MicroPeak Owner's Manual

A peak-recording altimeter for hobby rocketry

Keith Packard

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Acknowledgements

Thanks to John Lyngdal for suggesting that we build something like this.

Have fun using these products, and we hope to meet all of you out on the rocket flight line somewhere.

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Chapter 1. Quick Start Guide

MicroPeak is designed to be easy to use. Requiring no external components, flying takes just a few steps

- Install the battery. Fit a CR1025 battery into the plastic carrier. The positive (+) terminal should be towards the more open side of the carrier. Slip the carrier into the battery holder with the positive (+) terminal facing away from the circuit board.

- Install MicroPeak in your rocket. This can be as simple as preparing a soft cushion of wadding inside a vented model payload bay. Wherever you mount it, make sure you protect the barometric sensor from corrosive ejection gasses as those will damage the sensor.

- Turn MicroPeak on. Slide the switch so that the actuator covers the '1' printed on the board. MicroPeak will report the maximum height of the last flight in decimeters using a sequence of flashes on the LED. A sequence of short flashes indicates one digit. A single long flash indicates zero. The height is reported in decimeters, so the last digit will be tenths of a meter. For example, if MicroPeak reports 5 4 4 3, then the maximum height of the last flight was 544.3m, or 1786 feet.

- Finish preparing the rocket for flight. After the previous flight data have been reported, MicroPeak waits for 30 seconds before starting to check for launch. This gives you time to finish assembling the rocket. As those activities might cause pressure changes inside the airframe, MicroPeak might accidentally detect boost. If you need to do anything to the airframe after the 30 second window passes, make sure to be careful not to disturb the altimeter. The LED will remain dark during the 30 second delay, but after that, it will start blinking once every 3 seconds.

- Fly the rocket. Once the rocket passes about 10m in height (32 feet), the micro-controller will record the ground pressure and track the pressure seen during the flight. In this mode, the LED flickers rapidly. When the rocket lands, and the pressure stabilizes, the micro-controller will record the minimum pressure pressure experienced during the flight, compute the height represented by the difference in air pressure and blink that value out on the LED. After that, MicroPeak powers down to conserve battery power.

- Recover the data. Turn MicroPeak off for a couple of seconds (to discharge the capacitors) and then back on. MicroPeak will blink out the maximum height for the last flight. Turn MicroPeak back off to conserve battery power.

Chapter 2. Handling Precautions

All Altus Metrum products are sophisticated electronic devices. When handled gently and properly installed in an air-frame, they will deliver impressive results. However, as with all electronic devices, there are some precautions you must take.

The CR1025 Lithium batteries have an extraordinary power density. This is great because we can fly with much less battery mass... but if they are punctured or their contacts are allowed to short, they can and will release their energy very rapidly! Thus we recommend that you take some care when handling MicroPeak to keep conductive material from coming in contact with the exposed metal elements.

The barometric sensors used in MicroPeak is sensitive to sunlight. Please consider this when designing an installation, for example, in an air-frame with a see-through plastic payload bay. Many model rockets with payload bays use clear plastic for the payload bay. Replacing these with an opaque cardboard tube, painting them, or wrapping them with a layer of masking tape are all reasonable approaches to keep the sensor out of direct sunlight.

The barometric sensor sampling ports must be able to "breathe", both by not being covered by foam or tape or other materials that might directly block the hole on the top of the sensor, and also by having a suitable static vent to outside air.

As with all other rocketry electronics, Altus Metrum altimeters must be protected from exposure to corrosive motor exhaust and ejection charge gasses.

Chapter 3. Technical Information

1. Barometric Sensor

MicroPeak uses the Measurement Specialties MS5607 sensor. This has a range of 120kPa to 1kPa with an absolute accuracy of 150Pa and a resolution of 2.4Pa.

The pressure range corresponds roughly to an altitude range of -1500m (-4900 feet) to 31000m (102000 feet), while the resolution is approximately 20cm (8 inches) near sea level and 60cm (24in) at 10000m (33000 feet).

Ground pressure is computed from an average of 16 samples, taken while the altimeter is at rest. Flight pressure is computed from an exponential IIR filter designed to smooth out transients caused by mechanical stress on the barometer.

2. Micro-controller

MicroPeak uses an Atmel ATtiny85 micro-controller. This tiny CPU contains 8kB of flash for the application, 512B of RAM for temporary data storage and 512B of EEPROM for non-volatile storage of previous flight data.

The ATtiny85 has a low-power mode which turns off all of the clocks and powers down most of the internal components. In this mode, the chip consumes only .1µA of power. MicroPeak uses this mode once the flight has ended to preserve battery power.

3. Lithium Battery

The CR1025 battery used by MicroPeak holes 30mAh of power, which is sufficient to run for over 15 hours. Because MicroPeak powers down on landing, run time includes only time sitting on the launch pad or during flight.

The large positive terminal (+) is usually marked, while the smaller negative terminal is not. Make sure you install the battery with the positive terminal facing away from the circuit board where it will be in contact with the metal battery holder. A small pad on the circuit board makes contact with the negative battery terminal.

Shipping restrictions prevent us from including a CR1025 battery with MicroPeak. Many stores carry CR1025 batteries as they are commonly used in small electronic devices such as flash lights.

4. Atmospheric Model

MicroPeak contains a fixed atmospheric model which is used to convert barometric pressure into altitude. The model was converted into a 469-element piece wise linear approximation which is then used to compute the altitude of the ground and apogee. The difference between these represents the maximum height of the flight.

The model assumes a particular set of atmospheric conditions, which while a reasonable average cannot represent the changing nature of the real atmosphere. Fortunately, for flights reasonably close to the ground, the effect of this global inaccuracy are largely canceled out when the computed ground altitude is subtracted from the computed apogee altitude, so the resulting height is more accurate than either the ground or apogee altitudes.

5. Mechanical Considerations

MicroPeak is designed to be rugged enough for typical rocketry applications. It contains two moving parts, the battery holder and the power switch, which were selected for their ruggedness.

The MicroPeak battery holder is designed to withstand impact up to 150g without breaking contact (or, worse yet, causing the battery to fall out). That means it should stand up to almost any launch you care to try, and should withstand fairly rough landings.

The power switch is designed to withstand up to 50g forces in any direction. Because it is a sliding switch, orienting the switch perpendicular to the direction of rocket travel will serve to further protect the switch from launch forces.