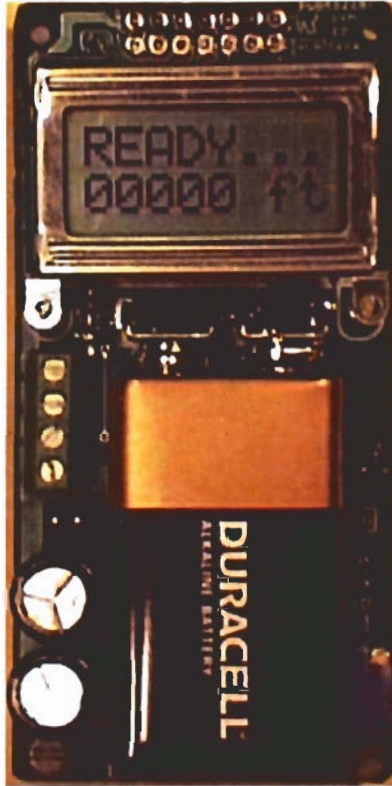


Model
FCP - M1 Altimeter
Rocketry - Flight Control Processor



Owners Manual
Olsen Advanced Electronics

Limited Warranty

The FCP-M1 is warranted to be free of defective parts and workmanship for a period of 2 years from the date of original purchase. This product will be replaced, or repaired (at the discretion of the manufacturer) if returned within 2 years of the original purchase date and found to be defective within the terms of this warranty. Shipping and other incidental costs are not covered under this warranty. The product will NOT be replaced or repaired under this warranty, if it has been improperly used, damaged and/or modified, or serviced by any entity other than the manufacturer. This warranty does not extend to any other product or equipment that may be damaged as a consequence (either directly or indirectly) with the use of this product.

Read This Disclaimer

This product is sold as an experimental electronic accessory. Olsen Advanced Electronics, its employees, vendors and/or contractors shall not be held liable for any incidental, consequential, or special loss; damages or expenses; or for personal injury; or for any loss or destruction of property, arising directly or indirectly from the use of this product; whether used solely, or in conjunction with any other product or equipment.

It is the responsibility of the user to fully to read and understand this manual; and to fully understand the function of this experimental device and the consequences of its potential failure, whether used solely, or if used in conjunction with any other device. It is expressly understood that the user assumes all responsibility, and any consequences thereof, for the use, of this product in any application. Further, it is the users responsibility to exercise good and prudent judgment, in the use of this device, with regard to personal safety and protection of property. Finally, if you do not fully agree with, or understand the above, or any component of this document, return this product to the manufacturer, within 5 working days for a prompt refund.

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General Description of the Model FCP-M1

This advanced rocketry Flight Control Processor/Altimeter provides you with numerous features not offered by any other altimeter product. To determine the status of the altimeter, deployment continuity, and maximum altitude - simply *read it* off of the large LCD display. You are no longer required to interpret a series of unnatural audible beeps or flashes of light to establish the status of your rocket's recovery system!

The FCP-M1 provides you with two deploy events - The first event occurs when the rocket has reached apogee and the second occurs when it has fallen to the low altitude set-point. The low altitude set-point can be easily changed from 750 ft or to 1250 ft by moving a jumper. Continuity checking is continuously performed for the **apogee** and **low altitude** deployment circuits. The status of each is continuously updated in the LCD display. When triggered, both deploy events supply sufficient energy and duration to fire a flashbulb.

Mach capable flight - By enabling one of three field selectable time delays, the altimeter will wait for the duration of the time-out, allowing the altimeter to *ride* through the mach event without taking action.

Feature Connectors - The FCP-M1 provides connectors for local and remote power switch and local and remote launch detect. These allow you to power-up and/or "launch" the altimeter from a remote switch.

FCP-M1 is a high quality product featuring a double sided printed circuit board, surface mount components and advanced construction techniques, resulting in a design that is both robust and abuse resistant (we fly rockets too!). Additionally, the firmware employs redundancy checking and is thus very fault tolerant - minimizing false event trips. These features should provide you with many years of reliable and safe operation.

How to use your FCP-M1

Mounting - When mounting the FCP-M1, the general orientation should be with the display towards the nose-cone of the rocket. If other orientations are needed, it is best to avoid placing the FCP-M1 on either of its sides because this will increase the likelihood of the battery moving and losing electrical contact.

Use the standoffs and the 4-40 screws (supplied in your kit) when mounting the FCP-M1 in your rocket. This will prevent damage to the components on the back side of the FCP-M1 printed circuit board

Static Port - This is a port (hole) that allows the external and internal air to commute, so that the FCP-M1 "sees" the same pressure that is outside of the rocket. We have had good success when the diameter of the static port(s) is 0.125 inches per 12 cubic inches of free volume. The free volume is the volume of the air in the altimeter bay (where your altimeter is mounted).

Altimeter Bay - It is best to isolate the air space of the altimeter bay from the air space of the ejection chambers. If you do not, the pressure that is developed when an ejection charge fires, may damage the FCP-M1 pressure sensor, and/or cause the altimeter to momentarily malfunction and fire the low altitude charge at apogee.

Deployment Wiring - As you face the FCP-M1 with the display up, you will see a four position screw terminal block (see figure 1). The upper two terminals should be connected to your apogee flash bulb (drouge chute). The lower two terminals should be connected to your low altitude flash bulb (main chute).

Power Switch - The slide switch on the right side provides ON/OFF control to the FCP-M1. When moved toward the LCD display your FCP-M1 will be turned on. If the switch is toward the bottom of the altimeter, the unit will be turned off. If a remote switch is used, the FCP-M1 can be turned on and off remotely.

Main Chute Jumpers - At the top, and to the right of the LCD connector, are three sets of pins. The right two pins are used to select the high/low setting for the main chute deployment. If the jumper is missing the Altitude setting will be the *low* value.

If the jumper is present, the Altitude setting will be the *high* value. When continuity is achieved for the low altitude circuit, the display will show either an "H" or an "L" indicating which altitude setting you have chosen. Try it!

Mach Delay Jumpers - The two left sets of pins are used to set the desired mach delay values (5, 10 or 15 seconds). If no jumpers are present, mach delay timeout is not enabled, and the altimeter should not be flown at, or near, mach velocities. If a jumper is present on the center two pins, then the first mach delay is enabled. If a jumper is present on the left two pins the second mach delay is enabled. If both jumpers are present then the third mach delay is enabled. The actual delay time is loaded during the boot-up sequence of the altimeter. Place the jumper for the desired delay time **before** turning the altimeter on.

Mach Delay LED - There is an LED located below the LCD data screen. When a mach delay has been enabled *and* the altimeter is READY, this LED will blink (3 times a second). When the altimeter is "launched" and a mach delay has been enabled, this LED will stay ON for the period of the selected delay time. This feature is useful for verifying the desired delay period.

Remote Launch Connector - The FCP-M1 is equipped with a remote launch connector. This circuit provides the user a means of initiating a launch sequence without actually launching the rocket - quite handy when testing deployment charges. Secondly, this input can be used to "launch" the altimeter with a remote G-switch. This is useful when launching rockets that can potentially go mach before the on-board "pressure sensing launch detection" has had time to complete (see Rocket Science).

Once the altimeter has reached the "READY..." state, use the two wire jumper set provided with your kit and connect it to the remote launch pins. Then short the ends of the wires together for at least one second. The altimeter will "detect" this event and "launch", then step through APOGEE and LOW ALTITUDE while firing the event circuits. This is the easiest way to test your deployment circuits - give it a shot!

Safety Switch/Jumper - *Removed.*

Deployment Configurations

Before you install a battery and power-up the FCP-M1, *make sure all of your deployment connections are made*. This will minimize the possibility of unintentionally firing a deployment charge while your rocket is on the ground. After your connections are made, be sure the power is turned off and install a fresh battery. Turn the power on.

Low Altitude Set Point - The Low Altitude jumper is located below the display on the right side. When the jumper is installed in the upper position, the HIGH setting is selected. If the jumper is installed in the low position, or is missing, the LOW setting is selected. Check the display to make sure the setting you want is selected.

In the following paragraphs a description is provided for four different deployment configurations. Each paragraph explains where to make the electrical connections for the type of deployment configuration you are interested in and what you should expect to see on the Status line of the display for each type.

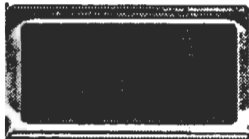
Altimeter Only - If you do not want your FCP-M1 to deploy a recover system (i.e. you have another means of recovery, or perhaps you *want* your rocket and FCP-M1 to come in ballistic!) you would not connect anything to the terminals. With this configuration, the upper display will read "READY...".



Apogee Only - With this configuration, the main chute (or other device) would be deployed at apogee. In this case a flashbulb or electric match would be connected to the upper two terminals and the lower two would be left open. If continuity is good (<1000 ohms) for the apogee circuit, then the upper display will read "READY-A".



Apogee and Low Altitude - In this configuration the upper two terminals would be connected to the apogee flashbulb and the lower two would be connected to the low altitude flashbulb. If continuity is good (<1000 ohms) for both circuits, then the upper display will read "**READY-AL**" or, if the low altitude is set for high value (1250 ft) then it will read "**READY-AH**".



Low Altitude only - With this configuration you would connect the lower two terminals to the low altitude flashbulb and leave the upper two open. When continuity is good (<1000 ohms) for the low altitude circuit, the upper display will read "**READY- L**" if the low altitude set point is for (LOW) 750 ft or it will read "**READY- H**" if the low altitude set point is for (HIGH) 1250 ft.



Keep in mind that the continuity of each circuit is checked and updated continuously, so if the display is indicating that continuity is periodic (the letter A and/or L or H is blinking) you should not attempt to fly your rocket! This condition indicates that you have an intermittent electrical connection in your deployment circuit, which could likely result in deployment failure! Fix the connection before you launch.

Safety Precautions - This section contains a few items that you should definitely heed once your altimeter has been wired to "live" deployment charges.

Do not turn the altimeter ON and OFF rapidly - this will almost always cause both event circuits to fire. Remember that this is essentially a micro-processor that expects a specific start-up sequence - if the start-up is *bad* the processor can do stupid, dangerous things.

Never launch if the altimeter does not display "READY". If the altimeter does not reach the ready state within about 1 minute the cause is very likely a low battery. There are other possible causes as well, see *Troubleshooting your M1*.

Selecting A Mach Delay Timeout

Selecting a Proper Mach Delay - As far as the FCP-M1 is concerned, there are two critical features to surviving a mach flight. The first is the time (from launch) when the rocket *enters* mach, and the second is the time (from launch) when the rocket has exited mach and *slowed* down to about 300 MPH (440 fps). It is assumed that characteristics of the mach flight are known (e.g. Rogers Aerospace ALT program).

Mach Entry Time - If your rocket enters mach *before* 1.5 seconds has elapsed, you will need to use the remote launch detect feature to fly safely. This is because the selected mach timeout is activated *after* launch has been detected and the barometric launch detect software function is considerably slower than the remote launch detect hardware.

Mach Exit and Slow Down Time - The mach delay that you select should be equal to or longer than to the time period from launch, to where the rocket has exited mach and slowed down to around 300 MPH, but not longer than the time period to apogee.

Be sure that all of the jumpers (Low Altitude and Mach) are in the correct position for the type of flight you are planning.

Care and Feeding

Your FCP-M1 was shipped to you surrounded by bubble wrap and inside of a so called *static bag*. This was done because we want your altimeter to arrive to you undamaged. The following paragraphs describe how you can avoid damaging the FCP-M1 during handling and use.

Static Electricity - We have all had the experience of walking on a carpet and then having a static electric spark jump from our hand to a door knob or lamp. Well, one of these little bolts of lightening can spell doom for your altimeter. The LCD display has historically been the most susceptible component, and is what usually gets destroyed, but any or all of the electronics on the PC board can either be destroyed or sufficiently "weakened" so that they fail shortly thereafter.

So, without getting paranoid, just use common sense when handling your altimeter - keep it in the static bag until you are ready to mount it in your rocket. If you have a room that is known to "charge you up" (living rooms with plush carpets are notorious), don't take your altimeter in there - take your friends, go to the damp basement and show it off there.

Battery Type - MN1604 (9v alkaline) or equivalent for maximum life and deployment reliability. A fully charged NiMH (nickel metal hydride) PBNH1606 (Plainview Batteries) works very well.

We recommend one fresh battery for each flight. Only use a battery that is fresh out-of-the-package. Don't even think about using the "new" one that has been flopping around in your flight box (we've done that too). Generally, if the battery voltage is greater than 9.0 volts you are good for a flight.

Battery Life - With a fresh Alkaline battery your altimeter will operate properly for no less than 5 hours and fire both apogee and low altitude charges. If the altimeter has been on longer than 5 hours, replace the battery before launching. Doing this will ensure reliable performance of your FCP-M1.

Storage - When not in use store your altimeter in its static bag without a battery installed. Keep it dry.

Rocket Science (Theory of Operation)

The FCP-M1 is essentially a barometer that reads in feet rather than inches of mercury. It utilizes a pressure transducer that has a vacuum reference incorporated with it. The transducer produces an output voltage that is proportional to the pressure difference between the ambient pressure (where your rocket is) and the vacuum reference (where your rocket would like to be). This signal is conditioned (amplified, linearized, and scaled) then supplied to the micro-controller for additional processing and display.

The following paragraphs give a general description of what is going on with the altimeter during a complete flight cycle.

FCPxx vn - Following power-up the upper display will indicate the model number (e.g. **FCPM1**) and the firmware version number (e.g. **v1**) of your altimeter. This will remain in the upper display for about 3 seconds. It is important to include these numbers in any correspondence with us.

Mach Delay Jumpers - The processor now "looks" at the state of the mach delay jumpers and sets internal flags as necessary to perform the selected mach delay timeout.

Custom Text - If you ordered your altimeter with optional text (for example "Bobs Alt") each 8 character segment will be displayed for a few seconds in the upper line at this time.

Zeroing - The FCP-M1 is now comparing the current pressure readings (altitude) to a previously measured reading. If these two are different by some error amount (in this case 1 foot), the system resets itself and this process continues until successive, stable readings are attained. This is what is going on when the Status line of the display is toggling between **"-RESET-"** and **"ZEROING"**. Since even solid state electronics need time to warm up, this process is performed to ensure that electronics are thermally stable before proceeding. Warm-up can take up to a minute but, usually takes about 15 seconds.

READY... - If a mach timeout jumper was detected during the boot-up, the LED will now be blinking 3 times every second. At this point you could launch your rocket, but you might have a recovery system that needs firing. So in order to verify the

continuity of the circuit(s), the FCP-M1 periodically pulses each circuit and measures its resistance. If this measured value is low enough, about 1000 ohms or less, the letter "A" and/or "L" or "H" is included in the right two spaces of the display status line. Each letter corresponds to the deployment circuit under test - "A" for the apogee circuit and "L" or "H" for the low altitude circuit. The letter "L" will be displayed if the low altitude is set for 750 ft, otherwise the letter "H" will be displayed. When a letter is present in the Status line, the corresponding circuit is OK and READY to USE. Otherwise that circuit is OPEN and NOT READY to USE. Please be aware that the FCP-M1 cannot distinguish between a short circuit and a flashbulb - *Check your wiring visually before you launch!*

Launch detect - Following the **ZEROING** process, the FCP-M1 enters the "READY" state and continuously compares the current altitude measurement to a value of zero and checks the state of the G-Switch. When the G-Switch has been active (in a closed state) for more than 0.5 seconds, launch is considered to have occurred. When this happens, the upper line of the display will read "LAUNCHED". When the rocket is launched, its altitude is sensed as a decreasing pressure by the FCP-M1.

Mach Delay - Now if one or more of the Mach delay jumpers is in place the altimeter will ignore pressure readings immediately following launch and simply wait until the selected time period has elapsed. The LED will remain ON for the duration of the timeout period. At the conclusion of the mach timeout the altimeter will turn off the LED and enter the Apogee detect phase.

Apogee detect - As your rocket approaches apogee the air pressure decreases. At apogee the air pressure stops changing and remains constant for a moment.

During flight, FCP-M1 makes comparisons between the current air pressure and previously measured air pressure. When the current readings are the same as or less than the previous readings, the FCP-M1 knows it has reached apogee. The apogee switch is then activated for 1 second and the upper display will read "APOGEE".

In an apogee only configuration, the main recovery system would be deployed at this time. Otherwise a drogue chute or streamer would be deployed.

Low altitude detect - Your rocket is now gently falling to earth. The pressure readings are increasing as the rocket gets closer to the ground. Once the rocket has passed below the low altitude set-point, either 750 or 1250 ft, the low altitude switch is activated for 1 second. In a dual recovery system the main parachute would be deployed at this time.

Maximum altitude - Following activation of the low altitude switch, the FCP-M1 displays the maximum altitude measured during the flight, and the processor then turns off all of the electronics, except the display, to conserve battery power. The altimeter can maintain the display data for well over ten hours on a fresh battery.

Trouble Shooting

Occasionally, your altimeter may behave in an unexpected manner. The following list includes symptoms and likely causes of unexpected behavior.

WILL NOT RESET - The cause of this is almost always due to a low battery. Replace the battery and check for proper reset.

The second most likely cause is extreme temperature variations. Do not leave your altimeter in direct sunlight for any period of time, it can get very hot and damage the LCD display! You will attain the best performance when your altimeter has had a chance to normalize to the temperature that it will be flying in. Also, don't hold the altimeter when it is zeroing.

DOES NOT FIRE A FLASH BULB WHEN TESTED - Check the battery. And verify that continuity is shown as good for the circuit being tested. Check for shorts in the wiring for that flashbulb circuit.

REMOTE POWER SWITCH DOES NOT TURN ALTIMETER OFF - The on-board power switch is in the ON position (toward the LCD display). The remote power switch will only function with the on-board power switch in the OFF position.

What it Does Features and Specification

The FCP-M1 provides you with a wealth of features that do not require you to be technically inclined to use. However, for those of you who are interested in the details, they are listed in Table 1. If you have any questions, or need clarification about this specification, please contact us, and we will happily answer any questions you may have.

Table 1

General

- Display:** 8 x 2 character, alpha-numeric LCD
Upper line: Shows Altimeter, and Deployment Circuit Status
Lower line: Shows altitude in feet
- Power:** Onboard power switch and remote power switch connector
- Functions:** Continuity, Launch Detect (local and remote), Mach Timeout, Apogee and Low Altitude Detect
- Remote G-Switch:** Relay Closure or Open Collector. +5VDC and GND provided
- Mach Timeout:** Jumper selectable - Disabled, 5, 10 or 15 sec - LED indicator
- Low ALT Select:** Jumper selectable - Low or High altitude (shown on screen)
- Reset:** Power-on reset
- Battery:** 9 volt Alkaline MN1604 or equivalent (life 10 hours following 5 hour pre-launch dwell)

Tolerances and Maximums

- Launch detection:** G-switch closure+0.5 second
- Apogee detection:** 3 pressure samples (900 mS max)
- Low Alt detection:** 2 pressure samples (600 mS max) - each set point
- Basic Accuracy:** Basic Range (0 - 15,000 ft) +/- 5%
Extended Range (>15,000 - 22,000 ft) +/- 7%

Maximum Overpressure: 2 atmospheres (200 KPa)

Environmental

Temperature

- Storage:** 0 to 50°C (32 to 122°F)
Operating : 15 to 40°C (57 to 104°F)

Deployment Switches

- Type:** Open emitter 2 ampere PNP transistor
- Current:** Flashbulb or Electric match (short circuit tolerant)
Will not fire high duration, high current type ignitors
- Firing Method:** 1 second Current Limited to 1 ampere
- Continuity sensitivity:** Less than 1000 ohms typical

Physical

- Size:** 1.7 x 3.5 x 1.0 (W x H x D inches)
- Weight:** 3.6 oz with 9.0 volt battery

Specialty/Custom Features

If you ordered your FCP-M1 with specific features, for example: different low altitude set points, or personalized text, they will be listed here with other important information about your custom FCP-M1.

If you have any further questions about your FCP-M1 Altimeter please contact us and we will be happy to answer them.

Accessories

Power Switch with Harness - Miniature toggle switch for turning the FCP-M1 ON and OFF. **\$15.00**

Custom Features - If you want different low altitude set points and/or different mach delay times with your FCP-M1 and/or you want custom text they can still be added or modified. **\$15.00**

Programmable Event Timer - This is the perfect companion for your FCP-M1 and will plug into the M1s remote launch connector. Use as a fully programmable backup or primary timer system. Set your event time(s) with an easy to use push button interface. You are no longer required to measure a voltage or compare your setting to a stopwatch. Just read the time in seconds right off the LCD display! Event times from 1 to 255 seconds in 1 second increments. Basic accuracy is better than 0.5% **\$69.00**

Prices are subject to change and do not include shipping and handling.

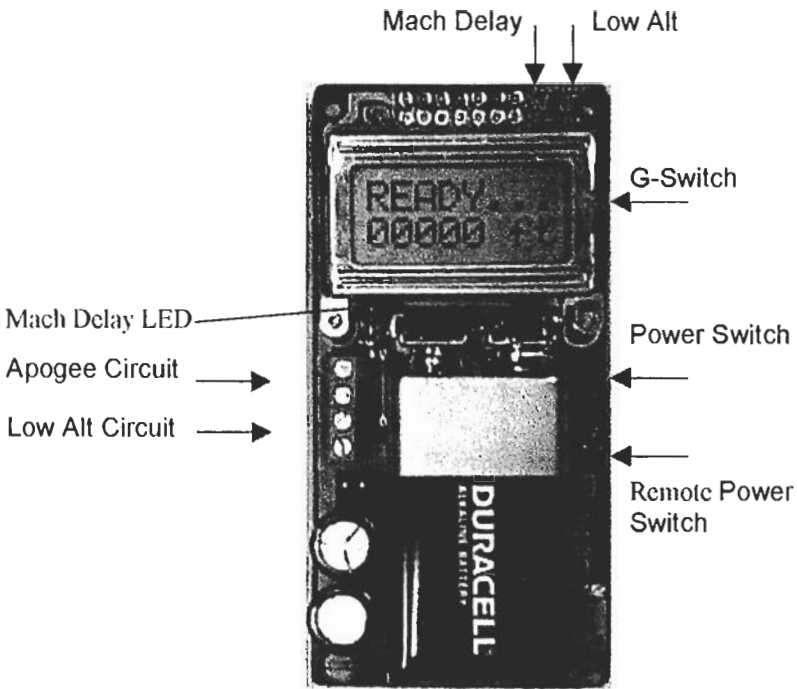


Figure 1 - Location of LED, Switches, Jumpers and Connectors