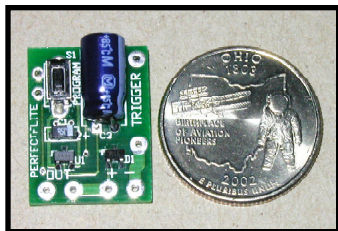
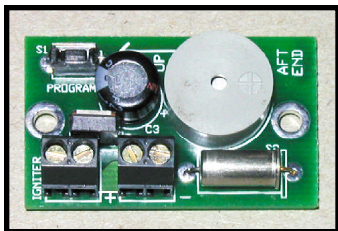


microTimer2 / miniTimer3 User's Manual

Miniature digital timers for auxillary motor ignition or recovery deployment.



microTimer2



miniTimer3

PerfectFlite

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Sales: sales@perfectflite.com
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Congratulations on the purchase of your new staging/ejection timer. Please read these instructions carefully before attempting to use the timer to insure safe and successful operation.

These timers can be used in a number of applications:

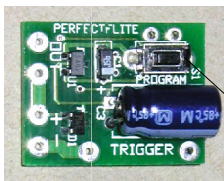
- o **Ignition of upper stages in multi-stage rockets.**
The first stage (booster) motor is ignited conventionally on the pad. The timer is triggered as the rocket rises, beginning its timing cycle. After the user-programmed interval (coincident with booster motor burnout), power is applied to the next stage's ignition system. Electronic ignition of the upper stage allows for staging of composite propellant motors and the use of longer booster sections which are not generally suitable for conventional "burn-through" (gap) staging techniques.
- o **Airstart ignition of auxillary motors in clustered rockets.**
The main motor is ignited conventionally on the pad, and the timer is triggered as the rocket lifts off. After the programmed time interval additional motors in the cluster are ignited by the timer, providing an extended burn time for greater altitude.
- o **Electronic deployment of recovery devices.**
The timer is activated at liftoff. After the programmed time interval power is provided to an ejection charge to deploy the parachute. The timer provides a wider range of precise, repeatable delay times than that which is available with the motor's built-in delay. Keeping an assortment of motors with different delay times is no longer necessary. Since the motor ejection charge is not used, the problem of delay "blow-by" causing premature ejection is eliminated.
- o **Redundant deployment of recovery devices.**
An altimeter or accelerometer provides the primary recovery system deployment, and the timer ignites an additional ejection charge several seconds "late" as a backup in case of altimeter/accelerometer failure.

Features

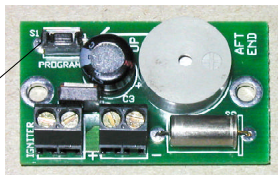
- **Easy to set delay time**
The delay time can be quickly set in the field and is reported numerically for confirmation after setup.
- **Audible or visual continuity indication**
The continuity of the igniter circuit is checked and reported while awaiting launch. The miniTimer uses a built-in beeper, and the microTimer uses a space-saving LED. An external beeper can be added to the microTimer.
- **Post flight locator siren**
The miniTimer's beeper produces a warbling "hi-low" siren tone after timeout to aid in locating your rocket. The optional external beeper for the microTimer also performs this function.
- **Automatic trigger sense configuration**
The timer determines whether a normally-closed trigger switch (e.g. breakwire) or normally-open trigger (e.g. G switch) is connected and configures itself accordingly.
- **False trigger filtering**
The trigger condition must be met for 0.5 second for the timing cycle to initiate. This eliminates false activations due to trigger switch glitches or momentary activation of a G switch.
- **High current capability**
The timers can switch very high current levels (refer to the specifications section at the end of this manual for exact numbers). This allows the use of multiple parallel-connected igniters for clustered airstarts.
- **High accuracy, nonvolatile setting**
The user-programmed time delay is derived digitally for repeatable, drift-free performance. The delay setting is stored in nonvolatile EEPROM and is retained even with power off.
- **Small size, light weight**
Allows for easy installation in virtually any application. Mounting hardware is supplied with the miniTimer.

Operation

When power is applied to the timer it will enter one of two modes depending on the state of the “program” button. If the button is held down when the timer is powered up, it will enter “program” mode to enable the setting of the delay time. If the button is not held down on powerup, normal timer mode will commence. The program button is only sampled at powerup, so pushing the button at any other time will have no effect on the operation of the timer.



Program Button



Program Mode (setting the delay)

If the timer is powered up while the program button is depressed, a confirmation tone will be heard from the beeper (the microTimer's LED glows instead). Releasing the program button will stop the tone and prepare the timer for programming. The time delay is then set by holding the button down for a time equal to the desired delay. The beeper will produce a tone while the button is held down to assist in setting the delay. When the button is released, the beeper will sound a long confirmation tone followed by a sequence of beeps representing the saved time delay in tenths of a second. If the delay is set to 1.6 seconds, the beeper will beep out a single beep (1), followed by six beeps (6), or 16 tenths of a second (1.6 seconds). The digit zero is represented by ten beeps, and leading (non-significant) zeroes are suppressed. If the programming button is held down for less than 0.6 seconds (the minimum time delay) then the actual saved delay will default to 0.6 seconds. *Note: The delay setting is from first trigger sense to output activation. You do not have to adjust for the 0.5 second trigger safety threshold.*

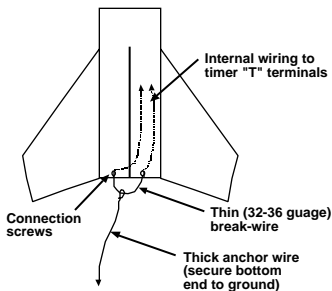
Normal Operation Mode

If the program button is not depressed when the timer is powered up, normal operation mode will be selected. A long tone will sound, followed by a sequence of beeps reporting the preset time delay as described earlier. The beeper then emits a high/low/high/low tone sequence as it looks at the trigger input to detect the “normal” (untriggered) state. If the trigger switch is open during this period (as in a G-switch trigger), the continuity check will report using a high pitched tone. If the trigger switch is closed (as in a breakwire), the continuity check will report using a low pitched tone. This feature allows the user to confirm that the trigger circuit is configured as expected prior to flight. *Note: The microTimer’s LED glows but will not differentiate normally closed vs. normally open.*

The continuity check tone will then be emitted until the timer is triggered. In order to generate a valid launch detect, the trigger condition must be met for a period of 0.5 second without interruption. This prevents wind or vibration induced glitches from prematurely initiating the timing cycle. When a valid launch condition is detected, the timer will wait out the remainder of the time delay before applying power to the igniter circuit. The igniter circuit is powered on for a period of approximately one second, and then the beeper sounds the post-flight siren.

Triggering Options

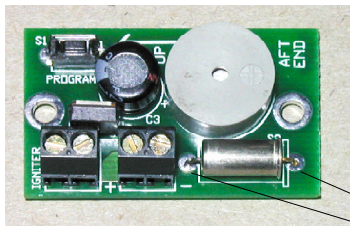
The timer can be triggered by a normally closed (shorted) or normally open (unshorted) circuit connecting the two “Trigger” connection pads. An example of a normally closed circuit is the “breakwire”, which is simply a thin wire connecting these terminals together, with a stronger piece of wire looped around the



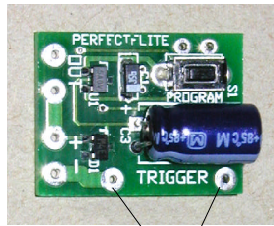
breakwire and fixed to the ground. When the rocket leaves the pad, tension from the heavier wire snaps the breakwire, opening the normally closed circuit and triggering the timer.

A similar triggering method involves the use of a pull-pin on a cord staked to the ground, which is then inserted into a switching mechanism such as the normally open contacts of a miniature 1/8" phone jack. When the pin is inserted into the jack, it closes the switch contacts, creating a normally closed condition. When the rocket leaves the pad, the pin is pulled, opening the contacts and triggering the timer.

The triggering circuit can be made completely self-contained (no external connections) with the addition of a "G switch". This device senses acceleration along its longitudinal axis and closes its contacts when the acceleration exceeds a specific threshold (a 2G threshold is common in this application). When the rocket experiences 0.5 second of acceleration in excess of this rating, the timer will be triggered. Make sure that G switches are oriented in the proper direction—one end (as specified by the manufacturer) will have to point in the direction of travel. The miniTimer is available with or without a pre-installed G switch. The G switch equipped model (MT3G) has "UP" and "AFT END" designations printed on the board to specify mounting orientation.



miniTimer with G switch installed on trigger pads



trigger connection pads

Installation and Connections

The miniTimer should be mounted using the supplied 4-40 hex standoffs and hardware. The smaller microTimer can be glued in place or restrained inside a piece of foam rubber. Make sure that your mounting scheme does not preclude access to the programming switch. If you are using a G switch trigger, make sure that the G switch is facing in the proper orientation.

The microTimer has solder pads for battery, igniter, and trigger connections. A smaller set of pads adjacent to the “program” button is provided for the connection of an optional piezoelectric speaker. Use care when soldering to the board to prevent solder bridges or damage to the surface mount components.

The miniTimer uses screw-down terminal blocks for battery and igniter connections. Loosen the screw, insert the wire, and tighten the screw down. If you are using stranded wire, make sure that the individual strands are twisted tightly together so that they don’t “peel back” and short to adjacent conductors. It’s a good idea to pull on the wires after they are clamped to insure that they are captured properly. The miniTimer without G switch (MT3T) has solder pads for connecting an external trigger source. Use care when soldering to the board to prevent solder bridges or damage to the surface mount components.

***** *Important* *****

Observe proper polarity (+/-) when connecting the battery!

If reverse voltage is applied, the switching FET’s body diode will conduct, resulting in immediate firing of any attached igniters.

If power is applied before attaching igniters (as is recommended in the operational checklist), proper polarity will be confirmed by the power-up beep (or LED) sequence. Improper polarity will result in silence or no LED glow.

Igniter Selection

Recovery Deployment Applications

When using the timer for recovery system deployment, the best choices for ejection charge igniters are DaveyFire N28B or Oxral ematches or Christmas tree bulb based charges (PerfectFlite ECK6). These are low current devices that provide a short burst of heat to ignite the easily combustible black powder ejection charge.

Auxillary Motor Ignition

When using the timer to ignite sustainer or airstart motors, longer burning, hotter igniters should be employed. Normal Estes igniters can be used in the smaller black powder motors. Composite motors work well with the DaveyFire N28F ematch (dip the head in pyrogen for extra reliability) or igniters made by dipping leadwires in conductive primer and auxillary pyrogen. The DaveyFire match heads are too large to fit in the nozzle throat of smaller composite motors, and therefore are generally used only in 38mm or larger motor sizes. Aerotech FirstFire igniters can also be used, but will require a more powerful (and therefore larger) battery.

Battery Guidelines

Igniters are basically small electric heaters that consume a relatively large amount of power (compared to the timer itself). The battery must be able to supply enough power to fire the igniter reliably and consistently. The timers incorporate brown-out protection so that the battery voltage can drop to zero during firing without affecting operation of the timer. In general, if the battery you use can fire the igniter when connected directly, it will work with the timer as well. ***Make sure that the battery's voltage and expected current do not exceed the specifications listed at the end of this manual.***

Calculating Igniter Current Requirements

The current demand of a particular igniter/battery combination can be determined relatively easily using Ohm's Law, which states that current (I) is equal to voltage (V) divided by resistance (R). Igniter

resistance is frequently specified by the igniter manufacturer, and can also be measured with a multimeter set to a low resistance range. Some representative igniter resistances are listed below.

The nominal open-circuit voltage of the battery is easily determined, but we must remember that the voltage will drop under load due to the battery's internal resistance. If you try to draw 20 amps from a 9V battery, the battery's voltage will drop to next to nothing. NiCad batteries tend to have the lowest internal resistance and keep their voltage up well under load. ***Nickel Metal Hydride (NiMH) batteries have high internal resistance and should not be used in this application.***

Use Ohm's Law ($I=E/R$) to determine the current demand of the chosen igniter. If you are using multiple igniters in parallel (for clustered applications) the current demand of each igniter must be multiplied by the number of igniters used. Once the total current draw is determined (not to exceed the current rating of the timer), an appropriate battery can be specified. Choose a battery that will be able to supply the required current while maintaining the necessary voltage. Note that even the "low current" ematches draw a lot of current at higher voltages due to their low resistance. Common 9 volt batteries are not well suited for this application!

<i>Igniter Type</i>	<i>Resistance</i>	<i>Firing Current*</i>
DaveyFire.....	1.6	.....1.0A (N28F)
Oxral.....	2.0	.....0.5A
Estes.....	0.6	.....2.0A
FirstFire	0.8	.....4.0A
Dipped.....	5 - 15	.....varies (~0.5A to 2A)

** Higher applied current will result in faster ignition and shorter duration of current flow.*

<i>Battery Type</i>	<i>Nom. V</i>	<i>V@2A</i>	<i>V@5A</i>	<i>V@10A</i>	<i>V@20A</i>
9V alkaline	9.3V	.....3.1V	.....	.....	.....
"9V" 7 cell NiCad	9.1V	.....4.5V	.....0.6V	.....	.....
"9V" N6PT NiCad	7.7V	.....6.9V	.....5.6V	.....2.9V	.....0.8V
4 cell 2/3AA NiCad.....	5.4V	.....5.1V	.....4.4V	.....3.3V	.....1.6V
4 cell 2/3A NiCad.....	5.4V	.....5.1V	.....4.7V	.....4.0V	.....2.8V
6 cell sub-C NiCad.....	8.1V	.....7.9V	.....7.6V	.....7.1V	.....6.2V

Igniter Fabrication

Dipped igniters can be created easily in the following manner. The resulting igniters will fire on a standard 9V NiCad battery, drawing less than 2 amps of current. You should test-fire a number of igniters in a fireproof, well-ventilated area to perfect your fabrication technique before relying on them for use in flight.

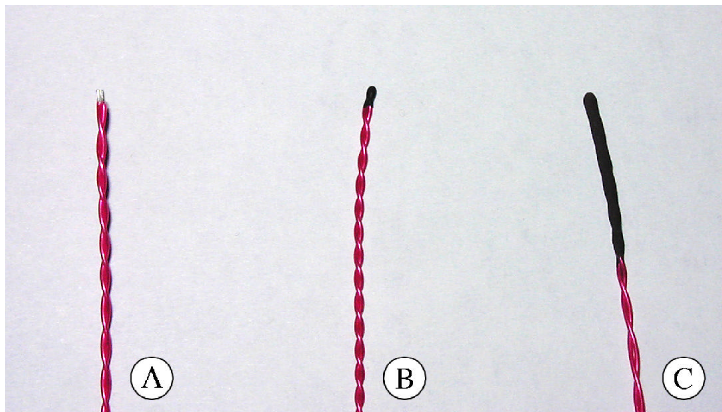
- A. Prepare the leadwires. For larger nozzle motors, standard 24 gauge solid conductor twinlead is inexpensive and durable. For smaller throat motors (E11, E15, and even smaller) the best choice is 30 gauge Kynar insulated wire-wrap wire. The wire-wrap wire needs to be twisted into a two-conductor cable before proceeding. This is easily done by chucking two lengths of the wire in an electric drill and twisting until a reasonably tight twist is created. Make up 10 or 20 feet at a time, and cut it into ~12" long sections for igniters.

Strip approximately 1/32"-1/16" insulation from the active end of the leadwire (the end that will be dipped) and 1/2" insulation from the other end (for connection to the timer).

- B. Dip the active end of the leadwire in conductive primer (FireFox ELV Conductive Primer or similar). The primer should be stirred thoroughly before each dipping session, and thinned with acetone to achieve a thick syrup-like consistency. You don't need much primer, a small bead covering the stripped ends is fine. If you use too much primer, it will ignite with a "pop" when fired, which can blow the second dip of pyrogen off without igniting it.

After dipping the leads in primer, allow the primer coat to dry for several hours before proceeding. When dry, the igniter resistance (measured between the 1/2" stripped lead ends) should be in the range of 5 to 20 . If the resistance is out of range, cut off the dipped end and try again. This shouldn't happen often, achieving a good primer dip isn't hard.

- C. Dip the primed end in pyrogen (FireFox PyroMag Pyrogen or similar). The pyrogen should be stirred and thinned as with the primer (if it becomes lumpy, try adding a bit of Methyl Ethyl Ketone to dissolve the lumps). You will want to adjust the consistency of the pyrogen to match the desired application -- narrow igniters for smaller motors should be dipped using thinner pyrogen, and bigger igniters will be created with a thicker consistency. Dip the leads to a depth of approximately 1", wiggling the lead as you withdraw it from the pyrogen to keep a large lump from forming on the end. Set the dipped igniters aside to dry overnight.



Making dipped igniters

Cautions

- Do not connect or install any igniters into rocket engines until rocket is out of the prep area and on the pad.
- When retrieving a rocket that did not fire all of its motors, remove the igniters from any live motors before handling or transporting the rocket.
- Do not touch circuit board traces or components or allow metallic objects to touch them when the timer is powered on. This could cause damage to your timer or lead to premature ejection charge deployment or motor ignition.
- Exercise caution when handling live ejection charges - they should be considered to be explosive devices and can cause injury or damage if handled improperly.
- Do not allow the timer to get wet. Only operate the timer within the environmental limits listed in the specifications section.
- Check battery voltage and polarity before connecting to the timer.
- Always follow proper operational sequencing as listed in preflight checklist.

Operational Checklist

- Insure that power is OFF or battery is disconnected.
- Connect external breakwire or install pull-pin as necessary, or confirm that G switch or other internal trigger mechanism is connected properly.
- Turn power switch ON. Observe proper powerup reporting of time delay setting. This will also confirm proper battery connection and polarity. Turn power switch OFF.
- Connect igniter or ejection system to igniter leads from timer.
- Turn power switch ON. Wait for the powerup beep sequence to finish and verify that the proper continuity is present.
- Launch!

Specifications

microTimer 2

dimensions:	0.9"L x 0.7"W x 0.35"T
weight:	3.5 grams
operating voltage:	4.8V to 10.5V (3.0V to 4.8V at half current rating)
operating current:	1.0 ma no continuity, 3.0 ma w / cont.
1 second firing current:	9.4 amperes
10 ms firing current:	21.8 amperes
1 ms firing current:	39.5 amperes
continuity check current:	75 μ A/V
trigger:	normally-open or normally-closed
timing range:	0.6 to 6553.5 seconds in 0.1 second steps
timing accuracy:	+/- 3% typical
operating temperature:	0°C to 70°C

miniTimer 3

dimensions:	1.5"L x 0.9"W x 0.5"T
weight:	7 grams
operating voltage:	4.8V to 10.5V (3.0V to 4.8V at half current rating)
operating current:	1.0 ma no continuity, 3.0 ma w / cont.
1 second firing current:	33.9 amperes
10 ms firing current:	64.5 amperes
1 ms firing current:	97.6 amperes
continuity check current:	75 μ A/V
trigger:	normally-open or normally-closed
timing range:	0.6 to 6553.5 seconds in 0.1 second steps
timing accuracy:	+/- 3% typical
operating temperature:	0°C to 70°C

Igniter Sources

Estes Industries. *EST2301 Igniter*
1295 H Street
Penrose, CO 81240

FireFox Enterprises...... *ELV, Pyromag (kits)*
P.O. Box 5366
11612 N. Nelson
Pocatello, ID 83202
(208) 237-1976
<http://www.firefox-fx.com>

Luna Tech *Oxral*
148 Moon Drive
Owens Cross Roads, AL 35763
(256) 725-4224
<http://www.pyropak.com>

Daveyfire..... *N28B, N28F*
7311 Greenhaven Drive, Suite 100
Sacramento, CA 95831-3572
(916) 391-2674
<http://www.daveyfire.com/html/electricinitiation.htm>

Quickburst *Frog series*
<http://www.quickburst.net>

Countdown Hobbies (dealer)
7 P.T.Barnum Sq.
Bethel, CT 06801-1838
(203)790-9010
<http://www.countdownhobbies.com>

Magnum Rockets (dealer)
P.O. Box 124
Mechanicsburg, OH 43044
(937) 834-3306
<http://www.magnumrockets.com>

Warranty

All *assembled* Perfectflite products include a full three year/36 month warranty against defects in parts and workmanship. All Perfectflite *kits* include a full three year/36 month warranty against defects in factory-supplied parts. Should your Perfectflite product fail during this period, call or email our Customer Service department for an RMA number and information about returning your product. The warranty applies to the timer 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.