

# HOLATRON

## OPERATION & MAINTENANCE GUIDE - Acoustic Triggered High Speed UHF Transmitter



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## **WARNING**

Holatron Systems specializes in the design and manufacture of standard and custom electronic control systems where reliability and error free data communication are critical. The transmitter described in this manual is part of a system intended to remotely actuate pyrotechnic or other hazardous devices, and the components of this system have been carefully designed to minimize the possibility of accidental actuation of such devices. Holatron's design goal is to ensure that data communication errors due to radio interference or to insufficient signal strength due to low battery, exceeding specified range, or conductive objects in the signal path will result in failure of intentional actuation rather than unintended actuation. Techniques used to achieve this design goal are described in section 1.9. Though the probability of unintended actuation is extremely small, it cannot be guaranteed to be zero. Therefore, **it is important that the user not enable the receiver until all persons who might be harmed by accidental actuation are in a safe area.**

As a condition of purchase, the user must acknowledge awareness and agreement that utilization of this product and participation in activities utilizing fireworks, rockets, and explosives is an ultra-hazardous activity carrying implied and explicit risks of injuries and damages to the user and to other participants. The user assumes the risk connected with the utilization of this product and all risks of participation in the activities for which this product is sold. User acknowledges that he/she/it has the necessary and required skill, expertise, training and licensing, as may be applicable or necessary by custom, usage, trade or law, to engage and participate in the ultra-hazardous activities connected with the use, purchase, transportation, or employment of the products sold under this agreement. User acknowledges that Holatron Systems, LLC, has not and will not conduct any investigation into the skill, expertise, training and licensing, as may be applicable or necessary by custom, usage, trade or law, of the user or of user's agents, employees and assigns, to engage and participate in the ultra-hazardous activities connected with the use, purchase, transportation, or employment of this product. User specifically agrees that Holatron Systems, LLC, its officers, employees, and agents shall not be liable for any claim, demand, cause of action of any kind whatsoever for, or on account of death, personal injury, property damage or loss of any kind resulting from or related to user's or user's employees', agents' or assigns' use of this product, and user agrees to indemnify, defend in any action at law, and hold harmless Holatron Systems, LLC, from same, whether brought by the user, user's agent, or assigns, or any third party.

Usage of this transmitter is authorized under FCC Rules and Regulations as listed in CFR 47 Ch.1 (10-1-96 Edition), part 15, subpart C, sections 15.209 and 15.231. This equipment has been tested and assigned **FCC ID number: OI4RFLS1XT.**

**Any changes or modifications to the hardware not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.**

This manual is divided into two sections. The first is a description of the system hardware. The second covers the recommended operating and maintenance procedure.

## 1.0 HARDWARE DESCRIPTION.

The model RFLS-MK3HSXT Fixed Channel High Speed UHF Transmitter with sequential acoustic trigger is a low power six channel, safety locking, hand-held remote control transmitter which can transmit commands over any of six different digital channels. The transmitter's channel setting is fixed in software and cannot be changed. A label displaying the channel setting is affixed to the top of the transmitter next to the antenna. Transmitters fixed to separate digital channel numbers can transmit simultaneously without interfering with each other. This permits up to six different receivers or groups of receivers to be controlled by separate transmitters simultaneously. The transmitter will only actuate receivers whose digital channel switches are set to select the same channel as the transmitter. Thus, multiple transmitters may be used to actuate different selected receivers even though all operate on the same frequency. Transmitters fixed to the same digital channel number will interfere with each other and result in failure-to-fire when actuated simultaneously.

When used with RFLS-96HSRC, RFLS-496HSRC, or RFLS-912HSRC receivers, a range of ½ mile can be achieved. All inscriptions on the transmitter panel are luminescent to facilitate use of the transmitter in a dark environment. The panel will continue to glow for two to three hours after being exposed to a bright light source. The transmitter's two commands are digitally encoded and amplitude modulated on a single carrier frequency of 418 MHz (or optionally 433.96 MHz). This frequency is controlled by a SAW (surface acoustic wave) device for exceptional stability. No alignment or tuning procedures are ever required to maintain optimum performance. The command signal is transmitted by amplitude modulating the carrier to indicate to the receiver which of the transmit buttons is depressed or whether an acoustic event has been detected.

In **acoustic trigger mode** (digital switch positions 0 – B), the "A command" signal (semi-automatic fire) is transmitted for 250 msec when an acoustic impulse exceeding the selected threshold is detected by the rear panel microphone while the "Fire A / Enable B" button is depressed, and it is transmitted continuously while the "B" button and "A" button are depressed simultaneously, permitting the "B" button to serve as an acoustic event simulator.

In **normal command mode** (digital switch positions C – F), the modulated RF output occurs continuously while either of the two transmit buttons is depressed. Resulting receiver output is continuous while the "A command" signal (semi-automatic fire) is being transmitted, and the receiver fires outputs in rapid-fire mode at a rate selected by the transmitter's FIRE RATE SELECTION SWITCH while the "B command" signal is being transmitted.

The user has access to the following components:

## 1.1 THE ANTENNA.

The RF signal is radiated by a quarter-wave flexible whip antenna which screws onto the top end of the transmitter box. **The transmitter should never be operated without this antenna in place, as damage to the RF components could result.** Such operation will void the warranty.

Antennas with red rings are used for 433 MHz, and antennas with blue rings are used for 418 MHz. Be careful not to overtighten the antenna when screwing it on, as this could cause its mating connector to rotate and break its internal connection. Rotation could also occur, with the same result, when subsequent removal of an overtightened antenna is attempted. The recommended way to install the antenna is to grasp it by its small diameter upper part and rotate gently in a clockwise direction until increased resistance is felt. It need not be tight to achieve a good electrical connection. When removing the antenna for storage, observe the base of the mating connector to ensure that it is not rotating. If the antenna is so tight that rotation is occurring, grasp the hex base of the mating connector with long nose pliers, and then unscrew the antenna.

## 1.2 THE SAFETY LOCKING SWITCH.

The Safety Locking Switch is a miniature keylock with two positions, "Safe" and "Xmtr Enabled". In the "Safe" position no RF output occurs even if a button is pressed. In the "Xmtr Enabled" position modulated RF output occurs continuously while a button is pressed. Whether transmitting or not, a green warning indicator near the switch flashes whenever the switch is in its "Enabled" position and the battery voltage is above the low battery detect threshold. Approximately 1 milliamp is drained continuously from the battery while the transmitter is enabled and not transmitting. So this switch should always be turned to the "Safe" position while the transmitter is not being used. Keys are interchangeable, as all Holatron RFLS-6HSXT transmitters are keyed the same.

Firing on all receivers set to the transmitter's digital channel always commences at cue 1 after the transmitter has first been enabled. Thus all receivers on this transmitter's fixed channel can be reset to cue 1 at any time by turning this switch momentarily to "Safe" and then back to "Transmitter Enabled".

### 1.3 THE “XMTR ENABLED” INDICATOR.

This green lamp, located at the “Enabled” position of the lockswitch, warns the user that transmission will occur when a button is pressed or an acoustic event is sensed, and that battery drain is occurring. It also verifies that battery voltage is adequate to transmit a signal over the specified range.

When the transmitter is turned on (transmitter enabled) with the keylock switch, battery status is indicated by the flashing of this lamp. It is of sufficiently high intensity to be visible in direct sunlight and will flash intermittently in bursts of one, two, or three flashes at a time if the battery has enough capacity to power the transmitter. If no flashing occurs, the battery must be replaced before the transmitter can be used reliably. Three flashes per burst indicate that the battery has full capacity, two flashes indicate that its capacity is beginning to diminish, and one flash indicates that it is near the end of its useful lifetime in which case it should be replaced immediately after the current use. Adequate transmitter output to achieve the specified range will occur as long as the battery voltage is above approximately 7.0 volts, but the battery voltage will drop rapidly at this point.

If in acoustic trigger mode (digital switch positions 0 – B), this indicator will glow continuously while the “Fire A / Enable B” button is pressed. Only while glowing continuously can command transmission occur in response to an acoustic event or a “Fire B” button press.

### 1.4 THE FIRE BUTTONS.

These buttons are snap action dome switches under a sealed overlay, labeled “Fire A” and “Fire B”, respectively. They have a high spring constant which requires a firm depression for actuation, decreasing the likelihood of accidental depression. The enabled transmitter can be kept in a shirt or jacket pocket without fear of accidental button depression. The action of the buttons depends on the position of the transmitter’s digital switch.

#### 1.4.1 Acoustic Trigger Mode (digital switch positions 0 – B)

For safety, transmission is enabled only while the “Fire A / Enable B” button is depressed. **Be aware that fire command transmission can occur immediately upon depression of the “Fire A / Enable B” button if acoustic events are occurring. Do not press the “Fire A / Enable B” button until it is quiet, and all persons who might be harmed by device actuation are in a safe area.** While “Fire A / Enable B” is depressed, the green “Xmtr Enabled” indicator will glow continuously, and “A command” (semi-automatic fire) transmission will occur while an acoustic event is being detected by the rear-panel microphone. Each detected acoustic event will result in the firing of the next sequential receiver output. Transmission will occur for 250 msec following an acoustic event, and maximum sense rate is approximately 3 events per second. An acoustic event is defined as a sound impulse exceeding the switch selected threshold. (See section 1.7)

If the “Fire B” button is pressed while “Fire A / Enable B” is also pressed, the “A command” is transmitted, resulting in the firing of the next sequential receiver output. The output remains on until at least one of the buttons is released.

#### **1.4.2 Normal Command Mode (digital switch positions C – F)**

In this mode the transmitter is idle while no buttons are pressed. Continuous transmission occurs while “Fire A” or “Fire B” is pressed. Output firing pulses are stretched to a minimum duration of 0.6 seconds in the receivers to ensure that cues fire reliably, even when the fire buttons are pressed for a shorter period of time. Note that it is not necessary to wait for the completion of the 0.6 second firing pulse period before firing subsequent cues. They can be fired as fast as the operator can press the button, provided that each button depression lasts at least 0.1 second, followed by at least 0.1 second with the button released. If many transmitters are transmitting simultaneously, it may be necessary to depress a fire button slightly longer than 0.2 second in order to ensure an output from the receiver.

### **1.5 THE TRANSMIT INDICATOR.**

This is a high intensity red indicator, visible in direct sunlight, that lights continuously while the transmitter is generating RF output. It is located between the two buttons. It will light even if the battery voltage is below the low battery detect threshold. It can be used to check microphone sensitivity by indicating acoustic event detection in acoustic mode with the receiver(s) switched off. “Fire A / Enable B” must be depressed while conducting this check. Adequate microphone sensitivity can be verified by observing a red flash each time an event is detected. This is a useful tool for setting microphone sensitivity with the digital switch. (See section 1.7)

### **1.6 THE BATTERY.**

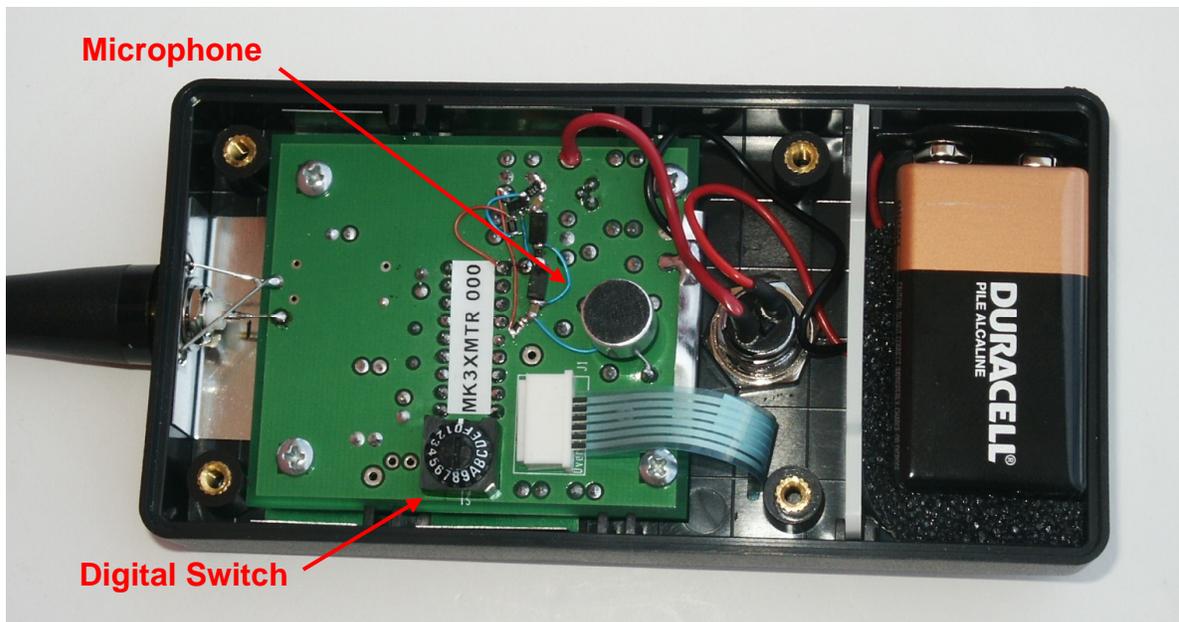
Power is supplied from an alkaline 9 volt battery, accessible beneath a slide-out door on the back side of the transmitter. This battery should be replaced when required by conditions described in section 1.3 above. In order to prevent the possibility of damage due to battery leakage, the battery should always be removed if the transmitter is to be stored for a prolonged period. Damage due to battery leakage is not covered under the warranty.

## 1.7 THE DIGITAL SWITCH.

A 16 position miniature rotary switch is accessible through a hole in the back of the transmitter. The switch is located on the left edge of the internal printed circuit board, as shown in the following photo. It can be set to digital channels 0 – 9 or A – F by rotation with a small screwdriver. The setting, or position, of this switch sets the transmitter operating mode and the acoustic event detection threshold as shown in the following table. Positions 0 – B select acoustic trigger mode, with higher switch settings corresponding to higher thresholds and lower acoustic sensitivity. Positions C – F select normal command mode (buttons only) with the switch setting selecting the automatic fire rate for depressions of the “Fire B” button. Holatron Systems can supply custom fire rates if required.

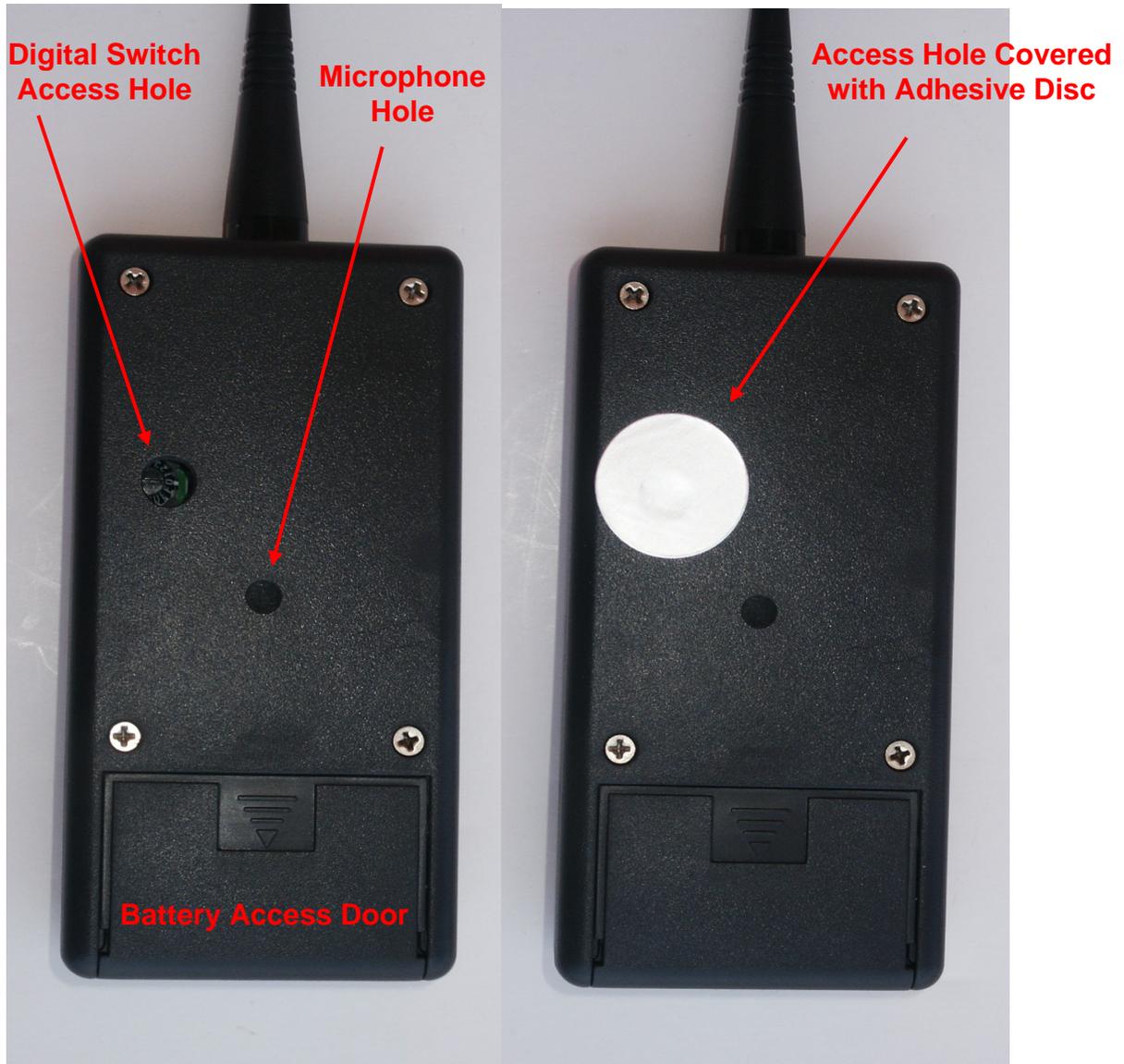
**NOTE:** Automatic firing always commences at the next cue after the last one fired, whether it was semi-automatic or automatic. Semi-automatic firing always commences at the next cue after the last semi-automatic cue fired, even if automatic cues have been fired in the meantime.

Semi-automatic or automatic firing always commences at cue 1 after the transmitter has first been enabled. Thus all receivers on the transmitter’s fixed channel can be reset to cue 1 at any time by turning the transmitter’s safety locking switch momentarily to “Safe” and then back to “Transmitter Enabled”.



(Transmitter with rear cover removed)

The access hole for the digital switch enables the operator to view the switch setting and insert a small screwdriver to change it without having to remove the rear cover.



(Transmitter back shown without and with adhesive disc in place.)

An adhesive disc normally covers the access hole for the digital switch to keep out contaminants and conductive objects. The disc can be peeled back when it is necessary to view or change the switch setting.

<b>Xmtr Digital Switch Setting</b>	<b>“Fire A / Enable B” Action</b>	<b>“Fire B” Action</b>
0	Enables transmission of a semi-automatic fire command upon detection of acoustic event or upon “Fire B” button depression. Minimum acoustic threshold (maximum acoustic sensitivity).	If “Fire A” button is also pressed, xmtr a semi-automatic (single-shot) fire command continuously until one or both buttons are released.
1	Same as above with higher acoustic threshold.	Same as above.
2	Same as above with higher acoustic threshold.	Same as above.
3	Same as above with higher acoustic threshold.	Same as above.
4	Same as above with higher acoustic threshold.	Same as above.
5	Same as above with higher acoustic threshold.	Same as above.
6	Same as above with higher acoustic threshold.	Same as above.
7	Same as above with higher acoustic threshold.	Same as above.
8	Same as above with higher acoustic threshold.	Same as above.
9	Same as above with higher acoustic threshold.	Same as above.
A	Same as above with higher acoustic threshold.	Same as above.
B	Same as above with highest acoustic threshold (minimum acoustic sensitivity).	Same as above.
C	Semi-automatic firing. (Single shot, sequential)	Automatic firing (rapid fire) at a rate of <b>7.69</b> shots / second while the button is pressed. (0.13 second per shot)
D	Semi-automatic firing. (Single shot, sequential)	Automatic firing as above at a rate of <b>10</b> shots / second. (0.1 second per shot)
E	Semi-automatic firing. (Single shot, sequential)	Automatic firing as above at a rate of <b>14.3</b> shots / second. (0.07 second per shot)
F	Semi-automatic firing. (Single shot, sequential)	Automatic firing as above at a rate of <b>20</b> shots / second. (0.05 second per shot)

## 1.8 REMOTE FIRE JACK.

Transmitters that include this optional feature can be actuated remotely through a two conductor shielded cable plugged into a jack located on the left side of the transmitter box. The jack accepts a standard 1/8" miniature stereo phone plug. The cable's shield connects to the plug's "shell", the red lead to the plug's "tip", and the black lead to the plug's "ring".

The transmitter is actuated remotely by connecting the tip to the shell (red to shield) to duplicate the action of the "FIRE A" button, and by connecting the ring to the shell (black to shield) to duplicate the action of the "FIRE B" button. The transmitter's FIRE buttons also remain operational while the cable is plugged in.

**NOTE: The transmitter should always be turned off when plugging in or extracting the remote cable to ensure that no fire commands are accidentally transmitted if jack contacts should be momentarily shorted during the insertion or extraction.**

## 1.9 RADIO INTERFERENCE REDUCTION.

For obvious safety reasons, Holatron's design goal is to ensure that data communication errors due to radio interference or to insufficient signal strength due to low battery, exceeding specified range, or conductive objects in the signal path will result in failure of intentional actuation rather than unintended actuation. This goal is achieved by transmitting a 64 bit noise-tolerant code repeatedly while a transmitter button is depressed. 60 of these bits must match the pattern expected by the receiver. Thus, there is one chance in  $(2 \text{ to the } 60^{\text{th}} \text{ power})$  of an actuation occurring due to reception of a random signal. Expressed in decimal numbers, this is  $(1.1529 \text{ times } 10 \text{ to the } 18^{\text{st}} \text{ power, or } 11529 \text{ followed by } 14 \text{ zeroes})$ . This is a probability of  $8.6736 \text{ times } 10 \text{ to the } -19^{\text{th}} \text{ power (or a decimal point followed by } 18 \text{ zeroes followed by } 86736)$ . Though this probability of unintended actuation is extremely small, it cannot be guaranteed to be zero. Therefore, **it is important that the user not arm the receiver until all persons who might be harmed by accidental actuation are in a safe area.**

Additional protection is offered by use of 418 MHz as the operating frequency. This frequency is sparsely used only by low power transmitters with a maximum range of approximately 100 yards. It is not commonly used by auto security systems, garage door openers, radio control models, cordless or cellular telephones, wireless microphones, or two way communications equipment. Because this system operates in the UHF region, interference from lamp dimmers, electrical discharges, and other natural sources is also minimal.

No instances of false triggering with this communications technology have been reported to date.

## 1.10 SPECIFICATIONS.

Parameter	Minimum	Typical	Maximum
Carrier Frequency, MHz.	417.96	418.02	418.08
Carrier Frequency, MHz. (optional)	432.90	433.96	434.02
Range (line-of-sight with RFLS-96RC-496RC receivers)			½ mile
Delay from start of button depression to receiver output (fewer than 4 transmitters transmitting simultaneously)		50 msec	75 msec
Delay from start of button depression to receiver output (more than 3 transmitters transmitting simultaneously)		100 msec	400 msec
Button depression time per cue (fewer than 4 transmitters transmitting simultaneously)	100 msec		
Button depression time per cue (more than 3 transmitters transmitting simultaneously)	400 msec		
Delay from acoustic event detection to receiver output (fewer than 4 transmitters transmitting simultaneously)			100 msec
Delay from acoustic event detection to receiver output (more than 3 transmitters transmitting simultaneously)			425 msec
Acoustic event transmission duration		250 msec	
Processing rate, acoustic events / sec			3
Battery current, average, (enabled)		1.0 mA	
Battery current, average, (xmtng)		4.0 mA	
Battery life (enabled, not transmitting)		500 hrs	
Low Battery Detect Threshold		7.7 V	
Transmitter Supply Voltage	7.0 V		

## 2.0 OPERATION AND MAINTENANCE.

This section describes the recommended operating procedure and maintenance for the transmitter-receiver system.

### 2.1 OPERATION.

- 2.1.1** With the receiver turned off and its arm switch set to “disarm” (RFLS-496HSRC) or “safe” (RFLS-96HSRC & RFLS-912HSRC), connect devices to the receiver outputs.

**2.1.2** With the arm switch still in the previous position, turn on the receiver. Verify a flashing green battery indicator on the receiver module. This indicator will flash intermittently in bursts of one, two, or three flashes at a time if the battery has enough capacity to power the receiver. If no flashing occurs, the receiver cannot be used reliably. Three flashes per burst indicate that the battery is fully charged, two flashes indicate that its charge is beginning to diminish, and one flash indicates that it is near the end of its useful charge, in which case it should be replaced immediately after the current use.

**2.1.3** Enable the transmitter, and **with the receiver's ARM switch in "safe" or "disarmed" position**, perform a range test by observing the green activity light on the receiver while pressing a transmitter button. There should be no intervening conductive objects for most reliable operation. All receivers must be elevated 12" or more above ground level to achieve specified range. When transmitting over water, range will normally exceed the specified value.

Range of the receiver is typically ½ mile, and its range can be tested with the arm switch off by observing the green activity indicator while the transmitter FIRE buttons are pressed. Verify that the transmitter battery is not depleted by observing the flashing "Xmtr Enabled" light while not pressing the FIRE buttons. (See section 1.3) Then turn the transmitter lock switch back to "Safe" position.

**2.1.4** If operating in acoustic trigger mode, check acoustic sensitivity by depressing "Fire A / Enable B" and observing the red transmit indicator's response to surrounding acoustic events. The transmitter should be held in a vertical orientation with its rear panel facing the source of the desired acoustic event. Set the digital switch to the highest acoustic threshold that still provides reliable triggering, as indicated by the transmit indicator. Higher thresholds reduce the risk of unintended triggering from background noise, and lower thresholds reduce the risk of failure-to-trigger from the desired acoustic event. **Note that the receiver must be disarmed for this test, as transmission is occurring.**

**2.1.5** Verify electrical continuity through the devices connected to the receiver outputs. Continuity is tested on the RFLS-96HSRC and RFLS-496HSRC receivers by pressing the test button. On the RFLS-912HSRC receiver, it is done by pressing the ARM toggle switch down into its "Test" position. Lighted lamps indicate open circuits. It is recommended this be done with the Arm Switch in the "Safe" or "Disarmed" position, but the test circuit will also function in the "Armed" position.

- 2.1.6** When the area around the devices to be actuated is clear of persons who might be injured by an accidental actuation, and after verifying that the receiver's green activity light is off (no radio signal is being detected), turn the receiver's ARM switch to its "Armed" position. Refer to the receiver manual for the corresponding arming procedure.

**WARNING - If the receiver's green activity light is erratic or on continuously, its output may be actuated immediately upon changing its ARM switch to the "Armed" position.**

- 2.1.7** If operating in Acoustic Trigger Mode (see section 1.4.1), turn the transmitter lock switch to its "Enabled" position. The transmitter should be held with the antenna in a vertical orientation, away from the body and other conductive objects to achieve maximum range and communication reliability. Generally, the higher the transmitter is held, the greater the range. Conductive objects such as chain-link fences, aluminum bleachers, and automobiles in the transmission path will reduce the range.

**Be aware that fire command transmission can occur immediately upon depression of the "Fire A / Enable B" button if acoustic events are occurring. Do not press the "Fire A / Enable B" button until it is quiet, and all persons who might be harmed by device actuation are in a safe area.**

When you are sure that background noise is below the acoustic trigger threshold and all persons who might be harmed by device actuation are in a safe area, press "Fire A / Enable B" and hold until occurrence of the acoustic event. The green "Xmtr Enabled" indicator will glow continuously, and "fire command A" transmission will occur when an acoustic event is sensed by the rear-panel microphone or when the "Fire B" button is pressed, resulting in one sequential shot for each event occurrence. Transmission will occur for 250 msec following an acoustic event and continually while the "Fire B" button is held down. An acoustic event is defined as a sound impulse exceeding the switch selected threshold. (See section 1.7)

- 2.1.8** If operating in Normal Command Mode (see section 1.4.2), turn the transmitter lock switch to its “Enabled” position. Press the appropriate button to actuate the desired receiver output channel. A button must be depressed for at least 75 milliseconds to produce a receiver output. **It is never necessary to hold a transmit button down longer than one second**, however. If no actuation has occurred in this period of time, none will occur, no matter how much longer the transmit button is depressed. The receiver may be attempting to actuate a short circuit, and damage could result.

The transmitter should be held with the antenna in a vertical orientation, away from the body and other conductive objects to achieve maximum range and communication reliability. Generally, the higher the transmitter is held, the greater the range. Conductive objects such as chain-link fences, aluminum bleachers, and automobiles in the transmission path will reduce the range.

- 2.1.9** When finished, turn off the receiver, and turn the transmitter lockswitch back to its “Safe” position to stop further drain of the transmitter battery. You may remove the antenna to make it easier to store the transmitter. Observe the precautions in section 1.1 before removing the antenna. If the transmitter is to be stored for a prolonged period, remove the battery as described in section 1.6 above.

## **2.2 MAINTENANCE.**

Since there are no calibration or tuning adjustments in the transmitter, the only maintenance required is periodic replacement of the 9 volt battery. This should be done at least once per year, or at the next opportunity if the “Xmtr Enabled” light fails to flash when the transmitter is enabled.

The face of the transmitter, which is completely sealed, may be safely cleaned by wiping with a damp cloth if care is taken not to get moisture into the lock switch. The battery compartment door and the junction between the front and back panels are NOT water tight, however. The transmitter must never be immersed in water. Care must also be taken not to splash liquids into the microphone or digital switch access holes on the rear panel. It may be desirable to keep the switch access hole covered with an adhesive label or plastic tape while not viewing or changing the switch setting.

If further information or service is required, contact:

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