Public Missiles, Ltd.

Co-Pilot v2.0 Dual-Deployment Recovery Altimeter

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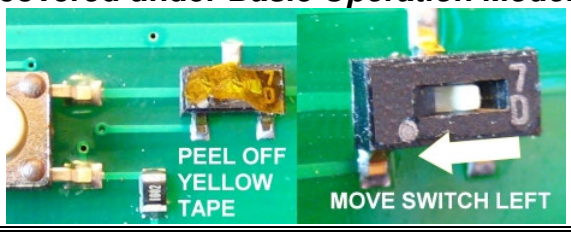
NOTE: Before installing a battery and using the Co-Pilot v2.0 for the first time, remove and discard the protective tape covering the Profile Switch. Slide the Profile Switch to the left, selecting Profile 1. The function of this switch is covered under *Basic Operation Mode.*



System Overview

The Public Missiles Ltd. Co-Pilot v2.0 altimeter was developed exclusively for PML by Missile Works Corp., and was designed specifically for PML's CPR3000 Recovery System (though it can be used in other applications as well, such as scratch-built deployment systems). The Co-Pilot v2.0 provides two-stage barometrically-controlled (pressure-sensing) deployment of rocket recovery systems and equipment. Using the Co-Pilot v2.0 altimeter and CPR3000 technology, a small drogue or streamer is deployed at apogee allowing for a fast but controlled descent. At a user-selectable lower altitude, the altimeter fires a second charge to deploy the main chute allowing for a soft landing. This system allows a high-altitude flight to be returned much closer to the launch area than if the main chute were deployed at apogee.

The Co-Pilot v2.0 is a very rugged and reliable unit in both design and construction. The Co-Pilot v2.0 uses a standard 9 volt alkaline battery, and has clearly-marked terminals for connecting the On/Off switch and the Drogue and Main deployment charges. The Co-Pilot v2.0 is also clearly labeled "Fore" (toward nosecone) and "Aft" (toward fins) to aid in proper mounting.

Specifications

Operational Range	0-40000 ft. MSL
Arming Mode	Barometric
Minimum Altitude for Arming	250 ft. AGL
Main Deployment Ranges	300 - 3000 ft. AGL, in 100 ft. increments
Altitude Reporting Accuracy	± 3%
Battery Power Range	9V / 7-10V
Nominal Battery Load	6-14 ma
Continuity Current	9 µa
Output Current (sinking)	5 A @ 0.5 sec.
Dimensions	1.35" W x 5.0" L x ~0.80" H
Weight	17 grams

MSL = Mean Sea Level; AGL = Above Ground Level; µa = microamps; ma = milliamps

Handling Precautions

— The Co-Pilot v2.0 altimeter should always be handled in a properly grounded environment. ESD (Electro-Static Discharge) damage is not covered under warranty.

— Never touch/handle the Co-Pilot v2.0 when it is powered ON and connected to live pyrotechnic charges as this may cause premature detonation of the charges.

— Always allow the Co-Pilot v2.0 to adjust to ambient temperature conditions prior to connecting, arming and flying.

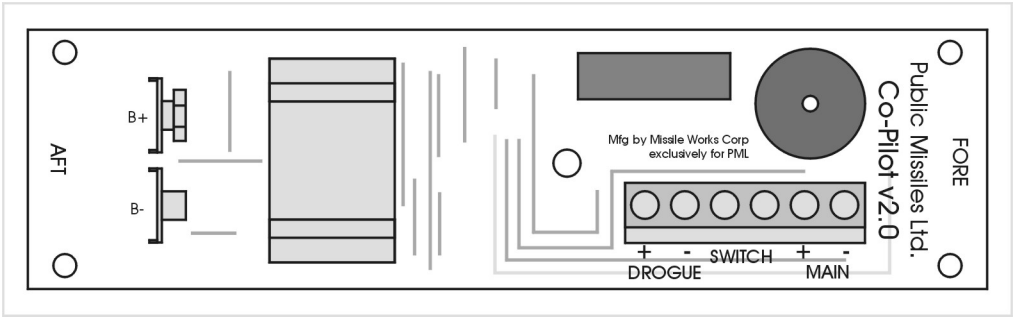
— Avoid exposure of a powered ON Co-Pilot v2.0 to high intensity light (including direct sunlight), heat, cold, wind, or other extreme environmental conditions.

— Always prepare your rocket and recovery system components with the Co-Pilot v2.0 powered OFF.

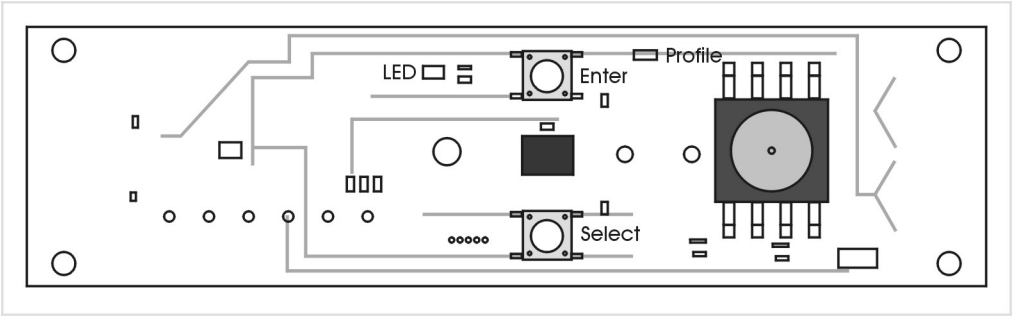
— Never cycle the power switch off, then immediately back on. Always allow the switch to remain OFF for at least 10 seconds prior to restoring power.

Overview

Figure 1 depicts the general component layout of the PML Co-Pilot v2.0. The Co-Pilot v2.0 is designed for several different modes of operation. All user input and output connections are made to the six terminals as shown. These terminals include: Switch (for an external power switch), Drogue (for external deployment charges or controls), and Main (for external deployment charges or controls). All terminals are marked on the board for reference.



FRONT



BACK

Figure 1 - Component Layout of the Co-Pilot v2.0

Flight and Recovery Operational Description

The Co-Pilot v2.0 has several distinct modes in its normal operation sequence. The piezoelectric beeper and the status LED indicator identify these modes of operation. These modes are discussed below in their order of occurrence in operation.

Power-Up Mode with Battery Indicator

When the switch connected to the Switch terminals of the Co-Pilot v2.0 is turned ON, the unit will produce a continuous 3-second chirp sound to indicate it has been turned ON. During this 3-second chirp period, the LED indicator on the back side of the circuit board (to the left of the Enter Switch) will flicker in one of three colors. The LED colors and the associated battery voltages are as follows:

GREEN (G)	**Battery voltage 8.5 or above**
YELLOW (Y)	**Battery voltage 7.5 to 8.5 volts**
RED (R)	**Battery voltage below 7.5**

In addition, the unit has an optional battery voltage "lockout" feature that is run during this mode (if enabled). When enabled, this lockout feature activates a continuous alarm tone and prevents flight operations when the battery voltage is at or below 6.5 volts. Information on how to enable/disable this mode is described under *Setpoint Menu Options*.

Pre-Launch Barometric Initialization Mode

After the Power-Up mode, the Co-Pilot v2.0 goes into the Pre-Launch mode. The LED will flash in **YELLOW** (actually both green and red together, which look somewhat like Yellow) while in this mode. This start-up delay allows stabilization of the electronics and establishes an initial launch site pressure level reading (which the Co-Pilot v2.0 then bases all other pressure changes on; the Co-Pilot v2.0 "zeroes" itself to the current pressure level of the launch site).

Battery/Setpoint Chirp Mode (Optional)

The Co-Pilot v2.0 has (2) optional start-up "chirping" options for on-the-pad "sanity checks" prior to launch.

- "**Battery Voltage" chirp feature:** When enabled, the battery voltage is chirped on the piezo beeper (and flashed in **YELLOW** on the LED) in volts and tenths of a volt.
- **"All Setpoints" chirp feature:** When enabled, ALL current setpoint values (discussed under *Setpoint Menu Options*) are chirped on the piezo beeper (and flashed in **YELLOW** on the LED) in setpoint order.

If neither of these options are enabled, this mode is skipped.

Launch Detect Mode

When all previous modes are complete, the unit transitions into Launch Detect mode. The piezo beeper and the **GREEN** LED indicate the continuity status of the Drogue and Main output terminals every 2 seconds as follows:

Long Beep/Flash	No continuity on Drogue or Main
1 Short Beep	Continuity on Drogue only
2 Short Beeps	Continuity on Main only
3 Short Beeps	Continuity on Drogue and Main

The unit also monitors the barometric sensor for a change of 250 feet in elevation to determine the launch of the rocket. After this change is sensed, the unit transitions into Mach Inhibit mode (if enabled) or Apogee Detection mode.

Mach Inhibit Mode (Optional)

For high-performance rocket flights approaching or exceeding the speed of sound (Mach), the Co-Pilot v2.0 can be configured to employ a time delay beginning just after lift-off is detected.

Mach Inhibit mode is used to prevent the Co-Pilot v2.0 from detecting atmospheric pressure fluctuations that occur during sonic-subsonic transitions during rocket boost. This is a Bernoulli-based effect and is most pronounced at motor burnout (typically the largest velocity delta of the rocket flight). These fluctuations can cause the Co-Pilot v2.0 to prematurely sense apogee, so Mach Inhibit Mode is used to delay running the apogee detection software until after the phase of flight where the fluctuations may occur. Simulation software such as RockSim or wRASP should be used to determine what portion of the flight might be in or near Mach such that a proper delay time can be chosen.

When Mach Inhibit mode is enabled, after launch detection the LED flashes **RED** once per second. The unit is still actively sampling barometric changes, but it will not run the apogee detection software during the Mach Inhibit period. After the expiration of the mach delay, the unit re-enables the software and goes into Apogee Detection mode.

Apogee Detect Mode

At this point, the rocket has detected launch and is in flight, and any mach delay time has expired. The LED will be solid **RED**. During this mode the Co-Pilot v2.0 is sampling for apogee, which is indicated by an increase in pressure as the rocket begins falling back to earth just after reaching apogee. When this pressure increase is detected, the Drogue and Main outputs *may* activate. Whether they activate or not is based upon the configuration of the Deployment Mode setpoint and the Drogue/Main Delay setpoints (each explained under *Setpoint Menu Options*).
NOTE: All flight data values are written to nonvolatile memory immediately after the Apogee event.

Main Detection Mode

After the unit has detected apogee, it will transition to Main Detection mode, indicated by a SOLID **YELLOW** LED. The unit will continue to sample barometric pressure during the descent phase of the flight until it reaches the designated main deployment elevation AGL. The Drogue and Main outputs *may* activate based upon the configuration of the Deployment Mode setpoint and the Drogue/Main Delay setpoints (each explained under *Setpoint Menu Options).*

Report Mode

After detection of the Main elevation, the unit will report the peak altitude it measured during flight. The piezo beeper and the **GREEN** LED will continuously report the peak altitude by chirping/flashing out the individual digits of the measurement. Depending on the peak altitude, the unit will chirp out (and flash) 3, 4, or 5 digits. For example, let's say the rocket flew to a peak altitude of 1302 feet. The Co-Pilot v2.0 would beep (and flash) as follows:

Beep (1)...pause
Beep, Beep, Beep (3)…pause
Beeeeeeeeeeep (0; a long beep means zero)… pause
Beep, Beep (2)…
then a short buzz indicating end of report, and then repeat the report

The altitude reporting repeats continuously until the Co-Pilot v2.0 is turned off.

Basic Operations

The Co-Pilot v2.0 provides many new and advanced features. These advanced features are truly *optional* and are not necessary to use the unit for traditional dual deployment purposes. For users that prefer simplicity in setup and use, Basic Operation provides an easy means to a simple "reach apogee, deploy the drogue, then deploy the main at XX altitude" flight.

Basic Operation Mode

For Basic Operation Mode, simply select the main deployment elevation of 500' AGL or 1000' AGL by the position of the Profile Select switch on the back side of the circuit board. The position of the switch is read at power-up time, so **be sure to set the switch BEFORE powering the Co-Pilot v2.0 on**.

- **Profile 1** (switch to the left): standard dual deployment operation with a 500' AGL Main event
- **Profile 2** (switch to the right): standard dual deployment operation with a 1000' AGL Main event

If you have used the Advanced Operations Mode and wish to return to Basic Operation Mode, simply reset all setpoints to Factory Defaults as described in *Setpoint Menu Options* in the Setpoint Menu section later in this manual.

Standard Two-Stage/CPR3000 Deployment

Standard two-stage CPR3000 flight and deployment is as follows:

- Initial launch, boost and coast phases of flight
- Apogee of flight detected, lower airframe separation and drogue chute or streamer deployed
- Rapid, controlled descent phase to pre-programmed main chute deployment level
- Nosecone/payload section separation, main parachute deployment and touchdown

For a standard CPR3000 flight, simply select either 500' or 1000' feet via the Profile Select Switch.

Single-Stage / Redundant Apogee Deployment

Though it is not used for PML CPR3000 System flights, the Co-Pilot v2.0 can operate in a redundant mode where both ejection charges are fired at apogee. This can be useful for a non-CPR-rocket flight to help ensure redundancy of main chute deployment. (If for some reason the Apogee charge does not fire or does not fully eject the parachute/streamer, the Main charge deployment can act as a backup.) Single-stage deployment operation is as follows:

- Initial launch, boost, and coast phases of flight
- Apogee of flight detected, Drogue output fires, nearly immediately followed by the Main output firing
- Main parachute/streamer deployed
- Slow descent and touchdown

As noted, this mode is NOT used for CPR3000 flights, but the information is provided here in case you choose to use your Co-Pilot v2.0 in a non-CPR rocket in which this mode may be useful. See *Deployment Mode* under *Setpoint Menu Options* elsewhere in this manual to see how to set up this mode.

Advanced Operations

Although the Co-Pilot v2.0 can be used in the Basic Operation Mode, it is much more capable with many new advanced operational functions and data recording features compared to the original Co-Pilot. These new functions and data are accessed by using the **SELECT** and **ENTER** pushbuttons in conjunction with the LED in a menu-driven user interface. User-programmable setpoints, historical flight data, and diagnostics are all accessible via this interactive operation.

The color and flash rate of the LED indicates what state/select point the Co-Pilot v2.0 is at during the advanced operations selections. The legend for the LED flash rate symbols is below:


Solid "On"/No Flash


Slow Flash Rate (1 per sec.)


Fast Flash Rate (5 per sec.)

For example,

would indicate a slowly flashing yellow LED and 

would indicate a fast-flashing red LED

Accessing the Start Menu

Please refer to the **Menus/Modes/Selections "Cheat Sheet"** reference at the end of this manual when reading and reviewing this section. Also refer to the **Menu Navigation and Operation Flowchart** for additional help.

To start the interactive operation of the Co-Pilot v2.0, press and hold the *SELECT* pushbutton while applying power to the unit. Release the pushbutton after you hear a brief chirp from the piezo beeper. You're now at the **Start Menu** and displaying the first choice, **Setpoint Menu** (SLOW FLASHING **RED**).

Start Menu Navigation

Navigate to Setpoint Menu

Navigate to Flight Log Menu

Navigate to Diagnostics Menu

Exit to Flight Mode

- To scroll to the next available choice in the menu, tap the *SELECT* pushbutton.
- To make a choice in this menu, tap the *ENTER* pushbutton.
  (Note: a brief chirp acknowledges each button press).

Start Menu Options

All other menus are accessed from the Start Menu. The available options are:

Setpoint Menu: Provides verification and adjustment for all user setpoints of the Co-Pilot v2.0
Flight Log Menu: Retrieve all previous flight information stored in the nonvolatile memory.
Diagnostics Menu: Perform the diagnostic features provided by the Co-Pilot v2.0 altimeter.
Escape to Flight Mode: Exit the Start Menu and return to normal flight operations mode.

Setpoint Menu

All user-adjustable setpoints are available from this menu. You can verify all setpoints, and you can adjust all setpoints. The Co-Pilot v2.0 provides 2 independent setpoint "profiles". A "profile" is a COMPLETE group of setpoints. A certain setpoint profile, whether you're programming it or flying that profile, is based upon the position of the *Profile Select* switch at power-up. Set the Profile Select switch to 1 or 2 before powerup to either 1) program that set of points or 2) fly that set of programmed points. All setpoint values are stored in nonvolatile memory.

		RANGE	DEFAULT VALUE
	*Main AGL Setpoint*	3 – 30 (300 to 3000 feet AGL)	5/10
	*Mach Inhibit Delay Time*	1 – 31 seconds (32 = no delay)	32
	*Drogue Delay Time*	1 – 3 seconds (4 = no delay)	4
	*Main Delay Time*	1 – 3 seconds (4 = no delay)	4
	*Deployment Mode*	1 – 3 (1 = Dual; 2 = Apogee Only; 3 = Main Only)	1
	*Operations Mode*	1 -16 (See **Operations Mode Setpoint Table**)	16
	*Exit to Start Menu*		

Setpoint Menu Navigation and Setpoint Adjustment

To scroll to the next available setpoint choice in the menu, tap the *SELECT* pushbutton. To choose a setpoint, tap the *ENTER* pushbutton. After a setpoint has been chosen, the piezo and LED will repeatedly flash/chirp the current value of the setpoint (for verification).

Tap the *SELECT* pushbutton to scroll to the next setpoint in the menu, *OR* tap the *ENTER* pushbutton to modify the chosen setpoint value. If you've elected to modify a setpoint, the unit is now awaiting the new setpoint value.

Tap the *SELECT* pushbutton according to the newly desired value (example: tap the button 10 times for a value of TEN), then tap *ENTER* when complete. **Tapping ENTER without making any new input will reset the setpoint value to its default value.**

The unit will now chirp back the newly entered setpoint value. If it is correct, tap the *SELECT* pushbutton to scroll to the next available setpoint. If you made a mistake, repeat the programming operation by tapping *ENTER* again.

Setpoint Menu Options

Main AGL: AGL elevation for the MAIN event. It is adjustable between 300' and 3000' in 100' increments (represented by a value of 3 to 30).

Mach Inhibit Delay: Delay time (in seconds) after launch that the unit will not apply the apogee detection algorithm. The actual delay time is adjustable between 0 and 31 seconds. *Note that 0 seconds (no Mach Inhibit) is actually represented by a value of 32.*

Drogue Delay: Delay time (in seconds) after event detection that the unit will delay the activation of the drogue output event. The actual delay time is adjustable between 0 and 3 seconds. *Note that 0 seconds (no delay) is represented by a value of 4.*

Main Delay: Delay time (in seconds) after event detection that the unit will delay the activation of the main output event. The actual delay time is adjustable between 0 and 3 seconds. *Note that 0 seconds (no delay) is represented by a value of 4.*

Deployment Mode: Represents how the Drogue and Main events are initiated.

Mode 1 (Dual Deploy) operates the Co-Pilot v2.0 in standard dual-deploy operation (Drogue event at apogee, Main event at Main AGL setpoint).

Mode 2 (Apogee Only) activates both Drogue and Main events at apogee. If no delay is programmed for Drogue or Main, then both events are activated simultaneously.

Mode 3 (Main Only) activates both Drogue and Main events at the Main AGL setpoint. Again, If no delay is programmed for Drogue or Main, then both events are activated simultaneously.

Operations Mode: Enables or Disables a specific operation based upon the setpoint value. Refer to the *Operations Mode Setpoint Table* for the specific operational values.

- *Low Freq Chirp:* Enable/Disable modulated piezo beeper operations. Use for dual-unit operation (such as with CPR-MAX) to discern one unit's chirp from the other by setting one to the Low Freq Chirp sound.
- *Chirp Battery Voltage:* Enable/Disable voltage chirp feedback during power up. Enabling allows you to verify "on-pad" battery voltage audibly.
- *Chirp All Setpoints:* Enable/Disable chirping of all setpoints (except for Operations Mode, since the unit is IN Operations Mode) in matrix order. Use this as an "on-pad" verification of all programmed operations. Note that any disabled timer feature (Mach Inhibit, Drogue Delay, or Main Delay) will be chirped out as a long beep (zero) during "Chirp All Setpoints".
- *Battery Alarm Lockout:* Enable/Disable the low battery lockout and alarm. When active, a continuous alarm tone sounds and the unit will not arm if the battery is 6.5 V and below.

Escape to Start Menu: *Exit the Setpoint Menu and return to the Start Menu.*

NOTE: All setpoints can be reset to Factory Defaults by pressing and holding both the ENTER and SELECT pushbuttons while powering up. The unit will respond by a quick chirp and a distinctive red/yellow/green flashing LED. Release both pushbuttons to complete the reset.

Operations Mode Setpoint Table

VALUE	BATTERY ALARM LOCKOUT	CHIRP ALL SETPOINTS	CHIRP BATTERY VOLTAGE	LOW FREQUENCY CHIRP
1	No	No	No	Yes
2	No	No	Yes	No
3	No	No	Yes	Yes
4	No	Yes	No	No
5	No	Yes	No	Yes
6	No	Yes	Yes	No
7	No	Yes	Yes	Yes
8	Yes	No	No	No
9	Yes	No	No	Yes
10	Yes	No	Yes	No
11	Yes	No	Yes	Yes
12	Yes	Yes	No	No
13	Yes	Yes	No	Yes
14	Yes	Yes	Yes	No
15	Yes	Yes	Yes	Yes
16	No	No	No	No

Flight Log Menu

Data from your last flight are available from this menu. These values are stored in nonvolatile memory after each flight immediately after apogee detection for later recall. The flight data stay stored until your next flight overwrites them with new data.

Last Apogee AGL

Last Peak Velocity

Last Time to Apogee

Total Launch Count

Exit to Start Menu

Flight Log Data Items

Last Apogee AGL: Peak AGL elevation (in feet)
Last Time to Apogee: Time (in seconds) from arming altitude to apogee event detection, rounded to the nearest second
Last Peak Velocity: Estimated velocity in feet per second, rounded to the nearest 10
Total Launches: Cumulative total launch count (0 to 255) since last reset
Escape to Start Menu: Exit the Flight Log Menu and return to the Start Menu

Flight Log Menu Navigation

To scroll to the next available log value in the menu, tap the SELECT pushbutton. To choose a log value, tap the ENTER pushbutton. When chosen, the piezo beeper and LED will flash/chirp the current value, then return back to the menu. Tap the SELECT pushbutton to scroll to the next setpoint in the menu, or tap the ENTER pushbutton again to reflash/rechirp the current value.

Similar to the Report Mode after each flight, log values can chirp out in 1 to 5 digits. For example, let's say the rocket flew to a peak altitude of 1230 feet. The unit would beep the following for the *Last Apogee AGL* value:

Beep (1)...pause
Beep, Beep (2)…pause
Beep, Beep, Beep (3)…pause
Beeeeeeeeeeep (0)…
short buzz

Diagnostics Menu

From this menu, the unit can also be placed into various modes to verify the basic operational integrity of the unit, including battery power, baro, continuity circuits and output controls. One can also ground test e-matches, ejection charges, or recovery system designs.

Battery Voltage Level

Current MSL Elevation

Input Test Mode

Output Test Mode

Exit to Start Menu

Diagnostics Menu Navigation

To scroll to the next available menu choice, tap the SELECT pushbutton. To choose a diagnostic, tap the ENTER pushbutton. The piezo and LED will flash/chirp based upon the type of diagnostic chosen. Tap the SELECT pushbutton to scroll to the next diagnostic in the menu (except in the case of Input and Output Test modes).

Battery Voltage
Chirp/Flash the approximate battery voltage in volts and tenths of a volt.

Current MSL
Chirp/Flash the current MSL elevation in feet. Note that this value is subject to ambient pressure and temperature conditions.

Input Test Mode

IMPORTANT: After selecting the Input Test Mode diagnostic feature, you must power off the unit prior to flight, additional testing, or usage of the altimeter.

This feature allows the user to verify the operation of the continuity input circuits. It operates identically to launch detect mode

Long Beep/Flash	**No continuity on Drogue or Main**
1 Short Beep	**Continuity on Drogue only**
2 Short Beeps	**Continuity on Main only**
3 Short Beeps	**Continuity on Drogue and Main**

Output Test Mode

IMPORTANT: After selecting the Output Test Mode diagnostic feature, you must power off the unit prior to flight, additional testing, or usage of the altimeter.

This feature allows the user to manually activate the Drogue and Main output circuits. When this diagnostic is selected, the piezo will emit a WARNING TONE for 5 seconds, and the LED will flash rapidly in **RED** to alert the user that output test mode has been selected. After the warning tone is complete, the unit is ARMED. Press the SELECT pushbutton to activate the MAIN output. Press the *ENTER* pushbutton to activate the DROGUE output.

12-volt DC panel lamps can be a useful accessory for testing the outputs. They are available at Radio Shack or similar stores. The lamps will allow you to observe the operation of the outputs without the use of pyrotechnic devices. **Always exercise caution if using live pyro charges in the output test mode.**

Escape to Start Menu
Exit the Diagnostics Menu and return to the Start Menu.

Battery and Power Source Considerations

The Co-Pilot v2.0 is designed to be operated with a standard 9-volt alkaline battery. Always use high-quality, name-brand alkaline batteries. 9-volt NiCad, NiMH, LiPo, or other battery types may also be used.

IMPORTANT: Always use a battery system less than 10 Volts to avoid damaging the Co-Pilot v2.0.

Pre-Flight Load Testing of Battery

IMPORTANT: Always load-test your battery prior to flight to ensure adequate power reserve for reliable operation and ignition of the ejection charges. High-current demands on the battery system during event initiation may lead to power and processor brown-out conditions, resulting in recovery failure.

To load-test a 9V battery, you will need 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. Nominal load during operation is about 6 ma. During output firing, the unit can draw well over 1 amp with low current e-matches.

Wiring Diagram

Figure 2 depicts the wiring convention for Co-Pilot v2.0. This configuration activates the e-matches using the same battery that powers the microcontroller and baro-sensing system. The success of this configuration relies on the voltage remaining relatively stable when firing a low-current e-match. If the voltage sags too low, this may result in a brown-out or other recovery malfunction.

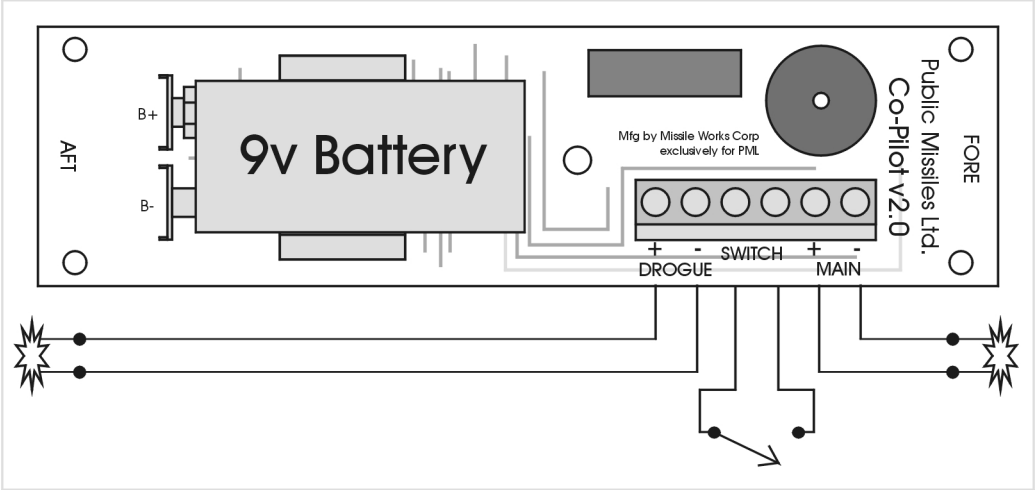


Figure 2 - Standard Wiring & Connections

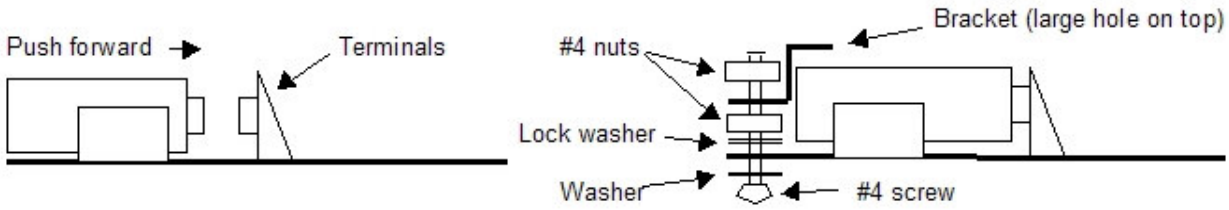


Figure 3 - Battery Retention Clip Detail

E-matches and Ejection Charges

The topic of e-matches and ejection charges is often overlooked and not given a proper evaluation. The ejection charge is as critical a component as the electronics. Improper selection or application of e-matches can result in failure of the recovery system and total loss of the rocket. It is foolhardy to attempt to "save money" on an ejection charge ignition device considering the hundreds of dollars invested in the electronic-based rocket, the altimeter, the motor casing, and the motor reload itself. The cost of a quality ignition device for each ejection charge is insignificant compared to the overall investment, yet the failure of an ignition device can cause destruction of the entire rocket. The message is clear: buy good-quality ejection ignition devices!

- IMPORTANT: Always ground test the type of e-match you'll be using under actual flight-ready conditions prior to committing to flight.
- Improper selection of an e-match will result in a malfunction. Always use an e-match that is suited for the firing conditions of the Co-Pilot v2.0 (e.g., do not use a match with very low current or very high current requirements.
- Always check your e-match, igniter, or flashbulb devices for continuity and proper resistance prior to using them under testing or actual flight conditions.
- PML recommends that all flashbulbs and electric matches have their electrical wires twisted together until just before installation in the rocket system. This may help prevent accidental ignition of the device due to static discharge.

Selecting an Adequate Electric Match for Deployment Charge Ignition

The Co-Pilot v2.0 has been tested and flown with several commercially available e-matches. It has also been successfully tested and flown with AG-1 flashbulbs. We recommend the M-Tek or J-Tek series e-matches from MJG Technologies (www.electricmatch.com) for the Co-Pilot v2.0.

Launch Day

It's best to prepare your rocket carefully and not to bypass any critical steps. The following list is a guideline of the necessary steps you should take in the preparation of your Co-Pilot v2.0. Also follow the directions given for your CPR3000 rocket kit.

At the Prep Table

- Load test the battery; after testing OK, install in Co-Pilot v2.0 and install retaining clip
- Check continuity and resistance of the ignition devices (e-matches, flashbulbs, etc.)
- Install e-matches/flashbulbs into CPR3000 system following CPR3000 instructions.
- Make final wiring connections to the ejection charges. Connect the (-) terminal first.

- Arm the electronics and verify ejection charge continuity; turn Co-Pilot v2.0 OFF after continuity check
- Prepare and pack the recovery components (parachutes, streamers, etc.)
- Put on safety glasses and protective gloves.
- Install BP charges as recommended in your CPR3000 instructions
- Install Co-Pilot v2.0/CPR3000 altimeter bay assembly into rocket
- Assemble the rocket and check all deployment coupling junctions, ensuring a snug and adequate fit
- Prepare and load the rocket motor

At the Pad

- Place the rocket on the launch rod or rail
- Insert the igniter in your rocket motor
- Arm the electronics and re-verify ejection charge continuity through the beep tones
- You're ready to launch!

Product Warranty

Missile Works Corporation has exercised reasonable care in the design and manufacture of this product and warrants the original purchaser that the Co-Pilot v2.0 altimeter 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, contact sales@publicmissiles.com or telephone 810-327-1710 9-5pm EST Mon.- Fri. within the warranty period for repair or replacement. PML will discuss your claim with you and direct you as to how to proceed, up to and including returning the Co-Pilot v2.0 to Missile Works for warranty repair. PML MUST PRE-AUTHORIZE YOUR WARRANTY CLAIM; DO NOT SEND THE CO-PILOT V2.0 TO MISSILE WORKS WITHOUT PML AUTHORIZATION OR IT WILL BE RETURNED TO YOU UNREPAIRED. The Co-Pilot v2.0 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 Co-Pilot v2.0, Missile Works Corporation will return the Co-Pilot v2.0 postage paid to the original purchaser.

For repairs after the Co-Pilot v2.0 is out of the warranty period, contact Missile Works Corporation directly.

(303) 823-9222 or www.missileworks.com
Mail, Service & Repair Address:
Missile Works Corporation
PO Box 1725
Lyons CO 80540

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 Public Missiles, Ltd. 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.

Menus/Modes/Selections "Cheat Sheet"

The color and flash rate of the LED indicates what state/select point the Co-Pilot v2.0 is at during the advanced operations selections. The legend for the LED state is below:

 Solid "On"/No Flash  Slow Flash Rate  Fast Flash Rate

Start Menu

 *Navigate to Setpoint Menu*

 *Navigate to Flight Log Menu*

 *Navigate to Diagnostics Menu*

 *Exit to Flight Mode*

Flight Log Menu

 *Last Apogee AGL*

 *Last Peak Velocity*

 *Last Time to Apogee*

 *Total Launch Count*

 *Exit to Start Menu*

Diagnostics Menu

 *Battery Volt Level*

 *Current MSL Elevation*

 *Input Test Mode*

 *Output Test Mode*

 *Exit to Start Menu*

Setpoint Menu

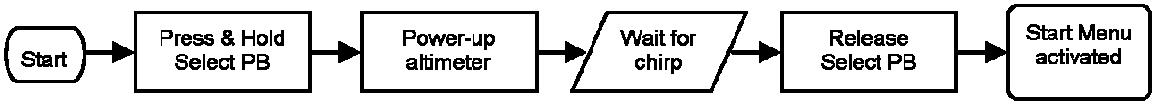
		RANGE	DEFAULT VALUE
	*Main AGL Setpoint*	3 – 30 (300 to 3000 feet AGL)	5/10
	*Mach Inhibit Delay Time*	1 – 31 seconds (32 = no delay)	32
	*Drogue Delay Time*	1 – 3 seconds (4 = no delay)	4
	*Main Delay Time*	1 – 3 seconds (4 = no delay)	4
	*Deployment Mode*	1 – 3 (1 = Dual; 2 = Apogee Only; 3 = Main Only)	1
	*Operations Mode*	1 -16 (See **Operations Mode Setpoint Table**)	16
	*Exit to Start Menu*		

Operations Mode Setpoint Table

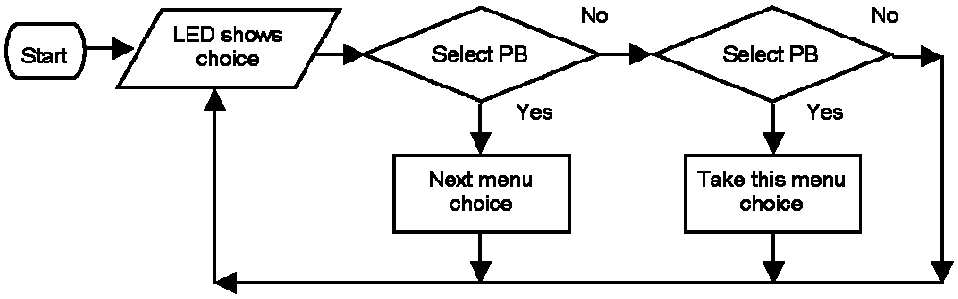
VALUE	BATTERY ALARM LOCKOUT	CHIRP ALL SETPOINTS	CHIRP BATTERY VOLTAGE	LOW FREQUENCY CHIRP
1	No	No	No	Yes
2	No	No	Yes	No
3	No	No	Yes	Yes
4	No	Yes	No	No
5	No	Yes	No	Yes
6	No	Yes	Yes	No
7	No	Yes	Yes	Yes
8	Yes	No	No	No
9	Yes	No	No	Yes
10	Yes	No	Yes	No
11	Yes	No	Yes	Yes
12	Yes	Yes	No	No
13	Yes	Yes	No	Yes
14	Yes	Yes	Yes	No
15	Yes	Yes	Yes	Yes
16	No	No	No	No

Menu Navigation and Operation Flowchart

Invoking the Start Menu



Menu Navigation



Modifying a Setpoint