



# Motor Testing

*Static and In-Flight Motor Performance Testing*

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# Chapter 1. Introduction and Overview

Welcome to the Altus Metrum community! Our circuits and software reflect our passion for both hobby rocketry and Free Software. We hope their capabilities and performance will delight you in every way, but by releasing all of our hardware and software designs under open licenses, we also hope to empower you to take as active a role in our collective future as you wish!

Thank you for your interest in motor testing products from Altus Metrum. Our first such product is EasyMotor, an in-flight motor data collection board for hobby rockets. EasyMotor is a small circuit board that is meant to log motor chamber pressure and rocket acceleration during flight. With this data it's possible to determine whether a research motor is performing as expected. With additional information about masses and airframe drag, it is even possible to closely estimate complete motor performance.

With EasyMotor, the dilemma of “do I burn this on a test stand to learn more about how it actually works, or do I go fly it” is no more! You can fly your motor and get real performance data about it too!

Because documentation is just as prone as software to contain “bugs”, and can always be improved... If you have questions that aren't answered in this manual, or just need a little help figuring things out, we strongly suggest joining the Altus Metrum user email list, which you can do by visiting <https://lists.gag.com/mailman/listinfo/altusmetrum>.

## Chapter 2. Configuration

There is very little that must be configured to make EasyMotor work. In fact, the default configuration from the factory is typically sufficient without change.

### 2.1. Connecting to a Unit

To change any EasyMotor configuration, you need to attach a battery and a power switch, then use a micro USB cable to connect the board to a computer running AltosUI.

### 2.2. Changing the Configuration

All available configuration options can be set using the “Configure Altimeter” menu selection within the AltosUI program.

## Chapter 3. Installation

EasyMotor needs to be rigidly attached in the airframe, and the long axis of the circuit board needs to be aligned with the axis of flight. By default, the round beeper on the board should be “up” towards the nose cone, and the screw terminal strips should be “down” towards the fins and motor nozzle end of the rocket.

### 3.1. Power Switch and Battery

In addition to the circuit board itself, EasyMotor needs a power switch and battery to operate. Unlike most other Altus Metrum products, EasyMotor does not work with single-cell LiPo batteries. That’s because commonly available inexpensive pressure sensors need 5V, which is more than a single-cell LiPo provides. Any battery that provides from 6.5 to about 15 volts should work. Good choices are the common 9V alkaline battery, or the very small and light A23 12V alkaline batteries.

Because he often mounts EasyMotor to the motor’s forward bulkhead instead of to the airframe itself, Bdale often uses a length of “shooter wire” from an e-match or used motor igniter as a power switch, routing the wire out of the typical fin can vent hole and using “twist and tape” to power up the board. Whatever works!

### 3.2. Pressure Sensor

The primary motivation for designing EasyMotor was to have a reliable way of recording motor chamber pressure during flight. To that end, EasyMotor supports attachment of a low-cost analog pressure sensor. The board provides 5V to power the sensor, and an input for measuring and logging the output voltage from the sensor.

The kind of sensor EasyMotor is designed to work with takes 5V in and has a linear analog output that ranges from 0.5V at 0 to 4.5V at the maximum pressure supported by the sensor. Very inexpensive sensors that have a “1/8 NPT” threaded input, a “Buick-style” 3-pin connector, and typically ship with a short cable and mating connector, are readily available on eBay and AliExpress.

To log in-flight chamber pressure, a typical approach might be to drill a 1/8" sampling hole all the way through the center of the motor’s forward closure, then drill and tap partially through the closure with a “1/8 NPT” pipe tap. Fill the touch hole with grease, screw in the pressure sensor, and attach the sensor leads to EasyMotor.

## Chapter 4. Operation

Operating an EasyMotor board is pretty easy. Turn the power on before launch, typically during the usual pre-flight electronics checklist after the rocket is installed on a launch rail.

The board will beep out a Morse code “P” every few seconds indicating that it’s in pad mode and ready to detect launch. Once launch is detected, the board logs pressure and acceleration data 100 times per second throughout the flight.

After flight, AltosUI can be used to download the flight data, then export it to a comma separated values (CSV) file. Such a file can easily be loaded into a spreadsheet for analysis.