1. Introduction

The Synthesizer is implemented with the following Components: PLL IC (IC1)

X-TAL (X1)

Varicap Diode (D19)

Transistor (Q20, Q21, Q22,)

LED Display

IC3 is COMS LS1 that includes most of the PLL block.
The VCO with Varicap Diode D25 as part of the oscillator than circuit.
Q20 is a switching transistor to connect or disconnect the tuning capacitor in the VCO oscillator tank circuit for transmitter or receiver.

2. Reference Frequency

The crystal x1 (10.240 MHz) and other component at pins 19 and 20 of IC1. Form an oscillator with an amplifier internal to IC1. The oscillator output is internally fed to a divide by 4096 to produce a 2.5 kHz. Square wave, which is the reference input to the phase detector.

3. VCO

Q21 is connected as a Harley type oscillator with Varicap diode as part of the tank circuit. With appropriate control voltage on D25 the VCO can be made to oscillator with Varicap diode as part of the tank circuit. With appropriate control voltage on D25 the VCO can be made to oscillate over the required rang of 13.4825MHz to 16.710MHz.

4. Programmable Divider and its Control

The programmable inputs (7-sefment code) are fed to pins 1 to 7 IC1 the programmable inputs consist a 7segment code to light channel indicator LED Display For CH.1 “B” and “C” of the first LED element of LED will light.

The programmable input “B” goes low to produce CH. 1 divide (RX: N=6508, TX: 5393), For each channel number input, an internal code converter ROM provides the appropriate binary control to the programmable divider for channel, since the binary number required is difference during transmit and receive, an additional bit is required at pin 20 to ic1 to allow the ROM to recognize the TX/RX status. The programmable divider output is fed to the phase detector for comparison with the 2.5 KHz reference.

5. phase Detector and VCO Control

The phase detector is a digital phase comparator which compares the leading edges of the reference with programmable divider output square waves and develops a series of pulses whose DC level depends on whether the phase error is leading. The phase detector pulse output is fed to a charge pump and then to base of amplifier Q502. The charge pump output is fed to an active low pass filter, which consist of R99, C47. The low pass filter output at pin 27 of IC1 is further and fed to Varicap D25 to control the VCO frequency. The result is a second order PLL with the loop dynamics essentially by the active low pass filter.

6. Transmit/ Receive, Buffer AMP.

The VCO output is fed into buffer AMP Q20 from secondary of T7

7. Transmit Doubter

The Q22 output obtained as base output and fed to the base of double transistor Q23 .At this stage, the frequency is double. The Q23 output tank circuit is double tuning circuitries (27MHz)T8 and to step the 13.5MHz, frequency.

8. Switching of Tuning Capacitor in VCO Oscillator Tank Circuit

The VCO circuit must tune with a wide rang of frequencies 13.4825MHz for transmitter and 16.27MHz~16.710MHz for receiver. The use for one tuning capacitor in common has such adverse effect and decreases is switched for transmission or reception. The tank circuit consist of the primary of T7, C152and C94 when receiving, Q21 becomes off so, the primary of T7 and make tuning function when transmitting, Q21 becomes on. So, the primary of T7 and parallel capacitance of C94 and C92 make turning function.

9. Receiver Local Oscillator Outputs

First Mixer

The secondary output of VCO tank circuit T7 is injected though buffer AMP Q22 and the buffer CKT output though the base of 1’st mixer.

Second Mixer

The oscillation output, oscillated with 10.240MHz crystals X1 across pins 19 and 20 of IC1, is output from pin 19 and injected into the base of Q4.

10.Fault Protection

IC1 includes an auxiliary exclusive or phase detector which functions as lock detectorl f lock is lost pin 18 goes low and the base bias of Q24 is cut off, to prohibit transmission and reception. Transmission cannot be made if a code other those than

those for 40 channel is input is IC1.

11. Frequency Stability

LET: FO=Crystal Oscillator Frequency

FR=Phase Detector Reference Frequency

FVCO=VCO Frequency

FT=Transmit Frequency

THEN=FR=FO/4096

And under locked conditions

RF=FVCO/N Where N is the programmable divider divide ratio

THEN: FVCO = NXFR = N (FO/4096)

From which it can be seen that the percentage error in FT is the same as the percentage error in FO.

The stability of the crystal oscillator is determined primarily by the crystal and to a lesser extent by the active and passive components of the oscillator. The choice of crystal and components is such that the requited frequency stability is maintained over the required voltage and temperature rang.

7.2. Transmitter

1. RF Amplification

   The output of double AMP Q23 is fed through double (27MHz)T8 and T9 the base of PREAMP. The output is then supplied through tuning circuit C2to RF driver AMP Q25 output is capacitance divided by tuning circuit C107 and C108 and passed through the base of final RF stage Q26 output is supplied to the antenna through L-C tuning circuit.

2. Circuit For Suppression Of Spurious Radiation

   The tuning circuit between frequency synthesizer and final AMP Q26 and LPF(Low Pass Filter) Module in the Q26 output circuit sever to suppress spurious radiation . This Module serves to impedance math Q26 to the antenna and to reduce spurious content to acceptable levels. In the frequency synthesizer.

3. Circuits For Limiting Power

   During factory alignment, the series base resistor of final Q26(R70) is selected to limit the available power to slightly more than 4 watts. The tuning is adjusted is adjusted so that the actual power is from 3.6 to 4.4 watts there are no other controls for adjusting power.

4. Modulation

The MIC input is fed to audio power IC2 which feeds modulation transformer T1. The audio output at the secondary of T1 is fed in series with the B + voltage the diode D11 to the collectors of driver Q25 and final Q26 to collector modulate both these stages.

5. Circuits For Limiting Modulation

A portion of the modulating voltage is rectified by D11 which turns on Q11 which attenuates the MIC input to MIC AMP IC2 the resulting feedback loop-keeps the modulation from exceeding 100% inputs approximately 40dB greater than that required to produce 50% modulation. The tack time is about 50ms and the release time is about 300ms.

7.3. Receiver

The receiver is a double conversion super heterodyne with the first IF at 10.695MHz and the second IF at 455KHz .The synthesizer supplies the first local oscillator 106.95MHz below the received frequency and the second local oscillator at 10.240MHz . Squelch is controlled by Q13

- Q3 is a 27MHz input amplifier, and any excessive input signal is limited by diodes D101 The amplified 27MHz is mixed with VCO frequency by channel switch. For CH.1 VCO is set at 16.27MHz The resulting first IF is 26.965 16.27 = 10.695MHz

- Q4 is the first converter, and the 10.695 MHz is sharply filtered by L104 and a ceramic flirt CF2 The first IF is again mixed with a second local oscillator of 10.24MHz
  10.695 – 10.24 = 0.455MHz

- Q5 the second convertr. Second IF is filtred by a razor sharp ceramic filtr of CF2 coupled wit Q6, T5
- Q6 is the first 455KHz amplifiers, and the Q7 being the last amplifier.
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D3 is a detector diode, which produces audio. The biasing voltage has a tive constant determined by R34 the Cathode of ANL .The biasing voltage has a tive constant determined by R34 and C29. There for any sharp negarive going pulse from D3.

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SQ is controlled by Q13

8. ALIGNMENT INSTRUCTIONS

Warning: Any repairs or adjustment should be made under the supervision of a qualified radio-telephone technician.

8.1. VCO

a. Connect the power supply (DC 13.8V)

b. Connect the oscilloscope probe to test point

c. Adjust the coilT7 for 2V at 1-Ch RX.

d. Check that CH-40 voltmeter of receiver reads from 2 to 4 volts

8.2 Transmitter

a. TX Power alignments

With RF voltmeter at base of Q23, transmit of channel 19 . Adjust in turnT8, T9. For maximum reading on RF voltmeter. Repeat as needed. Remove RF voltmeter.

b. Max Mod Alignments

Adjust RV2 to obtain 90% MOD. At 20db greater than 50% MOD. AF 1KHz.

c. Power Meter Alignments

1. Connect RF voltmeter and dummy load to antenna connector.

2. Push PTT switch and reduce supply voltmeter until read 3.6 watt from RF voltmeter output.

3. Adjust RV4 until p-4 (LED) just appeared.

d. Final Check

1. Output power should be from 3.6 to 4.4 watts.

2. Frequency should be within + 400Hz of channel center frequency.

3. Spurious content as observed on spectrum synthesizer should be at least 60db below carrier.

4. With 2500Hz modulation at 20db greater than that required to produce 50% Modulation, occupied bandwidth should be at least 2db better than limit spec.

8.3 RX

Sensitivity Alignment

a. Set the signal generator to provide 27.185MHz, 1KHz 30% modulation. Place the channel selector in channel 19 position.

b. Adjust T3, T4 and 45 for maximum audio output across the 8ohms dummy load resistor. This alignment should be performed by gradually decreasing the signal output signal to a minimum level required for tuning to avoid in accurate alignment due to AGC action.

S-Meter Alignment

a. Set the signal generator to provide -67dbm, 1KHz, 30% modulation antenna input.

b. Adjust RV3 until S-9(LED) Just appeared.