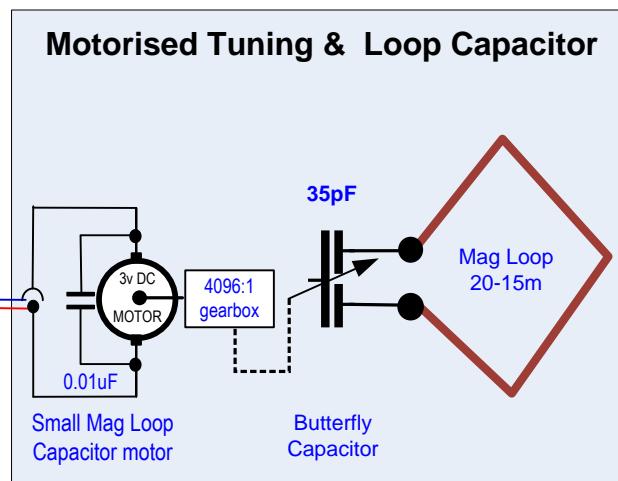
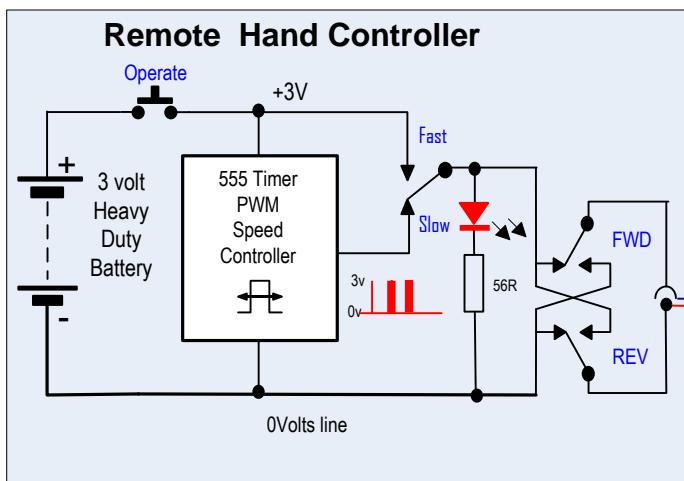


Simple Remote Tuning Control for HF Mag Loops – G8ODE

<http://www.rsars.org.uk/ELIBRARY/docsants.htm>



This simple battery operated remote control system was originally designed for a portable 2.5m circumference mag loop for 20m-15m. The two units are interconnected using a two core 10m cable with phono plugs to maintain the correct DC polarity at each end. The push to operate button helps to conserve the battery when the circuit is left unattended for a long time. A LED provides a visual indication when power is being supplied.

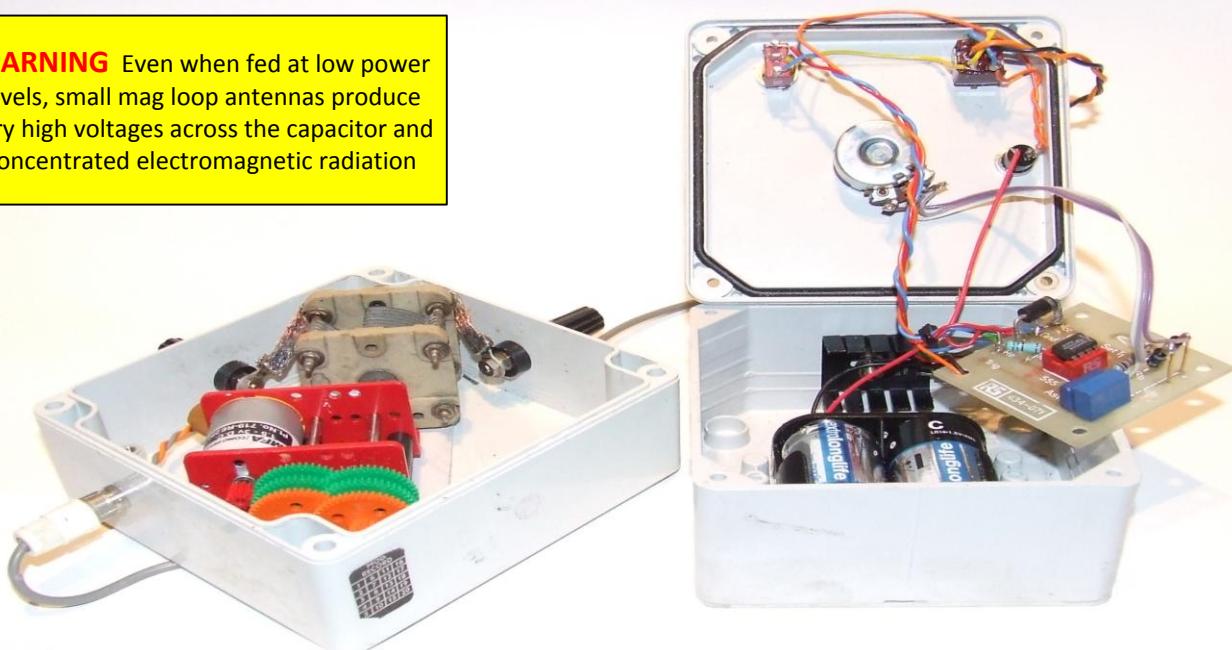
The butterfly capacitor has low friction bearings and is thus not a large burden on the motor or batteries. The hand controller enables the motor to operate at normal speed or to vary the speed using Pulsed Width Modulation (PWM). The design also eliminates the need for any limit switches that are required for capacitors with only 180° of movement.

There is no position indication because the 35pF butterfly capacitor can rotate 360°. The capacitor is fully engaged and disengaged with every 90° of rotation. You simply set the transceiver to the require frequency and then operate the controller until you hear maximum noise or strong signal, the momentarily go to TX and fine tune for a minimum SWR.

For safety, it is important to house the tuning capacitor in a plastic box because very high voltages (>1kV) that develop across the capacitor plates when the loop is at resonance.

G8ODE updated Mar 2014 iss 1.31

WARNING Even when fed at low power levels, small mag loop antennas produce very high voltages across the capacitor and concentrated electromagnetic radiation



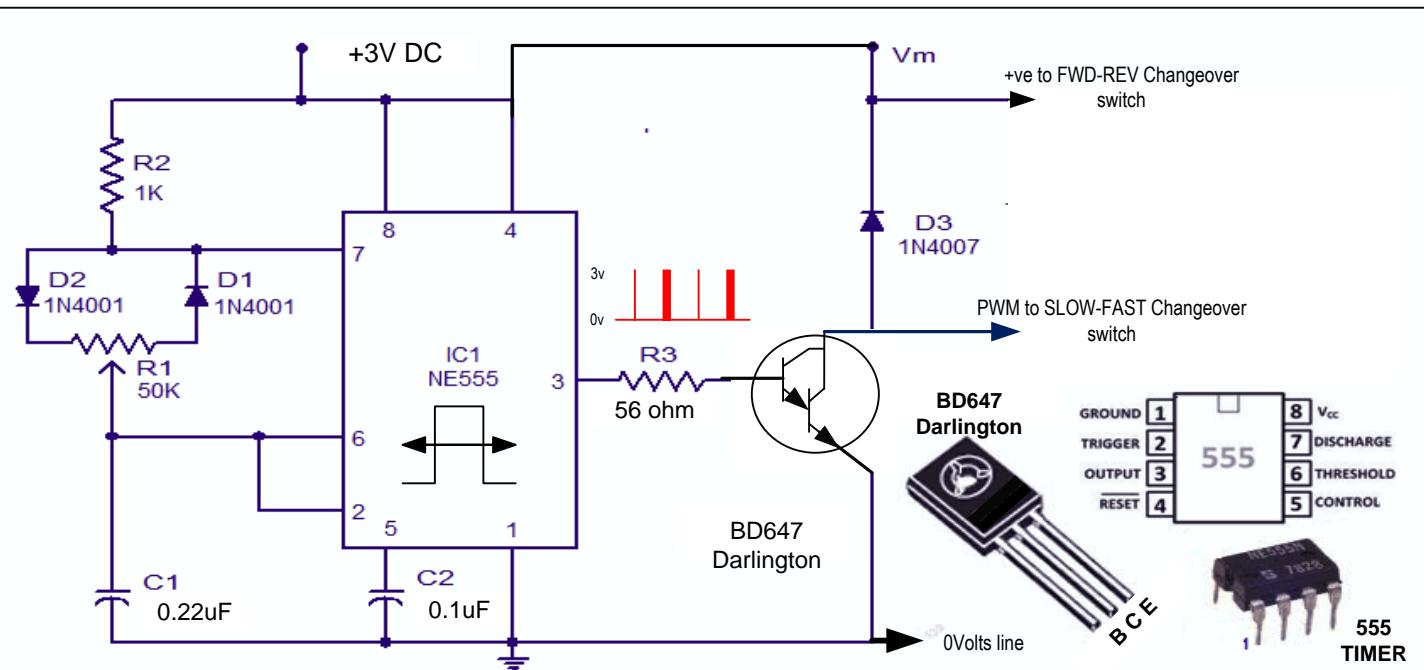
The motorised tuning capacitor unit and the remote hand controller during testing

Designed by G8ODE updated Mar 2014 iss 1.31

Simple Remote Tuning Control for HF Mag Loops – G8ODE

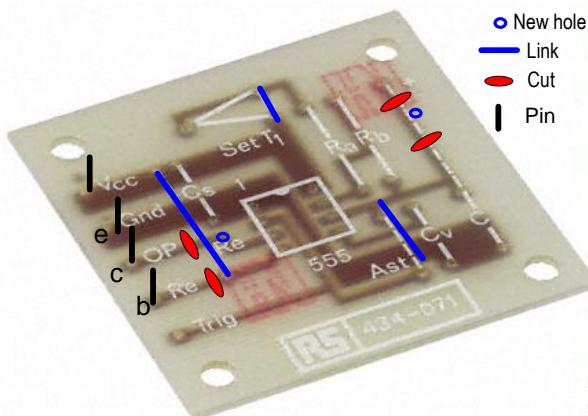


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555 Timer Pulse Width Modulated Speed Controller Circuit

Modifying the RS Stock No. 431-071 555 Timer PCB



THE 555 TIMER PWM CIRCUIT

The 555 Timer PWM circuit is a standard text book design with the timing components chosen to pulse the motor sufficiently slowly for accurate tuning at the higher frequencies when the capacitance needs to change tiny amounts..

The ready made PCB needs to be modified by cutting four tracks and drilling two 1.2mm holes adjacent to two of the cuts to enable components to be fitted. Three wire links are also required.

The metal pins help to secure the battery power wires and the EBC connections of the Darlington pair transistor. The Darlington transistor's high gain guarantees that the 555 timer output current fully saturates it to provide the PWM required to drive the motor

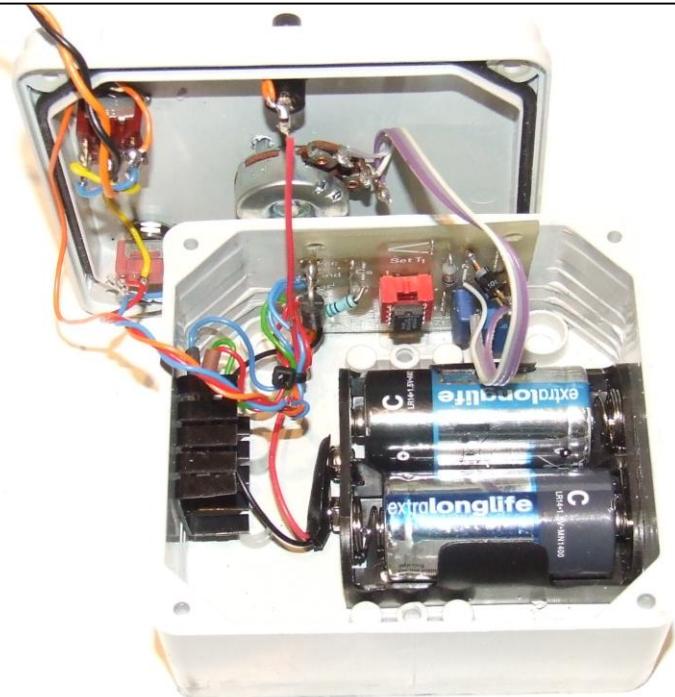
Simple PWM Controller Based On 555 Timer IC



The waterproof remote control

Simple Remote Tuning Control for HF Mag Loops – G8ODE

<http://www.rsars.org.uk/ELIBRARY/docsants.htm>



The PWM circuit board, battery holder and the Darlington power transistor with black heatsink are all secured with 3mm bolts and nuts.

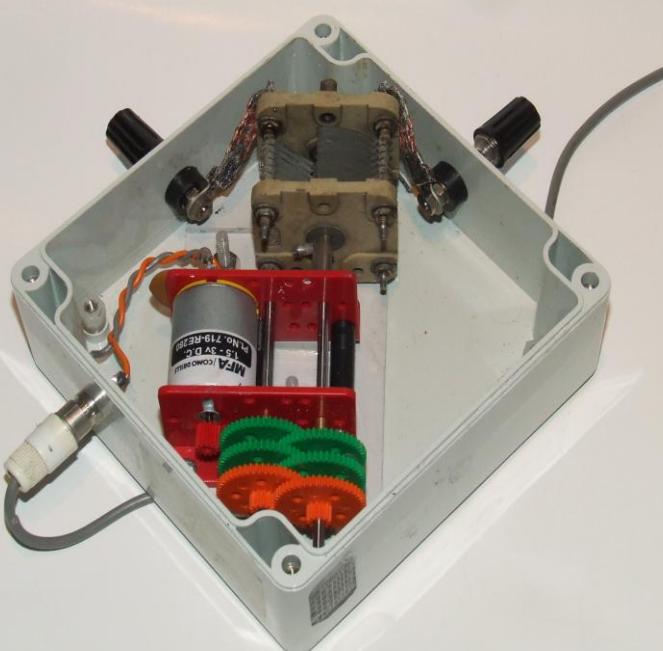
The Battery bolt is countersunk.

THE HAND CONTROLLER

The circuit is constructed in an ABS plastic box with a silicone rubber seal to make it waterproof. This type of box is easy to drill and file and deep enough to allow the speed control variable resistor to be mounted centrally on the lid of the box without touching the batteries underneath.

The RS Components 555 Timer PCB is mounted so that it sits on the floor of the box behind the two circular mouldings on the bottom – (only the RHS one is visible in the photo). This allows the PCB to be secured using a single nut & bolt through sidewall of the box. The BD647 Darlington pair transistor is mounted on a small black finned heat sink on the other side wall also using a single nut and bolt.

The switches are positioned so that their mounting holes allow the switches to be fitted to avoid the corner mouldings that the lid screws go into. Coloured PVC multi-strand 1.2mm wire is used to connect the switches to the Timer PCB.



The 35-pF butterfly capacitor with low friction ball bearings

DC Motor & Gearbox (4096:1 ratio) supplied by Maplins UK.
Type MFA Como Gearbox Multi-ratio 920D/AME
infor@mfacomo.com tel 01304 612132

THE MOTORISED TUNING CAPACITOR

The 35pF butterfly capacitor and proprietary 3 volt motor and 4048:1 gearbox are secured on a small ABS plastic sub-chassis that has two small pieces of scrap ABS stuck to it. These form supports for the motor-gearbox assembly and align it with the rotor shaft of the capacitor. The diagonal orientation allows the assembly to be installed in the square box after the gearbox shaft is shortened slightly.

The capacitor and gearbox output shafts are 3mm in diameter and are coupled together using a brass terminal insert recovered from an nylon electrical termination strip. The motor is noise-suppressed using a 0.01uf 750v DC disc ceramic capacitor. The high voltage rating is required to withstand the back-EMF from the motor when it is operating.

The two black 4mm screw terminals have short connecting straps made from RG213 braid that need to be soldered and drilled before fitting to the terminals. The other ends of the braid locate on the butterfly capacitor stator pillars carefully and are soldered. Because of the high currents that develop when the loop is being used to transmit the braid is necessary to minimise the copper losses.

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OPERATION

It is fairly obvious that a 35pF butterfly capacitor has a limited ability to tune reasonably large HF mag loops, simply because of its value. A useful mag loop calculation tool has been provided by KI6GD's mag loop antenna calculator "loopcalc.exe" ver 1.6 copyright 2003 and down loaded from <http://www.standpipe.com/w2bri/software.htm>.

A few trial values will show you that a 2.5m square circumference loop's results are;

2.5m circumference 15mm copper square	Frequency (MHz)	7	14	18	21	25
Tuning Capacitor	205pF	45.5pF	24.5pF	15.9pF	8.9pF	
Loop efficiency	3.80%	30.70%	51.70%	64.70%	77.10%	

*"OK not too
efficient but works
great as DX receive
antenna!"*

Where as a 3m copper circular loop's results are;

3.0m circumference 15mm copper circle	Frequency (MHz)	7	14	18	21	25
Tuning Capacitor	173.9pF	36.6pF	18.6pF	11.3pF	6.8pF	
Loop efficiency	9.90%	55.40%	75.00%	83.70%	90.40%	

*"slightly more
efficient and works
better as a DX
receive antenna!"*

The capacitor's small value is not really a disadvantage because fixed value or preset capacitors can be connected in parallel with the motorised capacitor. For instance a 3 m circumference circular copper loop requires the tuning capacitor to swing between 173.9pF and 163pF to cover frequencies 7.0MHz to 7.2Mhz. Thus a fixed value 150pF capacitor can be used with the motorised capacitor to tune the loop.

The motorised tuning capacitor was tested on a portable 2.5m circumference square loop made from 12.5mm electrical earth tape (braid) shown in the photo on this page and a 3.3m circumference circular RG213 loop. Both required the help of a 25pF ceramic door knob capacitor connected in parallel with the tuner to cover the 20m band. The surprise came that with the antenna only a metre or so off the ground a JA4 could be heard talking to a local Ham at the other end of the village on 15m. A large pile up followed the QSO and many European & old Soviet Bloc stations were heard exchanging details with the JA4 proving the antenna worked well as a DX antenna.

The remote hand controller without any position feedback seems to work OK since it is relatively easy to peak the tuning and reduce the VSWR down to 1:1. With a little practice you quickly learn where the best variable resistor positions are and when the pulses are so narrow that the motor stops. This is easily done on a table top with the lid off the motorised capacitor unit as shown on the previous page.

The PWM circuit does not have to be built on a the RS PCB, ordinary 0.1mm strip board can be used and the ABS boxes sized to suit the type of capacitor and motor that is available or switches that will be used.

The 3v motor with the 4096:1 gear ratio is quite powerful so it should be able to drive larger sized capacitors, although the larger capacitor may have a larger diameter shaft making coupling a little more difficult.

The PWM circuitry can be operated from a 12 volt supply to drive a more powerful motor, but the controller will require an external power source. The Darlington transistor will also need to be mounted on a larger heat sink because it may dissipate in excess of 12 watts from a 12 volts supply when the off period of the PWM is very small e.g. transistor is on for more than 90% of the time.

Mario G8ODE

