SSB TRANSCEIVER

Part 2

Although not included on the PCB, there are a couple of additional circuit facilities which have been used with this transceiver, and circuits are shown here for them.

Soldering irons at the ready? Well, let's begin construction, after a guided tour to some optional extras from the Kanga Gang.

They are an S-meter and a reflectometer, which uses the same meter movement as the S-meter.

The S-meter is driven from the source of the final IF amplifier, and uses a very simple circuit which depends on the fact that the source current of this stage will vary as the AGC voltage applied to the second gate varies. A simple bridge circuit enables this variation to be registered on the meter.

The reflectometer circut cuts into operation automatically on the changeover to transmit. Both circuits are shown together in **Fig. 1.**

The frequency display unit be used here can be obtained from Timestep Electronics and wired up for direct frequency readout. However the offset of the dial can be set to only 455kHz, although on LSB the offset should be 453.5 and USB 456.5, so there is a slight frequency readout error, but if the displayed frequency is considered to be the centre of the transmitted frequency it is a simple matter to mentally subtract 1.5 from the dial reading on USB or add 1.5 on LSB.

Assembly

May we take the advantage of this article to reinforce what we have said before about faults on units constructed from articles? Over the last few months we have seen many examples of home brew equipment, and these range from excellent to worse than bad! Examples in the latter category are caused by the constructor not paying attention to detail, mounting components poorly and using incorrect tools. To cover these points in order we start with detail; the worst seen here was a board where some components were soldered at only one end, the other not having seen the iron let alone some solder. Another typical problem in this category is getting diodes, electrolytic capacitors (especially tantalum types) and transistors and ICs in the board the wrong way round.

Mounting components properly is important, and to find out the correct way look at a commercially constructed PCB. Ideally resistors should be mounted half a millimetre above the board, but the insulation on them is adequate for most working voltages for them to be laid flat on the surface. Capacitors again should be just off the surface but diodes can be mounted flat on the board. Transistors should be pushed home to between three and five millimetres from the board as should integrated circuits.

The use of poor or inappropriate tools shows up in the large majority of cases we see. Cutters which are too large are given away by long wires poking out of the solder bead. Ideally the wire should be cut one millimetre above the board prior to soldering, but this is rather fiddly. To save having to fight through a forest of wire ends, we insert one component at the time, solder it, then trim it using flush cutters.

Large puddles of solder indicate too thick a solder and ridged solder beads indicate too small an iron. A little more care taken in constructing the boards will reduce the errors considerably and proportionally increase the chance of the board working first time to switch on!

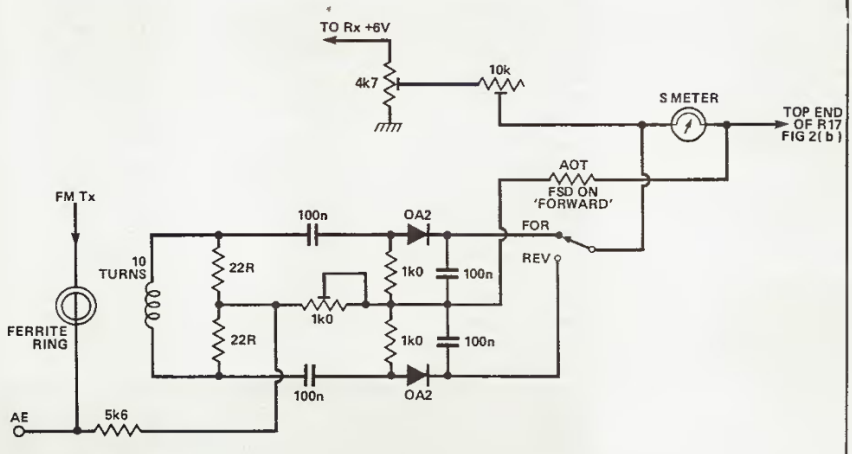

Fig. 10 Suggested S-meter and reflectometer circuit.

Setting up — Receiver

On applying power, aerial signals should be audible from the loudspeaker as the set is tuned over the band. Select a suitable signal in the middle of the band and peak T1 and T2. Now peak T8 and T9 for maximum output. By this time the selected signal should be fairly strong and on tuning T10 it will be noticed that the signal will decrease in amplitude as the core comes to resonance; this is because the AGC voltage increases as this core is resonated and this in turn reduces the gain of the receiver. This core should be tuned for minimum loudspeaker signal.

Now the CIO frequencies have to be set up. To do this find a carrier and it will be noticed that as the signal is tuned to zero beat it will either disappear before you get

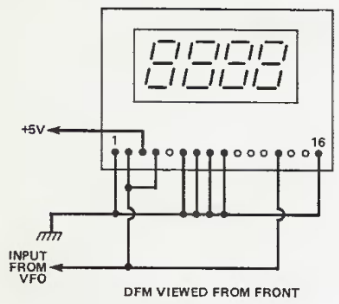

Fig. 11 Connection details of the DFM used in the circuit.

there or the signal will go through zero, rise the other side somewhat and then go. The trimmer of each resonator must be adjusted so that the signal disappears just as the signal arrives at zero beat. Having set one, switch to the other sideband on the mode switch and adjust the other. That completes setting up of the receiver.

Setting up — Transmitter

Before we start it is assumed that the Cirkit PA module has already been set up as instructed in the kit.

Two things must be done prior to tuning the main PCB; firstly RV3 must be rotated fully anticlockwise to unbalance the balanced modulator and secondly 12 volts applied to the filter control pin to switch to the AM filter. This will supply a signal to set up the transmitter bandpass circuits.

With a reflectometer and dummy load connected to the aerial socket apply power and press the PTT. If all is well a signal will be evident on the reflectometer. Tune the dial to mid band and peak T11, T4, T5, T6, and T7 for maximum output.

Tune to 1970khz and adjust T4 and T6 for maximum signal, then tune to 1850 and tune T5 and T7 for maximum. If the dial is now tuned across the band the output level should be fairly constant. Do not worry if this level is only a watt or two as the degree of unbalance of the balanced modulator varies from device to device and is dependant on the value of R61.

Using another receiver very loosely coupled to the transmitter, listen to the 160 metre signal and adjust RV3 for minimum carrier, this should be at about half track setting. If a microphone is now plugged in and spoken into, the output should talk to full output of the PA, 15 to 20 watts. The value of R66 is now increased so that it is only just possible to reach full output when speaking into the microphone with a normal voice and the microphone gain up full.

The set can either be left as an SSB only rig, or if CW is required a keyed 454.5kHz oscillator must be built. This frequency is 1kHz HF of the USB CIO signal which is used to receive and transmit a LSB signal on 160 metres. This signal is fed into the transmit IF strip at the diode gate formed by D4. The small length of track on the top side of the board between pin 4 IC6 and the top end of R47 must be cut. This will have two effects, the supply is removed from TR6 effectively isolating the signal from the sideband generator from reaching the transmitter stages and will also turn off gate D4. The signal from the keyed CW oscillator is fed onto the cathode of D4 and passes through the transmitter stages in the normal way. The drive level is adjusted on first setting up using the preset on the keyed oscillator PCB. **Fig. 15** shows the wiring necessary for CW operation and it will be noted that the supply to the oscillator is keyed by the TX+6V supply and that this is selected by the mode switch in the CW mode. This will disable the oscillator in the sideband modes. The emitter is also keyed by the PTT line. The CW key is plugged into the microphone socket on the front panel or a jack socket could be included on the backdrop.

The reason for this double keying is to ensure that the oscillator is running prior to the amplifier stages coming to life so reducing 'click' on the make of the key. The click on the break of the key relies on the Q of the resonator prolonging the signal after removal of supply and so shaping the break.

Errors

Unfortunately, a number of errors crept into the circuit diagrams published with the first part; most of these are fairly obvious.

On all circuit diagrams, the little boxes marked 'FB' indicate the position of ferrite beads.

On Fig. 2, the output pin of IC1 should be labelled pin 3; the two connections labelled 'RX +6V SUPPLY,' etc., and 'CONTROL RF AMP ON/OFF' are in fact to the same point and they have a pair of decoupling capacitors added, C111, 112. The wiring round RLA6 is obviously wrong, the earth symbol should have been drawn attached to the RH side of the coil box, at the junction with C24. Also, below Q2, the lower junction of C18 and R9 should go to earth, not to the junction of R7, R10 and C19. And the right-hand output to the frequency meter unit should be labelled 'GND', ie ground.

Fig. 3 gained a few duplicate capacitors: the one directly below R25 should be C43, not a second C42, and that below T9 should be C46 not C45. The tops of R24 and R31 should go to the +8V line, not to the +6V (Rx) line. R28 is 330R not 300R and R40 is 10R.

IC6 on Fig. 4 has an additional capacitor, C113 (10n) between pin 5 and earth. On the same diagram, C67 is connected between earth and pin 8 of IC7 (though this will not make any practical difference, it's the way the PCB is designed) and the capacitor labelled C89 above IC7 should be C69.

Like all the other NPN transistors in the project, Q12, 13, 14 should be BC183 or similar, not BC182 as wrongly stated on Fig. 5. Also R51 should be 470K not 470K and the connection to the pole of SW1c should be labelled +8V.

Finally, on Fig. 9 the switch to the middle left is SW2, the main on-off switch, and the socket is SK4. The top pin of this should be connected to +12V from the supply and the bottom to 0V. C10, below Q22, is in fact C110.

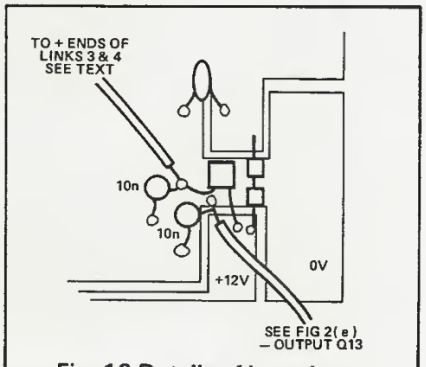

Fig. 12 Details of how the additional circuitry is added to the PA module.

Components List

Coil Winding Data

T4, 5, 6, 7	Primary: 60 turns centre taped; secondary 10 turns; both in enamelled copper wire, 40 SWG, on Toko 10K coil former.
L1	30 turns 36 SWG wire, close wound, on ½in dia former with slug.
L4, 5	25 turns 26 SWG wire on T68.2 former

RESISTORS (all 0.25W 5%)

R1, 16, 76	47R
R2, 4, 14	68R
R3	12R
R5, 22, 29, 62	68k
R6	15k
R7	47k
R8, 37, 50, 53, 58, 60, 72	1k0
R9, 18-20, 25-27, 32-34, 65	100R (11 off)
R10, 56, 61, 69, 73, 74, 77	10k
R11	220R
R12, 48, 51, 59	470K
R13	1k8
R15	470R
R17, 49, 52	56k
R21, 28, 35, 66	330R
R23, 30, 57	1k5
R24, 31, 44	6k8
R36	220k
R38, 70, 71	18k
R39, 41	120k
R40	10R (but see text)
R42	1M0
R43, 67, 68, 75, 78, 79	2k2
R45, 46, 47, 63, 64	100k
R54, 55	22k
RV1, 2	10k panel-mounting pots, logarithmic
RV3	47k miniature horizontal preset pot
RV4	470k miniature horizontal preset pot

CAPACITORS (all ceramic disc unless specified)

C1, 3, 12	270p polystyrene
C2	10p
C4-7, 9, 10, 18, 19, 29-31, 36, 37, 52, 58, 59, 85, 87, 89-94, 105, 106, 108, 113	10n (23 off)
C11	100p
C13, 14, 72, 74, 76, 78	560p polystyrene
C15, 16, 20, 23, 24, 32, 38-40, 42-50, 53, 55-57, 60, 61, 63, 66, 68, 73, 77, 84, 86, 109-112	100n (31 off)
C17, 21, 22, 26, 34	22p
C25, 27, 33, 35, 75, 79	220p polystyrene
C41, 51, 54, 62, 64, 65, 67, 80, 81, 83, 99	1n0 (11 off)
C69, 71	100u 15V electrolytic
C70, 82, 88	2u2 tantalum electrolytic, 25 volts
C95-98	1n5
C100, 101	470n
C102, 103, 107	1u0 25 volt tantalum electrolytic
CV1	5-50p variable capacitor
CV2, 3	9-50p trimmer capacitor, 5mm size

SEMICONDUCTORS

IC1, 7	SL610 or SL1610
IC2	SBL1
IC3, 4	78L05
IC5	78L08
IC7	ULN2283
IC8	SL640 or SL1640
IC9	4069B
Q1	2N3819
Q2-5, 9-15, 17-22	BC183 or similar (17 off)
Q6-8, 16	3N204 or 3SK85, or similar
D1-3	OA2 or similar germanium diode
D4-7	1N4148
D8	1N4001
ZD1	3V3 zener diode

MISCELLANEOUS

T1, 2	KANK 3333 (Toko)
T3	RMC41996 filter matching transformer (Cirkit)
T4-7	See coil winding data
T8-11	YHCS11100AC2 (Bonex)
L1, 4, 5	see coil winding data
L2	1 mH RF choke
L3	ferrite bead on lead
FL1	MF31C SSB filter (IQD Ltd)
FL2	CFW455H AM filter (IQD Ltd)
XTAL1	455B ceramic filter (Bonex)
XTAL2	455H ceramic filter (Bonex)
RLA1	2 pole 2 way relay, 6V coil (MS Components)
RLA2-6	1 pole 2 way relay, 6V coil (MS Components)
SW1	4 pole 3 way rotary switch
SW2	on-off switch
SK1	Phones jack
SK2	CW jack
SK3	Microphone/PTT socket
SK4	Power supply connector
SK5	Antenna connector

PCB, ferrite beads, Cirkit PA module (see text), heatsink, connectors, wire, case, loudspeaker.