Measurement/Technical Report

Fukuda Denshi Co., LTD. , Model HLX-501

FCC ID: DV8HLX501A

August 16, 1999

This report concerns (check one): Original Grant__x_ Class II Change_____

Equipment Type Biomedical Telemetry Transmitter

Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)? yes_____ no__X__

If yes, defer until: _____N/A_____
date

Fukuda Denshi Co., LTD. agrees to notify the Commission by: _____N/A_____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

Northwest EMC, Inc.
120 South Elliott Road, Suite 300
Newberg, OR 97132
(503) 537-0728
fax: (503) 537-0735

Table of Contents

1.0 General Information

1.1 Product Description

Manufactured By ..... Fukuda Denshi Co., LTD.

Address ..... 17725 NE 65th St. Bldg. C Redmond, WA 98052

Test Requested By: ..... Drew Queen

Model HLX-501

FCC ID DV8HLX501A

Serial Number(s) 00000006

Date of Test..... August 10, 1999 through August 16, 1999

Job Number..... FUKU0006

The Equipment Under Test (EUT) is the Fukuda Denshi Co. Model HLX-501, Serial No. 00000006, FCC ID: DV8HLX501A. The EUT is a Telemetry Transmission Module to transmit physiological parameters monitored by a bedside monitor in the DS-5000 series via wireless technology. The EUT is programmed through software transferred from an IC card installed in the bedside monitor.

Quanity Production is planned for this product.

Hardware Description:

- Clocks/Oscillators Frequencies: 2.4000 MHz (reference for carrier frequency), 84 kHz (clock for Gate Array), 16 MHz (CPU clock)
- Ports: Patient Monitor I/F connecto
- Antenna Permanently attached

1.2 Related Submittals/Grants

None.

1.3 Tested System Details

EUT and Peripherals

Item	FCC ID	Description and Serial No.
EUT	DV8HLX501A	Fukuda Denshi Co. Model HLX-501, Serial No. 00000006.
Patient Monitor		Fukuda Denshi Co. Model DS-5100E, Serial No. 10030141.
Patient Simulator		DNI Nevada Inc. Model MedSim 300B Serial No. 2407.

Cables:

Wire Adapter	~55 cm. in length. 8 wires shielded cable, Model No. 0A-287.
ECG Relay cable	~325 cm. in length. 3 wires shielded cable, Model No. CI-161.
ECG 3 Lead cable	~75 cm. in length. Shielded cable x 3, Model No. CM-62.
Wire Adapter Extension Cable	~350 cm. 8 wires (temperature test only).

1.4 Test Methodology

See attached test plan submitted by Northwest EMC, and the faxed approval from the Federal Communications Commission located in Appendix I.

1.5 Test Facility

The Open Area Test Site and conducted measurement facility used to collect the radiated and conducted data is located at

Northwest EMC, Inc.
14128 3309th Ave SE
Sultan, WA 98294
(360) 793-8675
Fax: 793-2536

The Open Area Test Site, and conducted measurement facility used to collect this data is located at the address shown above. This site has been fully described in a report filed with the FCC, dated September 10,1998, and accepted by the FCC in a letter dated November 4, 1998 (31040/SIT)(1300F2).

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

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 (± 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 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 it's output is feeding to Q3 base through C11. The Q3 collector is feeding to Q5 emitter and it's output is feeding to pre-scalar 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 $\pm$ 2.5ppm 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)

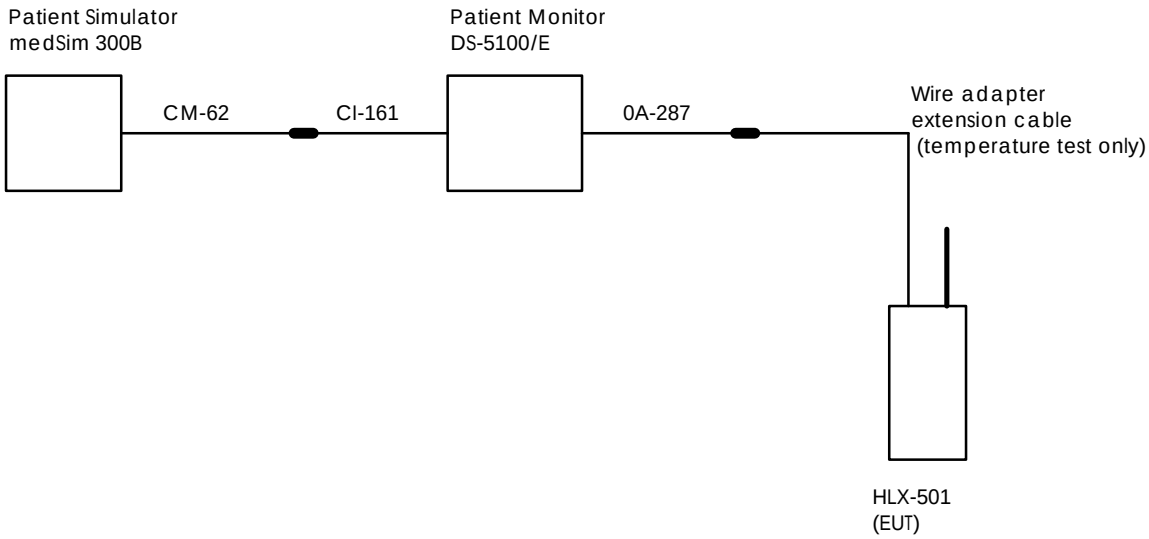
The output power is limited by the current drain of the final amplifier stage and the level of the signal going into the final stage. The current drain of the final stage is adjusted to be slightly less than the rated power. The cabinet which contains all of the circuitry is locked by a unique screw 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 gausshan 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.

Figure 2.1: Configuration of Tested System



3.0 RF Power Output Data

3.1 Test Setup

Power output was measured at the RF output terminals with the transmitter biased for normal operation. The output power level was factory set (to 1mW), and not adjustable by the user.

The output terminals were directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator. The characteristic impedance of the attenuator and the front end of the analyzer are 50. Power measurements were made with the carrier unmodulated using a peak detector on the spectrum analyzer. Resolution bandwidth was set to 120kHz.

Maximum permissible power was 20mW or the minimum required for satisfactory operation. This measurement verified 1mW of power output as specified by the manufacturer.

3.2 Test Results

Low Frequency	Mid Frequency	High Frequency
814.7mW	778.04mW	734.51mW

Judgment: Passed

4.0 Modulation Characteristics Data

4.1 Test Setup

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.

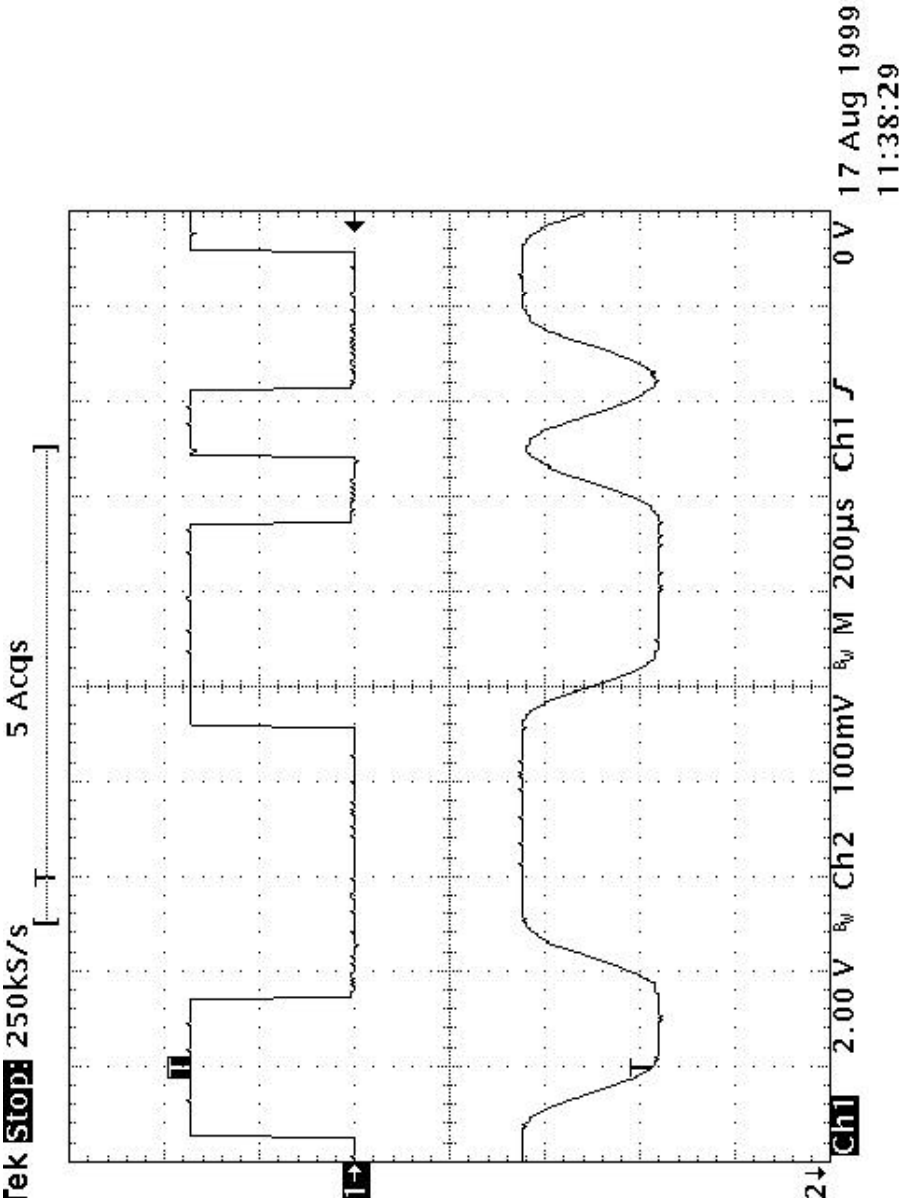
The emission designator “F1D” was selected based upon the guidelines in CFR 2.201: “F” designates an emission in which the main carrier is frequency modulated. “1” designates a single channel containing digital information without the use of a modulating sub-carrier (the applicant confirmed that no sub-carriers 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.

A waveform of the modulating signal as stored on the oscilloscope screen was recorded on a printer.

For telemetry operations, only A1D, A2D, F1D, and F2D emissions are authorized. The EUT utilizes F1D emissions.

4.2 Test Results

See data sheet on next page.


Tek Stop: 250kS/s 5 Acqs
Ch1 2.00 V BW Ch2 100mV BW M 200µs Ch1 ƒ 0 V
17 Aug 1999
11:38:29

5.0 Necessary Bandwidth

The applicant specifies a maximum modulation frequency of 3.5 kHz. The necessary bandwidth, calculated using Carson's Rule: 2M + 2D = 2(3500) + 2(1750) = 10.5 kHz.

The applicant specifies a maximum data rate of 7kBpS (7000 bits per second).

6.0 Occupied Bandwidth Data

6.1 Test Setup

The occupied bandwidth was measured at the RF output terminals with the EUT set for normal operation. The output terminals were directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator.

The spectrum analyzer was set with a peak detector, a resolution bandwidth of 100Hz (VBW≥ 100 Hz), and a frequency span of 125kHz. No video filtering was used. The carrier was modulated (typical of normal operation). The peak envelope of the out-of-band emissions, as stored on the spectrum analyzer screen, was recorded on a plotter.

"...the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability was adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency was attenuated at least 30 dB below the unmodulated carrier."

6.2 Test Results

Low Frequency	Mid Frequency	High Frequency
-63.40dBc	-65.14dBc	-64.24dBc

Judgment: Passed, the highest emission within 25 kHz of the assigned frequency is attenuated greater than 60dBc

7.0 Spurious Emissions at Antenna Terminals Data

7.1 Test Setup

No testing is required for spurious emissions at the antenna terminals **if** the antenna is integral to the construction of the EUT. If the antenna is detachable, then measurement data is required:

Spurious emissions were measured at the RF output terminals with the EUT set for normal operation. The output terminals were directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator. The carrier was modulated (typical of normal operation).

The spectrum was scanned from 30MHz to 1GHz with a 10kHz resolution bandwidth and a peak detector. The spectrum was also scanned from 1GHz to 5GHz (10^{th} harmonic of carrier is 4.6 to 4.7 GHz) with a resolution bandwidth of 1MHz and a peak detector. No video filtering was used. The peak envelope of the spurious emissions, as stored on the spectrum analyzer screen, was recorded on a plotter. The magnitude and frequency of any spurious emission attenuated less than 50 dB (within 20 dB of the limit) below the power of the unmodulated carrier was recorded.

For up to 5GHz, any spurious emission appearing on a frequency 25 kHz or more removed from the assigned frequency was attenuated at least 30 dB below the unmodulated carrier.

7.2 Test Results

Low Frequency		Mid Frequency		High Frequency	
460 MHz (carrier)	105 dBµV	465.0 MHz (carrier)	104 dBµV	470 MHz (carrier)	103 dBµV
917.5 MHz	46.30 dBµV	927.2 MHz	45.97 dBµV	936.9 MHz	44.83 dBµV
1.383 GHz	53.42 dBµV	1.400 GHz	53.97 dBµV	2.645 GHz	51.73 dBµV
3.223 GHz	55.78 dBµV	3.258 GHz	57.11 dBµV	3.177 GHz	52.55 dBµV

Judgment: Passed, all spurious emissions 25 kHz or more removed form the assigned frequency are attenuated greater than 30 dB

8.0 Field Strength of Spurious Radiation Data

8.1 Test Setup

The field strength of spurious emissions that may be radiated from the EUT were measured in the far field. The EUT was taken to an Open Area Test Site on file with the FCC and set for normal operation. The carrier was modulated by patient data from the host device (typical of normal operation). The EUT's antenna was attached to the transmitter.

The measurement antenna to EUT test distance was 3 meters. With the spectrum analyzer connected to the appropriate measurement antenna, the spectrum was scanned from 30MHz to 1GHz with a 10kHz resolution bandwidth and a peak detector. The spectrum was also scanned from 1GHz to 5GHz with a resolution bandwidth of 1MHz and a peak detector. No video filtering was used.

The measurement antenna was scanned in height from 1 to 4 meters and the orientation of the EUT varied to maximize the level of any spurious emissions. Each spurious emission was maximized with the magnitude and frequency recorded for any signal attenuated less than 50 dB (within 20 dB of the limit) below the power of the unmodulated carrier. Measurement procedure ANSI C63.4 (1992) were referenced.

For up to 5 GHz, the field strength of any radiated spurious emission appearing on a frequency 25 kHz or more removed from the assigned frequency was attenuated at least 30 dB below the unmodulated carrier.

8.2 Test Results

Low Frequency		Mid Frequency		High Frequency	
460.011 (carrier)	92.8dBuV/m	464.999 (carrier)	98.2dBuV/m	469.986	98.1dBuV/m
1380.000	62.1dBuV/m	1394.913	60.3dBuV/m	1409.938	56.9dBuV/m
No other spurious emissions less than 50dBc were detected.		No other spurious emissions less than 50dBc were detected.		No other spurious emissions less than 50dBc were detected.	

9.0 Frequency Stability (Supply Voltage) Data

9.1 Test Setup

The frequency stability of the EUT's unmodulated carrier was measured. The transmitter was biased for normal operation. The output power level was factory set (≈1mW) , and not adjustable by the user.

Frequency stability of the unmodulated carrier will also be measured for variations in supply voltage. For AC powered devices, the primary supply voltage will be varied from 85% to 115% of the nominal value. Frequency measurements will be made at the nominal supply voltage and at each extreme.

The carrier frequency had to be within the assigned frequency by a margin no greater than the sum of: the bandwidth occupied by the emitted signal, plus the bandwidth required for frequency stability (2.5ppm ≈1.15kHz), plus 25 kHz. This is equal to 12.5 kHz + 1.15 kHz + 25 kHz, which is equal to 38.65 kHz.

9.2 Test Results

Supply Voltage	Low Frequency	Mid Frequency	High Frequency
100% = 115 VAC	465.01295 MHz	465.00039 MHz	469.98778 MHz
85% = 97.75 VAC	460.01276 MHz	465.00019 MHz	469.98778 MHz
115% = 132.25 VAC	460.01295 MHz	465.00039 MHz	469.98797 MHz

Judgment: Passed, the carrier frequency stayed within the assigned frequency by a margin no greater than 38.65 kHz.

10.0 Frequency Stability (Temperature) Data

10.1 Test Setup

The frequency stability of the EUT's unmodulated carrier was measured. The transmitter was biased for normal operation. The output power level was factory set (≈1mW) , and not adjustable by the user. 2.995(a1) specifies that the ambient temperature will be varied from -30° to +50° centigrade The EUT is specified to be used from +10° to +40° centigrade (hospital or clinic environment). Frequency measurements were made at the extremes of the test range (-30° to +50° centigrade), and at intervals of 10° centigrade through the range. A sufficient period of time was allowed at each temperature interval to allow the components of the oscillator / clock circuitry to stabilize (see attached Time Vs. Temperature graph).

The carrier frequency had to be within the assigned frequency by a margin no greater than the sum of: the bandwidth occupied by the emitted signal, plus the bandwidth required for frequency stability (2.5ppm ≈1.15kHz), plus 25 kHz. This is equal to 12.5 kHz + 1.15 kHz + 25 kHz, which is equal to 38.65 kHz.

10.2 Test Results

Temperature	Low Frequency	Mid Frequency	High Frequency
+50°	460.01237 MHz	465.00000 MHz	469.98744 MHz
+40°	460.01237 MHz	465.00000 MHz	469.98744 MHz
+30°	460.01237 MHz	465.00000 MHz	469.98744 MHz
+20°	460.01256 MHz	465.00019 MHz	469.98744 MHz
+10°	460.01237 MHz	464.99981 MHz	469.98725 MHz
0°	460.01237 MHz	465.00019 MHz	469.98744 MHz
-10°	460.01256 MHz	465.00000 MHz	469.98744 MHz
-20°	460.01218 MHz	464.99981 MHz	469.98725 MHz
-30°	460.01218 MHz	464.99981 MHz	469.98725 MHz

Judgment: Passed,.

11.0 Measurement Equipment

Instrument	Model	Serial No.	Freq Range	Last Cal	Cal Due
Spectrum Analyzer	HP 8593E	3710A02766	10 kHz - 22 GHz	02/05/99	02/05/00
Spectrum Analyzer	HP 8591E	3346A02097	10 kHz – 1.8 GHz	10/05/98	10/05/99
Spectrum Analyzer	HP 8568B	2601A02125	100 Hz – 1.5 GHz	09/01/98	09/01/99
Quasi-Peak Adapter	HP 85650A	2043A00214	10 kHz - 1000 MHz	09/01/98	09/01/99
Log Periodic Antenna	EMCO 3146	5060	200 MHz - 1000 MHz	12/31/98	12/31/99
Pre-Amplifier	HP 83017A	3123A00288	0.5 GHz – 26.5 GHz	07/17/99	07/17/00
Horn Antenna	EMCO 3115	9906-5818	1 GHz - 18 GHz	06/08/99	12/08/00
High Pass Filter	Microlab FH-1001	TE-447910	1 GHz	01/28/99	01/28/01
DC Power Supply	HP 6266B	2549A05642	N/A	NCR	NCR
AC Power Supply	Instek APS-9050	E991295	N/A	NCR	NCR
Multi-Meter	Fluke 79	56470635	N/A	07/22/99	07/22/00

FEDERAL COMMUNICATIONS COMMISSION

Equipment Authorization Division, Application Processing Branch
7435 Oakland Mills Road, Columbia, MD 21046
Telephone: (301) 725-1585, Facsimile: (301) 344-2050

Date: 2/13/97 Time:

From: George Tannahill Extension: 237

To: Greg Kiemel

Organization: Northwest EMC

Telephone: (503) 537-0728 Facsimile: (503) 537-0735

This cover sheet is page 1 of 1 pages. Please direct inquiries to the sender at the above extension.

Reference: Your Fax dated 2/6/97

The items indicated below must be submitted before processing can continue on the above referenced application. Failure to provide the requested information within 60 days may result in application dismissal pursuant to Section 2.917(c) and forfeiture of the filing fee pursuant to Section 1.1106.

☐ Block diagram(s) showing all clocks/oscillators or schematic diagrams

☐ Additional detailed photographs of _____

☒ Other Review of your fax shows the described procedure is basically acceptable but please see the following comments for some clarifications and corrections. For the occupied bandwidth tests the resolution bandwidth setting should be 100 Hz and the video bandwidth should be equal to or greater than that. For the spurious test data which shows emissions beyond the area of modulated spectrum, a resolution bandwidth of 10 kHz is acceptable. Also for radiated and conducted spurious testing, any emissions within 500 dB of the unmodulated carrier level should be reported. The necessary bandwidth should be calculated using Carson's Rule 2M+2D, not shown by measurement. Also, please clearly describe the modulating signal parameters. Also, note that the 90.217 requirements have changed with the Memorandum Opinion and Order PR Docket # 92-235 and 92-257 adopted 12/23/96 and released 12/30/96.
When testing frequency stability vs temperature, the frequency range -30° to +50°C must be tested unless the unit will not operate at the edges of that range. Be sure to specify at what frequencies the unit stops operating and measure tolerance at those points.

Initials _____

Preliminary Test Plan - Subject to FCC Approval

Revision: 2/02/97

This device will be seeking type acceptance from the Commission under 90.267(a5) and 90.217(b).

1.0 EUT Specifications

Classification:	One way, non voice, biomedical telemetry device
Modulation Method:	Digital, Frequency Shift Keying (F1D)
RF Output Power:	1mW
Transmission Frequency Band:	460 to 470 MHz (approx. 474 channels)
Channel Spacing:	12.5 kHz
Occupied Bandwidth:	8.5 kHz

2.0 Required Measurements

All measurements will be made with the EUT set to the lowest, a mid-range, and the highest frequency channels.

2.1 RF Power Output (2.985(a), 90.205, 90.217, 90.267(a5))

Power output will be measured at the RF output terminals with the transmitter biased for normal operation. The output power level is factory set (≈1mW), and not adjustable by the user.

The output terminals will be directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator. The characteristic impedance of the attenuator and the front end of the analyzer are 50Ω. Power measurements will be made with the carrier unmodulated using both peak and average detectors on the spectrum analyzer. Resolution bandwidth will be set to 120kHz.

Maximum permissible power is 20mW or the minimum required for satisfactory operation. This measurement will verify 1mW of power output as specified by the manufacturer.

2.2 Modulation Characteristics (2.987(d))

The modulation characteristics will be measured at the RF output terminals with the EUT set for normal operation. A typical load (antenna or resistive load) will be attached to the output terminals. A high speed oscilloscope (≥500 MHz) will be connected to the output terminals through a high impedance, low capacitance probe (e.g. 10MΩ, 8pF probe). The carrier will be modulated (typical of normal operation).

A waveform of the modulating signal as stored on the oscilloscope screen will be recorded on a plotter.

For telemetry operations, only A1D, A2D, F1D, and F2D emissions are authorized. This measurement will verify F1D emissions.

Revision: 2/02/97

2.3 Occupied Bandwidth (2.989(h), 2.202(c), 90.217(b))

The occupied bandwidth will be measured at the RF output terminals with the EUT set for normal operation. The output terminals will be directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator.

The spectrum analyzer will be set with a peak detector, a resolution bandwidth of 10kHz, and a frequency span of 125kHz. No video filtering will be used. The carrier will modulated (typical of normal operation). The peak envelope of the out-of-band emissions, as stored on the spectrum analyzer screen, will be recorded on a plotter.

"...the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier."

2.4 Spurious emissions at antenna terminals (2.991, 2.997, 90.217(b))

No testing is required for spurious emissions at the antenna terminals if the antenna is integral to the construction of the EUT. If the antenna is detachable, then measurement data is required:

Spurious emissions will be measured at the RF output terminals with the EUT set for normal operation. The output terminals will be directly coupled to a spectrum analyzer input through a 20dB (2W) attenuator. The carrier will be modulated (typical of normal operation).

The spectrum will be scanned from 30MHz to 1GHz with a 10kHz resolution bandwidth and a peak detector. The spectrum will also be scanned from 1GHz to 5GHz (10th harmonic of carrier is 4.6 to 4.7 GHz) with a resolution bandwidth of 1MHz and a peak detector. No video filtering will be used. The peak envelope of the spurious emissions, as stored on the spectrum analyzer screen, will be recorded on a plotter. The magnitude and frequency of any spurious emission attenuated less than 40 dB (within 20 dB of the limit) below the power of the unmodulated carrier will be recorded.

For up to 5GHz, any spurious emission appearing on a frequency 25 kHz or more removed from the assigned frequency should be attenuated at least 30 dB below the unmodulated carrier.

2.5 Field strength of spurious radiation (2.993, 90.217(b))

The field strength of spurious emissions that may be radiated from the EUT will be measured in the far field. The EUT will be taken to an Open Area Test Site on file with the FCC and set for normal operation. The carrier will be modulated by patient data from the host device (typical of normal operation). The EUT's antenna will be attached to the transmitter.

The measurement antenna to EUT test distance will be 3 meters. With the spectrum analyzer connected to the appropriate measurement antenna, the spectrum will be scanned from 30MHz to 1GHz with a 10kHz resolution bandwidth and a peak detector. The spectrum will also be scanned from 1GHz to 5GHz with a resolution bandwidth of 1MHz and a peak detector. No video filtering will be used.

The measurement antenna will be scanned in height from 1 to 4 meters and the orientation of the EUT varied to maximize the level of any spurious emissions. Each spurious emission will be maximized with the magnitude and frequency recorded for any signal attenuated less than 40 dB (within 20 dB of the limit) below the power of the unmodulated carrier. Measurement procedure ANSI C63.4 (1992) will be referenced.

For up to 5 GHz, the field strength of any radiated spurious emission appearing on a frequency 25 kHz or more removed from the assigned frequency should be attenuated at least 30 dB below the unmodulated carrier.

2.6 Frequency Stability (2.995(a1)(b)(d), 90.213, 90.217(b))

The frequency stability of the EUT's unmodulated carrier will be measured. The transmitter will be biased for normal operation. The output power level is factory set (≈1mW) , and not adjustable by the user. Although 2.995(a1) specifies that the ambient temperature will be varied from -30° to +50° centigrade, the EUT is specified to be used from +10° to +40° centigrade (hospital or clinic environment). The test will be destructive if performed from -30° centigrade. Therefore, frequency measurements will be made at the extremes of the operating range (+10° to +40° centigrade), and at intervals of not more than 10° centigrade through the range. A sufficient period of time will be allowed at each temperature interval to allow the components of the oscillator / clock circuitry to stabilize.

Frequency stability of the unmodulated carrier will also be measured for variations in supply voltage. For AC powered devices, the primary supply voltage will be varied from 85% to 115% of the nominal value. Frequency measurements will be made at the nominal supply voltage and at each extreme.

For battery powered devices, the primary supply voltage will be reduced to the battery operating end point specified by the manufacturer. Frequency measurements will be made at the nominal battery voltage and at the end point.

The carrier frequency must be within the assigned frequency by a margin no greater than the sum of: the bandwidth occupied by the emitted signal, plus the bandwidth required for frequency stability (2.5ppm ≈ 1.15kHz), plus 25 kHz. This is equal to 12.5 kHz + 1.15 kHz + 25 kHz, which is equal to 38.65 kHz.