More modifications to the KW2000

by M. A. HALL, G3USC*

SOME years ago, an article in *Radio Communication* by G3BA outlined some simple modifications to the KW2000 transceiver in order to increase the bass response of the received and transmitted signal. The author fully agrees with G3BA that these modifications are well worth while and suggests additional ones, assuming that one does not mind drilling two extra holes in the front panel.

The modifications, in increasing order of complexity, are:

(1) Incorporation of a variable rf drive control.
(2) Transistorizing the vfo.
(3) Improving the dynamic balance of the balanced modulator. (This also necessitates re-designed audio input stages and minor alterations to the vox circuitry.)
(4) Inclusion of a simple sideband clipper and filter.

RF drive control

The author never did like the idea of varying the rf drive to the pa by simply adjusting the microphone control. Although the cathode of the driver (6CH6) was decoupled by a very small capacitor (10pF), which gave less negative feedback and therefore greater gain at high frequencies—the author found that in this transceiver the microphone gain control had to be advanced considerably for 15 and 10m operation. This could have meant that the balanced modulator or transmitter mixing stages were being over-driven on the higher frequency bands—with consequent distortion; and conversely, under-driven on the lower frequency bands—so giving a higher relative carrier level.

Several attempts to vary the gain of V7 by variable current feedback resulted in instability of this stage, even though this is the method used in several well-known designs. A fet with variable gate bias was also tried in the cathode circuit of V7 in an attempt to keep connecting leads carrying rf really short. Although this method worked well on the lower frequencies, the 6CH6 was still barely stable on 10m. The final arrangement adopted, which was completely successful, is shown in Fig 1. The 6CH6 is changed for an EF183 and variable gain is provided by varying its cathode bias and therefore its gm. As long as the leads of the cathode decoupling capacitor are kept short, no instability should occur Although not so much drive power is available as before, there is still plenty to push the 6146 into grid current when using the method of pa neutralization recommended by KW.

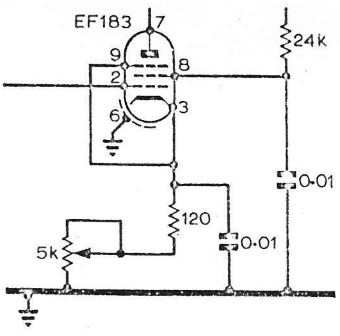


Fig 1. RF drive control

* "Morwenna", Bridgerule, nr Holsworthy, Devon.

The vfo

For static operation this modification is probably unnecessary. It does, however, remove most of the warm-up drift. When used mobile under conditions where the battery voltage can vary by as much as 25 per cent, the situation is very different. Variations of V11 heater voltage will affect the vfo frequency, as will minute variations of the stabilized +150V rail. This rail feeds the irt diode which is connected directly across the vfo tuned circuit.

When travelling under stop-start conditions in London's traffic, it was found to be very difficult indeed to resolve a station without continued "tweeking". Operators trying to copy the transmitted signal also had the same trouble. The complete cure was to transistorize the vfo and to feed both this and the irt diode from a well-stabilized low-voltage supply. The new circuit, which was borrowed from the *ARRL Handbook* is given in Fig 2.

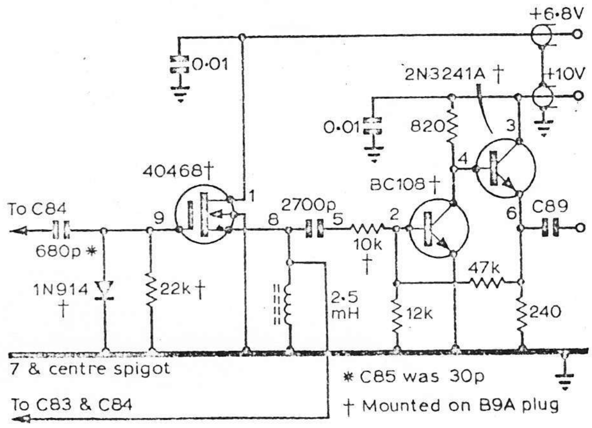


Fig 2. VFO

Removal of the vfo box is straightforward. The author took the opportunity of replacing the slow-motion drive at the same time—the original had become rather notchy. After unsoldering all connections, the front panel must be partly detached from the chassis by removing the securing nuts from controls which go through both the chassis and front panel. The three variable capacitor drive spindles must also be removed and then the vfo box can be withdrawn complete with slow-motion drive. All components concerned with dc feeds to V11 are removed from the box and the circuit re-wired accordingly. C85 is removed and replaced by a 680pF

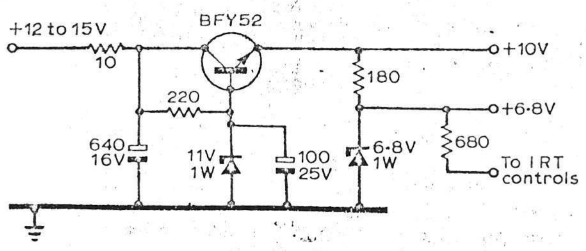


Fig 3. Low voltage regulator

component in order to provide a time constant suitable for the correct operation of the 1N914. R54 within the box and R62 without, both 47kΩ, are shorted and the irt controls both fed directly from the +6·8V rail via a 680Ω resistor. Components marked with a dagger in Fig 2 are conveniently mounted on a B9A plug; the pin connections used by the author are indicated. The low voltage regulator shown in Fig 3 is mounted on a small tag-strip bolted to the underside of the vfo box; it supplies both the vfo and the sideband low-pass filter. Re-alignment will now be necessary owing to a slight change in the irt diode voltage.

Balanced modulator and speech amplifier

When two-tone testing the transmitter in its original form, it was noticed that there was considerable carrier leak-through which was preventing a clear, stationary crt display from being obtained. On checking the static balance of the balanced modulator, the carrier rejection was found to be satisfactory. What seemed to be the trouble was that the diodes D1 and D2 were not properly matched over their whole characteristic, leading to a state of imbalance when audio was applied. The modification to be described, which may be thought rather academic and not essential to intelligible communication, gives a really clean display. The problems and expense of testing dozens of diodes in order to find two that were well enough matched were dispensed with by using a proven textbook design, namely—a low μ twin triode.

In Fig 4 the ECC81 is replaced by an ECC82 or better still by a 6067 or M8136 which are the special quality versions in which the two halves are better matched. Push-pull audio drive is supplied by V1(b) which is now a phase-splitter, the series resistor (11kΩ) is included to present approximately the same impedance to each grid of the balanced modulator. Provided that close tolerance components are used in the balanced modulator and phase-splitter and attention is given to wiring symmetry, no problems should arise.

Extra gain now required from the speech amplifier is provided by V1(a) and a small transistor amplifier mounted beside the microphone input socket; the circuit is shown in Fig 5. This circuit requires a supply of about 10V which is conveniently provided by the cathode of the audio output valve V17 via decoupling components. The microphone input socket is replaced by a five-pin type which is arranged to connect power to the transistor amplifier when the microphone is plugged in. A high level input is also included to enable auxiliary audio equipment to be connected without attenuator pads.

The level of tone fed into the balanced modulator when the transceiver is switched to TUNE is set by R8, now 560kΩ, to represent the normal peak audio level. This level is arranged to be 6dB below the overload point of the balanced modulator and can therefore act as a reference level to facilitate calibration of the microphone gain control. The procedure for setting up would simply be a matter of tuning up the transmitter into a dummy load in the normal way and finally noting the deflection of the output on a crt. The microphone gain control should then be set so that speech peaks cause the same deflection.

Having completed the balanced modulator changes, it was found that correct operation of the vox circuitry necessitated using the vox gain control RV111 nearly flat out. Unfortunately, doing this meant that V21 was being over-driven and severely overloading V1(a). In the original circuit, V1(b) acts as a buffer amplifier and isolates the vox amplifier from V1(a). The following steps show how the vox amplifier gain may be increased and the loading effects of V21 reduced:

(1) Remove link between the slider of RV111 and V21 pin 2 and insert a 1MΩ resistor.
(2) Connect a 1kΩ resistor across R108 (2·7kΩ).
(3) Change R105 (3·3MΩ) for 1MΩ.
(4) Connect a 1N914 diode, anode to earth, in place of R103 (100kΩ).

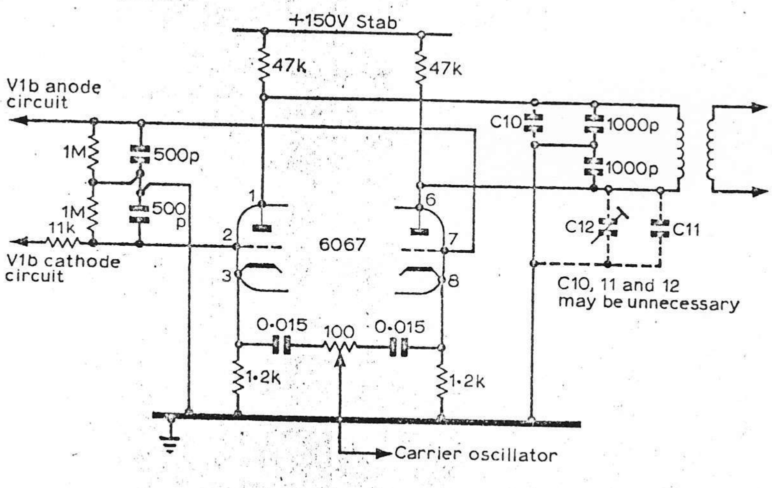


Fig 4. Balanced modulator

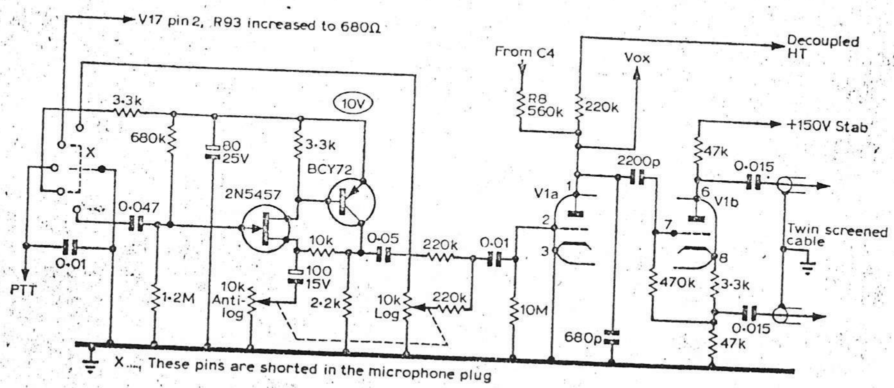


Fig 5. Speech amplifier

Sideband clipper and filter

This unit provides up to 15dB of clipping and it will be noted that only low-pass filtering has been included. On-air reports indicate an increase in signal strength of about 1½ S-points with little or no in-band or out-of-band intermodulation products. The author fully expected to have to use yet another bandpass sideband filter, but luckily it turned out that results did not justify the extra expense.

The circuitry consists of an amplifier (Fig 6) comprising two transistors connected as a single high input impedance device. At low gain settings this amplifier does in fact introduce a slight loss since the normal output from the mechanical filter is in excess of the clipping voltage of the 1N914 diodes. This loss plus the slight loss of the filter is made good by replacing the first and second transmitter mixers, ECC81s, by ECC85s. No other change will be found to be necessary except, of course, to the heater wiring of these valves. Pin 9 of an ECC85 is an inter-section screen and must be earthed.

The filter (Fig 7) is a conventional active low-pass type and has a very low order of ripple; it has a cut-off frequency of 460kHz. It would have been possible to use a four-element filter which gave the same attentuation to harmonics. However, since the diodes give a fairly hard squaring action when driven to 15dB of clipping, it was thought that a five-element type would create smaller overshoots and thus lower the distortion and lessen the risk of overloading the pa. At small amounts of clipping the action is fairly soft and, indeed,

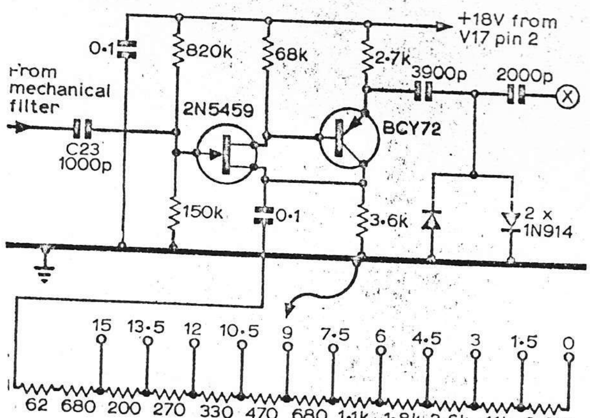


Fig 6. Sideband clipper

with none at all a small amount of compression takes place due to the gradual slope of the diodes. Power for the amplifier is again derived from the cathode of the ECL82, and for the filter from the vfo supply regulator. It is important that the leads to the front panel switch from the amplifier have a low capacity to earth, otherwise an increase in gain will result. Ordinary coaxial cable was found to be quite unsuitable, but the type used for car radio aerials or even just hook-up wire is satisfactory. The filter components should be of 5 per cent tolerance or better if it is to have the correct response.

Conclusions

It will be apparent that the modifications described are fairly involved and there will be those who will not wish to delve too deeply into their transceiver for fear of either causing damage or of reducing its second-hand value. The author would be the first to accept that the latter reason for not tampering is very valid. When buying a piece of second-hand equipment and one is told that such and such has been modified, there is a great possibility that something else has been breathed on also, and perhaps the vendor did not really know what he was doing anyway! It is, therefore, important that these suggestions be followed only by those who have had practical experience of rf circuitry and ssb equipment. The KW2000 is an excellent little transceiver and the author would hate to feel that he had been the cause of unnecessary meddling by inexperienced soldering irons.

Assembly of the sideband clipper and filter presents some difficulty as there is not much spare space. The author built his bird's-nest-fashion on two pieces of 16g wire soldered between the centre spigots of V3 and V4. No doubt this unit could be constructed as an outboard device but it would have to be driven from a source or compound emitter follower within the transceiver.

A few words of caution might be in order. The main power unit delivers a positive earthed dc supply for relay operation. It is, therefore, necessary to reverse MRs 13 and 14 and Cs 7 and 8 if a negative earthed supply is to be obtained. The author's car has a negative earth system, but if a positive earthed supply has to be used, reversal of electrolytics and the use of complementary transistors will be necessary in the relevant circuits. The low-pass filter should be made as compact as possible to prevent stray capacitance from affecting its characteristics. In certain installations it may be necessary to include rf filtering at the speech amplifier

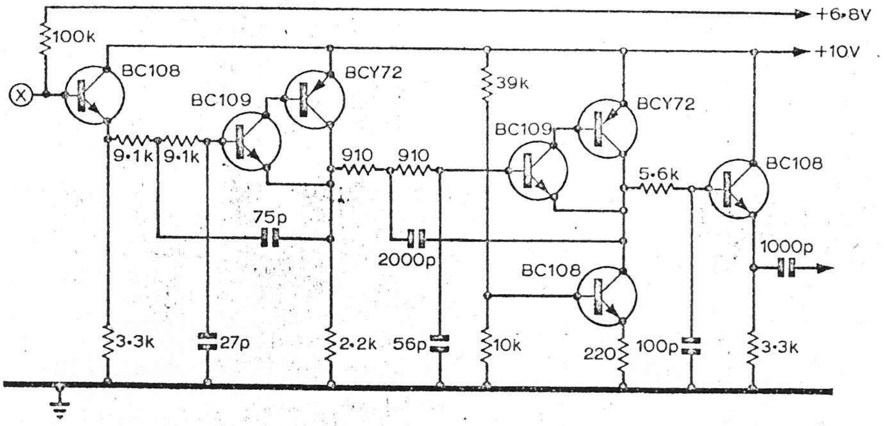


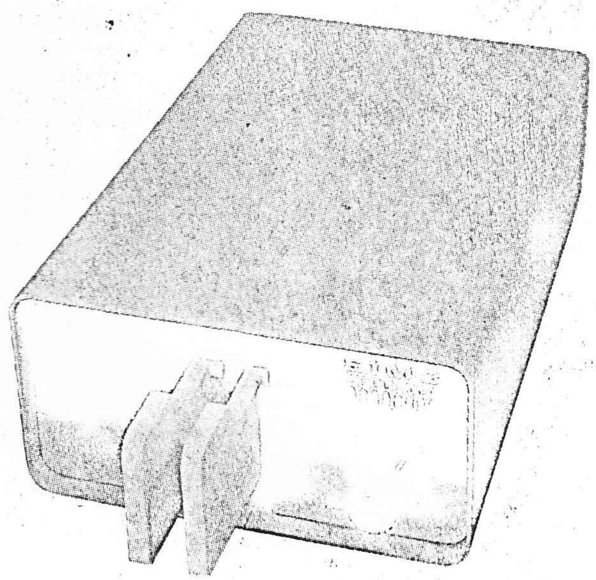
Fig 7. Sideband filter

input; this can take the usual form of series R and parallel C as in the original circuit or simply a small capacitor from gate to source of the fet. Attention must be paid to the balance of the valve heater voltages as they are wired in a series-parallel arrangement. The now reduced load on the +150V rail means that R96 could be increased in value to reduce the overall load; the author uses 3kΩ. It will be seen that some coupling and decoupling capacitors have old type values and some have new, the exact value is not of course necessary, the equivalents will do. The author is unaware of the exact differences between the different models of the KW2000, except that the A and B have greater output power, and it is probable that these modifications could apply to all of them.

EQUIPMENT REVIEW

Samson ETM-3 squeeze keyer

by PAT HAWKER, G3VA



WHEN an opportunity arose to review the ETM-3 squeeze keyer (made in West Germany and available in the UK from Spacemark Ltd, 14 Piccadilly, Manchester, price £24.75), it was recognized that any judgement on keys and keyers must inevitably be subjective rather than objective. A key that suits one operator may be virtually useless to another. So rather than attempt to measure or test its electrical or mechanical performance (and the ETM-3 performs in full accord with the manufacturer's claims) some account would be given of how one individual—the reviewer—reacted to using this keyer. This was to prove no easy task, and a review that was intended to be completed in a few weeks has stretched over many months.

What the reviewer hoped to do was to answer two questions: (1) Is twin-paddle, iambic-mode, squeeze keying an advance on conventional single paddle keys? (2) Does the ETM-3 represent good value for money? He must confess, at this point, that no entirely satisfactory answers have proved possible. Even now, after many, many hours of practice and some 50 on-air contacts with the keyer, he remains a little uncertain. This is no reflection on the keyer itself, which has shown all the virtues that one can expect from a design created with care and expertise. Rather it is simply that he found that, as far as he is concerned, to operate the keyer in the full "squeeze mode" represents a challenge not to be dismissed lightly, certainly not by those of us who, as the years roll by, have retained perhaps more enthusiasm than mental and manual dexterity.

Until the ETM-3 arrived (very well packed) the reviewer had read about but never tried squeeze keying; for 25 years the key at G3VA has been a Junker straight key, apart from