

## Temporarily Out of Production

### Adept Instruments - ALT2R Instructions and Data Sheet

#### Precision Recording Altimeter, Model ALT2R



This printed image is approximately actual size. It is shown with a MEM2R Memory Module installed in the connector at the right end of the device.

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**Price: \$99.00 - Includes ALT2R Recording Altimeter™, 1 MEM2R Memory Module, 1 CABUSB Downloading Cable with Software, and 2 GP-23A Batteries.**

#### DESCRIPTION

The ALT2R is a precision Recording Altimeter designed for use in rockets. It precisely measures and stores altitude readings for 45 seconds at a rate of 10 samples per second. Data are stored in a removable nonvolatile Memory Module (MEM2R), and at the end of a flight the ALT2R reports the maximum above-ground altitude value obtained during the flight. After a flight the Memory Module is removed and plugged into a special downloading cable that connects to an IBM compatible personal computer. Data files downloaded to the P.C. include Raw Altitude, Enhanced Altitude, vertical Velocity, and vertical Acceleration. Included software allows tabulation, plotting and printing of data vs. time. The files are also available in standard format for use in spread sheets and other programs.

The instrument is used in rockets that will reach at least 30 meters altitude. This altimeter may be used in any rocket configuration including multistage rockets, in which case maximum altitude information about a particular stage can be obtained by placing the device in the particular stage of interest. Or individual units (or other altimeter devices) may be placed in each stage of interest to report maximum altitudes obtained by each stage. The device runs on a 12-volt alkaline lighter battery, and the battery life is in excess of four hours, so you need not be concerned about how long your rocket sits on the launch pad after the Altimeter is powered up. The ALT2R is a totally stand-alone device.

The ALT2R uses a custom absolute pressure device to precisely measure and report altitude values. It uses a 16-bit logarithmic analog-to-digital converter to precisely (resolution of one-tenth of one meter) measure the nonlinear pressure versus altitude relationship over the altitude range. Once powered up, the instrument constantly measures and stores values, and waits for a quick change upward. It then records data for an additional 45 seconds, captures the maximum altitude obtained (above ground zero), then 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 ALT2R

NOTE 1: The precision amplifier circuitry on the instrument may be sensitive to noise and

static when being held. A 10-second silent time following power up gives time to get your hands off the unit before it starts taking readings. *Always handle the device by the edges when testing or installing to avoid touching any of the circuitry. Avoid carpeted floors and other sources of static electricity when handling and testing the device. **Never store the device in a clear plastic bag**; however, pink-colored or smoke-colored antistatic bags are ideal. Storage in a small cardboard box, or wrapped in a paper towel inside a plastic bag is acceptable. Do not use Velcro to secure the device. Use care to keep the device clean and dry.*

NOTE 2: This device must be installed only in a "clean area." *Electronic Instrumentation is not compatible with the fumes and residue created by rocket motors and deployment charges. **The ALT2R must be installed in an area that is totally sealed from motors and deployment charges.***

Install a MEM2R memory Module in the 5-pin connector. 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 when not in use to turn off the device and to avoid prolonged stress on the battery holder and possible long-term disfigurement of the battery holder. When the battery is first installed, there will be a long beep to indicate that power is on. Then after 10 seconds, the unit will beep every 1.6 seconds to indicate that it is recording data and is ready to start looking for a quick increase in altitude. The 10-second pause after power up gives the user time to slip the unit inside the rocket tube before it starts looking for liftoff. **For best data logging results with this super precision device, allow 3 minutes for the unit and its sensor to "warm up" before launching.**

A quick increase in altitude tells the unit it has liftoff, and to record data for an additional 45 seconds. The change in pressure may be very small, and wind blowing directly on the Altimeter can cause a false start. The problem is usually avoided when the unit is inside the rocket. When liftoff is detected, the beeping rate speeds up to a rate of one beep per 0.8 second. Always listen before launching to assure that the Altimeter is beeping at the slower rate. If it is beeping at the faster rate, then something has caused a false liftoff detection. In this case, the Altimeter must be removed from the rocket and restarted.

The ALT2R starts recording at power-up. It constantly measures the ground-level altitude and waits for a quick change upward. It then precisely captures the maximum altitude obtained above ground zero. The ALT2R uses the proprietary technique of beeping out (blinking on some device models) a value to report the maximum altitude value. The beeps can be heard even when the unit is still inside the rocket.

After a flight, the ALT2R will be beeping out the maximum altitude in this manner: (1,325 meters) Beep ..... Beep Beep Beep ..... Beep Beep ..... Beep Beep Beep Beep Beep. A zero is indicated with a long Beep: (1,310 meters) Beep ..... Beep Beep Beep ..... Beep .....Beeeeeep. After each sequence there is a long pause before it repeats. This system works for three, four, or five digits depending on the value. **This beeping system is copyrighted and patented, and is a registered trade mark of Adept Instruments, Inc.** The value beeped out is in meters to the nearest unit of one meter. However, all values recorded and calculated have ten times the resolution of one meter. Values are recorded and saved in files to a resolution of one-tenth of one meter.

**To simulate rocket liftoff** and to see (hear) the unit do its thing, it is necessary to pull a vacuum on the top of the pressure sensor (the black gizmo with four pins). A quarter-inch diameter piece of plastic or rubber tubing can be used. You need only hold the vacuum for a few seconds, then release slowly. However, the best method is to put the device inside a small bottle, and pull a vacuum on the bottle (or you may use an Adept VACBOT Vacuum

Chamber). 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 beeping will speed up to indicate that the Altimeter has detected liftoff. Then after an additional 45 seconds it starts beeping out the maximum altitude attained above ground.

## **AFTER A FLIGHT OR A SIMULATED FLIGHT**

If the Altimeter is not yet beeping out the maximum value, then wait the remainder of the 45-second recording time before retrieving or handling the device. Count the beeps to get the maximum altitude, and make note of the value. Immediately remove the Memory Module to assure that it cannot be affected in case of an accidental restart (usually when you are trying to remove the battery). Then you may remove the battery to turn off the instrument. Plug the Memory module into the end of the Downloading Cable. Plug the Cable into an available USB Port on the P.C. Then run the Adept software, **ALT2R.exe**.

## **THE SOFTWARE**

The software and USB driver first must be installed. See the ReadMe.txt file on the distribution disc. It will direct you to the Installation Instructions which are also on the disc.

## **SPECIFICATIONS**

- Altitude Capability: to 5,000 meters Above Ground Level (AGL), to limit of 5,000 meters Above Sea Level (ASL).
- Lowest Maximum Altitude Readable: 30 meters. Liftoff is detected when the altitude quickly increases by 30 meters. Mach compatibility: yes - captures maximum altitude at true apogee.
- Resolution of Measurement: one-tenth of one meter; system uses a logarithmic 16-bit A-to-D converter.
- Accuracy Over Full Range: +/- 5% of reading with all atmospheric, barometric, temperature, and other conditions considered. Calibration accuracy is +/- 2%, typical.
- Piezo Beeper reports maximum altitude and operational status.
- Battery Life: 4 hours minimum.
- Measures 0.85" wide by 0.65" thick by 3.35" long.
- Weight: 10.7 grams. Weight with battery and Memory Module installed: 19 grams (0.67 ounce).
- Fits inside a tube with a minimum ID of 0.86 inch (21.8 mm), a loose fit in a 24 mm or Estes BT-50 body tube.
- Accessories required: one 12-volt alkaline lighter battery, one MEM2R Memory Module, CABUSB Downloading Cable and Version 5 or later software for the ALT2R.

## **NOTES ON MOUNTING AND INSTALLING**

This device is intended to be installed lengthwise in a small rocket tube. It fits inside a 0.86 inch (21.8 mm) minimum ID tube; it is a loose fit in a 24 mm or BT-50 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-50 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, or contamination. The Altimeter will still be able to "breathe" through the porous materials. The Altimeter will still work normally.

**Do not use Velcro as a mounting device.** When installing lengthwise, always mount the Altimeter with the spring end of the battery holder facing upward toward the nose end of the

rocket. This will avoid compression of the spring and battery disconnection during a very high acceleration liftoff.

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 air flow 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. Keep hole sizes within +100% or -50% of the general guideline. Do not make the holes too small, and **especially do not make them too large.** A vent or vents in a BT-50 (24 mm) 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.

## LIMITED WARRANTY AND DISCLAIMER

Adept Instruments, Inc. warrants to the original purchaser that this product is free of defective parts and workmanship and that it will remain in good working order for a period of 90 days from the date of original purchase. This product will be repaired or replaced within 90 days of purchase if it fails to operate as specified, if returned by the original purchaser and if it has not been damaged or modified, or serviced by anyone other than the manufacturer. Adept Instruments, Inc., their owners, employees, vendors and contractors shall not be liable for any special, incidental, or consequential damages or for loss, damage or expense directly or indirectly arising from customer's or anyone's use of or inability to use this device either separately or in combination with other equipment, or for personal injury or loss or destruction of other property, for experiment failure, or for any other cause. This device is sold as an experimental accessory only, and due to the nature of experimental carriers such as rockets, the possibility of failure can never be totally removed. It is up to the user, the experimenter, to use good judgment and safe design practices and to properly pretest the device for its intended performance in the intended vehicle, or reasonable facsimile of same, under controlled conditions to gain reasonable belief that the device and vehicle will perform in a safe manner, and to assure that all reasonable precautions are exercised to prevent injury or damage to anyone or anything.

**WARNING:** Do not use this device unless you completely understand, agree with, and accept all of the above statements and conditions.

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