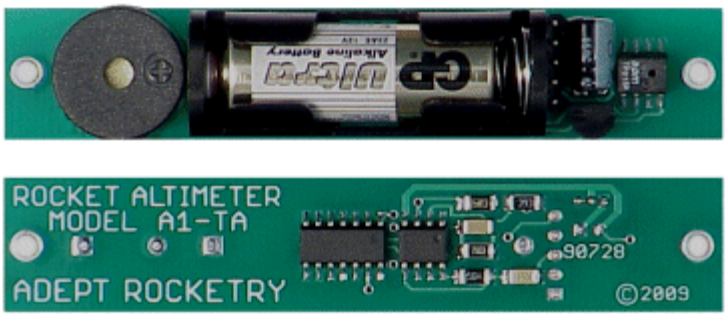
Adept Rocketry

A1-TA Altimeter Instructions and Data Sheet

Maximum Altitude Altimeter, Model A1-TA



DESCRIPTION

The A1-TA is a contest quality Maximum Altitude Altimeter that precisely measures and reports the maximum above-ground altitude value obtained during a rocket's flight. These altimeters may be used in any rocket configuration including multistage rockets, with individual altimeters in each stage of interest. The A1-TA is very small and light weight. It was designed specially for use in small contest rockets, for use in schools in science and math studies, or for use in small diameter rockets or darts.

- The **A1-TA** precisely captures the highest altitude obtained during a flight up to 15,000 feet above local ground level. **The maximum value obtained above the local ground-zero altitude is precisely measured and reported in one-foot increments.**

The A1-TA measures .55" wide by .62" thick by 2.9" long. Its weight with battery installed is only 0.50 ounce (14.2 grams). It fits inside a tube with a minimum ID of .69 inch (17.5 mm), a loose fit in an Estes BT-20 body tube). This device runs on a 12-volt alkaline lighter battery. The battery life for this product is in excess of 10 hours, so you need not be concerned about how long your rocket sits on the launch pad after the Altimeter is powered up. The A1-TA is a totally stand-alone device including the battery holder and arming mechanism. Nothing more is required.

The A1-TA uses a custom absolute pressure device to precisely measure and report altitude values. It uses an 18-bit logarithmic analog-to-digital converter to precisely (4 inch resolution) measure the nonlinear pressure versus altitude relationship over the altitude range. Once powered up, the A1-TA constantly measures the ground-level altitude and waits for an increasing change upward. It then captures the maximum altitude obtained (above ground zero), and begins to report the maximum altitude value. The value is "beeped" out as a series of counts that can be heard easily, even when the unit is still inside the rocket. The rocketeer knows the maximum altitude as soon as he/she picks it up, or just gets close to it.

TESTING AND USING THE A1-TA

NOTE 1: The precision amplifier circuitry on the altimeter may be sensitive to noise and static when being held. Following power up the A1-TA reports the previous flight's maximum altitude from permanent memory. The altitude is reported twice, then there is a 10-second silent period to allow time to get your hands off the unit before it starts taking

readings. The A1-TA is a super precision instrument. Use care to keep the device clean and dry.

NOTE 2: This device must be installed in a “clean area.” *Electronic Instrumentation is not compatible with the fumes and residue created by rocket motors and deployment charges.* **Install the A1-TA in an area that is totally sealed from motors and charges.**

To turn the unit on, install a 12-volt alkaline lighter battery (GP-23A, Eveready Energizer No. A23, Radio Shack, 23-144, etc.) in the battery holder. The spring end of the battery holder connects to the negative end of the battery. Remove the battery to turn off the device. When the battery is first installed, there will be a long beep to indicate that power is on. Then the A1-TA will report the previous flight's maximum altitude twice. Then after an additional 10 seconds, the unit will beep every 1.6 seconds to indicate that it is working and looking for an increasing altitude. The start up beeps and pause after power up gives the user time to slip the unit inside the rocket tube before it starts looking for liftoff. Also, it is best to wait at least three minutes after power up before launching. This assures that the precision circuitry has ample time to stabilize and adjust to local conditions.

An increase in altitude tells the unit it has liftoff. The A1-TA constantly measures the ground-level altitude and waits for movement upward. It then precisely captures the maximum altitude obtained above ground zero and begins reporting the maximum altitude.

After a flight, an A1-TA Altimeter will be beeping out the maximum altitude in this manner: (1,323 feet) Beep ..... Beep Beep Beep ..... Beep Beep ..... Beep Beep Beep. A zero is indicated with a long Beep: (1,310 feet) Beep ..... Beep Beep Beep ..... Beep ..... Beeeeeep. After each sequence there is a pause before it repeats. The A1-TA beeps out the altitude to the nearest foot. This system works for three, four, or five digits depending on the value.

To simulate rocket liftoff and to see (hear) the unit do its thing, you will need to place the altimeter inside a bottle or other make-shift vacuum chamber, then slowly pull a vacuum on the bottle. You need only hold the vacuum for a few seconds, then release slowly. Several such devices are available from various sources that serve the purpose well. It is easy to simulate rocket flights to altitudes of several thousand feet. Slowly pull the vacuum, then slowly release the vacuum. As the vacuum (altitude) increases, the A1-TA will start beeping at the faster rate of once every 0.8 second to indicate that it has detected liftoff. When it reaches maximum altitude, there will be two quick beeps. Then when the Altimeter starts its descent (vacuum is being released), it starts beeping out the maximum altitude attained above ground.

SPECIFICATIONS

- Altitude Capability: 50 feet to 15,000 feet Above Ground Level (AGL).
- Resolution of Measurement: 4 inches; system uses a logarithmic 18-bit A-to-D converter. Internal measurements and calculations are performed at the resolution of 4 inches. The A1-TA reports altitude to the nearest one foot.
- Altitude Sampling Rate: 10.0 samples per second.
- Launch Detection: due to the super fine resolution of the A1-TA, it is capable of measuring launch velocity and acceleration. To detect a slow launch, it watches the velocity for a period of 3 seconds. Launch detection is at 50 feet for a slow launch with acceleration over one G. An additional launch detect threshold of 150 feet is used for immediate detection of high speed launches. Problems with wind gusts are completely avoided with Adept Rocketry's Wind Burst Glitch Removal™ system.
- Nonvolatile Memory: remembers and reports the altitude of the most recent flight, no matter how long the device has been powered down.
- Mach Compatible: yes - uses Adept Rocketry's proprietary Real Time Dynamic

Lockout™ system that tracks speed in real time to ignore pressure glitches that occur when transitioning through the sound barrier, both in and out. This system is possible due to the extreme precision of 4-inch resolution measurements. Detects apogee at true apogee.

- Calibration Accuracy Over Full Range: better than 0.3 % + 4 feet. Calibration is optimized to the range 500 to 1,200 feet AGL.
- Piezo Beeper reports altitude and operational status. The Beeper uses a push-pull driver for increased volume level, loud enough to serve as a location beacon for a lost rocket.
- Battery Life: 10 hours minimum.
- Advanced on-board Voltage Regulator that is totally immune to reverse voltage (battery in backwards).
- Custom altitude sensor that is immune to light, including direct sunlight.
- Conformal Coating of components to avoid problems with carbon contamination and humidity.
- Measures .55" wide by .62" thick by 2.9" long.
- Fits inside a tube with a minimum ID of .69 inch (17.5 mm), a loose fit in an Estes BT-20 body tube.
- Weight: 6.2 grams. Weight with battery installed is 14.2 grams (0.50 ounce).
- Accessory required: one 12-volt alkaline lighter battery (2 included).
- Warranty is for the lifetime of the altimeter up to 5 years, as long as it remains clean, unmodified, and undamaged.

This device is intended to be installed lengthwise in a small rocket tube. It fits inside an 18 mm or BT-20 tube. When it is to be used in a larger diameter body tube, it may be mounted in any orientation. It may be mounted inside a BT-20 tube that is connected to bulkheads or other structural elements. Also, it may be wrapped with or rolled up in foam rubber or paper towels before being slipped into a larger diameter tube. This has the advantage of additional protection against crash damage, and contamination. The Altimeter will still be able to "breathe" through the porous materials. The Altimeter will still work normally.

When installing lengthwise, always mount the Altimeter with the spring end of the battery holder facing upward toward the nose end of the rocket.

An Altimeter must be mounted in a "sealed" chamber with a vent or vents to the outside. A sealed bulkhead below the altimeter chamber is necessary to avoid the vacuum caused by the aft end of a rocket during flight. A sealed bulkhead above the altimeter chamber is necessary to avoid any pressure fluctuations that may be created at the nose end of the rocket. If the front of the payload section slip fits to another section such as a nosecone, then the fit must be as free as possible from turbulence. A breathing hole or vent (also known as a static port) to the outside of the rocket must be in an area where there are no obstacles above it that can cause turbulent air flow over the vent hole. Do not allow screws, ornamental objects, or anything that protrudes out from the rocket body to be in line with and forward of a vent hole. Vents must be neat and burr free and on an outside surface that is smooth and vertical where airflow is smooth without turbulence. Some rocketeers use multiple static ports (vent holes) instead of just one. Very strong wind blowing directly on a single static port could affect the Altimeter. Multiple ports evenly spaced around the rocket tube may help cancel the effects of strong wind on the ground, the effects of transitioning through wind shears during flight, the pressure effects of a non-stable liftoff, or the pressure effects that occur due to flipping and spinning after deployment. If you wish to use multiple ports, then use three or four. **Never use two.** Ports must be the same size and evenly spaced in line around the tube.

The general guideline for choosing port size is to use one 1/4 inch diameter vent hole (or equivalent area, if multiple holes are used) per 100 cubic inches of volume in the altimeter chamber. For instance, an eight-inch long four-inch diameter tube has a volume of about 100 cubic inches. Use one 1/4 inch port, or three or four 1/8 inch ports evenly spaced around the

tube. An altimeter chamber two inches in diameter and eight inches long (25 cubic inches) needs one 1/8 inch vent hole or three or four 1/16 inch vent holes. Try to keep hole sizes within -50% or +100% of the general guideline. Do not make the holes too small, and **especially do not make them too large**. Obviously, a vent or vents in a BT-20 (18 mm) body tube will be quite small.

Vent holes should be a minimum of four body diameters below the junction of the nosecone with the rocket body. This is necessary with high performance (high speed) rockets. The tremendous pressure on the nosecone leeches down the rocket body as much as four diameters before it dissipates. With lower speed rockets, the "minimum of four body diameters" rule may be reduced to one or two.

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