

FCC TEST REPORT

Product : Bluetooth LE Module
Trade mark : N/A
Model/Type reference : MirX
Report Number : 170310001RFC-1R1
Date of Issue : April 5, 2017
FCC ID : TXTPTM10
Test Standards : 47 CFR Part 15 Subpart C
Test result : PASS

Prepared for:

Robert Bosch Tool Corporation
1800 West Central Road Mount Prosect, Illinois 60056 United States

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
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Technical Director

Date:

April 5, 2017



Version

Version No.	Date	Description
V1.0	/	Original
V1.1	April 5, 2017	Changed applicant and FCC ID.



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1 General Information

1.1 Client Information

Applicant:	Robert Bosch Tool Corporation
Address of Applicant:	1800 West Central Road Mount Prosect, Illinois 60056 United States
Manufacturer:	DongGuan Chang Hui Trading Co., Ltd.
Address of Manufacturer:	Second Industrial Area, Honqmei Town, DongGuan City, Guang Dong Province, PRC

1.2 General Description of EUT

Product Name:	Bluetooth LE Module
Model No.(EUT):	MirX
Add Model No.:	N/A
Trade Mark:	N/A
EUT Supports Radio application:	Bluetooth V4.0 BLE only
Power Supply:	DC 3.0V from UART adaptor
USB Micro-B Plug Cable:	N/A
Sample Received Date:	March 10, 2017
Sample Tested Date:	March 10, 2017 to March 27, 2017

1.3 Product Specification subjective to this standard

Operation Frequency:	2400MHz-2483.5MHz
Bluetooth Version:	V4.0 BLE
Modulation Technique:	DTS
Modulation Type:	GFSK
Number of Channel:	40
Channel Separation:	2MHz
Sample Type:	Mobile production
Antenna Type:	PCB Antenna
Antenna Gain:	5 dBi
Normal Test Voltage:	AC 120V 60Hz
Software Version:	-
Hardware Version:	E218213 94V-0

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz

1.4 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Brand	Model No.	Certification	Supplied by
Laptop PC	Lenovo	B40-80	FCC ID and DOC	UnionTrust
UART adaptor	-	-	-	Applicant

2) Cable

Cable No.	Description	Connector Type	Cable Type/Length	Supplied by
1	Antenna cable	SMA	0.2m(Shielded)	UnionTrust
2	USB Extension cord	USB	1.0m(shielded)	UnionTrust

1.5 Test Location

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

Telephone: +86 (0) 755 2823 0888 Fax: +86 (0) 755 2823 0886

Test items including Conducted Emission, Radiated Emission, Radiated Spurious Emissions and Band Edge Measurements(Radiated) were tested at:

Compliance Certification Services (Shenzhen) Inc.

No.10-1 Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan Distr, Shenzhen, Guangdong, China.

Tel: 86 0755 28055000 Fax: 86 0755 29055221

1.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Shenzhen UnionTrust Quality and Technology Co., Ltd.

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

The Semi-Anechoic chamber and shielding room used to collect the radiated data and conducted emission are Compliance Certification Services (Shenzhen) Inc. and located at No.10-1 Mingkeda

Shenzhen UnionTrust Quality and Technology Co., Ltd.

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Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan Distr, Shenzhen, Guangdong, China.
This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: 441872).

1.7 Deviation from Standards

None.

1.8 Abnormalities from Standard Conditions

None.

1.9 Other Information Requested by the Customer

None.

1.10 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 6.3 \times 10^{-8}$
2	RF power, conducted	± 1.31 dB
3	Conducted emission 9KHz-30MHz	± 3.2878 dB
4	Radiated emission 30MHz-200MHz	± 3.8928 dB
5	Radiated emission 200MHz-1000MHz	± 3.8753 dB
6	Radiated emission 1GHz-8GHz	± 5.3112 dB
7	Radiated emission 8GHz-18GHz	± 5.3493 dB
8	Temperature	± 0.64 °C
9	Humidity	± 5.6 %
10	Supply voltages	± 1.9 %

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2 Test Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2013 version of ANSI C63.10

Test Item	Test Requirement	Test method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)	KDB 558074 D01 v03r05, Section 9.1.2	PASS
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)	KDB 558074 D01 v03r05, Section 8.1	PASS
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e)	KDB 558074 D01 v03r05, Section 10.2	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d)	KDB 558074 D01 v03r05, Section 11	PASS
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v03r05, Section 12.1	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v03r05, Section 12.1	PASS

Remark:

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radiated Frequency.

CH: In this whole report CH means channel.

N/A: Not application,

3 Equipment List

3M Semi/full-anechoic Chamber						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
<input checked="" type="checkbox"/>	PSA Series Spectrum Analyzer	Agilent	E4446A	US44300399	02-17-2017	02-16-2018
<input checked="" type="checkbox"/>	Turn Table	N/A	N/A	N/A	N.C.R	N.C.R
<input checked="" type="checkbox"/>	Controller	Sunol Sciences	SC104V	022310-1	N.C.R	N.C.R
<input checked="" type="checkbox"/>	Controller	CT	N/A	N/A	N.C.R	N.C.R
<input type="checkbox"/>	Bilog Antenna	SCHAFFNER	CBL6143	5082	02-12-2017	02-11-2018
<input checked="" type="checkbox"/>	Horn Antenna	Schwarzbeck	BBHA9120	D286	02-11-2017	02-10-2018
<input checked="" type="checkbox"/>	Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170-497	02-11-2017	02-10-2018
<input checked="" type="checkbox"/>	Loop Antenna	COM-POWER	AL-130	121044	02-12-2017	02-11-2018
<input checked="" type="checkbox"/>	High Noise Amplifier	Agilent	8449B	3008A01838	02-11-2017	02-10-2018
<input checked="" type="checkbox"/>	Temp. / Humidity Meter	Anymetre	JR913	N/A	02-15-2017	02-14-2018
<input checked="" type="checkbox"/>	Antenna Tower	SUNOL	TLT2	N/A	N.C.R	N.C.R
<input checked="" type="checkbox"/>	Test S/W	FARAO	LZ-RF / CCS-SZ-3A2			

Conducted Emission Test Site						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	02-11-2017	02-10-2018
<input checked="" type="checkbox"/>	LISN(EUT)	ROHDE&SCHWARZ	ENV216	101543-WX	02-11-2017	02-10-2018
<input checked="" type="checkbox"/>	LISN	EMCO	3825/2	8901-1459	02-12-2017	02-11-2018
<input checked="" type="checkbox"/>	Temp. / Humidity Meter	VICTOR	HTC-1	N/A	02-15-2017	02-14-2018
<input checked="" type="checkbox"/>	Test S/W	FARAO	EZ-EMC/ CCS-3A1-CE			

RF test system						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	12-22-2016	12-21-2017
<input type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	12-22-2016	12-21-2017
<input type="checkbox"/>	Receiver	R&S	ESIB26	100114	12-22-2016	12-21-2017
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	12-22-2016	12-21-2017
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	12-22-2016	12-21-2017
<input type="checkbox"/>	EXG-B RF Analog Signal Generator	KEYSIGHT	N5171B	MY53051777	01-09-2016	01-08-2018
<input type="checkbox"/>	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	01-08-2016	01-07-2018
<input type="checkbox"/>	4ch. Simultaneous Sampling 14 Bits 2MS/s	KEYSIGHT	U2531A	TW55193502	11-09-2015	11-08-2017

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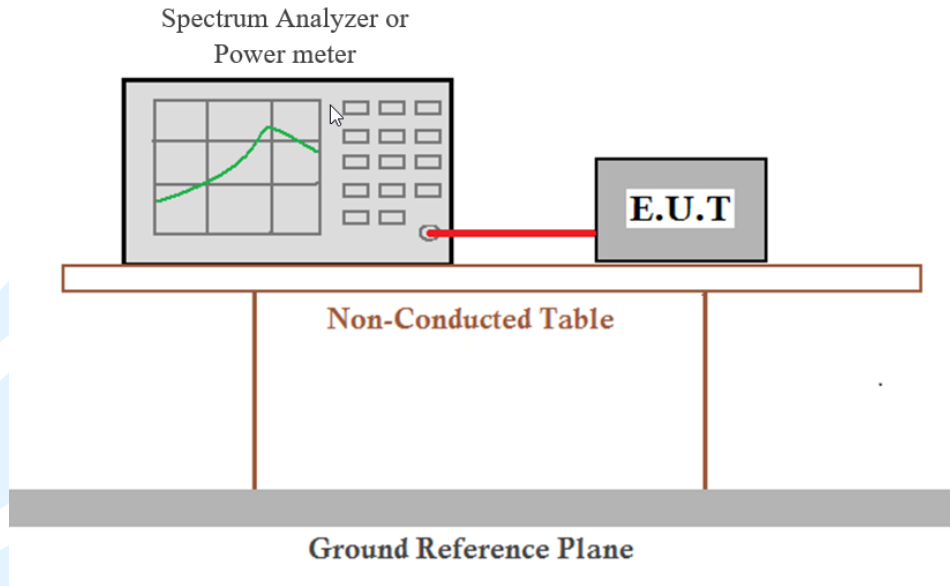
<input type="checkbox"/>	Universal Radio Communication Tester	R&S	CMU200	114713	12-22-2016	12-21-2017
<input type="checkbox"/>	Band rejection filter (5150MHz~5880MHz)	micro-tronics	BRM50716	G1868	06-15-2016	06-14-2017
<input type="checkbox"/>	Band rejection filter (2400MHz~2500MHz)	micro-tronics	BRM50702	G248	06-21-2016	06-20-2017
<input type="checkbox"/>	DC Source	KIKUSUI	PWR400L	LK003024	09-21-2016	09-20-2017
<input type="checkbox"/>	Temp & Humidity chamber	Ispec	GL(U)04K A(W)	1692H201P3	09-21-2016	09-20-2017



4 Test Requirement

4.1 Test setup

4.1.1 For Conducted test setup



4.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

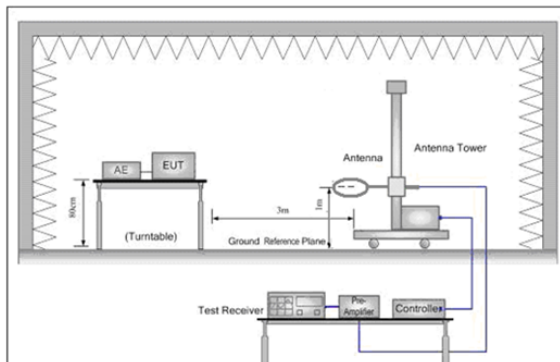


Figure 1. Below 30MHz

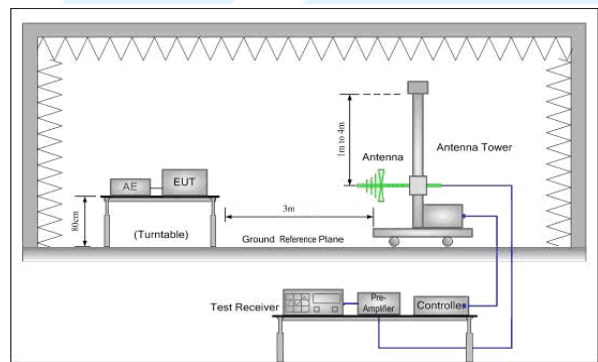


Figure 2. 30MHz to 1GHz

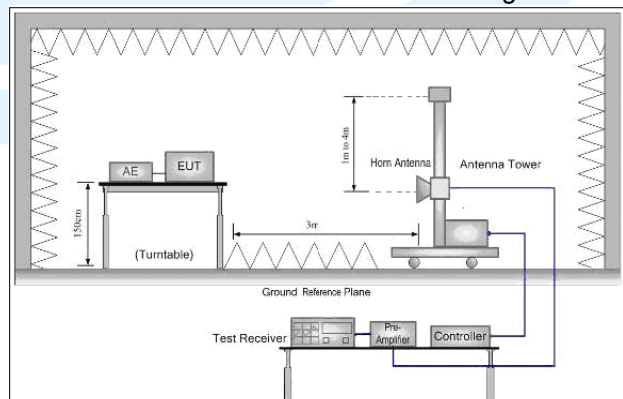
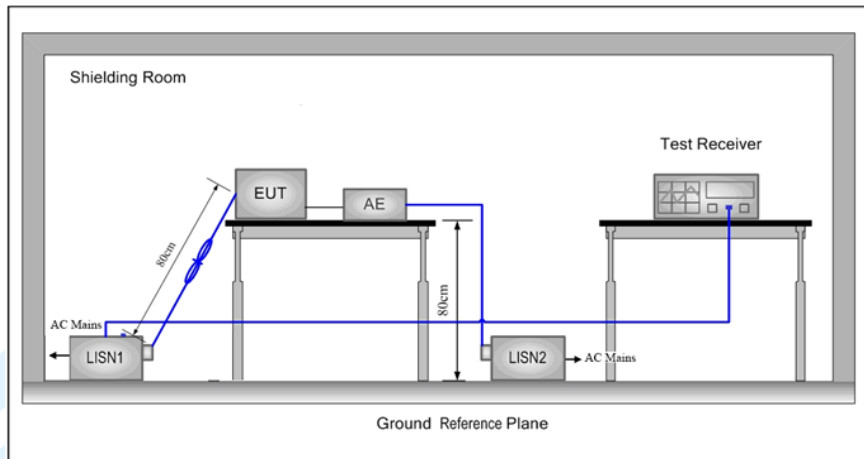


Figure 3. Above 1GHz

4.1.3 For Conducted Emissions test setup

Conducted Emissions setup



4.2 Test Environment

Operating Environment:	
Temperature:	24.3 °C
Humidity:	59 % RH
Atmospheric Pressure:	100.13 Kpa

4.3 System Test Configuration

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by DC 3.0V from UART adaptor. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency Band(GHz)	Mode	Antenna Port	Worst-case Orientation
Below 1GHz	1TX	Chain 0	Y-Portrait
Above 1GHz	1TX	Chain 0	Y-Portrait

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

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Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.4 Test Condition

4.4.1 Test channel

Modulation Type	Data Rate (Mbps)	Tx/Rx	RF Channel		
			Low(L)	Middle(M)	High(H)
GFSK	1	2402MHz ~2480 MHz	Channel 0	Channel 19	Channel 39
			2402MHz	2440MHz	2480MHz

Transmitting mode:
Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

4.4.2 Duty Cycle

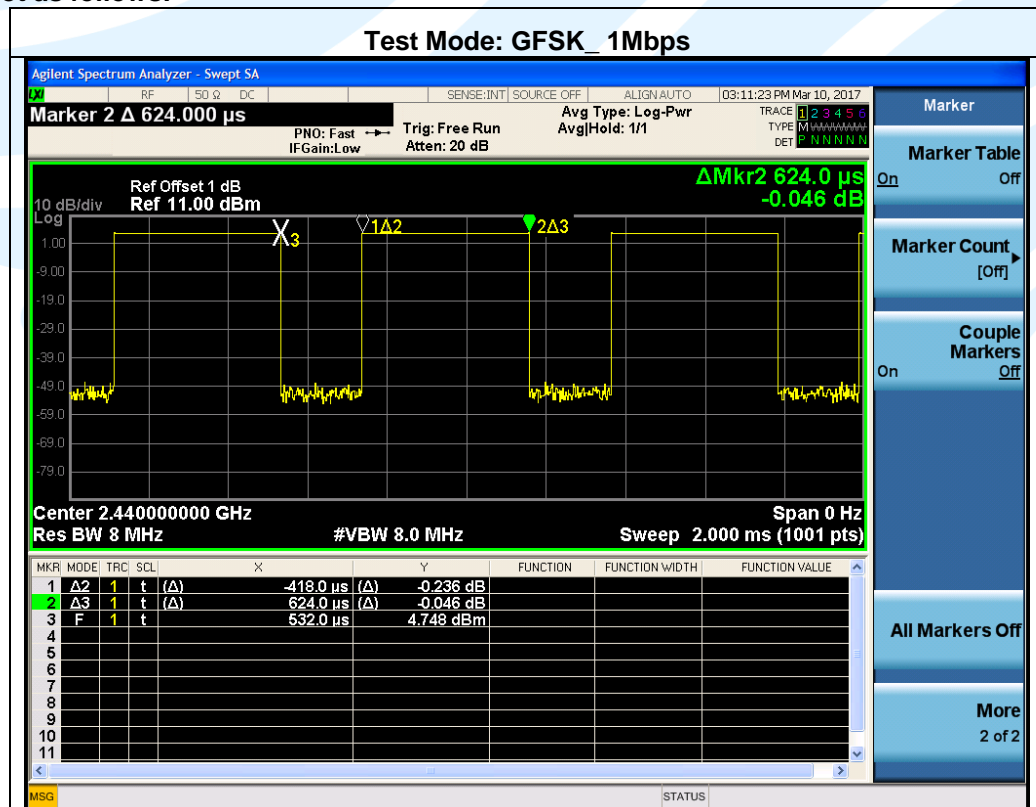
Procedure: KDB 558074 Zero-Span Spectrum Analyzer Method.

Results:

Modulation Type	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)
GFSK	1	0.418	0.624	0.6699	66.99	1.74	2.39

Remark:
1) Duty cycle= On Time/ Period
2) Duty Cycle factor = 10 * log(1/ Duty cycle)

The test plot as follows:



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5 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 558074 D01 DTS Meas Guidance v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

5.1 Antenna Requirement

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 5 dBi.

5.2 Conducted Peak Output Power

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)
Test Method:	KDB 558074 D01 v03r05, Section 9.1.2
Limit:	For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.
Test Procedure:	<ol style="list-style-type: none"> 1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter. 2. Measure out each test modes' peak or average output power, record the power level. <p>Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.</p>
Test Setup:	Refer to section 4.1.1 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Transmitter mode
Test Results:	Pass
Test Data:	

Maximum Conducted Power:

Modulation Type	Channel	Frequency (MHz)	Maximum Conducted Peak Power (dBm)	Maximum Conducted Peak Power (mW)
GFSK	0	2402	4.99	3.16
	19	2440	4.86	3.06
	39	2480	4.73	2.97

5.3 6dB Bandwidth

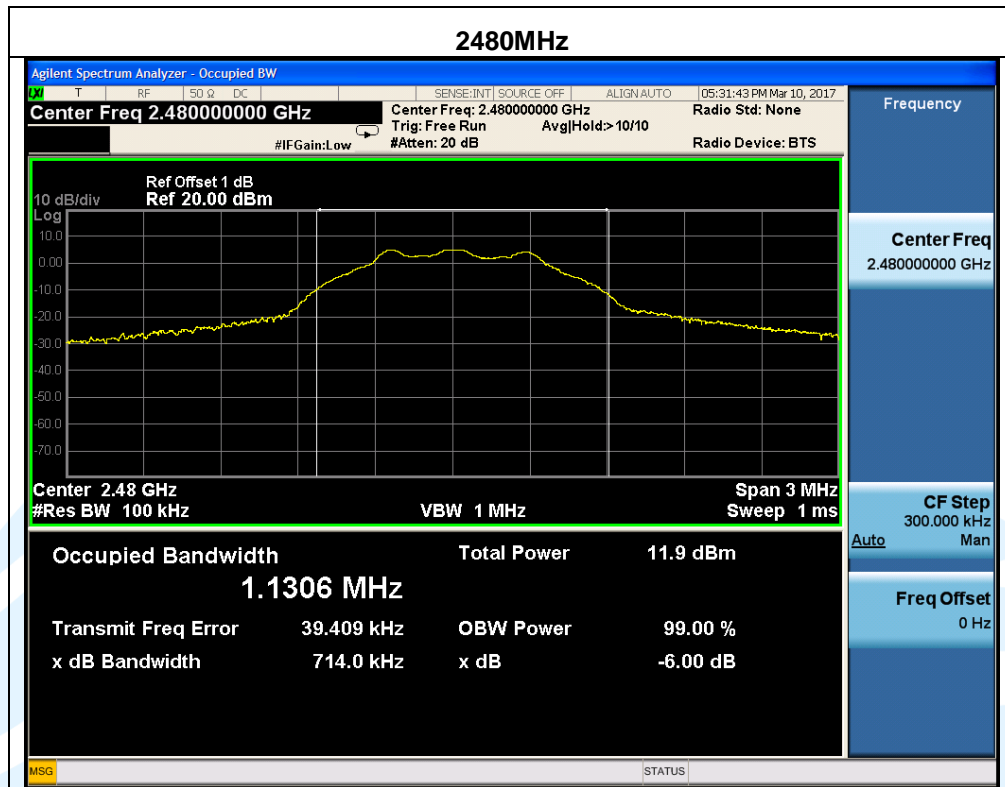
Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)
Test Method:	KDB 558074 D01 v03r05, Section 8.1
Limit:	For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz
Test Procedure:	<p>Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.</p> <p>Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> a) Set RBW = 100 kHz. b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW. c) Detector = Peak. d) Trace mode = max hold. e) Sweep = auto couple. f) Allow the trace to stabilize. g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. <p>Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.</p>
Test Setup:	Refer to section 4.1.1 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Transmitter mode
Test Results:	Pass
Test Data:	

Occupied Bandwidth:

Modulation Type	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Result (Pass / Fail)
GFSK	0	2402	0.6829	1.0951	> 500 kHz	Pass
	19	2440	0.7111	1.1269	> 500 kHz	Pass
	39	2480	0.7140	1.1306	> 500 kHz	Pass

The test plot as follows:





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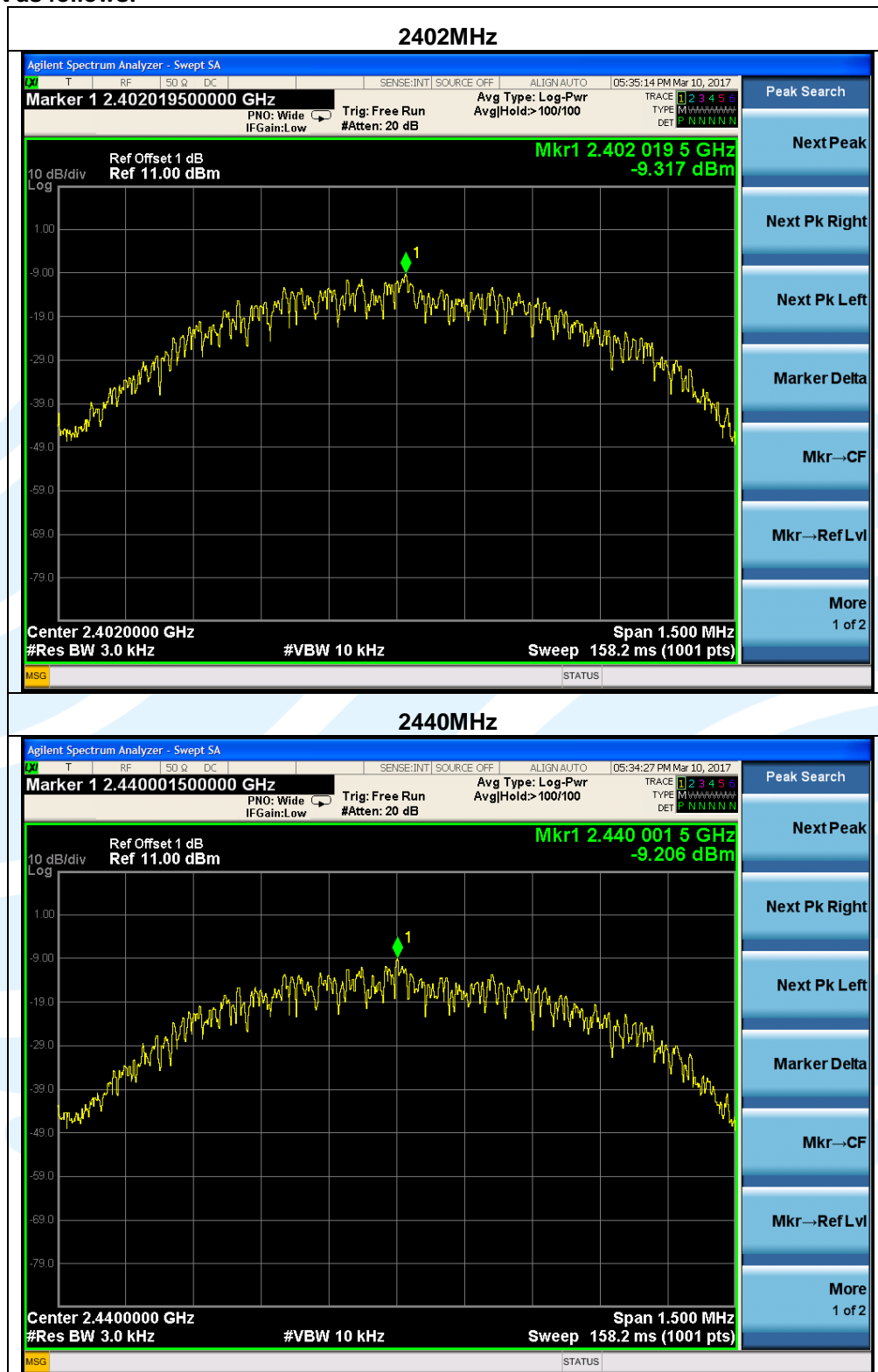
5.4 Power Spectral Density

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (e)
Test Method:	KDB 558074 D01 v03r05, Section 10.2
Limit:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
Test Procedure:	<p>Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.</p> <p>Use the following spectrum analyzer settings:</p> <ol style="list-style-type: none">Set analyzer center frequency to DTS channel center frequency.Set the span to 1.5 times the DTS bandwidth.Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.Set the VBW $\geq 3 \times \text{RBW}$.Detector = peak.Sweep time = auto couple.Trace mode = max hold.Allow trace to fully stabilize.Use the peak marker function to determine the maximum amplitude level within the RBW.If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat. <p>Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.</p>
Test Setup:	Refer to section 4.1.1 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Transmitter mode
Test Results:	Pass

Test Data:

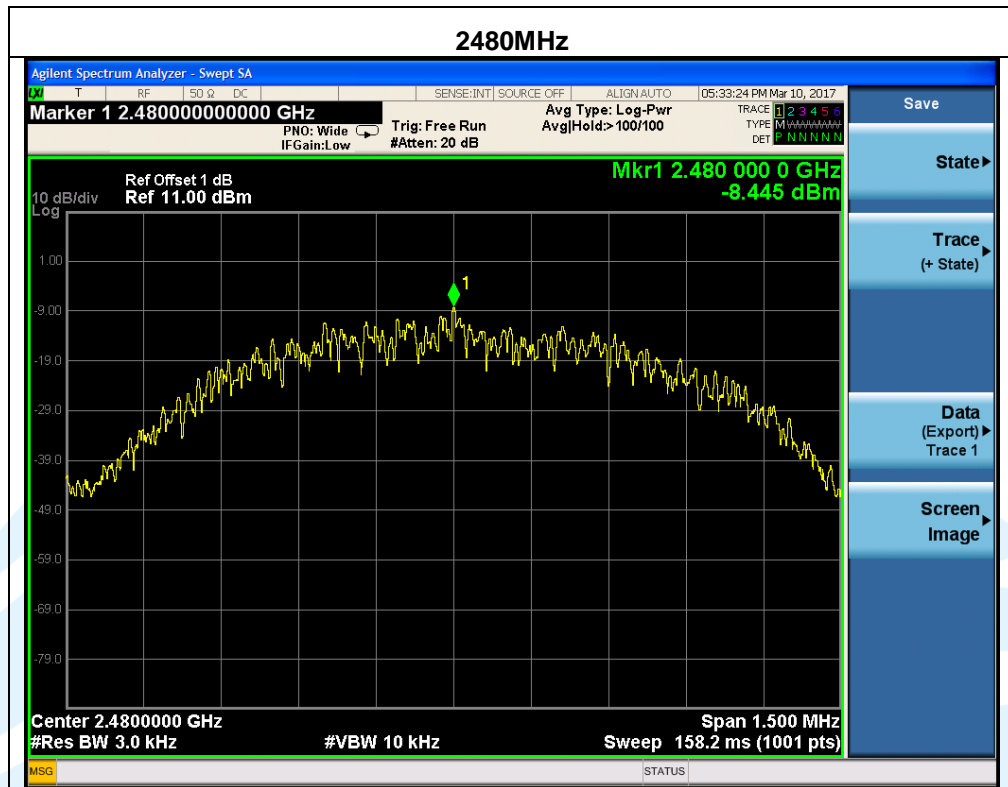
Modulation Type	Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Result (Pass / Fail)
GFSK	0	2402	-9.317	8	Pass
	19	2440	-9.206	8	Pass
	39	2480	-8.445	8	Pass

The test plot as follows:



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5.5 Conducted Out of Band Emission

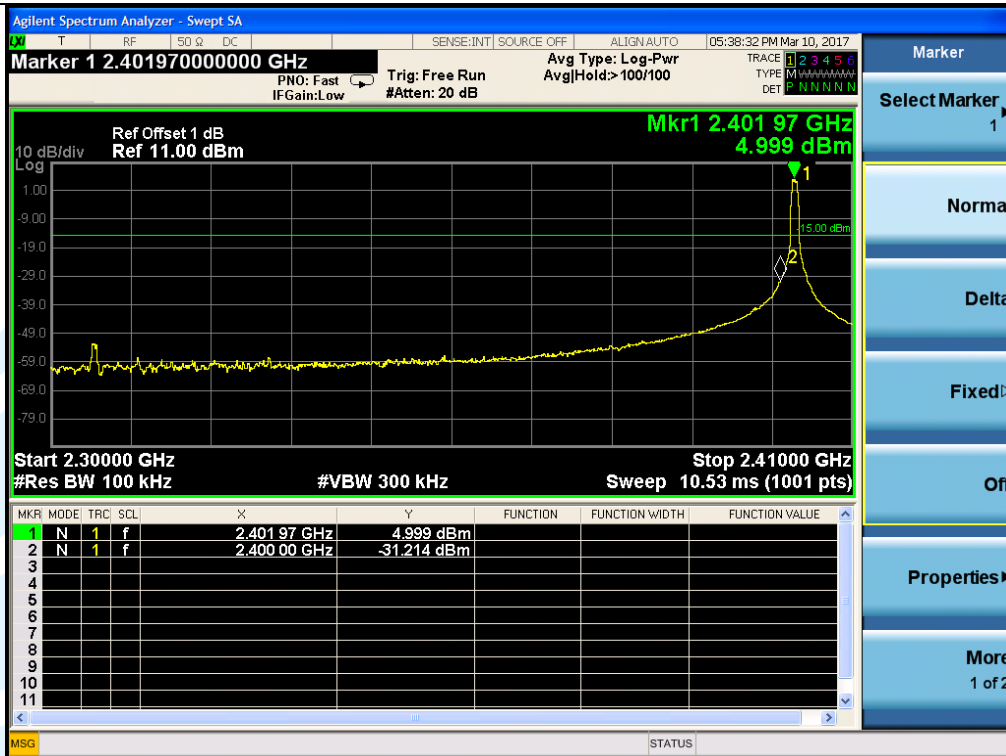
Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247(d)
Test Method:	KDB 558074 D01 v03r05, Section 11
Limit:	In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.
Test Procedure:	<p>Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.</p> <p>Use the following spectrum analyzer settings:</p> <p>Step 1: Measurement Procedure REF</p> <ol style="list-style-type: none"> Set instrument center frequency to DTS channel center frequency. Set the span to ≥ 1.5 times the DTS bandwidth. Set the RBW = 100 kHz. Set the VBW $\geq 3 \times$ RBW. Detector = peak. Sweep time = auto couple. Trace mode = max hold. Allow trace to fully stabilize. Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference level. <p>Step 2: Measurement Procedure OOB</p> <ol style="list-style-type: none"> Set RBW = 100 kHz. Set VBW ≥ 300 kHz. Detector = peak. Sweep = auto couple. Trace Mode = max hold. Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level. <p>Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.</p>
Test Setup:	Refer to section 4.1.1 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Transmitter mode
Test Results:	Pass

The test plot as follows:

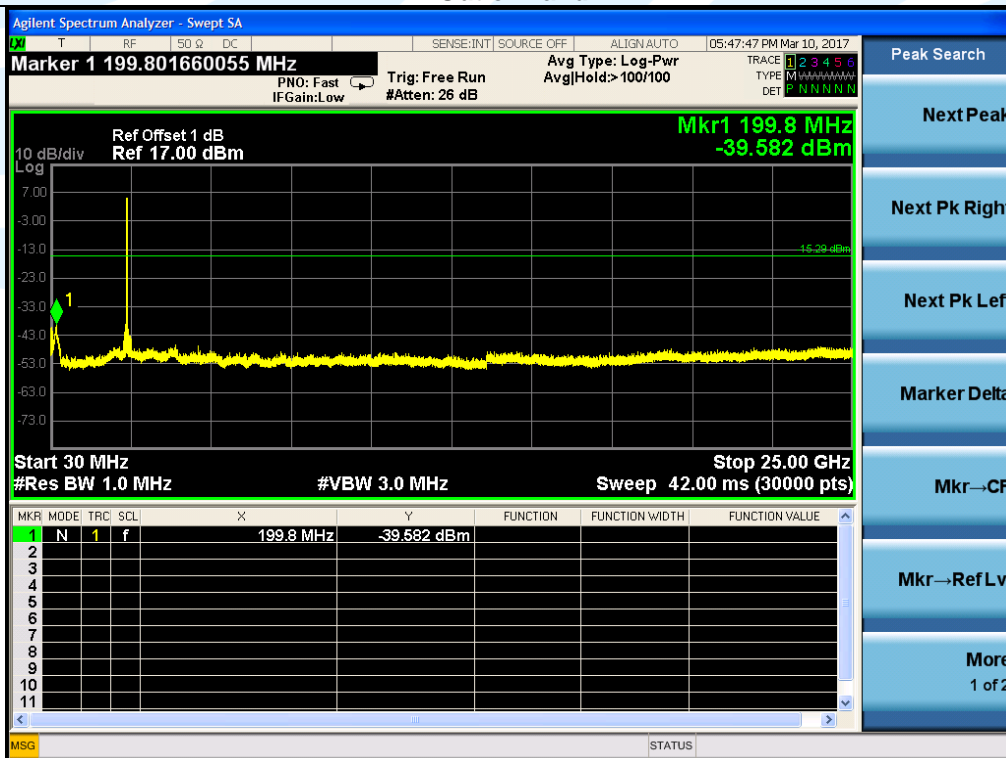
Test Mode: BLE

2402MHz

In-Band Reference Level



Out of Band

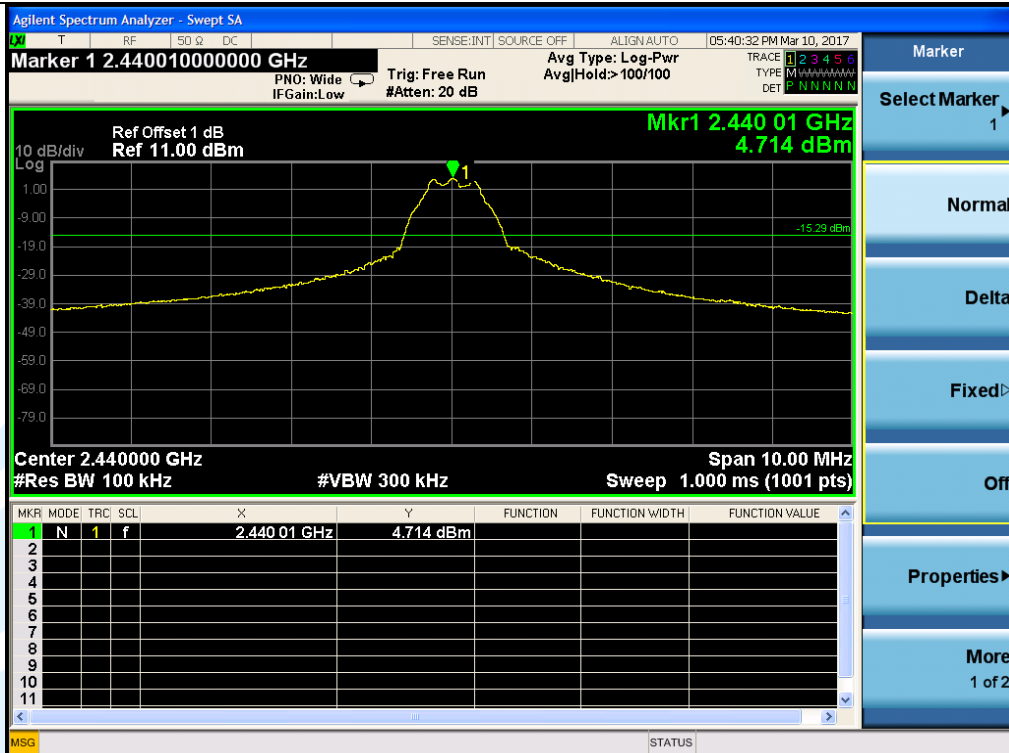


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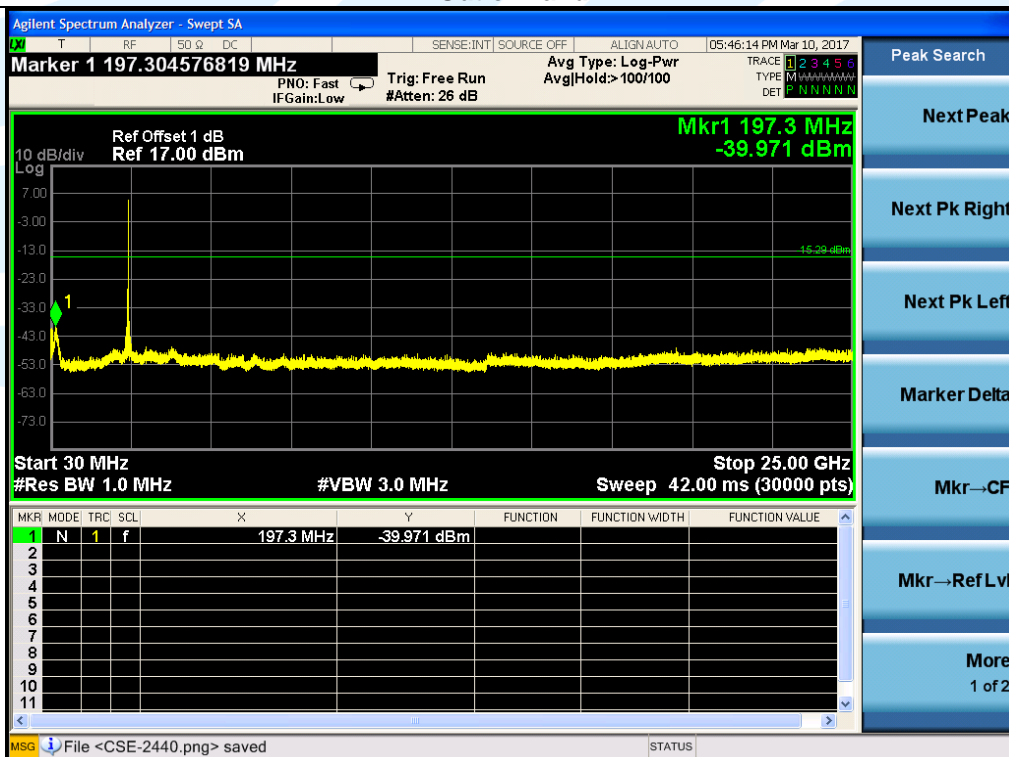
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2440MHz

In-Band Reference Level

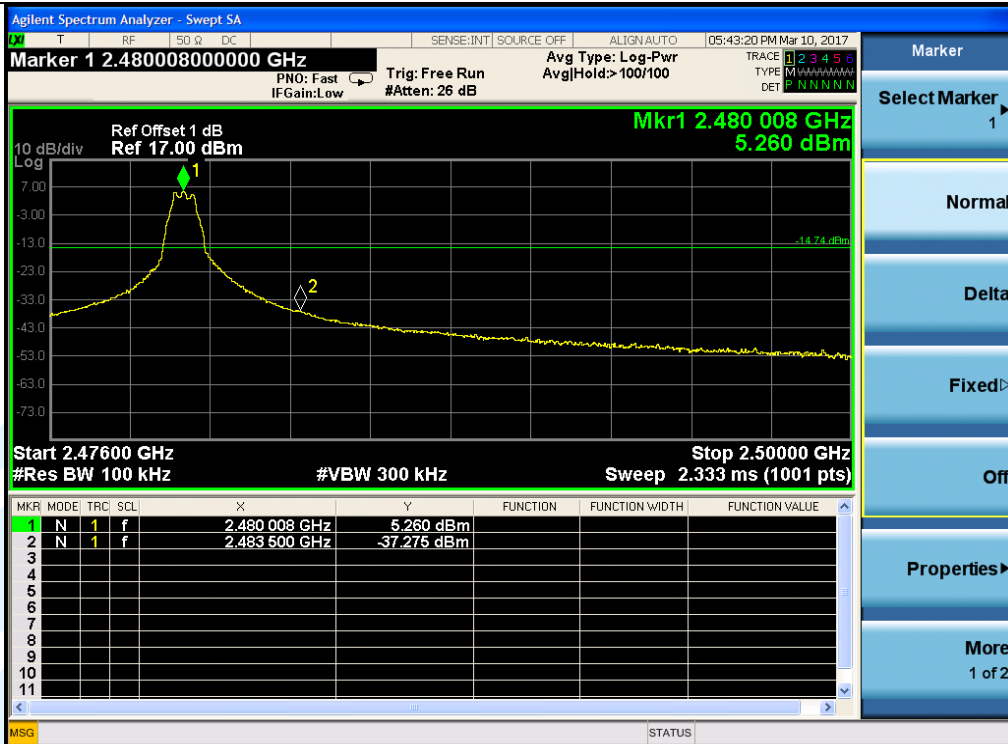


Out of Band

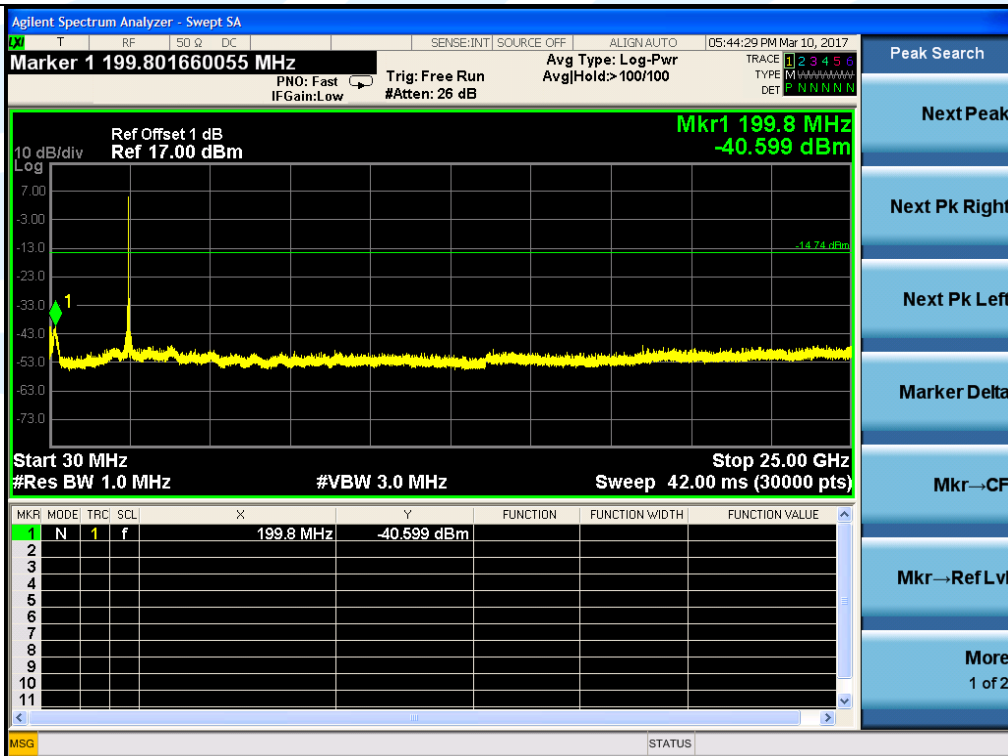


2480MHz

In-Band Reference Level



Out of Band



5.6 Radiated Spurious Emissions

Test Requirement:

FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method:

KDB 558074 D01 v03r05, Section 12.1

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBμV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

The emissions were measured using the following resolution bandwidths:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode. The high frequency, which started from 10 to 26.5GHz, Peak measurements and average measurements are made. All emissions were determined to have a peak-to-average ratio of less than 20dB.

Test Procedure:

Below 1GHz test procedure as below:

- a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both

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horizontal and vertical polarizations of the antenna are set to make the measurement.

- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f) Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

Above 1GHz test procedure as below:

- g) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
- h) Test the EUT in the lowest channel , the Highest channel
- i) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.
- j) Repeat above procedures until all frequencies measured was complete.

Refer to section 4.1.2 for details.

Test Setup:

Instruments Used:

Refer to section 3 for details

Test Mode:

Transmitter mode

Test Results:

Pass

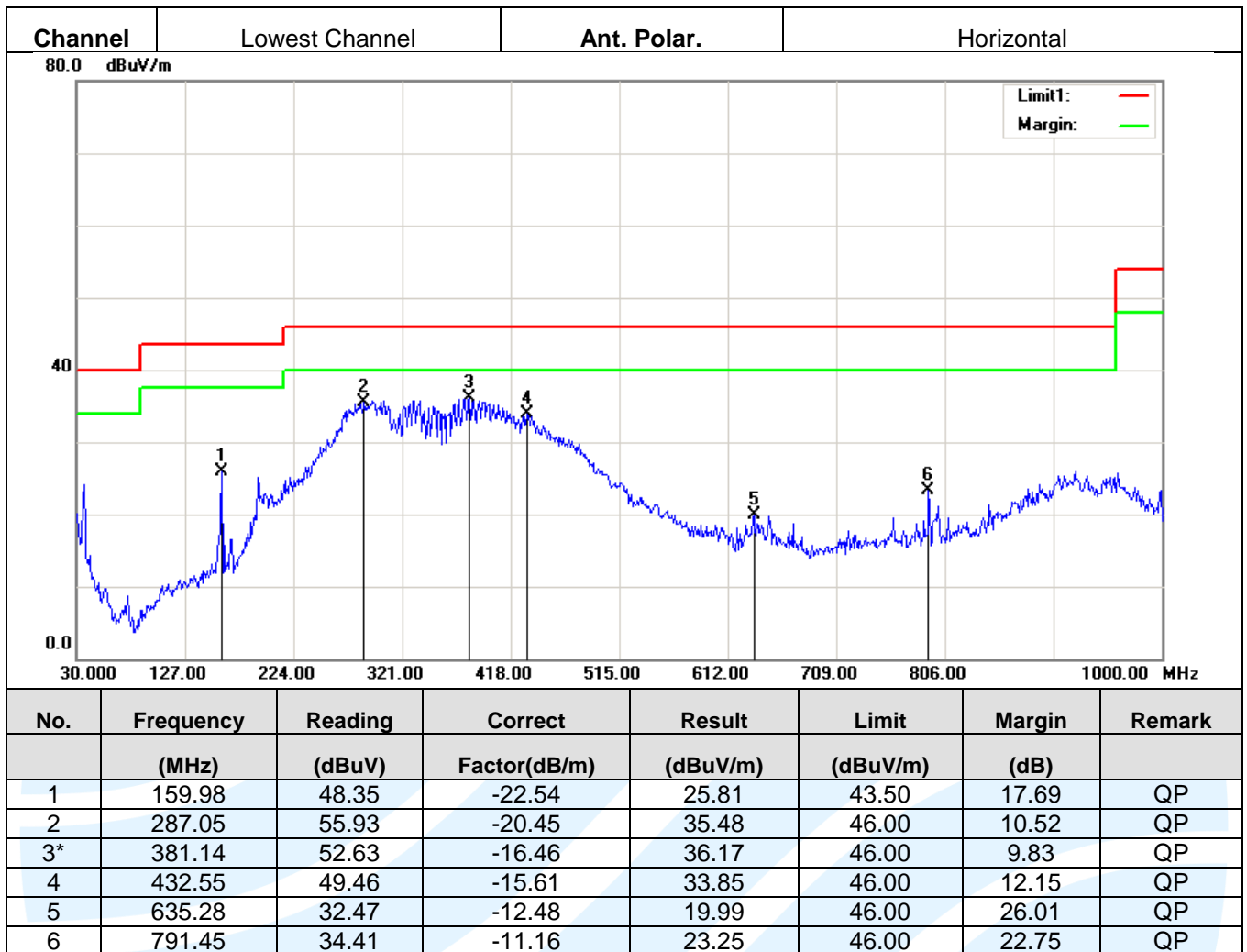
Test Data:

Radiated Emission Test Data (9 KHz ~ 30MHz)

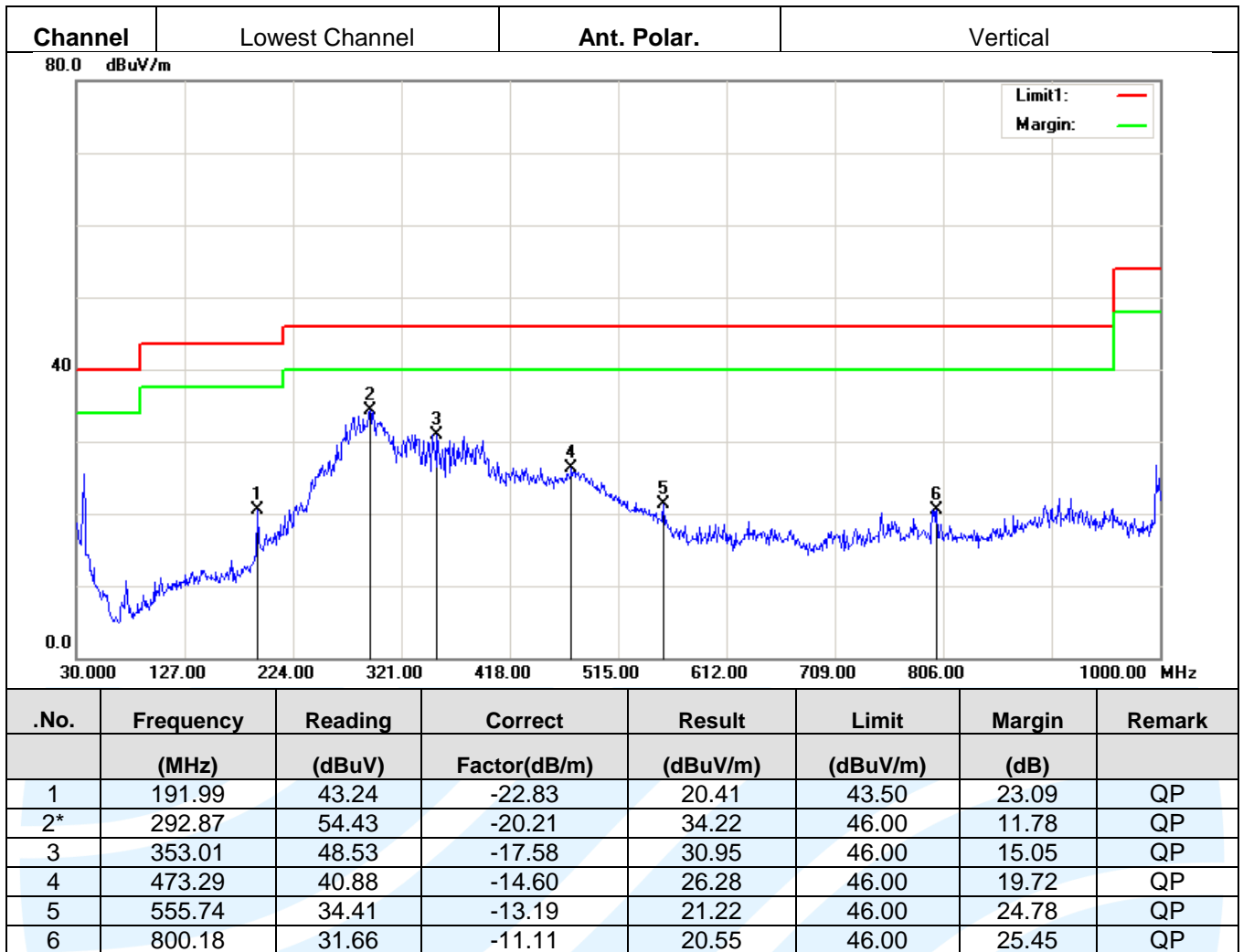
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Radiated Emission Test Data (Above 10 GHz)

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Radiated Emission Test Data (30MHz ~ 1 GHz Worst Case)

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Radiated Emission Test Data (Above 1GHz Worst Case):

Tx_2402 MHz						
.No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1441.00	47.39	74.00	26.61	Peak	Horizontal
2	2800.00	43.68	74.00	30.32	Peak	Horizontal
3	4249.00	46.88	74.00	27.12	Peak	Horizontal
4	4804.00	57.40	74.00	16.60	Peak	Horizontal
5	4804.00	48.30	54.00	5.70	Average	Horizontal
6	5878.00	48.10	74.00	25.90	Peak	Horizontal
7	7206.00	52.36	74.00	21.64	Peak	Horizontal
8	1756.00	42.05	74.00	31.95	Peak	Vertical
9	2512.00	43.78	74.00	30.22	Peak	Vertical
10	3934.00	44.53	74.00	29.47	Peak	Vertical
11	4804.00	53.89	74.00	20.11	Peak	Vertical
12	6517.00	48.37	74.00	25.63	Peak	Vertical
13	7206.00	53.54	74.00	20.46	Peak	Vertical

Tx_2440 MHz						
.No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1432.00	46.90	74.00	27.10	Peak	Horizontal
2	2521.00	43.33	74.00	30.67	Peak	Horizontal
3	3637.00	42.74	74.00	31.26	Peak	Horizontal
4	4880.00	58.65	74.00	15.35	Peak	Horizontal
5	4880.00	49.93	54.00	4.07	Average	Horizontal
6	5437.00	48.52	74.00	25.48	Peak	Horizontal
7	7320.00	54.44	74.00	19.56	Peak	Horizontal
8	7320.00	38.99	54.00	15.01	Average	Horizontal
9	1711.00	47.63	74.00	26.37	Peak	Vertical
10	2530.00	43.75	74.00	30.25	Peak	Vertical
11	3628.00	43.75	74.00	30.25	Peak	Vertical
12	4880.00	57.06	74.00	16.94	Peak	Vertical
13	4880.00	48.21	54.00	5.79	Average	Vertical
14	6571.00	48.87	74.00	25.13	Peak	Vertical
15	7320.00	56.64	74.00	17.36	Peak	Vertical
16	7320.00	45.58	54.00	8.42	Average	Vertical

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Tx_2480 MHz						
.No.	Frequency (MHz)	Result (dBUV)	Limit (dBUV/m)	Margin (dB)	Remark	Ant. Polar.
1	1432.00	47.97	74.00	26.03	Peak	Horizontal
2	2539.00	43.32	74.00	30.68	Peak	Horizontal
3	3772.00	43.92	74.00	30.08	Peak	Horizontal
4	4960.00	58.16	74.00	15.84	Peak	Horizontal
5	4960.00	49.97	54.00	4.03	Average	Horizontal
6	6337.00	49.02	74.00	24.98	Peak	Horizontal
7	7440.00	56.63	74.00	17.37	Peak	Horizontal
8	7440.00	45.33	54.00	8.67	Average	Horizontal
9	1747.00	44.15	74.00	29.85	Peak	Vertical
10	2593.00	42.73	74.00	31.27	Peak	Vertical
11	3925.00	44.59	74.00	29.41	Peak	Vertical
12	4960.00	55.89	74.00	18.11	Peak	Vertical
13	4960.00	48.82	54.00	5.18	Average	Vertical
14	6337.00	47.91	74.00	26.09	Peak	Vertical
15	7440.00	58.18	74.00	15.82	Peak	Vertical
16	7440.00	47.77	54.00	6.23	Average	Vertical

Note:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

$$\text{Final Test Level} = \text{Receiver Reading} - \text{Correct Factor}$$

$$\text{Correct Factor} = \text{Preamplifier Factor} - \text{Antenna Factor} - \text{Cable Factor}$$
- 2) Scan from 9 KHz to 25 GHz, the disturbance above 10 GHz and below 30 MHz was very low, the amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 3) Since peak data above 1 GHz are lower the average limit, so the average data are pass, no need for testing.

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5.7 Band Edge Measurements (Radiated)

Test Requirement:

FCC 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method:

KDB 558074 D01 v03r05, Section 12.1

Limit:

Frequency	Limit (dBμV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Test Procedure:

Radiated band edge measurements at 2390MHz and 2483MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

1. Use radiated spurious emission test procedure described in 5.6 clause. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

Test Setup:

Refer to section 4.1.2 for details.

Instruments Used:

Refer to section 3 for details

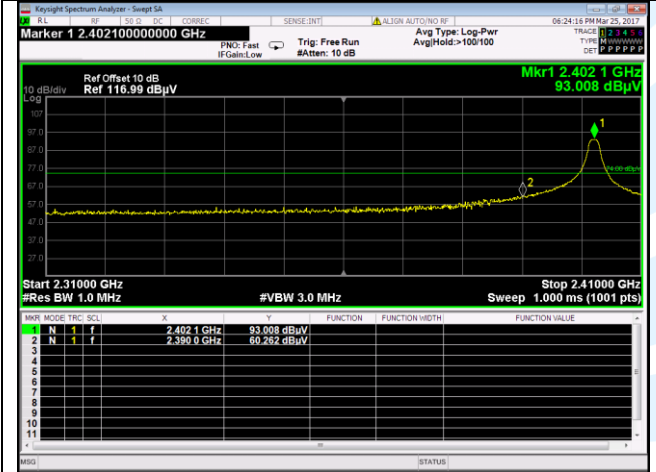
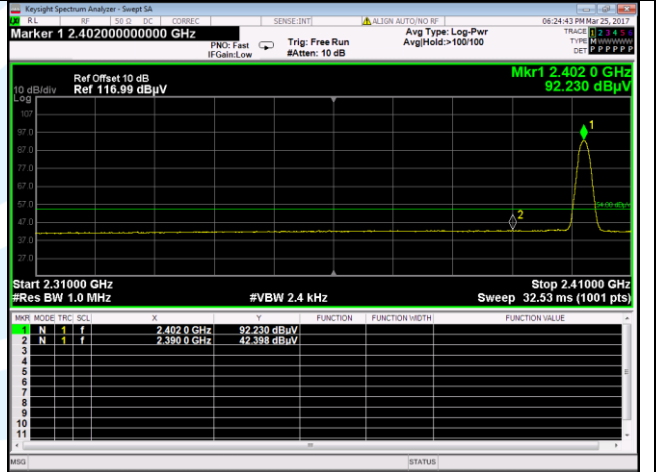
Test Mode:

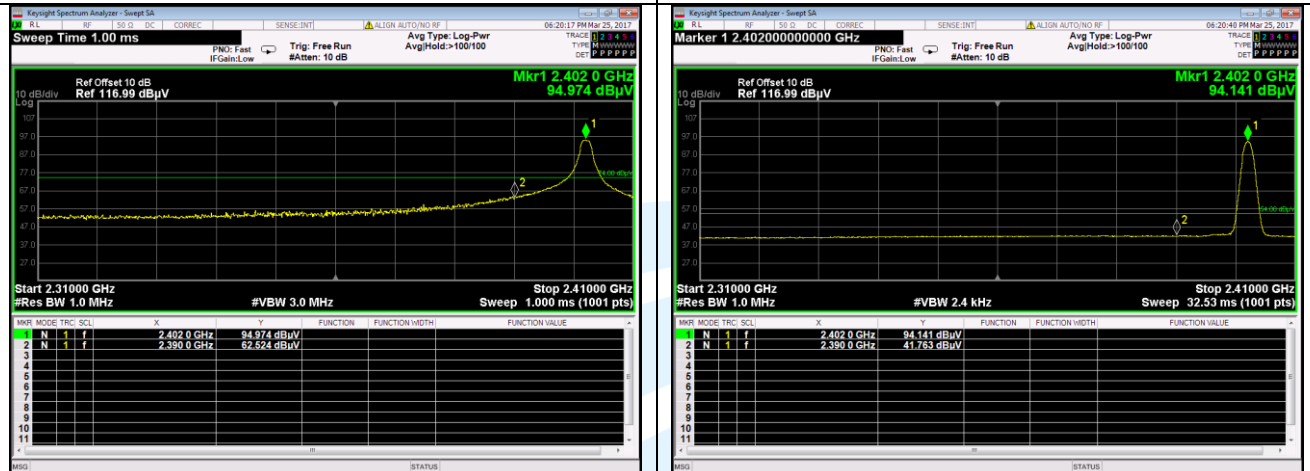
Transmitter mode

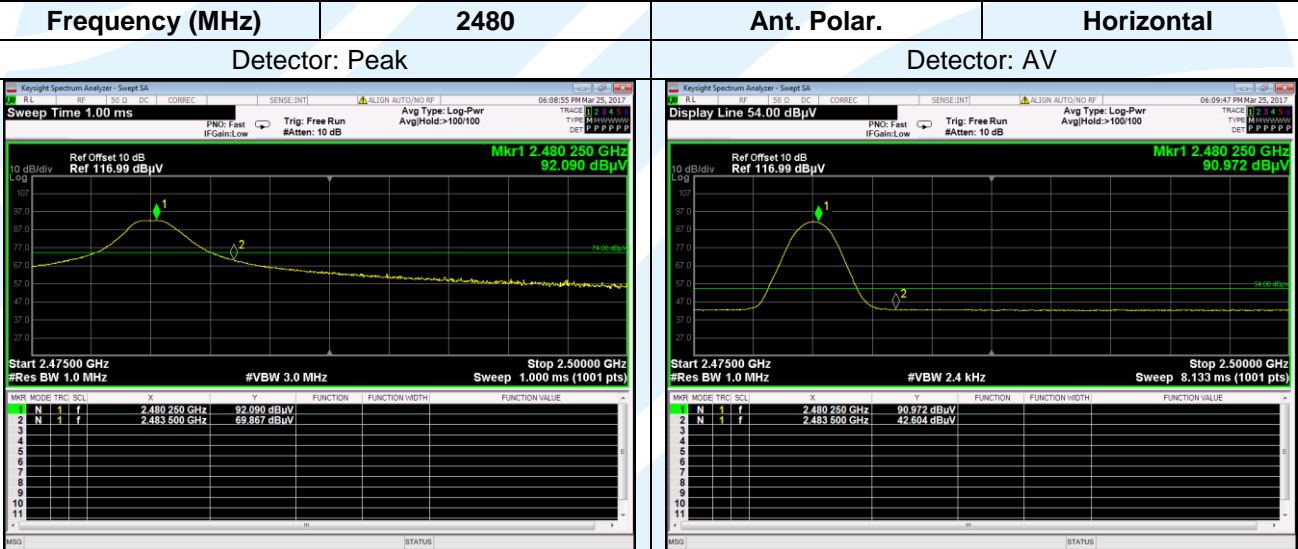
Test Results:

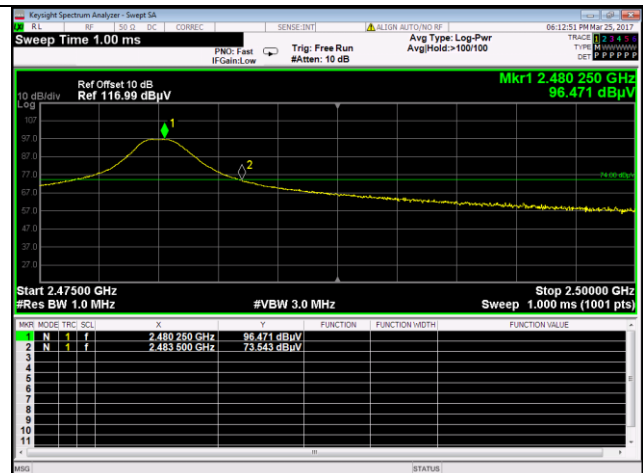
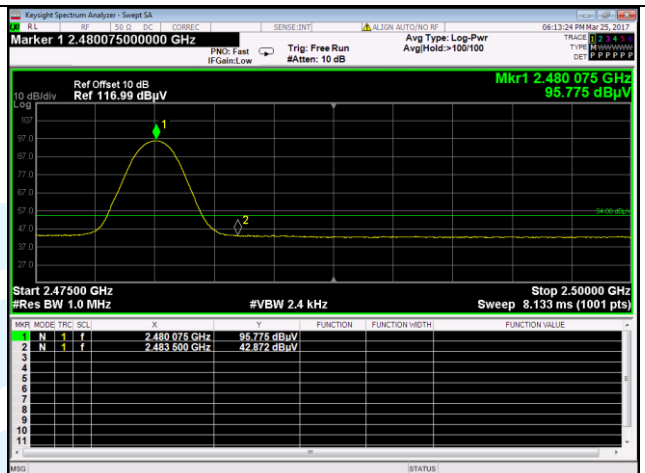
Pass

Test Data:

Frequency (MHz)			Ant. Polar.		Horizontal
2402					
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.0	60.262	74	42.398	54	Pass

Frequency (MHz)		2402	Ant. Polar.		Vertical
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.0	62.524	74	41.763	54	Pass

Frequency (MHz)		2480	Ant. Polar.		Horizontal
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.5	69.867	74	42.604	54	Pass

Frequency (MHz)			Ant. Polar.		Vertical
2480					
Detector: Peak			Detector: AV		
 <p>Keynote Spectrum Analyzer - Sweep SA Sweep Time 1.00 ms Ref Offset 10 dB Ref 116.99 dBuV Mkr1 2.480 250 GHz 96.471 dBuV Start 2.47500 GHz #Res BW 1.0 MHz #VBW 3.0 MHz Stop 2.50000 GHz Sweep 1.000 ms (1001 pts)</p>			 <p>Keynote Spectrum Analyzer - Sweep SA Marker 1 2.480075000000 GHz Ref Offset 10 dB Ref 116.99 dBuV Mkr1 2.480 075 GHz 95.775 dBuV Start 2.47500 GHz #Res BW 1.0 MHz #VBW 2.4 kHz Stop 2.50000 GHz Sweep 8.133 ms (1001 pts)</p>		
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.5	73.543	74	42.872	54	Pass

5.8 Conducted Emissions

Test Requirement: 47 CFR Part 15C Section 15.207

Test Method: ANSI C63.10

Test Frequency Range: 150KHz to 30MHz

Limit:

Frequency range (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

NOTE : The lower limit is applicable at the transition frequency

Test Procedure:

Test frequency range :150KHz-30MHz

1) The mains terminal disturbance voltage test was conducted in a shielded room.

2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,

4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Test Setup:

Refer to section 4.1.3 for details.

Instruments Used:

Refer to section 3 for details

Test Mode:

Transmitter mode

Test Results:

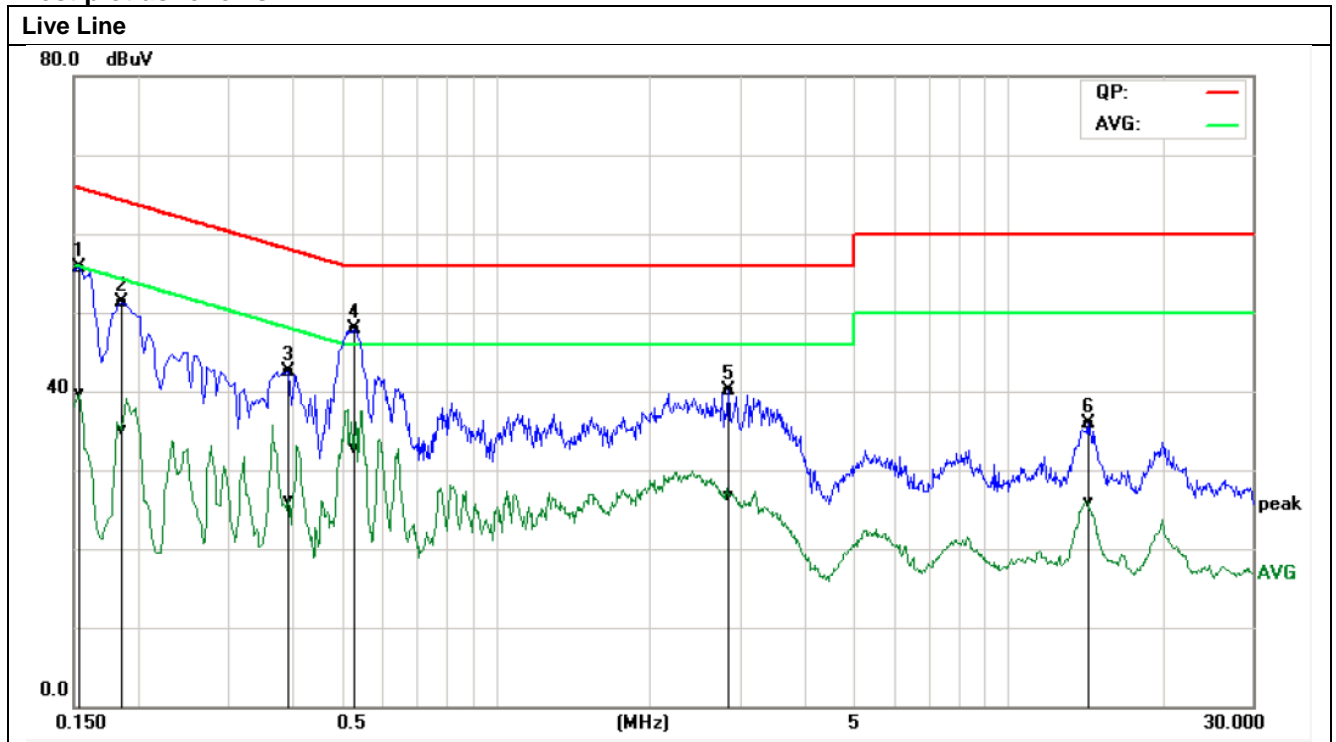
Pass.

Test Data

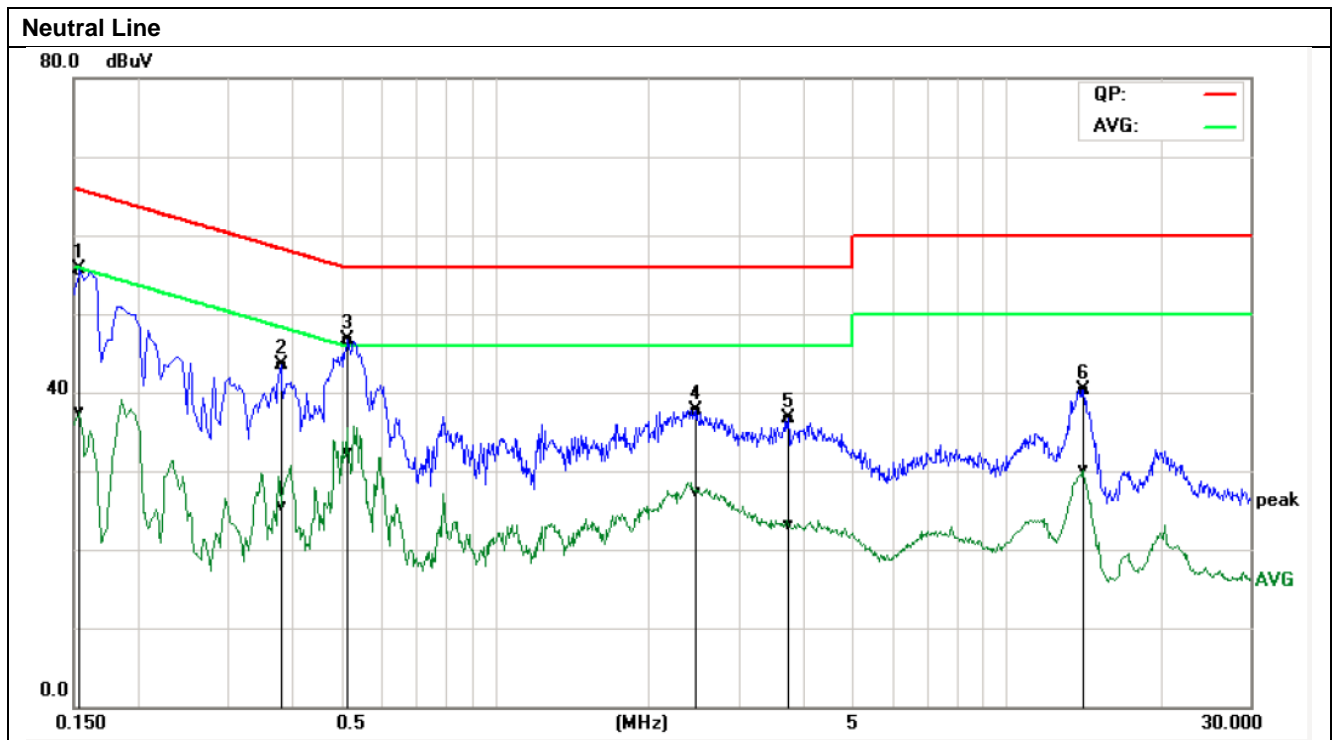
An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Test plot as follows:



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1539	36.26	20.21	19.53	55.79	39.74	65.78	55.79	9.99	16.05	Pass
2	0.1860	31.73	15.57	19.60	51.33	35.17	64.21	54.21	12.88	19.04	Pass
3	0.3940	22.87	6.57	19.63	42.50	26.20	57.98	47.98	15.48	21.78	Pass
4*	0.5299	28.19	13.10	19.65	47.84	32.75	56.00	46.00	8.16	13.25	Pass
5	2.8460	20.39	7.05	19.69	40.08	26.74	56.00	46.00	15.92	19.26	Pass
6	14.3100	15.93	5.88	19.94	35.87	25.82	60.00	50.00	24.13	24.18	Pass



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1539	35.88	17.74	19.72	55.60	37.46	65.78	55.79	10.18	18.33	Pass
2	0.3820	23.77	5.76	19.67	43.44	25.43	58.23	48.24	14.79	22.81	Pass
3*	0.5180	27.11	12.73	19.64	46.75	32.37	57.98	47.98	11.23	15.61	Pass
4	2.4620	18.05	7.67	19.72	37.77	27.39	56.00	46.00	18.23	18.61	Pass
5	3.7540	17.04	3.36	19.73	36.77	23.09	56.00	46.00	19.23	22.91	Pass
6	14.1460	20.59	10.23	19.78	40.37	30.01	60.00	50.00	19.63	19.99	Pass

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

See test photographs attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOGRAPHS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photographs.

*** End of Report ***

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