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 1.0 milliwatts (± 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 (± 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 under 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 1.5VDC and draws a current of 2.8 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 buffer amplifier. IC29 is used for reference crystal oscillator. Q2 is a NPN transisitor used to isolate the final amplifier of Q1.

Transistor Q1 also amplifies the frequency range of 460 MHz to 470 MHz and this output drives

(Refer to Block Diagram and Schematics)

VC2 is adjusted for maximum amplitude of the RF OUTPUT.

VC3 brings the oscillator within 200 Hz of the correct frequency. VR1 is then adjusted for the specified level at the 460MHz 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 IC29. R177, C167, VC3, X1, C162, C60, D2, R173, and IC29 form the RF Reference Crystal Oscillator. The RF Reference oscillation frequency of 2.4000MHz feeds the Phase Lock Loop IC, IC28. The Phase Lock Loop IC, IC28 controls the voltage controlled oscillator through R170, R167, C155, R161, C147, R160, C141, R1, C4, R2, L1, and D1. The Voltage Controlled Oscillator of Q2 collector feeds to Q1 emitter and it's output connects to Q3 base through C11. The Q3 collector feeds to Q5 emitter and it's output connects to pre-scalar IC, IC21 through L3, C50. The IC21 output feeds to phase lock loop IC, IC28 through C59 to feed back. The frequency data is memorized in the IC31 and connectes to the phase lock loop IC, IC28 through IC22, R189. The frequency is determined primarily by crystal X1. X1 is specified to have an initial tolarance of $\pm$ 10ppm and a temperature stability of $\pm$ 2.5 ppm from 0 degrees C to 40 degrees C.

VC3 adjusts the RF reference oscillation frequency and which bring the transmission frequency within $\pm$ 200 Hz. D2 compensate the deviation of the frequency modulatioin of lower frequency components.

2.11 Spurious Suppression
(Refer to Block Diagram and Schematics)

Spurious frequencies are generated by VCO which is in the PLL and the RF power amplifier. Suppression of VCO spurious frequencies is performed by the CR low pass filter which acts as a smoother for VCO response in the PLL. The filter composed of R170, R167, C155, R161, C147, R160, and C141 has a cut off frequency of 2 Hz to reject the nearby carrier frequency of 12.5 kHz and its harmonics.

Suppression of RF power amplifier spurious frequencies are performed by the coupled resonator filters which act as tuned loads for Q1. The filter following Q2, composed of L9, C152, C148 is tuned to transmission frequency and rejects all other harmonics of 460 MHz. The filter following Q1 composed of VC2, L8, and C143, and C144 is tuned to transmission frequency and rejects all other harmonics of the main carrier. The filter following Q1 coupled resonator act as loads of Q1, composed of FL1 is a low pass filter which is having the cut off frequency of approximately 470 MHz and rejects all other harmonics of main carrier by more than 25 dB relative to the 460 MHz component.

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 R54 to R58 resistor ladder network simulates the gausshan filter. The splatter filter following the blunted edge digital waveform generator composed of IC23A, C187, C188, R213, VR2, R212, C181, R210, C180, R35, R1, C4, and R2 acts as a Bessel filter with cut-off frequency of 4.5 kHz before modulating the voltage controlled oscillator. The amplitude and phase response of this filter is attached.

LX−5120 Block Diagram