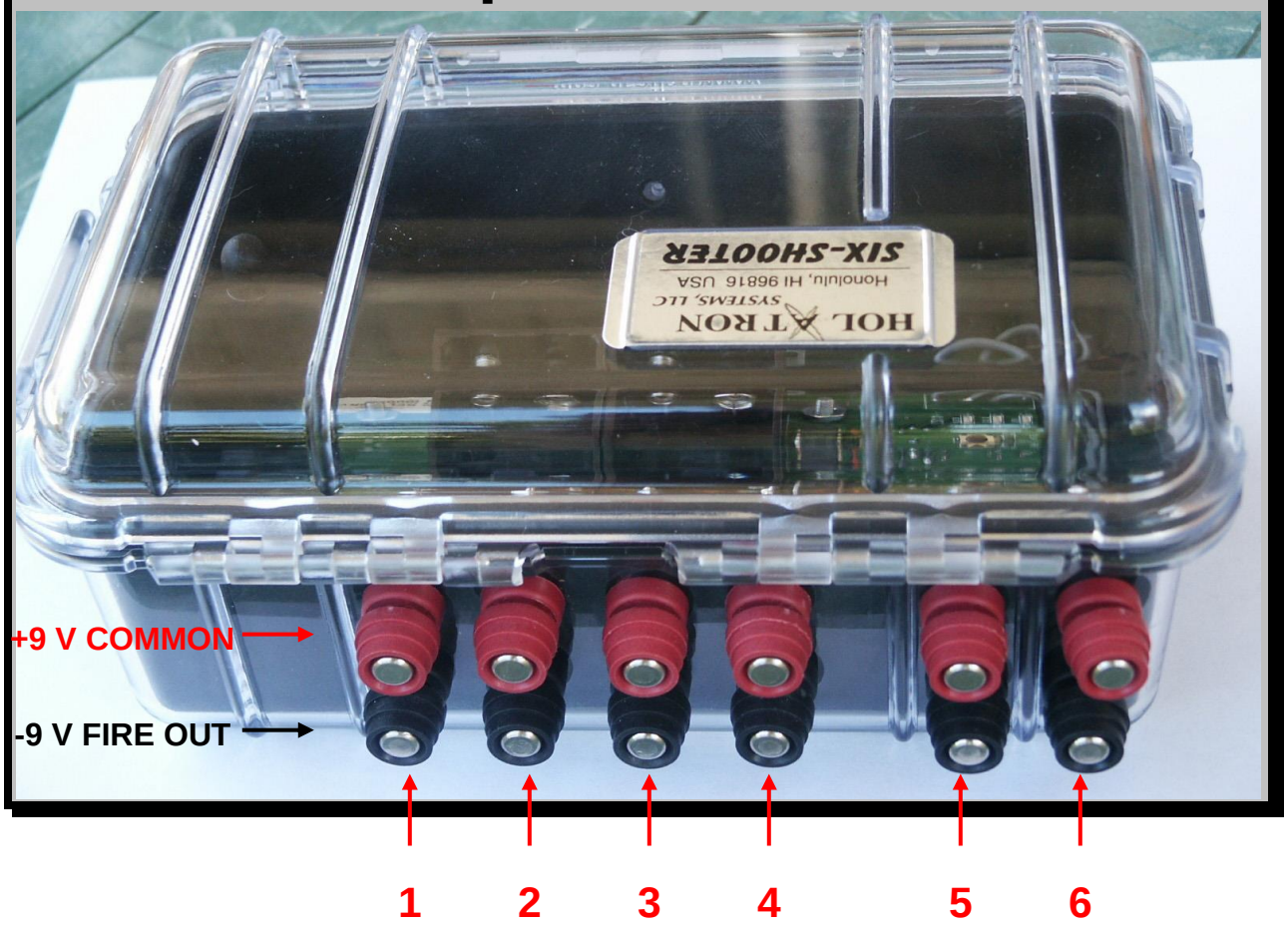
HOLATRON

OPERATION & MAINTENANCE GUIDE -

RAPID-FIRE 6 pairable 12 channel 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**.

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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-96HSRC "RAPID-FIRE 6" user pairable six-shot multi-mode high speed receiver is a highly sensitive narrow band (superhetrodyne) radio receiver designed to be used for remote control applications where high reliability and low latency are critical. This receiver can be "paired" with the desired cue range, channel #, and proprietary system code of any Holatron transmitter on a matching frequency via a very simple operation. The channel # (1-12) can optionally be selected via an internal digital switch, overriding the paired channel #.

When used with the Holatron model RFLS-1XT, RFLS-6HSXT, RFLS-6HSXTX, RFLS-12XT, RFLS-12XTX, XMTR12B, or XMTR12C remote control transmitters, 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 MHz by a crystal controlled phase-locked loop oscillator for exceptional stability. No alignment or tuning procedures are ever required to maintain optimum performance.

The receiver's firing signal is digitally decoded from the transmitted digital code which is amplitude modulated on a single carrier frequency of 418 MHz. The transmitted digital codes from the RFLS-6HSXT & RFLS-6HSXTX indicate to the receiver which of the two transmit buttons, "A" or "B", is being pressed. The "A" button fires the show cues sequentially. (Each depression of the button fires the next show cue in sequence.), and "B" button commands fire show cues in fully automatic mode as explained in the transmitter manual.

The digital code from the model RFLS-12XT or XMTR12 series transmitter indicates to the receiver which of its 12 random-fire buttons is being pressed and causes that cue to be fired immediately. The "Next Fire" button transmits a digital code that causes the next cue in sequence to be fired. After pressing the Rst button, the next depression of this button will fire cue 1. These transmitters can fire a maximum of 12 cues per channel on 12 channels for a total of 144 cues.

Pressing the Rst button on the model RFLS-12XTX or XMTR12 series transmitter causes the transmitter to switch to the channel indicated by the following press of one of the numeric keys (1 – 12). This allows manual selection of the communications channel. See the transmitter manual for a detailed description of channel selection.

There are 12 different communication channels (1-12) and two different cue ranges (1-6 and 7-12) available. The receiver will respond only to the transmitter channel it has been paired with, and its 6 outputs will fire only the cue range (1-6 or 7-12) it has been paired with. Receiver pairing and channel selection override can be implemented by the receiver digital switch setting as shown in the following table.

Rcvr Digital Switch Setting	Action
0	Pair with xmtd cue range (1-6 or 7-12), channel, & system code
1	Fire paired cue range, channel 1, and paired system code.
2	Fire paired cue range, channel 2, and paired system code.
3	Fire paired cue range, channel 3, and paired system code.
4	Fire paired cue range, channel 4, and paired system code.
5	Fire paired cue range, channel 5, and paired system code.
6	Fire paired cue range, channel 6, and paired system code.
7	Fire paired cue range, channel 7, and paired system code.
8	Fire paired cue range, channel 8, and paired system code.
9	Fire paired cue range, channel 9, and paired system code.
A	Fire paired cue range, channel 10, and paired system code.
B	Fire paired cue range, channel 11, and paired system code.
C	Fire paired cue range, channel 12, and paired system code.
D	
E	Pair with xmtd cue range (1-6 or 7-12), channel, & system code .
F	Fire paired cue range, paired channel, and paired system code.

Transmitters that are set to separate channels can transmit simultaneously to separate receivers or groups of receivers without interfering with each other, permitting up to 24 separate receivers or groups of receivers (144 cues) to be controlled by up to 12 separate transmitters simultaneously. Transmitters set to the same channel, even though they have different system codes, will interfere with each other and possibly result in failure-to-fire if fired simultaneously. Transmitters with different system codes will not cross-fire, however.

Multiple receivers can be used to fire more than 6 sequential cues from a single transmitter. For example, two receivers set to cue ranges 1-6 and 7-12, respectively, can fire 12 cues (cues 1-6 from the first receiver, and cues 7-12 from the second receiver), and 24 receivers can be used similarly to fire 144 cues using cue range 1-6 and 7-12 on each of 12 channels. Multiple receivers can be configured to fire simultaneously by setting their cue ranges and channels to the same numbers. Combinations of sequential and simultaneous receivers can also be used.

Receiver channels are selected by pairing or by switch position. Cue range and system code are selected only by pairing. Refer to section 4.2 for a detailed description of the pairing procedure.

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, antennas with blue rings are used for 418 MHz, and antennas with green rings are used for 315 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 “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 indicator, red if armed, green if safe, 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 6.5 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 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 or system code. 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 externally mounted spring clip terminals (Pyro-clips) as shown in the photo on the first page. No tools are required to secure the connections.There is a red and black terminal pair for each device to be actuated, with positive indicated by red and negative by black. To connect a wire to an output terminal, simply push down the plastic top of the connector and insert the wire into the gap between the metal terminal and the plastic. Release the plastic top to lock the wire into the terminal. Wire gauge should be #20 or higher to fit into the gap. Solid copper wire is best. If stranded wire is used, be careful that no frayed strands (whiskers) extend out and accidentally contact any adjacent terminals. Also be careful that the wire is not inserted so far that the metal terminal is contacting the wire’s insulation instead of its internal conductor. This will be detected during continuity check. Ensure that no exposed conductors are shorting any black terminals to adjacent terminals, as this condition will not be detected during continuity check. A short to a red terminal will result in a failure to fire and possible damage to the firing circuitry. A short to a black terminal will result in simultaneous firing of the outputs shorted together.

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 positions 0 – 9 or A – F by rotation with a small screwdriver. This switch is used to select receiver pairing mode or to override the paired channel selection as shown in the table in section 1.0. Refer to section 4.2 for a detailed description of the pairing procedure performed with this switch.

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 minus 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 315, 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 confirmed cases 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
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 Battery Voltage	6.5 V	9 V	10.0 V
Firing Battery Voltage	8 V	9 V	10.0 V
Low Battery Detect Threshold		7.0 V	
Output Fire Pulse Duration (semi-auto mode)			0.56 sec
Output Fire Voltage			9 V
Output Fire Current, (Armed)			3 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. Operation of these indicators is as described in section 1.4 above. Turn the transmitter off, and turn off the receiver.

4.1.2 Connect devices to receiver outputs. The operator should retain possession of the transmitter or transmitter key while performing the next two tasks. 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 ACTIVITY 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 ACTIVITY indicator does not show reception of signals, turn on the receiver’s ARM switch.

4.1.4 Turn the transmitter to its “ON” or “Enabled” state, arm it if necessary, and press the appropriate button to actuate the desired receiver output. 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 return the transmitter to its “OFF” or “Safe” state to stop further drain of its 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.

4.2 PAIRING.

Three parameters determine the transmitters to which the receiver will respond:
Proprietary System Code (0-255),
Digital Channel (1-12),
Cue Range (1-6 or 7-12)

With the digital switch set to position 0 or E, a single transmission will cause the receiver to grab all three parameters and pair itself with the transmitter that sent them. This pairing will be saved in non-volatile memory even when the receiver power is off. When the switch is subsequently set to position F, the receiver will continue to respond to this saved system code, channel, and cue range. Optionally, the channel number can be selected from the switch by setting it to positions 1-C, as shown in the table in section 1.0. The paired system code and cue range are still used in this case.

Paired channel number is displayed as a series of ACTIVITY flashes at power-on, and paired system code is displayed as a series of ACTIVITY flashes for each digit during the pairing operation. Zero digits are represented by a single long flash in this display. Leading zeroes are not displayed.

When the receiver pairs with a transmitter, it will flash the received system code number once and then cease flashing the battery level. Be sure to return the digital switch to position F or to 1-C after pairing with a transmitter to prevent possible change of the saved parameters on subsequent transmissions, and turn receiver power off for a few seconds and then back on to restore normal operation with the newly paired parameters.

4.3 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 transmitter's battery compartment door and the junction between its front and back panels are NOT water tight, however. The transmitter must never be immersed in water.

If further information or service is required, contact:

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