Battery Connections

The RRC²X is designed to be operated with a standard 9-volt alkaline battery. Always purchase and use premium alkaline batteries; 9-volt NiCad batteries may also be used – however, the voltage of this battery type can range from 7.2 to 8.4 volts. A higher voltage NiCad is more desirable, as 7.2 volts is on the very edge of operational acceptability. When your battery voltage is too low, the continuity circuit will fail to operate and will not report (beep) the status of the ejection charges. This is a good indication that it's time to change your battery. It can reliably operate using battery systems up to 12 volts.

IMPORTANT: Always load test your battery prior to flight to ensure adequate power for reliable operation and ignition of the ejection charges. Inadequate sizing of an external battery system will damage or cause the unit to malfunction. Always pre-test your external battery system design prior to launch.

To load test a 9 volt battery, you will require a DC multimeter capable of DC amp measurement with a 10 amp capability. A 9-volt battery can easily source in excess of 5 amps. Briefly connect the meter leads across the battery terminals to measure the DC current capacity. If the measurement is close to or drops below 2 amps, do not use the battery. Some batteries have built in testers, however it is still recommended that a meter be used for testing. Nominal load during operation is about 2.5 amps.

Mounting Considerations

The payload section or electronics bay used for the RRC²X must be a sealed chamber with a static pressure equalization port. The sealing of the chamber is necessary for several reasons:

- Isolation of the electronics from the ejection-charge heat, residue, and over-pressure
- Isolation from the aerodynamic pressure and vacuum effects on the rocket airframe during flight
- Provides uniform static pressure equalization to ambient flight conditions

IMPORTANT: Inadequate sealing of the payload section or electronics bay, or exposure of the electronics to ejection-charge heat, residue, or pressure will cause the RRC²X to malfunction.

Static Pressure Ports

Equally important as sealing the electronics bay or payload section is the proper location, sizing, quality, and quantity of static pressure ports. Always try to locate a static port on the airframe where it is not obstructed by any object that may cause turbulence upstream of the airflow over the port. Also try to locate the static port as far away as possible from the nose cone or body transition sections. The rule of thumb is a ¼” diameter hole for every 100 cubic inches of bay volume.

Bay Volume Calculations

The first step to sizing the static port hole is to compute volume... use the following formula:

Volume (cubic inches) = Bay Radius (inches) x Bay Radius (inches) x Bay Length (inches) x 3.14

With the known volume of the electronics bay or payload section, calculate the required nominal diameter for a single static port with the appropriate formula:

If volume <= 100 cubic inches, you can use this simple approximation for a vent hole: Single Port Diameter (inches) = Volume / 400

If volume > 100 cubic inches, use this formula to calculate vent hole diameter(s):

Single Vent Diameter = 2 * SQRT (Volume / 0.0004908 / 3.14)
Single Vent Area = ( Single Vent Diameter / 2 ) * ( Single Vent Diameter / 2 ) / 3.14

Multi Vent Diameter = 2 * SQRT ( ( Single Vent Area / # of holes ) / 3.14 )

Product Warranty

Missile Works Corporation has exercised reasonable care in the design and manufacture of this product and warrants the original purchaser that the RRC²X Rocket Recovery Controller is free of defects and that 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 of 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, judgements, 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, 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.

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User Manual and Instructions
Model RRC²X 25K/40K versions
Revision C

System Overview

The RRC²X Rocket Recovery Controller provides two stage barometrically controlled deployment of rocket recovery systems and equipment. Two-stage (or dual) deployment is preferable to single parachute or streamer recovery systems for high-power rocketry. Recovery of large, heavy rockets with a small parachute or streamer alone does not supply enough drag to safely recover the rocket without damage. An adequately sized parachute deployed at a high altitude may cause the rocket to drift out of the launch area, making recovery difficult if not impossible.

Two stage (or dual) deployment recovery systems either separate the rocket airframe into two sections or eject a small drogue parachute or streamer at apogee, allowing the rocket to descend at a rapid yet controlled rate. When the rocket descends to a predetermined altitude above its initial launch elevation, it then deploys the main parachute, allowing the rocket to make a safe landing.

Specifications

| Operational range | 25K/40K MSL |
| Dimensions | 1.30" W x 3.61" L |
| Arming mode | barometric |
| Minimum altitude for arming | 300 ft. AGL |
| Battery | Nominal Battery load 15mA |
| Weight | External 8-12 VDC |
| Firing Current | 0.91 oz. / 26 gm |
| | 1.25 amps @ 1 sec |

Handling Precautions

- These units are sensitive to damage from ESD (electro-static discharge) and should always be handled in a properly grounded environment. ESD damage is not covered under your warranty.
- Never directly handle the unit when it is armed and connected to live pyrotechnic charges as this may cause the premature detonation of the charges.
- Always allow the unit and the battery system to adjust to ambient temperature conditions prior to connecting, arming and flying.
- Avoid exposure of an armed unit to high intensity light (including direct sunlight), heat, cold, wind, or other extreme environmental conditions.

Operational Overview

Figure 1 depicts the general component layout of the RRC²X Rocket Recovery Controller. The unit is designed for several different modes of operation. Selection of these modes is made by the switches located on the circuit board.

Figure 1 - General component layout of the RRC²X

The switches are labeled 1 through 5 accordingly, switch 1 being the leftmost switch as illustrated in figure 1. The ON/OFF position is also labeled, with the ON position being UP, the OFF position being DOWN. The following table describes the switch functions and the corresponding modes of operation:
**Pre-launch mode**

After the 15-second power up and initialization delay, the unit goes into the pre-launch mode. The LED will flash at a slow 2-second rate, and the piezo beeper will indicate the continuation of the ejection charges as follows:

- Long Beep: No continuity on either channel
- 1 Short Beep: Continuity on channel 1
- 2 Short Beeps: Continuity on channel 2
- 3 Short Beeps: Continuity on channel 1 & 2

The unit also monitors the barometric sensor for a charge of 300 feet in elevation to determine the launch of the rocket. After this change, the unit transitions into mach delay mode (if selected) or apogee detection mode.

**Mach Delay Mode**

When either SW. 3 or SW. 4 is in the ON position, the unit will enter the mach delay mode. The LED flashes again at its fast rate of 5 times per second. There is no audible sound from the piezo beeper. After the expiration of the mach delay (if selected), the unit transitions into apogee detection mode.

**Apogee Detection Mode**

At this point, the RRCX has detected launch and is in flight. The LED continues to flash at its fast rate of 5 times per second. The piezo beeper will continue to flash at its fast rate of ½ second. During this mode the unit is sampling for apogee (indicated by an increase in pressure). When this pressure increase is detected, the unit transitions into deployment mode.

**Deployment mode**

Now that the unit has detected apogee, it will fire the channel 1 (J1) output. The LED will continue to flash at its fast rate of 5 times per second. There is no output from the piezo beeper. If the unit was set to operate in standard dual deployment mode, it will continue to sample barometric pressure until it reaches the designated main deployment elevation above the initial launch elevation before firing the channel 2 (J2) output. Otherwise the unit is operating in redundant apogee mode, and it will then fire the channel 2 output immediately following the channel 1 output. After the unit has fired both output channels, it transitions into report mode.

**Report mode**

After deployment of the recovery system, the unit will report the peak altitude it measured during flight. The LED will continue to flash at its fast rate of 5 times per second. The piezo beeper will continuously announce the peak altitude by beeping out the individual digits of the measurement. Depending on the peak altitude, the unit will announce 3, 4, or 5 digits. For example, let’s say the rocket flew to a peak altitude of 1230 feet. The unit would beep as follows:

Beep..pause..Beep..Beep..pause..Beep..Beep..Beep..pause..Beep..pause...Beep

**Test Mode Operation and Diagnostics**

The unit can also be placed into a test mode to verify the basic integrity of the unit, and also to ground test e-matches, igniters, ejection charges, or recovery system designs. To place the unit into a test mode, toggle either SW. #1 or SW. #2 during the power up and initialization period according to the test you’d like to run. Toggling SW. #1 will set the unit into input test mode. Toggling SW. #2 will set the unit into output test mode. The unit will continue to operate in the test mode selected until it is powered off.

**IMPORTANT:** After selecting a test mode, you must power off the unit prior to flight or additional testing.

**Input Test Mode**

After toggling SW. #1, the unit will enter the input test mode. This mode verifies the integrity of all the inputs to the microprocessor. Whenever an input is in the ON position, the unit will beep out a digit to indicate operational integrity of the input (see Table 2). A test mode scan reverts the inputs to their last stored value after 10 seconds of total delay. It is recommended to use the test mode to verify the inputs and how the inputs take priority over higher position switches and inputs.

**Test Mode beep indications**

Table 2 - Input Test mode beep indications

<table>
<thead>
<tr>
<th>Beeps</th>
<th>SW. #1 in the ON position</th>
<th>SW. #5 in the ON position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Beep</td>
<td>SW. #2 in the ON position</td>
<td>6 Beeps</td>
</tr>
<tr>
<td>2 Beeps</td>
<td>SW. #3 in the ON position</td>
<td>7 Beeps</td>
</tr>
<tr>
<td>3 Beeps</td>
<td>SW. #4 in the ON position</td>
<td>J1 Continuity</td>
</tr>
<tr>
<td>4 Beeps</td>
<td></td>
<td>J2 Continuity</td>
</tr>
</tbody>
</table>

**Output Test Mode**

After toggling SW. 2, the unit will enter the output test mode. This mode can be used to test the integrity of both outputs (J1 and J2) and also ground-test your pyrotechnic e-match, igniter, flashbulb, ejection charge, or ground test deployment of your entire recovery system. The test mode begins by beeping out the piezo beeper at a fast rate of 5 beeps per second. After 10 seconds of countdown, the unit will fire the J1 output. This is followed immediately by firing the J2 output (this functions identical to the deployment firing logic in the redundant apogee mode).

**IMPORTANT:** Always exercise caution when using live pyrotechnic charges in the output test mode.

Another useful accessory for testing the outputs are 12 volt DC panel lamps. The lamps will allow you to observe the proper operation of the outputs without the use of pyrotechnic devices.

**Barometric Limits Alarm**

The unit also features a barometric limit alarm. This alarm mode is easily identified by the continuous actuation of the piezo beeper. While the unit is in the pre-launch mode it tests the barometric sensor reading for basic integrity. If the reading is below 0” MSL or above 14000” MSL the alarm will sound. This extreme reading indicates a failed sensor (unless of course your attempting to launch from those base elevations, in which case you cannot do so).

**IMPORTANT:** Do not fly the unit if it activates the baro sensor alarm.