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EMC Test Report

Application for Grant of Equipment Authorization

FCC Part 15 Subpart C

Model: Proteus Patch SPC-0800

FCC ID:	X7906120
APPLICANT:	Proteus Digital Health, Inc. 2600 Bridge Parkway Suite 101 Redwood City, CA 94065
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-4 and 2845B-7
REPORT DATE:	January 14, 2014
FINAL TEST DATES:	September 9 and 13, 2013
TOTAL NUMBER OF PAGES:	37

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A2LA ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	January 14, 2014	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Proteus Digital Health, Inc. Proteus Patch Model SPC-0655, 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 National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2009
FCC DTS Measurement Guidance KDB558074

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(s) of Proteus Digital Health, Inc. model Proteus Patch Pod Model SPC-0655 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 Digital Health, Inc. model Proteus Patch Pod Model SPC-0655 and therefore apply only to the tested sample(s). The sample(s) were selected and prepared by Jonathan Withrington of Proteus Digital Health, Inc.

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)		Digital Modulation	Systems uses GFSK modulation	System must utilize a digital transmission technology	Complies
15.247 (a) (2)		Minimum 6dB Bandwidth	689 kHz	>500kHz	Complies
15.247 (b) (3)		Output Power (multipoint systems)	-17.2 dBm (0.000019 Watts) EIRP = 0.000028 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)		Power Spectral Density	-18.3 dBm / 30kHz	8dBm/3kHz	Complies
15.247(c)		Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions > -30 dBc	< -30dBc Note 2	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25 GHz	44.5 dBµV/m @ 2483.5 MHz (-9.5 dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies
15.203		RF Connector	Integral antenna	Unique or integral antenna required	Complies
15.247 (b) (5) 15.407 (f)		RF Exposure Requirements	Meets standalone SAR exclusion for 5mm separation. Calculation yields 0.19 which is less than 3 per KDB 447498	Refer to OET 65, FCC Part 1	Complies

Note 1: EIRP calculated using antenna gain of 1.7 dBi for the highest EIRP system.
Note 2: Limit of -30dBc used because the power was measured using the test procedure for maximum power averaged over a transmission burst.

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	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Proteus Digital Health, Inc. model Proteus Patch SPC-0800 is designed to collect physiologic information. The EUT is attached to a human during operation and is neither table-top equipment or floor-standing equipment. To meet the requirements of the relevant standards, the manufacturer opted to conduct EMC testing treating the EUTs as tabletop equipment. The electrical rating of the EUT is 3.0 Vdc supplied from an integral non-rechargeable battery.

The Proteus Patch SPC-0800 uses the same PCB as the Proteus Patch Pod Model SPC-0655 (model tested). Only the plastic housing is different. The sample(s) of the SPC-0655 were received on September 5, 2013 and tested on September 9 and 13, 2013. The following EUTs were tested:

Manufacturer	Model	Description	Serial Number
Proteus Digital Health	SPC-0655	Patch Pod	23342
Proteus Digital Health	SPC-0655	Patch Pod	23343
Proteus Digital Health	SPC-0655	Patch Pod	23345
Proteus Digital Health	SPC-0655	Patch Pod	23346

ANTENNA SYSTEM

The antenna system consists of an integral chip antenna with 1.7 dBi gain.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 3.3 cm wide by 0.8 cm deep by 4 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None	-	-	-	-

EUT OPERATION

During radiated emissions testing the EUT was in run mode with BLE advertising at maximum power. During “antenna port” conducted emissions testing, the EUT was in DTM mode with the radio transmitting on the selected channel at maximum power.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken 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	
Chamber 4	A2LA accreditation	2845B-4	41039 Boyce Road Fremont, CA 94538-2435
Chamber 7		2845B-7	

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. 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.

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 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

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 the receiver measurements of the voltage generated by the field strength at an antenna or voltage developed at the LISN measurement port. A personal computer runs automated data collection programs which control the receivers. 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.

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 C63.10 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 as specified in ANSI C63.4. 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 C63.10, and the worst-case orientation is used for final measurements.

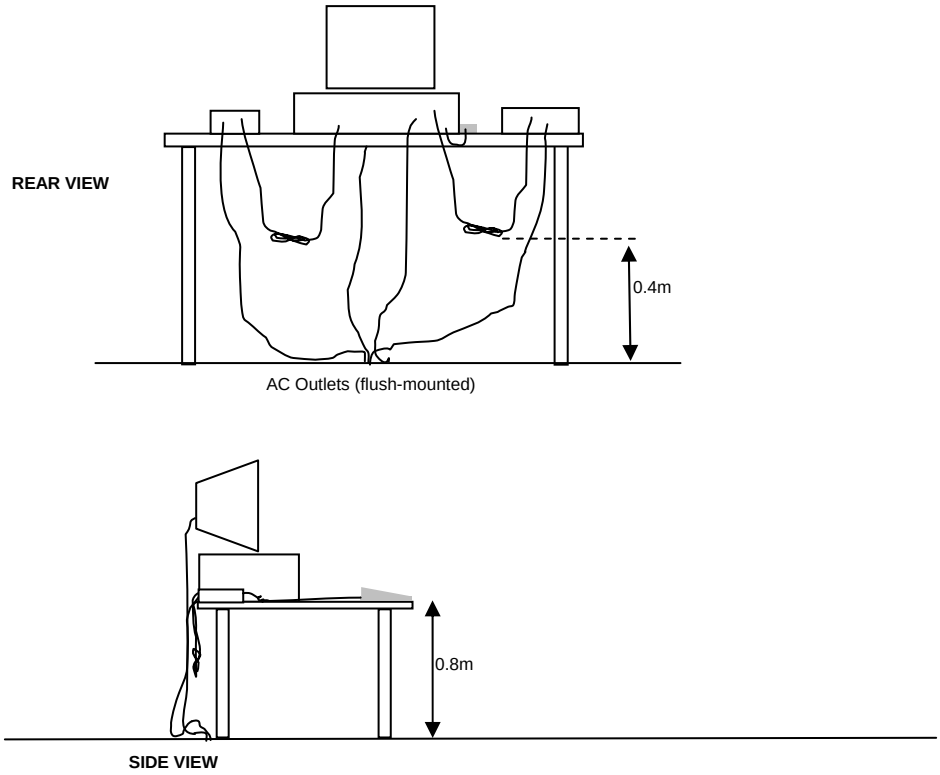
RADIATED EMISSIONS

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.

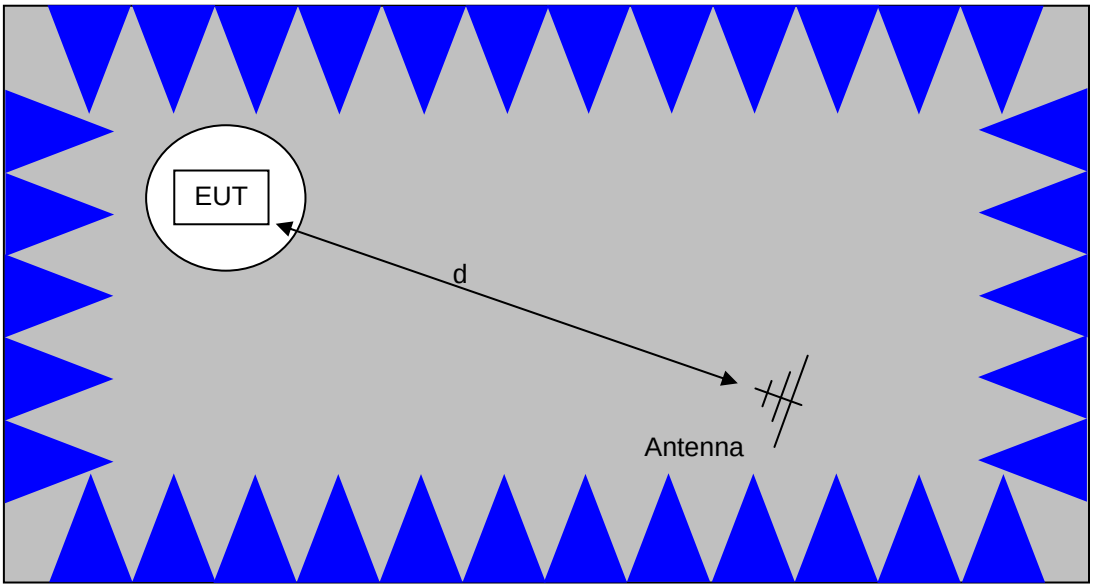
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

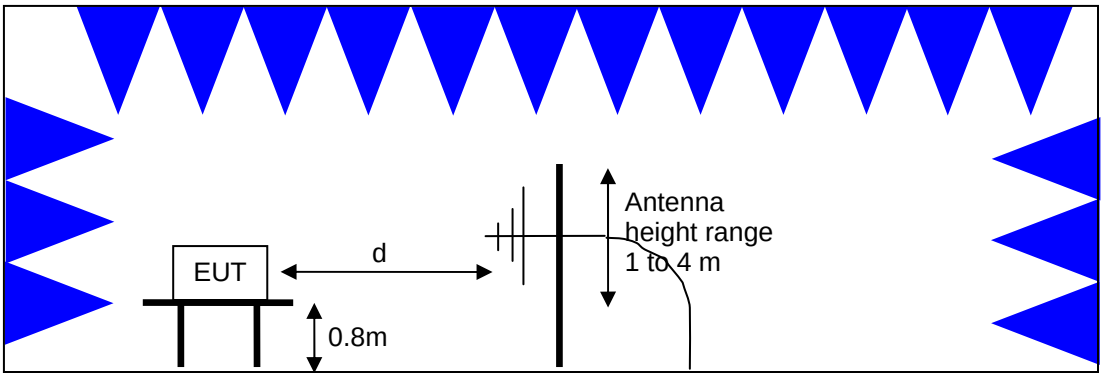


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

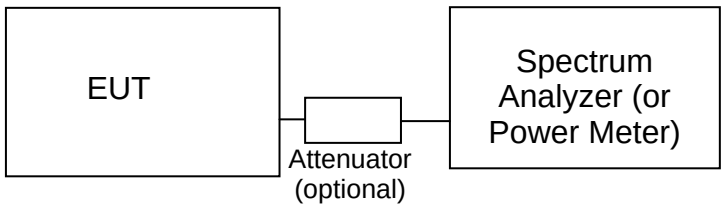
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and 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

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density.

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

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/RMS 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 d (meters) from the equipment under test:

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

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Cal Due
Radiated Emissions, 30 - 25,000 MHz, 09-Sep-13				
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	11/9/2013
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/12/2013
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/12/2014
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	6/4/2014
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/2/2014
Com-Power	Preamplifier, 30-1000 MHz	PA-103A	2359	2/20/2014
Radio Antenna Port (Power and Spurious Emissions), 13-Sep-13				
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	1/28/2014

Appendix B Test Data

T93385 Pages 20 – 36

Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Product	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Emissions Standard(s):	EN 60601-1-2 & EN 301 489-1/-17	Class:	B
Immunity Standard(s):	EN 60601-1-2 & EN 301 489-1/-17	Environment:	Residential

EMC Test Data

For The

Proteus Digital Health, Inc.

Product

Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656

Date of Last Test: 09/13/2013

Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements

Power, PSD, 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: 9/13/2013
Test Engineer: John Caizzi
Test Location: Fremont EMC Lab #4

Config. Used: Direct connection to antenna port.
Config Change: none
EUT Voltage: 3 VDC

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 25 °C
Rel. Humidity: 35 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	Max	-	Output Power	15.247(b)	Pass	-17.2 dBm
2	Max	-	Power spectral Density (PSD)	15.247(d)	Pass	-18.3 dBm/30kHz
3	Max	-	Minimum 6dB Bandwidth	15.247(a)	Pass	689 kHz
3	Max	-	99% Bandwidth	RSS GEN	-	1.570 MHz
4	Max	-	Spurious emissions	15.247(b)	Pass	All emissions > -30 dBc

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 Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BT LE	-	0.69	Yes	0.43	1.59	3.18	2326

Sample Notes

Sample S/N: 23342

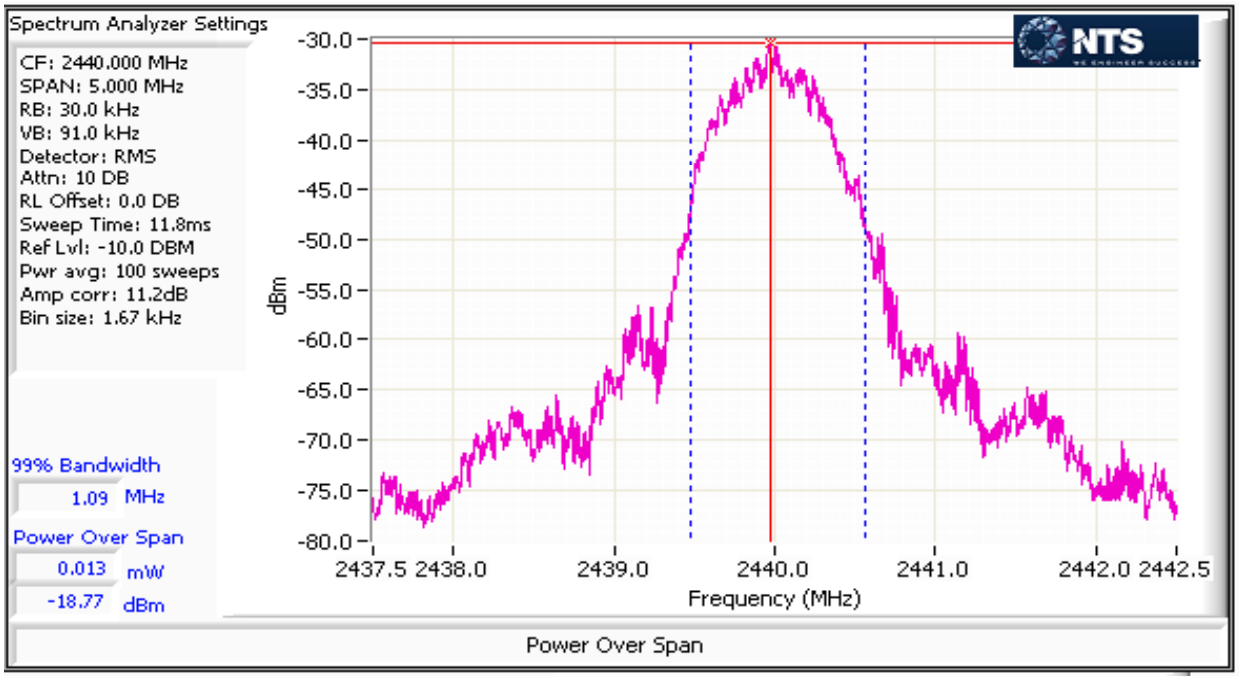
Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #1: Output Power

Mode: BT LE

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
Max	2402	-17.3	0.019	1.7	Pass	-15.5	0.000028		
Max	2440	-17.2	0.019	1.7	Pass	-15.5	0.000028		
Max	2480	-17.8	0.017	1.7	Pass	-16.1	0.000025		

Note 1:	Duty Cycle < 98%, constant duty cycle. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-2, in KDB 558074). Measurement corrected by Pwr Cor Factor. Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.



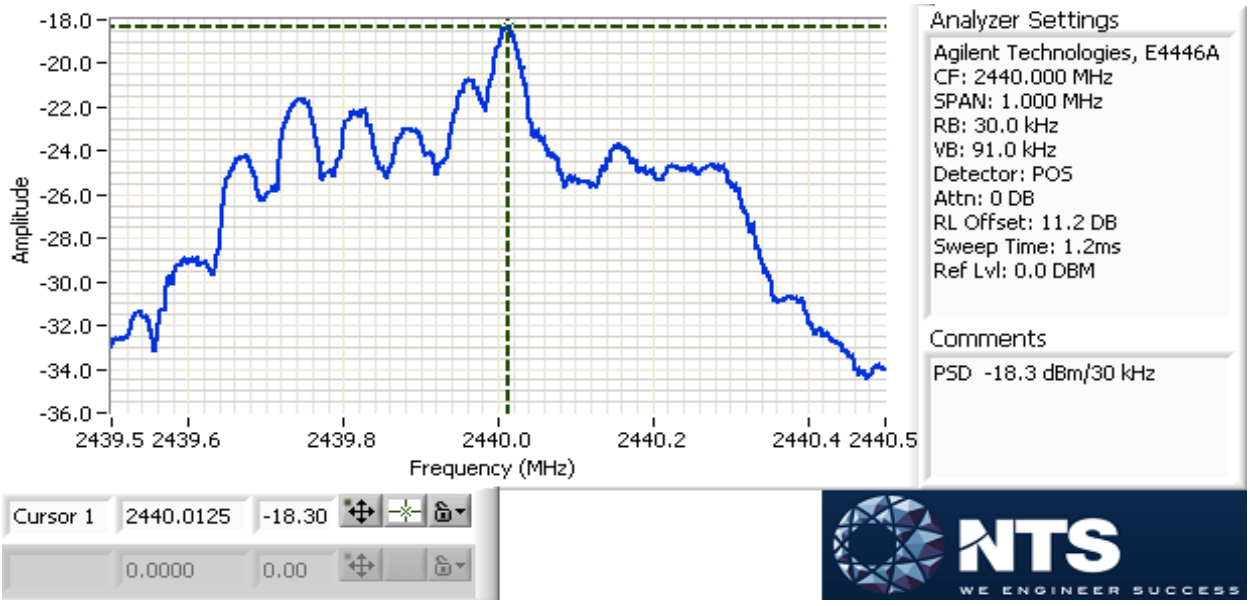
Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #2: Power spectral Density

Mode: BT LE

Power Setting	Frequency (MHz)	PSD (dBm/30kHz) Note 1	Limit dBm/3kHz	Result
Max	2402	-18.7	8.0	Pass
Max	2440	-18.3	8.0	Pass
Max	2480	-19.1	8.0	Pass

Note 1:	Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: 3kHz ≤ RBW ≤ 100kHz, VBW=3*RBW, peak detector, span = 1.5*DTS BW, auto sweep time, max hold.



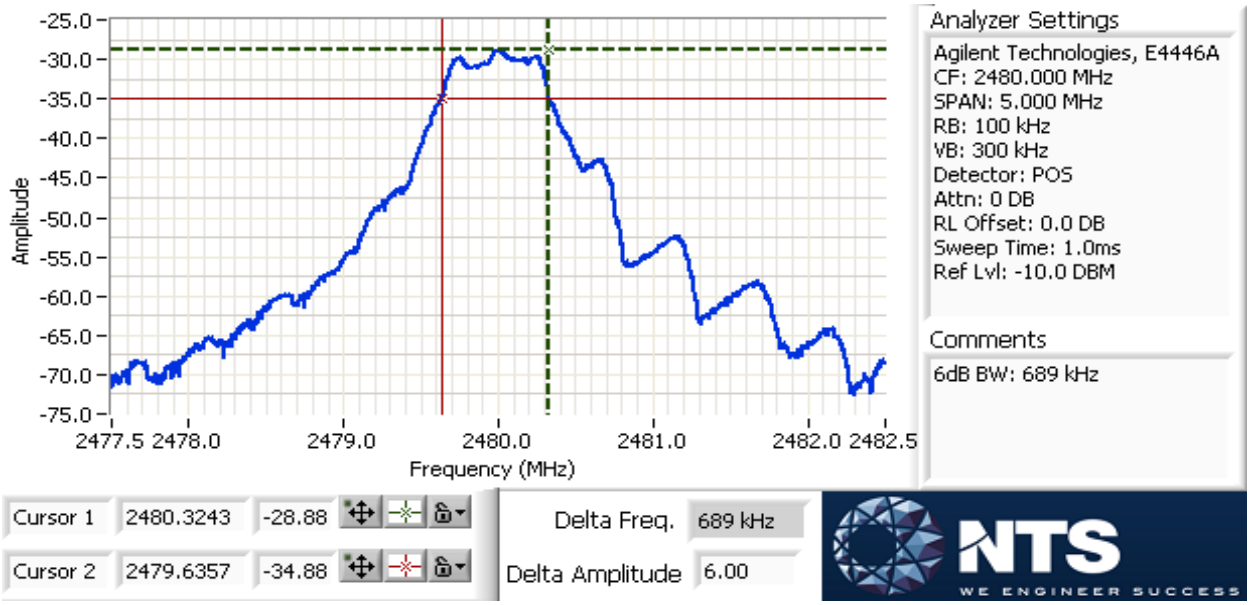
Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #3: Signal Bandwidth

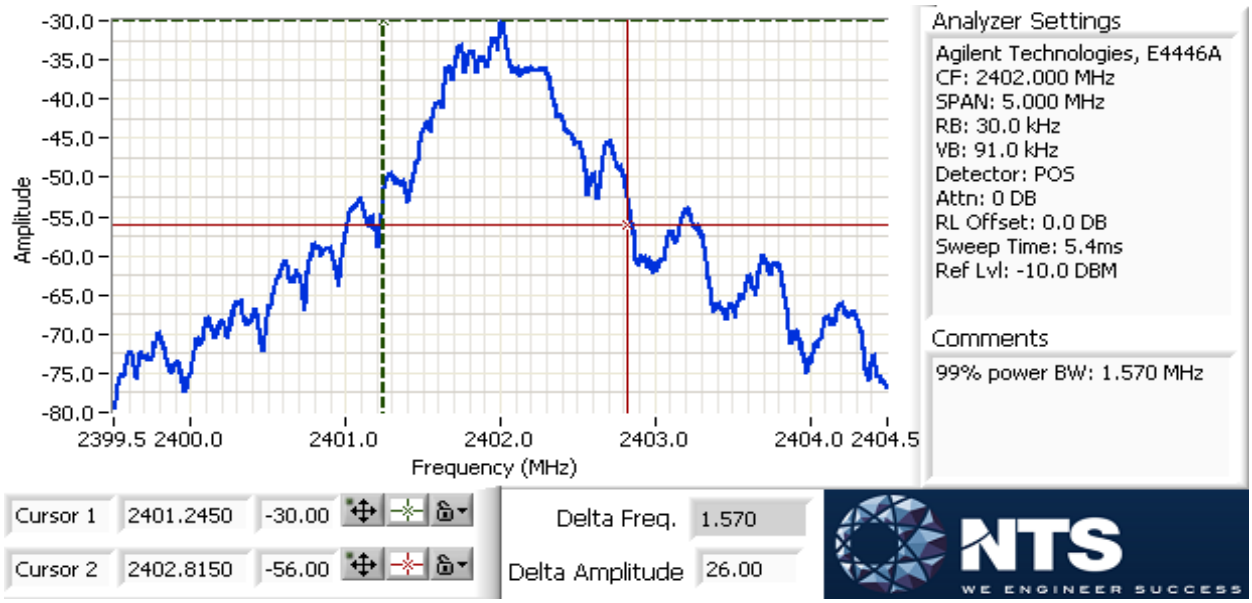
Mode: BT LE

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
Max	2402	0.707	1.570	100	30
Max	2440	0.712	1.332	100	30
Max	2480	0.689	1.182	100	30

Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. 99% BW: RBW=1-5% of of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.



Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

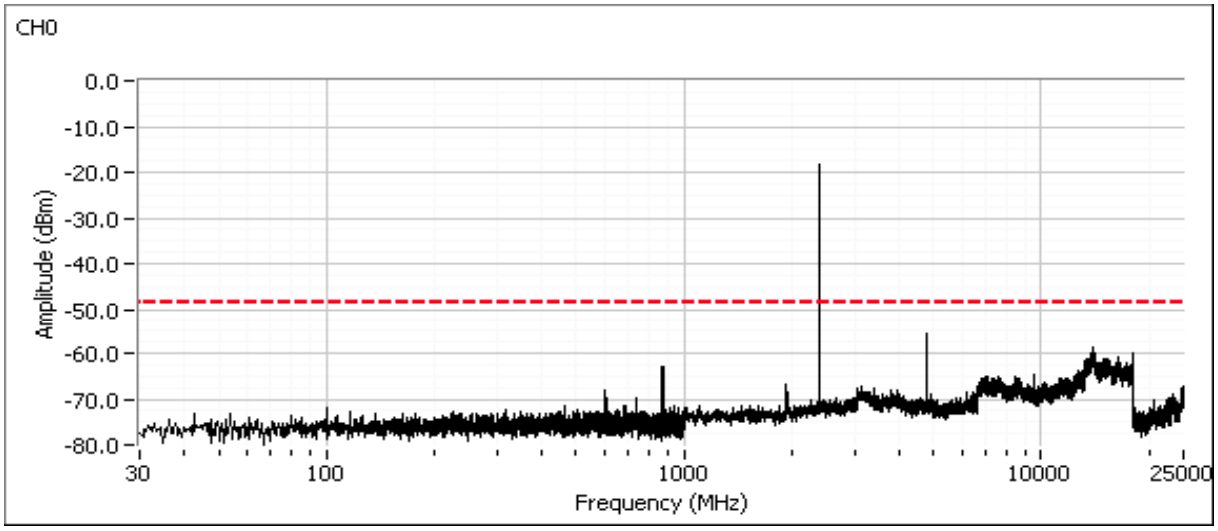


Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #4a: Out of Band Spurious Emissions

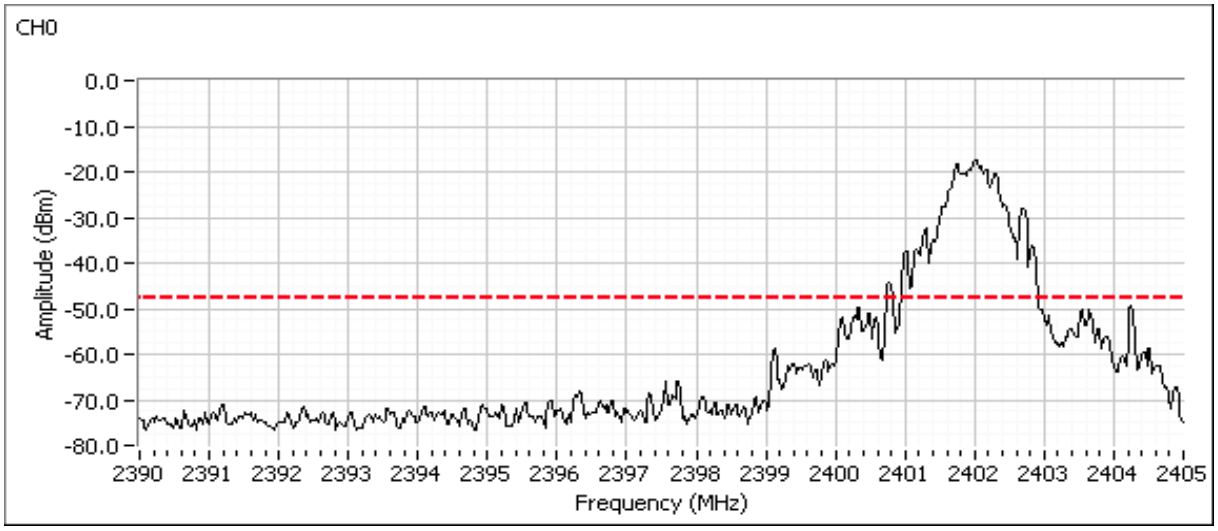
Frequency (MHz)	Power Setting	Mode	Limit	Result
2402	Max	BT LE	-30dBc	Pass
2440	Max	BT LE	-30dBc	Pass
2480	Max	BT LE	-30dBc	Pass

Plots for low channel

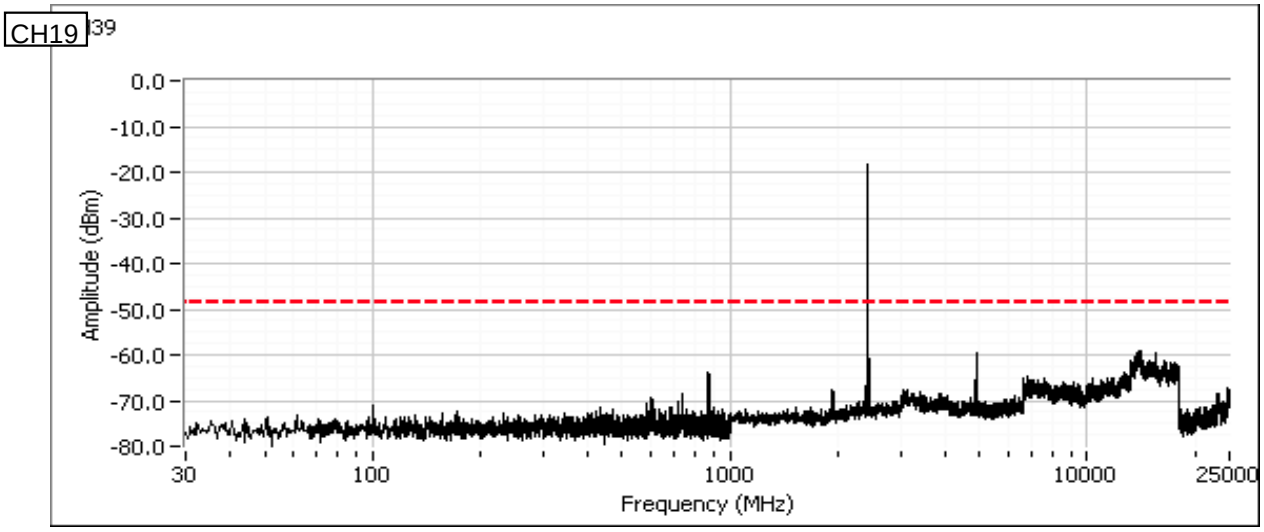


Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz and above 2483.5 MHz.

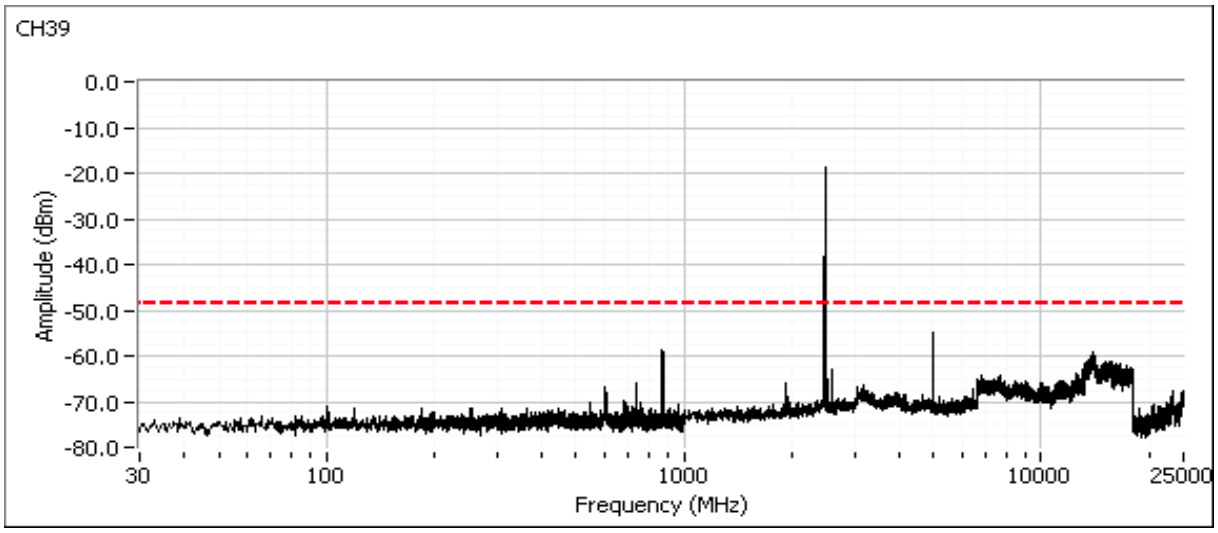


Plot for center channel



Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Plots for high channel



Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

FCC 15.247 DTS - 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: 9/9/2013
Test Engineer: J. Caizzi; M. Birgani
Test Location: Fremont Chamber #7

Config. Used: 1
Config Change: none
EUT Voltage: 3 VDC battery

General Test Configuration

Three EUTs were located on the turntable for radiated spurious emissions testing. They were transmitting on one channel, modulated with a PRBS signal.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 20-25 °C
Rel. Humidity: 40-50 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	30 - 25,000 MHz - Transmitter Radiated Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	44.5 dBµV/m @ 2483.5 MHz (-9.5 dB)

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.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	-	23.8%	Yes	0.15	6.23	12.46	-

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 3:	Emission has duty cycle < 98%, but constant. Average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

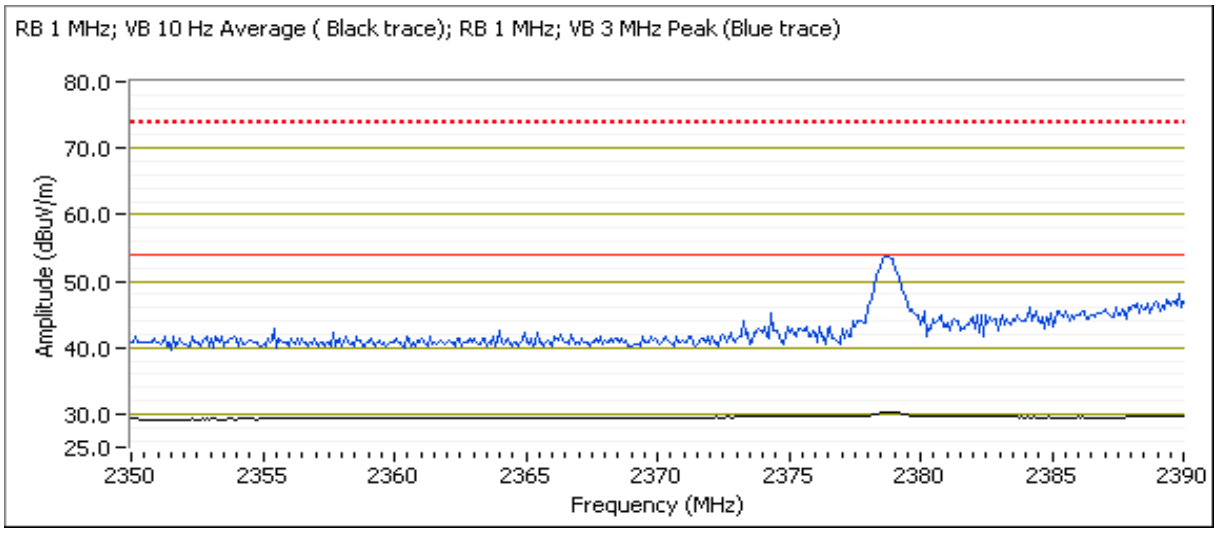
Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 25,000 MHz.

Run #1a: Radiated Spurious Emissions, Low Channel @ 2402 MHz.
#46 = CH0 (2402 MHz)

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		
2378.780	42.8	H	54.0	-11.2	AVG	349	1.0	Flat	Note 3, 4
2386.630	53.3	H	74.0	-20.7	PK	349	1.0	Flat	
2378.940	42.3	V	54.0	-11.7	AVG	0	1.2	Flat	Note 3, 4
2364.590	44.1	V	74.0	-29.9	PK	0	1.2	Flat	
2378.860	42.3	V	54.0	-11.7	AVG	345	1.0	Upright	Note 3, 4
2379.180	45.9	V	74.0	-28.1	PK	345	1.0	Upright	
2378.860	42.4	H	54.0	-11.6	AVG	175	1.8	Upright	Note 3, 4
2379.020	45.0	H	74.0	-29.0	PK	175	1.8	Upright	
2378.780	42.4	H	54.0	-11.6	AVG	206	1.1	Side	Note 3, 4
2356.730	46.8	H	74.0	-27.2	PK	206	1.1	Side	
2378.860	42.7	V	54.0	-11.3	AVG	254	1.2	Side	Note 3, 4
2378.220	51.7	V	74.0	-22.3	PK	254	1.2	Side	

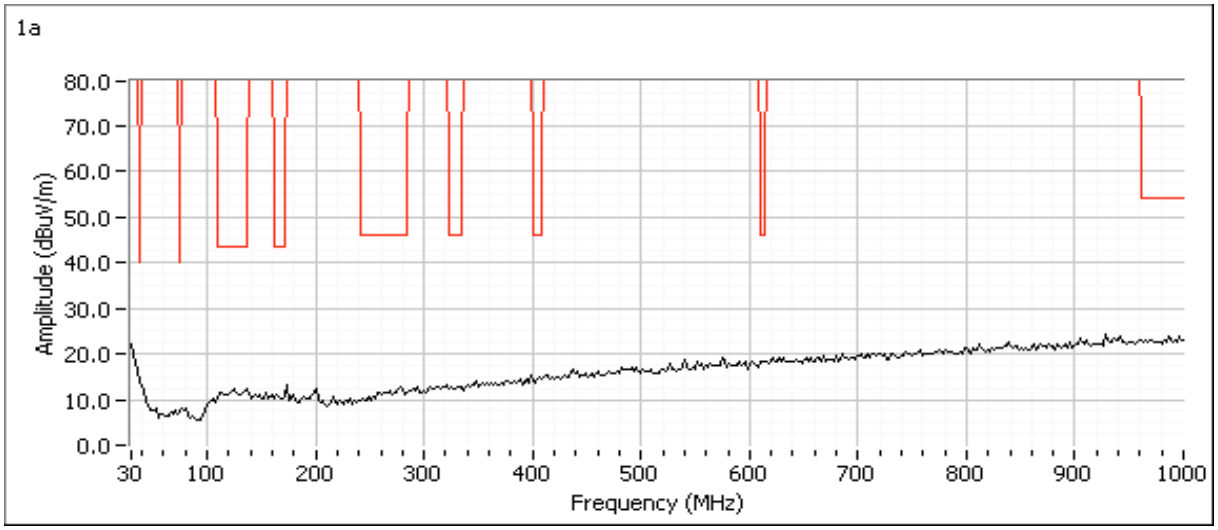


Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

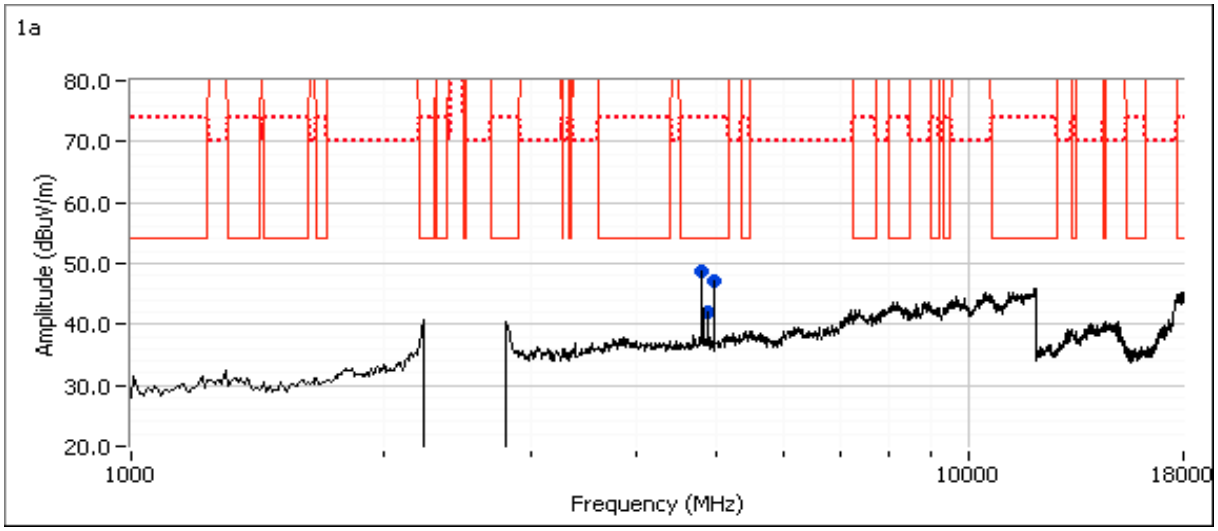
Other Spurious Emissions. 3 transmitters on 3 separate channels, each transmitter in one of 3 orthogonal orientations.
#42 = CH0 (2402 MHz), side
#43 = CH19 (2440 MHz), vertical
#45 = CH39 (2480 MHz), horizontal

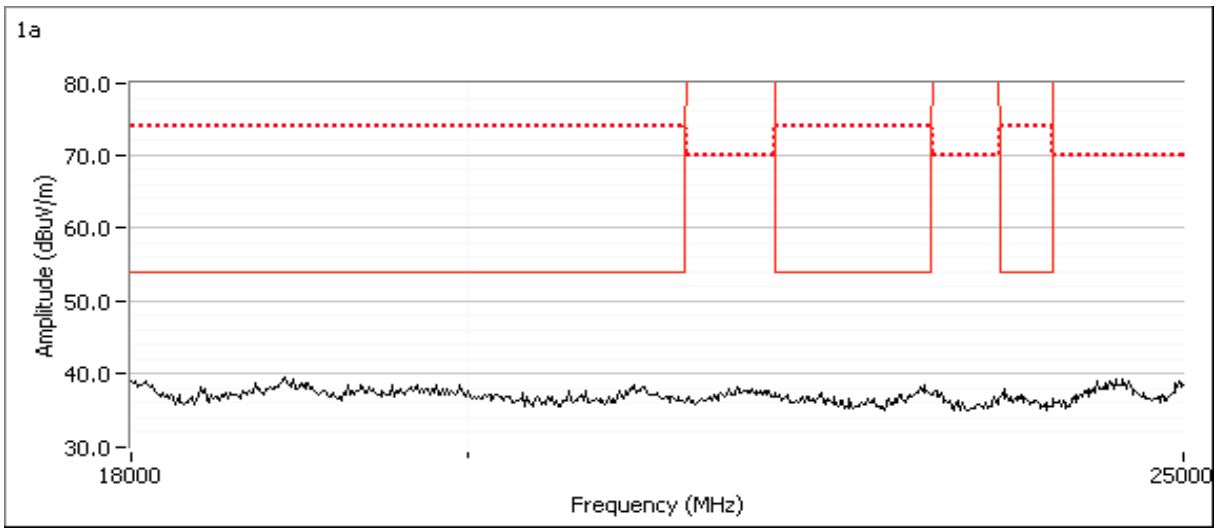
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4804.000	34.2	H	54.0	-19.8	AVG	34	1.00	
4803.030	51.7	H	74.0	-22.3	PK	34	1.00	
4959.930	40.7	H	54.0	-13.3	AVG	55	1.18	
4960.210	52.0	H	74.0	-22.0	PK	55	1.18	
4879.850	36.6	V	54.0	-17.4	AVG	344	1.56	
4879.080	49.2	V	74.0	-24.8	PK	344	1.56	

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 Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A



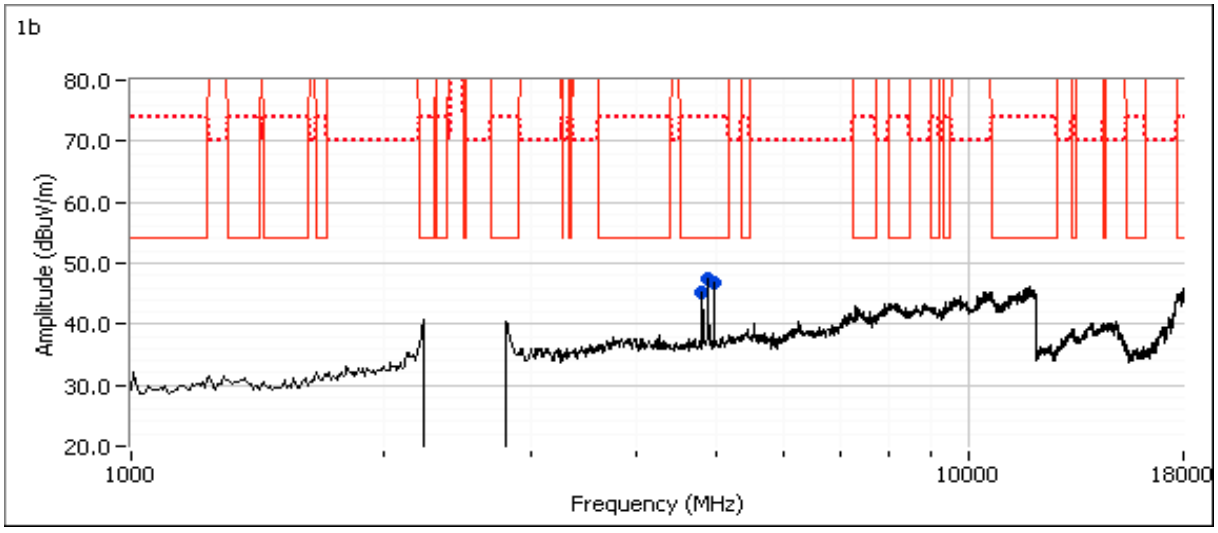


Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #1b: Radiated Spurious Emissions, 3 transmitters on 3 separate channels, each transmitter in one of 3 orthogonal orientations.
#46 = CH19, side
#43 = CH39, vertical
#45 = CH0, horizontal

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4959.910	38.1	V	54.0	-15.9	AVG	330	1.49	
4960.080	50.0	V	74.0	-24.0	PK	330	1.49	
4803.950	38.8	H	54.0	-15.2	AVG	56	1.11	
4804.230	50.5	H	74.0	-23.5	PK	56	1.11	
4880.100	41.7	H	54.0	-12.3	AVG	48	1.17	
4880.620	53.2	H	74.0	-20.8	PK	48	1.17	

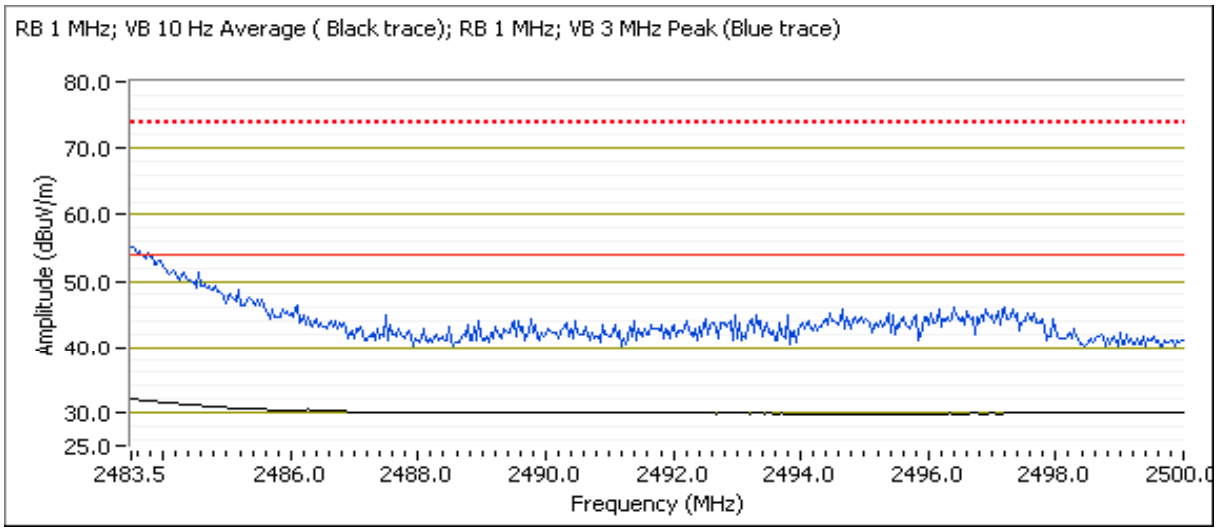
Note	#42 malfunctioned when changing channels, so it was swapped out for #46.
Note	No emissions found between 30-1000 MHz or above 18 GHz in Run 1a and thus these ranges were not repeated for this arrangement of the three samples.



Client:	Proteus Digital Health, Inc.	Job Number:	J93008
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Run #1c: Radiated Spurious Emissions, High Channel @ 2480 MHz
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	44.5	H	54.0	-9.5	AVG	263	1.0	Flat	Note 3, 4
2483.570	54.9	H	74.0	-19.1	PK	263	1.0	Flat	
2483.500	42.8	V	54.0	-11.2	AVG	236	1.1	Flat	Note 3, 4
2488.630	44.0	V	74.0	-30.0	PK	236	1.1	Flat	



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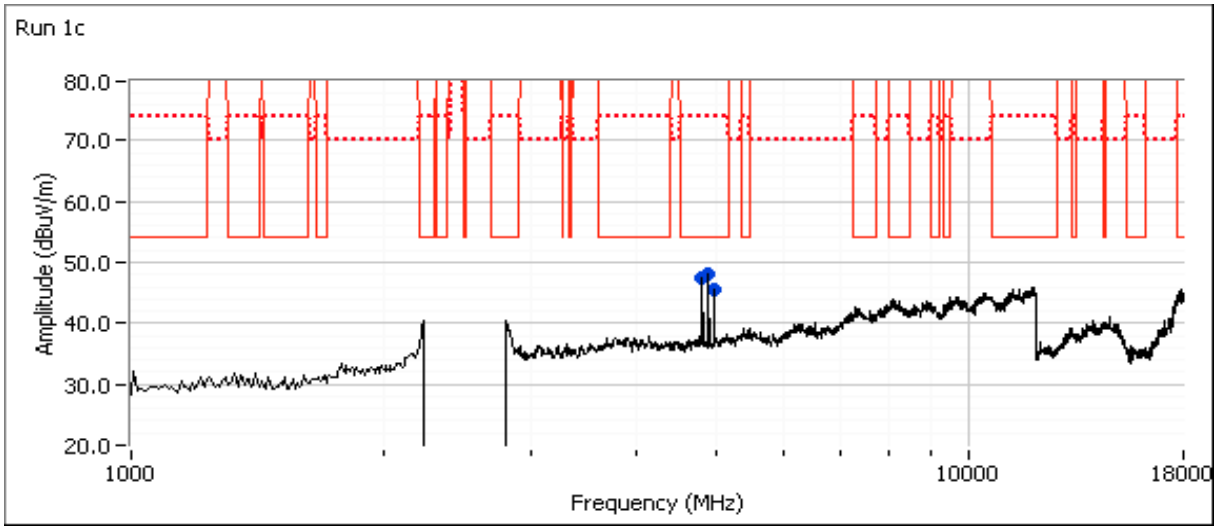
Model:	Patch Pod SPC-0655 with Replaceable Adhesive Strip SPC-0656	T-Log Number:	T93385
		Project Manager:	Deepa Shetty
Contact:	Jonathan Withrington / Jim Hutchison	Project Coordinator:	Tammy Nguyen
Standard:	EN 60601-1-2 & EN 301 489-1/-17	Class:	N/A

Other Spurious Emissions
#46 = CH39, side
#43 = CH0, vertical
#45 = CH19, horizontal

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4803.980	39.3	H	54.0	-14.7	AVG	48	1.09	
4804.170	50.8	H	74.0	-23.2	PK	48	1.09	
4880.020	42.2	H	54.0	-11.8	AVG	34	1.06	
4879.480	53.7	H	74.0	-20.3	PK	34	1.06	
4959.970	37.9	V	54.0	-16.1	AVG	344	1.96	
4959.990	49.3	V	74.0	-24.7	PK	344	1.96	

Note	No emissions found between 30-1000 MHz or above 18 GHz in Run 1a and thus these ranges were not repeated for this arrangement of the three samples.



End of Report

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