

EXHIBIT A

[FCC Ref. 2.1033(b)(5)]

"Installation and Operating Instructions  
Furnished to the User"



WATERLOO CONTROLS INC.

**Operators Manual**  
**Industrial Wireless Transceiver**  
**Model T0111**

**Manual #M-T0111-01**

FCC ID: P55-T0111  
Marstech Report No. 21458D  
EXHIBIT A(1)

111 Golf Course Rd.  
Conestogo, ON  
CANADA N0B 1N0  
Phone: 519 664-1485  
Email: [sales@waterloo-controls.com](mailto:sales@waterloo-controls.com)

## **Copyright notice**

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## **Patent notice**

Elements of the product are Patent Pending.

## **Limitation of Liability**



The T0111 Transceiver is not user serviceable. Modifying the controller or wiring could result in circuit damage or non-controllable actuators. Modifying this product voids the manufacturer's warranty, the certification with FCC and Industry Canada and clears Waterloo Controls of any liability caused by damage or injury.

Operation is subject to the following 2 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. The receiver has an algorithm that if the undesirable interference can only cause the outputs to go to a neutral state and the controller output relay will open to assure no unwanted movements.

The term "IC" before the radio certification number only signifies that Industry Canada technical specifications were met.

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## **General Operational Description**

The transceiver is designed and registered to operate with receiver module R0111. The transceiver and receiver comply with part 15 of the FCC rules in the USA, and RSS-210 of Industry Canada requirements in Canada. The transceiver is designed as an intentional radiator transmitting digital information. The transceiver is intended to be used in non-residential areas.

The user of this device does not require a license since the product follows the regulations as specified above. The user may not change or modify any components or circuitry associated with the transmitter or receiver including the antenna.

The wireless controller operates with an FM modulated carrier. The carrier frequency operates between 903.4 and 921.4 MHz. The receiver synchronizes to the transceiver's frequency after approximately 0.5 seconds of starting the transceiver (note the receiver must be powered up before the transceiver).

At power-up, the transceiver initially goes into receive mode and checks each frequency channel. The frequency with the least amount of detected noise is chosen as the transmitting channel and the transceiver turns off the receiver and starts transmitting data. The receiver will not start again until the power to the transceiver is cycled.

Digital information is transmitted between the transceiver and receiver 67 times per second. The last digital byte of each packet is a checksum. If the checksum transmitted does not match the checksum calculated in the receiver, it is assumed that the packet information is not valid. If eight consecutive checksum failures are received, the outputs are disabled. Similarly, if there is no information received for an equivalent of eight consecutive required packets, outputs will be disabled. Each transceiver and receiver has an internal identification code as part of its transmission and reception information. This identification will assure that an identical transceiver will not assume control of the receiver. The receiver tests each transmission packet for identification and transmission errors to assure that the packet information is correct for use.

### **Transceiver Module:**

The transceiver module transmits two types of data: analog and digital. Each analog input is represented as 8 bit data and the digital data is a single bit per data input.

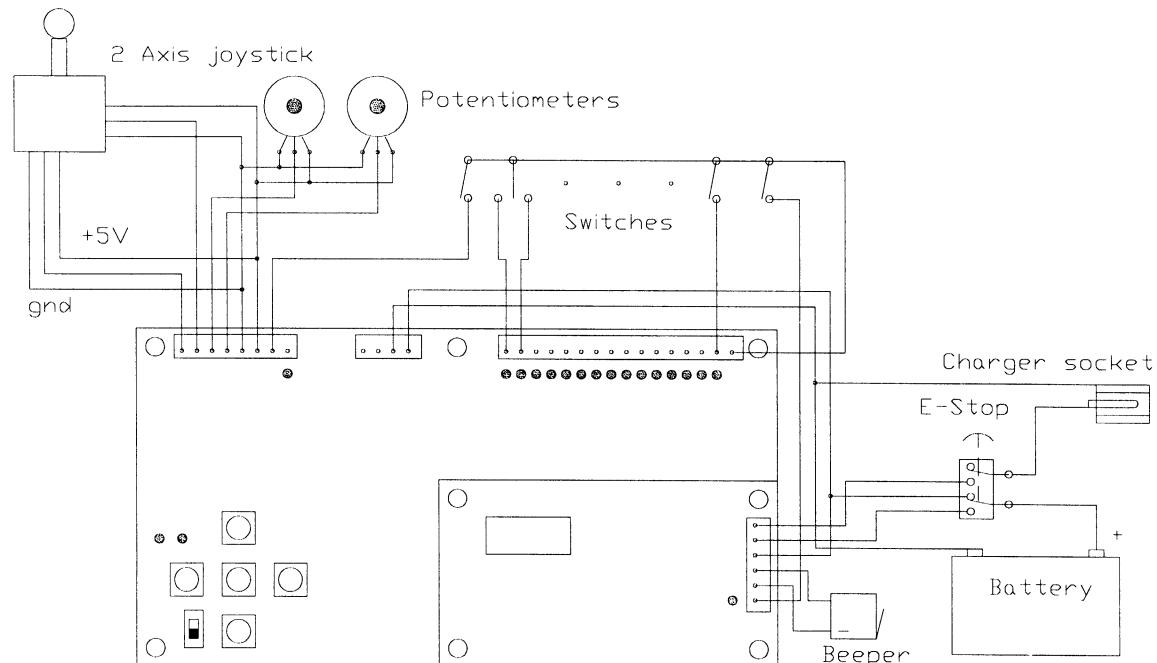
The analog data is provided to the transceiver board from joysticks and/or potentiometers. The supply voltage for the joystick and potentiometers comes from the transceiver board. The voltage of the analog supply is 5 volts and is protected from connections to high voltage and short circuits. If this supply voltage is pulled up or down as a result of faulty wiring, the transceiver will beep and flash an LED while the output signal to the receiver will be a neutral value. The beeping will have a fixed number of beeps followed by a pause to assist in troubleshooting. The joystick's analog output is

mechanically prevented from going over 4.75 and under 0.25 volts. The transmitter also monitors for voltages above and below this value and will beep and flash these fault codes. At powering up of the transceiver, the controller looks at the voltage of all analog inputs and expects the voltage to be a value that will not start motion of the intended actuator. If this voltage is not correct, an error code will beep. This error is cleared by adjusting the position of the joystick and/or pots to the position at which the actuator will be in their neutral position (see transceiver calibration).

The digital inputs come from switches. The circuit board sinks the current from the switches and indicates a closed switch by turning on an LED for each switch circuit that is closed. At power up, all digital inputs that are spring return to off (momentary on) are tested to verify that the digital input is off. If a switch that should be off is on, an error code is beeped out.

A rechargeable battery powers the transceiver. The battery is charged with an adapter that is plugged into the vehicle cigarette lighter and into the charger jack in the transceiver housing. To begin charging, the transceiver must be turned off with the e-stop switch, and then plugged into the vehicle. The transceiver cannot be operated while it is being charged.

## Transceiver Wiring Diagram



## **Calibration**

The analog input range and center position of the transceiver controller can be calibrated. This calibration allows the user the ability of changing the joystick stroke or the potentiometer rotation required to provide the maximum output for the joystick and potentiometer. The calibration from the factory will always have the calibration to provide maximum output from the transceiver at maximum stroke.

The analog output voltage or PWM output can also be adjusted with the calibration switches on the receiver module. The output calibration can lower the output voltage or PWM percentage from the maximum. The calibration from the factory will be setup to provide maximum output voltage or PWM to the valves or external controller at full stroke of the transceiver potentiometer or joystick

Since customers require different functionality for their analog inputs, a calibration routine can be provided by contacting the sales representative.

## **Battery Charging**

The battery in the transceiver is charged inside the transceiver. To charge, simply turn off the transceiver with the estop switch, and plug in the supplied cigarette lighter adapter into the power outlet in your vehicle and push the plug end of the adapter into the receptacle in the transceiver.

The battery supplied with the transceiver is a “Nickel Metal Hydride” rechargeable battery. The battery has an operating temperature range of -10°C to 40°C (14°F to 100°F). The battery should be charged between the temperature range of 0°C and 40°C (32°F and 100°F). If operating temperature conditions are outside of these limits, battery life will be reduced. It is recommended that the transceiver be placed in the vehicle cab or inside a heated building if the temperatures are below freezing so the batteries will not be damaged.

When the battery voltage drops to a point where charging should be considered, the transceiver will produce short beeping sounds, and the LED on the panel will have short light flashes. Once this flashing and beeping begins, the running time from the batteries will be less than 1 hour. It is recommended that batteries are not recharged until the low battery warning is noticed to increase the battery life. If the battery is discharged to a level below 6.5 volts, the transceiver will stop communication to the receiver. If the transceiver is left on and the battery discharges lower than 6.5 volts, the battery will be damaged. The transceiver has an alarm system built in so that there will be a continuous beeping and the panel LED will remain on if the transceiver is left on and there is no movement with any switch or pot or joystick for a period in excess of 6 minutes.

The transceiver has a built in smart charging system that will not over charge the batteries. Full charge from a low battery warning will take approximately 2 hrs. Battery

charging will not occur if the estop is out. While the battery is being charged, the transceiver cannot operate with the receiver.

## **Trouble shooting**

The transceiver is supplied fully wired and ready to operate. The transceiver has an LED on the front panel and an internal beeper to assist in fault detection by beeping and flashing out the code for a detected failure mode.

If the transceiver on power-up does not provide any error code, and the receiver does not respond at all, please follow this sequence:

1. Turn off the transceiver and place the joystick out of position forcing a joystick out of center fault.
  - a. If the transceiver does not beep or flash, this could mean either the battery voltage to the transceiver is too low, or the transceiver is in programming mode.
    - i. Open the cover of the transceiver and verify that the slide switch is switched toward the outside of the circuit board.
    - ii. With a voltmeter, check the voltage across the red and black wire terminations at the circuit board's 4 pin connector with the estop on. This voltage must be above 6.5 volts. If this voltage is below 6.5 but above 4 volts, recharging may allow the battery to recover. If the voltage is below 4 volts, the battery will need to be replaced. If the voltage is above 6.5 volts, there could be circuit problems and please call for service.
  - b. If the transceiver does beep but there is no output from the receiver, please check the following:
    - i. Identification code on the transceiver and receiver must match. Check that the last 2 digits on the circuit board serial number of the transceiver and receiver are identical. If they do not, you have the incorrect transceiver for the receiver.
    - ii. Check that the receiver is powered up (see receiver operating manual).
    - iii. There could be too much detuning material between the transceiver and receiver. Try and operate within 100 feet (30 meters) of the receiver and avoid having large objects between the transceiver and receiver.

If the receiver causes the vehicle to stop its functions after functions have begun without beeping or flashing warnings, the cause is likely that there is too much detuning material between the transceiver and receiver. Try and operate within 100 feet (30 meters) of the receiver and avoid having large objects between the transceiver and receiver.

If there is a digital or analogue output that does not function but there are other functions, please follow this sequence:

Note: be sure that the disable switches on the joysticks or potentiometers are not on:

1. Turn off the power to the receiver and open the transceiver cover. Switch the function on that was not responding. Turning this switch on should turn on an LED near the plug connection for this switch. In the case of an analog input, switch the disable switch and an LED should turn on and off as the switch turns on.
  - a. If the LED does not turn on, there is a problem with the switch and/or wire between the switch and connector. Please call for replacement components.
2. If the LED does turn on with the switch, then put the cover back on the transceiver, and remove the cover from the receiver. Start the receiver in the normal way. When all switches are in the off position on the transceiver, all LEDs should be off in the receiver. Switching the function on the transceiver should turn the LED on in the receiver.
  - a. If the LED is always on, there could be a harness short to this solenoid. Disconnect the wire from the connector associated with the LED.
    - i. If the LED goes out, there is a connection between the solenoid and the battery + voltage.
    - ii. If the LED stays on, there is a problem with the circuit and you should call for service.
  - b. If the LED does not come on or stay on when the switch on the transceiver is closed, there could be a short across the solenoid or between the solenoid and ground. Disconnect the wire associated with the LED and retry the function.
    - i. If the LED comes on and stays on as the switch is on, check for wiring shorts associated with this solenoid.
    - ii. If the LED still does not come on, there is a problem with the circuit and you should call for service.

The following chart shows the fault code as flashed or beeped out. To count the code, start counting after the pause in flash and count each flash until the next pause. This code is repeated until the cause of the fault is corrected.

<b>Flash Name #</b>	<b>What causes this</b>	<b>Output results</b>	<b>Fault Output duration</b>
1	Transmit box Vcc Hi	Pot bias wire shorted to B+ source	All analog outputs While fault persists 1/2 B+
2	Transmit box Vcc Low	Pot bias wire shorted to B- source	All analog outputs While fault persists 1/2 B+
3	Transmit box B+ Hi	Battery voltage too high	All analog outputs While fault persists 1/2 B+
4	Transmit box B+ Low	Battery voltage too low	All analog outputs While fault persists 1/2 B+
5	Joystick Swing input Hi	Wiper of joystick greater than 4.5 volts	All analog outputs Function restarts when output signal returns to zero 1/2 B+
6	Joystick Swing input Low	Wiper of joystick less than 0.5 volts	All analog outputs Function restarts when output signal returns to zero 1/2 B+
7	Joystick tilt input Hi	Wiper of joystick greater than 4.5 volts	All analog outputs Function restarts when output signal returns to zero 1/2 B+
8	Joystick tilt input	Wiper of joystick greater than	All analog outputs Function restarts when

9	Low Switch stuck	0.5 volts Switch output not in the center at turn on	1/2 B+ All analog outputs Latched fault, must restart 1/2 B+, all digitals with no fault set to 0	output signal returns to zero
18	Thrower belt not zeroed	Thrower pot must produce 0 speed at start up	Thrower and conveyor belts 1/2 B+	Until a 0 command received by receiver after start-up
19	Conveyor belt not zeroed	Conveyor pot must produce 0 speed at start up	Thrower and conveyor belts 1/2 B+	Until a 0 command received by receiver after start-up
20	Joystick zero	Joystick must zero on x and y at start up	Rotate and tilt at 1/2 B+	Until a 0 command received by receiver after start-up