



The G-QRP Club

The Limerick Sudden 40m Transmitter Kit



Circuit design – George Dobbs G3RJV

PCB design – Rex Harper W1REX

Kit – Graham Firth G3MFJ

Manual – G3RJV and G3MFJ



Founded in 1974, the G-QRP Club is the largest QRP Club in the world. The club exists to promote interest and growth in low power amateur radio communication (5 watts or less). Membership is open to any licensed radio amateur or short wave listener anywhere in the world.

The club publishes a quarterly journal called SPRAT, which is sent free to members. SPRAT contains many circuits, technical hints and ideas for QRP construction projects, together with club news, contest and award information and other items of interest to QRP operators. SPRAT is an exclusive QRP journal and contains much practical information in each issue. The club operates a club sales department where components are available at special prices to club members. We also publish QRP books which are available to members.

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Transmitter Overview

The Limerick Sudden Transmitter is a simple circuit for a reliable QRP transmitter. Although crystal controlled, the oscillator stage (T1) is a Variable Crystal **Oscillator** (VXO). The crystal supplied is a fundamental frequency crystal on 7.030MHz, the QRP calling frequency on the 40 metre band, although other frequencies are available for the CW end of this band. Notice that an inductor (L1) and a variable capacitor (VC1) have been added in series with the crystal and ground. These inductive and capacitive elements allow some shifting of the frequency.

The oscillator output is coupled via C4 to a 2N3904 **Driver** stage (T2). TR1 forms the RF (radio frequency) load for the stage. It is also a coupling transformer to drive the power amplifier. The transformer is wound on an FT37-43 core; a ferrite core for broadband coupling. The primary winding is 25 turns of 30 s.w.g. enameled wire. (Gold) The secondary winding is 5 turns of the red wire wound over the centre of the primary winding. The value of the resistance in the emitter of T2 determines the amount of drive available to T3 and hence the output power of the transmitter. A preset potentiometer (VR1) is placed in series with R6 and acts as a DRIVE control.

The NPN 2N3906 transistor (T4) is used as a **Key Switch** to key the transmitter. This keys both the oscillator and the buffer/driver (T1 and T2). In many QRP transmitter designs it is common to leave the oscillator free running and to key later stages. This is because keying an RF oscillator can result in a “chirpy” CW note. However, T1 is a crystal controlled oscillator and no such chirp occurs. Keying both stages overcomes the problem of oscillator break-through when the oscillator is still running in the receive mode.

SW1 is a NET switch that enables the oscillator to run without keying the transmitter. It provides 12 volts for the oscillator and D1 prevents this voltage reaching T2. This facility allows the oscillator to be heard in the receiver so that the VXO signal can be adjusted to a desired frequency or aligned with a desired station signal. “Netting” is standard practice when a separate transmitter and receiver are being used; it is also called “spotting” in North America.

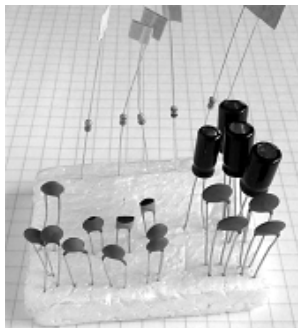
T3 is the transmitter power amplifier (the **Final**). This is a simple Class C amplifier biased by the drive voltage from TR1. The output load is provided by L2, an RF choke. A zener diode (ZD1) offers protection for the output transistor should the transmitter be inadvertently operated without an antenna or into a short circuit. A clip-on heat sink keeps the transistor cool. C6 couples the RF output to a seven element **Low-Pass Filter** based on the W3NQN filter data, with enhanced 2nd harmonic filtering.

The capacitor C7 leads to the transmitter-receiver break-in circuit popularized by W7EL in his “Optimised Transceiver” design. It is a simple method of sharing the same antenna by a transmitter and receiver without damage to the receiver during transmission or significant loss of signal from the transmitter. Some muting of the signal fed to the receiver is achieved by the circuit T5, T6 and T7. The muting circuit is such that when a receiver is connected to the transmitter, 12 volts must be connected to the transmitter to hear signals. The muting is most effective when the covers are on the transmitter and receiver.

Building the Transmitter

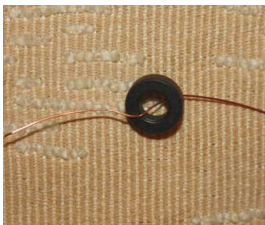
You will have noticed that this is a rather unusual kit. It has a printed circuit board without any holes. We call it “Limerick Construction” because it was designed by Rex Harper, W1REX, of Limerick, Maine. It is a surface mounted board in that the components are mounted on the surface of the board, although the components used are “through-hole” parts. This allows for ease of construction and easy correction of any errors. The main board also has the front and back panels for the transmitter. They are scored and can be snapped off the main board. We suggest you smooth the snapped off edges with emery paper or an emery board. The component parts are soldered to the top surface of the board using the leads that would go through the board on a conventional printed circuit board. The interconnections between the mounting pads are ready made but hidden by the black screen printed overlay. The designation of all the parts is printed next to the appropriate pads. Each section of the transmitter (OSCILLATOR, DRIVER, FINAL, LOW-PASS FILTER and KEY SWITCH) is also marked on the board. The MUTE circuit components are mounted on the back panel. Any references to **top**, **bottom**, **left** and **right** assume that the board is held with the printed text the correct way, with the G-QRP Club logo in the centre right. **Top** is actually the **Rear** of the finished board, and **bottom** is, of course, the **Front**.

It does help to set out all the components in the order of designation. i.e. C1, C2 etc. The best way is to use a small piece of polystyrene to hold the individual parts. If you are going to use this idea for semiconductors, a piece of aluminium foil wrapped round the polystyrene will prevent any static damage. Double check the capacitor values—there is a lot of difference between a 101 and a 104 capacitor!



The building of the transmitter does entail winding four coils on toroid cores (TR1, and L4, L5 and L6), and an RF choke for the PA wired on a pig-nosed binocular core (L2). The cores are the small rings that look like miniature “Polo Mints”. L1 and L3 are pre-wound chokes (coils) that look like fat resistors. Winding the coils is not difficult; it just requires a little care and the accurate counting of the number of turns. There is ample guidance in the pages of this manual. It is a good idea to wind TR1 before beginning to add any other components to the board. It is the most difficult of the hand-wound coils as it has two windings, a tuned winding and a smaller link winding.

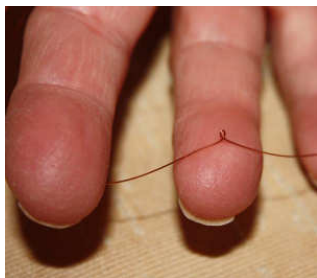
TR1 is wound on the FT37-43 core. This is the black core - the one without the yellow coating. The primary winding has 25 turns of the gold wire. There is guide as to how to wind these on the next page. Each time the wire passes through the hole of the core counts as one turn. The turns should be laid side by side and occupy about three-quarters of the circumference of the core. The link winding is 5 turns of the red wire wound over the centre of the main winding. Placement of the link winding is not too critical – just guess the centre position.



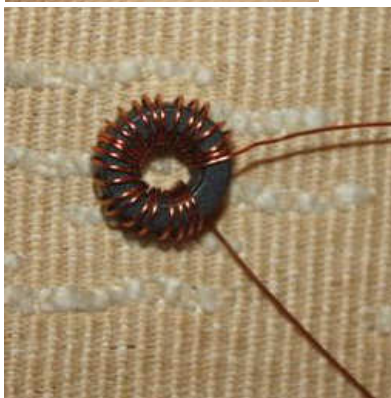
thread the wire through with the other hand, laying the windings side by side. Tighten the wire after each turn for a neat coil.



time the wire passes through the hole (including the first time) it counts as ONE turn. Hold the core firmly with one hand and



Sometimes if the wire gets twisted and forms a loop it results in a kink. Untwist the wire carefully. Trying to pull out the kink can snap the wire. Complete the 25 turns. They should occupy about three-quarters of the circumference. The 5 turn link winding, using red wire, is added over the centre of the main winding. Guess the centre, it is not really critical



When the windings have been made, trim the ends of the wires to about 1cm. The wire is coated with enamel insulation. About 5mm of each wire should be tinned with solder prior to making the connections. The enamel coating on the wire supplied is designed to melt when the soldering iron is applied. This does require quite a bit of heat. The best method is to form a blob of solder on the soldering iron tip. Apply the tip to the very end of the wire and wait until the enamel melts and the solder flows onto the copper wire. This can take up to 20 seconds. Then move the wire through the blob until you get the required 5mm or so tinned. It's best not to breathe in the smoke given off during this process.

TR1 is mounted vertically in the centre of four pads. The primary (larger) winding is soldered to the top right pad and the bottom left pad. The link (5 turn) winding to the other two pads.



The transmitter is built in two sections; the first being the left-hand side of the circuit diagram as far as R7. This includes the OSCILLATOR, the DRIVER and the KEY SWITCH. These are then tested before the rest of the stages are added.

Begin by soldering the transistors T1, T2 and T4 to the appropriate pads. The shape of the transistors marked on the board indicates their orientation. They must be placed the correct way round. To enable a secure solder connection of the parts, the leads are bent into an "L" shape for adding to the pads on the board.

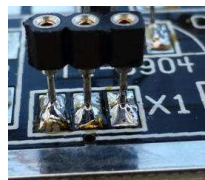


Add the resistors as far as R9 and the capacitors C1 to C5, C8 and C9, C10 and C11. Capacitor C11 is an electrolytic capacitor and must be connected the correct way round. The negative lead (marked with a series of dashes – see drawing) goes to the bottom pad of the two pads designat-



ed for C11. C8 should be bent to be flat against the board as otherwise it may foul the key jack later.

When the resistors and capacitors are in place, the socket for X1 (the quartz crystal), L1, D1 and RV1 should be added in their appropriate places. The socket for X1 is a 3 way strip and although we only use the outer 2 pins we will connect all three pins to the pads on the circuit board. The diode D1 pads have a bar marking to correspond with the band on the diode. This diode is very similar to ZD1 – you may need a magnifying glass to be sure that you have the correct diode.

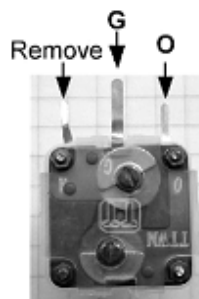


The front panel

The front panel holds the variable tuning capacitor (TUNE), the net switch (NET SW) and the key jack socket (KEY). These should be fitted, and we suggest that the wiring for these is added as well. Solder these at the component ends first, we will solder the main board ends later.

The tuning capacitor

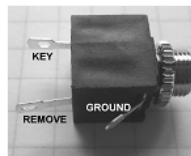
The tuning capacitor is a two section polyvaricon type but only the section with the smallest capacitance is used. There are markings (rather small) to indicate the capacitance of each section. A = 140pF, O = 60pF and G = Ground. We only require the O and G connections. The "A" solder tag can be cut short (but not removed) to avoid confusion. 2 off 3cm lengths of wire (yellow (O) and black (G)) for the tuning capacitor should be soldered on the capacitor.



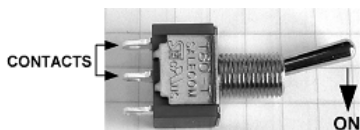
The tuning capacitor is mounted to the front panel using the two small screws provided. It is mounted tags downward.

The key jack socket

The socket is a 3.5mm socket to be used with a 3.5mm mono jack plug so one of the connections, (which is a switch contact), is unused. It is a good idea to cut off the unwanted solder tag to avoid confusion. The ground tag should be to the outer edge. The wires for this will be soldered to the main board first, and connected to the jack after the panel is fitted.



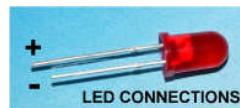
The NET switch



NET SW is a small toggle switch that requires two wires to be joined to the SW1 pads on the main board. Which wire goes to which pad is not important as this is a simple on/off switch. Use the top two contacts on the switch for the wires. When the switch lever is pointing

downwards a connection is made between these two contacts. The normal position of the lever when using the transmitter is upwards. 2 pieces of wire (blue and orange, 10 cm long) should be soldered to the net switch, and then twisted together over their full length. North American builders who seem to like their switches upside down compared to European switches may wish to use this switch with VFO on being up!

Now, the LED (light emitting diode) can be mounted on the front panel. This fits into a small hole marked "SIG" for signal because the diode to there to glow whenever a signal is being transmitted.



On the inside of the front panel, either side of the SIG hole, there is a double pad and a single pad. The negative side (-) of the LED is connected to ground at the single pad. The positive side of the LED is connected to the double pad nearest the hole. The outer pad, marked "LED" is connected with a wire to the LED pads to the right of R10 on the main board. The longest lead of the LED is the positive lead. To mount the LED, push it into the SIG hole and, using pointed pliers, gently bend the leads in an arc to reach the desired pads.

The finished front panel should look like this –



Now remove the insulation completely from two 2cm pieces of the black wire, and solder one end of each piece of bare wire to the KEY pads on the main board. Be careful you don't catch your fingers on these when they are stuck up in the air!

Add the side cheeks



This is a good time to solder the “side cheeks” into place either side of the main board. These are designed as fixing plate for the enclosure. Adding the side cheeks at

this point does mean that the fixing of the front and back panels of the receiver is much easier. Attaching the side cheeks does require a really hot soldering iron bit and plenty of solder. These are not identical so make sure you have the right ones at the correct sides – see the picture below to check. We should, at this point, recommend our SBSS clamps, which are designed for this purpose - both the side cheeks, and the front panel are easily fixed this way.

If you don’t use our clamps, then we suggest that you begin with a large blob of solder at one end to fix the position. Attempt to get the side cheek as near vertical as possible and exactly in line with the main board. When you are happy with this, you may put a few blobs of solder on the narrow pads on the length of the board. Be careful near the blue variable resistor, the plastic easily melts when touched by the iron!

When you have fitted these, the front panel can be soldered in place – after connecting the variable capacitor and net switch leads. The O (yellow) goes to the left-hand pad nearest to the centre of the front of the board, and the G connection (black) goes to the right-hand (nearer the edge) pad.

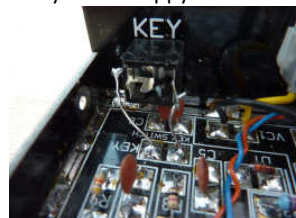
This picture shows that done, and the correct way round of the side panels although they have not been soldered into place yet.



Like the side cheeks the front panel is soldered to the main board. This panel, unlike the side cheeks, overlaps the base board. The base board should be put in the gap between the soldered tracks at the bottom of the front panel. This picture shows the correct position of the front panel against the base. Again, we suggest that you use the “one blob” technique underneath the board to get the panel aligned correctly and vertical. Add a second blob when you are happy with the alignment,

then you should put a few good blobs of solder along the top side of the board for extra strength.

Finally for this stage, connect the two bare wires to the key jack – this picture shows that done. The ground connection (see diagram—top of page 7) should be nearest the side of the case



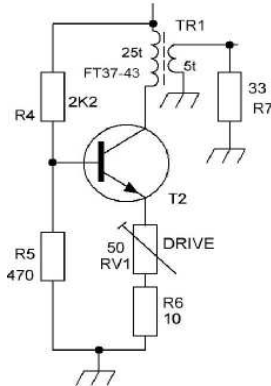
LOW PASS FILTER (40m)
 L4 & L6 = 21 turns on T37-6
 L5 = 20 turns on T37-6
 C12 = 330 + 47
 C13 & C14 = 330pF + 330pF
 C15 = 330pF + 100pF
 C18 = 100pF

LOW-PASS FILTER

MUTE CIRCUIT
 THE SQUARE BLOCKS = PADS ON BACK PANEL

COMPONENTS:
 C1 100n, C2 47p, C3 100p, C4 47p, C5 100n, C6 100n, C7 47p, C8 100n, C9 100n, C10 100n, C11 10p, C12 330 + 47, C13 330pF + 330pF, C14 330pF + 330pF, C15 330pF + 100pF, C18 100pF, D1 1N4148, D2 1N5711, D2/3 1N5711, D3 1N5711, D4 1N5711, D5 1N5711, D6 1N5711, D7 1N5711, D8 1N5711, D9 1N5711, D10 1N5711, D11 1N5711, D12 1N5711, D13 1N5711, D14 1N5711, D15 1N5711, D16 1N5711, D17 1N5711, D18 1N5711, D19 1N5711, D20 1N5711, D21 1N5711, D22 1N5711, D23 1N5711, D24 1N5711, D25 1N5711, D26 1N5711, D27 1N5711, D28 1N5711, D29 1N5711, D30 1N5711, D31 1N5711, D32 1N5711, D33 1N5711, D34 1N5711, D35 1N5711, D36 1N5711, D37 1N5711, D38 1N5711, D39 1N5711, D40 1N5711, D41 1N5711, D42 1N5711, D43 1N5711, D44 1N5711, D45 1N5711, D46 1N5711, D47 1N5711, D48 1N5711, D49 1N5711, D50 1N5711, D51 1N5711, D52 1N5711, D53 1N5711, D54 1N5711, D55 1N5711, D56 1N5711, D57 1N5711, D58 1N5711, D59 1N5711, D60 1N5711, D61 1N5711, D62 1N5711, D63 1N5711, D64 1N5711, D65 1N5711, D66 1N5711, D67 1N5711, D68 1N5711, D69 1N5711, D70 1N5711, D71 1N5711, D72 1N5711, D73 1N5711, D74 1N5711, D75 1N5711, D76 1N5711, D77 1N5711, D78 1N5711, D79 1N5711, D80 1N5711, D81 1N5711, D82 1N5711, D83 1N5711, D84 1N5711, D85 1N5711, D86 1N5711, D87 1N5711, D88 1N5711, D89 1N5711, D90 1N5711, D91 1N5711, D92 1N5711, D93 1N5711, D94 1N5711, D95 1N5711, D96 1N5711, D97 1N5711, D98 1N5711, D99 1N5711, D100 1N5711, D101 1N5711, D102 1N5711, D103 1N5711, D104 1N5711, D105 1N5711, D106 1N5711, D107 1N5711, D108 1N5711, D109 1N5711, D110 1N5711, D111 1N5711, D112 1N5711, D113 1N5711, D114 1N5711, D115 1N5711, D116 1N5711, D117 1N5711, D118 1N5711, D119 1N5711, D120 1N5711, D121 1N5711, D122 1N5711, D123 1N5711, D124 1N5711, D125 1N5711, D126 1N5711, D127 1N5711, D128 1N5711, D129 1N5711, D130 1N5711, D131 1N5711, D132 1N5711, D133 1N5711, D134 1N5711, D135 1N5711, D136 1N5711, D137 1N5711, D138 1N5711, D139 1N5711, D140 1N5711, D141 1N5711, D142 1N5711, D143 1N5711, D144 1N5711, D145 1N5711, D146 1N5711, D147 1N5711, D148 1N5711, D149 1N5711, D150 1N5711, D151 1N5711, D152 1N5711, D153 1N5711, D154 1N5711, D155 1N5711, D156 1N5711, D157 1N5711, D158 1N5711, D159 1N5711, D160 1N5711, D161 1N5711, D162 1N5711, D163 1N5711, D164 1N5711, D165 1N5711, D166 1N5711, D167 1N5711, D168 1N5711, D169 1N5711, D170 1N5711, D171 1N5711, D172 1N5711, D173 1N5711, D174 1N5711, D175 1N5711, D176 1N5711, D177 1N5711, D178 1N5711, D179 1N5711, D180 1N5711, D181 1N5711, D182 1N5711, D183 1N5711, D184 1N5711, D185 1N5711, D186 1N5711, D187 1N5711, D188 1N5711, D189 1N5711, D190 1N5711, D191 1N5711, D192 1N5711, D193 1N5711, D194 1N5711, D195 1N5711, D196 1N5711, D197 1N5711, D198 1N5711, D199 1N5711, D200 1N5711, D201 1N5711, D202 1N5711, D203 1N5711, D204 1N5711, D205 1N5711, D206 1N5711, D207 1N5711, D208 1N5711, D209 1N5711, D210 1N5711, D211 1N5711, D212 1N5711, D213 1N5711, D214 1N5711, D215 1N5711, D216 1N5711, D217 1N5711, D218 1N5711, D219 1N5711, D220 1N5711, D221 1N5711, D222 1N5711, D223 1N5711, D224 1N5711, D225 1N5711, D226 1N5711, D227 1N5711, D228 1N5711, D229 1N5711, D230 1N5711, D231 1N5711, D232 1N5711, D233 1N5711, D234 1N5711, D235 1N5711, D236 1N5711, D237 1N5711, D238 1N5711, D239 1N5711, D240 1N5711, D241 1N5711, D242 1N5711, D243 1N5711, D244 1N5711, D245 1N5711, D246 1N5711, D247 1N5711, D248 1N5711, D249 1N5711, D250 1N5711, D251 1N5711, D252 1N5711, D253 1N5711, D254 1N5711, D255 1N5711, D256 1N5711, D257 1N5711, D258 1N5711, D259 1N5711, D260 1N5711, D261 1N5711, D262 1N5711, D263 1N5711, D264 1N5711, D265 1N5711, D266 1N5711, D267 1N5711, D268 1N5711, D269 1N5711, D270 1N5711, D271 1N5711, D272 1N5711, D273 1N5711, D274 1N5711, D275 1N5711, D276 1N5711, D277 1N5711, D278 1N5711, D279 1N5711, D280 1N5711, D281 1N5711, D282 1N5711, D283 1N5711, D284 1N5711, D285 1N5711, D286 1N5711, D287 1N5711, D288 1N5711, D289 1N5711, D290 1N5711, D291 1N5711, D292 1N5711, D293 1N5711, D294 1N5711, D295 1N5711, D296 1N5711, D297 1N5711, D298 1N5711, D299 1N5711, D300 1N5711, D301 1N5711, D302 1N5711, D303 1N5711, D304 1N5711, D305 1N5711, D306 1N5711, D307 1N5711, D308 1N5711, D309 1N5711, D310 1N5711, D311 1N5711, D312 1N5711, D313 1N5711, D314 1N5711, D315 1N5711, D316 1N571

Testing the first section

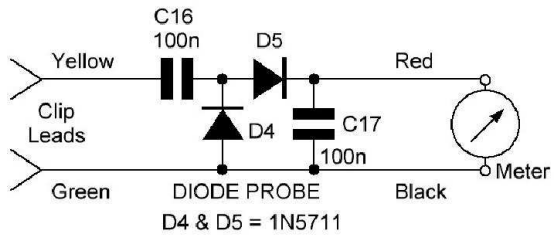


Testing the transmitter at this stage requires a Diode Probe. All the parts are provided for making such a probe as shown in the picture.

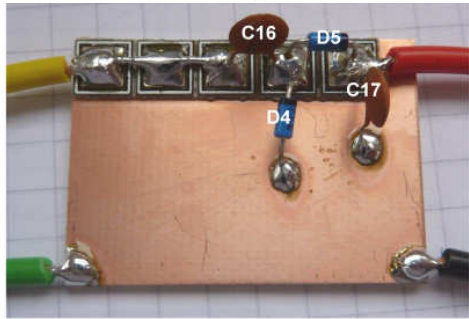
The diode probe is built “Manhattan-style” by attaching a strip of five pads to the top left-hand corner of the printed circuit board material using super glue.

The components are surface mounted as shown. The three left-hand pads are joined using an off-cut from one of the trimmed component leads.

Flexible wire in red, black, yellow and green is supplied. The yellow and green leads are terminated with crocodile clips and the red and black leads are terminated with 4mm plugs



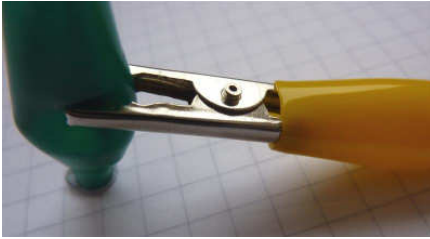
Yellow Clip Lead to top of R7
Green Clip Lead to ground
Red lead with 4mm plug to Meter +
Black lead with 4mm plug to Meter -



(the standard plug used in test meters). If your meter uses a different size of plug, then you will have to obtain these yourself. The placement of the four leads is shown in the circuit drawing. Later the diode probe will be converted into a basic wattmeter to measure the final transmitter output.

For those not familiar with 4mm plugs, the centre of the metal insert contains a grub screw to secure the end of the wire. A small screw driver pushed up the centre of the metal insert is used to clamp the end of the wire as shown. The metal insert is then pushed into the plastic housing of the plug, wire being place in line with the slot in the plastic housing. The insert is now pushed until the end of the plug is as far out as it will travel. This does take force! Pushing the end of the insert against a firm surface will help. You might need a screwdriver to push in the final bit of the metal insert.

The crocodile clips are easier to attach to the ends of the yellow and green wire. Prize the clip open a little and slide off the plastic covering. The wire can be soldered to the clip and held in place by the crimps at the end. Remember – Push the plastic covering onto the wire **before** soldering the wire in place.



The clip is chromium plated and soldering will be much easier if the area to take the solder is roughed a little with emery paper or the

edge of a sharp knife.

The red and black leads are plugged into the positive (+) and negative (-) inputs of the meter. The yellow lead is clipped on the left side of R7 (the pad connected to the output of TR1) and the green lead is connected to the other (grounded) end of R7. The meter should be set on a range that will indicate 10 volts DC.

Testing the Transmitter

Having made the RF probe, the first section of the transmitter is now ready for testing, so make a temporary supply lead using red & black wires – to the +12 and ground pads, respectively, in the centre of the board. We suggest that you make these about 20cm long. As a precaution, you should turn the blue drive preset fully anti-clockwise before you power the board – don't forget to insert the crystal!

When you are happy with all the connections (a check that all the parts are in the correct places is useful at this stage). Apply 12 Volt power to the board: +12v to the red wire, and the negative to the black wire.

Firstly, check the oscillator. If you press the net switch, the oscillator only will run, and this can be found around 7.030MHz on a suitable receiver. The tune control should vary the frequency from around 7.027MHz to 7.031MHz.

[NOTE – there is scope for experiment with the value of the series inductor L1. Increasing the value of this will give an increase in frequency range, however, this may be at the expense of oscillator stability. The value supplied with the kit is a safe value. See the modification notes on page 17]

Secondly, check the keying and driver stages.



A 3.5mm mono jack plug is supplied with the kit to fit the KEY jack socket. Attach this to a Morse key or two pieces of wire that can be shorted to simulate a Morse key.

Depressing the key or joining the wires should give an indication of a few volts in the meter connected to the RF probe. The Oscillator, Driver and Key Switch stages are all working if the meter shows an output voltage. Around 3 volts is a reasonable value, and you should be able to change this with the drive preset. Remember to turn this back to the fully anti-clockwise position before you move on to the next step.

Now, the rest of the transmitter.

The final amplifier

Firstly, wind the coil L2. This is 5 turns on a FT43-2402 binocular toroid. Each turn goes through both holes of the core, and you should end up with it looking like this.



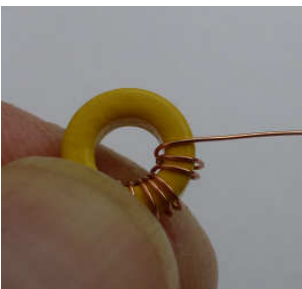
It is helpful to insert this and the other components in the section marked “FINAL” (ZD1, R10, C6 and C7) before adding the final amplifier transistor (T3) (2N3866). ZD1 must be connected the correct way round. The bottom pad of the ZD1 placement shows a bar marking; this corresponds to the bar (or ring) near one end of the zener diode.

Trim the transistor leads to about 10mm and bend the end 3mm of the transistor leads to form a “foot” that will lay flush with the pads. The best directions for the foot, assuming the tab on the transistor case points upwards, are emitter upwards, collector downwards and base to the left. Refer to the base connection diagram on the circuit schematic. Using pointed pliers manipulate the leads until each foot rests on the required pad. Tin the pads and the leads and solder them in place. The heatsink is applied to the transistor by placing a screwdriver blade in the gap and twisting it to open the vanes. The heatsink should now fit over the transistor casing. The screwdriver is removed to allow the heatsink to clamp firmly on the sides of the transistor.

The next step is to solder a 10cm length of yellow wire to the **LED** pad on the main board (just to the rear of the +12v power pad, connect the other end of this to the **LED** pad on the front panel. Tuck this wire in tidily as you can see on the picture of the main board and front panel below. The diodes D2 & D3 should be soldered into place - the diode D2/3 pads have a bar marking (like ZD1) to show the way to mount them. Finally solder the “fat resistor” sized inductor, L3 into place.

The low-pass filter

The low-pass filter coils (L4, L5 & L6) are wound on the yellow cores using the gold wire. L4 and L6 have 21 turns, L5 has 20 turns. These require 14” (35cm) of wire for each coil. Wind as for TR1 with one pass through the core being one turn. L5 has one less turn (20) than L4 and L6 (21 each) so wind L5 first and lay it aside so that it won’t be confused with the others. 35cm of wire is easily enough for each coil. The windings on each core should occupy about three-quarters of the circumference.



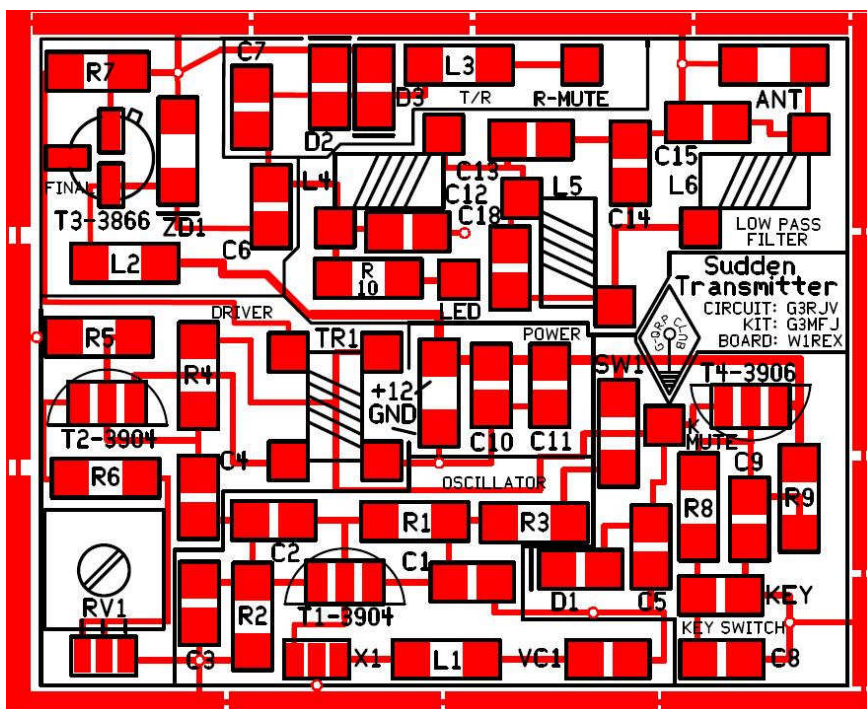


Nearly all the capacitors in the filter are actually two in parallel as the correct values are not commercially available. We suggest that you parallel these pairs first as shown here, before fitting them. A good plan is to mount C12 - C15, and C18, then mount L5, followed by L4 and L6.

Here is a picture of the completed board so far.



The layout of the printed circuit board. This shows the wiring between the pads



The back panel.

Firstly, mount the three sockets on the back panel – the antenna socket, the receiver aerial socket and the power socket.

The antenna sockets

The antenna socket (ANT) is a single hole fixing phono socket, as is the RECEIVER socket. These require two wires to be joined to the ANT pads on the main board and we will connect these in a moment.



The power socket



The POWER socket also has two connections that connect to the main board and it is vital to get these the correct way round. Again, we will connect these shortly.

The receiver muting

The components for the receiver muting section are mounted inside the back panel, and you should now fit these. Solder the resistors into place first, followed by the transistors. It is best to keep the lead length of these parts short if possible.

The next job is to connect the rear panel to main board. Firstly, you need to cut seven lengths of wire. The first three are on the back panel and are as follows:

RCVR on the back panel connects to the centre of the **RECEIVER** phono socket – use 3cm of orange wire for this.

GND on the back panel connects to the ground tag on the **RECEIVER** phono socket – use 1½cm of bare wire for this.

Solder a 10cm length of red wire to the **+12** tag on the back panel but do not connect the other end yet.

Now cut the other four pieces as follows and solder these to the pads on the main board:

R-MUTE on the main board – use a 9cm length of green wire for this.

K-MUTE on the (bottom of club logo) on the main board – use a 10cm length of orange wire for this.

ANT on the main board – use two 9cm lengths of wire – black and blue, the black (ground) connection goes to the left-hand pad and the blue (antenna connection) goes to the right-hand pad. Y

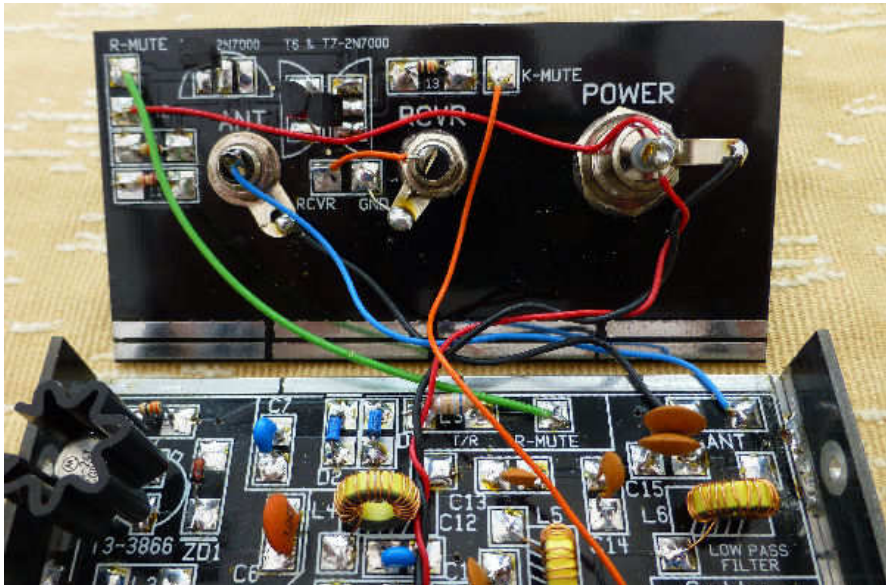
You should already have two pieces of wire connected to the +12V and GND tags of the main board that we used for testing. Cut these to 9cm long.

Wiring the back panel to the main board.

Now, if you place the rear panel behind the main board, you can connect the other end of all the wires – green to **R-MUTE**, orange to **K-MUTE**, black to the outer solder tag of the antenna socket, and the blue wire to the centre connection. Finally after stripping the ends of the two red wires, twist them together and solder them both to the centre pin of the power socket.

This picture shows that done.

(NB This picture is of the 30m version of the kit so the toroids L4/5/6 are different)

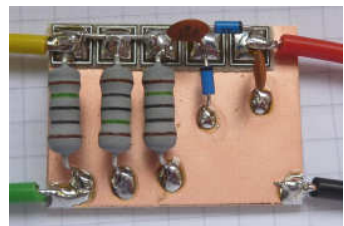


Finally, having finished the wiring to the back panel, you should solder the back panel in place using the same method that you used for the front panel. Be careful when soldering near the wires as the insulation is easily damaged by the soldering iron. There is enough length to move them out of the way of the iron.

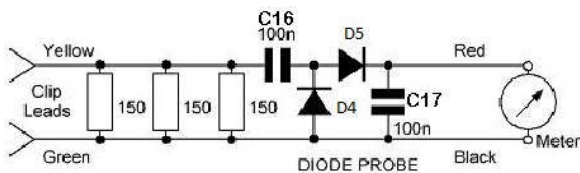
Testing the transmitter

The first step is to convert the RF Probe into a simple RF Wattmeter.

The original diode probe has three 150 Ohm large resistors added to the three left-hand pads and ground. These resistors connected in parallel form a 50 Ohm load for the transmitter. Do not attempt to transmit without either a 50 Ohm load or connecting the output to a matched antenna.



Connect the yellow clip lead to the centre of the ANT socket and the green clip to the ground of the ANT socket and the red and black leads to a voltmeter. Connect the 12 volt supply, leaving the NET SW switch upwards, and press the Morse KEY down. Read the output voltage. The



voltage is the peak to peak measurement. If you are going to use the RF wattmeter often, then we suggest that you replace the yellow and green leads with a shortish piece of 50 Ohm coax terminated in a Phono (RCA) plug. The inner

conductor should go where the yellow lead was connected, and the screen to the copper where the green wire was connected.

The output in watts = r.m.s voltage² divided by 50.

The calculation is simple:

- Voltage reading (peak to peak) divide by 2 = the peak voltage
- The peak voltage is multiplied by 0.707 = the r.m.s. voltage.
- The r.m.s. voltage multiplied by itself = r.m.s. voltage²
- Divide this by 50 (the load resistor value) for the RF power output in watts.

A suitable 2.1mm power plug is supplied with the kit – the centre pin is +ve and the outer connection is –ve. Do not get these reversed as there is no reverse polarity protection in the transmitter.

The transmitter should produce about 1 to 2 watts. The Drive control (RV1) may be used to adjust the final output. Although the 2N3866 final amplifier transistor is quite rugged and is protected by ZD1, it is possible to destroy the transistor by either overdriving it, or by transmitting for more than a few seconds into an incorrect load. With this in mind a spare 2N3866 is provided with the kit – do not destroy this as well! We suggest you begin below 2 watts and increase the output to around 2 watts maximum. Try for an output voltage on the test meter of some 25 to 28 volts. One to two watts on 40 metres represents a useful amount of QRP transmitter power. If you turn up the drive control up too much, the output power will start to go down - and this should be avoided as it will produce a bad output signal. Remember to use the transmitter with the NET SW in the upward (off) position. Pressing the switch downwards switches power to the oscillator only. Use this position to find the frequency of the transmitter on the receiver. This may be used to find a particular frequency or to “net” the transmitter to another station. The transmitter output is 50 Ohms and the transmitter should be used into a 50 Ohm antenna (e.g. a dipole) or via an Antenna Tuner to match the 50 Ohms to the antenna.

Finally – the case

The case parts should now be soldered together – the important point here is that the sides must be at right-angles to the top. Again, use the single blob technique until you are satisfied with the angles – it is better if you do not solder right up to the front of the lid as the case overlaps the front to give a hooded effect, and if you solder right up to the front, the case may not fit as well.

What next? - Possibilities for experiment

Radio amateurs would not be radio amateurs if they didn't want to experiment, so here are a couple of things that you may wish to experiment with. Remove the transmitter power, and be careful that you do not destroy anything in the transmitter whilst you are changing parts! If you are not sure of your own abilities, then ask a more experienced constructor to do it for you.

The VXO

The VXO circuit is a “sure fire” circuit that will always work, but there is a possibility to increase the shift range by altering the value of L3. If you increase L3, then the polyvaricon VC1 will move the frequency more. Possible disadvantages are that either the oscillator will stop oscillating at some parts of the tuning control travel, and/or, the oscillator will chirp when the TX is keyed. You will possibly need the use of the station receiver to test this. You will probably have to unfasten VC1 and move it aside to change any of these parts. The polyvaricon has a second section - this has a capacitance shift of 6 to 160pF. You may wish to try using the second section. When you have altered any values, take a careful listen on a good receiver to ensure that you have a stable non-chirping transmission. Be careful! Another change is that you could try two identical crystals in parallel—this can considerably increase the VXO shift.

The RX muting circuit

This circuit is a simple and reasonably effective way of considerably reducing the amount of transmitted signal that gets back to the receiver. Because it is a simple circuit, and there is no “mute” signal down a separate wire to the receiver, then the muting may appear to not be working very well. In fact, without it, the received signal from the TX would be considerably louder. This is another point at which you could do some experimenting and that is by replacing C7 with a smaller fixed capacitor in parallel with a trimmer. There is just room to do this—but you will have to be very careful with the soldering iron, and avoid touching nearby parts. Aim, with the two capacitors, for a value when the trimmer is mid-position, to be a value around the supplied (and now removed) C7. The trimmer should be adjusted with the TX powered up, but not transmitting. Adjust the trimmer for the maximum received signal strength of a weak signal on the receiver - the weaker the better. It should not be adjusted when you are either netting, or transmitting.

Again - be very careful - this is a modification for experienced constructors only.

We do not recommend that you touch or alter parts in the output of the PA. If you change anything, then you may reduce the harmonic filtering and then there could be unwanted or even illegal radiations from the transmitter.

Improvement to the SIG LED indicator

In a recent SPRAT article, Paul M0XPd suggested that the indication by the SIG LED can be improved, especially if there isn't a DC path at the Antenna connection. He suggested that an ordinary diode, for example a 1N4148 diode, be wired in inverse parallel to the LED on the front panel. This should be connected so that the +ve end of this (the one with the indicating band) should be wired to the double pad on the front panel, and the other end, to the single pad. An extra 1N4148 has been added to the parts bag in case you wish to try this.

	Value	Markings
Resistors		
R1	47k	Yellow, purple, orange, gold
R2	470	Yellow, purple, brown, gold
R3	120	Brown, red, black, black, brown
R4	2k2	Red, red, red, gold
R5	470	Yellow, purple, brown, gold
R6	10	Brown, black, black, gold
R7	33	Orange, orange, black, gold
R8	1k	Brown, black, red, gold
R9	47k	Yellow, purple, orange, gold
R10	1k	Brown, black, red, gold
R11	2k2	Red, red, red, gold
R12	10k	Brown, black, orange, gold
R13	10k	Brown, black, orange, gold
R14	150	Brown, green, black, black, brown
R15	150	Brown, green, black, black, brown
R16	150	Brown, green, black, black, brown
Capacitors		
C1	100nF	104
C2	47pF	47
C3	100pF	101
C4	47pF	47
C5	100nF	104
C6	100nF	104
C7	47pF	47
C8	100nF	104
C9	100nF	104
C10	100nF	104
C11	10uF	10uF (the –ve side is plainly marked)
C12	377pF (330 + 47pF) *	331 + 47
C13	660pF (330 + 330pF) *	331 + 331
C14	660pF (330 + 330pF) *	331 + 331
C15	430pF (330 + 100pF) *	331 + 101
C16 & 17	2 x 100nF	104 (for RF probe)
C18	100pF	101
	* these values are 2	capacitors in parallel – see text
Inductors		
L1	10uH	Brown, black, black, silver
L2	BN43-2402 binocular core	Pig nose – 5 complete turns 30SWG
L3	10uH	Brown, black, black, silver
L4	T37-6	Yellow/black – 21 turns
L5	T37-6	Yellow/black – 20 turns
L6	T37-6	Yellow/black – 21 turns
TR1	FT37-43	Black – 25t (30SWG) + 5t (27SWG)

Semiconductors

T1	2N3904	Oscillator
T2	2N3904	Driver
T3	2N3866 (4-247 CG9949)	PA (spare included)
T4	2N3906	Keyer
T5	2N7000	RX series mute
T6	2N7000	voltage inverter
T7	2N7000	RX parallel mute
D1	1N4148	For net switch
D2	1N5711	RX parallel mute
D3	1N5711	RX parallel mute
D4	1N5711	Probe detector
D5	1N5711	Probe detector
ZD1	33v zener diode (BZX55C33)	PA protector
LED	Output indicator	
Extra diode	1N4148	This is a second diode in case you wish to try the SIG LED indicator improvement (see

Other parts

RV1	50 Ohm	Drive control preset
VC1	60pF	Tuning
SW	miniature toggle switch	Net switch (may be a 2 tag part)
J1	3.5mm mono jack socket	Key jack
J2	Phono/RCA socket	Antenna
J3	Phono/RCA socket	Antenna to receiver
X1	Crystal	7.030MHz HC49U wire lead crystal
Socket	Crystal socket	3 SIL sockets
35mm knob	For VXO tuning capacitor	
Toroids	For L4, L5 & L6	3 x T37-6 - yellow/black
Toroid	For T1	FT37-43 - black
Pig-nose toroid	For L2	BN43-2402
Magnet wire	30 SWG	Gold coloured
Magnet wire	27 SWG	Red coloured
PVC wire	6 colours of wire	Red, Black, Orange, Yellow, Blue & Green
Heatsink	For PA transistor	
Power socket	Panel mounting 2.1mm	
Power plug	2.1mm	
4 feet	for case	
Key plug	3.5mm mono plug	
Blank PCB	For probe	
5 MESquares	For probe	
Extra flex wire	For probe	Black, Red, Yellow, Green
4mm plugs	For probe	Black, Red
Min crocodile clips	For probe	Yellow, Green
Screws	4 off self-tapping screws	For fixing the case to the base

The finished transmitter

NB - this is a picture of the 30m version of the kit



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V2.8 September 2016