ROTHENBUHLER ENGINEERING

# *REMOTE FIRING DEVICE*

# *OPERATOR'S MANUAL*

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# SPECIAL NOTICE

# WARNING TO USERS AND AFFECTED PERSONS.

The Remote Firing Device (RFD) is designed to be used in blasting operations. Explosives used in connection with the RFD may be extremely powerful. Improper use of explosives with or without the RFD or improper safety precautions taken with respect to personnel or property may result in death, serious personal injury, or property damage. Other manufacturers' equipment that may not be in compliance with frequency coordination may inadvertently interfere with the operation of the RFD. Be aware of other operations within the receiving range of the RFD.

The literature accompanying this warning contains information of a general nature for users of the RFD based upon the manufacturer's experience in the design and manufacture of remote radio frequency devices. In addition, the manufacturer provides product literature and technical data sheets periodically which should be consulted for detailed information on the characteristics, specifications and recommendations for the RFD. The manufacturer does not purport to give information or advice on explosives or their use.

The RFD and related explosive devices are intended for use only by trained professionals having comprehensive knowledge of the RFD, the explosives being used, and the application together with all related safety precautions. The manufacturer of the RFD is responsible only for the proper performance of the RFD itself and is not responsible for the performance, safety, or specifications of the explosive used, nor the suitability of the RFD for any particular purpose other than that expressly described in the manufacturer's literature.

# LIMITED WARRANTY.

The manufacturer warrants the Model 1669 Remote Firing Device (RFD) to be free of defects in workmanship or materials for the period of one year from the date of purchase. In the event any RFD or component thereof is shown to be defective in workmanship or materials within one year, the system or component will be repaired or replaced without charge by the manufacturer at the manufacturer's place of business.

This warranty does not cover damage or injury to equipment resulting from abuse, neglect, or use in applications other than expressly described by the manufacturer as fit purposes for the RFD.

This Limited Warranty is given in lieu of all other legal warranties express or implied and neither the manufacturer nor its representatives shall be liable for any direct, incidental or consequential loss or damages arising out of any occurrence or accident involving the use of this product.

# FCC NOTICE.

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

# FCC Warning Statement

**This radio can only be used during the course of employment by individuals aware of the hazards, and the ways to minimize such hazards. This radio is not intended for use by the "General Population." Further, this radio must not be co-located or operated in conjunction wiht any other antenna or transmitter.**

# TABLE OF CONTENTS.

# LIST OF ILLUSTRATIONS.

# SAFETY SUMMARY.

The following are WARNINGS and CAUTIONS, contained throughout this manual and are repeated here for emphasis. All personnel engaged in the handling, firing, and storage of the system covered in this manual must fully understand these WARNINGS and CAUTIONS, and procedures by which hazardous conditions are to be reduced or eliminated. Also listed are general safety precautions that are not related to any specific procedures and therefore don't appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

***WARNING*** Never rely on the equipment for your safety.

***WARNING*** Use of this system and its components must be restricted to personnel qualified and experienced in the field of explosives and detonating devices. Under no circumstances shall untrained personnel attempt to use this manual as a text for self-teaching.

***WARNING*** This system and its components should be stored in a secure area with no access to unauthorized personnel. This system can be used in conjunction with explosives as a deadly weapon.

***WARNING*** These radios contain batteries. The potential for activation is always present whether or not antennas are attached to the units.

***WARNING*** Employ standard blasting system safety standards when using this equipment with explosives.

***WARNING*** Lightning induced energy, caused by electrical storms, can detonate explosives. In the interest of safety, blasting on land, water and underground should be suspended and all personnel should be evacuated to a safe distance from the blast area whenever lightning storms are in the vicinity. Dangerous levels of static electricity can build up in the atmosphere. These levels can be sufficient to detonate explosives.

***WARNING*** Radio frequency energy of sufficient magnitude can cause blasting caps to detonate.

***WARNING*** To eliminate long wire runs, and to make the "shoot" from a safe distance, the Remote Firing Device uses low energy level radio frequency transmissions.

***WARNING*** Do not connect a blasting cap to a Remote Unit unless the green SAFE light is on, the red ARMED light is off, and the yellow ON/LOW BATT light is on steady. This indicates there is no voltage on the binding posts, the binding posts are electically isolated from the firing capacitor, the binding posts are shunted to each other, and the battery is not low.

***WARNING*** Ensure that blasting caps are not connected to any of the Remote Units during bench test.

***WARNING*** This is a sensitive electronic radio system and it may be damaged.

***WARNING*** Do not use the Controller Unit within 100 feet of explosives, blasting caps, or wires leading to them. The controller signal is 5 watts, which can cause detonation of caps if within 100'. The 5 watt controller complies with the Recommended Table of Distances established by the Institute for the Makers of Explosives (IME) when placed beyond 100 feet of explosives.

***WARNING*** Do not engage in RFD communications with the Remote Units when they are connected to explosive charges until the shot is prepared and all personnel are clear. The Remote Unit complies with the Recommended Table of Distances established by the Institute for the Makers of Explosives (IME) when placed 25 feet or more from blasting caps or wires leading to them. For further information, refer to the Institute for the Makers of Explosives Publication no. 20, Part II, Section (1).

***WARNING*** Do not touch the igniter tip jacks on the Radio Shock Tube Initiator (RSTI) when armed or firing. Lethal voltages may be present.

***CAUTION*** Do not assume the Disarm command has been received by the Remote Unit unless DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. If distance appears to be the problem, move closer to the Remote Unit following standard procedures for this type of situation. The “STATUS” and/or “DISARM” switches may be pressed repeatedly as the Remote Unit is approached. Maintain a safe distance from the Remote Unit. Do not approach the Remote Unit until DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. Under no conditions should the “FIRE” switch be pressed as the Remote Unit is approached. DO NOT bring the Controller Unit closer than 100 feet to blasting caps, wires connected to blasting caps, or other explosives.

***CAUTION*** All units must be thoroughly tested and the batteries fully charged prior to operational use.

***CAUTION*** Unequal air pressure inside the Controller Unit may affect the operation of membrane switch keypad. Extreme pressure differentials may irreversibly damage the keypad and/or cases.

***CAUTION*** Vents in all units should be momentarily opened and closed immediately before use.

***CAUTION*** Do not open a vent if there is water on or near the vent. Take necessary precautions to ensure water does not enter the vent.

***CAUTION*** Do not use any component that is damaged, suspected of being damaged, or is not able to operate as designed. The safety of the operation could be compromised.

# 1. INTRODUCTION.

1.1. PURPOSE.

1.1.1. The primary purpose of this manual is to provide descriptive information, operational information, instructions in assembly, and instructions in testing and preparation for operational or training use of the Remote Firing Device (RFD).

1.1.2. The Remote Firing Device (RFD) is used to activate electric detonator devices. The System is strictly an electronic device, containing no explosive. The Controller Unit shall be operated from 100 feet to five miles from the explosive. The Remote Unit shall be placed at the explosive site, with a two-conductor firing line running to the explosive. The Controller Unit communicates to the Remote Unit through a two-way RF transmitter data link, for a typical distance greater than 5 miles. The Remote Unit can return communication for a distance of 1 mile.

1.2. STORAGE AND ENVIRONMENTAL CONDITIONS.

1.2.1. The Controller Unit and Remote Unit have manual operated vents. The vents should always be CLOSED during air transport, underwater transport, storage and operational use to prevent moisture intake. The operator should momentarily open and close the vent after the unit has been subjected to changes in elevation or depth. This equalizes pressure within the case to the outside environment. DO NOT open the vent if there is water on or near the vent. Towel dry prior to opening vents. The vents should be OPEN, when stored in a dry hot environment.

1.2.2. The Controller Unit and Remote Unit (with vents closed) are airtight to an altitude of 30,000 feet and watertight to a depth of 100 feet.

1.2.3. The Controller Unit and Remote Units are shock resistant, drop tested from 5 feet onto concrete.

1.2.4. The battery pack and unit electronics are electrically isolated from the unit case.

1.2.5. The Controller Unit and Remote Unit have a temperature operation from -22 ºF to +140 ºF.

## 1.3. PACKAGING.

1.3.1. The RFD Systems are packaged in a hard-shell carrying case. The Controller Unit and all Remote Units have an individual cut-out location in the internal packing. There is a cut-out location in the internal packing for all the Antenna Assemblies. Provided in the Carrying Case Assembly is a cut-out location in the internal packing for the Battery Charger Assembly and optional Test Box Assembly. Do not damage or throw away the Carrying Case Assembly, this is used to store and ship the RFD System.

Table 1-1 RFD System

| Figure | Index No. | Description | Units Per System |
|---|---|---|---|
| Figure 1-1 | 1 | Controller Unit | 1 |
| Figure 1-1 | 2 | Remote Unit | 8 |
| Figure 1-1 | 3 | Battery Charger Assembly | 1 |
| Figure 1-1 | 4 | Antenna Assembly | 9 |
| Figure 1-1 | 5 | Carrying Case Assembly | 1 |
| Figure 1-1 | 6 | Test Box Assembly | 1 |

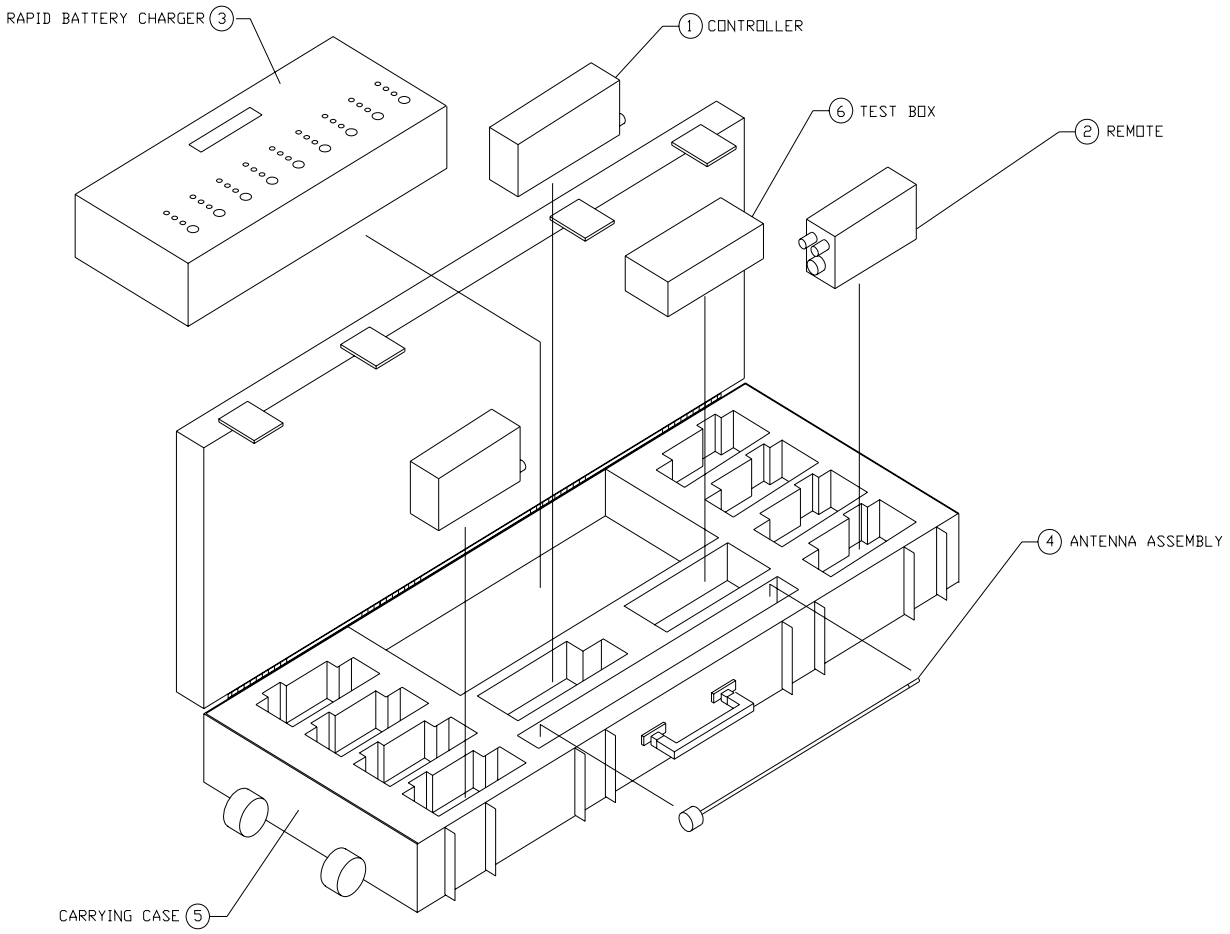


Figure 1-1 RFD System.

## 1.4. MAINTENANCE.

1.4.1. Periodic maintenance is limited to discharging and charging the battery packs.

1.4.2. Corrective maintenance shall be accomplished at the manufacturer or repair depot. Replacement of parts or repair at the user level and field disassembly is not authorized.

1.4.3. In case of failure of a component of the RFD System, ship the system to the repair depot.

# 2. INTRODUCTION TO RFD SYSTEM COMPONENTS.

2.1. SYSTEM.

2.1.1. The RFD is a battery powered, hand held, radio remote controlled system to be used on land as a primary firing mechanism to detonate explosive charges. The RFD system consists of a Controller Unit and 8 Remote Units.

2.1.2. The Controller Unit and Remote Units in one system will not operate with Units from another system.

2.1.3. The RFD is transportable over land, underwater to a depth of 100 feet, and in the air to an altitude of 30,000 feet. The units are shock resistant (5 feet to concrete) and impervious to static discharge.

2.1.4. The RFD will operate in a temperature range of -22 ºF to + 140 ºF.

2.1.5. The system has two modes of operation; the one-way (out of range) and the two-way (in range) mode.

2.1.5.1. Range for one-way mode is greater than 5 miles typically.

2.1.5.2. Range for two-way mode is up to 1 mile typically.

2.1.6. The RFD System consists of the component parts in Table 2-1. The total system is shown and identified in Figure 2-1.

Table 2-1 RFD System.

| Figure | Index No. | Description | Units Per System |
|---|---|---|---|
| Figure 2-1 | 1 | Controller Unit | 1 |
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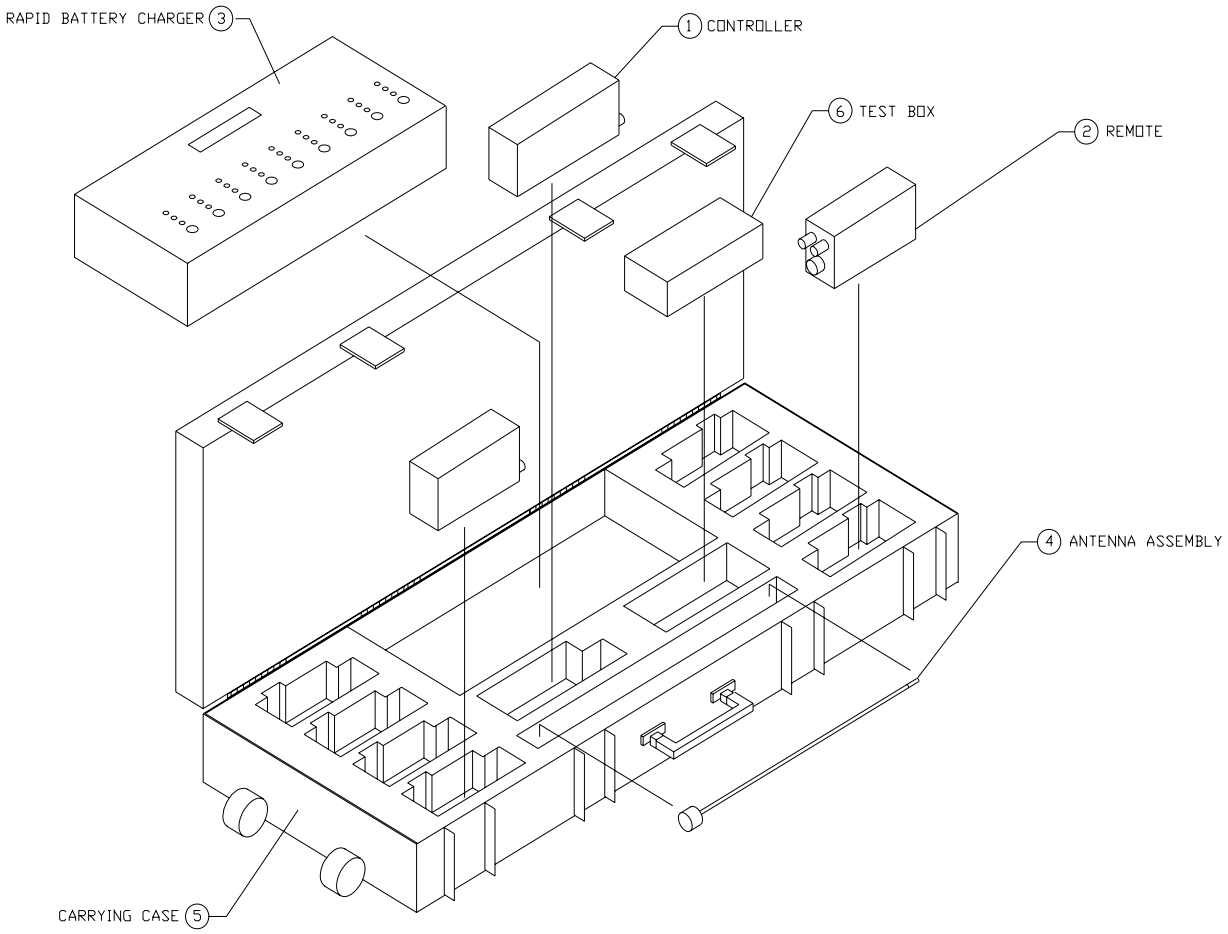



Figure 2-1 RFD System.

## 2.2. CONTROLLER UNIT.

2.2.1. Figure 2-2. Provides the physical size, weight, front panel light, and switch locations on the Controller Unit. The unit is sealed at the manufacturer or repair depot and should not be opened during field activity.

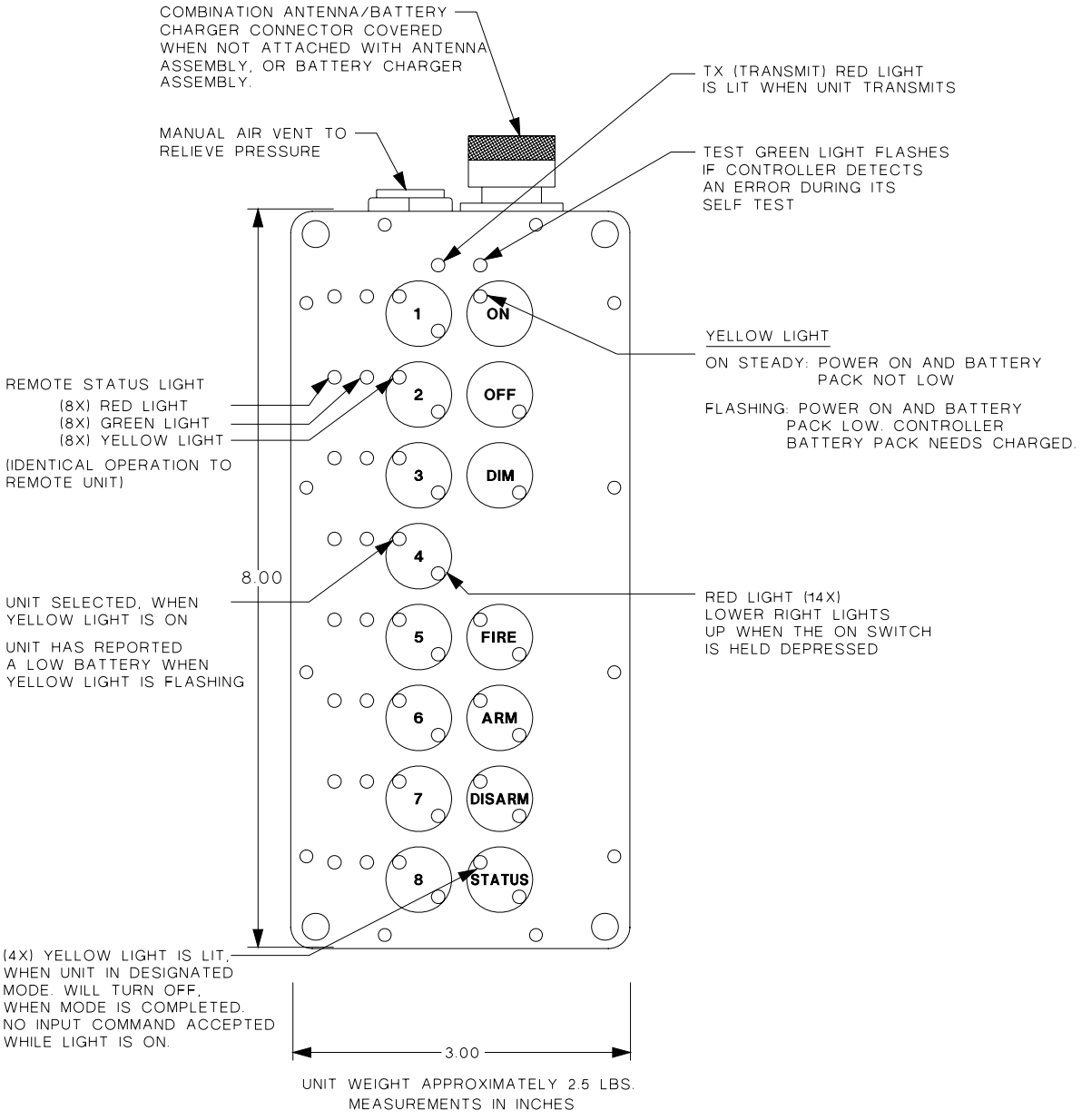



Figure 2-2 Controller Unit.

## 2.3. CONTROLLER UNIT SWITCH OPERATION.

2.3.1. **Unit Power Control**. Depress the “ON” switch for one second to turn the power on to the Controller Unit when the Antenna Assembly is attached. Depress the “OFF” switch to turn the power off to the Controller Unit. The power is off when the Antenna Assembly is removed.

2.3.2. **Display Panel Light Dimmer Circuit**. Depress the “DIM” switch to toggle the display panel lights dim or bright.

2.3.3. **Select Remote Units**. Depress “1” through “8” switches to select independently the Remote Units that will communicate with the Controller Unit. Any combination of the eight Remote Units may be selected. The yellow SELECT light on the switch indicates if the Remote Unit programmed for that switch is selected. Press the switch again and the yellow SELECT light for that Remote Unit will be turned off indicating the Remote Unit is not selected.

2.3.4. **Request Remote Unit Status**. Depress “STATUS” switch to transmit a status request signal to the selected Remote Units. The selected Remote Units will transmit their current status to the Controller Unit. If none of the Remote Units are selected, the Controller Unit will request status from all eight Remote Units. If the Controller Unit is within range of the Remote Unit transmitter, the status of the selected Remote Unit will be presented on the display panel with a steady light. If the Controller Unit is out of range of the Remote Unit transmitter, the status will be assumed from the last command sent to that Remote Unit. In that case the assumed status of the Remote Unit will flash on the display panel.

2.3.5. **Arm the Remote Unit**. Depress the “ARM” switch for 1/2 second and the Controller Unit will transmit the Arm command to the selected Remote Units. The red ARMED light at the selected Remote Units will flash on the Controller Unit display panel until the firing capacitor charging time is completed. The Controller Unit then requests status of the selected Remote Units. If the Controller Unit is within range of the selected Remote Unit transmitter, the ARMED red light for that Remote Unit will be on steady on the Controller Unit display panel. If the Controller Unit is out of range of the selected Remote Unit transmitter, the red ARMED light for that Remote Unit will continue to flash on the Controller Unit display panel. If the Fire command is not sent within 60 seconds, the system will disarm automatically.

2.3.6. **Disarm the Remote Unit**. Depress the “DISARM” switch, the Controller Unit will transmit the Disarm command to selected Remote Units. Selected Remote Units will internally discharge their firing capacitor. Selected Remote Units that receive the Disarm command will become disarmed within 3 seconds of receiving the command. The green DISARMED light for selected Remote Units will begin to flash on the Controller Unit display panel. The Controller Unit will then request status of selected Remote Units. If the Controller Unit is within range of the selected Remote Unit transmitter, the green DISARMED light for that Remote Unit will turn to steady on the Controller Unit display panel. If the Controller Unit is out of range of the selected Remote Unit transmitter, the green DISARMED light for that Remote Unit will continue to flash on the Controller Unit display panel. If the Fire command is not sent within 60 seconds of arming, the system will disarm automatically.

***CAUTION*** Do not assume the Disarm command has been received by the Remote Unit unless DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. If distance appears to be the problem, move closer to the Remote Unit following standard procedures for this type of situation. The “STATUS” and/or “DISARM” switches may be pressed repeatedly as the Remote Unit is approached. Maintain a safe distance from the Remote Unit. Do not approach the Remote Unit until DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. Under no conditions should the “FIRE” switch be pressed as the Remote Unit is approached. DO NOT bring the Controller Unit closer than 100 feet to blasting caps, wires connected to blasting caps, or other explosives.

2.3.7. **Activate the Remote Unit Firing Circuit**. Depress the “FIRE” switch for 1/2 second and the Controller Unit will transmit the Fire command to selected Remote Units. If the “FIRE” switch is pressed during the firing capacitor charge time, the Controller Unit will wait until the Remote Units have had time to fully Arm, and then it will send the Fire command automatically. The Controller Unit will only transmit the Fire command to selected Remote Units whose status is Armed. The selected Remote Units will be placed in Fire Mode and discharge the firing capacitor across the binding posts. The red ARMED light will turn off and the green DISARMED light for each selected Remote Unit will begin to flash on the Controller Unit display panel. The Controller Unit will then request status from the selected Remote Units. If the Controller Unit is within range of the selected Remote Unit transmitter, the DISARMED green light for that Remote Unit will turn to steady on the Controller Unit display panel. If the Controller Unit is out of range of the selected Remote Unit transmitter, the green DISARMED light for that Remote Unit will continue to flash on the Controller Unit display panel.

2.3.8. **Multistage Firing of Remote Units**. Multistage firing provides the ability to arm all eight Remote Units at one time, and select any combination of the Remote Units to fire at different intervals within the 60 second arm period. The procedure for multistage firing is :

- Depress “1” though “8” switches.

- Depress “ARM” switch – all eight Remote Units will arm.
- Depress the switches for the Remote Units that will not be fired initially.
- Depress the “FIRE” switch. Only Remote Units still selected will fire.
- Depress the switches for the Remote Units that were just fired.
- Depress the switches for Remote Units to be fired next.
- Depress the “FIRE” switch. Only Remote Units still selected will fire.
- Repeat as necessary. Remote Units will automatically disarm if not fired within 60 seconds of arming.

2.3.9. **Misfires**. If a Remote Unit does not fire when the Fire command is sent, repeat fire sequence up to 3 times. If the Remote Unit continues not to fire, then a thirty-minute wait prior to approaching is mandatory. Follow your standard operating procedures for misfires.

## 2.4. CONTROLLER UNIT DISPLAY OPERATION.

2.4.1. **Nighttime Panel Switch Locator**. There are fourteen red lights used for backlighting the Controller Unit switches. When the “ON” switch is pressed, the lights turn on to locate the switch positions.

2.4.2. **Display Panel Dimmer Circuit**. Pressing “DIM” switch reduces the intensity of all of the panel display lights except the ON light.

2.4.3. **Controller Unit Battery Status**. The yellow light at the “ON” switch displays the Controller Unit BATTERY status. If the Controller Unit battery is low, the yellow light at the “ON” switch will flash. Otherwise this light will be on steady.

2.4.4. **Remote Unit Battery Status**. The yellow select light at each of the “1” through “8” switches will indicate the selected Remote Units’ battery status after a status request command is issued. If the selected Remote Unit transmitter is within range of the Controller Unit and Remote Unit's battery is low, the yellow select light for that Remote Unit will flash. Else, the select light will be on steady.

2.4.5. **Remote Unit Disarmed**. A green light next to each of the “1” though “8” switches is used to indicate when the corresponding Remote Unit is disarmed. The light will be on steady when the Remote Unit transmitter is within range of the Controller Unit and it is disarmed. If the Remote Unit transmitter is out of range of the Controller Unit, the light will flash after a Disarm command has been sent.

2.4.6. **Remote Unit Armed**. A red light next to each of the “1” though “8” switches is used to indicate when the corresponding Remote Unit is armed. The ARMED light for selected Remote Units will flash after the Arm command is sent to the selected Remote Units. The ARMED light will go to steady after the firing capacitor charge time if the Controller Unit is within range of the selected Remote Unit's transmitter. If the Remote Unit transmitter is out of range of the Controller Unit, the ARMED light will continue to flash.

2.4.7. **Status**. A yellow light at the “STATUS” switch lights when the “STATUS” switch is pressed. The light remains on until the display panel has been updated with results of the status request. All new commands are blocked while this light is on.

2.4.8. **Arm**. A yellow light at the “ARM” switch lights when the “ARM” switch is pressed. This light will stay on for the firing capacitor charge time. Other commands will not be sent until this light is turned off.

2.4.9. **Disarm**. A yellow light at the “DISARM” switch lights when the “DISARM” switch is pressed. This light will stay on until the display panel is updated for the Disarm command. Other commands will not be sent until this light is turned off.

2.4.10. **Fire**. A yellow light at the “FIRE” switch lights when the “FIRE” switch is pressed. This light will stay on until the display panel is updated for the Fire command. Other commands will not be sent until this light is turned off.

2.4.11. **“TX” (Transmit)**. A red light at the “TX” position lights while Controller Unit is transmitting.

2.4.12. **TEST**. The green light flashes when the Controller Unit detects an error condition during its self-test that it initiates when the Controller Unit is turned on each time.

## 2.5. REMOTE UNIT.

2.5.1. Figure 2-3. Provides the physical size, weight, and front panel lights on the Remote Unit. The unit is sealed at the manufacturer or repair depot and should not be opened during field activity. The Remote Unit operates in a sleep mode to extend battery life. The Remote Unit turns off the display lights while it is sleeping. The Remote Unit wakes up every 2 seconds to check for a radio signal from the Controller Unit. The Remote Unit will stay awake for 2 minutes if it detects a radio signal addressed to it during its wake time. During those 2 minutes, the display lights will be illuminated as described in Figure 2-3. When the antenna is installed on the Remote Unit, the Remote Unit performs a self-test of its electronics. The red light will flash on the Remote Unit if the self-test fails. The Remote Unit should not be used, and should be returned for repair, if the red light is flashing.

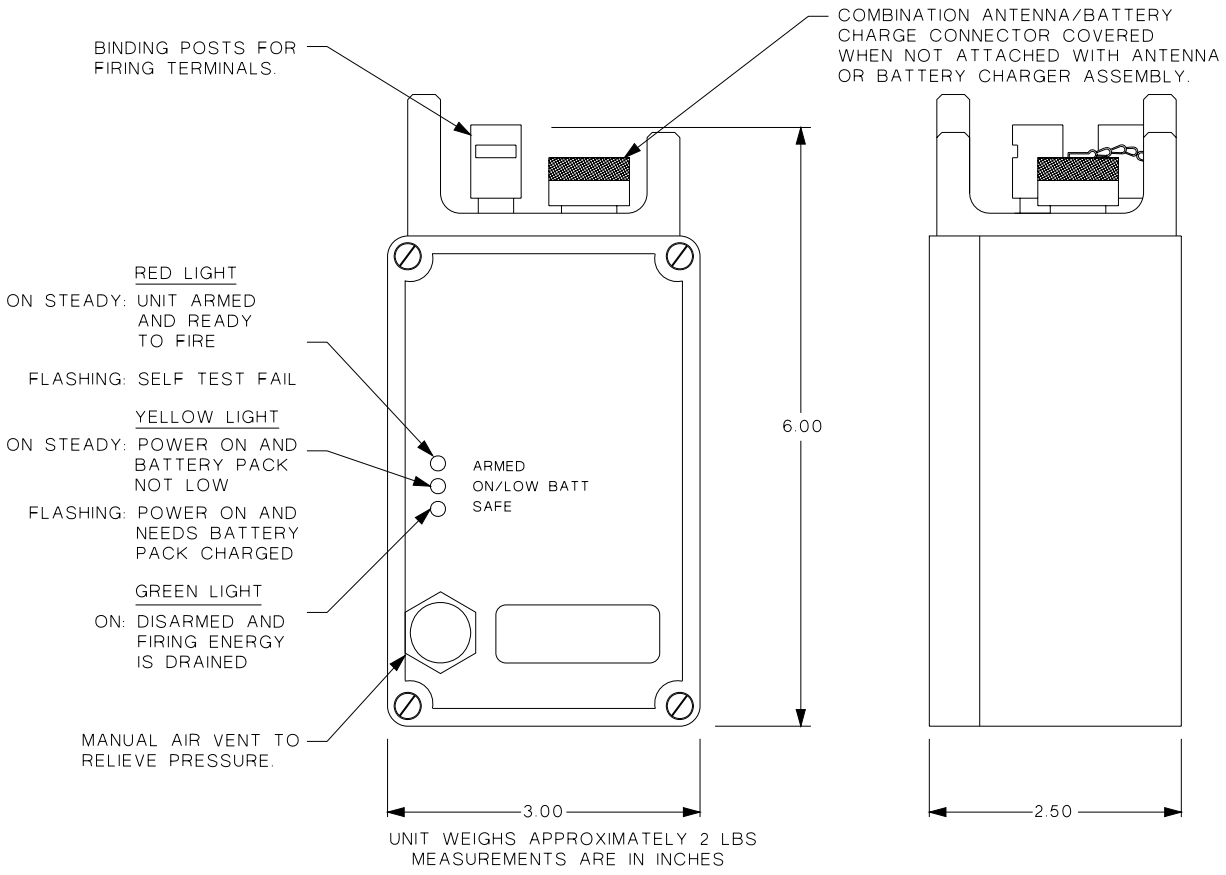



Figure 2-3 Remote Unit.

## 2.6. RADIO SHOCK TUBE INITIATOR.

2.6.1. Figure 2-4. Shows the optional Radio Shock Tube Initiator (RSTI) that may be supplied in addition to, or in placement of the standard electric detonator Remote Units. The RSTI operates identical to the standard Remote Unit, but initiates 1/8$^{th}$ inch non-electric tubing instead of electric detonators. The RSTI develops 2,500V at the igniter tip jacks when firing. No voltage is present at the jacks when armed. Use caution to keep hands and bodies away from the igniter tip jacks or igniter tip when armed or firing.

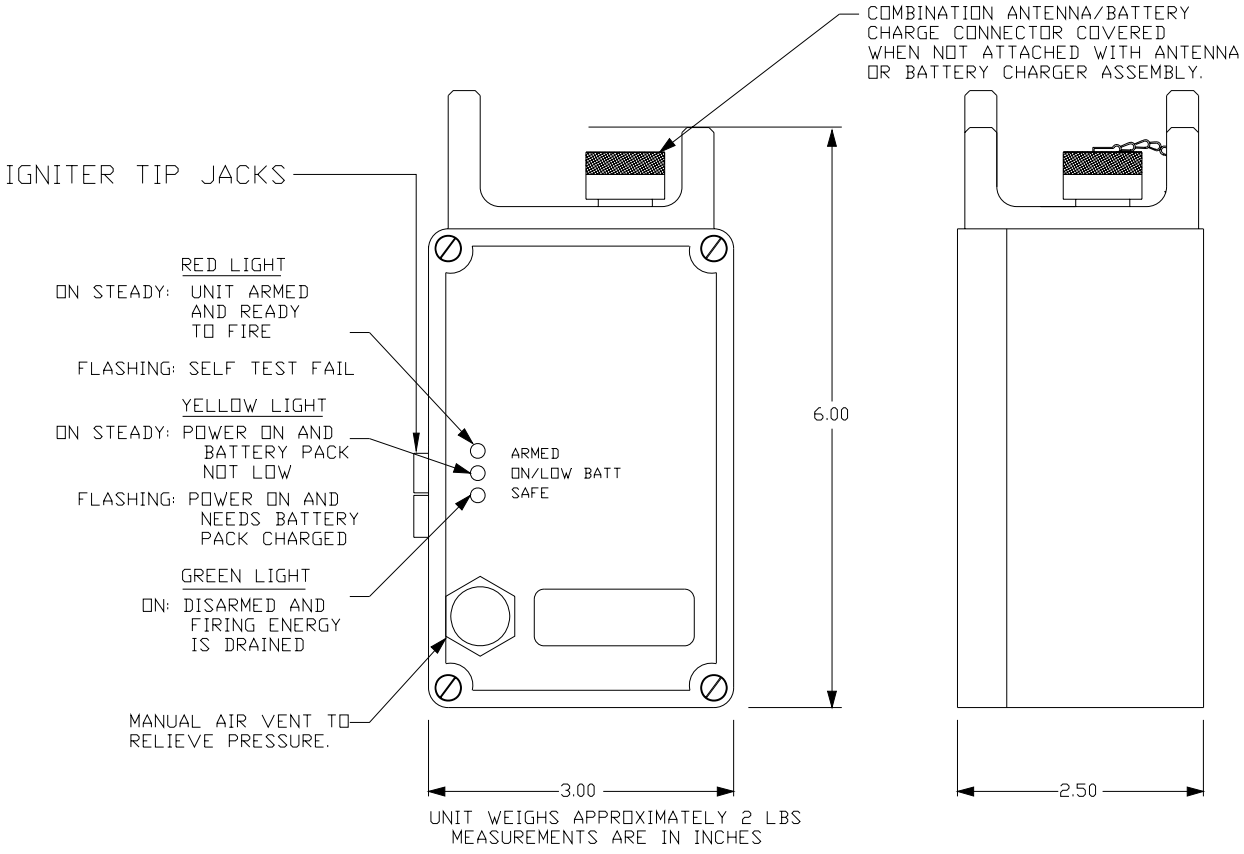



Figure 2-4 Radio Shock Tube Initiator (RSTI)

2.6.2. Figure 2-5. Shows the installation of the shock tube onto the igniter tip when preparing for use. Take care when handling the shock tube to prevent the incursion of debris or moisture into the tube. Keep open tube ends capped except during preparation for use. Keep the tip needle clean and dry. Replace the tip every 200 shots or if misfiring occurs.

***WARNING*** Do not touch the igniter tip jacks on the Radio Shock Tube Initiator (RSTI) when armed or firing. Lethal voltages may be present.

1. Make a fresh cut with a sharp knife removing the last 6 inches of shock tube.

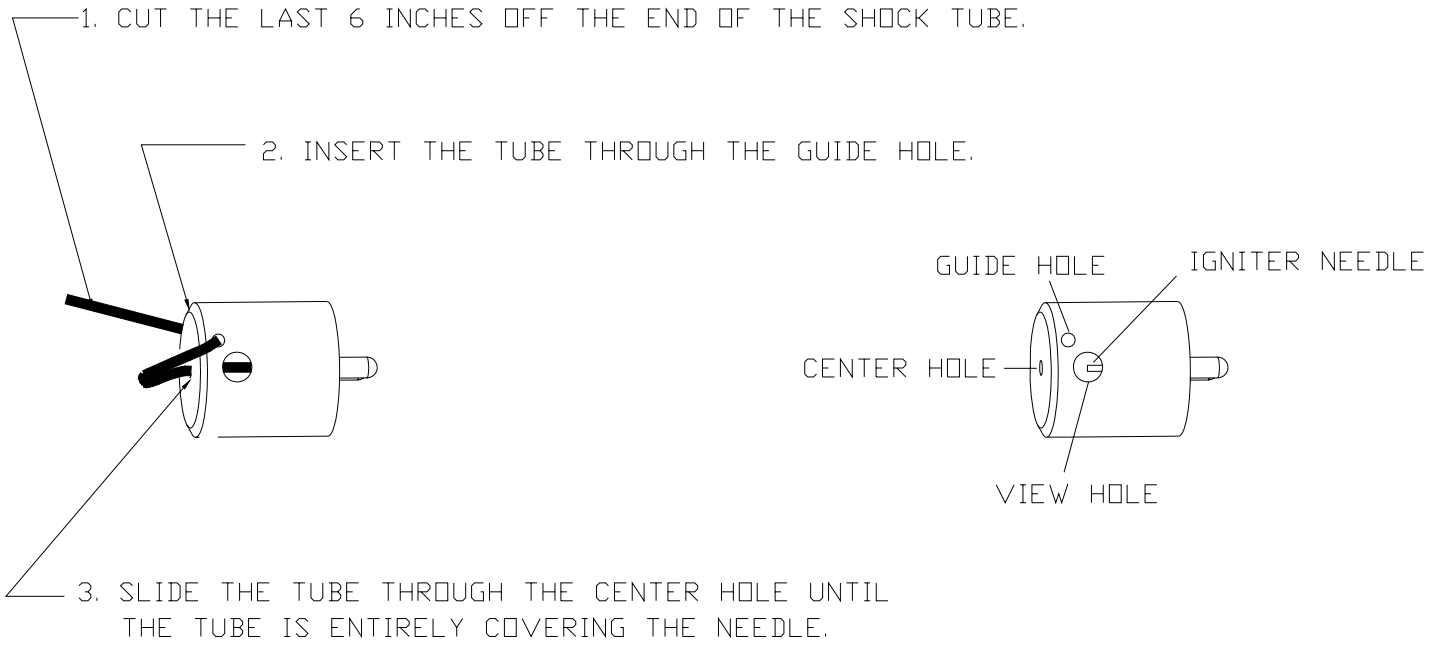



Figure 2-5 Shock Tube Igniter Tip

2. Insert the shock tube through the guide hole on the tip as shown in Figure 2-5. The guide hole secures the tube to the tip and prevents pulling out.

3. Insert the tube into the center hole on the flat side. Feed the tube through the hole observing the side view hole. The tube should slide onto the igniter needle until the needle is no longer visible and the tube is resting against the plastic tip housing.

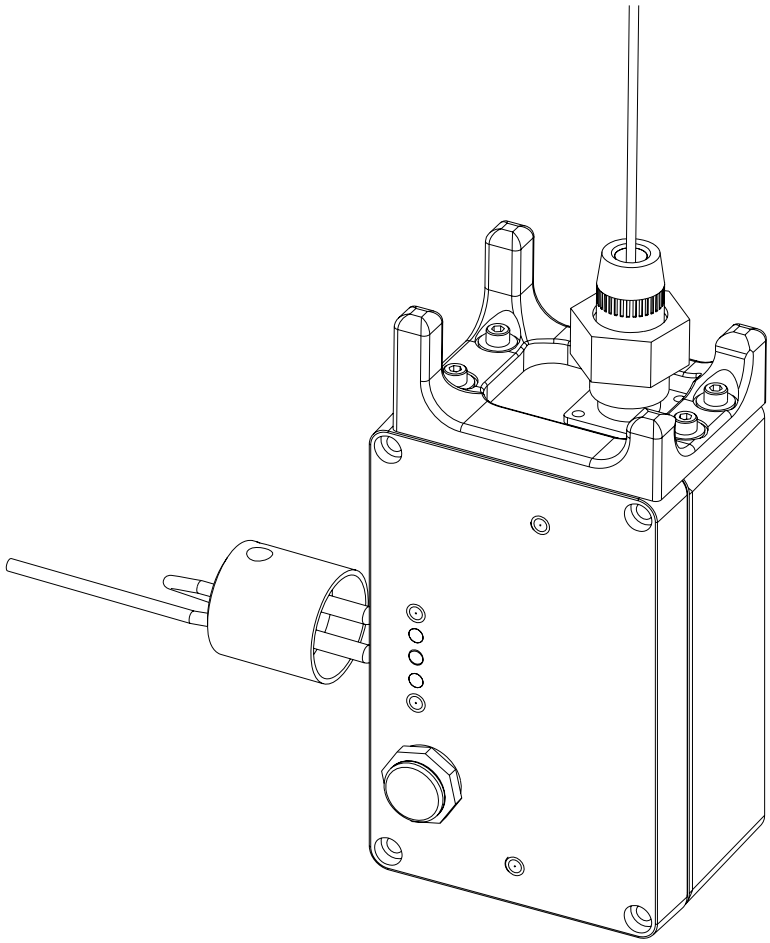


Figure 2-6 Igniter Tip Installation.

4. Install the loaded igniter tip into the igniter jacks located on the left side of the unit as shown in Figure 2-6. These connections are polarity insensitive. The unit is now ready for use.

## 2.7. BATTERY CHARGER ASSEMBLY.

2.7.1. Figure 2-7. Provides the front panel lights, and switch position on the Battery Charger Assembly. The unit is sealed at the manufacturer or repair depot and should not be opened during field activity.

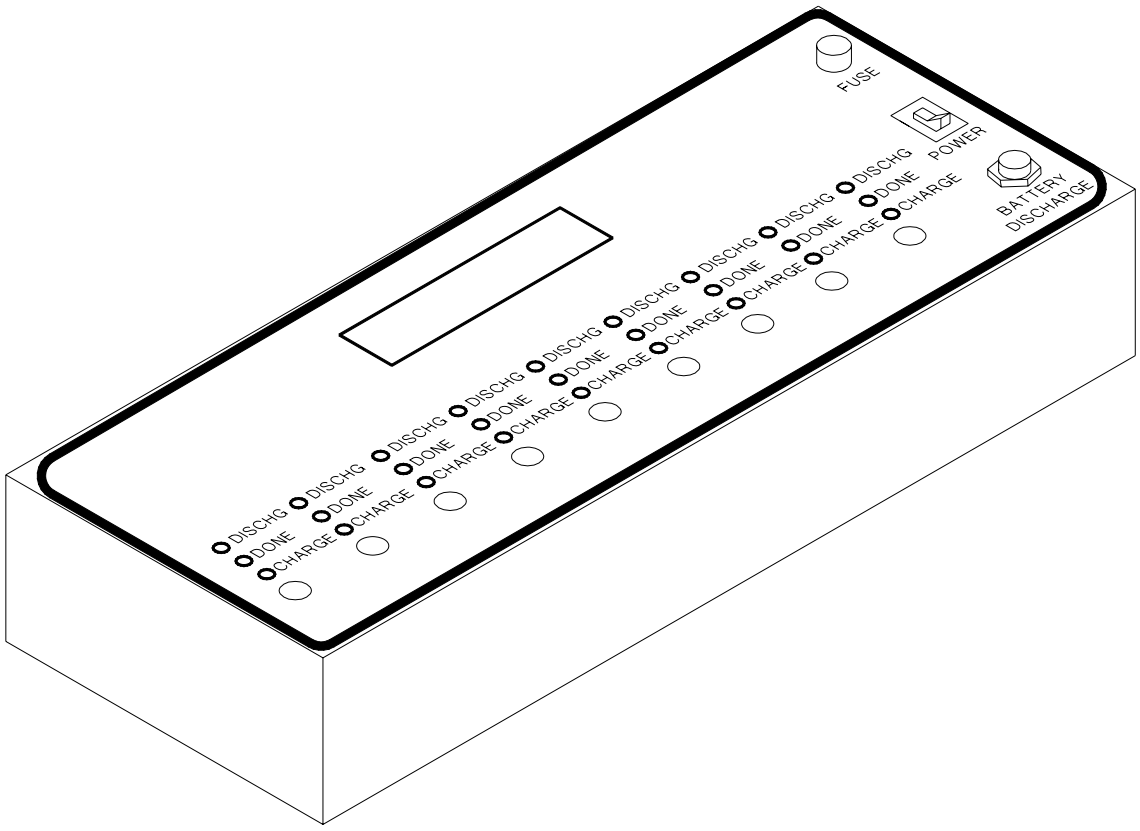



Figure 2-7 Battery Charger Assembly.

## 2.8. TEST BOX.

2.8.1. Figure 2-8. Provides a drawing of the Test Box. The Test Box is used to program and evaluate the condition of the Controller and Remote Units. The following data is displayed by the Test Box Assembly.

- Battery voltage of the Test Box
- System Address
- Unit ID
- Frequency
- Battery voltage of unit under test while the battery is being loaded down.
- Remote Units under test are armed and fired. The firing voltage is displayed.

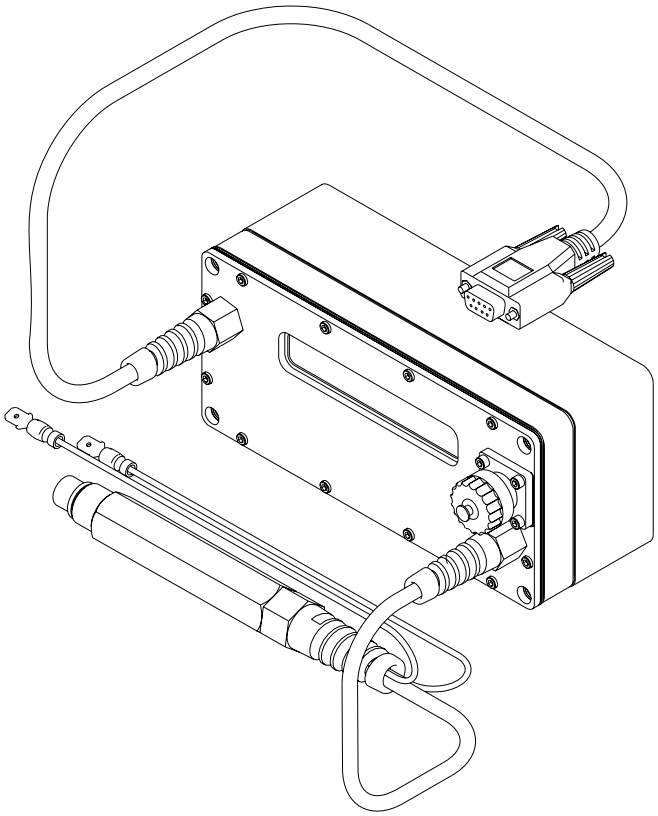


Figure 2-8 Test Box Assembly.

## 2.9. ANTENNA ASSEMBLY.

2.9.1. Figure 2-9. Provides the physical size, technical requirements and view of the Antenna Assembly. The power to the Controller Unit and Remote Unit is interrupted when the Antenna Assembly is not connected.

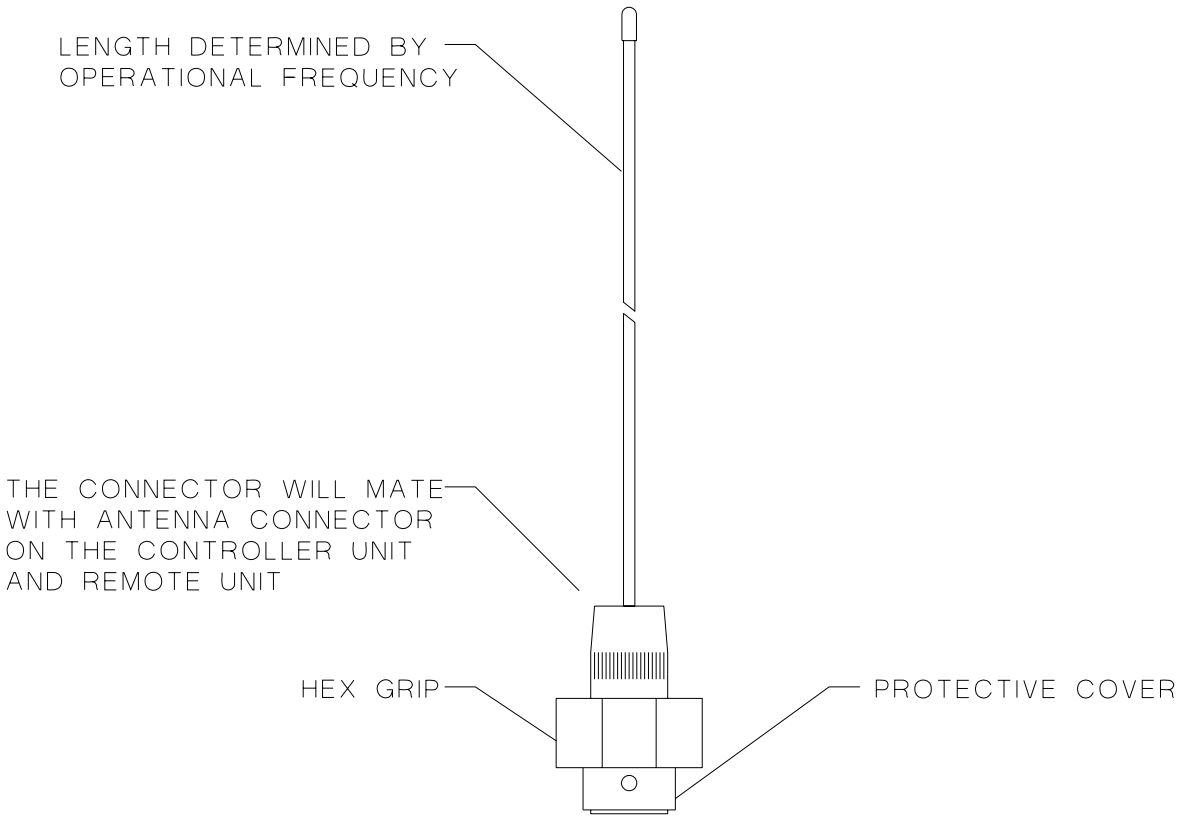



Figure 2-9 Antenna Assembly.

## 2.10. CARRYING CASE.

2.10.1. Figure 2-10. Provides the physical size of the Carrying Case and a view of the storage location for System assemblies in the Carrying Case. The Carrying Case has a pressure equalization vent near the handle. The vent should be opened prior to opening the Carrying Case. The vent should be kept closed during storage and shipment.

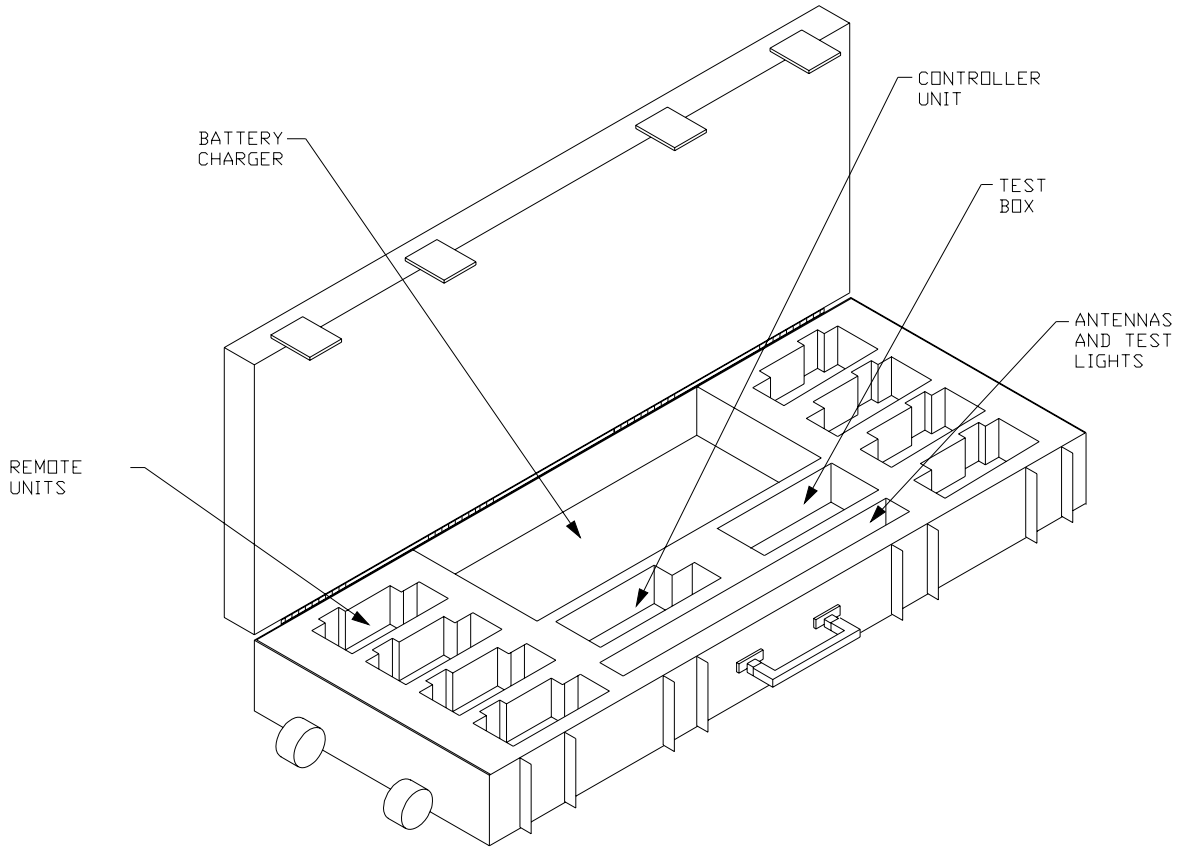



Figure 2-10 Carrying Case.

## 2.11. VENT OPERATION.

2.11.1. Figure 2-11. The Controller Unit and Remote Unit vents are manual and relieve internal pressure due to heat and altitude. When the vent is closed, it will not leak in 100 feet of water or up to 30,000 feet in altitude.

***CAUTION*** Unequal air pressure inside the Controller Unit may affect the operation of membrane switch keypad. Extreme pressure differentials may irreversibly damage the keypad and/or cases.

***CAUTION*** Vents in all units should be momentarily opened and closed immediately before use.

***CAUTION*** Do not open a vent if there is water on or near the vent. Take necessary precautions to ensure water does not enter the vent.

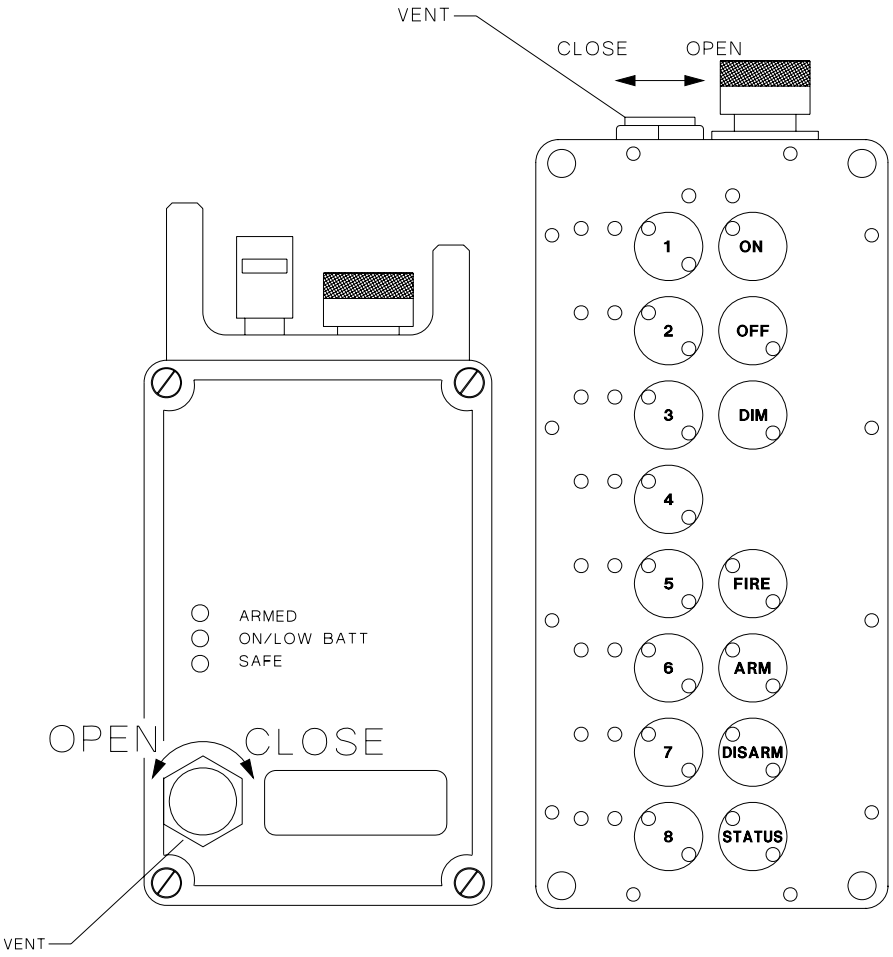



Figure 2-11 Vent Operation.

## 2.12. ANTENNA / BATTERY CHARGER CONNECTOR.

2.12.1. Figure 2-12. & Figure 2-13. The Controller Unit and Remote Unit antenna / battery charger connector accommodates the input requirements for both the Antenna Assembly and the Battery Charger Assembly. The unit electronics and battery pack are only connected together when the Antenna Assembly is connected to the antenna / battery charger Connector.

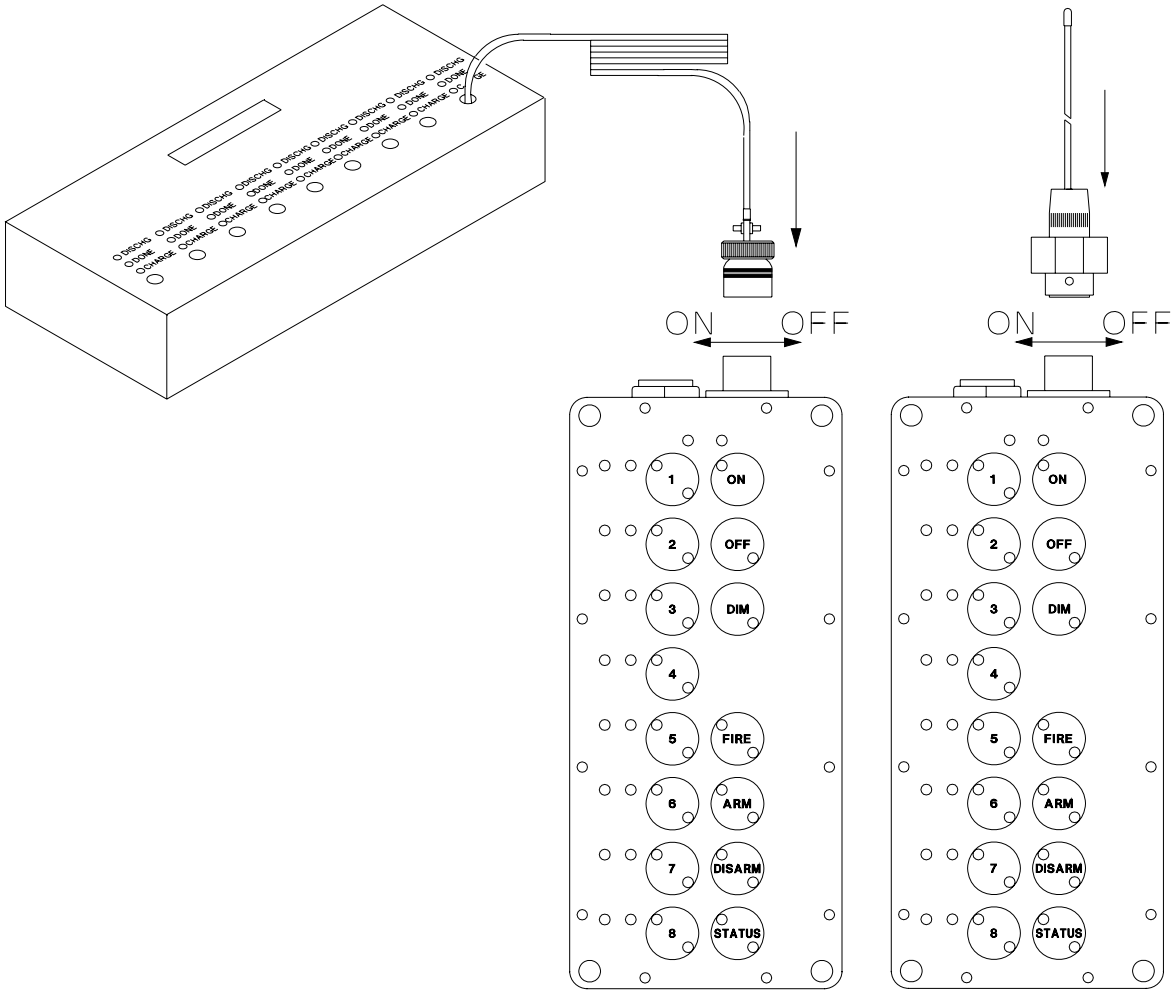



Figure 2-12 Controller Antenna / Battery Charger Connection.

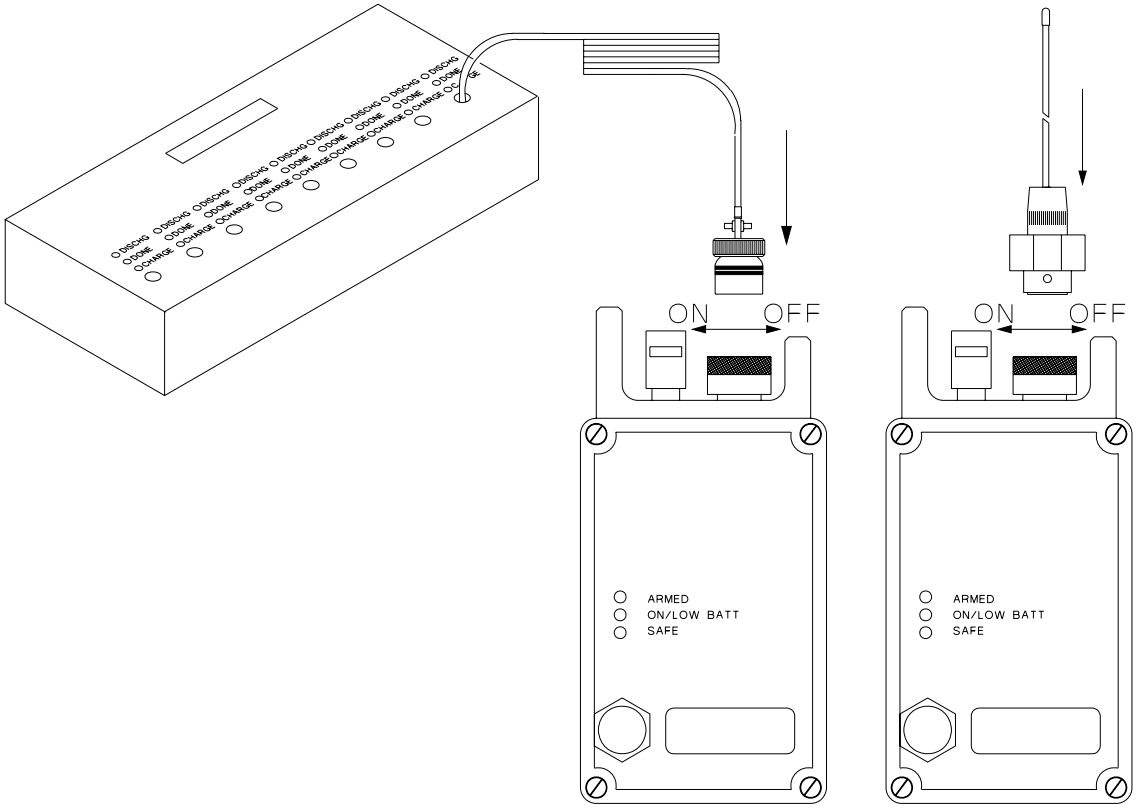



Figure 2-13 Remote Antenna / Battery Charger Connection.

## 2.13. CONNECTOR DUST COVER OPERATION.

2.13.1. Figure 2-14. The Controller Unit and Remote Unit antenna / battery charger connector dust cover protects the connector pins from shorting out and damage when the Antenna Assembly or Battery Charger Assembly is not connected. The connector dust cover should be connected to the connector when the connector is not in use.

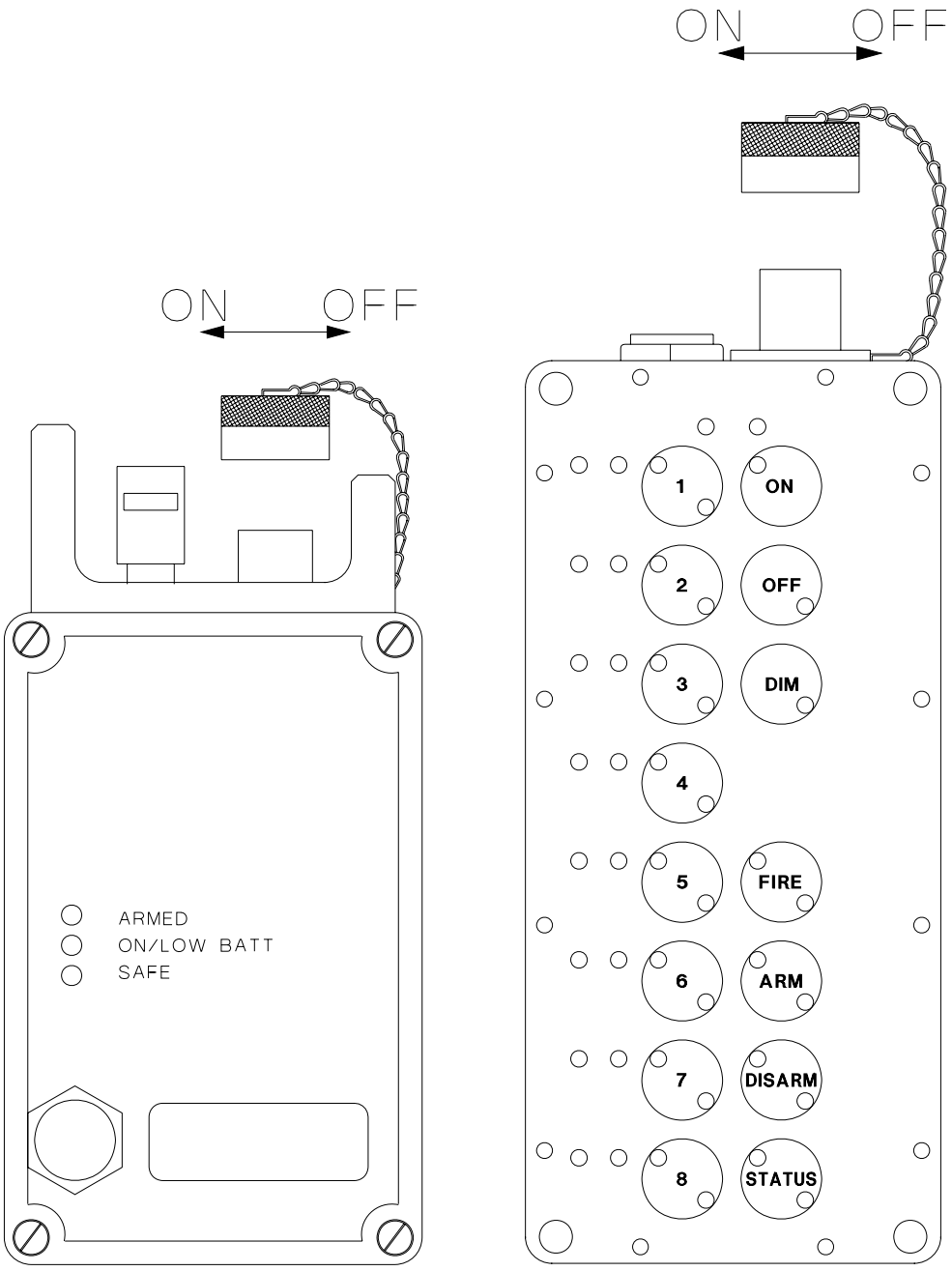



Figure 2-14 Connector Dust Cover Operation.

# 3. SYSTEM SPECIFICATIONS.

3.1. RADIO.

| | | | |
|---|---|---|---|
| CARRIER FREQUENCY | 150 - 174 MHz * | OPERATING TEMPERATURE RANGE | -30ºC to 60ºC<br>-22ºF to 140ºF |
| FCC | Certified | | <freq. diff. 1300 HZ (±650) |

| CONTROLLER UNIT | | REMOTE UNIT | |
|---|---|---|---|
| FREQUENCY STABILITY | ±5PPM OR (0.00005%) | FREQUENCY STABILITY | ±5PPM OR (0.00005%) |
| MODULATION | 10K6F2D (AFSK) | MODULATION | 9K56F2D (AFSK) |
| TRANSMIT POWER | 5 Watts | TRANSMIT POWER | 2 Watts |
| OPERATING POWER | 12 VDC | OPERATING POWER | 7.2 VDC |
| TRANSMISSION RANGE (LOS) | Greater than 5 miles | TRANSMISSION RANGE (LOS) | 1 mile |
| RECEIVER SENSITIVITY | 12 dB Sinad at 0.28uV | RECEIVER SENSITIVITY | 12 dB Sinad at 0.28uV |

(*) The Production Unit Frequency Designation will be provided in the contract.

(**) Typical transmission range, based on frequency used and terrain.

3.2. PHYSICAL.

| Controller Unit | | Remote Unit | |
|---|---|---|---|
| SIZE(w/out antenna) (in) | 8H x 3W x 2.5D | SIZE(w/out antenna)(in) | 6H x 3W x 2.5D |
| SIZE(w/out antenna) (cm) | 20.32H x 7.62W x 6.35D | SIZE(w/out antenna)(cm) | 15.24H x 7.62W x 6.35D |
| WEIGHT (w/battery) | 2.5 lbs., 1.14 kg | WEIGHT (w/battery) | 2 lbs., 0.91 kg |
| CASE | Die cast aluminum | CASE | Die cast aluminum |
| COLOR | Black | COLOR | Black |

3.3. BATTERY.

| Controller Unit | | Remote Unit | |
|---|---|---|---|
| BATTERY PACK | Rechargeable NiMH | BATTERY PACK | Rechargeable NiMH |
| BATTERY LIFE | 6 Hours | BATTERY LIFE | > 200 Hours* |
| BATTERY RECHARGE | 100 Minutes | BATTERY RECHARGE | 100 Minutes |
| STANDBY CURRENT | 60 milliamps | STANDBY CURRENT | 6 milliamps |
| TRANSMIT CURRENT | 2.5 Amp | TRANSMIT CURRENT | 1 Amp |

(*) At the end of the standby time, the Remote Unit can detonate 5 (2-Ohm) blasting caps connected in series and attached to 100 feet of wire.

3.4. TIMING.

| | |
|---|---|
| Controller Unit ARM time: | 1/2 ± 0.1 Seconds |
| Remote Unit ARM time: | 10 ± 0.1 Seconds |
| Controller Unit Auto DISARM time: | 60 ± 0.1 Seconds |
| Remote Unit Auto DISARM time: | 60 ± 0.1 Seconds |
| Controller Unit DISARM time: | 3 ± 0.1 Seconds |
| Remote Unit DISARM time: | 3 ± 0.1 Seconds |
| Controller Unit FIRE time: | 1 ± 0.1 Seconds |
| Remote Unit FIRE time:* | 20 Milliseconds |

*This is the delay after the Remote Unit receives the command signal from the Controller Unit to Fire.

3.5. DETONATE OUTPUT.

The Remote Unit detonation output pulse is from a 3300 microfarad capacitor charged to 27 volts.

| | |
|---|---|
| Stored Energy Level: | 1 Joule (minimum) |
| Pulse Voltage Level: | 27 VDC (typical), 26 VDC (minimum) |
| Circuit Current Limit:* | 3.4 Ohm (maximum)* |

*This is the maximum resistance between the firing capacitor and the output terminals.

3.6. SYSTEM IDENTIFICATION.

3.6.1. Each Controller Unit and Remote Unit is marked with an identification label. Figure 3-1 Shows how the identification label should interpreted. The Controller Unit will only communicate with Remote Units from the same system.

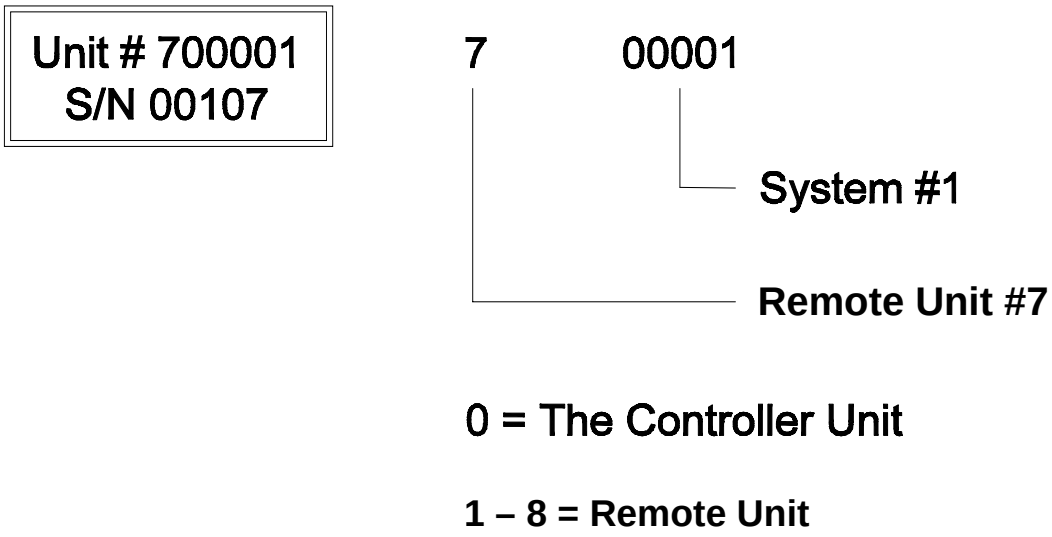



Figure 3-1 Identification Label.

# 4. PRE-OPERATIONAL PROCEDURES.

4.1. PHYSICAL INSPECTION.

4.1.1. Inspect all components for physical damage.

***CAUTION*** Do not use any component that is damaged, suspected of being damaged, or is not able to operate as designed. The safety of the operation could be compromised.

4.1.2. Ensure the antenna / battery charger connector on the Controller Unit and Remote Unit is not Damaged.

4.1.3. Remove the antenna / battery charger connector dust cover and ensure the electrical pin area is clean and free of foreign material. Replace the dust cover.

4.1.4. Ensure the Antenna Assembly whip is not broken and that the whip has not separated from the sealing compound at the top of the connector.

4.1.5. Ensure that the spring-loaded binding posts on the Remote Units are not damaged.

4.1.6. Remove the red dust cover from the Antenna Assembly and ensure that there is no foreign material in the electrical contact area. Replace the red dust cover.

4.2. BATTERY CHARGING.

4.2.1. The battery packs in the Controller Unit and Remote Units contain rechargeable NiMH batteries. The battery packs are recharged through the antenna / battery charger connector on each unit. Battery packs are not to be removed (case opened) in the field.

4.2.2. The battery pack in the Controller Unit and Remote Units should be charged before the system is used each time. The Battery Charger Assembly will charge the Controller Unit and Remote Units in 100 minutes typically. Each Battery Charger Assembly has nine independent rapid chargers. Each rapid charger has a CHARGE, DONE, and DISCHG light. The Battery Charger Assembly has a single “BATTERY DISCHARGE” switch. The Battery Charger Assembly will discharge all battery packs connected, when the “BATTERY DISCHARGE” switch is pressed. Complete discharge of battery packs occurs in approximately 3 hours. Battery capacity will be maintained if the battery packs are discharged prior to charging.

4.2.3. Turn off the power switch on the Battery Charger Assembly.

4.2.4. Plug the AC cord into a 110 VAC 60 Hz outlet. The Battery Charger Assembly will operate from 90-135/180-270 VAC, 47-63 Hz.

4.2.5. Connect each Remote Unit and the Controller Unit to the Battery Charger Assembly. The Controller Unit can be connected to any of the nine cables.

4.2.6. Open the vent on each Remote Unit and the Controller Unit.

4.2.7. Turn on the power switch on the Battery Charger Assembly.

4.2.8. The CHARGE light for each connected unit will flash for approximately 5 seconds. The flashing CHARGE light indicates that rapid charging is pending.

4.2.9. In normal operation, the CHARGE light will be on solid after 5 seconds has passed. The solid CHARGE light indicates that the battery is being rapid charged.

4.2.10. The battery must be within the temperature range 32 ºF and 104 ºF for rapid charging to occur. If the battery pack is not within temperature range for rapid charging, the CHARGE light will continue to flash beyond 5 seconds. While the CHARGE light is flashing, the battery pack is being slow charged.

4.2.11. If the detected battery voltage is less than 6 volts for Remote Units and 10 volts for Controller Units, the battery will be slow charged until the voltage is high enough for rapid charge. If the battery pack is defective and the voltage does not rise to the correct level, for rapid charge, the Battery Charger Assembly remains in slow charge mode. In that case the CHARGE light will continue to flash.

4.2.12. When rapid charging terminates, the DONE light will be on steady, and the CHARGE light will be turned off.

4.2.13. Rapid charging terminates when the charger detects the battery pack is charged. Rapid charging will also terminate after 3 hours, or if the battery pack temperature is out of range.

4.2.14. If a Controller Unit or Remote Unit is left turned on beyond the low battery point, the battery pack may not fully charge before the 3 hour rapid charge time limit expires. In that case, charge the battery pack again.

4.2.15. Close the vent on each Remote Unit and the Controller Unit

4.3. <u>BATTERY DISCHARGING.</u>

4.3.1. Turn off the power switch on the Battery Charger Assembly.

4.3.2. Plug the AC cord into an 110VAC 60Hz outlet. The Battery Charger Assembly will operate from 90-135/180-270 VAC, 47-63 Hz.

4.3.3. Connect each Remote Unit and the Controller Unit to the Battery Charger Assembly. The Controller Unit can be connected to any of the nine cables.

4.3.4. Open the vent on each Remote Unit and the Controller Unit.

4.3.5. Turn on the power switch on the Battery Charger Assembly.

4.3.6. The CHARGE light for each connected unit will flash for approximately 5 seconds. The flashing CHARGE light indicates that rapid charging is pending.

4.3.7. Press the “BATTERY DISCHARGE” switch. The DISCHG light will be on solid and the CHARGE light will flash.

4.3.8. After the battery pack has been discharged, the DISCHG light will turn off and the CHARGE light will be on solid indicating rapid charge mode.

4.3.9. When the battery pack is charged, the DONE light will be on steady, and the CHARGE light will be turned off.

4.3.10. Close the vent on each Remote Unit and the Controller Unit.

4.4. BENCH TESTING THE SYSTEM.

***WARNING*** Radio frequency energy of sufficient magnitude can cause blasting caps to detonate.

4.4.1. The System test must be conducted in an area that is at least 100 feet from the nearest blasting caps, wires connected to blasting caps, or other explosives.

4.4.2. All RFD System controls are described in detail in section 2.

***CAUTION*** All units must be thoroughly tested and the batteries fully charged prior to operational use.

4.4.3. Install the Antenna Assembly on the antenna / battery charger connector of the Controller Unit. Ensure the Controller Unit is off.

4.4.4. Install the Antenna Assemblies on the antenna / battery charger connectors of the Remote Units. The ON/LOW BATT and SAFE lights will come on steady. If the ON/LOW BATT light is flashing, the Remote Unit has a low battery. Recharge the battery in accordance with section 4.1.6.

4.4.5. Turn the Controller Unit on by pressing the “ON” switch for 1 second. A yellow light located in the upper left quadrant of the “ON” switch will come on steady. If the yellow light does not come on steady, but flashes, this indicates a low battery for the Controller Unit. Recharge the battery in accordance with section 4.1.6.

4.4.6. Press the “STATUS” switch for 1 second. The red TX light on the Controller Unit will start blinking for approximately 15 seconds. During that time the Controller Unit is requesting status from the Remote Units.

4.4.7. When the TX light stops flashing, the green DISARMED light will come on steady adjacent to the switches numbered “1” through “8”. A steady DISARMED light indicates that Remote Unit answered back with its status and it is disarmed. A flashing DISARMED light indicates the Controller Unit did not receive the Remote Unit’s status transmission.

***WARNING*** Ensure that blasting caps are not connected to any of the Remote Units during bench test.

4.4.8. Select all of the Remote Units by pressing switches “1” through “8”. A yellow light will be lit in each switch to indicate the corresponding Remote Unit is selected.

4.4.9. Press the “ARM” switch for ½ second. The red ARMED light for each selected Remote Unit will flash on the Controller Unit display panel for approximately 10 seconds and then come on steady. The ARMED light for each selected Remote Unit will grow brighter and then stay on steady. The Remote Units are now armed.

4.4.10. Observe the Controller Unit and Remote Units. In approximately 60 seconds the Remote Units will automatically disarm. The ARMED lights at the Controller Unit and Remote Units should turn off. The DISARMED lights at the Controller Unit and SAFE lights at the Remote Units should turn on.

4.4.11. Re-Arm the Remote Units. Before the 60 second time-out takes place, press the “DISARM” switch on the Controller Unit. The Controller Unit's ARMED light will be turned off. The DISARMED lights at the Controller Unit should blink for approximately 3 seconds and then turn on steady. The ARMED lights at the Remote Units will turn off and the Remote Units’ SAFE lights will turn on.

4.4.12. Connect a test bulb assembly to the binding posts of each Remote Unit. Arm the Remote Units. Press the “FIRE” switch on the Controller Unit. The test bulb should flash brightly. The ARMED light will turn off and the SAFE light will turn on at each Remote Unit. The displayed status at the Controller Unit will change from ARMED to DISARMED.

4.4.13. Turn off the Controller Unit by pressing the “OFF” switch. Turn off the Remote Units by removing their Antenna Assemblies.

4.4.14. The RFD system is now ready to use operationally.

# 5. OPERATIONAL PROCEDURES.

***WARNING*** Use of this system and its components must be restricted to personnel qualified and experienced in the field of explosives and detonating devices. Under no circumstances shall untrained personnel attempt to use this manual as a text for self-teaching.

***WARNING*** Employ standard blasting system safety standards when using this equipment with explosives.

***CAUTION*** All units must be thoroughly tested and the batteries fully charged prior to operational use.

5.1. READY THE SYSTEM AT SITE.

5.1.1. Remote Units. Select the number of Remote Units required for the operation. Remove the dust cover from the antenna / battery charger connector. Install the Antenna Assembly on to the antenna / battery charger connector. This will turn on the Remote Unit. The yellow ON/LOW BATT light and green SAFE light will be turned on. The green SAFE light will be on whenever the Remote Unit is turned on and it is disarmed. In the disarmed state, the firing capacitor charge circuit is disabled, the binding posts are electrically isolated from the firing capacitor, and the binding posts are shunted to each other. If the yellow ON/LOW BATT light is flashing, the Remote Unit battery is low and should be recharged before use.

***WARNING*** Do not connect a blasting cap to a Remote Unit unless the green SAFE light is on, the red ARMED light is off, and the yellow ON/LOW BATT light is on steady. This indicates there is no voltage on the binding posts, the binding posts are electically isolated from the firing capacitor, the binding posts are shunted to each other, and the battery is not low.

5.1.2. Open and close the vent on each Remote Unit and the Controller Unit to equalize the case pressure. Unscrew the vent, one revolution, to open.

5.1.3. Remove the dust cover from the antenna / battery charger connector of the Controller Unit. Install the Antenna Assembly on to the antenna / battery charger connector. This will enable the keypad on the Controller Unit.

***WARNING*** Do not use the Controller Unit within 100 feet of explosives, blasting caps, or wires leading to them. The controller signal is 5 watts, which can cause detonation of caps if within 100'. The 5 watt controller complies with the Recommended Table of Distances established by the Institute for the Makers of Explosives (IME) when placed beyond 100 feet of explosives.

5.1.4. Press the Controller Unit “ON” switch for one second. The yellow light in the upper left quadrant of the “ON” switch will come on steady. If the yellow light flashes, the Controller Unit battery is low and needs charging. Refer to Battery charging section 4.1.6.

5.1.5. Press the “STATUS” switch on the Controller Unit. The red TX light will flash for approximately 15 seconds. The green DISARMED light corresponding to each Remote Unit will come on steady if the Controller Unit receives a status message from that Remote Unit. If the Controller Unit does not receive a status message from a Remote Unit, the green DISARMED light for that Remote Unit will flash on the Controller Unit display panel.

***Note:*** The Controller Unit battery life is approximately 6 hours when in the “ON” condition. To conserve battery life, the Controller Unit should be turned off when not being used.

5.1.6. Turn the Controller Unit “OFF” until Remote Units are in place and wired to shoot.

5.2. PLACEMENT OF REMOTE UNITS.

***WARNING*** Do not connect a blasting cap to a Remote Unit unless the green SAFE light is on, the red ARMED light is off, and the yellow ON/LOW BATT light is on steady. This indicates there is no voltage on the binding posts, the binding posts are electically isolated from the firing capacitor, the binding posts are shunted to each other, and the battery is not low.

5.2.1. The range of the RFD is typically 5 miles under most conditions.

5.2.2. Place the Remote Units with the antenna in a vertical position and free from obstruction within 100 feet of the shot. Use sandbags or other suitable materials to protect the Remote Units from the shot.

5.2.3. Ensure that all Remote Units indicate a SAFE condition (green light on steady).

5.2.4. After performing standard demolition circuit checks and before placing initiator into main charge, depress the two spring-loaded binding posts on the Remote Unit.

5.2.5. Insert one leg of the demolition wire in each binding post and allow the binding posts to close on the wire ends.

5.2.6. Ensure the wire is held securely by the binding posts and that the wire ends are not touching the Remote Case or each other.

5.2.7. Prepare the shot and return to the safe firing area.

5.2.8. If all Remote Units are located within 1 mile of the Controller Unit, refer to section 5.2.10.

5.2.9. If all Remote Units are located more 1 mile than from the Controller Unit, refer to section 5.3.11.

5.2.10. If some Remote Units are located within 1 mile of the Controller Unit, and other Remote Units are more than 1 mile from the Controller Unit, refer to section 5.4.11.

5.3. SYSTEM OPERATION – REMOTE UNITS WITHIN 1 MILE OF CONTROLLER UNIT.

***Note:*** If the distance between the Controller Unit and the Remote Units is in excess of 5 miles, the Remote Units status transmissions may not be received by the Controller Unit. The Controller Unit will command the Remotes from a distance greater than 5 miles, but the Remote Status may not be confirmed. The Controller Unit performs just as it would when it is within 1 mile of the Remote Units. The only difference is the method the status indications are displayed on the Controller Unit display panel. The ARMED and DISARMED status lights for out of range Remote Units will flash on the Controller Unit display panel to indicate the Controller Unit did not receive a status message from the Remote Unit. Once the Remote Units are set up for the shot, the operator must assume the Remote Units have received the command.

5.3.1. Ensure the area is clear.

5.3.2. Turn the Controller Unit on.

5.3.3. Press the “STATUS” switch. The Controller Unit will request status from all Remote Units. The red TX light will flash for approximately 15 seconds. The green DISARMED light on the Controller Unit display panel will come on steady for the Remote Units that the Controller Unit receives a disarmed status message from.

5.3.4. Select the Remote Units that are to be used in the shot by pressing the corresponding numbered switches “1” through “8”. Press the numbered switches one at a time.

***System Safety Feature*** Once armed, the Remote Units must be sent a Fire command within 60 seconds. If the Remote Units do not receive a Fire command within 60 seconds of being armed, they will automatically disarm. The firing capacitor will be safely internally discharged, the binding posts will remain isolated from the firing capacitor and the binding posts will remain shunted together.

5.3.5. To arm the selected Remote Units, press the “ARM” switch. The red ARMED light next to each selected Remote Unit switch will flash for 10 seconds and then come on steady. The selected Remote Units are now ARMED!

5.3.6. To fire the Remote Units, press the “FIRE” switch. The operator should get an indication of shot initiation. The ARMED light will go out and the green DISARMED light for each selected Remote Unit will come on solid on the Controller Unit display panel.

5.3.7. If not all the Remote Units were selected for the shot, repeat above steps to initiate the remaining shots.

5.3.8. To disarm any Remote Units that have been armed, select the Remote Units and press the “DISARM” switch. All selected Remote Units will return to the DISARMED mode in approximately 3 seconds.

***CAUTION*** Do not assume the Disarm command has been received by the Remote Unit unless DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. If distance appears to be the problem, move closer to the Remote Unit following standard procedures for this type of situation. The “STATUS” and/or “DISARM” switches may be pressed repeatedly as the Remote Unit is approached. Maintain a safe distance from the Remote Unit. Do not approach the Remote Unit until DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. Under no conditions should the “FIRE” switch be pressed as the Remote Unit is approached. DO NOT bring the Controller Unit closer than 100 feet to blasting caps, wires connected to blasting caps, or other explosives.

5.3.9. Turn off the Controller Unit.

5.3.10. Recover the fielded Remote Units.

5.3.11. Refer to Post Operational Procedures in chapter 5.5.14.

5.4. SYSTEM OPERATION – REMOTE UNITS MORE THAN 1 MILE FROM CONTROLLER UNIT.

***Note:*** If the distance between the Controller Unit and the Remote Units is in excess of 5 miles, the Remote Units status transmissions may not be received by the Controller Unit. The Controller Unit will command the Remotes from a distance greater than 5 miles, but the Remote status may not be confirmed. The Controller Unit performs just as it would when it is within 1 mile of the Remote Units. The only difference is the method the status indications are displayed on the Controller Unit display panel. The ARMED and DISARMED status lights for out of range Remote Units will flash on the Controller Unit display panel to indicate the Controller Unit did not receive a status message from the Remote Unit. Once the Remote Units are set up for the shot, the operator must assume the Remote Units have received the command.

5.4.1. Ensure the area is clear.

5.4.2. Turn the Controller Unit on.

5.4.3. Press the “STATUS” switch. The Controller Unit will request status from all Remote Units. The red TX light will flash for approximately 15 seconds. The green DISARMED light on the Controller Unit display panel will flash for all Remote Units that the Controller Unit does not receive a status message from.

5.4.4. Select the Remote Units that are to be used in the shot by pressing the corresponding numbered switches “1” through “8”. Press the numbered switches one at a time.

***System Safety Feature*** Once armed, the Remote Units must be sent a Fire command within 60 seconds. If the Remote Units do not receive a Fire command within 60 seconds of being armed, they will automatically disarm. The firing capacitor will be safely internally discharged, the binding posts will remain isolated from the firing capacitor and the binding posts will remain shunted together.

5.4.5. To arm the selected Remote Units, press the “ARM” switch. The red ARMED light next to each selected Remote Unit switch will flash for 10 seconds, then come on steady for two seconds, and then continue to flash. The selected Remote Units are now assumed to be ARMED!

5.4.6. To fire the Remote Units, press the “FIRE” switch. The operator should get an indication of shot initiation. The ARMED light will go out and the green DISARMED light for each selected Remote Unit will flash on the Controller Unit display panel.

5.4.7. If not all the Remote Units were selected for the shot, repeat above steps to initiate the remaining shots.

5.4.8. To disarm any Remote Units that have been armed, select the Remote Units and press the “DISARM” switch. All selected Remote Units will return to the DISARMED mode in approximately 3 seconds.

***CAUTION*** Do not assume the Disarm command has been received by the Remote Unit unless DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. If distance appears to be the problem, move closer to the Remote Unit following standard procedures for this type of situation. The “STATUS” and/or “DISARM” switches may be pressed repeatedly as the Remote Unit is approached. Maintain a safe distance from the Remote Unit. Do not approach the Remote Unit until DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. Under no conditions should the “FIRE” switch be pressed as the Remote Unit is approached. DO NOT bring the Controller Unit closer than 100 feet to blasting caps, wires connected to blasting caps, or other explosives.

5.4.9. Turn off the Controller Unit.

5.4.10. Recover the fielded Remote Units.

5.4.11. Refer to Post Operational Procedures in chapter 5.5.14.

## 5.5. SYSTEM OPERATION – REMOTE UNITS BOTH WITHIN AND IN EXCESS OF **1 MILE** AND LESS THAN 5 MILES FROM CONTROLLER UNIT.

***Note:*** If the distance between the Controller Unit and the Remote Units is in excess of **1 mile**, the Remote Units status transmissions may not be received by the Controller Unit. The Controller Unit will command the Remotes from a distance greater than 5 miles, but the Remote status may not be confirmed. The Controller Unit performs just as it would when it is within 1 mile of the Remote Units. The only difference is the method the status indications are displayed on the Controller Unit display panel. The ARMED and DISARMED status lights for out of range Remote Units will flash on the Controller Unit display panel to indicate the Controller Unit did not receive a status message from the Remote Unit. Once the Remote Units are set up for the shot, the operator must assume the Remote Units have received the command.

5.5.1. The RFD will operate in a two-way mode (confirmed communications – range to 1 mile) and one-way mode (unconfirmed communications – range greater than 5 miles).

5.5.2. If the Remotes are within 1 mile of the Controller Unit, the status of the Remote Units (ON/LOW BATT, ARMED, and SAFE) will be displayed with solid lights on the display panel of the Controller Unit.

5.5.3. If one or more Remote Units are out of range of the Controller Unit, the status of these Remote Units will be assumed and their status lights will flash on the Controller Unit display panel to indicate unconfirmed status. Accordingly the operator must assume the following:

- Commands have been received by the Remote Units.
- The Remote Unit battery is sufficiently charged to activate the firing circuit.
- A DISARM command should not be assumed.

5.5.4. Ensure the area is clear.

5.5.5. Turn the Controller Unit on.

5.5.6. Press the “STATUS” switch. The Controller Unit will request status from all Remote Units. The red TX light will flash for approximately 15 seconds. The green DISARMED light on the Controller Unit display panel will flash for all the Remote Units that the Controller Unit does not receive a status message from.

5.5.7. Select the Remote Units that are to be used in the shot by pressing the corresponding numbered switches “1” through “8”. Press the numbered switches one at a time.

***System Safety Feature*** Once armed, the Remote Units must be sent a Fire command within 60 seconds. If the Remote Units do not receive a Fire command within 60 seconds of being armed, they will automatically disarm. The firing capacitor will be safely internally discharged, the binding posts will remain isolated from the firing capacitor and the binding posts will remain shunted together.

5.5.8. To arm the selected Remote Units, press the “ARM” switch. The red ARMED light next to each selected Remote Unit switch will flash for 10 seconds, and then come on steady for two seconds. ARMED lights for selected Remote Units that the Controller Unit did not receive a status message from will begin to flash again. The selected Remote Units are now assumed to be ARMED! For unconfirmed communications, count to 10 from when the "ARM" switch is pressed and assume the Remote Units are armed.

5.5.9. To fire the Remote Units, press the “FIRE” switch. The operator should get an indication of shot initiation. The ARMED light will go out and the green DISARMED light for each selected Remote Unit will flash on the Controller Unit display panel.

5.5.10. If not all the Remote Units were selected for the shot, repeat above steps to initiate the remaining shots.

5.5.11. To disarm any Remote Units that have been armed, select Remote Units and press the “DISARM” switch. All selected Remote Units will return to the DISARMED mode in approximately 3 seconds.

***CAUTION*** Do not assume the Disarm command has been received by the Remote Unit unless DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. If distance appears to be the problem, move closer to the Remote Unit following standard procedures for this type of situation. The “STATUS” and/or “DISARM” switches may be pressed repeatedly as the Remote Unit is approached. Maintain a safe distance from the Remote Unit. Do not approach the Remote Unit until DISARMED status is confirmed with a steady DISARMED light for that Remote Unit on the Controller Unit display panel. Under no conditions should the “FIRE” switch be pressed as the Remote Unit is approached. DO NOT bring the Controller Unit closer than 100 feet to blasting caps, wires connected to blasting caps, or other explosives.

5.5.12. Turn off the Controller Unit.

5.5.13. Recover the fielded Remote Units.

5.5.14. Refer to Post Operational Procedures in chapter 5.5.14.

# 6. POST OPERATIONAL PROCEDURES.

6.1. SECURING THE SYSTEM.

6.1.1. Turn the Controller Unit off and remove the Antenna Assembly. This action disables the Controller Unit.

6.1.2. Replace the dust cover on the antenna / battery charger connector on the Controller Unit and replace the plastic cap on the Antenna Assembly.

6.1.3. Remove the Antenna Assemblies from the Remote Units. This action turns off the Remote Units.

6.1.4. Replace the dust cover on the antenna / battery charger connector on the Remote Units and replace the plastic cap on the Antenna Assembly.

6.2. PHYSICAL INSPECTION.

6.2.1. Inspect the Controller Unit and Remote Units for physical damage.

6.2.2. Inspect the units for dirt or corrosion around/on connector pins and vent.

6.2.3. Replace any unit found to have damage. Return unit to manufacturer.

6.2.4. Clean units using a soft bristle brush.

6.2.5. If a unit cannot be cleaned by brushing, make sure the vent is closed securely and wash units in warm soapy water.

6.2.6. Rinse units with clean water and dry thoroughly.

6.2.7. Inspect units for damage. Replace as necessary.

6.3. PACKAGING.

6.3.1. Re-package all components in carrying case.

6.4. MAINTENANCE & EQUIPMENT STORAGE.

6.4.1. Periodic battery charging.

6.4.2. Check for signs of corrosion around and on connector pins.

# 7. BASIC TROUBLESHOOTING IN THE FIELD.

## 7.1. REMOTE UNITS.

### 7.1.1. ON and SAFE lights do not illuminate when the Antenna Assembly is installed.

a) Check Antenna Assembly and make sure it is seated, “clicks” on to the connector.

b) Recharge the battery.

c) Try a different Antenna Assembly.

## 7.2. CONTROLLER UNIT.

### 7.2.1. ON Light does not stay on.

a) Check Antenna Assembly and make sure it is seated, “clicks” on to the connector.

b) Press and hold the “ON” switch for 5 seconds.

c) Controller Unit battery needs to be recharged.

### 7.2.2. Command receipt is not confirmed by Remote Unit.

a) Remote Unit is more than 1 mile from Controller Unit.

b) If the Remote Unit is less than 1 mile away from the Controller Unit.

Check for damage to Controller Unit Antenna Assembly.

Try a different Antenna Assembly on the Controller Unit.

Move at least 25 feet in any direction and try again.

Reposition the Remote Unit if:

- The antenna is not positioned vertically.
- The antenna is next to another radio antenna.
- The antenna is surrounded by metallic objects.
- Use optional magnetic mount antenna for improved gain. This antenna is available by special order only.

## 7.3. RADIO SHOCK TUBE INITIATOR.

### 7.3.1. Unit will not ignite the shock tube.

a) The igniter tip may be worn or damaged. Replace tip.

b) The shock tube may be damaged from moisture. Try a fresh cut or replace the tubing. Ensure the tube covers the entire needle. Ensure both the needle and the tube are dry when mating.

# 8. OPTIMIZING RANGE.

8.1.1. When power lines are in the area, the radio transmission distance is reduced. The system can operate at the following distance, when the Controller Unit is elevated to a maximum transmission location angle to the Remote Unit location (see Figure 8-1).

| Over | Minimum Distance |
|---|---|
| Open Land or Water with Power Lines | 1 mile |
| Dense Vegetation without Power Lines | 1 mile |
| Open Land or Water without Power Lines | Greater than 5 Miles |

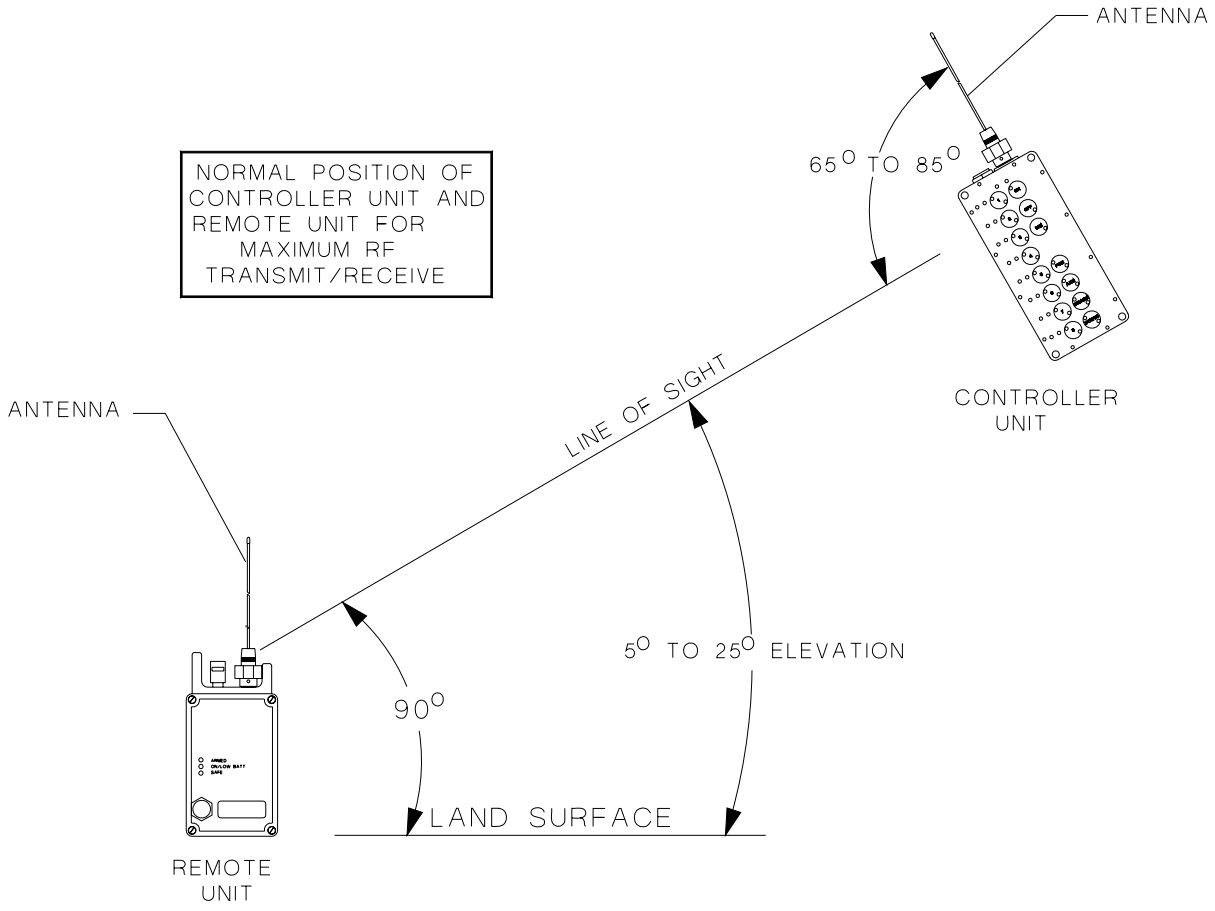



Figure 8-1 Unit Normal Transmission Location.

8.1.2. If the Controller Unit and Remote Unit must be placed in a position other than location in Figure 8-1, use Figure 8-2 or Figure 8-3. The minimum transmission will occur when the Controller Unit antenna and the Remote Unit antenna are placed in the line of site. The maximum transmission occurs when the line of site lays in a path of 5 to 25 degrees above unit top plane perpendicular to the antenna. Both the Controller Unit antenna and the Remote Unit antenna have the same radiant energy pattern as shown in Figure 8-4.

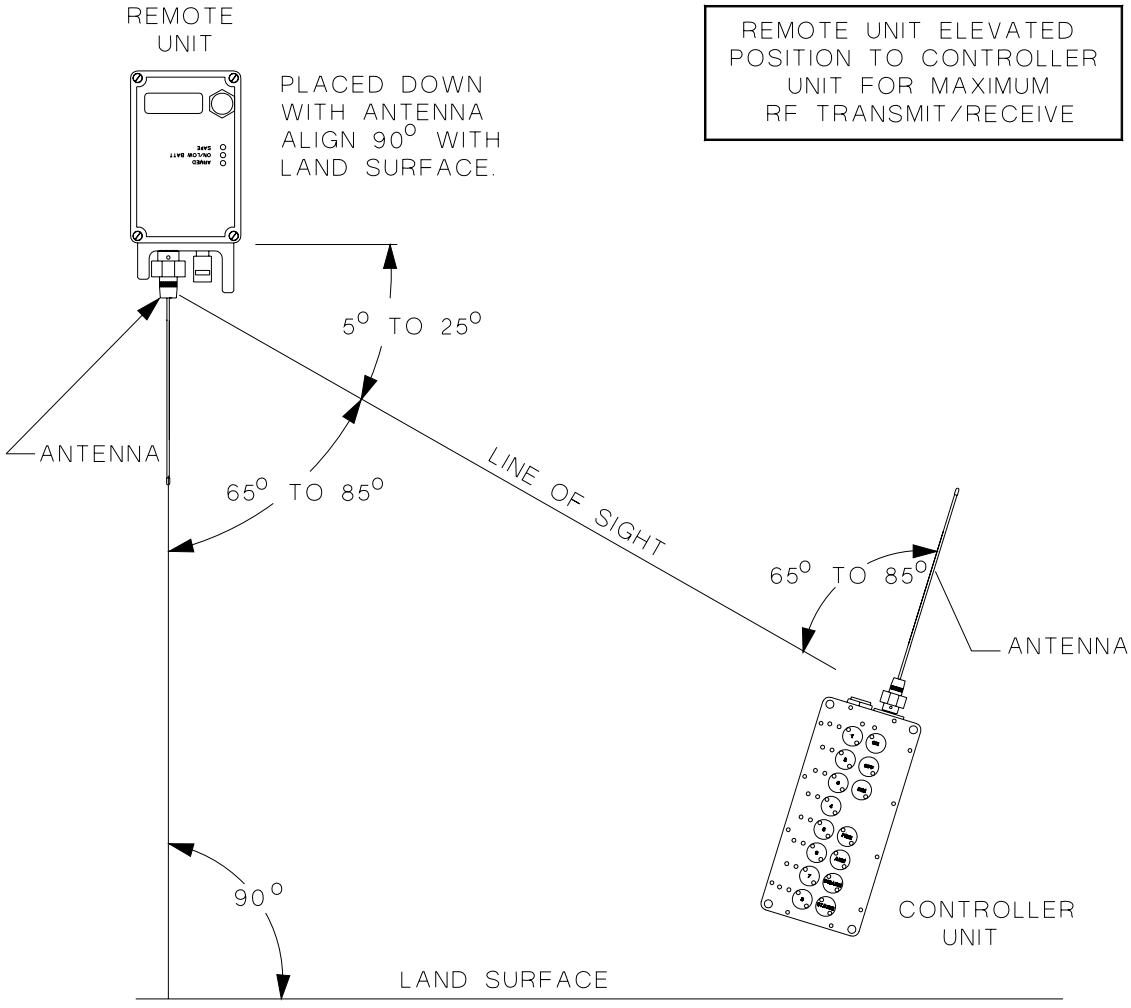



Figure 8-2 Remote Unit Elevated.

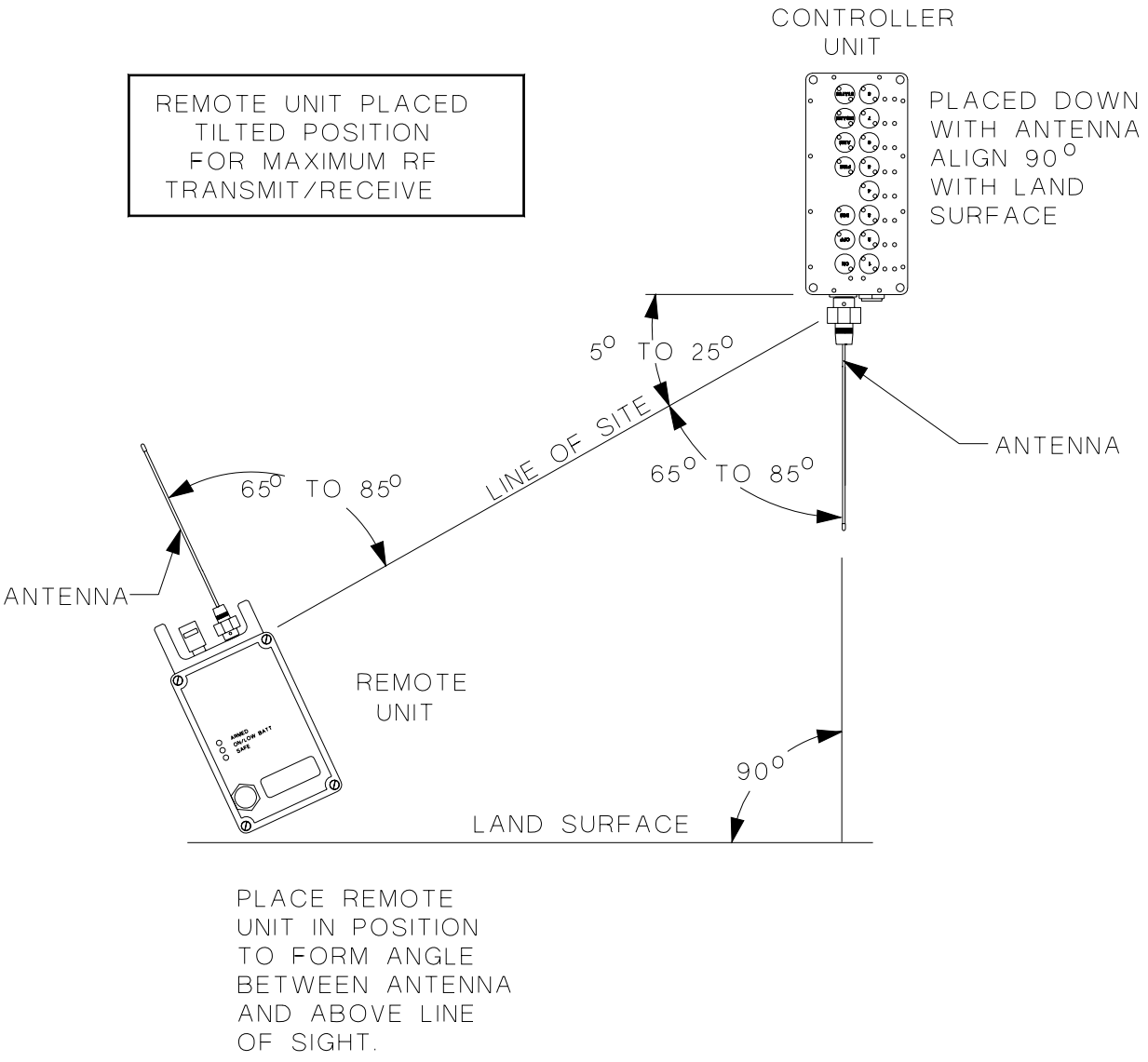



Figure 8-3 Controller Unit Elevated.

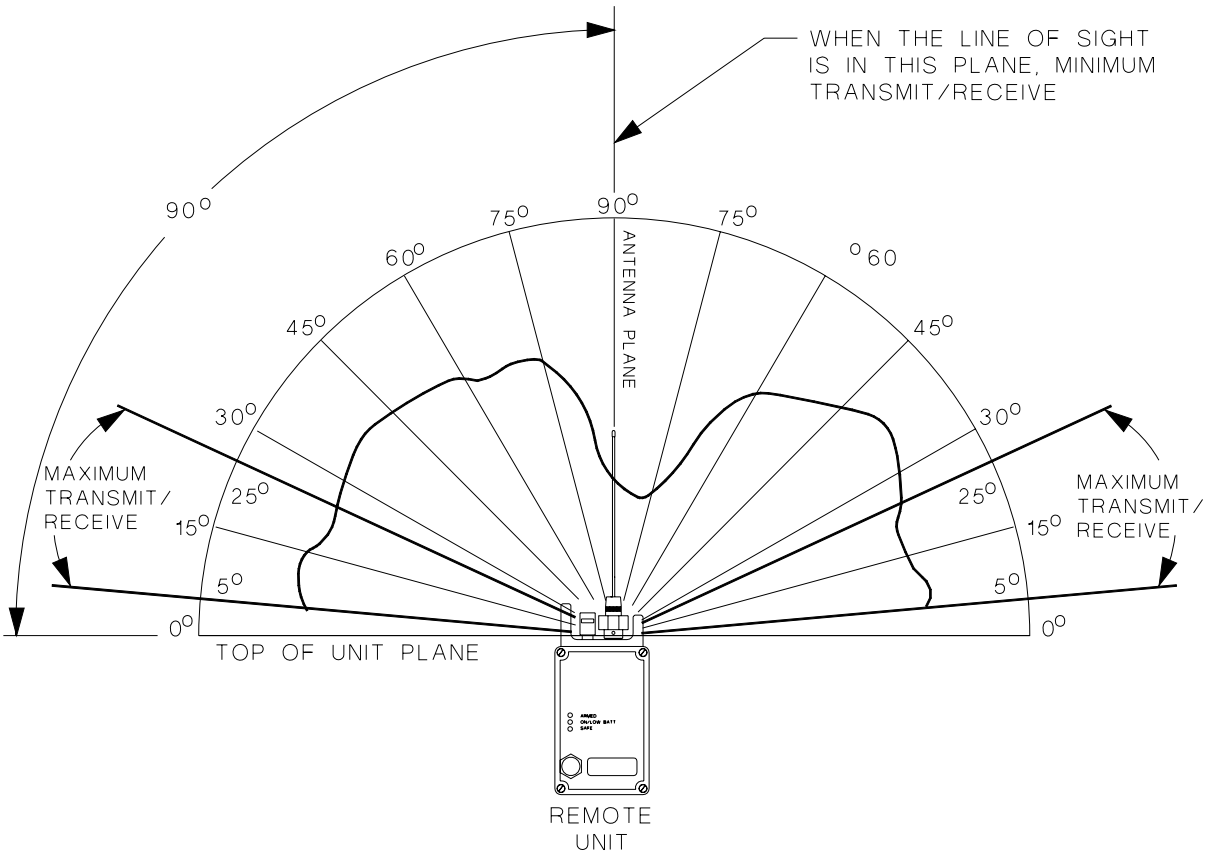



Figure 8-4 Antenna Radiation Pattern.

# 9. TEST BOX.

The Test Box allows the user to test Remote and Controller batteries under load as well as test Remote Arm/Fire functions, and test Remote receivers. The Test Box also serves as the programming interface between a computer and a RFD Unit.

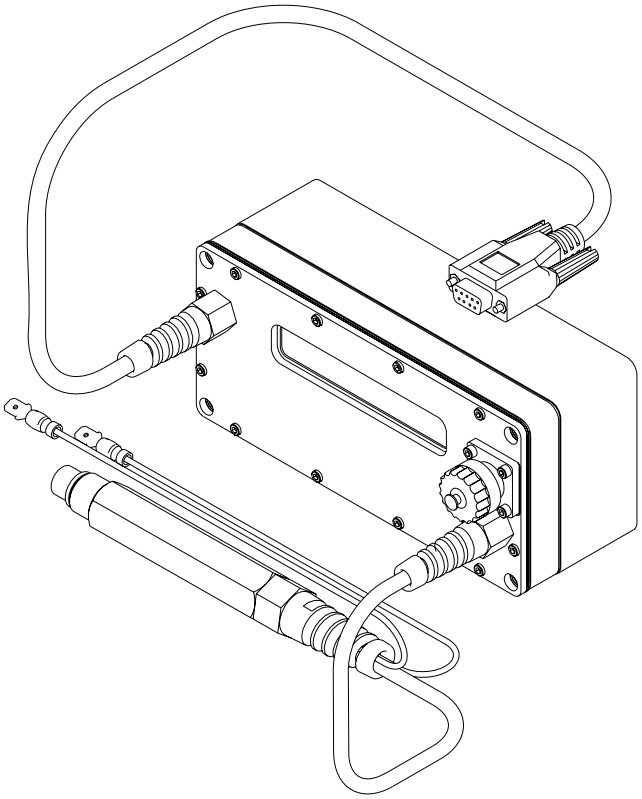


Figure 9-1 Test Box.

## 9.1. TEST BOX DESCRIPTIONS.

### 9.1.1. Antenna / Battery Charger Connector:

The Test Box has an Antenna/Battery Charger connector like the Remotes and Controller. Installing an antenna from the system onto the antenna connector turns on the Test Box. The Test Box has an internal battery pack that must be recharged using the system battery charger.

### 9.1.2. Probe:

The Test Box has a probe that plugs into the Remote or Controller under test. The Test box communicates to the Unit under test through the probe and by using a radio transmitter that is internal to the Test Box. The two leads coming off the probe are for connecting to the Remote binding posts. The firing voltage of the Remote will be measured through these connections.

9.1.3. Serial Connection:

A serial cable connects the Test Box to a computer serial port operating at 1200 baud. The serial cable must be connected to a computer when the Test Box is being used to program Controller and Remote Units. The serial cable may also be used when the Test Box is in the test mode. While in the test mode, the Test Box transmits the information displayed on the Test Box screen out the serial cable. A terminal program such as Hyper Terminal may be set up to capture this information to a file. The file can then be saved and printed.

## 9.2. TEST BOX OPERATION.

### 9.2.1. Test Box Messages

When the Test Box is turned on, the following message is displayed.

```
 166x Series  Test Box
    12/19/01  Ver 1.4
```

The "166x Series" part of the message identifies the system types that the Test Box is designed to operate with. "12/19/01" is the date of the Test Box firmware. "Ver 1.4" is the version of the Test Box firmware.

Plugging the Test Box probe into the Test Box Antenna Connector puts the Test Box into a self-test mode. In this mode, the Test Box loads its own internal battery and then displays the loaded battery voltage along with the low battery threshold point.

```
Battery Test - Standby
```

This message displays while the Test Box loads down the battery of the unit connected to the probe. This is done to get a more meaningful measurement of the battery status.

The Test Box will automatically step to the next message.

```
Loaded Battery  7.84
  Low Battery = 7.00
```

This message shows the battery voltage for the unit connected to the probe while the Test Box loads that battery. The Low Battery for the Unit is also displayed.

The Test Box will automatically step to the next message.

```
   Testing Completed
```

This message will be displayed until the probe is removed from the unit being tested.

9.2.2. Remote Messages

When the Test Box detects that a Remote Unit is connected to the probe, the following message will be displayed.

```
Frequency  154.570 Mhz
Address  65324  Unit  2
```

The data displayed will be the actual configuration data from the unit connected to the probe.

The Test Box will automatically step to the next message.

```
 S/N 12345     Type 82
 DOM 08/14/2000 Ver 1.0
```

This message shows the Serial Number, Unit Type, Date of Manufacture, and Firmware Version of the unit connected to the probe.

The Test Box will automatically step to the next message.

```
Remote Arm/Fire Test
          015
```

The Test Box will arm and fire a Remote Unit connected to the probe. The two leads from the probe must be connected to the Remote binding posts for the arm voltage to be measured. The “015” is the amount of time remaining in the Arm / Fire test. This number will count down to “000”. The Remote will then be fired.

The Test Box will automatically step to the next message.

```
Armed Voltage  27.16
  Pass Level = 26.00
```

This message show the actual armed voltage measured, and the minimum armed voltage level that is normal.

The Test Box will automatically step to the next message.

```
Battery Test - Standby
```

This message displays while the Test Box loads down the battery of the unit connected to the probe. This is done to get a more meaningful measurement of the battery status.

The Test Box will automatically step to the next message.

```
Loaded Battery  7.84
  Low Battery = 7.00
```

This message shows the battery voltage for the unit connected to the probe while the Test Box loads that battery. The Low Battery for the Unit is also displayed.

The Test Box will automatically step to the next message.

This message will be displayed until the probe is removed from the Unit being tested.

```
   Testing Completed
```

### 9.2.3. Controller Messages

Connect the Test Box probe to the Controller Unit antenna connector. Hold down the '3' button on the Controller Unit while pressing the 'ON' button. This puts the Controller in the Program/Test mode. When the Test Box detects that a Controller is connected to the probe, the following message will be displayed.

```
Address  65324  Unit 0
Frequency  154.570 Mhz
```

The data displayed will be the actual configuration data from the unit connected to the probe.

The Test Box will automatically step to the next message.

```
 S/N 12345     Type 81
 DOM 08/14/2000 Ver 1.0
```

This message shows the Serial Number, Unit Type, Date of Manufacture, and Firmware Version of the unit connected to the probe.

The Test Box will automatically step to the next message.

```
Battery Test - Standby
```

This message displays while the Test Box loads down the battery of the Unit connected to the probe. This is done to get a more meaningful measurement of the battery status.

The Test Box will automatically step to the next message.

```
Loaded Battery 12.26
  Low Battery = 11.75
```

This message shows the battery voltage for the unit connected to the probe while the Test Box loads that battery. The Low Battery for the Unit is also displayed.

The Test Box will automatically step to the next message.

```
   Testing Completed
```

This message will be displayed until the probe is removed from the unit being tested.

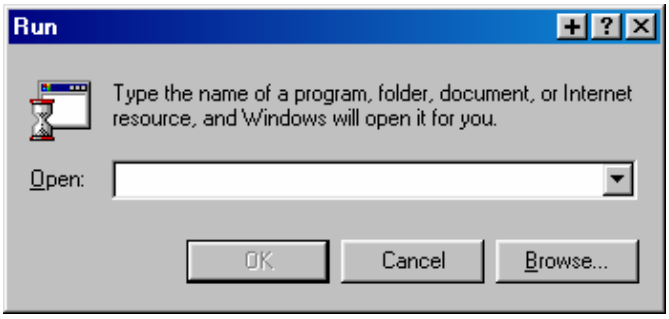
To run the tests again, disconnect and then reconnect the probe to a unit to be tested.

## 9.3. SAVING TEST BOX RESULTS TO A FILE USING HYPERTERMINAL

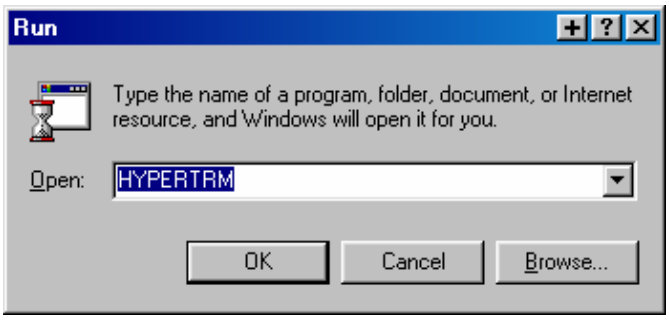
A situation might occur where the end users want to be able to record the Test Box results, but they may not be authorized to use the RFDSETUP.EXE program because of its capability of reprogramming. In that case the output of the Test Box serial cable can be captured to a terminal program such as HyperTerminal.

Click the Windows “Start“ button, then click “Run…”.

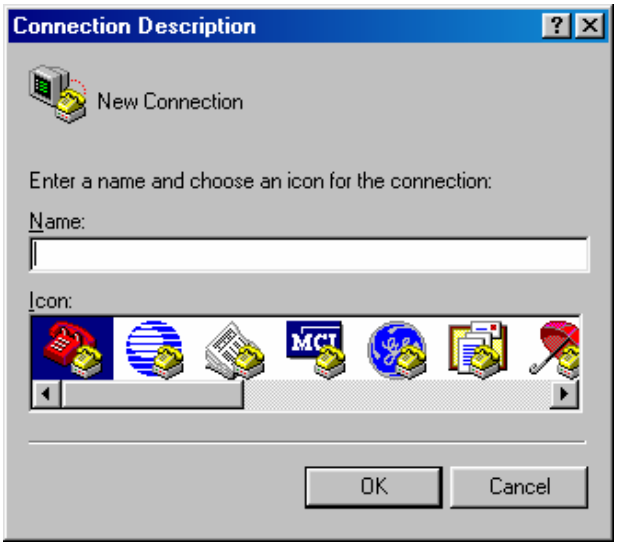
The dialog box shown below should appear.



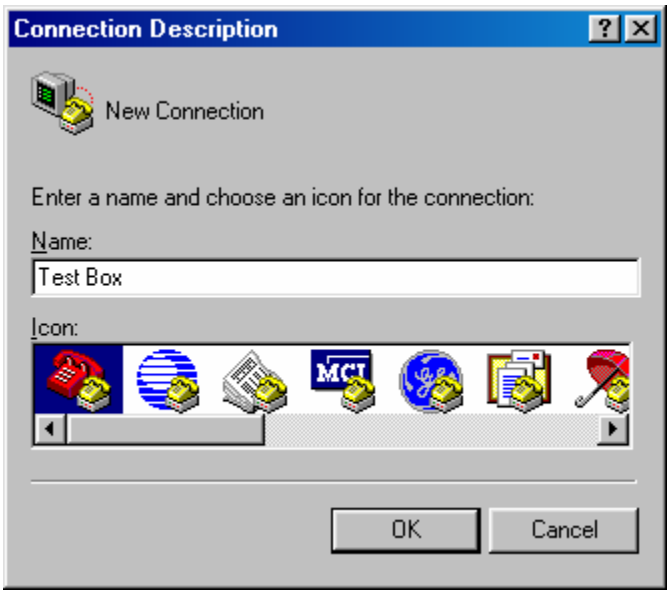

Type “HYPERTRM” in the open box (without the quote marks), and then click the “OK” button.




The dialog box shown below should appear.

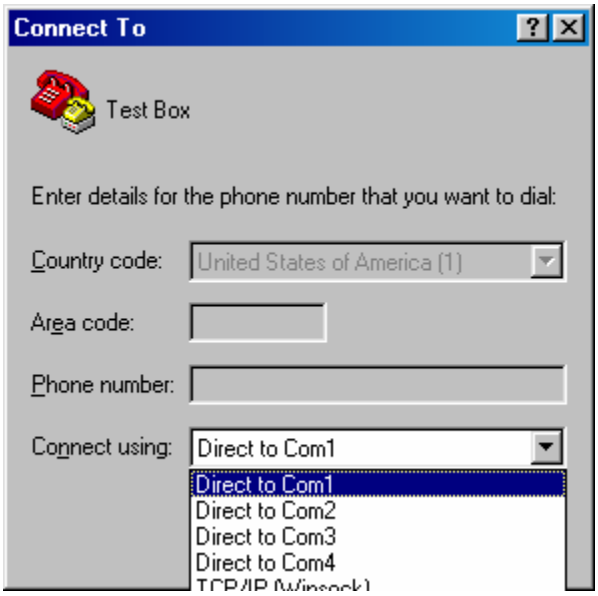

Connection Description
New Connection
Enter a name and choose an icon for the connection:
Name:
Icon:
MCI
OK
Cancel

Enter a name and choose an icon for the connection.  Click the “OK” button.

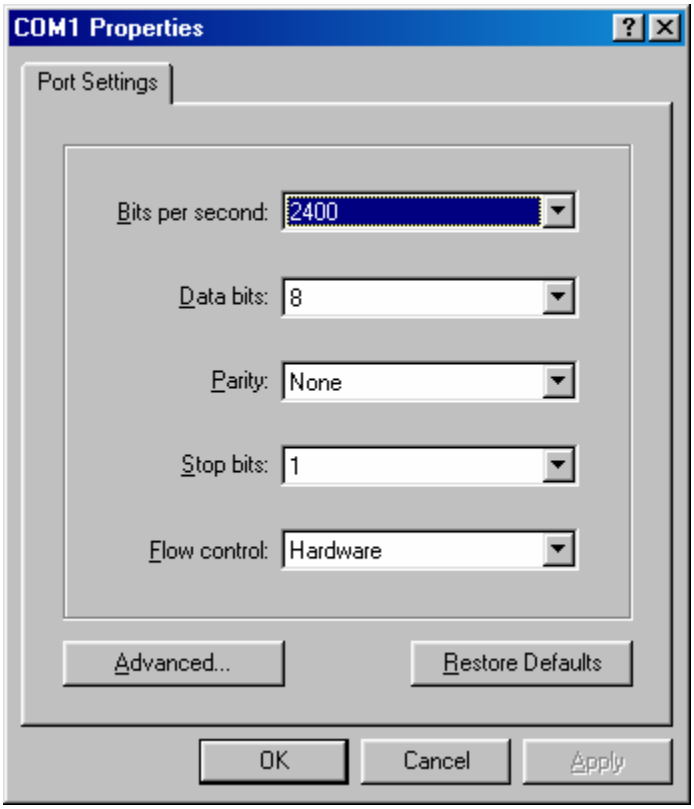



The dialog box shown below should appear.

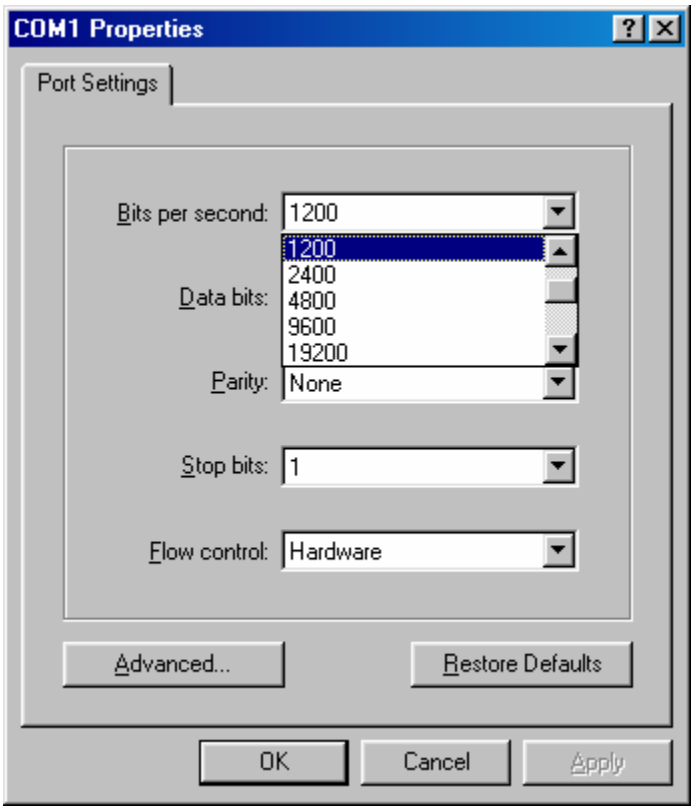
Click on the “Connect using:” list box and select either “Direct to Com1” or “Direct to Com2”. Select the one that corresponds with an unused serial port connector on the computer. Click the “OK” button.



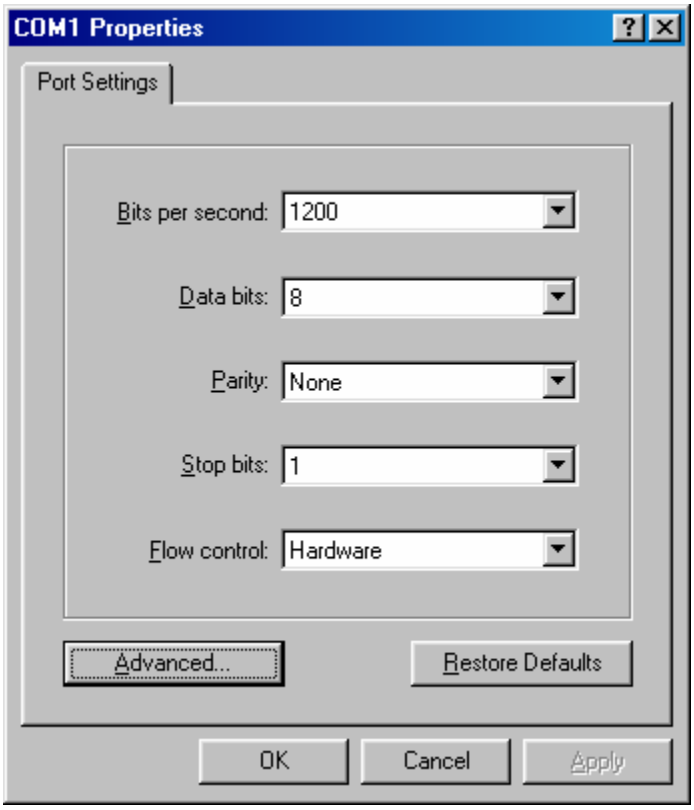

The dialog box shown below should appear.



Click on the “Bits per second:” list box and select 1200.

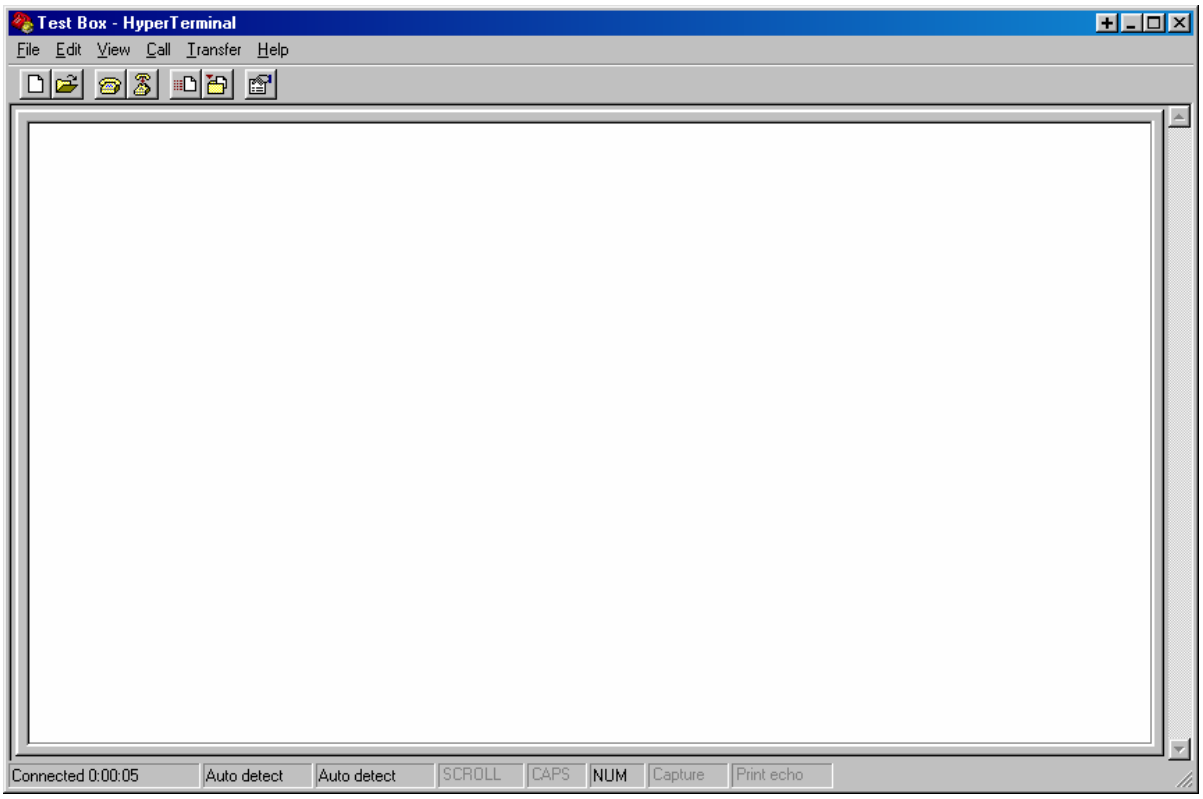



Leave the “Data bits:” set to ‘8’, “Parity:” set to ‘None’, “Stop bits:” set to ‘1’, and “Flow control:” set to ‘Hardware’ as shown in the following dialog box.

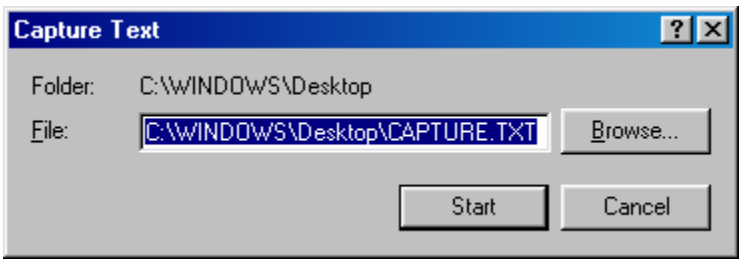



Click the “OK” button.

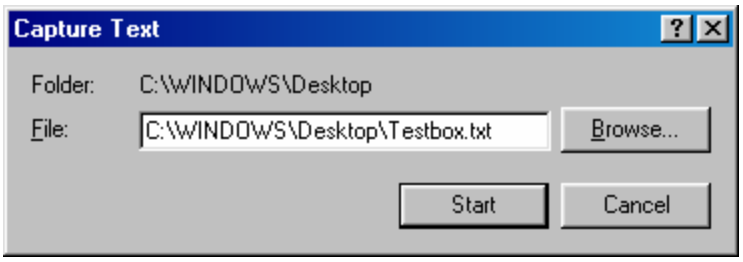
The dialog box shown below should appear.



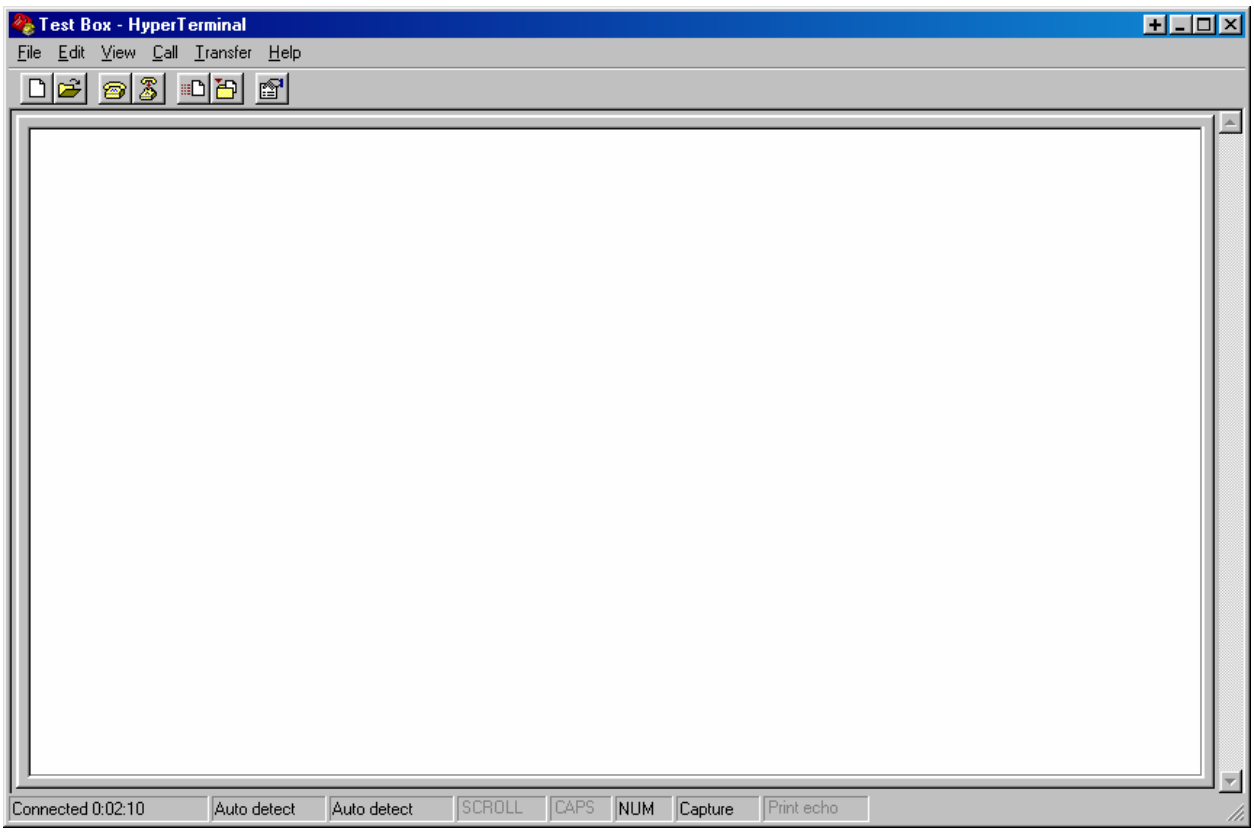
Click “Transfer” and then “Capture Text…”.  The dialog box shown below should appear.



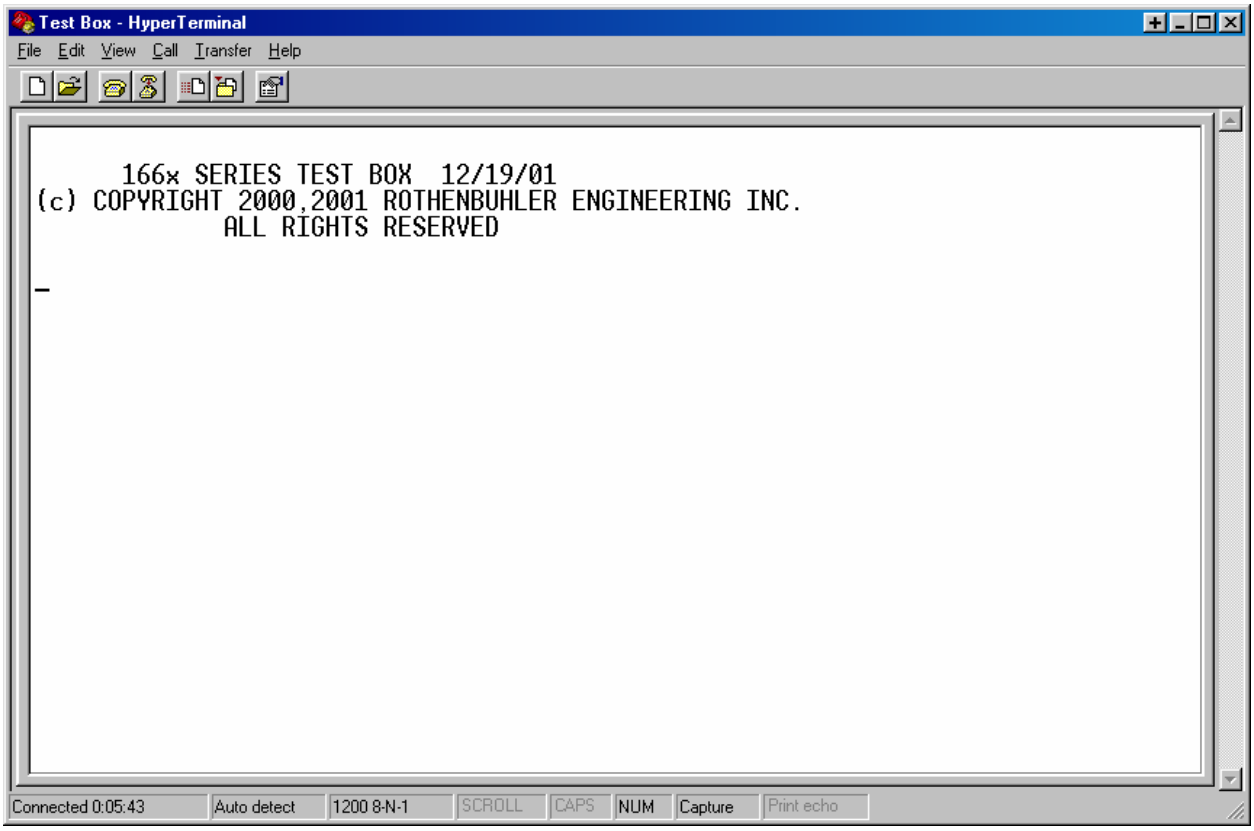

Enter a file name for the text output from the Test Box and click the “Start” button.



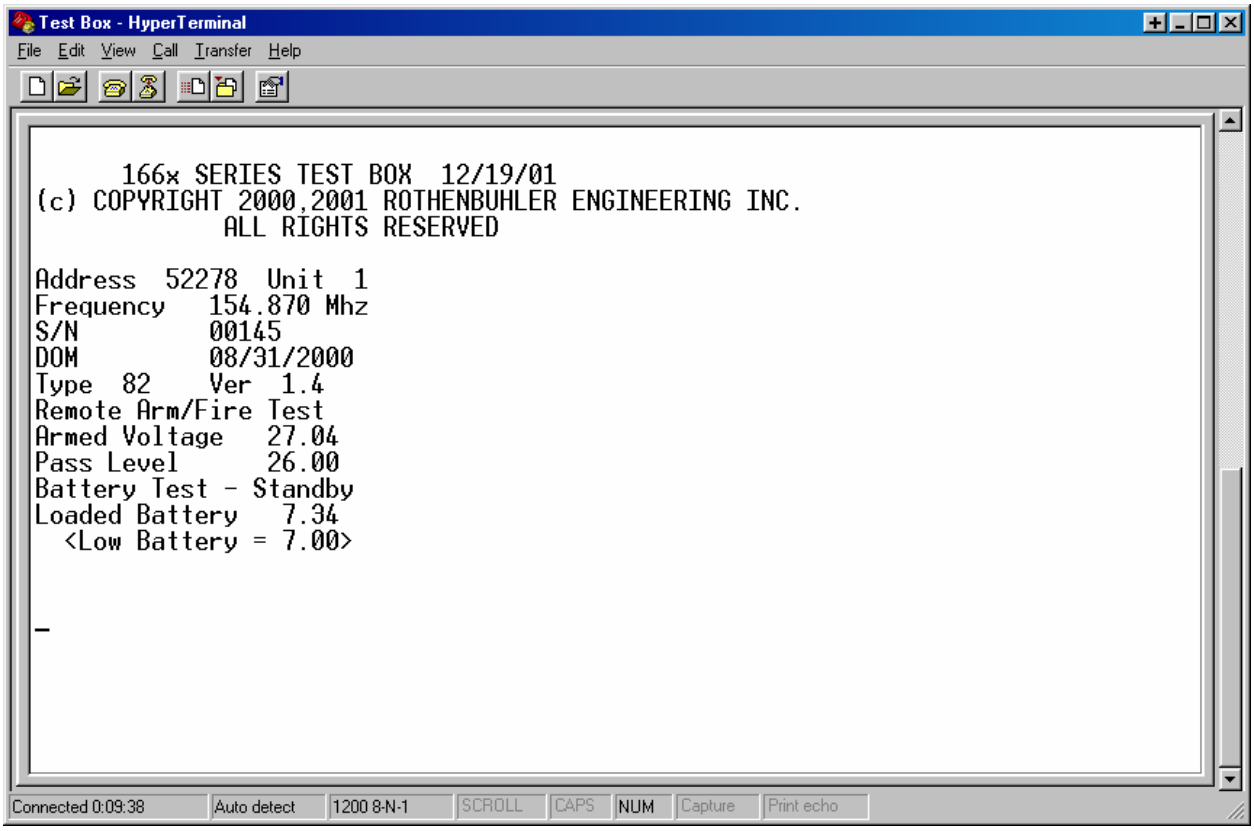

The dialog box shown below should appear.



Connect the Test Box serial cable to the serial port at the rear of the computer. This serial port must match up with the earlier selection of either “Direct to Com1” or “Direct to Com2”. Refer to documentation provided by computer manufacturer for more information on available serial ports. Turn the Test Box on by installing its antenna. The following text should appear in the window.




Proceed with testing the 166x system.




The test results will be saved to a file. Select "File" and then "Print" to print the test results to the computer's printer. Select "File" and then "Save" to save this configuration.

For future tests on the same computer, start HyperTerminal, Select "File" and then "Open", select the configuration name. Select "Transfer" and then "Capture text…". If the same capture file name is used, the new test results will be appended to the end of the previous test results.

Close the HyperTerminal window when the testing is completed.

If the above (or similar) text does not appear shortly after installing the Test Box antenna, check that the serial cable is connected from the Test Box to the computer correctly and that the selection under "Connect using:" matches the computer serial port number that the Test Box serial cable is connected to.

# 10. RFD PROGRAMMING GUIDE.

## 10.1. PROGRAMMABLE PARAMETERS.

### 10.1.1. Controller Unit

- Operating frequency: Frequency is programmable, but if the new frequency is greater than 4MHz away from factory set frequency, the controller will have to be retuned at the factory for optimum performance.

### 10.1.2. Remote Unit

- Operating frequency: Frequency is programmable, but if the new frequency is greater than 4MHz away from factory set frequency, the controller will have to be retuned at the factory for optimum performance.

- Unit ID: The Unit ID is a number from 1 to 8, and corresponds to the numbers on the Controller Unit keypad.

- Address: This is the address for the system. Remotes can be moved from one system to another by matching up the system address and frequency.

## 10.2. REQUIRED EQUIPMENT.

### 10.2.1. Test Box

10.2.2. AT compatible PC with available DB-9 serial port for RFDUSER.EXE. A Windows based PC with available DB-9 serial port for RFDSETUP.EXE

10.2.3. Configuration software RFDUSER.EXE (DOS) or RFDSETUP.EXE (Windows). Both programs allow the above listed programmable parameters to be modified. RFDSETUP can also create a log file of the Test Box results.

## 10.3. DOS CONFIGURATION SOFTWARE OPERATION (RFDUSER).

The RFDUSER.EXE program is supplied on a 3.5” floppy diskette. The program may be run from the floppy drive, or the program can be copied to a hard drive and run from there. Change directory and or drive to the drive and directory where the RFDUSER.exe program exists. Type RFDUSER in DOS, or double click on RFDUSER from Windows Explorer. The program starts, and the following text is displayed.

Type RFDUSER in DOS, or double click on RFDUSER from Windows Explorer. If the serial port address is not 3F8, which is usually the address for serial port 1, type RFDUSER followed by a space and then the address of your serial port. Other common serial port addresses are com 2 = 2F8, com 3 = 3E8, and com 4 2E8. The program starts, and the following text is displayed on the computer screen. The actual values displayed will be dependent on how the unit is currently configured.

```
RFD User Configuration Utility Ver 1.4U 9/08/00

     Usage:  rfduser [port_addr]

     Port addr: 3F8

     Press ESC key to exit

 (A)ddress,(U)nit ID,(F)requency,(R)ead, ESC to Exit

>
```

The Test Box must be plugged into a serial port on your computer. Install an antenna onto the Test Box to turn it on. – DO NOT connect the Test Box probe to a Controller Unit or Remote Unit yet!

The Test Box is then put into the programming mode automatically by the RFDUSER program. The Test Box display will change to the following message.

```
System Configuration

In Progress
```

Now plug the Test Box probe into either a Remote Unit or a Controller Unit. The RFDUSER program automatically detects when the probe is connected to a unit to be tested.

Note: The Test Box will remain in the programming mode until the ESCAPE key is pressed on the computer keyboard. If the Test Box probe is attached to a Remote Unit or Controller Unit, the Test Box will automatically begin testing that unit when the ESCAPE key is pressed.

### 10.3.1. RFDUSER Configuration Commands.

Type the following keystrokes to view the current configuration, and change programmable Coefficients. Pressing the ENTER key displays a command description line. Pressing the ESC key exits the program and returns to MS-DOS.

>(A)ddress,(U)nit ID,(F)requency,(R)ead, ESC to Exit

- A Address – Change the system address
- U Unit ID – Change the Unit ID
- F Frequency – Change the Frequency
- R Read Coefficients – Displays current settings

>A

`>System Address = 57383 ?` Displays current System Address and allows a new System Address to be entered. Press ENTER to keep current System Address.

>U

`>Unit ID (1-8) = 2 ?` Displays current Unit ID and allows a new Unit ID to be entered. Press ENTER to keep current Unit ID.

>F

`>Desired TX frequency (in Mhz) ?` Allows a new frequency to be entered. Press ENTER to keep current frequency.

```
>R

>Read Coefficients

System Type      92

Version          1.00

Checksum         FEFE

DOM              08-14-2000

S/N              12345

System Address   57383

Unit ID          2

Tx Freq.         154.5700 MHz

>
```

>System Type: The ‘9’ in system type of the above example indicates that it is a unit from a 1669 system. The ‘2’ indicates that the Unit is a Remote. A 1669 Controller would be displayed as 91.

Version: This is the version of the firmware for the unit. The system type and version are for information only and are not changeable.

10.3.2. Controller Unit Programming Procedure:

- Plug the Test Box probe into the controller antenna Connector.
- Press Remote selector switch 3 while turning Controller Unit on to place Controller Unit in the programming mode.
- Program Controller (frequency is the only parameter programmable; the other parameters can be read).

10.3.3. Remote Unit Programming Procedure:

- Plug the Test Box probe into the Remote Unit antenna connector.
- The steady red, flashing yellow, and steady green lights indicate the Remote Unit is in the programming mode.
- Program the Remote Unit: (frequency, unit id, and address are programmable).

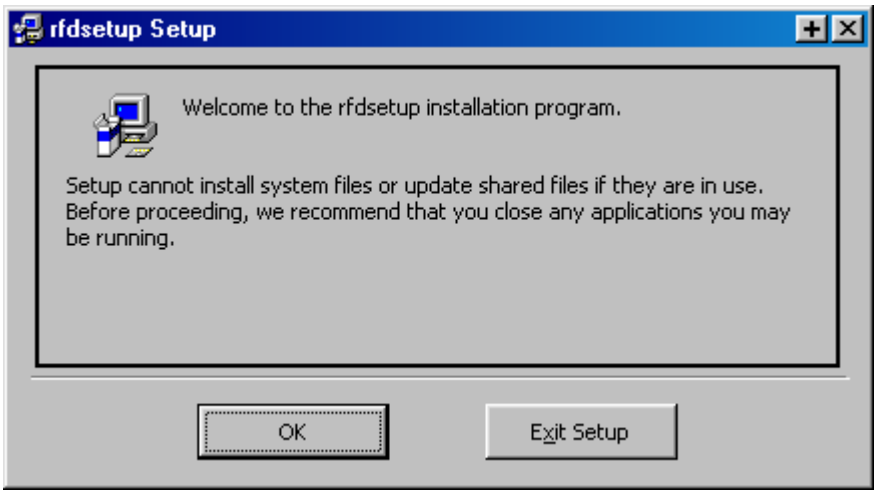
## 10.4. WINDOWS CONFIGURATION SOFTWARE OPERATION (RFDSETUP):

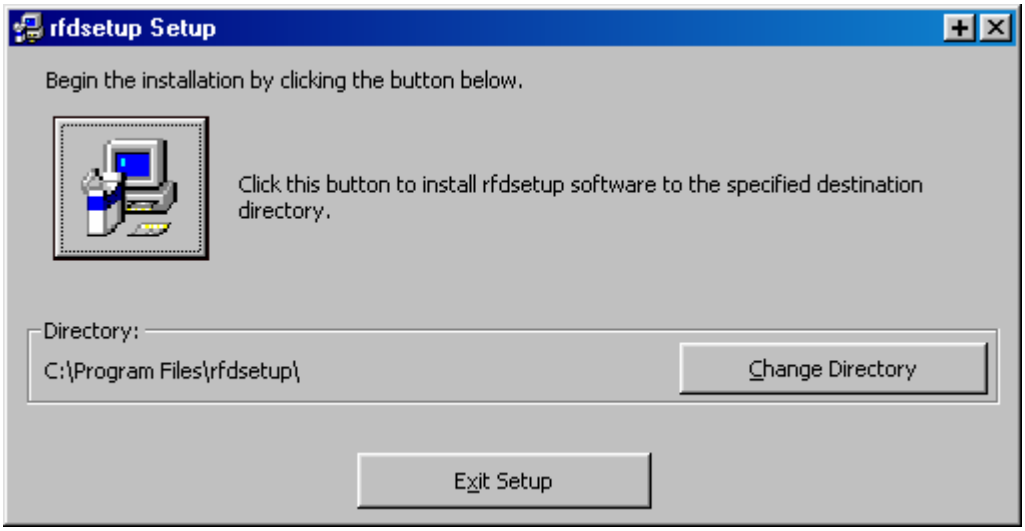
RFDSETUP is a Windows program designed for depot personnel to determine system information, make permissible changes to the system, and create a log file of test results.

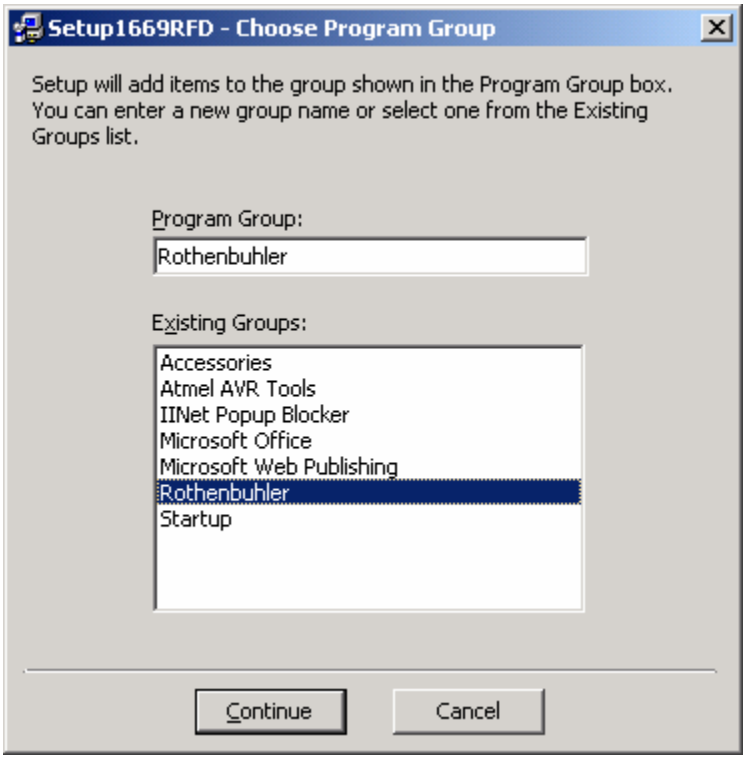
## 10.5. RFDSETUP INSTALLATION:

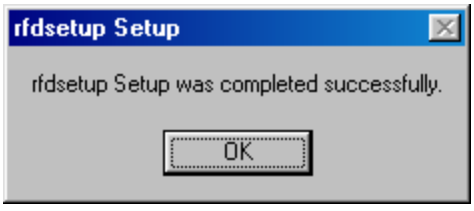
The RFDSETUP install files are distributed on two floppy diskettes. Follow the listed steps to install RFDSETUP on a computer.

- Copy the contents of the two diskettes to a folder.
- Run the setup.exe file from the folder.
- Follow the prompts in the dialog boxes that appear. Typical dialog boxes are shown below.




rfdsetup Setup
Begin the installation by clicking the button below.
Click this button to install rfdsetup software to the specified destination directory.
Directory:
C:\Program Files\rfdsetup\
Change Directory
Exit Setup


Setup1669RFD - Choose Program Group
Setup will add items to the group shown in the Program Group box.
You can enter a new group name or select one from the Existing Groups list.
Program Group:
Rothenbuhler
Existing Groups:
Accessories
Atmel AVR Tools
IINet Popup Blocker
Microsoft Office
Microsoft Web Publishing
Rothenbuhler
Startup
Continue
Cancel

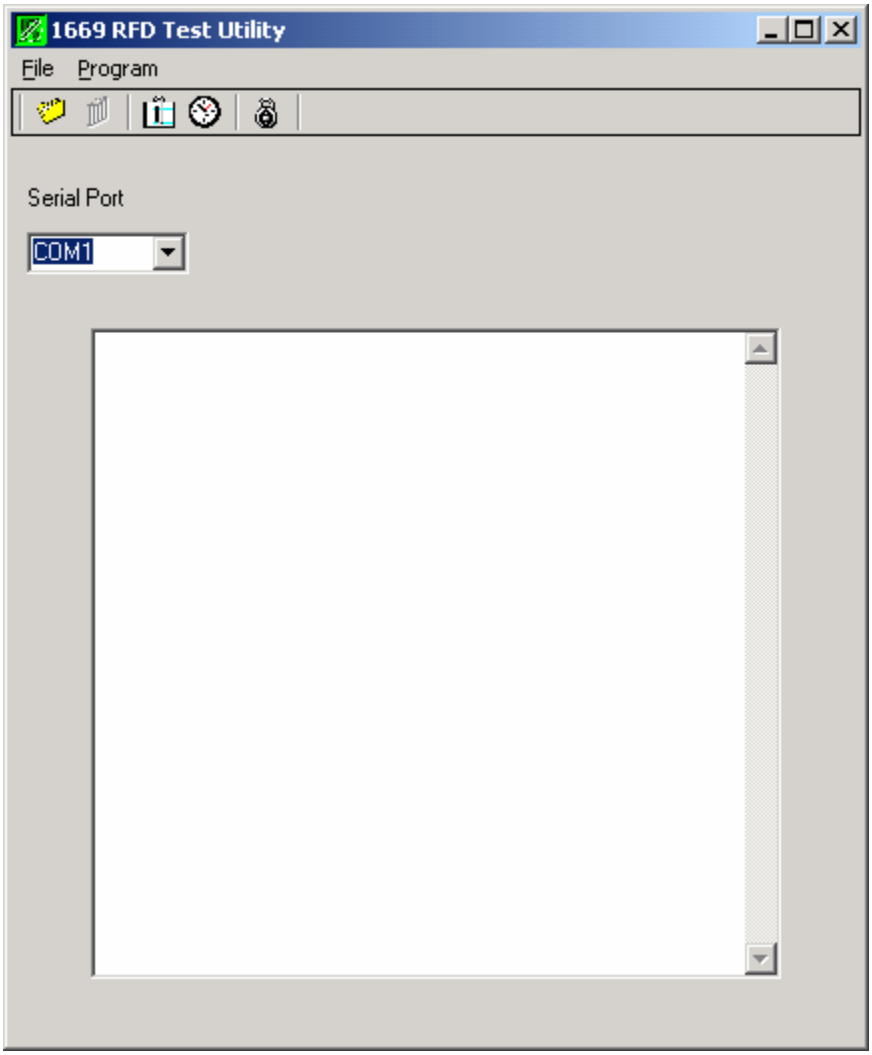

rfdsetup Setup
rfdsetup Setup was completed successfully.
OK

RFDSETUP is now installed on the computer.

## 10.6. CONFIGURING RFDSETUP

Follow the listed instructions to configure RFDSETUP.

- Click on the Windows “Start” button.
- Go to “Programs” then “RFDSETUP” and then click on “RFDSETUP”.




- The program will start and display the following dialog box.

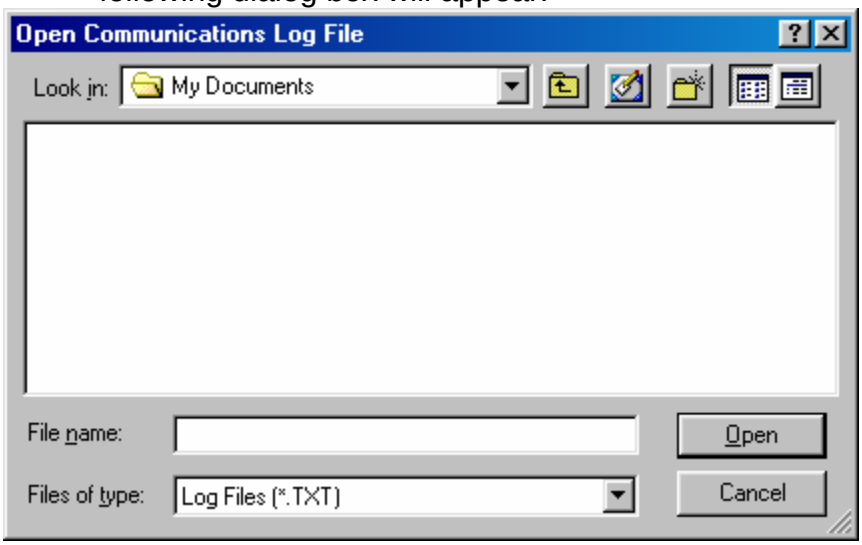
- Click on the Serial Port list box and select the serial port that will be used with the 166x Series Test Box.
- The serial port selection will be retained for future sessions automatically.
- The RFDSETUP program is now configured.

## 10.7. USING RFDSETUP TO TEST RFD UNITS:

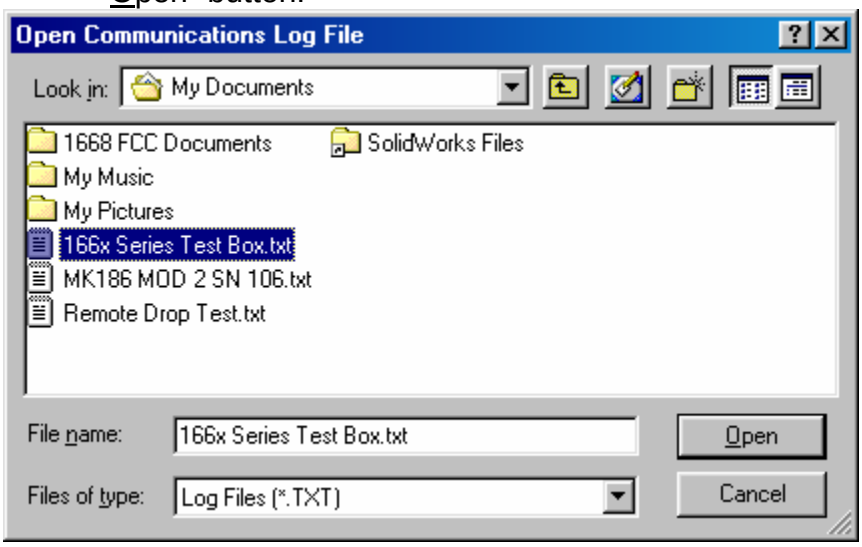
The RFDSETUP program may be used with the 166x Series Test Box to test 166x Series Units and record the results of those tests.

### 10.7.1. Creating A Test Results Log File:

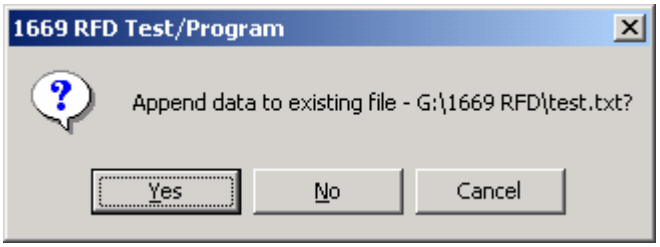
- If a log file of test results is desired, click "File" and then "Open Log File…". The following dialog box will appear.



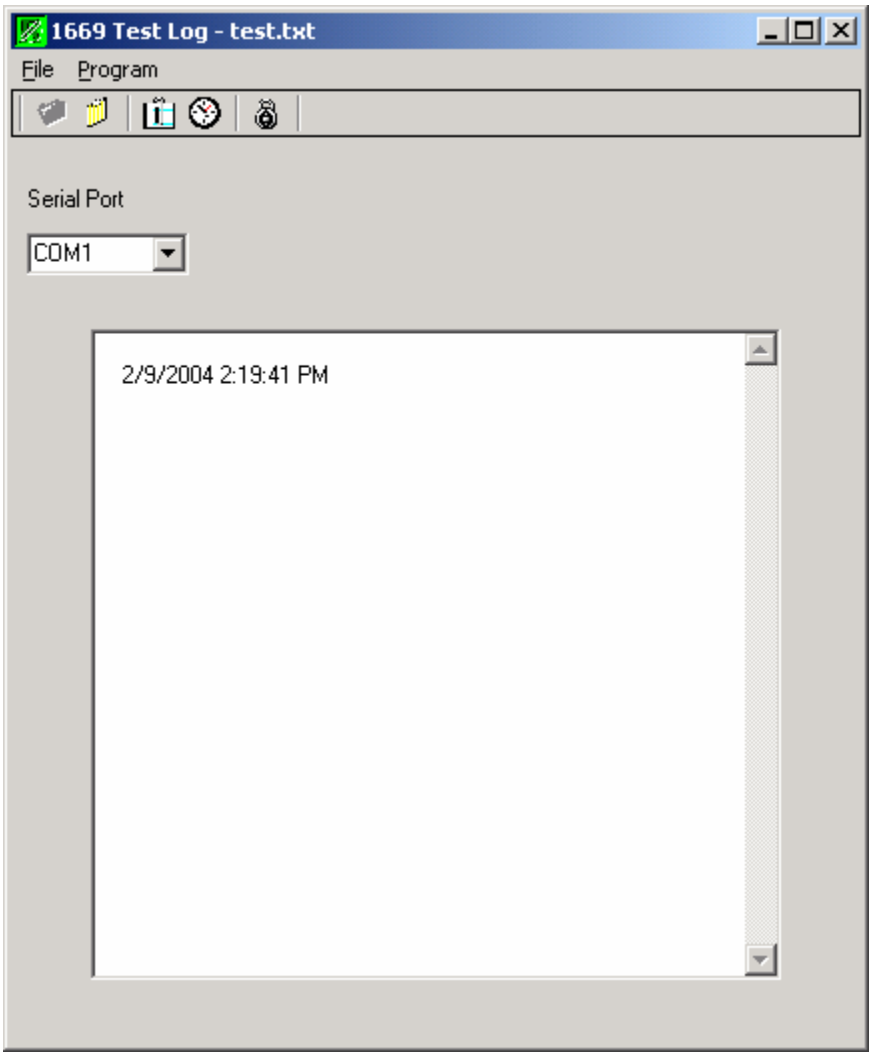

- Type in a file name for the log file or select an existing file to use. Click the "Open" button.




- If the file already exists, the following prompt appears.

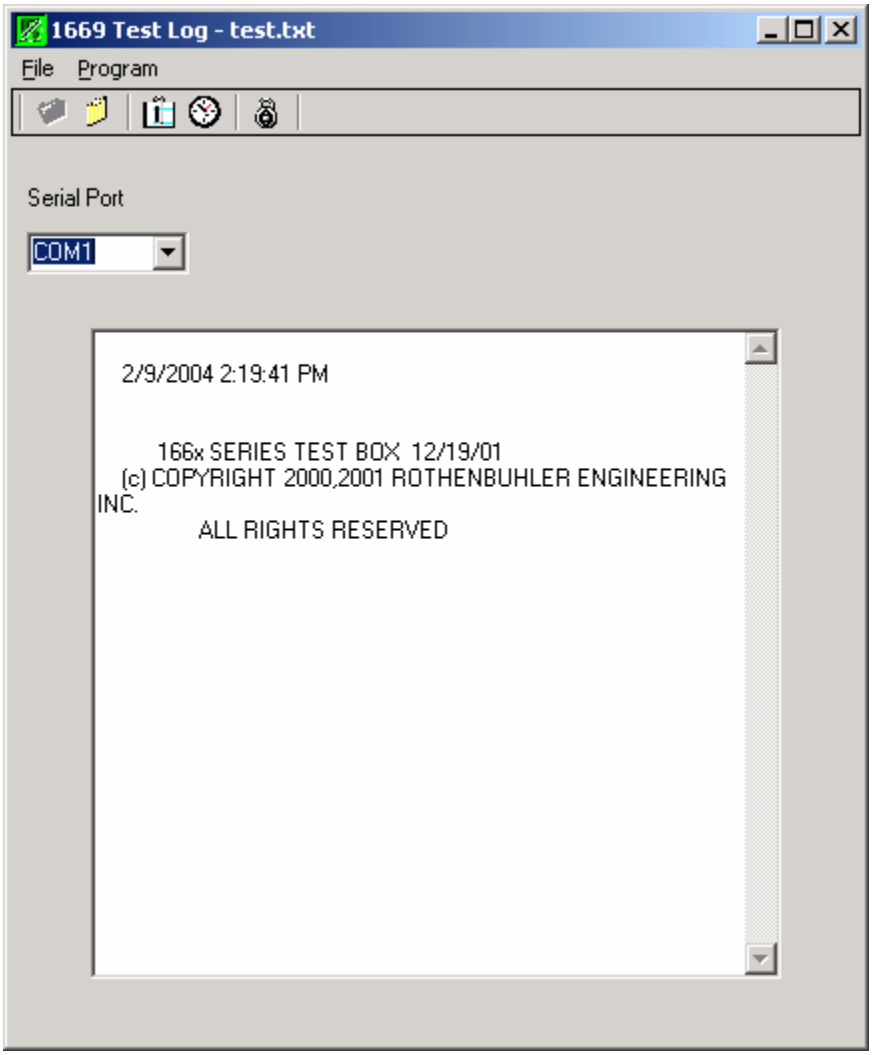



- Click "Yes" to append (add to) existing data or "No" to overwrite the existing file.

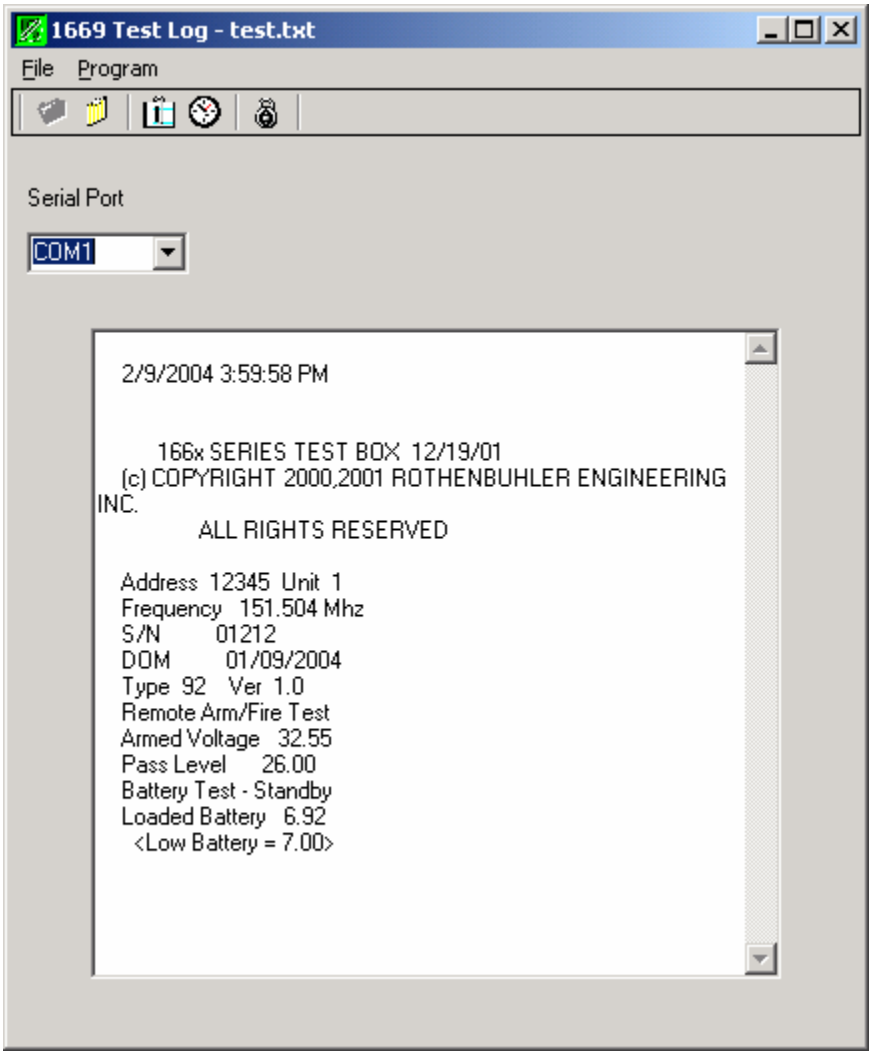



- The following window appears.

- A time and date stamp is added to the window.
- Notes can be added to the log file by clicking the note card icon and typing the note in the dialog box that appears. Multiple notes can be added as required.
- Connect the Test Box serial cable to the serial port selected in a previous step.
- Turn on the Test Box by installing its antenna. The following window is displayed.




- Connect the Test Box Probe to a Remote Unit.
- Connect the Test Box Probe Leads to the Remote Unit binding posts. It does not matter which lead goes to which binding post.
- The Test Box reads and displays the system information from the Remote Unit, and then executes an arm/fire test followed by a battery test. The results are displayed as shown in the next window.

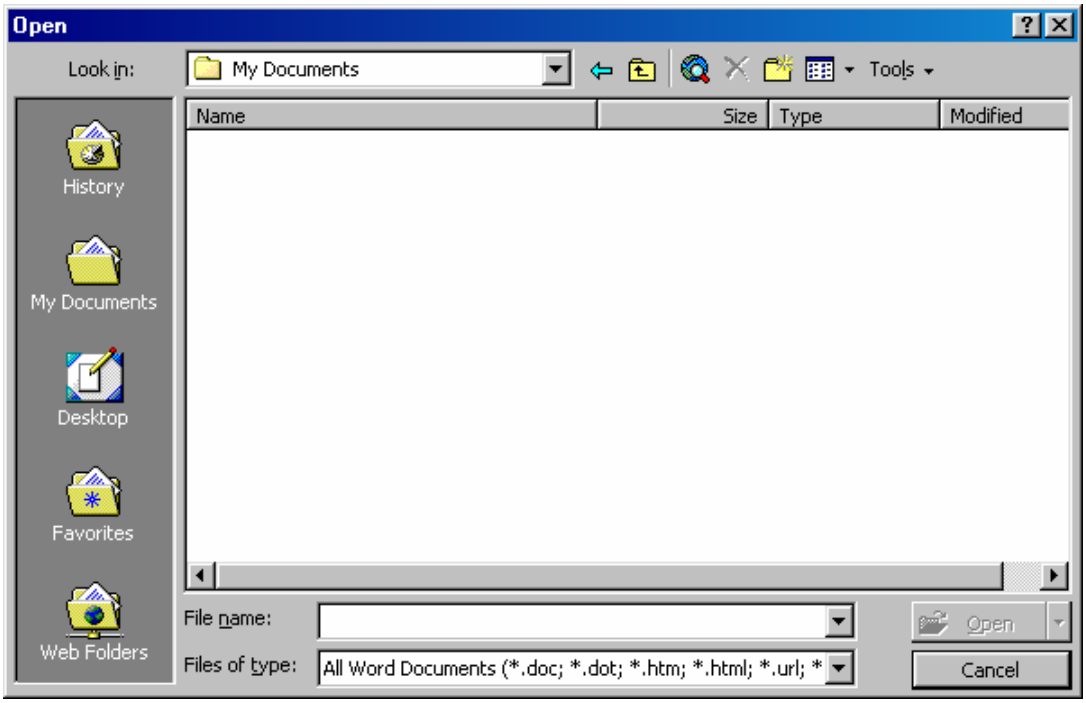



- To test the Remote Unit again, remove the Test Box Probe from the Remote Unit for a few seconds, and then reconnect the Test Box Probe to the Remote Unit.
- To end the testing and save the log file, click “File” and then “Close Log File…”.

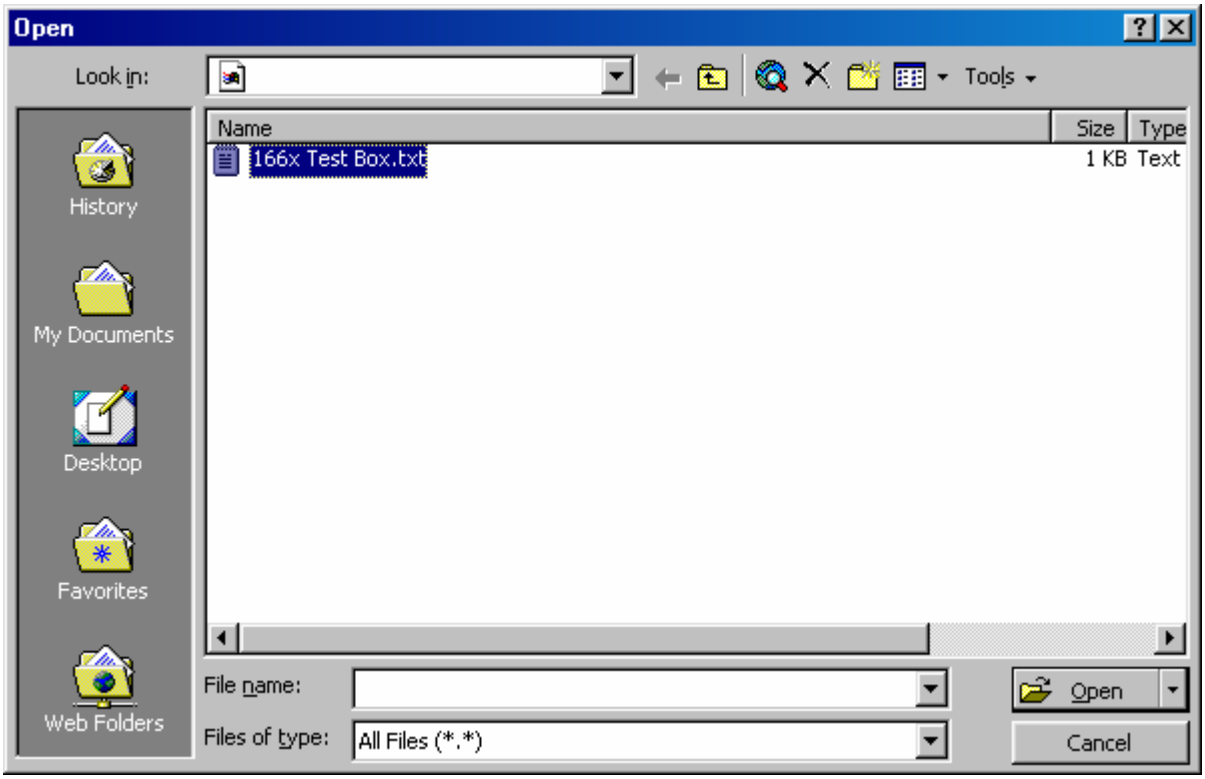
10.7.2. Printing A Test Results Log File:

- The log file must be printed from another Windows application such as Microsoft Word.

- Start Word, click “File” and then “Open”.



- Change the “Files of type:” list box to “All Files (*.*)”

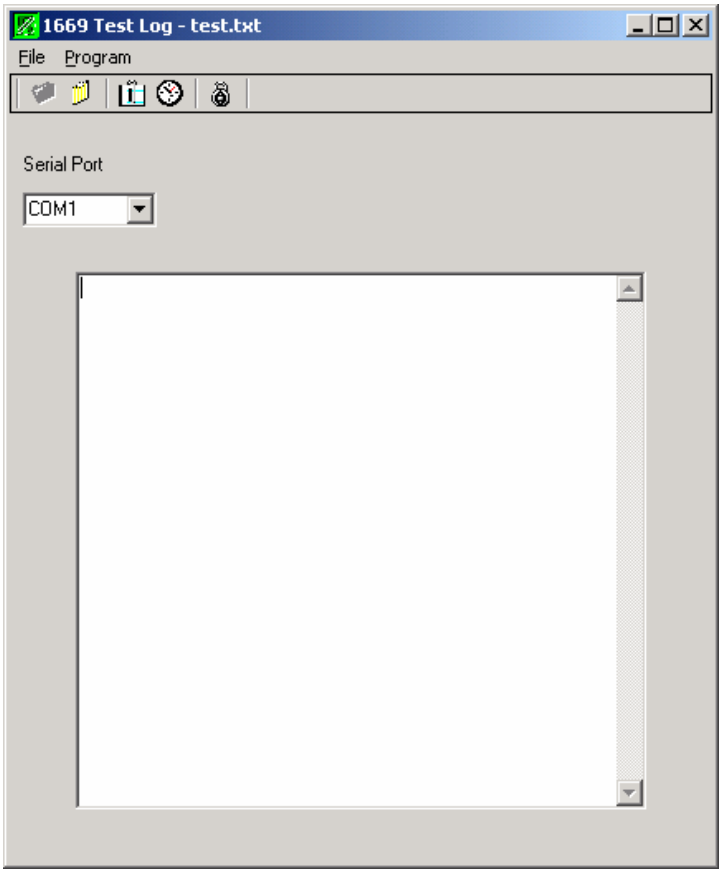



- Browse to the folder that contains the log file to print, and select the file.
- Print the file by clicking “File” and then “Print”.

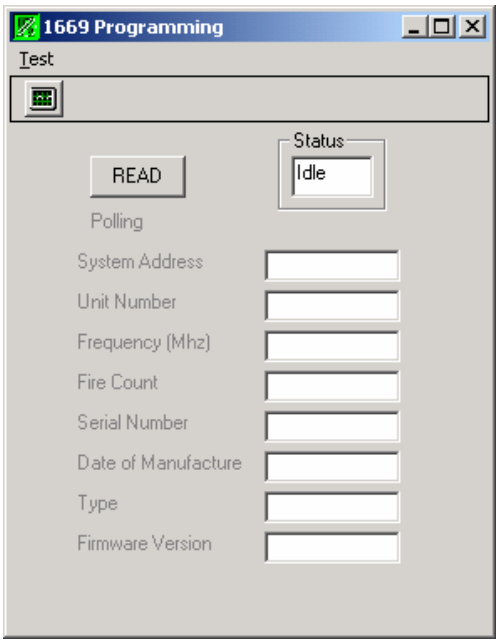
## 10.8. USING RFDSETUP TO PROGRAM RFD UNITS:

Follow the listed instructions to use RFDSETUP to Program RFD Units.

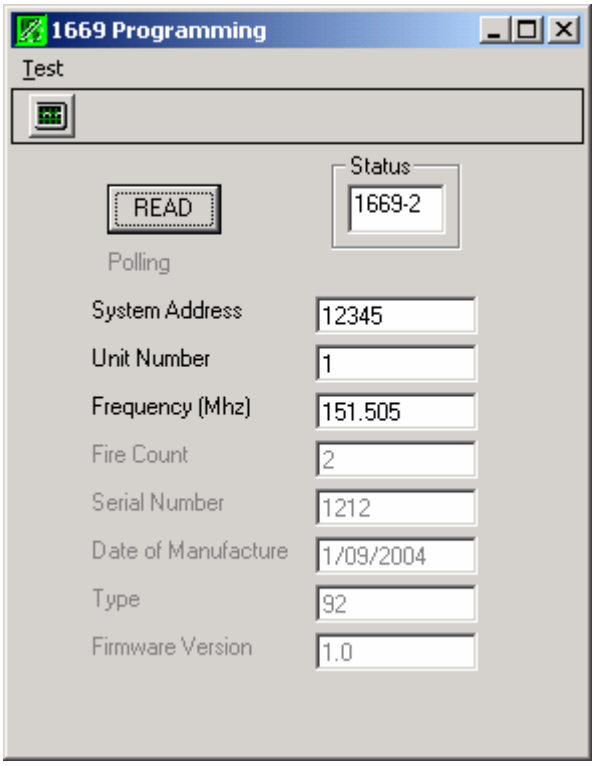
- Click on the Windows “Start” button.
- Go to “Programs” then “RFDSETUP” and then click on “RFDSETUP”.
- The program will start and display the following dialog box.




- Click on the Serial Port list box and select the serial port that will be used with the 166x Series Test Box.
- Click on "Program" and the following window appears.



- Connect the Test Box Probe to the Unit to be programmed.




- The Unit information is read and displayed.

- The “Status” box shows what type of Unit is connected to the Test Box. A connected Controller Unit will have a “Status” of “166x-1”. A connected Remote Unit will have a “Status” of “166x-2”.
- The “System Address” box displays the system address for the Unit. This number is unique to each system.
- The “Unit Number” box displays the number for the Unit within the system. Remotes will be 1 through 8 and the Controller will be Unit 0.
- The “Frequency(Mhz)” box displays the transmit and receive frequency, in Mega Hertz, for the Unit.
- The “Fire Count” box displays the number of times the Remote has been fired.
- The “Serial Number” box displays the Manufacturer’s serial number for the Unit.
- The “Date of Manufacture” box displays when the Unit was manufactured.
- The “Type” box displays the Manufacture’s type code for the Unit. A 166x Controller will be displayed as type “x1”. A 166x Remote will be displayed as type “x2”.
- The “Firmware Version” box displays the version of firmware that is programmed into the Unit.
- Boxes that are displayed in gray, are not programmable and are for information purposes only.

### 10.8.1. Changing the System Address:

The System Address is programmable only on Remote Units. It may not be changed on Controller Units. The System Address should only be changed by personnel having that authority. A possible scenario for changing the System Address is that a Remote Unit in system 12345 has become unserviceable. A Remote Unit from another system may be reprogrammed to have a System Address of 12345 to complete the system. The Unit Number for the replacement Remote Unit should be reprogrammed to match the Unit Number of the Remote Unit it is replacing.

To change the System Address follow the listed steps.

- Click on the “System Address” box and then type the desired System Address in the box. Allowable entries are in the range of 1 to 65536.
- Press the “Enter” Key or click the mouse to another box.
- Click the “Read” button to re-read the Unit information and confirm that the desired System Address was accepted.

### 10.8.2. Changing the Unit Number:

The Unit Number is used to assign a unique ID to each Remote Unit within a system. The same Unit Number should not be assigned to more than one Remote Unit within a system.

To change the Unit Number follow the listed steps.

- Click on the “Unit Number” box and then type the desired Unit Number in the box. Allowable entries are in the range of 1 to 8.
- Press the “Enter” Key or click the mouse to another box.
- Click the “Read” button to re-read the Unit information and confirm that the desired Unit Number was accepted.

### 10.8.3. Changing the Frequency:

The Frequency is the radio frequency that the Controller Unit and Remote Units use to communicate with each other. All Units within a system must have the same Frequency.

To change the Frequency follow the listed steps.

- Click on the “Frequency(Mhz)” box and then type the desired Frequency in Mega Hertz in the box. Allowable entries are in the range of 150 to 170 Mega Hertz.

- Press the “Enter” Key or click the mouse to another box.

- Click the “Read” button to re-read the Unit information and confirm that the desired frequency was accepted.

# 11. BATTERY MAINTENANCE.

The battery packs will provide optimum performance and maximum life when the following recommendations are adhered to.

## 11.1. BATTERY TEMPERATURE:

For maximum efficiency charge batteries when they are between 10 and 30 degrees Celsius. DO NOT attempt to CHARGE BATTERIES that are BELOW 0 degrees or ABOVE 40 degrees Celsius. Permanent damage to batteries and or equipment may result.

## 11.2. PRE-OPERATION:

Use the Battery Charger Assembly to discharge and then charge the battery of each unit.

## 11.3. PERIODIC:

Twice every two months use the Battery Charger Assembly to discharge and then charge the battery of each unit.

## 11.4. ANNUAL:

Have the battery packs replaced every 3 years or 300 charge / discharge cycles, whichever comes first.

## 11.5. EXTENDED NON-USE:

If the battery has not been discharged and charged within four months, repeat the discharge / charge cycle four times and check the battery capacity prior to operational use. Do not exceed storage temperature guidelines as it may reduce battery capacity and/or cause physical deterioration of battery components.

| Storage Time | Storage Temperature (deg. C) |
|---|---|
| <30 days | -20 to +50 |
| 30 - 90 days | -20 to +40 |
| >90 days | -20 to +30 |

11.6. BATTERY CAPACITY CHECK:

- Fully charge the battery.
- Press the “BATTERY DISCHARGE” switch.
- Note the amount of time from when the “BATTERY DISCHARGE” switch was pressed until the red DISCHG light turns off.
- A good battery will take approximately three hours to discharge. Replace the battery pack if the discharge time is less than two and one half hours and the discharge / charge cycle has been repeated four times.

***Controller Range*** 5 miles

***Detonator Range*** 1 mile

Summary of changes for Rev A

1. Changed ‘Detonator’ to ‘Remote’.

2. Removed ‘Draft’ from Title Page.

Summary of changes for Rev B:

1. Changed Low Battery level for controller from 10.00 volts to 11.75 to reflect actual performance.

2. Added information on using the RFDSETUP program to program and test units.

3. Added information on using RFDUSER program to program units.

4. Added information about saving Test Box results with HyperTerminal.

5. Removed references to MK186 MOD 2 and used 166x Series instead.

6. Updated Battery information to contain temperature considerations.

7. Updated figures for remote end protector, lid decal, and hex grip antenna.

Summary of changes for Rev C:

1. Added new section (2.6) describing the Radio Shock Tube Initiator. Subsequent chapters are incremented.

2. Added new section (7.3) for troubleshooting the Radio Shock Tube Initiator.

Summary of changes for Rev D:

1. Change Test Box configuration to non-navy windows version.

Summary of changes for Rev E:

1. Update Section 3 (System Specifications) to show FCC status as “Certified.”

Summary of changes for Ritron Version (“-R”) Rev A:

1. Revise frequency range to 150 to 174 MHz in Section 3 (System Specifications)..

2. Remove not to frequencies below 150 MHz in Section 3 (System Specifications)..

3. Change Controller transmit current to 2.5A, Remote to 1.0 Amp in Section 3 (System Specifications).