The G-QRP Club

The Limerick Sudden 80m Transmier 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.

If you are not a member, and would like to find out more, please look at www.gqrp.com. For a sample SPRAT and a membership form, please send your name and address to our membership secretary:

Daphne Newsum G7ENA, 33 Swallow Drive, Louth, LN11 0DN

membership@gqrp.co.uk

Please mention where you saw this information

Transmier Overview

The Limerick Sudden Transmier is a simple circuit for a reliable QRP transmier. Although crystal controlled, the oscillator stage (T1) is a Variable Crystal Oscillator (VXO). The crystal supplied is a fundamental frequency crystal on 3.560MHz, the QRP calling frequency on the 80 metre band, although other frequencies are available for the CW end of this band. No5ce that an inductor (L1) and a variable capacitor (VC1) have been added in series with the crystal and ground. These induc5ve and capaci5ve elements allow some shi7ing 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 emier of T2 determines the amount of drive available to T3 and hence the output power of the transmier. A preset poten5ometer (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 transmier. This keys both the oscillator and the buffer/driver (T1 and T2). In many QRP transmier 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 s5ll running in the receive mode.

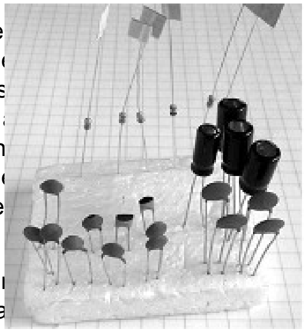
SW1 is a NET switch that enables the oscillator to run without keying the transmier. It provides 12 volts for the oscillator and D1 prevents this voltage reaching T2. This facility allows the oscillator to be heard in the receiver so that the VXO signal can be adjusted to a desired frequency or aligned with a desired sta5on signal. “NeHng” is standard prac5ce when a separate transmier and receiver are being used; it is also called “spoHng” in North America.

T3 is the transmier 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 protec5on for the output transistor should the transmier 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 transmier-receiver break-in circuit popularized by W7EL in his “Op5mised Transceiver” design. It is a simple method of sharing the same antenna by a transmier and receiver without damage to the receiver during transmission or significant loss of signal from the transmier. Some mu5ng of the signal fed to the receiver is achieved by the circuit T5, T6 and T7. The mu5ng circuit is such that when a receiver is connected to the transmier, 12 volts must be connected to the transmier to hear signals. The mu5ng is most effec5ve when the covers are on the transmier and receiver.

Building the Transmier

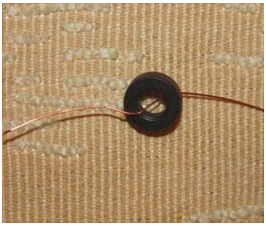
You will have no5ced that this is a rather unusual kit. It has a printed circuit board without any holes. We call it “Limerick Construc5on” because it was designed by Rex Harper, W1REX, of Limerick, Maine. It is a surface mounted board in that the components are mounted on the surface of the board, although the components used are “through-hole” parts. This allows for ease of construc5on and easy correc5on of any errors. The main board also has the front and back panels for the transmier. 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 conven5onal printed circuit board. The interconnec5ons between the moun5ng pads are ready made but hidden by the black screen printed overlay. The designa5on of all the parts is printed next to the appropriate pads. Each sec5on of the transmier (OSCILLATOR, DRIVER, FINAL, LOW-PASS FILTER and KEY SWITCH) is also mark the board. The MUTE circuit components are mounted on the back panel. Any references to top, boom, le4 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 boom is, of course, the Front.



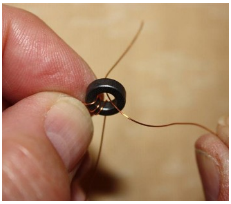
It does help to set out all the components in the orde of designa5on. i.e. C1, C2 etc. The best way is to us small piece of polystyrene to hold the individual parts If you are going to use this idea for semiconductors, piece of aluminium foil wrapped round the polystyren will prevent any sta5c damage. Double check th pacitor values—there is a lot of difference betwe 101 and a 104 capacitor!

The building of the transmier does entail winding fou coils on toroid cores (TR1, and L4, L5 and L6), and a 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 lile care and the accurate coun5ng 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.

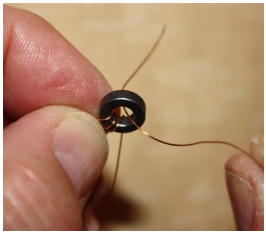
TR1 is wound on the FT37-43 core. This is the black core - the one without the yellow coa5ng. The primary winding has 25 turns of the gold wire. There is guide as to how to wind these on the next page. Each 5me the wire passes through the hole of the core counts as one turn. The turns should be laid 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 cri5cal – just guess the centre posi5on.



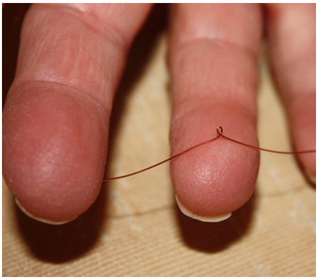
<u>Winding toroidal coils</u> is easy. It just requires pa5ence and care. TR1 uses the black core with the gold wire for the main winding. The 25 turns require 15" of wire. Each



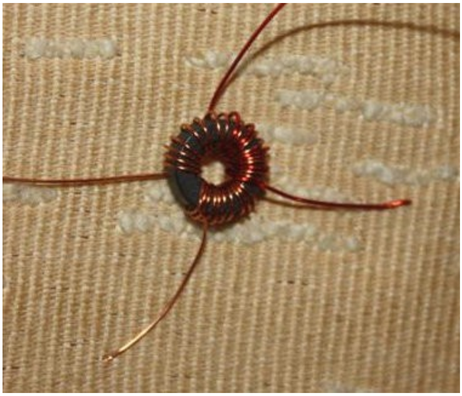
5me the wire passes through the hole (including the first 5me) it counts as ONE turn. Hold the core firmly with one hand and



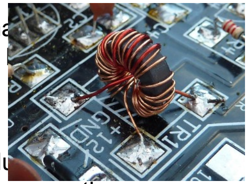
thread the wire through with the other hand, laying the windings side by side. Tighten the wire a7er each turn for a neat coil.



Some5mes 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 cri5cal

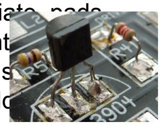


When the windings have been made, trim the ends of the wires to about 1cm. The wire is coated with enamel insula5on. About 5mm of each wire should be 5nned with solder prior to making the connec5ons. The enamel coa5ng on the wire supplied is designed to m when the soldering iron is applied. This does require quite a bit of heat. The best method is to form a blob of solder on the soldering iron 5p. Apply the 5p to the very end of the wire and wait un5l 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 un5l you get the required 5mm or so 5nned. It's best not to breathe in the smoke given off during this process.

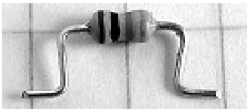


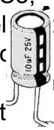
TR1 is mounted ver5cally in the centre of four pads. The prima (larger) winding is soldered to the top right pad and the le7 pad. The link (5 turn) winding to the other two pads.

The transmier is built in two sec5ons; the first being the hand side of the circuit diagram as far as R7. This inclu 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 appropria The shape of the transistors marked on the board indicates their orient 5on. They must be placed the correct way round. To enable a secure s der connec5on of the parts, the leads are bent into an "L" shape for adc to the pads on the board.



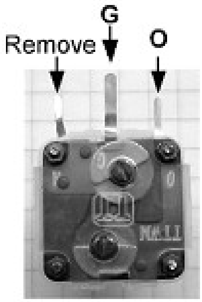


Add the resistors as far as R9 and the capacitors C1 to C5, C8 and C9, C10 and C11. Capacitor C11 is an el oly5c capacitor and must be connected the correct way rc. The nega5ve lead (marked with a series of dashes ee drawing) goes to the boom pad of the two pads designated for C11. C8 should be bent 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 quartz crystal), L1, D1 and RV1 should be added in their appropri places. The socket for X1 is a 3 way strip and although we only u the outer 2 pins, we will connect all three pins to the pads circuit board. The diode D1 pads have a bar marking to correspor 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 fied, and we suggest that the wiring for these is added as well. Solder these at the component ends first, we will solder the main boar ends later.

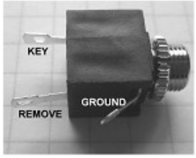


The tuning capacitor

The tuning capacitor is a two sec5on polyvaricon type but only th sec5on with the smallest capacitance is used. There are m (rather small) to indicate the capacitance of each sec5on. A = 14 O = 60pF and G = Ground. We only require the O and G connec The "A" solder tag can be cut short (but not removed) to avoid cc fusion. 2 off 3cm lengths of wire (yellow (O) and black (G)) for th tuning capacitor should be soldered on the capacitor.

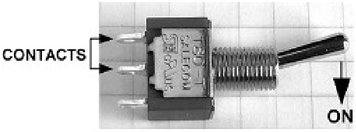
The tuning capacitor is mounted to the front panel using the two small screws provided. It is mounted tags downward.

The key jack socket

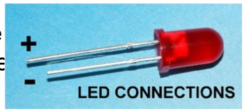


The socket is a 3.5mm socket to be used with a 3.5mm mono jack | so one of the connec5ons, (which is a switch contact), is unused. I good idea to cut off the unwanted solder tag to avoid confusion. Th ground tag should be to the outer edge. The wires for this will be sc dered to the main board first, and connected to the jack a7er the panel is fied.

The NET switch



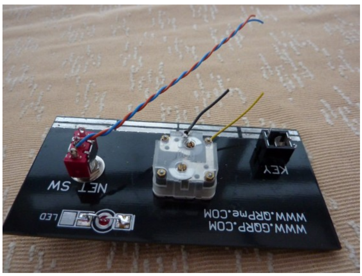
NET SW is a small toggle switch that requires two wires to be joined to the SW1 pads on the main board. Which wire goes to which pad is not important as this is a simple on/off switch. Use the top two contacts on the switch for the wires. When the switch lever is poin5ng downwards a connec5on is made between these two contacts. The normal posi5on of the lever when using the transmier 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 America builders who seem to like their switches upside down compared to European switches may wish to use this switch with VFO on being up!

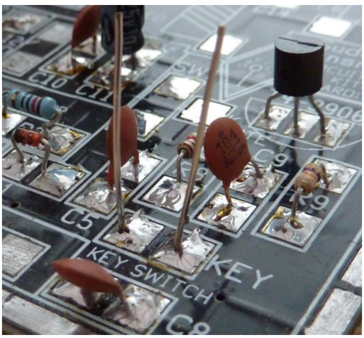


Now, the LED (light emiHng diode) can be mounted on the panel. This fits into a small hole marked “SIG” for signal because diode to there to glow whenever a signal is being transmied.

On the inside of the front panel, either side of the SIG hole, there is a double pad and a single pad. The nega5ve side (-) of the LED is connected to ground at the single pad. The posi5ve sid 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 posi5ve 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 insula5on 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

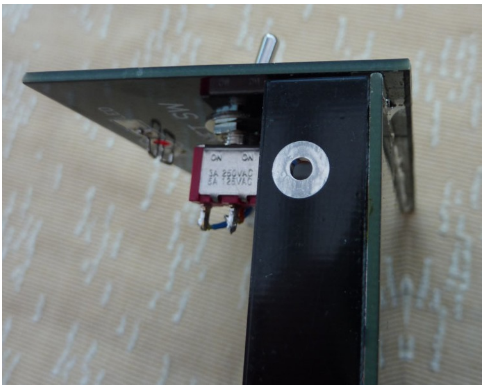
SIDE CHEEKS

This is a good 5me 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. Aaching the side cheeks does require a really hot soldering iron bit and plenty of solder. These are not iden5cal 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 clamp which are designed for this purpose - both the side cheeks, and the front panel are easily fixed this way.

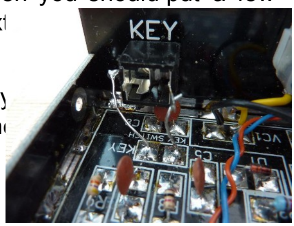
If you don't use our clamps, then we suggest that you begin with a large blob of solder at one end to fix the posi5on. Aempt to get the side cheek as near ver5cal as possible and exactly in line with the main board. When you are happy with this, you should put a few blobs along the narrow pads on the length of the board. Be careful near the blue variable resistor, the plas5c easily melts when touched by the iron!

When you have fied these, the front panel can be soldered in place – a7er connec5ng the variable capacitor and switch leads. The O (yellow) goes to the le7-hand pad near to the centre of the front of the board, and the G connec5o (black) goes to the right-hand (nearer the edge) pad.

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

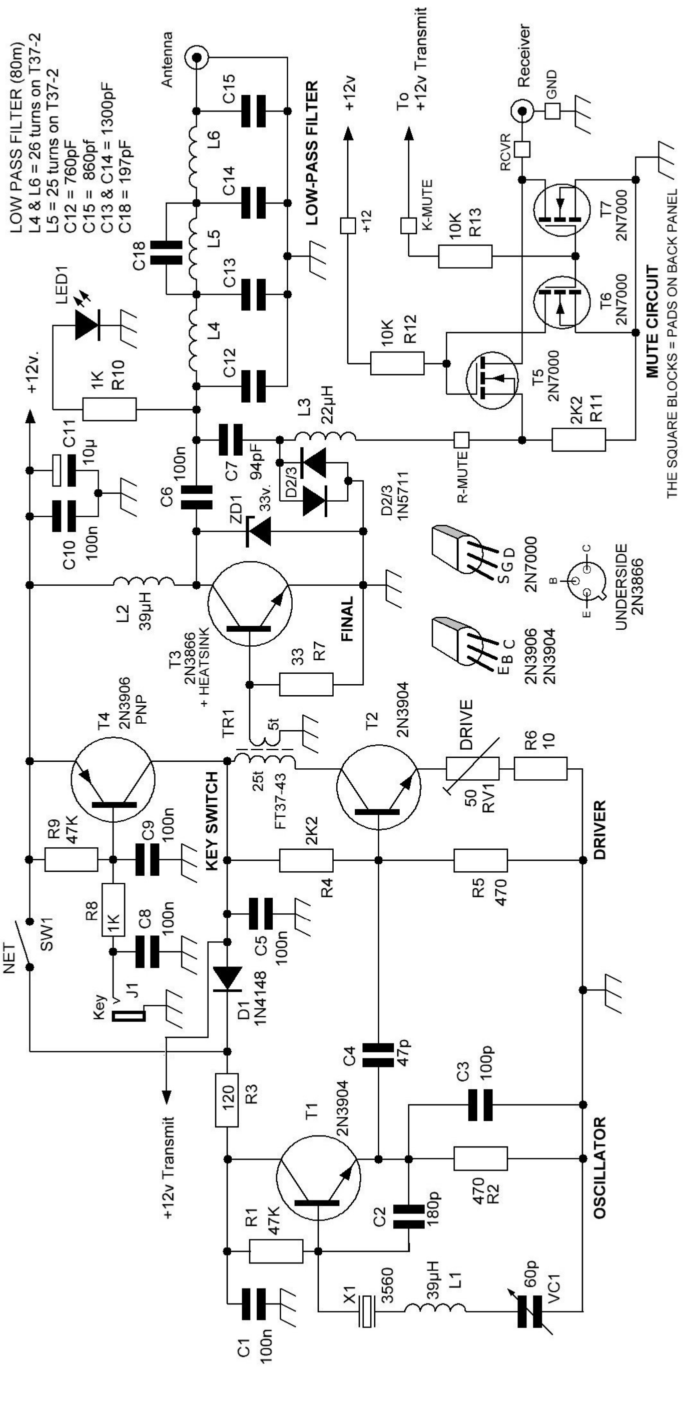


Like the side cheeks the front panel is soldered to the main board. This panel, unlike the side cheeks, overlaps the base board. The base board should be put in the gap between the soldered tracks at the boom of the front panel. This picture shows the correct posi5on of the front panel against the base. Again, we suggest that you use the "one blob" technique underneath the board to get the panel aligned correctly and ver5cal. 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 ext strength.

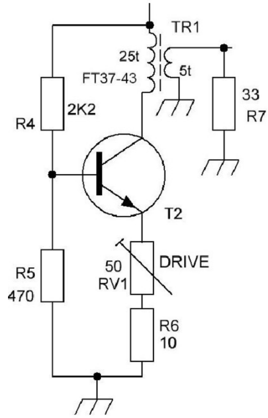


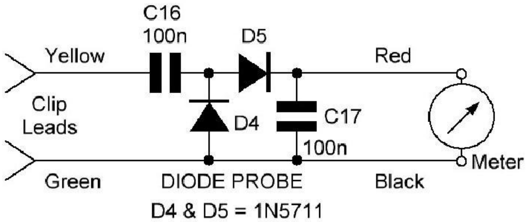
Finally for this stage, connect the two bare wires to the key jack – this picture shows that done. The ground conn (see diagram—top of page 7) should be nearest the the case

Complete circuit diagram

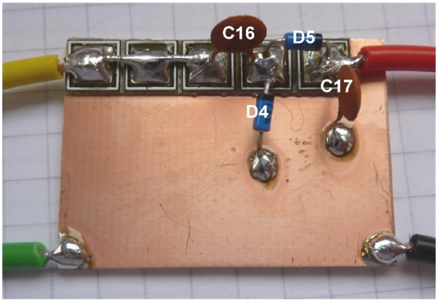


Tes9ng the first sec9on





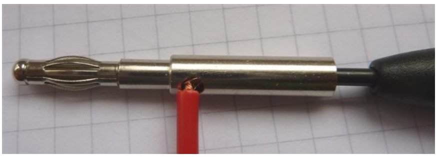
Yellow Clip Lead to top of R7
Green Clip Lead to ground
Red lead with 4mm plug to Meter +
Black lead with 4mm plug to Meter -

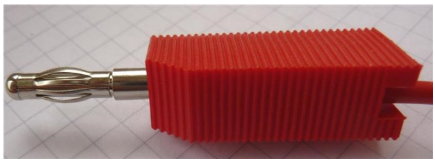


Tes5ng the transmier at this stage requires a Diode Probe. All the parts a provided for making such a probe as shown in the picture.

The diode probe is built “Manhaan-style” by aaching a strip of five pads to the top le7-hand corner of the printed circuit board material using super glue. The components are surface mounted as shown. The three le7-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 lead

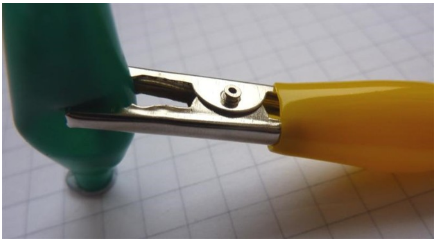




terminated with crocodile clips and the red and black leads are terminated with 4mm plugs (the standard plug used in test meters). If your meter uses a different size of plug, then you will have to obtain these yourself. The placement of the four leads is shown in the circuit drawing. Later the diode probe will be converted into a basic wameter to measure the final transmier 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 plas5c housing of the plug, wire being place in line with the slot in the plas5c housing. The insert is now pushed un5l 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 aach to the ends of the yellow and green wire. Prize the clip open a lile and slide off the plas5c covering. The wire can be soldered to the clip and held in place by the crimps at the end. Remember – Push the plas5c 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 lile with emery paper or the edge of a sharp knife.

The red and black leads are plugged into the posi5ve (+) and nega5ve (-) inputs of the meter. The yellow lead is clipped on the le7 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.

Tes9ng the Transmier

Having made the RF probe, the first sec5on of the transmier is now ready for tes5ng, so make a temporary supply lead using red & black wires – to the +12 and ground pads, respec-5vely, in the centre of the board. We suggest that you make these about 20cm long. As a precau5on, you should turn the blue drive preset fully an5-clockwise before you power the board – don't forget to insert the crystal!

When you are happy with all the connec5ons (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 nega5ve 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 3.560MHz on a suitable receiver. The tune control should vary the fre-quency from around 3.558MHz to 3.561MHz.

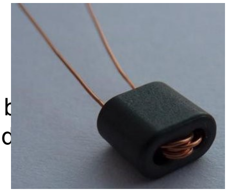
[NOTE – there is scope for experiment with the value of the series inductor L Increasing the value of this will give an increase in frequency range, however, this may be at the expense of oscillator stability. The value supplied with the kit i safe value. See the modifica5on notes on page 17]

Secondly, check the keying and driver stages.

A 3.5mm mono jack plug is supplied with the kit to fit the KEY jack socket. Aach 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 indica5on 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 an5-clockwise posi5on before you move on to the next step.

Now, the rest of the transmier.



The final amplifier

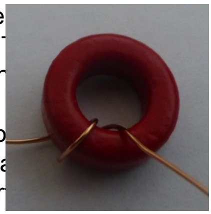
Firstly, wind the coil L2. This is 5 turns on a FT43-2402 b toroid. Each turn goes through both holes of the core, anc should end up with it looking like this.

It is helpful to insert this and the other components in the sec5on marked “FINAL” (ZD1, R10, C6 and C7) before adding the final amplifier transistor (T3) (2N3866). ZD1 must be connected the correct way round. The boom pad of the ZD1 placement shows a bar marking; this corresponds to the bar (or ring) near one end of the zener diode.

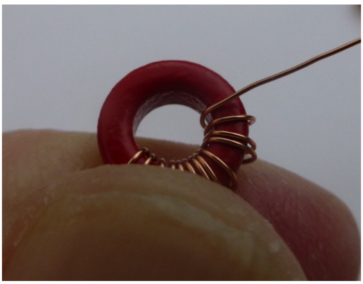
Trim the transistor leads to about 10mm and bend the end 3mm of the transistor leads to form a “foot” that will lay flush with the pads. The best direc5ons for the foot, assuming the tab on the transistor case points upwards, are emier upwards, collector downwards and base to the le7. Refer to the base connec5on diagram on the circuit schema5c. Using pointed pliers manipulate the leads un5l 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 twis5ng 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.

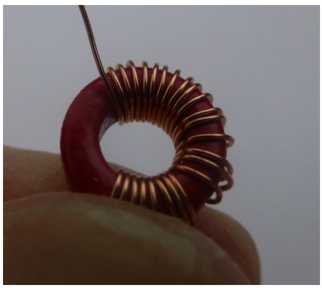
The next step is to solder a 10cm length of yellow wire to the LED pad on the main board (just to the rear of the +12v power pad, connect the other end of this to the LED pad on the front panel. Tuck this wire in 5dily as you can see on the picture of the main board and front panel below. The diodes 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



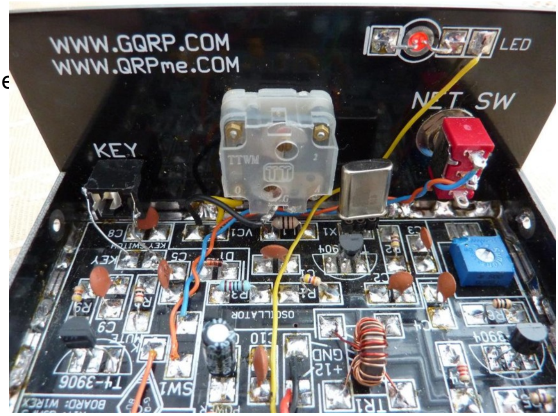
The low-pass filter coils (L4, L5 & L6) are wound on the red core using the gold wire. L4 and L6 have 26 turns, L5 has 25 turns. T require 18” (45cm) of wire for each coil. Wind as for TR1 with or pass through the core being one turn. L5 has one less turn (25) L4 and L6 (26 each) so wind L5 first and lay it aside so that it wo be confused with the others. 45cm of wire is easily enough for ea coil. The windings on each core should occupy about three-quar of the circumference.



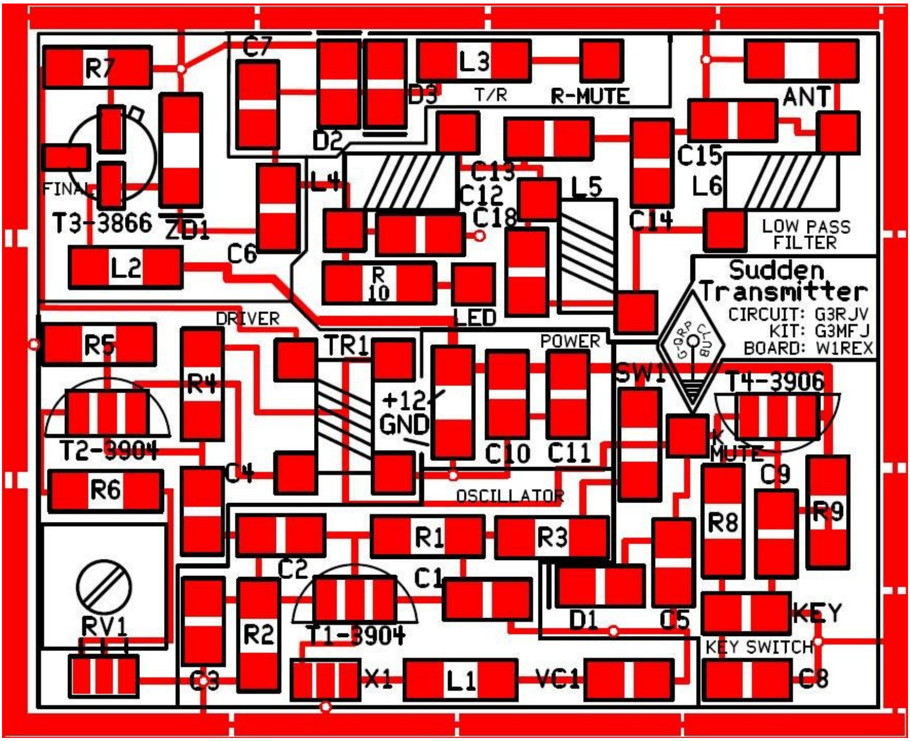


Quite a few of the capacitors around the PA transistor are actually two in parallel as the correct values are not commercially available. We suggest that you parallel these pairs first as shown here, before fiHng them. A good plan is to mount C12 - C15 and C18, then mount L5, followed by L4 and L6.

Here is a picture of the comple board so far.



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



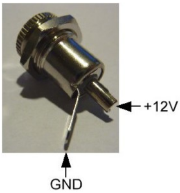
The back panel.

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 fi phono socket, as is the RECEIVER socket. T require two wires to be joined to the ANT pads or the main board and we will connect these in moment.

The power socket



The POWER socket also has two connec5ons 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 mu9ng

The components for the receiver mu5ng sec5on 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 seve 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 (boom of club logo) on the main board – use a 10cm length of orange wire for this.

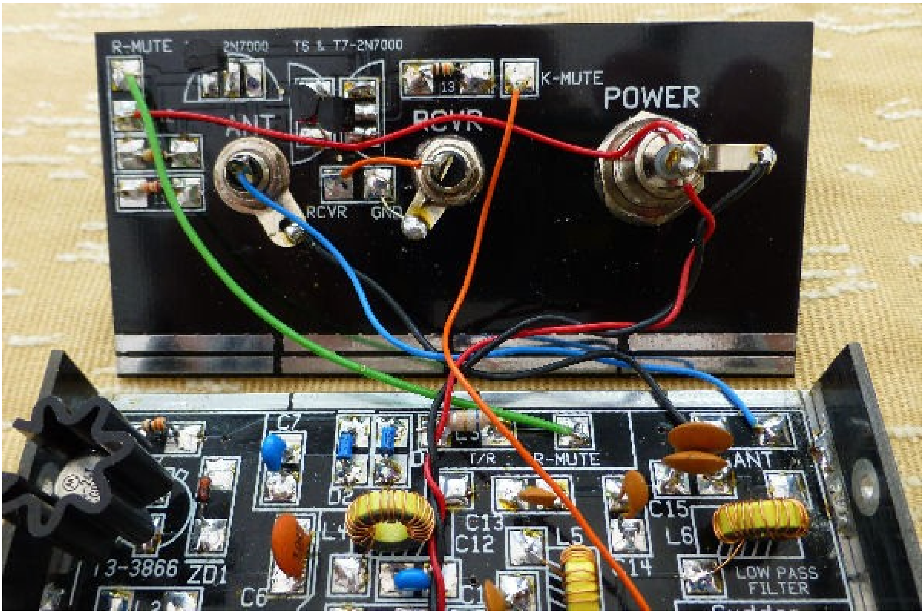
ANT on the main board – use two 9cm lengths of wire – black and blue, the bla (ground) connec5on goes to the le7-hand pad and the blue (antenna connec5on) goes to the right-hand pad. Y

You should already have two pieces of wire connected to the +12V and GND tags of the main board that we used for tes5ng. 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 connec5on. Finally a7er stripping the ends of the two red wires, twist them together and solder them both to the centre pin of the power socket.

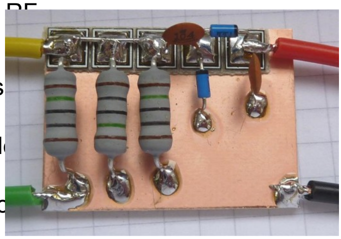
This picture shows that done. (Note—this picture is of a 30m transmier so some components may be different to the 80m TX.)



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 insula5on is easily damaged by the soldering iron. There is enough length to move them out of the way of the iron.

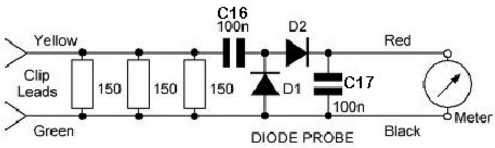
Tes9ng the transmier

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



The original diode probe has three 150 Ohm large res
tors added to the three le7-hand pads and ground.
These resistors connected in parallel form a 50 Ohm l
for the transmier. Do not aempt to transmit without
either a 50 Ohm load or connec5ng the output to
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 wa-meter o7en, then we suggest that you replace the yellow and green leads with a shor5sh 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 was = r.m.s voltage^2 divide by 50.

The calcula5on is simple:

- Voltage reading (peak to peak) divide by 2 = the peak voltage
- The peak voltage is mul5plied by 0.707 = the r.m.s. voltage.
- The r.m.s. voltage mul5plied by itself = r.m.s. voltage^2
- Divide this by 50 (the load resistor value) for the RF power output in was.

A suitable 2.1mm power plug is supplied with the kit – the centre pin is +ve and the outer connec5on is –ve. Do not get these reversed as there is no reverse polarity protec5on in the transmier.

The transmier should produce about 1 to 2 was. 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 transmiHng 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 1 wa and increase the output if you can, to around 2 was maximum. Try for an output voltage on the test meter of some 15 to 25 volts. Two was on 80 metres represents a useful amount of QRP transmier 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 transmier with the NET SW in the upward (off) posi5on. Pressing the switch downwards switches power to the oscillator only. Use this posi5on to find the frequency of the transmier on the receiver. This may be used to find a par5cular frequency or to “net” the transmier to another sta5on. The transmier output is 50 Ohms and the transmier 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 un5l you are sa5s-fied with the angles – it is beer 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? - Possibili9es for experiment

Radio amateurs would not be radio amateurs if they didn't want to experiment with things, so here are a couple of things that you may wish to experiment with. Remove the trans-mier power, and be careful that you do not destroy anything in the transmier whilst you are changing parts! If you are not sure of your own abili5es, 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 in-crease the shi7 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 oscilla5ng at some parts of the tuning control travel, and/or, the oscillator will chirp when the TX is keyed. You may need the use of the sta5on receiver to test these. You will probably have to unfasten VC1 and move it aside to change any of these parts. The polyvar-icon has a second part—this has a capacitance shi7 of 6 to 160pF. You may wish to swapping the two parts. When you have altered any values, take a careful list on a good receiver to ensure that you have a stable non-chirping transmission. Be careful! Another change is that you could try two iden5cal crystals in parallel—this can considerably increase the VXO shi7

The RX mu9ng circuit

This circuit is a simple and reasonably effec5ve way of considerably reducing the amount of transmied 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 mu5ng may appear to not be working very well. In fact, without it, the received signal from the TX would be consider-ably louder. This is another point at which you could do some experimen5ng 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-posi5on, to be a value around the supplied (and now removed) C7. The trimmer should be adjuste with the TX powered up, but not transmiHng. Adjust the trimmer for the maximum re-ceived signal strength of a weak signal on the receiver - the weaker the beer. It should not be adjusted when you are either neHng, or transmiHng.

Again - be very careful - this is a modifica5on for experience 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 radia5ons from the transmier.

	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	180pF	181
C3	100pF	101
C4	47pF	47
C5	100nF	104
C6	100nF	104
C7	94pF (47 + 47pF)*	47 + 47
C8	100nF	104
C9	100nF	104
C10	100nF	104
C11	10uF	10uF (the –ve side is plainly marked)
C12	780pF (390 + 390pF) *	391 + 391
C13	1300pF (1200 + 100pF) *	122 + 101
C14	1300pF (1200 + 100pF) *	122 + 101
C15	860pF (470 + 390pF) *	471 + 391
C16	100nF	104 (for RF probe)
C17	100nF	104 (for RF probe)
C18	197pF (150 + 47pF) *	151 + 47
	* these values are 2	capacitors in parallel – see text
Inductors		
L1	39uH	Orange, white, black, silver
L2	BN43-2402 binocular core	Pig nose – 5 complete turns 30SWG
L3	22uH	Red. red, black, silver
L4	T37-2	Red/black – 26 turns
L5	T37-2	Red/black – 25 turns
L6	T37-2	Red/black – 26 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	

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 T37-2 - red/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 flexible wire	For probe	Black, Red, Yellow, Green
4mm plugs	For probe	Black, Red
Min crocodile clips	For probe	Yellow, Green
Screws	4 x self tapping screws	To fasten the case on

The finished transmier

(NB - This is the 30m version of the kit so some parts will be slightly different)

V2.6 May 2016