

2.0 Technical Description

2.1 Type of Emission

The device has F1D emission.

The reference device uses a digital, frequency shift keying modulation scheme with no sub-carriers. The patient data (analog signals) are digitally encoded. The digital signal is used to frequency modulate the carrier with a maximum modulation frequency of 3.5 kHz and a maximum data rate of 7000 bits per second.

The emission designator "F1D" was selected based upon the guidelines in CFR 2.201: "F" designates an emission in which the main carrier is frequency modulated. "1" designates a single channel containing digital information without the use of a modulating sub-carrier (the applicant confirmed that no sub-carriers are used). "D" designates data transmission, telemetry. As detailed in the user manual, the device is used to transmit one way, non-voice, biomedical telemetry.

2.2 Frequency Range

The device has a frequency range of 460.0125 MHz to 469.9875 MHz.

2.3 Operating Power Level

The Operating Power Level is 1 milliwatts (\pm 2dB). This level is not adjustable.

2.4 Maximum Power Level

The maximum power level is the same as the operating power level of 1.0 milliwatts (\pm 2dB). The device will be operating under the exemption from technical standard (90.217) which permits output power levels to 120 mW. The device will also be operating 90.267(a)(5) which permits output levels to 20 mW.

2.5 DC Voltage and Current Applied

The final RF amplifier is supplied with 3.5VDC and draws a current of 2.2 mA.

2.6 Active Circuit Device (Refer to Block Diagram and Schematics)

Q2 and Q1 are NPN transistors that make up the cascade amplifier used as a Voltage Controlled Oscillator to oscillate the frequency range of 460 MHz to 470 MHz. Q3 and Q5 are NPN transistors that make up the cascade amplifier used as a buffer amplifier. IC17 is used for reference crystal oscillator. Q5 and Q6 are NPN transistors that make up the cascade amplifier that is used to isolate the final amplifier of Q4. Q4 is used to amplify the frequency range of 460 MHz to 470 MHz and its output drives the antenna.

2.7 Circuit Diagram

Block Diagram and Schematics are separate attachments.

2.8 Operators Manual (Instruction Book)

Operators Manual is separate attachment.

2.9 Tune-up Procedure (Refer to Block Diagram and Schematics)

VC1 is adjusted for maximum amplitude of the RF Output. VC2 brings the oscillator within 200 Hz of the correct frequency. VR1 is then adjusted for specified level at the 460 MHz to 470 MHz output.

2.10 Frequency Stabilizing Circuitry (Refer to Block Diagram and Schematics)

The frequency is determined by the RF Reference Crystal Oscillator through the Phase Lock Loop mechanism. The active device is IC17. R26, C66, VC2, X3, C68, C67, D4, R25, and IC17 form the RF Reference Crystal Oscillator. The RF Reference oscillation frequency of 2.4000MHz feeds the Phase Lock Loop IC, IC14. The Phase Lock Loop IC, IC14 controls the voltage controlled oscillator through R18, R24, C69, R84, C59, R85, C57, R1, C4, R2, L1, and D1. The Voltage Controlled Oscillator of Q2 collector is feeding to Q1 emitter and its output is feeding to Q3 base through C11. The Q3 collector is feeding to Q5 emitter and its output is feeding to pre-scaler IC, IC6 through L4, C74. The IC17 output is feeding to phase lock loop IC, IC14 through C50 to feed back.

The frequency data is stored in IC13 and feeds the Phase Lock Loop IC, IC14 through IC1, RM8. The frequency is determined primarily by crystal X3. X3 is specified to have an initial tolerance of +/- 10ppm and a temperature stability of ± 2.5 ppm from from 0 degrees C to 40 degrees C.

VC2 adjusts the RF reference oscillation frequency and brings the transmission frequency within +/- 200Hz. D4 compensate the deviation of the frequency modulation of lower frequency components.

2.11 Spurious Suppression (Refer to Block Diagram and Schematics located in Appendix I)

Spurious frequencies are generated by VCO which is in the PLL and the RF power amplifier. Suppression of VCO spurious frequencies are performed by the CR low pass filter which acts as a smoother for VCO response in the PLL. The filter composed of R18, R24, C69, R84, C59, R85, C57, R78, and C52 have a cut off frequency of 2 Hz to reject the nearby carrier frequency of 12.5 kHz and harmonics more than 40dB.

Suppression of RF power amplifier spurious frequencies are performed by the coupled resonator filters which act as tuned loads for both Q6 and Q4. The filter following Q6, composed of L5, C82, C27, and C80 are tuned to approximately 460 MHz and rejects all other harmonics of 460 MHz. The filter following Q4 composed of VC1, L2, C61, C58, C62 and D3 are tuned to approximately 460 MHz. The filter following Q4 coupled resonator act as loads of Q4, composed of F5 is a low pass filter which is having the cut off frequency of approximately 512 MHz and rejects all other harmonics of main carrier by more than 25 dB relative to the 460 MHz component.

The modulation is limited by the amplitude of the digital waveform, the gain of the splatter filter and the conversion gain of the PLL. The digital waveform is fixed at 0V to 3V and cannot be any larger. This signal amplitude is adjusted by the VR2 variable resistor. All circuits following this point have fixed gains.

2.11 Spurious Suppression (con't) **(Refer to Block Diagram and Schematics)**

The output power is limited by the current drain of the final amplifier stage and the level of the signal going into the final stage. The current drain of the final stage is adjusted to be slightly less than the rated power. The cabinet which contains all of the circuitry is locked by a unique screw and cannot be opened by the customer, so the output power cannot be adjusted.

2.12 Digital Modulation **(Refer to Block Diagram and Schematics)**

The analog data channels are time multiplexed and then encoded to digital codes. These digital codes are mixed with specific pseudo random digital codes to keep the frequency deviation neutral. The system is constrained so the minimum pulse width is about 143 uS. The specific digital code combinations are used for synchronization.

The blunted edge digital waveform generator composed of R10, R12, R14, R16, R56 and R60 resistor ladder network simulates the gaussian filter. The splatter filter following the blunted edge digital waveform generator composed of IC7A, C64, R87, C65, R88, VR2, R40, C30, R37, C26, R34, R79, R4, R5, and R3 act as a Bessel filter with cut-off frequency of 1 Hz before modulating the voltage controlled oscillator. The amplitude and phase response of this filter is attached.

HLX - 501 Block Diagram

