ROTHENBUHLER ENGINEERING®

1673 REMOTE FIRING DEVICE
OPERATION MANUAL

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TABLE OF CONTENTS

Chapter **Page**

LIST OF ILLUSTRATIONS

SAFETY WARNINGS

1) Always follow your local safety regulations. This manual and its procedures are secondary to governmental regulations, local regulations or company safety regulations and procedures. The operation procedures in this manual are only suggestions and should be checked against the above safety regulations and procedures. Company training should include the proper use of this machine and only trained personnel should use it.

2) Never rely on this equipment or any equipment totally for your safety. All mechanical and electronic equipment can fail. Always have a safety procedure that will protect you and minimize hazards of such failure.

3) High power radio transmissions can cause electric blasting caps to detonate. Store the Controller and Remote Units 25 or more feet (8 meters) from electric detonators.

4) The Shock Tube Initiator on the Remote Unit can develop up to 3,000 Volts. Do not touch the firing tip or the firing tip jacks while arming or firing the unit.

5) The Electric Detonator generates up to 400V. Do not touch the two firing terminals when arming or firing the unit.

6) Do not connect the shock tube or electric detonator leg wires or firing cable to a Remote Unit unless its green READY light is on, the red ARMED light is off, and the ON light is on steady.

7) Do not use the system if any of the units show damage to the point that failure is suspected. Thoroughly test the system prior to use.

8) Never approach the Remote Unit if it is attached to live explosives unless you have a confirmed READY status back to the Controller AND you have waited at least 20 minutes for the automatic disarm AND you have followed proper safety wait times.

LIMITED WARRANTY

The 1673 Remote Firing Device is guaranteed for 2 years (batteries –1 year, spark tips excluded) against defects in workmanship or materials. If the equipment should fail during this period, we will repair it at our factory or at the nearest authorized service facility. Warranty service on this equipment must be performed only by an authorized service center. Unauthorized service procedures or parts will void and cancel your warranty, and may cause radio equipment to fail, resulting in accidents and/or personal injury. This is a limited warranty and is given in places of legally implied warranties of merchantability and fitness for a particular purpose. Our liability is expressly limited to the cost of repair or replacement of the RFD under this guarantee, and does not extend to additional or consequential damages resulting from the operation of equipment.

REGULATORY INFORMATION

UNITED STATES

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.

The radio contained in this device operates in FCC regulated frequency bands. This device must be licensed by the FCC before use. Because this device contains a transmitter, federal law prohibits unauthorized use or adjustments of this radio.

Note: The Grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

CANADA

**This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil nume'rique de la classe B respecte toutes les exigences du Re'glement sur le mate'riel brouilleur du Canada.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de 'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

These radio transmitters (IC: 2758A-167301 & 2758A-167302) have been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated.

Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Antenna: ¼ wave whip, gain 2.15 dBi

Only Factory accessories are approved for use with this device – e.g. third party holsters, belt clips etc. are not approved for use.

Contact information where the user can obtain Canadian information on RF exposure and compliance.

1. Health Canada Safety Code 6:

http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

2. RSS-102:

http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01904.html

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio (IC: 2758A-167301 & 2758A-167302) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Stabantenne: ¼ longueur d'onde, gain 2.15 dBi

Seuls les accessoires d'usine sont approuvés pour une utilisation avec cet appareil - par exemple étuis de tiers, ceinture clips, etc ne sont pas approuvés pour l'utilisation.

Les coordonnées où l'utilisateur peut obtenir de l'information canadienne sur l'exposition aux radiofréquences et la conformité.
1. Santé Canada Code de sécurité 6:

http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

2. RSS-102:
http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01904.html

AUSTRALIA

The radio transmitters contained in this equipment are approved by the Australian Communications Authority (ACA). Frequency assignment/licensing must be obtained from the ACA before use.

This device is has been determined to be in compliance with AS2187.2 for underground and surface mines.

RADIATION HAZARD WARNING

This radio shall only be used during the course of employment by individuals aware of the hazards of radio frequency (RF) radiation exposure, 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 with any other antenna or transmitter. User should not allow antennas to come within 20 cm (8 inches) of the body during use.

Cette radio ne doit être utilisé au cours de l'emploi par des individus conscients des dangers de la fréquence radio (RF) l'exposition aux radiations et les façons de minimiser ces risques. Cette radio n'est pas destiné à être utilisé par la «population générale». En outre, cette radio ne doit pas être co-localisé ou exploité en conjonction avec une autre antenne ou transmetteur. L'utilisateur ne devrait pas permettre antennes à venir dans les 20 cm (8 po) du corps pendant l'utilisation.

1. INTRODUCTION

1.1. THEORY OF OPERATION

1.1.1. The Remote Firing Device (RFD) is used to activate both electric and non-electric detonator devices. The system is strictly an electronic device, containing no explosive. The Remote Unit is placed at the explosive site, with a shock tube or the electric detonator firing cable running to the detonator(s). The Controller is placed at the intended firing position.

1.1.2. Using remote control technology allows the blaster to increase his standoff distance for maximum safety. With the blaster unconnected to the firing line, he is free to move around to achieve both the safest firing position, as well as the preferred viewing position. Blast efficiency is improved as the consumption of non-electric lead-in-line is reduced by as much as 90%. In subsurface operations, safety is achieved when all headings are fired from one position with all personnel above ground. Significant cost savings may be found in comparison to expensive mains firing systems.

1.1.3. Critical features of this Remote Firing Device over other systems are the two-way communication link and the timed automatic-disarming function. The two-way communication feature provides a high degree of safety, by allowing the blaster to verify that each Remote Unit is disarmed before approach. The automatic-disarming function ensures that the unit returns to a safe state in the event of a loss of communications, after a time out period.

1.1.4. In subsurface operations, safety is achieved when all headings are fired from one position with all personnel above ground. Significant cost savings may be found in comparison to expensive mains firing systems. The motion detection feature can be used to help determine if the blast has been initiated successfully.

1.2. STORAGE AND ENVIRONMENTAL CONDITIONS

1.2.1. The Controller Unit and the Remote Unit cases (with lids closed) are airtight, watertight, and dustproof. The Remote Unit should normally be operated with the lid closed and fastened. The internal case contains the circuit electronics and should remain sealed.

1.2.2. The Controller and the Remote Units are shock resistant and will handle considerable abuse. They have been drop tested from 6 feet (1.8 m) onto concrete.

1.2.3. The Remote Unit firing terminals are electrically isolated from the firing energy at all times except when firing.

1.2.4. The RFD system should be stored in a cool, dry place. The storage temperature range is -4 to 86 °F (–20 to 30 °C). Exceeding the storage temperature range may result in damage to the internal battery packs.

1.2.5. The maximum operating temperature range of the RFD is –22 to 140 °F (-30 to 60 °C).

1.2.6. The battery chargers are for indoor use only. Charge time is approximately 3 hours.

	Minimum Temperature	Maximum Temperature
Operate	-22 °F (-30 °C)	140 °F (60 °C)
Store*	41 °F (5 °C)	77 °F (25 °C)
Charge	32 °F (0 °C)	104 °F (40 °C)

Table 1-1 RFD Temperature Ranges

*Exposure outside of this temperature range may result in decreased battery life or damage to the internal battery packs.

2. RFD SYSTEM COMPONENTS

2.1. CONTROLLER UNIT

Figure 2-1 Controller Unit

2.1.1. Figure 2-1 shows the Controller Unit. The Controller Unit is responsible for initiation of all communications with the Remote Unit(s). The Controller Unit's case is yellow for easy identification.

2.1.2. The Controller has an electronic key that must be installed before Arming and Firing is allowed.

2.1.3. The Controller Unit is capable of commanding up to 64 Remote Units, in 8-Remote groups that are hereafter referred to as “Systems”.

2.1.4. The Controller can operate in standby for typically 12-16 hours before recharging is required. The Controller’s charger is internal and is capable of worldwide operation. Typical charge time is 3 hours. The battery system features test and discharge functions.

2.1.5. The Controller features an internal history event log which stores 1024 events in non-volatile memory. The history log can be used to obtain information on the operation and performance of the RFD. Each event is logged with the current date and time along with GPS coordinates (if available).

2.1.6. When the Electric Detonator circuit has been selected on the Controller, transmission signal levels from responding Remote Units are automatically reduced for safety around blasting caps. The Controller’s transmission signal level remains unchanged.

2.2. REMOTE UNIT

Figure 2-2 Remote Unit

2.2.1. Figure 2-2 shows the Remote Unit. The Remote Unit contains the fire circuits used for the initiation of detonators. The Remote Unit is normally positioned at a protected location relatively close to the blast area.

2.2.2. The electronic keys used in the Remote Unit are matched to the Controller and must be installed for communication, arming and firing.

2.2.3. The Remote Unit's electric detonator circuit develops a minimum of 350V DC @ 5J with 27Ω of internal impedance. The maximum recommended series firing resistance (firing cable plus detonators) is 150Ω for group 1A detonators. Consult the specifications for the specific detonator that you are using.

2.2.4. The Remote Unit's shock tube circuit develops a high voltage spark to initiate non-electric shock tube.

2.2.5. The Remote Unit can run on standby for typically 12-16 hours before recharging is required. The Remote Unit's charger is internal and is capable of worldwide operation. Typical charge time is 3 hours. The battery system features test and discharge functions.

2.2.6. The Remote Unit features an internal history event log which stores 1024 events in non-volatile memory. The history log can be used to obtain information on the operation and performance of the RFD. Each event is logged with the current date and time along with GPS coordinates (if available).

2.3. BATTERY CHARGERS

2.3.1. Both Controller and Remote Units use internal battery chargers which are powered by +12VDC from an external AC adapter. The AC adapter operates from 100–240VAC, 50-60 Hz, and has changeable pins for worldwide operation. Typical charge time is 3 hours. Charging should be conducted indoors. Do not attempt to substitute another power supply or equipment damage may occur.

2.3.2. For battery charging procedure, refer to Section 3.2.

2.4. ENABLE KEYS

2.4.1. Each system is supplied with a unique group of enable keys. The enable keys contain the encoded information required for operation.

2.4.2. The Controller Unit has a unique enable key, and will only arm and fire with this specific key installed. The Controller Unit will perform status and disarm functions without the key installed. The Controller Unit automatically disarms all Remote Units upon key removal. The Controller key is labeled with a 'C' to distinguish it from the Remote keys.

2.4.3. The Remote Units' use of the enable key can be configured for one of two operation modes.

2.4.3.1. In generic (default) mode, the Remote unit assumes its System and Unit numbers from the key installed. Any key can work in any Remote unit (as long as that Remote is on the correct frequency assignment). Generic mode allows the flexibility to move Remote Units within different systems and units within those systems by changing the keys.

2.4.3.2. In dedicated mode, The Remote Unit is setup to only work with one specific key; for example a Remote Unit setup in dedicated to be Remote #3 from System #8 can only work with a key that matches these values. Dedicated mode can help when a very strict key control plan is required.

2.5. CONTROLLER UNIT EXTERNAL FEATURES

2.5.1. Figure 2-3 and Table 2-1 show the external features of the Controller Unit.

Figure 2-3 Controller External Features

Item	Item Name	Description
1	RETRACTABLE ANTENNA	Raised vertically during operation, retracted for protection during transport and storage.
2	ANTENNA GUARD	Protects the Antenna from damage. Holds the antenna in position.
3	CARRY HANDLE	Normal carry point for individual unit.
4	AUTOMATIC VENT	The vent allows for automatic pressure equalization inside the case ensuring proper function of the membrane keypad. The vent is waterproof.
5	CONDENSED INSTRUCTIONS	Basic instructions for operation of this equipment. Refer this manual for compete instructions.
6	LID	The lid should be closed and during transport, storage or when the unit is exposed to the elements for full protection.

Table 2-1 Controller External Features

2.6. CONTROLLER UNIT PANEL DISPLAY

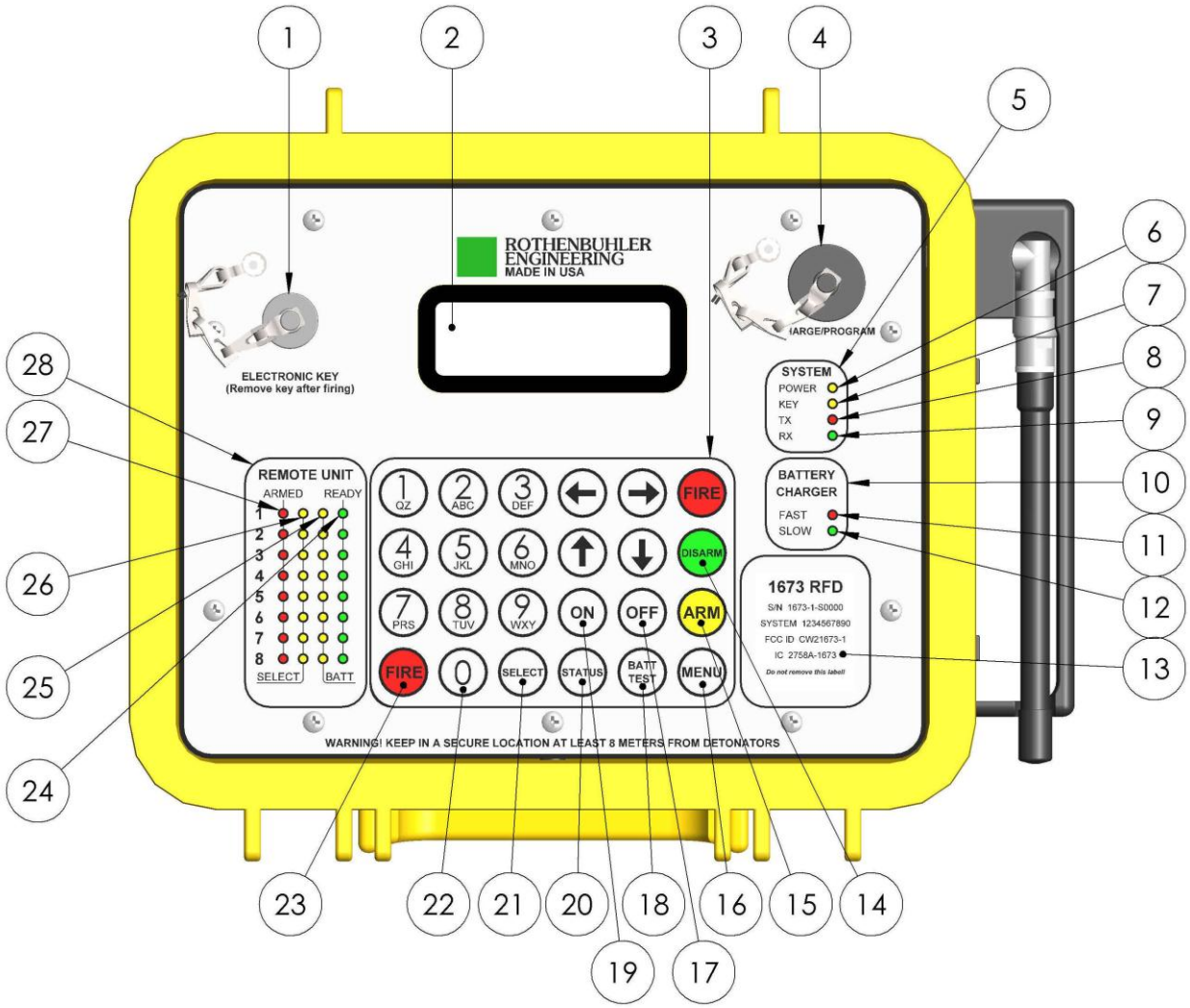


Figure 2-4 Controller Panel

Figure 2-4 and Table 2-2 illustrate the panel indicators, and switch locations on the Controller Unit.

Always press one switch at a time unless firing, and hold each switch for at least ½ second.

Item	Item Name	Description
1	ELECTRONIC KEY PORT	Electronic key must be installed to Arm and Fire Remote units.
2	LIQUID CRYSTAL DISPLAY	The LCD displays information to the user such as battery charge, operation mode, etc. Backlights when switches are pressed.
3	KEYPAD AREA	24 switches used to control the unit through various modes of operation.
4	CHARGE/PROGRAM PORT	Used to supply power to the internal charger and provides a serial connection for reading the history log and changing settings.
5	SYSTEM INDICATORS	Displays information related to system operation.
6	POWER LIGHT	Solid yellow indicates the unit is on. Flashes yellow to indicate the battery must be recharged.
7	KEY LIGHT	Solid yellow indicates the correctly programmed Controller key is installed and working. Flashes when a faulty or incorrect key is installed.
8	TX LIGHT	Lights red when unit is transmitting.
9	RX LIGHT	Lights green to indicate an on channel carrier or when receiving a message from a Remote unit.
10	BATTERY CHARGER INDICATORS	Displays battery charging status.
11	FAST CHARGING LIGHT	Lights red to indicate the battery is being fast charged. Blinks red when charge is pending.
12	SLOW CHARGING LIGHT	Lights green to indicate battery charging is complete and the battery is receiving a slow maintenance charge. Blinks green to indicate a charging error has occurred.
13	INFORMATION LABEL	Shows model number, serial number, system number, and regulatory information.
14	DISARM SWITCH	When pressed, sends a Disarm command to all selected Remote Units.
15	ARM SWITCH	When pressed and held for ½ second, sends the Arm command to all selected Remote Units.
16	MENU SWITCH	Brings up the main menu screen, or returns to the default screen.
17	OFF SWITCH	Turns power off to the unit when not in use or when charging.
18	BATTERY TEST SWITCH	Pressing causes a 10 second loaded battery test. Holding for 5 seconds causes unit to discharge the battery completely for long term storage and battery conditioning.
19	ON SWITCH	Turns power on to the unit.
20	STATUS SWITCH	Requests status response from Remote Units.
21	SELECT SWITCH	Pressing once allows up to 8 Remote Units to be selected with switches (1-8). Pressing a second time locks the selection into the unit.
22	NUMERIC SWITCHES (x10)	Used for selection of Remote units and various menu options and settings.
23	FIRE SWITCH (x2)	When both FIRE switches are pressed and held simultaneously for ½ second, all Remote Units that are both selected and armed will be fired.
24	REMOTE READY LIGHT (x8)	Lights solid green to indicate the corresponding Remote Unit's status is confirmed disarmed. Blinks green to indicate the corresponding Remote Unit's status is assumed to be disarmed (unconfirmed).
25	REMOTE BATTERY LIGHT (x8)	Lights solid yellow after receiving a status response from a corresponding Remote whose battery is ok. Blinks yellow to indicate the corresponding Remote unit has a low battery and should be recharged.
26	REMOTE SELECT LIGHT (x8)	Lights yellow to indicate the corresponding Remote Unit has been selected for communications with the Controller.
27	REMOTE ARMED LIGHT (x8)	Solid red indicates the corresponding Remote Unit is confirmed to be armed. Blinks red when the corresponding Remote unit is assumed to be armed but has not been confirmed as armed.
28	REMOTE UNIT DISPLAY AREA	Displays basic information related to the operation of up to 8 Remote Units.

Table 2-2 Controller Unit

2.7. CONTROLLER LCD DISPLAY

2.7.1. The LCD display provides information that is supplemental to the basic operation of the 1673 RFD. The LCD is rated for -20 to 70 ºC (-4 to 158 ºF). At low temperatures, the LCD may unreadable. In most cases, the standard LED indicators are sufficient to complete blasting operations. In the event the display becomes unreadable due to low temperature, normal display operation should be restored as the unit comes back within the normal temperature range.

2.7.2. Whenever a switch is pressed, the LCD display's backlighting function will be enabled. After 30 seconds of inactivity, the backlighting will automatically turn off to save battery power.

2.7.3. When the Controller is turned on by pressing the 'ON' switch, The Controller goes through a series of self-tests. Once the self-testing is complete, The Controller will show the default screen of Figure 2-5.

Figure 2-5 Controller Unit Default Screen

2.7.4. UNIT TYPE: This informs the user this is a Controller Unit (yellow box).

2.7.5. GPS ACCURACY: If the unit is equipped with GPS, data received from satellite signals are used to record date, time, and positional information in the history log. The GPS accuracy is a number (0-3) which represents the calculated accuracy of the reported data. A GPS rating of '0' indicates GPS has not been acquired. The highest rating of '3' indicates an accuracy of approximately 3 meters (10 feet) and the recorded positional data is considered 'data ok'. GPS takes approximately 1 minute to acquire after the unit is turned on. GPS signals are not available in underground installations, inside vehicles, or where the unit is surrounded by metal. The GPS unit will remember the date and time when no signal is available. You can check the actual GPS

information on the Normal menu by choosing option ‘3’. Units that are not equipped with GPS use a separate clock for recording the date and time of events in the history log.

2.7.6. SYSTEM SELECTED: This is the active System # that is currently selected. You can change to select a different System # on the Normal menu by choosing option ‘2’ and entering the number of your desired System (1-8). The Controller is capable of commanding up to 8 Systems, but it can only command one system at a time. Each System contains up to 8 Remote Units, for a total operational capability of 64 Remote Units.

2.7.7. CURRENT BATTERY VOLTAGE: This represents the current state of charge of the unit. It is recommended that the unit be recharged when the battery falls below 7.5V. The unit will operate normally down to 7.0V however below this the unit must be recharged. If you are operating this system at a temperature below freezing, it is recommended that you fully charge before use. The batteries will start to lose capacity below 0 ºC (32 ºF). A more thorough battery test can be performed by pressing the BATT TEST switch. Below 7.0 V the yellow POWER light begin flashing.

2.7.8. KEY PRESENT: This indicates that the Electronic Key is installed is the correct key for your Controller. The Controller can only be matched to one key at a time. An error will be indicated if a different key or if a faulty key is installed. The yellow KEY light in the SYSTEM indicators also lights solid when the correct key is installed, but will blink if an incorrect key is installed. The Controller’s key must be present to allow arming and firing. Other operations such as status and disarm may be performed without the Controller’s key installed.

The Controller’s key should be stored in a secure place away from the Controller when you are not actively engaged in blasting activities. Without the Controller’s key, the Controller is incapable of arming or firing the Remote Units.

Note: Removing the Controller’s key will cause it to select and send a disarm command to all Remote units of the currently selected system. Avoid removing the Controller’s key when the Controller is on, unless you intend to disarm all Remotes. Normally this would be in a panic situation.

2.7.9. FIRING MODE (FM): ST indicates the Shock Tube Initiator circuit is selected. ED indicates the Electric Detonator circuit is selected. When arming and firing, the current selection will be used. The Controller remembers the last mode selected the next time you turn it on. You can change the Firing Mode selection on the Normal menu.

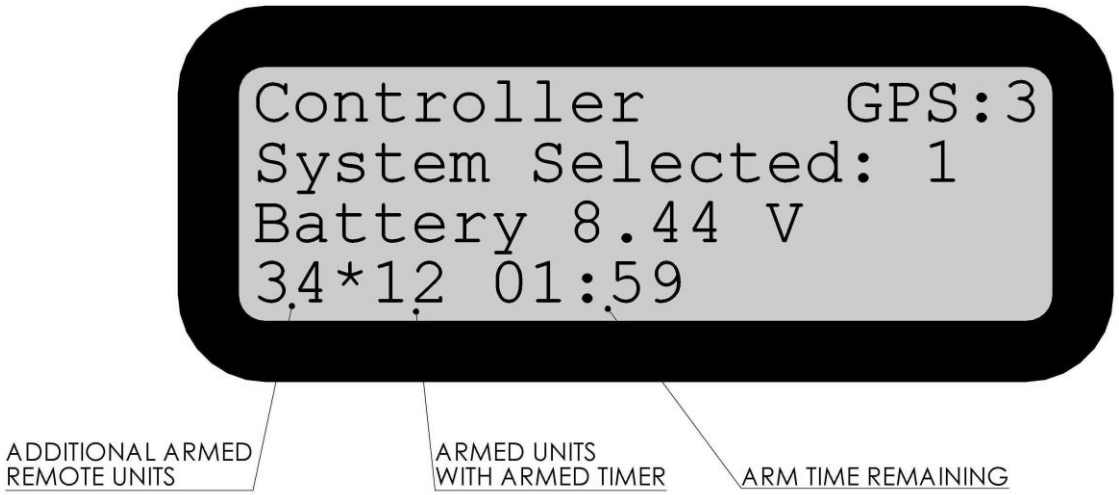
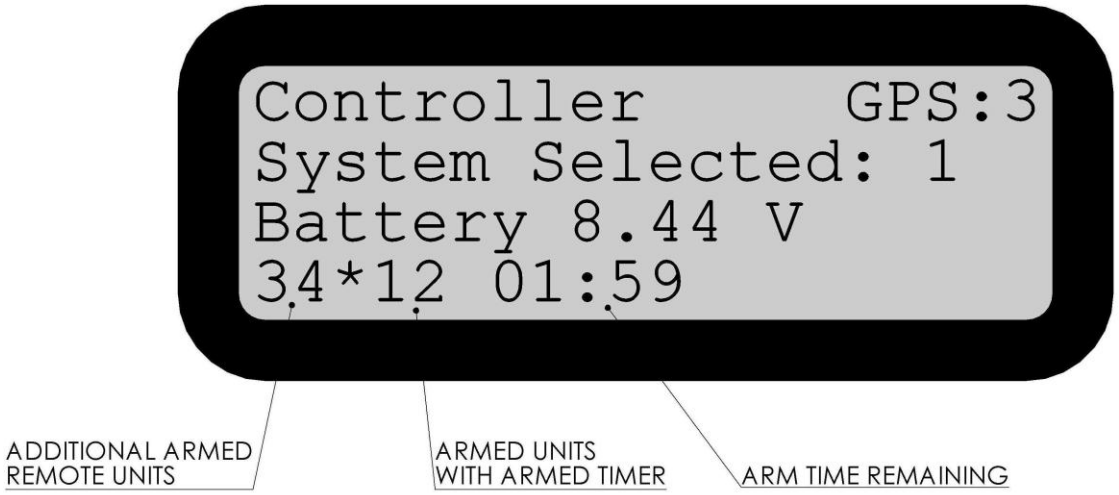


Figure 2-6 Controller Armed Screen



2.7.10. Figure 2-6 shows the Controller Armed Screen that is displayed when the Controller Unit is armed. The ARM TIME REMAING portion shows a count-down timer for the Remote Units that are expected to auto-disarm first (01:59). The units associated with the arm timer are shown to the adjacent left of the ARM TIME REMAINING timer. Additional units that are armed, that have a different (longer) remaining arm time are shown to the left of the asterisk.

2.7.11. In Figure 2-6, Remote Units 1 and 2 have 1 min. 59 sec. of arm time remaining. Units 3 and 4 have a longer period until automatic disarming occurs. Once units 1 and 2 have been disarmed or fired, the time remaining for units 3 and 4 will be shown.

2.7.12. The actual Arm Time has a default value of 20 minutes. The arm time can be changed in the Advanced User menu to other values if needed in the range of 1-60 minutes (See Advanced User Section of this manual). Only the Controller needs to be

changed, Remote Units are updated from the Controller.

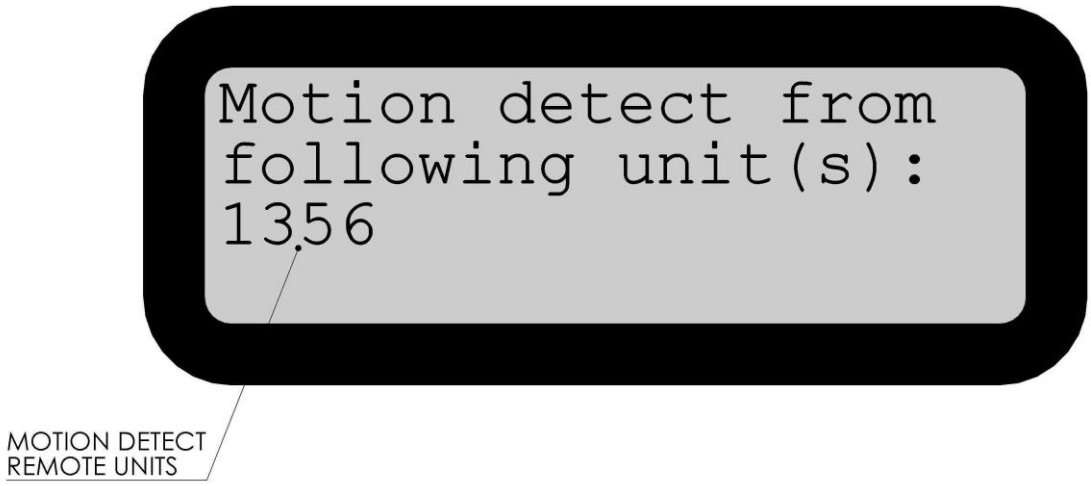


Figure 2-7 Motion Detect Screen

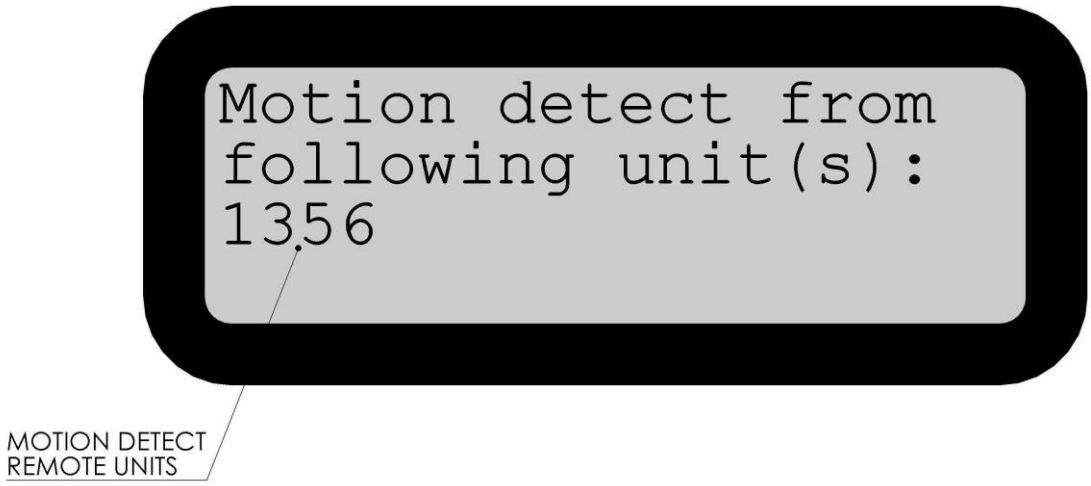
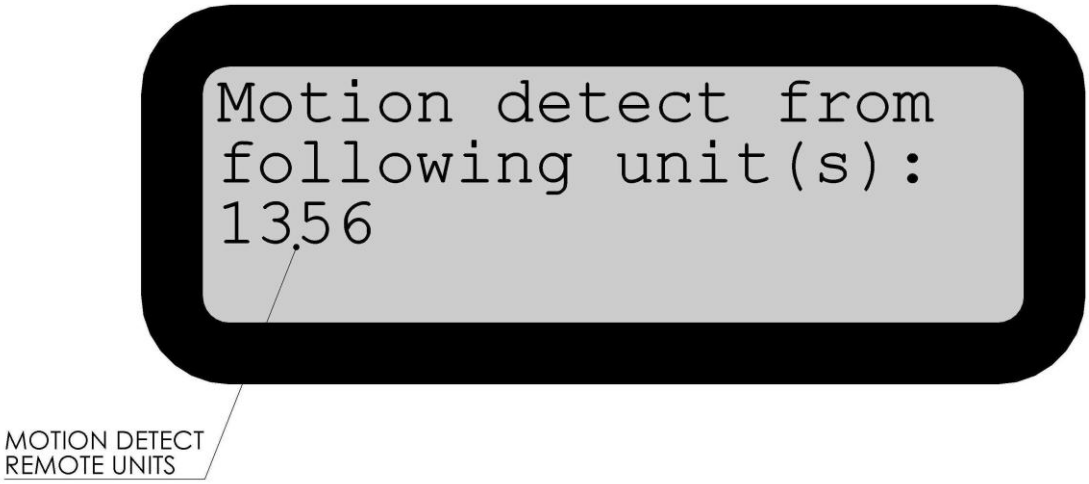


Figure 2-7 shows the Motion Detect Screen which is displayed after firing. After firing, the Remote Units have sensors which measure vibration between 8 and 12 Hz. About 10 seconds after firing, the Motion Detect Screen will be updated automatically to show any Remote Units that have detected a motion. Remote units that do not report that a motion was detected are not shown. In



2.7.13. Figure 2-7 Remote Units 1, 3, 5, and 6 report that they have detected a motion following initiation.

2.7.14. The Motion Detect feature can be helpful to determine if a blast has successfully been initiated when sight or sound methods are not available. See the Advanced User Section of this Manual for more details on how to configure and use the Motion Detect feature of this product. Never depend on this feature for your safety.

2.8. REMOTE UNIT EXTERNAL FEATURES

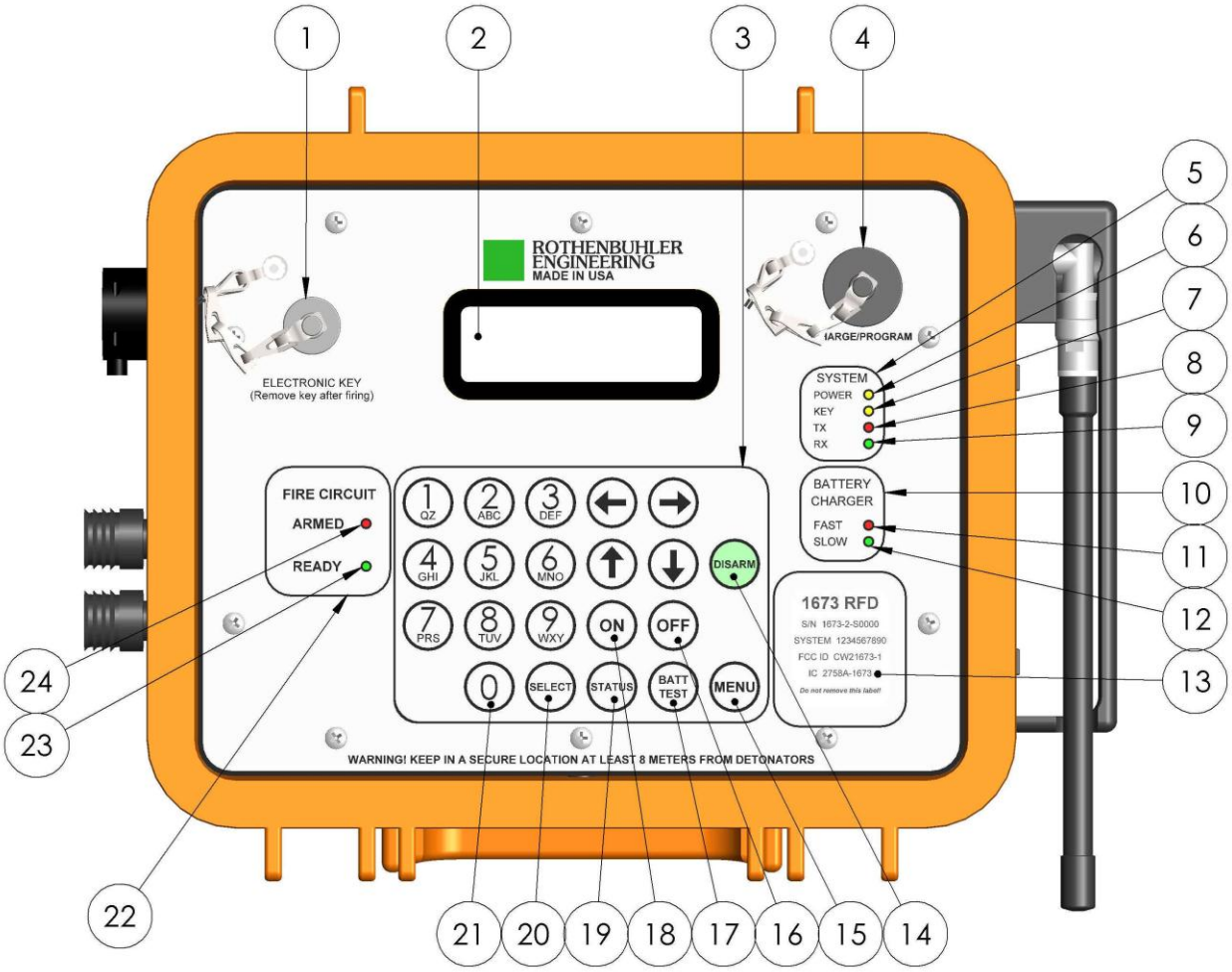
2.8.1. Figure 2-8 and Table 2-3 show the external features of the Remote Unit.

Figure 2-8 Remote Unit External Features

Item	Item Name	Description
1	RETRACTABLE ANTENNA	Raised vertically during operation, retracted for protection during transport and storage.
2	ANTENNA GUARD	Protects the Antenna from damage. Holds the antenna in position.
3	AUTOMATIC VENT	The vent allows for automatic pressure equalization inside the case ensuring proper function of the membrane keypad. The vent is waterproof.
4	CARRY HANDLE	Normal carry point for individual unit.
5	FIRING TERMINALS	Used to attach the firing cable when Electric Detonator circuit is used. Do not touch when arming or firing.
6	SHOCK TUBE FIRING TIP	Mounted into two sealed jacks on the side of the unit. Do not touch when arming or firing.
7	STORAGE POUCH	Used to store Shock Tube Firing Tips as well as the Test Lamp, and the Electronic Key.
8	Lid	The Lid should be closed and latched when blasting, transporting, or when the unit is exposed to the elements for full protection.

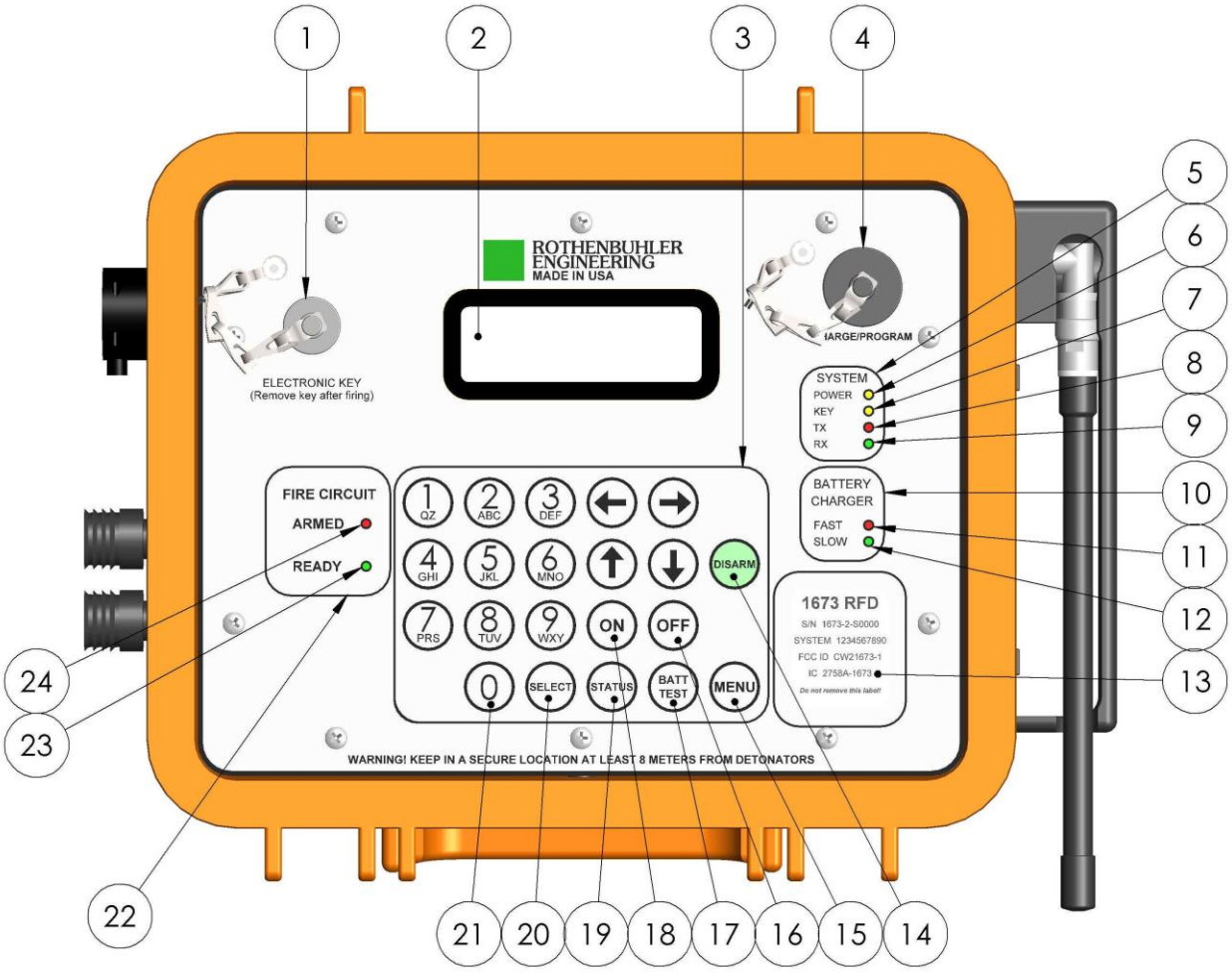
Table 2-3 Remote Unit External Features

2.9. REMOTE UNIT PANEL DISPLAY



2-9 Remote Unit Display Panel

Figure



2.9.1. 2-9 and **Error! Reference source not found.** illustrate the panel indicators, and switch locations on the Controller Unit.

2.9.2. Always press one switch at a time and hold each switch for at least ½ second.

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2.10. REMOTE UNIT LCD DISPLAY

2.10.1. The LCD Display provides information that is supplemental to the basic operation of the 1673 RFD. The LCD is rated for -20 to 70 ºC (-4 to 158 ºF). At very low temperatures, the LCD may become unreadable. In most cases, the standard LED indicators are sufficient to complete blasting operations. In the event the display becomes unreadable due to low temperature, normal display operation should be restored as the unit comes back within the normal temperature range.

2.10.2. Whenever a switch is pressed, the LCD display's backlighting function will be enabled. After 30 seconds of inactivity, the backlighting will automatically turn off to save battery power.

2.10.3. The Remote Unit is turned on by pressing the 'ON' switch. When switched on, the Remote Unit goes through a series of self-tests. Once the self-testing is complete, The Remote Unit will display the default screen as shown in.

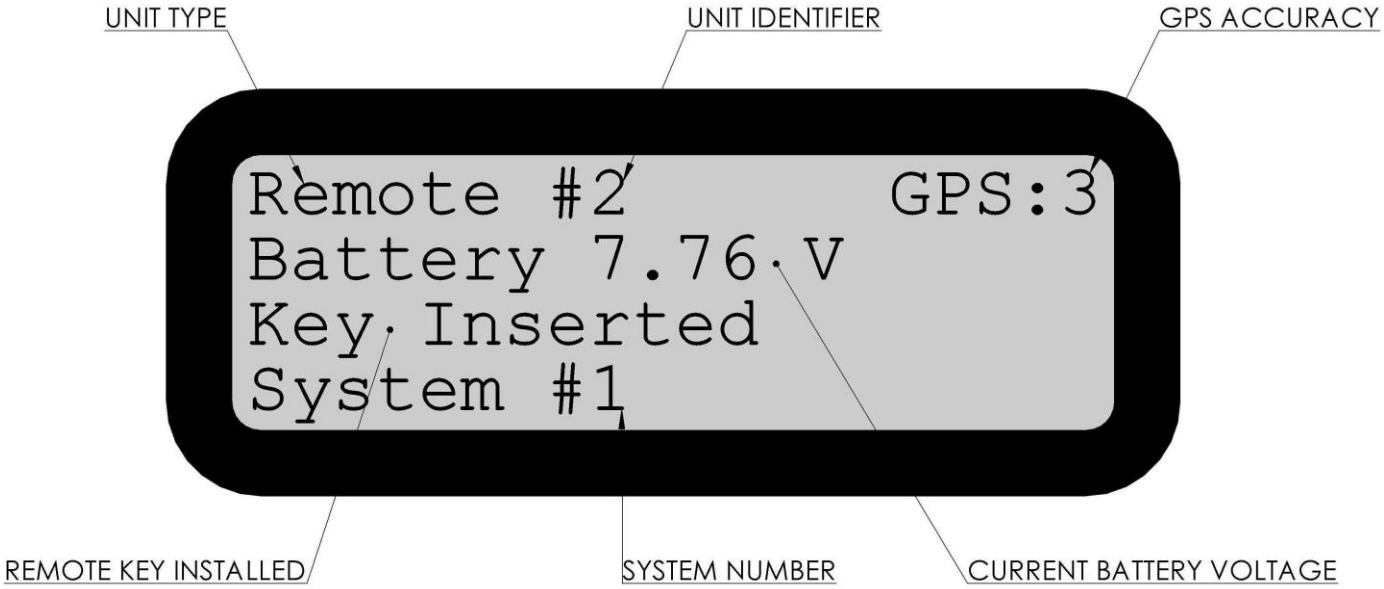


Figure 2-10 Remote Unit Default Screen

2.10.4. UNIT TYPE: This informs the user this is a Remote Unit (orange box).

UNIT IDENTIFIER: This number (1-8) is read from the Electronic Key and corresponds with one of the 8 positions on the Controller's Remote Unit Display Area. The unit identifier in shown in

2.10.5. Figure 2-10 shows that this unit is #2.

2.10.6. GPS ACCURACY: If the unit is equipped with GPS, data received from satellite signals are used to record date, time, and positional information in the history log. The GPS accuracy is a number (0-3) which represents the calculated accuracy of the reported data. A GPS rating of '0' indicates GPS has not been acquired. The highest rating of '3' indicates an accuracy of approximately 3 meters (10 feet) and the recorded positional data is considered 'data ok'. GPS

takes approximately 1 minute to acquire after the unit is turned on. GPS signals are not available in underground installations, inside vehicles, or where the unit is surrounded by metal. The GPS unit will remember the date and time when no signal is available. You can check the actual GPS information on the Normal menu by choosing option ‘3’. Units that are not equipped with GPS use a separate clock for recording the date and time of events in the history log.

2.10.7. CURRENT BATTERY VOLTAGE: This represents the current state of charge of the unit. It is recommended that the unit be recharged when the battery falls below 7.5V. The unit will operate normally down to 7.0V however below this the unit must be recharged. If you are operating this system at a temperature below freezing, it is recommended that you charge before use. The batteries will start to lose capacity below 0 ºC (32 ºF). A more thorough battery test can be performed by pressing the BATT TEST switch. Below 7.0 V the yellow POWER light will flash.

2.10.8. SYSTEM NUMBER: The system number is read from the Remote Unit’s electronic key and is display on the LCD. To work with the Controller, the system number on the Remote must match the currently selected system displayed on the Controller to be operational.

2.10.9. REMOTE KEY INSTALLED: This indicates that a Remote Unit Electronic Key has been inserted and correctly read. The yellow KEY light in the System indicators will light in one of two modes (flashing or solid) when a valid Remote key has been installed.

Note: Removing the Remote’s key will cause it to disarm itself, if previously armed. Pressing the DISARM switch or turning the unit off will also disarm the unit.

2.10.10. FIRING MODE (FM): ST indicates the Shock Tube Initiator circuit is selected. ED indicates the Electric Detonator circuit is selected. When arming and firing, the current selection will be used. The Controller saves the currently active selection when turned off.

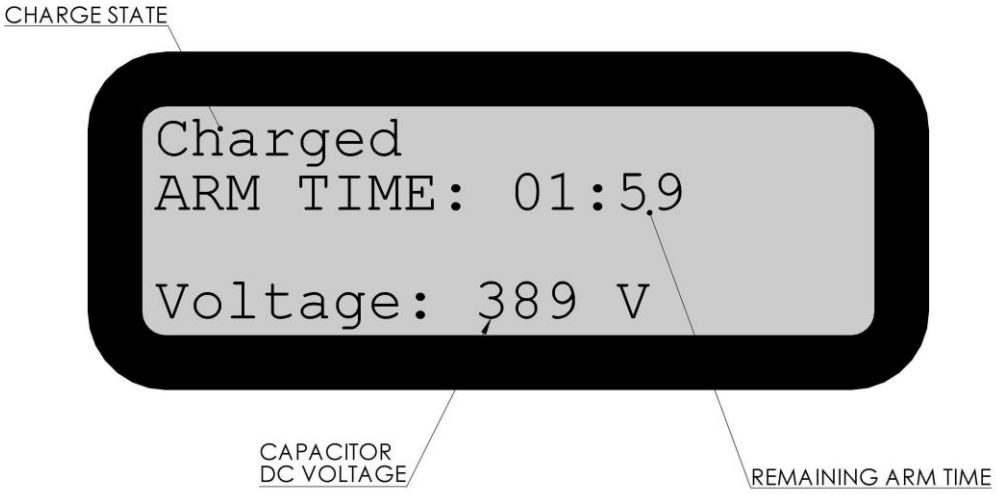
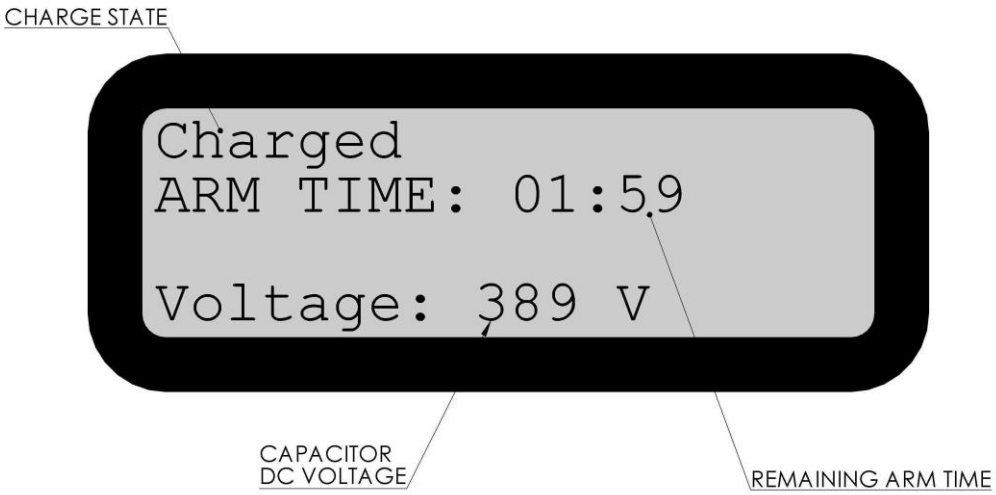


Figure 2-11 Remote Unit Electric Detonator Armed Screen

2.10.11. f.



2.10.12. Figure 2-11 shows the screen that is displayed on the Remote Unit when its Electric Detonator circuit is armed. The CHARGE STATE will initially display ‘Charging’ as the firing capacitor voltage begins to rise. As the capacitor becomes fully charged, this will change to ‘Charged’ and the red ARMED light on the front panel will also turn on. The REMAINING ARM TIME will be displayed as minutes: seconds as it counts down to zero. When it reaches zero, the capacitor will discharge internally and the unit will return to READY or disarmed state. The CAPACITOR DC voltage will also be displayed while the unit is armed. This value will be continuously updated to show the true value of the capacitor voltage.

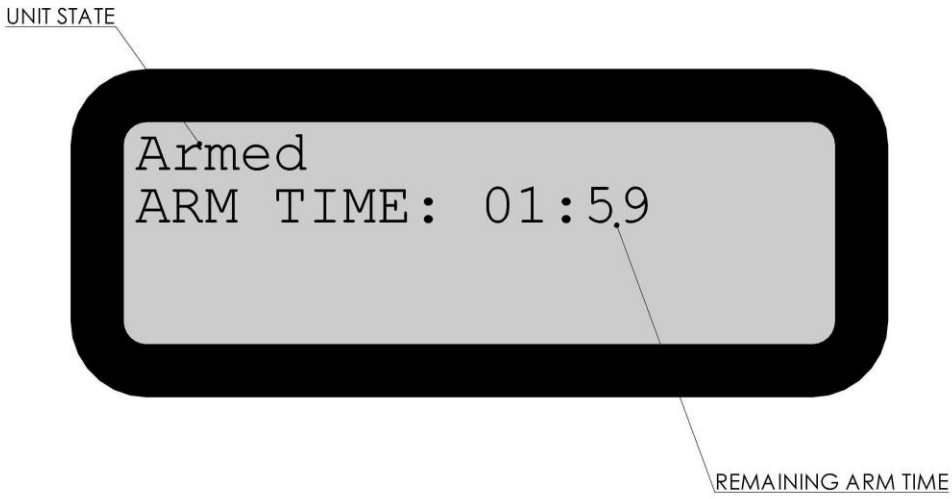


Figure 2-12 Remote Unit Shock Tube Initiator Armed Screen

2.10.13. Figure 2-12 shows the screen that is displayed on the Remote Unit when its Shock Tube Initiator circuit is armed. The UNIT STATE will display ‘Armed’ and the red ARMED light on the front panel will also turn on. The REMAINING ARM TIME will be displayed as in minutes : seconds

as it counts down to zero. When it reaches zero, the unit will return to READY or disarmed state. The firing capacitor is not charged while the unit is armed, but as the unit is in the act of firing. After firing, the capacitor voltage will be briefly reported as the unit disarms back to the READY state.

2.11. SHOCK TUBE FIRING TIP

2.11.1. **Shock Tube Initiation**. The shock tube initiator circuit ignites the explosive powder contained inside of the shock tube creating a dust explosion which transverses through tube at a high rate of speed toward to the detonator. The Remote Unit develops a high-energy spark at the igniter needle located in the Igniter Port shown in Figure 2-13 of the firing tip. Care must be taken to ensure no water or moisture is allowed on or near the igniter needle, or misfires may occur. Keep the tip clean and dry before use and keep the shock tube ends capped at all times. Once the shock tube is installed onto the igniter needle, the unit may be operated in the rain.

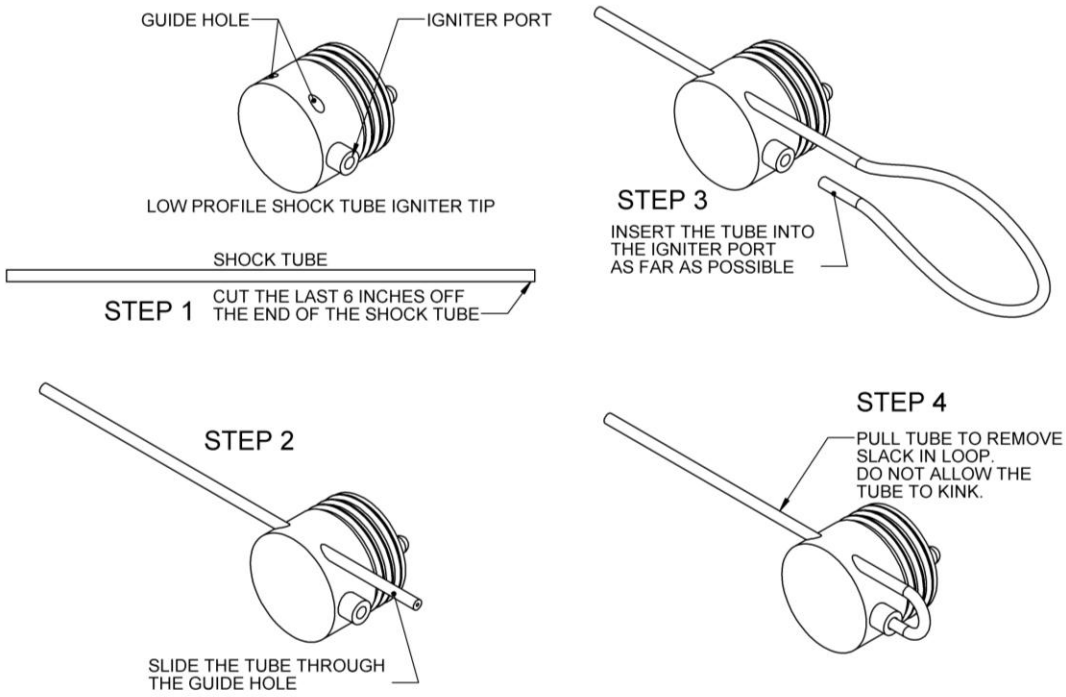


Figure 2-13 Firing Tip, Shock Tube

2.11.2. **Shock Tube Installation on Firing Tip**. Figure 2-13 shows the shock tube firing tip and how the shock tube is installed.

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

2. Insert the shock tube through the guide hole on the tip as shown in Figure 2-13. The guide hole secures the tube to the tip and prevents pulling out.

3. Insert the tube into the igniter port on the side. Slide the tube into the igniter port until the tube comes to a firm stop.

4. Pull the tube exiting the guide hole, removing any slack in the loop formed. This prevents the tube from coming loose from the igniter needle. Do not allow the tube to form a kink.

2.11.3. **Tip Care**. The two tips provided with the RFD are rugged, and will each last for up to 500 shots if properly cared for. Take care to keep mud and debris from getting on the igniter needle. In some cases, the tip's life can be extended by washing in soapy water and gently rubbing the igniter needle with a non-metallic device such as a cotton swab.

2.11.4. **Tip Replacement**. It is recommended the tip be replaced at regular intervals to prevent the likelihood of misfires resulting from worn tip electrodes. You may choose to hold one tip in reserve as a replacement or spare at a location apart from your RFD. Then estimate your tip usage, and schedule replacement when the tip's use reaches your estimated 500 shots.

3. PREOPERATIONAL PROCEDURES

3.1. PHYSICAL INSPECTION

3.1.1. Inspect all components for physical damage.

3.1.2. Remove the caps from the CHARGE/PROGRAM ports on the Controller Unit and Remote Units are clean and dry and show no signs of physical damage.

3.1.3. Ensure that the Remote and Controller Unit antennas are clean and free of damage and can be extended and retracted with relative ease.

3.1.4. Examine the shock tube igniter jacks on the Remote Units. The jacks should be clean and dry.

3.1.5. Examine the Remote Unit's shock tube igniter tips. They should be clean and dry. If more than 500 shots have accumulated on either tip, replacement is recommended to ensure reliable shot initiation.

3.1.6. Ensure the Electronic Key port on the Controller Unit and Remote Units are clean and dry. Ensure the enable keys can be inserted smoothly and show no signs of physical damage.

3.2. CHARGING THE BATTERIES

3.2.1. Ensure all units are turned off and indoors.

3.2.2. Ensure the ambient air temperature is between 32 and 86 °F (0 to 30 °C).

3.2.3. Remove the dust covers from the CHARGE/PROGRAM ports. Line the key on the charger adapter plugs with the slot on the top of the CHARGE/PROGRAM ports mounted on each unit. Insert the plugs and turn clockwise until locked in place.

3.2.4. Insert the supplied battery chargers into suitable power outlets (100-240 VAC, 50/60 Hz).

3.2.5. Once the battery charger is connected to a RFD Unit, the red FAST light will begin blinking for a few seconds and then the light turns to red to indicate the unit is charging. When charge is complete, the green SLOW light turns on. If either of the two lights blinks continuously, then an error has been detected. Charge time is approximately 3 hours. For maximum battery life, avoid leaving the charger connected for more than 24 hours when possible.

3.2.6. When charging is complete, disconnect the battery chargers and reinstall the dust covers on the CHARGE/PROGRAM ports.

3.3. POWER ON TEST

3.3.1. Turn the Controller and Remote Units on by pressing the ‘ON’ switch and verify all units display their default screen with no errors.

3.3.2. Press the BATT TEST switch on each unit. The loaded battery voltage will be displayed after test completion. It is recommended that the batteries be recharged if below 7.5 V, or if the outside ambient temperature is below freezing. Units must be recharged before use if below 7.0 V or of the POWER light is blinking.

3.3.3. When freshly charged, the units will run for up to 16 hours at an ambient temperature of 68 °F or 20 °C. Allow for reduced run times for hot or cold temperatures. Each unit can be fired approximately 100 times before recharging is required. Allow 15 minutes less run time, for each firing event.

3.3.4. The batteries will self-discharge at a rate of approximately 1% per day. This rate will increase as the temperature increases.

3.3.5. The RFD battery cells are reasonably resistant to developing a memory. For best results, allow the RFD to become mostly discharged before recharging, and allow the unit to fully charge without interruption or run a condition cycle. See Section X for details regarding battery usage, health, servicing, and replacement.

3.3.6. Always turn the units off when not in use to conserve the battery charge.

3.4. TESTING THE ELECTRIC DETONATOR MODE

3.4.1. This test procedure must be conducted in an area that is at least 100 feet from the nearest electric detonators or wires connected to electric detonators.

3.4.2. All RFD system components are described in detail in Section 2.

3.4.3. Ensure all units are sufficiently charged according to procedures 3.2.

3.4.4. Position the Controller and Remote Units at least 5 feet (1.5 meters) apart, in a position where all units can be observed while testing.

3.4.5. Raise the antennas vertically on the Controller and Remote Units.

3.4.6. On the Remotes, insert the enable keys and press the ON switches. Observe that the Remote Units display the default screen, the green READY and yellow POWER lights are on and the yellow KEY light is blinking.

3.4.7. On the Remote Units, observe the green READY lights are on, and the red ARMED lights are out. Install a test lamp across each Remote Unit’s firing terminals.

3.4.8. On the Controller Unit, insert the Controller's key and press the ON switch. Observe the yellow ON and KEY lights are on steady.

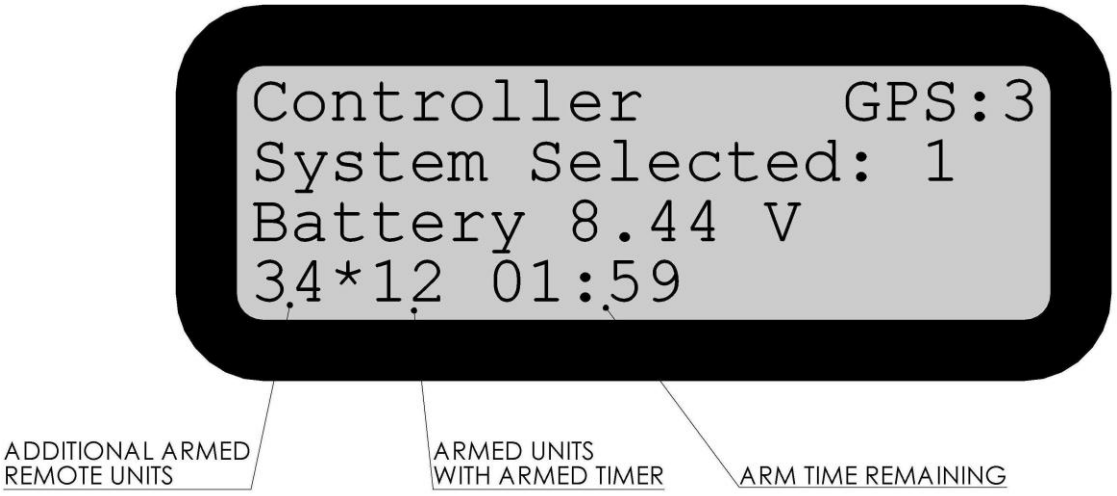
3.4.9. On the Controller, make sure the electric detonator circuit is selected. The LCD screen should show 'FM:ED' (firing mode electric detonator) in the lower right. To change the selection, to electric detonator, press MENU and choose '1. Normal User' and then choose '1. CIRCUIT' and then choose type '1. ELECTRIC'. Press MENU to return to the default screen.

3.4.10. On the Controller, press the STATUS switch. After a short time the green READY lights for the Remote Units that were previously prepared for use, will come on steady to show they are disarmed and communicating two-way. The SELECT lights will automatically be turned on for Remote Units that answered back to the Status request (if Auto-Select Mode is enabled - default is enabled). See the Advanced User section regarding Auto-Select Mode.

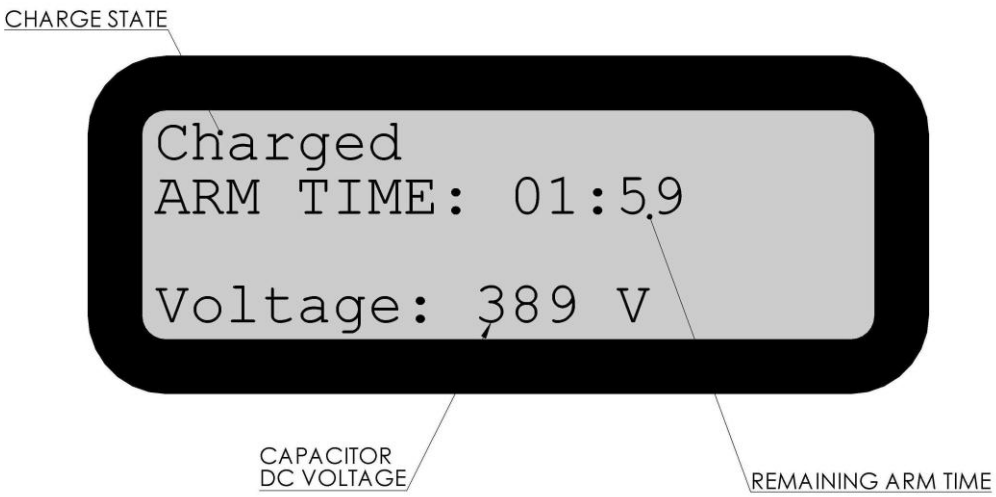
3.4.11. Ensure all Remote Units to be tested are selected on the Controller Unit. Units can be manually selected or deselected by pressing the 'SELECT' switch on the Controller, pressing '1-8' to select or deselect as required, and then press 'SELECT' again, returning to the default screen. The yellow SELECT lights illuminate on the Controller Unit for the selected Remote Units.

3.4.12. On the Controller, press the ARM switch. The ARMED lights for the selected Remote Units will blink for about 10 seconds and come on steady.

On the Remote Units, the red ARMED lights will come on steady. The system is armed. The display on the Controller will show the armed screen of



3.4.13. Figure 2-6 and the Remote Units will show the electric detonator armed screen of f.



3.4.14. Figure 2-11. The voltage displayed on the Remote Units should be above 350V and all of their ARMED lights should be on.

3.4.15. On the Controller, before the arm time counter has expired, press the DISARM switch. All Remotes will disarm within 10 seconds. The red ARMED lights will go out, and the green READY lights will come on steady.

3.4.16. Re-arm the Controller Unit and wait for the arm time counter to expire. After expiration, all Remote Units will return to the disarmed state. The red ARMED lights will go out, and the green READY lights will come on steady.

3.4.17. Re-arm the Controller Unit, and before the arm time counter has expired, press both FIRE switches together and hold for ½ second. You should notice that the test lamps light for all Remote Units. All units subsequently return to the disarmed state. The red ARMED lights will go out, and the green READY lights will come on steady.

3.4.18. Turn off all units. Restore test lamps, retract antennas, and close lids as required. The system is now operationally ready for use.

3.5. TESTING THE SHOCK TUBE INITIATOR MODE

3.5.1. This test procedure must be conducted in an area that is at least 100 feet from the nearest electric detonators or wires connected to electric detonators.

3.5.2. All RFD system components are described in detail in Section 2.

3.5.3. Ensure all units are sufficiently charged according to procedures 3.2.

3.5.4. Position the Controller and Remote Units at least 5 feet (1.5 meters) apart, in a position where all units can be observed while testing.

3.5.5. Raise the antennas vertically on the Controller and Remote Units.

3.5.6. On the Remotes, insert the enable keys and press the ON switches. Observe that the Remote Units display the default screen, the green READY and yellow POWER lights are on and the yellow KEY light is blinking.

On the Remote Units, observe the green READY lights are on, and the red ARMED lights are out. Install the Shock Tube Firing Tip across the shock tube firing jacks as shown in

3.5.7. Figure 2-8.

3.5.8. On the Controller Unit, insert the Controller's key and press the ON switch. Observe the yellow ON and KEY lights are on steady.

3.5.9. On the Controller, make sure the shock tube initiator circuit is selected. The LCD screen should show 'FM:ST' (firing mode shock tube) in the lower right. To change the selection, to shock tube, press MENU and choose '1. Normal User' and then choose '2. CIRCUIT' and then choose type '1. SHOCK TUBE'. Press MENU to return to the default screen.

3.5.10. On the Controller, press the STATUS switch. After a short time the green READY lights for the Remote Units that were previously prepared for use, will come on steady to show they are disarmed and communicating two-way. The SELECT lights will automatically be turned on for Remote Units that answered back to the Status request (if Auto-Select Mode is enabled - default is enabled). See the Advanced User section regarding Auto-Select Mode.

3.5.11. Ensure all Remote Units to be tested are selected on the Controller Unit. Units can be manually selected or deselected by pressing the 'SELECT' switch on the Controller, pressing '1-8' to select or deselect as required, and then press 'SELECT' again, returning to the default screen. The yellow SELECT lights illuminate on the Controller Unit for the selected Remote Units.

3.5.12. On the Controller, press the ARM switch. The ARMED lights for the selected Remote Units will blink for about 10 seconds and come on steady.

On the Remote Units, the red ARMED lights will come on steady. The system is armed. The display on the Controller will show the armed screen of

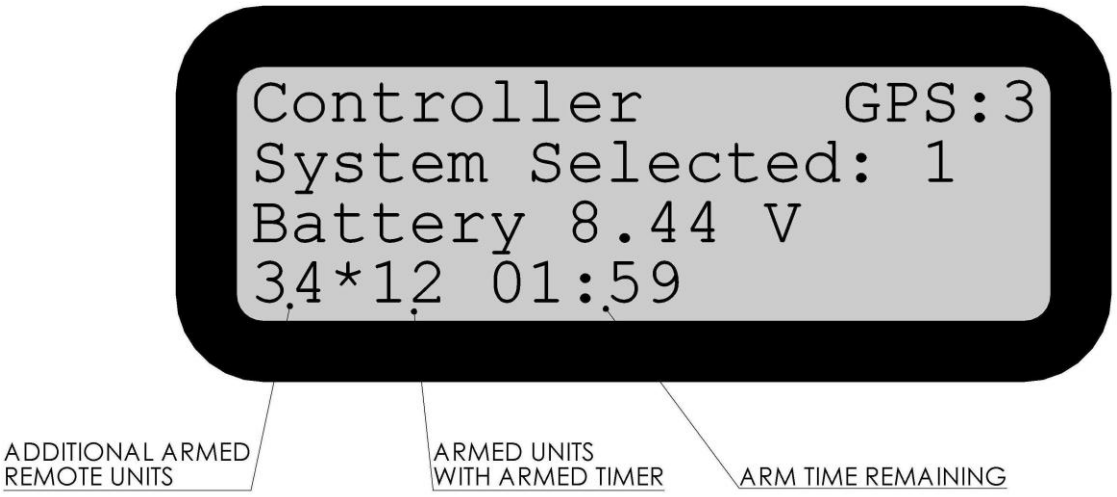


Figure 2-6 and the Remote Units will show the shock tube armed screen of

3.5.13. Figure 2-12. The Remote Units' ARMED lights should be on.

3.5.14. On the Controller, before the arm time counter has expired, press the DISARM switch. All Remotes will disarm within 10 seconds. The red ARMED lights will go out, and the green READY lights will come on steady.

3.5.15. Re-arm the Controller Unit and wait for the arm time counter to expire. After expiration, all Remote Units will return to the disarmed state. The red ARMED lights will go out, and the green READY lights will come on steady.

3.5.16. Re-arm the Controller Unit, and before the arm time counter has expired, press both FIRE switches together and hold for ½ second. You should notice that a spark is developed across the firing tips of the Remote Units. The spark can be both heard and seen. All units subsequently return to the disarmed state. The red ARMED lights will go out, and the green READY lights will come on steady.

3.5.17. For a brief moment after firing, the shock tube firing voltage will be displayed on the Remote Unit. The shock tube firing voltage should be above 2,250 V for reliable initiation. Typical firing voltage is 2,500 V.

3.5.18. Turn off all units. Restore firing tips, retract antennas, and close lids as required. The system is now operationally ready for use.

4. RFD OPERATIONAL PROCEDURES

4.1. SETTING UP THE RFD

4.1.1. Select the number of Remotes required for the operation. Ensure all units are sufficiently charged and tested according to Chapter 3.

Figure 4-1 Raising the Controller Antenna

4.1.2. Ensure the Controller Unit electronic key is removed. Position the Controller Unit at the intended firing position and raise the antenna vertically.

4.1.3. Select a position for the first Remote Unit close to the blast area, but far enough to ensure the Remote is safe from direct air blasts and falling rocks.

Figure 4-2 Raising the Remote Antenna

4.1.4. Raise the antenna vertically on the Remote Unit. Ensure the antenna is free of obstruction.

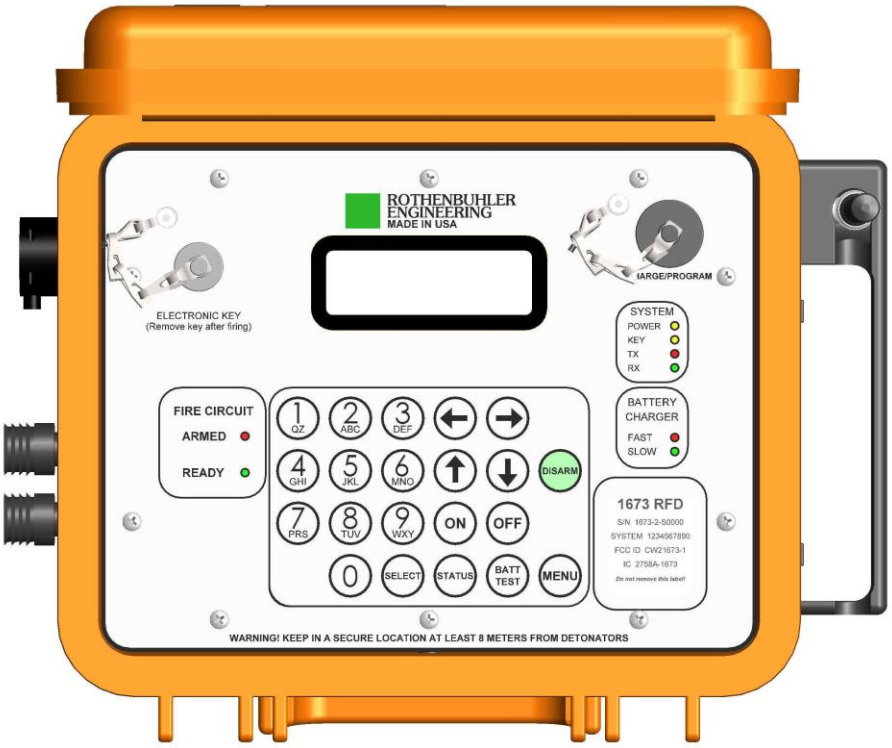


Figure 4-3 Activating the Remote Unit

4.1.5. Press the ON switch. Observe the yellow ON light is on and not flashing. Press the BATT TEST switch and verify the battery voltage. If the battery voltage is below 7.0 V, the unit must be recharged before use.

4.1.6. If the green RX light is on, it suggests there may be an interfering radio signal or noise present. The RX light is similar to breaking squelch on a handheld radio and does not necessarily indicate operation is degraded.

4.1.7. Verify the green READY light is on, while the red ARMED light remains off.

4.1.8. Install the tube into the Shock Tube Firing Tip, and install the tip into the jacks on the front panel of the Remote as described in section 2.11.

4.1.9. Install the enable key into the Remote Unit, and observe the yellow KEY light blinks.

4.1.10. Close the lid on the Remote Unit for environmental protection.

4.1.11. Repeat Sections 4.1.3 to 4.1.9 for the remaining Remote Units to be used in the operation.

4.2. FIRING THE RFD

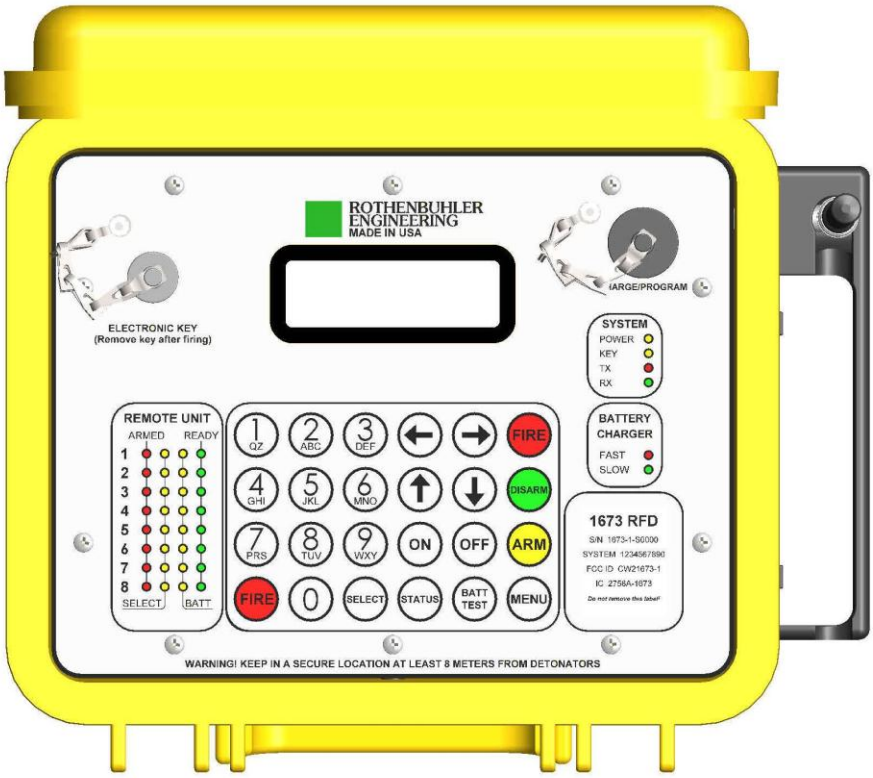


Figure 4-4 Controller Unit Face Panel

4.2.1. Activate the Controller Unit on pressing the ON switch. Observe the yellow POWER light is on and not flashing. Conduct a battery level test by pressing the BATTERY TEST switch. The battery must be recharged if below 7.0 V.

4.2.2. When the area is clear and all shots are prepared, insert the enable key into the Controller Unit in the Electronic Key port shown in Figure 4-4. The yellow KEY light will turn on.

Figure 4-5 Controller Default Screen

4.2.3. Ensure that the System (#1-8) that you intend to fire is active on the Controller (Figure 4-5). If you have 8 Remotes or less, by default System #1 should be selected. To change to select a different system, press the MENU switch and choose the ‘Normal’ menu. Press ‘2’ and select and save your desired System (1-8) using the arrow keys. Press MENU to return to the default screen. Your new System selection should be displayed.

4.2.4. Ensure that the correct firing circuit (Firing Mode) is active on the Controller. ST indicates that shock tube or non-electric detonator is chosen. ED indicates that the electric detonator circuit is chosen. You may change the selection on the ’Normal’ menu.

4.2.5. Press the SELECT switch and press the 1-8 keys to select the Remote Units to be fired. The yellow SELECT lights will illuminate as the corresponding Remotes are selected. Confirm the selection by pressing the SELECT switch a second time. The LCD returns to the default menu.

4.2.6. Press the STATUS switch and observe after a few seconds that the green READY lights illuminate for each selected Remote Unit that is operational and within range.

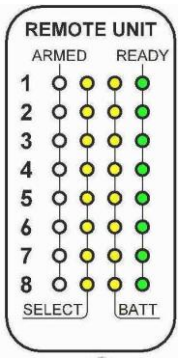


Figure 4-6 Status Check Results on Controller

Shown in

4.2.7. Figure 4-6 are the results of our STATUS check with all 8 Remote Units reporting. The steady green READY lights for Remote Units #1-8 indicate they are disarmed. The steady yellow BATT lights indicate Remote Units #1-8 do not have low batteries.

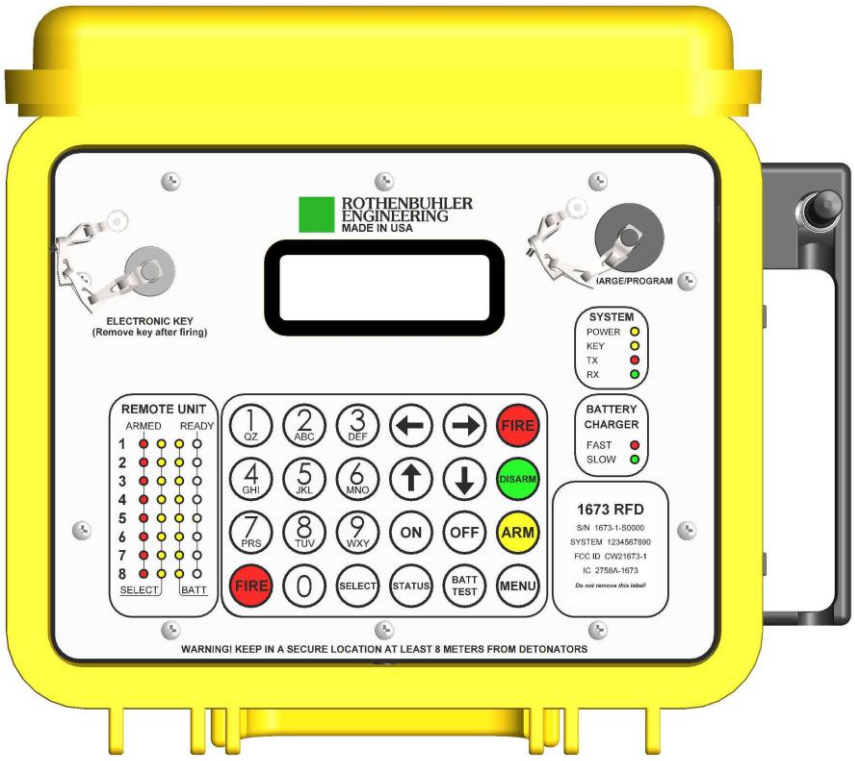


Figure 4-7 Arm the SELECTED Remote Units

4.2.8. Wait for the appropriate warning sirens. About 30 seconds from firing, press and hold the ARM switch for ½ second. The red ARMED lights will blink for up to 15 seconds and come on steady as shown in Figure 4-7.

4.2.9. Any Remotes that are not within communications range will not be armed.

4.2.10. When ready to fire, press the two FIRE switches together at the same time and hold for ½ Second as shown. Shot initiation in surface mines is normally detected.

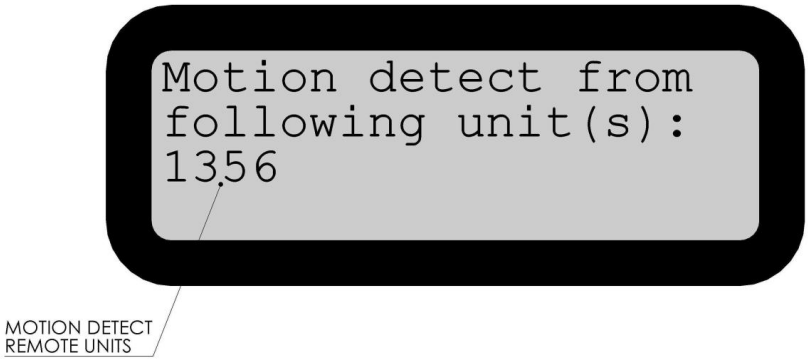


Figure 4-8 Motion Detect Screen

After firing, the following Motion Detect Screen will be shown as in

4.2.11. Figure 4-8. About 10 seconds later, the screen will be updated for any units that have detected a motion that was likely caused by the blast.

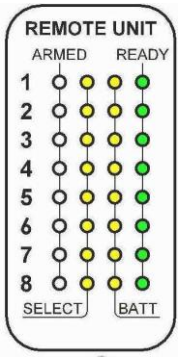


Figure 4-9 Verify the green READY Lights are on steady

4.2.12. At the same time the Motion Detect Screen is displayed, the REMOTE UNIT display will but updated as shown in Figure 4-9. Any READY lights which continue to blink indicate that the Controller did not get a response that Remote Unit. Do not approach those Remote Units which remain blinking until you get a solid green READY light to indicate they are confirmed to be disarmed and safe for approach.

4.2.13. To manually check status, press the STATUS switch at any time. The updated status of the SELECTED Remotes will be reported on the Controller panel. You may alternately press DISARM and STATUS until all Remotes have reported they are confirmed READY.

4.2.14. With all deployed Remote Units having reported steady READY status, deactivate the Controller by pressing the OFF switch.

4.2.15. Remove the Controller Unit's enable key.

4.2.16. Wait an additional 2 minutes, and following standard safety procedures, you may approach and retrieve the Remote Units.

4.2.17. Turn OFF the Remote Units. Retract the Antennas and remove and store the enable keys, and shock tube tips.

4.2.18. Inspect all units for physical damage. Restore the dust caps and close the lids.

5. RFD SYSTEM CONFIGURATION –MENUS

5.1. START MENU

5.1.1. To enter the Start Menu, press the ‘MENU’ switch. The Start Menu shown in Figure 5-1 will be displayed, with further sub-menu options available.

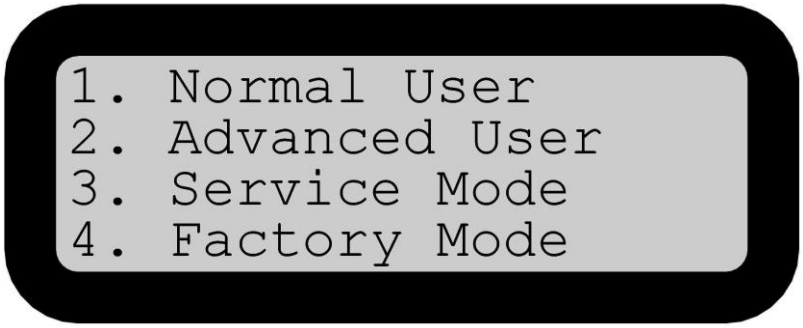


Figure 5-1 Start Menu

5.2. NORMAL USER

5.2.1. The Normal User menu provides basic options and settings for which you may want to view or change in the normal day to day operations. This is the only sub-menu which does not require a 4-digit pin code to access. Simply press ‘1’ and the normal user sub-menu will be displayed. Not that there are different options for the Controller and Remote menus.

5.2.2. From the Normal User menu, there are several selections available. The Controller’s selections are shown in Table 5-1. You can scroll through the various menu options with the up and down arrow keys and press the number to make the selection. Press the back arrow or MENU switch to escape. Follow the on screen instructions.

Item	Item Name	Description
1	CIRCUIT	Allows the selection of Electric Detonator or Shock Tube Firing Circuit. Controller remembers user selection.
2	SELECT SYSTEM	Select the desired system for operation (1-8). Default selection is System #1.
3	DISPLAY GPS	Displays the GPS coordinates along with GPS date and time.
4	SET TIME ZONE	This should be set to the correct GMT for your local area.
5	SET LCD CONTRAST	Change the contrast for the LCD test. Higher number means darker text.
6	RUN SAFETY POLL	Choose the systems (1-8) and Safety Poll™ runs.
7	DISP FIRE COUNT	Displays the number of times the Controller has been used fired.
8	BATT DSHCH TIME	Displays the last battery discharge time when discharge-mode was used. Can be useful for determining battery health.
9	FIRMWARE VER.	This displays the current version of firmware and the program checksum for the main processor.

Table 5-1 Controller Normal Menu Options

5.3. CONTROLLER ADVANCED USER

5.3.1. The Advanced User menu allows the user to make changes to system settings that are not normally required for the day to day operations of the RFD. The Advanced User menu requires a 4-digit PIN code for access to prevent unauthorized changes to the system settings. The PIN code must be obtained from the Manufacturer or from the Distributor where you purchased the RFD. We recommend that you keep your PIN code confidential and share only with personnel that have a need to make changes and who understand the impact of those changes on the system as a whole.

Item	Item Name	Description
1	CONFIGURE MODE	Allows changes to the various features: ASM: Auto-Select Mode (Enabled – 1) allows auto selection of responding Remote Units. RLM: Receive Light Mode (Carrier Detect – 1) RX lights whenever signal present, (RX Data – 0) lights only when receiving messages CM: (Default – 1) requires 2-way communication for Arm and Fire. GPS: Used to enabled GPS on GPS equipped units.
2	WIFI	Not currently Available
3	USB	Allows a serial connection to a PC for downloading history log, changing settings, and changing configuration data.
4	PROGRAM KEYS	This mode is used adding or replacing keys within the 8 systems (see XXX for key programming instructions).
5	TESTS	Tests can be performed of the LED display and GPS signal data (current position, date and time) can be viewed.
6	LED INTENSITY	You can change the brightness of the LED displays between dim, medium, and bright (default is medium). The unit remembers the last used setting.
7	SET RTC	For units without GPS, a real-time-clock (RTC) is available for logging history events. You can change the settings here.
8	DISP KEY DATA	Displays configuration information stored in the Electronic Key. Some information stored in the unit is also displayed.

Table 5-2 Controller Advanced User Menu

5.4. REMOTE NORMAL USER

5.4.1. From the Normal User menu, there are several selections available. The Remote's

selections are shown in Table 5-3. You can scroll through the various menu options with the up and down arrow keys and press the number to make the selection. Press the back arrow or MENU switch to escape. Follow the on screen instructions.

Item	Item Name	Description
1	DISPLAY GPS	Displays the GPS coordinates along with GPS date and time.
2	MOTION DETECT BG	Calibrates the Motion Detection feature of the 1673.
3	SET TIME ZONE	This should be set to the correct GMT for your local area.
4	SET LCD CONTRAST	Change the contrast for the LCD test. Higher number means darker text.
5	BATT DSHCH TIME	Displays the last battery discharge time when discharge-mode was used. Can be useful for determining battery health.
6	FIRMWARE VER.	This displays the current version of firmware and the program checksum for the main processor.

Table 5-3 Remote Unit Normal Menu Options

5.5. REMOTE UNIT ADVANCED USER

5.5.1. The Advanced User menu allows the user to make changes to system settings that are not normally required for the day to day operations of the RFD. The Advanced User menu requires a 4-digit PIN code for access to prevent unauthorized changes to the system settings. The PIN code must be obtained from the Manufacturer or from the Distributor where you purchased the RFD. We recommend that you keep your PIN code confidential and share only with personnel with a need to make changes and understand the impact of those changes on the system as a whole.

Item	Item Name	Description
1	CONFIGURE MODE	Allows changes to the various features: ASM: Auto-Select Mode (Enabled – 1) allows auto selection of responding Remote Units. RLM: Receive Light Mode (Carrier Detect – 1) RX lights whenever signal present, (RX Data – 0) lights only when receiving messages CM: (Default – 1) requires 2-way communication for Arm and Fire. GPS: Used to enabled GPS on GPS equipped units.
2	WIFI	Not currently Available
3	USB	Allows a serial connection to a PC for downloading history log, changing settings, and changing configuration data.
4	LED INTENSITY	You can change the brightness of the LED displays between dim, medium, and bright (default is medium). The unit remembers the last used setting.
5	TESTS	Tests can be performed of the LED display and GPS signal data (current position, date and time) can be viewed.
6	SET RTC	For units without GPS, a real-time-clock (RTC) is available for logging history events. You can change the settings here.
7	DISP RCOUNT	Display rolling count stored in key and fire count.
8	SET SEQ TIME	If you are using sequential firing mode, there will be a delay between the firing of each Remote unit. You can change the delay here in millisecond increments. When firing multiple Remote Units, this can help to prevent Motion from one blast event from being picked up by another blast event.
9	DISP KEY DATA	Displays configuration information stored in the Electronic Key..

Table 5-4 Remote Advanced User Menu

5.6. SERVICE MENU

5.6.1. Service Menu a PIN protected menu only available to the manufacturer or authorized service shops. Service Menu allows changes of various to critical operation parameters such radio settings, calibration, and arm time. Consult the manufacturer or distributor if you feel you need to have adjustments to your system.

5.7. FACTORY MENU

5.7.1. Factory Menu is a PIN protected mode where change can only be performed by the manufacturer.

5.8. PROGRAMMING ELECTRONIC KEYS

5.8.1. The Key Programming Mode of the Controller allows you to create replacement keys if you have a lost or damaged key, or you can create a new key if you need to add a new Remote to your system. An important feature of the key programming mode is that it will not allow duplicate keys to be created. This means that if a key is lost or stolen, once you reprogram the keys, the key that was lost or stolen will no longer be functional, unless it also is reprogrammed.

5.8.2. When programming a key associated with a particular system, you must also reprogram all of the other keys associated with that system at the same time (up to 8 Remotes and the Controller key must be programmed together). You do not need to reprogram keys that are associated with other systems, unless you are adding or replacing their keys as well.

5.8.2.1. Identify which systems (1-8) the new or replacement keys will be matched to. If you have 8 Remotes or less, by default you will be reprogramming only the System #1 keys. If you have more than 8 Remotes, you may be programming keys from other Systems as well.

5.8.2.2. Gather all of the keys associated with the system(s) for which you have identified in 5.8.2.1 to the Controller Unit. You must reprogram all Remote Units from that system together at the same time; even the ones that are working correctly.

5.8.2.3. Remove the Controller’s key from the electronic key port. Turn the Controller on, and press the MENU switch to enter the start menu.

5.8.2.4. Press ‘2’ to select the Advanced Menu. Enter the PIN supplied to you by the manufacturer or distributor.

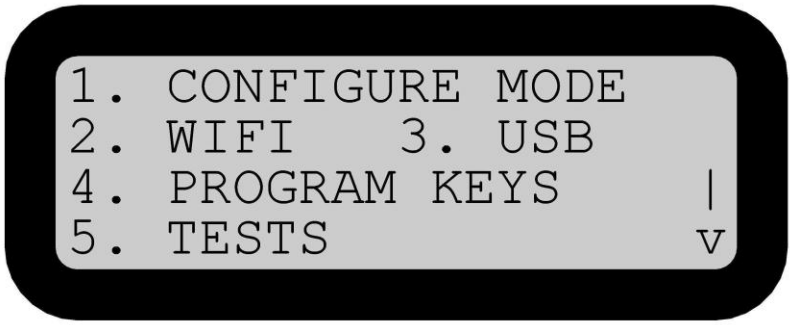


Figure 5-2 Advanced User Menu

5.8.2.5. On the Advanced Menu screen, choose ‘4. PROGRAM KEYS’.

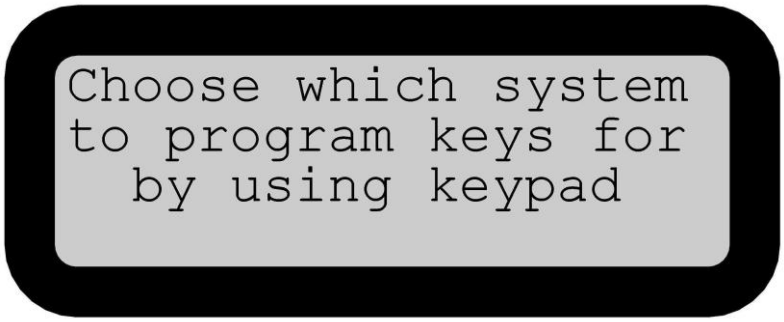


Figure 5-3 Choose System # (1-8)

5.8.2.6. Choose which System # you wish to program keys for. If you have 8 or less Remote Units, by default you will choose ‘1’.

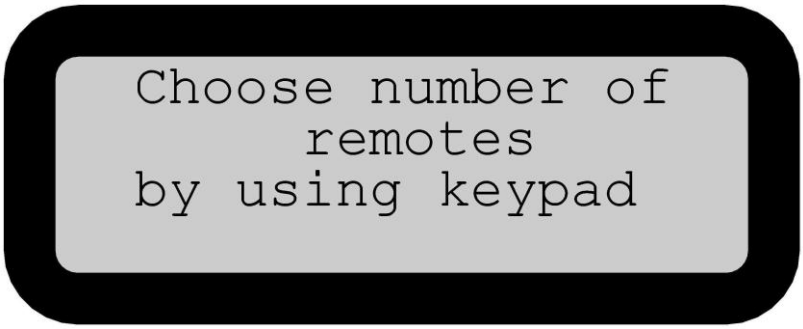


Figure 5-4 Choose the Number of Remotes in the System

5.8.2.7. Choose the number of Remotes that are associated with the System you have chosen with the keypad (up to 8 Remotes). You must have the key for each Remote available.

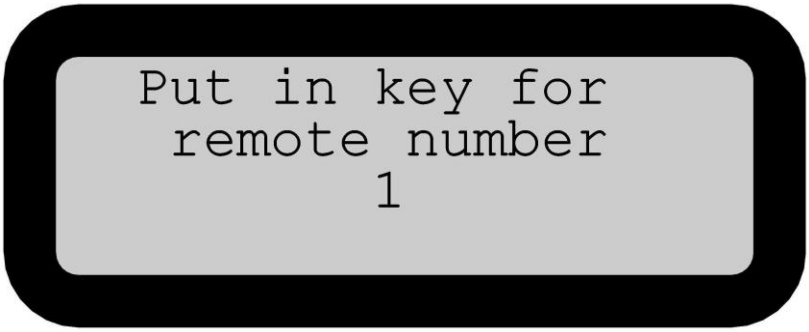


Figure 5-5 Program Remote Keys

5.8.2.8. Put in the key to be used as Remote #1 first. If the keys are labeled, ensure the Unit #s on the labels match the Remote number you are programming. Then continue following the screen instructions until all of the Remote keys are programmed.

5.8.2.9. Follow the screen instruction to put in the Controller's key and Remove when programming is complete.

5.8.2.10. Repeat procedures 5.8.2.1 through 5.8.2.9 until all the Systems that you have determined have been programmed.

5.8.2.11. Test the RFD following the Preoperational Procedures of Section 3.

6. 1673 CONFIGURATION SOFTWARE

6.1. ABOUT THE CONFIGURATON SOFTWARE

6.1.1. The programming software allows the user to view and change various settings within the RFD units to best match the equipment to the blasting application. Many of the settings can also be configured through the Advanced User menu directly. The programming software also allows the user to upload the history event log, which stores a record of the last 1024 operation events.

6.1.2. Refer to Section 7 for installation instructions for the USB driver and program.

6.1.3. To display the history log function, you must have Microsoft™ Excel 2003 or later installed on your PC.

6.2. RUNNING THE CONFIGURATION SOFTWARE

6.2.1. Connect one end of the USB adapter cable to the Controller or Remote Unit's CHARGE/PROGRAM connector and the other end to the host PC.

6.2.2. Use the Windows™ Start Menu and browse to the folder '1673 RFD Configuration' and select the '1673 RFD Configuration' program. The program opens and displays the main screen shown in Figure 6-1.

6.2.3.

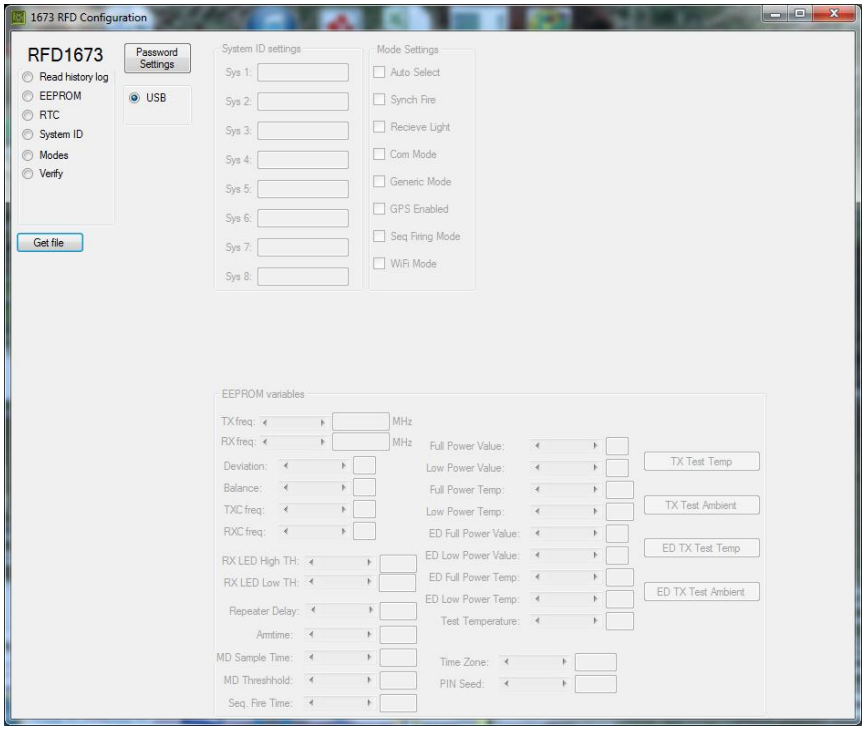


Figure 6-1 1673 RFD Configuration – Main Screen

6.3. READING THE EVENT HISTORY LOG

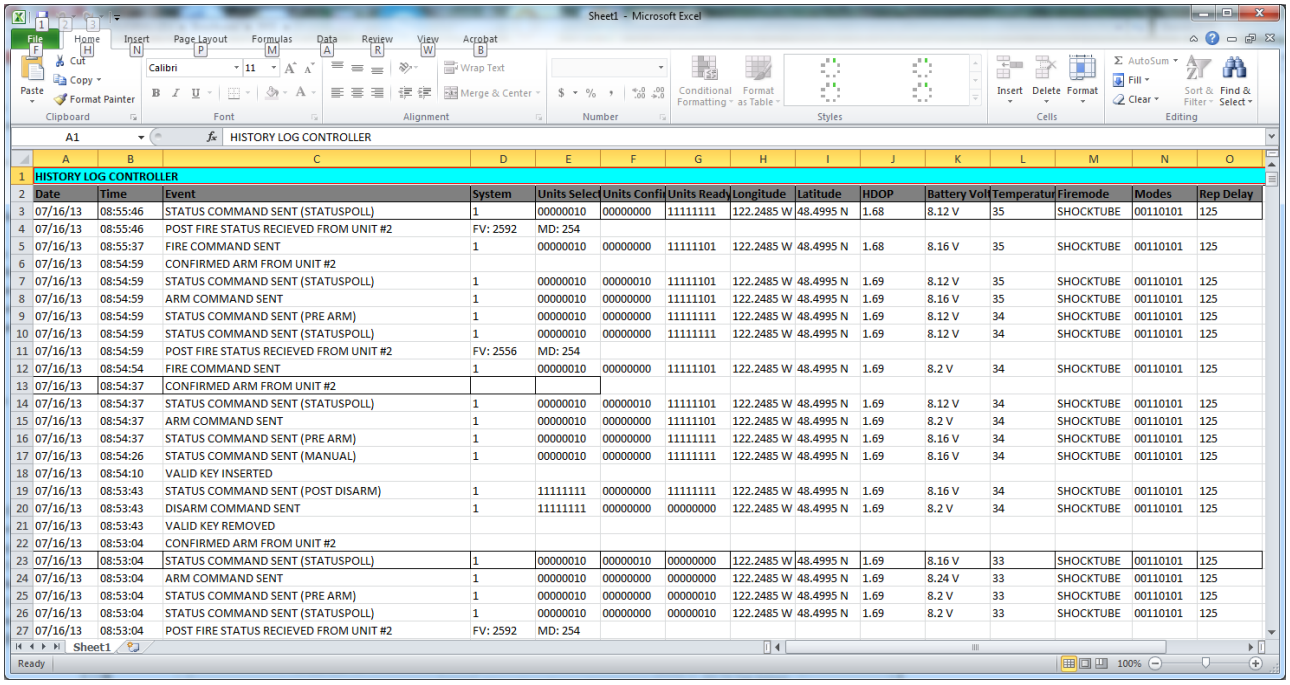
6.3.1. Within both the Controller and Remote Units is stored a record of the last 1024 operation events. Recorded events include commands (arm, fire, disarm, status), battery status, key status, firing voltage, motion detect level, auto-disarm, internal temperature, and selected firing circuit. The Controller and Remote's event history logs differ; the Controller log contains operation information for the system that was selected when the event was recorded. The Remote's history log contains only information pertaining to its own operation.

6.3.2. To read the event history log, turn the Controller or Remote on, and press the MENU switch to go to the Start menu display. Select '2. Advanced User'. The screen will prompt you for the Advanced User PIN. Enter the Advanced User PIN provided for your system including all 5 digits (include leading zeros too).

6.3.3. Once the PIN is entered, the Advanced User Menu is displayed. Select '3. USB' to connect the unit to the USB port.

6.3.4. To read the History Log, check 'Read history log' and press the 'Get File' button. You may need to press the 'Get File' more than once to synchronize the connection of the unit to the PC. Once you have made the connection, the history log will begin uploading to the PC. This may take a few minutes. When complete, an Excel spreadsheet, like the one shown in Figure 6-2 will be shown. You can save or share the spreadsheet read-only protected file.

6.3.5. Each event is provided a time and date stamp, and GPS coordinates are included if the GPS module is installed and a GPS signal is available. Figure 6-2 shows provides an example of the history log from a Controller unit with date, time, and GPS coordinates for each event.



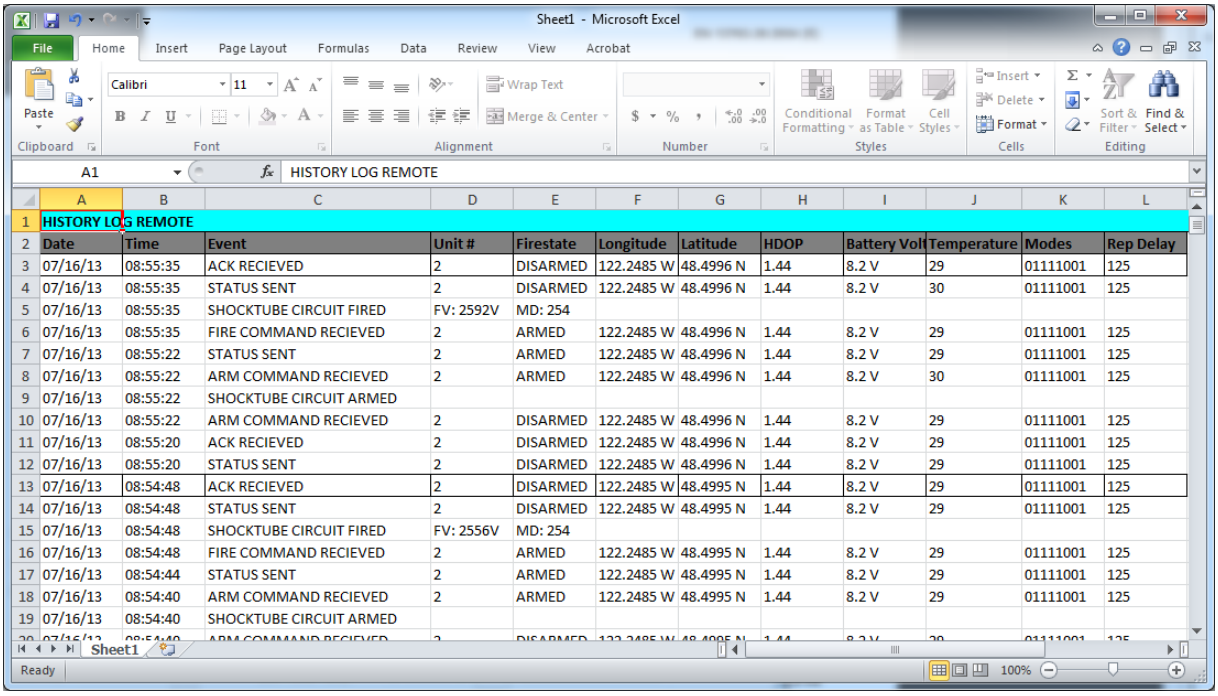
HISTORY LOG CONTROLLER

Date	Time	Event	System	Units Select	Units Confi	Units Ready	Longitude	Latitude	HDOP	Battery Vol	Temperatur	Firemode	Modes	Rep Delay
07/16/13	08:55:46	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000000	11111111	122.2485 W	48.4995 N	1.68	8.12 V	35	SHOCKTUBE	00110101	125
07/16/13	08:55:46	POST FIRE STATUS RECIEVED FROM UNIT #2	FV: 2592	MD: 254										
07/16/13	08:55:37	FIRE COMMAND SENT	1	00000010	00000000	11111101	122.2485 W	48.4995 N	1.68	8.16 V	35	SHOCKTUBE	00110101	125
07/16/13	08:54:59	CONFIRMED ARM FROM UNIT #2												
07/16/13	08:54:59	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000010	11111101	122.2485 W	48.4995 N	1.69	8.12 V	35	SHOCKTUBE	00110101	125
07/16/13	08:54:59	ARM COMMAND SENT	1	00000010	00000000	11111101	122.2485 W	48.4995 N	1.69	8.16 V	35	SHOCKTUBE	00110101	125
07/16/13	08:54:59	STATUS COMMAND SENT (PRE ARM)	1	00000010	00000000	11111111	122.2485 W	48.4995 N	1.69	8.12 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:59	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000000	11111111	122.2485 W	48.4995 N	1.69	8.12 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:59	POST FIRE STATUS RECIEVED FROM UNIT #2	FV: 2556	MD: 254										
07/16/13	08:54:54	FIRE COMMAND SENT	1	00000010	00000000	11111101	122.2485 W	48.4995 N	1.69	8.2 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:37	CONFIRMED ARM FROM UNIT #2												
07/16/13	08:54:37	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000010	11111101	122.2485 W	48.4995 N	1.69	8.12 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:37	ARM COMMAND SENT	1	00000010	00000000	11111101	122.2485 W	48.4995 N	1.69	8.2 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:37	STATUS COMMAND SENT (PRE ARM)	1	00000010	00000000	11111111	122.2485 W	48.4995 N	1.69	8.16 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:26	STATUS COMMAND SENT (MANUAL)	1	00000010	00000000	11111111	122.2485 W	48.4995 N	1.69	8.16 V	34	SHOCKTUBE	00110101	125
07/16/13	08:54:10	VALID KEY INSERTED												
07/16/13	08:53:43	STATUS COMMAND SENT (POST DISARM)	1	11111111	00000000	11111111	122.2485 W	48.4995 N	1.69	8.16 V	34	SHOCKTUBE	00110101	125
07/16/13	08:53:43	DISARM COMMAND SENT	1	11111111	00000000	00000000	122.2485 W	48.4995 N	1.69	8.2 V	34	SHOCKTUBE	00110101	125
07/16/13	08:53:43	VALID KEY REMOVED												
07/16/13	08:53:04	CONFIRMED ARM FROM UNIT #2												
07/16/13	08:53:04	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000010	00000000	122.2485 W	48.4995 N	1.69	8.16 V	33	SHOCKTUBE	00110101	125
07/16/13	08:53:04	ARM COMMAND SENT	1	00000010	00000000	00000000	122.2485 W	48.4995 N	1.69	8.24 V	33	SHOCKTUBE	00110101	125
07/16/13	08:53:04	STATUS COMMAND SENT (PRE ARM)	1	00000010	00000000	00000010	122.2485 W	48.4995 N	1.69	8.2 V	33	SHOCKTUBE	00110101	125
07/16/13	08:53:04	STATUS COMMAND SENT (STATUSPOLL)	1	00000010	00000000	00000010	122.2485 W	48.4995 N	1.69	8.2 V	33	SHOCKTUBE	00110101	125
07/16/13	08:53:04	POST FIRE STATUS RECIEVED FROM UNIT #2	FV: 2592	MD: 254										

Figure 6-2 Event History Log for Controller

6.3.6. In the ‘System’ column of the Controller’s event history event log, ‘FV’ is displayed after firing to indicate the firing voltage for each particular Remote Unit that was fired. For the Electric Detonator, FV is typically 350-400V. For the Shock Tube Initiator circuit, FV is typically 2,250-2,750V.

6.3.7. In the ‘Units Selected’, the post fire Motion Detect levels are shown for each Remote that was fired next to ‘MD’. The Motion Detect level increases with an increasing post-fire vibration level and has a range from 0 to 254. The threshold level, which is the level that the Controller’s LCD reports that a motion was detected, is adjustable within the Controller within the Service Menu. The default setting is ‘50’.



Sheet1 - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K	L
1	HISTORY LOG REMOTE											
2	Date	Time	Event	Unit #	Firestate	Longitude	Latitude	HDOP	Battery Volt	Temperature	Modes	Rep Delay
3	07/16/13	08:55:35	ACK RECIEVED	2	DISARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
4	07/16/13	08:55:35	STATUS SENT	2	DISARMED	122.2485 W	48.4996 N	1.44	8.2 V	30	01111001	125
5	07/16/13	08:55:35	SHOCKTUBE CIRCUIT FIRED	FV: 2592V	MD: 254							
6	07/16/13	08:55:35	FIRE COMMAND RECIEVED	2	ARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
7	07/16/13	08:55:22	STATUS SENT	2	ARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
8	07/16/13	08:55:22	ARM COMMAND RECIEVED	2	ARMED	122.2485 W	48.4996 N	1.44	8.2 V	30	01111001	125
9	07/16/13	08:55:22	SHOCKTUBE CIRCUIT ARMED									
10	07/16/13	08:55:22	ARM COMMAND RECIEVED	2	DISARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
11	07/16/13	08:55:20	ACK RECIEVED	2	DISARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
12	07/16/13	08:55:20	STATUS SENT	2	DISARMED	122.2485 W	48.4996 N	1.44	8.2 V	29	01111001	125
13	07/16/13	08:54:48	ACK RECIEVED	2	DISARMED	122.2485 W	48.4995 N	1.44	8.2 V	29	01111001	125
14	07/16/13	08:54:48	STATUS SENT	2	DISARMED	122.2485 W	48.4995 N	1.44	8.2 V	29	01111001	125
15	07/16/13	08:54:48	SHOCKTUBE CIRCUIT FIRED	FV: 2556V	MD: 254							
16	07/16/13	08:54:48	FIRE COMMAND RECIEVED	2	ARMED	122.2485 W	48.4995 N	1.44	8.2 V	29	01111001	125
17	07/16/13	08:54:44	STATUS SENT	2	ARMED	122.2485 W	48.4995 N	1.44	8.2 V	29	01111001	125
18	07/16/13	08:54:40	ARM COMMAND RECIEVED	2	ARMED	122.2485 W	48.4995 N	1.44	8.2 V	29	01111001	125
19	07/16/13	08:54:40	SHOCKTUBE CIRCUIT ARMED									

Figure 6-3 Event History Log for Remote

7. CONFIGURATION SOFTWARE INSTALLATION

7.1. 1673 RFD CONGURATION SOFTWARE

7.1.1. The programming software allows the user to view and change various settings within the RFD units to best match the equipment to the blasting application. Many of the settings can also be configured through the Advanced User menu directly. The programming software also allows the user to upload the history event log, which stores a record of the last 1024 operation events.

7.1. INSTALLING THE USB CABLE DRIVERS

7.1.1. Connect the USB cable from the 1673 Controller or Remote Unit to the USB port on the PC.

7.1.2. If the automatic installation takes place there is no need to continue with the procedure outlined below.

7.1.3. The USB drivers are available on the RFD USB thumb drive. Insert the USB thumb drive provided. Browse the driver install program to the Rothenbuhler USB Drivers folder. Complete the install process.

7.1.4. Press the Windows start button to bring up the start menu and right click on ‘Computer’.

7.1.5. Select ‘System Properties’.

7.1.6. Select ‘Manage’ and the ‘Computer Management’ window opens.

7.1.7. Expand the ‘Ports (COM & LPT)’ category.

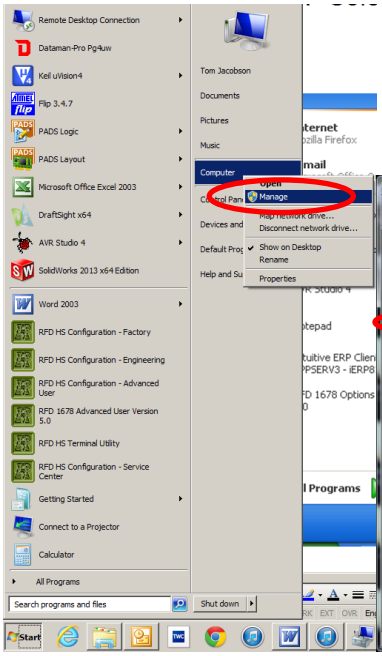


Figure 7-1

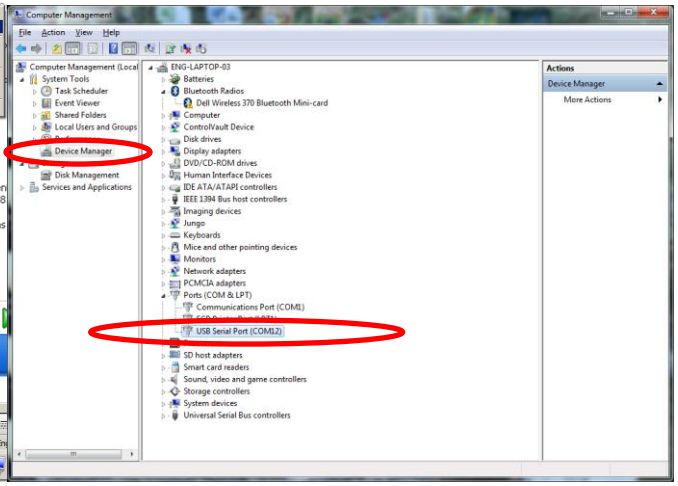


Figure 7-2

7.1.8. Note the COM number that has been assigned to the device. The COM number will be necessary when connecting to the 1673 RFD Configuration

7.1.9. The assigned COM number **must** be between 1 and 16 for compatibility with the 1673 RFD Configuration Software. Note that the computer reserves COM assignments for previously installed serial devices even if they are no longer attached to the computer. This can cause COM numbers greater than 16 to be assigned. If the assigned COM number is greater than 16, it must be manually reassigned to a value between 1 and 16.

7.1.10. To manually reassign the COM number, right click on its entry in the 'Ports (COM & LPT)' listing. Then click the 'Advanced' button on the Port Settings tab.

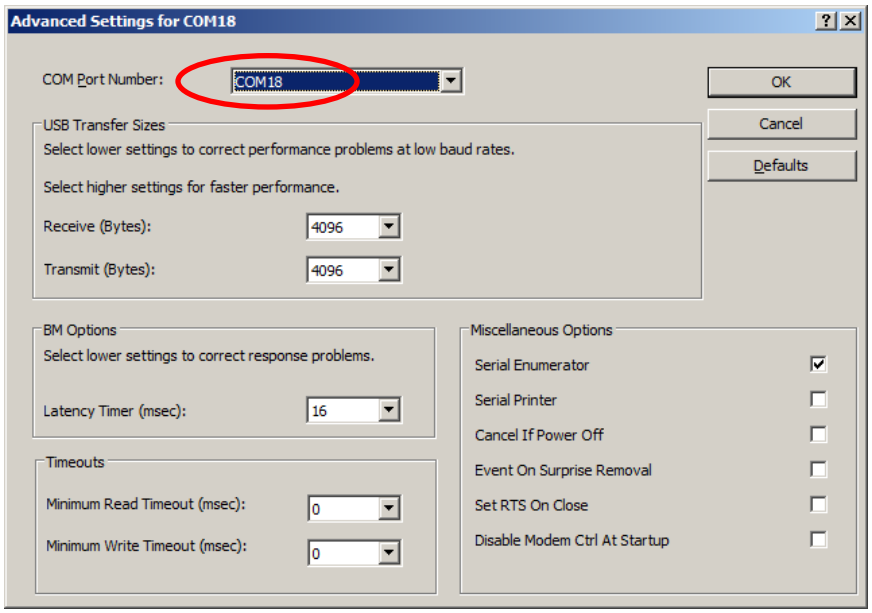


Figure 7-3

7.1.11. A drop down list shows the currently assigned COM port number.

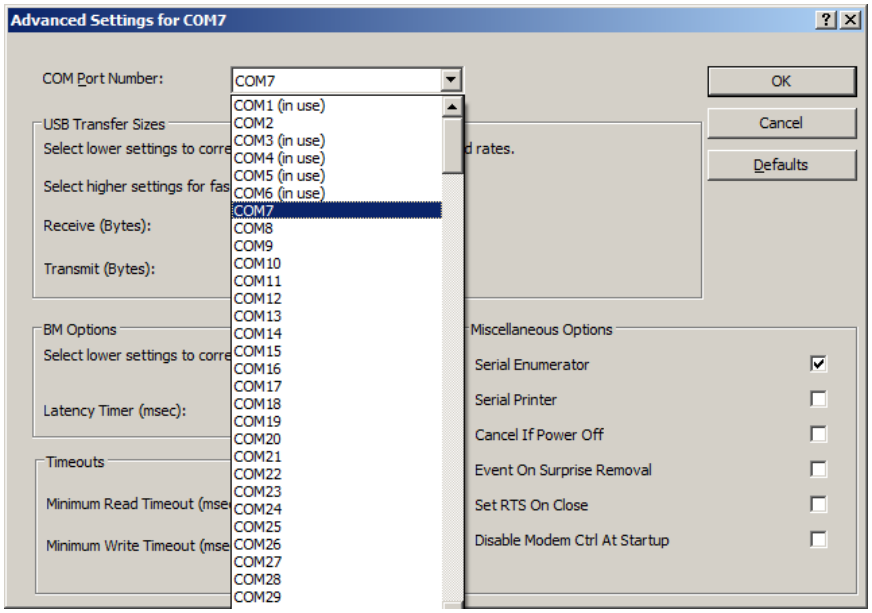


Figure 7-4

7.1.12. Select a COM number less than or equal to 16 that is known to be not in use from the list. Click ‘OK’. A warning message may be displayed, press yes to continue. The computer may have to be restarted. The computer should now retain the new COM assignment.

7.1.13. If the USB Serial port is not listed under ‘Ports (COM & LPT)’ then expand the

‘Universal Serial Bus Controllers category’.

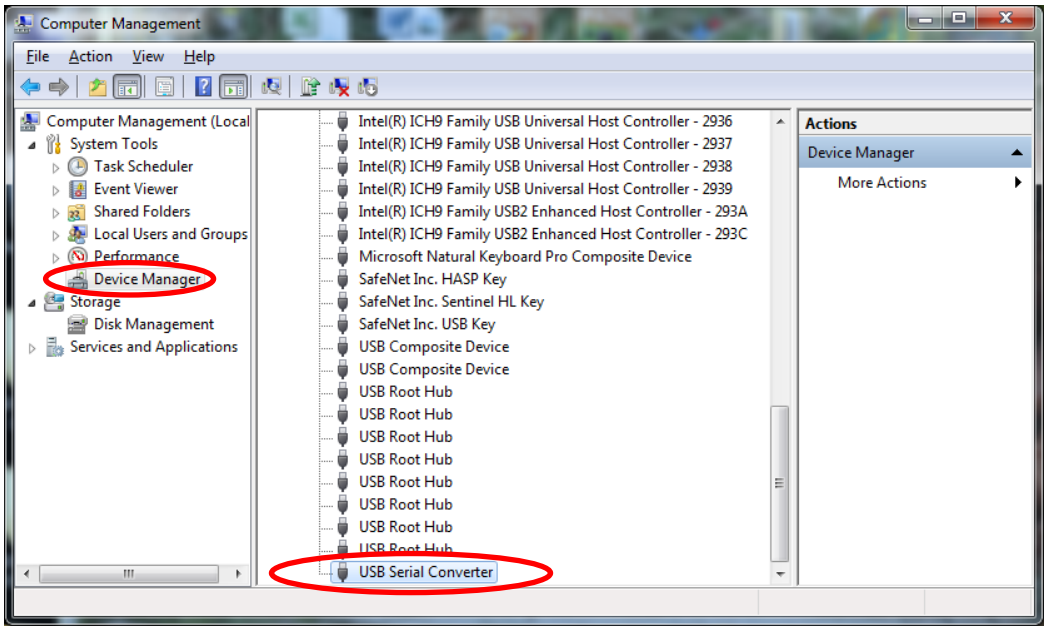


Figure 7-5

7.1.14. Select the USB Serial Converter, and right click to open its properties.

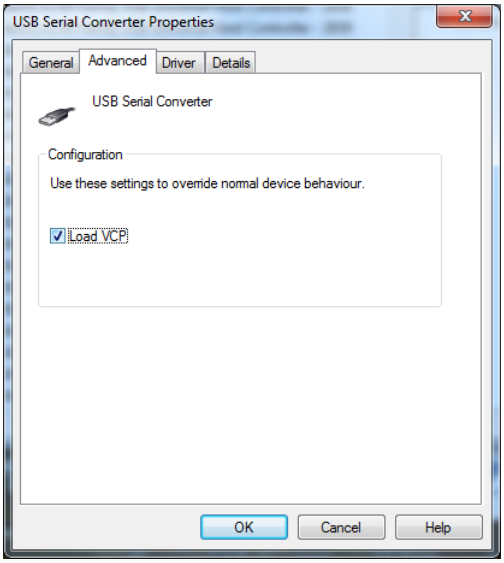


Figure 7-6

7.1.15. Open the Advanced tab and make sure the ‘Load VCP’ box is checked. It may be necessary to disconnect and reconnect the USB cable to refresh the listing in the device manager, after checking the ‘Load VCP’ box.

7.1.16. Installing the 1673 RFD Configuration Software

7.1.17. Install the installation thumb drive into the USB port. Browse to the folder '1673 RFD Configuration Software' and file and double click the file 'Setup.exe'.

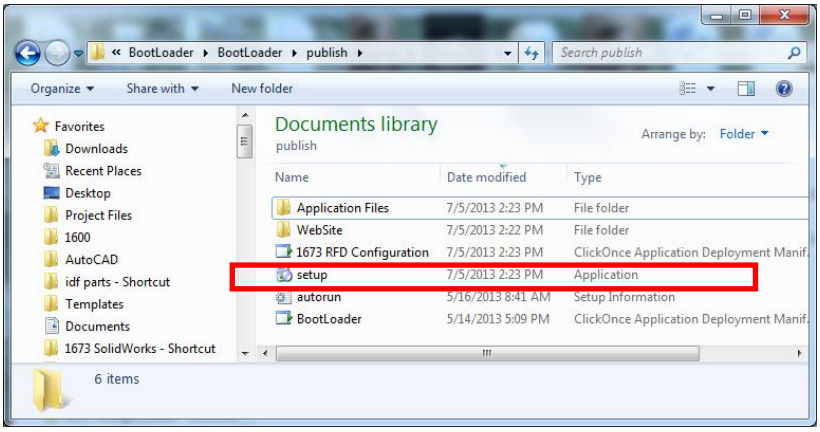


Figure 7-7 Select Setup.exe

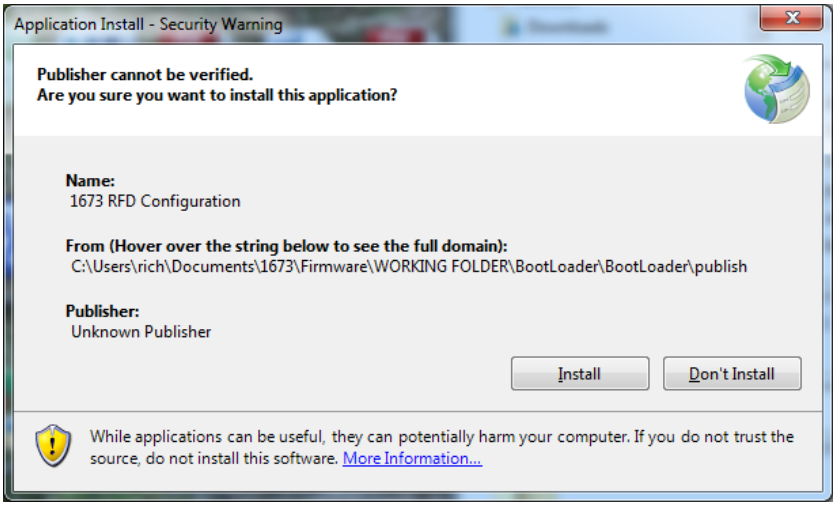


Figure 7-8 Install 1673 RFD Configuration Software

7.1.18. Click "Install" to install the 1673 RFD Configuration Software to your PC to finish process.

8. MAINTENANCE

8.1. MAINTENANCE PROCEDURES

8.1.1. **Normal Maintenance.** Normal maintenance is limited to periodic battery charging and cleaning the outer surfaces and panels with a damp cloth removing dirt and debris. Ensure the CHARGE/PROGRAM, ELECTRONIC KEY port, and firing terminals are clean and dry with a cotton swab. Check for signs of corrosion around and on connector pins. Ensure the electric detonator firing terminals are clean, and easy to depress.

8.1.2. **Scheduled Maintenance**. It is recommended that the 1673 RFD be returned to the manufacturer or an authorized service shop every two years for periodic maintenance. At this time the latest improvements are added, fresh battery packs are installed, the radio transceivers are tuned and verified, and the overall performance of the RFD is thoroughly tested.

8.1.3. **Corrective Maintenance**. Corrective maintenance should be performed at the manufacturer or an authorized service shop only. Replacement of parts or repair at the user level and field disassembly is strongly discouraged and may result in death, injury, or unsafe equipment operation. The Remote Unit contains dangerously high voltage levels when armed.

8.1.4. **Battery Maintenance**. Your RFD contains heavy-duty 7.2V NiMH battery packs that should be replaced after 500 charge/discharge cycles or every three years, whichever comes first. If a decrease in run time has developed, there may be a memory problem caused by repeated shallow discharges or interrupted charge cycles.

8.1.5. **Battery Condition (Discharge).** To keep the battery packs running optimally, it is recommended that you perform a full discharge before recharge using the discharge feature of the at least once per month. To perform a Battery Condition, connect the Charger Power Supply to a wall outlet, and connect the cable connector to the CHARGE/PROGRAM connector. Turn the unit on and then press and hold the ‘BATT TEST’ switch for 5 seconds. The unit will discharge the battery to a low level and then it will be recharged. The whole process takes up to 10 hours to complete. Always ensure the power supply is connected and working before discharging.

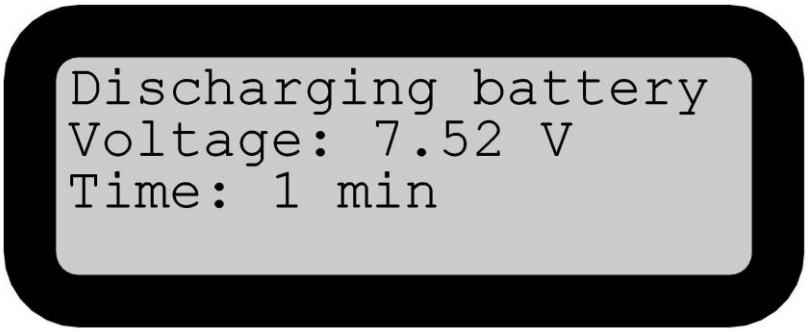


Figure 8-1 Battery Condition (Discharge Battery)

8.1.6. **Tip Care**. The two shock tube igniter tips provided with the RFD are rugged, and will last for 500 or more shots if properly cared for. Take care to keep mud and debris from getting on the igniter needle. In some cases, the tip's life can be extended by washing in soapy water and gently rubbing the igniter needle with a non-metallic device such as a cotton swab.

8.1.7. **Tip Replacement**. As the tips are used, the electrodes will wear and eventually become unreliable. Therefore, it is highly recommended that your company adopt a strict tip replacement/tracking plan. Tip usage can be tracked using the serial number engraved on the tip. Discard each tip when its usage reaches 500 shots. Always hold a replacement tip handy. You may also dry fire the old tip and compare it to the sound and spark intensity of a new tip. If the old tip's spark is noticeably weaker, replace it.

9. BASIC TROUBLESHOOTING IN THE FIELD

9.1. REMOTE UNIT

9.1.1. Will not Initiate shock tube

a) Igniter tip may be worn or damaged. Try a new tip.

b) There may be water on tip. Blow out tip and test fire the tip without any tube installed.

c) Shock tube may be damaged. Cut a fresh section.

d) Unit needs recharging.

9.1.2. Charger does not work

a) Ensure the battery charger and RFD Units are indoors and the air temperature is between 32 and 86 °F (0 to 30 °C)

9.2. CONTROLLER UNIT

9.2.1. Charger does not work

a) Ensure the battery charger and RFD Units are indoors and the air temperature is between 32 and 86 °F (0 to 30 °C)

9.2.2. The ARMED and READY lights will not come on or blink continuously

a) The Remote Unit is out of 2-way range of Controller Unit.

b) The Remote Unit is within 2-way range of the Controller Unit.

- Check for damage to Controller Unit antenna or antenna jack
- Check for damage to Remote Unit antenna or antenna jack.
- Move at least 10 meters in any direction and try again.

Reposition any units if:

- The antenna is not positioned vertically.
- The Unit is isolated by large dirt walls, rocks, or metal objects.
- The antenna is next to another radio antenna.

10. RFD SPECIFICATIONS

GENERAL

CARRIER FREQUENCY: VHF 150 – 174 MHz
FCC VHF: CW21673-1
IC VHF: 2758A-167301

Max. Operating Temp** -22°F to 140°F (-30 to 60°C)
Rec. Operating Temp** 23°F to 122°F (-5 to 50°C)
Storage Temp** -4°F to 86°F (-20 to 30°C)
Charge Temp 32°F to 86°F (0 to 30°C)

CONTROLLER

FREQUENCY STABILITY	± 5 PPM
MODULATION	11K3F1D
TRANSMIT POWER	1-5 Watts
OPERATING VOLTAGE	7.2 VDC
TRANSMISSION RANGE	1–5 miles*
RECEIVER SENSITIVITY	12 dB SINAD
	< 0.30μV
SIZE	9.25 x 7.5 x 4.5 in
	23.5 x 19 x 11.5 cm
WEIGHT	6 lbs
	2.7 kg
CASE	Sealed Pelican
COLOR	Yellow
BATTERY PACK	Rechargeable NiMH
BATTERY RUN TIME AT 68°F (20°C)	
Standby	18 hours
Complete Recharge	4 hours
CURRENT DRAW	
Standby	100 mA
Transmitting	1-2.5 Amps

REMOTE

FREQUENCY STABILITY	± 5 PPM
MODULATION	11K3F1D
TRANSMIT POWER	1-5 Watts
OPERATING VOLTAGE	7.2 VDC
TRANSMISSION RANGE	1-5 miles*
RECEIVER SENSITIVITY	12 dB SINAD
	< 0.30μV
SIZE	9.25 x 7.5 x 4.5 in
	23.5 x 19 x 11.5 cm
WEIGHT	6.25 lbs
	2.8 kg
CASE	Sealed Pelican
COLOR	Orange
BATTERY PACK	Rechargeable NiMH
BATTERY RUN TIME AT 68°F (20°C)	
Standby	18 hours
Complete Recharge	4 hours
CURRENT DRAW	
Standby	100 mA
Transmitting	1-2.5 Amp
FIRE OUTPUT (SHOCK TUBE)	2.5 kV (0.69 Joules)
FIRE OUTPUT (ELECTRIC)	350 V (5 Joules)
MAX Ω (ELECTRIC)	175 Ω

NOTES:

*Line-of-sight. Typical transmission range based on transmit power, frequency, terrain, and local interference.

**Exceeding the temperature range may result in reduced battery life or damage to battery.

Revision ‘A’
6-25-2013