The Tucker Tin Mark 2*

An SSB Transmitter of simple design — Part 3

Here is the third and final article describing the author's easily-built solid state SSB transmitter. He gives full details of the setting up and alignment procedures, and also details of the modification required to adapt the rig for AM operation.

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Getting the rig to perform involves two main steps which I am calling "setting up" and "alignment". The "setting up" phase involves checking the rig thoroughly for general operation. When this is concluded the "alignment" stage involves adjusting the various preset controls for optimum suppression of the unwanted sideband.

Before either step can be undertaken, it is important to discuss the test equipment that you should have available. You need several essential items. These are all useful in the shack for other tasks so are a separate wise investment. You will have to construct three simple items of test equipment — a wavemeter, an audio oscillator and a dummy load. A multimeter and a receiver are two other items that are necessary. The only other item you could find useful is an oscilloscope. This is not an essential item but there is no doubt that it is of great assistance. Two alignment methods will be described later — one that uses the oscilloscope and one that uses a receiver.

A simple absorption wavemeter is shown in figures 15 and 16. This should cover 3.5 to 3.9 MHz for checking on the mixer and PA stages, 5 to 5.5 MHz for checking the VFO, and 9 MHz for checking the crystal oscillator and balanced modulator sections. By making the wavemeter cover 3.5 to 9.0 MHz in one sweep of its tuning capacitor all these tasks can be easily done. This is another task where a printed-circuit board can be used to advantage to provide the mounting baseboard and also the interconnecting wiring as well as a panel.

The photograph shows how my unit evolved. Any meter scale can be used. There is nothing critical about this construction. Calibration can be arranged using a signal generator, grid-dip oscillator, or some similar signal source that covers 3.5 to 9 MHz. Even the local oscillator of an all-wave receiver could be used to provide the calibration signal, provided you make the necessary correction (knowing its intermediate frequency) to relate the signal frequency indicated on the receiver dial to its local oscillator frequency.

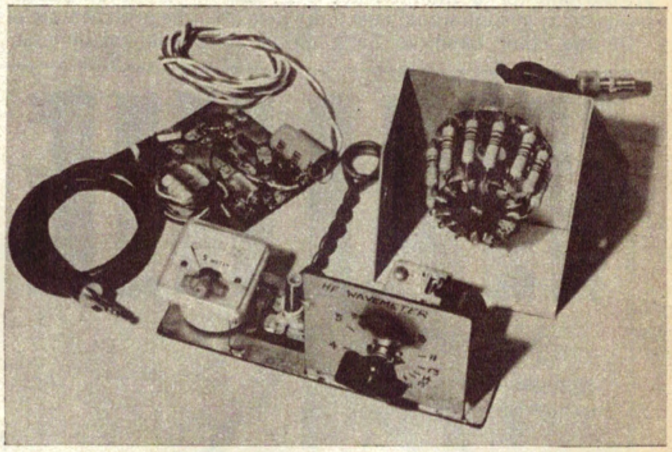
Other types of meter, diode, coil and construction could be used.

Figures 17 and 18 show an audio oscillator circuit using a field-effect transistor. This circuit provides a 1000 Hz sinusoidal signal which is suitable for use as a tone for alignment of phasing-type SSB rigs. The requirement is for a 1000 Hz tone with very little harmonic content. I have been unable to achieve adequate signal purity from a simple R-C type transistor oscillator, so have resorted to using a tuned circuit.

The output signal level must be comparable to the output from a microphone. Too much output is undesirable otherwise overloading (hence distortion) in the audio preamplifer (i.e., before the gain control) can occur. The voltage divider (gate-leak resistor) feeding the oscillator output can be modified (by changing the value of the lower resistor) to alter the output level if required.

This is another unit that is useful to have in the shack for other tasks.

A dummy load is essential when carrying out tests and adjustments to any transmitter. A very simple load for this rig can be made by connecting seven one-watt 470 ohm CARBON resistors in parallel. This gives an effective load of about 67 ohms. These can be mounted on a coaxial lead with a plug that fits into the antenna socket on the rig. Any resulting load between 50 and 80 ohms and rated at 5 watts or more is satisfactory. Avoid wire-wound resistors (which may be inductive). I used fourteen 1000 ohm 1 watt carbon resistors in parallel and connected to a coaxial socket. This load was constructed many years ago and has been used with many transmitters.



The test tone oscillator, wavemeter and dummy load built up by the author for testing the original Tucker Tin rig.

The first stage in setting up the rig is the debugging that is necessary before alignment can proceed. The aim is to get each stage operating successfully with a signal path from the microphone right through to the antenna. When all circuits are functioning satisfactorily, then the adjustment of the circuits that establish the sideband suppression can be attempted.

When all wiring up has been completed, and your rig looks tidier than the prototype and before switching on, please do one thing — sit down, take your time, and go over the complete circuit and rig, wire by wire, component by component. You will be surprised what you may find. In particular, look at the polarity of all electrolytic capacitors, the types and positioning of all transistors, and the connections to all transistors. Time spent doing this is time well spent.

Test conditions at points throughout the prototype rig are shown in Table 2, to assist with any possible troubleshooting. All measurements are made with a 1 kHz tone fed into the microphone socket, and with a 75 ohm RF wattmeter acting as a dummy load, Audio gain fully "on", and with rig tuned up on 3.7 MHz.

All voltmeter readings are made with a 20,000 ohm per volt multimeter.

Oscilloscope readings are peak-to-peak. These readings can be changed to a peak reading by dividing the values quoted by 2, or converted to RMS by dividing the value quoted by 2 and then multiplying by 0.707 (this latter should be the value read from a peak-sensing RMS — indicating VTVM with RF probe).

Oscilloscope measurements are made

*This article is reprinted from the August 1971 issue of "Break-In", the official journal of the New Zealand Association of Radio Transmitters Inc., by arrangement.

with a 10:1 high-impedance input probe to minimise loading and detuning. The oscilloscope was AC coupled to remove the DC component.

Now comes the switch-on time. It is advisable to disable the PA stage while the transistor circuitry is set up. This is most easily done by removing the 12BY7 valve from its socket. To remove the possible hazard from the +300 volt HT line, the centre-tap of the power transformer can now be temporarily lifted from earth. The primary 230V mains wiring (which should have been appropriately protected during construction) will now be the only dangerous potential present (I am assuming it to be unlikely that you could become connected across the extreme ends of the HT secondary winding). The first thing to check is that the +12 volt line is active. Next check the voltage drop across R35 in the power supply and compare the result with Table 2. S2 should be in the SSB position for this.

I suggest that you start with the 9 MHz crystal oscillator. Hold the wavemeter near L1, and set the wavemeter to 9 MHz. Run the slug of L1 throughout its range and a wavemeter deflection should be detected. The control range of the slug should be such that the oscillator drops out of oscillation with the slug fully in, and with the slug fully out. Set the slug to about half-way between these positions and leave it set for the moment.

Now check the VFO. With the VFO capacitor fully meshed, set the wavemeter to 5.0 MHz. Turn the VFO capacitor to minimum capacity and check with the wavemeter that the VFO frequency has moved to 5.5 MHz or higher. A receiver with a calibrated dial is useful here for checking the exact VFO tuning range. L6 and C26 should be adjusted and changed so that 5.0 to 5.5 MHz is covered with some leeway available at each end (say 50 kHz beyond each end).

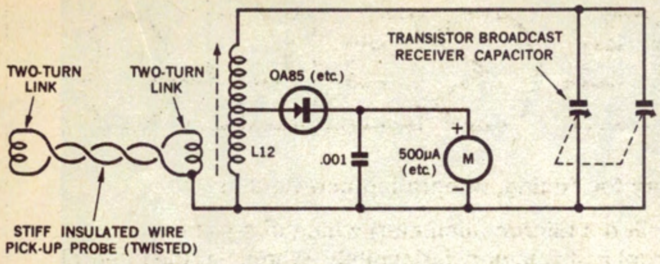
Both oscillators should now be working satisfactorily. So far so good!

Now check the path from the 9 MHz crystal oscillator through the balanced modulators to the mixer. Turn both carrier balance potentiometers to an extreme end. Hold the wavemeter alongside L4. Set wavemeter reading to 9.0 MHz. Now set the two carrier balance pots to a midway position and try adjusting them for a minimum wavemeter deflection. If a minimum cannot be located, adjust the oscillator slug L1. When a minimum has been located, unbalance one pot a little and repeak L4 for a maximum on the wavemeter. The aim is to locate a balance point (i.e., a dip point) on both balance pots which is somewhere near the centre of their tracks, and at the same time peak L4 for maximum deflection when slight unbalance of one of the pots is made. It sounds confusing, but it is more difficult to explain than to do.

Now move to L8. Unbalance one of the carrier balance pots. Set the wavemeter to 9 MHz and hold it alongside L8. Adjust L8 for a maximum wavemeter reading.

Now move to L7. Set the wavemeter to somewhere between 3.5 and 4.0 MHz and at the same time run the slug of L7 throughout its range. Peak L7 and the wavemeter on the signal when you have located it.

It is now possible to give a final adjusting peak to L4 and L8 with the wavemeter held



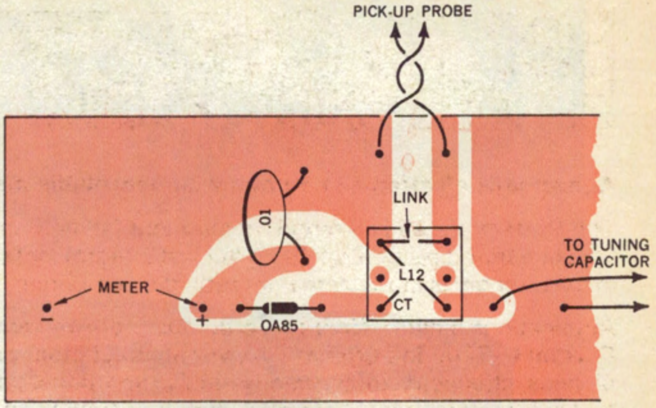


Figure 15 (above) and figure 16 (right): The circuit and wiring diagram of the small wavemeter used for alignment of the rig. Although shown here on a printed wiring board, this is not necessary and we do not plan to make the pattern available.

in this position alongside L7.

Check that the carrier balance pots can null the signal from L7 by returning both pots to their balance point (i.e., look for null indication on the wavemeter — which is still held alongside L7 and tuned to somewhere between 3.5 and 4.0 MHz). If you cannot get a null indication with this check, then L7 may be tuned incorrectly to the direct VFO signal. If the wavemeter is correctly calibrated then of course this should be unlikely. The signal at L7 should vary in frequency as the VFO tuning capacitor varied, and should vary in amplitude as each carrier balance pot is run throughout its range, and should be able to be nulled out with both carrier balance pots positioned somewhere near the centre of their tracks.

Let us ignore the audio board for the moment and try the PA stage. Plug in the 12BY7. Switch off the mains supply and reconnect the transformer centre-tap. Connect the dummy load to the antenna socket. Switch on, and check the +300 volt supply (i.e., the voltage across C48). Unbalance one of the carrier balance pots. Run the PA tuning capacitor through its range. At some point the front-panel meter should deflect. The aim now is to adjust L7, C44 (PA tuning capacitor) and S3 (antenna loading) for a maximum reading on the front-panel meter. If the meter tries to read backwards off the scale, then reverse D6.

Once a deflection on the panel meter is obtained, then L4, L8, L7, C44 and S3 can all be adjusted for maximum meter deflection. Vary the VFO frequency and retune L7 and C44. Confirm that C44 is tuned to the 80 metre (3.5 to 4.0 MHz) signal and not to the direct VFO signal, by balancing the carrier balance pots once more. The panel meter indication should drop to a very small indication indeed.

It is unlikely that the meter can be made to indicate zero at this test. This is because some VFO signal (5.0 to 5.5 MHz) will probably be sneaking through the PA to the antenna. L11 is a VFO trap and this should now be adjusted so that the meter reading returns to zero with a sharp "notch" characteristic with L11 slug adjustment. With L11 correctly adjusted, it should be possible to balance the carrier balance pots for zero output on the panel meter.

Now switch S2 to "tune" position and the panel meter should indicate a large reading. In the "net" position is should only indicate a very small deflection.

S2 should now be used to provide the "tune" signal when required. The carrier balance pots can now be kept balanced — these are both set in the "SSB" position of S2 for a null on the panel meter.

The neutralising capacitor (Cn) consists of three turns of plastic-covered hook-up wire wrapped tightly around the anode lead to the valve. The stage should be quite stable with this arrangement. If it is noticed that the meter shows an indication when an output signal is not expected, then the wavemeter should be used to check the frequency of any undesired oscillation. The neutralising could be adjusted by either changing the value of Cn or the value of C36, until the stage is perfectly stable, irrespective of the setting of any of the controls. The voltage reading at the 12BY7 cathode test point (on a 0-10 voltmeter) can be read directly as 0-100 mA anode current.

So much for the RF circuitry. The audio board can now be investigated. It is assumed that you will already have checked the audio oscillator out on an amplifier of some sort to satisfy yourself that it is operating.

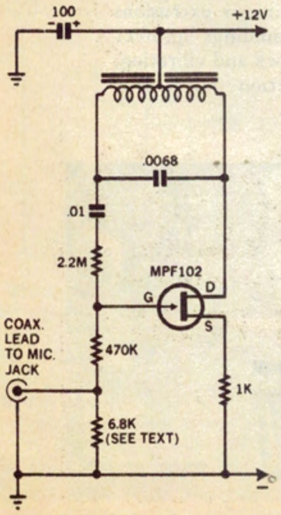
Plug the audio oscillator into the microphone socket and connect its DC supply to an external DC source or to the +12 volt line in the transmitter itself. Turn the audio gain control to its minimum output end, switch the function switch S2 to the "SSB" position and check the carrier balance pots, adjusting if necessary for zero carrier signal output as indicated on the panel meter. Now advance the audio gain control. The meter should commence to read and smoothly increase until the audio gain pot reaches its maximum position. (The reading should be somewhere between half and three-quarters of the meter reading obtained when S2 is in the "Tune" position).

If the meter reading "flattens off" (i.e., does not continue to increase) before the audio gain control reaches its maximum, then one of the stages is being overdriven and a closer examination will have to be made. This may be happening in an RF stage or an audio stage. If the wavemeter (set to 9 MHz) is held near L8 and the test repeated, it can be determined if the "flattening" is occurring in the signal path before L8 or after it. Operation in this flattening condition is not proper and some reason for it occurring will have to be found. The signal level from the audio oscillator may be too great and could be the reason.

The second and third tests on the audio stage are very similar and I have dubbed them the "break lead E" test, and the "break lead F" test, respectively. These are the two audio leads to each balanced modulator. The initial condition for each test is to feed the tone into the mic. socket (as before) and advance the gain control to maximum as before. Note the meter reading. If lead E is broken (unsolder it at the sideband switch) then the meter reading should drop to approx. 0.63 of its previous reading. Replace it, and do the same again with lead F. Similar reading changes should be obtained with each test. The settings of the preset pots (P2 and P3) on the audio board can affect all readings so do not be too fussy with these measurements at this stage.

If these four tests are satisfactory, i.e.,

1. The steady increase in meter reading as the audio gain control setting increases,
2. The relative meter levels with the gain



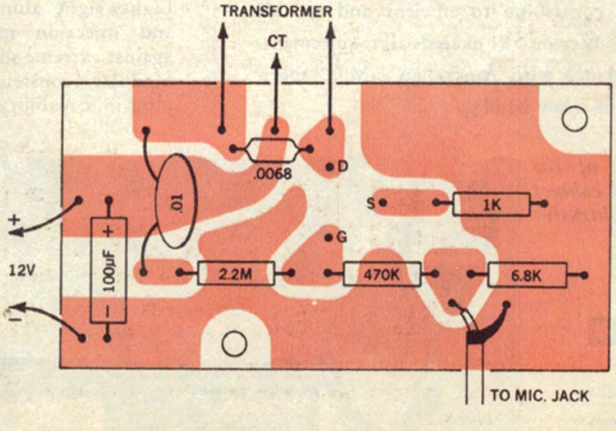


Figure 17 (left) and figure 18 (above): The circuit and wiring diagram for the test tone oscillator. Again the wiring board is not really necessary.

control at maximum and that with S2 in the "tune" mode,
3. The "break lead E" test, and finally,
4. The "break lead F" test,

then the rig can be considered suitable for alignment and regarded as relatively bug-free!

A microphone can now be plugged into the microphone socket. The meter needle should flicker to a large reading when a short whistle is delivered into the microphone (with rig on "SSB" and with the gain control advanced).

The basic setting-up arrangement for alignment of the rig requires the audio oscillator to be fed into the microphone socket, the rig on "SSB" and the dummy load connected to the transmitter output socket. If the oscilloscope is to be used then the scope is connected across the load. Sufficient Y-amplifier gain should be used to produce a display that two-thirds fills the screen. The horizontal time-base should be set to about 1 mS per cm or similar so that 1000 Hz variations in carrier amplitude will be visible. It may be found advisable to use the external trigger or sync facility and lock the timebase direct from the audio oscillator.

If the receiver method is to be used, then the above basic setting-up is the same except that an AM-type receiver is used to listen to the transmitted signal. It is important to realise that no overloading of the RF stages of the receiver can to tolerated. This can be ensured by turning the receive audio gain up to maximum and turning the receiver RF gain down. It may even be necessary to put a direct short between the receiver aerial and earth to prevent any possibility of overload.

Irrespective of whether the oscilloscope or receiver method is to be followed, the controls to be adjusted are: P2, P3, C20, L3, and L1. P2 and P3 are the prime controls, but some changes in C20 and L1 may be found desirable. L3 can be inserted and tried as well. The carrier balance pots P4 and P5 will also probably require some adjustment from time to time. R13 may need to be changed too.

Now for the philosophy of the alignment! The oscilloscope and receiver are really only being used as indicators, so the alignment method is really the same in each case. It is just the interpretation of the indicated results on the scope or receiver that is different.

If a pure sinusoidal tone is fed into the microphone socket, then the ideal SSB output signal should consist of a single "carrier" (on either the USB or LSB position, depending upon the position of S1). The adjustments made to P2, P3 (etc) are made until a pure output is obtained. This means that the carrier is suppressed and the unwanted sideband also suppressed. On the oscilloscope we should see a stripe of constant-height. The controls should be adjusted until all visible "ripple" is eliminated. On the receiver we should hear the same signal we would hear from a cw station with his key held down — a steady carrier.

It is perhaps easiest to use the receiver with its BFO "off". This enables the audio beat-notes between the wanted sideband and the residual carrier (1 kHz pitch) and the wanted sideband and the unwanted sideband (2 kHz pitch) to be heard. Both

TABLE 1 — COIL DATA

Coils L1, L4, L6, L7, L8, L11 and L12 are wound on ¼ inch slug-tuned formers.

L1	— 20 turns 28 SWG, enamelled, close-wound.
L2	— 6 turns 28 SWG, enamelled, close wound over "cold" end of L1.
L3	— About 6 turns of 28 SWG, wound direct on to a ¼ inch slug. This coil may not be necessary (see text).
L4	— 6 turns 28 SWG, bifilar wound. 3 turns in each half-winding.
L5	— Two turns hook-up wire wound over centre of L4. This same wire forms the twisted link to the mixer board.
L6	— 42 turns 28 SWG, enamelled, close-wound.
L7	— 40 turns 28 SWG, enamelled, close-wound.
L8	— 20 turns 28 SWG, enamelled, close-wound.
L9	— 3 turns 28 SWG, enamelled, wound over "cold" end of L8.
L10	— 40 turns 28 SWG, 2 inches diameter, spaced over 3¼ inches. Tapped at 1, 2, 4, 6, 8, 10 turns.
L11	— 35 turns 28 SWG, enamelled, close-wound.
L12	— 40 turns No. 32 SWG, enamelled, close-wound, tapped at 20 turns.

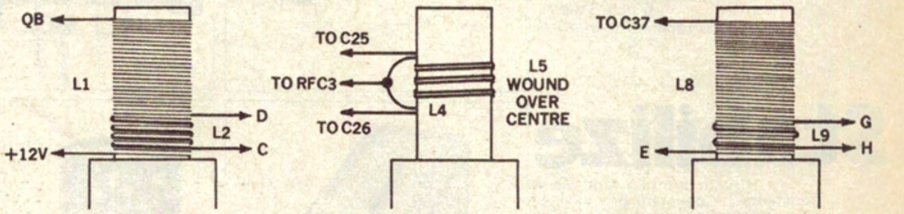


Figure 19: Winding details for the various coils used in the Tucker Tin rig. Note that L4 is formed from three bifilar turns.

these pitch notes can be readily identified by ear and the appropriate controls (etc.) adjusted until there is no sign of any beat note at all.

Time spent on these tests and adjustments is being wasted if there is any overloading occurring at any point in the circuit. So keep the audio gain down while making these adjustments. Several good general-type articles on the alignment of SSB transmitters have appeared in the amateur literature and I recommend that you study these in order to appreciate the various effects that you may notice during alignment — too time-consuming to be dealt with here.

This alignment phase should not take long. It is unfortunate that it is a process that is difficult to describe, and yet is fairly easy to accomplish once you have tried it or seen it carried out. It is rather like learning to ride a bicycle from a text-book!

Once the rig is aligned and ready for on-the-air tests, the send-receive switch S2C can be connected into the receiver so that operation of S2 turns the receiver off and the transmitter on, and vice versa, as required. S2C could be used to operate an external relay. This relay could perform the aerial changeover function (i.e., switch the antenna between transmitter and receiver) as well as disable the receiver when on transmit. I consider it simpler to use two antennas — the main one for the transmitter, and a random wire for the receiver. This eliminates the antenna changeover problem. S2C can then be used to switch the receiver on and off as required, giving a single-control station.

Your own ingenuity will soon produce an effective solution to the send-receive problem with your particular receiver.

Caution is necessary with on-air tests. There are several traps that you could come up against and should be aware of.

The first concerns operators. It is absolutely pointless in getting checks from an inexperienced sideband station. Many

TABLE 2: DC & SIGNAL VOLTAGES

Point	Voltmeter	Oscilloscope PK to PK
1. POWER SUPPLY		
(a) Junction R33 and C48 (nominal + 300 v line) to earth	+295 v. D.C.	—
(b) Junction R35 and C51 (nominal + 12 volt line) to earth	+13 v. D.C.	—
(c) Voltage drop across R35 (from which the total transistor section load current can be calculated)	2.3 v. D.C.	—
(d) Heater voltage	6.6 v. A.C.	—
2. AUDIO BOARD		
(a) Microphone socket	—	40 mV
(b) Gate Q1	—	40 mV
(c) Source Q1	2.2 v	Approx. 40 mV
(d) Drain Q1	9.7 v	400 mV
(e) Junction R5 and R6	0.35 v	Approx. 200 mV
(f) Emitter Q2	11 v	300 mV
(g) Collector Q2	7.4 v	2.6 volts
(h) Junction R9 and C9 to earth	12.3 v	—
(j) Top of Mic. gain pot	—	2.1 volts
(k) Base of Q3 to earth	1.4 v	2.1 volts
(l) Collector Q3 to earth	6.2 v	8.1 volts
(m) Emitter Q3 to earth	1.2 v	1.2 volts
(n) Gate Q4 to earth	—	2.6 volts
(o) Gate Q5 to earth	—	2.8 volts
(p) Source Q4 to earth	2.2 v	1.2 volts
(q) Source Q5 to earth	2.2 v	1.2 volts
(r) Lead A to earth	—	1.2 volts
(s) Lead B to earth	—	1.2 volts
(t) Junction R15 and C13 to earth	12.8 v	—
3. CRYSTAL OSCILLATOR BOARD		
(a) Base Q6 to earth	2.0 v	6.2 v
(b) Collector Q6 to earth	12.5 v	16 v
(c) Emitter Q6 to earth	3.7 v	—
(d) Lead C to earth	—	3.2 v
(e) Lead D to earth	—	3.3 v
4. BALANCED MODULATOR BOARD		
(a) Junction L4 and C25 to earth	—	0.4 v
(b) Junction L4 and C26 to earth	—	0.4 v
(c) Lead G to earth (with point H deliberately earthed)	—	0.2 v
5. VFO/MIXER BOARD		
(a) Source Q7 to earth		11 v
(b) Base Q8 to earth	4.2 v	6.2 v
(c) Emitters Q8/Q9 to earth	3.8 v	6.0 v
(d) Base Q9 to earth	2.0 v	Approx. 0.5v*
(e) Collector Q9 to earth	12.6 v	15 v*
6. POWER AMPLIFIER STAGE		
(a) Pin 2 (Grid) of 12BY7 to earth	—	16 v*
(b) Cathode test point to earth	+4.1 v (41mA)	2.1 v*
(c) Pins 1 and 9 (Cathode) to earth	+6.6	4.1 v*
(d) Pin 8 (Screen) to earth	+260	—
(e) Pin 7 (Anode) to earth	+290	350v* (approx.)
(f) Fixed Plates C43 to earth	—	350v* (approx.)
(g) Antenna lead to earth	—	43
(h) RF indicator meter reading (rig front panel)	0.82 mA	
(i) RF Wattmeter reading (75 ohm load)	4.1 watts	

*. Signal pattern is distorted by the presence of VFO signal.

operators of sideband equipment know nothing of the technicalities of sideband transmissions. Checks with these stations usually result in confusion at both ends of the transmission. You will get worthwhile checks from technically experienced sidebanders only, so pick on an operator who has built his own equipment at some time and who knows what he is about.

The second concerns receivers. It is pointless trying to get a check on sideband suppression from a station who does not possess a receiver with a good quality SSB filter. You cannot use a receiver that lacks a filter (i.e., an AM receiver) to check on sideband suppression.

The third concerns receivers and intermodulation. Some commercial SSB receivers (and transceivers) suffer from poor intermodulation performance in "the front end". This can be minimised by the receiver operator turning his RF gain control down, turning the receiver audio gain control fully up, and using the RF gain to set the signal level from the speaker. Many operators seem reluctant to do this (probably because the "S" meter is no longer useable)! Sideband suppression checks made with an SSB receiver in this condition are generally useful.

The fourth trap concerns the method used to switch sidebands while checking suppression. It is generally more convenient for a phasing transmitter to switch sidebands (because it swaps to the other side of the fixed carrier frequency) than for a filter-type transceiver to switch sidebands while on receive. Some filter rigs exhibit "carrier shift" when switching sidebands. So I recommend that if you want a sideband suppression check, that you work an experienced SSB station with a receiver that contains a good-quality filter. Call him on "lower sideband" and then switch to "upper sideband" for a further call (say 30 seconds) and then switch back to the lower sideband. If your sideband suppression is ideal, then he should not have heard a thing for the 30 second period that you were on upper sideband.

Carrier suppression checks can be made by asking the receiving station to tune across your signal and listen for a steady beat-note (your carrier beating with his receiver carrier-insertion oscillator or BFO).

The audio gain control should be advanced with caution. It can be roughly set by noting the meter reading when in the "tune" position. With speech input it should dither about ONE-QUARTER of this reading. This is because an SSB signal is very "peaky". Flattening of peaks can cause splatter so it is advisable to keep the gain well back so that the high peaks are accommodated without clipping. The meter will not respond to speech peaks — it follows the average output signal level on speech.

Incidentally, lower sideband is the mode generally used on the 80 metre band.

As promised earlier, details will now be given of a modification to permit the rig to be used for AM operation. AM can be provided in one of two ways. "Compatible AM" (i.e., one sideband plus carrier) can be provided by simply unbalancing one or other of the balance pots. Care must be exercised to ensure that adequate carrier is provided and yet ensure that the linear PA stage is not overdriven. This means that the mike audio gain will have to be turned well back from its usual SSB position. The meter should indicate a carrier level of about half the deflection shown in the "tune" position.

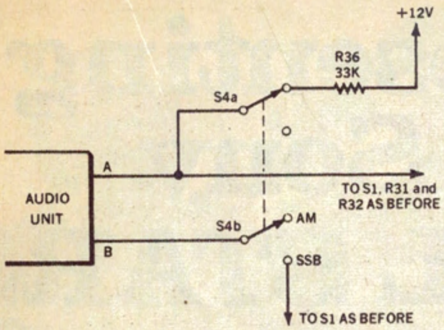


Figure 20: Details of the simple modification required to adapt the rig for AM operation, as explained in the text.

"Compatible AM" presents a puzzle for some receiver operators. It should be tuned in for best received audio quality and not greatest S meter reading.

A more elegant method which produces double sideband plus carrier (i.e., AM) is shown in figure 20. (This diagram with the additional components shown is an extension of the previous numbering system). S4 can be a double-pole double-throw toggle switch mounted wherever you like. S4b removes the audio feed to one of the balanced modulators when S4 is in the AM position. S4a applies DC bias to the remaining balance modulator to unbalance it and hence provide carrier. "Netting" must be done with S4 in the SSB position (to prevent R36 shorting R31). Tests show that if the rig is set up for SSB (i.e., S4 in SSB position, both carrier balance pots adjusted for balance, and the mike gain set for the correct level for SSB) then when S4 goes to the AM position both carrier and sideband levels are about right for AM. S1 can be left in either position for AM.

The meter should read about half the "tune" reading when on AM and with negligible flicker with modulation.

It must be realised that the power output limitation of about 4 watts PEP output also applies to AM, so mean RF output power on AM is therefore only 2 watts. Two watts AM is a poor servant compared to 4 watts PEP SSB and the results obtained with the rig on AM will reflect this. It was this decrease in performance that swayed the decision to omit AM from the original design. However, if constructors must have AM then this modification should suffice.

I have hooked up the circuitry shown in figure 20 to the prototype to check it out and it works as expected. I worked three stations (two in Auckland) on AM and all had SSB receivers copying me as SSB Finally I phoned a local ham who I knew had an AM receiver and got him to check it out! This makes me wonder if anyone still uses AM or needs this modification! All reports on AM have been satisfactory, but I will not be permanently modifying my rig.

The time of writing is too early to expect any other constructor to have another rig on the air so it is probably appropriate to mention again the problem of spread in transistor parameters Some changes to the values of R7, R10, R13 or R14 and R23 may be found necessary. Only time will tell. I am interested to receive comments and experiences from other constructors of this rig on this matter in particular.

The carrier balance stability of the prototype is the best I have ever experienced with a phasing rig. I went overseas for six weeks and used the rig for two nights after getting back before realising that I had not touched the carrier balance pots since going away!

That just about covers the field and all I can do now is to wish you well. If you strike difficulties, I suggest that you use some of that scarce commodity, patience, and try and reason out the problem for yourself. The RSGB "Radio Communication Handbook" has a good section on SSB and on the adjustment of a phasing rig (page 10.48).

I wish to thank all who have assisted me with the development of this project — both on and off the air. In particular Denis, ZL2AVK, for technical assistance, and Glen, ZL2KY, for taking and producing the photographs.