Radio Frequency Remote Firing Device Malfunction Report form is contained in Appendix B of this manual.

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1.0 SAFETY PRECAUTIONS

WARNING

Do not use the Radio Frequency Remote Firing Device (RFD) if it is seriously deteriorated or damaged. A damaged RFD may function prematurely, causing serious bodily injury or death, or fail completely.

WARNING

Hazardous voltages exist inside the receiver unit. Do not strike, tamper with, or attempt to remove or investigate the contents. Tampering with this equipment may damage the RFD and can cause serious bodily injury or death.

WARNING

Always test-fire the receiver/transmitter combination up range, set on the channel to be used, prior to priming. **Separate receivers by not less than 2 feet when testing more than one receiver. Test with minimum of 6 feet separation between transmitter and receiver.** A general procedure for test-firing is provided in paragraph 3.3.1. Failure to confirm proper operation of the RFD may cause serious bodily injury or death.

WARNING

Hazardous, potentially fatal voltages exist on the metal binding posts when the RFD is fired. Contact with the posts may result in serious bodily injury or death. The binding posts are shunted and electronically isolated from the high voltage circuitry prior to firing, and again one second after firing.

CAUTION

Do not store batteries in the RFD when it is not in use. Long-term storage of batteries may damage the equipment.

CAUTION

Do not use lithium batteries with the RFD. Use only alkaline, 1.5-volt, AA batteries for operation of the RFD.

2.0 INTRODUCTION

2.1 Purpose

This manual provides users with basic information for effective use of the RFD.

2.2 Scope

This manual describes operation and maintenance procedures for the RFD. It sets forth the applicable safety requirements and safety precautions. Safety precautions include those applicable to (1) handling the RFD, (2) preparing the RFD for firing, and (3) interfacing the RFD with either shock tube or electric caps. This manual is intended to provide a broad and sound basic knowledge for operating and maintaining the RFD. It is not intended to establish or supercede existing local agency policies or procedures.

3.0 RFD DESCRIPTION

ETI developed the RFD to be a reusable device for remote initiation of shock tube and electric detonators, powered by commercially available batteries. The RFD is capable of remotely initiating either electric detonators or shock tube devices by radio from a safe distance. Each RFD set consists of one transmitter and multiple receivers. Both transmitter and receiver include a rotary switch to select one of five available channels. Receivers may all be set to fire on one channel, each on a different channel, or in any combination thereof. Under ideal line-of-sight conditions, functional ranges of 1,000 meters are possible.

This system is intended for use by qualified law enforcement agencies, military units, and professional demolition personnel. All personnel engaged, whether directly or indirectly, in the operation of the RFD should thoroughly review and understand this manual prior to using it.

3.1 Definition of Terms

The following terms are applicable to RFD operations.

Explosive Ordnance Disposal (EOD) - The detection, identification, field evaluation, rendering safe, recovering, evacuation, disposal, and reporting of explosive ordinance or improvised explosive devices that have been fired, dropped, launched, projected, or placed as to constitute a hazard to operations, installations, personnel, or material. EOD also includes the rendering safe and/or disposal of items that have become hazardous or unserviceable by damage or deterioration when the disposal of such items is beyond the capabilities of personnel normally assigned the responsibility for routine disposition.

Electric Cap - Caps which are electrically initiated, including both conventional electric blasting caps, and exploding bridgewire (EBW) caps.

3.2 RFD Controls and Indicators

This section describes the controls and indicators for both the RFD receiver and transmitter units. Procedures for operating the transmitter and receiver are separately described later in this chapter.

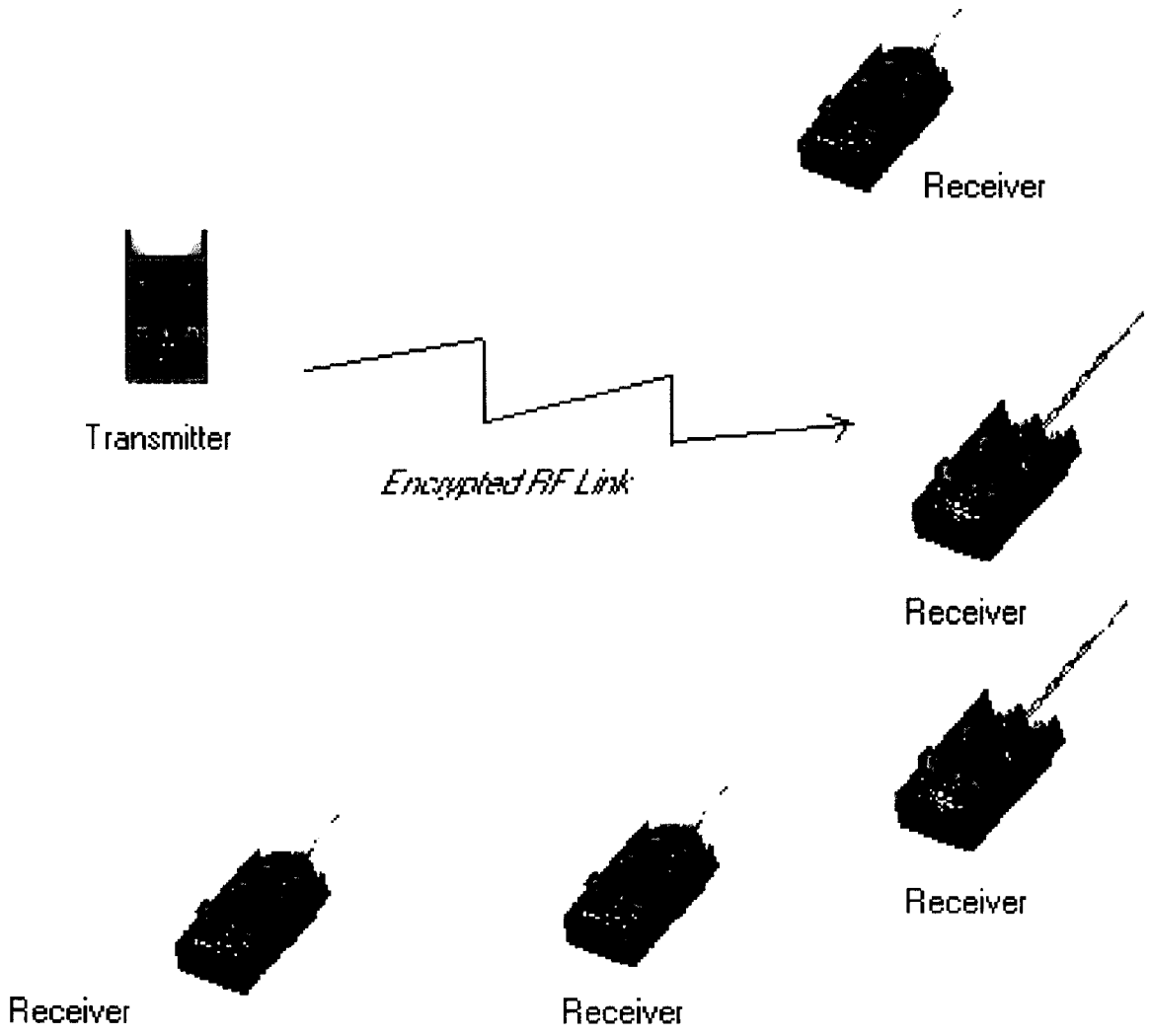


Figure 1. Radio Frequency Remote Firing Device transmitter and receivers.

3.2.1 Receiver Unit Controls and Indicators.

The receiver is shown below.

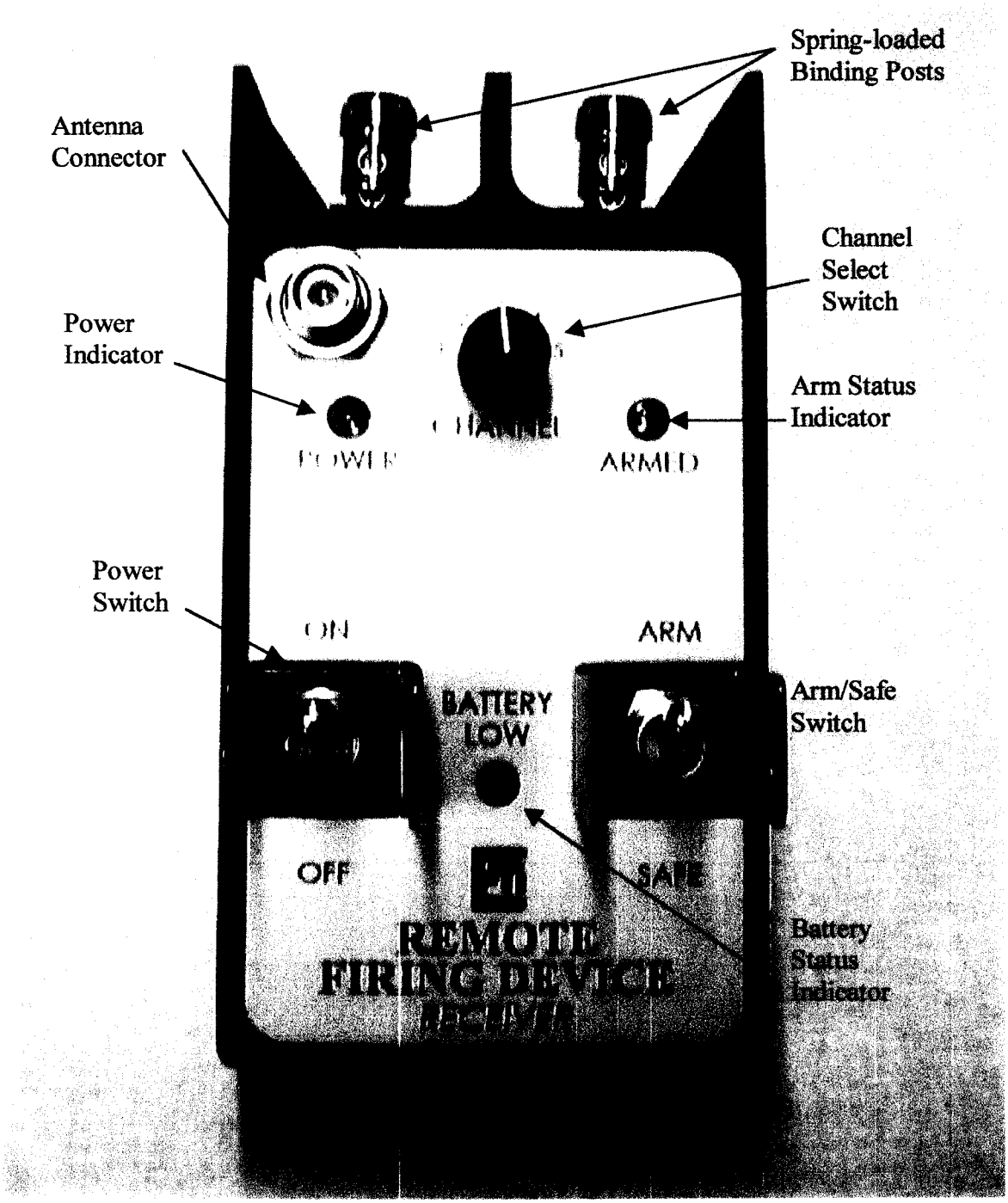


Figure 2. RFD receiver unit controls and indicators.

The receiver is clearly distinguishable from the transmitter by the bright yellow background on the receiver faceplate. The transmitter faceplate is red. Preprinted adhesive labels are provided with each kit to allow the user to assign each receiver with a numerical identifier. This is helpful in operations employing multiple receivers.

Each receiver has three control switches/knobs and three Light Emitting Diode (LED) status indicators. The switches on the receiver are:

1) POWER toggle switch. Applies power to the unit.
2) CHANNEL SELECT rotary switch. Selects one of five communication channels for the receiver. Available channels are 1-5.

NOTE

The unit reads the CHANNEL SELECT switch at the **beginning** of the safe separation period. Changing the setting of this switch after the ARM switch is engaged will not affect the channel setting.

3) ARM/SAFE toggle switch. Arms the unit.

The three status indicators are:

1) A red ARM STATUS LED
2) A green POWER ON LED
3) A yellow LOW BATTERY LED

The green POWER ON LED is lit whenever power is applied to the unit (i.e., the power switch is in the ON position).

The yellow BATTERY STATUS LED indicates the energy level of the batteries

The red ARM STATUS LED indicates the current armed state of the RFD receiver

Table 1 indicates possible combinations of the yellow BATTERY STATUS and red ARM STATUS LEDs.

Table 1. RFD Receiver BATTERY STATUS and ARM LED Status Indications.

ARM STATUS LED	BATTERY STATUS LED	CONDITION
OFF	ON	Batteries are very weak. Further operation is inhibited until the batteries are replaced.
OFF	FLASHING	Batteries should be replaced soon. Further operation is permitted.
FLASHING Short blink once every two seconds.	ANY	Arm switch has been placed in armed position. Receiver will start to generate and store firing energy in two minutes.
FLASHING Longer flash once every two seconds	ANY	Beginning two minutes after arm switch has been placed into ARM position. Unit has begun to generate and store firing energy.
ON	OFF or FLASHING	Beginning 5 minutes after receiver placed in ARM mode, unit is armed and awaiting a FIRE command.
FLASHING Four times per second.	ANY	Unit has received a valid FIRE command.
ON	ON	A fault condition has been detected. See section 3.7 for troubleshooting procedures.

NOTE

The RFD supplies its own energy. No external input power is required.

NOTE

A flashing BATTERY STATUS LED indicates at least one hour of operation is guaranteed, but batteries should be replaced immediately if practical. A fresh set of batteries provides up to six hours of receiver operation.

NOTE

After the ARM/SAFE switch is placed in the ARM position, the red ARM STATUS LED will blink once every two seconds for the first two minutes of the 5 minute safe wait period. During this initial two minutes the receiver is in standby and not generating and storing any firing energy to the firing circuit. After the initial 2 minutes of the 5 minute safe wait the LED will flash for a longer duration as the receiver begins to store firing energy to the firing capacitor until the full 300 volts of firing energy is stored. At this point the receiver will maintain the firing energy until the safe separation time of five minutes has expired. After that, the ARM STATUS LED will remain ON.

NOTE

The red ARM STATUS LED will blink four times per second once a valid FIRE command has been received. The LED will continue to blink at this rate until power is lost or the receiver turned off.

Two spring-loaded binding posts are located at the top of the receiver. The binding posts are designed to connect to either electric caps, or to the STInger shock-tube adapter included with each receiver.

To use shock tube, the STInger shock tube adapter (see figure 3) must be attached to the receiver. The STInger is attached to the receiver's binding posts by pressing the spring clips on the rear of the STInger onto the binding posts. No screws are required. Figure 4 is a receiver unit with STInger attached.

If shock tube to be employed the following procedure should be followed to connect the shock tube to the STInger adapter.

a. Trim ends of shock tube.
b. Loosen the plastic knob (turn counter-clockwise).
c. Insert cut length of shock tube through the hole in the plastic knob until fully seated.
d. Tighten the plastic knob (turn clockwise). Tug on tubing to insure that the attachment is secure.
e. Once the unit has fired, loosen plastic nut and remove fired tubing.

NOTE

The white shock tube compression nut shown in figure 3 accepts shock tube that is nominally 0.120 inches in diameter (with a maximum diameter of 0.128 inches). Larger diameter shock tube (0.150 nominally) used by some military agencies will not interface with the STInger with the standard white compression fitting. ETI has a green colored compression fitting suited to this larger diameter shock tube which has been included in your kit.

CAUTION

The retaining nut should be finger-tightened only. Over-tightening the retaining nut may damage the unit.

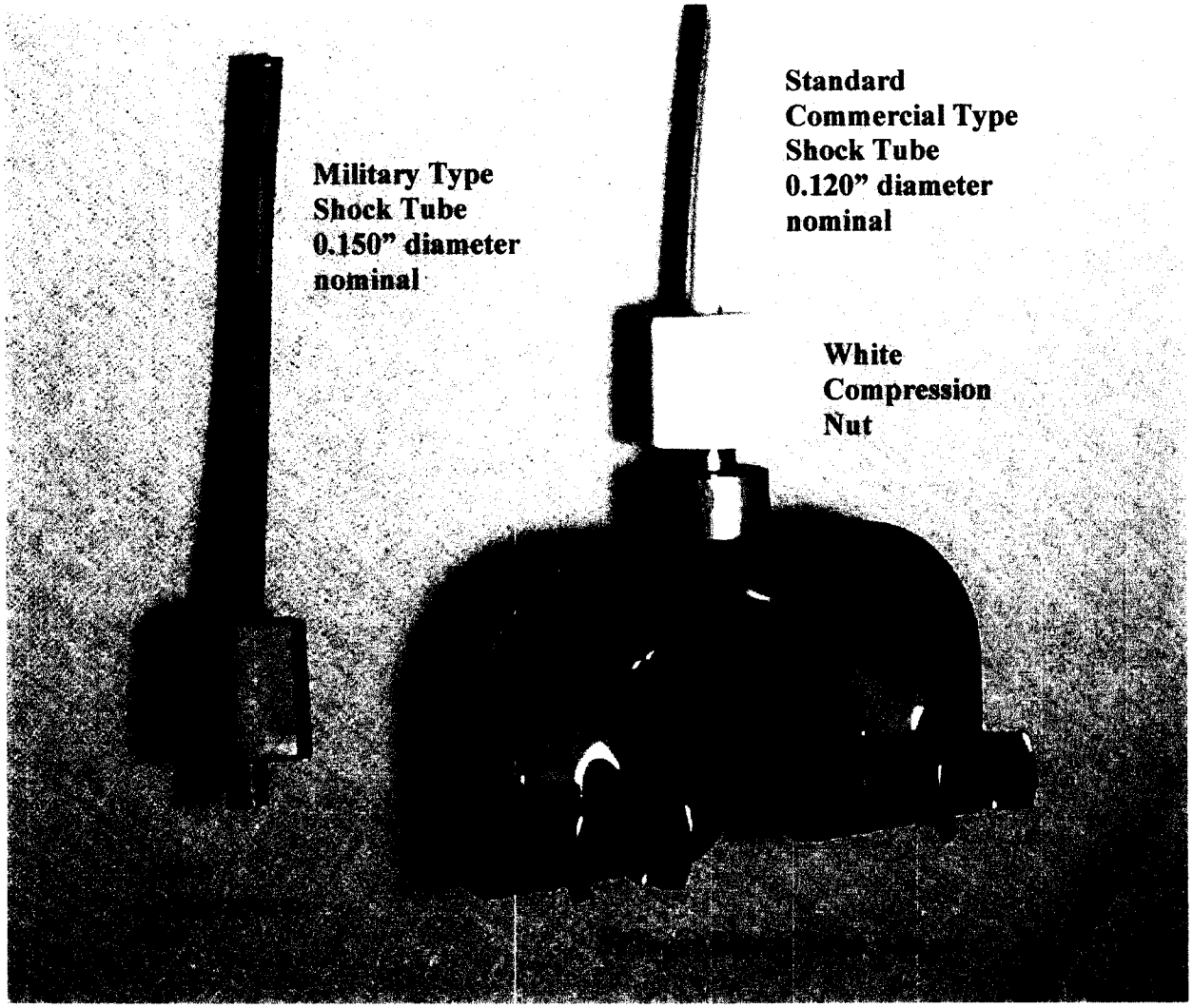


Figure 3. STInger shock tube adapter with plastic tubing fitting retaining nut.

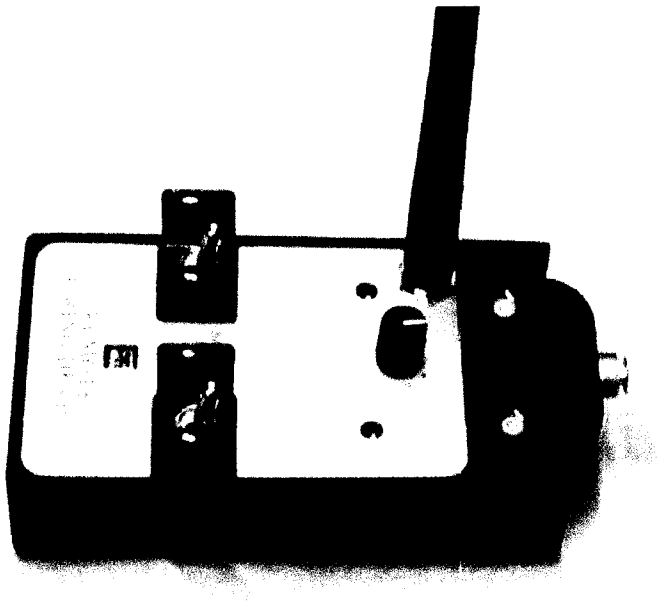


Figure 4. RFD receiver configured with STInger shock tube adapter.

The receiver unit may also be used with electric caps (see figure 5). The contact wires should be attached directly to the spring-loaded binding posts. Attach one contact wire to each spring-loaded binding post, as follows:

1. Press down on the spring-loaded binding posts to open the wire connection.
2. Insert the wire into the opening and release to clamp the wire. Approximately ½ - inch of insulation should be removed from the end of the wire prior to making the connection to the spring-loaded binding posts.

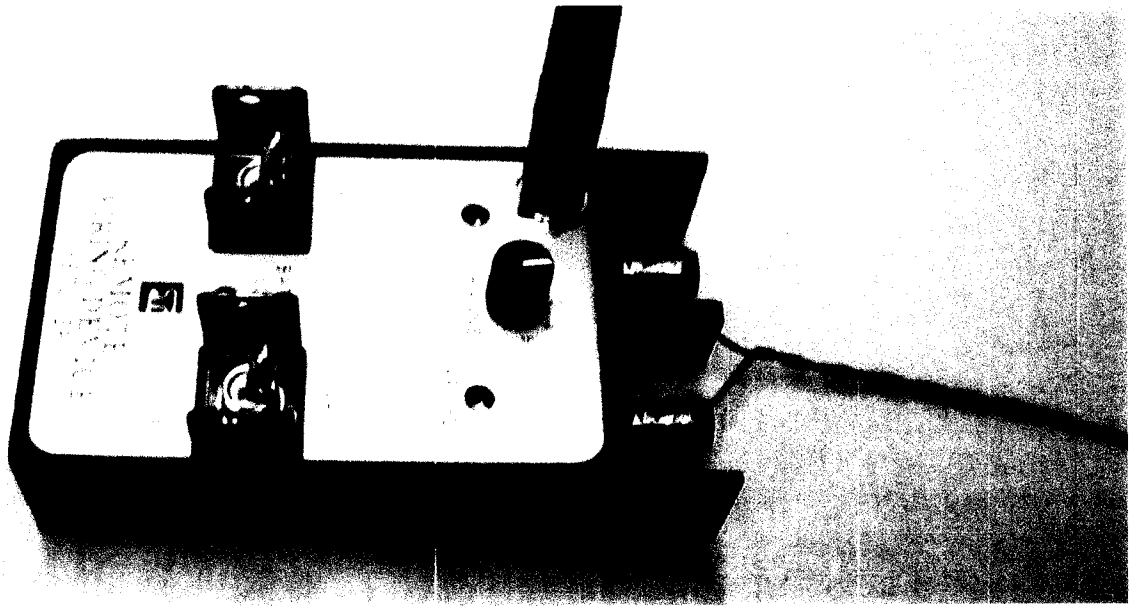


Figure 5. RFD receiver configured for use with electric caps.

3.2.2 Transmitter Unit Controls and Indicators

Figure 6. RFD transmitter unit controls and indicators.

The transmitter (red faceplate) has four control switches and three LED status indicators. The switches are:

1) POWER toggle switch. Applies power to the unit
2) CHANNEL SELECT rotary switch. Selects the communication channel for the transmitter. Channels 1-5 are available.
3) ARM key switch. Allows FIRE commands to be sent. The key should be removed as a safety measure while the receivers are being placed. The arm key is locked into the key switch when in the ARM position. Key may only be removed when switched to the SAFE position.
4) FIRE toggle switch. Sends FIRE commands to the receivers.

The three status indicators are:

1) A red ARM STATUS LED.
2) A green POWER ON LED.
3) A yellow BATTERY STATUS LED.

The green POWER ON LED is lit any time power is applied to the unit (i.e., the power switch is in the ON position).

The yellow BATTERY STATUS LED indicates the energy level of the batteries.

The red ARM STATUS LED indicates the current armed state of the RFD transmitter.

Table 2 indicates possible combinations of the yellow BATTERY STATUS and red ARM STATUS LEDs.

Table 2. RFD Transmitter ARM STATUS LED and BATTERY STATUS LED Indications.

ARM STATUS LED	BATTERY STATUS LED	CONDITION
OFF	ON	Batteries are very weak. Further operation is inhibited until the batteries are replaced.
OFF	FLASHING	Batteries should be replaced soon. Further operation is permitted.
FLASHING	ANY	Unit is transmitting a FIRE command.
ON	OFF or FLASHING	Unit is armed and ready to transmit a FIRE command.
ON	ON	A fault condition has been detected. See section 3.7 for troubleshooting procedures.

3.3 Method of Operation

A test firing should always be performed up range before an actual initiation. A typical test firing sequence is provided below. Live firing procedures are provided in paragraph 3.3.2.

3.3.1 Test Fire Procedures

Test fire procedures are generally specified by local agency policy and should always be completed before live firing the RFD. In the absence of local test firing procedures, use the following general procedure.

1. Remove transmitter and receivers from their containers and inspect for damage.
2. Insert batteries in transmitters and receivers.
3. Install antennas on transmitters and receivers.
4. Install STInger shock tube adapters on all receivers.
5. Set each receiver on a different channel.
6. Power each unit ON and ensure the battery light is not illuminated. If the battery light is illuminated, replace the batteries.
7. Set each receiver ARM/SAFE key switch to ARM. The key is locked into the key switch when in the ARM position.
8. Place each receiver in the order of channel selection (1 through 5), with each receiver antenna oriented vertically. Each unit should be no closer than 2 feet from any adjacent receiver and not less than 6 feet from the transmitter.
9. Wait until all receiver units ARM lights display solid red, indicating units are ready to fire.
10. Remove locking pins from transmitter unit and set transmitter to ARM. Move at least 6 feet away from the receiver(s).
11. Fire each receiver in channel selection order (one through five) and observe to ensure each STInger fires.

WARNING

In the event of a misfire, during test firing, do not use the failed receiver with live explosives. Follow troubleshooting procedures in paragraph 3.7 to determine the cause of the misfire.

3.3.2 Live Fire Procedures

1. Perform a site survey to determine positioning of the transmitter, receiver, detonator, and explosives.

2. Test fire the RFD according to local agency procedures. Do not use the RFD with live explosives until a test fire is successfully completed.

WARNING

The RFD should always be test fired up range, following local agency procedures, before using live explosives. An RFD which has not been test fired may malfunction, resulting in serious bodily injury or death. A typical test firing procedure is provided in paragraph 3.3.1.

3. Secure detonator by placing it in the ground or covering with sandbags. Ensure the detonator or tool is not in contact with explosive materials.

CAUTION

Protect the RFD from potential blast damage by distance, shielding, and cover. Units not adequately protected from blast may malfunction or fail completely.

4. At the receiver unit:

Step 1: Ensure the power switch is turned OFF.
Step 2: Attach the device (shock tube or electric caps) to be initiated.
Step 3: Turn POWER switch to ON.
Step 4: Set the CHANNEL SELECT switch to the desired channel ID.
Step 5: When ready to fire, the receiver arming sequence may be started by placing the ARM/SAFE switch in the ARM position. The time should be recorded and a stopwatch started at this point, since the transmitter gives no indication of when the safe separation period is over.

Upon completion of step 5, the ARM STATUS LED will begin flashing and will continue to do so for five minutes. The flashing state is an indication that the unit is operating in the five-minute safe separation period. During this time, commands received over the radio link are ignored. At the completion of the safe separation period, the ARM STATUS LED goes to a steady ON state. Should a validated fire command be received from the transmitter, the unit fires, and the ARM STATUS LED flashes approximately four times per second. All indicators remain in this state until power is cycled (turned off, then back on) on the receiver.

At any time before firing, the ARM/SAFE switch may be placed into the SAFE position to immediately return the receiver unit to the SAFE condition. Restoring the switch to the ARM position starts a new five-minute safe separation period.

NOTE

If there is any possibility of the ARM or POWER switches being displaced prior to the firing of the receiver, (for example, due to vibrations from nearby detonations), the switches may be locked in the ON and ARM positions by inserting the supplied locking pins through the holes in the switch guards.

5. Prime the explosive charge.

WARNING

Do not touch the RFD receiver after the explosive charge has been primed.

NOTE

The RFD should not be relied on to function properly if left in an armed state for more than six hours.

6. At the transmitter unit:

Step 1: Ensure the power switch is turned OFF and the ARM/SAFE switch key is removed.
Step 2: Ensure all personnel are at a safe distance from the detonation area.
Step 3: Turn the POWER switch to ON.
Step 4: Set the rotary switch to the desired Channel ID.
Step 5: Insert the key into the ARM/SAFE switch.
Step 6: Place ARM/SAFE switch in the ARM position. The ARM STATUS LED will light.

7. When ready to fire:

Step 7: Remove the locking pin from the FIRE switch guard.
Step 8: To fire, momentarily push the FIRE switch to the FIRE position and hold, then release. The ARM STATUS LED will briefly flash during transmission of the FIRE command.

After step 8 has been completed, the rotary switch may be turned to a different channel and the FIRE switch pushed to fire any receiver(s) located on that channel. Channels may be re-selected only between FIRE commands. Wait for the ARM LED to stop flashing before pushing the FIRE switch again.

WARNING

In the event of a misfire, safe procedures must be followed. See paragraph 3.5 for misfire safe procedures.

3.4 Line-of-Sight/Radio Considerations

The RFD transmitter and receiver have been tested to operate at a separation distance of up to 1000 meters. Significantly longer distances may be possible under ideal conditions. This assumes a clear line-of-sight between transmitter and receiver, i.e., in a flat area, and with no obstructions between the two. One thousand meters may not be attainable in urban environments due to the presence of obstructions (such as RF-absorbing/reflecting walls and other surfaces) and extensive interference from RF emitting devices such as cellular telephones. There should also be a minimum of 6 feet separation between the transmitter and receiver, a distance of several wavelengths at to transmitter frequency. The RFD may not function reliably at distances of less than 6 feet.

NOTE

At distances of greater than 1000 meters, it may be necessary to elevate the receiver from the ground slightly to ensure good reception. Elevation of as little as one foot above the ground can often provide greater reliability at these longer distances.

NOTE

For maximum range, antennae for both transmitter and receiver should be vertically oriented (facing up).

3.5 Safe Procedures in the Event of Misfire

Procedures for handling a misfire are generally specified by agency policy and should be followed. General procedures in the event of a misfire are as follows:

Step 1: On the transmitter, turn the ARM/SAFE key switch to the SAFE position and turn the transmitter POWER switch OFF.

Step 2: Maintain a safe distance from the receiver for at least 30 minutes after the misfire.

Step 3: After 30 minutes have elapsed since the misfire, approach the detonator. Do not touch the RFD.

Step 4: Remove any sandbags or soil covering the detonator and detach the detonator from the main charge.

Step 5: Remove the electric detonator wires or shock tube from the RFD.

Step 6: The RFD may now be safely handled. Note the status of the ARM and POWER lights before powering the receiver OFF.

Step 7: Follow troubleshooting procedures in paragraph 3.7 to determine the cause of the misfire.

Step 8: If the cause of the misfire can be determined, correct the problem, then perform a test fire following the procedures in paragraph 3.3.1 If the cause of the misfire cannot be determined, use a different RFD, perform a test fire following the procedures in paragraph 3.3.1, replace the detonator or shock tube, and repeat the firing procedure in paragraph 3.2.2.

NOTE

Appendix B is a Malfunction Report Form. Please use this form to report malfunctions of the RFD to ETI.

3.6 Power

The RFD is powered by three internal alkaline, 1.5-volt, AA batteries. No external power supply is required. See paragraph 4.1 for battery replacement procedures.

3.7 Troubleshooting

Q: The indicator lights remain dark when the unit is powered up.

A: Check the batteries for correct orientation and try again. If this does not help, try replacing the batteries.

Q: The POWER, ARM/SAFE and BATTERY STATUS indicators all light and remain lit.

A: This indicates an internal failure has been discovered by the unit. Try cycling power. If this condition continues to occur, the unit should be replaced.

Q: A FIRE command was sent by the transmitter to the receiver and no detonation occurred.

A: Follow misfire safe procedures (see section 3.5). Before powering down the receiver, observe the state of the ARM STATUS indicator.

If the indicator is not flashing rapidly, check the CHANNEL SELECT switch to ensure the receiver and transmitter are both set to the same communication channel. Verify the antenna is securely attached to both transmitter and receiver. Also verify a clear line-of-sight is available for communication between the transmitter and receiver.

A rapidly flashing ARM STATUS indicator indicates communication between transmitter and receiver was successful, but something prevented energy from being supplied to the detonator. Check for good electrical contact being made between the binding posts and the device being initiated, whether through electric cap wires or the STInger. Check the batteries.

4.0 MAINTENANCE

WARNING

Hazardous voltages exist inside the receiver unit. Do not strike, tamper with, or attempt to remove or investigate the contents. Tampering with this equipment may damage the unit and can cause serious bodily injury or death. There are no user-serviceable parts in the unit.

4.1 Battery Replacement

NOTE

A flathead tool, such as a flathead screwdriver or a coin, is useful for replacing the batteries.

For maximum longevity, replace the batteries with each use. Three alkaline, 1.5-volt, AA batteries are required for each transmitter and receiver. The RFD is designed to allow battery replacement with minimal tools (e.g., a flat-head screwdriver, a dime, or even a fingernail).

Before replacing the batteries, turn the ARM/SAFE key switch to the SAFE position and turn the POWER switch to the OFF position. Leave power off for at least five minutes.

a. Turn the battery cover screw with a screwdriver or coin counterclockwise, as shown in figure 7 and figure 8. The screw is captured in the cover.

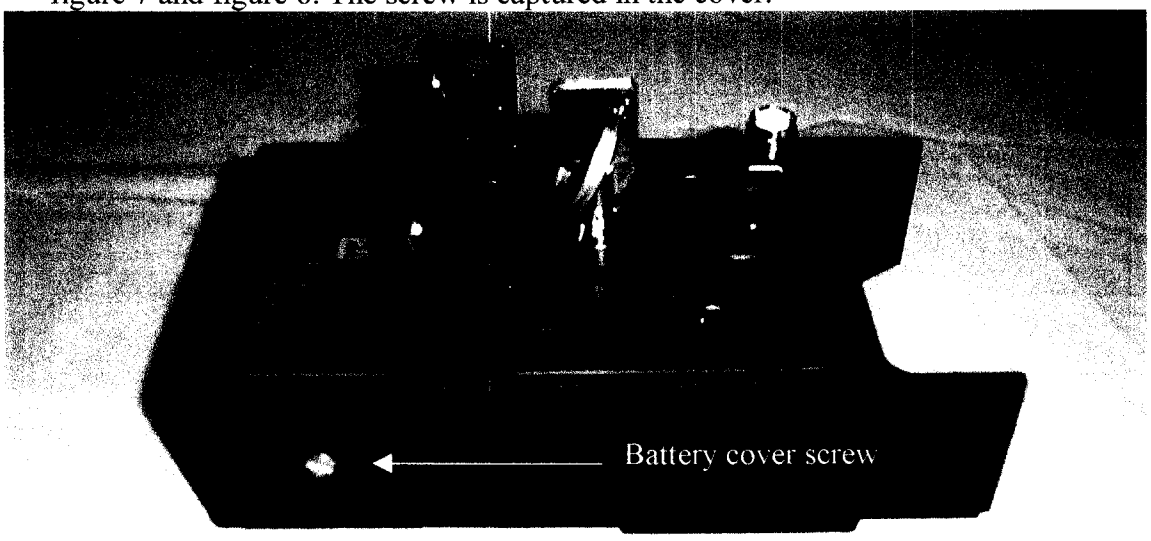


Figure 7. Battery cover screw removal

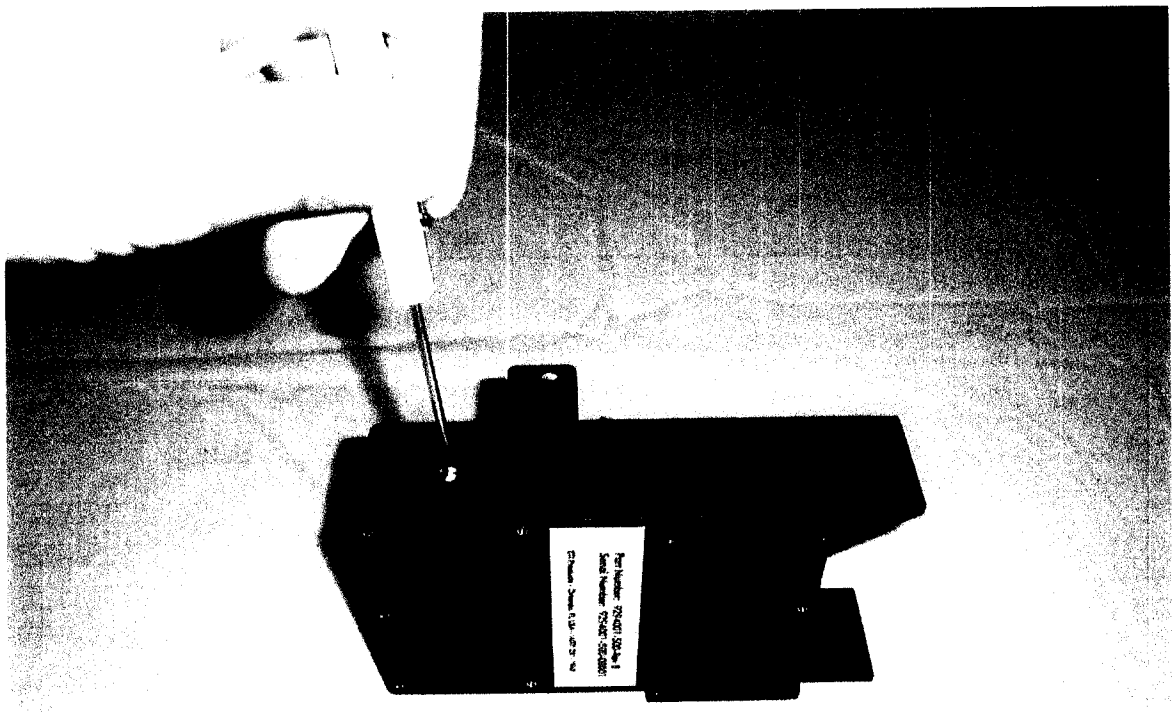


Figure 8. Battery compartment cover removal.

b. Remove the cover and replace the old batteries with new ones. Check battery orientation (see figures 9 and 10) before insertion. The battery compartment is keyed so inserting the batteries improperly will not damage the unit.
c. Re-install the battery cover.
d. Hand-tighten the securing screw.

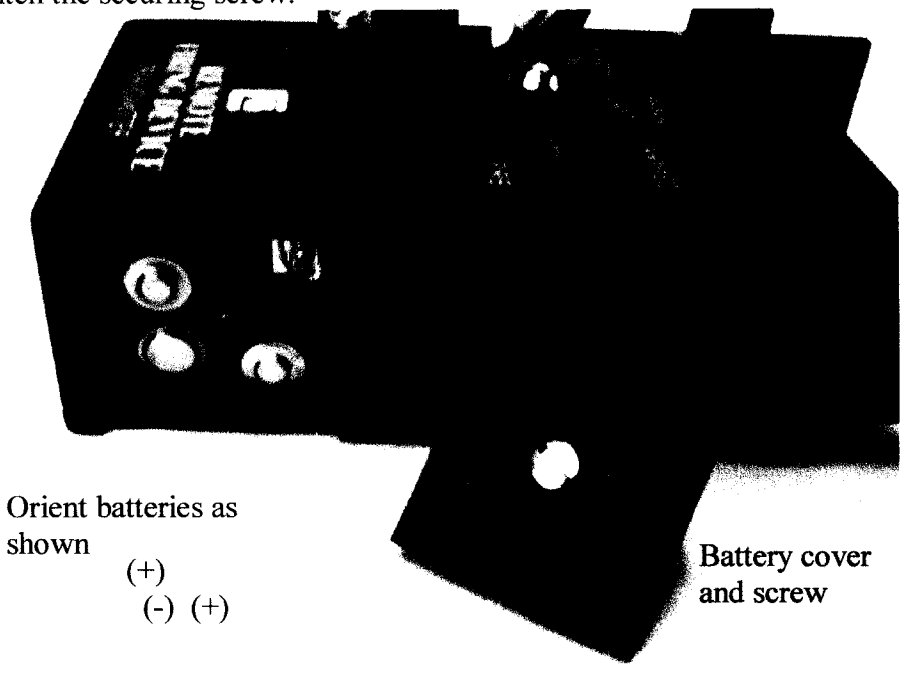


Figure 9. Battery orientation.

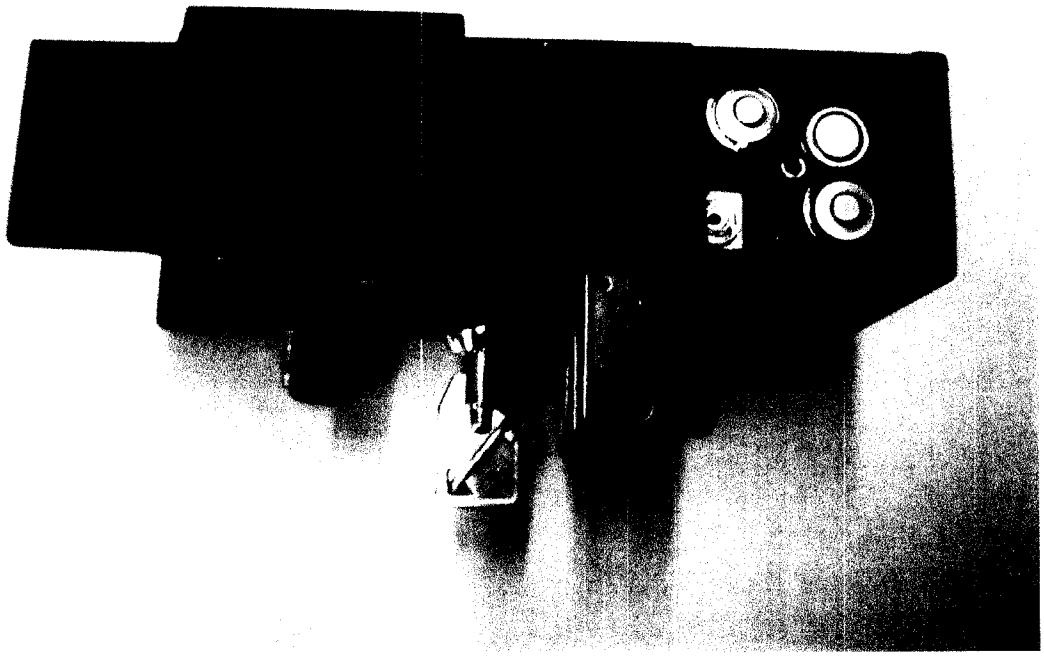


Figure 10. RFD with battery compartment cover removed.

CAUTION

Do not over-tighten screw. Over-tightening screw may strip screw threads or damage the RFD.

4.2 Re-carbonizing STInger Spark Ignitor

The spark ignitor in the STInger relies on carbon residue to bridge to high voltage contacts providing a conductive path from which the spark is generated. The spark ignitors in the STInger were treated initially to apply this conductive carbon trace. Under normal conditions this carbon trace is regenerated each time the module is functioned. In some instances, the carbon deposition may fail to provide the conductive path necessary for spark generation. This condition may be promoted from long periods of disuse or operation in high humidity or exposure to moisture. The conductive carbon bridge may be easily re-established. As shown in figure 11, remove the shock tube compression nut from the module and set it aside. Insert a pencil lead into the bottom of the shock tube receptacle and apply a fresh coating of graphite. For best results use pencil leads for lead holders used in drafting and graphic arts. An initial supply of these leads have been provided with your kit.

Figure 11. Spark igniter re-carbonizing procedure.

4.3 Cleaning

Keep the RFD free from dirt, dust, and debris. Use a mild soap, such as dishwashing detergent, and a dampened rag for topical cleaning. The RFD is designed to be water-resistant, but should never be immersed in water.

CAUTION

Do not use any solvents, harsh cleaning agents, or cutting fluids on the RFD. Use of these agents/fluids may damage the unit.

4.4 Kit Serialization and Module Replacement

Each module in a RFD Kit is assigned a unique serial number. This serial number as well as the identity of your agency is included in the digital, encrypted fire command that is sent from the transmitter to the receiver. A transmitter is capable of initiating receiver units only from it's kit. No receiver will accept a fire command from any transmitter other than the transmitter programmed for it's kit. Although any number of receivers are available in a single kit, ETI will not provide more than one transmitter per kit.

The transmitter and receiver serial numbers are printed on the label on the back of each module. The format of the serial number is;

Transmitter;	T	0001	–	01	– R00
Receiver #1:	R	0001	–	01	– R00
Receiver #2:	R	0001	–	02	– R00
	Module Type (Tx or Rx)	Kit No.		Serial No.	Revision No.

NOTE

If your agency has purchased more than one RFD Kit, you will need to keep the modules together by kit number. Avoid mixing transmitters and receivers from different kits.

Additional receivers or replacements may be ordered from ETI and programmed to accept the firing code from the pre-existing kit. Please specify your user agency and the kit number with your order. In the event your transmitter is damaged or lost, you may order a replacement transmitter as well. When ordering a replacement transmitter for an existing kit you will need to return all of the receiver modules. The receiver modules will be reprogrammed to accept the new firing code to match the replacement transmitter. This is done as a precaution to insure that no two transmitters will be able to initiate the same set of receivers.

APPENDIX A

RADIO FREQUENCY REMOTE FIRING DEVICE UNIT USAGE AND TEST LOG

SERIAL NUMBER	DATE	INITIALS	COMMENTS

APPENDIX B

RADIO FREQUENCY REMOTE FIRING DEVICE MALFUNCTION REPORT

Date: _____

Originator Name: _____

Address: _____

Phone Number: _____ Fax Number: _____

Malfunction Priority: (Circle the correct priority)

1. Jeopardizes safety, prevents mission accomplishment.
2. Adversely affects mission accomplishment.
3. Affects mission, but a work-around solution exists.
4. User/operator inconvenience or annoyance.
5. Documentation.
6. Other. Please use the space provided below or additional sheets to describe in detail.

Is the malfunction repeatable?

Always_____ Occasionally_____ Random_____ Once_____

Describe malfunction and itemize the steps leading to the error. Include all switch positions and LED states.

_____

_____

_____

_____

_____

APPENDIX C

RADIO FREQUENCY REMOTE FIRING DEVICE EVALUATION QUESTIONNAIRE

These evaluation sheets are provided to give users an opportunity to provide Engineering Technology, Inc., with feedback on the Radio Frequency Remote Firing Device unit. Your input is appreciated. This questionnaire should be completed and returned as soon as possible.

Instructions:

1. Complete the information section for Name, Organization, Address, etc.

2. Rate each item on a scale from one to five in the score column on the Radio Frequency Remote Firing Device Overall Evaluation form.

3. Answer each question carefully and thoughtfully.

4. Please use the last sheet of the form and additional pages, if required, to discuss features, observations, or suggestions not addressed in the questionnaire.

5. Return completed forms to:

   Engineering Technology, Inc.
   3275 Progress Drive, Suite D
   Orlando, FL 32826
   Phone: 407-281-1948
   FAX: 407-275-1630

Please enter your:

NAME _____ DATE _____

ORGANIZATION _____

ADDRESS _____

_____

TELEPHONE _____

RADIO FREQUENCY REMOTE FIRING DEVICE OVERALL EVALUATION

Scale:1 (unsatisfactory), 2 (poor), 3 (fair), 4 (good), 5 (excellent)

#	Performance Area	Score (1-5)
1	Durability	
2	Labeling	
3	Size	
4	Weight	
5	Status Indicator (LED)	
6	Switch Placement	
7	Maintainability (Batteries)	
8	Ease of Use	
10	Manuals and Troubleshooting	
11	Overall Performance	

Please answer the following questions about the Radio Frequency Remote Firing Device (RFD):

1. What did you like about the RFD? _____

_____

_____

2. What did you dislike about the RFD? _____

_____

_____

3. Does the Operations and Maintenance Manual sufficiently explain the use of the RFD?

_____

_____

_____

4. How would you improve the next generation of the RFD? _____

_____

_____

4. Does the RFD, as is, meet all your training and operational needs? If NO, please explain.

_____

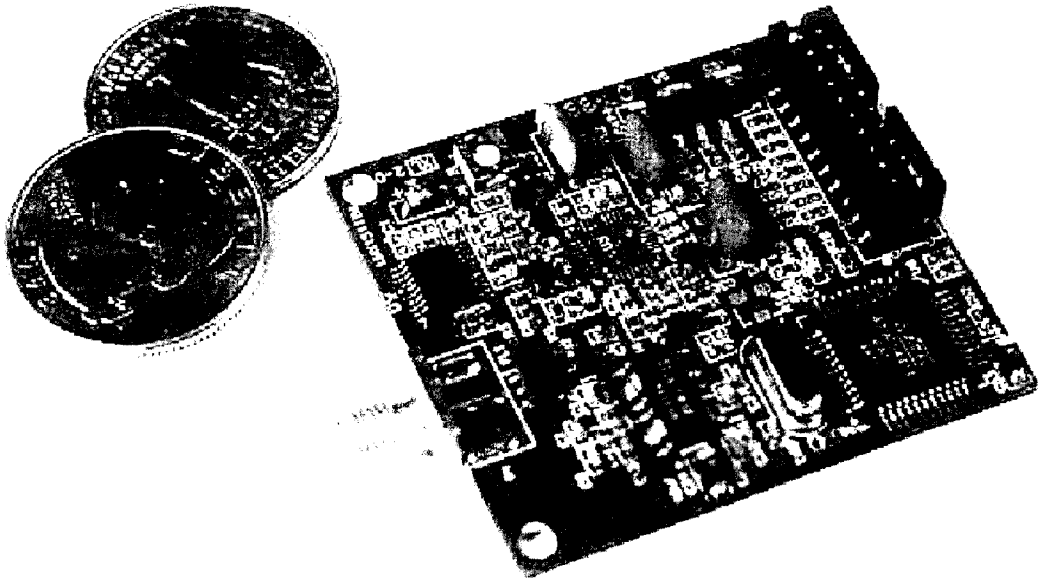
_____

_____

6. Additional Comments _____

World Wireless Communications, Inc.™

Envision The Future



WWC 900 SS MICROHOPPER DATA RADIO™ USER'S GUIDE

Document 090-0010 Rev 03

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REVISIONS AND CORRECTIONS

Document	Revision	Changes
090-0010	Rev. 00	Initial Release
090-0010	Rev. 01	Updated pass thru, power levels, misc.
090-0010	Rev. 02	Pg 10 limits, Pg. 28 group code.
090-0010	Rev. 03	Updated and moved table of contents to page i. Corrected formatting to entire document. Corrections to Pages i, iii, 2, 9,12,13, 16, 18, 19, 29, 30, 34, 36, 39

FIRMWARE APPLICATIONS

Name	Revision	Notes
MicroHopper	V1.0.9	For Hardware Revision G

World Wireless Communication's products are intended for use in normal commercial applications. Applications requiring extended temperature range or unusual environmental requirements such as military, medical life-support or life-sustaining equipment, are specifically not recommended without additional testing for such application.

TABLE OF CONTENTS

FCC Compliance Warning

Changes or modifications to the 900 SS MicroHopper Data Radio not expressly approved by World Wireless Communications could void the user's authority to operate this product.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: If this radio is integrated into another product, the system integrator is responsible for complying with the external labeling requirements as directed in the FCC Rules and Regulations Part 15.19. The system integrator may only use antennas that have been tested and approved with this radio to maintain the FCC approval. If a system integrator uses a non-approved antenna they are responsible for obtaining their own FCC certification.

ANTENNA WARNING

In order to comply with FCC Section 15.203 the 900 SS MicroHopper radio was tested with and can only be installed with the types of antennas listed below.

WWC P/N	Description
900-200384	1/2 Wave Flexible Whip, SMA connector, Reverse Polarity
900-200385	1/4 Wave Flexible Whip, SMA connector, Reverse Polarity
900-200386	1/2 Wave Flexible Whip, Right Angle, Reverse Polarity
900-0039	5dB Gain Omni directional, N male connector
900-0040	6dB Gain Yagi, N female connector

LABELING REQUIREMENTS WARNING

The original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the World Wireless Communications FCC identifier for this product as well as the FCC label below.

ID's for US and Canadian Operations are:
FCC ID: NQE-900 Uhopper
CE: 33981021583A
This device complies with Part 15 of the FCC rules. Operation is subject to the following conditions:

(1) This device may cause harmful interference
(2) This device must accept any interference received including interference that may cause undesired operation.

RF EXPOSURE WARNING

In order to comply with the FCC RF exposure requirements the Data Radio must be installed with the approved antenna listed and a minimum separation of 20 cm must be maintained from the antenna to the user.

Introduction

The World Wireless **900 SS MicroHopper** is a frequency hopping data transceiver radio designed for integration with other products. The 900 SS MicroHopper is connected to a host device using a 20-pin dual in-line header. This connection provides the radio with the required DC power source and allows the 900 SS MicroHopper to be programmed, configured, and provides I/O lines for a TTL level RS-232 port.

The 900 SS MicroHopper operates within the 900 MHz ISM Band and operates under Part 15 or the FCC Rules and Regulations. Because it is made for integration with other products the 900 SS MicroHopper is designed for professional installation.

The 900 SS MicroHopper allows OEMs to integrate the radio into their own systems. When installed using a World Wireless Communications approved antenna, the system integrator needs to make sure the 900 SS MicroHopper's FCC label, or a copy of that FCC label, is clearly visible on the outside of the integrated product.

Worldwide Wireless 900 SS MicroHopper Features

Using Spread Spectrum (SS) technology means the 900 SS MicroHopper is highly secure and is resistant to noise and interference

To increase the security of the radio signal, World Wireless Communications developed Secure-Sync ™ technology. This proprietary coding feature adds security, throughput efficiency, and error detection. Secure-Sync provides faster effective communication speeds while enhancing the 900 SS MicroHopper's reliability.

Features for the World Wireless 900 SS MicroHopper include:

- Frequency Hopping Spread Spectrum Transceiver
- World Wireless Secure-Sync ™ Technology
- Selectable transmission power, 100 milliwatts max.
- 19.2 Kbps RF data rate
- 500 Meters effective range*
- Cost-efficient
- Easy-to-use Windows-based configuration software

*Range calculations are line of sight. Actual range will vary based on specific
board integration, antenna selection, environment, and the OEM's device.

The 900 SS MicroHopper can be used for many applications. Some examples are:

- Short/Long Distance Telemetry
- Supervisory Control and Data Acquisition (SCADA)
- Security and Access Control
- Environmental Monitoring and Control
- Production and Flow Tracking

Installation

The World Wireless 900 SS MicroHopper is configured before it is shipped. In most cases no configuration is necessary and the radios should work immediately when they are installed. Should the factory configuration need to be altered, the Radio Support Utility software allows you to configure the radio for your specific application. See the "Configuring the Radio" section for information on using the support utility.

Site Requirements

You should carefully plan for radio sites that ensure that strong and stable signals are received and transmitted. A good site provides the radio with the following:

- Protection from direct weather exposure
- A power source
- Antenna location that is unobstructed

Transmission Path

The 900 SS MicroHopper operates in the 900 MHz (902-928) ISM frequency band. While this band offers many advantages for data transmission, radio signals travel primarily by line-of-sight. Signal loss due to obstructions such as terrain, foliage, buildings and other things that block the transmission path are possible. A line-of-sight transmission path between the host radio and the remote sites provides the most reliable signaling link.

Signal Distances

The importance of a clear transmission path relates closely to the distance to be covered by the radios. If the radios only cover a limited area, for example within 500 meters, some obstructions in the transmission path can be tolerated with minimal impact. For maximum range radio systems, any substantial obstruction in the transmission path will severely deteriorate or even block completely the radio signals.

Testing Using RSSI

An RSSI (Received Signal Strength Indicator) feature of the 900 SS MicroHopper can help you test the signal strength and background noise when determining site location (see "RSSI Tab" in the Configuring the Radio section for additional information on the RSSI feature).

Configuring the Radio

Use the Radio Support Utility to configure your 900 SS MicroHopper radio. Once the settings are configured and stored in the radio, those settings will remain the same, even when the radio is powered off.

Note: Configuration settings are saved in non-volatile memory on the 900 SS MicroHopper radio. That means configuration settings are always saved, even if the power to the radio is turned off.

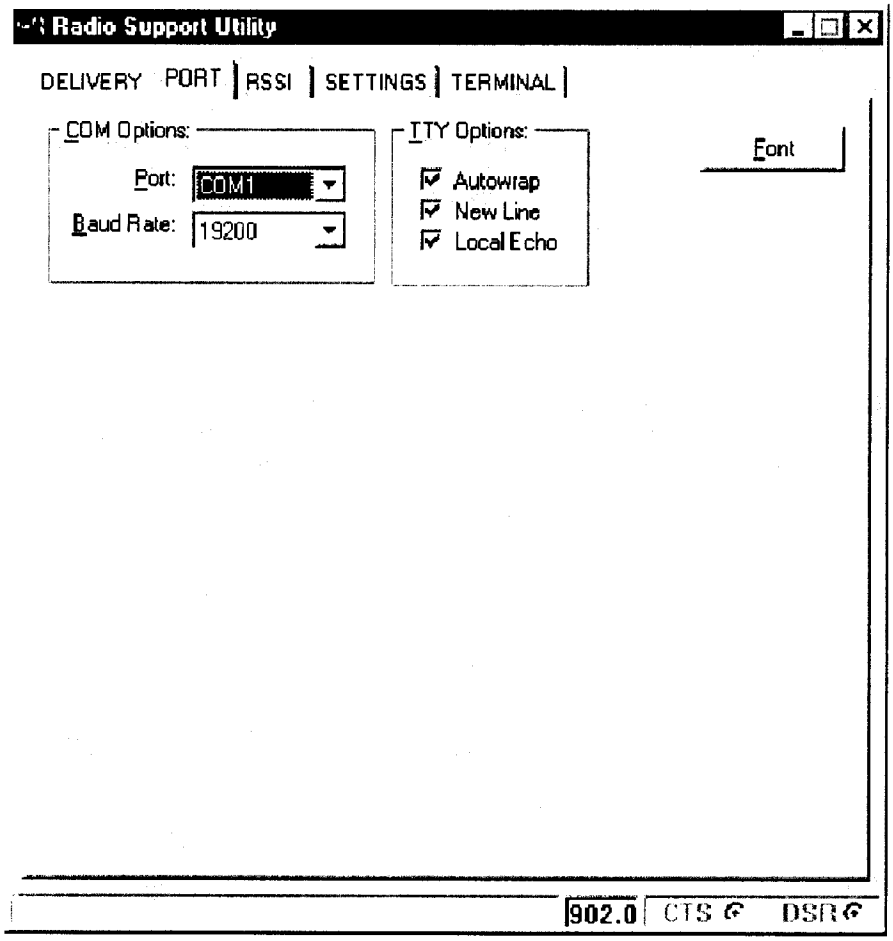
If you are using the radio in a field device such as PLC, RTU, Data Logger, etc., and need to change the configuration settings, those changes can be done using the Radio Support Utility on a PC. Once the radio has been reconfigured attach it to the field device.

The Radio Support Utility uses tabs to organize the MicroHopper's settings and features. To alter the configuration, select the tab of the section you want to change and alter the settings. Select "Write" to store the altered settings in the radio memory.

Port Tab

The Port Tab contains the serial COM port settings "COM Options" and the Terminal window display settings "TTY Options". The PC communicates with the radio through the COM port. The Port Tab allows the user to select the COM port to which the 900 SS MicroHopper radio is connected.

The serial interface used must be set to 8 Data Bits, No Parity, and 1 Stop Bit.



Port

The default port is COM1. The Radio Support Utility supports COM1 through COM8. Only one serial communications software program can use this COM port at a time.
If your radio is not connected to COM1, alter the COM port setting to match the COM port to which your radio is connected.
If the COM port that appears in the Port Tab is not the COM port to which the radio is connected, an error message appears when you start the radio support utility or select another tab. If you see an error message, change the COM port setting to match the COM port to which your radio is connected. You will not be able to make changes to any of the radio settings until the PC is communicating with the radio through the correct COM port.

Baud Rate-Port

The default is 19,200. Sets the baud rate the PC uses to communicate. A drop-down menu allows standard baud rates from 1200 to 19200 bps.

> *Caution: The Radio Support Utility uses two separate baud rates; the Baud Rate--Port found in the Port Tab, which is the communication baud rate of the PC or serial input device; and the Baud Rate-Radio found in the Settings Tab, which is the communication baud rate of the radios serial interface port. These baud rate settings must match for the radio and the PC to communicate effectively.*

If you choose another baud rate, make sure you also reset the Baud Rate-Radio in the Settings Tab if you want the computer and the radio to communicate effectively. The 900 SS MicroHopper's Baud Rate-Radio highest setting is 19,200. Radio baud rates must match each other.

TTY Options

Used with the Terminal Window that appears when you select the Terminal Tab. These are the settings used by Terminal Mode and are not part of the radio settings. All three settings are checked on by default.

Auto Wrap

When checked, turns on Auto Wrap in the Terminal Window. Text characters automatically wrap when they reach the right edge of the window. When unchecked, wrapping is turned off. Note: You will need to use the
horizontal scroll bar to see the full window.

New Line

When checked, terminal mode recognizes <Return> as a line feed and scrolls the screen up one line while starting a new line. When unchecked, characters are displayed on a single line and <Return> starts at the beginning of that single line.

Local Echo

When checked, characters being input are displayed in the Terminal Window.

Local Echo causes each character to be sent to the receiving radio (device) and also to be printed in the Terminal Window.

When unchecked, characters are sent directly to the receiving radio and no display is given.

Using Local Echo actually slows down communication speeds. If throughput speed is a concern, un-checking Local Echo can increase performance. Always un-check Local Echo when testing the transfer rate of the radio between the host device and the radio.

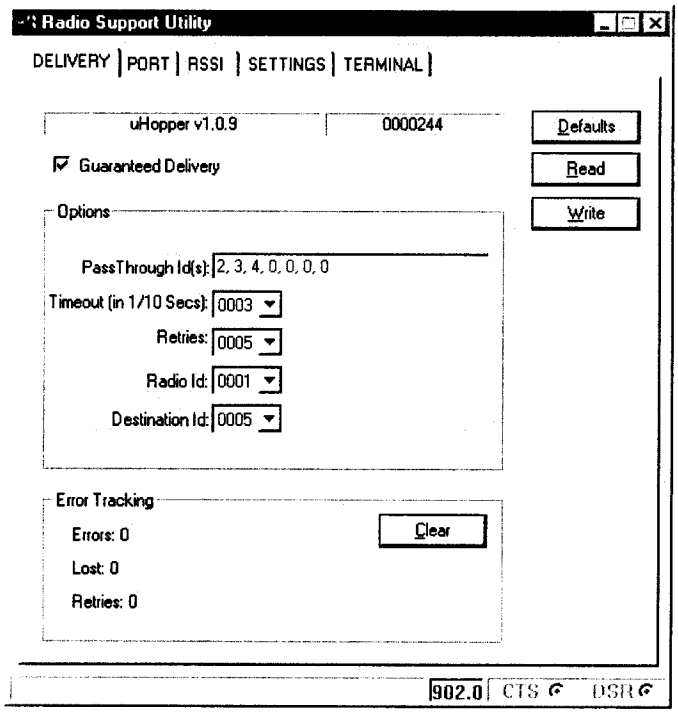
If the radio (receiving device) has an "Echo Utility" you will see double characters as the character that was sent is returned to the host by radio. Echo utilities on the radio will also slow communication speeds and should be turned off when testing transfer rates.

Font Button

Sets the font and size of the characters displayed in the Terminal Window. Clicking on the Font button displays the Windows Character screen where you can change the font and its size.

Delivery Tab

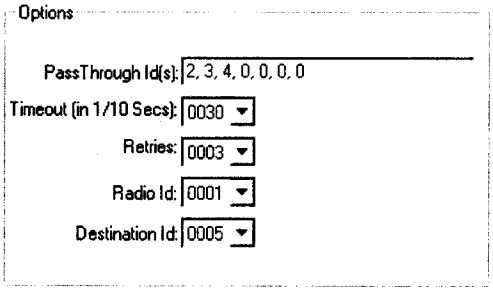
The Delivery Tab contains configuration settings that pertain to **the Guaranteed Delivery and Repeater Mode** feature of the 900 SS MicroHopper.



Guaranteed Delivery Checkbox
The Guaranteed Delivery checkbox controls the point-to-point settings on the 900 SS MicroHopper. When the checkbox is unchecked none of the settings in the Delivery Tab are available.

With the Guaranteed Delivery system on, the 900 SS MicroHopper is able to specify a destination radio, as well as Pass Through Ids (Repeater Path) to reach the destination radio. It is considered Guaranteed Delivery because the host radio receives a confirmation from the destination radio that the transmission has been received.

The settings in Options on the Delivery Tab are all based on the Guaranteed Delivery feature.



Pass Through Id(s) (Repeater Path)

This is a list of radios the transmission must pass through to reach the Destination radio.
Using the Options setting from the illustration above, Radio 1 would pass through Radio 2, Radio 3, and Radio 4 (the Pass Through radios) to send a point-to-point transmission to the Destination Radio 5.

For the Radio 5 to respond its Pass Through order would be the opposite, that is—4, 3, 2, because the transmission from 5 would have to go through a reverse order to reach Radio 1.
A 0 ends the pass-through list. All values following the first 0 must also be 0.

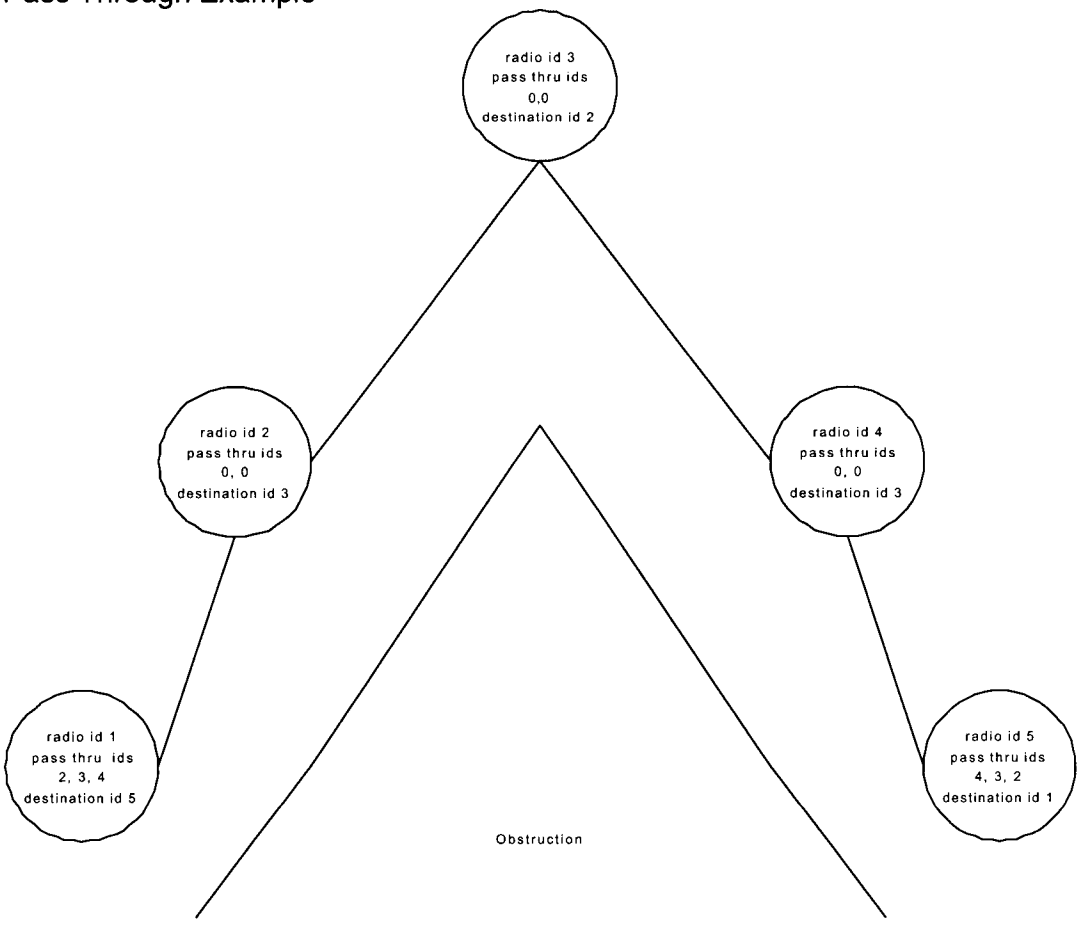
Configuring the Pass Through radios

The pass through radio "Destination ID" requires a value; it may be set to any radio in the communications string.
Set the pass through ID's to 0,0
Write these settings to the Pass Through radios.
NOTE: To enable broadcast from a pass through radio, set its destination ID to 0000, delete the 0,0 pass through Ids and write to the radio.

If not using a PC or Serial input device attached to a pass through radio see "Connector J1 – Configuration".

Use a serial interface program for communications on end point radios.

Pass Through Example



Timeout (in 1/10 Seconds)

The length of time the radio waits to receive the acknowledge signal from the Destination radio.
Limits: 0 (Zero) to 255, or 25.5 seconds maximum.

Retries

The number of times the radio sends transmission and waits for a reply.
Limits: 0 (Zero) to 255 maximum.

Radio Id

The Id of the 900 SS MicroHopper you are configuring.
256 possible radio Id's – 0 (Zero) to 255.

Destination Id

The Id of the intended receiver to which a message is being sent. A 0 indicates a broadcast packet that can be routed through repeaters.
256 possible radio Id's – 0 (Zero) to 255.

Default Button

Click the Defaults button to see the factory default settings for the radio.

Read Button

Click the Read button to have the configuration software "read" the current settings from the radio.

Write Button

Click the Write button to "write" the information from the Delivery Tab (as it is currently set) to the radio. Use the Write button any time you want to change the radio settings to reflect what is entered in the fields.

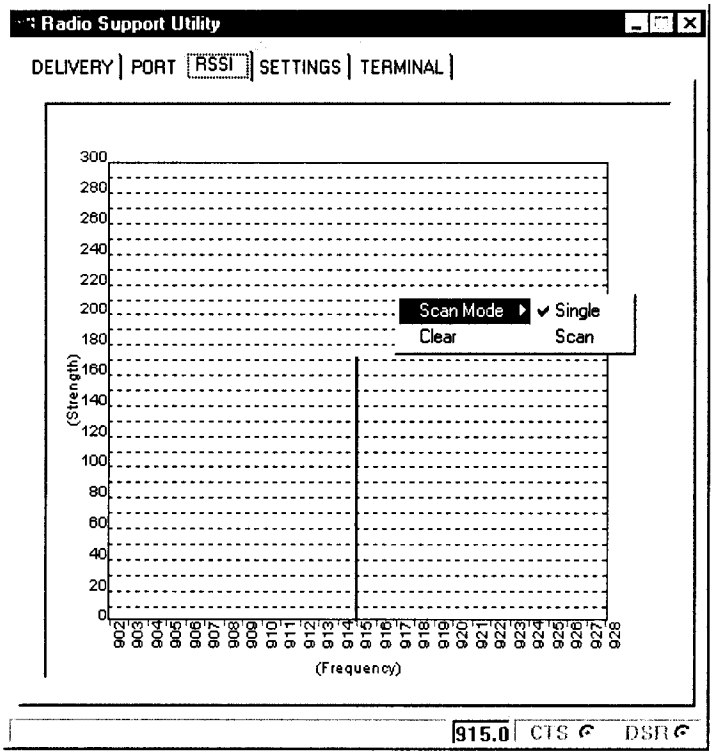
RSSI Tab (Receive Signal Strength Indicator)

This tab shows a grid that indicates relative signal strengths of the radio output and the local background noise in the radios frequency band. Background noise in excess of 90 may indicate a limitation of radio performance. Click on the grid with the left mouse button. When the RSSI window is active, it allows you to select from two different modes, Scan or Single.

Red represents the strength of the current received signal.
Blue is the maximum strength of the received signal since the radio was turned on. **NOTE:** The RSSI scale is not calibrated and is non linear in its response. Its function is to display "relative" signal amplitudes.

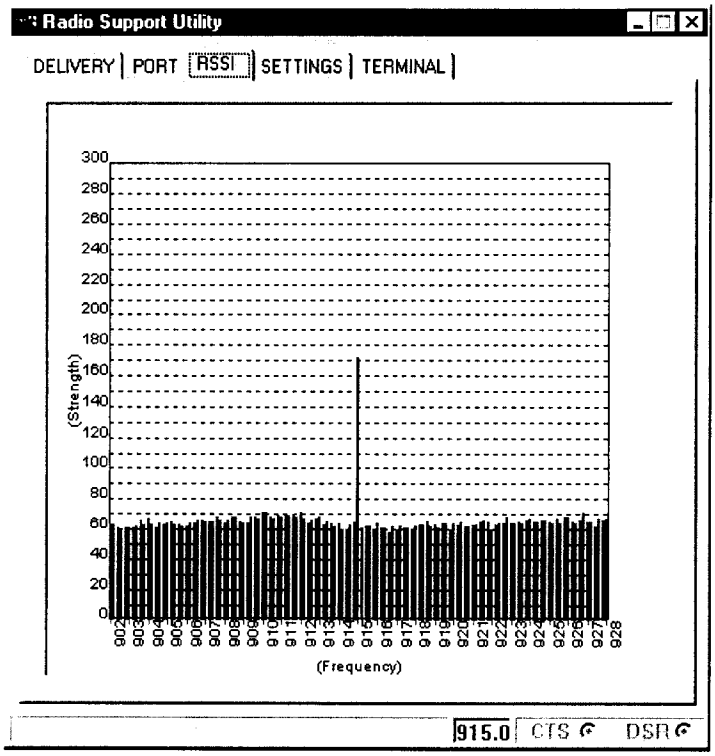
Single- **(Default)**

Select the frequency to sample by selecting the text box at the bottom of the display window then changing the Frequency Select number.
The picture below indicates an RSSI of 170 at a frequency 915.0 Mhz.



Scan

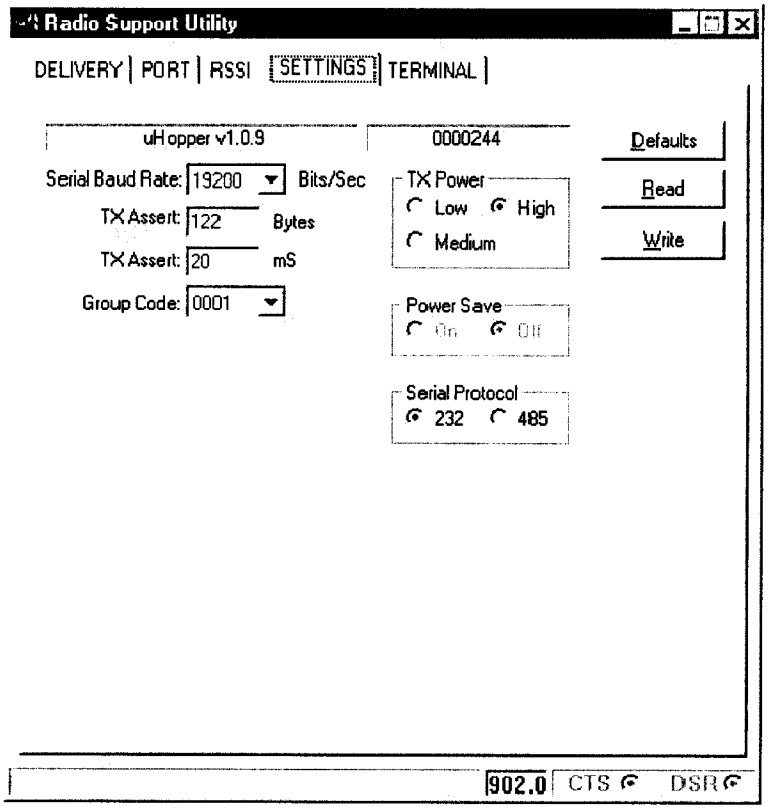
Scan Mode provides a running sample of all frequencies between 902 and 928, the 900 SS MicroHopper frequency range.
The window below shows a strong signal on 915.0 and background noise on all other frequencies. The scan rate is approximately 50 mS per sample



Settings Tab

The Settings Tab contains the settings for the radio. Use these settings to configure the 900 SS MicroHopper radio.

Note: The Flow Control default settings in the Settings Tab provide the maximum throughput for the 900 SS MicroHopper radio.



Serial Baud Rate (Baud Rate-Radio)

The default is 19,200. Sets the serial radio baud rate the radio uses to communicate. A drop-down menu allows standard baud rates from 1200 to 19200 bps.

Caution: The radio CTS flow control must be monitored to insure the data source does not overrun the radio input buffer.

These baud rate settings must match the slowest device in the communications chain to communicate effectively.

If you choose another baud rate, the Baud Rate (Port) in the Port Tab will automatically be updated.
Full Bi-directional communication is most effective when all the devices in the communications chain are at the same baud rate.
One-way data transfer can be accomplished with the receiving devices at a higher baud rate than the source device.
The radios will always broadcast to each other at 19.2kbps.
The PC serial port may be set to any value equal to or greater than the radio baud rate. The communications software must be set to the baud rate of the radio serial port.

TX Assert (bytes)

The default is 122 bytes. Transmissions are sent when the buffer reaches the TX Assert (bytes) level.

CTS Assert, CTS De-Assert, TX Assert (bytes), and TX Assert (mS) are all settings that manage input so that it is gathered together and sent in packets. Packets are sent when they reach the TX Assert (bytes) buffer level. **The TX Assert setting should always be equal to or below the CTS De-Assert setting which defaults to 122 bytes.** For details on CTS Assert/ De-Assert see Appendix C.

TX Assert (mS)

The default is 20 mS. TX Assert (mS) acts as a timeout. It is used to force transmission if the buffer fails to fill. It should always be set to slightly longer than the expected buffer fill time. Low values of this setting can cripple communications.
If the input being stored waits for 20 milliseconds, TX Assert sends a transmission. When input is not constant, or when a small amount of input is left over from the previous transmission, the TX Assert (mS) setting ensures that all information is sent. Packet Transmission can be triggered by either buffer full or mS timeout.

As part of flow control management, TX Assert (mS) always clears out the buffer by making a transmission based on a timing setting.

Group Code

The default is Group 1. The Group Code feature allows you to assign any number of radios to the same group. There are 1600 groups available in the Group Code setting. Radios that have different group codes will not communicate with each other. Radios with the same Group Code will communicate with each other.

The Group Code is contained in the packet heading and only transmission packets with matching group codes will be recognized by those radios

within the group. Using Group Codes is not the same as changing frequencies.

TX Power (radio button)

The default is "High". The TX Power setting allows the user to change the transmitter output power.

Power Save (radio button)

The Default is "Off". Power save options are not available for this radio.

Default Button

Click the Default button to see the factory default settings for the radio.

The factory defaults are stored in memory and will appear when the Default button is clicked. However, to reset the radio to the factory defaults you must also click the Write button—clicking Defaults and then selecting another tab, or closing down the Radio Support Utility will not reset the radio to the factory defaults.

Read Button

Click the Read button to have the configuration software "read" the current settings from the radio.

Write Button

Click the Write button to "write" the information from the configuration window (as it is currently set) to the radio. Use the Write button any time you want to change the radio settings to reflect what is entered in the fields.

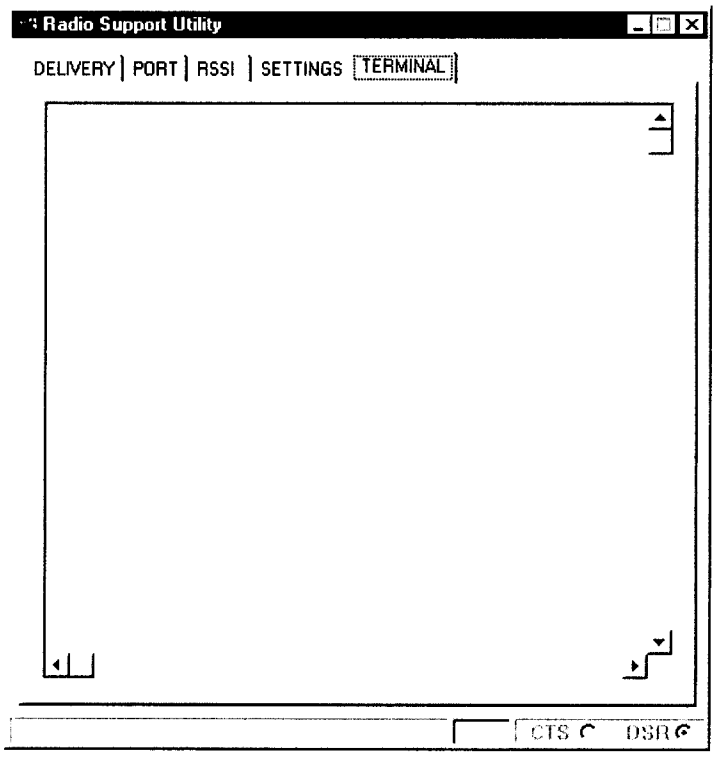
Terminal Tab

Click the Terminal tab to bring up the "Terminal Window".

Note: You must also click your mouse within the window to activate the Terminal window so that you can send or receive characters.

The settings for the Terminal Window are found in the Port Tab. To alter the baud rate, modem settings, fonts, or TTY options for the Terminal Window, see "Port Tab".

Use the Terminal Window to establish serial ASCII (typed text) communication between radios.



How the 900 SS MicroHopper Works

What is Spread Spectrum?

The 900 SS MicroHopper uses frequency-hopping signals instead of narrowband signals. The advantages of frequency hopping include traffic privacy, low probability of intercept, multiple access capability, and short synchronization time. With World Wireless Communication's Secure-Sync technology, the 900 SS MicroHopper provides fast, reliable and secure radio communication.

The 900 SS MicroHopper operates on 25 discrete frequencies within the ISM band; each frequency is about 400 kHz apart. Using a high-speed phase-locked loop synthesizer, the radio receiver is able to quickly acquire synchronization with the transmitter and receive the transmitted data.

Data is transported across the RF channel in a transparent, promiscuous mode. This means that data sent into the serial port on one radio will be presented out of the serial port on all other radios that are within range and have the same group code.

Connections

The Data Radio is connected to a host device using a 20-pin dual in-line header for TTL mode. The radio requires external DC power delivered through the 20-pin header, an RS485 adapter or RS-232/DB9 adapter board for supported serial communications modes. These connections provide the radio with the required DC power source and allow the Data Radio to be programmed and configured, while providing I/O lines for an RS-232 port.

Interference

The radio shares frequency spectrum with other services and other unlicensed devices using the 902 Mhz to 928 Mhz frequency band. Systems that are installed in rural areas will encounter the least amount of interference, but because of the frequency sharing some level of interference is expected. However, the Hopper's flexible design and hopping technology should allow adequate performance as long as care is taken in choosing site locations.

Specifications

Frequency Range:	902 to 928 MHz
Power Source:	5 VDC +/- 10%, 1.5 Watts
Current consumption:	Receive Transmit
	35 mA 350 mA max
Antenna Impedance:	50 Ohms unbalanced
Antenna Connection:	Reverse Polarity SMA male
Operation Mode:	Frequency Hopping Spread Spectrum
Frequency Control:	PLL Synthesizer, 100 kHz step size
Operating Band:	ISM 902 MHz to 928 MHz
Channel Spacing:	400 kHz
Modulation System:	Direct FM
System Deviation:	100 kHz max
Sensitivity:	-103 dBm
FCC Compliance:	Part 15
Transport Protocol:	Transparent
Data Interface:	Asynchronous Serial – RS-232 or TTL, RS-485
RF Data Rates:	19,200 bps
Data Interface Rates:	2,400 to 19,200 bps
Data Protocols:	8 data bits, no parity, 1 stop bit, transparent (No protocol).
Operating Temperatures:	0 to 70C (Commercial temperature range)
Size:	Approximately 1.75" x 2.47" x 0.375"
Range (line of sight):	500 meters

Default Settings

Serial Baud Rate: .....19,200 bps

Preamble Length: ..... 180ms fixed*

RF Data Rate: .....19.2kbps fixed*

RX Buffer Size:.....160 bytes fixed*

TX Buffer Size: .....142 bytes fixed*

CTS Assert:.....112 bytes fixed*

CTS De-Assert:.....122 bytes fixed*

TX Assert:..... 122 bytes/20 mS

CD Level:..... Factory setting*

Group Code: 0001-1600

Deviation:.....Factory Setting*

TX Power:.....High*

Frequencies:.....25 fixed*

Power Save: .....Off

RSSI Mode: .....Single

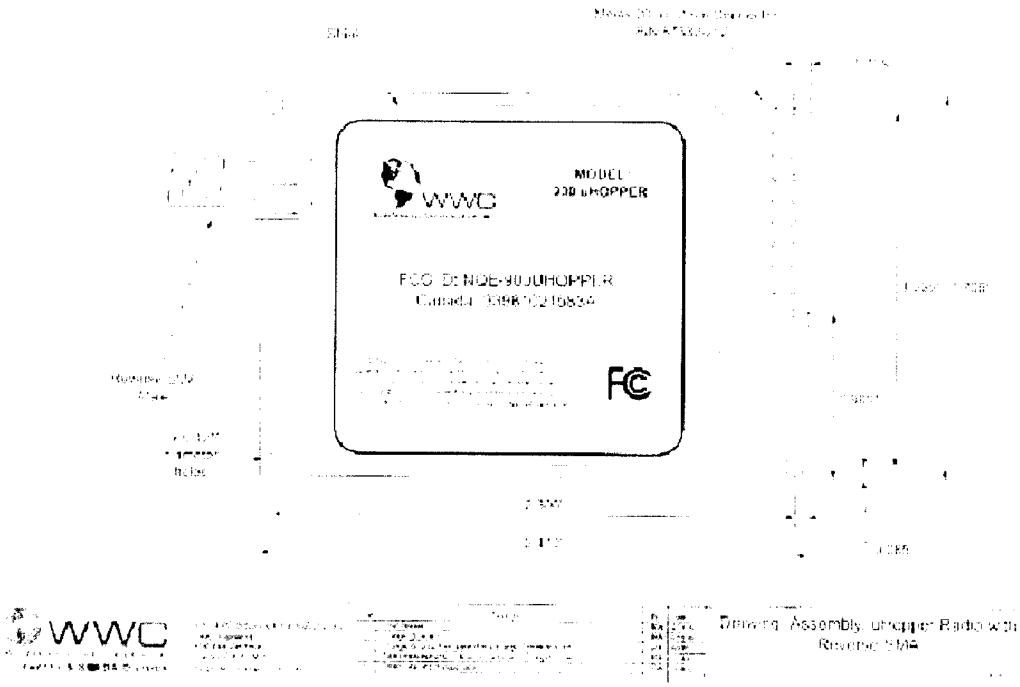
Test Frequency:.....915.0 Mhz

*Predetermined by manufacturer

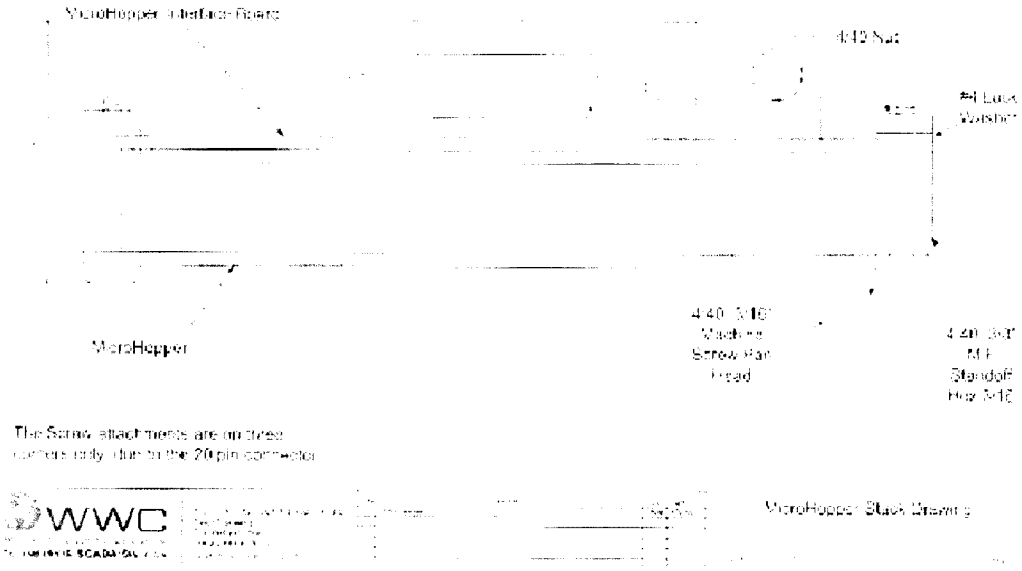
MECHANICAL DRAWINGS

ASSYEMBLY

RADIO (part number 011-1882)



SIDE VIEW


MicroHopper
4-40 Nut
4-40 3/16"
Screw Pan
Head
MicroHopper Stack Drawing

PIN DEFINITIONS FOR CONNECTOR J1

The following pin out summary is achieved through a 20-pin 2mm connector J1 (Molex P/N 87332-2020).

PIN	FUNCTION	RS232 UNIT COMMENTS
1	Factory Use Only	
2	Received Data	Radio Output - Digital
3	Factory Use Only	
4	Clear to Send Out	Radio Output - Digital
5	Factory Use Only	
6	Data Terminal Rdy In	Low (configure) and High(normal)* Radio Input
7	Reset	
8	Request to Send In	Radio Input - Digital
9	Factory Use	
10	Transmit Data	Radio Input - Digital
11	Factory Use	
12	NC	
13	NC	
14	NC	
15	NC	
16	NC	
17	5 VDC In	
18	Ground	
19	5 VDC In	
20	Ground	

Pass Through Configuration

If using the TTL interface alone (radio only) DTR is High (configure) or Low (normal). Make sure DTR is grounded and that power and ground are applied to the radio interface connector.

If connected to a PC through an interface board on a radio, make sure the terminal window is open (click inside the window). This will provide low DTR.

Configuration Interface-Command Set

If you wish to write your own configuration utility the following instructions apply.

All data is binary using MSB order. Example: 9600 is sent (0x00, 0x00, 0x25, 0x80)

Startup

Setup

1. When attempting to interface to the 900 SS MicroHopper through the 232 interface in command mode the first thing to do is to bring the DTR line low for RS232 interface or high for TTL (radio only) interface.
2. Then wait 500ms. This is to give the 900 SS MicroHopper a chance to see the DTR change and to enter configuration mode.
3. The 900 SS MicroHopper will then wait for the configuration key sequence or for the DTR line to go high (RS232) or low (TTL).
4. If the configuration key sequence is received, the 900 SS MicroHopper will respond by sending the same configuration key sequence to the user.
5. If the user receives the configuration key sequence they will know that they are officially in configuration mode. The configuration key sequence consists of 4 bytes: 0xf0 0xaa 0xe4 0x0f
6. To exit the configuration mode set the DTR line to high (RS232) or low (TTL). The radio will respond with 1 byte: 0x0f.

The Command Set

The command set for interacting with the 900 SS MicroHopper in configuration mode follows:

COMMAND SET	
#define GET_CONFIG	0x01
#define SET_CONFIG	0x02
#define SET_FREQ	0x03
#define SET_VCO	0x04
#define SET_MOD	0x05
#define GET_VERSION	0x06
#define SET_RSSI	0x07
#define GET_RSSI_DATA	0x08
#define GET_ERRORS	0x09
#define SET_ERRORS	0x0a
#define GET_ROUTELIST	0x0b
#define SET_ROUTELIST	0x0c
#define GET_GDINFO	0x0d
#define SET_GDINFO	0x0e

Command Examples

SET_FREQ

The command <0x03, FREQUENCY> where FREQUENCY is the 2 byte integer representing the frequency in 100 KHz sets the radio frequency. For example,
<0x03, 0x23, 0xBE> sets the radio to 915.0 MHz.

SET_RSSI

The command <0x07, MODE>
where MODE is 0x00 for off, 0x01 for single channel, and 0x02 for scan, sets the RSSI mode.

GET_RSSI_DATA

The command <0x08> reads the radio frequency and RSSI data.
The response format is <FREQUENCY, RSSI_DATA> where FREQUENCY is
the 2 byte integer representing the radio frequency in 100KHz and RSSI_DATA
is a 2 byte integer representing the signal strength.

ERROR_ACCESS

Error count clearing and reading is accomplished by first de-asserting DTR. Verify that the 4 byte configuration key is received at 9600 baud.

SET_ERRORS

Send the <0x0a> byte to set the error count values to zero.

GET_ERRORS

To read error values send <0x09>. The radio will respond with 6 bytes of data as described below. The first 2 bytes are the errSyncByte.
This value is either guaranteed or normal delivery. This value is incremented when the radio receive code has locked onto the data packet. The last byte transmitted is a special value to tell the receiver the packet is done. If the receiver exits the receive loop without seeing the special end of packet value, this count is incremented. The next 2 bytes are the lost packet count. The value is incremented in guaranteed delivery mode only. If the retry count equals the maximum number of retries, this value is incremented (i.e. no acknowledge was received). The last 2 bytes are the total retry count, which is incremented on each retransmission.

Setting and Getting Configuration Data

The following defines are used for the GET_CONFIG and SET_CONFIG commands.
They have format <0x01, offset, length> for GET_CONFIG and <0x02, offset, length, data> for SET_CONFIG.
The offsets are indicated and the length is in bytes.

PARAMETER	(Offset)/Length	DESCRIPTION
#define EE_BAUD_1	(0)/1	// baud msb
#define EE_BAUD_2	(1)/1	
#define EE_BAUD_3	(2)/1	
#define EE_BAUD_4	(3/1)	// baud lsb
#define EE_CTSOFF	(4)/1	// CTS off value
#define EE_CTSON	(5)/1	// CTS on value
#define EE_PKTSIZE	(6)/1	// when to start packet transmission <1 to Transmit Buffer Size-1>
#define EE_CHARDELAY	(7)/1	// character delay before sending <0 to 255ms>
#define EE_CHANNELS	(8)/1	// number of channels <25 or 50>
#define EE_TXPOWER	(9)/1	// transmitter power level <1 to 3>
#define EE_MODULATION	(10)/1	// modulation level<0>
#define EE_PREVALUE	(11)/1	// permanent preamble value
#define EE_ENCODINDEX	(12)/1	// encode index offset
#define EE_RXBUFSIZE	(13)/1	fixed
#define EE_TXBUFSIZE	(14)/1	fixed
#define EE_POWERSAVE	(15)/1	<0 or 1>
#define EE_GEN_PRODID	(16)/1	<0-Data Radio,16-MicroHopper>
#define EE_RS485_SEND	(17)/1	// if TRUE send 485 version is active

Configuration Examples
For example <0x01,0,4> would get baud rate information.
And the command <0x02,0,4,DATA[4]> would set baud rate information.

Guaranteed Delivery Information

The following offsets are used to configure the guaranteed delivery information.

For example to turn on guaranteed delivery a SET_GDINFO with an offset of 0, a length of 1, and a value of 1 would turn on the guaranteed delivery code.(the radio ID and destination ID would also have to have been set) The command would appear
as follows <0x0e, 0, 1, 1> Write zeros for pass through ID's that are not used.

PARAMETER	(Offset)/Length	DESCRIPTION
#define EE_GDACTIVE	(0)/1	// guaranteed deliver active
#define EE_GDTIMEOUT	(1)/1	// gd timeout <0 to 255>
#define EE_GDRETRIES	(2)/1	// gd retries <0 to 255>
#define EE_GDRADIOID	(3)/1	// gd radio ID <0 to 255>
#define EE_GDDESTID	(4)/1	// gd destination radio ID <0 to 255>
#define EE_GDPASS1	(5)/1	// gd pass through radio ID's <0 to 255>
#define EE_GDPASS2	(6)/1	<0 to 255>
#define EE_GDPASS3	(7)/1	<0 to 255>
#define EE_GDPASS4	(8)/1	<0 to 255>
#define EE_GDPASS5	(9)/1	<0 to 255>
#define EE_GDPASS6	(10)/1	<0 to 255>
#define EE_GDPASS7	(11)/1	<0 to 255>

WARNING: Writing configuration data outside of the valid range may cause the radio to operate improperly.

Troubleshooting Tips

Radio is not responding

If your radio is not responding, check the following settings to make sure both radios can communicate:

The Baud Rate for both radios should be set the same in the Radio Configuration window.

Does the configuration information on both Radio Support Utility screens match? All of the settings in the configuration window must match for the radios to communicate effectively.

Garbled characters appear in the "Terminal" window

Does garbled text appear? If text appears, but appears garbled, the radios are set to different baud rate than the PC. Make sure that radios and the PCs are set to the same baud rate.

Range is limited

Check the antenna and make sure it is firmly attached to the unit. Remove any obstructions that are close to the radio (within a 5 foot radius).

Glossary of Terms

Baud
Measurement of the signaling speed of a data transmission device. Baud rate and bits per second are not necessarily the same.

CD
Carrier Detect level. Used to tell the scanning radio if a transmitting radio is present.

Communication (COM) Ports
Designation of serial communications channels. COM port designations for this radio are COM1 through COM8.

Configuration Default
Operating characteristics of this data radio. The configuration default parameters are stored in the data radio's non-volatile memory and are predetermined by the manufacturer.

CTS
Clear to Send. A control signal used in conjunction with Request to Send (RTS) to perform data flow control.

Flow Control
A method used to regulate the flow of data between two devices. In this instance, between the customer DTE and the data radio.

Group Code
This setting is used to designate which group a radio will belong to. A radio will only "hear" other radios with the same group code. In "Broadcast" mode you may program up to 1600 different groups with unlimited radios in each group. When using "Guaranteed Delivery" mode a maximum of 256 radios may be assigned a unique radio ID.

Modulation

The shifting of transmit frequency representing the data being transmitted.

Point to Point RF Signals

Point-to-point describes a system where two radios exclusively share communications. All messages occur between the two radios. It is similar to wired communications between a host computer and a terminal.

Point-to-Point signals can be passed through different radios, but the transmit (TX) and receive (RX) only occur on the two radios that share communications.

Point-to-Multipoint RF Signals

Point-to-multipoint describes a system where one master radio communicates with several remote radios. The remote radios only communicate with the master site, not with each other. Point-to-multipoint systems are built on addressing (See Group codes) , as the master radio must be able to specify which of the many remote sites is expected to receive and respond to the message.

Preamble Length

The length of time a transmitting radio sends a preamble to search for the receiving radio (180mS). The preamble is sent only when starting a new transmission on a new frequency.

RF Data Rate

How fast the transmitting radio sends data across the RF channel.

RSSI

Receive Signal Strength Indicator. Indicates signal strength on any given frequency.

RTS

Request to Send. A control signal used in conjunction with Clear to Send (CTS) to perform data flow control.

RX Buffer Size

The RX (receiving) buffer size is the number of bytes stored in the receive buffer.

Serial Baud Rate

Baud rate the radio uses to talk to a PC or external device.

TX Assert

Amount of time or volume the transmitting radio will wait before it sends data.

TX Buffer

Number of bytes available for the transmit buffer.

TX Power

Transmitting power. This radio has 3 settings for range, preset by the manufacturer. Low (25mW), Med (50mW) and High (100mW)
* Powers are approximate.

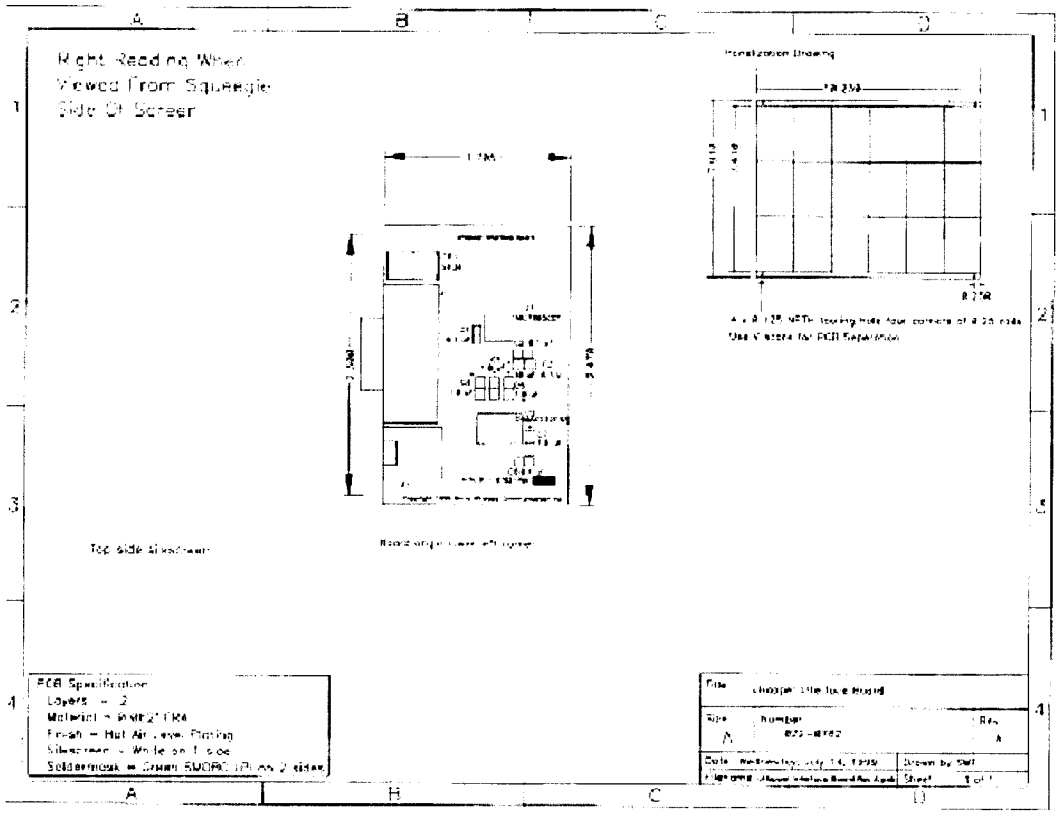
APPENDIX A-RS232 INTERFACE

Part Number: 011-0782

INTERFACE BOARD LAYOUT

Electrical

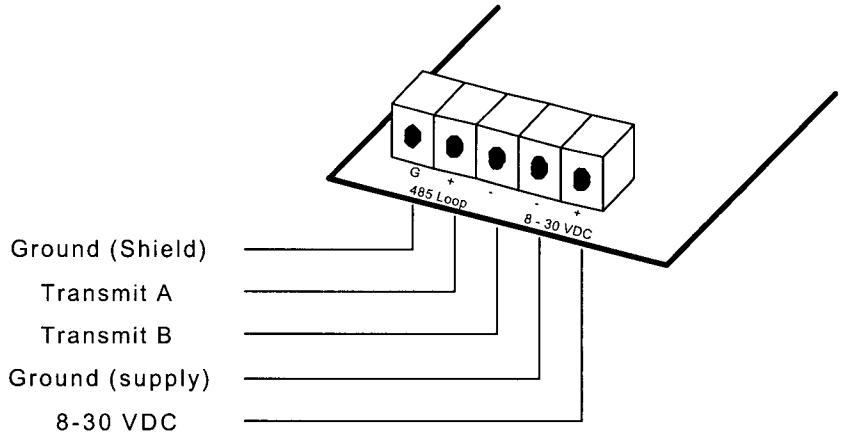
Typical Current Draw	Radio Installed	Radio Absent	Radio Alone
At 5 Volts			39mA
At 9 Volts	49mA	7mA	
At 12 Volts	49mA	7mA	



Serial DB9 pin out

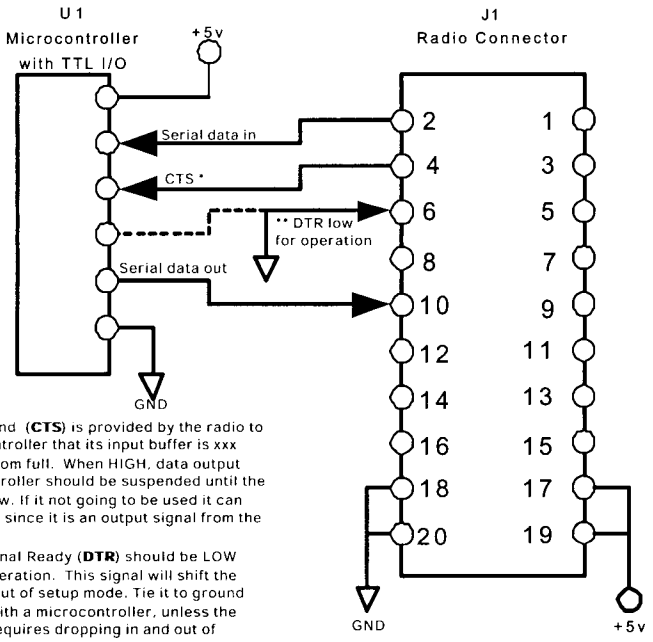
DB9M	FUNCTION	ABBREVIATION
PIN 1	DATA CARRIER DETECT	CD
PIN2	RECEIVE DATA	RD or RX or RXD
PIN3	TRANSMITTED DATA	TD or TX or TXD
PIN4	DATA TERMINAL READY	DTR
PIN5	SIGNAL GROUND	GND
PIN6	DATA SET READY	DSR
PIN7	REQUEST TO SEND	RTS
PIN8	CLEAR TO SEND	CTS
PIN9	RING INDICATOR	RI

APPENDIX B-RS485 INTERFACE



The RS485 standard for differential multipoint data transmission is ideal for transmitting high data rates over long distances in noisy environments. The interface is half duplex with peak data rates that are a function of distance (10Mbps at 40 feet to 100Kbps at 4000 feet). It will support up to 32 connections, however, the MicroHopper 485 interface board is terminated and the MicroHopper will transmit any data that appears on the bus. The MicroHopper 485 interface board was intended to provide a connection between a MicroHopper and a single device with a 485 interface. The MicroHopper itself is not addressable except through the Group Codes, Radio ID and Destination ID settings. Also, there is no flow control on the MicroHopper 485 interface board so data rates must be kept low to avoid buffer overrun.

APPENDIX C-RADIO CONNECTOR J1



* Clear to Send (**CTS**) is provided by the radio to notify the controller that its input buffer is xxx characters from full. When HIGH, data output from the controller should be suspended until the lead drops low. If it not going to be used it can just float free since it is an output signal from the radio.

** Data Terminal Ready (**DTR**) should be LOW for normal operation. This signal will shift the radio in and out of setup mode. Tie it to ground when using with a microcontroller, unless the application requires dropping in and out of SETUP.

Connector Layout for WWC 900 Microhopper

1. AT90s8515MOSI
2. Received Data (send to controller serial port)
3. AT90s8515MISO
4. Clear to Send Out
5. AT90S8515 SCK
6. Data Terminal Ready
7. Reset
8. Request to Send
9. Factory Use
10. Transmit Data (received from controller)
11. Factory Use
12. - 16. NC
17. 5 VDC in
18. Ground
19. 5 VDC in
20. Ground

FREQUENTLY ASKED QUESTIONS

How Buffer Settings Work

Note: For the examples found in this section, the default settings are used.

The settings for flow control are found in the Settings Tab. The Radio Support Utility allows you to alter the TX Assert settings.

Flow Control

The basic idea behind flow control is that it maximizes the size of data that is being sent and received by the radio. The TX Buffer Size of 142 is the upper limit for the number of bytes that can be stored without an overflow. By managing the buffer size, overflows are prevented and throughput increased through the flow control settings.

When the TX Buffer fills to the TX Assert (bytes) setting, a transmission is initiated.

Buffer input (fill) occurs whenever memory space is available, gated by CTS.

The default CTS Assert value is 112 bytes. The TX Assert (send threshold)
should be less than or equal to the CTS De-assert value for the radio to transmit data. The default for both of these is 122 bytes.

Timing for Flow Control

A radio will cycle through the flow control settings in milliseconds, so the buffering and transmission process happens quickly. The only setting based on timing is the TX Assert (mS) setting. Once the input being stored waits for the selected number of milliseconds without any additional bytes being placed in the buffer, TX Assert sends a transmission. When input is not constant, or when a small amount of input is left over from the previous transmission, the TX Assert (mS) setting ensures that all information is transmitted.

How Group Codes Work

The Group Code should be considered a form of radio address. Group Codes do not affect the frequencies the radio uses. When a group of radios are assigned the same Group Code, a radio will only receive data from another radio using the same Group Code. Group Codes can be changed dynamically. Updates take approximately 1 sec.

Data Rate Information

The BAUD rate radio to radio is 19,200 (19200 BITS/second). The actual streaming data rate, end to end, is about 10,000 bits per second or about 1Kbyte per second assuming 8 data bits, 1 start bit, 1 stop bit. When streaming, data coming from the MicroHopper will be choppy because the radio has to stop every 400 mS to change channels.

When using Guaranteed Delivery the data throughput is limited to approximately 2300 bits per second.

The lowest baud rate is 1200 baud.

Restricted Frequencies

Here are some frequencies to avoid when integrating the radio into OEM systems. When selecting the switching frequency for the OEM power supply, oscillators, or clock signals avoid using both the indicated frequencies and any frequencies that would have harmonics on the indicated frequencies.

TX/RX = 902-928 MHz.
IF = 10.70 MHz.

There may be other frequencies that could cause problems, but these would probably need to be determined by testing.

Parts Information

1. The manufacturers part numbers for the surface mount 20 pin connector J1 and its mate are:

MicroHopper J1	PCB mating connector
Molex 87332-2020	Molex 79109-0009

Pin housing for cables
Housing - Molex 51110, Pins- Molex 50394, Crimp Tool – Molex 11-01-0204

2. There are 4 approved sources for the reverse polarity SMA male connector used on the MicroHopper radio.

Manufacturer	Part Number
1. Johnson	142-4701-86
2. Amphenol	901-9864
3. Pasternack	PE4874
4. ATS	CTA-7700

3. The part numbers for the interface boards are:
   RS232: 11-0782
   RS485: 11-0021

4. Part numbers for the Reverse SMA Antenna are:
   ½Wave: Astron AXH900RPSM
   ¼ Wave: Astron AXQ900RPSM

Interface Control Lines

For asynchronous TTL, CTS is active low.
CTS is set high when received data is being sent out the serial port.

RTS should not be used. The radio ignores this line.

To configure the radio, DTR must be held Low (TTL) or High (RS232) for the duration of configuration. Currently when initiating configuration mode, the radio will send out 4 bytes to indicate it has gone into configuration mode. You may then send the appropriate configuration commands.

DTR must be set High (TTL) or Low (RS232) for the radio to receive or transmit. It should not be left unconnected.

There is no Carrier Detect available to the user.

The Reset (pin 7 on the 20 pin connector) is used by the factory for loading micro-code into the radio and should be left open by the user.

With regards to the TTL interface the voltage levels are 0 (Low) and 3.6 volts (High).

The DTE must be ready to accept incoming data at all times.

Using the Configuration Command Interface

Set DTR according to the interface used TTL or RS232, then SEND the initialization command to the radio. The radio confirms entry into configuration mode by sending an echo of the initialization command

If invalid values are specified in a set configuration command to the radio, it will not operate properly. Valid values are listed as factory defaults.

The memory map does not allow all configuration values to be read or written with one instruction.

The modulation level parameter must always be set to zero (left unchanged) for compliance with FCC regulations.

Guaranteed Delivery

A one (1) enables guaranteed delivery mode and a zero (0) disables it from the configuration command set. This can also be activated at the delivery tab.

Activating guaranteed delivery enables error (CRC checking) not correction. A packet with an error will be discarded from the point of the error to the end of the packet. The data prior to the error will be delivered.

If the radio never gets an acknowledgement after the specified number of retries, there is no way to notify the host application.

Packetization

The packet size is affected by lots of different things (interface baud rate, response to handshaking, preamble length, TX Assert settings, Time in streaming mode. There is no way to predict what the individual packet lengths will be.
The packet transmission will start after the first byte is received. The rate at which the transmit buffer empties will vary.

Networking

For data networking applications please see our X-NODE and X-GATE products.

A MicroHopper cannot broadcast directly to a Hopper radio. However a Hopper and uHopper radio can be directly connected through the RS232 DB9 connector using a "Null Modem" connection. What the Hopper receives from broadcast is automatically placed on the RS232 bus and rebroadcast by the MicroHopper and vice versa.

Powering

Because of power dissipation issues here are our recommendations...

MicroHopper alone 5 vdc
MicroHopper with 232 Interface or 485 Interface 7-12 vdc

Power up delay time:

The time from power applied until the radio is ready to receive data at its input port.
From the time power supply voltage reaches operating level.
150 to 700 mS reset delay.
260 mS software delay.
The MicroHopper is ready for operation in 960 mS.

Vertical Dimensions

Just the 900 MicroHopper radio (without the interface board or standoffs) is 0.450" thick.

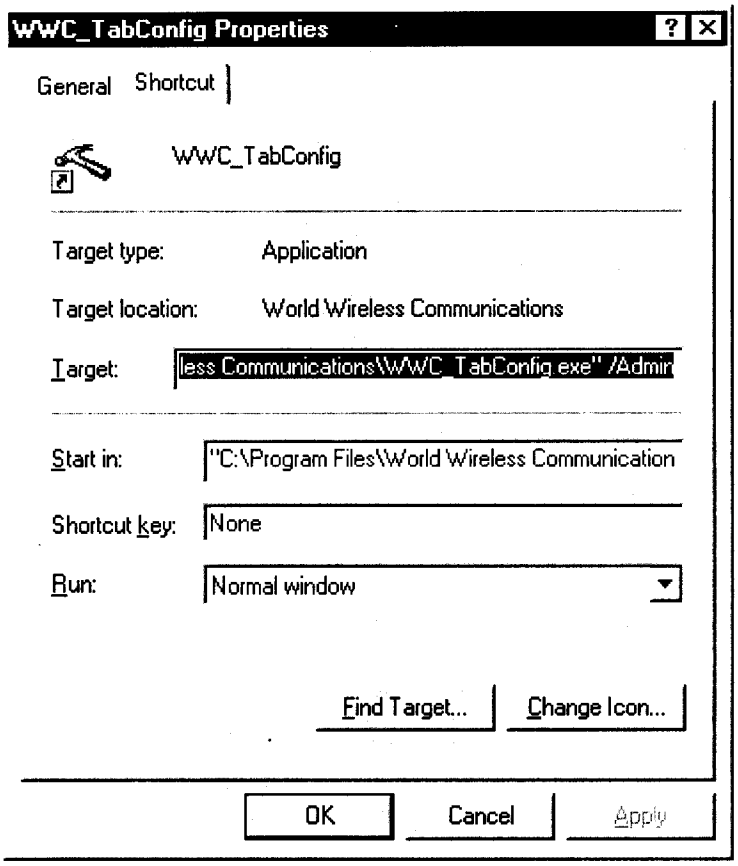
The 900 MicroHopper with the interface board is 1.025" thick.

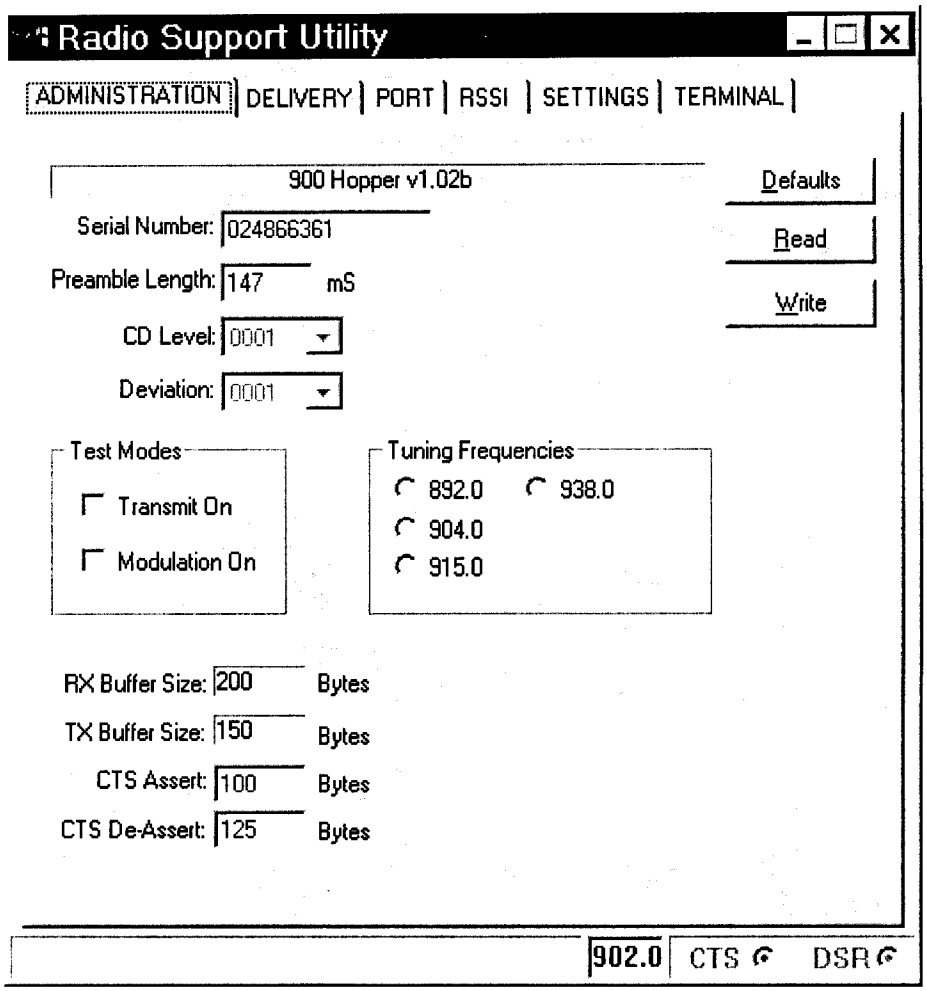
RF Power

The output power is Software selectable with approximate values of Low (25mW), Med (50mW) and High (100mW)

To add the administration tab to the radio utility, follow this procedure:

1.) Right click on the utility shortcut and select properties,
2.) Then select the shortcut tab where you will see target.
3.) In the target area enter a space after the parentheses, then type /Admin.
4.) Click OK and you will have successfully created an admin tab.




Radio Support Utility
ADMINISTRATION
DELIVERY
PORT
RSSI
SETTINGS
TERMINAL
900 Hopper v1.02b
Defaults
Read
Write
Serial Number: 024866361
Preamble Length: 147 mS
CD Level: 0001
Deviation: 0001
Test Modes
Transmit On
Modulation On
Tuning Frequencies
892.0
938.0
904.0
915.0
RX Buffer Size: 200 Bytes
TX Buffer Size: 150 Bytes
CTS Assert: 100 Bytes
CTS De-Assert: 125 Bytes
902.0
CTS
DSR

The World Wireless / X-traWeb radio firmware re-programming procedure
5\18\00

Document number: 042-0241doc Revision: 00

Purpose: This document is for reprogramming firmware into the radio.

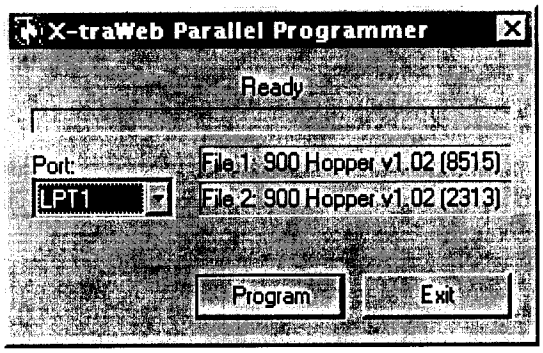
Requirements:

1. The latest version of firmware from a disk or the Internet: www.worldwireless.com
2. Program cable (042-0241)
3. PC with a printer port

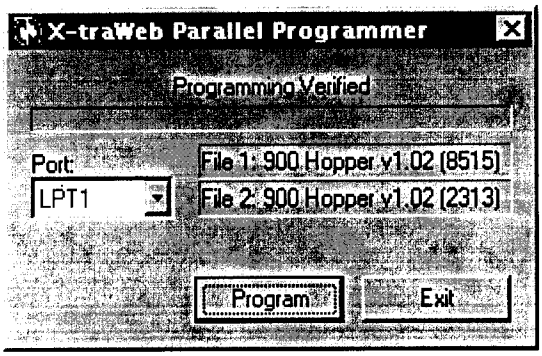
Instructions:

1. Plug program cable (042-0241) into your PC's printer port and plug in the cable's power supply.
2. Install the latest version of the program on your PC.
   a.) There are two possible ways to install software.
      1. Install with floppy disk by;
         a) Inserting the disk into the drive, Click Start, Run, Type a:\setup.exe. The install program will give you step by step instructions for installation.
      2. Install software from the Internet at www.worldwireless.com
         a) Click on support, then click on support again to reveal downloads, then click on downloads to show all possible downloads. Then click on the download you want to install. Now choose where to save the install file. When it is finished loading click open and click on the install program. The install program will give you step by step instructions for installation.

   Note: The installation program creates a shortcut on your desktop.
3. Double click on the software shortcut and this screen will appear;



4. Select the printer port (which signifies where the cable was installed on your PC).
5. Connect the program cable to the radio that needs programming.
Note: The connector is keyed.
6. Click program. (When the program has finished loading it will say program verified).



7. The radio now has the latest firmware. It is now ok to exit the program or program another radio. (Note: The serial number will be erased when programmed. The assembly serial number is defined by serial number tag affixed to the radio module.)