RF Test Report

Bluetooth (Low Energy)

Report No.	:	FCCBVCO-WAY-P21090029-1R1
Customer	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Use of Report	:	Certification
Model Name	:	SM-R865U (Alt. SM-R865F)
FCC ID (Model)	:	A3LSMR865 (SM-R865U, SM-R865F)
IC No. (Model)	:	649E-SMR8651 (SM-R865F)
Date of Test	:	2021.10.07 to 2021.10.15
Test Method Used	:	FCC 47 CFR PART 15 Subpart C (Section §15.247) / ISED RSS-247
Testing Environment	:	Refer to the Test Condition
ISED# / CAB Identifier	:	26316 / KR0158

Test Result : ☒ **Pass** ☐ **Fail**

ISSUED BY: BV CPS ADT Korea Ltd., EMC/RF Laboratory

ADDRESS: Innoplex No.2 106, Sinwon-ro 306, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea 16675

TEST LOCATION: HeungAn-daero 49, DongAn-gu, Anyang-si, Gyeonggi-do, Korea, 14119

Tested by

Name : Donghwa Shin

(Signature)

Technical Manager

Name : Jongha Choi

(Signature)

2021. 10. 27

BV CPS ADT Korea Ltd.

RELEASE CONTROL RECORD

REPORT NO.	REASON FOR CHANGE	DATE ISSUED
FCCBVCO-WAY-P21090029-1	Original release	2021.10.18
FCCBVCO-WAY-P21090029-1R1	Update	2021.10.27

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1 Summary of Test Results

The EUT has been tested according to the following specifications

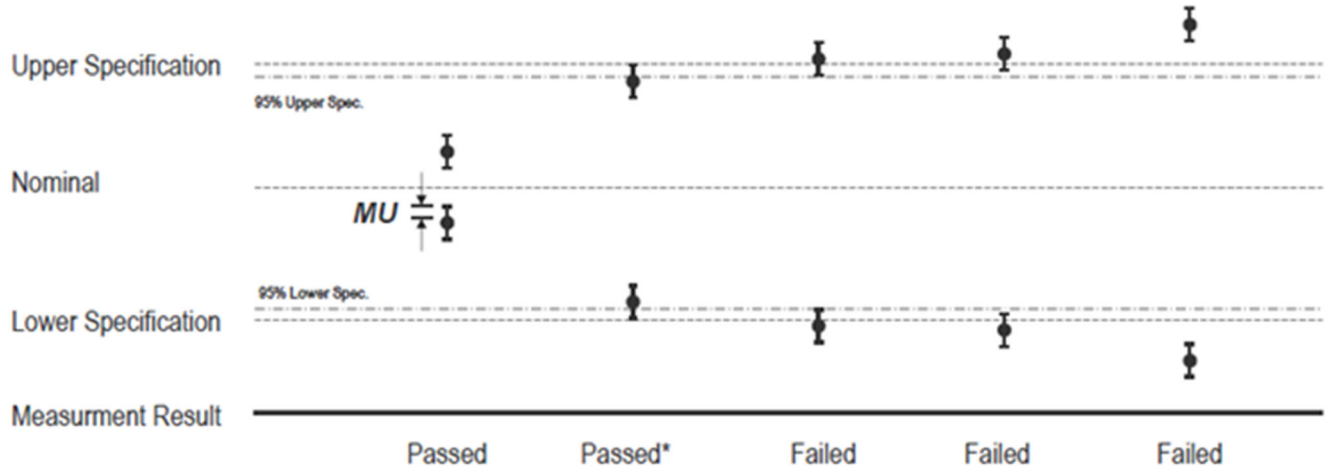
Applied Standard : FCC Part 15, Subpart C 15.247, RSS-247					
FCC Part Section(s)	**RSS Section(s)**	**Test Description**	**Limit**	**Test Result**	**Reference**
15.247(a)(2)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz	PASS	Section 3.2
-	-	Occupied Bandwidth (99 % Bandwidth)	N/A	PASS	Section 2.5
15.247(b)(3)	RSS-247 [5.4(4)]	Maximum Conducted Output Power	< 1 Watt	PASS	Section 3.3
15.247(e)	RSS-247 [5.2]	Power Spectral Density	< 8 dBm / 3 kHz Band	PASS	Section 3.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions (Conducted Spurious Emission)	≥ 20 dBc	PASS	Section 3.5
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in Restricted bands must meet the radiated limits detailed in 15.209 (RSS-247 limits)	PASS	Section 3.5
15.207	RSS-Gen [8.8]	AC Conducted Emissions (150 kHz – 30 MHz)	< FCC 15.207 limits (RSS-Gen [8.8] limits)	PASS	Section 3.6

NOTES

1) The general test methods used to test on this devices are ANSI C63.10.

2) Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

1.1 Decision Rules for Statement of Conformity



QUA-52 Decision Rule(QA Document) was applied.

Step 1) : Reference Check, Daily Check, Peripheral device Check

Step 2) : Re-test Procedure (Repeat the test maximum 3 times, Different Test Engineer)

1) If the original test results are subject to retesting and the judgement is unclear, the retest is carried out.
2) If the result of the first retest is the same as the initial test, the judgement is made based on the value.
3) If the result of the first retest differ from the results of the initial test, the second re-test is carried out.
4) After completion of the second retest, the average of the three test results is determined as the final result. However, if the deviation of the three test values is more than 5 % of the reference value, the technical manager should review the reproducibility of the test from the beginning.

1.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement Items	Frequency Range	Expanded Uncertainty U = *k*Uc (*k* = 2)
Conducted Emissions at main ports	150 kHz – 30 MHz	2.99
Radiated Spurious Emissions	9 kHz – 30 MHz	1.92
	30 MHz – 1 GHz	4.00
	1 GHz – 18 GHz	5.68
	18 GHz – 26.5 GHz	5.24

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k = 2.

2 General Information

2.1 General Description of EUT

Product	Smart wearable
Brand	Samsung
Model	SM-R865U (Alt. SM-R865F) for FCC ID : A3LSMR865
Identification No. of EUT	-
Series Model	SM-R865F for IC No. : 649E-SMR8651
HVIN	SM-R865F1
Model Difference	-
Power Supply	DC 3.88 V
Modulation Type	GFSK
Transfer Rate	1 Mbps, 2 Mbps
Operating Frequency	2 402 to 2 480 MHz
Number of Channel	40 Channels
Output Power	8.10 dBm (6.46 mW)
Antenna Type	LDS Antenna
Antenna Connector	Internal
H/W Version	REV1.0
S/W Version	R865U.001(SM-R865U), R865F.001(SM-R865F)

NOTES

1) The above equipment has been tested by **Bureau Veritas Consumer Products Services ADT Korea**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

2) The following antennas were provided to the EUT.

Antenna	Type	Connector	Peak Gain (dBi)				
			2.4 GHz	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
Bluetooth/ Wi-Fi	LDS Antenna	Internal	-8.9	-5.4	-6.5	-8.9	-8.4

3) Spurious emission of the simultaneous operation and the test data please refer to report no. FCCBVCO-WAY-P21090029-3 (U-NII Test Report).

4) **List of Accessories**

Accessories	Brand	Model	Manufacturer	Specification
Wireless Charger	Samsung	EP-OR825	Samsung	FCC ID : A3LEPOR825/ IC : 649E-EPOR825

2.2 Description of Test Mode

[Test Channel of EUT]

- Bluetooth Low Energy

Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
0	2 402	10	2 422	20	2 442	30	2 462
1	2 404	11	2 424	21	2 444	31	2 464
2	2 406	12	2 426	22	2 446	32	2 466
3	2 408	13	2 428	23	2 448	33	2 468
4	2 410	14	2 430	24	2 450	34	2 470
5	2 412	15	2 432	25	2 452	35	2 472
6	2 414	16	2 434	26	2 454	36	2 474
7	2 416	17	2 436	27	2 456	37	2 476
8	2 418	18	2 438	28	2 458	38	2 478
9	2 420	19	2 440	29	2 460	39	2 480

2.2.1 Test Mode Applicability and Tested Channel Details

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. All Radiated emission tests have been performed two mode(with charger and without charger). The worst case was found when positioned on Y axis and without charger mode for radiated emission. Following channel(s) was(were) selected for the final test as listed below :

EUT Configure mode	Applicable to				Description
	RE < 1G	RE ≥ 1G	PLC	APCM	
Without Charger	√	√	-	√	-
With Charger	-	-	√	-	-

Where RE ≥ 1 G : Radiated Emission above 1 GHz & Bandedge Measurement
RE < 1 G : Radiated Emission below 1 GHz
PLC : Power Line Conducted Emission
APCM : Antenna Port Conducted Measurement

Radiated Emission Test (Below 1 GHz)

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and data rate.

☒ Following channel(s) was (were) selected for the final test as listed below.

Available Channel	Tested Channel	Modulation Type	Data Rate
0 to 39	0	GFSK	2 Mbps

NOTES

According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒.

Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Radiated Emission Test (Above 1 GHz)

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and data rate.

☒ Following channel(s) was (were) selected for the final test as listed below.

Available Channel	Tested Channel	Modulation Type	Data Rate
0 to 39	0, 19, 39	GFSK	125 kbps
0 to 39	0, 19, 39	GFSK	500 kbps
0 to 39	0, 19, 39	GFSK	1 Mbps
0 to 39	0, 19, 39	GFSK	2 Mbps

Radiated Emission Test (Above 18 GHz)

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and data rate.

☒ Following channel(s) was (were) selected for the final test as listed below.

Available Channel	Tested Channel	Modulation Type	Data Rate
0 to 39	0	GFSK	2 Mbps

Power line Conducted Emission Test

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and data rate.

☒ Following channel(s) was (were) selected for the final test as listed below.

Available Channel	Tested Channel	Modulation Type	Data Rate
0 to 39	0	GFSK	2 Mbps

Antenna Port Conducted Measurement

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and data rate.

☒ Following channel(s) was (were) selected for the final test as listed below.

Available Channel	Tested Channel	Modulation Type	Data Rate
0 to 39	0, 19, 39	GFSK	125 kbps
0 to 39	0, 19, 39	GFSK	500 kbps
0 to 39	0, 19, 39	GFSK	1 Mbps
0 to 39	0, 19, 39	GFSK	2 Mbps

Test Condition

Applicable to	Environmental Conditions	Test Voltage	Tested by
RE < 1G	22 °C, 48 % RH	DC 3.88 V	Donghwa Shin
RE ≥ 1G	22 °C, 50 % RH	DC 3.88 V	Donghwa Shin
PLC	23 °C, 47 % RH	DC 3.88 V	Donghwa Shin
APCM	22 °C, 46 % RH	DC 3.88 V	Donghwa Shin

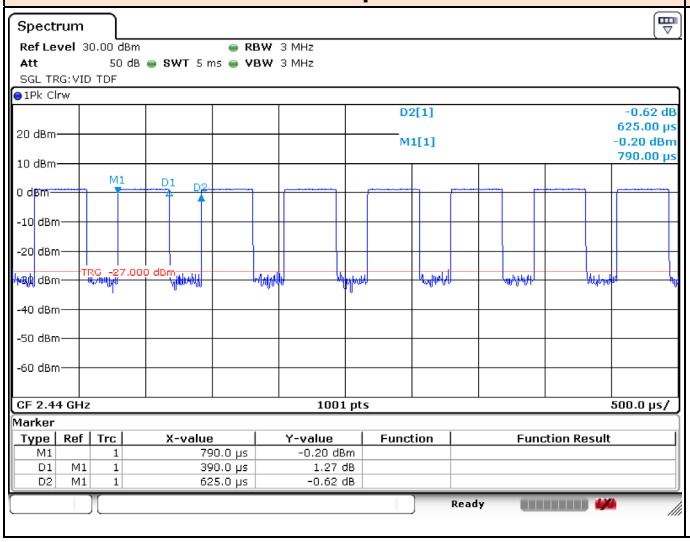
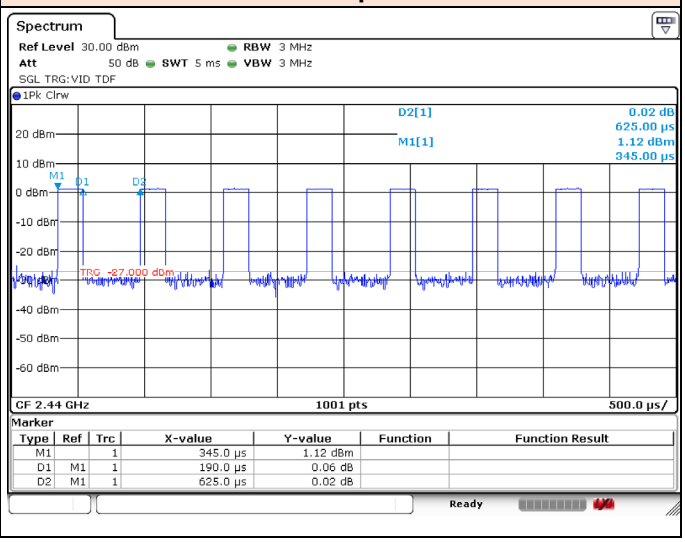
2.3 Maximum Output Power

Frequency Range [MHz]	Test Items	Test Mode	Result [dBm]	Result [mW]
2 402 ~ 2 480	Peak Power	1 Mbps	7.63	5.79
		2 Mbps	8.10	6.46
	Average Power	1 Mbps	7.41	5.51
		2 Mbps	7.82	6.06

2.4 Duty Cycle of Test Signal

Test Items	Mode	On Time B [msec]	Period [msec]	Duty Cycle X [Linear]	Duty Cycle [%]	DCF [dB]
Duty Cycle	1 Mbps	0.390	0.625	0.624	62.4	2.05
	2 Mbps	0.190	0.625	0.304	30.4	5.17

[Test Plot of Duty Cycle]

1 Mbps	2 Mbps
	

2.5 99 % Bandwidth

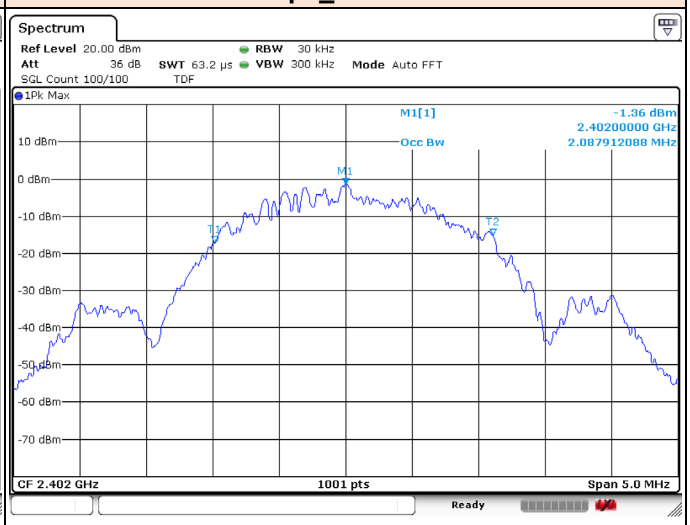
[Test Data of 99 % Bandwidth]

Test Mode	Channel	Frequency [MHz]	99 BW [MHz]
1 Mbps	Lowest	2 402	1.049
	Middle	2 440	1.046
	Highest	2 480	1.049
Worst Result			1.049
2 Mbps	Lowest	2 402	2.088
	Middle	2 440	2.083
	Highest	2 480	2.078
Worst Result			2.088

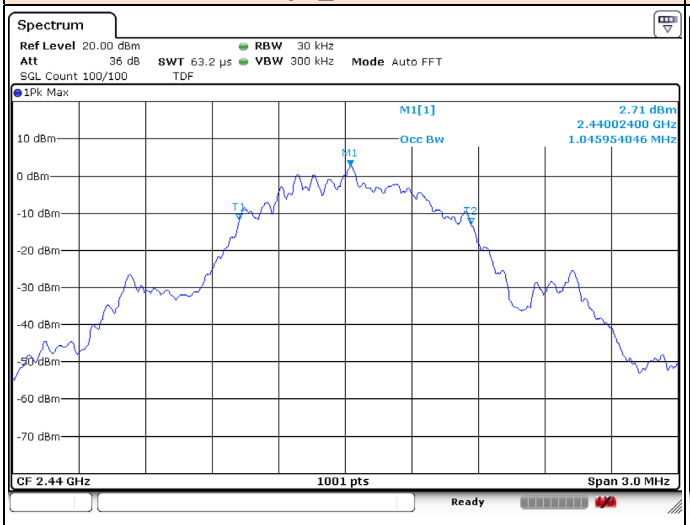
Test Plot of 99 % Bandwidth

1 Mbps_2 402 MHz

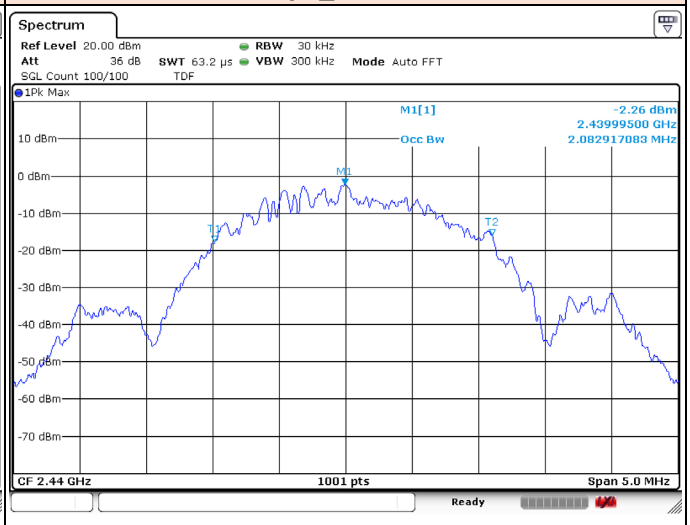
2 Mbps_2 402 MHz



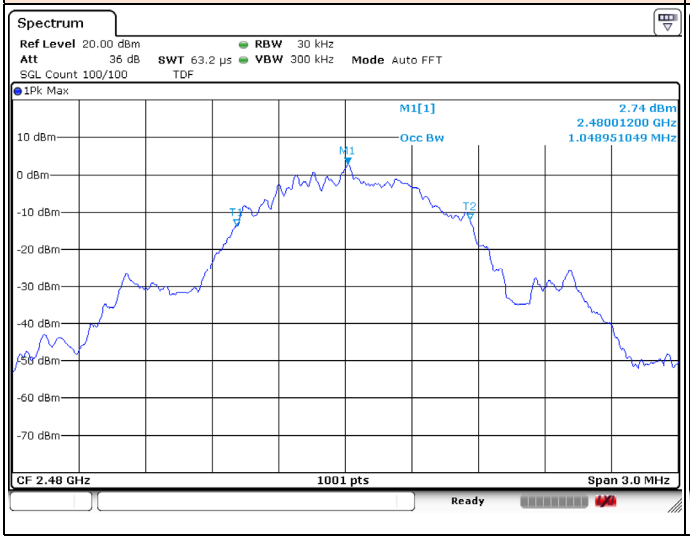
1 Mbps_2 440 MHz



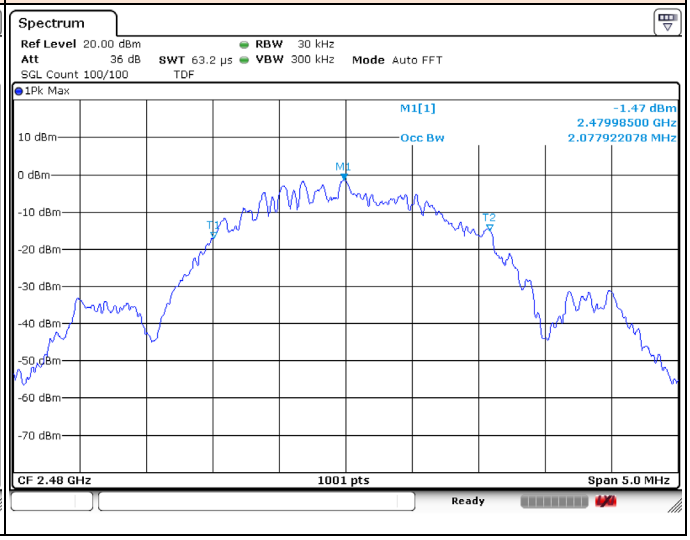
2 Mbps_2 440 MHz



1 Mbps_2 480 MHz



2 Mbps_2 480 MHz



2.6 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards.

FCC CFR 47 Part 15, Subpart C (§15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013
RSS-247 Issue 2
RSS-Gen Issue 5

All test items in this test report have been performed and recorded as per the above standards.

2.7 Test Equipment

Test Equipment is traceable to the National Institute of Standards and Technology (NIST). Measurement antenna used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Serial Number	Cal Date	Cal Due
R&S	HFH2-Z2E	Active Loop Antenna, 30 MHz	349806	2021.02.18	2023.02.18
Schwarzbeck	VULB 9163	Trilog Antenna, 3 GHz (with 6 dB ATT.)	01199	2021.02.22	2023.02.22
Schwarzbeck	VUBA 9117	30 MHz ~ 1 GHz	403	2020.01.09	2022.01.09
R&S	HF907	Horn Antenna, 18 GHz	102772	2020.12.09	2021.12.09
R&S	SCU08F2	Signal Conditioning Unit, 8 GHz	08400016	2020.12.09	2021.12.09
R&S	SCU-18F	Signal Conditioning Unit, 18 GHz	180111	2020.12.09	2021.12.09
Schwarzbeck	BBHA9170	15 - 40 GHz, 10 W (cont.) 25 W (peak)	00955	2020.12.09	2021.12.09
L3 Narda-MITEQ	JS44-18004000-33-8P	Amplifier, 40 GHz	2142086	2021.01.05	2022.01.05
R&S	FSW50	DC Coupled : 2 Hz to 50 GHz AC Coupled : 10 MHz to 50 GHz	101403	2020.12.09	2021.12.09
R&S	ESW44	EMI Test Receiver, 44 GHz	101812	2020.12.09	2021.12.09
R&S	FSV30	Spectrum Analyzer, 30 GHz	103017	2020.12.07	2021.12.07
Aeroflex	40AH2W-3	Attenuator, 3 dB	1	2020.12.24	2021.12.24
Mini-Circuits	VAT-10W2+	Attenuator, 10 dB	1531	2020.12.08	2021.12.08
Pasternack	PE7087-10	10 dB Atten / 2 W / DC to 26 GHz	1712-2	2021.06.04	2022.06.04
Aeroflex	40AH2W-10	Attenuator, 10 dB	1	2021.06.04	2022.06.01
Micro-Tronics	HPM17543	High Pass Filter 3 GHz	028	2021.06.04	2022.06.04
R&S	NRP6A	Average Power Sensor	102045	2020.12.07	2021.12.07
R&S	NRP6A	Average Power Sensor	102044	2020.12.07	2021.12.07
R&S	NRX	Power Meter, 110 GHz	100947	2020.12.07	2021.12.07
Keysight Technologies	MP400B	MIMO Power Set Master, 18 GHz	None	2020.12.31	2021.12.31
R&S	ENV216	LISN	102437	2020.12.08	2021.12.08
R&S	ESR	EMI Test Receiver, 3.6 GHz	102529	2020.12.08	2021.12.08

3 Test Results

3.1 Antenna Requirement

Except from §15.203 of the FCC Rules/Regulations:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 the section.

- The antenna(s) of the EUT are Permanently attached.
- There are no provisions for connection to an external antenna.

Result

The EUT complies with the requirement of §15.203

3.2 6 dB Bandwidth

3.2.1 Regulation

§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.

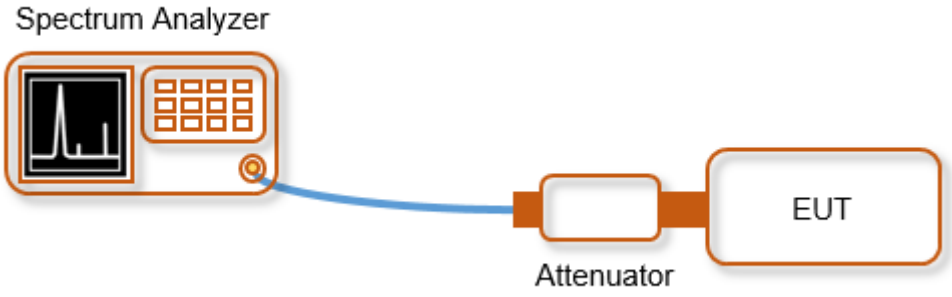
3.2.2 Test Procedure

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 in 11.8.1 (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, and 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.

3.2.3 Deviation from Test Standard

No deviation.

3.2.4 Test Setup



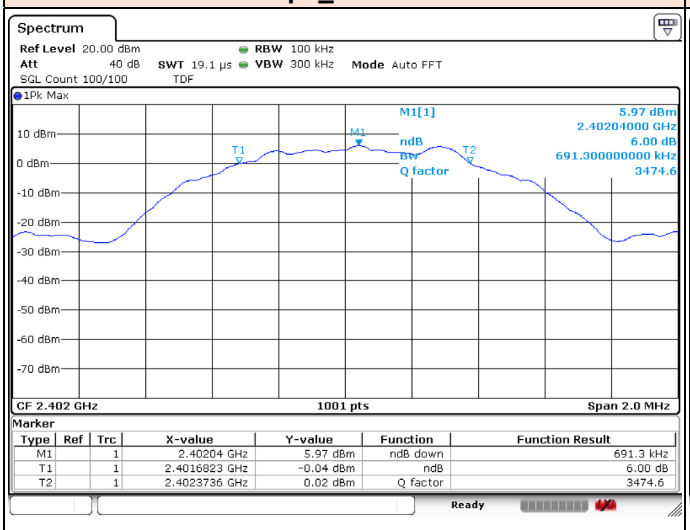
3.2.5 Test Result

[Test Data of 6 dB Bandwidth]

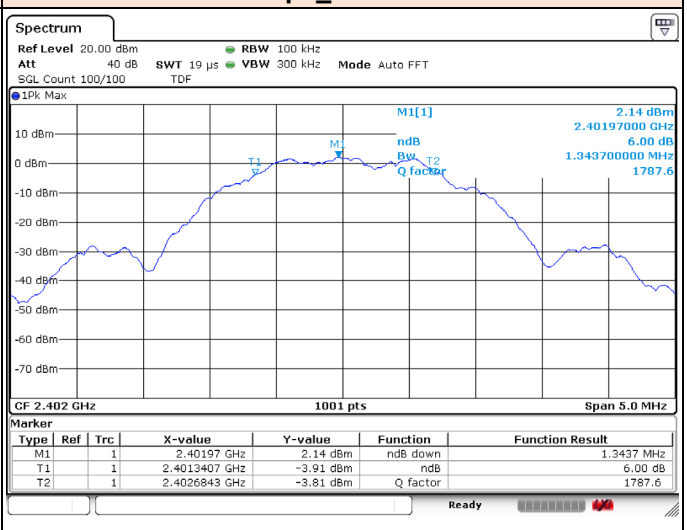
Test Mode	Channel	Frequency [MHz]	6 dB BW [MHz]	Minimum Limit [MHz]
1 Mbps	Lowest	2 402	0.691	0.500
	Middle	2 440	0.675	0.500
	Highest	2 480	0.679	0.500
Worst Result			0.675	0.500
2 Mbps	Lowest	2 402	1.344	0.500
	Middle	2 440	1.364	0.500
	Highest	2 480	1.384	0.500
Worst Result			1.344	0.500

[Test Plot of 6 dB Bandwidth]

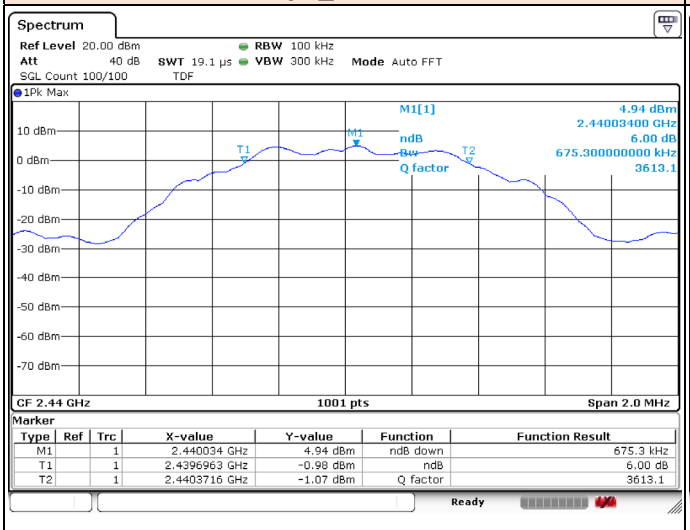
1 Mbps_2 402 MHz



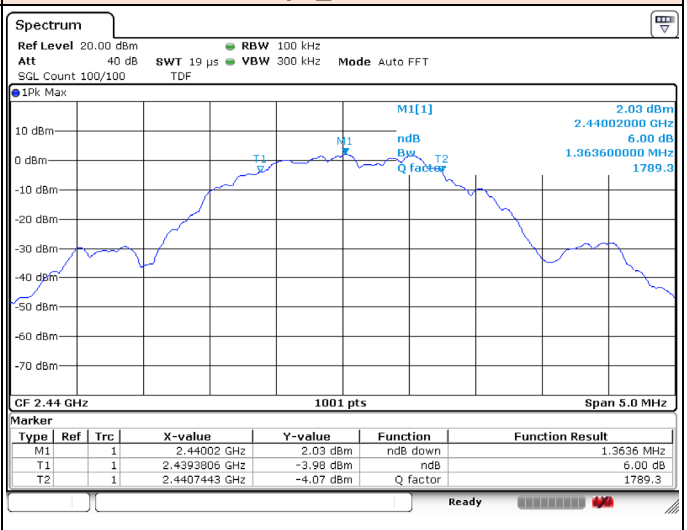
2 Mbps_2 402 MHz



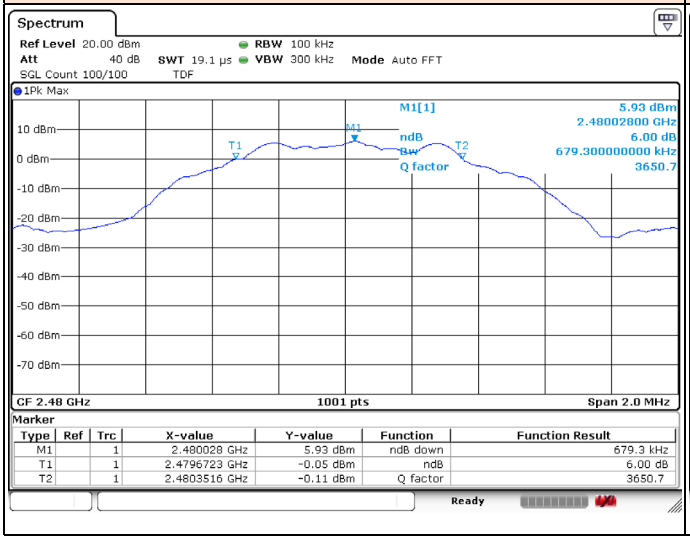
1 Mbps_2 440 MHz



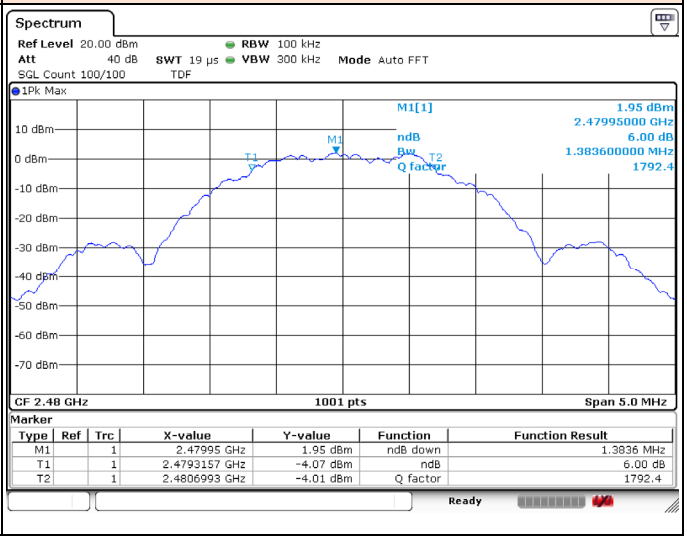
2 Mbps_2 440 MHz



1 Mbps_2 480 MHz



2 Mbps_2 480 MHz



3.3 Maximum Peak Output Power

3.3.1 Regulation

§15.247(b)(3) : For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

§15.247(b)(4) : 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.

3.3.2 Test Procedure

General

Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).

When using a spectrum analyzer or EMI receiver to perform these measurements, it shall be capable of utilizing a number of measurement points in each sweep that is greater than or equal to twice the span/RBW to set a bin-to-bin spacing of ≤ RBW/2 so that narrowband signals are not lost between frequency bins.

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle; however a small reduction in duty cycle (to no lower than 98 %) is permitted, if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

If continuous transmission (or at least 98 % duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible during which sweep triggering/signal gating techniques may be used to perform the measurement over the transmission duration.

3.3.2.1 Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.

b) Set VBW ≥ [3 × RBW].

c) Set span ≥ [3 × RBW].

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

PKPM1 Peak power meter method

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

Measurement using a power meter (PM)

Method AVGPM is a measurement using an RF average power meter, as follows:

a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements maybe performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
   1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
   2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
   3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6.

c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.

d) Adjust the measurement in dBm by adding [10 log(1/D)], where D is the duty cycle

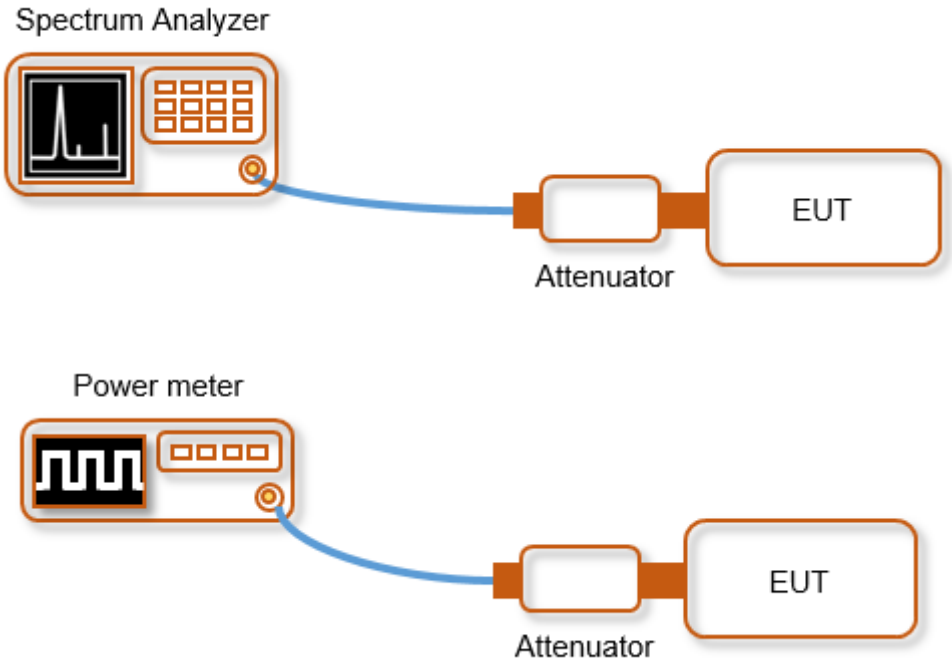
Notes:

A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

3.3.3 Deviation from Test Standard

No deviation.

3.3.4 Test Setup



3.3.5 Test Result

[Test Data of Peak Power]

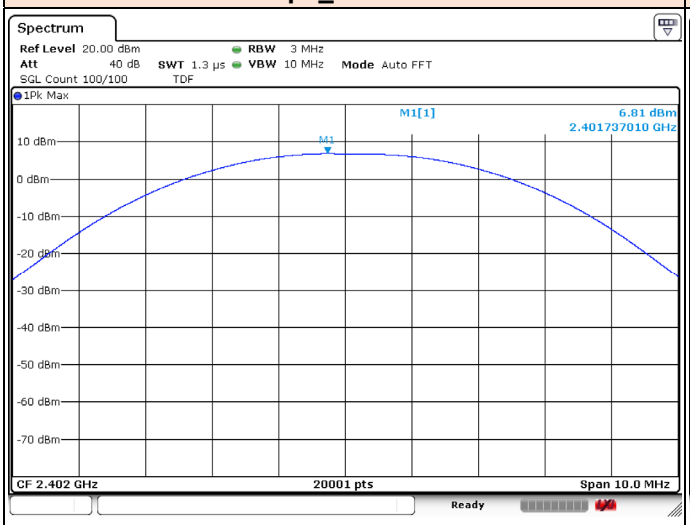
Test Mode	Channel	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin [dB]
1 Mbps	Lowest	2 402	7.63	30.00	22.37
	Middle	2 440	6.29	30.00	23.71
	Highest	2 480	6.76	30.00	23.24
Worst Result			7.63	30.00	22.37
2 Mbps	Lowest	2 402	8.10	30.00	21.90
	Middle	2 440	6.32	30.00	23.68
	Highest	2 480	7.07	30.00	22.93
Worst Result			8.10	30.00	21.90

[Test Plot of Average Power]

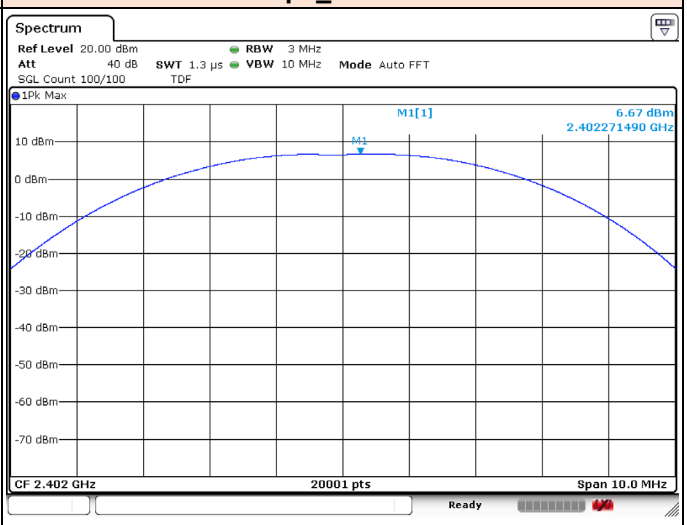
Test Mode	Channel	Frequency [MHz]	Aveage Power [dBm]	Aveage Power [mW]
1 Mbps	Lowest	2 402	7.41	5.51
	Middle	2 440	6.06	4.03
	Highest	2 480	6.54	4.51
2 Mbps	Lowest	2 402	7.82	6.06
	Middle	2 440	6.07	4.05
	Highest	2 480	6.78	4.77

[Test Plot of Peak Power]

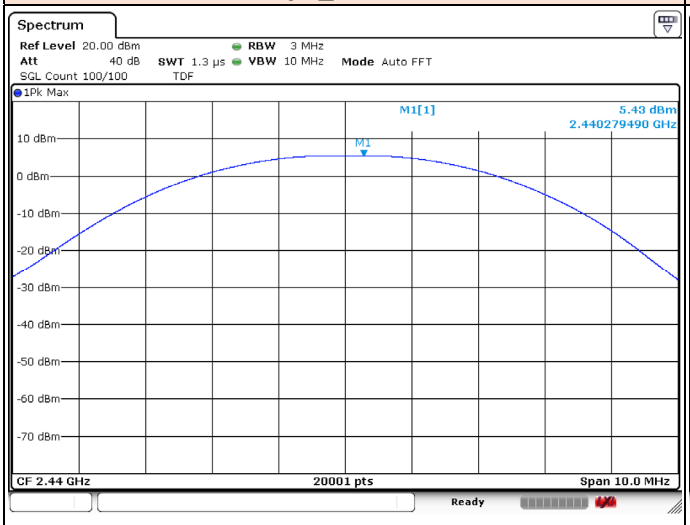
1 Mbps_2 402 MHz



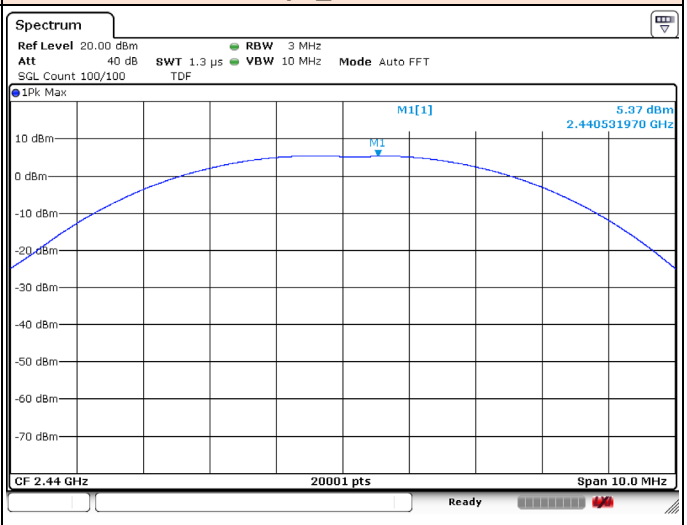
2 Mbps_2 402 MHz



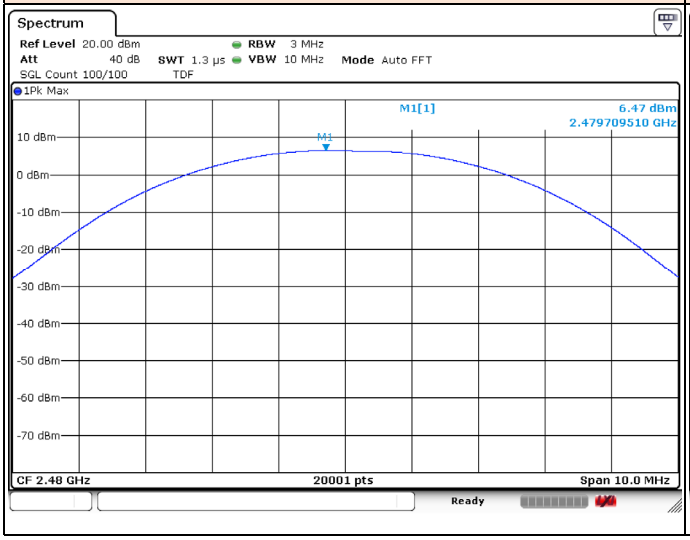
1 Mbps_2 440 MHz



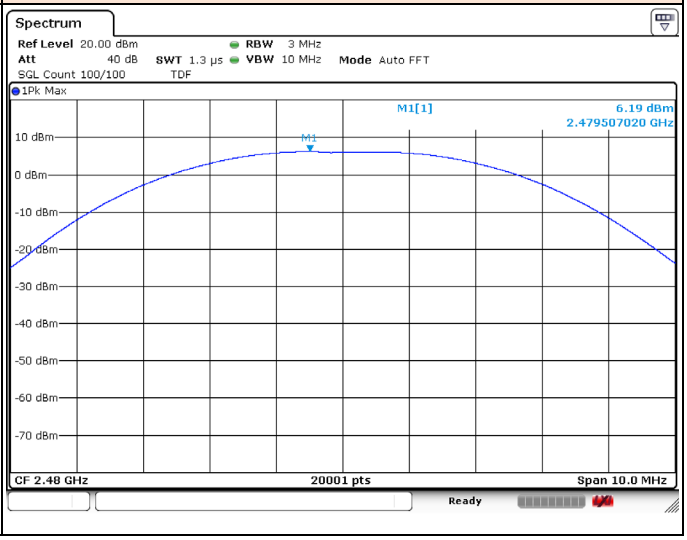
2 Mbps_2 440 MHz



1 Mbps_2 480 MHz



2 Mbps_2 480 MHz



3.4 Power Spectral Density

3.4.1 Regulation

§15.247(e) : 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 shall be used to determine the power spectral density.

3.4.2 Test Procedure

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

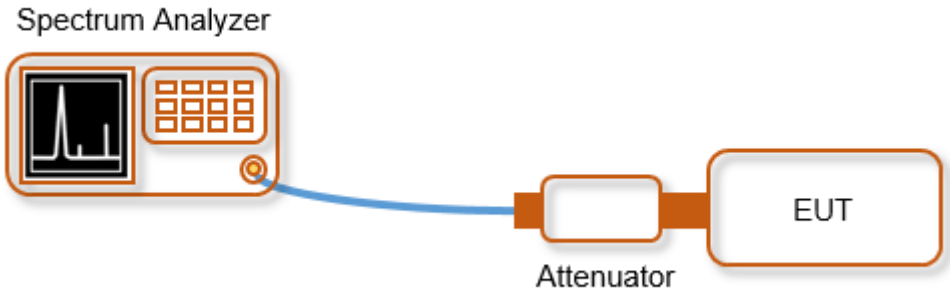
i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

3.4.3 Deviation from Test Standard

No deviation.

3.4.4 Test Setup



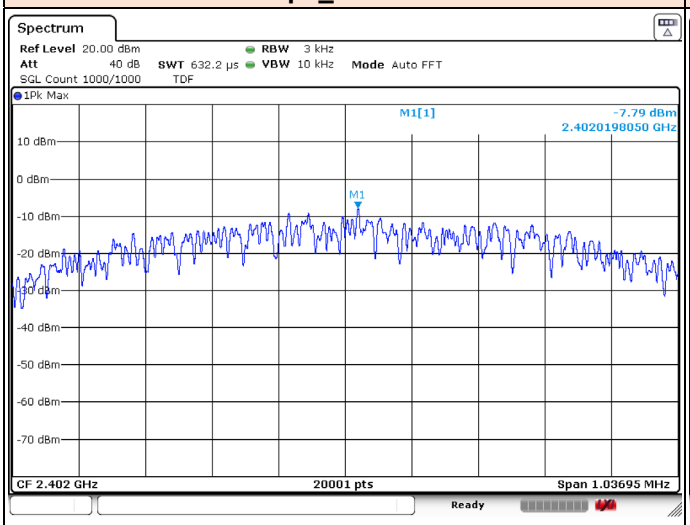
3.4.5 Test Result

[Test Data of Power Spectral Density]

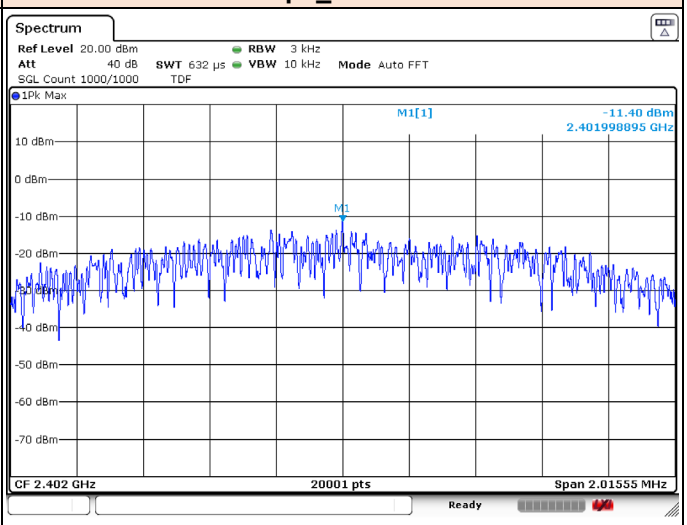
Test Mode	Channel	Frequency [MHz]	PSD [dBm/3 kHz]	Limit [dBm/3 kHz]	Margin [dB]
1 Mbps	Lowest	2 402	-7.79	8.00	15.79
	Middle	2 440	-9.08	8.00	17.08
	Highest	2 480	-8.46	8.00	16.46
2 Mbps	Lowest	2 402	-11.40	8.00	19.40
	Middle	2 440	-12.68	8.00	20.68
	Highest	2 480	-11.97	8.00	19.97

[Test Plot of Power Spectral Density]

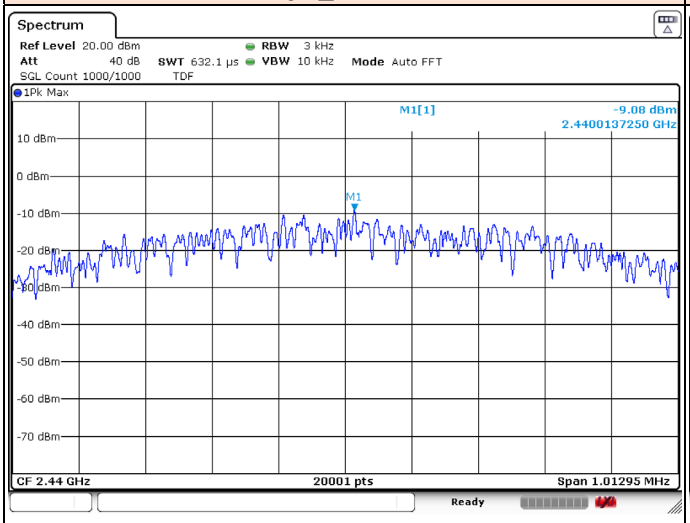
1 Mbps_2 402 MHz



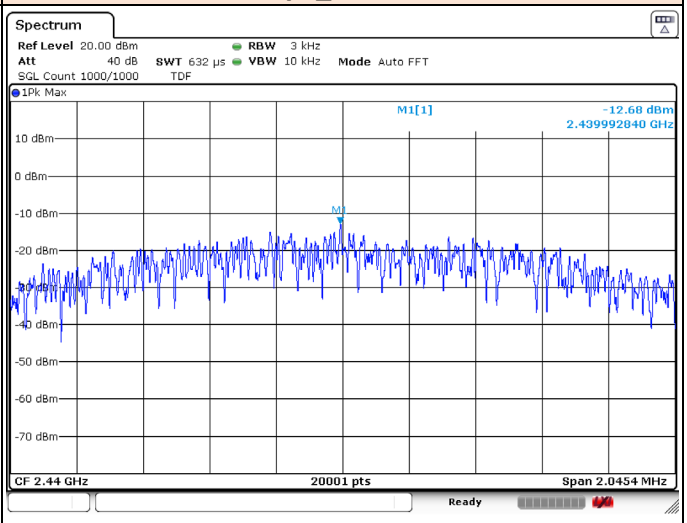
2 Mbps_2 402 MHz



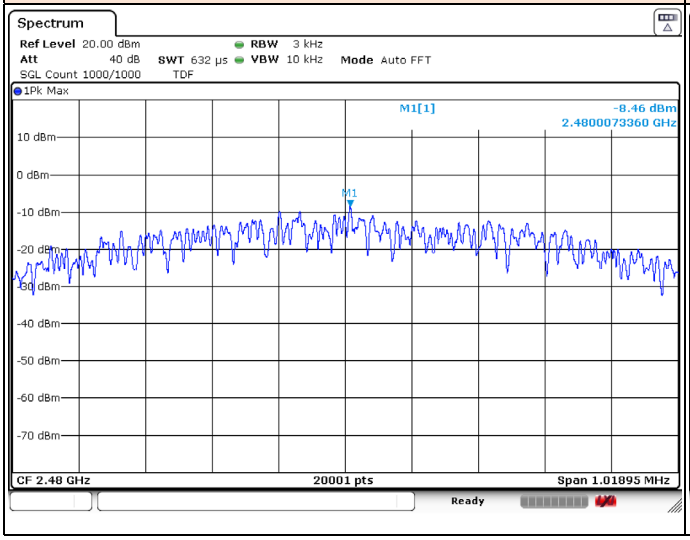
1 Mbps_2 440 MHz



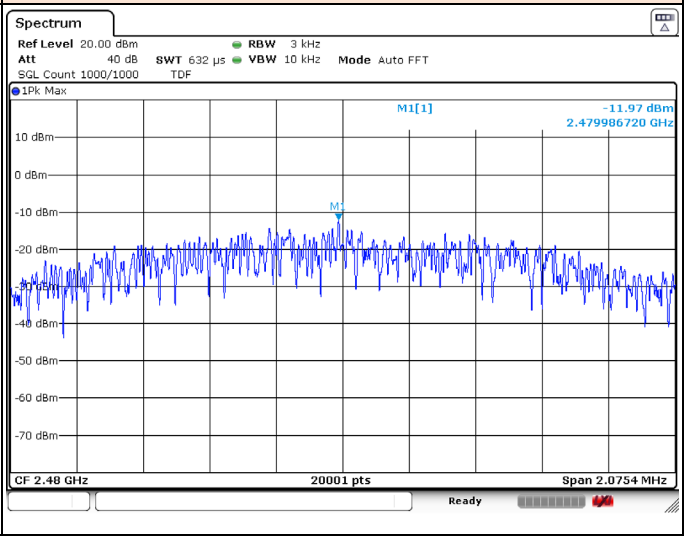
2 Mbps_2 440 MHz



1 Mbps_2 480 MHz



2 Mbps_2 480 MHz



3.5 Spurious Emission, Band edge and Restricted Bands

3.5.1 Regulation

§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)).

§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 (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

§15.205(a) : Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2]Above 38.6

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

3.5.2 Test Procedure

Band-edge Compliance for RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Band-edge tests are typically performed as a conducted test but may be performed as radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2.

When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normalmode of operation” as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

   1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

   2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

   3) Attenuation: Auto (at least 10 dB preferred).

   4) Sweep time: Coupled.

   5) Resolution bandwidth: 100 kHz.

   6) Video bandwidth: 300 kHz.

   7) Detector: Peak.

   8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can takeseveral minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Spurious RF Conducted Emissions

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results,account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Spurious Radiated Emissions

1. The preliminary radiated measurement were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.

2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360^{o}.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the Bi-Log antenna, and from 1000 MHz to 26500 MHz using the horn antenna.

4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 x 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.

5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector fuction with specified bandwidth.

6. The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1GHz testing.

- Procedure for unwanted emissions measurements below 1 000 MHz

The procedure for unwanted emissions measurements below 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- Procedure for peak unwanted emissions measurements above 1 000 MHz

The procedure for peak unwanted emissions measurements above 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Peak emission levels are measured by setting the instrument as follows:

1) RBW = 1 MHz.

2) VBW ≥ [3 × RBW].

3) Detector = peak.

4) Sweep time = auto.

5) Trace mode = max hold.

6) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not ontinuous, then the time required for the trace to stabilize will increase by a factor of pproximately 1 / D, where D is the duty cycle. For example, at 50 % duty cycle, the easurement time will increase by a factor of two, relative to measurement time for ontinuous transmission.

- Procedure for average unwanted emissions measurements above 1 000 MHz

Trace averaging with continuous EUT transmission at full power

If the EUT can be configured or modified to transmit continuously (D ≥ 98%), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

a) RBW = 1 ㎒ (unless otherwise specified).

b) VBW ≥ (3×RBW).

c) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

d) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or ㏈ averaging shall not be used.

e) Sweep time = auto.

f) Perform a trace average of at least 100 traces.

Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle D of the transmitter output signal as described in 2.4

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ [3 × RBW].

e) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in step f), then the applicable correction factor is [10 log (1 / D)], where D is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.

3) If a specific emission is demonstrated to be continuous (D ≥ 98%) rather than turning ON and OFF with with the transmit cycle, then no duty cycle correction is required for that emission.

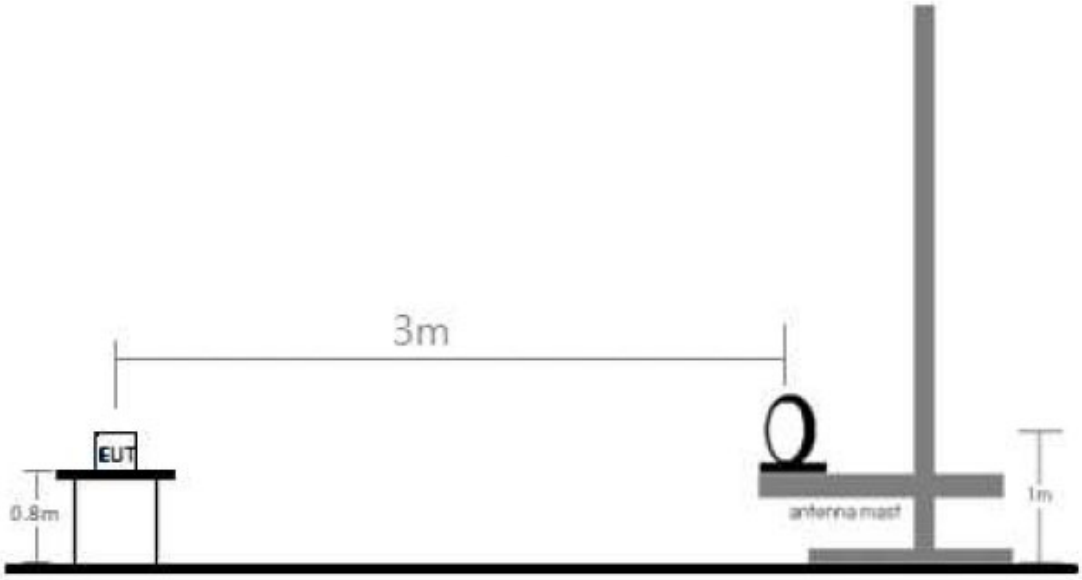
- Sample Calculation

- Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable loss [dB]
- Margin [dB] = Field Strength Level [dBµV/m] – Limit [dBµV/m]

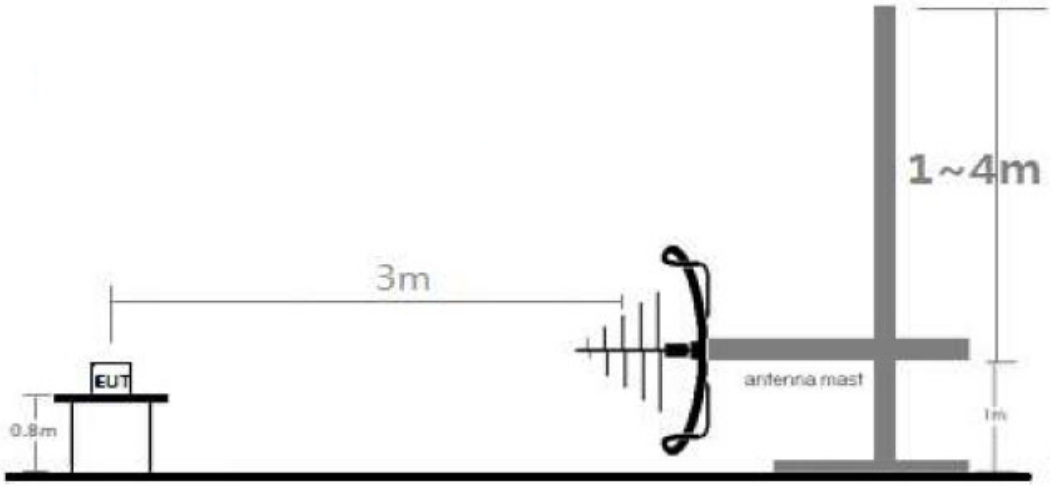
3.5.3 Deviation from Test Standard

No deviation.

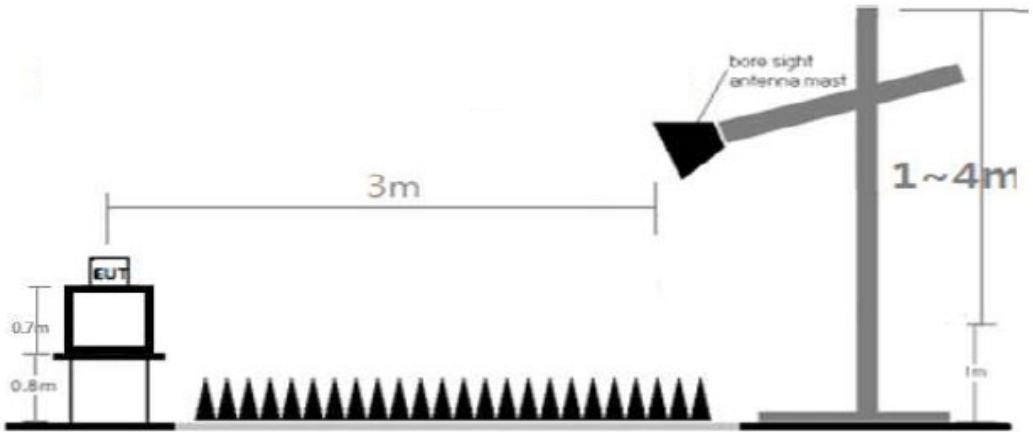
3.5.4 Test Setup

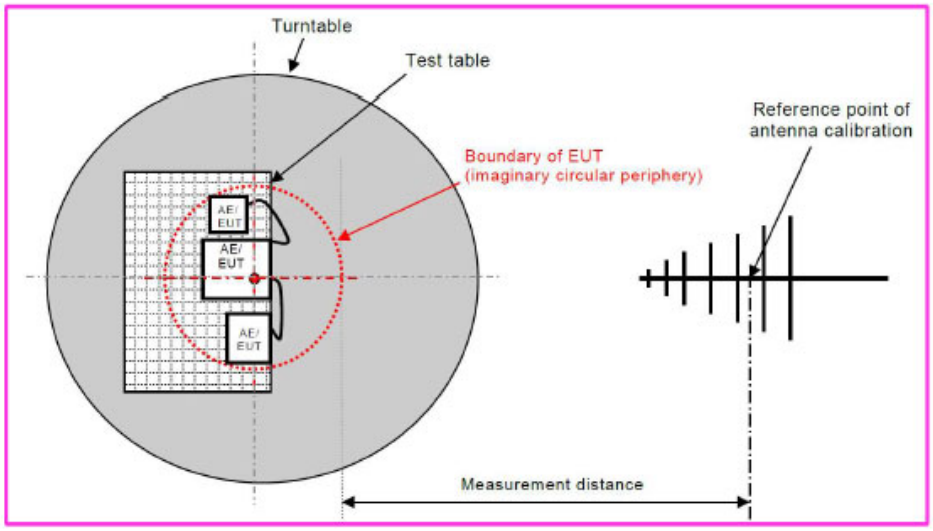


[Radiated Emission Test Setup Below 30 MHz]

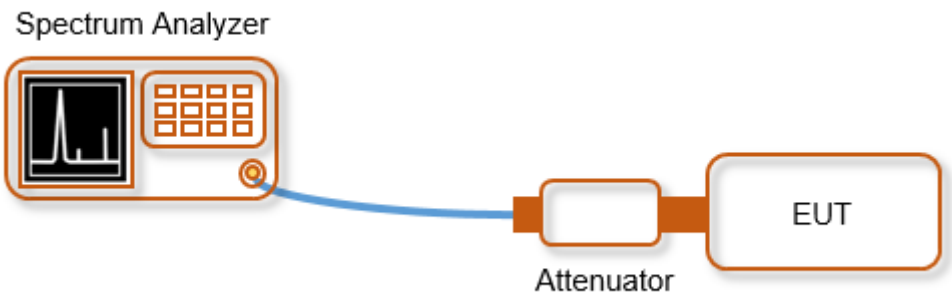


[Radiated Emission Test Setup Below 1 GHz]





[Radiated Emission Test Setup Above 1 GHz]

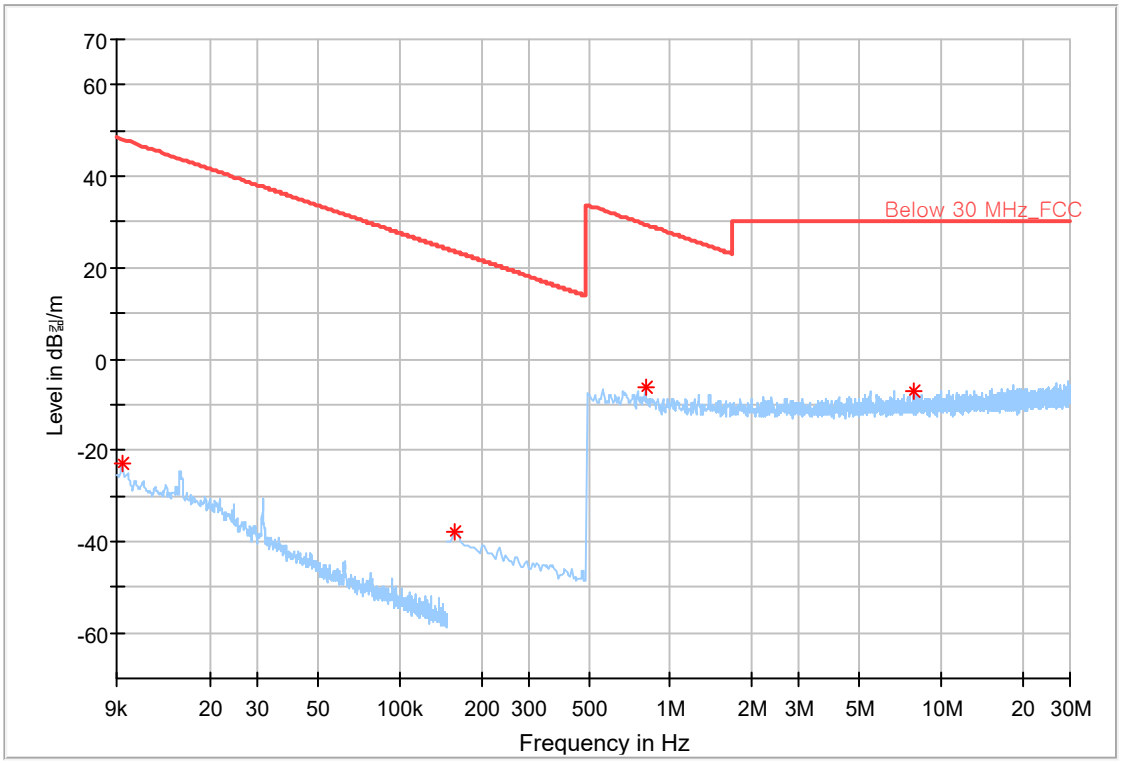


[Conducted Spurious Emission]

3.5.5 Test Result of Radiated Spurious Emission

3.5.5.1 Radiated Emissions (Below 30 MHz)

Worst case - RSE(Below 30 MHz)_Bluetooth LE 2M_GFSK_2402_X



Frequency [MHz]	Peak Reading Value [dBuV]	Peak [dBuV/m]	Distance Correction Factor [dB]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
0.01	36.77	-23.03	-80.00	48.09	71.12	100.00	Parallel	5.00	-59.80
0.16	21.33	-38.07	-80.00	23.55	61.62	100.00	Parallel	30.00	-59.40
0.81	12.84	-6.36	-40.00	29.41	35.77	100.00	Parallel	0.00	-19.20
7.90	11.33	-6.97	-40.00	30.00	36.97	100.00	Parallel	259.00	-18.30

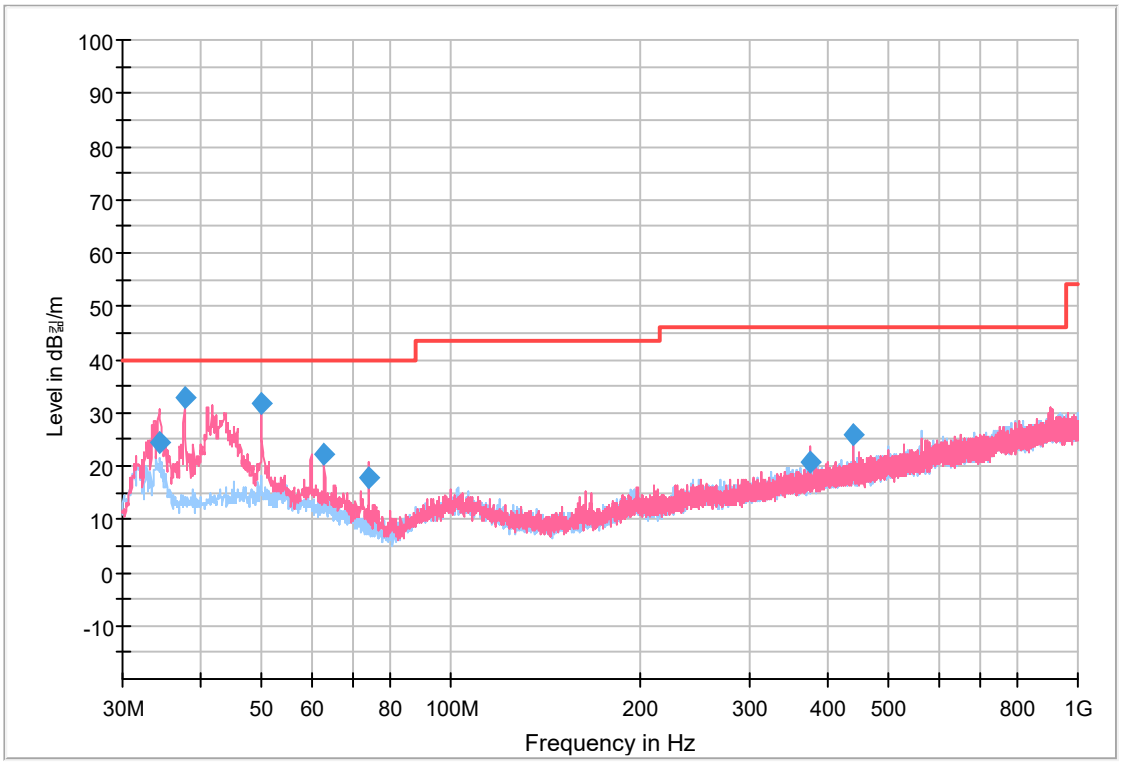
Frequency [MHz]	Peak Reading Value [dBuA]	Peak [dBuA/m]	Distance Correction Factor [dB]	Limit [dBuA/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
0.01	-14.73	-74.53	-80.00	-3.41	71.12	100.00	Parallel	5.00	-59.80
0.16	-30.17	-89.57	-80.00	-27.95	61.62	100.00	Parallel	30.00	-59.40
0.81	-38.66	-57.86	-40.00	-22.09	35.77	100.00	Parallel	0.00	-19.20
7.90	-40.17	-58.47	-40.00	-21.50	36.97	100.00	Parallel	259.00	-18.30

Remarks

1. Peak(dBuV/m) = Peak Reading Value(dBµV/m) + Correction Factor(dB) + Distance Factor(dB)
2. Correction Factor(dB) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin(dB) = (Peak) Result (dBµV/m) – (Peak) Limit (dBµV/m)

3.5.5.2 Radiated Emissions (Below 1 GHz)

Worst case - RSE(Below 1 GHz)_Bluetooth LE 2M_GFSK_2402

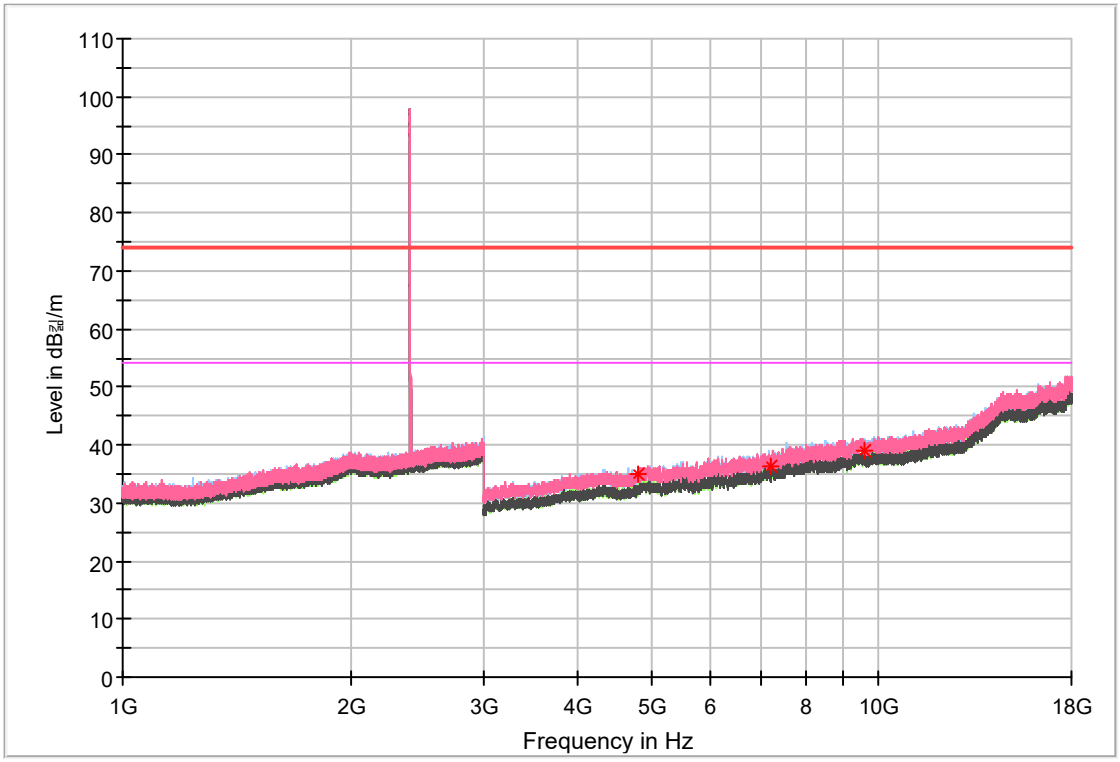


Frequency [MHz]	Quasi Reading Value [dBuV]	Quasi Peak [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
34.41	45.87	24.37	40.00	15.63	100	V	334	-21.50
37.66	53.31	32.91	40.00	7.09	100	V	137	-20.40
49.98	50.31	31.61	40.00	8.39	104	V	341	-18.70
62.83	42.77	22.07	40.00	17.93	150	V	330	-20.70
74.14	42.74	17.64	40.00	22.36	134	V	338	-25.10
374.98	36.35	20.55	46.02	25.47	100	V	268	-15.80
437.50	40.16	25.76	46.02	20.26	317	V	340	-14.40

Remarks
1. Quasi Peak(dBµV/m) = Quasi Peak Reading Value(dBµV/m) + Correction Factor(dB)
2. Correction Factor(dB) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin(dB) = (Quasi Peak) Result (dBµV/m) – (Quasi Peak) Limit (dBµV/m)

3.5.5.3 Radiated Emissions (Above 1 GHz)

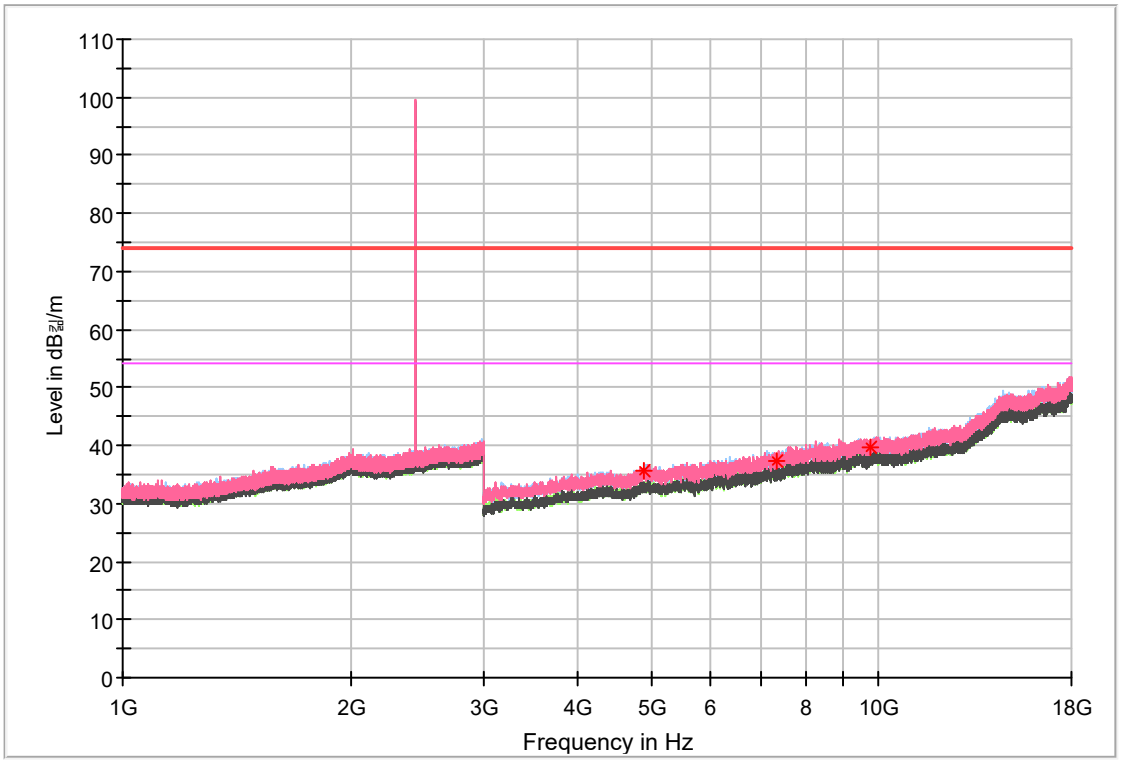
RSE Bluetooth LE_GFSK_2402_1 Mbps



Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 803.75	32.33	35.13	---	---	---	200	V	138	2.80	38.87	74.00	---	54.00
7 206.09	28.55	36.45	---	---	---	300	H	185	7.90	37.55	74.00	---	54.00
9 607.97	28.37	39.17	---	---	---	200	H	64	10.80	34.83	74.00	---	54.00

Remarks
1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

RSE Bluetooth LE_GFSK_2440_1 Mbps

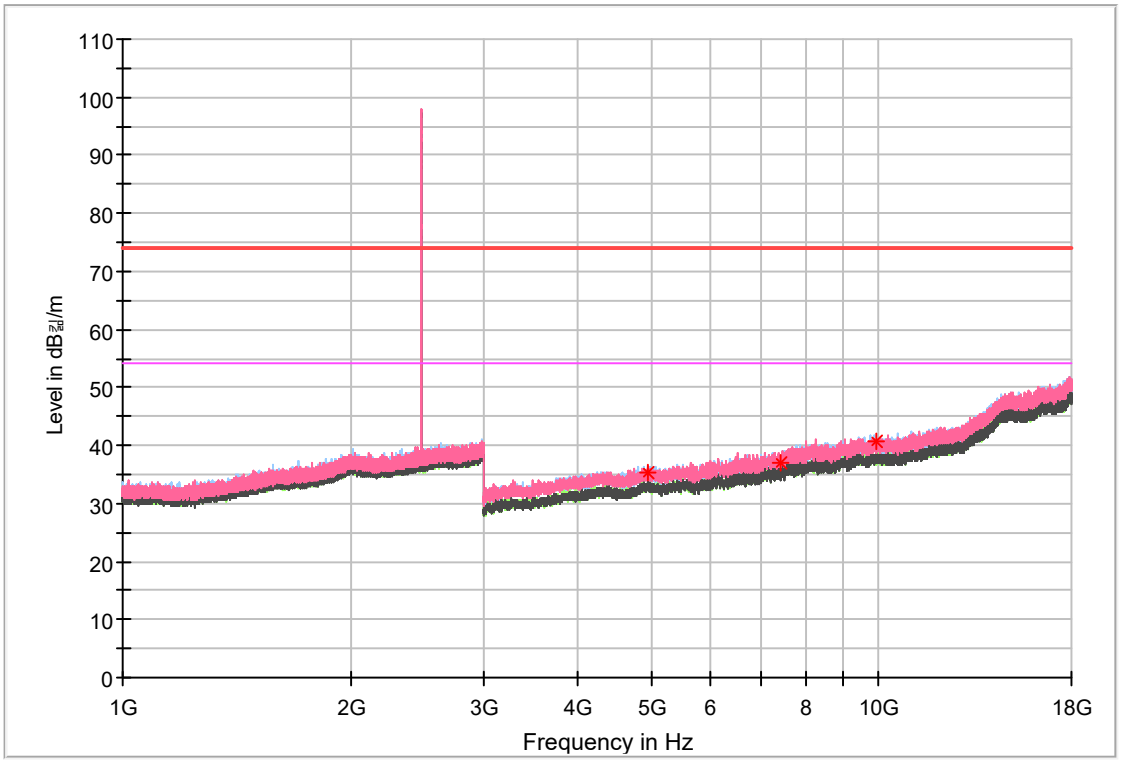


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 880.16	32.37	35.67	---	---	---	300	H	184	3.30	38.33	74.00	---	54.00
7 320.47	29.21	37.21	---	---	---	300	V	0	8.00	36.79	74.00	---	54.00
9 760.31	28.80	39.70	---	---	---	200	H	336	10.90	34.30	74.00	---	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

RSE Bluetooth LE_GFSK_2480_1 Mbps

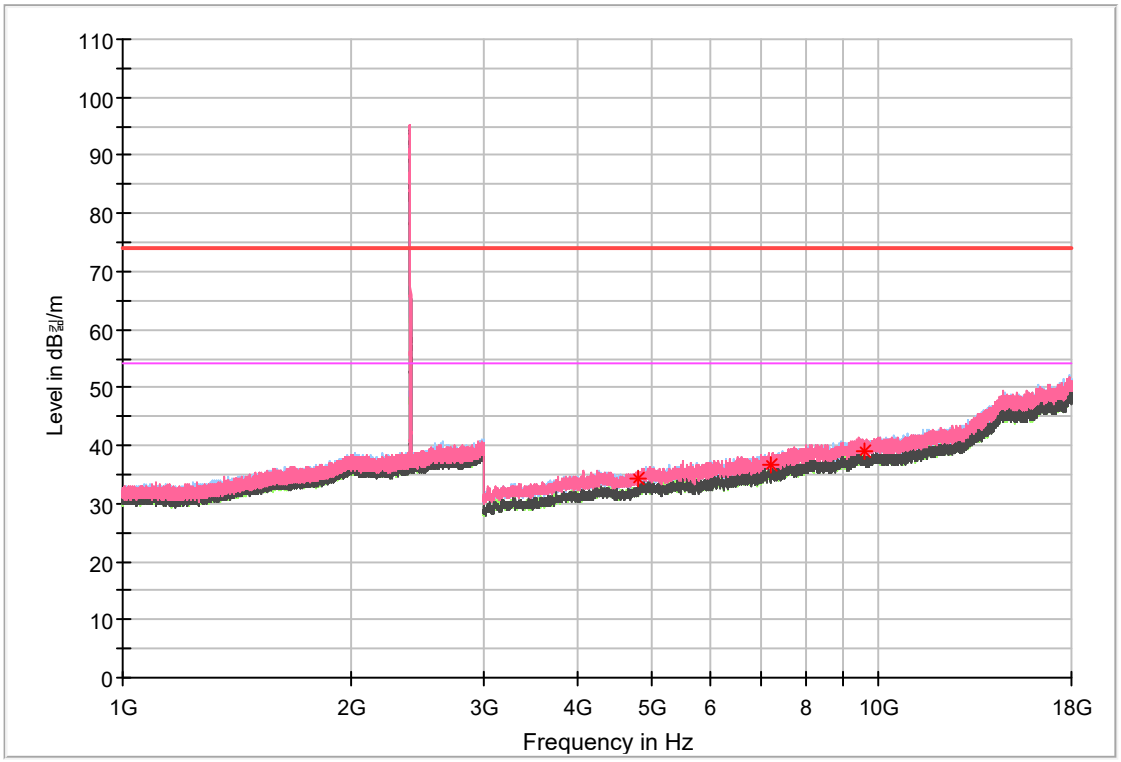


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 960.31	31.79	35.29	---	---	---	300	H	35	3.50	38.71	74.00	---	54.00
7 440.00	28.67	37.07	---	---	---	200	H	0	8.40	36.93	74.00	---	54.00
9 921.09	29.26	40.56	---	---	---	300	H	11	11.30	33.44	74.00	---	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

RSE Bluetooth LE_GFSK_2402_2 Mbps

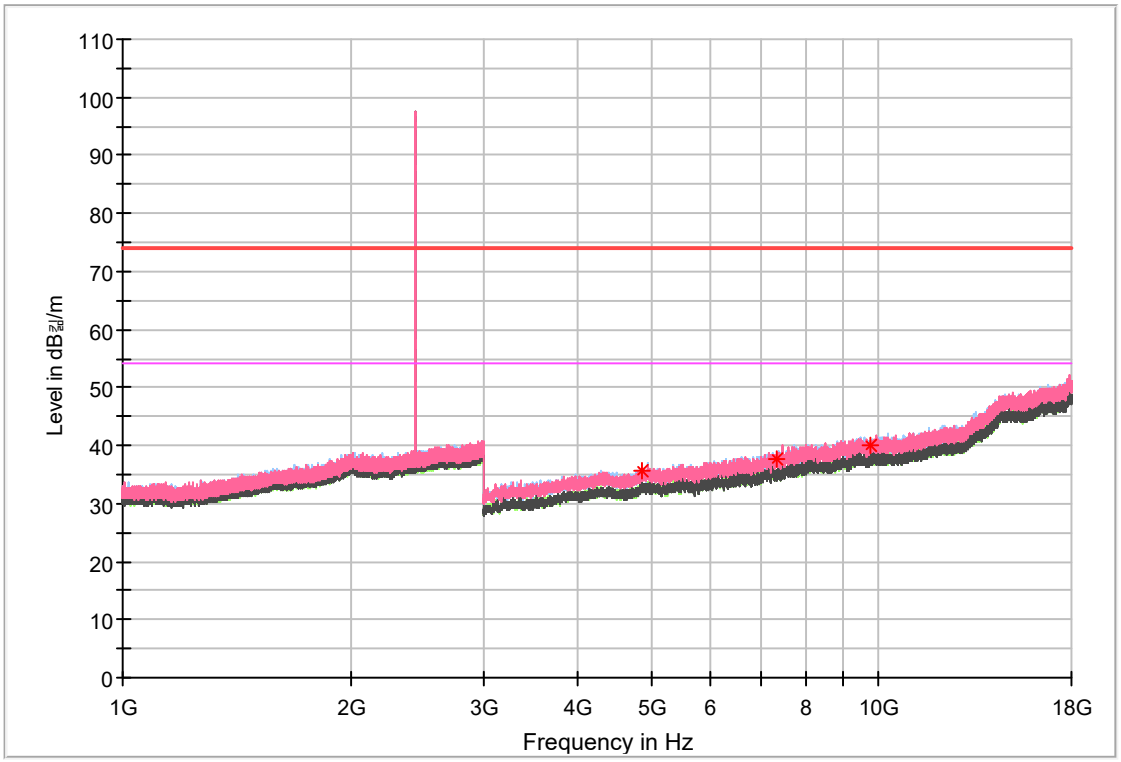


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 804.22	31.38	34.18	---	---	---	300	H	58	2.80	39.82	74.00	---	54.00
7 206.09	28.78	36.68	---	---	---	300	H	232	7.90	37.32	74.00	---	54.00
9 607.97	28.36	39.16	---	---	---	200	H	133	10.80	34.84	74.00	---	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

RSE Bluetooth LE_GFSK_2440_2 Mbps

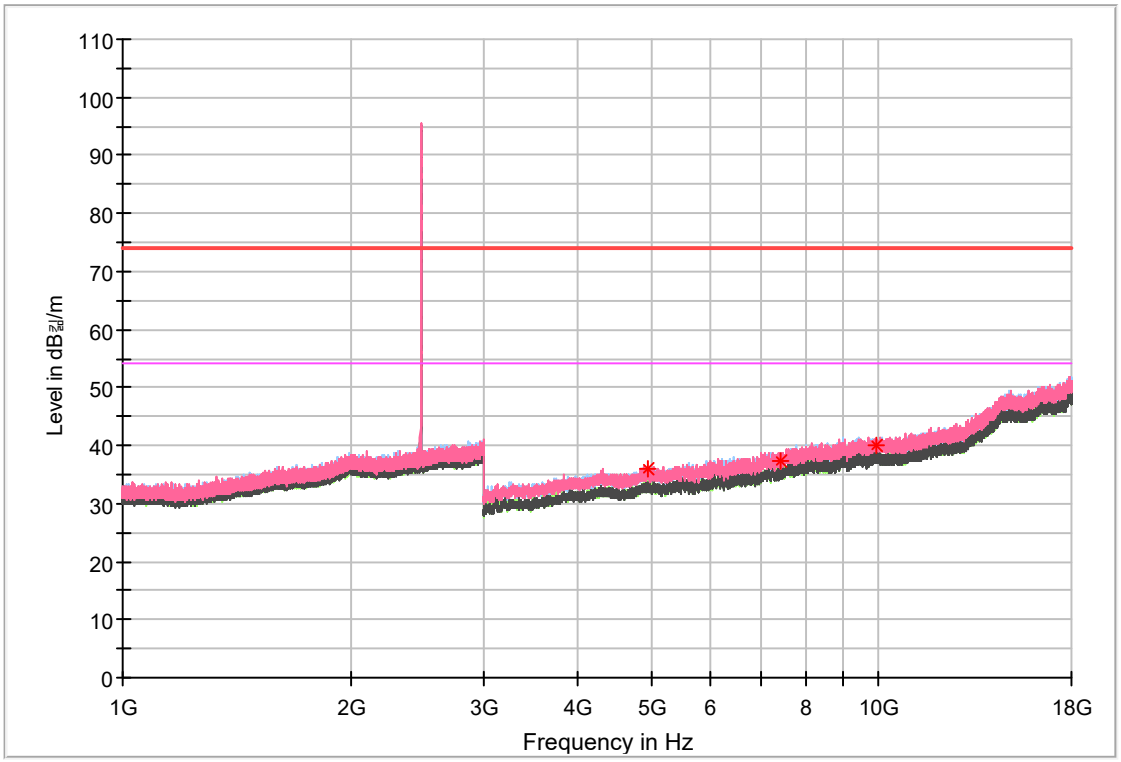


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 878.75	32.52	35.82	---	---	---	200	H	358	3.30	38.18	74.00	---	54.00
7 320.00	29.52	37.52	---	---	---	300	H	110	8.00	36.48	74.00	---	54.00
9 764.06	29.14	40.14	---	---	---	300	H	157	11.00	33.86	74.00	---	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

RSE Bluetooth LE_GFSK_2480_2 Mbps



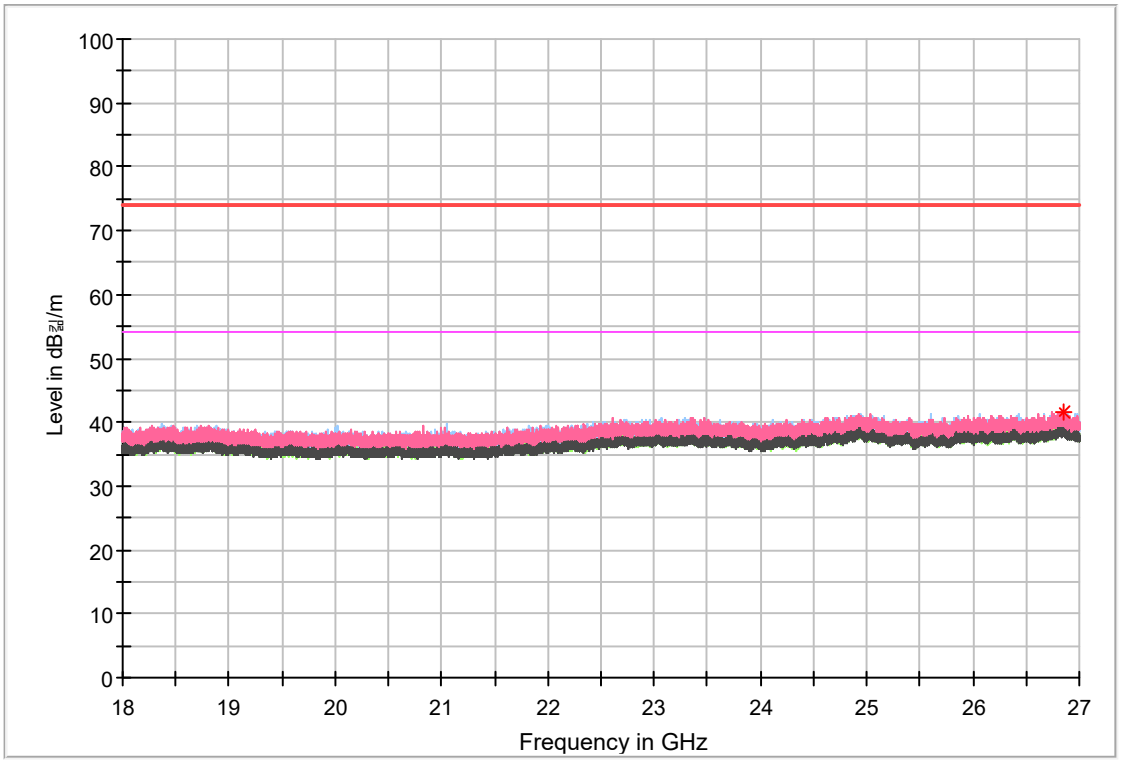
Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 959.84	32.33	35.83	---	---	---	300	H	329	3.50	38.17	74.00	---	54.00
7 440.00	29.04	37.44	---	---	---	200	H	337	8.40	36.56	74.00	---	54.00
9 920.16	28.57	39.87	---	---	---	300	H	9	11.30	34.13	74.00	---	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

3.5.5.4 Radiated Emissions (Above 18 GHz)

RSE(Below 18 GHz)_Bluetooth LE 2M_GFSK_2402

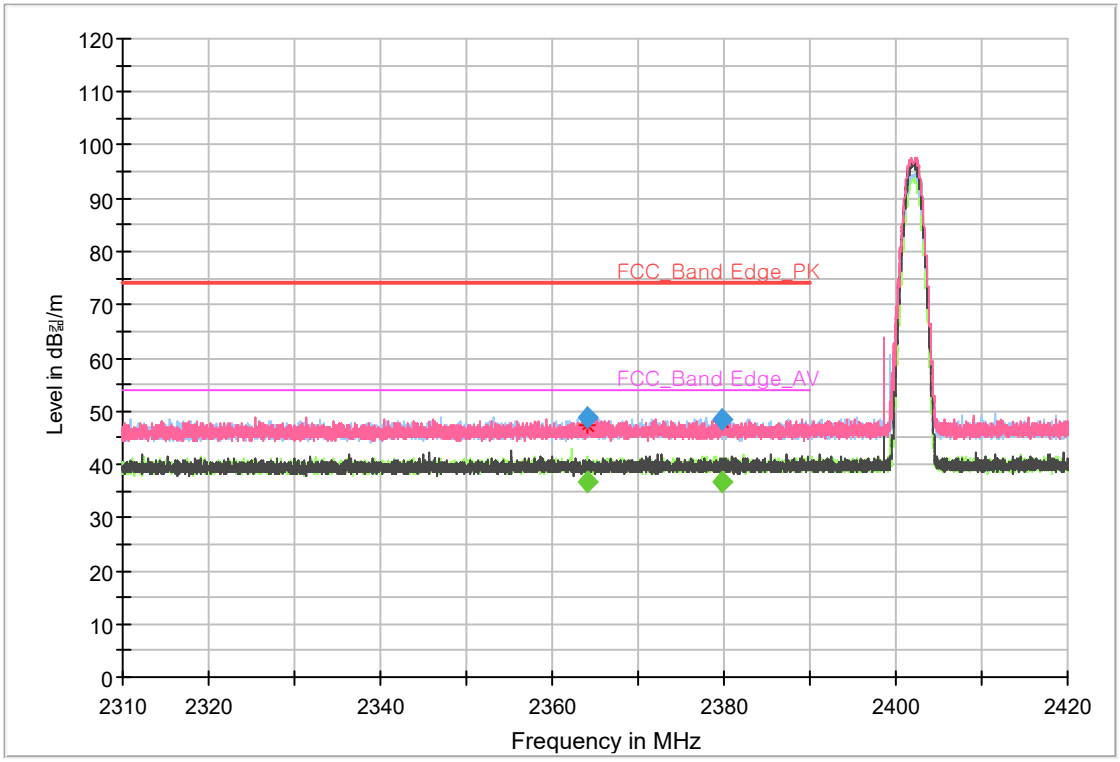


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
26848.13	40.27	41.57	-	-	-	200	H	93	1.30	32.43	74.00	-	-

Remarks
1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

3.5.5.4 Restricted Band Edge Measurements

Band Edge_Bluetooth LE_GFSK_2402_1 Mbps

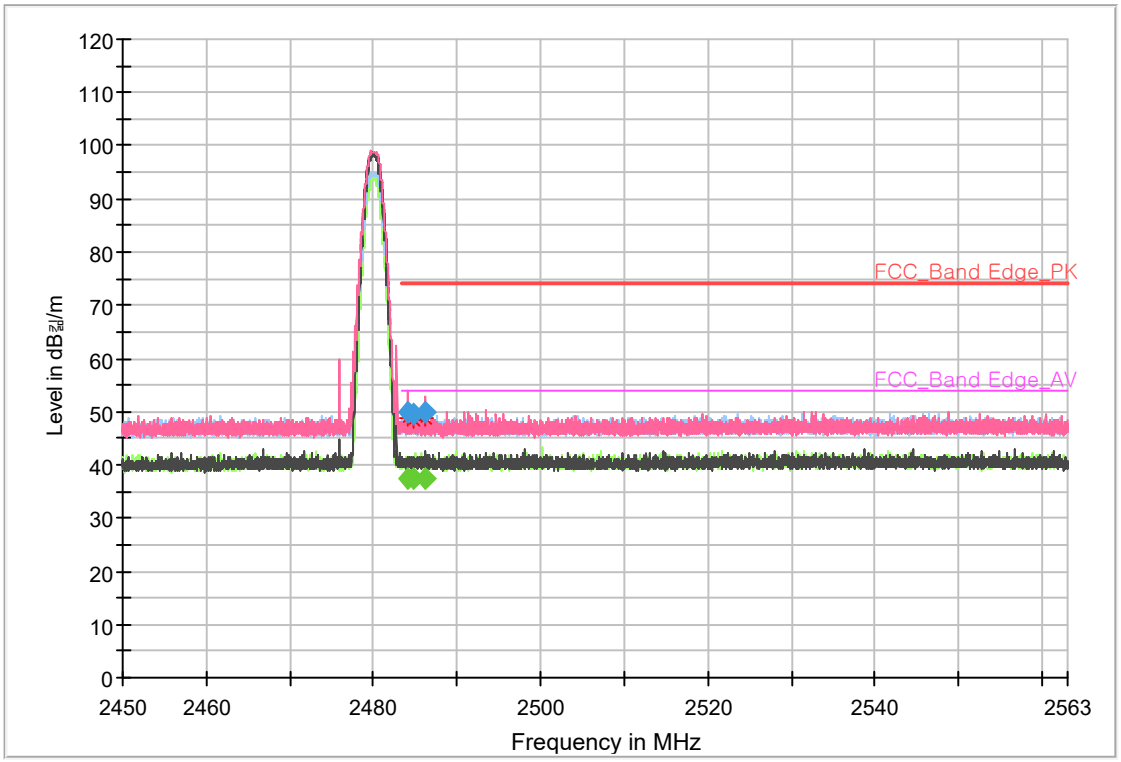


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 363.99	45.56	48.76	---	---	---	260	H	304	3.20	25.24	74.00	---	54.00
2 363.99	---	---	33.53	38.78	2.05	260	H	304	3.20	---	74.00	15.22	54.00
2 379.73	45.21	48.51	---	---	---	250	V	262	3.30	25.49	74.00	---	54.00
2 379.73	---	---	33.49	38.84	2.05	250	V	262	3.30	---	74.00	15.16	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

Band Edge_Bluetooth LE_GFSK_2480_1 Mbps

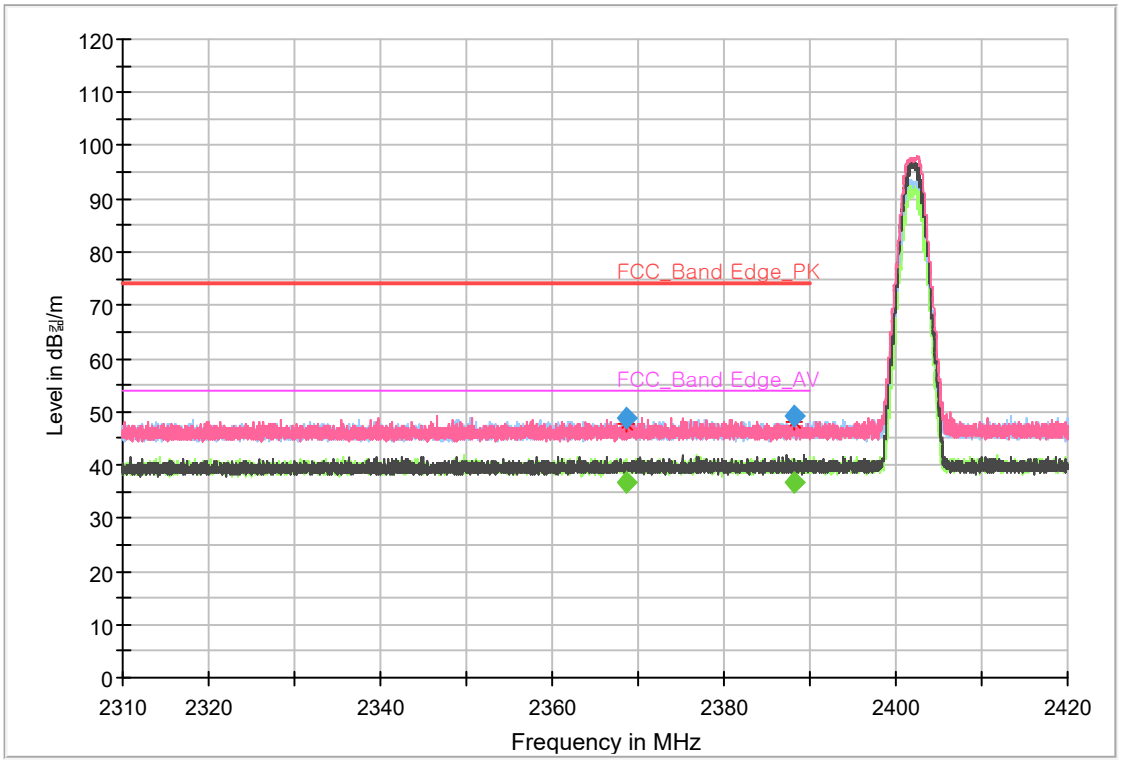


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 484.00	45.88	49.78	---	---	---	350	V	229	3.90	24.22	74.00	---	54.00
2 484.00	---	---	33.60	39.55	2.05	350	V	229	3.90	---	74.00	14.45	54.00
2 484.87	45.52	49.42	---	---	---	210	H	31	3.90	24.58	74.00	---	54.00
2 484.87	---	---	33.55	39.50	2.05	210	H	31	3.90	---	74.00	14.50	54.00
2 486.24	46.14	50.04	---	---	---	181	V	316	3.90	23.96	74.00	---	54.00
2 486.24	---	---	33.62	39.57	2.05	181	V	316	3.90	---	74.00	14.43	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

Band Edge_Bluetooth LE_GFSK_2402_2 Mbps

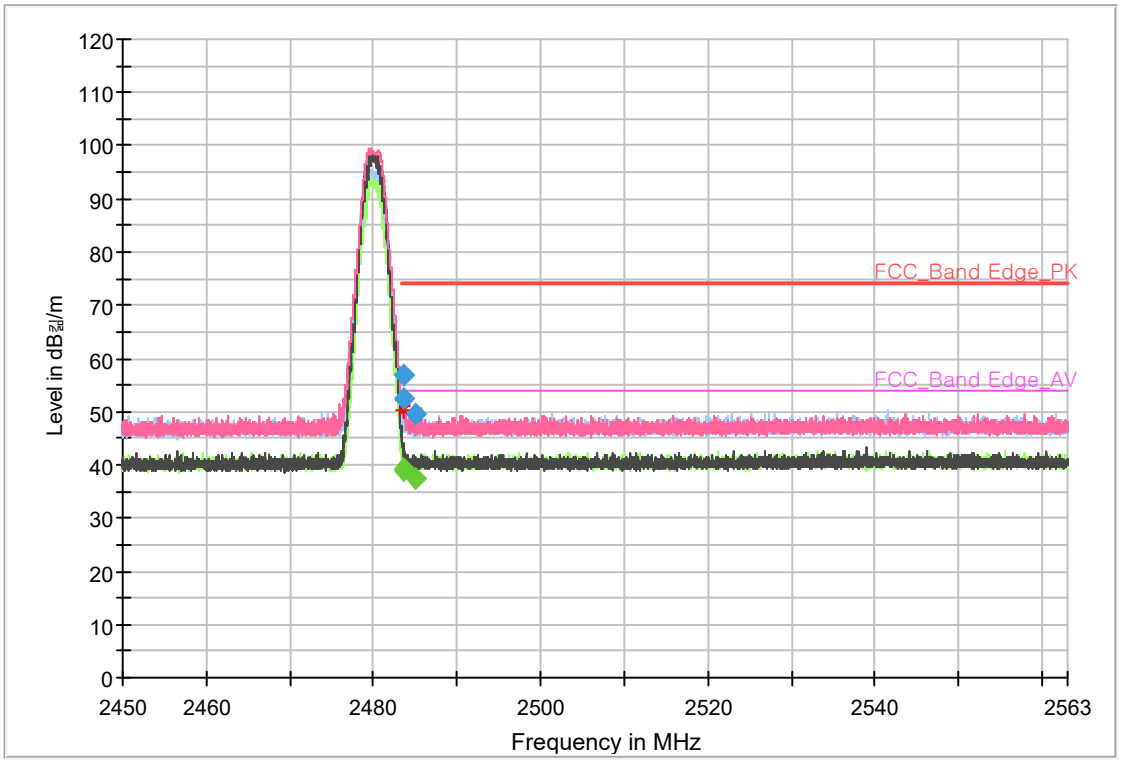


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 368.54	45.64	48.84	---	---	---	198	V	346	3.20	25.16	74.00	---	54.00
2 368.54	---	---	33.57	41.94	5.17	198	V	346	3.20	---	74.00	12.06	54.00
2 388.19	45.89	49.19	---	---	---	260	H	23	3.30	24.81	74.00	---	54.00
2 388.19	---	---	33.52	41.99	5.17	260	H	23	3.30	---	74.00	12.01	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

Band Edge_Bluetooth LE_GFSK_2480_2 Mbps

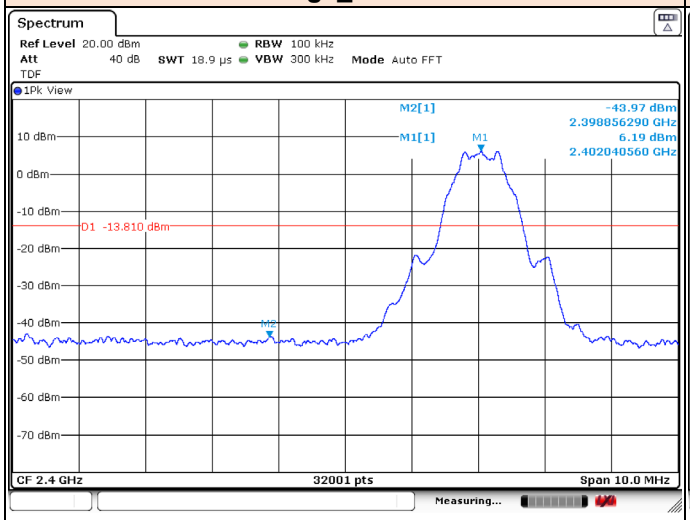
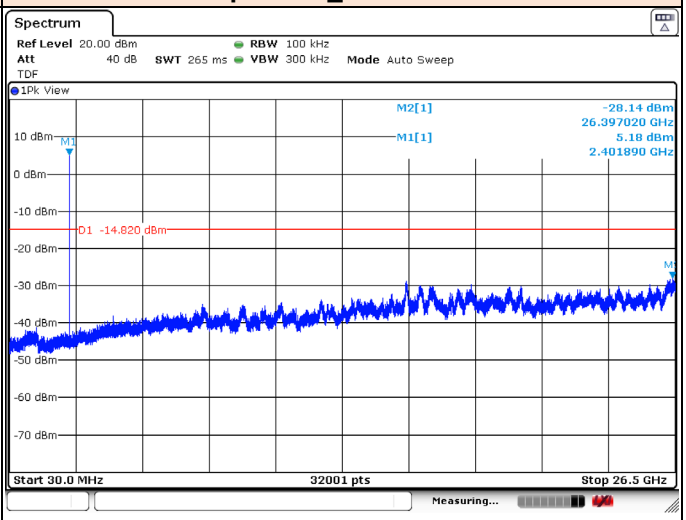
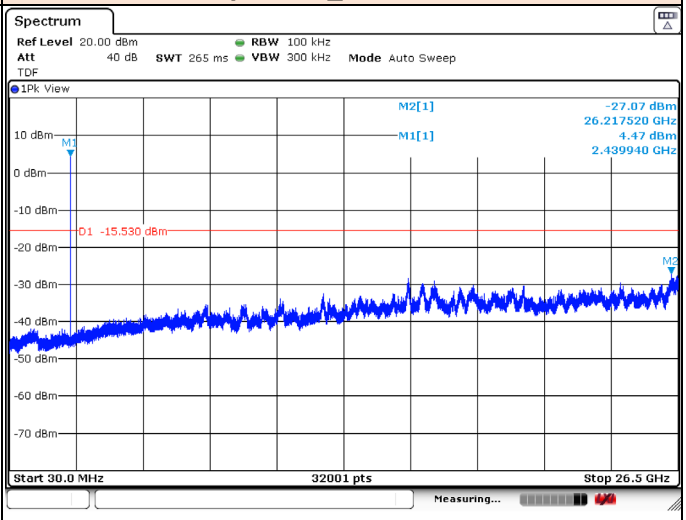
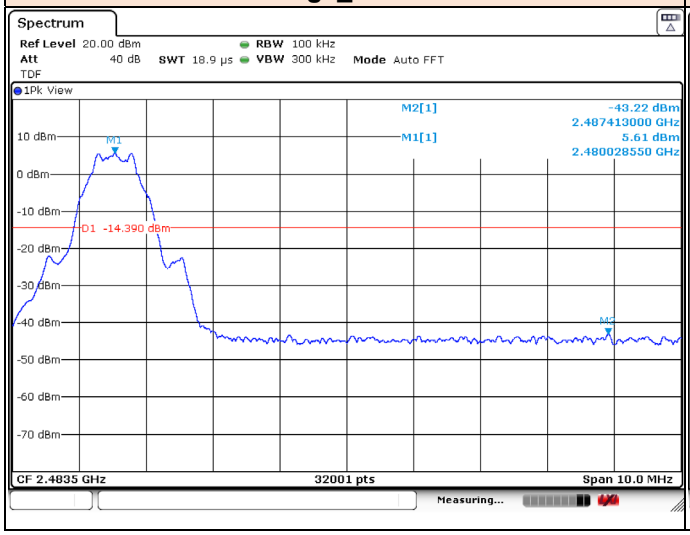
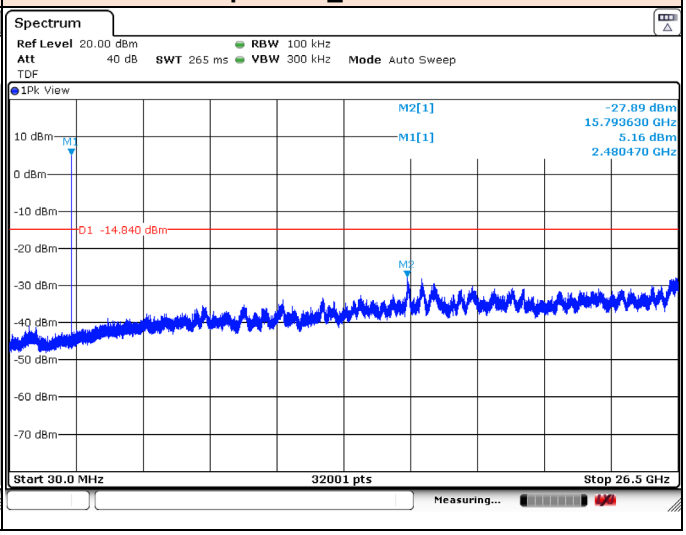


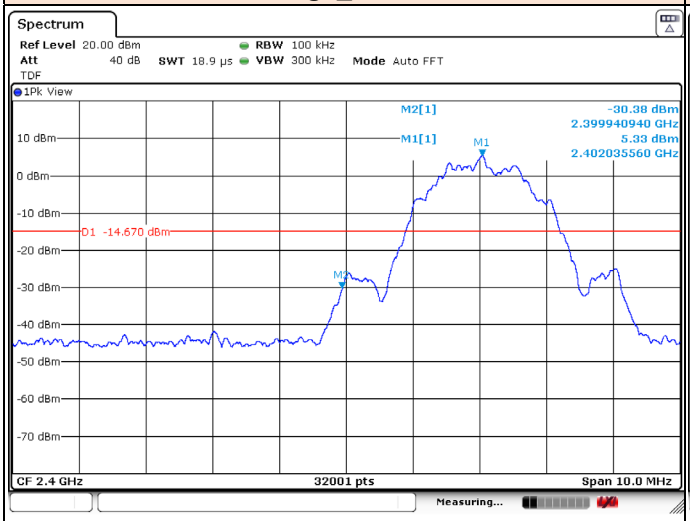
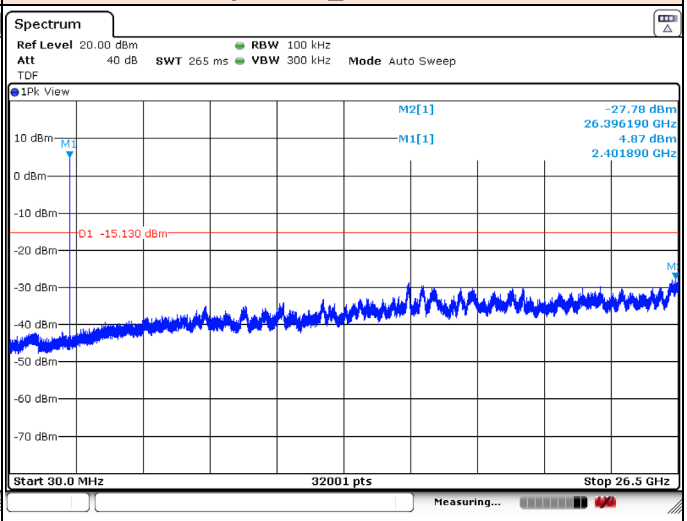
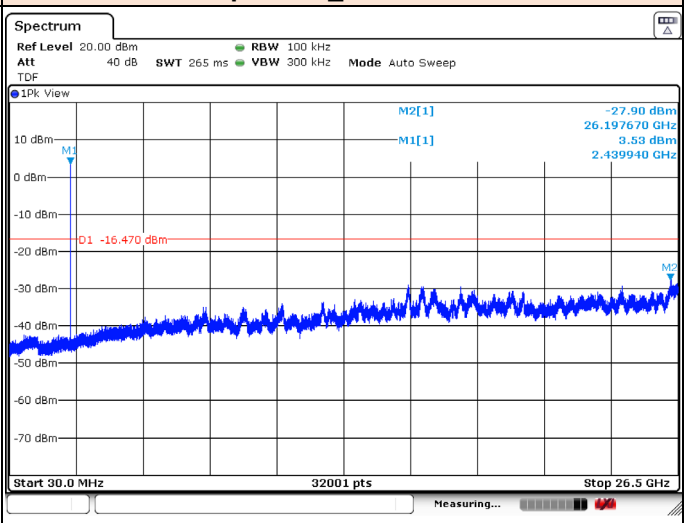
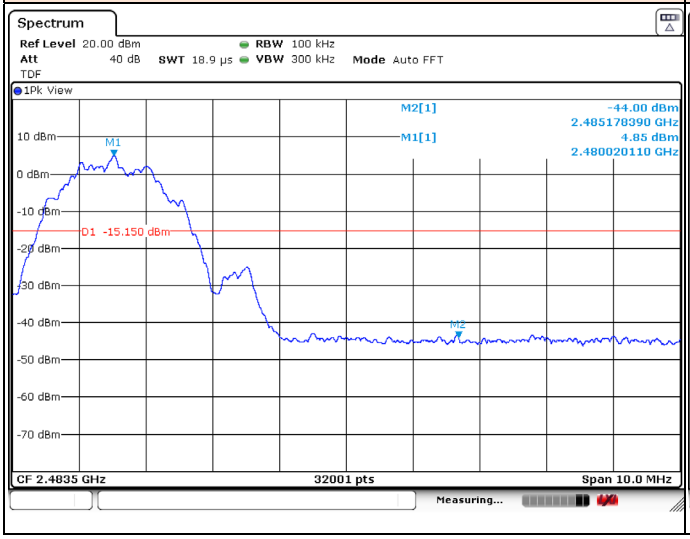
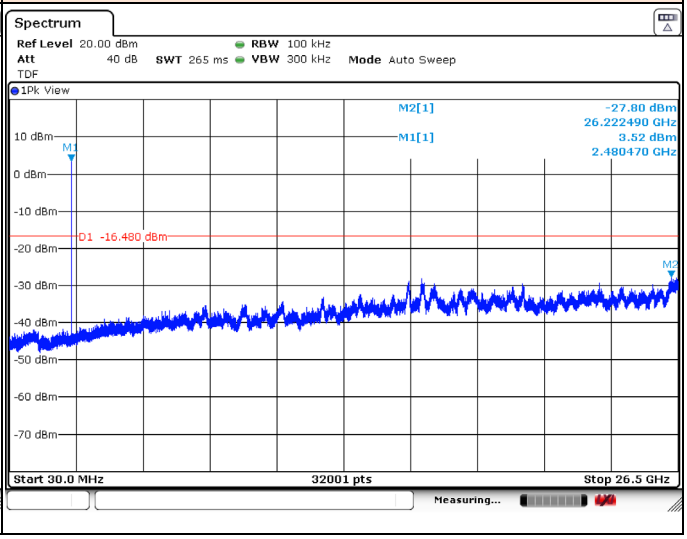
Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 483.58	52.90	56.80	---	---	---	250	V	357	3.90	17.20	74.00	---	54.00
2 483.58	---	---	35.38	44.45	5.17	250	V	357	3.90	---	74.00	9.55	54.00
2 483.66	48.65	52.55	---	---	---	251	V	8	3.90	21.45	74.00	---	54.00
2 483.66	---	---	34.86	43.93	5.17	251	V	8	3.90	---	74.00	10.07	54.00
2 484.94	45.74	49.64	---	---	---	151	H	354	3.90	24.36	74.00	---	54.00
2 484.94	---	---	33.58	42.65	5.17	151	H	354	3.90	---	74.00	11.35	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = AVG Reading Value(dBuV) + DCCF + Correction Factor(dB/m)
3. DCCF(Duty Cycle Correction Factor) = 10 x Log(1/Duty Cycle)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Result (dBuV/m) – (Peak/AVG) Limit (dBuV/m)

3.5.6 Test Result of Conducted Spurious Emission

Bluetooth LE 1 Mbps	
Bandedge_2 402 MHz	**Spurious_2 402 MHz**
	
Bandedge_2 440 MHz	**Spurious_2 440 MHz**
-	
Bandedge_2 480 MHz	**Spurious_2 480 MHz**
	

Bluetooth LE 2 Mbps	
Bandedge_2 402 MHz	**Spurious_2 402 MHz**
	
Bandedge_2 440 MHz	**Spurious_2 440 MHz**
-	
Bandedge_2 480 MHz	**Spurious_2 480 MHz**
	

3.6 AC Conducted Emissions (150 kHz to 30 MHz)

3.6.1 Regulation

§15.207(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.

	Conducted limit (dBµV)	
Frequency of emission (MHz)	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.

3.6.2 Test Procedure

a) The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm / 50 µH of coupling impedance for the measuring instrument.

b) Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

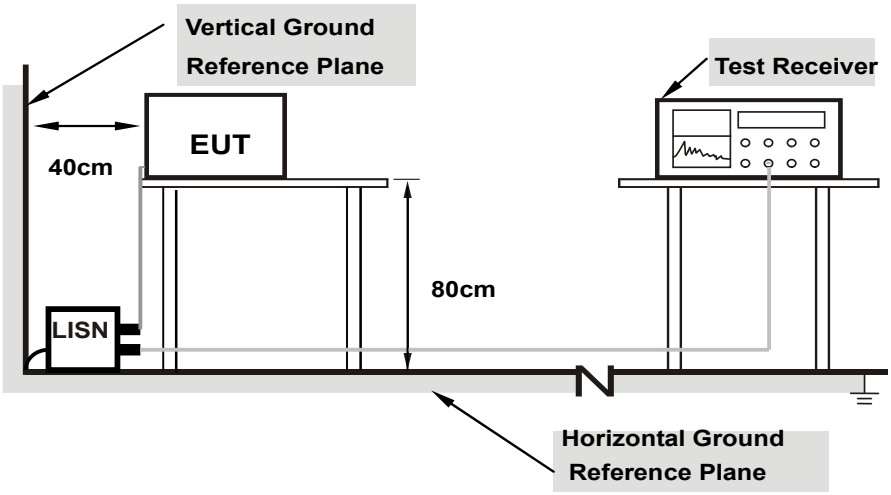
c) The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Remark : The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

3.6.3 Deviation from Test Standard

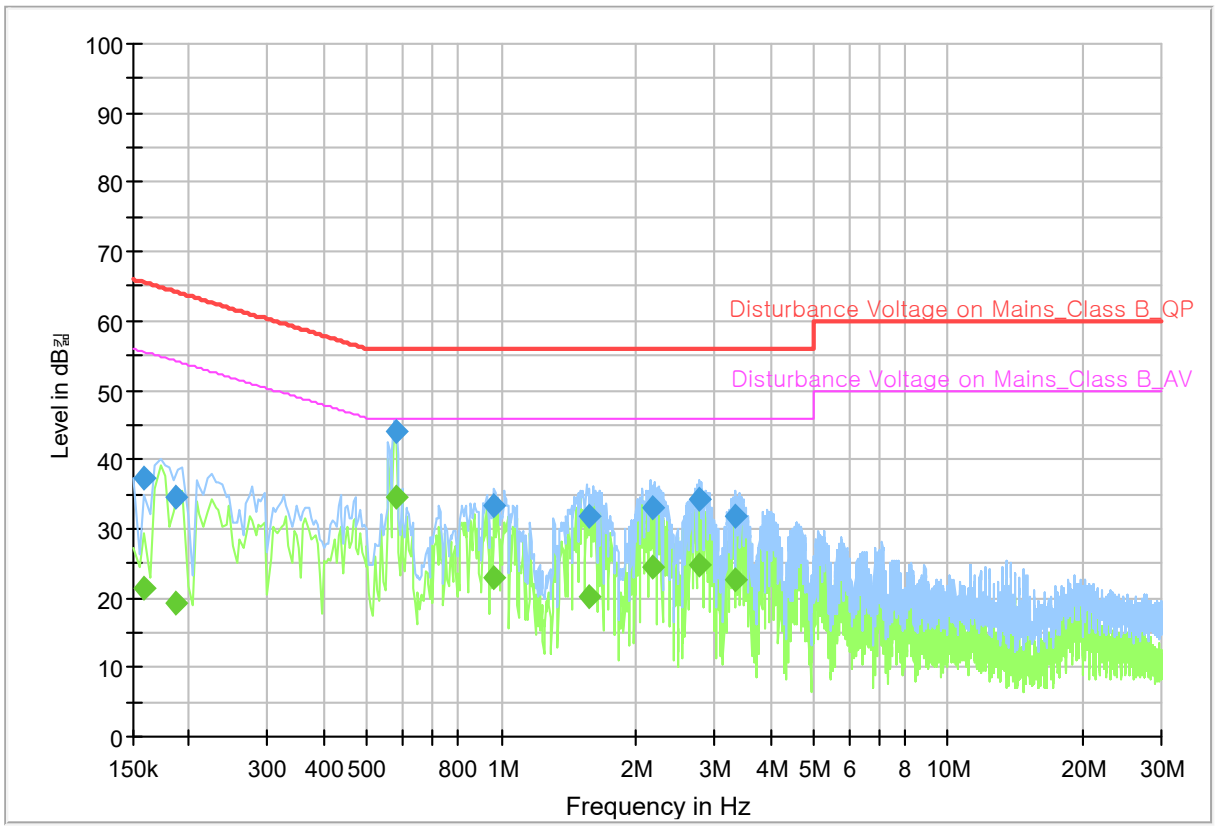
No deviation.

3.6.4 Test Setup



3.6.5 Test Result

Bluetooth LE_GFSK_2402_2M



Frequency [MHz]	Quasi Peak Reading Value [dBuV]	Quasi Peak Result [dBuV]	CAV Reading Value [dBuV]	CAV Result [dBuV]	Line	Correction Factor [dB/m]	Quasi Peak Margin [dBuV]	Quasi Peak Limit [dBuV]	CAV Margin [dBuV]	CAV Limit [dBuV]
0.16	27.19	37.19	---	---	N	10.00	18.81	56.00	---	---
0.16	---	---	11.41	21.41	N	10.00	---	---	24.59	46.00
0.19	24.65	34.65	---	---	L1	10.00	21.35	56.00	---	---
0.19	---	---	9.29	19.29	L1	10.00	---	---	26.71	46.00
0.58	33.95	43.95	---	---	L1	10.00	12.05	56.00	---	---
0.58	---	---	24.44	34.44	L1	10.00	---	---	11.56	46.00
0.97	23.42	33.32	---	---	L1	9.90	22.68	56.00	---	---
0.97	---	---	12.99	22.89	L1	9.90	---	---	23.11	46.00
1.57	22.09	31.89	---	---	L1	9.80	24.11	56.00	---	---
1.57	---	---	10.47	20.27	L1	9.80	---	---	25.73	46.00
2.18	23.31	33.11	---	---	L1	9.80	22.89	56.00	---	---
2.18	---	---	14.56	24.36	L1	9.80	---	---	21.64	46.00
2.77	24.20	34.10	---	---	N	9.90	21.90	56.00	---	---
2.77	---	---	15.02	24.92	N	9.90	---	---	21.08	46.00
3.35	21.95	31.85	---	---	N	9.90	24.15	56.00	---	---
3.35	---	---	12.69	22.59	N	9.90	---	---	23.41	46.00

Remarks

1. Final Value (QP and/or CAV) = Reading Value (QP and/or CAV) + Corr. (LISN Insertion Loss + Cable Loss)
Margin (QP and/or CAV) = Limit – Final Value (QP and/or CAV)
QP = Quasi-Peak, CAV = CISPR-Average, Corr. = Correction Factor
2. Two graphs measured for both Live (L1) and Neutral (N) of the LISN are combined into one graph.

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services Korea. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

Test Firm Name : BV CPS ADT Korea Ltd.

Address : Innoplex No.2 106, Sinwon-ro 306, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675 KOREA

FCC

Designation Number : KR0158
Test Firm Registration Number : 666061

ISED

Designation Number : KR0158
Test Firm Registration Number : 25944

If you have any comments, please feel free to contact us at the following:

Email: Meyer.Shin@bureauveritas.com
Web Site: www.bureauveritas.co.kr/cps/eaw

The address and road map of all our labs can be found in our web site also.

- End of report -