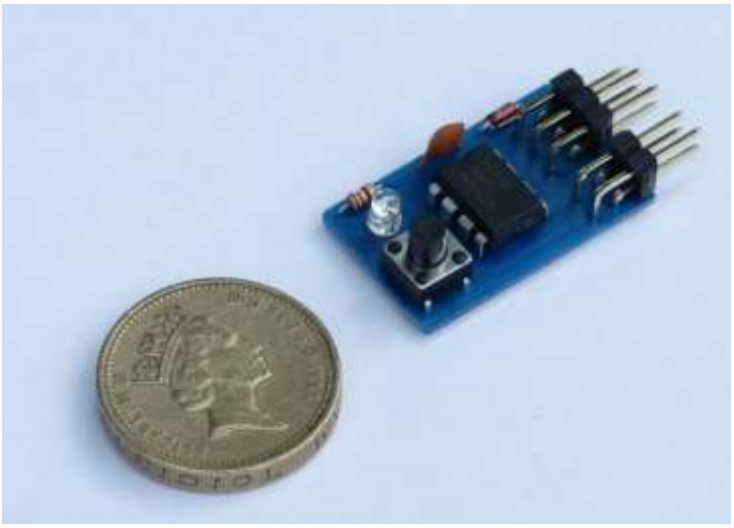
E-ZEE SDG3 – Servo DT Glider Timer



Note:
This unit is a direct replacement for the discontinued SDG2, the new part number signifying three software upgrades. Firstly, to address the needs of competition flyers, the unit now supports "circle towing" (see later), secondly the maximum timing duration has been increased to 10 minutes with an improved method of setting to minimise button presses and thirdly the battery monitoring feature has been improved such that the rate of LED flicker during standby mode now directly reflects the battery voltage, so users can make a judgement of the state of battery health, rather than waiting for a sudden cut-out to announce a seriously discharged battery.

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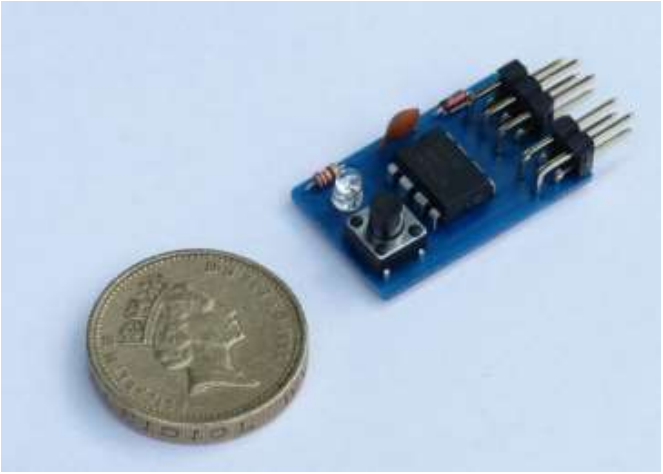
Introduction



Accurate and repeatable control of DT timing make for enjoyable frustration free flying. The E-ZEE Glider timer has been designed and developed so that flyers can enjoy all these advantages at a realistic price.

This timer drives a D/T servo to terminate the flight, the D/T periods being set by a simple push button / LED interface.

It also interfaces with a piezo sounder and towline release contacts.

This is an enhanced version of the SDG1 unit and was developed to meet the additional needs of competition glider flyers, though sport fliers may find certain of the additional features are desirable.

The additional features of the SDG3 over the SDG1 are as follows:-

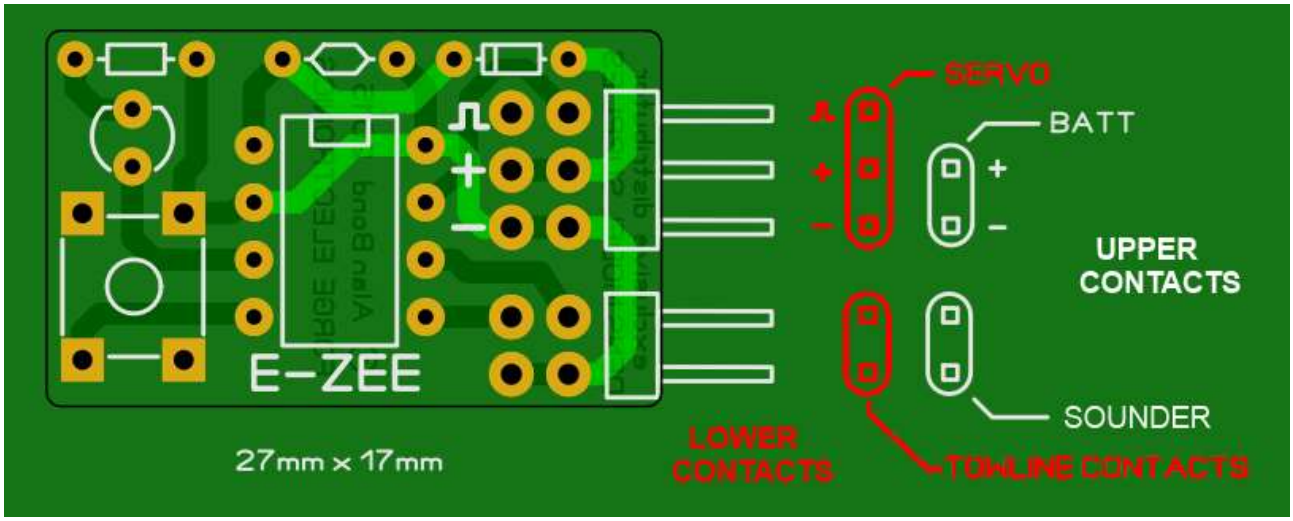
- Option for D/T timing to start only when the glider leaves the towline - there are reports (SAM35, Sept 2015) that under certain conditions "hi-start" gliders can reach D/T time whilst still attached to the towline/bungee. This feature is aimed towards competition fliers and requires fitting the glider with a set of towline operated contacts which communicate with the timer. The SDG3 also supports “circle towing”.
- Maximum D/T duration increased from 5 to 10 minutes.
- An optional piezo sounder can be connected to the timer which emits regular "beeps" following D/T to allow fliers to more easily locate models landing in tall grass/crops or on the far side of a boundary hedge etc. Typically an SDG3 equipped model can be heard up to 50 metres away (Sticks & Tissue #103)
- A battery monitoring/cut-out function to detect seriously low battery voltage. This causes an immediate D/T, which can prevent a fly-away if the model is aloft or prevent a launch should the model be on the ground.

Key Features

- Can operate from a single cell Li-Po battery – *max voltage 5.5v (a single cell Li-Po battery is 3.7v nominal and 4.2v fully charged)*
- d/t duration:- adjustable 10 seconds to 10 minutes, set in 10 second increments
- optional (beeping) piezo sounder assists model location after D/T
- option to commence D/T timing period only upon towline release
- circle towing supported
- low battery voltage cut-out (3.3V) – operates D/T for safety
- visual indication of state of battery ‘health’
- piezo resonance set-up routine to optimise volume of the sounder
- push button immediately cancels the flight at any time
- duration setting is saved in memory – so a single button push serves to repeat a flight

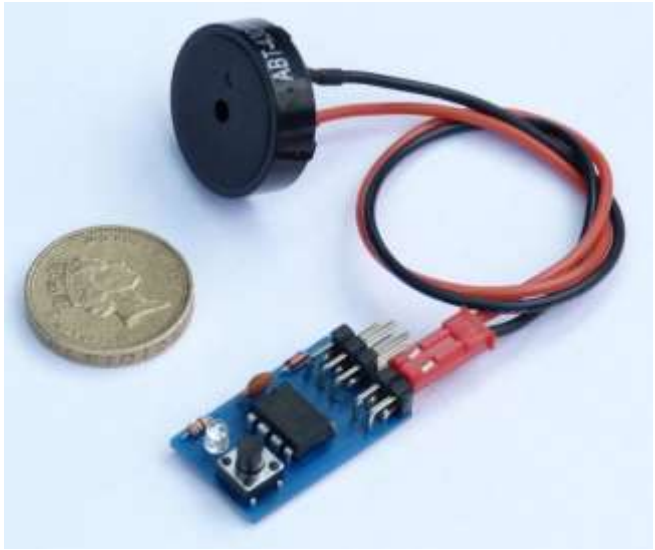
Installation

The image below shows the connectors to the other components of the system.



The battery lead usually coloured red/black, connects to the upper two pin header on the timer as shown in the image above and the D/T servo to the lower three pin header. Note the polarities of the battery and servo leads. The piezo sounder and towline contacts connect to the upper and lower two pin headers respectively and are not polarity sensitive.

Using the piezo sounder and/or the towline release features are both optional, so if required, these items must be bought separately.



The supplied piezo sounder is a passive device and is driven by the timer in the same way that a loudspeaker is driven by an amplifier. This is to distinguish it from some piezo “buzzers” that look similar but contain integral drive electronics – *these types will not work with this timer.*

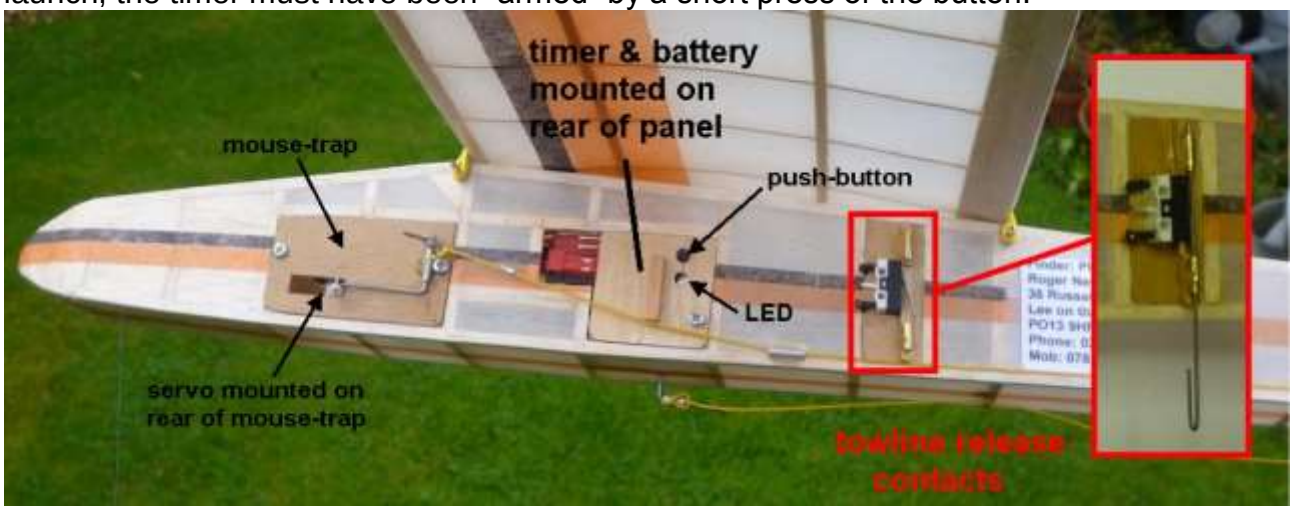
The piezo sounder may be omitted without consequence to the operation of the timer.

Note that the sounder (if fitted) is also used to register button presses as well as the “find-me” beeps after D/T time.

Straight Towing / Bungee Launch

The towline release contact mechanism is down to the ingenuity of the user, but the successful flight-proven system designed by Roger Newman is recommended. The picture below shows his implementation. A sub-miniature microswitch is mounted on a small ply plate with two thin brass tubes affixed such that a release pin can be inserted through them to keep the blade of the microswitch depressed. This pin is connected by a short length of cord to the towline, such that when the towline is released the pin is pulled out,

the microswitch operates and the timer then commences timing the D/T period. Prior to launch, the timer must have been “armed” by a short press of the button.



The piezo sounder (not fitted in this picture) with attached cable and JST connector to mate with the timer is available as a plug & play item from DMS (Dens Model Supplies). Similarly, the microswitch with attached cable and JST connector to mate with the timer is also available from DMS. It is hoped that in the fullness of time that DMS will be able to supply a complete plug & play towline release assembly.

If users make up their own switch lead, the microswitch MUST be wired so as to present closed contacts when the release pin is holding the blade depressed.

The mouse-trap is a traditional way of activating D/T mechanisms but 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.

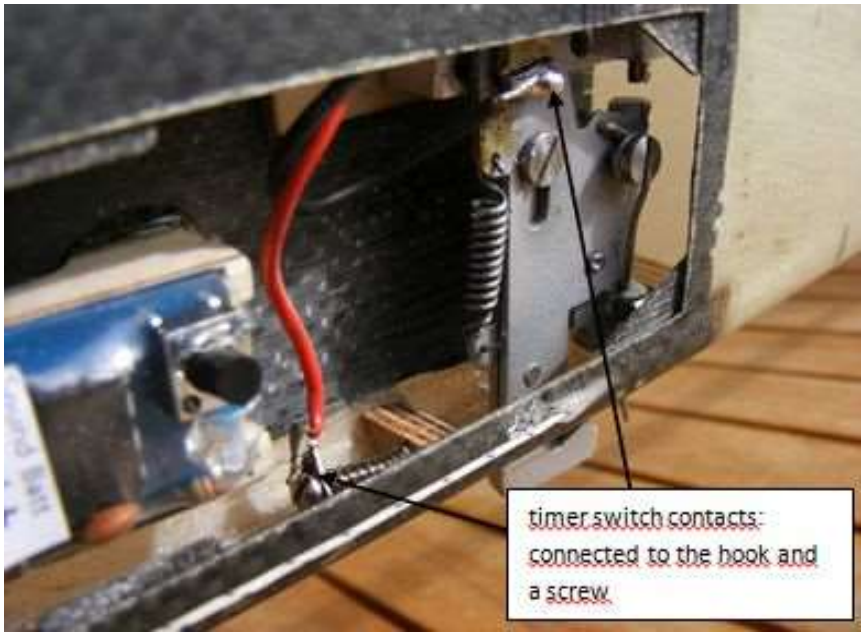
The picture above shows the grenade pin which sits in the tube with a short length protruding at the rear, over which the rubber band holding down the tailplane is looped.

Circle Towing

A brief description of circle towing follows, for which thanks are due to Guenther Platz, who helped with specifying the requirement and test flying the prototype.

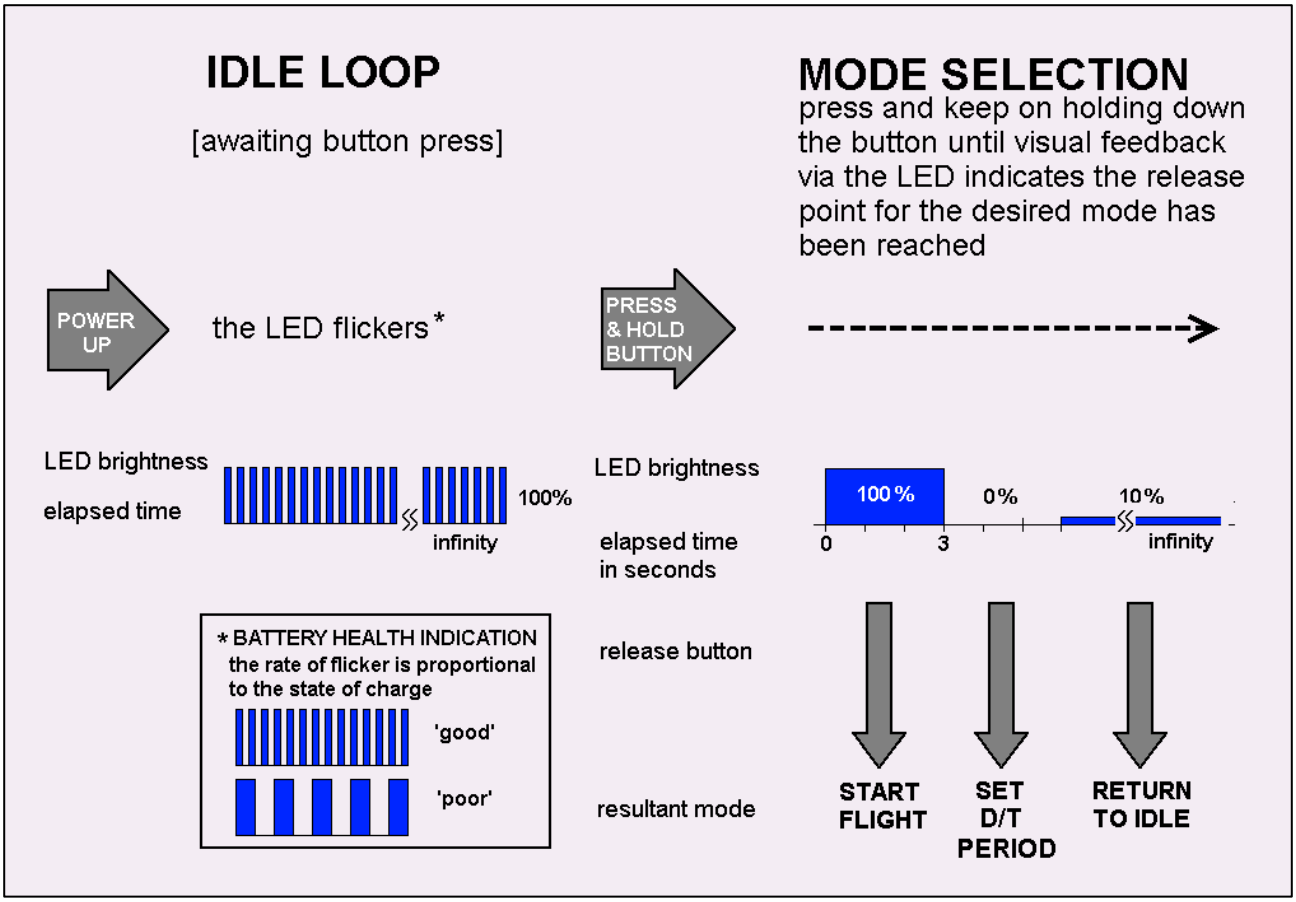
The circle hook has two functions. When towing the hook is held forward by the tight towline and puts the rudder straight. If the towline is slack the hook goes back (pulled back by a spring) and sets the rudder for a narrow circle. The second function is a locking mechanism which closes the hook (that is done manually on the ground), so that the towline cannot slip off the hook when the towline is slack (closed hook). After some circles, when you think there is a thermal and you decide to launch you have to pull the towline with 2-3kg. Now the locking mechanism opens (open hook) and the towline slips off the hook and we have departure. Because of the spring, the hook now is in its final back position for the rest of the flight and this final back position should start the full timer time. If we look at one circle the hook is in the back position for about 80% of the circle (towline slack) and in the front position for about 20 % of the circle (towline tight) . But the final position after departure is the back position.

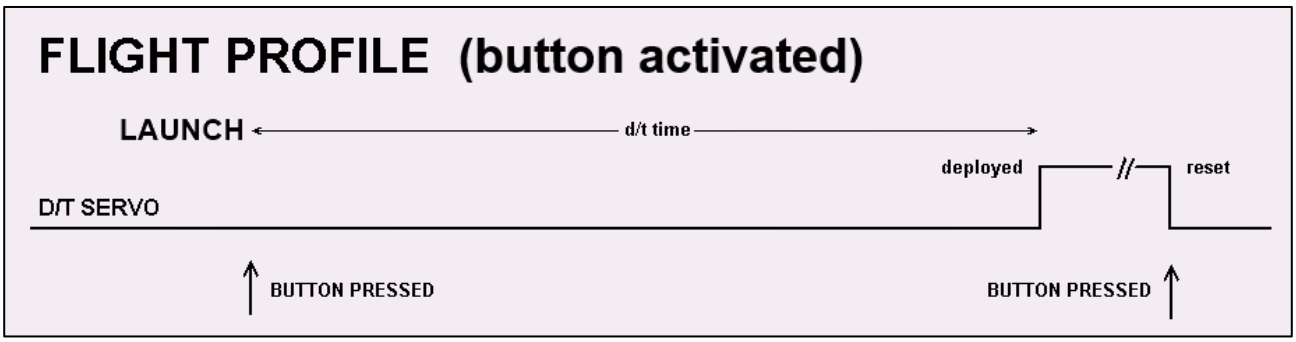
Thus when circle towing, the timer tow hook contacts (which in this case are operated by the fore/aft hook position) repeatedly open and close during each circle. At each opening the timer starts but the following closure “re-arms” the timer so it’s ready to start again at the next opening. Thus as long as the maximum circle time is less than the user set DT time the glider can be circle towed indefinitely.

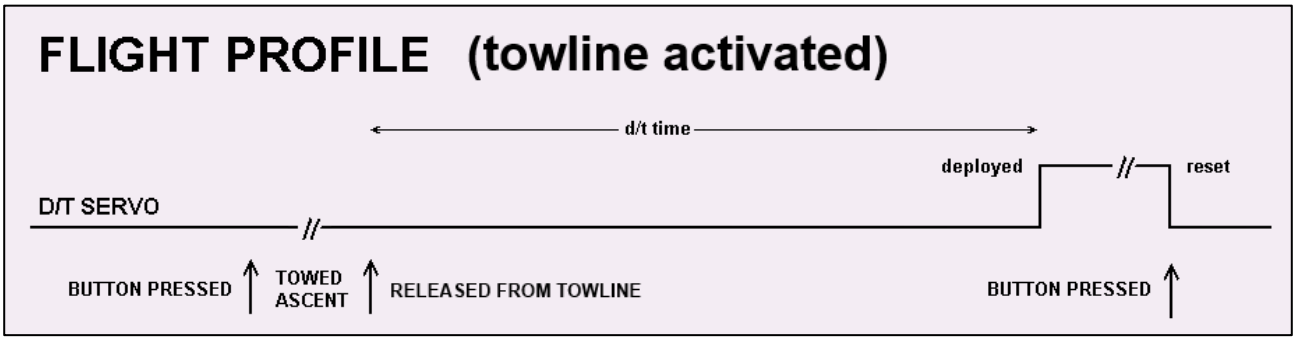


Hopefully from the above it will be seen that the timer supports both towline release from a bungee/straight tow or circle towing without any changes in timer configuration required because from a bungee or straight tow, once the glider is released there is no mechanism to further operate the microswitch which could “re-arm” the timer.

E-ZEE SDG3 TIMER - QUICK GUIDE







E-ZEE SDG3 TIMER – IN DETAIL

Idle Loop – initially entered at power up and the sounder (if fitted) gives a quick double beep. Subsequently it is entered following the successful conclusion of modes [1] or [2] below. Here it awaits a button press, either to commence a timed flight or to enter the D/T duration setting mode. Whilst in the loop, the LED flickers to signify that the unit is powered.

Operating Modes

There are two 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. The two possibilities given below for mode 1 depend on whether or not towline release contacts are connected to the timer.

[1A] BUTTON ACTIVATED FLIGHT – *this results if a towline contact lead is NOT attached to the timer.* This mode is entered from the idle loop by a *brief* press of the button (must be less than 3 seconds or the subsequent D/T duration setting routine will be entered instead). The LED is lit and, if fitted, the sounder also issues a 'trill' to acknowledge the button press. When the button is released the sounder is silenced, the D/T timing period commences and the LED counts off each second by giving a brief flash accompanied by a short "beep"

When the D/T period has elapsed the servo activates and the LED brightness then slowly fades up and down to indicate this condition was reached. If fitted, the piezo sounder operates briefly at the maximum brightness period of the LED. A press of the button returns the unit to idle mode, re-sets the D/T servo and silences the sounder.

The D/T timing period may be aborted at any time by a brief press of the push-button which returns the unit back to the idle loop.

[1B] TOWLINE RELEASE ACTIVATED FLIGHT – *this results when a towline or tow hook contact lead IS attached to the timer and its microswitch is closed*. This mode is entered from the idle loop by a *brief* press of the button (must be less than 3 seconds or the subsequent D/T duration setting routine will be entered instead). This "arms" the timer and the LED is lit. If fitted, the sounder also issues a 'trill' to acknowledge the button press.

- Bungee or Straight Towing - the LED now stays permanently lit until the towline contacts break at the point when the glider leaves the towline. Only then does the D/T timing period commence, the LED now counting off each second by giving a brief flash.
- Circle Towing - the LED now stays permanently lit until the tow hook contacts break and the timing period commences, the LED counting off each second by giving a brief flash. When the tow hook contacts make again the timing period is reset and the timer is re-armed (LED permanently ON again). This cycle repeats until the glider finally leaves the towline at which point the full DT timing period (which has just re-commenced) is now able to continue until completion.

When the D/T period has elapsed the servo activates and the LED brightness then slowly fades up and down to indicate this condition was reached. If fitted, the piezo sounder

operates briefly at the maximum brightness period of the LED. A press of the button returns the unit to idle mode, re-sets the D/T servo and silences the sounder.

The D/T timing period or the “timer armed” state may be aborted at any time by a brief press of the push-button which returns the unit back to the idle loop.

[2] D/T DURATION – selected 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 D/T duration may now be set in units of minutes and 10’s of seconds by repeated long or short presses of the button respectively – each long press (hold until the LED extinguishes and only then release) sets a minute and each short press sets 10 seconds (release button *before* the LED extinguishes). The maximum available period is 600 seconds (10 minutes) and any combination of presses yielding a total greater than 10 minutes are ignored – this is signified by the LED now failing to acknowledge subsequent button presses.

So for example, three long presses and four short presses would set the DT duration to 3 minutes 40 seconds. Although it is not recommended, the long and short presses can be made in any order/combination that yields the desired total. When the timer ascertains that no further presses are being made, the LED reports the duration with a series of long and short flashes representing the total minutes and 10’s of seconds set – in the above case that would be 3 long flashes/beeps followed by 4 short flashes/beeps. Note that even if the duration is set using only short presses it will still be reported in minutes and 10’s of seconds by long and short flashes.

After reporting the duration the timer 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 the last example a further flight with a 3 minute 40 second D/T duration would only require a single button press from the idle loop to start it.

If after having entered the D/T setting mode no button presses are made then after 5 seconds the timer reports the existing D/T duration and then reverts to the IDLE loop. This is useful for users wishing to verify the last used duration setting.

Battery Life

It is anticipated that a fully charged 70mAh battery should last for a full days flying, which obviates the need to disconnect the battery between flights.

However, the battery MUST be disconnected once flying has ceased or during storage it will eventually become totally discharged resulting in irreversible damage to the battery. The low voltage cut-out only serves to WARN of a badly discharged battery and prematurely operates the D/T to prevent a fly-away - it DOES NOT disconnect the battery.

Battery life will however be seriously compromised if the design of the user’s D/T mechanism puts a permanent torque load on the servo arm as the servo will then draw a heavy current to maintain its commanded position by resisting that torque with an equal and opposite torque.

Neither of the previously described installations present any permanent torque loading to the servo.

Additional Features

PIEZO RESONANCE SET-UP

To maximise the volume available from the piezo sounder it needs to be driven at a frequency which matches the resonant frequency of the device itself. Thus a special configuration mode is available whereby the user can adjust the drive frequency to the sounder to attain the loudest result. The resulting frequency is stored in memory and used thereafter for all sounding.

To enter this set-up mode, the push button should be held pressed *prior to powering up the unit.* Five long beeps/flashes will be issued to indicate the set-up routine has been entered. The LED then extinguishes. When the button is released a continuous tone is emitted from the sounder. Successive *short* pushes of the button light the LED and gradually increment the drive frequency to the sounder and it will be quite evident when the resonant frequency of the piezo element is reached. Proceeding further the volume from the sounder will decrease, so to begin decreasing the drive frequency hold the button pressed for a longer period until the LED goes off and then release it. Successive *long* presses of the button now decrease the drive frequency and the resonance spot can be re-acquired. When the upper or lower limits of the adjustment range are reached the LED flickers to indicate this situation. When the optimum drive frequency has been found, simply remove power from the unit to exit this set-up mode. The chosen drive frequency is stored in memory for subsequent use.

Note that the range of drive frequency adjustment (2.5kHz to 3.0kHz) has been chosen to suit the supplied piezo sounder which resonates at about 2.7kHz. ***It may not be possible to match the resonant frequency of sounders other than the DMS supplied unit.***

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 D/T servo to operate. ***Users should check that their chosen servo is capable of still working at 3.3v and with sufficient torque to operate the D/T mechanism – 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 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 timer is “armed”, battery checking is suspended until the towline is detected to have detached (microswitch OPEN) as it is considered undesirable for a (low battery voltage induced) D/T to occur whilst the glider is being towed/bungee’d.

When the D/T timing period is activated, battery checking is re-instated so 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.

There are however consequences for those not using towline release or those practicing circle towing

- button activated flight without towline release contacts – here the user has pressed the button immediately prior to launch so as far as the timer is concerned it is already in the ‘glide’ phase, so a premature D/T could occur during the tow or bungee launch.
- circle towing – here the towline contacts open during the circling part of the tow, suggesting to the timer that it is already in the ‘glide’ phase and the battery monitoring/cut-out is activated – only to be cancelled during the straight part of the tow when the contacts close – this cycle repeats for as long as the glider circles, so a premature D/T could occur during circle towing

Thus in the above situations 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.