E-ZEE IC Power Free Flight Timer Mk1

Note:
The latest in the E-ZEE family of timers, this is a software variant of the established Electric Free Flight Timer EEF1, adapted to suit IC powered free flight models, where the engine is either an RC type with a servo operable venturi air barrel or it is equipped with a servo operable fuel cutout device. As before, the variant supplied is identified by the inappropriate ident boxes being struck out.

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Introduction

Accurate and repeatable control of the duration of an ic engine run and the DT timing make for enjoyable frustration free flying. The E-ZEE IC Free Flight timer has been designed and developed so that sports flyers can enjoy all these advantages at a realistic price.

The D/T function is especially valuable as most of the major free flight venues are now requiring ALL models to be fitted with D/T to keep them within the bounds of the site.

This timer drives a servo to operate a fuel cut-off or venturi air barrel to govern the run time of IC engines. In the case of RC equipped engines the air barrel can be smoothly and progressively closed to ensure a gentle transition into level flight, rather than suffering a stall if the engine is stopped abruptly whilst the model is in a climbing attitude.

After a further delay the timer drives a D/T servo to terminate the flight. The throw of the throttle servo is set by a single turn potentiometer and the engine run and D/T periods are set by a simple push button / LED interface.

Key Features

- engine run duration:- adjustable 1 to 30 seconds, set in 1 second increments
- d/t duration:- adjustable 10 seconds to 5 minutes, set in 10 second increments
- throttle servo throw is fully adjustable by potentiometer
- engine run down:- adjustable 0 to 10 seconds
- push button immediately closes the throttle at any point during the flight profile
- operable from a single (3.7v) LiPo cell – max voltage 5.5v
- low voltage cut-out and visual indication of state of battery “health”
- duration settings are saved in memory – so a single button push serves to repeat a flight.
- provision to fit remote pushbutton and remote LED

Users may wish to read the account of the trial of the prototype in Sticks & Tissue 112 – the article being entitled **Dual Function E-Zee Timer for i/c Powered Free Flight by Mike Edwards.** Mike was using an engine with a simple fuel cut-out so the engine ramp down period was set to zero.

With Mike’s kind permission, this account is also published on the Forge Electronics website www.forge-electronics.co.uk/images/aircraft/icff1-review.pdf

INSTALLATION

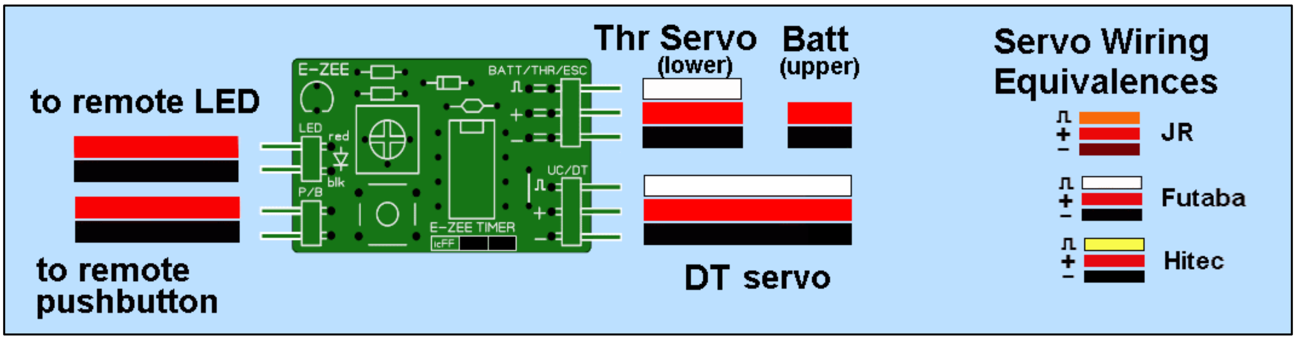
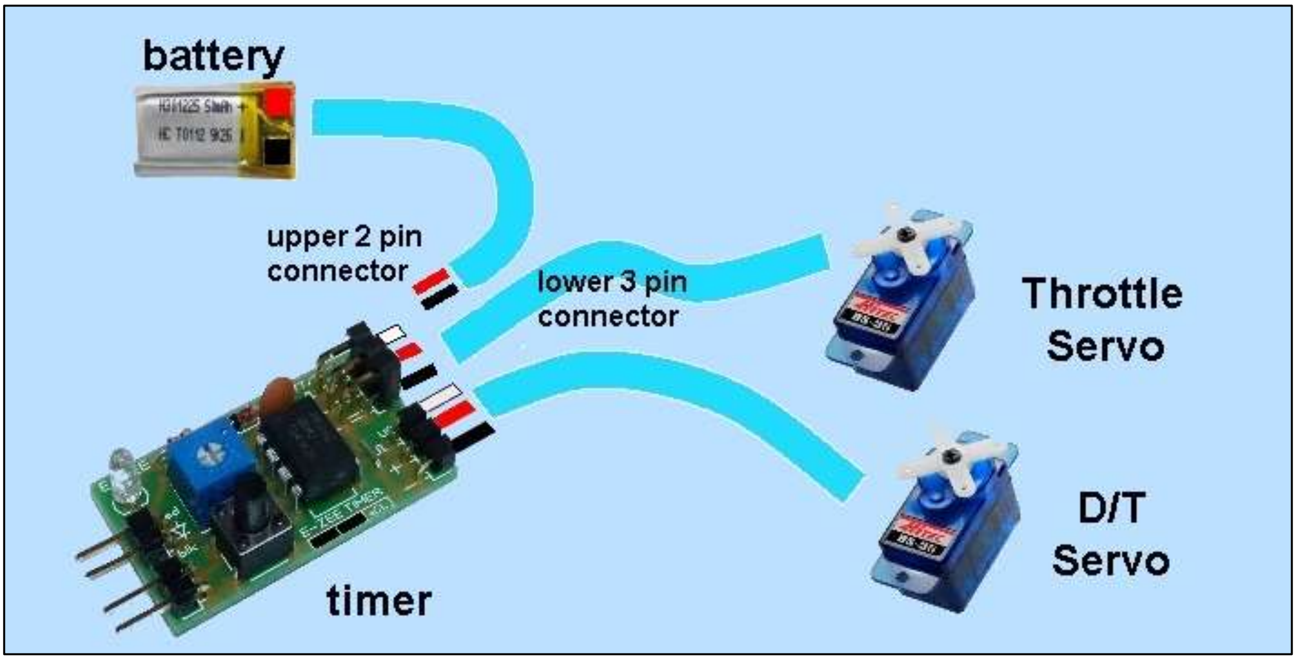
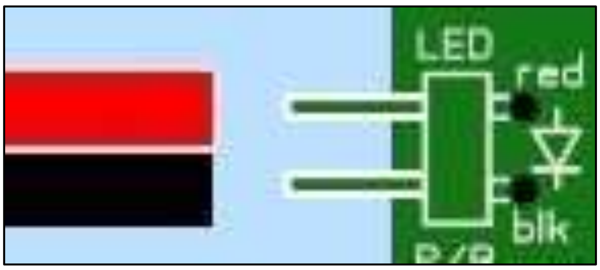


diagram showing connections to the timer board



pictorial representation of connections to timer board

The throttle servo lead (usually coloured white/red/black), connects to the lower 3 pin header at the top edge of the board and the battery to the two pin header immediately above it. The D/T servo connects to the three pin header at the bottom edge of the board. Note the orientation of white/red/black leads. The remote push button and/or remote LED (if used) are connected to the two pin headers at the other edge of the board – LED to the upper connector, push button to the lower connector.



The remote LED (if fitted) is polarity sensitive and must be connected as shown. No damage will occur if it is incorrectly connected, it simply will not work.

Although the optional remote pushbutton has red and black leads it is not polarity sensitive.

The chip used in the timer has a maximum rating of 5.5v, so ESCs with a 6v BEC must NOT be used.

D/T Servo Installation

The D/T "armed" position is the default position assumed by the servo when receiving a 1.0mSec pulsewidth signal. The "tripped" position corresponds to a 2.0mSec pulsewidth.

The mouse-trap is a traditional way of activating D/T mechanisms that doesn't apply any holding force to the clockwork timer mechanism and is thus suitable for use with a servo activated D/T.

But this is not necessarily the only way. In another other successful installation by John Bainbridge, at D/T time the servo operates a light cord running to the end of the fuselage to pull out a "grenade pin" which releases the tailplane to pop up.

The picture above shows the grenade pin which sits in the tube with a short length protruding at the rear, over which the rubber band holding down the tailplane is looped.

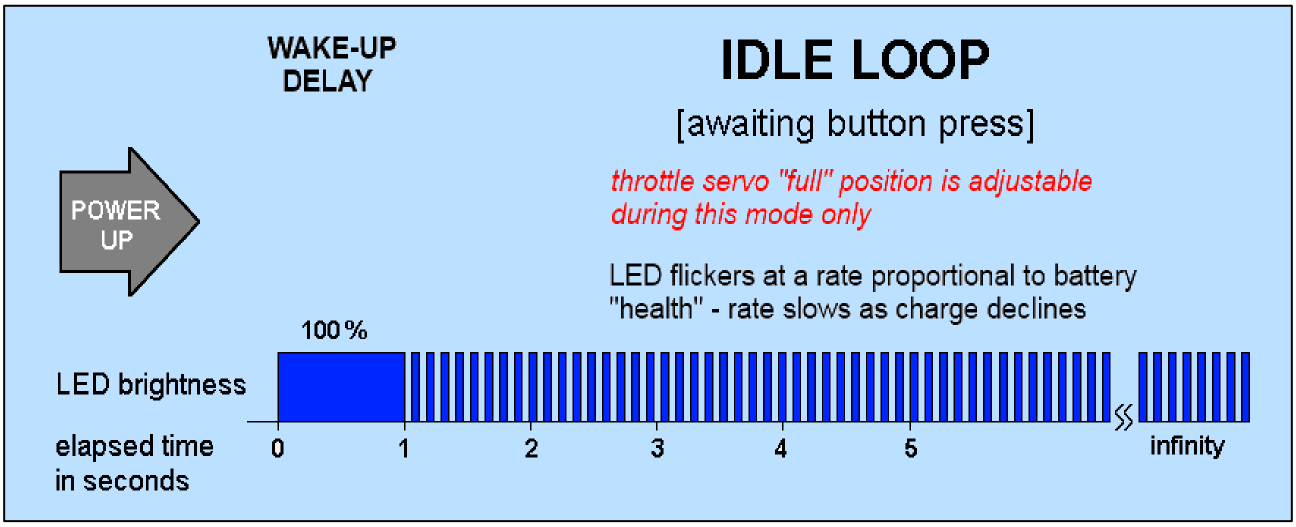
Throttle Servo Installation

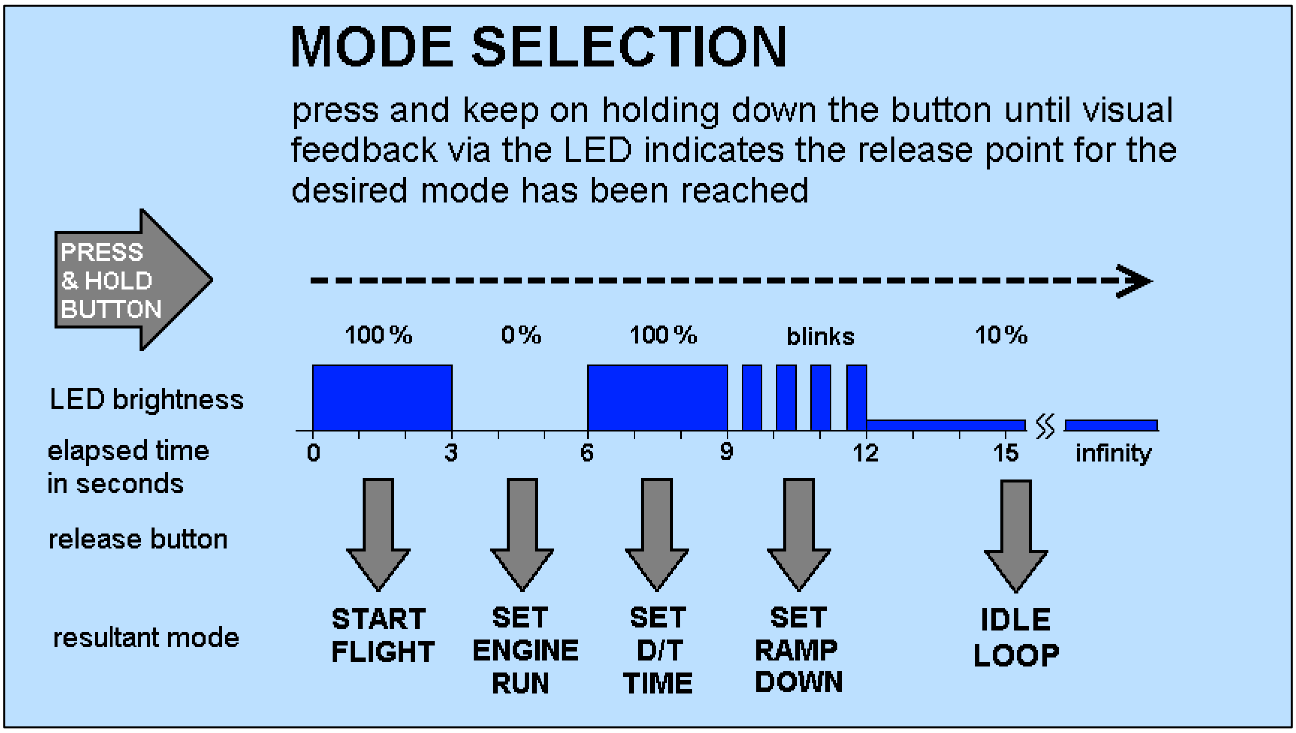
The images below illustrate just how simple the installation can be - the throttle servo operates a simple push rod to operate (in this case) the fuel cutout.

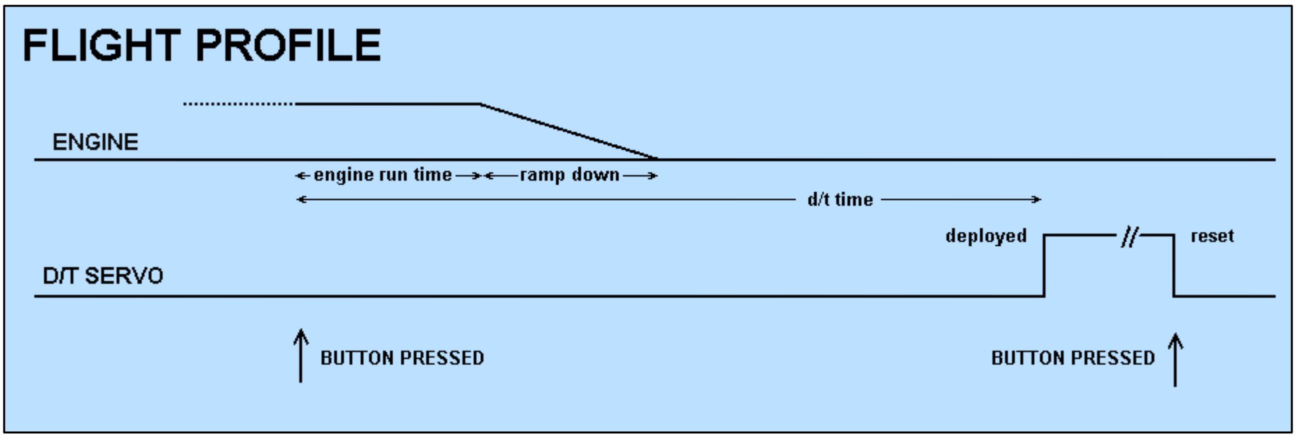
The throttle “closed” position is the default position assumed by the servo when receiving a 1.0mSec pulsewidth signal. The servo horn should be adjusted on its splines accordingly such that the throttle linkage holds the engine in the OFF condition. Throttle “fully open” position is governed by the setting of the potentiometer and may be varied over the entire 1.0mSec to 2.0mSec range. *The “fully open” position may only be adjusted when the timer is in IDLE MODE.*

Users are warned that the D/T and throttle servo mechanisms should be designed and/or installed such that they do not result in the servo having to apply significant torque to maintain the commanded positions (ie working against springs) – otherwise the servo power consumption(s) will be very high and battery life will be badly compromised.

E-ZEE icFF1 TIMER - QUICK GUIDE







E-ZEE icFF1 TIMER – IN DETAIL

Power Up

The LED is fully ON for one second to announce the unit being powered. If found displaced from their initial positions, the throttle servo assumes the “fully open” position and the D/T servo assumes the “armed” position.

Idle Loop – initially entered after the power up. Subsequently it is entered following the successful conclusion of modes [1] to [4] below. Here it awaits a button press, either to commence a timed flight or to enter one of the adjustment modes. Whilst in the loop, the LED flickers to signify that the unit is powered. The rate of flicker is proportional to the state of battery “health” – the flicker rate slows as the battery charge declines. The “fully open” position of the throttle servo may be adjusted by the potentiometer during this mode.

Operating Modes - there are four possible modes of operation which are entered by a single press of the push-button. The duration of the press determines the mode selected and visual feedback from the LED informs the user when to release the button as each mode becomes available.

[1] FLIGHT – entered from the idle loop by a brief press of the button (must be less than 3 seconds or the subsequent set-up routines will be entered instead). The LED is lit to acknowledge the button press. When the button is released the LED extinguishes and the engine run timing period commences and the LED counts off each second by giving a brief flash. At the end of the set engine run period the LED goes on solid and throttle servo now closes over the user defined period (can be set 0 to 10 secs in 1 second increments) , the LED brightness decaying from maximum to zero during this ramp period.

The D/T timing period continues with the LED counting off the remaining seconds by giving a brief flash. When the D/T period has elapsed the D/T servo activates and the LED brightness then slowly fades up and down to indicate this condition was reached. A press of the button returns the unit to idle mode and re-sets the D/T servo.

Should the D/T period have been mistakenly set to less than the engine run period, the D/T servo will not activate until the engine run period has expired.

[2] ENGINE RUN TIME – entered from the idle loop by holding the button pressed until the LED extinguishes (in the 3 to 6 second window) and then releasing it. The duration is now set by repeated brief presses of the button – so 10 pushes would set 10 seconds and so on. The maximum available period is 30 seconds and any presses in excess of 30 are ignored. When the timer ascertains that no further presses are being made, the unit then returns to the idle loop. The selected duration is stored in memory and is retained indefinitely (including power cycles) until it is next altered by the user - so in this example a further flight with a 10 second engine run would only require a single button press from the idle loop to start it.

[3] D/T DURATION – selected from the idle loop by holding the button pressed until the LED returns to full brightness (in the 6 to 9 second window) and then releasing it. The D/T duration is now set in units of 10 seconds by repeated brief presses of the button – so 10 pushes would set 100 seconds and so on. The maximum available period is 300 seconds (5 minutes) and any presses in excess of 30 are ignored. When the timer ascertains that no further presses are being made, the unit then returns to the idle loop. The selected duration is stored in memory and is retained indefinitely (including power cycles) until it is next altered by the user - so in this example a further flight with a 100 second D/T duration would only require a single button press from the idle loop to start it.

[4] THROTTLE RAMP DOWN - entered from the idle mode by holding the button pressed until the LED begins to blink (in the 9 to 12 second window) and then releasing it. The ramp duration is set in units of 1 second. A single press sets zero delay (ie turns it OFF) so to set 3 seconds press the button 4 times, counting “0, 1, 2, 3”. Maximum available ramp down time is 10 seconds. When the timer ascertains that no further presses are being made, the unit then returns to the idle loop. The selected ramp down time is stored in memory and is retained indefinitely (including power cycles) until it is next altered by the user.

Abort Flight

The engine run and/or the D/T timing period may be aborted at any time by pressing the push-button. *As engines with a fuel cut-out device may not stop immediately, the button should be kept pressed until the engine has stopped*. Following button release the timer will return to the idle loop in which the throttle position is set to fully open, so a brief press might only cause a hiccup in revs and the engine would continue to run. To address this issue, from the moment of button press the timer waits for a minimum of 5 seconds before it is allowed to return to the idle loop. So a brief press results in a 5 second delay, a 3 second press results in a further 2 second delay and so on. *Users should ascertain that their engine stops well within this 5 second safety window if they choose to rely on giving a short button press rather than holding the button until the engine has stopped*.

Battery ‘Health’ Indication

During the idle period (timer powered but inactive) the LED flickers to denote the unit is powered. The timer monitors the battery voltage and adjusts the flicker rate accordingly. Thus with a fully charged battery the flicker is very rapid but gradually slows down as the battery voltage declines. Just prior to the cut-out the flicker is still too rapid to be confused with the bright flash that counts off each second when the timer is running.

With experience the user will be able to judge the state of battery health by observing the rate of LED flicker.

Low Voltage Cut-Out

This is set to operate at approximately 3.3v to both protect the single cell Li-Po battery from excessive discharge and also to ensure there is still sufficient voltage available for the throttle and D/T servos to operate. ***Users should check that their chosen servos are capable of still working at 3.3v and with sufficient torque to operate the throttle and D/T mechanisms – note that the microcontroller chip will continue to work down to 1.8v.***

During the IDLE loop, the timer continuously checks the battery voltage and if the voltage is found to be too low then *to prevent a launch*, the throttle servo closes, the D/T operates and the timer enters an endless loop giving three rapid flashes of the LED (concurrent with three 'beeps' if the sounder is fitted) repeated at one second intervals. *The timer must be power cycled to exit this endless loop*.

When the button is pressed at launch time, the battery checking is suspended for the duration of the motor run as it is undesirable that a D/T occurs whilst the aircraft is under power.

When the 'glide' phase is entered, five seconds later battery checking is re-instated – this gives time for an engine with a fuel cut-out time to decide to stop. So now a premature D/T could occur during the glide, should the battery voltage become seriously low during this phase. Li-Poly batteries are noted for a very swift decline in voltage as they approach fully discharged and it may happen that though there may be sufficient voltage to permit a launch, during a long D/T period the voltage could drop to a level where it's unable to operate the servo. Hence the monitoring/cut-out is active in the glide phase to err on the side of safety.

Nevertheless, it is the responsibility of the user to ensure the battery is sufficiently charged for the flight about to be undertaken. A visual battery 'health' monitoring facility has been provided and with experience users should become familiar with the characteristic flicker rate of the LED and avoid launching with marginal battery charge remaining.

SAFETY

Note that the blue LED used is a high brightness type to ensure good visibility outdoors in bright sunlight. If the timer is operated in the workshop under poor lighting conditions avoid looking directly at the LED to avoid potential damage to your eyes.