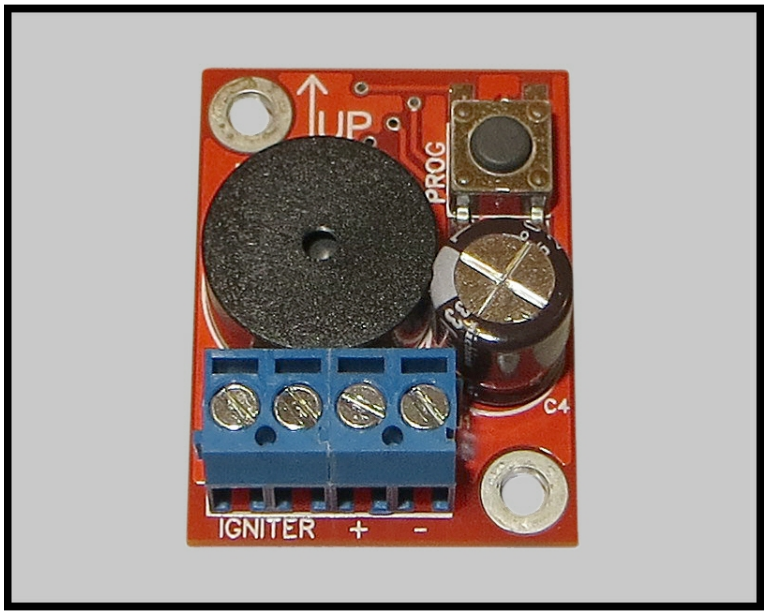
MiniTimer4 Users Manual



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The PerfectFlite miniTimer4 is a small sized, high current, accelerometer-based digital timer for rocketry applications. It can be used to ignite air-started clusters, sustainer motors in multistage rockets, or for recovery device deployment. The time delay is easily programmed from 0 to 99.9 seconds in 0.1 second increments, and the timer can also be configured to begin timing from detection of movement (ignition) or from burnout of the primary motor. Timing from ignition is typically used for igniting airstarts that overlap their burn with the primary motor (to provide increased initial thrust), and timing from burnout is used for delayed airstarts (for staggered ignition effects), staging, and recovery device deployment.

After flight, the timer reports the maximum acceleration (in "G"s) and the maximum speed (in MPH) encountered. It alternates reporting these values with a warbling siren sound that can make locating your rocket easier (particularly useful if it is hidden in tall grass or other vegetation).

Please take the time to read this brief manual in order to familiarize yourself with the proper operation of the timer. In particular, pay special attention to the "caution" statements that are highlighted throughout the document. It is also a good idea to spend a few minutes at your workbench setting up the timer with a 9V battery and a small lightbulb to become familiar with the programming and operation of the timer before installing it in your rocket.

Programming The Timer

The timer has a single programming button which allows you to set the triggering option and time delay period. Hold down the button (and keep it held down) as you apply power to the timer to enter programming mode. The timer will emit a constant tone while the button is held down.

Setting the Trigger Option

Release the button and the tone will stop. Promptly (within 3 seconds) tap the button once for trigger on ignition, or twice for trigger on burnout (a tone will sound while you are pressing the button for audible confirmation). If you wait longer than three seconds, the timer will not alter the trigger option and will use the saved trigger option from the previous time that it was programmed.

Setting the Time Delay

After the trigger option is set (or left unchanged), the timer will emit a long beep to signify that it is ready for programming the time delay. When the beep stops, promptly enter the first digit of the time delay (in tenths of a second) by tapping the button the corresponding number of times (e.g. five times for digit 5). After a couple of seconds you will hear a short beep to prompt you for the next digit. Tap in the second digit, wait, and you will be prompted for the third digit. If you are entering a delay of less than one second, you can skip the second and third digits. If you are entering a delay of less than ten seconds, you can skip the last digit. *Note: The digit "0" (e.g. for 3.0 seconds or 20.5 seconds), is entered by tapping the button ten times.*

Once the new time delay is set, it is stored in nonvolatile memory and is retained even after power is disconnected. The time delay and trigger option do not need to be re-set unless you want to change them to different values.

After the timer programming is complete, the timer will go into normal operating mode and report its settings (refer to the next section on Operating the Timer).

Programming Examples

For a delay of 0.5 seconds (5 tenths of a second) from ignition:

* Turn on power with button down. Timer makes continuous tone.
* Release button. As soon as tone stops, tap button once for trigger on ignition mode.
* Timer makes long tone. As soon as tone stops, tap button five times for first digit “5”.
* Timer will make short beep to prompt you for next digit. Since there are no additional digits, you don’t have to do anything.
* Timer will go into flight-ready mode, reporting settings and battery voltage (see next section).

For a delay of 1.7 seconds (17 tenths) from burnout:

* Turn on power with button down. Timer makes continuous tone.
* Release button. As soon as tone stops, tap button twice for trigger on burnout mode.
* Timer makes long tone. As soon as tone stops, tap button once for first digit “1”.
* Timer will make short beep to prompt you for next digit. Tap button seven times for second digit “7”.
* Timer will make short beep to prompt you for next digit. Since there is no third digit, you don’t have to do anything.
* Timer will go into flight-ready mode, reporting settings and battery voltage (see next section).

For a delay of 20.8 seconds (208 tenths) from burnout:

* Turn on power with button down. Timer makes continuous tone.
* Release button. As soon as tone stops, tap button twice for trigger on burnout mode.
* Timer makes long tone. As soon as tone stops, tap button twice for first digit “2”.
* Timer will make short beep to prompt you for next digit. Tap button ten times for second digit “0”.
* Timer will make short beep to prompt you for next digit. Tap button eight times for third digit “8”.
* Timer will go into flight-ready mode, reporting settings and battery voltage (see next section).

Operating The Timer

Caution: Always ensure that the battery is connected properly before powering up the timer . If the polarity is reversed (swapping "+" and "-" connections), the timer will not be harmed, but it will energize the igniter as soon power is connected. Before connecting an igniter, turn on the timer and insure that it starts up properly (makes normal startup beeps), then turn it off and connect the igniter. If it does NOT make any sound on power-up, check, correct any wiring problems, and re-test BEFORE connecting any igniter(s).

As long as the programming button is NOT held down during power-up, the timer will enter normal operating (flight-ready) mode.

When powered up, the timer emits a long tone, then reports its trigger mode with a single beep (trigger on ignition) or two beeps (trigger on burnout). It then emits another long tone, and then reports a one to three digit time delay in tenths of a second, with a pause between each digit. Each digit is reported by a series of beeps – one beep for the number "1", two beeps for the number "2", and so on. The number "0" is represented by ten beeps. Example: The two digit number "26" (2.6 seconds) would be reported by two beeps, a pause, and then six beeps.

After the time delay is reported, the timer emits another long tone and then reports the battery voltage in tenths of a volt (e.g. nine beeps, pause, one beep = 91 tenths or 9.1 volts).

At this point the accelerometer data is checked to confirm that the timer is installed properly ("UP" arrow pointing upwards). If there is a problem, the timer will sound a ten second warbling siren to alert you that you may have installed it incorrectly. If you hear this siren, turn the timer off and check your installation. The "UP" arrow must be facing upwards, towards the tip of the nosecone.

The timer will then check for proper continuity on the igniter circuit, and will sound a periodic "beep" while awaiting launch to indicate good continuity. If you don't get a periodic beep, turn the timer off and check your igniter and associated wiring for an open circuit.

> ***Caution: Never press the program button while the continuity beeps are sounding and a live motor/igniter is connected to the timer. You could activate the TEST feature (see section on testing) and ignite the motor prematurely.***

When your rocket is launched, the timer will detect ignition or burnout (as configured) and wait the preset delay period before sending power to the igniter. The igniter power is turned on for one second, then turned off, to prevent damage or battery drain in the case of a shorted igniter.

When the timer has sensed that the rocket has slowed and is near apogee, it will begin reporting the peak acceleration (in tenths of a "G"), peak speed (in miles per hour), and will then sound a 10 second rocket locater siren. This sequence is repeated until the power is switched off.

Installation

Mount the timer securely in your rocket using the included mounting hardware. Make sure that you will be able to access the timer readily for programming and testing. *The "UP" arrow on the timer must face towards the tip of the nosecone.* When using the timer for igniting the sustainer motor of a multistage rocket, mount the timer and battery in the sustainer rather than the booster, so the igniter does not get pulled out of the sustainer motor before it comes up to pressure on ignition.

Battery

The battery is connected to the two terminals closest to the mounting hole, observing proper polarity ("+" and "-"). A suitable switch should be wired in series with the battery to provide an ON/OFF function. Make sure that the switch you use is capable of handling the current that you will be putting through it. All connections must be tight and secure (preferably clamped in terminal blocks and/or soldered). Since the battery may have a significant amount of mass make sure it is secured properly against acceleration forces.

> ***Caution: Always ensure that the battery is connected properly before powering up the timer . If the polarity is reversed (swapping "+" and "-" connections), the timer will not be harmed, but it will energize the igniter as soon power is connected. Before connecting an igniter, turn on the timer and insure that it starts up properly (makes normal startup beeps), then turn it off and connect the igniter. If it does NOT make any sound on power-up, check, correct any wiring problems, and re-test BEFORE connecting any igniter(s).***

Igniters

The igniter(s) are connected to the terminal block labeled "IGNITER". For recovery device deployment, nearly any low current electric match or substitute can be used. Motor igniters for staging and airstarts need to be chosen more carefully, there are a number of variables involved. Small composite motors require very thin igniters to pass up into the core of the propellant, while larger composite motors require much larger igniters to insure adequate amounts of pyrogen to guarantee proper ignition. In addition, the igniter's current requirements need to match the current capabilities of your battery so the battery can fire the igniter as soon as it is energized. For example, you would not want to use an Aerotech First Fire or Copperhead igniter (intended for ground based ignition using a high current 12 volt lead-acid battery) with a 9V alkaline battery. You also would not want to use an igniter/battery combination that slowly heats and ignites after nearly a second – not only will this increase the effective delay time to ignition but if the battery is cold or there is variation in the igniter it may not ignite at all. You want an igniter that fires *immediately* when battery power is applied!

Make sure you test your igniter/battery combination on the ground (see section on testing) before flying in your rocket. If you encounter *any* problems with reliability or delayed ignition, choose a different battery or igniter! Remember, it is always best to use a proper low current, fast acting igniter – it will increase overall reliability and reduce the weight and size of the battery that is required.

With proper low current igniters, a simultaneous airstart of 20 or more motors can easily be achieved with a lithium-polymer battery weighing less than one ounce. There is more information on making low current electric match substitutes and low current igniters in the "Downloads" section of the PerfectFlite website.

Wiring

Keep all wiring as short as possible to minimize power loss due to wire resistance. Installations using low current igniters can be wired with 24 to 22 gauge wiring, but for higher current applications 18 gauge wire is preferred. It is good practice to secure heavier gauge wire to the avionics sled or airframe with nylon wire ties to prevent pulling on connection during acceleration.

Testing

The miniTimer4 can be tested in two ways; a swing test which will test the entire timer from accelerometer to igniter output, and a firing test which is used primarily for validating the battery/igniter combination you have chosen.

Swing Test

The swing test is easiest to perform with the timer removed from your rocket (swinging a large rocket in a circle with the nosecone facing in towards the center of the circle can be quite cumbersome if not impossible!). To perform the swing test, connect a small lightbulb (e.g. mini XMAS bulb) to the igniter terminals in place of an igniter to provide visual indication of firing. Power up the timer in normal operating

mode (arrow facing UP, program button NOT pressed) and wait until the continuity beeps start. With the timer oriented such that the "UP" arrow is pointing towards the center of rotation (your shoulder), swing the timer in a circle with the arrow continuing to point inwards throughout the entire rotation. You will need to complete one arm's length of rotation in about one second to generate enough centripetal acceleration to trigger the timer. When the timer has been triggered, the time delay will count down and the lightbulb will light, confirming proper operation of the timer.

Firing Test

The firing test bypasses the accelerometer and allows you to simulate launch using the Program button. The firing test can be used to confirm that the delay time has been set as desired and that the igniter and battery are properly matched.

To perform the firing test, connect your battery and igniter to the timer. Make sure the igniter is NOT installed in a motor and is in a fireproof place (e.g. coffee can). Turn the timer on in normal operating mode (arrow facing UP, program button NOT pressed) and wait until the continuity beeps start. Hold the program button down and a constant tone will sound. After approximately three seconds the tone will stop, indicating that the timer has been triggered. The timer will then count down the preset time delay and energize the igniter output for one second, igniting the igniter. If the igniter doesn't fire, or fires lethargically, a more powerful battery or a more sensitive igniter are required. It is good

practice to test with two igniters in parallel for every one that you plan on using in your rocket – if the battery can fire two igniters simultaneously during testing then it will be able to fire a single igniter in flight with a good safety margin.

Note: Since the accelerometer was bypassed by the manual trigger, the reported acceleration and speed values after the firing test will be zero.

Specifications:

Power:	5V – 16V
Current consumption:	4.5 ma
Maximum time delay:	99.9 seconds
Timing accuracy:	+/- 2% typical
Output “on” time:	1.0 second
Output “on” resistance:	4 mΩ typical
1 second firing current:	45 amperes maximum
10 ms firing current:	65 amperes maximum
1 ms firing current:	100 amperes maximum
	(all current must be supplied by battery)
Trigger threshold:	2.0G for 500ms
	4.0G for 250ms
	5.0G+ for 200ms
Sample rate:	100 samples per second
Maximum acceleration:	15G (best accuracy)
Maximum acceleration:	23G (before saturation)
Maximum acceleration:	100G (for timer functionality)
Operational temperature:	-40C to +85C (-40F to +185F)
Dimensions:	1.2”L x 0.9”W x 0.6”H
Weight:	0.25 oz.

Warranty

All PerfectFlite products include a full three year/36 month warranty against defects in parts and workmanship. Should your PerfectFlite product fail during this period, call or email our Customer Service department for information about returning your product. The warranty applies to the PerfectFlite product only, and does not cover the rocket, motor, or other equipment. This warranty does not cover damage due to misuse, abuse, alteration, or operation outside of the recommended operating conditions included with your product.

Liability

Due care has been employed in the design and construction of this product so as to minimize the dangers inherent in its use. As the installation, setup, preparation, maintenance, and use of this equipment is beyond the control of the manufacturer, the purchaser and user accept sole responsibility for the safe and proper use of this product. The principals, employees, and vendors of the manufacturer shall not be held liable for any damage or claims resulting from any application of this product. If the purchaser and user are not confident in their ability to use the product in a safe manner it should be returned to the point of purchase immediately. Any use of this product signifies acceptance of the above terms by the purchaser and user.