CIRCUIT DESCRIPTION

A general description of the overall circuit is covered in the instruction manual. This section provides the description of circuits required by subpart 2.983 of the Commissions' rules.

The following are included:

1) Means for Frequency Stabilization

2) Means for Modulation Limiting

3) Means for Attenuation of Higher Audio Frequencies

4) Means for Attenuation of Spurious Emissions

5) Means for Limiting Output Power

6) Means for Modulation Techniques

7) Means for Transient Frequency Behavior

1) **Means For Frequency Stabilization**
Frequency stability is maintained by a reference oscillator/programmable temperature compensation circuit located in the frequency synthesizer IC U201. The oscillator is a Colpitts design with an amplifier in the IC. The 16.8 MHz crystal FL201, varactor and feedback capacitors are external circuitry. A control voltage applied to the varactor via the programmable compensation circuit maintains the frequency stability to within +/-2.5 ppm over temperature. Frequency tuning, also from the programmable compensation circuit, has 128 steps of resolution.

Each 16.8 MHz crystal is numerically coded providing its unique characteristic over the temperature range. With the crystal temperature characteristic known, a computed compensation characteristic is programmed into the compensation algorithm.

2) **Means for Limiting Modulation**
Modulation limiting is accomplished within the custom IC, U404. The limiting action itself occurs at the rails (i.e., 3.3V and ground). Using an opamp with feedback, very hard limiting is obtained. The limited modulation signal is then input through a low-pass splatter filter then to an electronic attenuator within U404 in order to adjust for variations in modulation sensitivities of the frequency synthesizer.

The electronic attenuator is controlled by the radio's micro-processor, U409. To keep the deviation constant over the RF frequency range & channel bandwidth, the microcomputer adds the proper correction factor to the attenuator.

3) **Means for Attenuation Of Higher Audio Frequencies**
The output of the limiter is applied to a low-pass splatter filter. This filter is a fifth-order switched capacitor filter with the rolloff corner located at 3000 Hz. The output of the low-pass filter is input to the electronic attenuator before routing to the modulator.

4) **Means For Attenuation Of Spurious Emissions**
The final stage of the RF power amplifier circuit feeds a low-pass filter in order to attenuate harmonics of the carrier frequency as well as any spurious signals. The filter is a Elliptic 7 element design using LC lump elements.

5) **Means For Limiting Output Power**
The radio utilizes a current sense ALC IC U102 to regulate its output power. The current sensing resistor R102 provides a feedback signal to U102. This signal is then compared to the preprogrammed current reference and the error signal is amplified and used to generate a control voltage to control the bias for Driver U101 and final stage RF Power Amplifier, Q110.

6) **Means Modulation Techniques**
The transmitter is capable of the following types of modulation:

i) Modulation of PL (Private Line) - Direct FM tone modulation of 67 Hz to 250.3 Hz at 15% of full system deviation.

ii) Modulation of DPL (Digital Private Line) - Direct FM modulation at 134 BPS at 15% of full system deviation.

iii) Modulation of DTMF tones at nominally 60% of full system deviation

Direct FM of PL or DPL is generated by a 6-bit D/A converter contained within U404. The frequency-determining clock signal is generated by the radio microcomputer. The modulation signal is processed through a five pole switched capacitor filter. The output of the filter is input to the electronic attenuator circuit.
The microcomputer adjusts the attenuator to compensate for modulation sensitivity variations of the synthesizer & channel bandwidth ensuring 15% of full system deviation for PL and DPL.
DTMF tones are generated by the audio processing IC, U404. The tones are routed and processed in the same manner as the voice signals.

7) **Means of Transient Frequency Behavior**

RF power amplifier input impedance swings very wild during sudden turn on. The drastic impedance change can pull or shift the VCO frequency momentarily. This will cause interference to the adjacent channel user. It is very hard to eliminate the problem totally. But FCC has come up a certain requirement on how much power and frequency deviation is allowed to happen during a specific time.

This radio is design in such away that the VCO and RF power amplifier are properly isolated. This is achieved by putting a three dB pad in the VCO buffer and the RF PA Pre-driver. Controlling the rate of power rise and down helps significantly in reducing the transients.