The Fareham Radio Club 80m ~~Transceiver~~ RECEIVER

The Fareham radio club transceiver project consists of three sections. The first contains a complete direct conversion receiver for the 80m band. ~~The second consists of an amplifier that takes the VFO output from the receiver and produces a 1 watt CW signal. This section also contains the necessary control circuitry for transmit/receive switching and RIT. The third section is a direction finding antenna, to be used for club "foxhunt" events~~.

Circuit Description.

On receive, signals are routed via the TR switch to the preselector filter. This is a fixed tuned design, covering 3.5 MHz to 3.8MHz. This serves to reject any out of band signals which might cause overloading problems.

The mixer multiplies the incoming signals with the output from the variable frequency oscillator (VFO). The VFO frequency is arranged to be either on the carrier frequency for single sideband use , or offset from the carrier frequency for CW reception. If the incoming signal is on a frequency of 3.5MHz ,the VFO could be set to 3.501MHz to give a 1kHz note.

The VFO is a conventional colpitts design covering roughly 3.4MHz to 3.9MHz. It is followed by a buffer amplifier which prevents changes in load impedance from pulling the oscillator frequency. These can occur due to keying the transmitter, or to changes in antenna impedance.

The mixer output is amplified by IC2A to make sure that the received signals are above the noise level of the following stages. IC2B is a low-pass filter rejecting frequencies above 3kHz. This serves to reject high pitched whistles and some adjacent channel signals. For CW work, IC2C can be switched in giving fairly sharp filtering centred on 600Hz to pick signals out from the general band noise. IC2D operates as a variable gain stage. This gives superior gain control to a potentiometer when the incoming signal is strong. Under these conditions, there is little gain in the receiver so that signals are not amplified up sufficiently to cause overloading. Also little noise is produced which can make listening unpleasant at low gain settings.

The output stage is a simple emitter follower. This does not produce sufficient output to drive a loudspeaker, but will comfortably drive any impedance headphones. Loudspeakers are not as effective as headphones with simple receivers as they do not exclude background noise. A further problem with loudspeaker amplifiers is that they draw pulses of current from the power supply which can cause instability with this type of receiver.

The transmitter design will be described separately. It will consist of a chain of amplifiers to produce about 1 watt CW output. Also fitted to this board will be the control circuitry which will have a number of tasks to perform.

Some form of transmit receive switching will be needed to change the antenna from the transmitter output to the receiver input. On transmit the receiver will need to be muted and sidetone generated. Receiver Incremental tuning (RIT) will need to offset the VFO frequency on receive to give a comfortable beat note, otherwise a station will be called off frequency.

Construction.

The recommended form of construction for this receiver is to build it "ugly style". The components can be soldered together using copper clad circuit board as a ground plane. Integrated circuits (ICs) are glued upside down to the board while smaller components are hand wired in between, using the ground plane for all earth connections. This method is known as "dead bug construction". An alternative method is to use single sided circuit board as a ground plane. Components are mounted on the copper side of the board with any leads not going to earth passed through to the blank side of the board. Here they are hand wired together. Both of these forms of construction give layouts that work well at radio frequencies and can easily be modified.

Initial Checks and Alignment.

Having completed the construction of the receiver, it should be connected up to a pair of headphones and a power supply (preferably current limited) via a 100mA meter. If all is well it should draw about 30mA. The prototype drew 20mA at 9V and 28mA at 12V.

It should now be possible to hear a hissing sound in the headphones when the AF gain control is advanced. If this is present then the receiver is ready for alignment.

Direct conversion receivers are extremely easy to align. First the VFO core needs to be adjusted to give the correct frequency coverage. This can be achieved by listening for the VFO signal on an existing HF receiver. A short length of wire connected to the test receiver antenna socket, and held a few inches from the VFO should provide sufficient signal. The core should be adjusted to give a frequency of 3.4MHz with the capacitor vanes fully meshed. With the capacitor unmeshed, the frequency should be greater than 3.8MHz. Reducing or increasing the value of the capacitor in series with the tuning capacitor will give a smaller or larger frequency range. If a frequency counter is available, this can be used to read the VFO frequency at the

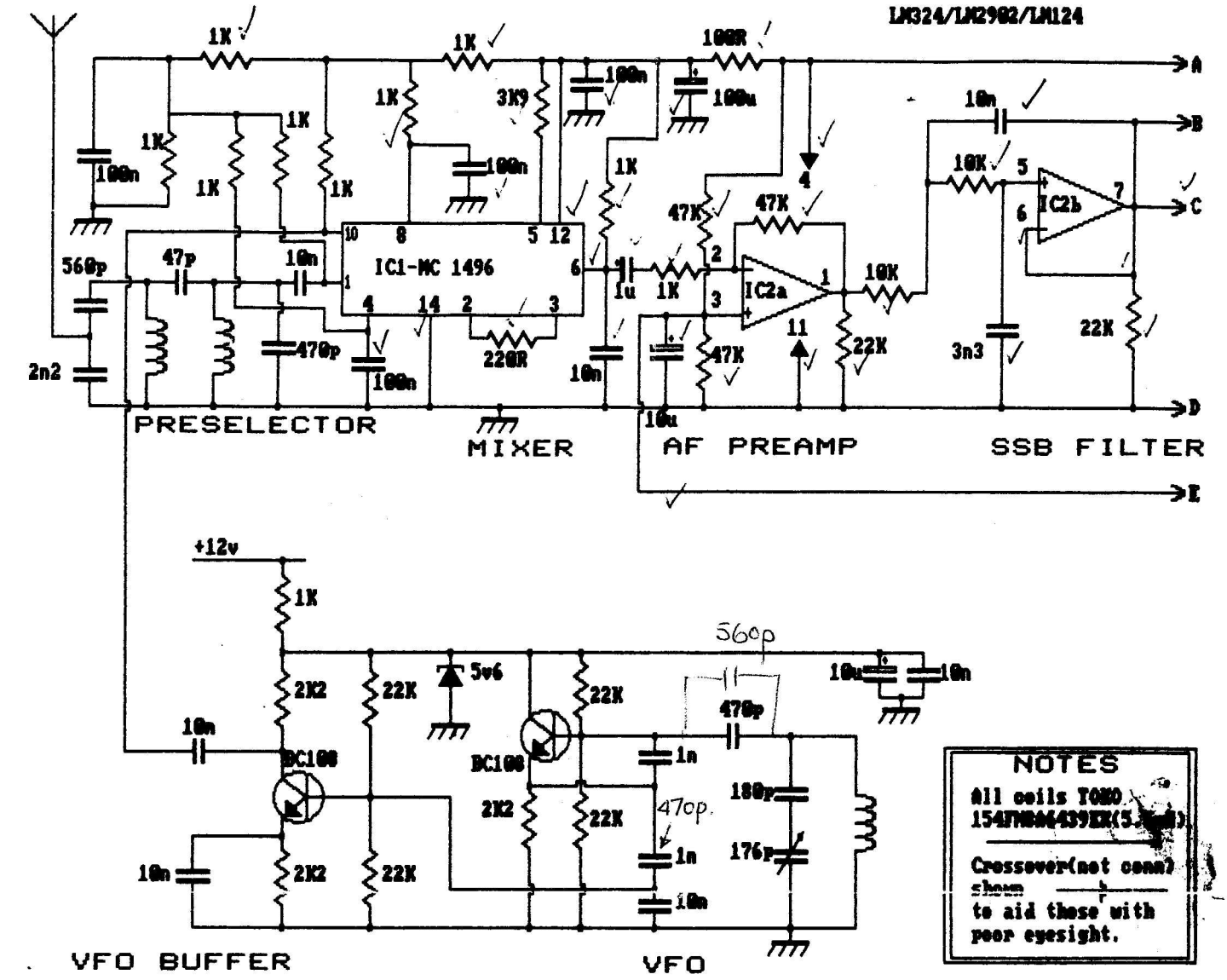
output of the buffer amplifier making adjustment even simpler.

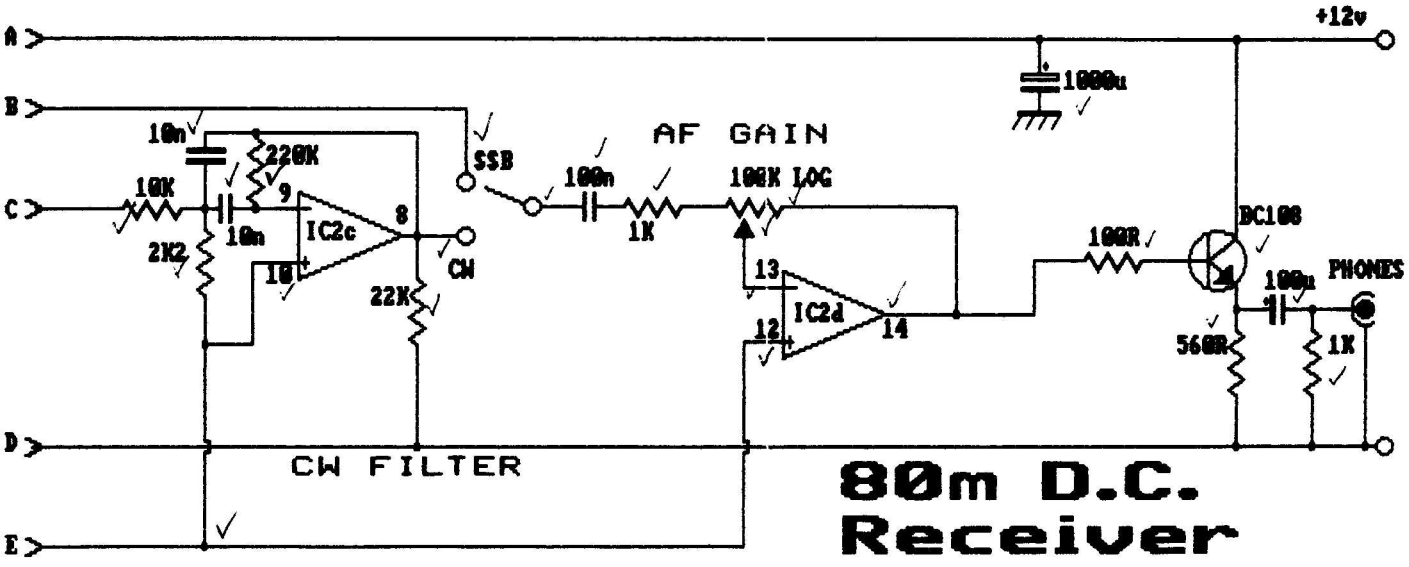
Finally, the cores of the two preselector coils should be adjusted for maximum sensitivity at the centre of the band. This can be achieved by tuning to the output of a signal generator set to 3.65MHz. The coils are then adjusted to give the loudest signal. This adjustment should be repeated several times as one coil will de-tune the other. This adjustment is very non-critical. If no signal generator is unavailable, the preselector can be peaked on the output of a GDO, a crystal marker or even on a steady signal from an antenna.

Fault Finding.

Fault finding consists of logically working through the receiver until the fault is found. If little test equipment is available, it may be easiest to start at the output and work backwards through the receiver. All pins on the quad op-amp IC2 should be at half the supply voltage, apart from pins 4 and 11. Note however if the potential divider on pin 3 is not working, all sections will have incorrect voltages on them. As a further test a finger applied to pins 2,5,9 and 13 in turn, should produce an audible hum at the output. The VFO can be checked for correct operation using an existing receiver. A diode probe will indicate if the buffer amplifier is operating correctly.

Note that direct conversion receivers have a tendency to suffer from mains hum pickup and microphony. The hum problem is usually caused by the VFO signal being radiated by the receiver and leaking into mains wiring. Any rectifiers in nearby mains powered equipment will then re-radiate this signal, modulated by 50Hz, which is demodulated by the receiver. Microphony is caused by the VFO signal leaking back into the receiver input. This signal causes a DC output to be produced by the mixer. The level of this signal will vary with any slight change in amplitude or phase of the input, causing microphony. The answer is to construct the receiver so that the VFO signal does not leak into the receiver front end or the antenna. In desperate cases of hum, it may help to bypass the rectifiers in the power supply with 10nF disc ceramic capacitors, or to fit an RF filter between the receiver and mains power supply.

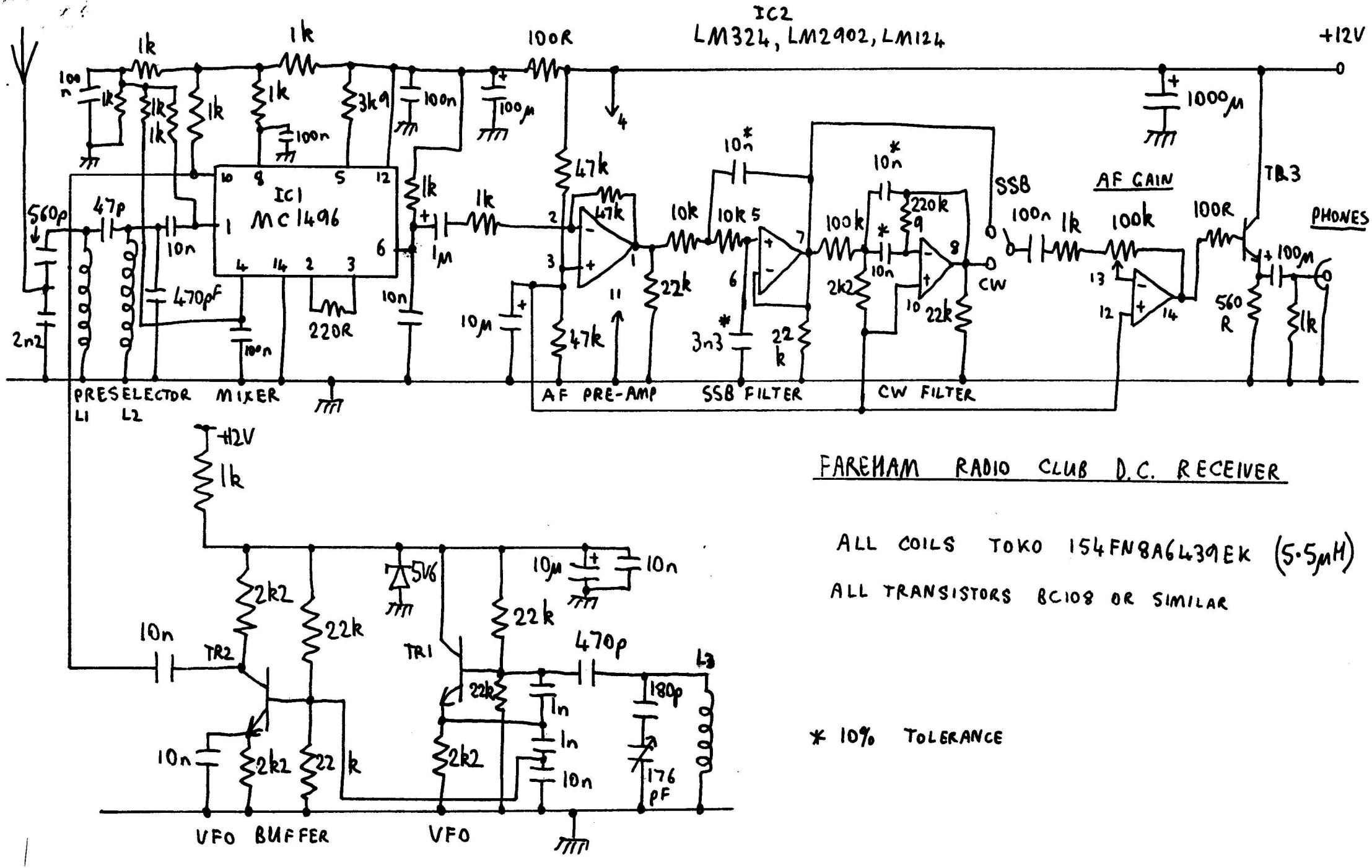




80m D.C. Receiver by G0AMS

artwork by G0LDM

Fareham and District Amateur Radio Club Project



FAREHAM RADIO CLUB D.C. RECEIVER

ALL COILS TOKO 154FN8A6439EK (5.5μH)

ALL TRANSISTORS BC108 OR SIMILAR

* 10% TOLERANCE

G8AMS 30/11/91

Test Voltages.

The following voltages were measured using a digital multimeter having a 10M ohm input impedance and a 12V power supply.

IC1 MC1496

PIN	Voltage
1,4	3.6V
2,3	2.9V
5	1.9V
6	8.7V
7	0
8,10	7.2
9	0
11	0
12	11
13	0
14	0

IC2 LM324

ALL PINS 6V EXCEPT
PIN 4 12V AND PIN 11 0V

TR1 (AF O/P)	C	12V	TR2 (VFO)	C	5.5V
	B	6V		B	2.7V
	E	5.3V		E	2.2V

TR3 (BUFFER)	C	3.4V
	B	2.6V
	E	2.1V

The current consumption of the prototype receiver was 20mA at 9V and 28mA at 12V.

The RF voltage at the VFO buffer transistor collector was 1.3V peak to peak equivalent to 0.45V RMS. (Measured using an oscilloscope and X10 probe.)

Parts List.

Resistors 0.6W Metal film 1%

2	100R
1	560R
1	220R
12	1k
4	2k2
1	3k9
2	10k
7	22k
3	47k
1	100k
1	220k

Capacitors polyester layer 10%

1	3n3
2	10n

Capacitors Electrolytic (radial)

1 1u 100V
2 10u 50V
2 100u 25V
1 1000u 35V

3 coils Toko 154FN8A6439EK 5.5uH

2 14pin DIL sockets

100k LOG potentiometer.

Capacitors plate ceramic

1 47p
1 560p
2 2n2
6 10n
5 100n

Capacitors polystyrene

1 180p
2 470p
2 1n

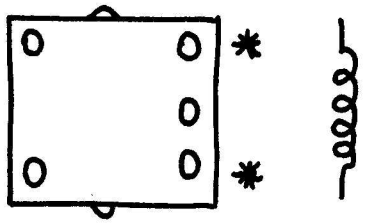
3 BC108
1 MC1496
LM324 or LM124 or LM2902
1 5V6 1.3W zener diode.

6:1 reduction drive

176pF,208pF tuning capacitor

COMPONENT IDENTIFICATION

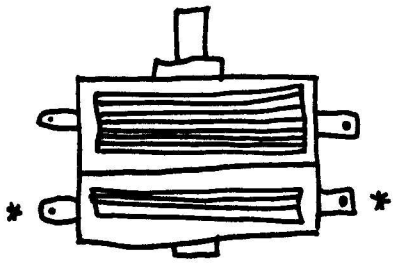
COILS



CONNECT TO *

(VIEW FROM BASE)

TUNING CAPACITOR



CONNECT FRAME TO EARTH

USE EITHER OF TERMINALS MARKED *

DISC CERAMIC CAPACITORS

103 = 10nF
222 = 2n2
104 = 100nF

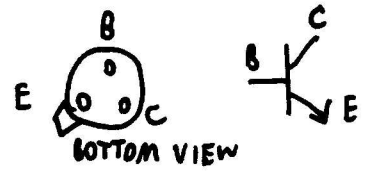
47 = 47pF
n56 = 560pF

POLYESTER CAPACITORS

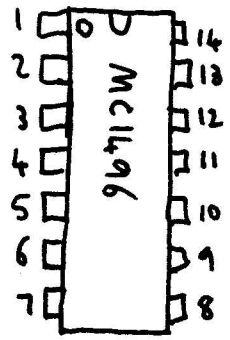
·01K63 = 10nF (CW FILTER)

400
3n3 = 3n3 (SSB FILTER)

TRANSISTORS (BC108)

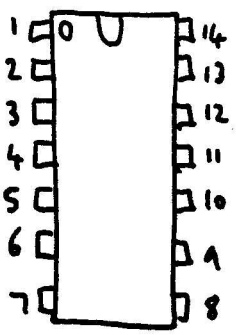


MIXER (MC1496)



VIEW FROM TOP

OP-AMP



LM124
LM224
LM324
LM2902
9A224

Suggested Layout