MARK 2 QTC 80/40 LOOP ANTENNA

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The original experimental QTC transmitting loop antenna was built in late 1990, tested immediately, and details were published in the June 1991 issue of this magazine. The design raised a lot of interest and a number of fellow amateurs in both the UK and the USA advised the author that they were apartment dwellers (no outdoor antenna possible!) and were going to construct it. Others asked whether a two-band 80/40 metre (3.5–7.0 MHz) version was feasible. That request is answered in this article.

IN response to the comments and questions of a number of readers, particularly in the UK and the USA, a Mark 2 QTC loop antenna was constructed to cover the 80 m and the 40 m bands. A similar octagonal configuration as for the original was used, but the tuning/coupling impedance matching circuits were redesigned for two-band operation after a number of experiments and tests. The result is even simpler than the original.

The original QTC loop was a 30 in. (75 cm) diameter octagonal spiral loop, of novel design, whose general circuit and configuration is shown again in Fig. 1. The loop was designed for indoor use, set up on a table alongside an 80-m low-power CW transmitter. It was intended as a possible answer for those amateur transmitting enthusiasts who, for one reason or another, cannot erect an outdoor antenna.

Theoretically, a small, indoor loop using a maximum of 10 W RF power cannot be expected to produce a signal comparable with the conventional 100 W transmitter/outdoor dipole set-up. However, in practice, it occasionally does; we think for the following reasons.

1. The QTC loop being directional, and comparatively narrow-band, reduces incoming interference (and outgoing, such as TVI!).
2. Being 'on hand' alongside the operator, the QTC loop can be peak resonated for absolute maximum performance and directivity on the spot frequency being used.
3. Some outdoor dipoles (and other types) are erected to textbook dimensions, with little or no regard being paid to the height and surrounding objects, resulting in an off-tune compromise, which, when fed with, say, 100 watts, produces results that are accepted without the realization that these could be greatly improved if the antennas were tuned to optimum frequency at optimum height. To which should be added the antenna compass alignment, and the type, length and condition of the coaxial feedline, and so on. The overall result is that the original 100 W signal is largely dissipated or attenuated in the system.

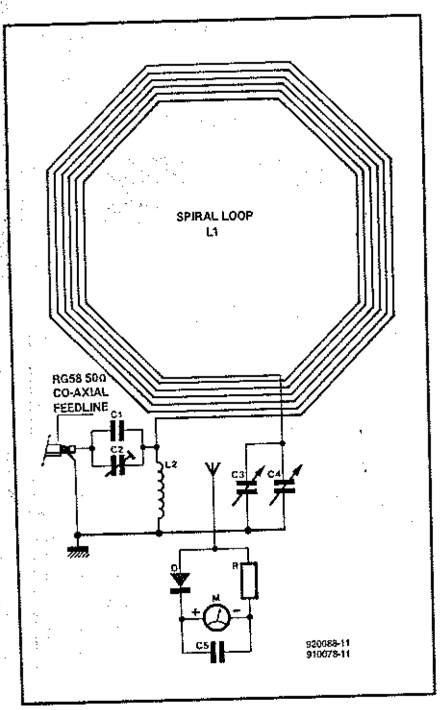


Fig. 1. The original QTC Loop.

Reason 3. became apparent during various contacts with continental European stations when using the QTC Loop, and later the Mk. 2 QTC Loop, and discreet questions were asked about the height, length and surrounds of their antennas.

Nevertheless, it must be stressed that in most cases the QTC loop signal was somewhat down on the outdoor dipole/transmitter set-up. It was, however, quite adequate for 2-way communication, which must be considered satisfactory when an enthusiast is lumbered with a 'no outdoor antenna' situation, for whatever reason.

The circuit

The original QTC Loop was intended for operation on the 80-m (3.5 MHz) amateur band. The circuit and general layout are given in Fig. 1. A spiral 5 $^1/_8$ turns loop, L_1, and inductance L_2 were resonated to frequency by bandset and bandspread variable capacitors C_1–C_2. There was also an optional tuning meter.

The Mark Two QTC 80/40 Loop uses an identical spoke framework—see Fig. 2. The total number of turns of L_1 is five for 80 metres and an optional tap for 40 metres. It is resonated by C_1–C_2, which is a good-quality receiving type two-gang variable capacitor (2×125 pf) with the built-in padders removed. Coupling to the transmitter (and receiver) is by C_3 (300 pF ceramic variable) to 48 in (120 cm) of RG58 coaxial feedline. The original tuning meter—see Fig. 1—can be used with advantage.

Construction

The construction is shown in Fig. 3. It consists of an eight-spoke octagonal frame, a vertical member, and a heavy base to prevent it tipping over. On to this is fixed the sim-

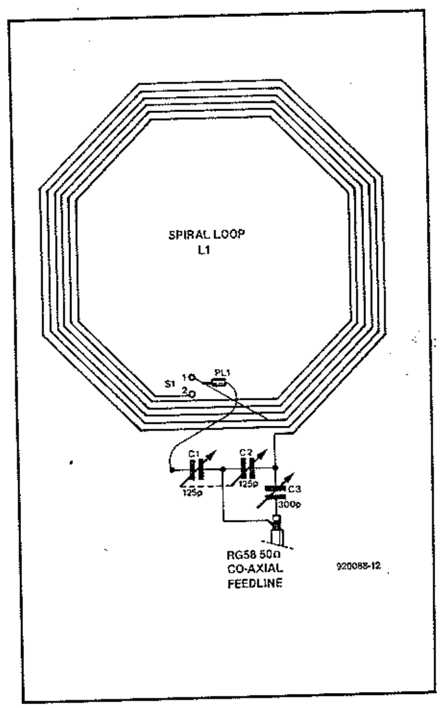


Fig. 2. The QTC Mark 2 circuit.

ple resonating/loading unit, which is constructed on a standard 9"×4" (23×10 cm) fibre-glass board, copper-clad on one side. Ideally, this should be replaced by a suitable box. However, as it was anticipated that the loop would be used as a test bed for future experiments, a board was used as this can be re-used, or quickly replaced, at little cost—see Fig. 3 and Fig. 4.

The loop frame consists of eight spokes made from four lengths of moulded hardwood, each 30 in. long, $^5/_8$ in. wide and $^1/_4$ in. thick (760×16×6 mm). A 2BA (5 mm dia) clearance hole is drilled in the centre of each spoke. The spokes are then glued and clamped together with a long 2BA (5 mm dia) bolt, nut and washers. The spokes must overlap in the order shown in Fig. 3 and evenly spaced apart. The assembly should then be allowed to dry out thoroughly, after which it is given a coat of polyurethane varnish. A six-way, 2 A polythene terminal block (cut from a standard 12-way block) is screwed to the end of each spoke to provide the necessary securing, spacing and insulation of the wire turns.

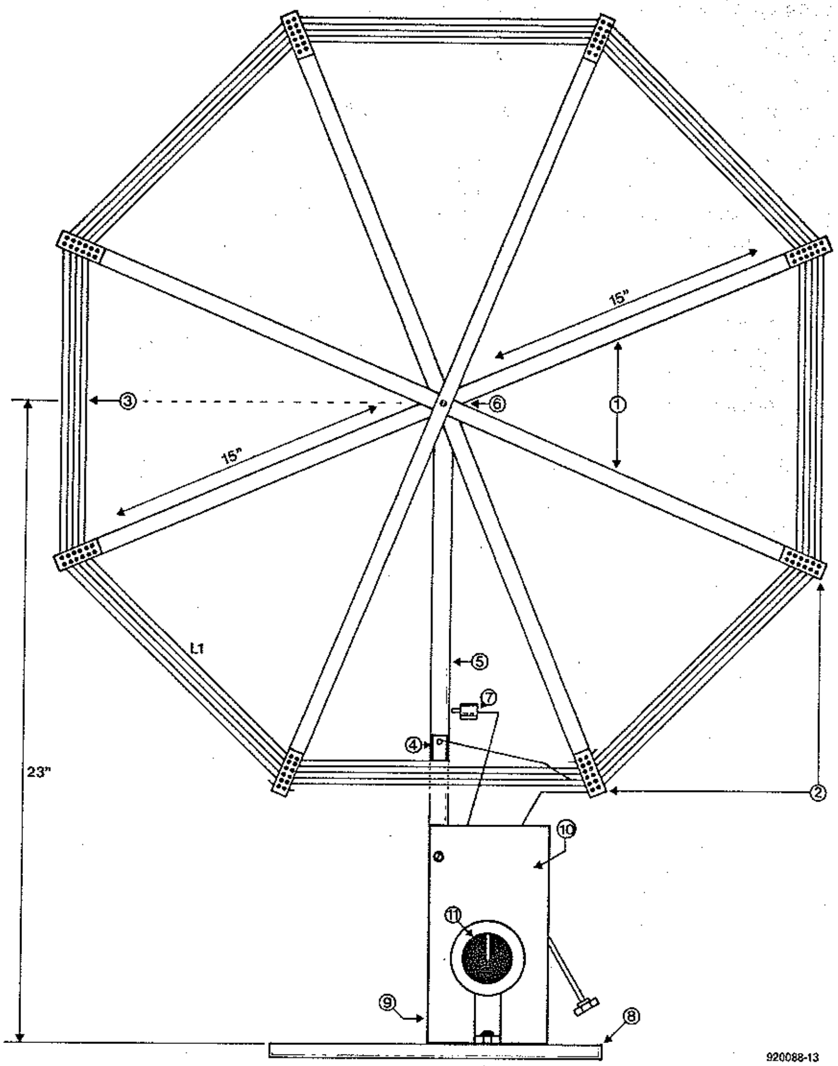
A 23×0.8×0.8 in (585×20×20 mm)vertical wooden support is glued, screwed and bracketed to a suitable 12×8×0.5 in (300×200×12 mm) wooden base, the whole being teak-wood stained. The loop frame is then glued and bolted to the top of the vertical support as shown.

The loop winding, L_1, uses PVC covered 7/0.2 mm wire with an outside diameter of 1.2 mm and rated at 1 kV, 1.5 A. After loosening the grub screws in the terminal blocks, thread the wire through, turn by turn, for five turns, starting at the outer hole of the bottom right-hand spoke, threading through all the blocks in an anti-clockwise direction, and terminating at the inner hole of the bottom left-hand spoke. Tighten the grub screws while going along just enough to hold the wire in place, and firmly when all the wire is threaded through and pulled tight. Leave long wire tails at both ends: these can be cut back and soldered later—see Fig. 3.

Next, secure the fibre-glass board to the wooden upright—see Fig. 3 and Fig. 4. Positioning the capacitors depends on their actual size and shape, but should be more or less as shown in Fig. 4. Capacitor C_1–C_2 must be fastened to the panel as shown and fitted with an extension shaft, with front support bracket and panel bush as shown in Fig. 4, with a wooden support platform, cut to size, to support the bracket.

Capacitor C_3 is mounted at an angle and fitted with an *insulated* extension shaft as shown in Fig. 3 and Fig. 4. *It must be completely insulated from the copper-clad fibre-glass panel.* Also, it should be fitted such that the knob is well away from the loop winding. This capacitor requires setting in only one position for 80 m (3.5 MHz) and 40 m (7.0 MHz) and may, therefore, be considered preset.

A two-way polythene terminal block is screwed to the vertical support just inboard of the bottom inner end of L_1—see Fig. 3. This is to give the 40 m (7.0 MHz) facility later.



1. 4 lengths of moulded hardwood 30×$^5/_8$×$^1/_4$ in. (760×16×6 mm). Varnished. 2BA (5 mm dia.) holes drilled in the centre of each length. Then glued and bolted together, spaced evenly, as shown.
2. 8 off 6-way, 2-amp polythene terminal blocks used as insulated wire spacers.
3. 5 turns PVC stranded 7/.02 mm wire; o/d = 1.2 mm; rating 1 kV, 1.5 A.
4. 2-way, 2-amp polythene terminal block
5. Vertical wood support 23×0.8×0.8 in. (585×20×20 mm). Wood stain.
6. 2 in×2BA (50 mm × 5 mm dia) bolt.
7. Fly lead (for 7 MHz tap) fitted 2 mm plug.
8. Wooden base 12×8×$^1/_2$ in. (300×200×12 mm). Wood stain.
9. 2$^1/_2$ in (6 cm) bracket behind vertical wood support.
10. 9×4 in. (23×10 cm) single-side copper-clad fibre glass board.
11. Knob for C_1+C_2.
12. Knob, shaft coupler and shaft (insulated) for remote control of C_3.

Fig. 3. Construction of the Mark 2 QTC Loop.

The outer end of L_1 must be cut back and soldered to the junction of C_2 and C_3 as shown in Fig. 3. The inner end of L_1 is cut back and inserted into the bottom connection on the terminal block—see Fig. 2 and Fig. 3. Solder a flexible plug lead, cut to length, to the stator of C_1. A 2 mm plug is a snug fit in the block terminal insert.

Selecting of the 40 m (7 MHz) tap is discussed in 'Testing and operation' later.

All other behind-the-panel wiring must be in 16 SWG tinned copper wire, with the copper cladding of the board used for the 'earth' connections—see Fig. 4.

Fit a large 3 in. dia (75 mm) control knob to C_1–C_2.

Secure a 48 in (1.20 m) length of RG58 coaxial feedline with cleats to the wooden base.

Testing and operation

1. **80-metre (3.5 MHz) band**
   Initial tests must be made with a receiver. Rotate the resonating control, C_1–C_2, to ensure that it covers the 3500–3800 kHz (3500–4000 kHz in the USA) band. Then rotate C_3 for maximum signal in the centre of the band.
   Feed a small amount of RF to the loop and re-adjust C_1–C_2 to resonate at the exact transmit frequency. Capacitor C_3 may also require a small re-adjustment for maximum loading (or lowest SWR if a SWR meter is available). Check the loop radiation with a nearby field strength meter (the tuning meter used on the original QTC Loop is ideal). It should now be possible to fully load the loop. Capacitor C_3 should not require any further adjustment over the band.
   Check the directional properties by tuning the receiver to a signal and rotating the loop for maximum signal—this is also the position for maximum radiation to the desired station.

2. **40-metre (7 MHz) band**
   The approximate position of the 40-m 'tap' on L_1 is shown in Fig. 2 and Fig. 3. The exact position must be selected carefully so that C_1–C_2 are enmeshed about 15% at 3800 kHz. The tap is made with a flexible lead.
   To avoid mutilating the PVC wire covering on L_1 when seeking the correct 'tap' position, take a lead from the top insert on the two-way terminal block. Solder a thin sewing needle at the other end.
   With the receiver tuned to about the centre of the 40-m band, insert the 2 mm plug into the two-way terminal block at the top and push the needle through the PVC wire cover in the position shown in Fig. 2 and Fig. 3. Resonance should be obtained at 3800 kHz with C_1–C_2 enmeshed about 15% and C_3 peaked for maximum signal. If necessary, move the 'needle' tap slightly to the left or right as required. The tapping point will vary between loop models, depending on the construction. Once the tap point has been found, the PVC can be removed, and the lead end soldered on in place of the needle. It will be found that any tiny needle holes will not show if the wire is squeezed between finger and thumb.
   The transmitter can now be resonated/loaded to the loop as in the 80-m band.

3. **Other bands**
   There seems to be no obvious reason why a further tap cannot be added for another band, such as the 20 m (14 MHz) band using a similar technique to the one described. A slow motion drive could be added between the knob and C_1–C_2. The loop would probably be less directional on the higher frequencies.

Safety

The QTC 80/40 Loop is designed for use with *low* transmitter power. The prototype has been operated with up to 10 watts CW. It has been tested up to 20 watts, but any higher powers would necessitate higher voltage variable capacitors and thicker wire for L_1.

In the interest of domestic household safety, *10 watts should not be exceeded*. There will be no prizes for the operator for setting fire to the curtains or giving the kids a nasty RF shock, or scaring the living daylights out of the cat.

Reference

'The QTC loop antenna', *Elektor Electronics*, June 1991, p. 40.

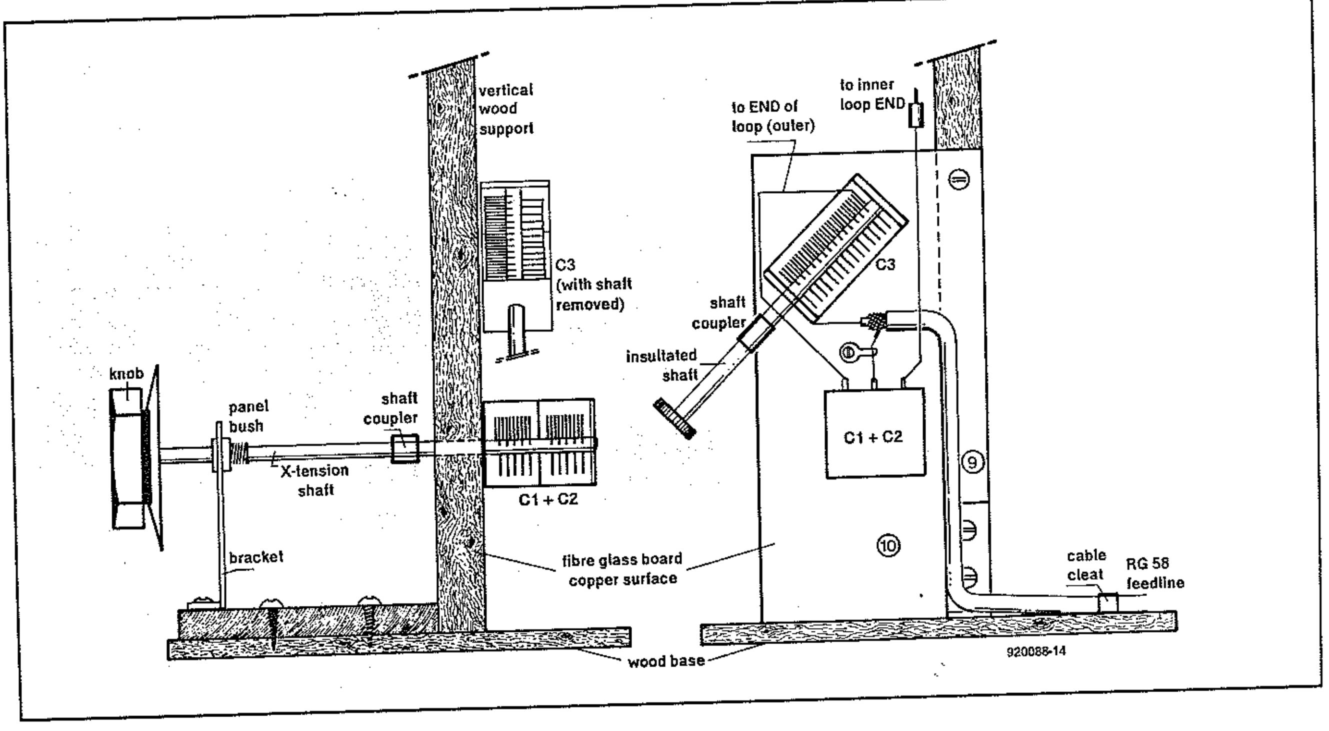


Fig. 4. Panel details.