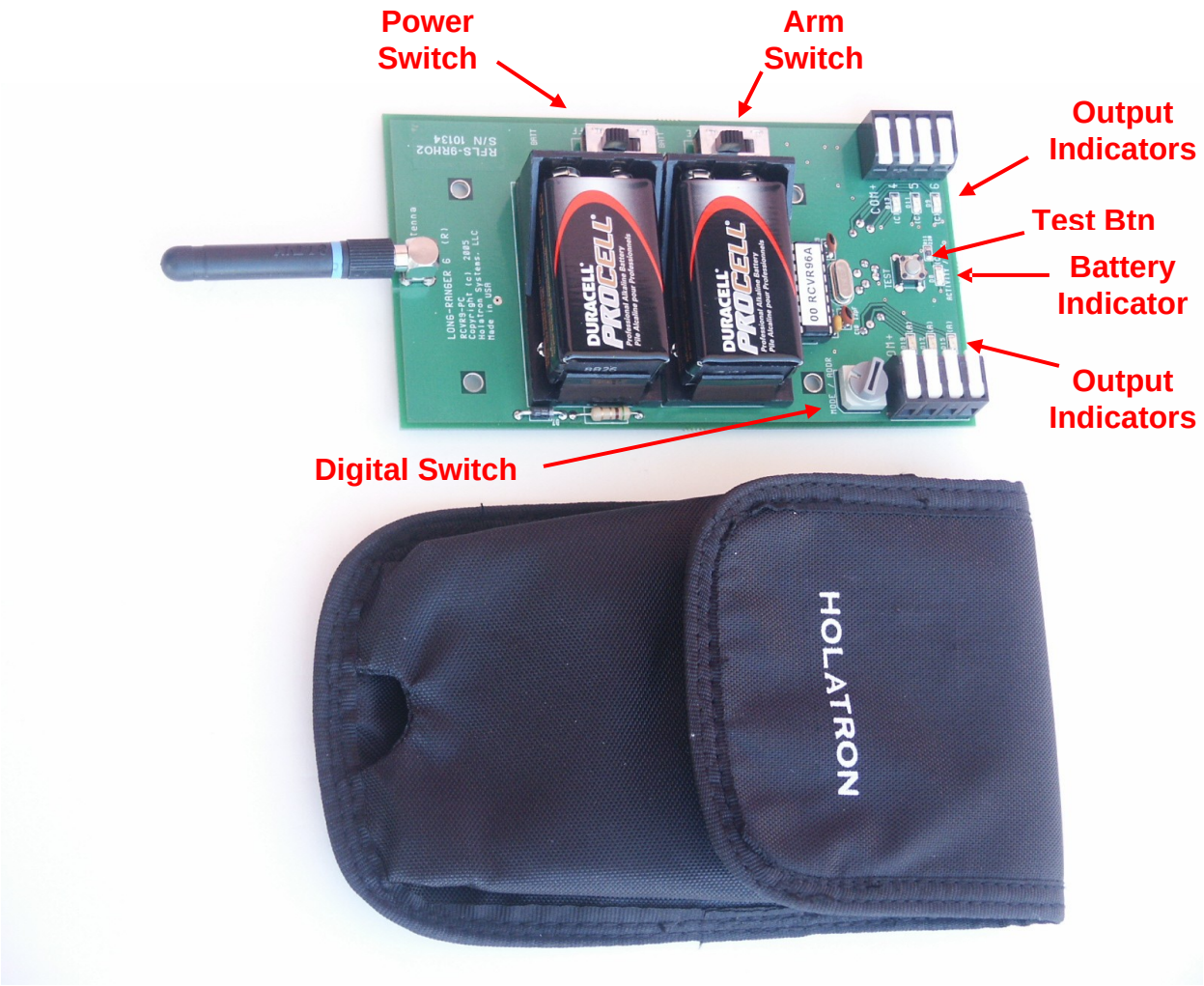
HOLATRON

OPERATION & MAINTENANCE GUIDE -
RAPID-FIRE 6 Belt-loop Pouch Receiver



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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 receiver 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 2.0. Though the 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**.

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.

This manual is divided into four sections. The first is a description of the system hardware. The second describes radio interference suppression methods. The third lists transmitter specifications. The fourth covers the recommended operating and maintenance procedure.

1.0 HARDWARE DESCRIPTION.

The model RFLS-96HSRCBL "RAPID-FIRE 6" six-shot multi-mode UHF receiver is a highly sensitive narrow band (superhetrodyne) radio receiver designed to be used for remote control applications where high reliability is critical. When used with the Holatron model RFLS-6HSXT remote control transmitter, a range of ½ mile (line of sight operation) is typical, provided there are no intervening conductive objects such as automobiles, chainlink fences, etc. Range increases as the receiver is elevated above earth or other conductive objects (such as aluminum bleachers). Range will be even greater when transmitting over water.

The reception carrier frequency is fixed at 418 or 433 MHz by a SAW (surface acoustic wave) oscillator for exceptional stability. No alignment or tuning procedures are ever required to maintain optimum performance.

The receiver's firing signals are digitally decoded from the transmitted digital code which is amplitude modulated on a single carrier frequency of 418 or 433 MHz. The transmitted digital code indicates to the receiver which of the two transmit buttons, "A" or "B", is being pressed. The manner in which the received code applies 9 volt firing pulses to the six outputs is determined by the setting of the digital channel switch, as described in the following table. The digital channel switch is described in more detail in section 1.7.

Transmitters that are set to separate digital channel numbers can transmit simultaneously to separate receivers without interfering with each other. There are six digital communication channels which permit up to six different receivers or groups of receivers to be controlled by separate transmitters simultaneously as shown in the following table. Note that a receiver's digital switch setting must correspond to the digital communication channel of the transmitter controlling it, as shown in the following table:

Rcvr Digital Switch Setting	Digital Channel Number	Fire "A" Action	Fire "B" Action
0	None	No action.	No action.
1	1	Semi-automatic firing of cues 1 – 6.	Automatic firing (rapid fire) of cues 1 – 6 while the fire button is pressed (rate selected by transmitter switch).
2	2	Semi-automatic firing of cues 1 – 6.	Automatic firing of cues 1 – 6 as described above.
3	3	Semi-automatic firing of cues 1 – 6.	Automatic firing of cues 1 – 6 as described above.
4	4	Semi-automatic firing of cues 1 – 6.	Automatic firing of cues 1 – 6 as described above.
5	5	Semi-automatic firing of cues 1 – 6.	Automatic firing of cues 1 – 6 as described above.
6	6	Semi-automatic firing of cues 1 – 6.	Automatic firing of cues 1 – 6 as described above.
7	None	No action.	No action.
8	None	No action.	No action.
9	1	Semi-automatic firing of cues 7 – 12.	Automatic firing (rapid fire) of cues 7 – 12 while the fire button is pressed (rate selected by transmitter switch).
A	2	Semi-automatic firing.	Automatic firing of cues 7 – 12 as described above.
B	3	Semi-automatic firing.	Automatic firing of cues 7 – 12 as described above.
C	4	Semi-automatic firing.	Automatic firing of cues 7 – 12 as described above.
D	5	Semi-automatic firing.	Automatic firing of cues 7 – 12 as described above.
E	6	Semi-automatic firing.	Automatic firing of cues 7 – 12 as described above.
F	None	No action.	No action.

Semi-automatic and automatic firing sequences will restart at cue 1 after passing cue 12. Receivers set to switch positions 1 – 6 will only fire on cues 1 – 6. Receivers set to switch positions 9 – E will only fire on cues 7 – 12. Thus, it is possible to set two receivers to fire a total of twelve cues on the same digital channel.

Multiple transmitters and receivers may communicate simultaneously, provided the transmitters are all set to different digital channel numbers. Transmitters set to the same digital channel number will interfere with each other and result in failure-to-fire.

The user has access to the following components:

1.1 THE ANTENNA.

The RF signal is received optionally by a quarter-wave solid conductor bendable antenna or by a reduced height quarter wave antenna which screws onto the top of the receiver PC board. Antennas with red rings are used for 433 MHz, and antennas with blue rings are used for 418 MHz.

1.2 THE POWER & ARM SWITCHES.

These slide switches are located on the top side of the PC board. The “POWER” switch turns on power to the receiver and resets the semi-automatic and automatic firing modes to start at output 1. The “ARM” switch has “Safe” and “Armed” positions. In the “Safe” position, output firing current is limited to 200 microamps so that no outputs can be fired, although the firing position will advance each time the transmitter button is pressed, and the firing indicators will glow faintly. **It is recommended that the receiver always be powered up in “Safe” mode if devices are already connected to the outputs. The operator can then verify that the green “BAT / ACTIVITY” light does not indicate that any firing signal reception is occurring before arming the receiver.**

1.3 THE TEST BUTTON.

Pressing this button, located between the two output connectors, performs a continuity test on all six outputs simultaneously. While the button is pressed, a maximum test current of 1 milliamp flows through each load, and red LED indicators light next to outputs with “open” loads (resistance > 500 ohms). LEDs next to outputs that see continuity to COM+ (< 500 ohms) will remain dark. **Remember that red LEDs during test indicate OPEN outputs, and such outputs will not fire when actuated.** These output connections should be examined and the electric match and/or wire should be replaced if necessary. The receiver must be turned on to perform the continuity test, but the “ARM” switch may be in either position. Normally, the continuity test is performed before arming the receiver.

1.4 THE “ACTIVITY / BAT” INDICATOR.

While the power switch is on, this green indicator, located on the top side of the circuit board, 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 battery must be replaced before the receiver 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 receiver power is available as long as the battery voltage is above approximately 7.0 volts, but the battery voltage will drop rapidly at this point. While this additional time should be adequate to complete the current firing sequence, it is not absolutely predictable, and so the battery(s) should be replaced at the very next opportunity.

This green indicator will light while a signal is being received that matches the expected preamble and sync code of the system communication protocol, even if it is from a transmitter set to a different digital channel. This feature is useful for warning of reception of signals before the arm switch is turned on and for indication of activity on other digital channels.

1.5 THE OUTPUT CONNECTORS.

Electric matches are connected to a pair of toolless terminal blocks. A screwdriver is not required to secure the connections. Simply insert a wire into each hole on the side of the connectors, and press the white tab down flush with the connector top to lock the wire into the hole. The left terminal block accepts wires for outputs 1 – 3, and the right terminal block for 4 – 6. One of each pair of wires from electric matches 1 – 3 are twisted together, and the twisted triplet is inserted into the hole labeled “COM+”. The other three wires are inserted individually into holes 1 – 3, respectively. Electric matches 4 – 6 are similarly connected to the right-hand terminal block. Wire gauges should be #22 or higher to fit into the “COM+” hole. Solid copper wire should be used.

1.6 THE BATTERY(S).

Power is optionally supplied from one or two alkaline 9 volt batteries, inserted into snap-in cases on top of the PC board. In the one-battery configuration, receiver power and firing power are derived from the same battery. For applications that will fire more than one electric match per cue, the two-battery configuration should be used. In this configuration, receiver power and firing power are derived from separate 9 volt batteries.

The batteries should be replaced when required by conditions described in section 1.4 above. In order to prevent the possibility of damage due to battery leakage, the batteries should always be removed if the receiver 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 located just above the left-hand output terminal block on the receiver PC board. It can be set to digital channels 0 – 9 or A – F by rotation with a small screwdriver or fingers. The receiver will only respond to transmitters whose digital channels correspond to the channel selected by this switch as shown in the table in section 1.0. Thus, multiple transmitters may be used to actuate different receivers even though all operate on the same frequency. Simultaneous multiple transmissions are possible without interference if all transmitters are set to different digital channel numbers. Transmitters set to the same digital channel number will interfere with each other and result in failure-to-fire when actuated simultaneously.

2.0 RADIO INTERFERENCE REDUCTION.

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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 to the 60th power) of an actuation occurring due to reception of a random signal. Expressed in decimal numbers, this is (1.1529 times 10 to the 18st power, or 11529 followed by 14 zeroes). This is a probability of 8.6736 times 10 to the -19th power (or a decimal point followed by 18 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 or 433 MHz as the operating frequency. These frequencies are 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.

3.0 SPECIFICATIONS.

Parameter (dual on-board batteries)	Minimum	Typical	Maximum
Carrier Frequency, MHz.	417.96	418.02	418.08
Carrier Frequency, MHz. (optional)	433.86	433.92	433.98
Range (line-of-sight with RFLS-1XT xmtr)			½ mile
Delay from start of transmission to receiver output (fewer than 4 transmitters transmitting simultaneously)		50 msec	75 msec
Delay from start of transmission to receiver output (more than 3 transmitters transmitting simultaneously)		100 msec	400 msec
Delay from start of transmission to receiver output		75 msec	150 msec
Receiver battery drain, (Rcvr switch on) Receiver battery drain, (Rcvr switch off) Fire battery drain, (Not testing or firing) Fire battery drain, (Test btn pressed) Fire battery drain, (Firing)		8 mA	9 mA 0 mA < 1 μA 75 mA 1100 mA
Battery life (not firing)	40 hrs	48 hrs	
Receiver Supply Voltage	6.5 V		
Low Battery Detect Threshold		7.7 V	
Battery Input Voltage	7 V	9 V	10.0 V
Output Fire Pulse Duration (semi-auto mode)			0.56 sec
Output Fire Voltage			9 V
Output Fire Current, (Armed)			1 amp
Output Fire Current, (Safe)			200 uamp
Output Continuity Test Current (while test button pressed, 0 while not pressed)		0.9 mA	1.1 mA

4.0 OPERATION AND MAINTENANCE.

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

4.1 OPERATION.

4.1.1 Before connecting electric matches, perform a range test by observing the receiver firing lights while pressing the transmitter buttons. An assistant may be needed for this test. Determine the limits of the range in the current environment, and position the transmitter and receiver so that their separation does not exceed ¾ of this maximum range. Verify that the transmitter and receiver batteries are not depleted by observing the flashing “ACTIVITY / BAT” lights on each (red on the transmitter, green on the receiver). Operation of these indicators is as described in section 1.4 above. Turn the transmitter lock switch back to “Safe” position, and turn off the receiver.

4.1.2 Connect devices to receiver outputs. With the “ARM” switch turned off, turn on the receiver power switch. Verify continuity through the devices by pressing the “TEST” button. All red indicators should remain off. Check that the green indicator is only flashing in bursts of one, two or three to indicate battery status. If this indicator exhibits continuous or erratic behavior, there is a signal being received which could cause firing when the “ARM” switch is turned on. Determine the source of the interference before attempting to use the system.

4.1.3 When the area around the devices to be actuated is clear of persons who might be injured by an accidental actuation, and with the “ARM” switch turned off, turn on the receiver. After verifying that the receiver’s green ACTIVITY indicator does not show reception of signals, turn on the receiver’s ARM switch.

4.1.4 Turn the transmitter lock switch to its “Enabled” position, and press the appropriate button to actuate the desired receiver output channel. A button must be depressed for at least 100 milliseconds to produce a receiver output. 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.

4.1.5 When finished, turn off the receiver POWER and ARM switches, and turn the transmitter lockswitch back to its “Safe” position to stop further drain of the batteries. If the receiver and transmitter are to be stored for a prolonged period, remove their batteries as described in section 1.6 above.

You may remove the transmitter antenna to make storage easier. Be careful not to overtighten the transmitter antenna when screwing it back 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.

There is no danger of overtightening the receiver antenna.

4.2 MAINTENANCE.

Since there are no calibration or tuning adjustments in the units, the only maintanance required is periodic replacement of the 9 volt batteries. This should be done at least once per year, or at the next opportunity if the battery indicators fail to flash at least twice per burst while power is switched on.

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 and receiver must never be immersed in water.

If further information or service is required, contact:

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