Electromagnetic Compatibility Test Report

Applicable Requirements:

FCC CFR Title 47 Part 15, Subpart C (§15.247) –
Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

Equipment Under Test:	Satellite Texting Device
Model Number:	SatPaq
Serial Number:	N/S
Prepared for:	Higher Ground LLC 2225 East Bayshore Road, Suite 200 Palo Alto, CA 94303 - 3220

Tested by:	Bob Cole
Prepared by:	Amy Jones
Verified and Approved by:	Bob Cole
Authorized Signatory	Bob Cole

EMCE Engineering, Inc.
1726 Ringwood Ave.
San Jose, CA 95131 USA

NVLAP®
Testing
Lab Code 200092-0

ACCREDITED BY THE NATIONAL VOLUNTARY LABORATORY
ACCREDITATION PROGRAM FOR THE SPECIFIC SCOPE
OF ACCREDITATION UNDER TESTING LAB CODE #: 200092-0

Note:

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Test Report Revision History

Report Format	Report Version	Description	Issue Date
EMCE-TRF-TNB_15	1.0	Original Release	6-20-2017
EMCE-TRF-TNB_15	1.1	Content Revisions per TCB Review	9-13-17

ADMINISTRATIVE INFORMATION

Test Laboratory: Facility No. registered through NVLAP: Test Site:	EMCE Engineering 1726 Ringwood Ave. San Jose, CA 95131 USA 510-490-4307 NVLAP Lab Code: 200092-0 FCC : US0125
Applicant Company Name : Applicant Contact Name :	Higher Ground LLC Rob Reis
Application Purpose :	Original
EUT Description :	This product is a Satellite Texting Device.
Product Name :	SatPaq
Model Number :	SatPaq
Serial Number :	N/S
Applied Requirements :	**FCC CFR Title 47 Part 15 Subpart C §15.247 –** Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
Measurement Distance :	3 Meters
Classification of EUT :	DTS
RF Operating Frequencies :	2402 – 2480 MHz
Modulation :	GSFK
Rated RF Output Power (Watts)	0.0016331
Type of Equipment :	Satellite Texting Device
Testing Configuration :	The EUT model name SatPaq, was setup per applicable specifications during EMI testing.
Operating Condition (Temp) :	Ambient
Supply Power to EUT : (If Battery supply details)	Lithium-Ion (Li-Ion): Ascent Batteries, ABI-H235471, 3.15 Wh, +850 mAh, 3.7 V
Supply Voltage :	3.7V DC
Receipt of EUT :	6/10/2017
Date of Testing :	6/16/2017 - 9/7/2017
Tested By :	Bob Cole
Approved By (CTO) :	Bob Cole
Test Report Number :	4322-1
Test Report Issue Date :	9/8/17
Test Report Prepared By:	Amy Jones
Test Report Reviewed By:	Bob Cole

Additional Items Provided

Spare Batteries	N/A
Battery Charging Device	N/A
External Power Supply or AC Adapter	N/A
Test Jig of Interface Box	N/A
RF Test Fixture (for integrated Antennas)	N/A
Host System	N/A
User Manual	Reviewed
Technical Documentation	Reviewed

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Accreditation

EMCE Engineering, has been placed on the Federal Communications Commission's list of recognized facilities for Parts 15 and 18 DoC approvals. Per the request of EMCE Engineering, the facility has been added to the list of those who perform Measurement Services for the public on a fee basis. This list is published periodically and is also available on the FCC Website. Additionally, EMCE Engineering has been accredited by the National Institute for Standards and Technology under the NVLAP program (Testing Lab Code 200092-0).

Disclaimer

EMCE Engineering, Inc., assumes no responsibility for the continuing validity of test data when the Equipment under Test is not under the continuous physical control of EMCE. The signature below attests to the fact that all measurements reported herein were performed by myself or were made under my supervision, and are correct to the best of my knowledge and belief as of the date specified. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Tests were conducted by qualified EMCE Engineering, Inc. personnel utilizing test equipment maintained in a "current" state of calibration with traceability to NIST.

- This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.
- This report or certificate shall not be reproduced except in full without the written approval of the issuer.

Modifications

There were no modifications installed by EMCE Engineering. The manufacturer may declare the EUT as complying with the CE Mark EMC Directive requirements.

Any modifications installed previous to testing by the Manufacturer will be incorporated into each production model, sold or leased.

Statement of Compliance

We, EMCE Engineering, declare under our sole responsibility that the product tested complies with the following listed standards:

Equipment Under Test:	Satellite Texting Device
Model Number:	SatPaq
Serial Number:	N/S
Report Number:	4322-1
Test Date:	6/16/2017 – 9/7/2017
Company:	Higher Ground LLC
Street Address:	2225 E. Bayshore Rd, Suite 200 Palo Alto, California, 94303

This Statement of Compliance is based upon compliance of the product with the following FCC Rules:

FCC CFR Title 47 Part 15 Subpart C §15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

Issued by Test Laboratory:

Testing Lab Code: 200092-0

EMCE Engineering
1726 Ringwood Ave
San Jose, CA 95131 USA

Verified By:

Bob Cole
Authorized Signatory

Test Location

Test Facility

All EMC Testing was performed at:

EMCE Engineering, Inc.
1726 Ringwood Ave.
San Jose, CA 95131
USA

Site Attenuation

The site attenuation for radiated measurements has been determined for this test site using the method described in ANSI C63.10:2013 Paragraph 5.2 and C63.4:2010 paragraph 5.4.1. The site attenuation is measured annually.

Input Power for EUT

Battery Powered 3.7V DC Lithium-ion

Accessory Equipment Precautions

Care was taken that accessory equipment or adjacent equipment did not produce unacceptable interference so as to contaminate the final test data. The EMI receiver and its associated computer, printer and plotter were located greater than 15 meters away from the EUT during testing and were powered from a separately filtered power source.

Ambient Interference

3 Meter Semi-Anechoic Chamber is scanned for ambient RF interference before final RF Testing.

Personnel

All testing was performed by EMCE Engineering personnel who are properly trained for the instruments and procedures used.

Use of Interference Measurement Equipment

All of the emission measurements and field strength measurements were performed utilizing various EMC measurement equipment. The Emissions Measurement Lab utilizes the following basic instruments:

1. Toshiba Satellite Laptop Computer
2. EMI Test v4.1 measurement software
3. Rohde & Schwarz FSV40 Spectrum Analyzer
4. HP 8477F Pre Amp
5. HP 8449B Pre Amp
6. Sunol Sciences JB-6 Hybrid Antenna
7. EMCO 3110 Horn Antenna

Test results are recorded on tabular data sheets and show final corrected values compared to the specification limit. Sample calculations show how the antenna factors, cable losses, amplifier gain, etc. are combined in the automatic analyzer program to produce the final corrected values shown on the graphs and data sheets.

Calibration of Measuring Equipment

The EMI Receiver (spectrum analyzer) is calibrated by an ISO 17025 Accredited calibration laboratory on an annual basis. The laboratory provides certification accredited to ISO 17025. Antenna factors are measured on an annual basis by an ISO 17025 Accredited Antenna Calibration Facility. Cable losses as well as amplifier gains are swept at least every month to verify accurate values.

Equipment Calibration Data

Equipment	Serial Number	Last Calibration Date	Calibration Due Date
Omega-IBTHXBP	14490199	7/8/2016	7/8/2018
Schaffner-NSG435	5892	7/8/2016	7/8/2018
Fluke-87	64920001	6/28/2016	6/28/2018
Sunol Sciences-JB1	A061416	6/12/2017	6/12/2018
EMCO-3816-2	9809-1089	8/12/2016	8/12/2018
Rohde & Schwarz-FSV40	101424	6/20/2016	6/20/2018
Sunol Sciences-JB6	A042610	6/12/2017	6/12/2018
A. H. Systems-SAS-571	236	6/13/2016	6/13/2018

MEASUREMENT UNCERTAINTY

Measurement Uncertainty Budget
Conducted Emissions 150 kHz – 30 MHz
Per CISPR 16-4-2

Input Quantity	*Uncertainty of x_1*		*$u(x_i)$ dB*	*c_i*	*$c_1 u(x_i)$ dB*
	dB	*Probability Distribution Function*			
Receiver Reading	*+/• 0.1*	*K = 1*	*0.1*	*1*	*0.1*
Attenuation: AMN – Receiver	*+/• 0.1*	*K = 2*	*0.05*	*1*	*0.05*
AMN Voltage Division Factor	*+/• 0.2*	*K = 2*	*0.1*	*1*	*0.1*
Receiver Corrections					
Sine Wave Voltage	*+/• 1.0*	*K = 2*	*0.5*	*1*	*0.5*
Pulse Amplitude Response	*+/• 1.5*	*Rectangular*	*0.87*	*1*	*0.87*
Pulse Rep Rate Response	*+/• 1.5*	*Rectangular*	*0.87*	*1*	*0.87*
Noise Floor Proximity	*+/• 0.0*		*0.0*	*1*	*0.0*
Mismatch: AMN – Receiver	*+/• 0.75*	*U•shaped*	*0.53*	*1*	*0.53*
AMN Impedance	*+/• 2.65*	*Triangular*	*1.08*	*1*	*1.08*
Total Measurement uncertainty – Conducted Emissions 150 kHz – 30 MHz $2u_c(P)$ = 4.45 dB					*4.45 dB*

Measurement Uncertainty Budget
Radiated Emissions @ 10 Meters

Input Quantity	*Uncertainty of x_i*		*U(x) dB*	*C_i*	*C_i u (x_i) dB*
	dB	*Probability Distribution Function*			
Receiver Reading	*+/- 0.1*	*K = 1*	*0.1*	*1*	*0.1*
Attenuation, Antenna - receiver	*+/- 0.1*	*K = 2*	*0.05*	*1*	*0.05*
Antenna Factor	*+/- 2.0*	*K = 2*	*1.0*	*1*	*1.0*
Receiver Corrections					
Sine Wave Voltage	*+/- 1.0*	*K = 1*	*0.5*	*1*	*0.5*
Pulse Amplitude Response	*+/- 1.5*	*Rectangular*	*0.87*	*1*	*0.87*
Pulse Rep Rate Response	*+/- 1.5*	*Rectangular*	*0.87*	*1*	*0.87*
Noise Floor Proximity	*+/- 0.5*	*K = 2*	*0.25*	*1*	*0.25*
Mismatch Antenna – Receiver	*+/- 0.9*	*U shaped*	*0.67*	*1*	*0.67*
Antenna Corrections					
AF Freq Interpolation	*+/- 0.3*	*Rectangular*	*0.17*	*1*	*0.17*
AF Height Deviations	*+/- 0.5*	*Rectangular*	*0.29*	*1*	*0.29*
Balance	*+/- 0.3*	*Rectangular*	*0.17*	*1*	*0.17*
Site Corrections					
Site Imperfections	*+/- 3.0*	*Rectangular*	*1.22*	*1*	*0.82*
Separation distance	*+/- 0.1*	*Rectangular*	*0.06*	*1*	*0.06*
Table Height	*+/- 0.1*	*K = 2*	*0.05*	*1*	*0.05*
Total Measurement Uncertainty - Radiated Emissions @ 10 Meters					*5.87*

Sample Calculations

Conducted Spurious Emissions

Measurements are compared directly to the applicable limits. The calculation is a s follows:

$$R_r - S = M$$

Where:

R_r = Measured value in dBm
S = Specification Limit
M = Margin

Radiated Spurious Emissions

Receiver readings are compared directly to a converted specification limit (dB form), the conversion uses the effective radiated power limit specified in the standard to calculate the expected field strength in free space using the following formula:

$$E = \sqrt{30*P*G} / d$$

Where:

E = Field Strength in V/M
P = Power in Watts
G = Gain of antenna in dB
D = Distance in meters

The field strength limit is then converted to decibel form (dBuV/M) and the margin of a given peak is calculated as follows:

$$M = R_c - L_s$$

Where:

M = Margin
R_c = Corrected Reading in dBuV/M
L_s = Calculated Specification Limit in dBuV/M

When substitution measurements are required (all signals with <6 dB margin relative to the Specification limit) the margin of the emission relative to the effective radiated power is calculated as follows:

$$P_s - S = M$$

Where:

P_s = ERP determined from antenna substitution (dBm)
S = Specification limit in dBm
M = Margin

PREPARATION OF EUT FOR TEST

Setup of EUT

Power to EUT: Battery
Grounding of EUT: N/A
Software: Channel Master - provided by Higher Ground LLC.

No Support Equipment was used.

Support Equipment				
Description	**Model Number**	**Serial Number**	**Manufacturer**	**Power Cable Description**
N/A	**N/A**	**N/A**	**N/A**	**N/A**
Cable Description				
From	**To**	**Length (Meters)**	**Shielded (Y/N)**	**Ferrite Loaded (Y/N)**
N/A	**N/A**	**N/A**	**N/A**	**N/A**

ATTACHMENT 1

NVLAP ISO 17025:2005

Accreditation Certificate

1.0 Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200092-0

Universal Compliance Labs dba EMCE Engineering
Fremont, CA

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2016-12-28 through 2017-12-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

ATTACHMENT 2

FCC 47 CFR
Part 15
Measurement Data

2.0 Summary of Test Results

FCC 47 CFR Part 15

The EUT has been tested according to the following specifications:

Test Standard FCC CFR Title 47 Part 15	Description of Test	Test Condition	Result (Pass / Fail)
15.205, 15.209	Radiated Spurious Emissions	Radiated	**Pass**
15.247(d)	Radiated Restricted Bandedge	Radiated	**Pass**
15.247(a)(2)	6 dB Bandwidth	Conducted	**Pass**
15.247 (d)	Conducted Maximum Peak Output Power	Conducted	**Pass**
15.247(e)	Power Spectral Density	Conducted	**Pass**
15.247(d)	Conducted Spurious Emissions	Conducted	**Pass**
15.247(d)	Conducted Bandedge (Out of Band Emissions)	Conducted	**Pass**
15.207	AC Power Line Conducted Emissions	Conducted	**N/A**
N/A	99% Bandwidth	Conducted	**N/A**
	ANSI C63.10:2013 / FCC KDB 558074 D01 DTS Meas. Guidance v04 dated 4/5/17 PS: All measurement uncertainties are not taken into consideration for all presented test result.		

PASS - The EUT passed that particular test.
FAIL- The EUT failed that particular test.
N/A - Not Applicable

FCC CFR Title 47 Part 15 Test Results

2.1.1 Transmitter Radiated Spurious Emissions

LIMITS

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table;

Frequency (MHz)	*Field Strength (uV/m)*	*Field Strength (dBuV/m)*
30-88	*100*	*40.0*
88-216	*150*	*43.5*
216-960	*200*	*46.0*
Above 960	*500*	*54.0*

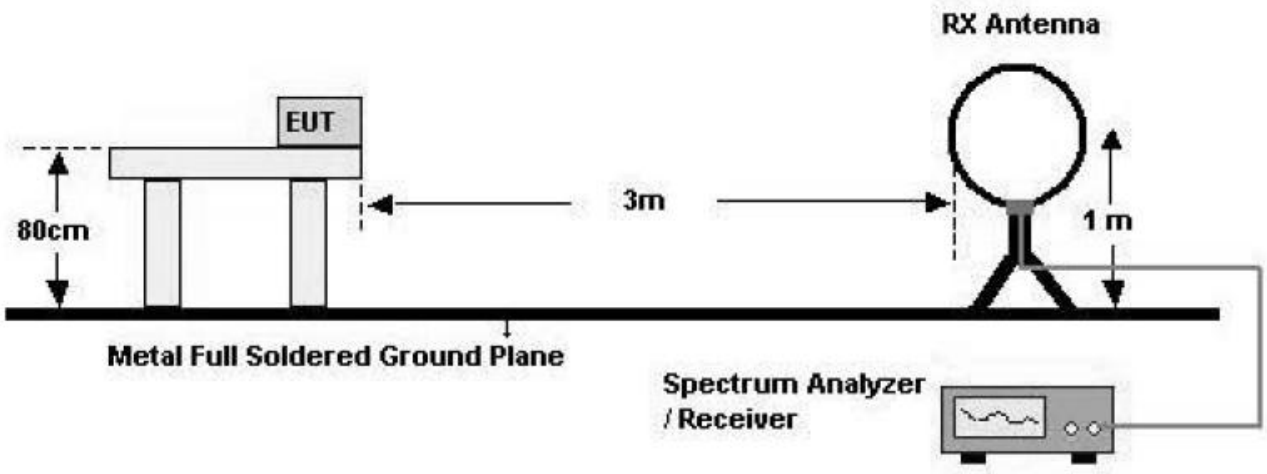
ANSI C63.10:2013, Section 10.2.8.2 states:
"For ITE unintentional radiators, the Frequency and Amplitude of the six highest radiated emissions relative to the limit and independent of antenna polarization shall be reported, unless such emissions are more than 20 dB below the limit. If less than the specified number (less than six) of emissions are within 20 dB of the limit, the noise level of the measuring instrument at representative frequencies shall be reported.

ANSI C63.10:2013, Section 5.5 states:
"Unless otherwise noted for a specific unlicensed wireless device, the spectrum shall be investigated from the lowest radio frequency signal generated in the device and up to at least the frequency shown in Table 2.33 However, frequencies below 9 kHz do not need to be investigated.

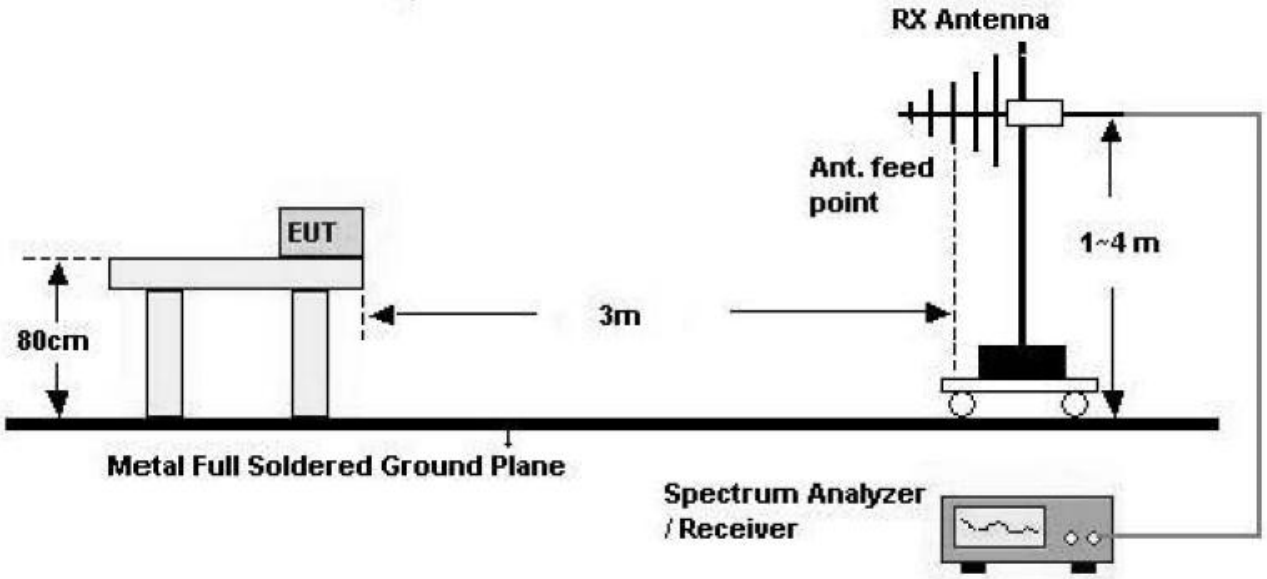
Lowest RF frequency generated by EUT during any radio operation is 32 MHz, therefore the frequency range to be investigated starts at 30 MHz.

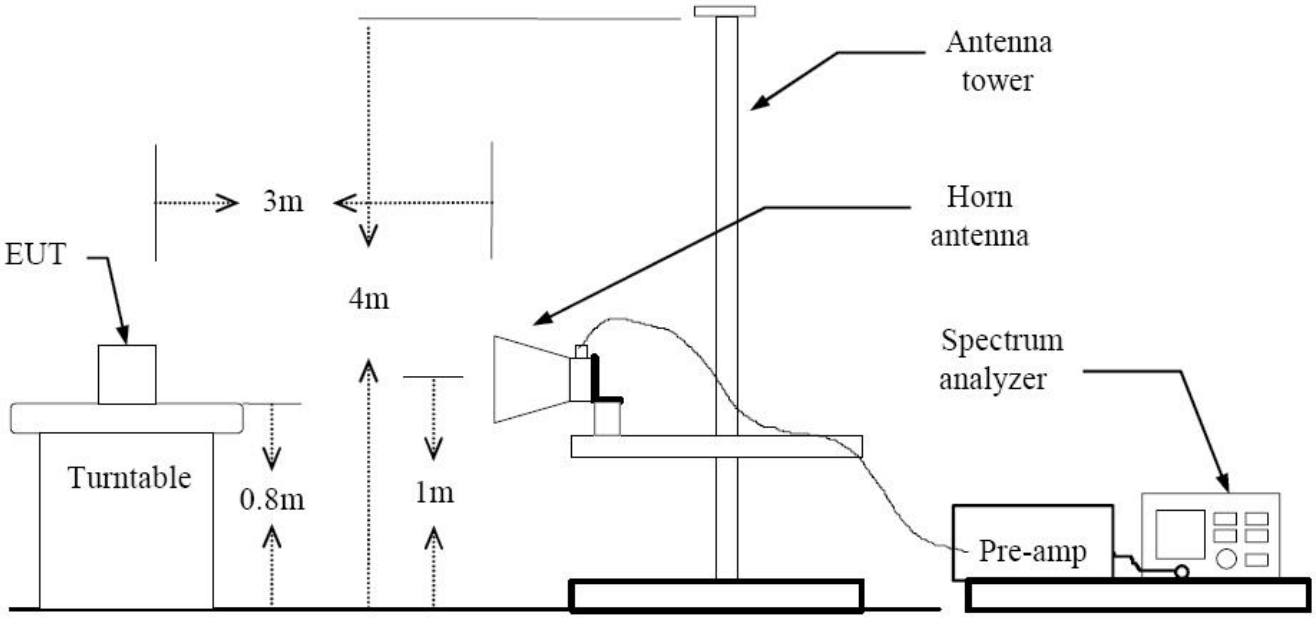
Test Configuration

Below 30 MHz



30 MHz - 1 GHz





TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground for frequencies < 1000 MHz, 150 cm above the ground plane for frequencies > 1000 MHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10:2013. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 KHz for peak detection measurements or 120 KHz or quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and VBW of 10 Hz for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS:

NO non-compliance noted.

Note
1. The antenna is manipulated through typical positions, polarity and length during the testing
2. The frequency range was scanned from 30 MHz to 25 GHz and the worst-case emissions are reported.
3. There is detected level above reference noise floor spectrum analyzer.

FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

Assume a receiver reading of 21.5 dBuV is obtained. The Antenna Factor of 7.4 dB/m and a Cable Factor of 1.1
dB is added. The 30 dBuV/m value is mathematically converted to its corresponding level in uV/m.

FS = 21.5 + 7.4 + 1.1 = 30 dBuV/m

9 kHz – 30MHz
Operation Mode: Continuous Tx

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm /m	dBm	(H/V)	dBμV/m	dBμV/m	dB
No Critical peaks found							

30 MHz – 25 GHz
Operation Mode: Continuous Tx

Test Location: EMCE Engineering •1726 Ringwood Avenue • San Jose, CA 94538 •

Customer:	**Higher Ground LLC**		
Specification:	**FCC 15.209 30 - 25000 Limits**		
Work Order #:	**4322**	Date:	6/16/2017
Test Type:	**Radiated Scan**	Time:	09.16.32 AM
Equipment:	**Satellite Messaging Device**	Sequence#:	1
Manufacturer:	Higher Ground LLC	Tested By:	Bob Cole
Model:	SatPaq		
S/N:	N/A		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Satellite Messaging Device*	Higher Ground LLC	SatPaq	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
SmartPhone	Apple	iPhone 6	N/A

Test Conditions / Notes:

BLE frequencies 2402 / 2440 / 2480 tested. Worst case emission reported

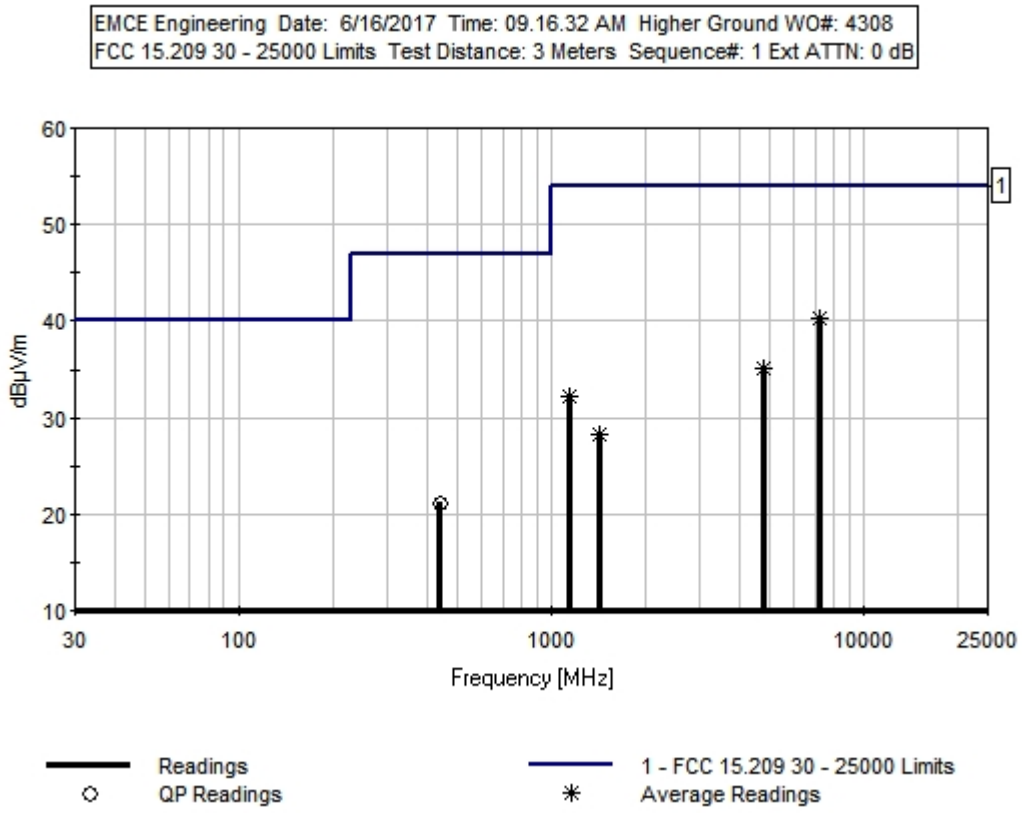
Transducer Legend:

T1=8447 Pre-Amp Asset 377 T2=25' LMR #001
T3=A.H. SAS-200/571 Horn T4=8449B Preamp
T5=Sunol 1GHz JB6 S/N A42610

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	7205.755M	30.0	+0.0	+4.1	+37.0	+30.9	+0.0	40.2	54.0	-13.8	Horiz
	Ave		+0.0				92		2402 Xmit		172
2	4804.725M	28.2	+0.0	+2.6	+34.7	+30.3	+0.0	35.2	54.0	-18.8	Vert
	Ave		+0.0				97		2442 Xmit		219
3	1148.011M	33.1	+0.0	+0.9	+27.7	+29.5	+0.0	32.2	54.0	-21.8	Horiz
	Ave		+0.0				88		2480 Xmit		154
4	1437.883M	29.0	+0.0	+0.9	+27.9	+29.6	+0.0	28.2	54.0	-25.8	Vert
	Ave		+0.0				171		2442 Xmit		208
5	440.925M	31.1	+26.9	+0.3	+0.0	+0.0	+0.0	21.2	47.0	-25.8	Vert
	QP		+16.7				241		2480 Xmit		128



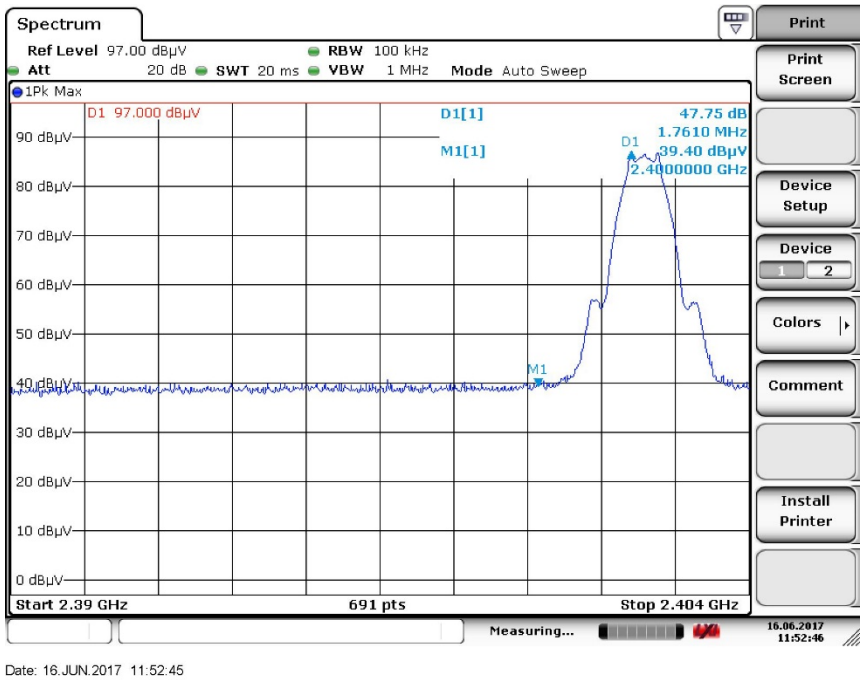
2.1.2 Radiated Spurious Emissions – Bandedge

LIMITS

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. **In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).**

Frequency	Modulation	Delta	Limit	Result
2402	GSFK	47.75	>20	Pass
2480	GSFK	47.67	>20	Pass

2402 Radiated Bandedge



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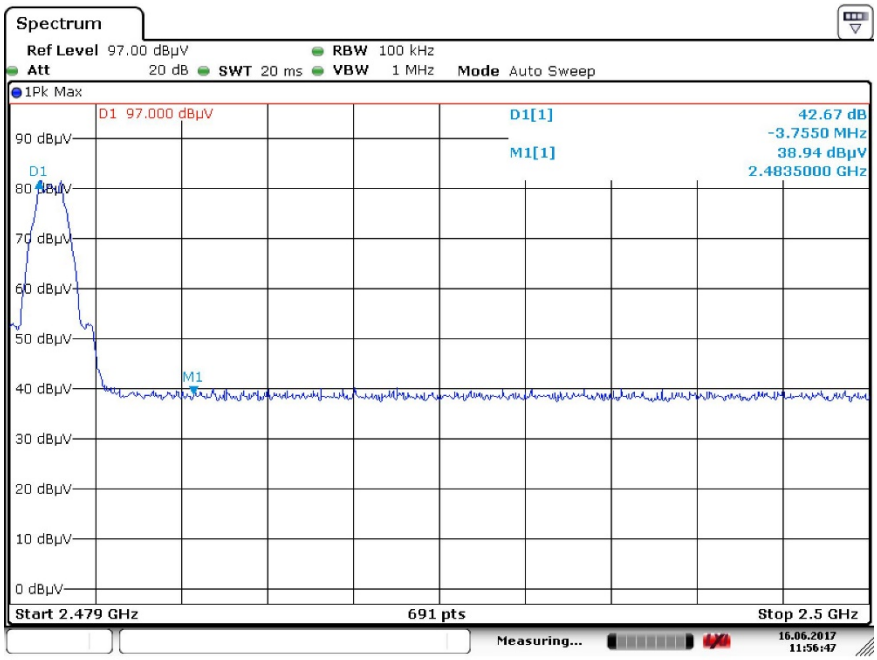
2480 Radiated Bandedge



2.1.3 6 dB BANDWIDTH

LIMIT:

FCC 47 CFR Part 15

§15.247(a) (2)
Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

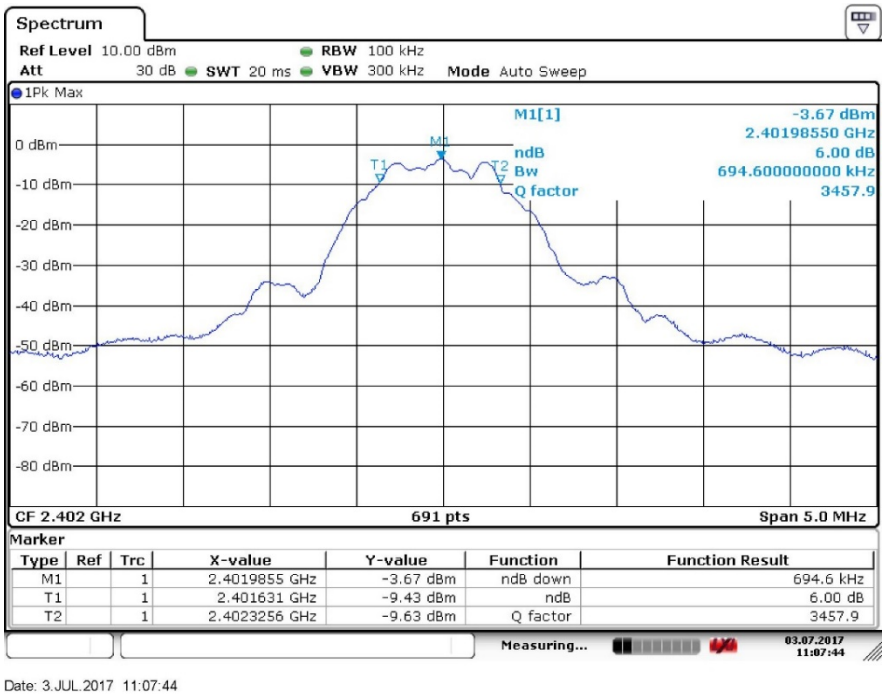
TEST PROCEDURE:

- The transmitter output is connected to the spectrum analyzer
- All modulations tested, worst case data shown
- The RBW is set to 100KHz. The VBW is set to 100KHz. The sweep time is coupled.
- Signal Peak is detected
- Bandwidth is determined at the points 6 dB down from the peak value of the modulated carrier.

Operating Frequency (MHz)	6dB Bandwidth (KHz)	Limit (KHz)	Result
2402	694.6	>500	**PASS**
2440	694.6	>500	**PASS**
2480	694.6	>500	**PASS**

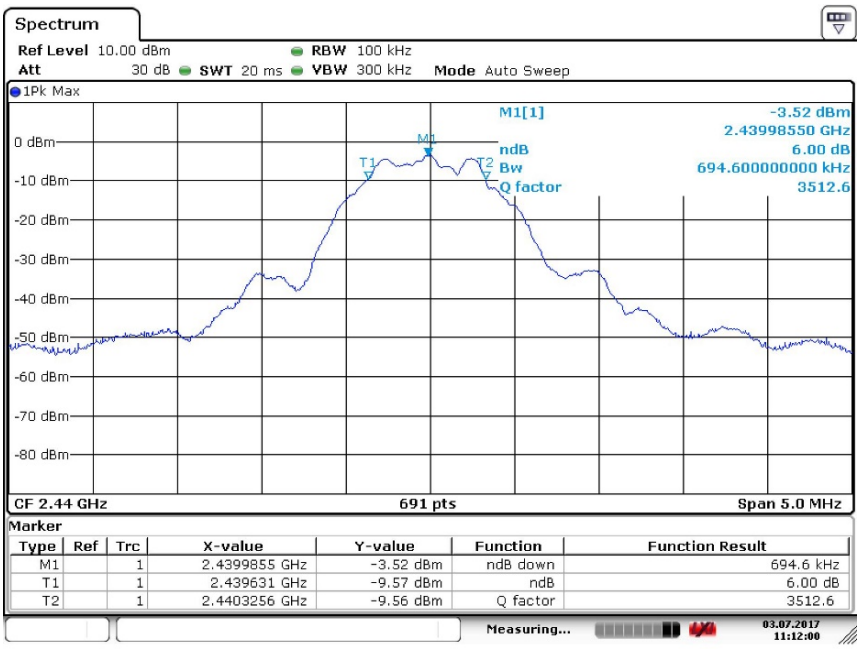
RESULTS:

2402 MHz



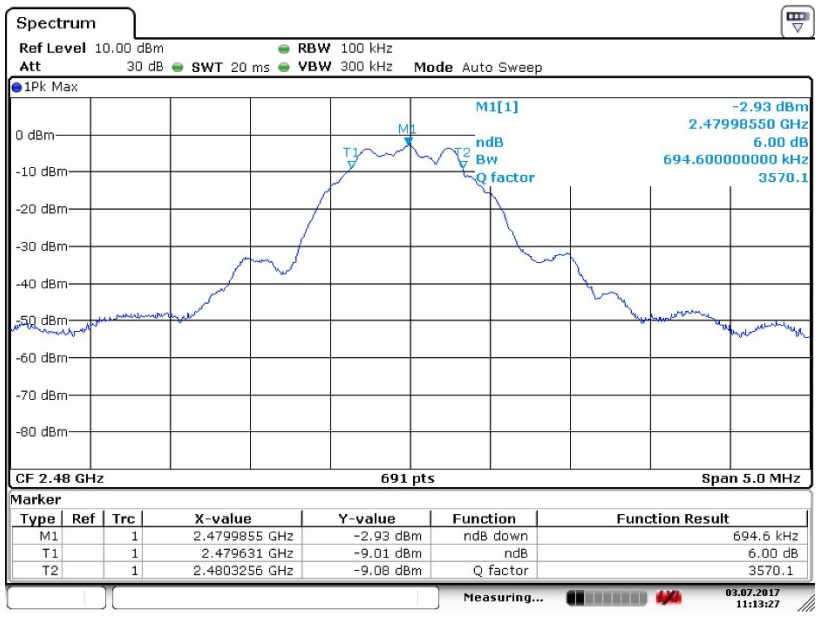
Date: 3.JUL.2017 11:07:44

2440 MHz



Date: 3.JUL.2017 11:12:00

2480 MHz



Date: 3.JUL.2017 11:13:27

2.1.4 Conducted Maximum Peak Output Power

LIMIT:

FCC 47 CFR Part 15

§15.247(d)

1 Watt / 30dBm / 137 dBuV (50 Ohms conversion)

TEST PROCEDURE:

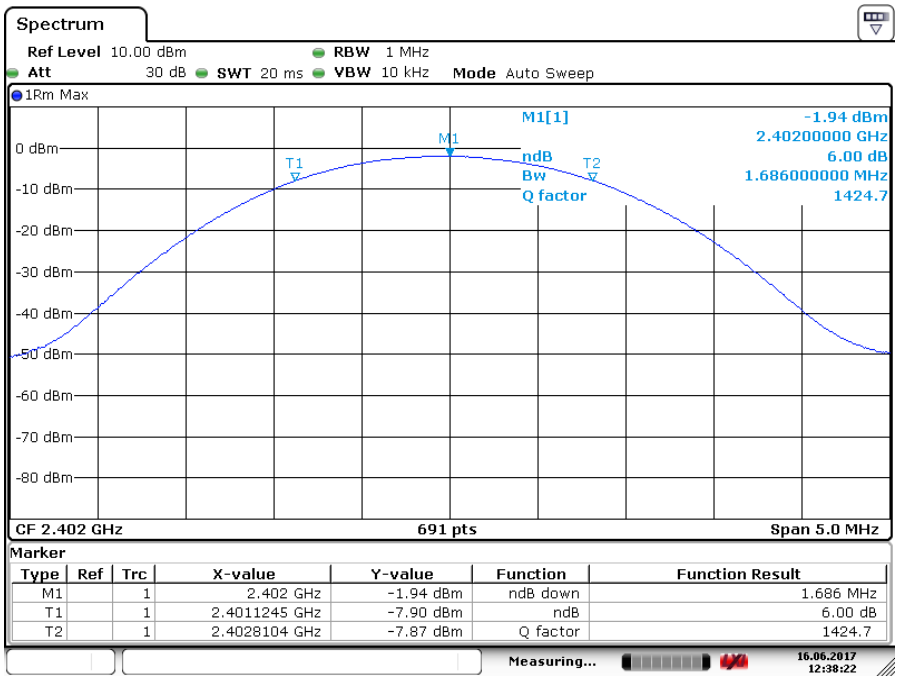
The transmitter output to the antenna is connected to a spectrum analyzer. The RBW / VBW is set to 1. The sweep time is coupled and the span is set to 5 MHz.

RESULTS:

Peak Output Power

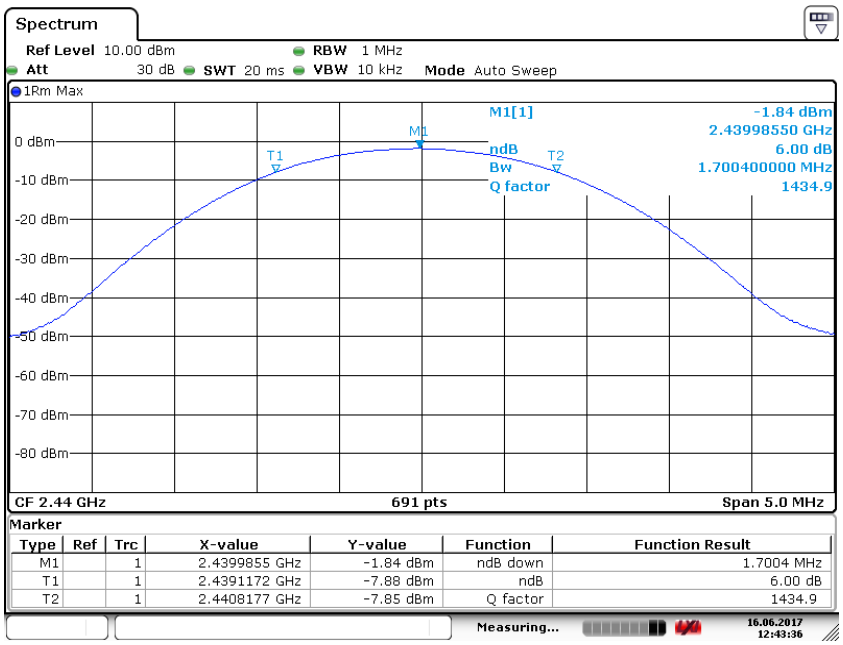
Frequency (MHz)	Peak Output Power(dBm)	Limit (dBm)	Results
2402	1.94	20	PASS
2440	1.84	20	PASS
2480	2.13	20	PASS

2402 MHz



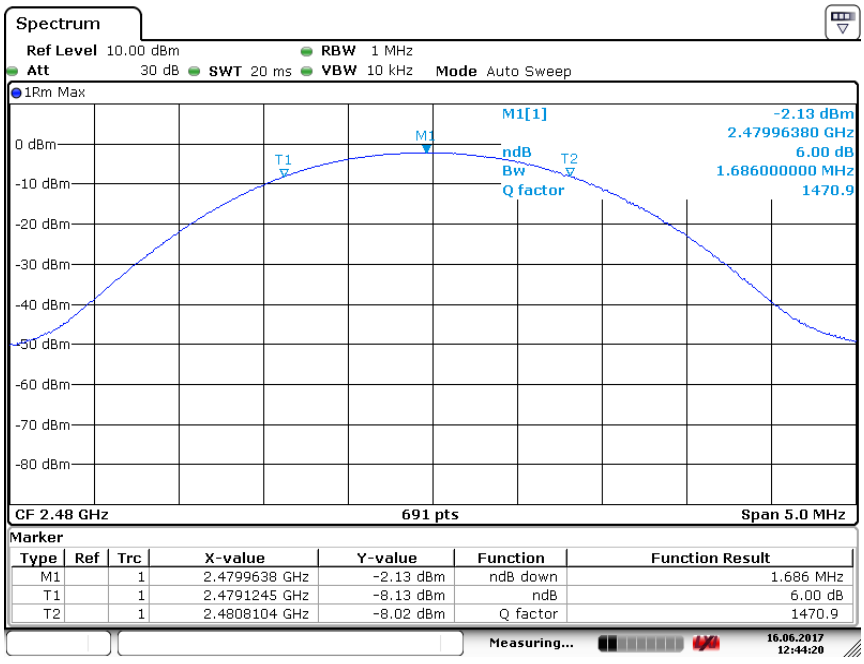
Date: 16.JUN.2017 12:38:22

2440 MHz



Date: 16.JUN.2017 12:43:36

2480 MHz



Date: 16.JUN.2017 12:44:21

2.1.5 Power Spectral Density

LIMIT:

FCC 47 CFR Part 15

§15.247 (e)

For digitally modified systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. The power spectral density shall be determined in accordance with the provisions of FCC 15.247 (b). The same method of determining the conducted output power shall be used to determine the power spectral density.

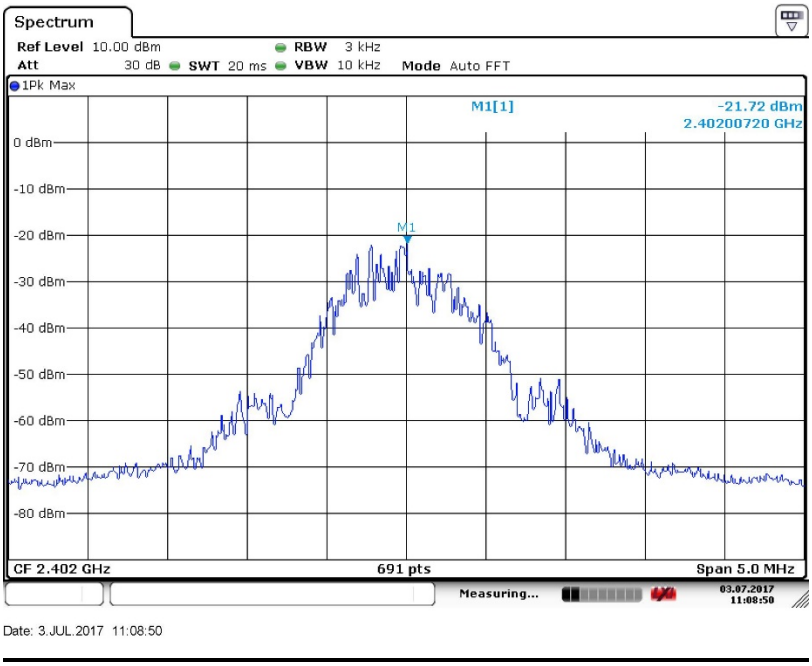
TEST PROCEDURE:

The transmitter antenna output is connected to a spectrum analyzer. The RBW is set to 3 KHz and the VBW is set to 10 KHz. All modulations tested, worst case data shown

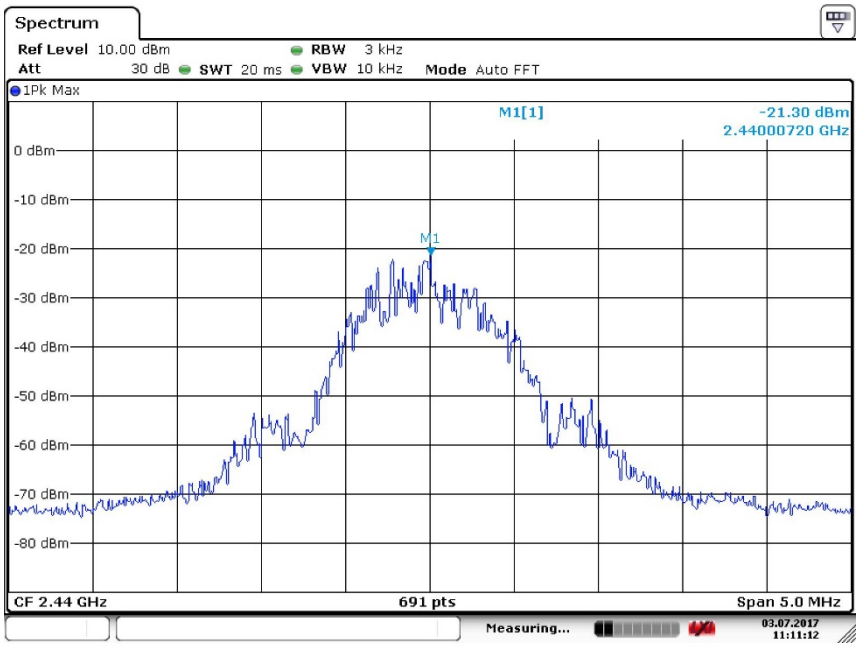
RESULTS:

Description	Channel	Measured Value	E.I.R.P.	Limit	Result
Power Spectral Density	2402	-21.21 dBm	-22.21	10 dBM	**PASS**
	2440	-21.30 dBm	-22.30		
	2480	-20.62 dBm	-21.62		

2402

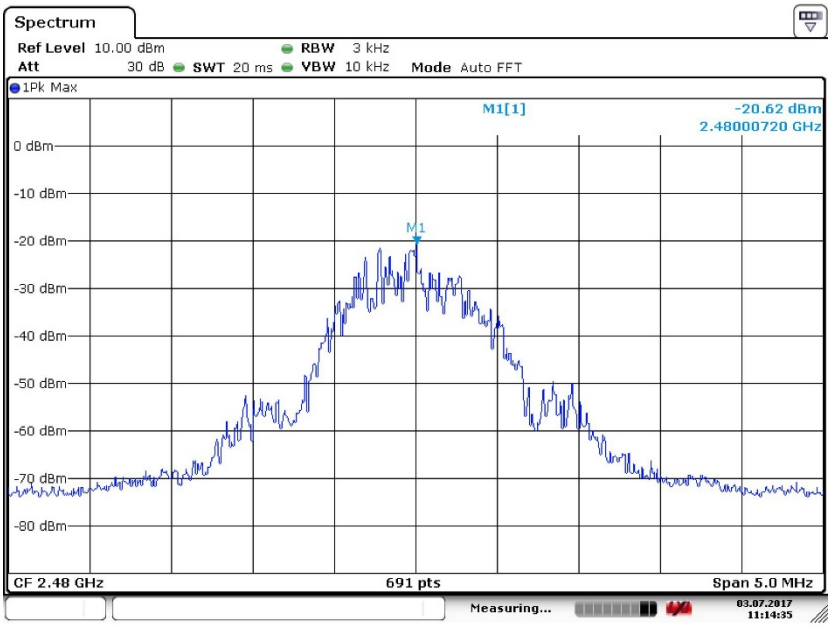


2440



Date: 3.JUL.2017 11:11:12

2480



Date: 3.JUL.2017 11:14:35

2.1.6 Conducted Bandedge

LIMIT:

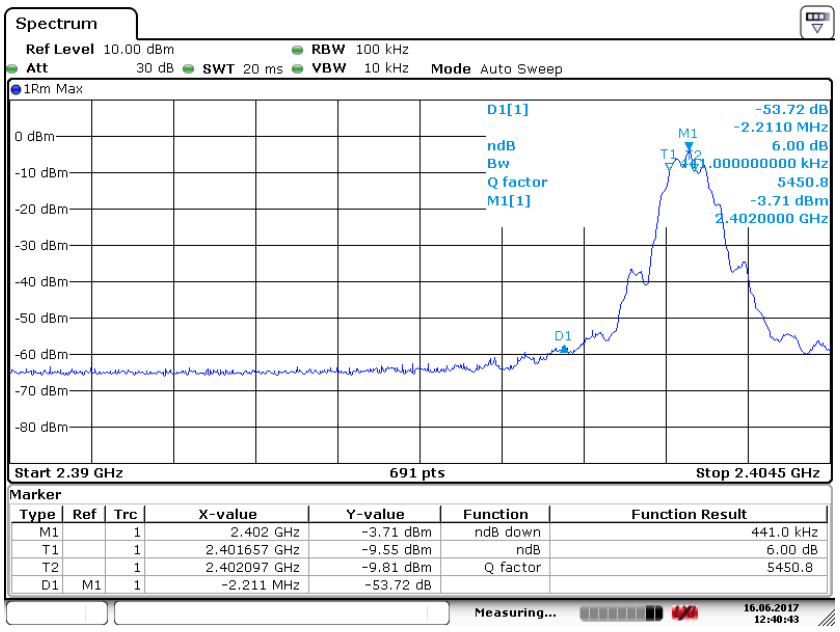
§15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required**. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).**

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	**2310-2390**	15.35-16.2
8.362-8.366	156.52475-156.52525	**2483.5-2500**	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

RESULTS:
NO non-compliance noted.

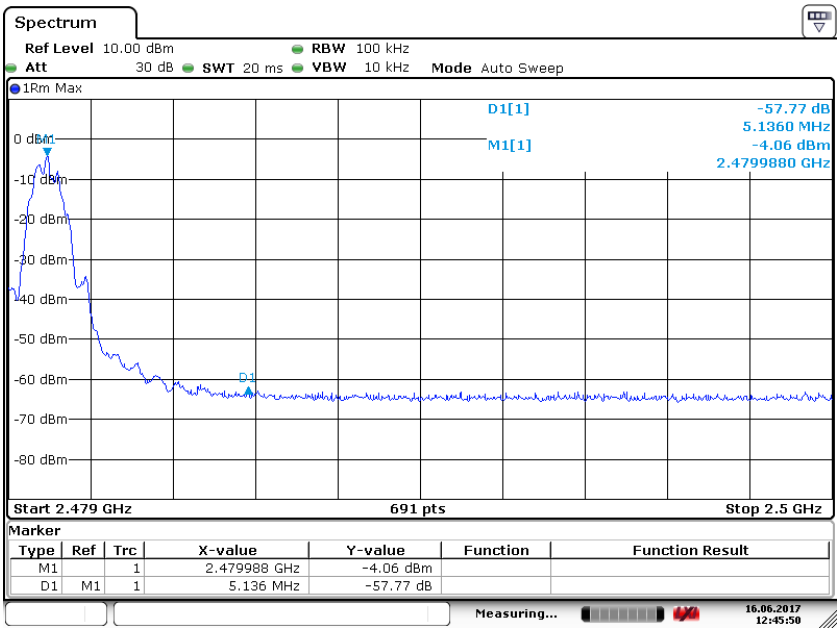
Frequency	Modulation	Delta	Limit	Result
2402	GSFK	53.72	>20	Pass
2480	GSFK	57.72	>20	Pass

2402 MHz / GSFK



Date: 16.JUN.2017 12:40:43

2480 MHz



Date: 16.JUN.2017 12:45:50

2.1.7 Conducted Spurious Emissions

LIMITS

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

2402 MHz

Test Location: EMCE Engineering •1726 Ringwood Avenue • San Jose, CA •

Customer: **Higher Ground LLC**
Specification: **FCC 15.247 PK 30M-25G**
Work Order #: **4322** Date: 6/16/2017
Test Type: **Radiated Scan** Time: 1:39:06 PM
Manufacturer: Higher Ground LLC Tested By: Bob Cole
Model: SatPaq
S/N: N/A

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Satellite Messaging Device*	Higher Ground LLC	SatPaq	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
SmartPhone	Apple	iPhone 6	N/A

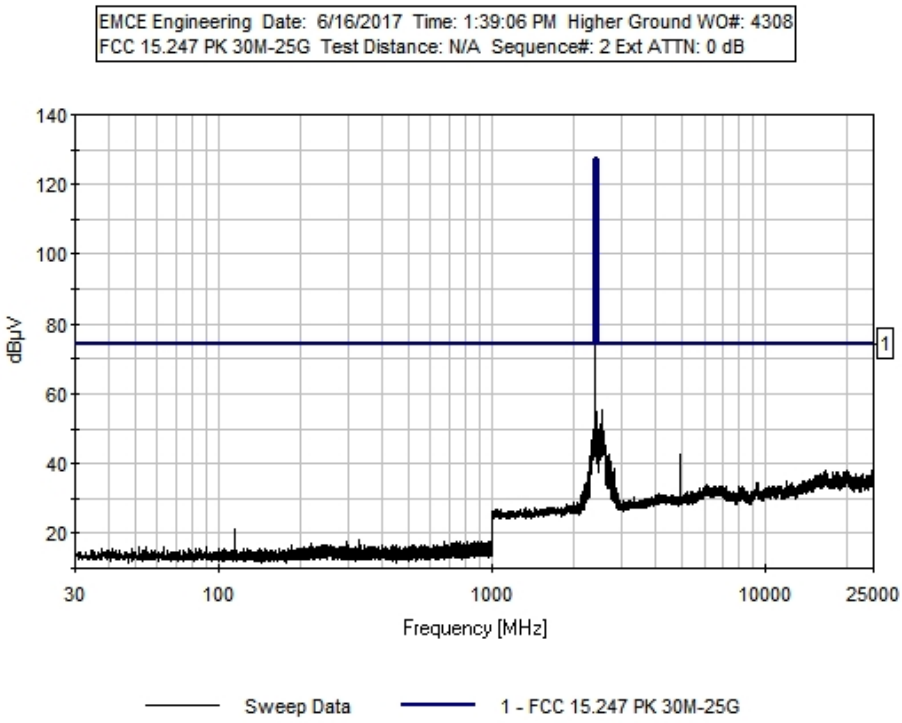
Test Conditions / Notes:

2402 Xmit

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: N/A

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
2	2546.626M	55.2					+0.0	55.2	74.0	-18.8	N/A
3	2379.158M	54.9					+0.0	54.9	74.0	-19.1	N/A
4	2402.175M	105.4					+0.0	105.4	127.0	-21.6	N/A
5	2519.572M	51.4					+0.0	51.4	74.0	-22.6	N/A
6	2554.642M	50.5					+0.0	50.5	74.0	-23.5	N/A


EMCE Engineering Date: 6/16/2017 Time: 1:39:06 PM Higher Ground WO#: 4308
FCC 15.247 PK 30M-25G Test Distance: N/A Sequence#: 2 Ext ATTN: 0 dB
140
120
100
80
60
40
20
dBµV
1
30
100
1000
10000
25000
Frequency [MHz]
Sweep Data
1 - FCC 15.247 PK 30M-25G

2440 MHz

Test Location: EMCE Engineering •1726 Ringwood Avenue • San Jose, CA •

Customer: **Higher Ground LLC**
Specification: **FCC 15.247 PK 30M-25G**
Work Order #: **4322** Date: 6/16/2017
Test Type: **Radiated Scan** Time: 1:49:11 PM
Manufacturer: Higher Ground LLC Tested By: Bob Cole
Model: SatPaq
S/N: N/A

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Satellite Messaging Device*	Higher Ground LLC	SatPaq	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
SmartPhone	Apple	iPhone 6	N/A

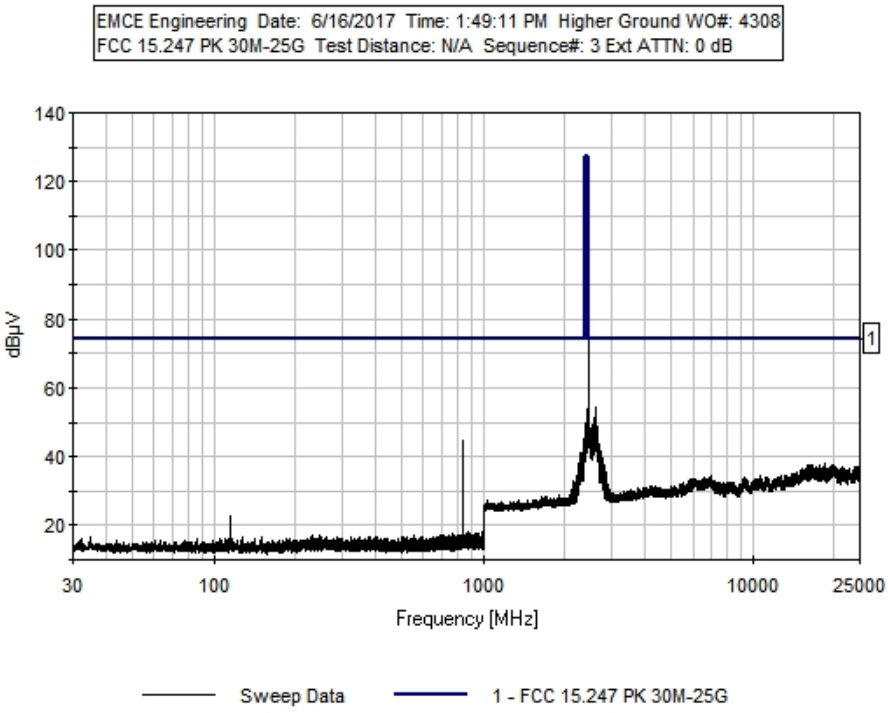
Test Conditions / Notes:

2440 Xmit

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: N/A

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2599.732M	54.5					+0.0	54.5	74.0	-19.5	N/A
2	2454.886M	105.5					+0.0	105.5	127.0	-21.5	N/A
3	2571.676M	51.4					+0.0	51.4	74.0	-22.6	N/A
4	2578.690M	50.0					+0.0	50.0	74.0	-24.0	N/A
5	2392.786M	49.7					+0.0	49.7	74.0	-24.3	N/A
6	2607.749M	49.7					+0.0	49.7	74.0	-24.3	N/A


EMCE Engineering Date: 6/16/2017 Time: 1:49:11 PM Higher Ground WO#: 4308
FCC 15.247 PK 30M-25G Test Distance: N/A Sequence#: 3 Ext ATTN: 0 dB
140
120
100
80
60
40
20
dBµV
1
30
100
1000
10000
25000
Frequency [MHz]
Sweep Data
1 - FCC 15.247 PK 30M-25G

2480 MHz

Test Location: EMCE Engineering •1726 Ringwood Avenue • San Jose, CA •

Customer: **Higher Ground LLC**
Specification: **FCC 15.247 PK 30M-25G**
Work Order #: **4322** Date: 6/16/2017
Test Type: **Radiated Scan** Time: 12:51:36 PM
Manufacturer: Higher Ground LLC Tested By: Bob Cole
Model: SatPaq
S/N: N/A

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Satellite Messaging Device*	Higher Ground LLC	SatPaq	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
SmartPhone	Apple	iPhone 6	N/A

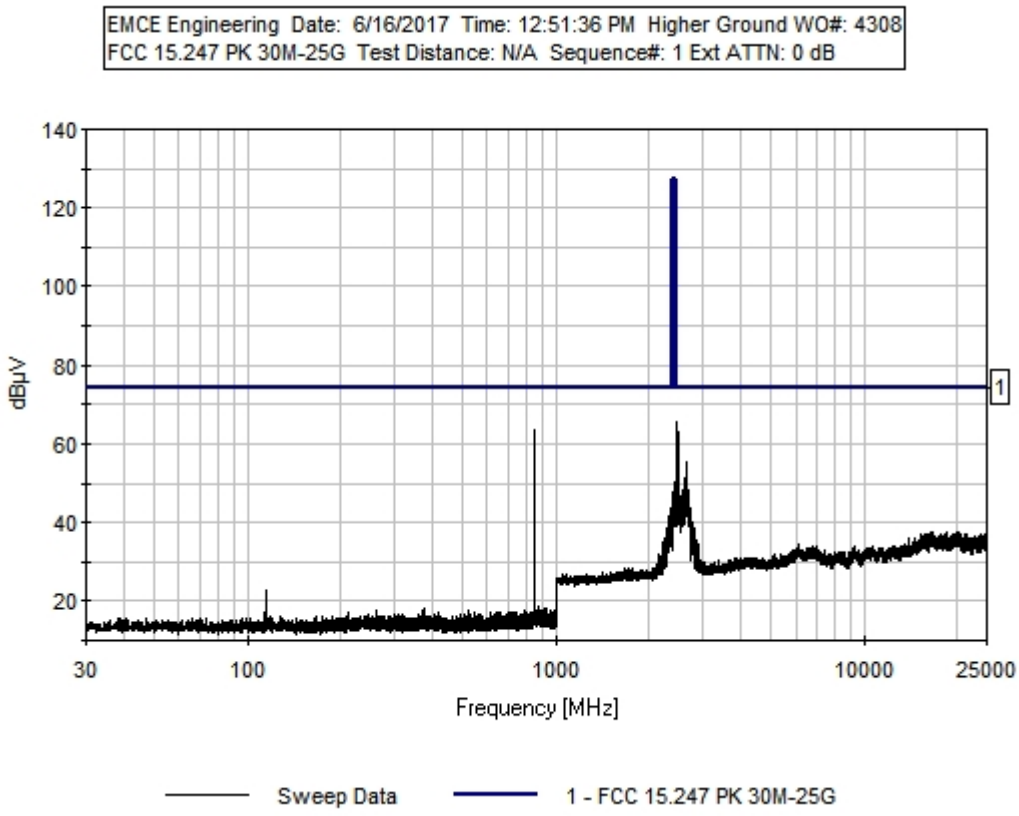
Test Conditions / Notes:

2480 Xmit

Ext Attn: 0 dB

Measurement Data: Reading listed by margin. Test Distance: N/A

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
2	854.649M	63.7					+0.0	63.7	74.0	-10.3	Horiz
3	855.351M	62.9					+0.0	62.9	74.0	-11.1	Horiz
4	2654.843M	55.3					+0.0	55.3	74.0	-18.7	Horiz
5	2627.789M	51.2					+0.0	51.2	74.0	-22.8	Horiz
6	2662.859M	50.6					+0.0	50.6	74.0	-23.4	Horiz


EMCE Engineering Date: 6/16/2017 Time: 12:51:36 PM Higher Ground WO#: 4308
FCC 15.247 PK 30M-25G Test Distance: N/A Sequence#: 1 Ext ATTN: 0 dB
140
120
100
80
60
40
20
dBµV
1
30
100
1000
10000
25000
Frequency [MHz]
Sweep Data
1 - FCC 15.247 PK 30M-25G

2.1.8 AC Power Line Conducted Emissions

LIMITS

§15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)		Quasi-peak	Average
	0.15-0.5	66 to 56 *	56 to 46*	
0.5-5	56	46		
5-30	60	50		

*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
(2) For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.
(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.
(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

RESULTS:

Frequency (MHz)	*(MHz)*	*Limit (MHz)*	*Result*
			N/A

2.1.8 99% Bandwidth

LIMITS

Not Applicable

RESULTS:

None – For information purposes only

Frequency (MHz)	*99% BW (MHz)*	*Limit (MHz)*	*Result*
			N/A

CONCLUSION

The data collected relates only the item(s) tested and shows that the Higher Ground LLC SatPaq is in compliance with Part 15 of the FCC Rules.

END OF REPORT