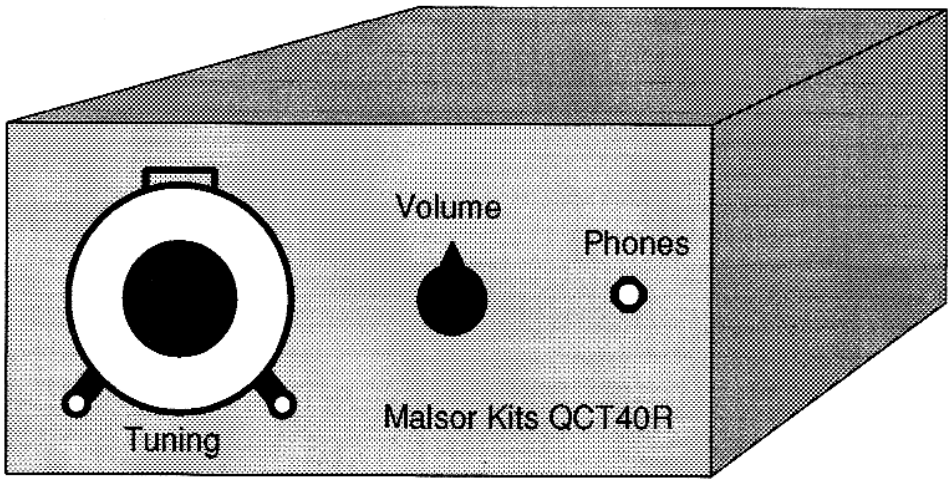
# QCT40R
# 40m QRP CW RECEIVER
# Instruction Manual

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## INTRODUCTION

The QCT40R is a 40m superhet receiver incorporating a number of advanced features not usually found in low-cost equipment. These include a 4-pole crystal IF filter, a 'hang' AGC system, and a 'strong' front-end. Additionally, the IF filter can be configured for an SSB bandwidth (2.5KHz) or for CW (600Hz). The QCT40R can be used together with the companion QCT40T transmitter to form a high performance QRP CW transceiver.

## HOW IT WORKS (Refer to Circuit Diagram)

Signals from the antenna pass through a band-pass filter (L1-C1-C2) to a dual-gate MOSFET mixer (TR1) where they are heterodyned to the IF of 10.240MHz. Wanted signals are selected by a crystal ladder filter (X1-X4 and C7-C11) which is impedance matched by T1 and T2. IF gain and AGC control is provided by IC1. IC2 is a combined Product Detector / BFO which demodulates signals to baseband. The resulting audio signals are amplified in IC3 which drives the headphones or speaker.

A sample of the audio output is amplified in IC5b and rectified by D5-D7. An inverted (by IC5c) version of the audio signal is also rectified by D8-D9. The audio signal is thus full wave rectified and the resulting DC signal charges C40. The charge on C40 is buffered by IC5d and applied to IC1 as an AGC control voltage. Whilst audio signals are present, TR5 conducts and keeps C43 discharged; once the audio signal disappears, C43 charges via R34 until pin 1 of IC5a goes low and discharges C40 rapidly via R24. When used with the companion QCT40T board, a high fixed-level AGC voltage is applied via pin E during transmit periods.

The local oscillator comprises TR2 and an isolating buffer (TR3-TR4). The buffer provides a high level output to TR1 and an attenuated output to pin F for use in the QCT40T. The oscillator covers the frequency range 3.14-3.24 MHz.

## CONSTRUCTION

As you carry out each step in the assembly:-

a. Refer to the component layout to see where on the PCB to place the component. Where a component lead is marked with a "blob", the lead is soldered to the groundplane on top of the board

b. If the assembly instruction mentions a particular 'style', refer to the style diagram to see how to shape the component leads. Be careful not to bend the leads too close to the body of the component .... you may crack it

c. After you have soldered the component in place, cut off any excess lead length.

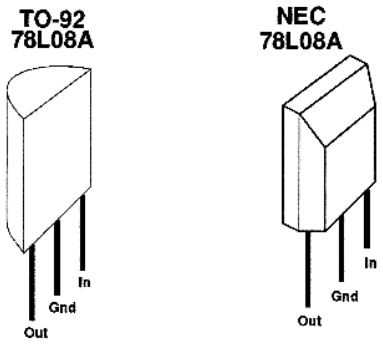
d. Tick off the step in the box provided.

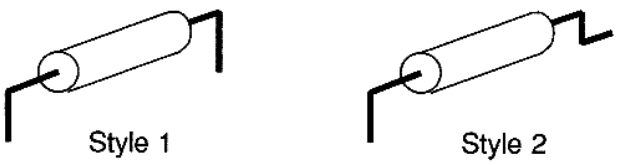
You have the option to configure the IF filter for a bandwidth of 2.5KHz (SSB and CW) or 600Hz (CW only). Decide now which you require.

## IMPORTANT NOTE

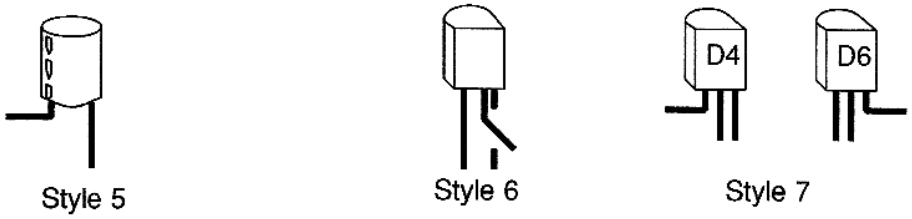
In some kits, the NEC version of the 78L08 may be supplied in place of the more usual TO-92 cased version.

The component layout shows you how to orientate the TO-92 version. If you have been supplied with the NEC version, examine the drawing on the right to see how to orientate the component correctly.








**Component Styles**

## 1. TERMINAL PINS

[ ] Solder 6 terminal pins at positions A B C D E and F. Solder the pins on the track side and cut off any excess length on the underside of the board.

[ ] Solder 5 through-board links at the positions marked with an isolated "blob". Solder the wire on the track side and the top side of the board. Cut off any excess length on both sides of the board.

## 2. INTEGRATED CIRCUITS

CAUTION There is very little clearance between the groundplane and the pins of IC1, IC2 and IC3. If necessary, mount these circuits slightly higher above the groundplane than normal, in order to avoid pins shorting to ground.

[ ] Solder the MC1350 at IC1, taking care to orientate it correctly. Solder pins 3 and 7 on the top side of the board.

[ ] Solder the NE612 at IC2, taking care to orientate it correctly. Solder pin 3 on the top side of the board. Note that an NE602 may be supplied in place of the NE612.

[ ] Solder the LM386 at IC3, taking care to orientate it correctly. Solder pins 2 and 4 on the top side of the board.

[ ] Solder the 78L08 at IC4, taking care to orientate it correctly. Solder the centre pin on the top side of the board.

[ ] Solder the TL084 at IC5, taking care to orientate it correctly. Solder pin 11 on the top side of the board.

## 3. RESISTORS

[ ] Solder seven 10K resistors (Brown-Black-Orange) style 1 at R1, R2, R6, R29, R30, R31, and R32.

[ ] Solder a 10K resistor (Brown-Black-Orange) style 2 at R33.

[ ] Solder a 120R resisitor (Brown-Red-Brown) style 2 at R3.

[ ] Solder two 100R resistors (Brown-Black-Brown) style 1 at R4 and R7.

[ ] Solder a 560R resistor (Green-Blue-Brown) style 1 at R5.

[ ] Solder two 1K8 resistors (Brown-Grey-Red) style 1 at R8 and R9.

[ ] Solder a 47K resistor (Yellow-Mauve-Orange) style 2 at R10.

[ ] Solder a 22R resistor (Red-Red-Black) style 1 at R11.

[ ] Solder a 15R resistor (Brown-Green-Black) style 1 at R12.

[ ] Solder a 15R resistor (Brown-Green-Black) style 2 at R20.

[ ] Solder a 100K resistor (Brown-Black-Yellow) style 2 at R13.

[ ] Solder a 100K resistor (Brown-Black-Yellow) style 1 at R28.

[ ] Solder a 8K2 resistor (Grey-Red-Red) style 1 at R14.

[ ] Solder a 10R resistor (Brown-Black-Black) style 1 at R15.

[ ] Solder a 820R resistor (Grey-Red-Brown) style 1 at R16.

[ ] Solder a 1K5 resistor (Brown-Green-Red) style 2 at R17.

[ ] Solder a 12K resistor (Brown-Red-Orange) style 1 at R18.

[ ] Solder a 270R resistor (Red-Mauve-Brown) style 1 at R19.

[ ] Solder a 1K resistor (Brown-Black-Red) style 2 at R21.

[ ] Solder a 3K3 resistor (Orange-Orange-Red) style 1 at R23.

[ ] Solder a 220K resistor (Red-Red-Yellow) style 1 at R24.

[ ] Solder three 4K7 resistors (Yellow-Mauve-Red) style 2 at R25, R26 and R36.

[ ] Solder a 82K resistor (Grey-Red-Orange) style 1 at R27.

[ ] Solder a 180K resistor (Brown-Grey-Yellow) style 1 at R34.

[ ] Solder a 150K resistor (Brown-Green-Yellow) style 1 at R35.

[ ] Solder two insulated wire links at positions LK1 and LK2.

## 4. DIODES

[ ] Solder four 1N4148 diodes style 1 at D2, D5, D6 and D8, taking care to orientate them correctly. Note that D1 is no longer used and is not supplied with the kit (link LK2 takes its place).

[ ] Solder three 1N4148 diodes style 2 at D3, D7 and D9, taking care to orientate them correctly.

[ ] Solder the 4v7 zener diode style 1 at D4.

## 5. TRANSISTORS

[ ] Solder the 40673 MOSFET at TR1, taking care to orientate it correctly. Note that a 3N201 may be supplied in place of the 40673.

[ ] Solder the 2N3819 at TR2, taking care to orientate it correctly.

[ ] Solder three 2N2222A transistors at TR3, TR4 and TR5 taking care to orientate them correctly. Solder the emitters (lead nearest tag) of TR3 and TR5 to the groundplane.

## 6. CAPACITORS

[ ] Solder the 220p ceramic capacitor style 4 at C1.

[ ] Solder three 40p trimmers at C2, C3 and C18. Solder the pins connected to the moving vanes to the top of the board.

[ ] Solder the 56p ceramic capacitor style 4 at C4.

[ ] Solder nine 10n ceramic capacitors style 4 at C5, C6, C12, C13, C15, C17, C29, C32 and C37.

[ ] Solder four 10n ceramic capacitors style 3 at C16, C36, C38 and C39.

[ ] Solder two 180p ceramic capacitors style 3 at C7 and C11. However, if you wish to configure the IF filter for narrowband (CW) operation, use 560p ceramic capacitors.

[ ] Solder three 180p ceramic capacitors style 4 at C8, C9 and C10. However, if you wish to configure the IF filter for narrowband (CW) operation, use 560p ceramic capacitors.

[ ] Solder three 100u capacitors style 6 at C14, C24 and C28 taking care to orientate them correctly.

[ ] Solder a 100u capacitor style 5 at C30 taking care to orientate it correctly.

[ ] Solder a 47p ceramic capacitor style 3 at C19. However, if you wish to configure the IF filter for narrowband (CW) operation, use a 150p ceramic capacitor.

[ ] Solder a 47p ceramic capacitor style 4 at C20. However, if you wish to configure the IF filter for narrowband (CW) operation, use a 150p ceramic capacitor.

[ ] Solder two 0.047u capacitors style 4 at C21 and C22.

[ ] Solder a 1u capacitor style 5 at C23 taking care to orientate it correctly.

[ ] Solder a 1u capacitor style 6 at C40 taking care to orientate it correctly.

[ ] Solder a 10u capacitor syle 5 at C25 taking care to orientate it correctly.

[ ] Solder a 10u capacitor style 6 at C43 taking care to orientate it correctly.

[ ] Solder two 100n ceramic capacitors style 4 at C26 and C27.

[ ] Solder four 100n ceramic capacitors style 3 at C31, C41, C42 and C44. You may need to bend the capacitor leads to fit the board hole spacing.

[ ] Solder the 10p ceramic capacitor style 3 at C33.

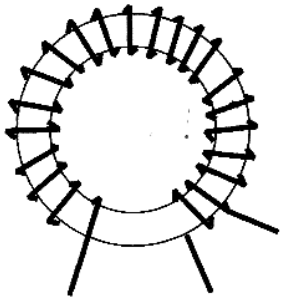
[ ] Solder the 330p polystyrene capacitor style 2 at C34.

[ ] Solder the 47p polystyrene capacitor style 2 at C35.

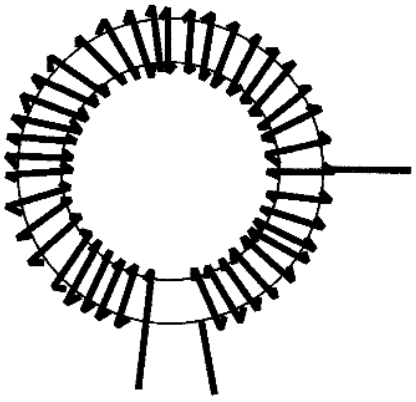
[ ] Solder the 47u capacitor style 6 at C45 taking care to orientate it correctly.

## 7. MISCELLANEOUS

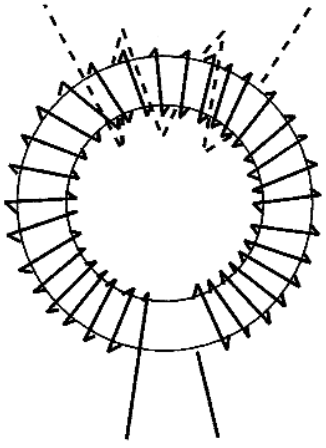
[ ] Wind 22 turns of 28 swg wire onto the T37-2 toroid (red) with a tap at the second turn as shown. Mount it at vertically at L1. Make sure that the tap is 2 turns (not 20 turns) from the ground connection.



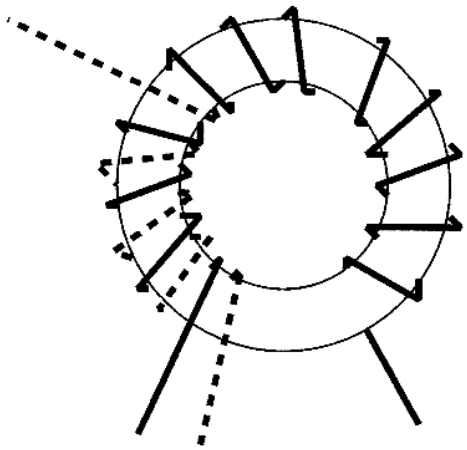
[ ] Wind 40 turns of 28 swg wire onto the T50-6 toroid (yellow, 0.5" diameter) with a tap at the tenth turn as shown. Mount it horizontally at L2 using a 3mm nut and bolt, and two insulating washers. Pass the bolt through the board, a washer, the toroid and another washer so that the toroid is spaced from the board. Suitable washers can be cut from perspex sheet. Make sure that the tap is the tenth turn (not the thirtieth turn) from ground.



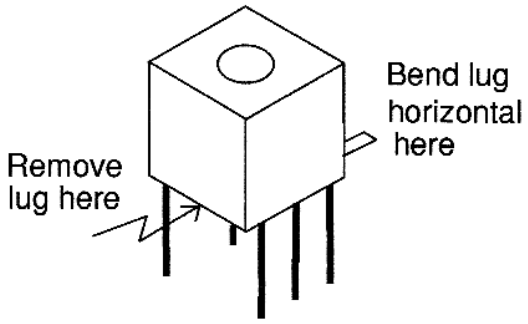
[ ] Wind 32 turns of 28 swg wire onto the T37-6 toroid (yellow, 0.37" diameter). Wind a three turn link of insulating wire over the first winding as shown. Mount the assembly at T1.



[ ] Wind 12 turns of 28 swg wire onto the black toroid. Wind 4 turns of insulated wire over the first winding as shown. Mount the assembly at T2. Note that the 4 turn link is the primary winding and the 12 turns are the secondary.



[ ] Refer to the diagram and cut off the earth tag of the Toko IF transformer as shown. Bend the other tag horizontally as shown. Mount the transformer at T3. Solder the five pins on the track side of the board and solder the tag to the groundplane.




[ ] Solder five 10.240MHz crystals at X1, X2, X3, X4 and X5.

## ASSEMBLY (Refer to Wiring Diagram)

In addition to the QCT40R board you will need the following components to complete the receiver :-

a. A metal case approximately 6" X 4" X 2" (or 6" X 6" X 2" if you are making a complete transceiver.

b. A 25pF air-spaced variable capacitor for the tuning control. We strongly recommend you use a slow motion drive with the capacitor.

c. A 500 Ohm linear potentiometer for the volume control.

d. A coaxial socket for the antenna connection.

e. A jack socket for the headphone connection.

f. A DC socket for the power supply connection.

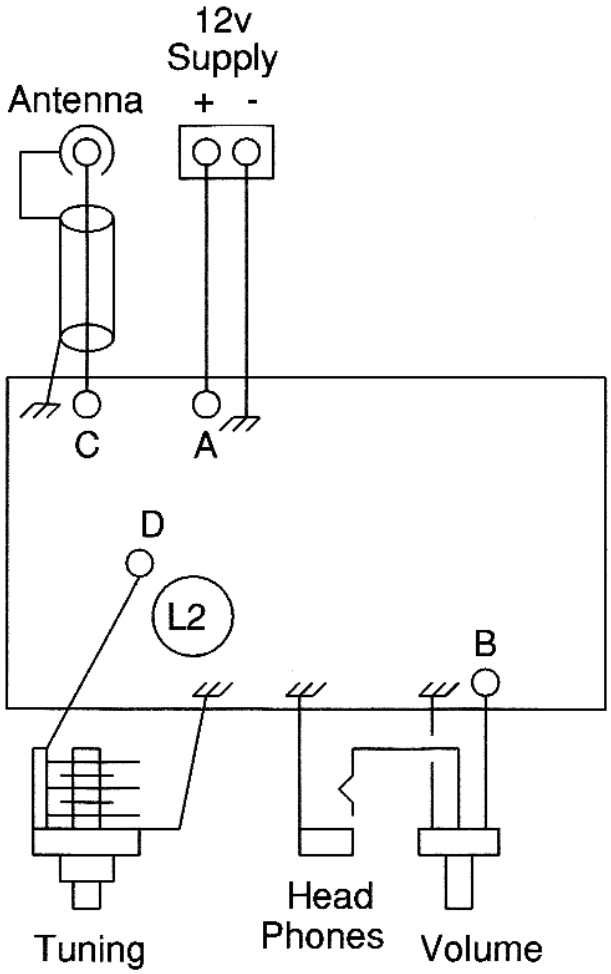
g. Mounting pillars for the board.

[ ] Bolt the QCT40R board into a suitable metal case, being careful to use pillars to lift the board clear of the bottom of the case.

[ ] The way in which you mount the variable capacitor will depend on your choice of slow-motion drive and size of case. Try to arrange for it to be close to pin D on the board. Connect the fixed vanes on the capacitor to pin D using rigid wire. Connect the moving vane tag to the board ground-plane.

[ ] Mount the potentiometer on the front panel and connect it to pin B as shown. Mount a headphone socket on the front panel and connect it to the potentiometer as shown.

[ ] Mount a coaxial antenna socket on the rear panel and connect it using screened cable to pin C and the groundplane as shown. Mount a DC connector on the rear panel and connect it to pin A and the groundplane as shown.




**Wiring Diagram**

## ALIGNMENT

[ ] Connect the receiver to a power supply with an output between 11 and 15 volts. Switch on the supply and check that the current drawn is between 60 and 90 mA.

[ ] Rotate the volume control fully anti-clockwise, plug in the headphones, and slowly increase the volume. You should hear receiver noise (a hissing sound).

[ ] Adjust the core of T3 for a peak in receiver noise using a plastic trimming tool. Don't use a metal screwdriver ..... you may break the core !

[ ] Connect a frequency counter between pin F and ground. Check that the frequency varies from about 3.14 MHz to 3.24 MHz as the tuning control is rotated. Minor variations to the tuning range can be made by compressing or spreading the turns on L2. Major adjustments can be made by reducing the number of turns on L2 to increase the frequency, or increasing the turns to reduce the frequency.

[ ] Connect an antenna to the receiver. At some positions of the tuning range you should be able to hear received signals; alternately adjust trimmers C2 and C3 for loudest reception. Do not worry if at this stage the signals are not intelligible.

[ ] If you have opted for the wide bandwidth IF filter, tune into an SSB signal for maximum received signal and adjust trimmer C18 for intelligible speech. If you have opted for the narrow bandwidth filter, tune into a morse signal for maximum strength and adjust trimmer C18 for an audio tone of about 700Hz.

Your QCT40R is now ready for use.

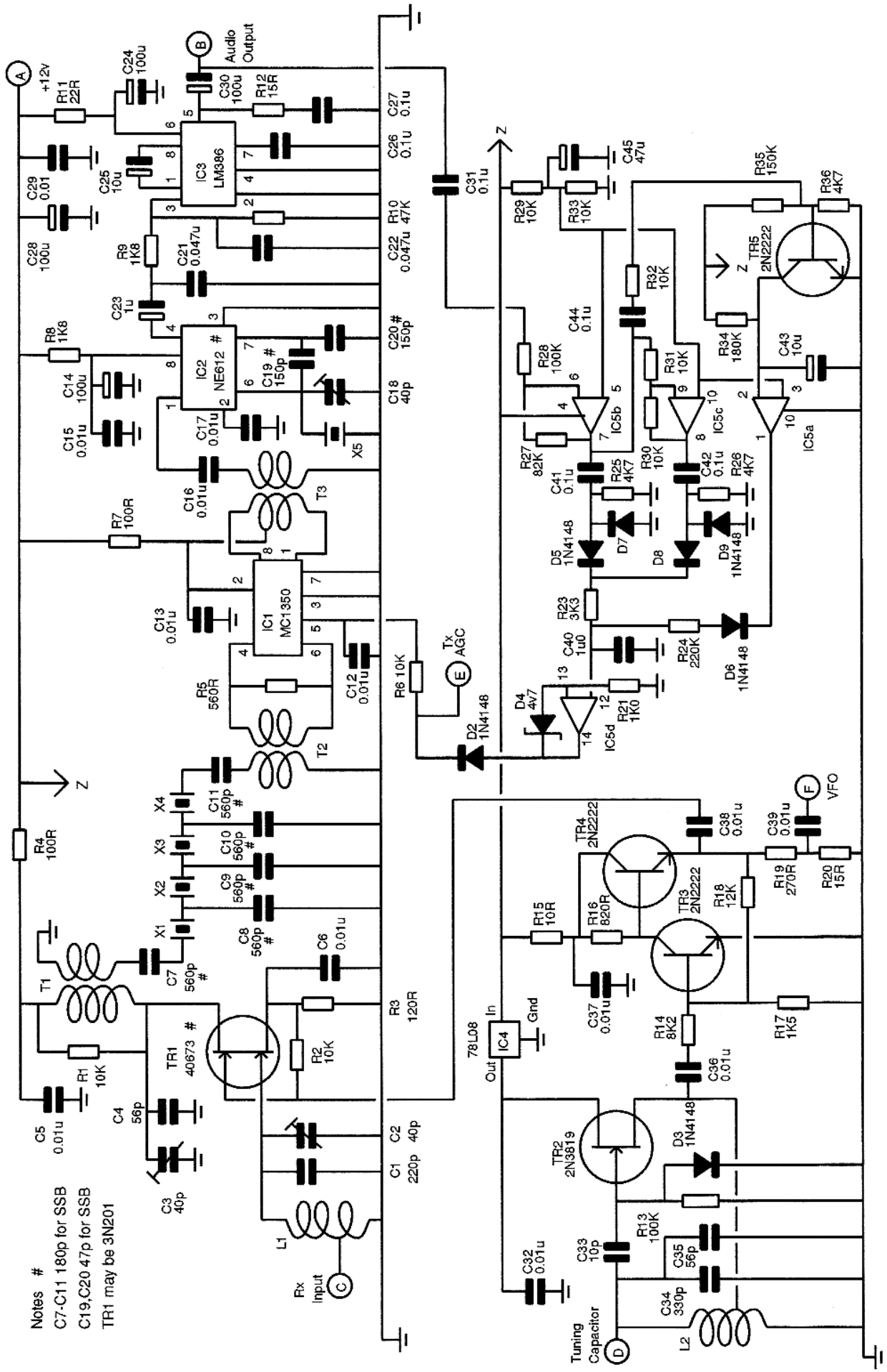
## COMPONENT LIST

| | | | |
|---|---|---|---|
| R1,R2,R6,R29,R30 | 10K | R17 | 1K5 |
| R31,R32,R3 | | R18 | 12K |
| R3 | 120 | R19 | 270 |
| R4,R7 | 100 | R21 | 1K |
| R5 | 560 | R22 | No longer used |
| R8,R9 | 1K8 | R23 | 3K3 |
| R10 | 47K | R24 | 220K |
| R11 | 22 | R25,R26,R36 | 4K7 |
| R12,R20 | 15 | R27 | 82K |
| R13,R28 | 100K | R34 | 180K |
| R14 | 8K2 | R35 | 150K |
| R15 | 10 | R16 | 820 |

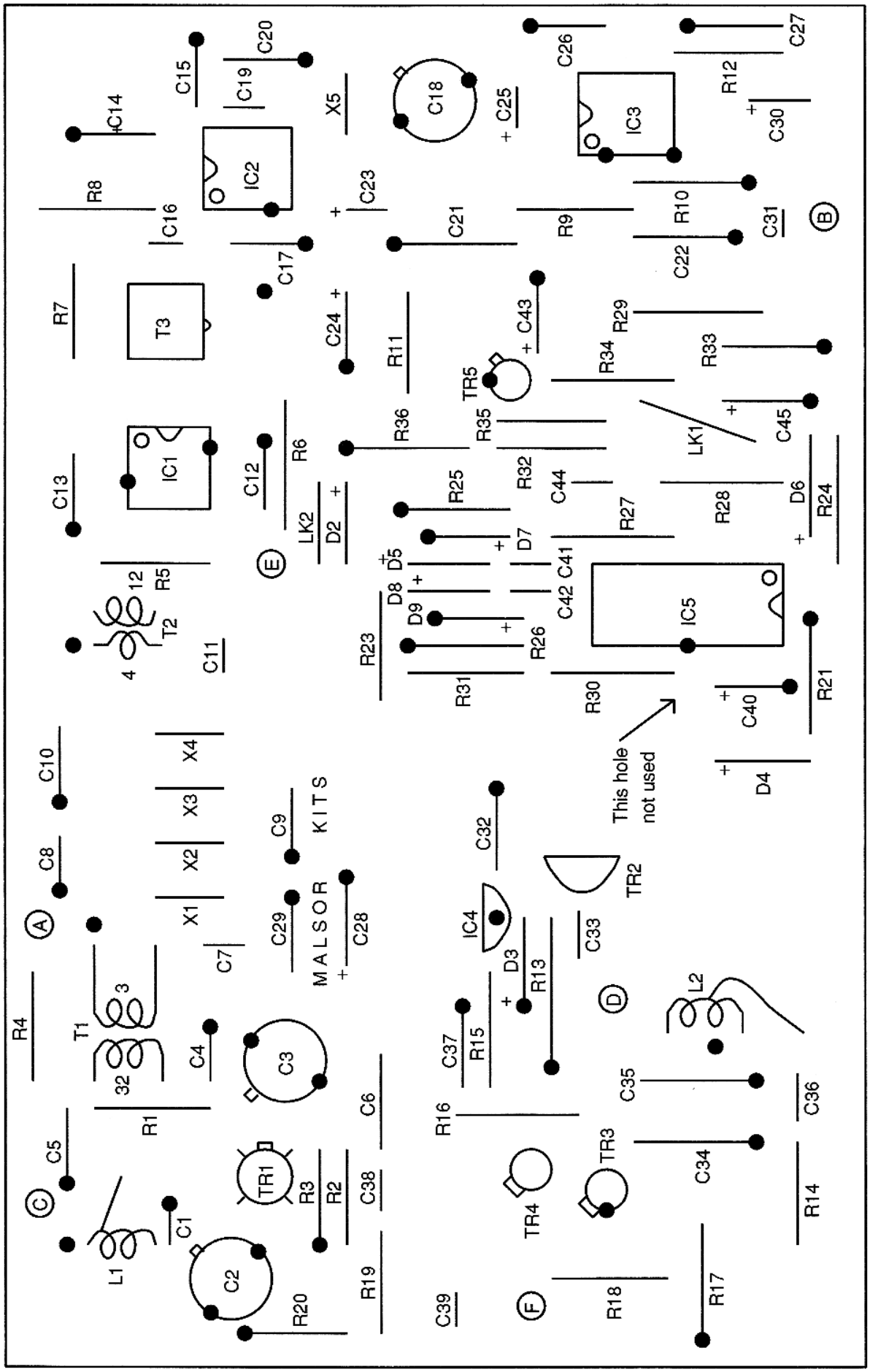
| | | | |
|---|---|---|---|
| C1 | 220p | C14,C24,C28,C30 | 100u |
| C2,C3,C18 | 40p trimmer | C19,C20 | 150p or 47p |
| C4 | 56p | C21,C22 | 0.047u |
| C5,C6,C12,C13,C15 | 10n | C23,C40 | 1u |
| C16,C17,C29,C32 | | C25,C43 | 10u |
| C36,C37,C38,C39 | | C26,C27,C31,C41 | 0.1u |
| C7,C8,C9,C10,C11 | 180p or 560p | C42,C44 | |
| C34 | 330p poly. | C33 | 10p |
| C45 | 47u | C35 | 47p polystyrene |

| | |
|---|---|
| L1 | 22 turns on T37-2 tapped at 2 turns |
| L2 | 40 turns on T50-6 tapped at 10 turns |
| T1 | 32 turns on T37-6. Secondary 3 turn link |
| T2 | Siemens B64290, Primary 4 turns, Secondary 12 turns |
| T3 | Toko KACSK3894A |
| X1 - X5 | 10.240 MHz crystal |
| D2 - D3, D5 - D9 | 1N4148 (Note D1 no longer used) |
| D4 | 4v7 zener diode |
| TR1 | 40673 dual gate MOSFET (or 3N201) |
| TR2 | 2N3819 FET |
| TR3 - TR5 | 2N2222A |
| IC1 | MC1350 |
| IC2 | NE612 (or NE602) |
| IC3 | LM386 |
| IC4 | 78L08 |
| IC5 | TL084 |

Terminal pins (6), PCB, Instruction manual




Circuit Diagram




## Component Layout