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 U4201. The oscillator is a Colpitts design with an amplifier in the IC. The 16.8 MHz crystal Y4261, varactor D4261, and feedback capacitors are external circuitry. A control voltage applied to the varactor via the programmable compensation circuit within U4201maintains the frequency stability to within +/-2.5 ppm over the specified operating temperature range. 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 operating temperature range. With the crystal temperature characteristic known, a computed compensation characteristic is programmed into the compensation algorithm.

For applications requiring higher frequency stability, an external TCXO module, Y4262, replaces crystal Y4261 and varactor D4261, with the frequency-determining control voltage applied to the frequency adjust pin of the TCXO module.

2) **Means for Limiting Modulation**

Modulation limiting is accomplished within the custom IC, U0221. The limiting action itself occurs at the rails (i.e., 5V and ground). Using an op-amp with feedback, very hard limiting is obtained. The limited modulation signal is then applied to a low-pass splatter filter, and then to an electronic attenuator within U0221 in order to adjust for variations in modulation sensitivities of the frequency synthesizer.

The electronic attenuator is controlled by the radio's microprocessor, U0101. 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 roll-off corner located at 3000 Hz. The output of the low-pass filter is applied to the electronic attenuator before being routed 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 five-pole elliptic design using LC lumped elements.

The cast metal chassis forms a compartmentalized shielded enclosure upon which the main circuit board is mounted. A second cast metal compartmentalized shielded enclosure is placed over the main circuit board and secured to the chassis with screws. A conductive elastomeric coating is bonded to the edges of the metal chassis and shield enclosure walls, which come in contact with gold-plated areas of the circuit board when the circuit board and shield are assembled to the chassis. This technique provides very effective and reliable shielding of the various circuits on the main board from each other and from the external environment, minimizing spurious RF radiated emissions.

5) **Means For Limiting Output Power**

Output power is regulated through the use of a forward power detection ALC loop. A directional coupler samples a portion of the forward RF power. The sampled RF is rectified by diode D4451, and the resulting dc voltage is routed to the Power Control IC U4501. This signal is then compared to the preprogrammed reference and the error signal is amplified and used to generate a control voltage to control the bias of the first and second transmitter stages, U4401 and Q4421 respectively.

6) **Means For Modulation**

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 U0221. 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, U0221. The tones are routed and processed in the same manner as the voice signals.

7) **Transient Frequency Behavior**

The effects of VCO frequency shifts due to transmitter key-up and de-key impedance variations are minimized through the use of a multiple-stage transmitter lineup with resistive isolation pads between various stages, including a pad between the output of the VCO/buffer IC and the input of the transmitter circuit.

Additionally, the value of the DAC which controls output power is gradually raised during transmitter key-up and lowered during de-key, shaping the transmitter attack and decay characteristics by gradually changing the power control voltage.

Finally, a pre-bias voltage is applied to the RF detector diode in the directional coupler so that the power control circuit does not react to a zero-power condition at transmitter key-up by attempting to increase the power output instantaneously to a high level.