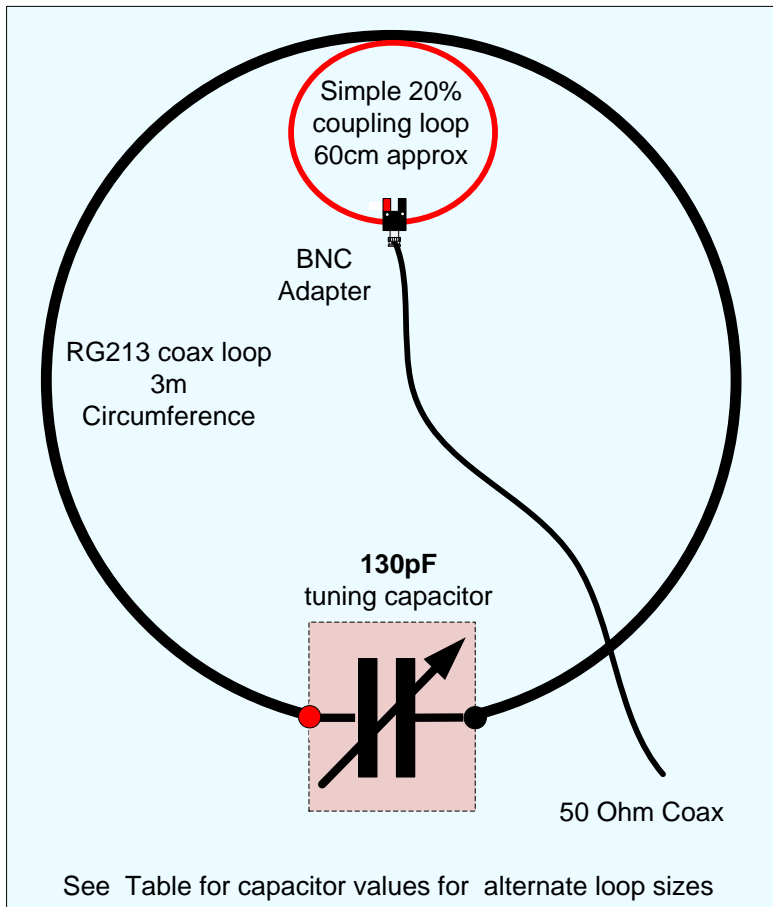


# Simple RG213 Mag Loop ( 30m-15m ) - G8ODE



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

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



Quick and simple way to install the loop as a manually tuned or fixed frequency auxiliary antenna

Its amazing what you can do with a bit of spare coax and an old vintage brass 130PF capacitor with 1mm spacing. During the Lighthouse weekend, when the local QRN was really bad, this simple loop was constructed and performed remarkably well. For safety the capacitor is housed in a recycled plastic wristwatch presentation case.

The loop was made from a spare 3m length of RG213, two pieces of 15mm plastic conduit and a Tee piece to join them which was together to make a spreader tie-wrapped to my 10m tall fibreglass fishing pole. The natural stiffness of the RG213 enables a reasonable circular loop to be formed using fixings points 90 degrees apart. These can be seen clearly in the accompanying photo.

The simple coupling loop is made from about 60cm ( 20% of the main loop's circumference) of 2.5mm single insulated wire. It's best to cut it slightly longer and trim to get the SWR down to 1:1. The wire is stiff enough to retain a circularly shape. However, sometimes the SWR does not come down to 1:1 and it's necessary to distort the coupling loop's wire shape to reduce the SWR down to 1:1 on 15m as shown in the photo above.

Using this antenna I managed to hear a JA4 on 15m for the first time. This was a very pleasing result since the antenna was so low and the Inverted G7FEK antenna I normally uses at about 6m was significantly noisier. The comparison was possible because the two antennas were connected to my homebrew outdoor antenna relay box which can be seen on the next page. Using this I was able to switch quickly between the two antennas.

Mario G8ODE

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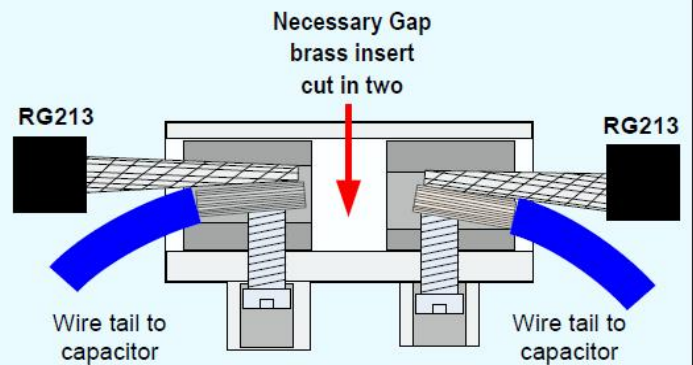
<http://www.rsars.org.uk/ELIBRARY/docsants.htm>



The vintage brass 130pF tuning cap is fitted inside the plastic box with the connections brought out to two black 4mm screw terminals using two 2.5mm insulated wires. The top and two sides of the box are taped using insulation tape to protect against water entering the box. The bottom edge is left open to drain any water that might get in via the spindle shaft.



## Modified nylon heavy duty electrician's connector block



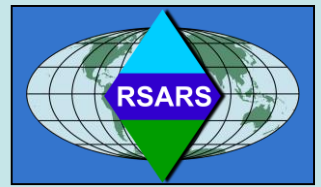
The mag loop requires a modified nylon heavy duty electrician's connector block. The diagram shows how this is modified to create a gap by cutting the brass insert in two. This ensures that the ends of the RG213 are held physically together to form the circle but don't short out. Two short 2.5mm stranded wire tails with spade terminals connect the tuning capacitor box to the RG213 mag loop.



The 3m circumference RG213 loop with a remotely controlled tuning capacitor connected. ( RSARS e-Library article for more details)

The coupling loop is 20% of the main loop's circumference to match a 50 ohms feeder. Shown here is simple wire loop made with a BNC-4mm terminals adapter- see notes further on.

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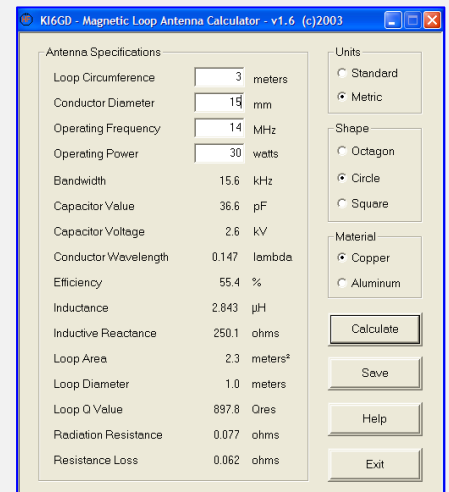


<http://www.rsars.org.uk/ELIBRARY/docsants.htm>

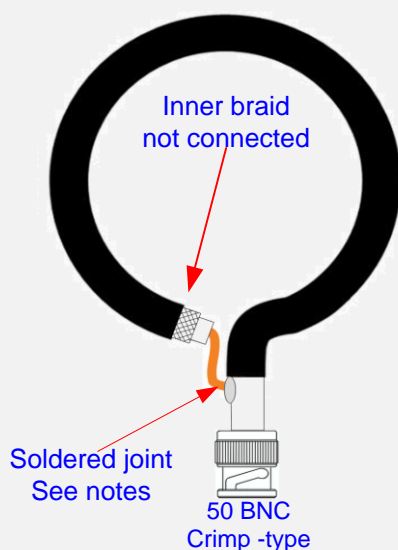
The table below shows the predicted multi-band operation of three practical sized loops. Maximum efficiency is achieved with circular loop. These have the largest area for a given perimeter (circumference in the case of a circle). The KI6GD loop calculator used for this exercise is an excellent tool and allows simple computations to be made for a variety of loop shapes using either copper or aluminium conductors.

The results show that the efficiency of small loops falls off dramatically below 20m when they are smaller than 0.1 wavelength in size. However, it is still possible to get good results on 40m. Small mag loops are quiet on receive because they are not sensitive to electric field noise such as local QRN and this helps to compensate for the lower efficiency. A Faraday coupling loop further improves the signal to noise ratio. The 4.5m loop will also perform reasonably well on 30m because the efficiency is close to 60% (not shown on table). The efficiency of the smaller loops is well below this level. The smaller loops fall well below this.

Circular mag loops have max efficiency	Values Calculated using KI6GD Mag loop Antenna Calculator V1.6 © 2003					
	Frequency (MHz)	7	14	18	21	25
3 metre circumference 15mm dia copper pipe	Tuning Capacitor	173.9pF	36.6pF	18.6pF	11.3pF	6.8pF
	Loop efficiency	9.90%	55.40%	75.00%	83.70%	90.40%
3.5 metre circumference 15mm dia copper pipe	Tuning Capacitor	149.4pF	29.9pF	14.2pF	7.8pF	
	Loop efficiency	14.80%	66.40%	82.60%	89.10%	
4.5 metre circumference 15mm dia copper pipe	Tuning Capacitor	116.4pF	20.3pF	7.6pF		
	Loop efficiency	27.00%	80.70%	91.00%		



## FARADAY SHIELDED LOOP

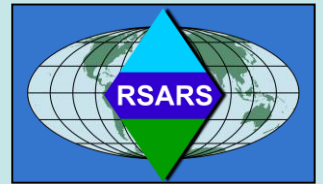


## FARADAY SHIELDED LOOP FOR IMPROVED RECEIVE PERFORMANCE

The Faraday shielded loop reduces the antenna's response to E-field interference (e.g. power line noise). The loop can be made from a length of RG58 or Mini-8 coax. The length should be slightly longer than 20% of the main loop's circumference. In the case of a 3.0m mag loop, start off with about 65cm of coax with a BNC connector crimped on one end and the other end stripped to expose the inner core ..

Using an alligator clip, short the coax inner core to the body of the BNC connector. Then tune the main loop to the lowest band and shorten the coax by a cm, repeat as necessary until the SWR is 1:1. The illustration on the left shows a soldered connection made after the final adjustment. Finally, check the other bands to make sure that the SWR is around 1:1. Sometimes distorting (reshaping) the Faraday loop may help to reduce the SWR further.

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## THE SMALL MAG LOOP'S CHARACTERISTICS:-

1. The main loop diameter "D" is a parallel resonant circuit and coupled with a smaller loop diameter "d", where  $D/d > 20$ . The main loop's inductance is cancelled out by a capacitor, leaving a very low radiation resistance ( $R_a$ ) typically 0.018ohms @7.1Mhz & 0.76 ohms @18.1MHz.  
**See note 5&6 below.**
2. Has a high Q ( 200-1000) and therefore low losses – almost all the RF is radiated.
3. The high Q causes very high voltages to develop across the tuning capacitor - Voltage > 2300v @ 30w RF.
4. The loop has a narrow bandwidth at the lower frequencies, e.g. 7KHz @7 MHz and 90kHz @18MHz. Below 10Mhz this helps to filter the TX output and on receive behaves like a pre-selector limiting the affects of static or strong adjacent channel signals from overloading the front end of the receiver.
5. The efficiency of the loop is  $\eta = (R_a / R_a + R_L) \times 100 \%$   
where  $R_a$  = Radiation Resistance &  $R_L$  = resistive losses in loop & capacitor.  
Note that at 7MHz  $\eta=21.4 \%$ .
6. The losses ( $R_L$ ) can be minimised by using large diameter copper tube or aluminium and by using a high quality capacitor designed for loops e.g. butterfly capacitor.  $R_L$  also affects the "Q" of the loop and hence its bandwidth. If the losses are too small the "Q" becomes very large and bandwidth can fall to around 1KHz and be too narrow for AM or SSB

## SMALL MAG LOOP OPERATION

Since the RF currents of a vertically oriented small loop's associated image above the ground are in phase with those of the loop, the performance is hardly affected by the proximity of the ground. This contrasts with those of a horizontal dipole whose image RF currents are in the opposite phase.

The efficiency of the small loop antenna improves when it is elevated slightly. At very low heights, close coupling to the ground can cause detuning. In contrast dipole or beams need to be elevated > 1 /4 wavelength above the ground to perform well.

For operation on 14 MHz and higher frequencies, with the loop at table top heights the loop's ground losses are minimal, and the efficiency approaches that of a full size dipole at the same frequency. For the 7 MHz band and lower, ground losses become more of a problem, so elevated operation (i.e. from a second or higher floor) can result in improved performance.

Furthermore the figure-8 doughnut shaped far field radiation pattern means mag loops perform well at all distances. This is in contrast to dipole or beams whose far field radiation patterns are significantly affected by the antennas height above ground.

## MAG LOOP FAR FIELD PLOTS

