

## RRC2L Quick Start Guide

### Overview

Like the racing Greyhound, the RRC2L embodies the same collection of traits that exemplify this amazing breed. The RRC2L unit is ready to fly DD (dual deployment) duties as it comes, right out of the box, providing a drogue event at apogee and a main event at 500 ft AGL. Changing this default setting is covered in the *Pushbutton Programming* section.

At apogee (highest point of the rocket flight) the RRC2L will fire a "drogue" charge to separate the rocket airframe (if drogueless) and/or deploy a small drogue chute to stabilize the airframe components during their free fall. Then at 500 ft. it will fire a "main" charge to deploy your main parachute.

The RRC2L is a "barometric" based altimeter -- it needs to sample air to take its readings and function correctly. It must be solidly mounted in an avionics bay with vent holes in the bay to sample air pressure as the rocket travels up (ascent) and down (descent). The RRC2L has built-in mach immunity. Regardless of how fast your rocket is flying, you no longer need to be concerned with setting a mach delay. This ensures no issues during your flight if you transition through mach velocities..

The RRC2L will "beep" out continuity before flight, telling you all connections are GO for flight; and upon landing will "beep" out your max altitude. There is also an LED that blinks in conjunction with the beeps if hearing is a problem. In addition, a very comprehensive collection of flight performance data items (along with settings and diagnostics) can also be viewed using our "plug in" LCD Terminal. Please refer to the *LCD Settings* section herein and the *RRC2L User Manual*.

The RRC2L provides many enhancements over the original RRC2+ by providing a subset of recovery and flight controls inherited from the RRC3. These operations are programmed using a new, 4th deployment mode that utilizes the MAIN Event output for staging/separation controls and other specialized applications while providing a drogue event for recovery.

### Handling Precautions

For the best user experience, please follow these guidelines when handling and using your RRC2L altimeter:

- Always handle the RRC2L in a static-free, grounded environment
- Never touch/handle the RRC2L when it is armed and connected to live pyrotechnic charges
- Always allow the RRC2L to adjust to ambient temperature conditions prior to arming and flying
- Always prepare your rocket and recovery system components with the RRC2L powered off
- Never cycle the RRC2L power switch off, then immediately back on (allow at least 10 seconds).
- Never fly the RRC2L with the LCD connected to the altimeter.

## Mounting the RRC2L

The RRC2L needs to be mounted solidly on a "sled," or plate made of plywood, fiberglass, or other rigid material. Mounting is accomplished by utilizing standard 4-40 size machine screws and nuts. Mounting hardware can be found on the Missile Works website or big box stores like Lowes, Home Depot, Ace Hardware, etc.

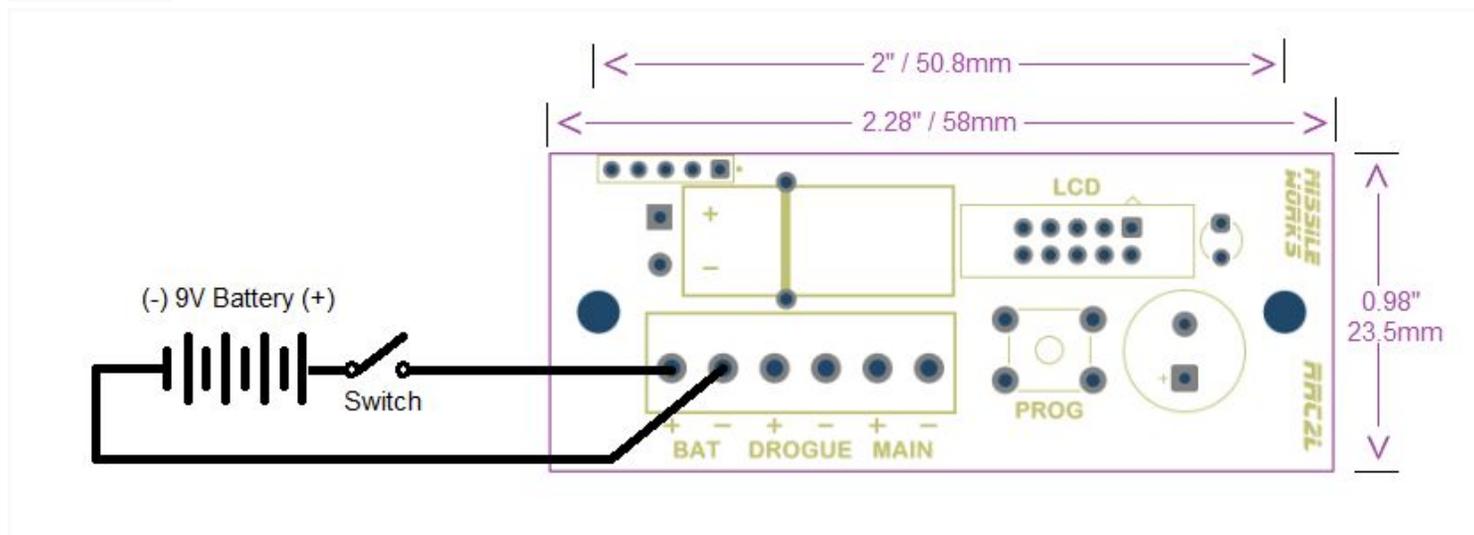
The RRC2L can be mounted in any direction on the sled. There is no forward or aft orientation. It may also be mounted on one of the bulk plates in the avionics bay. DO NOT USE VELCRO to mount the unit (due to static discharge potential).

The RRC2L should be mounted above the sled a minimum of 1/8" on standoffs or insulated washers. The barometric sensor mounted on the bottom of the altimeter has tiny holes in it to sample air. They must NOT be blocked by mounting too tight on the sled. If you can slip a credit card between the bottom of the RRC2L and sled, you're good to go!

## Batteries

The RRC2L is designed to be powered by a standard 9-volt alkaline battery. You can use any battery within 3.7V to 10V, but additional considerations should be followed when using non-alkaline battery types. Batteries must be mounted solidly to the sled, usually via a battery box (available on the Missile Works website) or securely zip tied to the sled. If using a battery clip it is advisable to use several wraps of electrical tape around the battery and clip, before securing it to the sled. Always check the battery voltage before installing & before each flight as even new batteries can be defective with sub-par voltage.

## Connections



All the RRC2L terminals are clearly labeled:

- |                |   |
|----------------|---|
| BAT+ and BAT - | Connect power from your battery and power switch here                         |
| DROGUE         | Low current e-match for first charge that fires (apogee)                      |
| MAIN           | Low current e-match for second charge (main parachute or specialized control) |

Connections on the altimeter are by means of screw terminals blocks which raise and lower a tiny set of vice jaws. Strip your wire ends NO more than 1/4". Place the bare wire end into the jaws and snug down the screw. Give a light tug on the wire.

**Congratulations!** If your wire remains in place, you have just averted the number 1 failure with altimeters and electronic deployment -- **loose wiring**. Using the "pull" test on EVERY connection you make will assure successful and safe flights.

Be SURE to connect the positive [ + ] on your battery to the terminal screw on the altimeter marked BAT+ . Then do the same for the [ - ] negative terminal screw. DO NOT REVERSE THE POLARITY!

The RRC2L does have built-in polarity protection to prevent damage to components should you "accidentally" connect the battery in backwards. Carelessness, "Go Fever", loose wiring and reverse polarity are the most common problems with fliers causing damage to their units. Take your time and don't be one of them.

## Vent Holes

Vent holes in avionics bay allow the altimeter to sample air pressure. Here are typical some 3-hole example sizes:

- A. 38 mm by 6 in.      3 x 1/16" holes
- B. 54 mm by 7 in.      3 x 1/8" holes
- C. 3 in. by 9 in.      3 x 5/32" holes
- D. 4 in. by 12 in.      3 x 3/16" holes
- E. 6 in. by 18 in.      3 x 1/4"holes

Make sure when drilling holes they are clean and clear from fuzz and debris for smooth, clear airflow. Locate your vent holes equally spaced around the avionics bay in a single circumference. If you want more information about proper venting sizes, refer to the complete RRC2L User Manual (on the downloads page @ missileworks.com)

## Reading the Beeps/Blinks

When you first power up the RRC2L, it will beep an "init tone" 5 seconds. After a short pause, the RRC2L will beep the last altitude flown on its previous flight (this operation and others can be modified by using the LCDT display). The RRC2L then starts a **POST (Power On Self Test)**. If a fault is detected during the POST, the RRC2L will beep out a fault code (see the POST Mode Section), otherwise it beeps continuity readiness pre-launch, and after landing it will beep out the peak altitude.

On the pad you will have the following beeps/blinks for continuity every 5 seconds:

- Drogue only              1 beep repeating every 5 seconds
- Main only                2 beeps repeating every 5 seconds
- Drogue and Main        3 beeps repeating every 5 seconds (for Dual Deploy)
- No charges              1 Long beep (ride along only, and nothing hooked up)

***After 5 minutes of beeping continuity, the RRC2L will switch into power saving mode, conserving your battery for flight operations. You will hear 1 short beep every 15 seconds during power saving mode as it waits for launch. (Note: this operation can also be modified via the LCDT display)***

After flight and upon landing, the RRC2L will beep/blink your maximum altitude (Example: 2650 ft.):

- 2 beep-beep [pause]
- 6 beep-beep-beep-beep-beep-beep [pause]
- 5 beep-beep-beep-beep-beep [pause]
- 0 long-beep [pause]
- low buzz [long pause / beeping complete] (NOTE: The RRC2L repeats this sequence until you turn power off).

## POST Mode Fault Codes (Power On Self Test)

Codes are preceded by a very distinct warning tone (7 very quick low beeps), followed by the beeping/flashing of the fault. ***DO NOT FLY THE RRC2L until the fault or warning is resolved and corrected.***

### **Code    Fault**

- 1      *User performed factory settings default (push and hold PROG for 5 seconds at power up)*
- 2      *LCD attached and the SWITCH LINE is active or shorted*
- 3      *No reply from MS5607 Prom Read Command*
- 4      *CRC mismatch from MS5607 Prom Reads*
- 5      *Barometric pressure Fault / Pressure < 10 mbar or > 1200 mbar*
- 6      *Temperature Fault / Temperature < -40 deg. C or > 85 deg. C*
- 7      *Battery level <= Low lockout level*
- 8      *Pre-arming baro conditions unstable*

## Ejection Charges and E-matches

The RRC2L is designed to be used with low-current electric matches. These include Daveyfire, Oxral, MTEK, JTEK, or low current motor igniters like the Quest Q2G2. Another common mistake made with altimeters and electronic deployment is crossing up the drogue and main connections. Always double check your wiring to verify the drogue and main connections.

## Final Assembly Testing

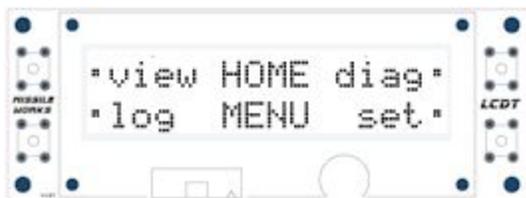
Once you've got your ejection charges ematches connected to the altimeter (pre black powder loading) and your av-bay is assembled, it's always a wise idea to "pre-test" for continuity and avoid any surprises on the pad when the rocket is assembled and launch ready. Be sure that prior to performing this test that you're safely clear of people, vehicles, or other flammable materials. Safety glasses and other personal protection are also recommended. Be sure the charges are facing away from you and others, and then power up the altimeter to assure everything is operating as you intend.

## Pushbutton Programming

The RRC2L "PROG" pushbutton allows you to set the elevation for your main parachute deployment altitude in 100' increments from a minimum of 300' AGL up to a maximum of 3000' AGL. To start the programming operation, tap the pushbutton anytime during the initial 5-second beep. The RRC2L will then "beep out" the currently programmed AGL setting in 100' increments (a default of 5). After it completes "beeping" this value, it emits a low "completion" tone, then pauses for 5 seconds, and then starts over. Start tapping the button anytime during that 5 second pause to "tap in" the new desired main elevation you wish to store in the altimeter's non-volatile memory. Once you complete "tapping in" the new setting, the altimeter will beep an acknowledgement of its memory update with a short, higher pitched "double beep". Programming is now complete and you can power down to prep your rocket for flight.

## LCD Settings and Operations

The LCD interface can be used to review flight data and settings, adjust settings, and to perform diagnostics on your altimeter. It's a handy way to interact with the altimeter at the field. Before connecting the LCD module, be sure your altimeter is powered *off*. After connecting the LCD, apply power to the altimeter, at which point you should hear three quick beeps from the piezo, and an animated startup screen displays on the LCD. If the display is difficult to read, you can adjust contrast by turning the knob to the right of the cable connector on the LCD unit (the LCD is *not* backlit, and requires external light).



The LCD navigation is based around the four "1-touch" buttons on each side of the display. The center of the display shows the subject/context, and next to each button symbol is an icon or word, describing the button's action. While the LCD Navigation and operation are intended to be intuitive and self-explanatory, a more detailed description can be found in *RRC2L User Manual* on the Missile Works website (on our Downloads page).

## Base Settings Description (LCDT required / SET menu)

**Arm AGL'**      ***Range: 100 ft. to 300 ft. / Default: 300 / 10' increments***

Establishes the minimum AGL altitude (in feet) required for the altimeter to arm itself for flight operations.

**Main AGL'**      ***Range: 300 ft. to 3000 ft. / Default: 500 / 100' increments***

Defines the AGL altitude (in feet) at which the main deployment event is activated during the descent phase.

**Deploy Mode**    ***Range: 1 to 4 / Default: 1***

Defines how/when the altimeter activates the drogue and main deployment events during flight:

- |                                |  |
|--------------------------------|--|
| 1 = <i>Dual Deploy Primary</i> | Drogue @ Apogee / Main @ Main Deployment Altitude                          |
| 2 = <i>Dual Deploy Backup</i>  | Drogue @ Apogee + Drogue Delay / Main @ Deployment Altitude                |
| 3 = <i>Apogee Only</i>         | Drogue @ Apogee / Main @ Apogee + 1 sec                                    |
| 4 = <i>Main OCS Mode</i>       | Drogue @ Apogee / Main as set by the MOCS controls (see RRC2L User Manual) |

**Audio Setup**    ***Range: 1 to 32 / Default: 4***

Controls how the onboard piezo/beeper is utilized throughout flight and specified in a binary-based value as follows:

- |  |                     |
|--|---------------------|
| Beep Battery Voltage (X.X volts) Pre-Launch            | Setting Value += 1  |
| Beep Deployment Mode and Main Altitude Pre-Launch      | Setting Value += 2  |
| Enable Pad Power Saver Mode (disable continuity beeps) | Setting Value += 4  |
| Beep Time to Apogee (seconds) Post-Flight              | Setting Value += 16 |
| Disable all Audio Options                              | Setting Value = 32  |

### Units Setup     **Range: 1 to 4 / Default: 1**

Determines how the RRC2L will report all the flight performance values (post flight audio and LCD terminal)

- 1 = Imperial Units (feet, deg F) / Velocity (feet per second / fps)
- 2 = Metric Units (meters, deg C) / Velocity (Kilometers per hour / KPH)
- 3 = Imperial Units (feet, deg F) / Velocity (Miles per hour /MPH)
- 4 = Metric Units (meters, deg C) / Velocity (meters per second /mps)

### Low Volt Lock     **Range: 2 to 9 / Default: 2**

This setting validates the RRC2L battery voltage is above the minimum voltage level specified (2 = lockout disable)

### Piezo Tone     **Range: 2 to 12 / Default: 12**

Determines the frequency of the piezo “beeper”. The lowest setting (2) = 6.25 KHz / the highest setting (12) =1..04 KHz.

### Drog Delay     **Range: 0 to 9 / Default: 0**

IGNORED unless using the *Dual Deploy Backup Deployment Mode*, and delays the drogue event (in seconds).

NOTE: You can reset the settings of the RRC2L back to these defaults using the following procedure:

- Push and Hold the programming pushbutton.
- Apply power to the RRC2L while the pushbutton is pressed (the LED will flicker).
- Continue holding down the pushbutton for approximately 5 seconds.
- Release the pushbutton when it beeps a POST code of 1.
- Shut the RRC2L off.

Alternatively from the SET MENU, choose the **.defs** (Default) option and make the **.sets** choice, then **DEFAULT ALL**

## **Advanced Settings / Main OCS (Output Control Sequence) Mode**

As mentioned in the Overview section, the RRC2L provides a subset of recovery and flight controls inherited from the RRC3. This collection of control settings is accessed via the “**MOCS**” (**M**ain **O**utput **C**ontrol **S**equence) section of the Settings Menu. These settings are intended for Advanced Users and thus, the scope of these controls are outside the context of this Quick Start Guide. A more detailed description can be found in *RRC2L User Manual* on the Missile Works website (on our Downloads page).

## **Log Data and Flight Performance**

Pressing the Log (lower left) button from the Home Menu allows you to review data from the Flight Log (ie. *the last flight recorded*). Items are displayed two per page, as shown below:



There are a total of 8 pages of data displayed, with the first 5 providing data for the latest flight, and the last 2 providing cumulative statistics for the altimeter. The items displayed, in order of display are:

MaxAlt	Apogee for the latest flight
MaxVEL	Maximum velocity for the latest flight
Pad	Number of seconds between power on and liftoff
Apogee	Number of seconds between liftoff and apogee
Chute	Number of seconds between apogee and the rocket reaching the ground
Power On	Altimeter bay temperature at power on
Launch	Altimeter bay temperature at liftoff
Low	Lowest altimeter bay temperature during last flight
Drogue	Average Velocity during drogue descent

Main	Average Velocity during main descent
Flights	Total number of flights on the RRC2L
Time	Total flight time on the RRC2L
Altitude Total	Total vertical distance up the RRC2L has travelled
Date	Born on Date of your RRC2L

Note that each item has associated “units” as established by the **Units** setting. Some items also have a superscripted “icon” to assist in interpretation:

<i>Hourglass</i>	All “Time” related items
<i>Degrees</i>	All “Temperature” related items
<i>Sigma</i>	All “Total” related items

NOTE: You can reset the cumulative Flight Log statistics of the RRC2L back to zero using the following procedure:  
From the SET MENU, choose the **·defs** (Default) option and make the **·stat** choice, then DEFAULT ALL

### Operating Tips for Success

- Always pre-test your altimeter as COMPLETELY as possible prior to every flight. This includes a test of the inputs, outputs, and baro system.
- Always pre-test your batteries before each flight and ensure they have adequate power capacity for the anticipated worst case flight profile, including unplanned “on-the-pad” waiting time.
- Always pre-measure your deployment charge ematch initiators for a nominal resistance and verify they are not shorted.
- Proper port-sizing creates ideal equilibrium rates. Ensure that your porting is compliant with the recommended sizing. Improperly sized porting or other leaks in the electronics bay can create parasitic pressure effects, impacting recovery.

### Specifications

Microcontroller	16MHz 16-bit MSP430 Series mCU
Pressure/Temperature sensor	MSI MS5607 Pressure sensor with 24 bit $\Delta\Sigma$ ADC
Operational Range	40K MSL recommend (100K MSL capable)
Arming Mode	Barometric / 300’ AGL
Battery Voltage	3.5 volts to 10 volts
Continuity/Firing Current (@9V)	50 $\mu$ A / 3A for 1 second (Drogue & Main)

### Product Warranty

Missile Works Corporation has exercised reasonable care in the design and manufacture of this product and warrants the original purchaser that the RRC2L is free of defects and that it will operate at a satisfactory level of performance for a period of one year from the original date of purchase. If the system fails to operate as specified, then return the unit (or units) within the warranty period for repair or replacement (at our discretion). The system must be returned by the original purchaser, and be free of modification or any other physical damage which renders the system inoperable. Upon repair or replacement of the unit, Missile Works Corporation will return the unit postage-paid to the original purchaser.

### Product Disclaimer and Limit of Liability

Because the use and application of this equipment are beyond our control, the purchaser or user agrees to hold harmless Missile Works Corporation and their agents from any and all claims, demands, actions, debts, liabilities, judgments, costs, and attorney fees arising out of, claimed on account of, or in any manner predicated upon loss or damage to property of, or injuries to or the death of any and all persons arising out of the use this equipment. Due to the nature of electronic devices, and the application and environments for those devices, the possibility of failure can never be totally ruled out. It is the responsibility of the purchaser or user of this equipment to properly test and simulate the actual conditions under which the device is intended to be used to ensure the highest degree of reliability and success.