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FCC/ISED RF TEST REPORT

Vista Labs
TEST • CERTIFY • COMPLY

Test Report Number……	**PTK-18103001-LC-RF-BLE**
Applicant……	**Pacific Track, LLC**
Applicant Address……	**1300 Bristol Street North, Suite 100, Newport Beach, CA 92660**
Product Name……	Telematics Device
Model Number……	PT40
Family Product/Model……	None
FCC ID……	2ALBDPT40
IC ID……	23259-PT40
Date of EUT received……	01/21/2019
Date of Test……	01/23/2019 – 02/12/2019
Report Issue Date……	02/12/2019
Test Standards……	**47CFR Part 15.247: 2018** **RSS-247 Issue 2.0: Feb 2017** **RSS-Gen Issue 5: Apr 2018**
Test Result……	Pass

Issued By:

Vista Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com

Tested by:	**Approved By:**
Sherwin Lee/Test Engineer	**David Zhang/Technical Manager**

Laboratory Introduction

Vista Labs is an A2LA accredited 17025 compliant regulatory compliance testing laboratories (Cert. number: 4848-01) strategically located in Orange County, providing services in the electrical and telecommunication industries. Vista labs is also recognized testing facility for Australia (ACMA), Chinese Taipei (BSMI), Chinese Taipei (NCC), Hong Kong (OFCA), Israel (MOC), Korea (RRA), Singapore (IMDA), Vietnam (MIC), etc.

Our comprehensive testing services include safety testing, EMC emission and susceptibility testing, RF and wireless testing (including DFS).

As your partner, Vista investigates appropriate test standards, develops test plans, performs troubleshooting & failure analysis, reviews documentation, and provides test reports for a complete compliance testing and certification package.

ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

VISTA LABORATORIES, INC.

San Clemente, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 21st day of June 2018.

President and CEO
For the Accreditation Council
Certificate Number 4848.01
Valid to July 31, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

17025 Product Testing Accreditation Certificate

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REVISION HISTORY

Revision	Issue Date	Description	Note
Original	02/12/2019	Original release	N/A

1 General Information

1.1 Applicant

Applicant:	Pacific Track, LLC
Applicant address:	1300 Bristol Street North, Suite 100, Newport Beach, CA 92660
Manufacturer:	Pacific Track, LLC
Manufacturer Address:	1300 Bristol Street North, Suite 100, Newport Beach, CA 92660

1.2 Product information

Product Name	Telematics Device
Model Number	PT40
Family Product/Model Number	None
Serial Number	IMEI: 352753091654895
Frequency Band	BLE: 2402-2480MHz LTE Cat-M1 Band 2: 1850.7-1909.3MHz LTE Cat-M1 Band 4: 1710.7-1754.3MHz LTE Cat-M1 Band 5: 824.7-836.5MHz LTE Cat-M1 Band 12: 699.7-715.3MHz LTE Cat-M1 Band 13: 777.7-786.3MHz
Type of modulation	GFSK (BLE), QPSK/16QAM (LTE Cat-M1)
Equipment Class/ Category	DTS (BLE), PCB (LTE Cat-M1)
Maximum output power	3.99 dBm (BLE), 24.50 dBm (LTE Cat-M1)
Antenna Information	BLE - On board PCB trace antenna, gain: 5.3 dBi LTE Cat-M1 – On board PIFA antenna, gain: 0 dBi
Clock Frequencies	N/A
Port/Connectors	USB-C port, Molex Micro-Fit 3.0™ 20 pin connector
Input Power	Battery: 12VDC on vehicle
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BLE and LTE can transmit simultaneously.
Additional Info	N/A

1.3 Test standard and method

Test standard	47CFR Part 15.247: 2018
Test method	ANSI C63.10: 2013 558074 D01 15.247 Meas Guidance v05

1.4 Test Purpose and statement

The purpose of this test report is intended to demonstrate the compliance of product listed in section 1.2, received from company listed in section 1.1, to the requirements of standard and method listed in section 1.3. Based on our test results, we conclude that the product tested complies with the requirements of the standards indicated.

2 Test site information

Lab performing tests	**Vista Laboratories**
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www. Vista-compliance.com

Test condition	Test Engineer	Test Environment	Test Date
RF conducted	Sherwin Lee	23.5°C / 58.2%/996 mbar	01/23/2019 – 02/12/2019
Radiated	Sherwin Lee	23.5°C / 58.2%/996 mbar	01/23/2019 – 02/12/2019

3 Modification of EUT

For RF conducted measurement purpose, the original antenna of test sample was removed and replace with external SMA connector; a short serial wire cable was soldered onto the PCB for sending command from Laptop to EUT to enable RF test mode; the special test firmware is used for testing purpose.

4 Test configuration and operation

4.1 EUT test configuration

EUT is powered by external battery. It is connected to a test laptop through USB-C to USB cable to receive test command for RF measurement. Serial port utility software is used to send command to EUT to enable the RF test mode.

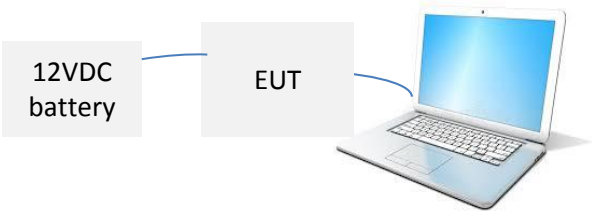
4.2 EUT test mode

Radio	Channel	Data Rates	Frequency (MHz)
BLE	1 (Low)	1 Mbps	2402
BLE	17 (Mid)	1 Mbps	2440
BLE	39 (High)	1 Mbps	2480
BLE	1 (Low)	2 Mbps	2402
BLE	17 (Mid)	2 Mbps	2440
BLE	39 (High)	2 Mbps	2480

4.3 Supporting Equipment

Index	Description	Model	S/N	Brand	Remark
1	Laptop	P29G003	G1H5102	Dell	N/A

4.4 EUT setup diagram



4.5 EUT operation

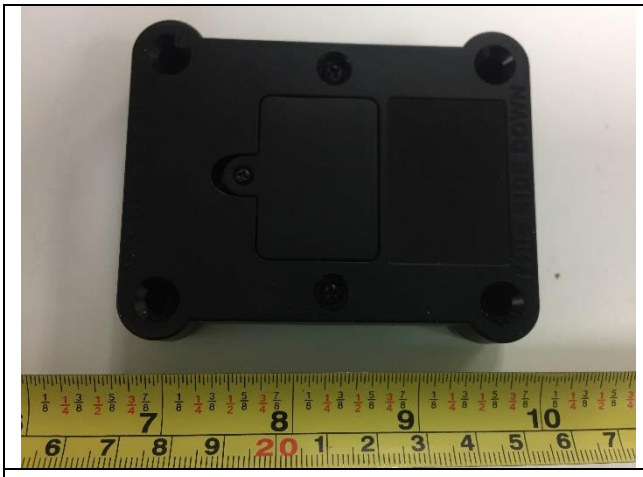
Serial port utility software is used to send command to EUT to enable the RF test mode.

4.6 Test software

Index	Description	Remark
1	Serial Port Utility 3.8.2.0302	Serial utility software to send command to device for running RF test mode.
2	U-Blox m-Center 01.12.00	Software to send command to device for running RF test mode.
3	EMISoft Vasona 6.0049	EMC/Spurious emission test software used during testing

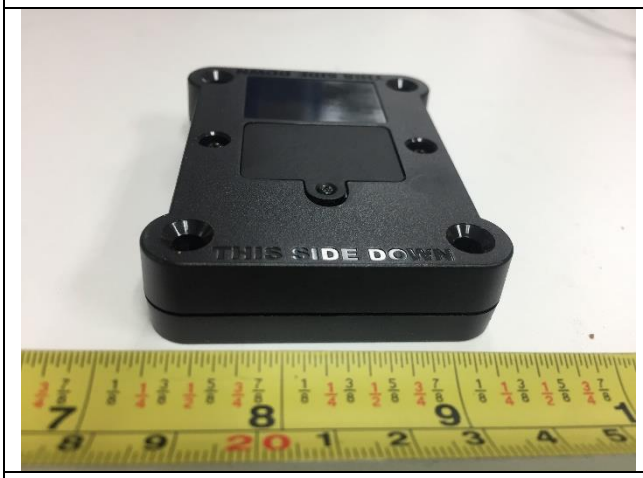
5 EUT and test setup pictures

5.1 EUT pictures



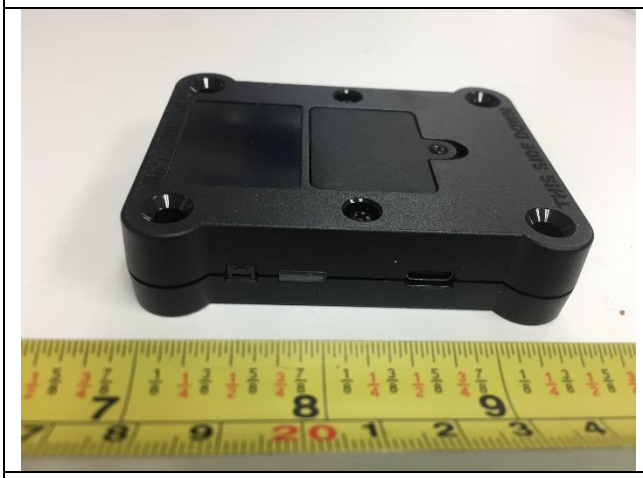
EUT Top View

EUT Bottom View

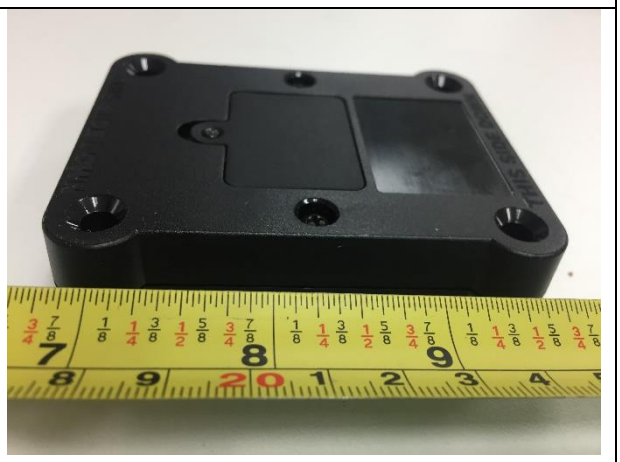


EUT Front View

EUT Rear View



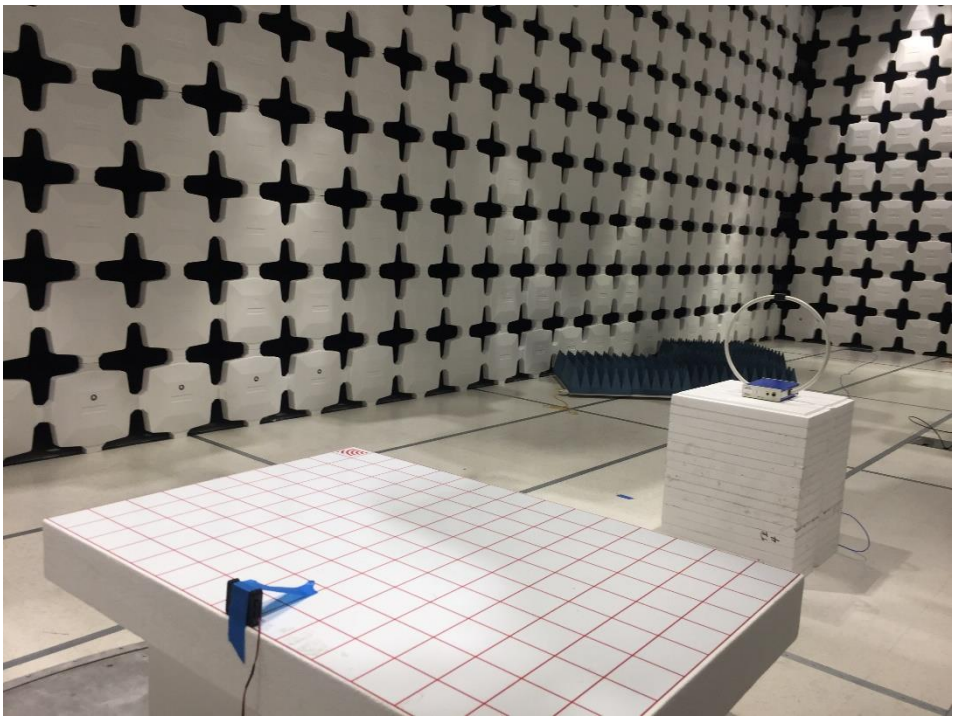
EUT Left View



EUT Right View

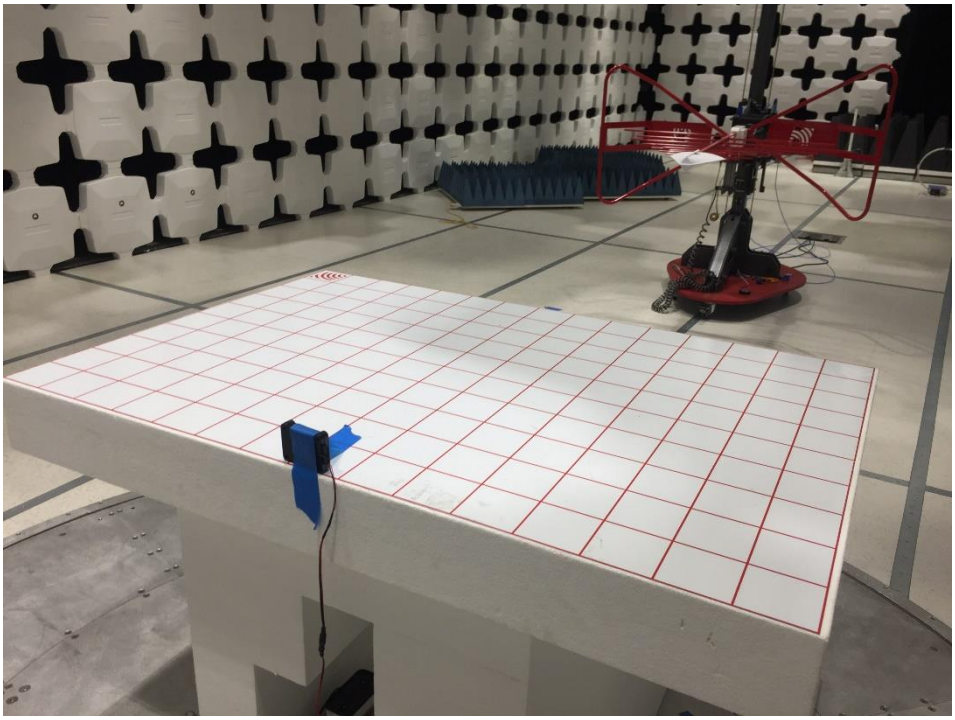
5.2 EUT test setup pictures

Radiated Emissions Below 30MHz setup – Front

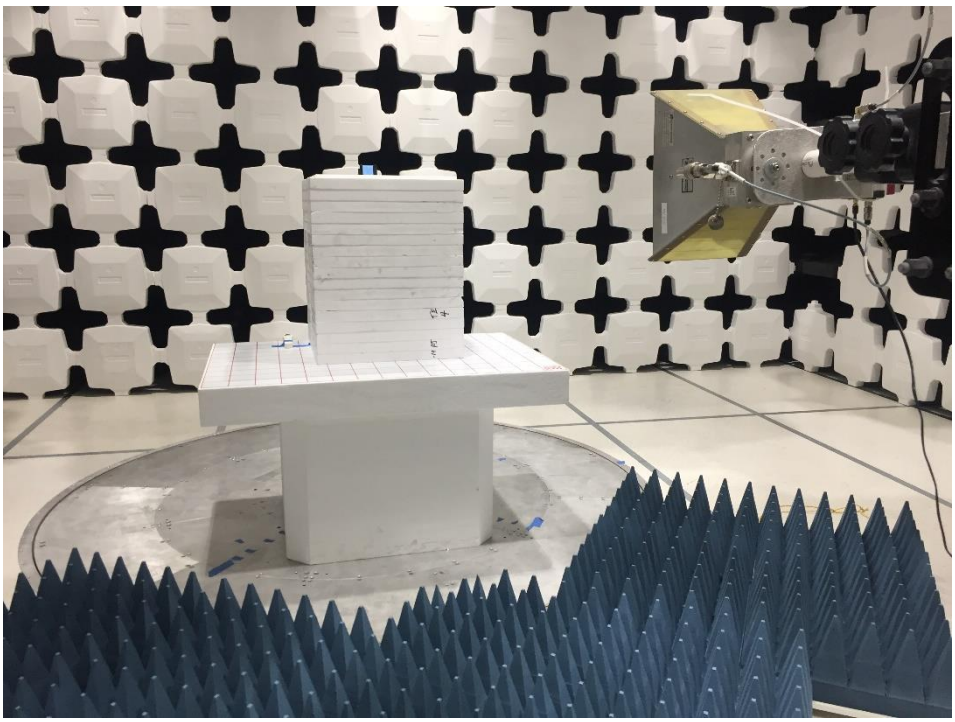


Radiated Emissions Below 30MHz setup – Rear

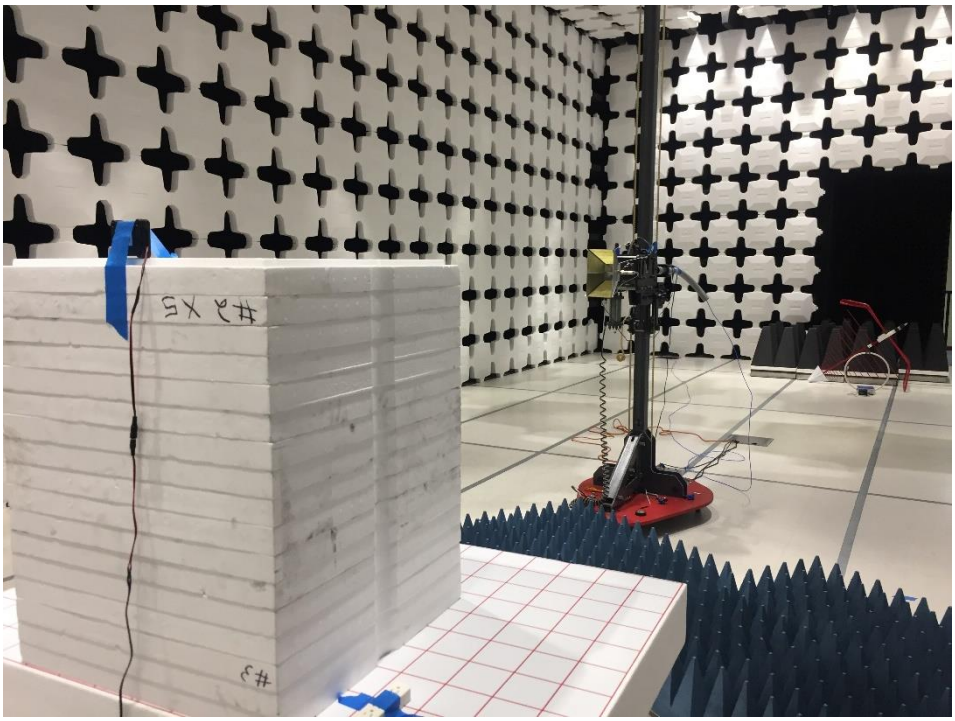
Radiated Emissions Below 1GHz setup – Front



Radiated Emissions Below 1GHz setup – Rear



Radiated Emissions Above 1GHz setup – Front



Radiated Emissions Above 1GHz setup – Rear

6 Test Summary

FCC Rules	ISED Rules	Test Item	Section	Verdict
§15.203	-	Antenna Requirement	8.1	Pass
§15.247 (a)(2)	RSS-247 §5.2	DTS (6 dB) Channel Bandwidth	8.2	Pass
-	RSS-Gen §6.7	Occupied Bandwidth	8.3	N/A
§15.247(b)(3)	RSS-247 §5.4	Conducted Maximum Output Power	8.4	Pass
§15.247(e)	RSS-247 §5.2	Power Spectral Density	8.5	Pass
§15.247(d)	RSS-247 §5.5	Conducted Band-Edge & Unwanted Emissions	8.6	Pass
§15.207 (a)	RSS-Gen §8.8	AC Power Line Conducted Emissions	N/A	N/A 1)
§15.205, §15.209, §15.247(d)	RSS-247 §5.5	Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	8.7	Pass
-	RSS-Gen §7.3	Receiver Spurious Emission	8.8	N/A 2)

Note:

1) EUT is powered by battery only. This item is not applicable.
2) Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

7 Uncertainly of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

8 Test summary and result

8.1 Antenna Requirement

8.1.1 Requirement

Per § 15.203, 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 shall be considered sufficient to comply with the provisions of this section. 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.

8.1.2 Result

Analysis:

- EUT use on board PCB trace antenna that is soldered permanently attached onto the PCB.
- There is no provision for connection to an external antenna.

Conclusion:

EUT complies with antenna requirement in § 15.203.

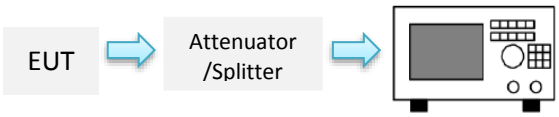
8.2 DTS (6 dB) Bandwidth

8.2.1 Requirement

§ 15.247 (a)(2), RSS-247 §5.2

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

8.2.2 Test setup



8.2.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05 and subclause 11.8 of ANSI C63.10-2013:

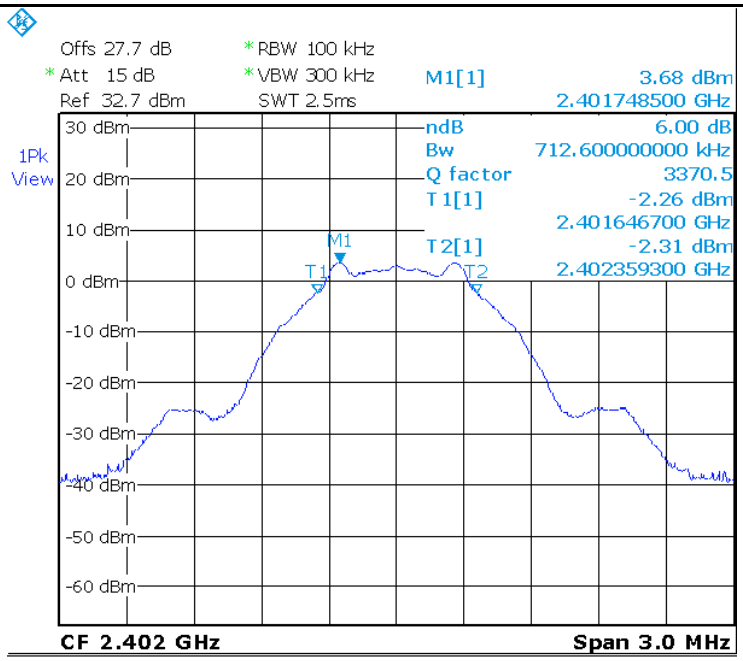
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

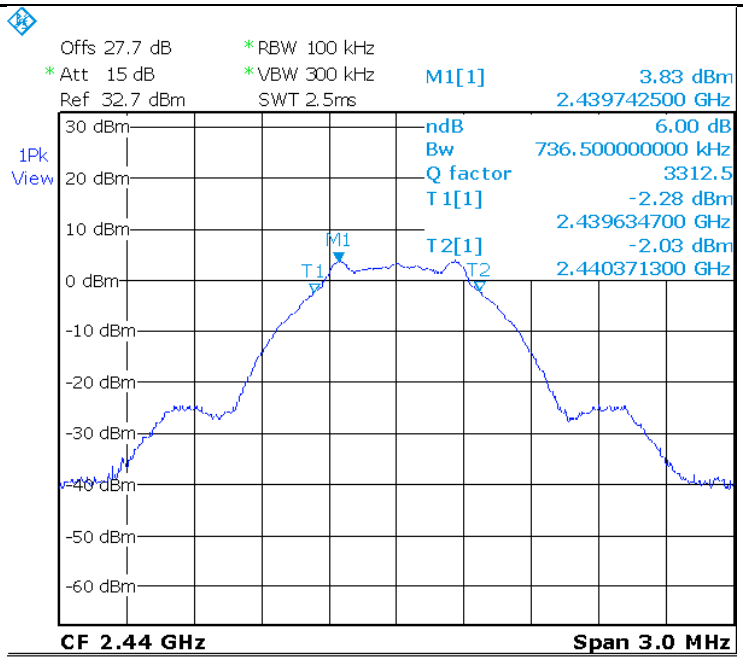
8.2.4 Test Result

Radio	Data rate	Test Frequency (MHz)	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
BLE	1Mbps	2402	712.6	500	Pass
	1Mbps	2440	736.5	500	Pass
	1Mbps	2480	730.5	500	Pass
	2Mbps	2402	1287.0	500	Pass
	2Mbps	2440	1397.0	500	Pass
	2Mbps	2480	1307.0	500	Pass

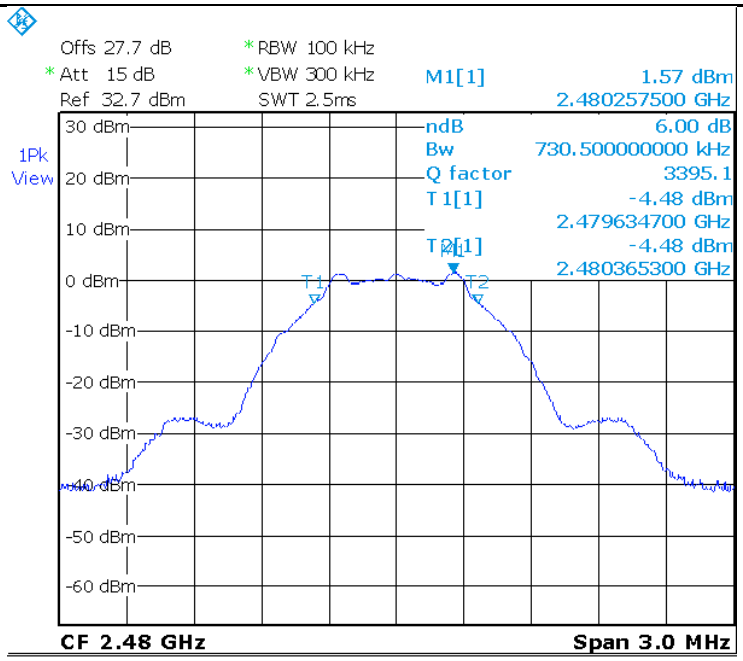
8.2.5 Test Plots



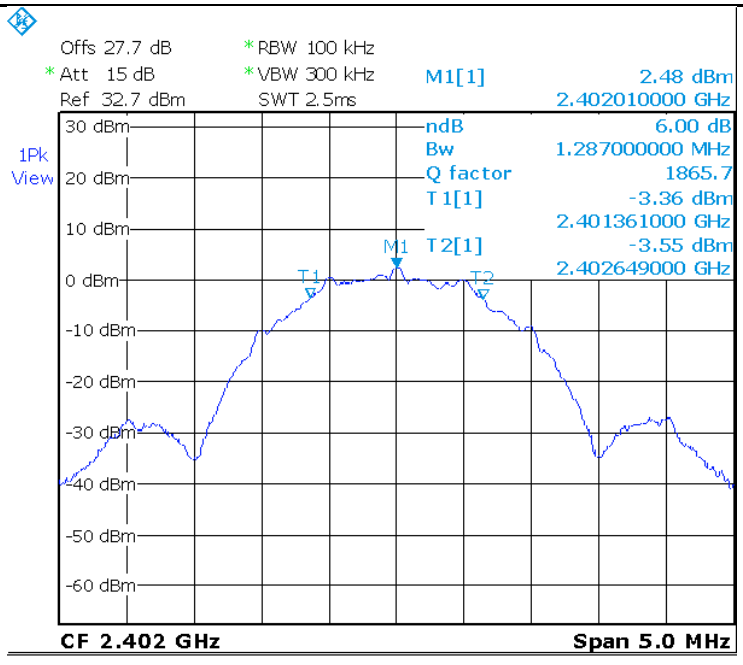
BLE-2402MHz-1Mbps



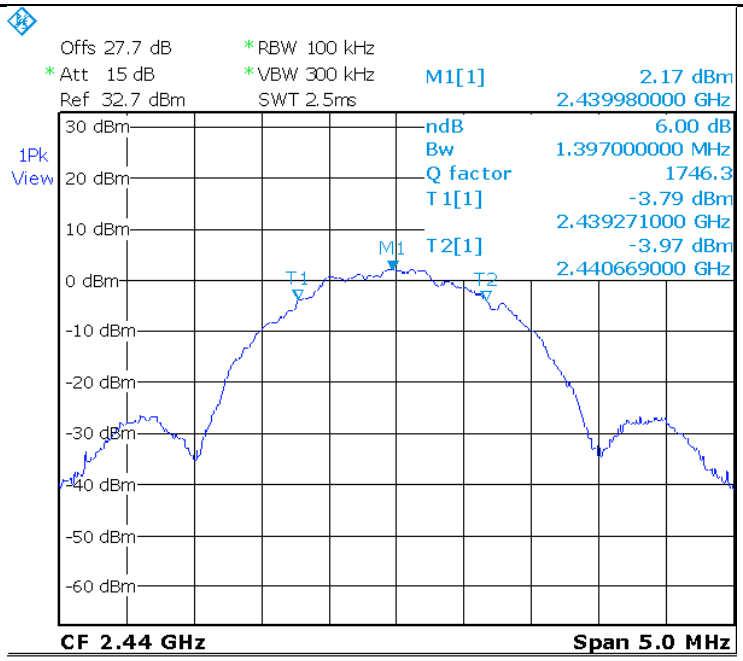
BLE-2440MHz-1Mbps



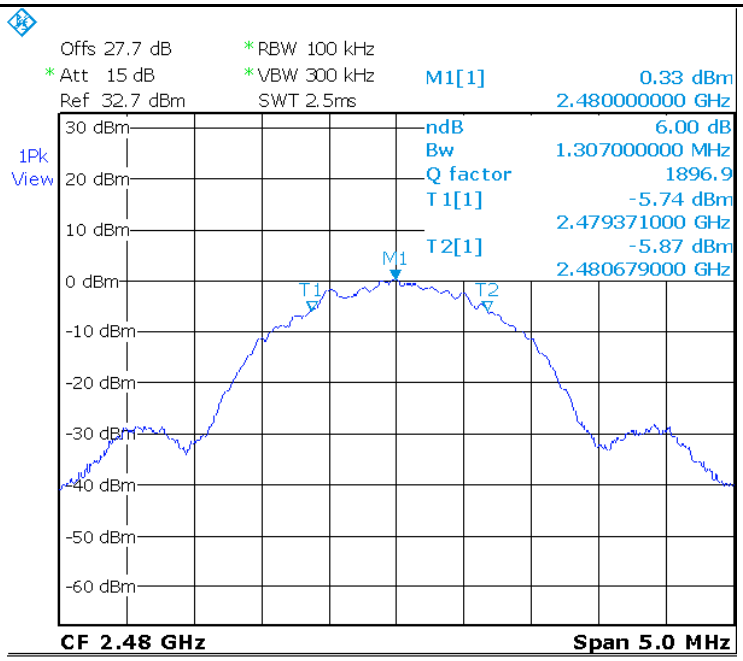
BLE-2480MHz-1Mbps



BLE-2402MHz-2Mbps



BLE-2440MHz-2Mbps



BLE-2480MHz-2Mbps

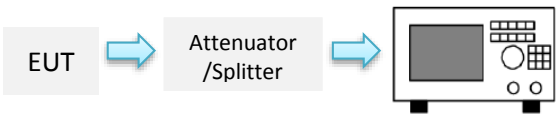
8.3 Occupied Bandwidth (99%)

8.3.1 Requirement

RSS-Gen §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.3.2 Test setup



8.3.3 Test Procedure

According to section RSS-Gen §6.7

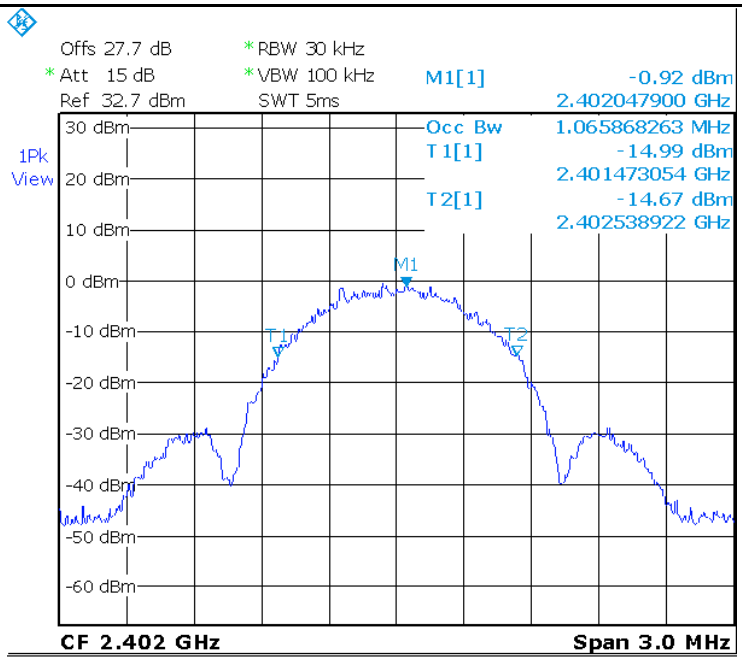
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

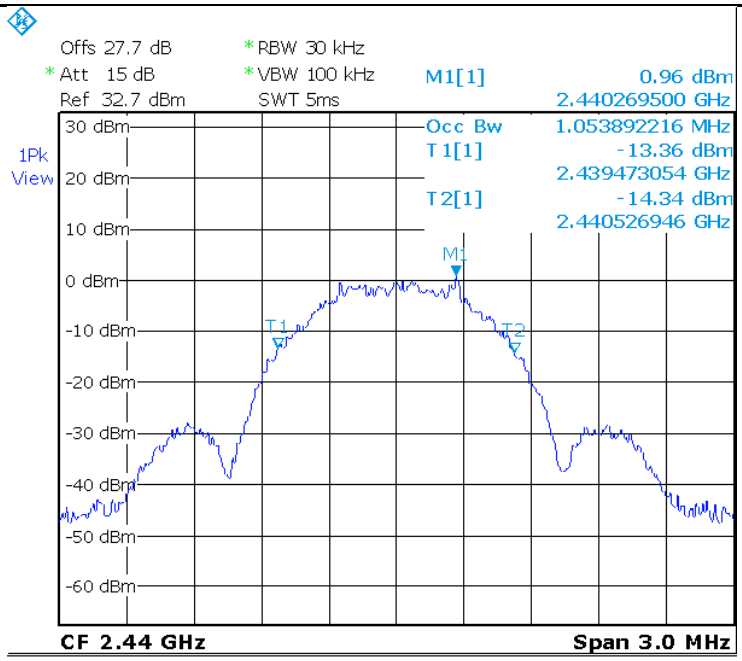
8.3.4 Test Result

Radio	Data rate	Test Frequency (MHz)	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
BLE	1Mbps	2402	1065.87	N/A	N/A
	1Mbps	2440	1053.89	N/A	N/A
	1Mbps	2480	1071.86	N/A	N/A
	2Mbps	2402	2083.83	N/A	N/A
	2Mbps	2440	2095.81	N/A	N/A
	2Mbps	2480	2143.71	N/A	N/A

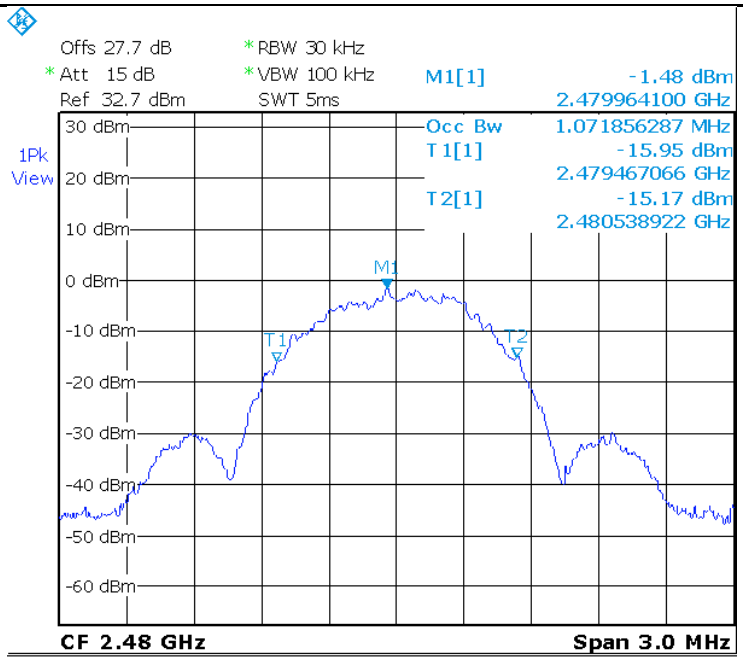
8.3.5 Test Plots



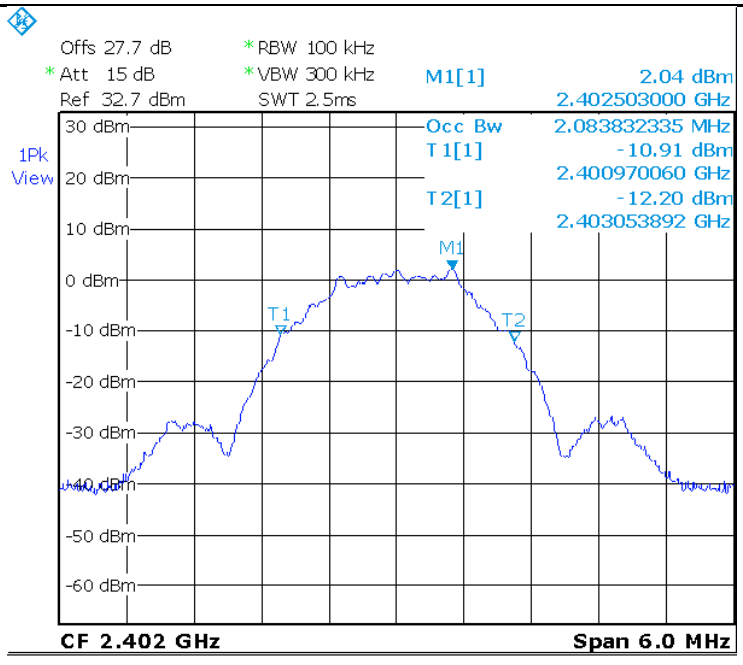
BLE-2402MHz-1Mbps



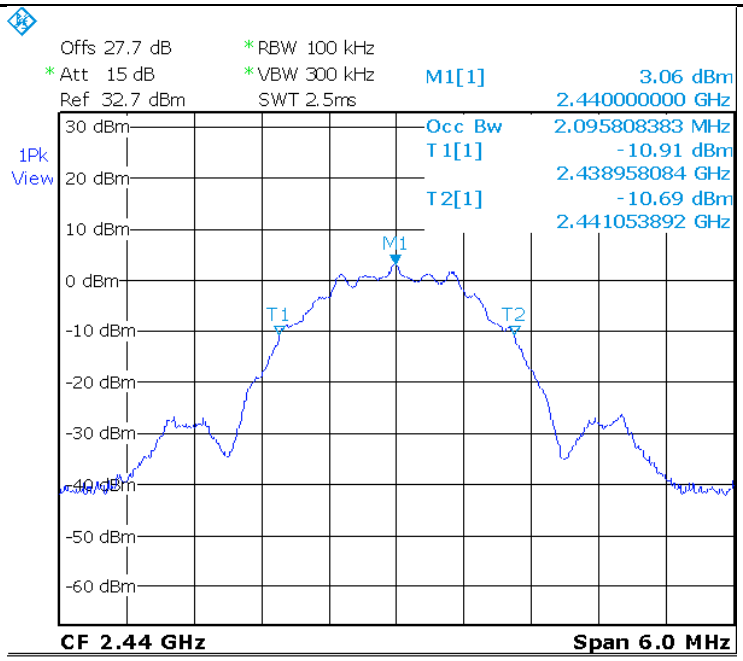
BLE-2440MHz-1Mbps



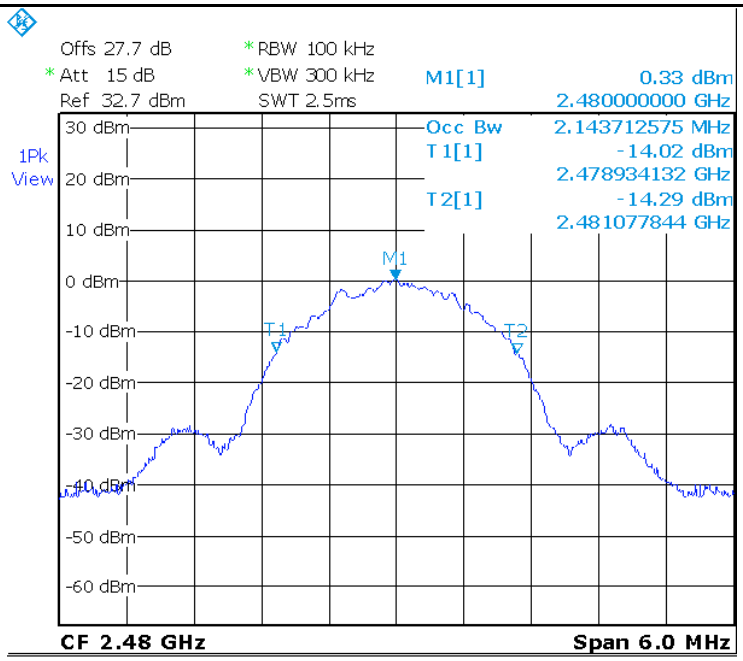
BLE-2480MHz-1Mbps



BLE-2402MHz-2Mbps



BLE-2440MHz-2Mbps



BLE-2480MHz-2Mbps

8.4 Maximum Output Power

8.4.1 Requirement

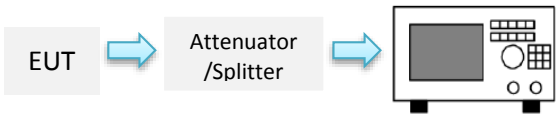
§ 15.247 (b)(3), RSS-247 §5.4

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Per RSS-247, the e.i.r.p. shall not exceed 4 W, except as provided in RSS-247 section 5.4(e).

8.4.2 Test setup



8.4.3 Test Procedure

According to section 8.3.1.1 RBW≥DTS bandwidth, in KDB 558074 D01 DTS Meas Guidance v05 and subclause 11.9.1.1 of ANSI C63.10-2013:

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 X RBW.
3. Set span ≥ 3 X RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

8.4.4 Test Result

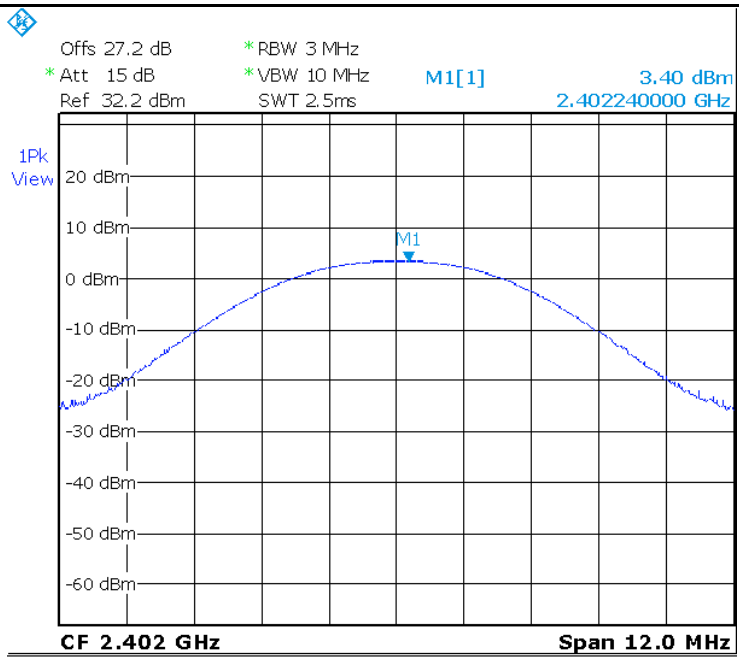
Conducted Output Power

Radio	Data rate	Test Frequency (MHz)	Measured Output Power (dBm)	Maximum TX Output Power (dBm)	Result
BLE	1Mbps	2402	3.40	30	Pass
	1Mbps	2440	3.99	30	Pass
	1Mbps	2480	1.75	30	Pass
	2Mbps	2402	3.36	30	Pass
	2Mbps	2440	3.96	30	Pass
	2Mbps	2480	1.74	30	Pass

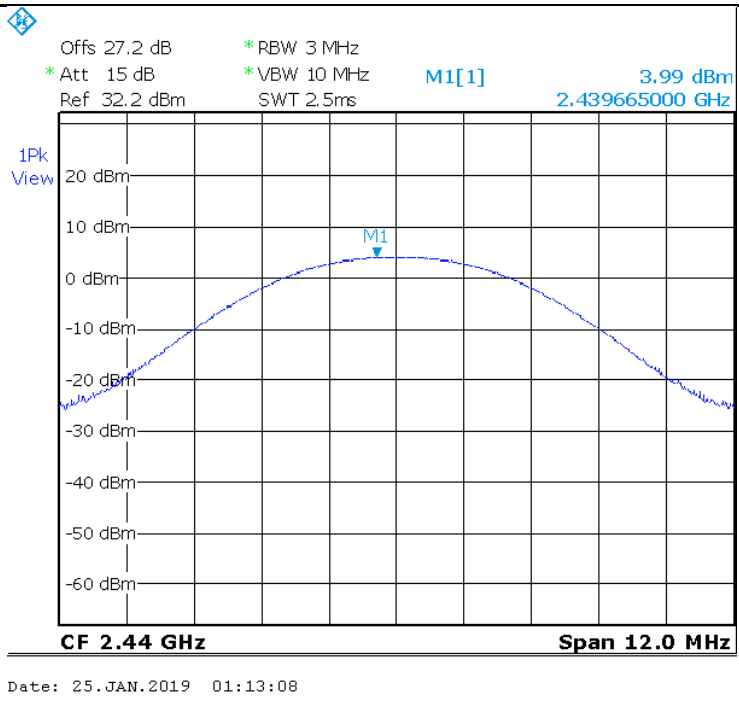
Max e.i.r.p

Radio	Data rate	Test Frequency (MHz)	Measured Output Power (dBm)	Antenna Gain (dBi)	Max e.i.r.p (dBm)	Limit	Result
BLE	1Mbps	2402	3.40	5.3	8.70	36	Pass
	1Mbps	2440	3.99	5.3	9.29	36	Pass
	1Mbps	2480	1.75	5.3	7.05	36	Pass
	2Mbps	2402	3.36	5.3	8.66	36	Pass
	2Mbps	2440	3.96	5.3	9.26	36	Pass
	2Mbps	2480	1.74	5.3	7.04	36	Pass

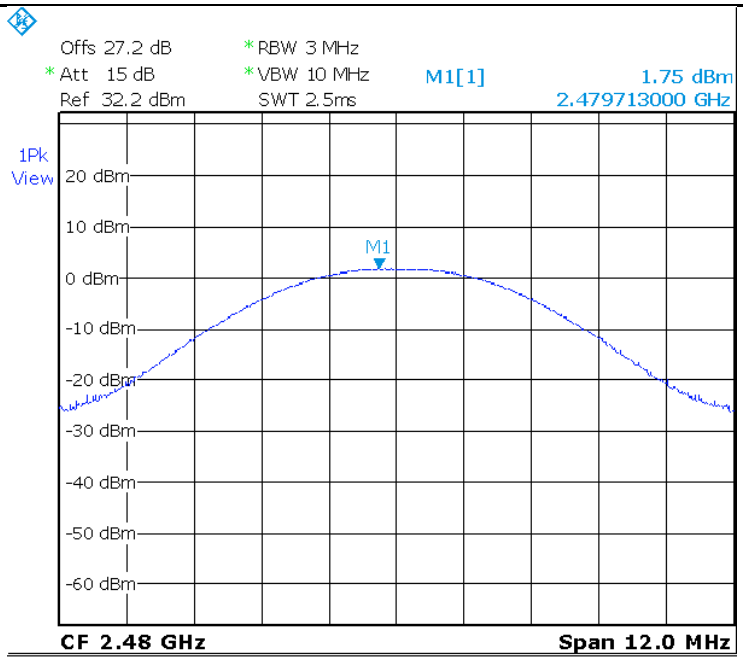
8.4.5 Test Plots



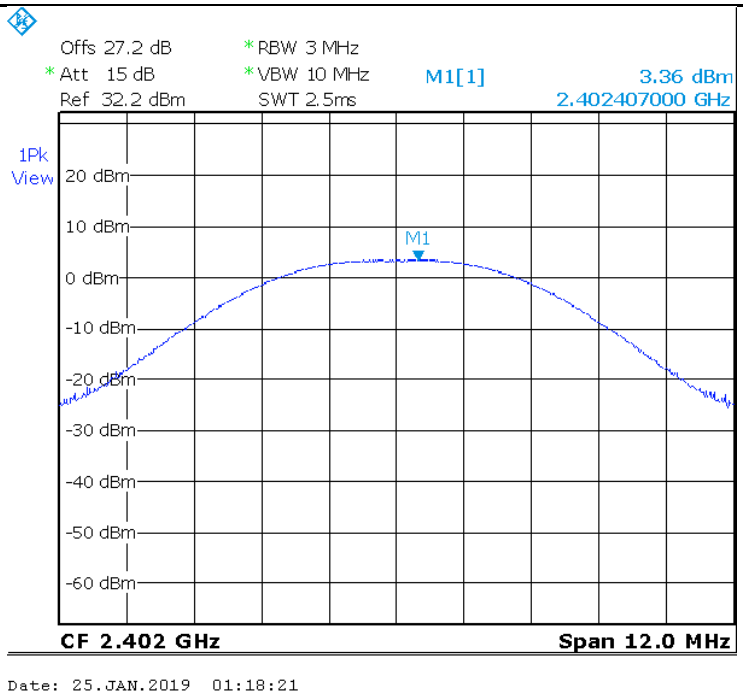
BLE-2402MHz-1Mbps



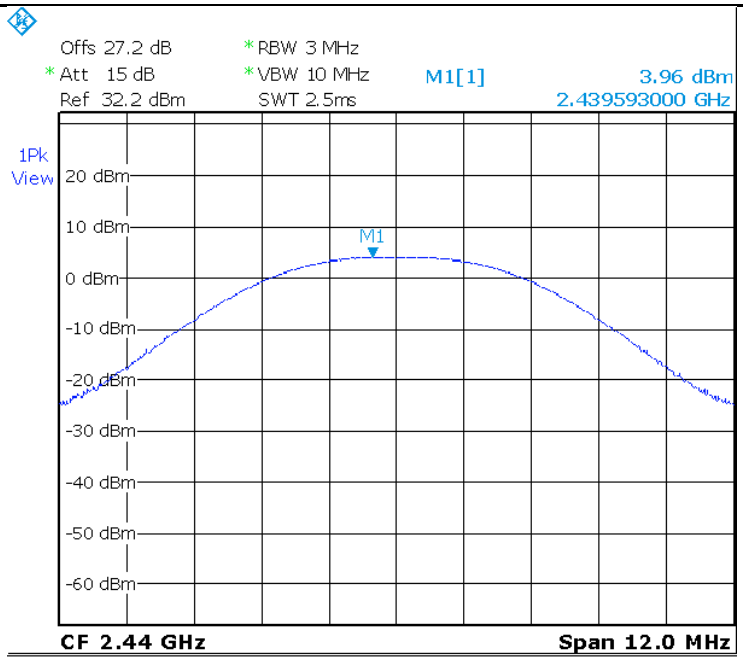
BLE-2440MHz-1Mbps



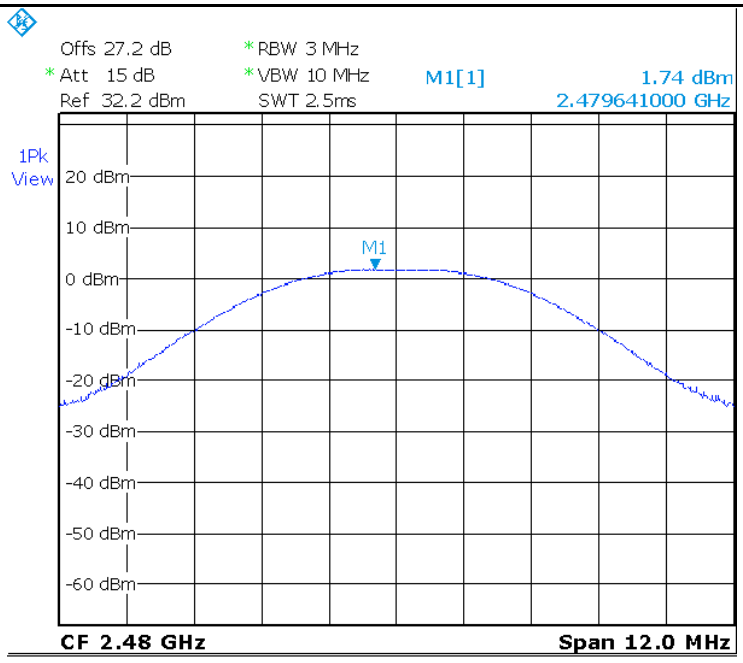
BLE-2480MHz-1Mbps



BLE-2402MHz-2Mbps



BLE-2440MHz-2Mbps



BLE-2480MHz-2Mbps

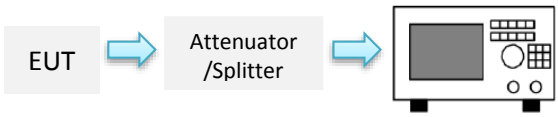
8.5 Power Spectral Density

8.5.1 Requirement

§ 15.247 (e), RSS-247 §5.2

For digitally modulated 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

8.5.2 Test setup



8.5.3 Test Procedure

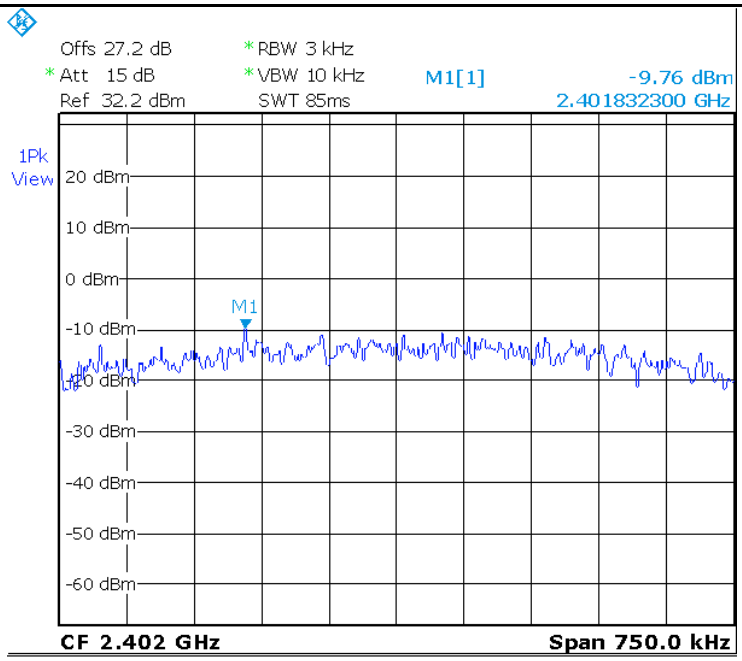
According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05 and subclause 11.10.2 PKPSD of ANSI C63.10-2013:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

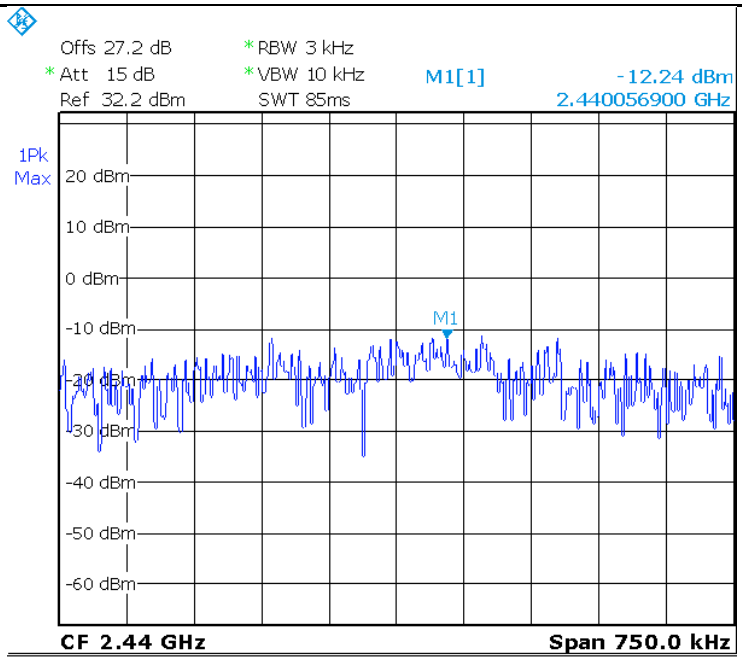
8.5.4 Test Result

Radio	Data rate	Test Frequency (MHz)	Measured Output Power (dBm/3KHz)	Maximum Output Power (dBm/3KHz)	Result
BLE	1Mbps	2402	-9.76	8	Pass
	1Mbps	2440	-12.24	8	Pass
	1Mbps	2480	-12.20	8	Pass
	2Mbps	2402	-12.79	8	Pass
	2Mbps	2440	-13.17	8	Pass
	2Mbps	2480	-14.09	8	Pass

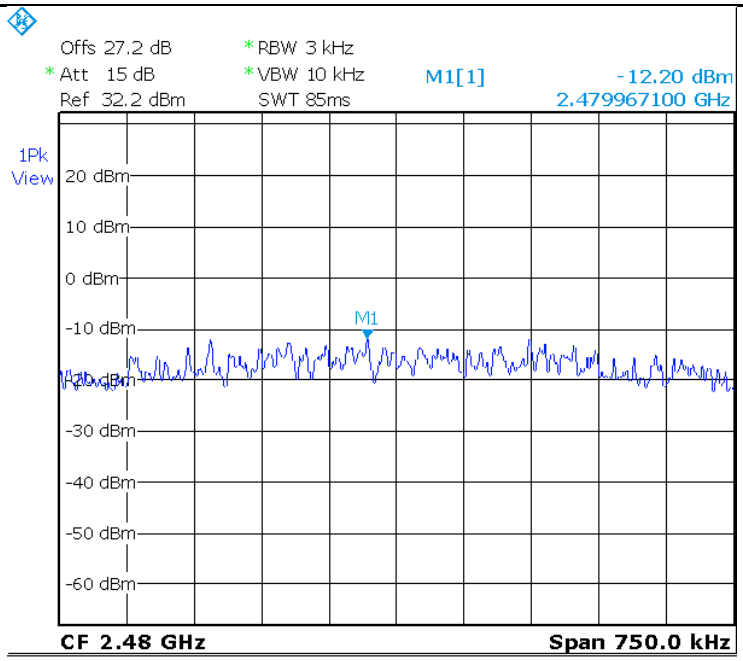
8.5.5 Test Plots



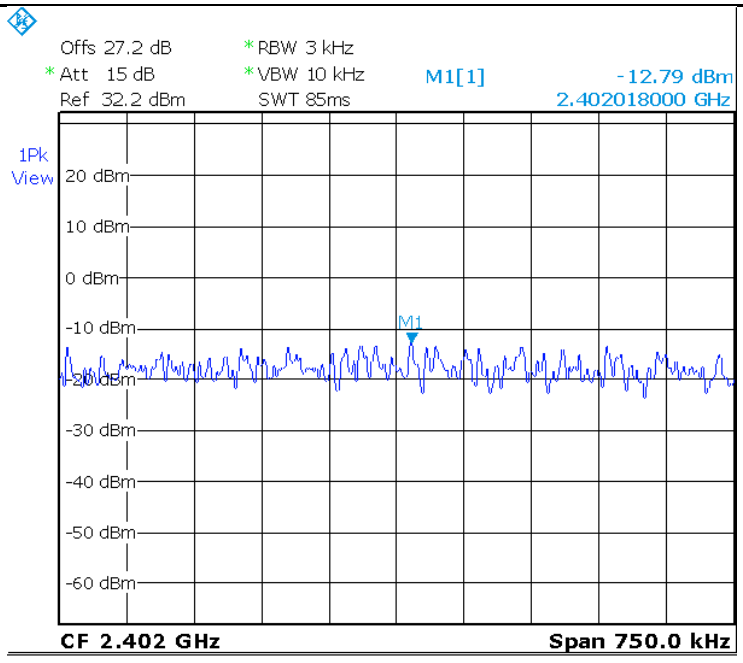
BLE-2402MHz-1Mbps



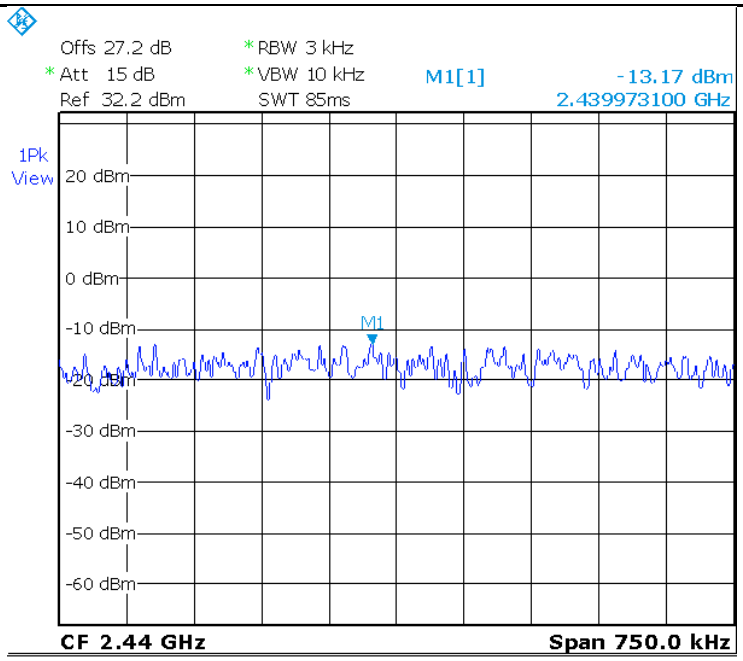
BLE-2440MHz-1Mbps



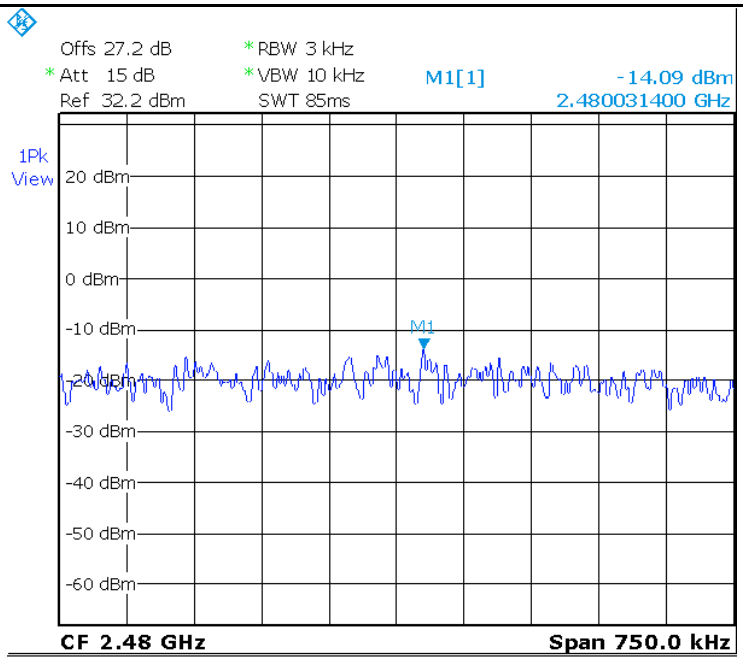
BLE-2480MHz-1Mbps



BLE-2402MHz-2Mbps



BLE-2440MHz-2Mbps



BLE-2480MHz-2Mbps

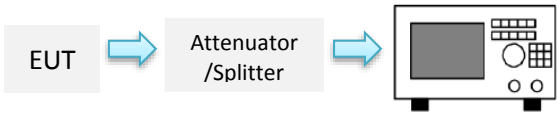
8.6 Conducted Band-Edge & Unwanted Emissions Measurement

8.6.1 Requirement

§ 15.247 (d), RSS-247 §5.5

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.

8.6.2 Test setup



8.6.3 Test Procedure

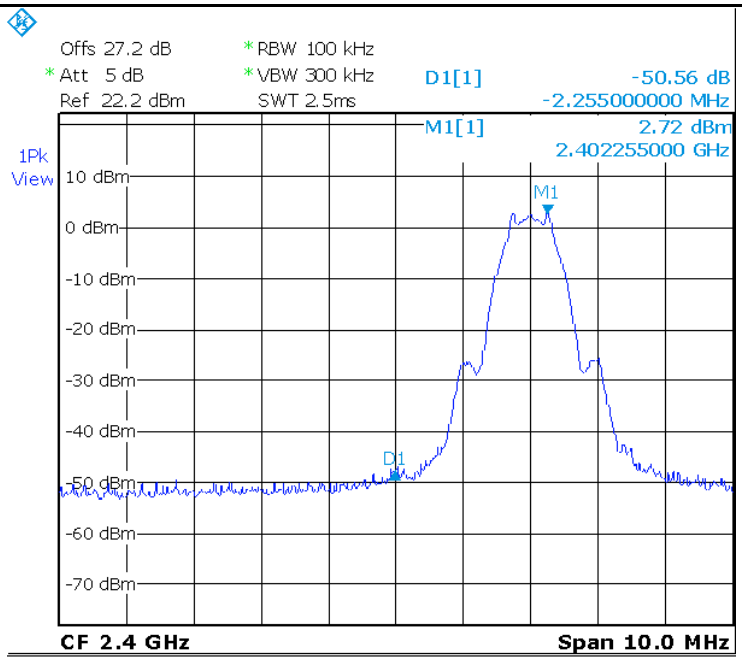
According to section 8.5 Emission level measurement, in KDB 558074 D01 DTS Meas Guidance v05 and subclause 11.11.3 in ANSI C63.10-2013:

1. Set the centre frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 3 X RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

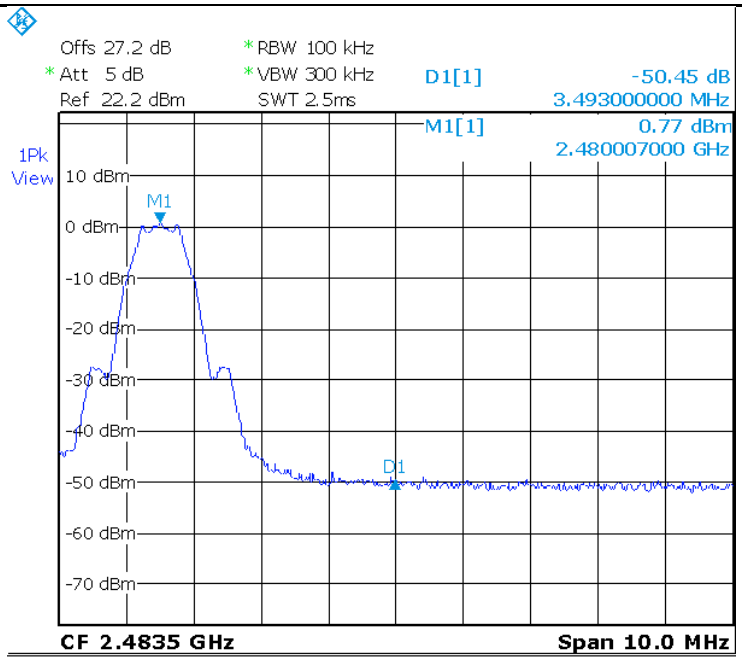
8.6.4 Test Result

See test plots

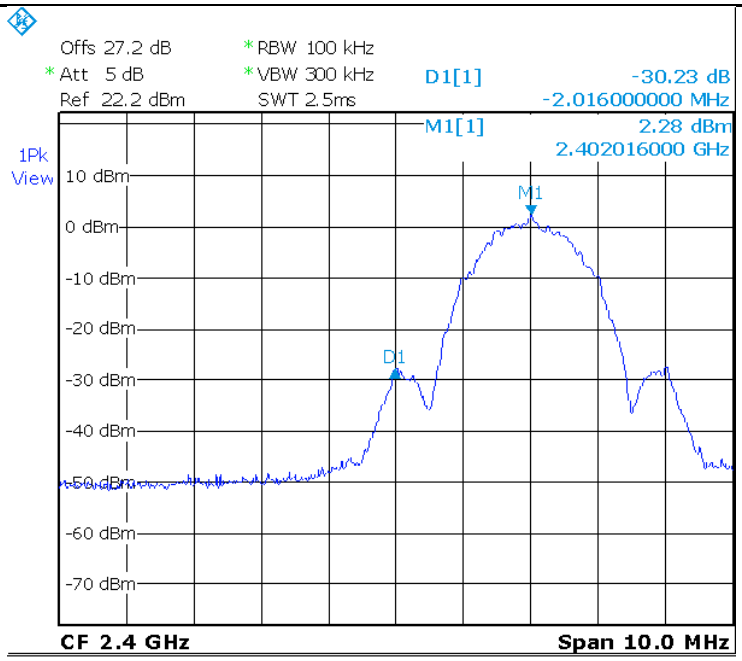
8.6.5 Test Plots



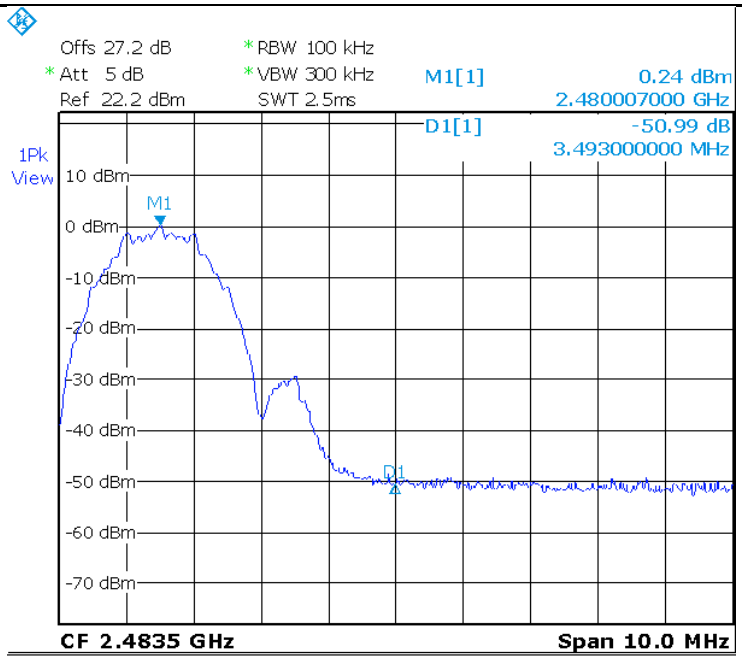
Conducted Band-Edge - BLE-2402MHz-1Mbps



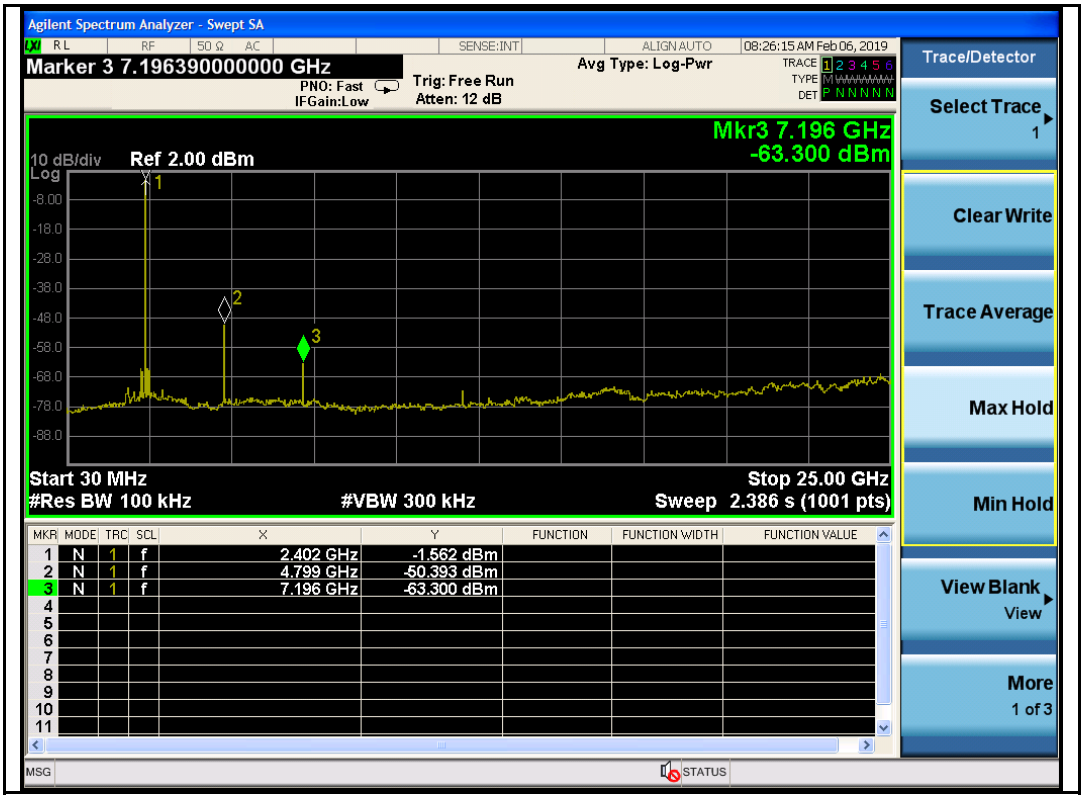
Conducted Band-Edge - BLE-2480MHz-1Mbps



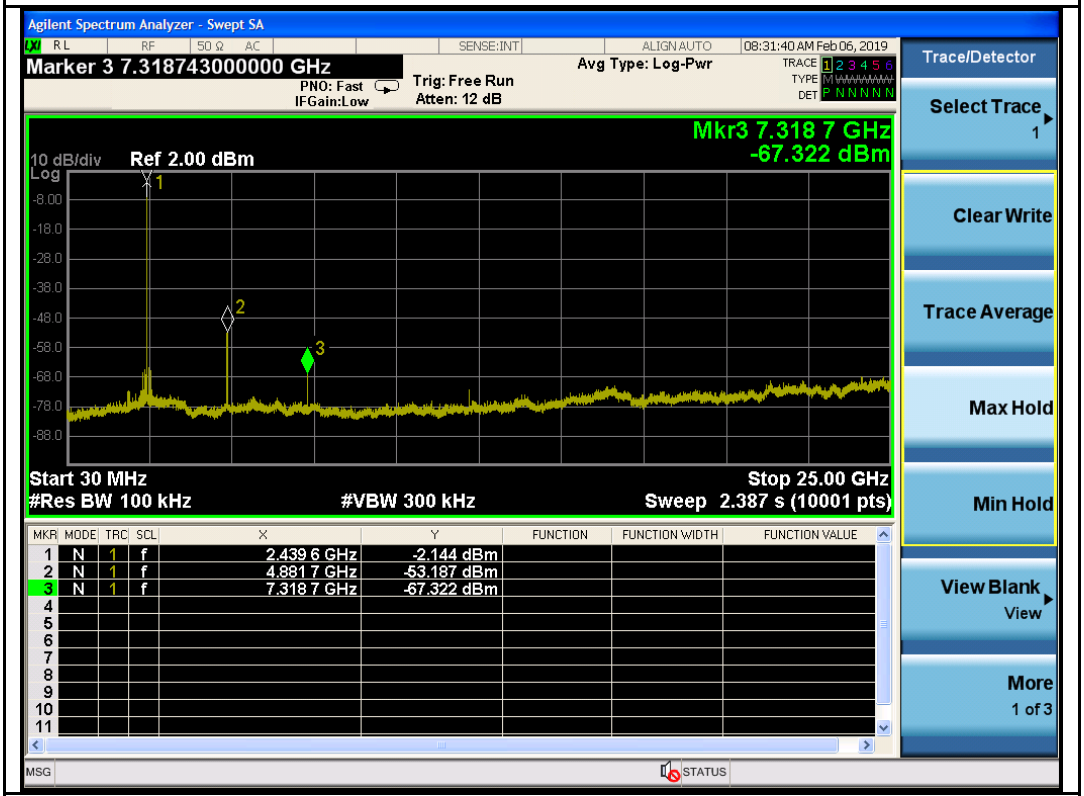
Conducted Band-Edge - BLE-2402MHz-2Mbps



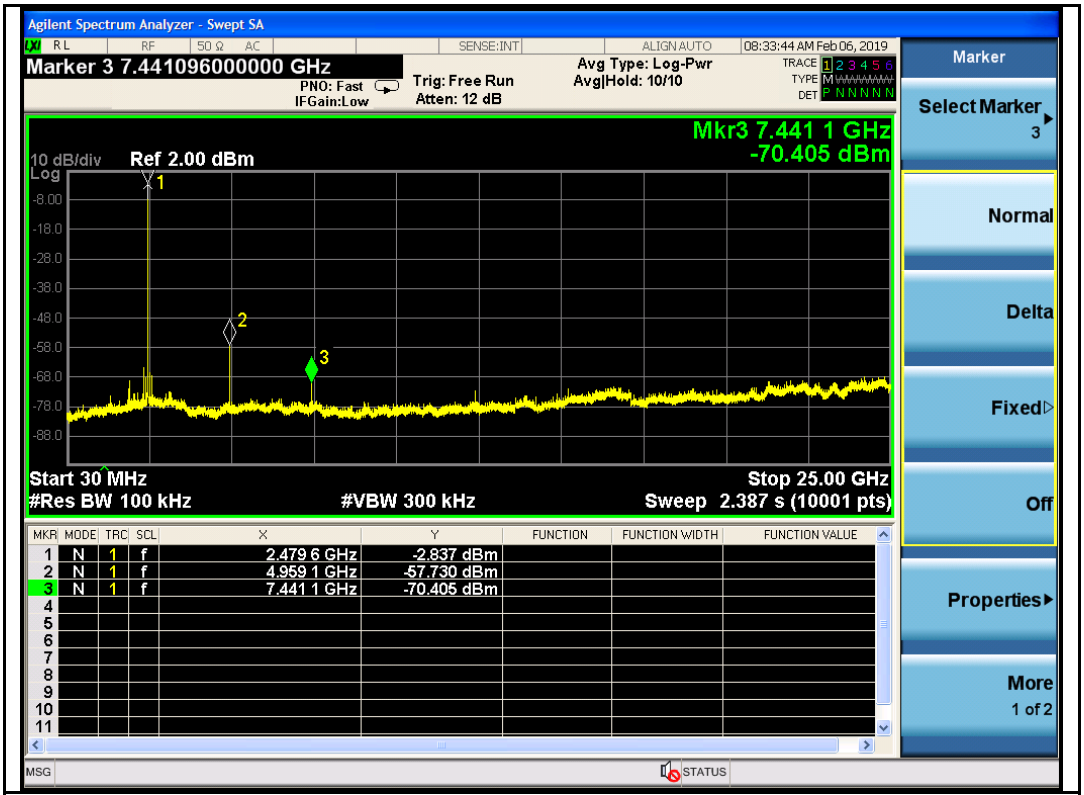
Conducted Band-Edge - BLE-2480MHz-2Mbps



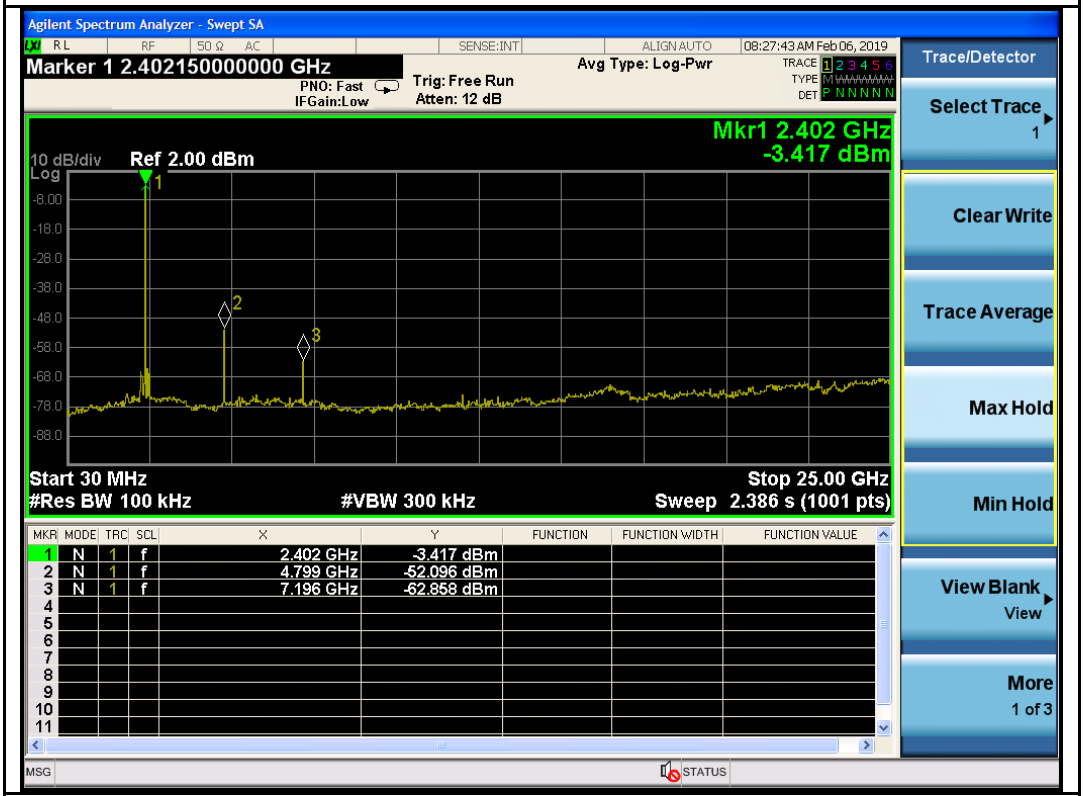
Conducted Unwanted Emission - BLE-2402MHz-1Mbps



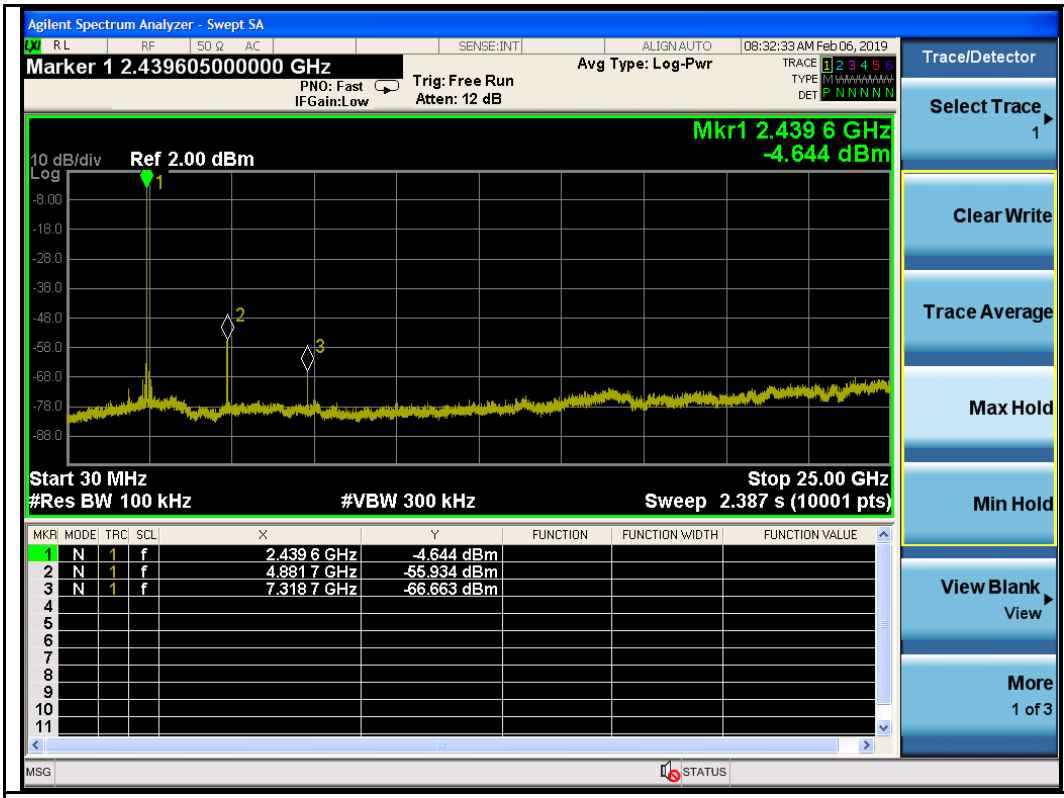
Conducted Unwanted Emission - BLE-2440MHz-1Mbps



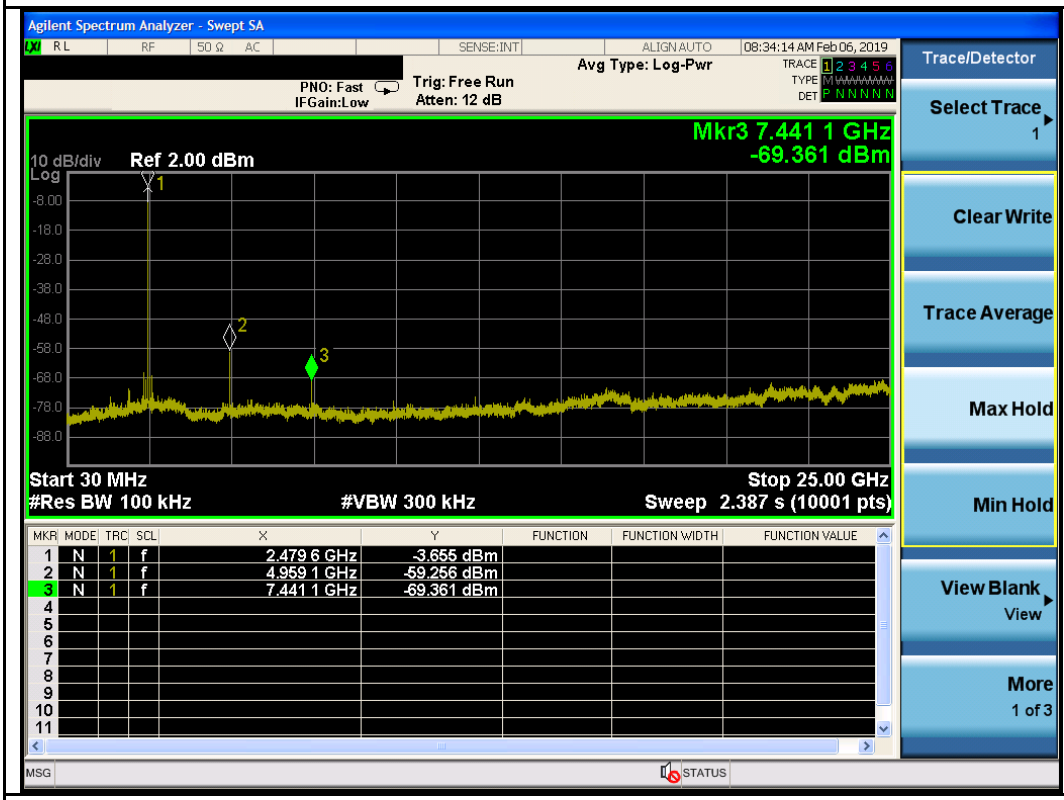
Conducted Unwanted Emission - BLE-2480MHz-1Mbps



Conducted Unwanted Emission - BLE-2402MHz-2Mbps



Conducted Unwanted Emission - BLE-2440MHz-2Mbps



Conducted Unwanted Emission - BLE-2480MHz-2Mbps

8.7 Radiated Band-Edge & Spurious Emissions into Restricted Frequency Bands

8.7.1 Requirement

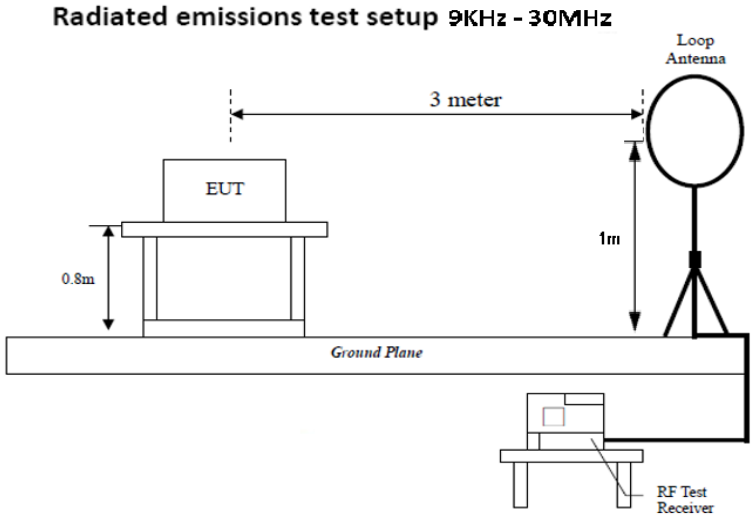
§ 15.247 (d), RSS-247 §5.5

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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

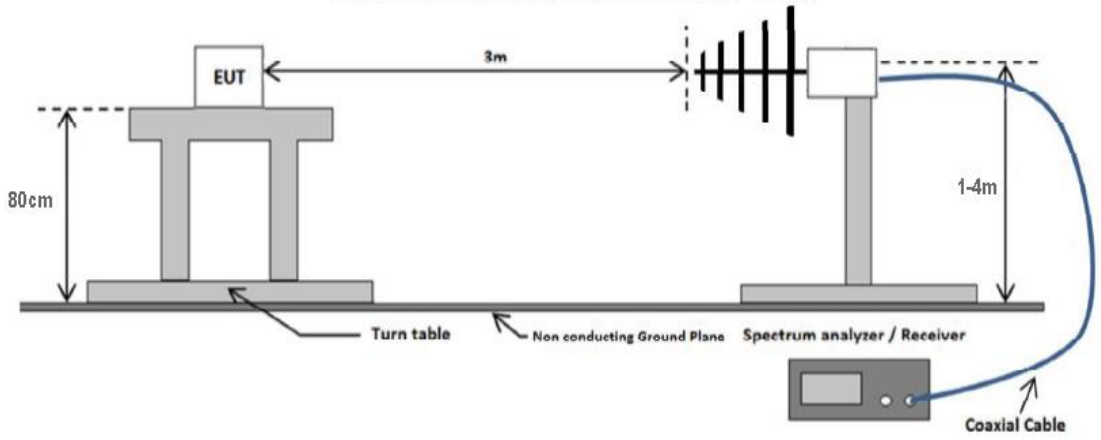
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency range (MHz)	Field Strength (µV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

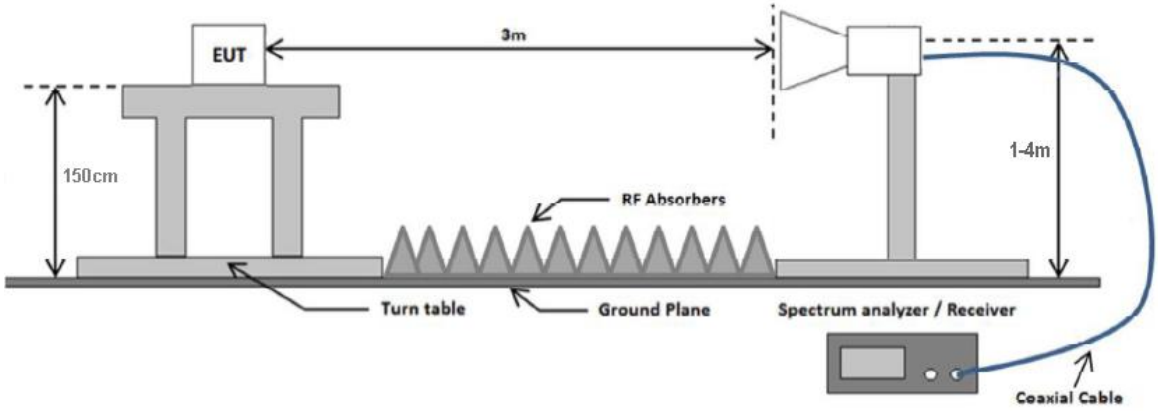
8.7.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



8.7.3 ***Test Procedure***

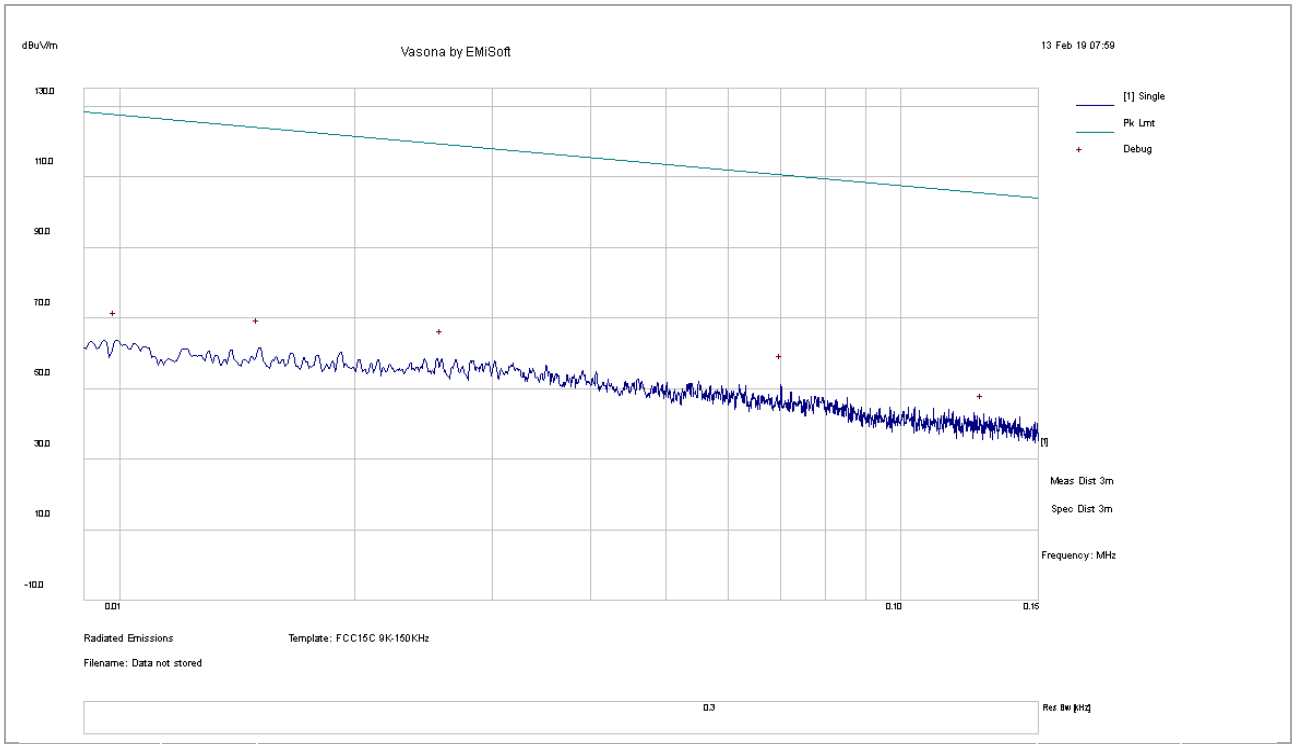
According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

8.7.4 Test Result

9KHz – 150KHz test result

Test Standard:	**15.209, RSS-Gen**	**Mode:**	**2440MHz-1Mpbs**
Frequency Range:	**Below 150KHz**	**Test Date:**	**02/12/2019**
Antenna Type/Polarity:	**Loop / 0 deg & 90 deg**	**Test Personnel:**	**Sherwin Lee**
Remark:	**Internal antenna**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table cm	Limit dBuV/m	Margin dB
0.02	49.85	0.35	10.83	61.03	PK	0	100	360	124.07	-63.04
0.07	37.99	0.51	12.50	51.00	PK	0	100	360	110.68	-59.68
0.03	44.81	0.41	12.99	58.20	PK	0	100	360	119.38	-61.18
0.01	52.84	0.31	10.15	63.30	PK	0	100	360	127.74	-64.44
0.13	28.20	0.56	11.00	39.76	PK	0	100	360	105.55	-65.79

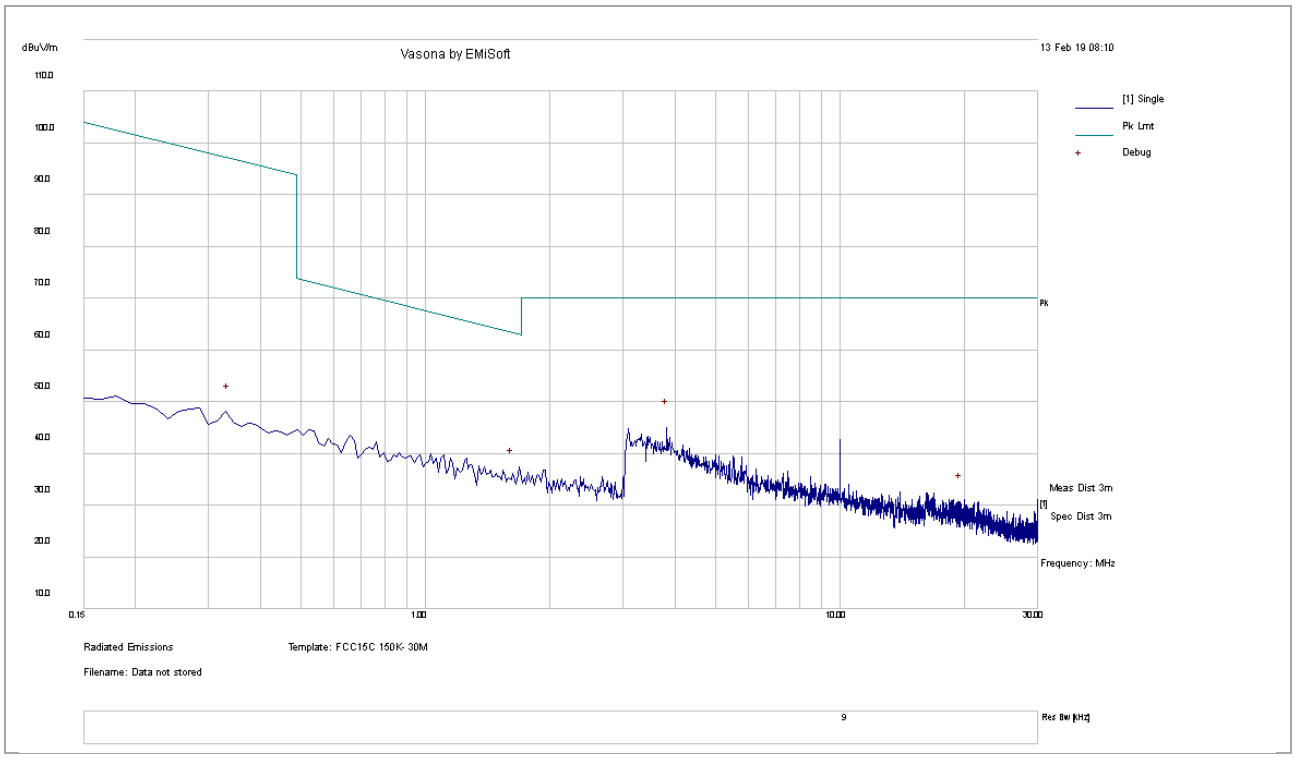
Note: 1) Both 0 deg and 90 deg setup of the loop antenna have been verified and the worst case result is presented here.

2) All different modes have been verified and the worst case result is presented here.

3) EUT was tested in 3 orientations.

150KHz – 30MHz test result

Test Standard:	**15.209, RSS-Gen**	**Mode:**	**2440MHz-1Mpbs**
Frequency Range:	**150KHz – 30MHz**	**Test Date:**	**02/12/2019**
Antenna Type/Polarity:	**Loop / 0 deg & 90 deg**	**Test Personnel:**	**Sherwin Lee**
Remark:	**N/A**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table cm	Limit dBuV/m	Margin dB
0.33	34.58	0.66	12.27	47.52	PK		100	360	97.13	-49.61
1.62	21.17	0.82	13.11	35.10	PK		100	360	63.43	-28.33
3.82	30.71	0.90	13.02	44.63	PK		100	360	70.00	-25.37
19.48	14.26	1.74	14.18	30.18	PK		100	360	70.00	-39.82

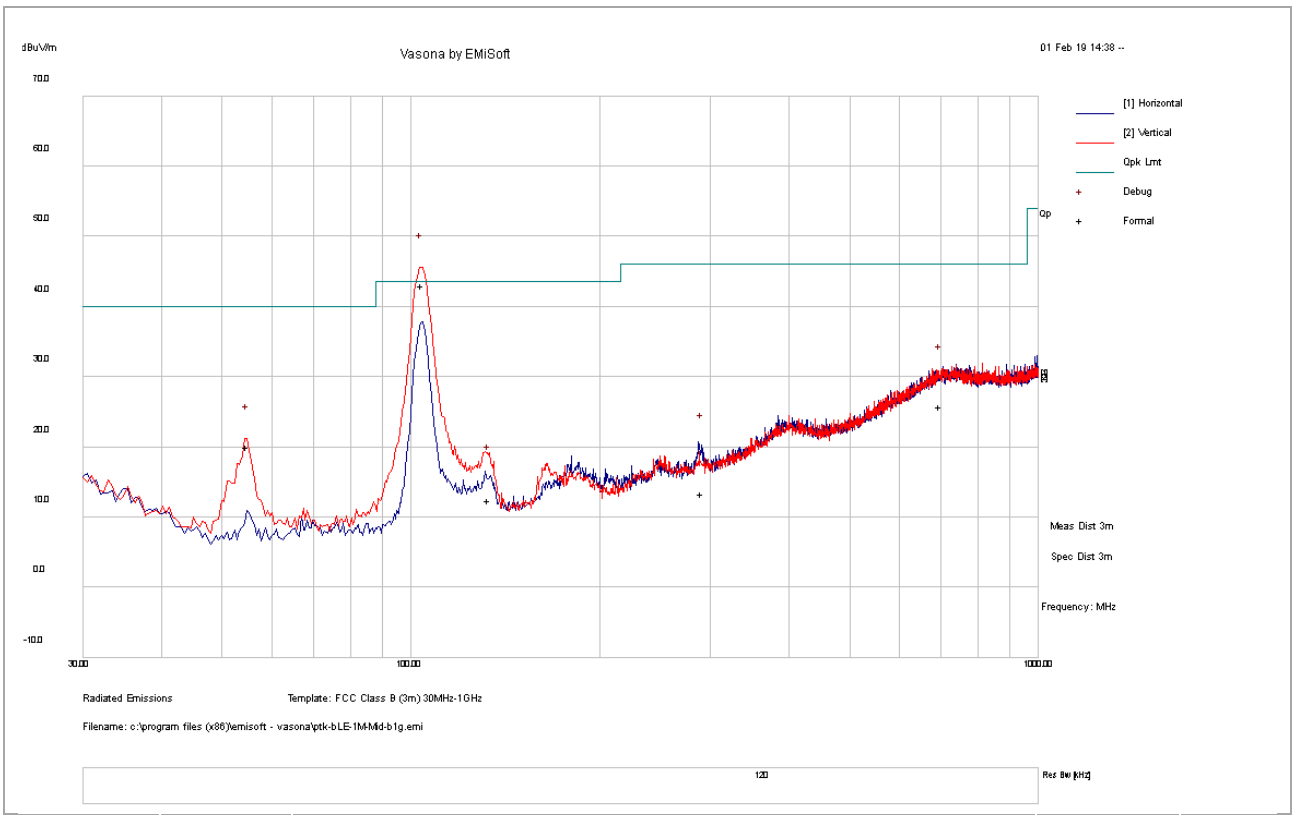
Note: 1) Both 0 deg and 90 deg setup of the loop antenna have been verified and the worst case result is presented here.

2) All different modes have been verified and the worst case result is presented here.

3) EUT was tested in 3 orientations.

30-1000MHz test result

Test Standard:	**15.209, RSS-247**	**Mode:**	**BLE-2440MHz**
Frequency Range:	**30-1000MHz**	**Test Date:**	**02/01/2019**
Antenna Type/Polarity:	**Bi-Log/Hor & Ver**	**Test Personnel:**	**Sherwin Lee**
Remark:	**N/A**	**Test Result:**	**Pass**

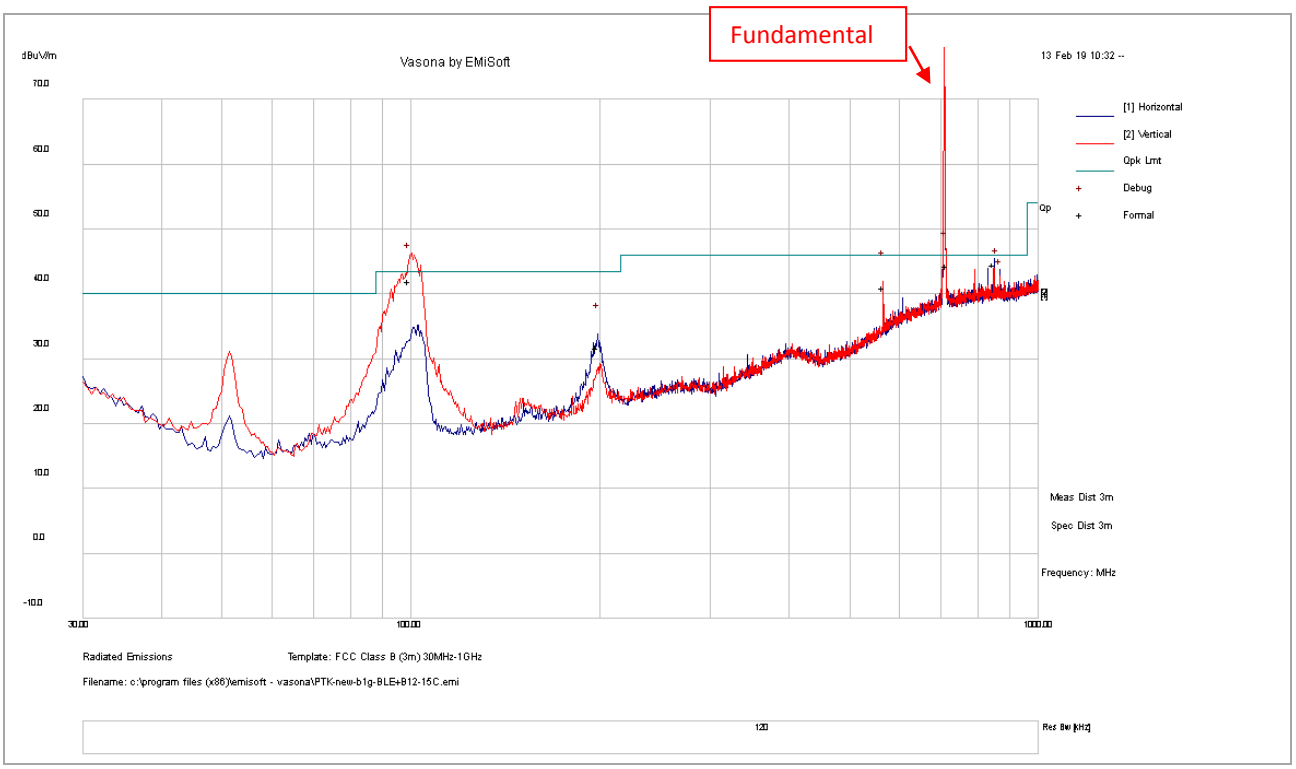


Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table cm	Limit dBuV/m	Margin dB
54.92	41.87	2.90	-24.73	20.04	QP	V	134	66	40.00	-19.96
103.96	61.93	3.63	-23.58	41.98	QP	V	140	245	43.50	-1.52
132.81	31.22	4.04	-22.87	12.40	QP	H	158	343	43.50	-31.10
290.69	26.64	5.61	-18.82	13.43	QP	H	371	74	46.00	-32.57
695.86	25.05	7.31	-6.57	25.79	QP	H	163	199	46.00	-20.21

Note:

1) For below 1GHz, all different channel and modes were verified but only the worst case result is shown here.
2) All different modes have been verified and the worst case result is presented here.
3) EUT was tested in 3 orientations.

Test Standard:	**15.209, RSS-247**	**Mode:**	**BLE-2440MHz & LTE B12**
Frequency Range:	**30-1000MHz**	**Test Date:**	**02/01/2019**
Antenna Type/Polarity:	**Bi-Log/Hor & Ver**	**Test Personnel:**	**Sherwin Lee**
Remark:	**BLE/LTE transmit simultaneously**	**Test Result:**	**Pass**



Frequency MHz	Raw dB	Cable dB	AF dB	Level dBuV/m	Det	Pol deg	Height cm	Table cm	Limit dBuV/m	Margin dB
100.37	30.15	3.57	7.91	41.63	QP	V	134	268	43.50	-1.87
198.13	17.18	4.71	9.97	31.87	QP	H	227	20	43.50	-11.63
565.98	13.92	6.82	20.30	41.04	QP	V	248	108	46.00	-4.96
712.60	14.42	7.30	22.76	44.48	QP	V	110	246	46.00	-1.52
848.99	13.87	7.43	23.55	44.85	QP	H	110	11	46.00	-1.15
868.42	13.21	7.50	23.45	44.16	QP	H	202	113	46.00	-1.84

Note:

1) For below 1GHz, all different channel and modes were verified but only the worst case result is shown here.
2) All different modes have been verified and the worst case result is presented here.
3) EUT was tested in 3 orientations.

1GHz – 25GHz Test Result

Test Mode: BLE -2402MHz-1Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4804.00	39.76	12.87	-5.54	47.09	PK	V	178	98	74.00	-26.91	Pass
7206.00	44.41	15.18	-1.40	58.19	PK	V	209	96	74.00	-15.81	Pass
14239.67	28.59	20.25	8.03	56.87	PK	H	257	340	74.00	-17.13	Pass
4804.00	31.75	12.87	-5.54	39.09	AV	V	178	98	54.00	-14.91	Pass
7206.00	39.03	15.18	-1.40	52.82	AV	V	209	96	54.00	-1.18	Pass
14239.67	13.54	20.25	8.03	41.82	AV	H	257	340	54.00	-12.18	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

Test Model: BLE -2440MHz-1Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4880.00	37.36	12.89	-5.55	44.71	PK	V	155	116	74.00	-29.30	Pass
7320.00	45.19	15.42	-1.18	59.43	PK	V	251	98	74.00	-14.57	Pass
14220.94	24.61	20.20	7.95	52.76	PK	H	214	5	74.00	-21.24	Pass
4880.00	28.70	12.89	-5.55	36.04	AV	V	155	116	54.00	-17.96	Pass
7320.00	38.24	15.42	-1.18	52.48	AV	V	251	98	54.00	-1.52	Pass
14220.94	11.65	20.20	7.95	39.80	AV	H	214	5	54.00	-14.20	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

Test Mode: BLE -2480MHz-1Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4960.00	35.17	12.91	-5.70	42.38	PK	V	174	70	74.00	-31.62	Pass
7440.00	43.28	15.67	-1.14	57.80	PK	V	232	104	74.00	-16.20	Pass
14407.38	28.26	20.66	8.18	57.10	PK	H	382	154	74.00	-16.90	Pass
4960.00	25.09	12.91	-5.70	32.29	AV	V	174	70	54.00	-21.71	Pass
7440.00	38.27	15.67	-1.14	52.79	AV	V	232	104	54.00	-1.21	Pass
14407.38	12.71	20.66	8.18	41.55	AV	H	382	154	54.00	-12.45	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

Test Mode: BLE -2402MHz-2Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4804.00	39.22	12.87	-5.54	46.55	PK	H	101	143	74.00	-27.45	Pass
7206.00	48.41	15.18	-1.40	62.19	PK	H	204	113	74.00	-11.82	Pass
14314.59	29.01	20.43	8.29	57.74	PK	V	326	41	74.00	-16.26	Pass
4804.00	30.71	12.87	-5.54	38.05	AV	H	101	143	54.00	-15.95	Pass
7206.00	39.72	15.18	-1.40	52.50	AV	H	204	113	54.00	-1.50	Pass
14314.59	16.69	20.43	8.29	45.41	AV	V	326	41	54.00	-8.59	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

Test Model: BLE -2440MHz-2Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4880.00	36.86	12.89	-5.55	44.20	PK	V	181	118	74.00	-29.80	Pass
7320.00	46.65	15.42	-1.18	60.89	PK	V	147	108	74.00	-13.11	Pass
14448.89	27.94	20.76	7.92	56.63	PK	H	306	360	74.00	-17.37	Pass
4880.00	27.39	12.89	-5.55	34.74	AV	V	181	118	54.00	-19.26	Pass
7320.00	37.93	15.42	-1.18	52.17	AV	V	147	108	54.00	-1.83	Pass
14448.89	16.27	20.76	7.92	44.96	AV	H	306	360	54.00	-9.04	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

Test Mode: BLE -2480MHz-2Mbps

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4960.00	35.65	12.91	-5.70	42.86	PK	V	169	110	74.00	-31.14	Pass
7440.00	44.33	15.67	-1.14	58.86	PK	V	253	93	74.00	-15.14	Pass
14450.08	26.43	20.76	7.92	55.11	PK	H	352	81	74.00	-18.89	Pass
4960.00	26.39	12.91	-5.70	33.60	AV	V	169	110	54.00	-20.41	Pass
7440.00	37.92	15.67	-1.14	52.45	AV	V	253	93	54.00	-1.55	Pass
14450.08	13.01	20.76	7.92	41.69	AV	H	352	81	54.00	-12.31	Pass

Note: Scan up to 25 GHz. EUT was tested in 3 orientations.

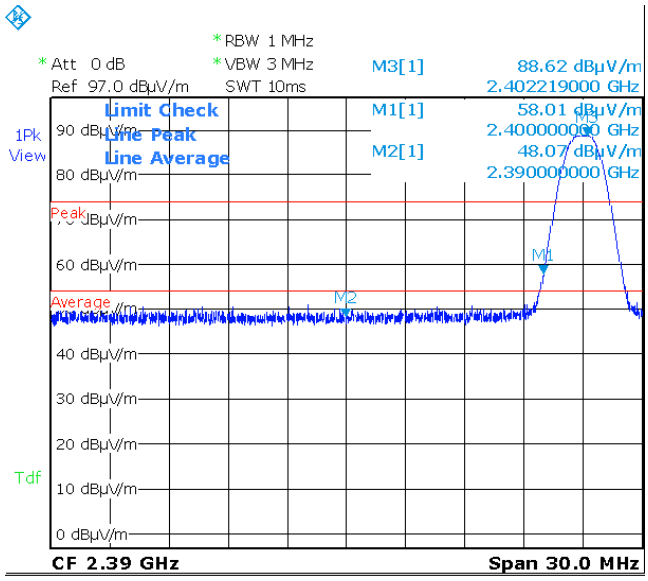
Test Mode: BLE -2402MHz-2Mbps & LTE transmit simultaneously

Freq. MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Meas. Type	Pol	Hgt cm	Deg	Limit dBuV/m	Margin dB	Pass /Fail
4804.00	38.73	12.87	-5.54	46.06	PK	H	141	98	74.00	-27.94	Pass
7206.00	47.23	15.18	-1.40	61.01	PK	H	192	13	74.00	-12.99	Pass
14382.11	29.01	21.18	8.54	58.73	PK	V	273	182	74.00	-15.27	Pass
4804.00	30.79	12.87	-5.54	38.12	AV	H	112	109	54.00	-15.88	Pass
7206.00	36.99	15.18	-1.40	50.77	AV	H	187	221	54.00	-3.23	Pass
14382.11	17.29	21.18	8.54	47.01	AV	V	308	188	54.00	-6.99	Pass

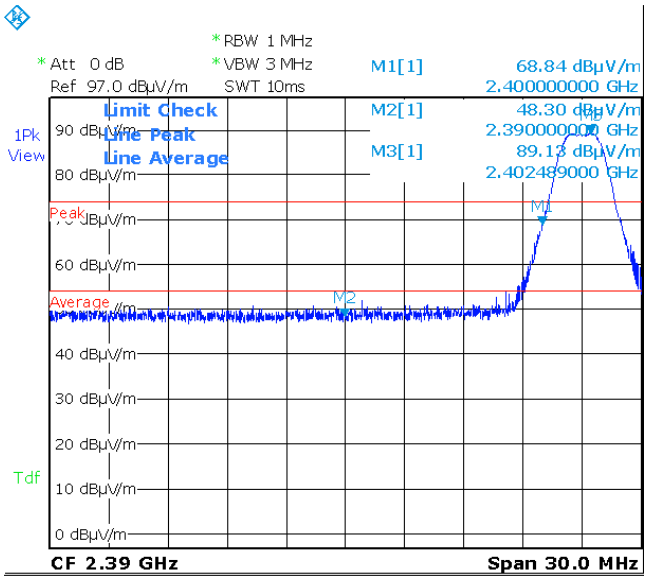
Note:

1) Scan up to 25 GHz. EUT was tested in 3 orientations.
2) Only the worst case BLE and LTE mode were chosen for the simultaneous transmission testing.

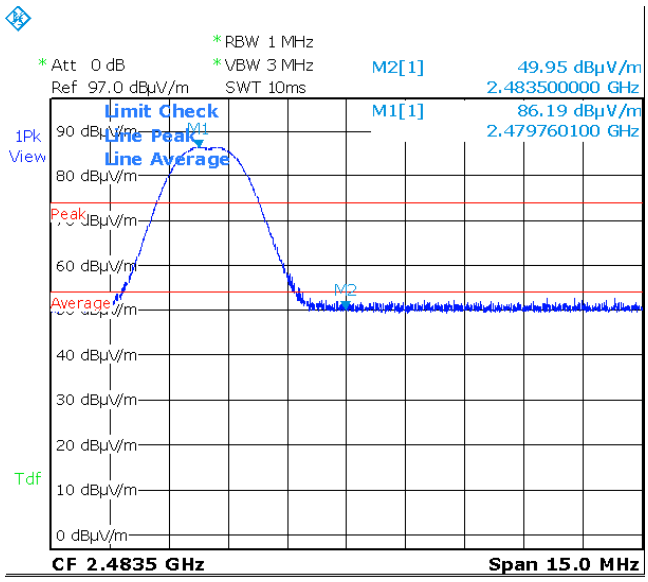
Radiated Band Edge measurement result



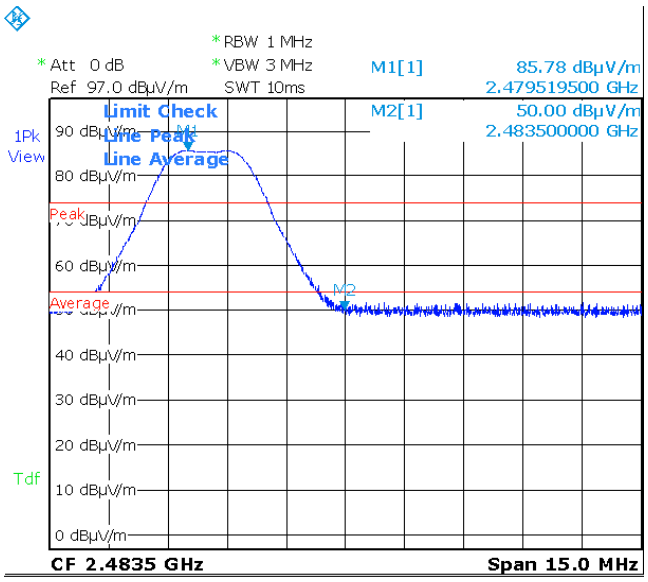
BLE-2402MHz-1Mbps-Band Edge



BLE-2402MHz-2Mbps-Band Edge



BLE-2480MHz-2Mbps-Band Edge



BLE-2480MHz-2Mbps-Band Edge

Note:

1) Both Horizontal and vertical polarities were investigated.

9 Test instrument list

Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	5/11/2018	5/11/2019
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	5/4/2018	5/4/2019
EMC Test Receiver	R&S	ESL6	100230	5/7/2018	5/7/2019
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/2018	5/4/2019
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2018	11/15/2019
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/2/2018	5/2/2019
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	5/2/2018	5/2/2019
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	5/10/2018	5/10/2019
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/10/2018	5/10/2019
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/9/2018	5/9/2019
RF Attenuator	Pasternack	PE7005-3	VL061	5/10/2018	5/10/2019
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	5/10/2018	5/10/2019
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/9/2018	5/9/2019
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	5/10/2018	5/10/2019
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	5/10/2018	5/10/2019
RE test cable (>18GHz)	Sucoflex	104	344903/4	5/10/2018	5/10/2019
Pulse limiter	Com-Power	LIT-930A	531727	5/15/2018	5/15/2019
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	5/10/2018	5/10/2019
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	5/9/2018	5/9/2019