D42 reverse biasses D18 and D19 to hold the filter bypass link open circuited. (This link is in circuit during a.m. transmission - see paragraph 24).

15. The 9V at S4H is also fed through R40, R39 and T9 secondary to the slider of RV4. This causes the modulator to be unbalanced and to operate as an a.m. detector circuit.

TRANSMIT PATH

Microphone Amplifier and Balanced Modulator

16. Audio voltages from the microphone at pins 1 of both audio sockets are fed via pin 18 of the main p.c.b. to the two-stage amplifier VT15 and VT14. Diode D12 conducts when the 9V TX supply is applied to R68. The amplified audio from VT14 is fed via C54 and the distribution transformer T9, to the input of the balanced modulator D14 and D15, where it is heterodyned with the 10,7MHz signal from carrier oscillator VT16. The carrier is balanced out and the double sideband signal is fed to the 10,7MHz d.s.b. line via the distribution transformer T9.

DSB Amplifier and Sideband Filter

17. Input from the d.s.b. line is fed via diode D9 to the common emitter amplifier VT4 and matched to the input of the sideband filters by the primary of the tuned transformer T5. The unwanted sideband is rejected and the wanted sideband is matched to the input of the balanced mixer by the tuned transformer T4.

Balanced Mixer

18. The 10,7MHz sideband is fed to the balanced mixer diodes D20 and D21, and mixed with the output of the channel r.f. amplifier, VT19. The channel oscillator signal is balanced out and the output from the mixer, consisting of the radiated frequency plus an image signal and breakthrough of the 10,7MHz signal, is matched by transformer T3 to the input of the image suppression filter.

Image Suppression Filter

19. The filter has lowpass characteristics, with a cut-off at 8MHz and a rejection notch at the i.f. of 10,7MHz. Output from the filter is matched by transformer T2 to the base circuit of the pre-amplifier VT27.

Pre-Amplifiers

20. Pre-amplifiers VT27 and VT26 operate in broadband configuration, resistors R115 and R109 across the collector loads T19 and T18 enhancing the broadband characteristics. VT27 and VT26 operate in class A, and the output of VT26 is matched by transformer T18 to the input of the driver stage.

Driver Stage

21. VT24 and VT25 operate in common emitter, class B push-pull, the quiescent current being set by RV9 and held by diode D23. The amplified signal appearing in the collector loads T16 and T17, is matched to the bases of the parallel push-pull combination VT20, VT21, VT22 and VT23.

Linear Power Amplifier

22. This stage is operated in class B with the quiescent current held by diode D22 and resistors R106, R101 and R102. The paralleled outputs from pairs VT20/VT21 and VT22/VT23 are matched via transformers T15 and T14 to the 50 ohm line. The 50 ohm line is connected to the antenna tuning unit via change-over relay contact RL1/1.

Antenna Tuning Unit

23. This unit is switched for high or low band operation (4-8MHz and 2-4MHz) and will tune whip antenna connected to the WHIP socket and dipoles and slant wire antenna connected to the 50 ohm socket SK3. The antenna tuning unit supplies the necessary inductance to tune capacitive antenna of less than one quarter wave in length.

AM Transmission

24. When the controls are set for a.m. transmission the 9V TX supply is fed through MODE switch S4G contact 6 to the carrier oscillator circuit. This circuit feeds a 10,7MHz signal to the unbalanced modulator circuit where it is mixed with the audio to form a double sideband plus carrier signal.

25. In the sideband filter circuit the 9V RX supply to D42 anode is not available when the PTT switch is operated. Resistor R120 is earthed as before (paragraph 14) but the 9V RX supply is not available at D42 anode. Thus the 9V supply at the anode of D3 and D4 causes current flow via diodes D5 to D8, diodes D18 and D19 to earth through R120. D18 and D19 are forward biassed and provide a short circuit link across the filters for the a.m. signal from T5.

Overload Protection

26. To protect the p.a. transistor against bottoming, due to causes such as antenna mistuning, an overload protection stage is incorporated. Diodes D48 and D49 are forward biassed to about 5V via potential divider R118, R131, R117. Should the collector potential of the p.a. transistors tend to fall below 5V, the 5V at the anodes of D48 and D49 will be connected to the collectors. During reception the junction of R128 and R129 is earthed by one contact of the transmit-receive relay to prevent any damaging transients being effective.

Automatic Level Control (ALC)

27. Under conditions of no modulation, the collector voltage of the ALC control transistor VT18 is approximately 2,7V and consequently the current through diode D9 is maximum. In this condition diode D9 presents a low resistance to the r.f. drive applied to VT4 base.

28. When drive is applied to the transmitter, the resulting voltage at the emitter of VT20 is applied, via RV7, R81 and R80, to the base of VT18 where it progressively reduces the collector voltage and hence reduces the current through D9. This reduction of current effectively increases the resistance of D9 to the r.f. drive applied to VT4 base, and serves to control the drive level. RV7 is normally adjusted so that when transmitting on 'Tune' an output of 12,5 watts is obtained.

Break-in CW

29. With the mode switch set to BKCW, the key is connected across the PTT switch via S4A, contact 4, and the emitter of the tone oscillator VT13 is connected to battery negative via switch S4B, contact 4. Operating the key energises the transmit/receive changeover relay. Thus the tone oscillator runs continuously and transmission is obtained by keying the relay.

CW

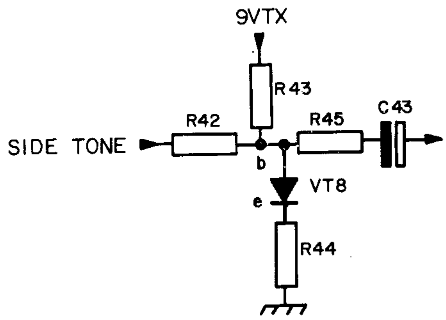
30. With the mode switch set to CW the PTT relay is connected to battery negative via switch S4E, contact 5. The relay is energised and the resulting changeover switching holds the set in a transmitting condition. At the same time the key is connected between the emitter of VT13 and earth via S4A contact 5. The transmitter is thus switched on and the tone oscillator, VT13, is energised by the key.

Tone Oscillator

31. VT12 and VT13 comprise a simple RC-coupled oscillator operating at approximately 1kHz. Audio signals developed across R58 are fed via C53 and R62 to the base of the second microphone amplifier VT14. From this point on, the transmitter operates as described previously. Thus it is possible to operate CW on u.s.b. or l.s.b.

Side tone

32. In the transmit condition the 9V RX line is de-energised and the voltage is removed from the collector of VT8. The base-emitter circuit of VT8 can now be regarded as a diode which is forward biased by the 9V TX through R43 (see sketch). Thus R42 and R44 form a potential divider to the incoming sidetone and an attenuated signal will be fed through R45, C43 to the base of VT9. The audio stages operate as before and sidetone will appear in the headphones.



TUNING CIRCUITS

Tuning the Receiver

33. With the BAND switch S3 set to TUNE, 9V regulated is applied via switch S3E, contacts 1 or 6, to the multivibrator VT1 and VT2. Output from the multivibrator is a pulse train of relatively low frequency with a high harmonic content which is loosely coupled to the coil of the antenna tuning unit via an open-turn link. The spectrum is monitored in the earphones during tuning.

Tuning the Transmitter

34. As an alternative method of tuning the set the BAND switch may be set to HP or LP with the mode switch at BK CW. Under these conditions the tone oscillator is energised and operating the PTT switch will bring the set into a transmit condition. Maximum power to the antenna will now coincide with maximum brilliance of the front panel neon lamp, LP1. While this method of tuning is accurate for whip antennas it is advisable to use the receiver tuning method when antennas other than whips are used.

Metering

35. The front panel meter performs two functions: It gives an indication of the strength of the received signal, and indicates the battery volts on transmit.

36. In the receive position the meter is connected in the emitter of VT6 and will thus become operative at the automatic gain control threshold.

37. In the transmit position the meter is connected in a bridge network with the zener diode D50 connected to the 12V TX supply via relay contact RL113. The zener diode only starts conducting at 9V and the meter will begin to read; at 14V the meter is reading full scale. The meter set potentiometer RV10 is adjusted such that the meter reads half scale at 12V. The effect of connecting the zener diode in series with the meter is to amplify the meter movement, thus enabling small changes in the battery voltage to be readily seen.

38. The crystal board comprises three banks of 12 crystals. Each bank has its own oscillator and any one of the 12 crystals in a bank can be switched into the oscillator circuit using BAND switch S3.

39. Consider the case where the USB/LSB switch, S1, is set to 'A' (either u.s.b. or l.s.b.) and the channel switch, S2, is set to '1'. In this case the 9V supply at the wiper of S1 is fed only to the oscillator and circuits in bank A. There is no supply to banks B and C so that the oscillators in these two banks cannot operate. The cathode of diodes D1A, D1B and D1C are connected through switch S2 and R22 to earth.

40. Current will now flow through VT1A, D2A, D1A and R22 to earth. The two diodes will be forward biased, D2A providing virtually a short circuit between crystal XL1A and the emitter circuit of VT1A. The other end of the crystal is connected through two capacitive circuits to the emitter of VT2A in accordance with the requirements of the Butler type oscillator circuit used in this set. The circuit will now oscillate at the frequency of XL1A. The output from the emitter of VT2A is taken through emitter follower VT3A to the mixing circuits of the transceiver.

41. Only the two diodes D1A and D2A will conduct with the switches set as in paragraph 39. No other diode is forward biased either because there is no supply to the anode (D1B, D2B, D1C, D2C) or because there is no earth to the cathode (all other diodes). Thus only one crystal (XL1A in this case) can be selected for any combination of the setting of the two switches.

42. The frequency of each crystal can be pre-adjusted to a limited extent by the parallel connected fixed and variable capacitors (C4A and C16A for XL1A) in series with the crystal. The fixed capacitor and varicap diode which are common to each bank of crystals also allow the frequency of the selected crystal to be varied. The effective capacitance of the varicap depends on the voltage across it, the higher the voltage the lower the capacitance. The control voltage for the varicap is taken from the NET control potentiometer RV12 on the front panel. Adjusting this control allows antenna frequencies slightly above or below the nominal frequency to be received (netted) by shifting the mixing frequency to a value which gives optimum clarity.

POWER SUPPLIES

General

43. The power supply circuits can be conveniently divided into two parts:
   (a) The voltage regulator and switching circuits housed on the main pcb which provide the power supplies for the receiver circuits and for the level transmitter circuits.
   (b) The DC Converter which has two functions:
      (i) To provide the power for the transmitter power amplifiers
      (ii) To connect an external charging source to the internal battery.

Voltage Regulator and Switching Circuits

44. The 12V supply from the internal battery is switched by mode switch S4C to the voltage regulator comprising series transistor VT32, error amplifier VT31 and reference diode D29. VT32 emitter output is the 9V supply which is fed to circuits common to both transmitter and receiver. Should the level of this supply tend to rise above 9V, the potential at the slider of RV11 and hence at the base of VT31 will also rise. Conduction through VT31 will increase and give a greater voltage drop across its collector load resistor R125. The base of VT32 will go more negative to increase the effective resistance of the series regulator.