ZeptoMag User Manual

Introduction

The ZeptoMag is an electronic device which detects when a rocket turns over at apogee and fires the ejection charge. It can also deploy based on a timer starting at launch detect.

This manual was last updated 26th April 2014. If that's not recent or if your ZeptoMag doesn't have a 1.x version number you may want to check www.zeptobit.com an updated version.

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Features

- Detects when the rocket turns over at apogee by measuring the Earths magnetic field.
- 2 high current (5A) pyro channels.
- Fires one pyro channel at apogee.
- Fires second pyro channel as backup for the first or as set by a timer.
- Accelerometer for launch detect, prevents pyro channels from firing when handling the rocket and starts timer at launch.
- On-board LED will turn on when the ZeptoMag is pointing below the horizon. Makes it easy to verify correct operation.
- Easy calibration function. Hold the board at the angle you wish to deploy and press the button. Allows adjusting for different magnetic fields worldwide and to deploy at the angle you choose.
- Magnetic sensor resets several times per second to avoid errors from temporary exposure top magnetic fields.
- Small size: 39.4 x 12.7mm. Fits inside a 13mm ID tube (BT-5).
- Capacitor to supply power in case of momentary loss of power during flight or drop in battery voltage when firing the pyro channels.

Battery and power

	Minimum	Typical	Maximum
Battery voltage	2.8V	3-13V Recommended.	16V Permanent damage if exceeded.
Current use	450µA While firing pyro channels.	1.5mA Ground or flight, LED off.	4.5mA Ground, while LED on.

The ZeptoMag has an on board regulator supplying 2.5V to the microcontroller and the sensors. Because of the voltage drop in the regulator and the input diode, a battery voltage of at least 2.8V is required. Lower voltages will not cause any permanent damage, but the ZeptoMag may not function correctly.

Recommended voltage is 3-13 volts. Never exceed 16 volts, it may cause permanent damage.

Recommended number of cells: LiPo: 1-3, Alkaline/NiCd/NiMh: 3-8

When selecting batteries it is important to consider not only the nominal voltage, but also the maximum and minimum voltage. For example, a LiPo cell has a nominal voltage of 3.7V, but it will be 4.2V when fully charged and drop as low as around 3V when fully discharged. So while it would appear safe to use a 4 cell LiPo battery based on the nominal voltage, it would actually exceed 16V when fully charged.

When selecting a battery it is important that it can provide enough current to reliably fire your e-matches/igniters.

Verify and set the apogee detection angle

While the ZeptoMag is powered up but have not yet detected launch, the LED will turn on whenever it points below the horizon. You can use this to verify that it will detect apogee at an acceptable angle.

If you wish to change the angle it fires at, hold it at the desired angle and press the button >0.5 seconds. Verify that the angle is correct.

The button is small and it may be easier to push it using a screwdriver or a similar object, but do not use a magnetic screwdriver or another magnetic object to push the button.

The ZeptoMag shout be mounted with the arrow on the back of the board pointing up when used on the northern hemisphere. When used on the southern hemisphere the ZaptoMag must be mounted with the arrow pointing down. The accelerometer based launch detect will work in either orientation. Do not mount the board at any other angles.

The pyro channels

The ZeptoMag has two pyro channels. Both are capable of sourcing 5A (amperes). The terminals labeled P1+ and P1- are connected directly to the Bat+ terminal and therefor to the positive terminal of your battery. When firing the pyro channels, P1- and P2- will be connected to Bat- (the negative terminal of the battery) and current can then flow trough your igniter.

The ZeptoMag has a capacitor to supply power in case of momentary loss of power during flight or drop in battery voltage when firing the pyro channels. This prevents unintentional restart/shut down.

The pyro channels will never fire simultaneously. This is to avoid misfire if the battery can not supply enough current to fire two igniters/e-matches at the same time.

To avoid damage to the ZeptoMag and to ensure reliable firing of your igniters you should use igniters/e-matches which draws less than 5 amperes.

Testing the pyro channels
It is important to test the ZeptoMag together with the e-match/igniter and battery you will use to verify that the combination will reliably fire. There is a 2 minute delay before the pyro channels fire. This delay is intended to give you enough time to prepare the rocket for testing parachute ejection as well as time to disconnect the power if you don't intend to fire the pyro channels.

Pyro1: Always fires at apogee as detected by the magnetic sensor.

Pyro2: By default it fires immediately after Pyro1 as a backup.

It can also be configured to be fired by a timer. The timer delay can be set to 0 seconds to 9 hours in 0.5 second increments. Because of this the timer will fire after 0.1 seconds if set to fire at 0 seconds. Longer delays are exact within 2%.

The timer starts when the accelerometer detects launch. A continuous acceleration of at least 1.5G for 100ms is required for launch detect.

To allow the unit to be mounted upside down for Southern hemisphere use it will detect acceleration in either direction. Normal handling of the rocket will usually not get close to generating 100ms of continuous acceleration in one direction, but there are some exceptions. If you place the rocket on a launch rail and drop it or in some other way slide it quickly up or down tha rail, this will likely cause the ZeptoMag to detect launch.

To set the Pyro2 in timer mode and set the delay:
- Connect your battery.
- Press the button for >10 seconds. *The LED will blink slowly 4 times to confirm.*
- Press the button once for each 0.5 second of delay. If you want 0 second delay (fire at launch detect), don't press the button.
- *10 seconds after you last button press the LED will start blinking slowly. There will be one blink for each 0.5 second of delay. If delay is set to 0 seconds (launch detect) it will instead*

blink rapidly for 1 second.

To set Pyro2 to fire at apogee:
- Connect your battery.
- Press the button for >5 seconds. *The LED will blink slowly 2 times to confirm.*

To test the pyro channels:
- Connect your e-matches/igniters.
- Connect your battery.
- Press the button for >20 seconds. *The LED will blink rapidly for 2 minutes. Then Pyro1 will fire for 2 seconds, followed by Pyro2 for 2 seconds. This will happen regardless of the orientation of the ZeptoMag.*

Button functions

Set angle	Hold the ZeptoMag at the angle you want it to detect apogee. Press button for >0.5 sec.
Pyro2 fired at apogee	Press the button for >5 seconds. *The LED will blink slowly 2 times to confirm.*
Pyro2 fired by timer	Press the button for >10 seconds. *The LED will blink slowly 4 times to confirm.* Press the button once for each 0.5 second of delay. If you want 0 second delay (fire at launch detect), don't press the button. *10 seconds after you last button press the LED will start blinking slowly. There will be one blink for each 0.5 second of delay. If delay is set to 0 seconds (launch detect) it will instead blink rapidly for 1 second.*
Test pyro channels	Press the button for >20 seconds. *The LED will blink rapidly for 2 minutes. Then Pyro1 will fire for 2 seconds, followed by Pyro2 for 2 seconds. This will happen regardless of the orientation of the ZeptoMag.*
Reset	Press the button for >30 seconds. *The LED will blink slowly until you disconnect the battery.* Disconnect the battery and connect it again. *All settings have been reset to the default values.*

Schematic