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Measurement/Technical Report

Spacelabs Medical Model 90343/90347 Digital Telemetry Transmitter

FCC ID: CM676A90343

September 3, 1998

This report concerns (check one):		Original Grant ☒ X	Class II Change ☐
Equipment Type: <u>Model 90343/90347 Digital Telemetry Transmitter</u>			
Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)?		yes ☐ no ☒ X	
If yes, defer until:		<u>N/A</u> date	
Spacelabs Medical agrees to notify the Commission by:		<u>N/A</u> date	
of the intended date of announcement of the product so that the grant can be issued on that date.			
Transition Rules Request per 15.37:		yes ☐ no ☒ X	
If no, assumed Part 15, Subpart B for unintentional radiators - new 47 CFR [10-1-92] provision.			
Report prepared by:	Northwest EMC, Inc. 120 South Elliott Road, Suite 300 Newberg, OR 97132 (503) 537-0728 fax: (503) 537-0735		
Report No. SPAC0171			

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Photos of Tested EUT

1.0 General Information

1.1 Product Description

Manufactured By Spacelabs Medical
Address 15220 NE 40th Street, Redmond, WA 98073
Test Requested By: Stephen Cantwell
Model Model 90343/90347 Digital Telemetry Transmitter
FCC ID CM676A90343
Serial Number(s) 340-200250
Date of Test July 15, 1998 through September 14, 1998
Job Number SPAC0171

This application is being submitted in support of an equipment authorization request for the Spacelabs Medical Model 90343 Enhanced Digital Telemetry Transmitter (FCC ID: CM676A90343), in accordance with Part 2 and Part 15 of the Federal Communications Commission's Rules and Regulations.

The Model 90343 is a wideband VHF biomedical telemetry transmitter which is used for the transmission of a patient's vital signs data, including the electrocardiogram (ECG), blood oxygen saturation (SpO₂), and non-invasive blood pressure (NIBP). This physiological data is encoded in a digital format and used to FSK-modulate a crystal controlled, RF carrier. This device is intended for use within hospital buildings. It is battery powered (9 volt alkaline type) and worn by the patient.

This transmitter operates on a 50 kHz channel spacing, on unused VHF television channels (channels 7 through 13; 174 MHz to 217 MHz) in accordance with 47CFR15.242. The RF signal from this transmitter is radiated on one of the patient ECG lead wires, which, at a 3 meter distance, produces a field strength of approximately 104.6 μ volts per meter (2mW power). The allowable field strength for this class of device as authorized under the amendment to the FCC Rules (FCC 97-379) is 200 μ volts per meter (7.3 mW power) at 3 meters.

This transmitter's RF design is based on Spacelabs Medical's Model 90340 UHF telemetry transmitter (FCC ID: CM676A90340), and has had the RF passive components sized for VHF operation. This transmitted RF signal is received by the Model 90478 digital telemetry receiver (FCC ID: CM676A90478). The receiver down-converts and demodulates the vital signs information to baseband, whereby they are processed for display in any of the Spacelabs Medical (SML) Patient Care Management System (PCMSTM) patient monitors.

- Clocks/Oscillators Frequencies: 174 MHz - 217 MHz

1.2 Related Submittals/Grants

The EUT operates in conjunction with the Model 90478 Digital Telemetry Receiver (FCC ID: CM676A90478).

1.3 Tested System Details

EUT and Peripherals

<u>Item</u>	<u>FCC ID</u>	<u>Description and Serial No.</u>
EUT	CM676A90343	Spacelabs Medical Model 90343/90347 Digital Telemetry Transmitter, Serial No. 340-200250.

Cables:

<u>Item</u>	<u>Descriptions</u>
ECG Lead Set	24 inches in length, unshielded. Part Number 012-0285-01.
SpO2 Adapter Cable	39 inches in length, unshielded. Part No. 012-0589-00.
NIPB Cable	58 inches in length, unshielded. Part No. 012-0588-00.

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters. Please reference Appendix I for further detail on Test Methodology.

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.
30475 NE Trails End Ln
Newberg, OR 97132
(503) 537-5566
Fax: 537-5562

The Open Area Test Site, and conducted measurement facility is located in Newberg, OR, at the address shown above. These sites have been fully described in reports filed with the FCC (Federal Communications Commission), and accepted by the FCC in letters maintained in our files.

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.

Northwest EMC, Inc. has been assessed and accredited by NEMKO (Norwegian testing and certification body) for European emissions and immunity testing. As a result of NEMKO's laboratory assessment, they will accept test results from Northwest EMC, Inc. for product certification (Authorization No. ELA 119).

3.0 System Test Configuration

3.1 Justification

The EUT, using the test software described below was exercised and operated in a diagnostic mode using simulated data. The EUT was operated at the high and low frequencies and was tested with a new battery.

3.2 EUT Exercise Software

The diagnostics software executes on the CPU (Motorola 68CK16Z4) of the Transmitter's SpO2 printed circuit board assembly (PCBA) at a clock rate of 8.389 MHz via the internal Phase Locked Loop (PLL) on the CPU. The clock to the CPU is a standard watch crystal (32.768 kHz). A pulse width modulator (PWM) is used to drive the SpO2 red and infrared diodes at 2,048 Hz rate. The CPU buses used for drive, gain, baseband signal output (numerical SpO2 and NIBP data), and SpO2 sampling operate at 2.097 MHz. These buses control the digital-to-analog converters (DACs) for drive current, gain, baseband signal output to the RF modulator. With simulated ECG waveform data inputted into the ECG PCBA, all functions are activated in the diagnostics software and represent a worst case data scenario. Under normal operation, the analog-to-digital converter (A/D) and drive circuitry will power down momentarily to conserve power-this does not occur in the test software.

3.3 Special Accessories

None.

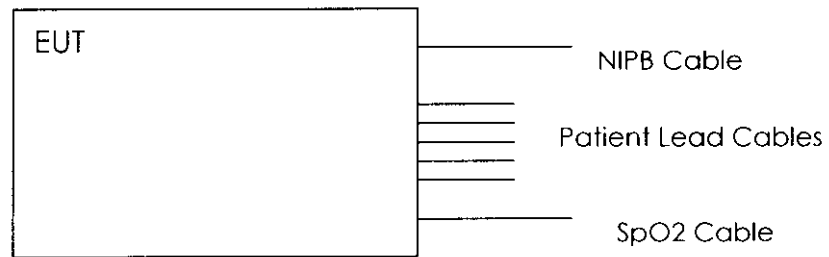
3.4 Equipment Modifications

None.

3.5 Configuration of Tested System

The EUT was connected to a standard patient cable assembly and placed on a non conductive table 0.8 meters above the reference plane.

Figure 3.1: Configuration of Tested System



5.0 Radiated Emissions Data

5.1 The following data lists the most significant emission frequencies, total (corrected) levels, and specification margins. Correction factors, antenna height, table azimuth, etc., are contained in the data sheets immediately following. Explanation of the correction factors is given in paragraph 5.2 of this report. Complete graphs and data sheets may be referenced on the following pages. Minimum margins are listed below:

FCC Part 15.209 Specification Limits

Low Frequency Band

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
174.009	QP	88.3	106.0	17.7	Vertical
174.009	QP	95.1	106.0	10.9	Horizontal

Judgment: Passed, minimum margin of 10.9 dB.

High Frequency Band

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
215.988	QP	64.3	106.0	41.6	Vertical
215.988	QP	72.2	106.0	33.8	Horizontal

Judgment: Passed, minimum margin of 33.8 dB.

5.0 Radiated Emissions Data con't

FCC Part 15.242 Specification Limits

Low Frequency Band

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
522.038	QP	42.6	46.0	3.4	Horizontal
522.038	QP	41.2	46.0	4.8	Vertical
348.018	QP	38.8	46.0	7.2	Horizontal
1740.220	PK	46.3	54.0	7.7	Vertical
1218.154	PK	45.9	54.0	8.1	Horizontal
1566.198	PK	43.9	54.0	10.1	Vertical

Judgment: Passed, minimum margin of 3.4 dB.

High Frequency Band

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
431.970	QP	32.1	46.0	13.9	Horizontal
863.925	QP	32.0	46.0	14.0	Vertical
863.925	QP	29.4	46.0	16.6	Horizontal
647.944	QP	26.5	46.0	19.4	Horizontal
647.944	QP	24.4	46.0	21.6	Vertical
431.970	QP	23.6	46.0	22.4	Vertical

Judgment: Passed, minimum margin of 13.9 dB.

Test Personnel:



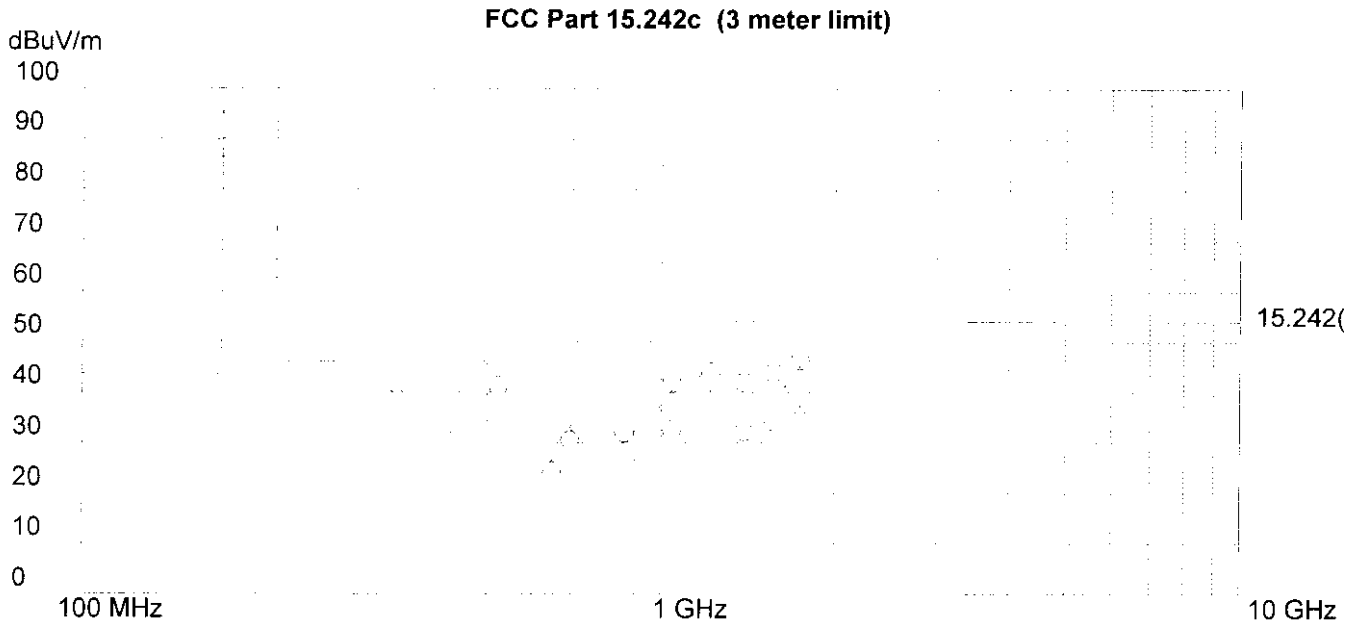
Tester Signature

Typed/Printed Name: Greg Kiemel

Northwest EMC, Inc.

EUT Name: 90343
 Serial Number: 340-200250
 Manufacturer: Spacelabs Medical
 Job Number: SPAC0166
 Test Date: 07-15-1998
 Tested By: Greg Kiemel, TE03
 Test Distance: 3 meters.
 Comments: Transmitting High and Low frequencies
 Run #1

Horizontal= X
 Vertical = O



Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor (dB/m)	Antenna Horizontal Vertical	Preamp Gain (dB)	Cable Loss (dB)	Adjusted Level (dBuV/m)	Spec Limit (dBuV/m)	Table Azimuth (degree)	Antenna Height (meters)	Compare (To Limit (dB)
522.038	17.6	QP	18.1	HLPA	0.0	6.9	42.6	46.0	192.0	2.0	-3.4
522.008	16.2	QP	18.1	VLPA	0.0	6.9	41.2	46.0	0.0	1.0	-4.8
348.018	18.4	QP	15.0	HLPA	0.0	5.4	38.8	46.0	309.0	2.0	-7.2
1740.220	50.3	PK	28.0	VHRN	43.5	11.5	46.3	54.0	92.0	1.4	-7.7
1218.154	54.5	PK	25.9	HHRN	44.5	10.0	45.9	54.0	116.0	1.0	-8.1
1566.198	49.9	PK	27.2	VHRN	44.2	11.0	43.9	54.0	244.0	1.7	-10.1
174.009	77.9	QP	13.4	HDIP	0.0	3.8	95.1	106.0	304.0	1.3	-10.9
1392.176	50.2	PK	26.5	HHRN	44.8	10.4	42.3	54.0	0.0	1.4	-11.7
1044.132	50.7	PK	25.3	VHRN	44.0	9.8	41.8	54.0	295.0	1.8	-12.2
696.047	30.5	QP	26.1	HDIP	31.6	8.0	33.0	46.0	77.0	1.2	-13.0
431.970	41.2	QP	16.3	HLPA	31.4	6.0	32.1	46.0	299.0	1.0	-13.9
863.925	32.4	QP	22.6	VLPA	31.7	8.7	32.0	46.0	301.0	1.1	-14.0
863.925	29.8	QP	22.6	HLPA	31.7	8.7	29.4	46.0	26.0	1.0	-16.6
647.944	30.3	QP	20.0	HLPA	31.4	7.7	26.5	46.0	195.0	1.8	-19.4
647.944	28.1	QP	20.0	VLPA	31.4	7.7	24.4	46.0	0.0	1.2	-21.6
431.970	32.7	QP	16.3	VLPA	31.4	6.0	23.6	46.0	131.0	1.2	-22.4
215.988	52.5	QP	15.5	HDIP	0.0	4.2	72.2	106.0	204.0	1.8	-33.8

Signature

Temperature 80F 42% Humidity

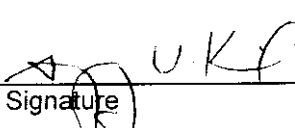
Northwest EMC, Inc.

Version 5.3, April 1998
Freq. Sort

Equipment Tested: 90343
Serial Number: 340-200250
Manufacturer: Spacelabs Medical
Job Number: SPAC0166
Test Date: 07-15-1998
Tested By: Greg Kiemel, TE03
Test Distance: 3 meters.
Comments: Transmitting High and Low frequencies
 Run #1

FCC Part 15.242c (3 meter limit)

Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor (dB/m)	Antenna Horizontal Vertical	Preamplifier Gain (dB)	Cable Loss (dB)	Adjusted Level (dBuV/m)	Spec Limit (dBuV/m)	Table Azimuth (degree)	Antenna Height (meters)	Compare (To Limit (dB))
174.009 Low Frequency	71.1	QP	13.4	VDIP	0.0	3.8	88.3	106.0	300.0	2.0	-17.7
174.009 Low Frequency	77.9	QP	13.4	HDIP	0.0	3.8	95.1	106.0	304.0	1.3	-10.9
215.988 High Frequency	44.7	QP	15.5	VDIP	0.0	4.2	64.3	106.0	275.0	1.6	-41.6
215.988 High Frequency	52.5	QP	15.5	HDIP	0.0	4.2	72.2	106.0	204.0	1.8	-33.8
348.018 Low Frequency	18.4	QP	15.0	HLP A	0.0	5.4	38.8	46.0	309.0	2.0	-7.2
348.018 Low Frequency	18.2	QP	15.0	VLPA	0.0	5.4	38.6	46.0	68.0	1.0	-7.4
431.970 High Frequency	41.2	QP	16.3	HLP A	31.4	6.0	32.1	46.0	299.0	1.0	-13.9
431.970 High Frequency	32.7	QP	16.3	VLPA	31.4	6.0	23.6	46.0	131.0	1.2	-22.4
522.008 Low Frequency	16.2	QP	18.1	VLPA	0.0	6.9	41.2	46.0	0.0	1.0	-4.8
522.038 Low Frequency	17.6	QP	18.1	HLP A	0.0	6.9	42.6	46.0	192.0	2.0	-3.4
647.944 High Frequency	30.3	QP	20.0	HLP A	31.4	7.7	26.5	46.0	195.0	1.8	-19.4
647.944 High Frequency	28.1	QP	20.0	VLPA	31.4	7.7	24.4	46.0	0.0	1.2	-21.6


 Signature

Temperature 80F 42% Humidity

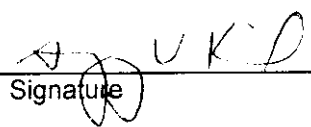
Northwest EMC, Inc.

Version 5.3, April 1998
Freq. Sort

Equipment Tested: 90343
Serial Number: 340-200250
Manufacturer: Spacelabs Medical
Job Number: SPAC0166
Test Date: 07-15-1998
Tested By: Greg Kiemel, TE03
Test Distance: 3 meters.
Comments: Transmitting High and Low frequencies
 Run #1

FCC Part 15.242c (3 meter limit)

Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor (dB/m)	Antenna Horizontal Vertical	Preamp Gain (dB)	Cable Loss (dB)	Adjusted Level (dBuV/m)	Spec Limit (dBuV/m)	Table Azimuth (degree)	Antenna Height (meters)	Compare (To Limit) (dB)
696.047 Low Frequency	28.0	QP	26.1	VDIP	31.6	8.0	30.5	46.0	67.0	1.5	-15.5
696.047 Low Frequency	30.5	QP	26.1	HDIP	31.6	8.0	33.0	46.0	77.0	1.2	-13.0
863.925 High Frequency	29.8	QP	22.6	HLP A	31.7	8.7	29.4	46.0	26.0	1.0	-16.6
863.925 High Frequency	32.4	QP	22.6	VLPA	31.7	8.7	32.0	46.0	301.0	1.1	-14.0
1044.132 Low Frequency	50.7	PK	25.3	VHRN	44.0	9.8	41.8	54.0	295.0	1.8	-12.2
1044.132 Low Frequency	41.5	AV	25.3	VHRN	44.0	9.8	32.5	54.0	295.0	1.8	-21.4
1044.132 Low Frequency	42.8	AV	25.3	HHRN	44.0	9.8	33.9	54.0	16.0	1.0	-20.1
1044.132 Low Frequency	49.1	PK	25.3	HHRN	44.0	9.8	40.2	54.0	16.0	1.0	-13.8
1218.154 Low Frequency	44.9	AV	25.9	VHRN	44.5	10.0	36.3	54.0	56.0	1.7	-17.7
1218.154 Low Frequency	48.9	AV	25.9	HHRN	44.5	10.0	40.3	54.0	116.0	1.0	-13.7
1218.154 Low Frequency	52.6	PK	25.9	VHRN	44.5	10.0	44.0	54.0	56.0	1.7	-10.0
1218.154 Low Frequency	54.5	PK	25.9	HHRN	44.5	10.0	45.9	54.0	116.0	1.0	-8.1


 Signature

Temperature 80F 42% Humidity

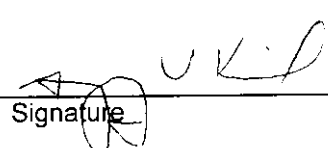
Northwest EMC, Inc.

Version 5.3, April 1998
Freq. Sort

Equipment Tested: 90343
 Serial Number: 340-200250
 Manufacturer: Spacelabs Medical
 Job Number: SPAC0166
 Test Date: 07-15-1998
 Tested By: Greg Kiemel, TE03
 Test Distance: 3 meters.
 Comments: Transmitting High and Low frequencies
 Run #1

FCC Part 15.242c (3 meter limit)

Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor (dB/m)	Antenna Horizontal Vertical	Preamp Gain (dB)	Cable Loss (dB)	Adjusted Level (dBuV/m)	Spec Limit (dBuV/m)	Table Azimuth (degree)	Antenna Height (meters)	Compare (To Limit) (dB)
1392.176 Low Frequency	50.2	PK	26.5	HHRN	44.8	10.4	42.3	54.0	0.0	1.4	-11.7
1392.176 Low Frequency	40.1	AV	26.5	VHRN	44.8	10.4	32.2	54.0	295.0	1.8	-21.8
1392.176 Low Frequency	49.9	PK	26.5	VHRN	44.8	10.4	42.0	54.0	295.0	1.8	-12.0
1392.176 Low Frequency	39.3	AV	26.5	HHRN	44.8	10.4	31.4	54.0	0.0	1.4	-22.6
1566.198 Low Frequency	49.8	PK	27.2	HHRN	44.2	11.0	43.8	54.0	163.0	1.0	-10.2
1566.198 Low Frequency	40.2	AV	27.2	VHRN	44.2	11.0	34.2	54.0	244.0	1.7	-19.8
1566.198 Low Frequency	49.9	PK	27.2	VHRN	44.2	11.0	43.9	54.0	244.0	1.7	-10.1
1566.198 Low Frequency	39.3	AV	27.2	HHRN	44.2	11.0	33.3	54.0	163.0	1.0	-20.8
1740.220 Low Frequency	41.6	AV	28.0	VHRN	43.5	11.5	37.6	54.0	92.0	1.4	-16.4
1740.220 Low Frequency	49.0	PK	28.0	HHRN	43.5	11.5	45.0	54.0	124.0	1.0	-9.0
1740.220 Low Frequency	50.3	PK	28.0	VHRN	43.5	11.5	46.3	54.0	92.0	1.4	-7.7
1740.220 Low Frequency	41.3	AV	28.0	HHRN	43.5	11.5	37.3	54.0	124.0	1.0	-16.7


 Signature

Temperature 80F 42% Humidity

Northwest EMC, Inc.

Version 5.2, Jan. 1998

Equipment Tested: 90343-10
 Serial Number: 340-200250
 Manufacturer: Spacelabs Medical
 Job Number: SPAC0178
 Test Date: 10-01-1998
 Tested By: Daniel Haas, TE04
 Test Distance: 3 meters.
 Comments: Transmitting at 195.030MHz Ch K121, v0.00.04(CRC=4E56)
 Run #1 Transmitting Mid Frequency

FCC Part 15.242c (3 Meter Limit)

Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor (dB/m)	Antenna Horizontal Vertical	Preamp Gain (dB)	Cable Loss (dB)	Adjusted Level (dBuV/m)	Spec Limit (dBuV/m)	Table Azimuth (degree)	Antenna Height (meters)	Compared (To Limit) (dB)
195.030	67.0	QP	14.4	VDIP	0.0	2.5	83.9	106.0	319.0	2.4	-22.1
195.030	78.7	QP	14.4	HDIP	0.0	2.5	95.6	106.0	67.0	1.8	-10.4
390.035	43.3	QP	20.4	HDIP	32.2	3.5	35.0	46.0	317.0	1.0	-11.0
390.035	34.9	QP	20.4	VDIP	32.2	3.5	26.6	46.0	267.0	2.4	-19.4
585.047	29.7	QP	24.0	VDIP	32.3	4.4	25.8	46.0	230.0	1.2	-20.2
585.047	34.0	QP	24.0	HDIP	32.3	4.4	30.1	46.0	327.0	1.8	-15.8
780.057	45.4	QP	26.5	HDIP	32.6	5.0	44.3	46.0	223.0	1.2	-1.7
780.057	37.8	QP	26.5	VDIP	32.6	5.0	36.7	46.0	256.0	2.0	-9.3
975.068	31.5	QP	28.4	VDIP	31.5	5.6	34.0	54.0	10.0	2.0	-20.0
975.068	34.4	QP	28.4	HDIP	31.5	5.6	36.9	54.0	296.0	1.3	-17.1
1170.078	40.5	AV	26.2	HHRN	33.8	7.3	40.2	54.0	208.0	1.0	-13.8
1170.078	46.4	PK	26.2	VHRN	33.8	7.3	46.1	54.0	9.0	1.6	-7.9
Vid BW: 1MHz											
1170.078	41.7	AV	26.2	VHRN	33.8	7.3	41.4	54.0	9.0	1.6	-12.6
1170.078	45.0	PK	26.2	HHRN	33.8	7.3	44.7	54.0	208.0	1.0	-9.3
Vid BW: 1MHz											
1365.000	28.7	AV	26.8	HHRN	34.0	7.7	29.2	54.0	144.0	1.2	-24.8
1365.000	39.3	PK	26.8	HHRN	34.0	7.7	39.8	54.0	144.0	1.2	-14.2
Vid BW: 1MHz											
1365.000	39.5	PK	26.8	VHRN	34.0	7.7	40.0	54.0	161.0	1.1	-14.0
Vid BW: 1MHz											
1365.000	29.5	AV	26.8	VHRN	34.0	7.7	30.0	54.0	161.0	1.1	-24.0
1560.000	38.0	PK	27.5	VHRN	34.1	8.4	39.8	54.0	40.0	1.0	-14.2
Vid BW: 1MHz											
1560.000	27.2	AV	27.5	VHRN	34.1	8.4	29.0	54.0	40.0	1.0	-25.0
1560.000	26.9	AV	27.5	HHRN	34.1	8.4	28.7	54.0	223.0	1.2	-25.3
1560.000	37.1	PK	27.5	HHRN	34.1	8.4	38.9	54.0	223.0	1.2	-15.1
Vid BW: 1MHz											
1755.000	26.9	AV	28.3	HHRN	34.2	9.1	30.1	54.0	180.0	1.0	-23.9
1755.000	38.3	PK	28.3	HHRN	34.2	9.1	41.5	54.0	180.0	1.0	-12.5
Vid BW: 1MHz											

Temperature 70F 40% Humidity



5.2 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured level. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

where :

- FS = Field Strength
- RA = Measured Level
- AF = Antenna Factor
- CF = Cable Attenuation Factor
- AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/meter.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dBuV/meter}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm} [(32 \text{ dBuV/m})/20] = 39.8 \text{ } \mu\text{V/m}$$

5.3 Measurement Bandwidths

Peak Data

150 kHz - 30 MHz	10 kHz
30 MHz - 1000 MHz.....	100 kHz
1000 MHz - 2000 MHz.....	1000 kHz

Quasi-peak Data

150 kHz - 30 MHz	9 kHz
30 MHz - 1000 MHz.....	120 kHz

All radiated measurements are quasi-peak unless otherwise stated. A video filter was not used.
All conducted measurements are peak unless otherwise stated. A video filter was not used.

6.0 Measurement Equipment

Instrument	Model	Serial No.	Freq Range	Last Cal	Cal Due
Spectrum Analyzer	HP 8567A	2718A00358	10 kHz – 1.5 GHz	04/21/98	04/21/99
Quasi Peak Adapter	HP 85650A	2811A01175	10 kHz – 1000 MHz	02/20/98	02/20/99
Pre-Amplifier	AR LN1000	15224	100 kHz – 1300 MHz	07/20/98	07/20/99
Bicon Antenna	EMCO 3110	1240	30 MHz – 200 MHz	01/31/98	01/31/99
LPA Antenna	EMCO 3146	9212-3486	200 MHz – 1000 MHz	01/31/98	01/31/99
Horn Antenna	EMCO 3115	9804-5441	1 GHz – 18 GHz	05/13/97	05/13/99
Spectrum Analyzer	HP 8594E	3543A02557	9 kHz – 2.9 GHz	04/03/98	04.03.99
Pre-Amplifier	ASI8732N	103	1 GHz – 2 GHz	07/08/98	07/08/99
Dipole Antenna	Roberts	264	28 MHz – 1000 MHz	09/30/97	09/30/98

Appendix I: Measurement Procedures

Each frequency was measured in both the horizontal and vertical antenna polarization's.

The EUT position was maximized for each frequency, for both the horizontal and vertical antenna polarization's, using a remotely controlled turntable.

The antenna height was varied from 1 - 4 meters at each frequency, for both the horizontal and vertical positions to maximize the emission level.

The cable and peripheral positions were manipulated to ensure maximum levels at each frequency for both horizontal and vertical antenna polarization's.

Measurements are made at an antenna to EUT distance of 3 meters.