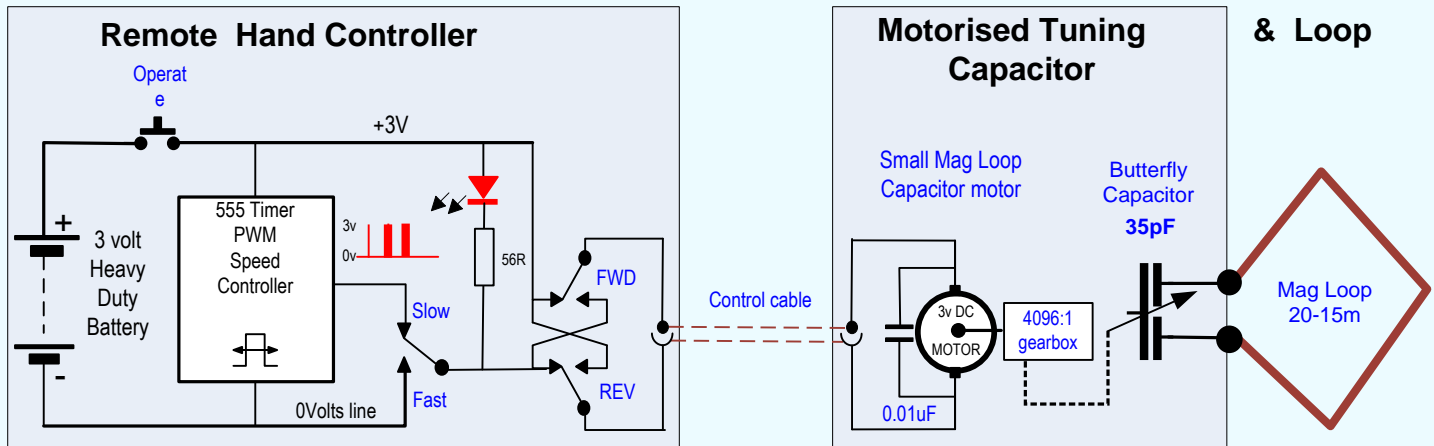


Simple Remote Tuning Control for HF Mag Loops – G8ODE



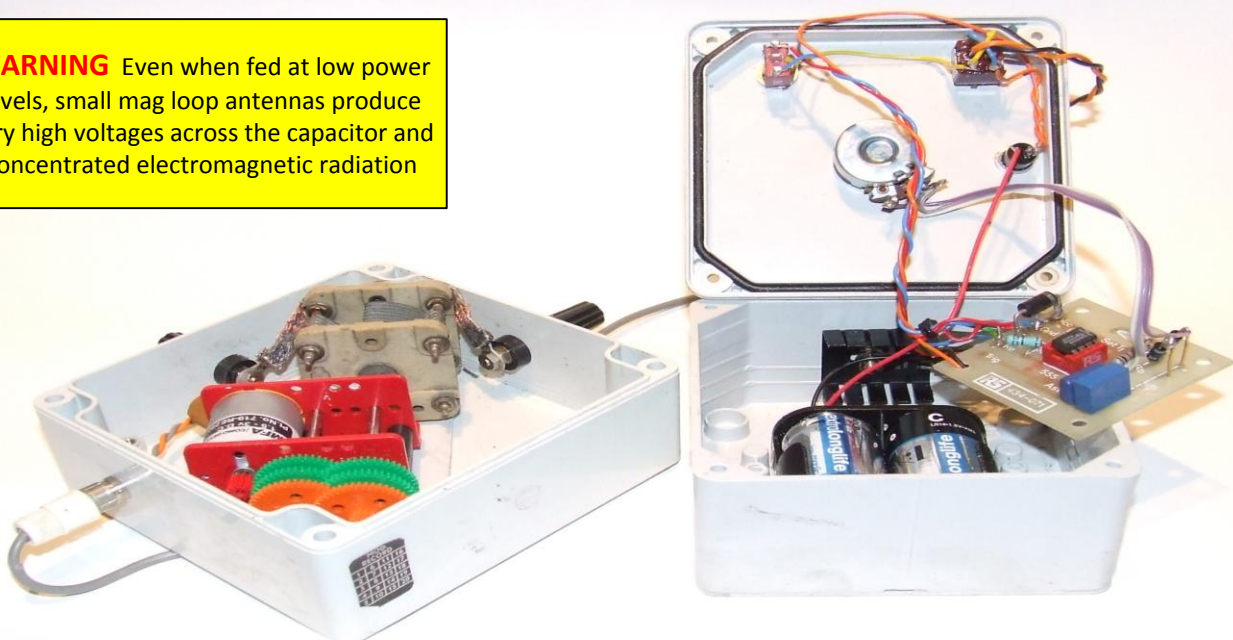
The simple remote control was originally designed to operate with a 2.5m portable mag loop for 20-15m and therefore uses batteries. The push to operate button helps to ensure that the battery is not discharged when the circuit is left unattended for a long time. The butterfly capacitor has low friction bearings and is thus not a large burden on the motor or batteries.

There is no position indication because the 35pF butterfly capacitor can rotate 360 degrees. This is not a real disadvantage because the butterfly capacitor is fully engaged and disengaged with every 90 degrees of rotation. The circuit enables fast motor operation to assist with band changing and the PWM speed controller can reduce the motor movements to very tiny steps or to a complete stop. This design also eliminates the need for position limit switches. An LED is incorporated in the design to provide a visual indication when power is being supplied.

The two units are interconnected using two core cable with phono plugs and sockets to maintain the correct DC polarity at each end. For safety it is important to house the tuning capacitor in a plastic box because very high voltages (>2Kv) that can develop across it when the loop is resonant.

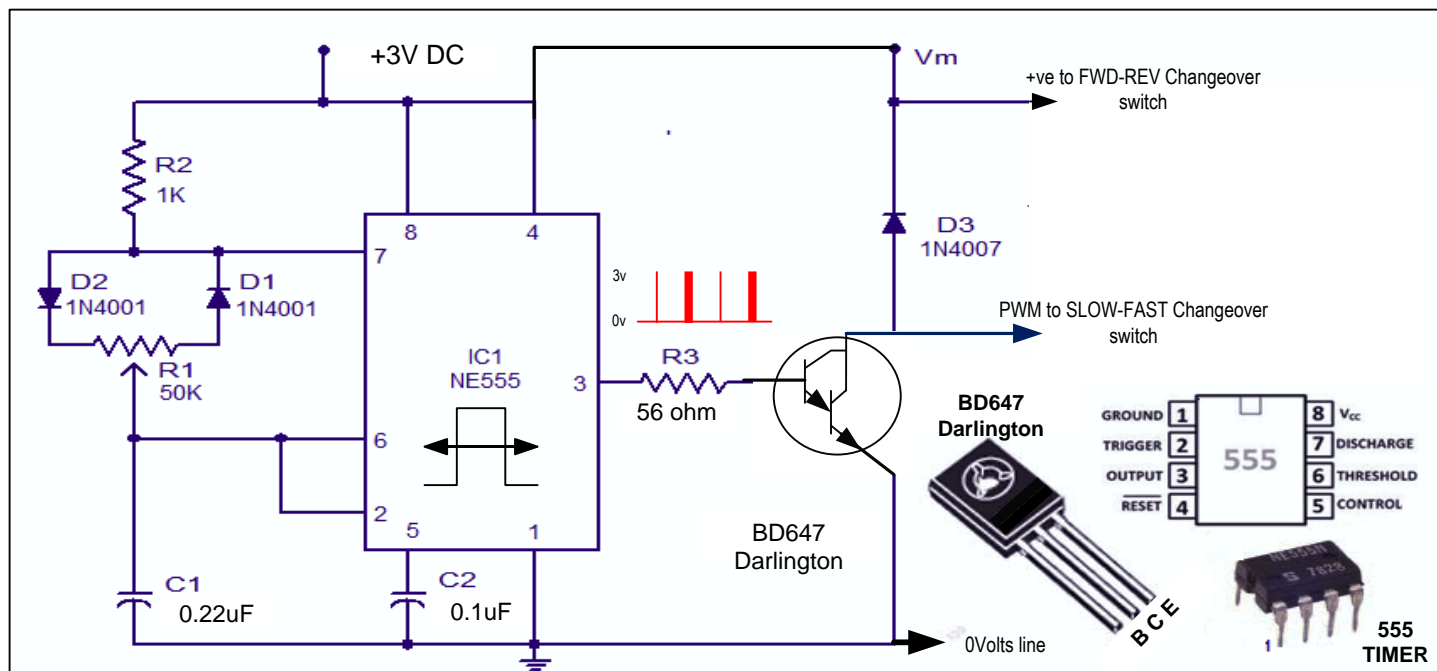
G8ODE Aug 2011 iss 1.2

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



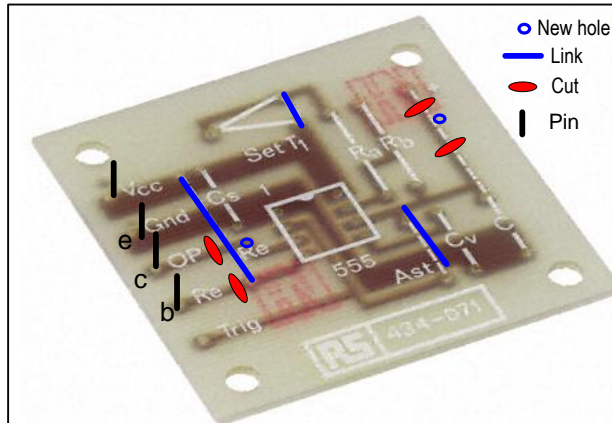
The motorised tuning capacitor unit and the remote hand controller during testing

Simple Remote Tuning Control for HF Mag Loops – G8ODE



555 Timer Pulse Width Modulated Speed Controller Circuit

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



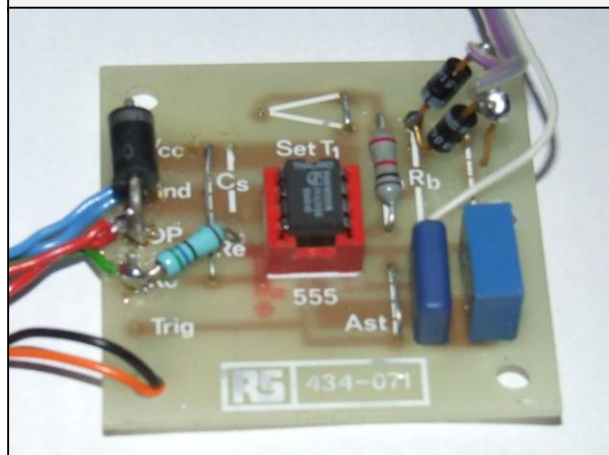
THE 555 TIMER PWM CIRCUIT

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.

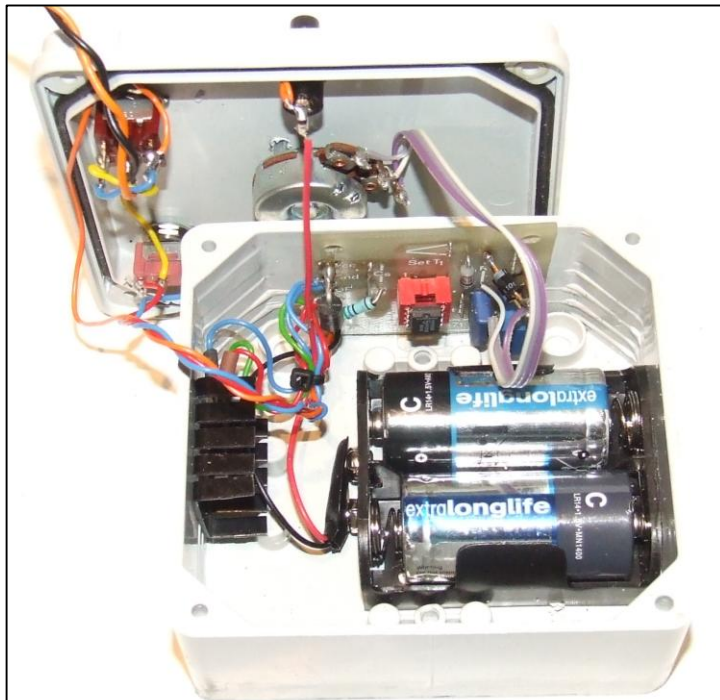
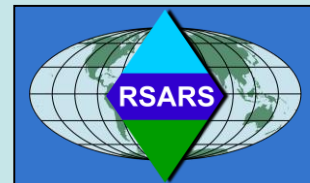
The metal pins help to secure the battery power wires and the EBC connections of the Darlington pair transistor. The Darlington transistor's high gain guarantees that the 555 timer output current fully saturates it to provide the PWM required to drive the motor

Simple PWM Controller Based On 555 Timer IC



The waterproof remote control

Simple Remote Tuning Control for HF Mag Loops – G8ODE



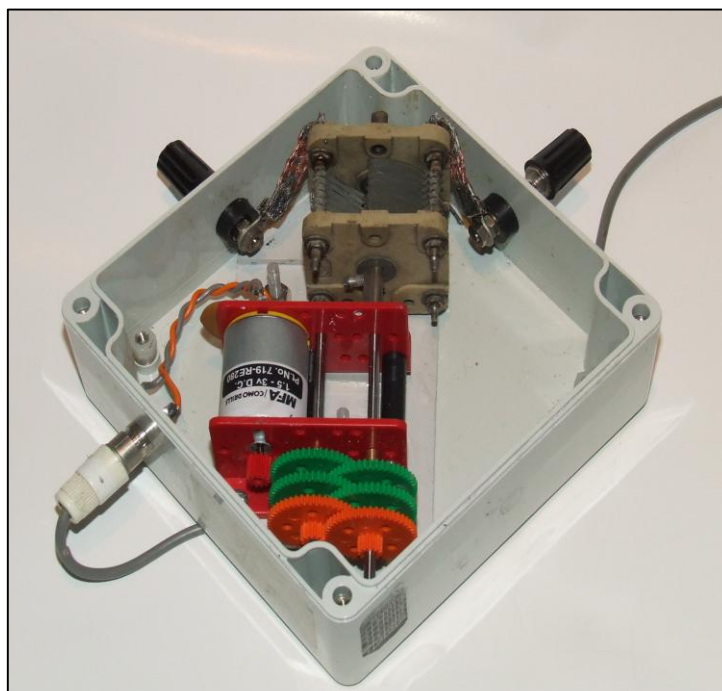
The PWM circuit board, battery holder and the Darlington power transistor with black heatsink are all secured with 3mm bolts and nuts. The Battery bolt is countersunk.

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.

Simple Remote Tuning Control for HF Mag Loops – G8ODE



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](http://www.loopcalc.exe)" ver 1.6 copyright 2003 and downloaded 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 that 90% of the time.

Mario G8ODE

