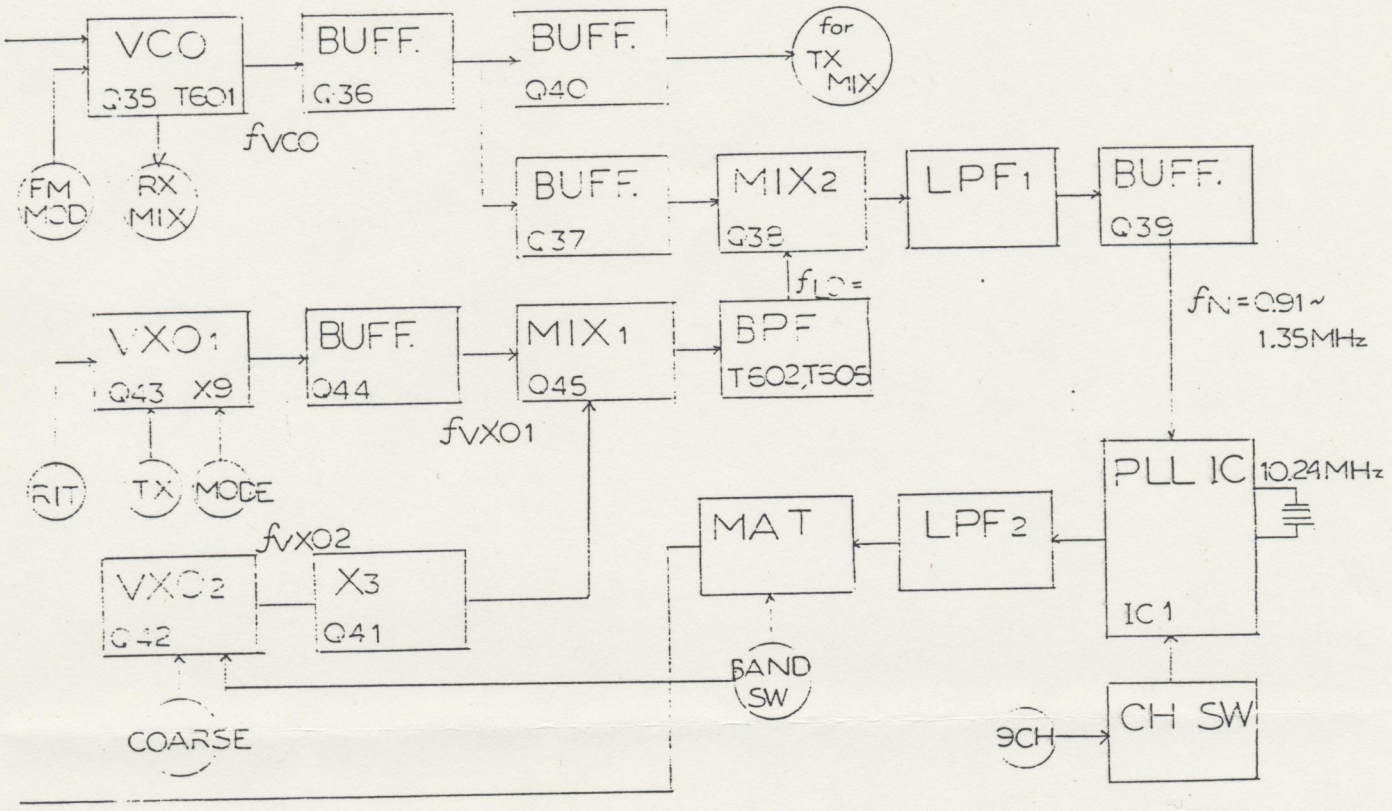
SPECIFICATIONS

Frequency Range	:	25.615 - 28.755 MHz (280 channels)
Type of Emission	:	SSB (A3J)
		AM (A3)
		FM (F3)
Operating Voltage	:	13.8VDC +/-15%, floating chassis
Antenna Impedance	:	50 ohms
Transmitter Power Output	:	SSB 12W (PEP)/2W (PEP)
		AM 4W/0.5W
		FM 4W/0.5W
Type of Modulation	:	SSB - balanced modulation
		AM - collector modulation in pre-stage
		FM - variable reactance frequency modulation
Occupied Bandwidth	:	4.2 KHz
Max. Frequency Deviation	:	+/-1.5 KHz (FM)
Carrier Wave Suppression	:	less than -40 dB (SSB)
Current Consumption	:	less than 2.5A max.
Receiving System	:	single super-heterodyne
Receiver Sensitivity	:	AM 1.0uV at 10 dB S/N ratio
		FM 1.0uV at 20 dB S/N ratio
		SSB 0.5uV at 20 dB S/N ratio
Image Rejection	:	less than -60 dB
Intermediate Frequency	:	7.8 MHz
Selectivity	:	4.2 KHz -6 dB
Audio Output Power	:	4.0W max. at external output terminal (8 ohms)
RIT Range	:	more than +/-800 Hz (variable)
COARSE Range	:	more than +/-5 KHz
Center Freq. Tolerance	:	less than +/-1.5 KHz
PA Power Output	:	4.0W max. at 8 ohms

CIRCUIT DESCRIPTION and TUNING

PLL SECTION



PLL Section Block Diagram

VCO : FM modulator and local oscillator for TX/RX.
VXO1 : Shifts frequency according to operating mode, and oscillates to vary TX/RX frequency.
VXO2 : Oscillates to vary frequency in bands A to G and COARSE level.
MIX1 : Mixer to take out the difference between tripled frequency of VXO2 and frequency of VXO1.
MIX2 : Mixer to take out the difference between VCO and MIX1 frequencies.
CH SW : Rotary switch for selection of operating channels 1 to 40.
PLL IC: Integrated circuit to divide input signals from channel selector switch (CH SW), to compare phase difference between the input signal and 10 KHz which is 1/1024 of 10.24 MHz crystal frequency, and to supply the difference to LPF2.
MAT : Circuit to add the voltage from LPF2 and DC voltage from band switch by means of resister matrix, and to supply the sum to VCO.

$$f_{VCO} = f_{N} + (f_{VXO2} \times 3 - f_{VXO1})$$

fN : divider input frequency
fVXO2 : band select frequency
fVXO1 : mode, TX or RX (RIT) frequency
fVCO : TX/RX local oscillator frequency

CIRCUIT COMPOSITION

1. PLL Circuit

By use of a 40-channel PLL IC, 280 channels over 7 bands are available. (RIT circuit, COARSE circuit and FM modulator are also contained in the PLL circuit.)

2. Carrier Generating Circuit

This generates carrier frequencies in each mode. When receiving, it functions as BFO for USB and LSB, and stops functioning in AM and FM modes.

3. Receiver Circuit

A signal from antenna is amplified by Q9, then is supplied to Q10 frequency conversion circuit to be synthesized with VCO frequency and converted to 7.8 MHz intermediate frequency.

Then it passes through the 7.8 MHz crystal filter and amplified by Q12, Q13 and Q14 to be supplied to detector circuit. In FM mode, the signal is further limiter amplified and detected by IC6.

4. Detector, AGC, Squelch and Meter Circuits

AM : The signal amplified in IF stage is detected by bi-voltage at D112 and D113, then it goes to D114 ANL circuit. When ANL is switched on, pulse noise is filtered. But when ANL is switched off, the signal is amplified at Q20 audio frequency amplifier while the pulse noise is not being filtered.

USB,LSB: The IF amplified signal is supplied to IC3 balanced modulator to be mixed with carrier signal from carrier generating circuit, and then product detected.

FM : The IF amplified signal is further limiter amplified by IC6 and FM detected.

AGC : The signal detected by D109 and D110 is amplified by Q15 to work as AGC in Q12 and Q13 IF stage. The signal amplified by Q15 is turned over by Q16 to give AGC voltage to the 1st gate of Q9 RF amplifier

Squelch: DC element detected by bi-voltage at D112 and D113 is taken out by Q8, and amplified by Q7 and Q6 to turn on and off IC2 audio frequency power amplifier.

Meter : S meter is activated by DC element detected by D109 and D110.

5. NB Circuit

The signal RF amplified by Q9 is further amplified by Q17 and detected by D101 and D102. Pulse element of the signal is amplified by Q18, and IF signal is switched on and off by Q11.

6. Audio Frequency Amplifier

Signals detected in each mode of operation go through AF VR (variable resister) and amplified by IC2 to drive speaker. In PA mode, microphone signal goes through AF VR and amplified by IC2 to work as PA output.

7. Transmitter Circuit

Carrier frequency and VCO frequency are synthesized by IC4 frequency conversion circuit and converted to a transmitting frequency, which is then amplified by Q4, Q3, Q2 and Q1 in order and supplied to antenna through LPF.

8. AM Modulation Circuit

Audio signal from microphone is amplified by Q32 and IC2 to work as collector voltage for Q3 and Q2 of TX section through Q29 emitter follower.

Output voltage of the modulator is detected by D502 and amplified by Q34, then controls impedance between collector and emitter of Q33 and functions as AF attenuator to prevent from over modulation (OML).

9. USB and LSB Modulation Circuit

Audio signal from microphone is amplified by Q32 and Q31 and supplied to IC3 balance modulator.

And the signal is balance modulated by carrier frequency 7.8025 MHz (USB) or 7.7975 MHz (LSB), then DSB mode appears at output stage. The DSB signal becomes SSB signal by 7.8 MHz crystal filter and is amplified by Q12, then supplied to IC4 through Q5 buffer amplifier and mixed with VCO frequency. After it passed through 27 MHz band filter, it activates Q33 AF attenuator to stabilize maximum power output when the transmitter output voltage which was amplified by Q4, Q3, Q2 and Q1 and detected by D503 and D504 exceeds the rated output level.

10. FM Modulator Circuit

Audio signal from microphone is amplified by Q32 and IC2, and its output voltage is detected by D502 to activate Q33 AF attenuator to stabilize maximum power output.

The signal amplified by IC2 gives modulation direct to VCO through IC7 buffer amplifier.

11. AM/FM Carrier Output Circuit

Carrier frequency 7.8 MHz is supplied to IC3 balance modulator, and DC element is given by VR301 to have the modulator unbalanced, thus output appears. This output signal goes through 7.8 MHz crystal filter and is amplified by Q12, then supplied to IC4 through Q5 buffer amplifier and mixed with VCO frequency to become transmitting frequency.

TUNING

PLL SECTION

1. How to align VXO1

Condition: Set RIT control at center, and measure frequency at Q44 collector.

A. In receive mode:
1) LSB mode - Tune T608 to 13.9475 (depends on filter).
2) FM mode - Tune T609 to 13.9450 MHz.
3) USB mode - Tune T610 to 13.9425 MHz.

B. In transmit mode: USB mode - Tune VR802 to 13.9425 MHz.

2. How to align VXO2

Condition: Set COARSE control at center position, and measure frequency at Q41 base.

In receive mode:
1) Place band switch in position A, and tune CV601 to 15.4833 MHz.
2) Place band switch in position A, and tune T607 so that COARSE control range is set between +1.65 KHz and -1.65 KHz.
3) Set band switch at A, and tune CV601 to 15.4833 MHz.
4) Set band switch at A, and rotate COARSE control and confirm its variable range.
5) Set band switch at B, and tune CV602 to 15.6333 MHz.
6) Set band switch at C, and tune CV603 to 15.7833 MHz.
7) Set band switch at D, and tune CV604 to 15.9333 MHz.
8) Set band switch at E, and tune CV605 to 16.0833 MHz.
9) Set band switch at F, and tune CV606 to 16.2333 MHz.
10) Set band switch at G, and tune CV607 to 16.3833 MHz.
11) Set band switch at G, rotate COARSE control knob and confirm its variable range.

3. How to align X3

Condition: Observe waveform at Q45 base.

In receive mode: Set band switch at D and CH SW at channel 20, and adjust T606 for maximum amplitude of waveform, when the frequency counter should read 47.800 MHz.

4. How to align 10.240 MHz.

Condition: Measure frequency at IC1 pin No. 14.

Adjust CV901 so that frequency is set at 10.240 MHz.

5. How to align VCO

Condition: Observe waveform and measure frequency at Q39 collector.

In receive mode:
1) Set band switch at D and CH SW at channel 1, and adjust T601 VCO coil so that frequency is locked in at 0.91 MHz.
2) Adjust T602, T605 and T606 so that amplitude of the wave reaches maximum.
3) Rotate band switch A through G, and adjust T601 so that the counter reads 0.91 MHz in each band.
4) Set band switch at G and channel switch at channel 40, and confirm the counter reads 1.35 MHz.
5) Set band switch at G and turn on channel 9 switch. Confirm the counter reads 1.01 MHz and it does not change even if channel switch is rotated.

6. How to align Lock Voltage

Condition: Measure voltage at terminal No. 18, and check frequency at Q19 collector. Set mode switch in FM.

In receive mode:
1) Set band switch at G and channel switch at channel 40. Adjust T601 so that voltage reads 3.0V.
2) Check if frequency reads 36.555 MHz.
3) Set band switch at A and channel switch at channel 1. Confirm frequency reads 33.415 MHz.

7. How to align Carrier Frequency

Condition: Check frequency at Q23 emitter.

In transmit mode:
1) Set mode switch at USB, and tune CV401 to 7.8025 MHz.
2) Set mode switch at LSB, and tune T401 to 7.7975 MHz (depending on filter).
3) Set mode switch at FM, and tune CV402 to 7.8000 MHz.
4) Repeat steps 1) to 3), and confirm.

TRANSMITTER SECTION

1. How to adjust Power

   A. FM, AM

      Condition: Set RF power switch at HIGH position.

      1) Set band switch at D and channel switch at 20, and tune T1 for maximum power output.
      2) Set band switch at G and channel switch at 40, and tune T2 for maximum power output.
      3) Set band switch at A and channel switch at 1, and tune T3 for maximum power output.
      4) Set band switch at A and channel switch at 1, and tune T4 for maximum power output.
      5) Set band switch at G and channel switch at 40, and tune T5 for maximum power output.
      6) Adjust L15 so that change in output level over bands A through G can be minimized.
      7) Adjust VR505 to obtain 5W output power, and tune VR301 to minimize spurious emission.
      8) Set RF power switch at LOW, and tune VR506 to obtain 0.5W power output.

   B. USB, LSB

      Condition: Set RF power switch at HIGH, and modulate with 1KHz, 10mV audio signal at microphone input jack.

      1) Adjust VR503 so that output power reads 10W.
      2) Set RF power switch at LOW, and adjust VR502 so that output power reads 2W.

2. Modulation

   A. FM, AM

      Condition: Set band switch at D and channel switch at 20, and modulate with 1 KHz, 10mV signal to the microphone input.

      FM - Adjust VR801 so that output deviation reads 2 KHz PEP/2.
      AM - Tune VR203 so that modulation reads 85% at HIGH power mode.

   B. How to adjust Balance

      Adjust L12, L13, L14, L15 and L16 so that modulation and output power are obtained averagedly over channel 1 on band A through channel 40 on band G.

3. Adjustment of Carrier Leak

      Tune VR504 for minimal leak of carrier frequency without modulation for both USB and LSB.

RECEIVER SECTION

1. Sensitivity Alignment

Condition: Give 30% modulation with 1 KHz 1uV input in AM mode.

A. RF

1) Set band switch at D and channel switch at channel 20, and tune T112 for maximum sensitivity.
2) Set band switch at A and channel switch at channel 1, and tune T105 for maximum sensitivity.
3) Set band switch at G and channel switch at channel 40, and tune T106 for maximum sensitivity.

B. IF

Condition: Set mode at AM, band at D and channel at 20, and modulate with 1uV input.

Tune T107, T108, T109 and T110 for maximum sensitivity at 10 dB S/N ratio.

C. Meter, Squelch

Condition: Set mode at AM, band at D and channel at 20, and moudlate with 1mV input.

1) Adjust VR101 so that S meter pointer deflects at level 9.
2) Tune VR201 so that squelch opens at maximum position of the squelch control.

D. FM

Condition: Set mode at FM, band at D and channel at 20, and modulate with 1 KHz 1uV input.

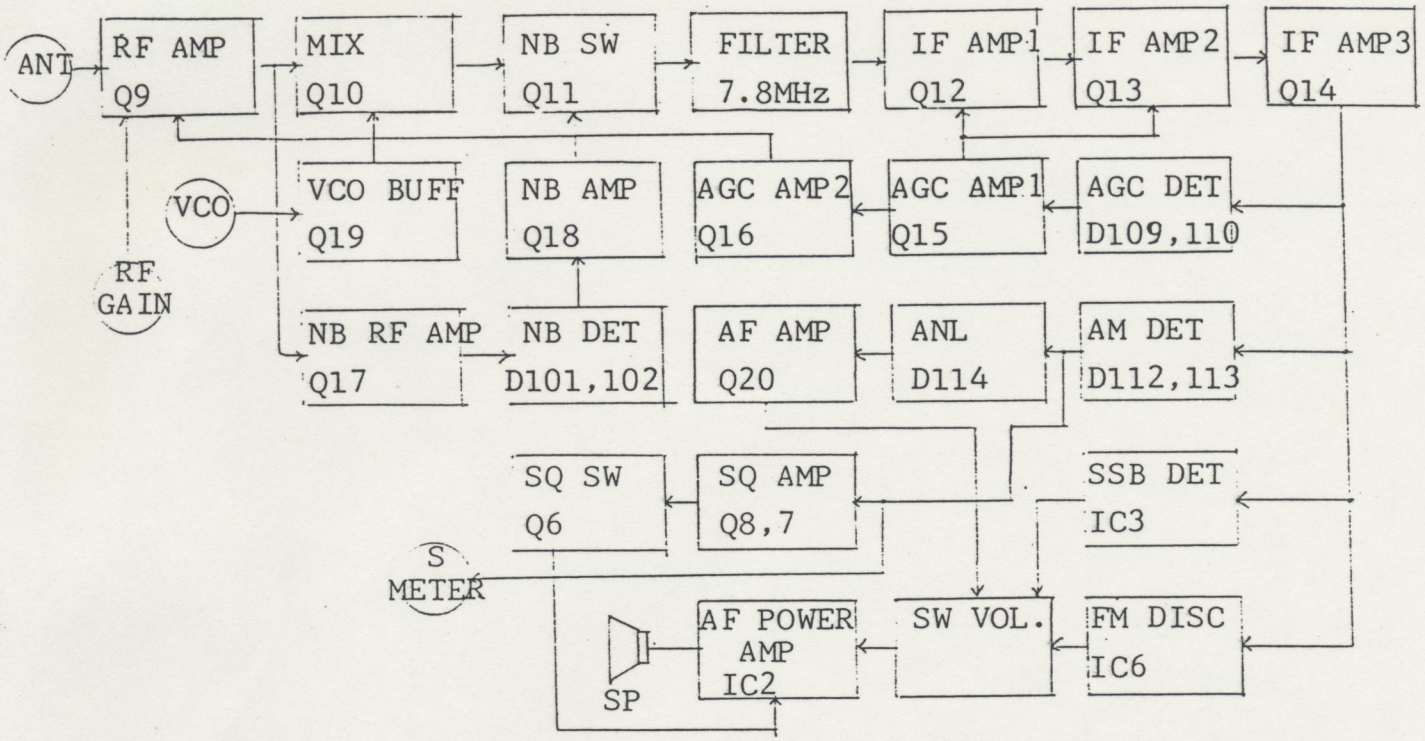
Tune T107, T108, T109 and T110 to adjust center frequency at 20 dB S/N ratio.

(Note: It is not necessary to align FM receiver sensitivity in case AM alignment is found good, because FM detection is done by crystal.)

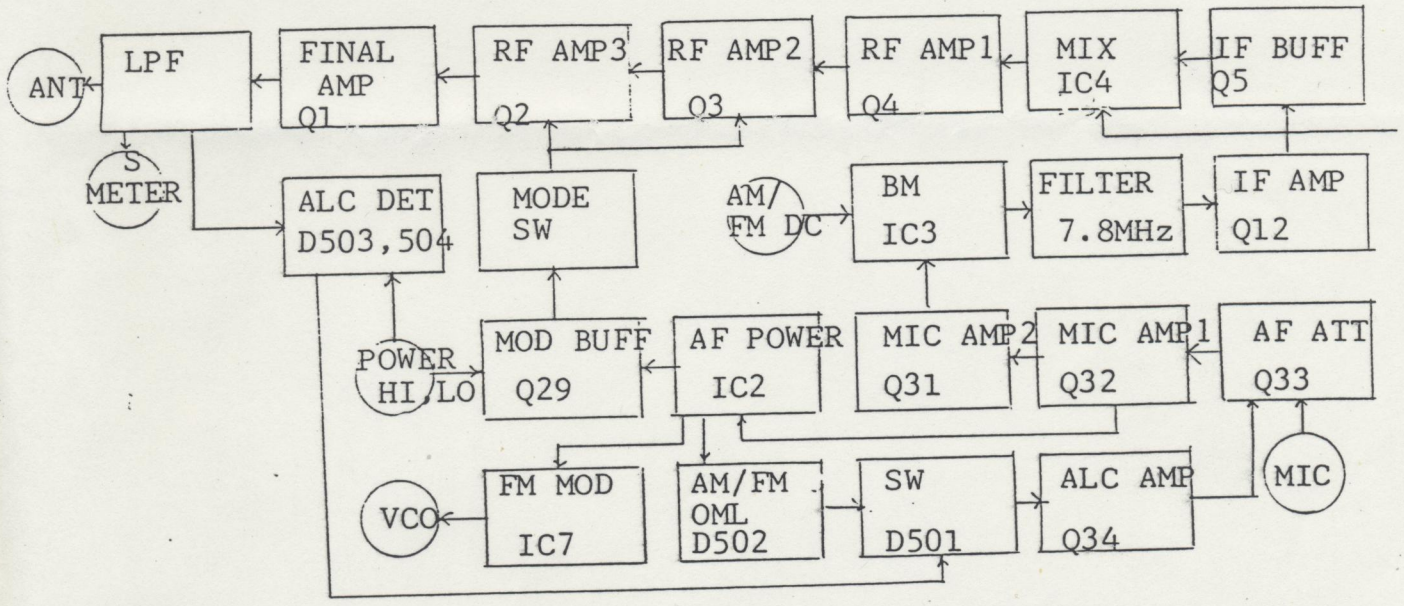
E. USB, LSB

Condition: Set mode at CW, band at D and channel at 20, and supply 0.5uV input without modulation.

Tune T107, T108, T109 and T110 for maximum sensitivity at 20 dB S/N ratio.



RECEIVER Section Block Diagram



TRANSMITTER Secton Block Diagram