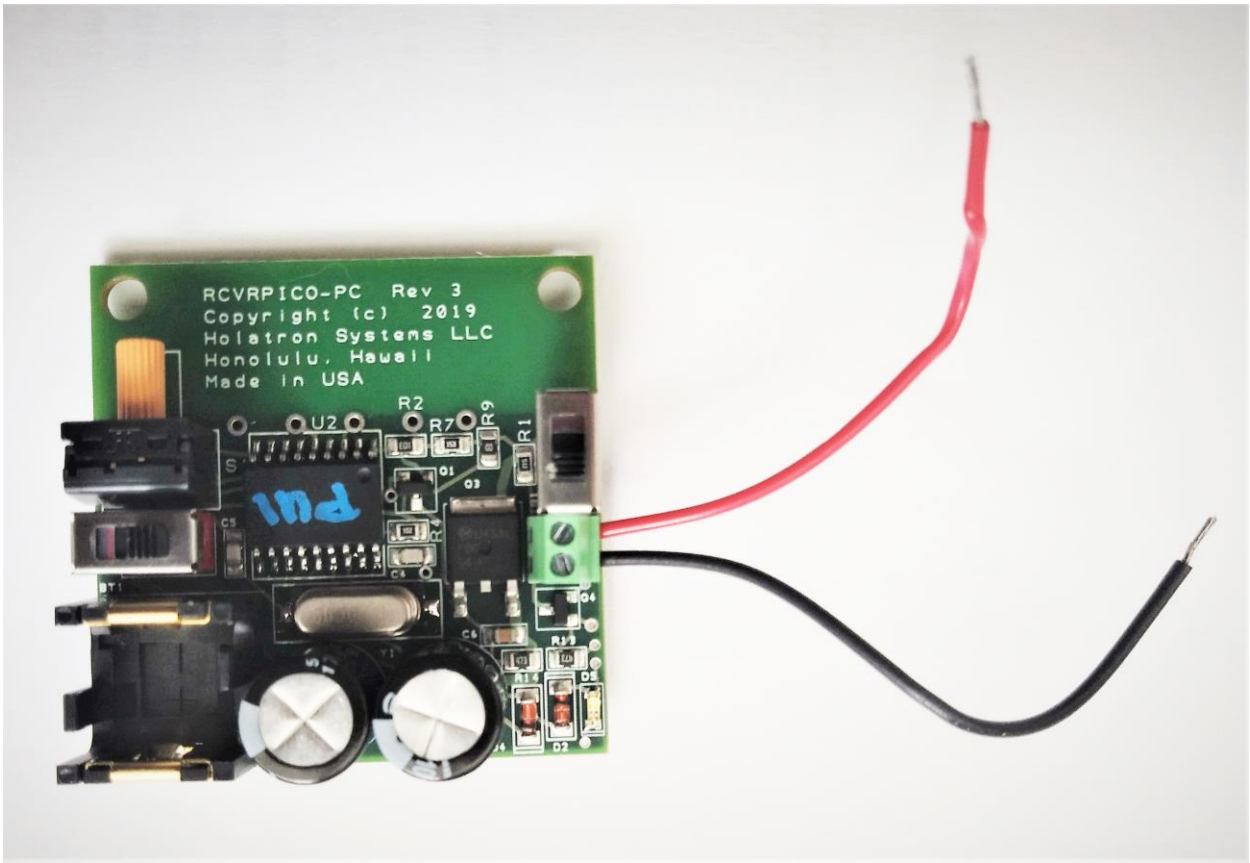
HOLATRON

OPERATION & MAINTENANCE GUIDE -
Pairable Single Output UHF Micro-receiver



HOLATRON SYSTEMS, LLC
2800 Woodlawn Dr, Ste. 138
Honolulu, HI 96822
(808) 372-0956
www.holatron.com

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.

HOLATRON SYSTEMS, LLC
2800 Woodlawn Dr, Ste. 138
Honolulu, HI 96822
(808) 372-0956
www.holatron.com

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 device specifications. The fourth covers the recommended operating and maintenance procedure.

1.0 HARDWARE DESCRIPTION.

The model RFLS-P91HSRC pairable micro-miniature single output multi-mode UHF receiver is a highly sensitive narrow band (superhetrodyne) digital radio receiver designed to be used for remote control applications where high reliability is critical. This receiver can be “paired” with the desired cue #, channel #, and proprietary system code of any Holatron transmitter on a matching frequency via a very simple operation. The cue # (1-12) can optionally be selected via an internal digital switch, overriding the paired cue #.

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 ¼ 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 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 315, 418, or 433 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 off 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 available. Each channel is designated by a numeral (1 through 12). The transmitter will control receivers set to the channel matching that being used by the transmitter. Receiver cue numbers can be selected by the receiver digital switch setting as shown in the following tables.

Cue Selection and Pairing Action for Receiver:

Rcvr Digital Switch Setting	Action
0	Pair receiver with next transmission
1	Use cue 1 with paired channel and system code
2	Use cue 2 with paired channel and system code
3	Use cue 3 with paired channel and system code
4	Use cue 4 with paired channel and system code
5	Use cue 5 with paired channel and system code
6	Use cue 6 with paired channel and system code
7	Use cue 7 with paired channel and system code
8	Use cue 8 with paired channel and system code
9	Use cue 9 with paired channel and system code
A	Use cue 10 with paired channel and system code
B	Use cue 11 with paired channel and system code
C	Use cue 12 with paired channel and system code
D	
E	Pair receiver with next transmission
F	Use paired cue, channel, and 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 144 separate receivers or groups of receivers to be controlled by up to 12 separate transmitters simultaneously. Transmitters set to the same channel will interfere with each other and possibly result in failure-to-fire if fired simultaneously.

Multiple receivers can be used to fire sequential cues from a single transmitter. For example, two receivers set to switch positions 1 and 2, respectively, can fire 2 cues (cue 1 from the first receiver, and cue 2 from the second receiver), and 12 receivers can be used similarly to fire 12 cues on each channel. Multiple receivers can be configured to fire simultaneously by setting their cues and channels to the same numbers. Combinations of sequential and simultaneous receivers can also be used.

Receiver cues are selected by pairing or by switch position. Channel 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 by an ebedded internal antenna. No external antenna is required.

Note that reception is best when the receiver is elevated at least 12” above ground level.

1.2 THE POWER & ARM SWITCHES.

These miniature slide switches are located on the circuit board. They may be optionally located remotely. The “POWER” switch turns on power to the receiver and its firing circuitry. Its “ON” position is toward the edge of the circuit board. The “ARM” switch has “Safe” and “Arm” positions. In the “Safe” position, the output leads are shunted so that the output cannot be fired. Output continuity checking is disabled in “Safe” position. **It is recommended that the receiver always be powered up in “Safe” mode if a device is already connected to the output. The operator can then verify that the STATUS INDICATOR does not indicate that any radio reception is occurring before arming the receiver.**

1.3 THE STATUS INDICATOR.

While the power switch is on and the receiver is in “Safe” mode, this indicator, located on the top side of the circuit board, will flash periodically 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 1.6 volts, but the battery voltage will be dropping rapidly at this point, and receiver cutoff will occur within seconds. So the battery must be replaced immediately.

For the first minute after the receiver is armed and output continuity is detected, indicator color will be amber during battery status indication. If disarmed or if the output is open, indicator color will be green.

In order to conserve battery life, the indicator light is disabled after one minute of uninterrupted amber continuity indication. Switching to “Safe” mode or loss of continuity reactivates the indicator light, and the one minute timer will then restart upon switching to “ARM” mode with continuity detected.

This indicator will also 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 cue number or 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. A received signal that matches the receiver's cue and channel number will cause a red indication, even if the receiver is not armed. If the receiver is armed, a red signal will generate a firing output. Received signals that do not match the receiver's cue and channel number will cause a green indication.

The functionality of this indicator is summarized in the following table.

Status Indicator Function Table:

Flash Pattern	**Green**	**Amber**	**Red**	**Battery Level**
3 flashes	Output open or not armed	Output connected and armed		High
2 flashes	"	"		Medium
1 flash	"	"		Low
No flashes				Very low, or dead
Continuous (1 sec or more)	Non-matching signal rcvd		Matching signal rcvd (FIRE if armed)	

1.4 THE OUTPUT LEADS.

The device to be actuated should be connected to the 2 leads extending from the "+" and "–" pads on the edge of the receiver circuit board.

Be careful that no frayed strands (whiskers) accidentally short the output leads together, as this condition will not be detected by the output continuity checker, and it will result in a failure to fire. When armed and a fire command is received that matches the receiver's switch setting, a pulse with peak voltage of 5V is presented to the output leads. The energy in this pulse is 0.025 joules, sufficient to fire at least 2 standard e-matches in parallel or in series. The output leads are shunted when the ARM switch is in "safe" position.

1.5 THE BATTERY.

All power is supplied from one 3 volt 1/3N lithium coin type battery, contained on the receiver circuit board. Optionally, a pair of #357 silver-oxide or a pair of LR44 alkaline coin type batteries may be used, but longest life is obtained from the lithium battery.

The receiver and battery holder are not reverse polarity protected. So it is important to observe the polarity markings on the battery holder. Inserting the batteries backwards could permanently damage the receiver. Note that the shell of the battery is the positive terminal, and the projecting electrode is the negative terminal. The positive terminal of the battery holder is next to the edge of the circuit board.

The 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 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. The batteries can be removed from the holder by prying out gently with a miniature screwdriver.

1.6 THE DIGITAL SWITCH.

A 16 position miniature rotary switch is located on the top side of the circuit board. It can be set to positions 0 – 9 or A – F by rotation with fingers or a small screwdriver.

The receiver will only respond to a transmitter whose channel # and system code match the paired number and code of this receiver, and whose transmitted cue corresponds to the paired cue # of this receiver, or to the cue # selected by this switch as shown in the table in section 1.0. Multiple transmitters may be used to actuate different receivers simultaneously, even though all operate on the same frequency, if the transmitters are operating on separate digital channels and the receivers are paired with those channels. **Transmitters set to the same digital channels will interfere with each other and result in failure-to-fire when actuated simultaneously.**

2.0 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 to the 60^{th} power) of an actuation occurring due to reception of a random signal. Expressed in decimal numbers, this is (1.1529 times 10 to the 18^{th} power, or 11529 followed by 14 zeroes). This is a probability of 8.6736 times 10 to the -19^{th} 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 a UHF 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, WiFi networks, 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	Minimum	Typical	Maximum
Carrier Frequency, MHz. (US, Canada)	314.95	315.00	315.05
Carrier Frequency, MHz. (US, Canada)	417.96	418.02	418.08
Carrier Frequency, MHz. (Europe)	433.86	433.92	433.98
Range (line-of-sight with RFLS-1XT xmtr)			¼ mile
Delay from start of transmitter button depression to receiver output (fewer than 4 transmitters transmitting simultaneously)		50 msec	75 msec
Delay from start of transmitter button depression to receiver output (more than 3 transmitters transmitting simultaneously)		100 msec	400 msec
Battery life, (with LR44 alkaline battery pair) Battery life, (with #357 silver-oxide battery pair) Battery life, (with single 1/3N lithium battery)		2.5 hrs 4.0 hrs 7.5 hrs	
Low Battery Detect Threshold		2.4 V	
Battery Input Voltage	1.6 V	3 V	3.5 V
Standard e-matches fired in parallel Standard e-matches fired in series	2 2		
Output Fire Voltage, (Armed)			5 V
Output Fire Energy, (Armed)		0.025 joules	
Output Fire Current, (Safe)			0.0 amp
Output internal shunt resistance, (Safe)			0.0 ohm
Output Continuity Test Current (Armed) (low duty cycle pulse, once per two seconds)		0.9 mA	1.1 mA
Board length, inches		1.75 inch	
Board width, inches		1.75 inch	
Height above circuit board, inches			0.5 inch
Height below circuit board, inches			0.15 inch
Weight (with batteries installed)		1.0 oz	

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 the output device, perform a reception test by observing the receiver status indicator while pressing the transmitter buttons. An assistant may be needed for this test. If the receiver location will be fixed, 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 receiver and transmitter batteries are not depleted by observing the flashing indicators on the receiver and transmitter, respectively. Operation of these indicators is as described in section 1.3 above. Turn the transmitter and receiver off.

4.1.2 Connect device to receiver output leads as described in section 1.4 above. 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. Check that the receiver indicator is only flashing in bursts of one, two or three to indicate battery level. 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.

NOTE: If the indicator is red, the output will fire immediately upon turning on the “ARM” switch.

4.1.3 When the area around the devices to be actuated is clear of persons who might be injured by an accidental actuation, turn on the receiver’s ARM switch. Verify electrical continuity through the output device by observing that the receiver indicator is displaying amber flashes. If the indicator is flashing green, the output is open or the ARM switch is in “safe” mode, and the receiver will not fire. If red, the output will fire immediately when armed.

4.1.4 Turn the transmitter to its “ON” or “Enabled” state, arm it if necessary, and press the appropriate button to actuate the 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 antenna, 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 (one year or longer), remove their batteries as described in section 1.5 above.

You may remove the transmitter antenna to make it easier to store. Be careful not to overtighten the transmitter antenna when screwing it on, as this could cause the 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 an 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 an 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 Number (1-12)

With the digital switch set to position 0 or E, a single transmission will cause the receiver to grab all three paramaters 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. After power is cycled and the switch is subsequently set to position F, the receiver will respond only to this saved system code, channel, and cue number. Optionally, the cue 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 channel number are still used in this case.

Paired channel number is displayed as a series of amber flashes at power-on, and paired system code is displayed as a series of amber 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.

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.

4.2 MAINTENANCE.

Since there are no calibration or tuning adjustments in the units, the only maintenance required is periodic replacement of the 9 volt battery in the transmitter and the coin batteries in the receivers (if the receivers are not being used in disposable applications). This should be done at least once per year, or at the next opportunity if the battery indicators fail to flash at least 3 times 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 must never be immersed in water.

If further information or service is required, contact:

Holatron Systems, LLC.
2800 Woodlawn Dr, Ste. 138
Honolulu, HI 96822
(808) 372-0956
www.holatron.com