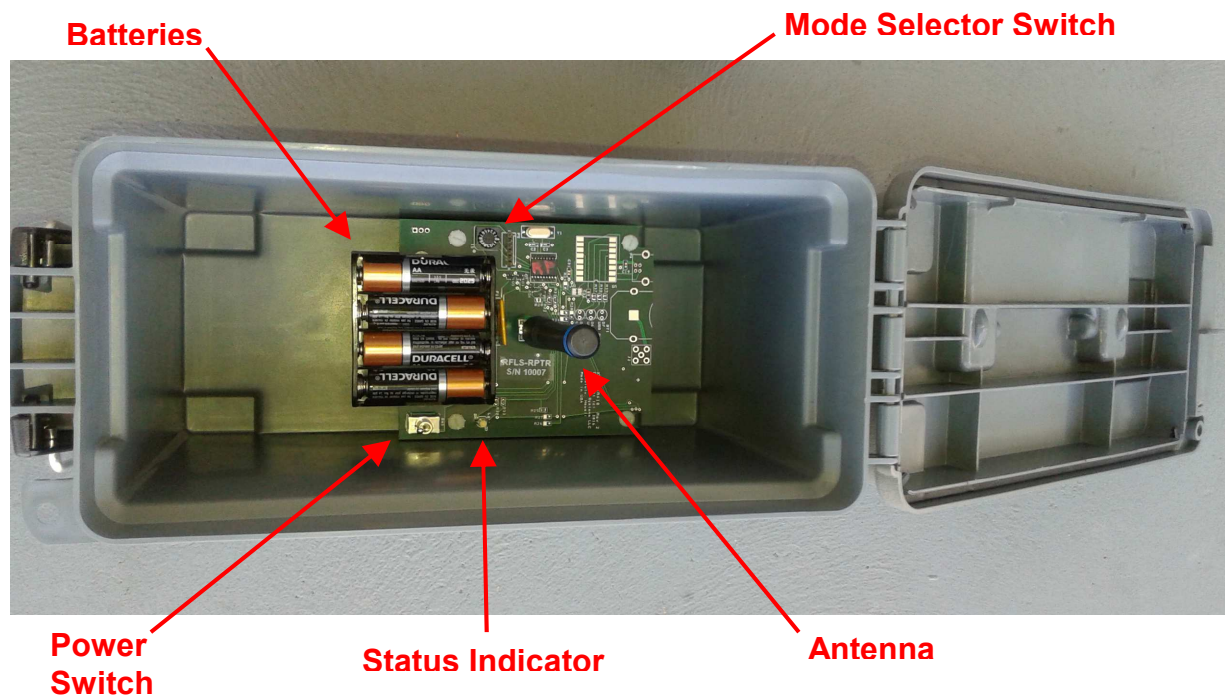


HOLATRON

OPERATION & MAINTENANCE GUIDE 418 MHz High-speed Smart Repeater



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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 repeater 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.

INFORMATION TO USER

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested, assigned FCC ID number **OI4RPTR418**, and found to comply with the limits for Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

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

Les changements ou modifications non approuvés expressément par la partie responsable de la conformité pourrait annuler l'autorité de l'utilisateur à faire fonctionner l'équipement..

This device also complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This radio transceiver **11556A-RPTR418** has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur/récepteur radio **11556A-RPTR418** a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

This radio transceiver is approved for operation with Linx Technologies ANT-418-CW-HD monopole antenna with RP-SMA connector and peak gain of -1.8 dBi.

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 RPTR418 high-speed smart repeater can be used to extend the range or enhance the coverage of standard Holatron systems operating on 418 MHz. The repeater accomplishes this by receiving a Holatron digital signal and retransmitting it if it is correctly formatted. Only Holatron digital signals will be retransmitted. Other signals on 418 MHz or other frequencies will be ignored. Multiple repeaters may be arrayed equidistant from the Holatron transmitter to provide enhanced coverage with simultaneous retransmissions, or they may be arranged in a linear cascade to multiply the effective range of the transmitter. For example, one repeater midway between transmitter and receiver will double the transmitter's range in that direction. A repeater located at distance D from the transmitter, and a second located at distance 2D will triple the transmitter's range (extend it to 3D), and so on, with a maximum cascade of 4 repeaters possible for a five-fold extension of range. Combinations of enhanced coverage arrays and linear cascades are possible, provided no cascade contains more than 4 repeaters. These repeaters are also useful for extending coverage around corners of conductive buildings, over hills, and onto rooftops.

In addition to filtering out non-Holatron signals and incorrectly formatted digital signals, the repeater can be set to cause only Holatron signals on a selected digital channel to be retransmitted, or optionally to retransmit any of 12 available channels. The repeater will retransmit any proprietary system code on its selected channel(s). Repeater performance is optimum if only one channel at a time is transmitting. It may degrade if multiple channels are transmitting simultaneously.

Retransmission is performed by a highly sensitive narrow band (superhetrodyne) digital radio transceiver that receives encoded radio commands from standard 418 MHz Holatron transmitters and retransmits them through a common antenna. A microcomputer decodes and error checks the received signals in real-time before initiating retransmission. This system is designed to be used for remote control applications where speed and high reliability are critical. When used with the Holatron model XMTR12B, RFLS-6HSXT series, or RFLS-12XT series remote control transmitters, a single repeater will typically double the transmitter's range from ½ mile to one mile (line of sight), provided there are no intervening conductive objects such as automobiles, chain-link fences, etc, in the receive and transmit paths. Range increases as the repeater is elevated above earth or other conductive objects (such as aluminum bleachers). Range will be even greater when receiving and transmitting over water.

The repeater is environmentally sealed when its hinged lid is closed and latched, and it may be operated in this configuration under heavy rainfall and other adverse environmental conditions, but it is not designed to be submerged under water.

The user has access to the following components (refer to annotated cover photo):

1.1 THE ANTENNA.

The RF signal is received and retransmitted by a single quarter-wave screw-on antenna. The circuit board acts as a ground plane for this antenna. Both are contained within the repeater enclosure and will operate with undiminished range even when the lid is closed. Note that range is optimized when the receiver is elevated at least 12" above nearby conductive objects such as car hoods, metal bleachers, or earth ground, and the antenna is vertical. 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 antenna jack to the internal circuit board.

The antenna should never be tightened with pliers or any similar tool.

1.2 THE POWER SWITCH.

This miniature toggle switch, located on the top side of the internal circuit board, turns on power to the receiver. When finished, don't forget to turn it off in order to conserve battery life. There is no external indicator to show that it is on.

1.3 THE STATUS INDICATOR.

While the power switch is on, this indicator, located on the top side of the internal circuit board, will flash intermittently in bursts of one, two, or three green flashes at a time if the battery voltage is high enough to reliably power the repeater.

The bursts indicate the amount of energy remaining in the batteries. If no flashing occurs, the batteries must be replaced before the transmitter can be used reliably. Three flashes per burst indicate that the batteries have full capacity, two flashes indicate that their capacity is beginning to diminish, and one flash indicates that they are near the end of their useful lifetime in which case they should be replaced immediately after the current use. Adequate repeater output to achieve the specified range will occur as long as the total series battery voltage is above approximately 5 volts, but the battery voltages will drop rapidly at this point

This indicator will also light green while a signal is being received that matches the expected Holatron preamble and sync code of the system communication protocol, even if it is from a transmitter operating on digital channel that is different from the one selected with the mode selector switch.

When repeater mode is selected (switch positions 0 – D), this indicator will light up orange while retransmission is occurring. In continuous transmission (broadcast) mode (switch positions E or F), it will light up red as each data packet is transmitted.

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

Status Indicator Table

Flash Pattern	Color	Status
3 flashes	Green	Battery normal
2 flashes	Green	Battery reduced
1 flash	Green	Battery critically low
No flashes	None	Battery excessively low, or dead
Continuous (1 sec or more)	Green	Preamble & sync signal rcvd (can be triggered by background noise)
Rapid flashing	Green	Holatron command being received on a channel that is different from switch selection
Rapid flashing	Orange	Holatron command being retransmitted
One blink per 2 seconds	Red	Holatron cue 1 command being broadcast on channel 1, code 0, once every 2 seconds
Rapid flashing	Red	Holatron cue 1 command being broadcast on channel 12, code 0, continuously

1.4 THE MODE SELECTOR SWITCH.

This 16 position miniature rotary switch, located on top of the internal circuit board as shown in the cover photo, is used to select one of 16 possible repeater operating modes. It can be set to positions 0 – 9 or A – F by rotation with a small screwdriver. The mode selected by each switch position is shown in the following table:

Repeater Mode Selection Table

Switch Position	Repeater Mode
-----	-----
0	Repeat all Holatron commands.
1	Repeat only channel 1 Holatron commands.
2	Repeat only channel 2 Holatron commands.
3	Repeat only channel 3 Holatron commands.
4	Repeat only channel 4 Holatron commands.
5	Repeat only channel 5 Holatron commands.
6	Repeat only channel 6 Holatron commands.
7	Repeat only channel 7 Holatron commands.
8	Repeat only channel 8 Holatron commands.
9	Repeat only channel 9 Holatron commands.
A	Repeat only channel 10 Holatron commands.
B	Repeat only channel 11 Holatron commands.
C	Repeat only channel 12 Holatron commands.
D	Repeat all Holatron commands on channel 1, code 0.
E	Transmit channel 1, code 0, cue 1 command at 0.50 Hz.
F	Transmit channel 12, code 0, cue 1 command at 6.22 Hz.

NOTE: Positions “E” and “F” have been disabled in order to comply with FCC and IC requirements.

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 receiver 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 18th 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.**

This repeater performs the same error checking that occurs in all Holatron receivers, and it does not retransmit any commands that are not error free.

3.0 SPECIFICATIONS.

Parameter	Minimum	Typical	Maximum
Carrier Frequency, MHz.	417.96	418.02	418.08
Input range (line-of-sight from standard Holatron xmtrs)			½ mile
Output range (line-of-sight to standard Holatron rcvrs)			½ mile
Delay from end of rcvd packet to start of packet retransmission)			1 msec
Supply Voltage	5 VDC	6 VDC	14 VDC
Battery current (standby)		23 mA	
Battery current (xmting)		26 mA	

4.0 OPERATION AND MAINTENANCE.

This section describes the recommended operating procedure and maintenance for the smart repeater.

4.1 OPERATION.

- 4.1.1 Set the Mode Selector Switch to the desired position from the table in section 1.4.
- 4.1.2 Turn on the Power switch.
- 4.1.3 Verify adequate battery level by the flashing pattern as described in the table in section 1.3. Replace the batteries if fewer than 2 flashes per burst are observed.
- 4.1.4 **Make sure no receivers in the vicinity are armed and connected to devices to be fired**, and then verify that an orange rapid flash occurs on the status indicator when a transmitter on the selected channel is actuated. A rapid green flash indicates that the wrong channel is selected.
- 4.1.5 If a rapid orange flash was observed in the previous step, the repeater is now operational. Close and latch the lid, and place the repeater box in its desired location. It can be placed on the ground, but the higher it is and the farther from conductive objects it is, the more effective it will be. It should also be oriented with the antenna vertical for maximum range. Suspending it from a point above the reach of spectators by a cord tied to its handle has the dual advantage of enhancing range and preventing tampering.

4.1.6 Receivers may now be turned on and armed.

4.1.7 When finished with the system, **be sure to remember to turn off the repeater Power Switch** to stop further drain of its batteries. If the repeater will be stored for a prolonged period of time (6 months), remove the batteries to avoid damage to the electronics from possible battery leakage.

4.2 MAINTENANCE.

Since there are no calibration or tuning adjustments, the only maintenance required is periodic replacement of the batteries and checking to make sure the antenna is tight. The exterior of the box, which is completely sealed, may be safely cleaned by wiping with a damp cloth. It may be operated out in heavy rain and dust, but it should never be immersed in water.

If further information or service is required, contact:

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