OPERATION & MAINTENANCE GUIDE –
Radio Triggered Propane Blaster

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

1.0 HARDWARE DESCRIPTION.

The model RFLS-1912PB radio triggered propane blaster contains a single output multi-mode UHF receiver that receives encoded radio commands from standard Holatron transmitters and uses them to trigger a sequenced solenoid valve and spark ignition output. Radio signals are received by a highly sensitive narrow band (superhetrodyne) digital radio receiver designed to be used for remote control applications where high reliability is critical. When used with the Holatron model XMTR12B, RFLS-6HSXT series, or RFLS-12XT series 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 receiver box is sealed (including the miniature toggle switches) and may be safely operated under heavy rainfall, but it is not designed to be submerged under water.

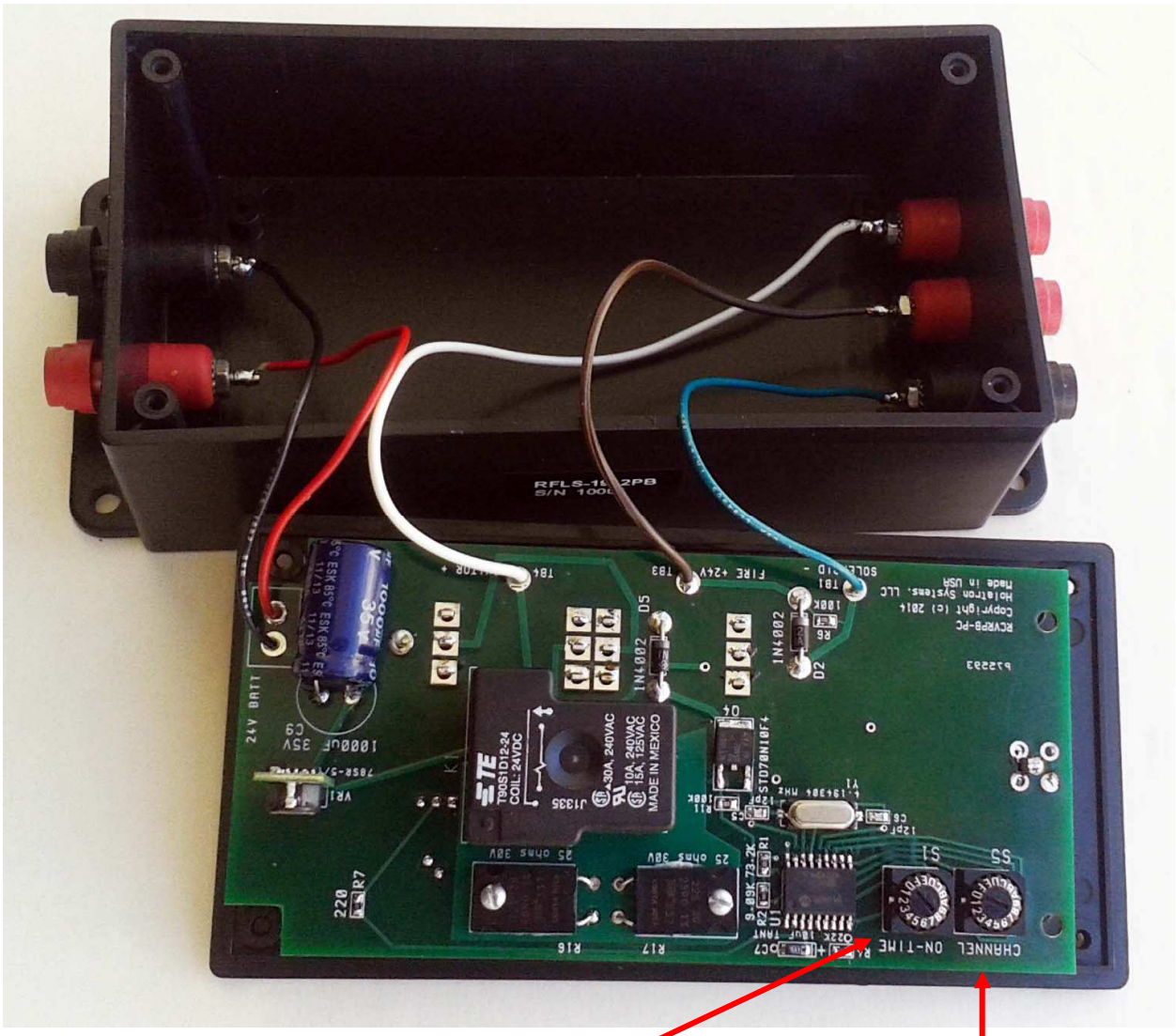
The reception carrier frequency is fixed at 418 MHz by a quartz crystal contolled phase lock loop for exceptional stability. No alignment or tuning procedures are ever required to maintain optimum performance.

The receiver's firing signal is 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 series transmitters indicate to the receiver which of the two transmit buttons, "A" or "B", is being pressed. The "A" button triggers the receiver if its external CH switch is in the "A" position, and the "B" button triggers it if the switch is in the "B" position, allowing independent control of two groups of receivers from a single transmitter.

The transmitted digital codes from the model XMTR12B or RFLS-12XT series transmitters indicate to the receiver which of the 12 random-fire buttons is being pressed and triggers the receiver if it is set to the CH "A" position. Depression of any numeric button will immediately trigger the receiver's valve / ignition sequence.

There are 12 different communication channels available. Each channel is designated by a numeral (1 through 9, and A, B, and C for channels 10, 11, 12). The transmitter will control receivers set to the channel matching that being used by the transmitter. Receiver channel number is selected by the internal digital switch setting shown in Figure 1 below:

FIGURE 1
(inside view with lid removed)

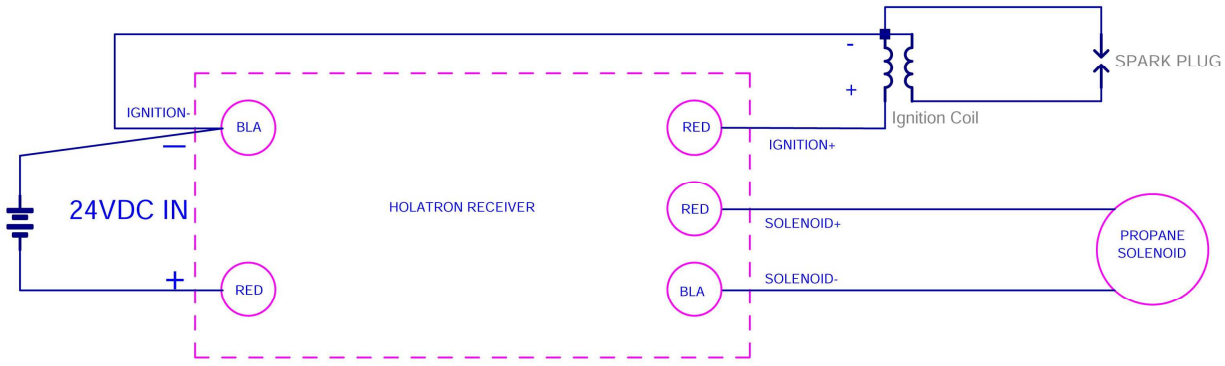


The internal ON-TIME selector switch shown above is used to select the amount of time the solenoid valve output will remain on after the receiver is triggered, and hence, the magnitude of the propane explosion. The effects of the different switch settings are shown in the following table.

Solenoid Output Duration Table

SWITCH	ON-TIME, SEC
0	0.5
1	1.0
2	1.55
3	2.15
4	2.8
5	3.5
6	4.25
7	5.0

Solenoid, ignition coil, and power input are connected to 5 spring terminals (PyroClips) on the ends of the receiver box as shown in the following diagram:



The two terminals marked "24 VOLTS" connect to your 24 volt DC supply.

--- WARNING ---

Power polarity must match the marked polarity of the terminals, as defined by the + and – markings and by the red and black terminals. Red is positive and black is negative. Any connection with reverse polarity or in a manner other than shown in the above diagram can cause damage to the trigger circuitry and will void the warranty.

Please note that the output is not fused. So be very careful not to connect to a short circuit. Modules with internal automatic resetting fuses are available at a higher price.

The user has access to the following components:

1.1 THE ANTENNA.

The RF signal is received by a quarter-wave screw-on antenna. It can be unscrewed and removed for storage. When installing the antenna, it should only be hand-tightened to the point where mechanical resistance begins to be felt. That is all that is required for good electrical contact. Excessive tightening can damage the connection of the antenna jack to the internal circuit board. **The antenna should never be tightened with pliers or any similar tool.**

Note that reception is best when the receiver is elevated at least 12” above conductive objects such as car hoods, metal bleachers, or earth ground, and the antenna is vertical

1.2 THE POWER & ARM SWITCHES.

These miniature toggle switches are located on the top side of the receiver. The “POWER” switch turns on power to the receiver. The “ARM” switch has “Safe” and “Armed” positions. In the “Safe” position, no outputs can be fired, even if fire commands are received. **It is recommended that the receiver always be powered up in “Safe” mode if devices are connected to the output. 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 BATTERY INDICATOR.

While the power switch is on, this indicator, located on the top side of the receiver, will flash intermittently in bursts of one, two, or three flashes at a time if the input voltage is high enough to power the receiver. If the receiver is armed, it will flash red. If “safe”, it will flash green.

If no flashing occurs, the input voltage is not adequate for reliable operation. Three flashes per burst indicate normal +24V input, two flashes indicate slightly reduced voltage, and one flash indicates critically low voltage input. Adequate receiver power is available as long as the input voltage is above approximately 22 volts.

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.

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

Battery Indicator Function Table

Flash Pattern	Green	Red	Input Voltage Level
3 flashes	Safe	Armed	Normal
2 flashes	"	"	Reduced
1 flash	"	"	Critically Low
No flashes			Excessively low, or dead
Continuous (1 sec or more)	Preamble & sync signal rcvd (MAY FIRE IF ARMED)	Preamble & sync signal rcvd (MAY FIRE)	

1.4 THE CHANNEL SWITCH.

Two 16 position miniature rotary switches are located inside the enclosure lid on the PC board as shown in Figure 1. Each can be set to positions 0 – 9 or A – F by rotation with a small screwdriver.

The receiver will only respond to a transmitter whose channel corresponds to the numeric position of the receiver's CHANNEL switch. Note that switch positions A, B, and C select channels 10, 11, and 12, respectively. Multiple transmitters may be used to actuate different receivers simultaneously if the transmitters are operating on separate digital channels and the receivers are set to those channels. **Transmitters set to the same digital channel will interfere with each other and result in failure-to-fire when actuated simultaneously.** Receivers set to identical channels will fire simultaneously.

1.5 THE ON-TIME SWITCH.

The receiver's ON-TIME switch, shown in Figure 1, selects the amount of time the solenoid valve output will remain on after the receiver is triggered, and hence, the magnitude of the propane explosion. The effects of the different switch settings are shown in the Solenoid Output Duration Table in section 1.0.

1.6 THE A / B SWITCH.

This miniature toggle switch, located on the top side of the receiver, selects which transmitter commands will cause the receiver to actuate its outputs. When set to the “A” position and used with the RFLS-6HSXT series transmitters, the receiver will respond only to depression of the transmitter’s “A” button. When set to the “B” position, it will respond only to the transmitter’s “B” button, allowing independent control of two receivers, or two groups of receivers from a single transmitter. Note that the transmitter and receiver channels must also match.

When used with the model XMTR12B or RFLS-12XT series transmitters, this switch must be set to the “A” position. If receiver and transmitter channels match, depression of any transmitter numeric button will immediately trigger the receiver’s valve / ignition sequence.

1.7 THE SOLENOID OUTPUT.

The red and black terminals labeled SOLENOID on the end of the box output 24 VDC to turn on the propane solenoid for the duration selected by the ON-TIME switch. **Be sure to use a DC, not an AC, solenoid.** Use of a solenoid not specified for 24 VDC may damage the internal circuitry and void the warranty. The red terminal is positive with respect to the black terminal, but normally DC solenoids are not polarity sensitive (provided they are not shunted with a suppression diode).

1.8 THE IGNITION OUTPUT.

The red terminal labeled IGNITION+ on the end of the box connects to the positive terminal of the ignition coil primary. The negative primary terminal of the ignition coil connects to the negative (black) 24V input terminal on the other end of the box as shown in the connection diagram in section 1.0. The coil’s negative primary terminal is also common to its secondary output and provides the ground (frame) connection to the spark plug. Note that **operating the coil without a spark plug connected can cause damage to the coil from internal arcing**. Any standard automotive 12V ignition coil can be used, but it must be the type that does not contain an internal resistor.

The ignition output automatically turns on 200 msec after the solenoid output turns off. It causes the coil to generate a continuous spark for a period of 200 msec, and then it turns off.

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 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 418 MHz as the operating frequency. This frequency is sparsely used only by low power transmitters with a maximum range of approximately 100 meters. It is not commonly used by auto security systems, garage door openers, radio control models, cordless or cellular telephones, wi-fi networks, 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 instances of false triggering with this communications technology have been reported to date.

3.0 SPECIFICATIONS.

Parameter	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 standard Holatron xmtrs)			½ mile
Delay from start of transmission to solenoid output (fewer than 4 transmitters transmitting simultaneously)		50 msec	75 msec
Delay from start of transmission to solenoid output (more than 3 transmitters transmitting simultaneously)		100 msec	400 msec
Ignition Delay From Solenoid Off		200 msec	
Ignition Output Duration		200 msec	
Supply Voltage	22 VDC	24 VDC	26 VDC
Solenoid Output Voltage		24 VDC	
Solenoid Output Current			3 Amps

4.0 OPERATION AND MAINTENANCE.

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

4.1 OPERATION.

4.1.1 Turn off the power switch and set the arm switch to its SAFE position.

4.1.2 Connect the gas solenoid valve and ignition coil to their designated receiver outputs, and then connect the two terminals marked "24 VOLTS" to your 24 volt DC supply as shown in the wiring diagram in section 1.0.

--- WARNING ---

Power polarity must match the marked polarity of the terminals, as defined by the + and – markings and by the red and black terminals. Red is positive and black is negative. Any connection with reverse polarity or in a manner other than shown in the wiring diagram can cause damage to the trigger circuitry and void the warranty.

4.1.3 With the “ARM” switch turned off, turn on the receiver power switch. Check that the green indicator is only flashing in bursts of one, two or three to indicate power input 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 nature of the interference before attempting to use the system.

4.1.4 The operator should retain possession of the transmitter, or the key that enables the transmitter, to eliminate the possibility of unexpected transmission of firing commands during this step. **When certain that the area around the devices to be actuated is clear of persons who might be harmed by an unexpected actuation, set the receiver’s ARM switch to its ARMED position. The operator should be aware that the output devices are now “hot” and should be prepared for actuation of them by received radio commands, expected or unexpected.**

4.1.5 Turn on the transmitter, and press the appropriate button to actuate the selected 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.

4.1.6 When finished, turn off the receiver ARM switch and then the POWER switch, disconnect the power input, and then disconnect the solenoid and ignition coil.

Turn off the transmitter to stop further drain of its batteries. If the transmitter is to be stored for a prolonged period, remove its batteries.

You may remove the receiver antenna to make storage easier. Be careful not to overtighten the antenna when screwing it back on, as this could cause its mating connector to damage its internal connection to the circuit board. Similar damage could occur 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 really tight to achieve a good electrical connection. Pliers or similar tools should never be used to tighten the antenna.

4.2 MAINTENANCE.

Since there are no calibration or tuning adjustments and no batteries in the unit, the only maintanance required is periodic cleaning. The exterior of the box, which is completely sealed, may be safely cleaned by wiping with a damp cloth. The junction between the lid and the box, while able to withstand exposure to rain and dust, is NOT water tight. The box should never be immersed in water.

If further information or service is required, contact:

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