

# **NOS -36 Magic**

**An electronic timer for E-36 and F1S Class free flight model aircraft**

**January 2017**

**This document is for timer version 2.0**

**Magic Timers Copyright Roger Morrell January 2017**

## NOS MAGIC – E36 and F1S version

### How you use it

NOS 36 Magic is a timer with two functions – electric motor run and D/T. It is intended for E-36, F1S and similar electric powered free flight models.

The timer is connected to the electric motor's ESC or speed control unit. The timer is powered by the speed controller's BEC or battery elimination circuit. An R/C servo is also connected to the timer to activate the D/T function. It is the responsibility of the builder of the model to come up with a mechanism that causes the servo to activate the D/T.

Optionally a radio D/T (RDT) receiver may be attached to the timer to let the flyer stop the flight early if he wishes.

The timer lets you set the length of the electric motor run with a precision of 1/10 of a second. It also lets you set the total flight time in increments of 5 seconds. The total flight time information set is displayed on a 3 digit numeric read out on the timer.

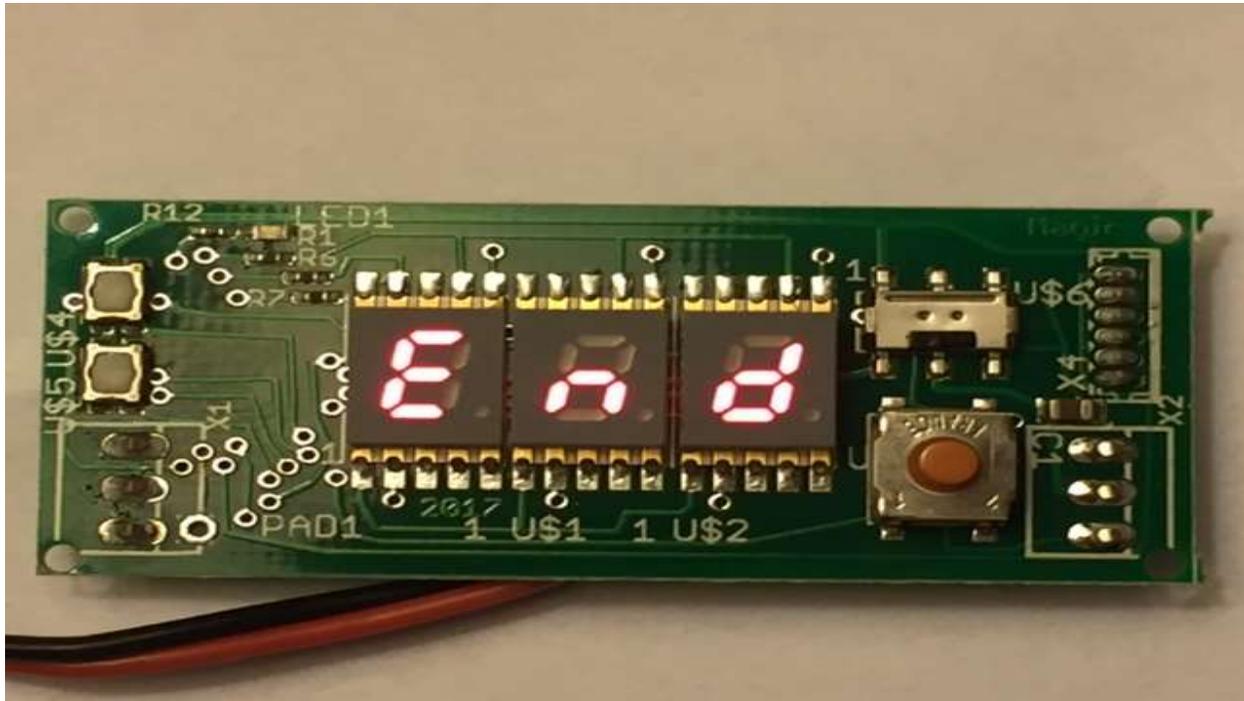
While not used in the E-36 and F1S classes an Energy Limiter as used in F1Q can also be used with this timer to stop the motor after a pre-allocated amount of energy has been consumed.

### Normal Operation

This is how you would go about a normal flight once the model had been set up and properly adjusted / test flown.

Connect the motor battery and turn the timer on. The timer will beep out the length of the flight. In other words there will be one beep for each minute of flight and a beep in a different tone for each additional 15 seconds. The total flight time is then displayed in seconds on the 3 digit display. The beeps and time display provide a means for the flyer to make sure the D/T is set to the proper value. Always when turning on the power to an electric model keeps your hands well clear of the propeller and a firm grip on the model. Point the model skywards in the correct angle and direction to launch the model, and press and hold the start button, keeping well clear of the propeller. The motor will not start instantly; you must hold the start button down for a finite period before the motor starts. This is a safety feature to avoid starting the motor with an accidental brief brush of the timer button. The motor will start so be sure to have a firm grip on the model. The word **Fly** is displayed on the timer and the buzzer sounds. Launch the model; the timer will start when the model is released. The electric motor will run for the motor run time you have set in the timer. When this time has elapsed, the motor will stop. Also at this point the D/T servo will move to the mid-point of the travel.. This is an optional feature that lets the flyer operate an auto rudder or the like if the rules permit for the class of model he is flying. The flight will then continue and when the total flight time is reached, the timer will move the servo to the end point of the travel, activating the D/T and terminating the flight.

During the flight the total flight time is counted down to zero and the word **End** is displayed as the model D/Ts.



### End Message

To make another flight the timer must be turned off and on again in order to arm the timer. The flyer must also decide if the battery for the electric motor needs to be recharged.

There is an additional safety feature in that once the motor has been started and the start button released, pressing the start button again after a half second wait will stop the motor.

Once the flight is over there are two options that the flyer may configure. The first is to have the beeper on the timer beep once a second, this can help find the model. The beeping stops either when the timer is turned off or the start button is pressed. During this beeping period the word. End is displayed. The other alternative is to put the timer into sleep mode. This cuts the signal to the ESC. This may cause the ESC to beep or otherwise complain. This behavior may vary from ESC to ESC.

### Adjusting the timer

The timer is adjusted (i.e. the motor run and flight times are set) as follows:

1. Turn off the timer.
2. Press and hold the start button.
3. Turn on the timer.
4. Keep holding the start button while timer beeps and displays the current flight time and then the buzzer makes a continuous noise.
5. When you hear this take your finger off the start button.
6. Now the timer displays **Eng** for Engine or Motor on the display. This means you are about to modify the length of the motor run. Depending on the current position of the servo it may move to the start position and display the total flight time again before displaying Eng again. During the modification step from this point the timer will not send pulses to either the servo or the ESC, the ESC may issue a warning beep to indicate that it is not getting the pulse. This is OK at this point.
7. The timer then displays the current length of the motor run in tenths of a second with the decimal point showing. [Note: if you don't see the decimal point, you are looking at the flight time, not the motor run!]
8. To the left of the display are the increment and decrement buttons. Each push on one of these buttons increments or decrements the motor run by a tenth of a second. You will see the changes that you make on the display. When you have the motor run you want, push and release the start button.
9. The display will now show the word **All**, an indication that you are about to modify the total flight time. This is shown in seconds. Each time you tap the increment or decrement button the total flight time is increased or decreased by 5 seconds. When you have the time you want, push and release the start button.
10. The timer will now re-cycle with the new settings, show the new total flight time and be ready to fly.
11. Note that if you do not need to change one of the setting, you just do not push the increment and decrement buttons; just push the start button and the timer setting process goes to the next step.
12. When checking out a new airplane many flyers use a process called a short D/T. This is often combined with a shorter engine run. This is what you do to the timer for a short D/T. It is not possible to set the total flight time to shorter than the motor run. You set the length of motor run you want, then you decrement the total flight time down to the motor run. The shortest total flight time the timer will let you do is one second more than the motor run. When you get

to this point you can stop and fly the model. When you increment the total flight time the first increment will be one second; every one after that will be 5 seconds. This means the shortest flight is one second more than the motor run, the next possible setting is 2 seconds more than the motor run and the next 7 seconds more. It works this way because different models and modelers have different preferences as to how they go about adjusting their model.

13. Once the model is checked out and the power part of the flight is working properly, you would then adjust the total flight time to make sure the glide is OK too.
14. Note that all of these setting that you program into the timer are saved in the timer even after the power is turned off. So they are ready for next time you come out to fly.

### **Radio D/T unit**

The timer has a connection for a Radio D/T unit; one of the popular units on the market such Airtek, Aeris or Vivchar can be used. The connection on the timer is a small locking 6 pin connector of which 3 pins are currently used for the RDT unit. They provide power to the RDT unit and get a D/T signal from the RDT device. The cable provided from the timer to the RDT is 75mm or 3 inches in length. Other lengths are available on request.

### **Differences in Version 2.0**

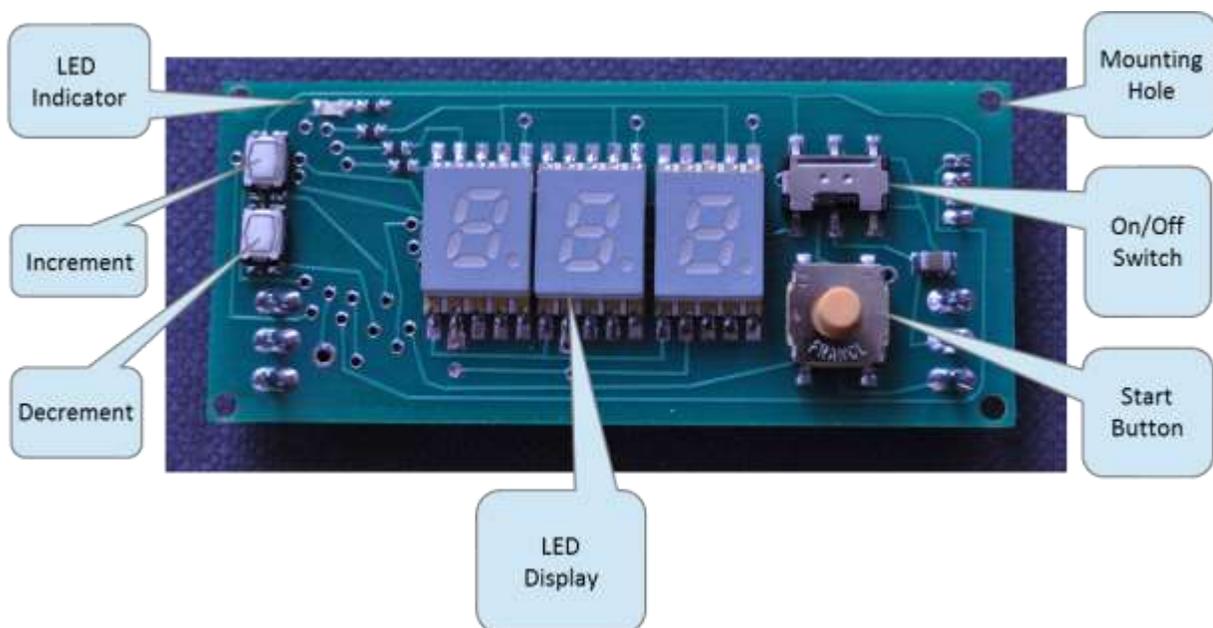
The version 2.0 of the timer has the following changes from version 1.0

1. The addition of the optional Beep on DT and ability to configure it from the reset function
2. The 6 position plug for the RDT
3. Some minor performance improvements and bug fixes

## Parts of the timer

These pictures show the first production version of timer. Note that there is no casing surrounding the timer. This is to keep the timer as light as possible. It is important that you do not get conducting material touching then components on the front or back of the timer. It is also important that you do not get metal filings or carbon dust or particles on the timer. If you want to cover the timer with a protective housing that is a good idea but make sure you can see the display and get at the controls on the front of the timer. The protective cover should be of a non-conducting material.

### Front



**Mounting Hole.** There are four mounting holes at the corners that can be used to mount the timer.

**Indicator LED.** An additional indicator that shows that the timer is working ... it doesn't do anything except give you a warm fuzzy feeling.

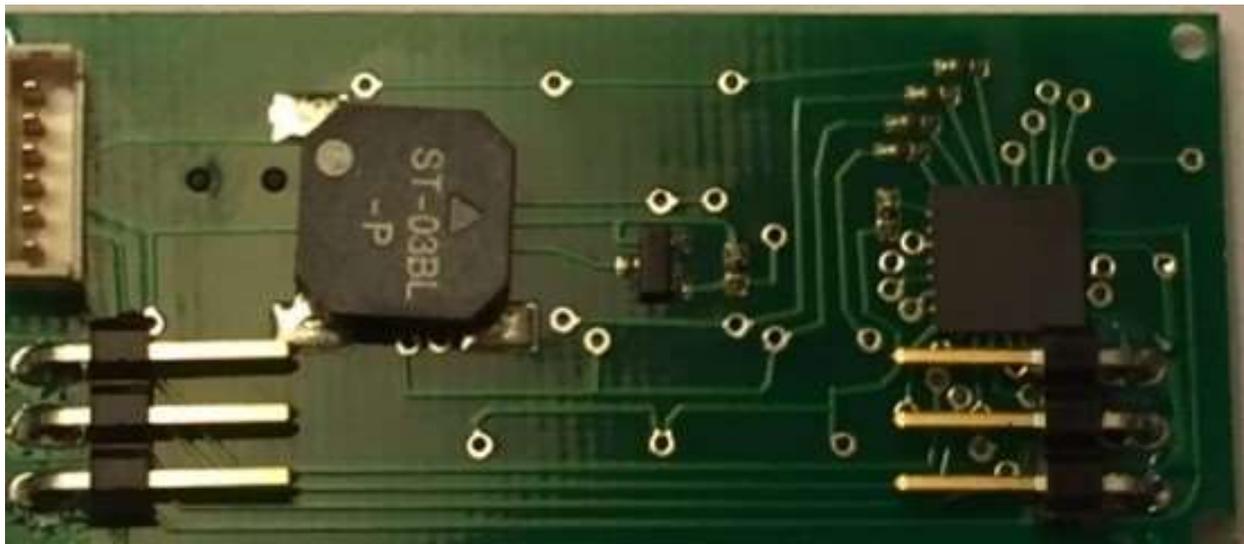
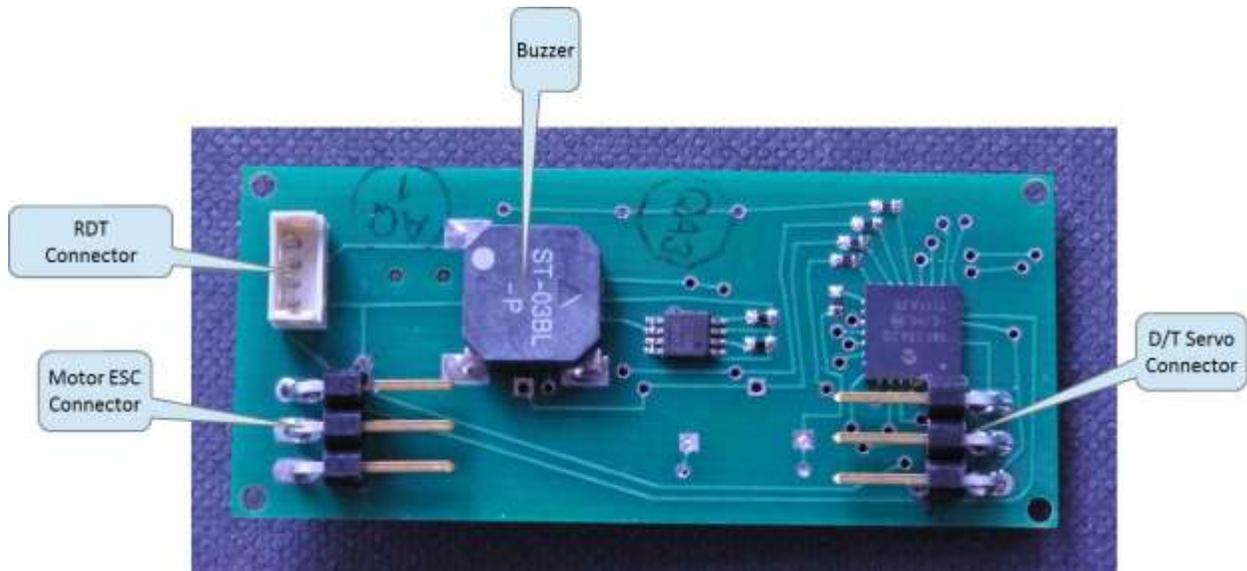
**LED Display.** This displays the total flight time in seconds, various status messages, counts down the time when the timer is running and is used when setting the timer (for example to show the length of the motor run).

**Increment and Decrement.** These are buttons that increment and decrement [increase and decrease] the times when the timer is being set.

**Power On/Off.** Turns the timer on and off. On is to the left towards the LED

**Start Button.** Starts the timer and is used when the timer is being set.

Back



**RDT.** This is the connector for a compatible RDT, Radio Dethermalizer unit. Typically there is a short lead plugged into the socket. This is a locking connector so the lead will not fall out by accident. It may be necessary to squeeze the connector at the top or lever it out using the two small holes in the back.

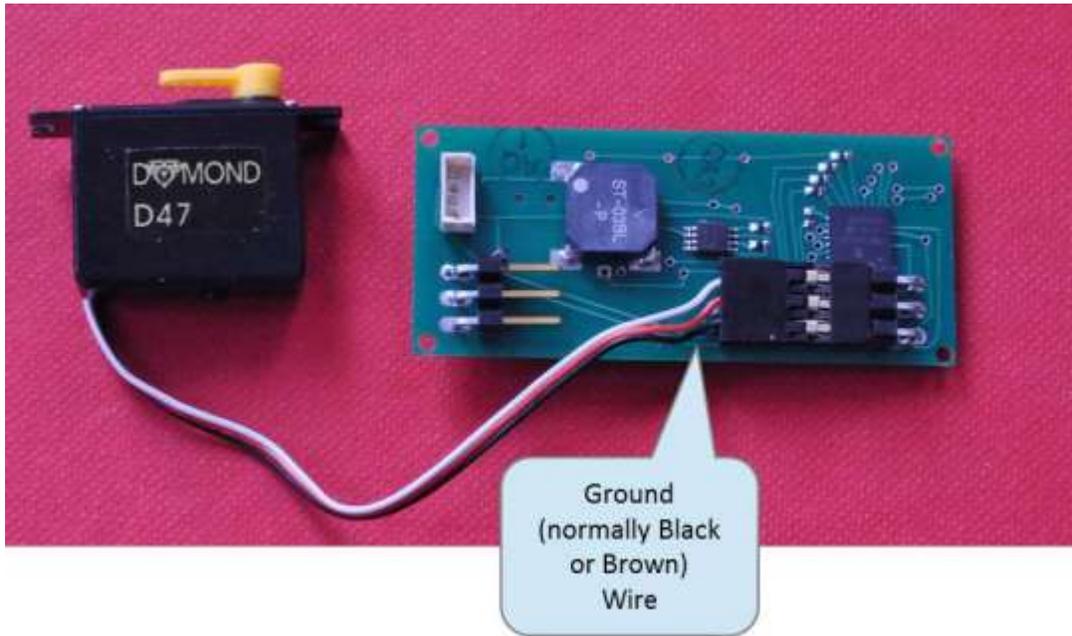
Never pull on the wires. This will work with Airtek, Aerios or Vivchar RDT systems. The timer provides unregulated power to the RDT unit. Looking at the picture above the pins are front the top:

- **Energy Limiter when enabled**
- **RDT signal**
- **RDT +5 [Voltage from ESC BEC]**
- **RDT ground**
- **Not Used**
- **Not Used**

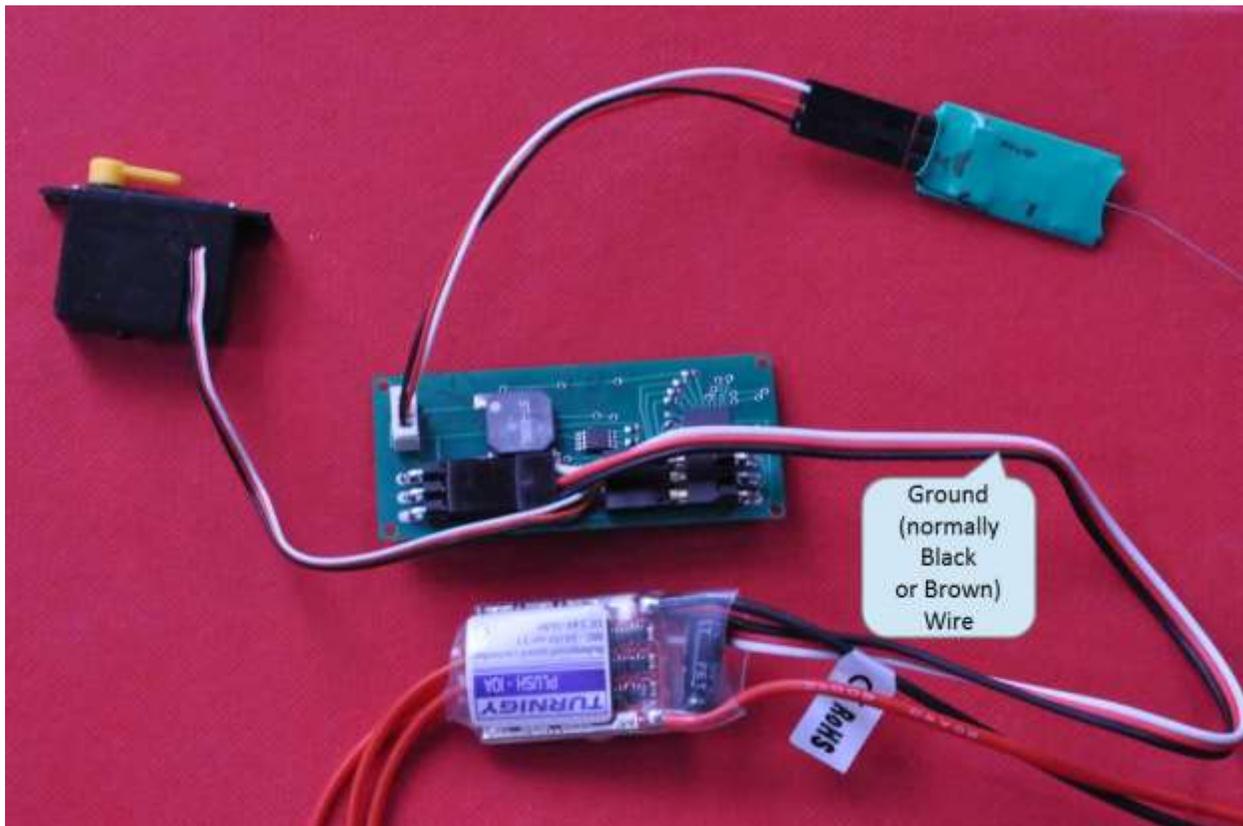
**Servo Connector.** The flight is terminated by mechanisms activated by an R/C servo. The servo is connected to this plug. The ground wire on the servo should be on the bottom (outside) pin of the connector. Make sure that the servo connector does not foul the electronic component on the board, it may be necessary to trim the connector slightly.

**Motor ESC Connection.** The motor controller or ESC is plugged into this connector. The negative or black wire is the bottom (outside) wire. For this timer no battery is needed as the ESC provides power for the timer from the motor battery. Make sure that the ESC connector does not foul the buzzer on the board, it may be necessary to trim the connector slightly.

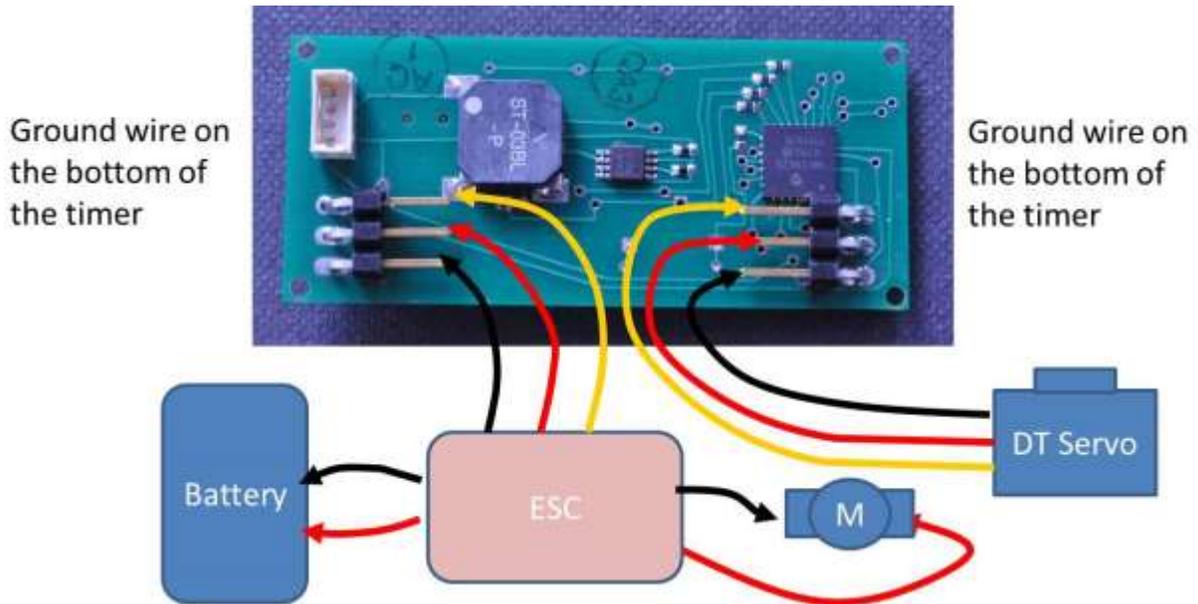
D/T servo connection to the timer



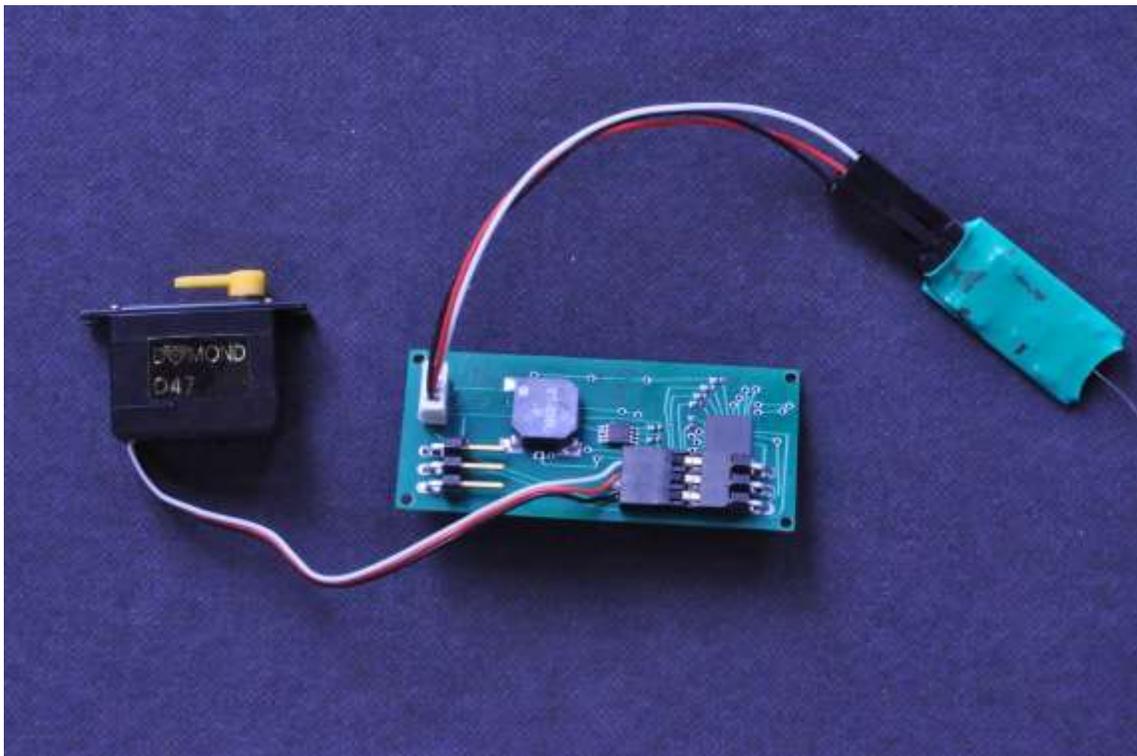
Motor ESC Connection to the timer



**Back of Timer without RDT**



**Back of Timer with RDT**



## How it works

### Normal Operation

The timer stores the flight program in non-volatile memory. The flight program is how long you want the engine run to be and how long you want the flight to be. Non-volatile memory means that this information is remembered when you turn the timer off. The engine run time is set in seconds and tenths of a second; the total flight time is set in seconds with the increment of change being 5 seconds.

On power up the timer reads the flight program and does an internal self-check to make sure that everything is OK. It then displays the total flight timer in seconds on the 3 digit LED display. So a 3 minute flight would show 180 for 180 seconds or 3 minutes. The timer is then ready to run.

The flyer makes sure all the mechanisms for stopping the motor and terminating the flight are connected and activated. He then starts the engine. When he is ready to fly, he pushes and holds down the start button. The timer then buzzes and displays the word **Fly** on the LED display. The flyer then launches the model, releasing the start button. The action of releasing the start button starts the timer running. After the prescribed time for the motor run, the timer tells the Motor ESC to stop the motor. Note that it might take a little while for the motor to stop and for the sound of the engine stopping to reach the time keeper. So the engine run as set in the timer should almost certainly be shorter than the time specified in the rules. The timer also moves the D/T servo the mid-point of its movement; if the rules permit the flyer may use this movement to, for example, change the rudder positioning. Once the motor is stopped, the timer continues to run until the total flight time has elapsed. The D/T servo is then moved to the extremity which will activate the D/T mechanism to terminate the flight.

While the timer is running it will show on the 3 digit LED display the remaining time in seconds for the flight. This feature can be used during bench testing.

After the flight the timer will go into sleep mode and power has to be cycled to restart the timer.

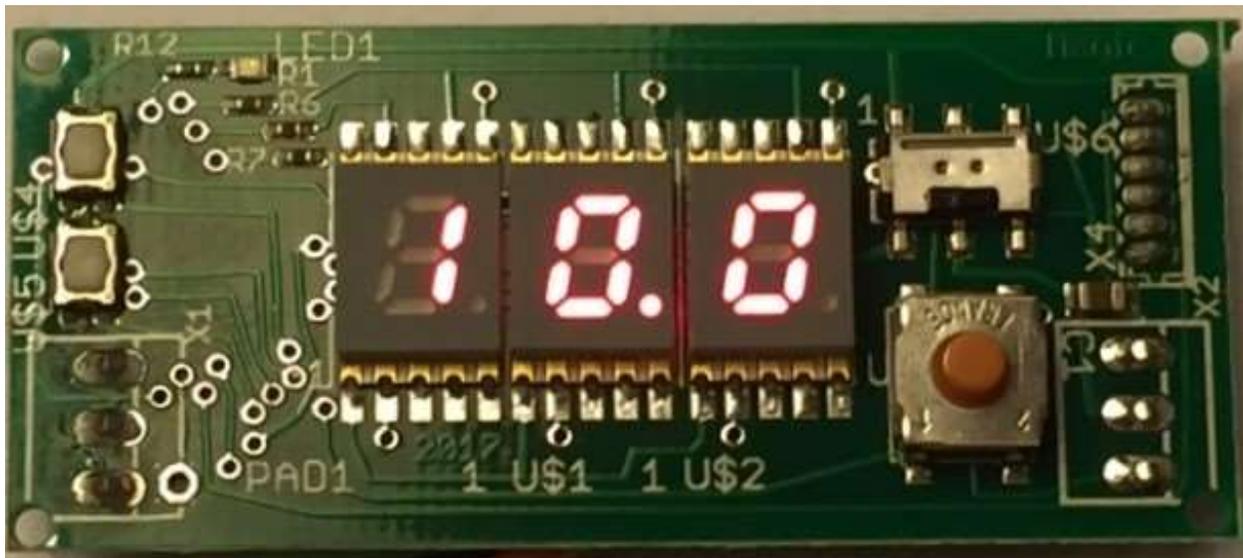
If the timer is connected to an optional Radio D/T [RDT] system then the flyer may use this to terminate the flight earlier than the total time. To do this he activates the RDT, typically by pushing a button on the RDT transmitter. This sends a coded radio message to the RDT receiver that is attached to the timer; this in turn signals the timer. The timer moves the D/T servo immediately to the engine stop position; it then waits one second and moves the servo to the D/T position. The delay is to give the motor time to stop (if it is not already stopped) before popping the D/T.

### Setting the timer

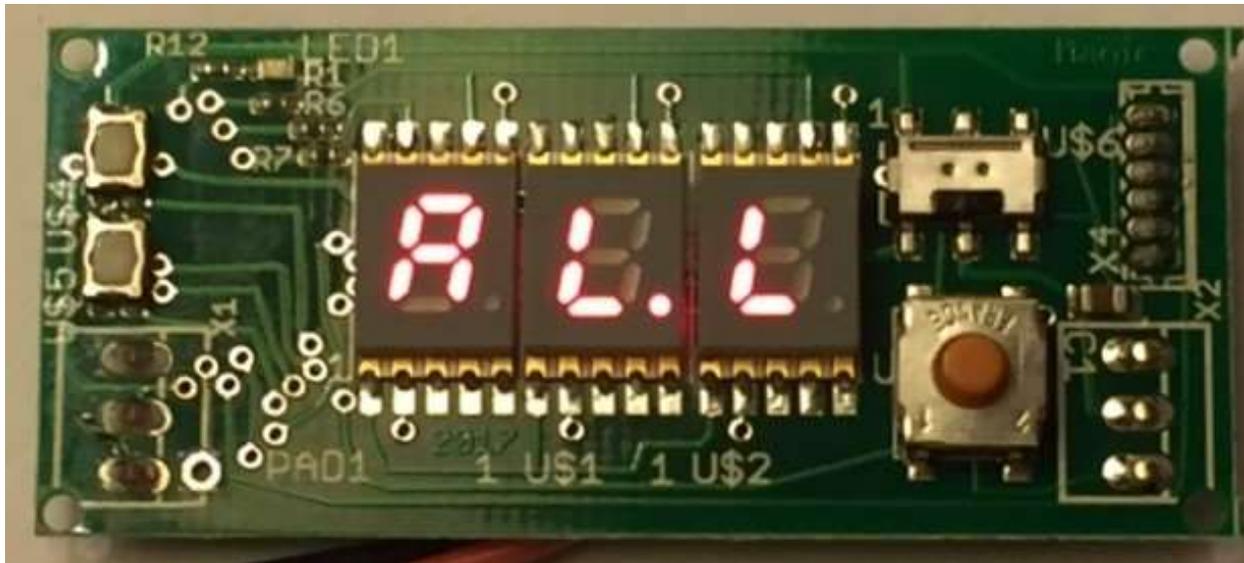
To set the timer, turn off the timer then press and hold the start button. Turn the timer on and the timer buzzer will make a continuous noise. Release the start button and the LED Display will show **Eng** for engine. After a short delay it will show the current engine run time. This has a decimal point and is in tenths of second. To change this time use the Increment (Up) or Decrement (Down) button to increase

or decrease the time; each push of the button makes a change of a tenth of a second. The button has to be pushed and released; it can't be held down to make big changes. Once the engine run time is set, press the start button. The LED Display will then show **All** and after a slight delay will show the total flight time that includes the engine run time. Tenths of a second are not counted for the total flight time. The number is changed by the increment / decrement buttons process. The change is made 5 seconds at a time. Note that the total flight time is set to the nearest 5 seconds. The flight time cannot be made shorter than the engine run. Once the time is set, press the start button. The word **End** will be displayed on the LED Display and the timer will return to the power up position.

#### Sample Displays



10.0 seconds motor run



Next display is complete flight time

### **Electric powered models**

The timer is powered by the ESC. This is a function of most ESCs; it is called the BEC or battery Elimination Circuit. It takes a small amount of power from the motor battery and drops it down to 5 volts for the R/C receiver or in our case the timer. The ESC have a number of safety features to make sure the ESC is being properly controlled and in some cases to determine the setting for a stopped motor and full throttle. The process for doing this varies from one ESC to another. But it is fairly common for the ESC to expect a signal from the R/C Rx or in our case the timer very soon after being turned on. So once the flight battery is connected to the ESC, the timer should be turned on as soon as possible because the ESC is expecting the signal from the timer. Failure to do this may cause the ESC to function abnormally.

In addition when the flyer pushes the start button to arm the timer, the timer starts the electric motor so it can get up to speed before the launch. It is important to be aware of this so the flyer is not caught by surprise and has a firm grip on the model.

When the flight is over power the timer must be cycled before the start button will work again and start the motor.

The timer also supports the connection of an Energy Limiter as used by F1Q electric models. Details will be explained later.

### **Installation**

The timer is sold without a servo and mechanical mechanisms. Virtually any R/C servo can be used. The timer starts with the servo at the midpoint of the travel in the at-rest position and moves it to one end for the motor stop and the other end for the D/T.

The timer should be mounted in the side of the fuselage or pylon.

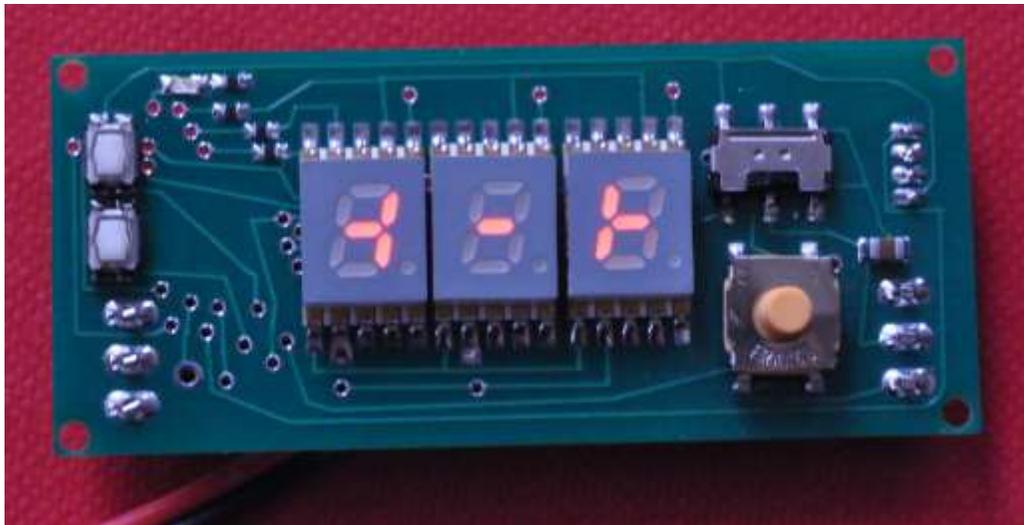
### **When something goes wrong**

Internally the timer carries out a number of checks to make sure that it is working properly. When you change the flight time, that information and some additional information that is used for internal calculations are stored in special non-volatile memory that retains its contents even when power is turned off. Normally this memory is very robust and it is hard to lose or corrupt the contents. However the flying environment is electrically very noisy and while under most circumstances the power supplied to the timer via the ESC is very stable, it can vary if the ESC or the battery becomes damaged. To protect against this unusual circumstance some checks are performed when the timer is turned on.

A continual buzzing noise indicates that there is a consistency check failure in the timer's non-volatile memory. There are two courses of action. The recommended course is to reset and reprogram the timer. A reset is performed by turning the timer off and pushing and holding both the increment and decrement buttons simultaneously while turning the power on. You will see the symbols in the picture below displayed on the LED display; at this point you can release the increment and decrement buttons. Do not turn off the power during a reset. If it happens by accident, repeat the reset process. After this is done, reprogram the timer with your desired motor and flight times.

It can be difficult to be sure that you have pressed both of the buttons together so it might be easier to do it by pushing down on the buttons with a small piece of hard wood or plastic.

When you are setting your airplane for the first time and still learning how to do things you might end up by getting the timer in an abnormal state and not knowing how you got there, do a reset like this will put it back so you can start off again with a clean slate. After showing the symbols below the version number of the timer firmware will be displayed. It is something like 140 meaning version 1.40



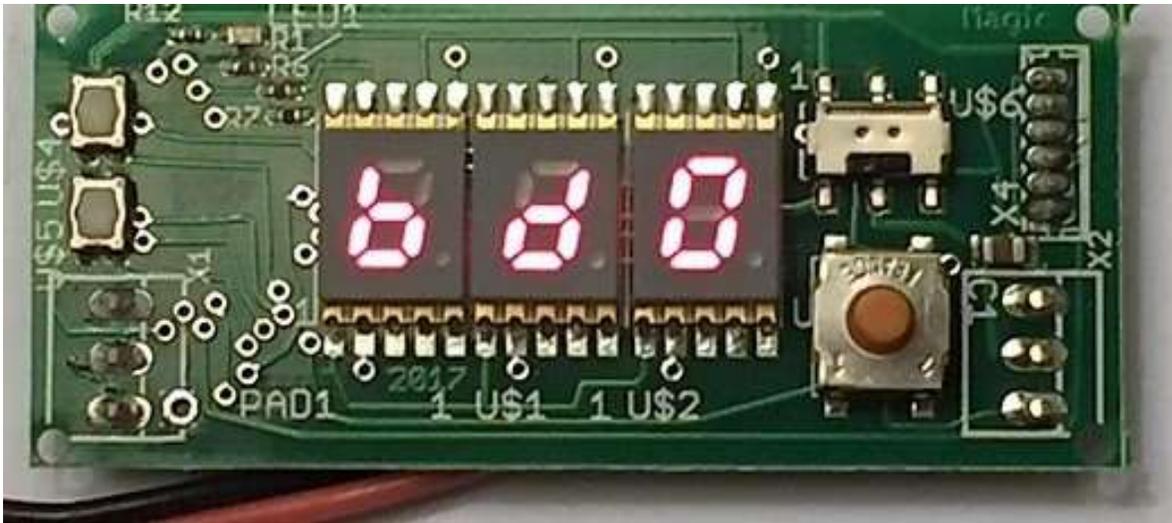
Alternatively you can push the start button and the buzzing will stop; it may be possible to fly the airplane but it is not recommended as your flight data may not be correct.

Note that it is very rare that this non-volatile data be corrupted and the most like reason is an unstable power supply. This is caused by ESC or battery failure. Rapid cycling of the power button can also cause this situation by “confusing” the timer or ESC.

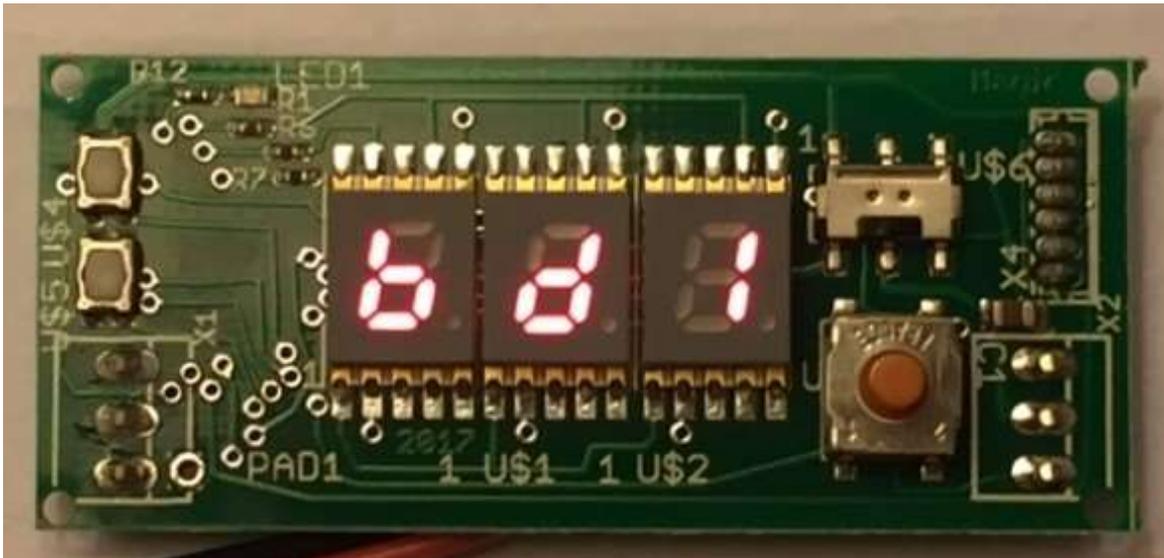
### Timer Reset and Option Selection

As described above the timer can be reset by the following process. . A reset is performed by turning the timer off and pushing and holding both the increment and decrement buttons simultaneously while turning the power on. You will see the symbols in the picture below displayed on the LED display; at this point you can release the increment and decrement buttons. Do not turn off the power during a reset. If it happens by accident, repeat the reset process. After this is done, reprogram the timer with your desired motor and flight times. The reset process will erase your flight times and set a motor run of 10 seconds and total flight time of 65 seconds.

In addition the reset process lets you configure the Beep on DT options. After displaying the symbols on the LED as in the diagram the display will show bd0 this is for **bEEP ON dT off** and means that timer will not beep after DT. If you push the increment or decrement buttons it will change to bd1 which means **Beep on DT** is on. Now push the start button at that setting will be displayed.

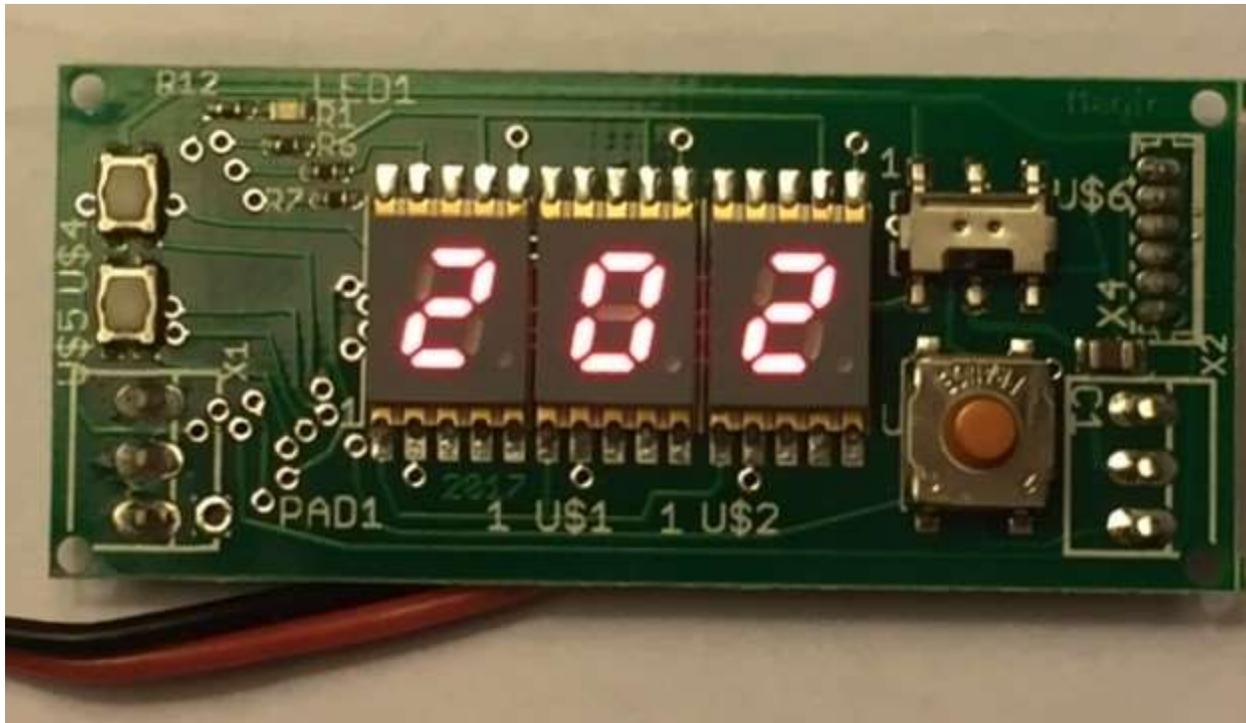


Bd0 display



Bd1 Display

The Timer version number will now be displayed. For example 202 means version 2.02



Version 202

### Energy Limiter

The timer can also be used for F1Q class of models. The FAI rules require that these models have an energy allotment based on the weight of the model. A full explanation is in the FAI Sporting Code. To obtain maximum advantage of the energy allotment a device called an energy limiter can be used. This will indicate when the allotted energy for the model had been consumed. The energy limiter has to be connected to the timer to tell it when the energy is consumed. See the diagram below that shows how this is done. A special cable will probably be required as the energy limiter shares a ground connection with the radio D/T unit.

Back of Timer with RDT and Energy Limiter

