53 A breadboard 80 m CW transmitter

Introduction

In the early days of radio, many circuits were built on a wooden baseboard, the parts being screwed down on the board. This was called breadboard construction, because it was a breadboard that was frequently commandeered for the process! Wives have always been generous in this respect, it appears!

This circuit was originally designed by GM3OXX, and became known as the *Oner*, because it was built on a circuit board one inch square! The circuit appeared in the G QRP Club journal *Sprat* and, since that time, many hundreds of *Oner* circuits have been built and used on the air. It is a well-proven circuit.

The transmitter has no tuned circuits in the power amplifier (PA) and thus has a rather high *harmonic* content. It **must** be used with the ***low-pass filter*** described elsewhere in this book. Without the low-pass filter, interference will be caused to other stations.

Simple aerial changeover switching is provided, which allows this circuit to be used with any of the 80 m receivers, such as the *Colt*, described in this book. It can also be used with any kit or commercial receiver for the 80 metre band.

The circuit

The transmitter circuit is shown in **Figure 1**. TR1 is a crystal oscillator, the frequency of which is controlled by crystal X1. A small trimmer capacitor, TC1, is added to allow the frequency of X1 to be varied by a small amount. If adjustment of this trimmer is made possible from the front panel, it is useful to adjust the transmit frequency to avoid other stations already on the crystal frequency. The collector load resistor, R2, of the oscillator transistor, TR1, determines the power output; a value of 3.3 kΩ seems to work well in producing an output of 3 watts.

TR1 is directly coupled to TR3, a VMOS transistor (a type of field-effect transistor (FET)). This acts as the power amplifier (PA) stage. TR3 should

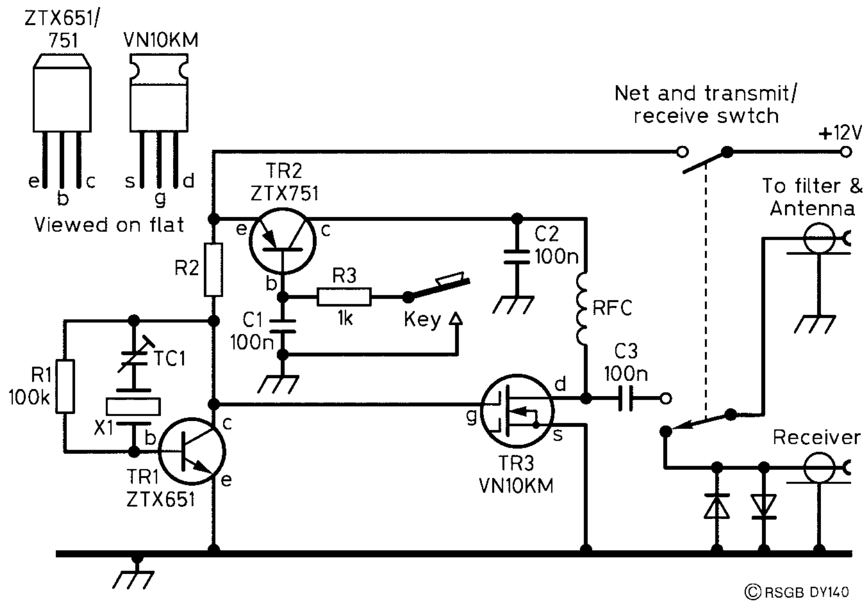


Figure 1 Circuit diagram of the breadboard transmitter

give about 3 W output, which is then coupled to the output by C3. The radio-frequency choke (RFC) providing the drain load of TR3 is simply a few turns of wire on a ferrite bead.

TR2 is an interesting addition to the circuit. It is used as a switch to 'key' the PA, TR3. The transmitter *could* be built without TR2, just placing the Morse key between the top of the RFC and the 12 volt supply. Adding TR2 is helpful, because it means that one side of the Morse key can be grounded (always a good thing), and some degree of *shaping* of the output RF waveform is provided by R3 and C1. This makes the transmission sound a little better and reduces the possibility of spurious frequencies being generated and transmitted. TR2 is a pnp transistor; note that it is the *emitter* of this transistor which is connected to the positive side of the supply.

Some form of changeover switching is needed for the aerial. A double-pole changeover toggle switch can be used. See the chapter on switches, later on in this book. One pole is used to switch the aerial between transmitter and receiver; the other pole is connected in the 12 volt supply line, and is labelled RECEIVE/TRANSMIT – NETTING. Its use will be described later. In this simple circuit, the PA cannot work when the key is open, because the key breaks its supply (via the RFC). When the key closes, TR2 switches on and applies the 12 volt supply to the top of the RFC. C2 is a *decoupling* capacitor, which prevents any residual RF signals at the top of the RFC reaching TR2.

Building

The prototype was put together as follows. Take a piece of plain printed-circuit board (PCB) measuring 5 cm by 4 cm. Then, with a *new, sharp blade* in a junior hacksaw, draw the blade horizontally across the surface of the copper in order to make a pattern of 6 squares along the 5 cm side and 5 squares along the 4 cm side. No more pressure should be applied than is necessary to cut through the copper! All the parts will be soldered on these pads in a form of surface-mount construction. To do this, each active pad (i.e. one that is going to have a component soldered to it) needs to be *tinned*. This means coating the pad's surface with solder, and is carried out as follows. Place the hot tip of the soldering iron on to the pad, and hold it there for a second or so. Then, with the tip still in place, touch the end of your reel of solder *on the pad*, not the tip of the iron. The solder should flow evenly all over the pad, and you can remove the iron. The solder should solidify in a rounded, shiny blob! This provides a good surface for making soldered joints.

To join component leads to the pads, cut each lead about 1 cm long, and then bend the last 2 mm at right angles to the rest of the lead. As you did before, tin the 2 mm length of each lead. Place the tinned portion on to the pad, and place the tip of your iron *on the pad*, close to the lead. The solder on the pad and on the lead will melt and run together; remove the iron and *hold the component still* until the solder solidifies. When the joint has cooled, give the lead a gentle tug to make sure you have a good joint (a good *mechanical* joint is usually a good *electrical* joint, too!). Each transistor straddles three pads, so the centre lead will need to be shorter than the other two. Take care here to get the lead lengths right – if you do, you will be surprised how much more firmly the transistor is held than if you just botched the lead lengths by bending them to fit! Make sure the connections to the transistors are correct.

Winding the RFC is quite simple. Seven (or more) turns of thin (32 SWG) enamelled copper wire are threaded through a small ferrite bead. This requires care, because the bead is small and the wire is thin. Trim the ends to within about 1 cm of the bead, remove the enamel carefully with sandpaper and tin the bare ends, prior to soldering the choke to the board.

After completion of the wiring, check the circuit against Figure 1. Bread-boarding a circuit like this has its advantages, but it can have disadvantages, too. One of these disadvantages is that it can make circuit checking difficult. For a simple circuit like this, it is not too bad! Check that no solder has run between the pads. Plug in your crystal for the 80 m band, and connect up the 12 V power supply. Do not connect the Morse key yet and do not switch on the power.

Testing and operating

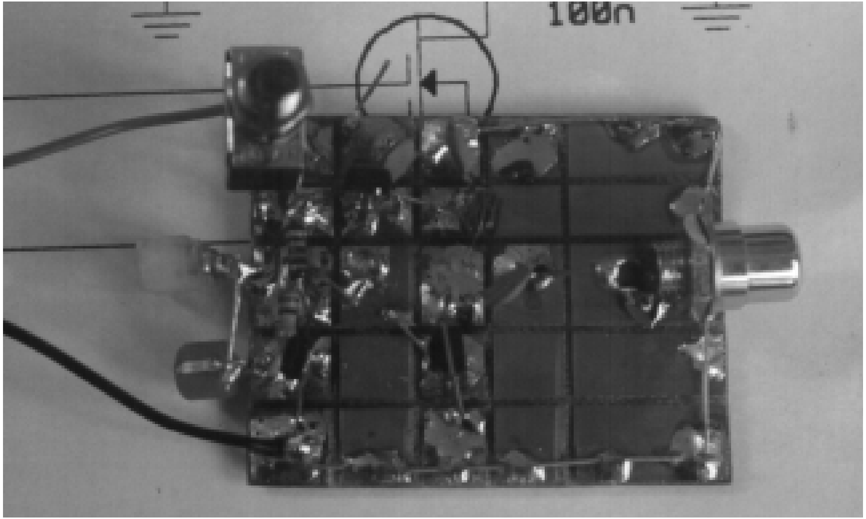
Clear your workbench of all metallic objects, slivers of copper, bits of wire, etc., switch on your power supply. With an external receiver, listen on and around your crystal's frequency for a signal. Remember that the oscillator runs all the time and, because you haven't yet connected the Morse key, your receiver is close enough to pick up the signal from the oscillator. This confirms that your oscillator is running. Switch off.

Connect the station aerial to the transmitter's aerial socket, and the receiver to the transmitter's receiver socket. Connect the Morse key, put the Receive/ Transmit–Netting switch in the receive position and switch on. You should be able to hear stations in the normal way. Now put the switch in the Transmit–Netting position. Signals in the receiver should almost disappear, as the circuit has disconnected the receiver's aerial.

Tune the receiver until you can hear your own crystal oscillator signal. This is known as *netting*, tuning your receiver and transmitter to the same frequency. Pressing the key will now transmit your signals when the switch is in the Transmit–Netting position; switch back to the receive position to listen for stations answering your call. As soon as you are happy that your circuit is functioning properly, **you must build the low-pass filter circuit** before using the transmitter regularly.

Parts list

Resistors: all 0.25 watt, 5% tolerance	
R1	100 kilohms (kΩ)
R2	See text
R3	1 kilohm (kΩ)
Capacitors	
C1, C2, C3	100 nanofarads (nF), or 0.1 microfarad (μF)
TC1	3–60 picofarads (pF) trimmer
Semiconductors	
TR1	ZTX651
TR2	ZTX751
TR3	VN10KM
Additional items	
RFC	7 turns of 32 SWG enamelled copper on a ferrite bead
Switch	Double-pole changeover (DPDT or DPCO) toggle
Crystal	For 80 m band
Crystal holder	HC25 type
Sockets	According to station fittings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