

**EXHIBIT 4**  
**CIRCUIT DESCRIPTION**

**4.1. Carrier Frequency Generation and Stabilization**

A 16.8 MHz reference frequency is generated and stability is maintained with +/- 1.5 ppm temperature stability from -30 to +60 degrees Celsius by a purchased, self contained temperature compensated crystal oscillator (TCXO) reference oscillator. The reference frequency is multiplied up to the carrier frequency by a custom fractional-N synthesizer IC and voltage controlled oscillator (VCO) forming a phase-locked loop.

**4.2. Digital Modulation Techniques**

The transmitter is capable of the following types of modulation:

- i) Voice 300Hz to 3kHz
- ii) Modulation of PL (Private Line) - Direct FM tone modulation of 67 Hz to 250.3 Hz at 15% of full system deviation.
- iii) Modulation of DPL (Digital Private Line) - Direct FM modulation at 134 BPS at 15% of full system deviation.
- iv) Modulation of DTMF tones at nominally 60% of full system deviation.
- v) Trunking High Speed Data.

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

**4.3. Modulation Limiting and Post Limiter Filter**

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.

**4.4. Means for Output Power Limiting**

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.

**4.5. Spurious and Harmonic Emissions Suppression**

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.