EMC Test Report
Application for Grant of Equipment Authorization
Class II Permissive Change
pursuant to
FCC Part 15 Subpart C

Model: Proteus Personal Monitor Model SA002225

FCC ID:	X7931308
APPLICANT:	Proteus Biomedical Inc. 2600 Bridge Parkway Suite 101 Redwood City, CA 94065
TEST SITE:	Elliott Laboratories 41039 Boyce Road Fremont, CA. 94538
REPORT DATE:	November 2, 2010
FINAL TEST DATES:	March 3 and October 21, 2010

AUTHORIZED SIGNATORY:

David W. Bare
Chief Engineer
Elliott Laboratories

A2LA ACCREDITED
Testing Cert #2016.01

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	5/25/2010	First release	
2	8/10/10	Modified results table to indicate which items have not changed from original filing.	DWB
3	11/02/2010	Modified report to replace radiated emission test data with new data taken without HBM simulator.	DMG/DWB

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SCOPE

An electromagnetic emissions test has been performed on the Proteus Biomedical Inc. model Proteus Personal Monitor Model SA002225, pursuant to the following rules:

FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
FHSS test procedure DA 00-0705A1, March 2000

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Proteus Biomedical Inc. model Proteus Personal Monitor Model SA002225 complied with the requirements of the following regulations:

FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Proteus Biomedical Inc. model Proteus Personal Monitor Model SA002225 and therefore apply only to the tested sample. The sample was selected and prepared by Jim Hutchison of Proteus Biomedical Inc..

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

FREQUENCY HOPPING SPREAD SPECTRUM (2400 – 2483.5 MHz, 75 channels or more)

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1)		20dB Bandwidth	No change from original filing	Channel spacing > 2/3 of the 20dB bandwidth	Complies
		Channel Separation	No change from original filing		Complies
15.247 (a) (1) (iii)		Channel Dwell Time (*average time of occupancy)*	No change from original filing	<0.4 second within a period of 0.4 x number of channels	Complies
15.247 (a) (1) (iii)		Number of Channels	No change from original filing	75 or more	Complies
15.247 (a) (1)		Channel Utilization	No change from original filing	All channels shall, on average, be used equally	Complies
15.247 (b) (3)		Output Power (multipoint systems)	EIRP = 0.00043 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(c)		Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25GHz	47.5dBµV/m @ 2483.5MHz	15.207 in restricted bands, all others < -20dBc	Complies (- 6.5dB)
15.247 (a) (1)		Receiver bandwidth	No change from original filing	Shall match the channel bandwidth	Complies

Note 1: EIRP calculated from field strength.

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203		RF Connector	Non-standard type	Non-standard type	Complies
15.207		AC Conducted Emissions	N/A – EUT is battery powered		
15.247 (b) (5) 15.407 (f)		RF Exposure Requirements	Device output is below the low threshold for SAR, so no testing is required.	Refer to OET 65, FCC Part 1 and RSS 102	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	0.015 to 30	± 3.0
Radiated Emissions	30 to 1000	± 3.6
Radiated Emissions	1000 to 40000	± 6.0

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The EUT is a Bluetooth radio module used inside a Proteus Personal monitor. The Proteus Biomedical Inc. model Proteus Personal Monitor Model SA002225 is a body worn medical sensor, data processor & data logger that communicates wirelessly with a remote computer through a Bluetooth link. The EUT was treated as table-top equipment during testing. The electrical rating of the EUT is 3.7 VDC supplied from an internal non-rechargable battery.

The sample was received on February 11, 2010 and tested on March 3 and October 21, 2010. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Proteus Biomedical	SA002225	Wireless medical sensor	20617	Contains FCC ID: X7931308

OTHER EUT DETAILS

The following EUT details should be noted: The EUT cannot simultaneously sense & log medical data, and operate as a Bluetooth transceiver. Therefore, it must be tested in 2 modes: as a stand-alone device (medical mode), & as a wireless transceiver (wireless mode). In medical mode, there is no remote support equipment.

ANTENNA SYSTEM

The Isolated Magnetic Dipole™ (IMD) ceramic antenna is integral to the Personal Monitor. It connects to the module via traces on the Personal Monitor PCB.

ENCLOSURE

The Personal Monitor enclosure is primarily constructed of plastic. It measures approximately 9 cm wide by 4 cm deep by 2 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Proteus Biomedical	NA	Human body model	NA	-

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Dell	-	Laptop	-	-
Roving Networks	BU-2073-J	Bluetooth transceiver	NA	OQGBU2073J

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Laptop USB	Bluetooth transceiver	Multiwire	Shielded	2.0
DC Power (laptop)	External DC supply	2 wire	Unshielded	2.0
AC Power (pwr supply)	AC mains	3 wire	Unshielded	2.0

EUT OPERATION

During emissions testing the EUT was operated using modified code to hold both the MSP and DSP processors in RESET to free up the Bluetooth UART control bus for direct PC UART commands. Test firmware was downloaded into the Bluetooth EEPROM to allow setup of the transmit channel and modulation. The EUT was placed on the "human body model". The EUT was set to transmit on a selected channel and with a selected modulation type at maximum output power. For hopping tests, the EUT was operated with standard code and set to transmit data continuously.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on March 3 and October 21, 2010 at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
SVOATS #2	90593	2845A-2	684 West Maude Ave, Sunnyvale CA 94085-3518
Chamber #7	A2LA accreditation	2845B-7	41039 Boyce Road, Fremont CA. 94538-2435

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception, on OATS sites, of predictable local TV, radio, and mobile communications traffic. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

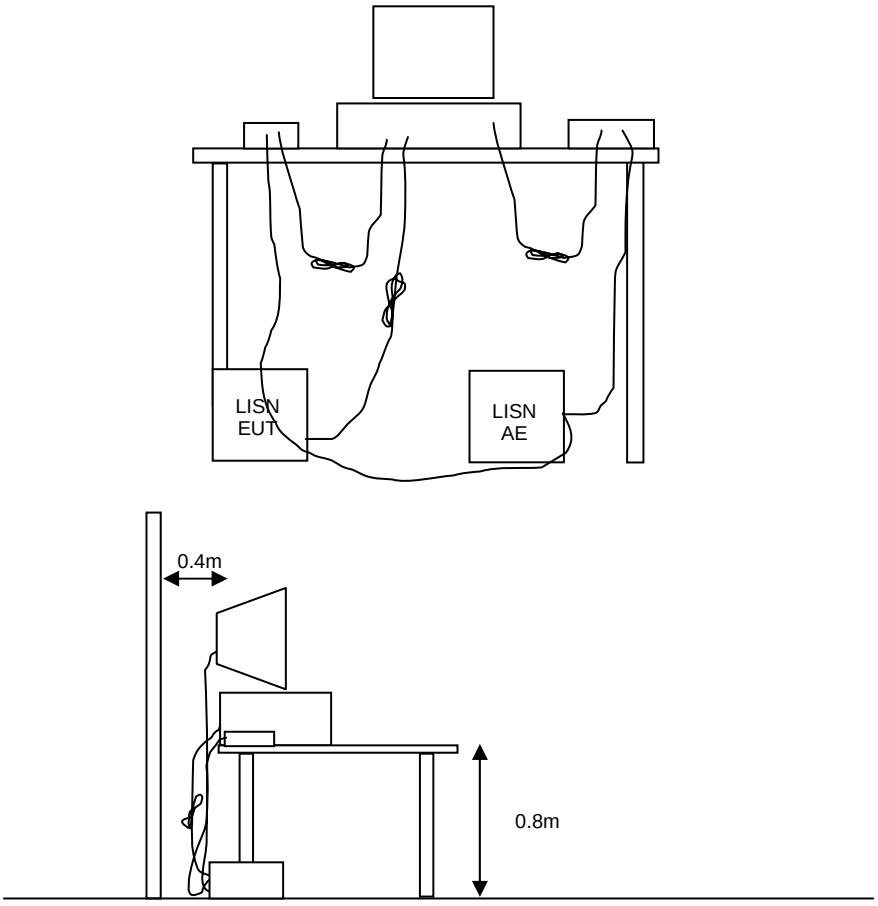
TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.



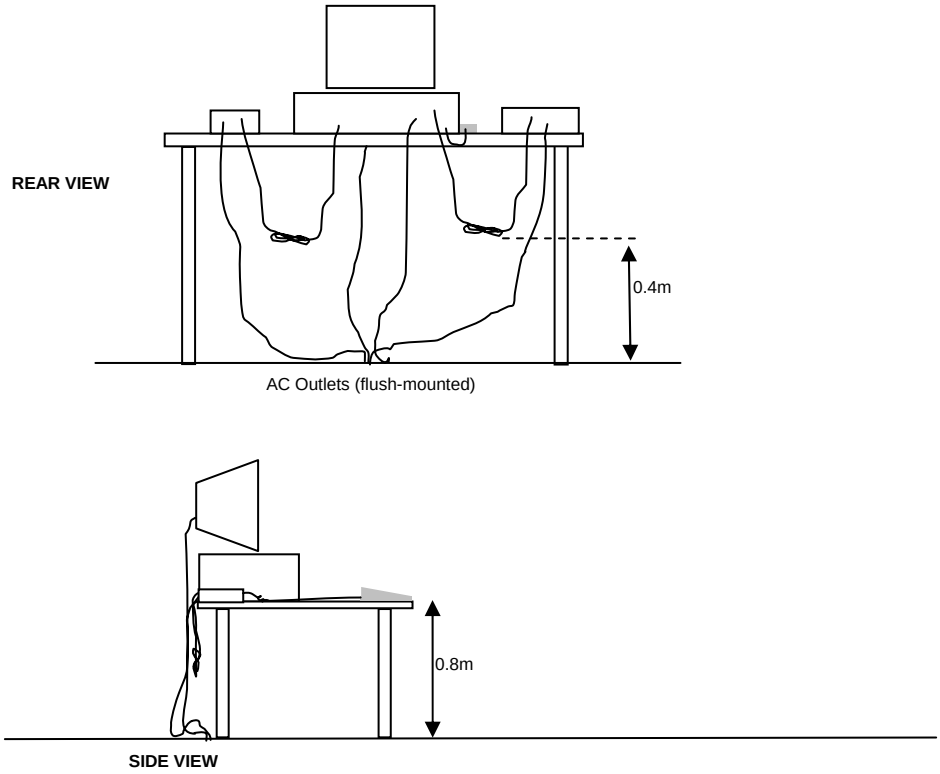
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

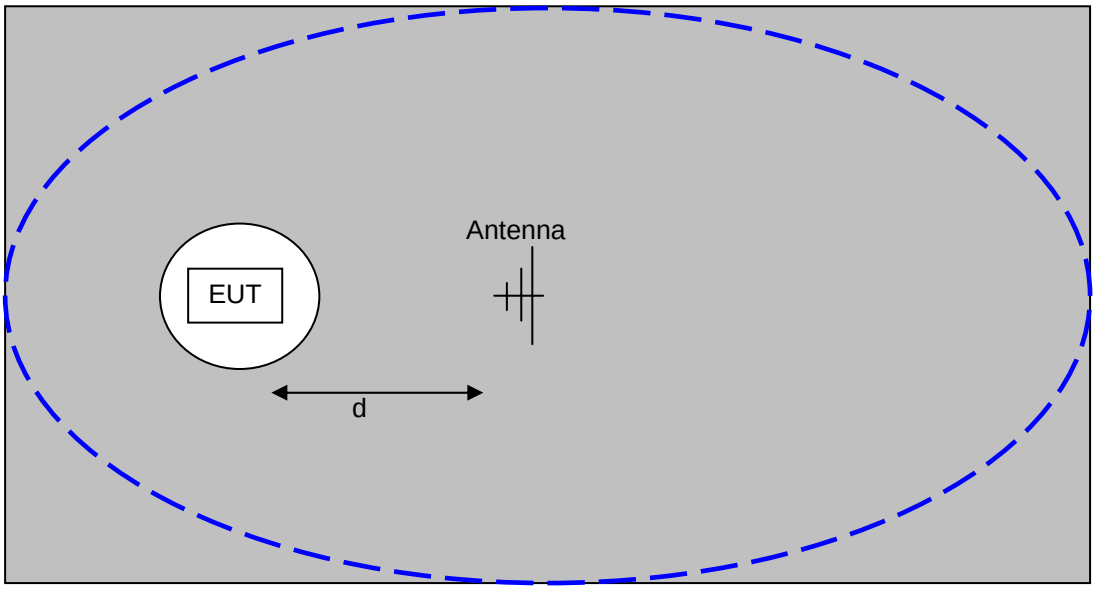
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

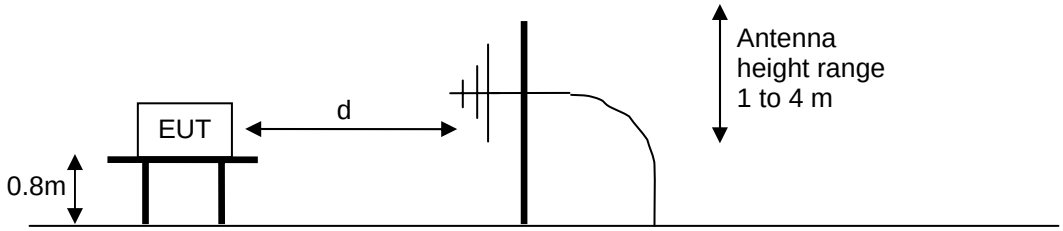
When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.



Typical Test Configuration for Radiated Field Strength Measurements



The ground plane extends beyond the ellipse defined in CISPR 16 / CISPR 22 / ANSI C63.4 and is large enough to accommodate test distances (d) of 3m and 10m. Refer to the test data tables for the actual measurement distance.



Test Configuration for Radiated Field Strength Measurements
OATS- Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{3} \text{ microvolts per meter}$$

where P is the eirp (Watts)

Appendix A Test Equipment Calibration Data

Radio Antenna Port (Power and Spurious Emissions), 03-Mar-10

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	19-Aug-10
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	15-Jul-10
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	29-Jul-10

Appendix B Test Data

T78327 17 Pages

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		-
Emissions Standard(s):	EN60601-1-2 and EN 301 489-1	Class:	B
Immunity Standard(s):	EN60601-1-2 and EN 301 489-1	Environment:	-

EMC Test Data

For The

Proteus Medical

Model

Proteus Personal Monitor Model SA002225

Date of Last Test: 10/21/2010

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

FCC 15.247 FHSS - Power, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 10/21/2010 10:35
Test Engineer: John Caizzi
Test Location: Fremont Chamber #7

Config. Used: Stand alone, no human body model.
Config Change: NA
EUT Voltage: 3.7 VDC internal battery

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Radiated Fundamental and Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	47.5dBµV/m @ 2483.5MHz (-6.5dB)
2	Output Power	15.247(b)	Pass	-3.7 dBm (0 .00043 W)

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 25,000 MHz.
Date of Test: 10/21/2010
Test Engineer: John Caizzi
Test Location: FT7

Run #1a: Radiated Spurious Emissions, 30 - 25,000 MHz. Low Channel @ 2402 MHz, upright orientation.
Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

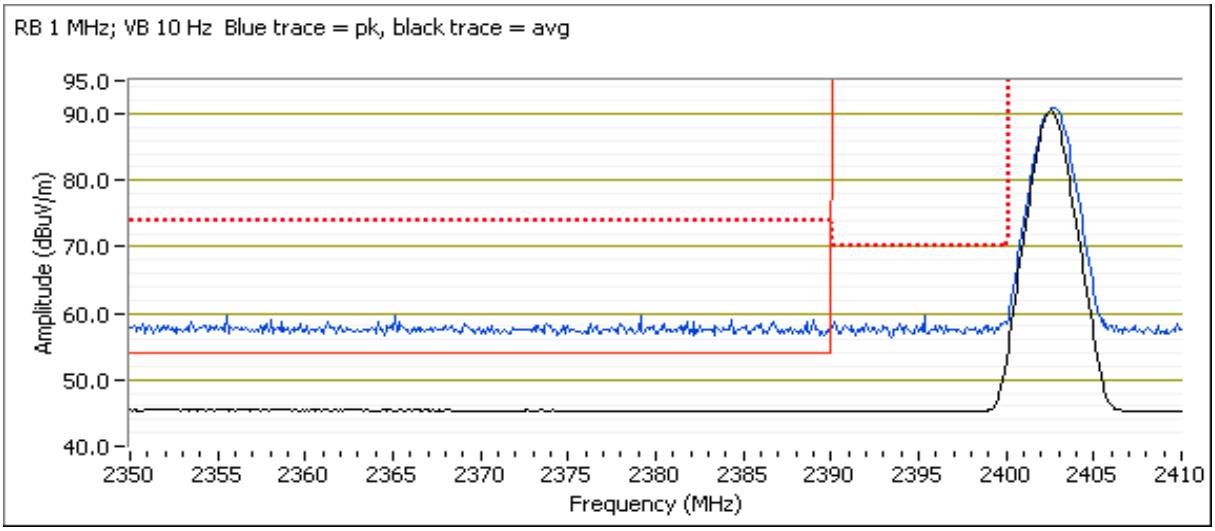
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2402.170	91.2	H	120.0	-28.8	Pk	203	1.0	RB 100 kHz;VB 100 kHz
2402.200	91.0	H	120.0	-29.0	AVG	203	1.0	
2402.170	91.1	H	120.0	-28.9	PK	203	1.0	

Fundamental emission level @ 3m in 100kHz RBW:	91.2	
Limit for emissions outside of restricted bands:	71.2 dBµV/m	Limit is -20dBc

Band Edge Signal Field Strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2352.070	46.9	H	54.0	-7.1	AVG	196	1.0	
2366.930	58.9	H	74.0	-15.1	PK	196	1.0	

Note 1	Since vertical polarization was > 8 dB lower than horizontal for the center channel in the worst case orientation, it was not measured.



Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4804.120	35.2	V	54.0	-18.8	AVG	180	1.00	Vertical rotated 90
4804.480	45.9	V	74.0	-28.1	PK	180	1.00	Vertical rotated 90
4803.980	34.2	H	54.0	-19.8	AVG	187	2.08	Vertical rotated 90
4799.000	45.4	H	74.0	-28.6	PK	187	2.08	Vertical rotated 90
7206.450	50.4	H	71.2	-20.8	PK	310	1.91	Horizontal, RBW = 1MHz = VBW
7201.970	51.2	V	71.2	-20.0	PK	0	1.36	Horizontal, RBW = 1MHz = VBW
9607.670	40.7	V	71.2	-30.5	Pk	53	1.00	Upright, RB 100 kHz;VB 100 kHz
9608.950	40.7	H	71.2	-30.5	Pk	275	1.84	Upright, RB 100 kHz;VB 100 kHz

Note 2	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 25,000 MHz. Center Channel @ 2441 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

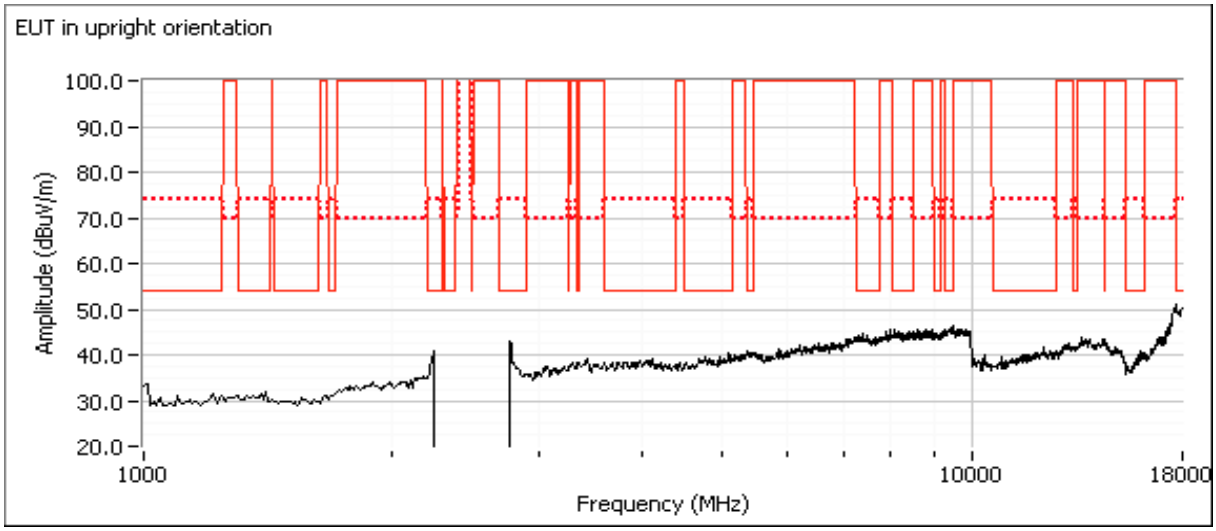
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Upright orientation								
2441.170	81.2	V	120.0	-38.8	Pk	286	1.0	RB 100 kHz;VB 100 kHz
2441.170	81.2	V	120.0	-38.8	AVG	286	1.0	
2441.150	81.3	V	120.0	-38.7	PK	286	1.0	
2441.170	89.8	H	120.0	-30.2	Pk	204	1.0	RB 100 kHz;VB 100 kHz
2441.170	89.9	H	120.0	-30.1	AVG	204	1.0	
2441.270	90.2	H	120.0	-29.8	PK	204	1.0	
Vertical rotated 90 orientation								
2441	86.7	V	120	-33.3	Pk	173	1.47	RB 100 kHz;VB 100 kHz
2441	86.5	V	120	-33.5	AVG	173	1.47	
2441	86.9	V	120	-33.1	PK	173	1.47	
2441	81.6	H	120	-38.4	Pk	147	1.51	RB 100 kHz;VB 1 kHz
2441	81.7	H	120	-38.3	AVG	147	1.51	
2441	82.2	H	120	-37.8	PK	147	1.51	
Horizontal orientation								
2441	77.1	V	120	-42.9	Pk	4	1.00	RB 100 kHz;VB 1 kHz
2441	76.9	V	120	-43.1	AVG	4	1.00	
2441	77.6	V	120	-42.4	PK	4	1.00	
2441	89.8	H	120	-30.2	Pk	136	1.01	RB 100 kHz;VB 1 kHz
2441	89.7	H	120	-30.3	AVG	136	1.01	
2441	89.9	H	120	-30.1	PK	136	1.01	

	H	V
Fundamental emission level @ 3m in 100kHz RBW:	89.8	81.2
Limit for emissions outside of restricted bands:	69.8 dBµV/m	

Note 1	Upright orientation was worst case and was used for fundamental and bandedge measurements and the lowest and highest channels as well.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Spurious Emissions



Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Upright orientation								
4882.190	36.6	H	54.0	-17.4	AVG	212	1.04	
4882.000	46.6	H	74.0	-27.4	PK	212	1.04	
4881.920	34.2	V	54.0	-19.8	AVG	360	1.00	
4879.850	45.2	V	74.0	-28.8	PK	360	1.00	
7319.070	38.8	V	54.0	-15.2	AVG	222	1.65	
7322.370	50.6	V	74.0	-23.4	PK	222	1.65	
7318.350	38.8	H	54.0	-15.2	AVG	332	1.67	
7327.030	50.1	H	74.0	-23.9	PK	332	1.67	
9760.380	52.6	H	69.8	-17.2	PK	67	1.87	RBW = 1MHz = VBW
9763.910	51.7	V	69.8	-18.1	PK	174	2.50	RBW = 1MHz = VBW

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Vertical rotated 90 orientation								
4884.530	34.0	H	54.0	-20.0	AVG	308	1.34	
4886.970	45.4	H	74.0	-28.6	PK	308	1.34	
4882.180	37.0	V	54.0	-17.0	AVG	168	1.34	
4882.070	46.4	V	74.0	-27.6	PK	168	1.34	
7320.870	38.8	V	54.0	-15.2	AVG	352	2.16	
7323.950	50.1	V	74.0	-23.9	PK	352	2.16	
7318.080	38.7	H	54.0	-15.3	AVG	0	2.31	
7327.300	49.7	H	74.0	-24.3	PK	0	2.31	
9766.770	52.4	H	69.8	-17.4	PK	17	1	RBW = 1MHz = VBW
9763.970	51.8	V	69.8	-18.0	PK	24	1.51	RBW = 1MHz = VBW
Horizontal orientation								
4882.170	34.8	H	54.0	-19.2	AVG	234	1.03	
4882.330	45.3	H	74.0	-28.7	PK	234	1.03	
4882.050	34.6	V	54.0	-19.4	AVG	261	1.28	
4886.300	45.9	V	74.0	-28.1	PK	261	1.28	
7319.230	38.9	V	54.0	-15.1	AVG	308	1.96	
7323.780	51.8	V	74.0	-22.2	PK	308	1.96	
7320.930	38.9	H	54.0	-15.1	AVG	0	2.50	
7319.600	50.0	H	74.0	-24.0	PK	0	2.50	
9762.800	51.8	H	69.8	-18.0	PK	360	1.38	RBW = 1MHz = VBW
9763.920	52.0	V	69.8	-17.8	PK	112	1.00	RBW = 1MHz = VBW

Note 1	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2	**Bold** readings are worst case orientations for individual harmonics.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Run #1c: Radiated Spurious Emissions, 30 - 25,000 MHz. High Channel @ 2480 MHz, upright orientation.
Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

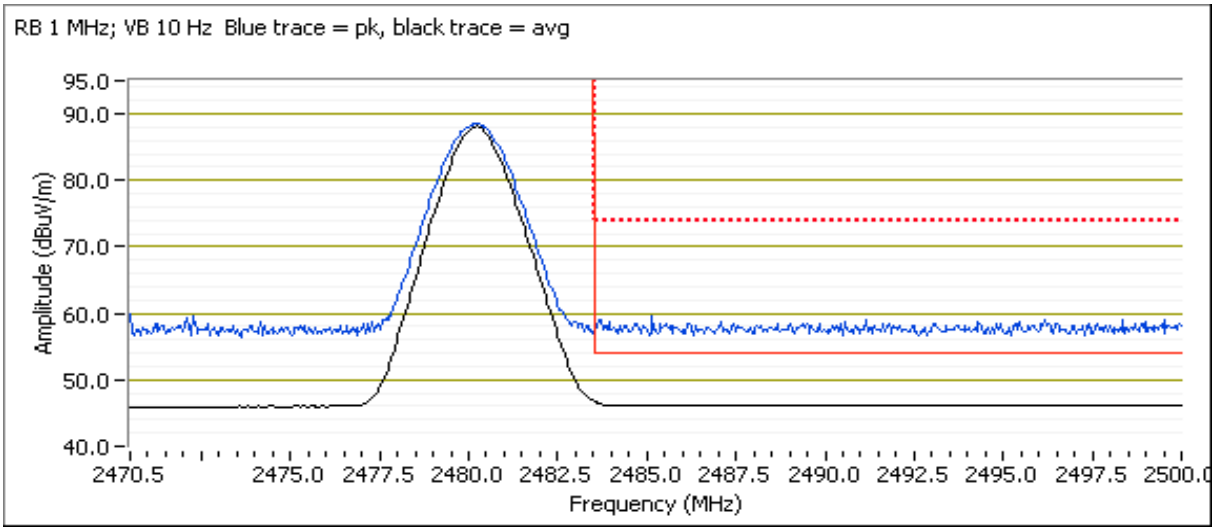
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2480.130	88.4	H	120.0	-31.6	Pk	200	1.00	RB 100 kHz;VB 100 kHz
2480.150	88.4	H	120.0	-31.6	AVG	200	1.00	
2480.170	88.5	H	120.0	-31.5	PK	200	1.00	

Fundamental emission level @ 3m in 100kHz RBW:	88.4	
Limit for emissions outside of restricted bands:	68.4 dBµV/m	Limit is -20dBc

Band Edge Signal Field Strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	47.5	H	54.0	-6.5	AVG	200	1.00	
2486.410	58.6	H	74.0	-15.4	PK	200	1.00	

Note 5	Since vertical polarization was > 8 dB lower than horizontal for the center channel in the worst case orientation, it was not measured.



Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4960.170	38.4	H	54.0	-15.6	AVG	337	1.04	Vertical rotated 90
4959.830	47.1	H	74.0	-26.9	PK	337	1.04	Vertical rotated 90
4960.180	41.3	V	54.0	-12.7	AVG	172	1.00	Vertical rotated 90
4960.520	48.5	V	74.0	-25.5	PK	172	1.00	Vertical rotated 90
7444.030	39.1	H	54.0	-14.9	AVG	0	1.00	Horizontal
7438.800	50.6	H	74.0	-23.4	PK	0	1.00	Horizontal
7438.570	39.0	V	54.0	-15.0	AVG	19	2.27	Horizontal
7441.500	51.5	V	74.0	-22.5	PK	19	2.27	Horizontal
9918.700	40.4	H	68.4	-28.0	Pk	39	2.22	Upright, RB 100 kHz;VB 100 kHz
9920.960	40.8	V	68.4	-27.6	Pk	207	1.42	Upright, RB 100 kHz;VB 100 kHz

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Run #2: Output Power

Date of Test: 10/21/2010

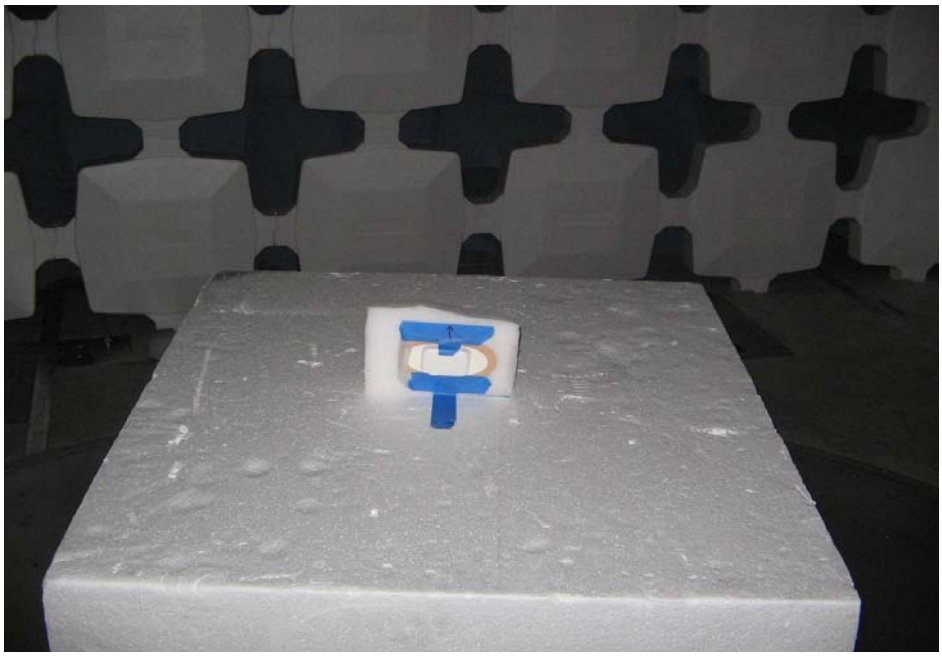
Test Engineer: John Cazzi

Test Location:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Channel	Frequency (MHz)	Field Strength at 3m (dBuV/m)	Antenna Pol. (H/V)	Res BW	Signal Bandwidth	Bandwidth Correction	Power (dBm)	Power (Watts)
Low	2402	91.1	H	1	1.131	0.5	-3.7	0.00043
Mid	2441	90.2	H	1	1.123	0.5	-4.6	0.00035
High	2480	88.5	H	1	1.115	0.5	-6.3	0.00023

Note 1:	Output power calculated from field strength at 3m based on free space path loss formula E = √(30PG) / d, where E is the field strength (V/m), PG is the effective isotropic radiated power (W) and d is the distance (3m). Additional correction to the calculated power is made to account for the difference between the measurement bandwidth and signal bandwidth.



Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

FCC 15.247 FHSS - Bandwidth

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2010 19:29
Test Engineer: Rafael Varelas
Test Location: SVOATS #2

Config. Used: 1
Config Change: None
EUT Voltage: 3.7V DC (Battery Operated)

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 13 °C
Rel. Humidity: 74 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	20dB Bandwidth	15.247(a)	Pass	1350 kHz
1	99% bandwidth	15.247(a)	Pass	1290 kHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

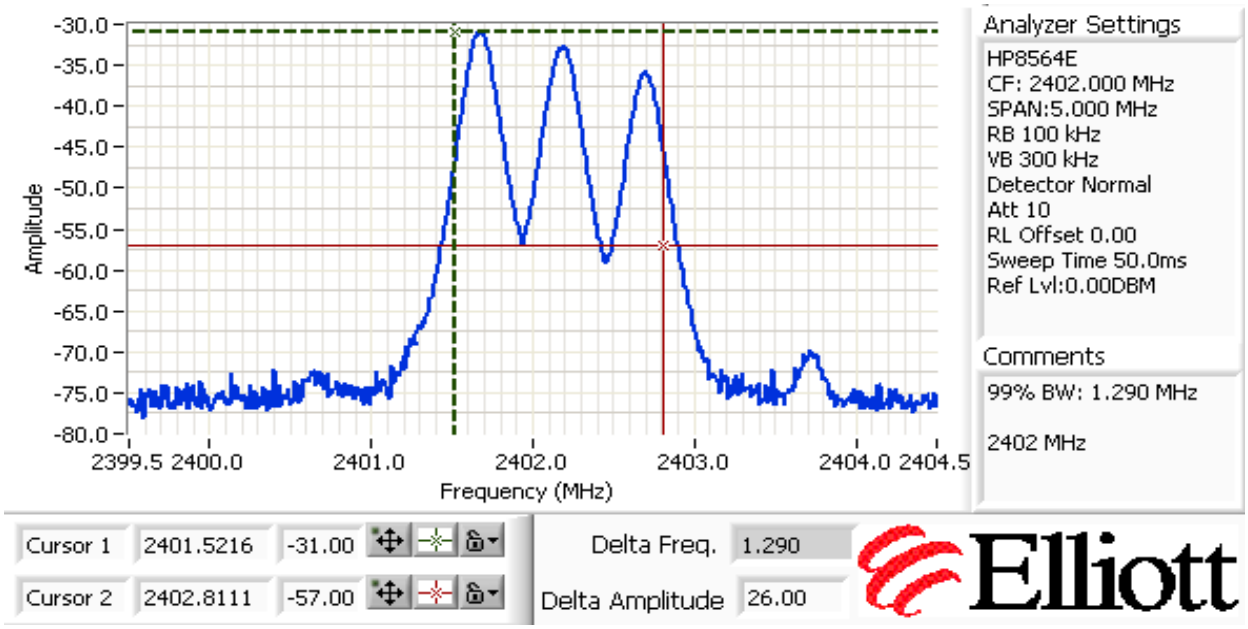
No deviations were made from the requirements of the standard.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

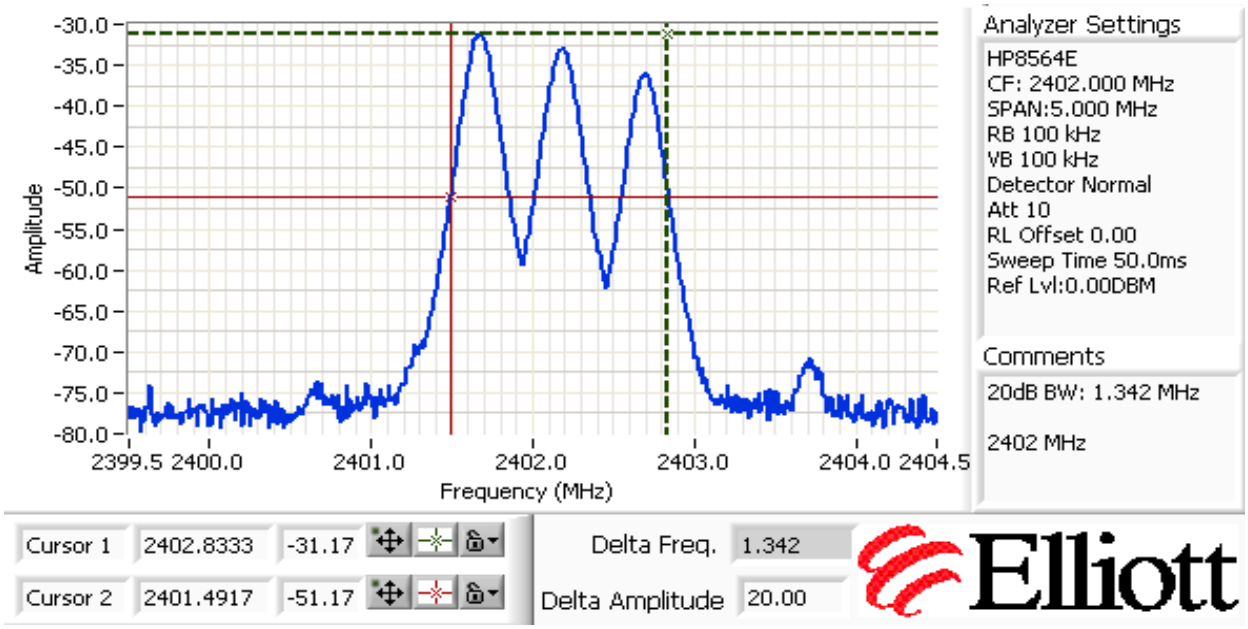
Run #1: Bandwidth

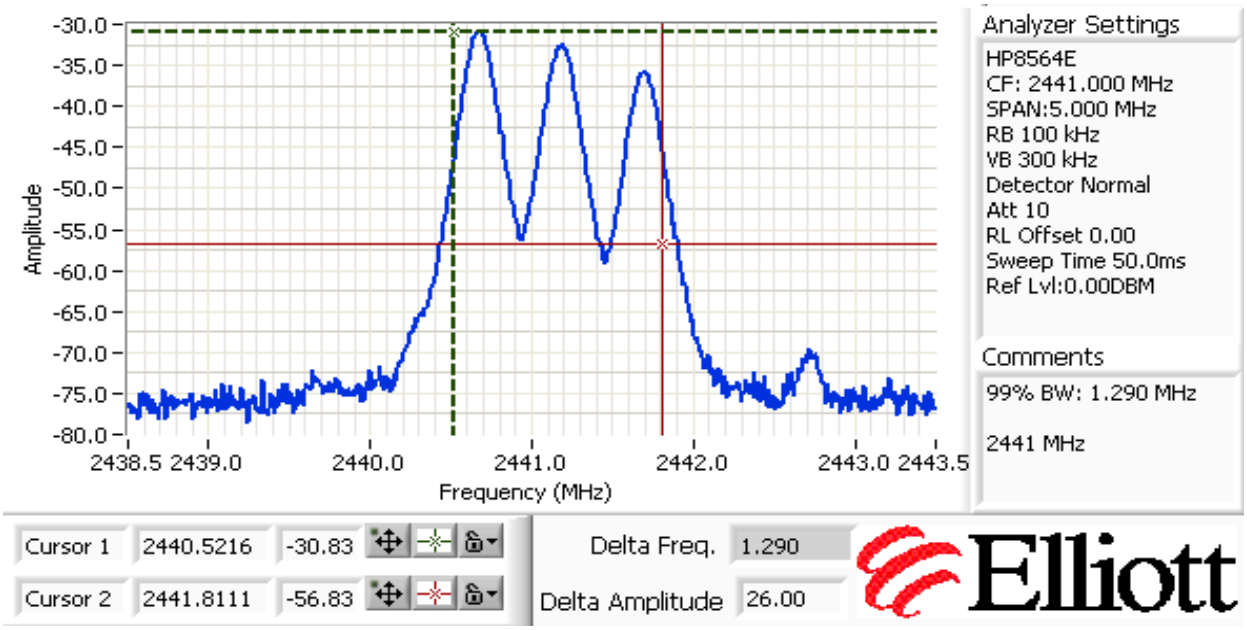
Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)	Resolution Bandwidth	99% Bandwidth (kHz)
Low	2402	100kHz	1342	100kHz	1290
Mid	2441	100kHz	1350	100kHz	1290
High	2480	100kHz	1333	100kHz	1273

Note 1:	20dB bandwidth measured using RB = 100kHz, VB = 100kHz (VB > RB)
Note 2:	99% bandwidth measured using RB = 100kHz, VB = 300kHz (VB >=3RB)

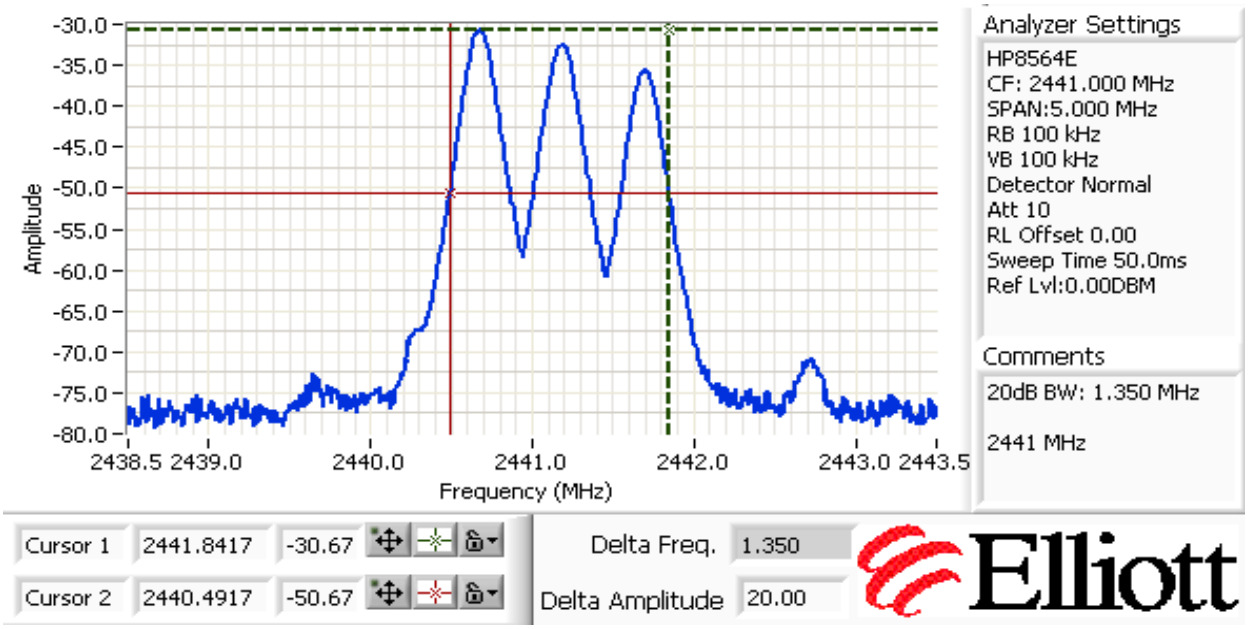


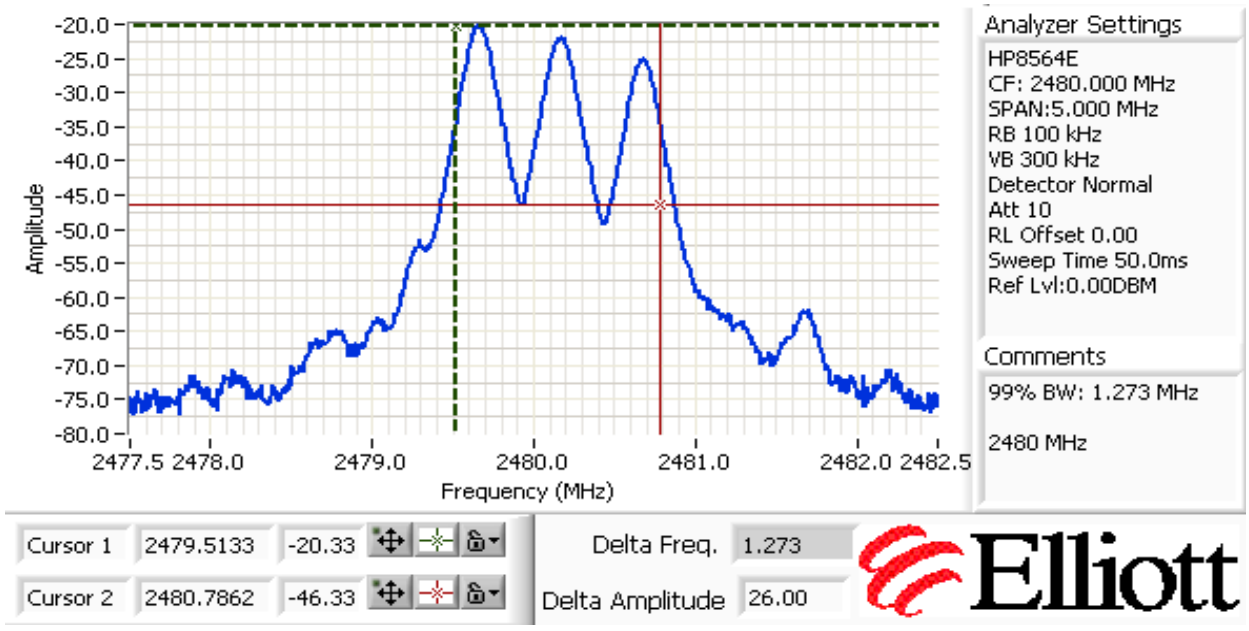
Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A



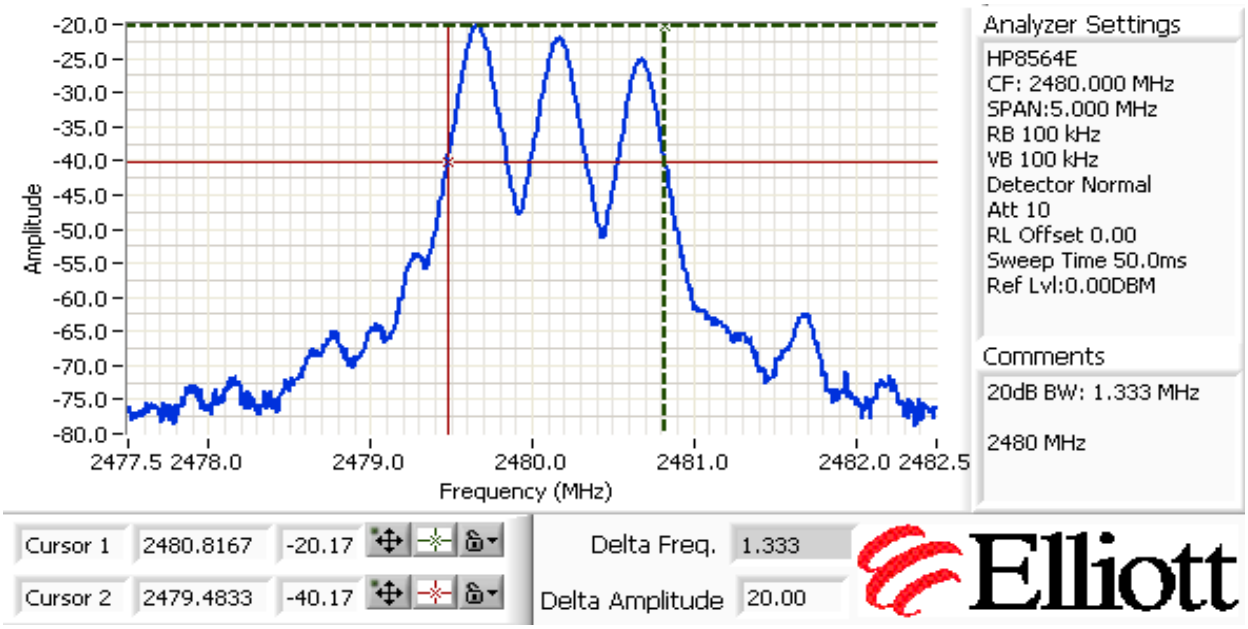


Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A





Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A



Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

RS-210 and FCC 15.247 FHSS - Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2010 19:29
Test Engineer: Rafael Varelas
Test Location: SVOATS #2
Config. Used: 1
Config Change: None
EUT Voltage: 3.7V DC (Battery Operated)

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 13 °C
Rel. Humidity: 74 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	30 - 18,000 MHz - Radiated Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	38.7dBµV/m @ 9765.4MHz (-15.3dB)

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Test Notes

Based on preliminary tests, the highest amplitude emissions form the device in receive mode were observed with it set to the middle channel.

Client:	Proteus Medical	Job Number:	J78127
Model:	Proteus Personal Monitor Model SA002225	T-Log Number:	T78327
		Account Manager:	Deepa Shetty
Contact:	Jhutchison@proteusbiomed.com		
Standard:	EN60601-1-2 and EN 301 489-1	Class:	N/A

Run #1b: Radiated Spurious Emissions, 30 - 18,000 MHz. Center Channel @ 2441 MHz
EUT on Rx Mode

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 -18000 MHz	3	3	0.0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
9765.420	38.7	H	54.0	-15.3	AVG	139	1.3	RB 1 MHz; VB: 10 Hz
9765.460	38.6	V	54.0	-15.4	AVG	10	1.0	RB 1 MHz; VB: 10 Hz
7323.340	36.6	H	54.0	-17.4	AVG	192	1.0	RB 1 MHz; VB: 10 Hz
7323.560	36.6	V	54.0	-17.4	AVG	348	1.0	RB 1 MHz; VB: 10 Hz
6507.830	33.5	H	54.0	-20.5	AVG	109	1.0	RB 1 MHz; VB: 10 Hz
6507.830	33.5	V	54.0	-20.5	AVG	245	1.0	RB 1 MHz; VB: 10 Hz
4880.500	32.0	H	54.0	-22.0	AVG	298	1.0	RB 1 MHz; VB: 10 Hz
4880.500	31.7	V	54.0	-22.3	AVG	28	1.0	RB 1 MHz; VB: 10 Hz
3259.510	30.2	H	54.0	-23.8	AVG	71	1.4	RB 1 MHz; VB: 10 Hz
9765.390	50.0	H	74.0	-24.0	PK	139	1.3	RB 1 MHz; VB: 1 MHz
9763.970	49.7	V	74.0	-24.3	PK	10	1.0	RB 1 MHz; VB: 1 MHz
3255.740	29.5	V	54.0	-24.5	AVG	99	1.7	RB 1 MHz; VB: 10 Hz
7322.750	48.4	H	74.0	-25.6	PK	192	1.0	RB 1 MHz; VB: 1 MHz
7324.210	47.7	V	74.0	-26.3	PK	348	1.0	RB 1 MHz; VB: 1 MHz
6509.900	45.1	H	74.0	-28.9	PK	109	1.0	RB 1 MHz; VB: 1 MHz
6507.960	44.6	V	74.0	-29.4	PK	245	1.0	RB 1 MHz; VB: 1 MHz
4881.720	43.7	V	74.0	-30.3	PK	28	1.0	RB 1 MHz; VB: 1 MHz
4881.040	42.8	H	74.0	-31.2	PK	298	1.0	RB 1 MHz; VB: 1 MHz
3256.080	41.3	H	74.0	-32.7	PK	71	1.4	RB 1 MHz; VB: 1 MHz
3253.810	40.4	V	74.0	-33.6	PK	99	1.7	RB 1 MHz; VB: 1 MHz

Note 1:	Above 1 GHz, the FCC specifies the limit as an average measurement. In addition, the FCC states that the peak reading of any emission above 1 GHz, can not exceed the average limit by more than 20 dB.

Appendix C Photographs of Test Configurations

Uploaded as a separate exhibit