

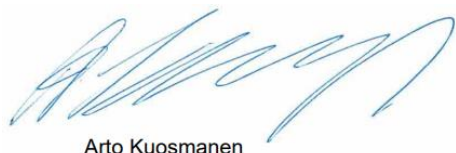
Radio Test Report

According to

**FCC part 15C,
RSS-247, RSS-Gen**

DUT Name: PAN9019A
Model No. : ENWF9511C1KF
Customer: Panasonic Industrial Devices Europe GmbH
Address: Zeppelinstr. 19, 21337 Lüneburg, Germany
Summary IN COMPLIANCE
Date of Reception: 27.11.2023
Date(s) of Test(s): 08.02.2024 – 16.02.2024

Tested by Test Engineer


Arto Kuosmanen

Approved by Technical Manager


Jukka Rauma

The test report shall not be reproduced except in full, without the written approval of the laboratory. This report is only for the equipment which is described in page 4.

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Document Version History	Date of issue	Comments	Approved by
v0.1	28.02.2024	Initial version	
v0.2	01.03.2024	Radiated spot check result for additional antennas added	
v1.0	28.3.2024	Review corrections included	Jukka Rauma

1. General Information

Test Engineer(s): Arto Kuosmanen, Pekka Pulkkinen

Location:

Test Firm Name	Eurofins Electric & Electronics Finland Oy (EEEF)
Test Site	Yrttipellontie, Peltola
Address of Test Site	Yrttipellontie 6, 90230 Oulu, Finland
FCC Designation number	FI0008
FCC site registration number	771880
ISED number	29576
CAB Identifier	T290

Customer: Panasonic Industrial Devices Europe GmbH
Zeppelinstr. 19, 21337 Lüneburg, Germany
Marcus Nottorf
tel: +49 (0) 4131-899 435
email: marcusnottorf@eu.panasonic.com

Climate Conditions: Temperature: 15 - 35 °C
Air pressure: 860 - 1060 hPa
Humidity: 30-60 rH%
These limits were not exceeded during testing.

2. Test Samples

General description:

The PAN9019 and PAN9019A are 2.4 GHz and 5 GHz ISM band Wi-Fi, Bluetooth, and 802.15.41 radio modules, which allow easy integration of Wi-Fi, Bluetooth, and 802.15.41 based technologies into various electronic devices.

Test sample (Conducted):

Sample number	Serial number	Manufacturer	DUT Type	Model	HW version	SW version
3938ER001	00000297	Panasonic	Wireless module	ENWF9511C1KF	03	01

Test sample (Radiated):

Sample number	Serial number	Manufacturer	DUT Type	Model	HW version	SW version
3938ER005	00000295	Panasonic	Wireless module	ENWF9511C1KF	03	01
3938ER004	00000327	Panasonic	Wireless module	ENWF9511C1KF	03	01
3938ER003	00000283	Panasonic	Wireless module	ENWF9511C1KF	03	01
3938ER006	na	Taoglas	Antenna	GW.51.5153	na	na

Auxiliary equipment:

Sample number	Serial number	Manufacturer	DUT Type	Model	Description
3938ER005	#6	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3
3938ER001	#5	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3
3938ER004	#7	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3 with 2JF1002P antenna

Sample number	Serial number	Manufacturer	DUT Type	Model	Description
3938ER003	#8	Embedded Artists	Host Board	EAK00393	MX8M Mini Developer's Kit V3 with ANT162442DT-2001A2 antenna
3938ER007	na	Phihong Technology Co. Ltd.	Switching Power Supply	PSAA30R-120	
3938ER008	na	Phihong Technology Co. Ltd.	Switching Power Supply	PSAA30R-120	

Description	Information	
Additional model	ENWF9501C1KF, ENWF9511CMKF, ENWF9501CMKF, ENWF9511AMKF, ENWF9501AMKF	
Brand Names(s)	PAN9019, PAN9019A-M2E-EVD, PAN9019-M2E-EVD, PAN9019A-M2E-C-EVD, PAN9019-M2E-C-EVD	
PMN	PAN9019A	
HVIN	ENWF9511C1KF	
FVIN	n/a	
HMN	n/a	
FCC ID	T7V9019	
IC ID	216Q-9019	
Equipment type	Bluetooth radio module	
Radio type	Transceiver	
- operating frequency range:	2400.0 MHz – 2483.5 MHz	
- Nominal Channel Bandwidth:	1, 2 MHz	
Radio technology / type of equipment	Bluetooth 5.4	
Modulation:	GFSK	
Number of antennas	1	
Bluetooth Specification	LE 1Mbps PHY	Yes
	LE 2Mbps PHY	Yes
	LE Coded PHY S=2 (500 kbit)	Yes
	LE Coded PHY S=8 (125 kbit)	Yes
	Stable Modulation Index - Transmitter	No
	Stable Modulation Index - Reer	No
Antenna 1	Type	Terminal Mount Dipole Antenna
	Model	GW.51.5153
	Manufacturer	Taoglas
	Gain	5.2 dBi
Antenna 2	Type	2.4/5.0/6.0 GHz WIFI 6E / WIFI 7 ISM Flexible ultra-thin PCB Adhesive Antenna
	Model	2JF1002P
	Manufacturer	2J Antennas
	Gain	4.2 dBi
Antenna 3	Type	TDK RF Ceramic Chip Antenna
	Model	ANT162442DT-2001A2
	Manufacturer	TDK
	Gain	2.1 dBi
Supply voltage	1.8/3.3VDC	
Type of Power source	Host board / AC/DC adapter	
Operating Temperature	TNom = 25°C TMin = -40°C TMax = 85°C	
Manufacturer	Panasonic Industrial Devices Europe GmbH Zeppelinstr. 19, 21337 Lüneburg, Germany	

3. Configuration and Operation Modes

Conducted RF test:

Test modes / description
GFSK modulation, data rate 1 Mbps, duty cycle 85%
GFSK modulation, data rate 2 Mbps, duty cycle 43%
GFSK modulation, LE coded S=2 PHY, duty cycle 45%
GFSK modulation, LE coded S=8 PHY, duty cycle 97%
Continuous modulated carrier at 2402 MHz, 2442 MHz and 2480 MHz, power level setting 8 dBm

Conducted and radiated emission test:

Test modes / description
Continuous modulated carrier at 2402 MHz, 2440 MHz and 2480 MHz, power level setting 8 dBm, according to conducted output power measurements worst cases for radiated emission test are LE 2M PHY (2 MHz nominal channel bandwidth) and LE Coded S=2 PHY (1 MHz nominal channel bandwidth)
Continuous reception at 2442 MHz

Test/configuration software

Manufacturer	Name	Version
Panasonic Industry	Web server application	

4. Test equipment

Conducted RF tests

R&S TS8997 Test System equipment list:

Equipment	Certification-No.	Calibration Date	Next calibration
SMW200A	1035089-D-K-15195-01-00-2022-03	26.06.2023	25.06.2026
SMB100A	1041326-D-K-15195-01-00-2022-03	26.06.2023	25.06.2026
OSP-B157WX+OSP220	300642762-D-K-15195-01-00-2022-03	26.06.2023	25.06.2024
OSP-B157W8plus+OSP150	300639878-D-K-15195-01-00-2022-03	26.06.2023	25.06.2024
ESW	1039208-D-K-15195-01-00-2022-03	05.07.2023	04.07.2024
CMW500	300693633-D-K-15195-01-00-2023-04	25.04.2023	24.04.2024

Radiated emission

New ID	Manufacturer	Equipment type	Description	Serial	Calibration information	Next calibration
G4C265	Rohde & Schwarz	ESW26	EMI test receiver	101324	29.6.2023	29.6.2024
G4C273	Frankonia	ALX-4000E	Broadband Antenna, 25MHz-4GHz with 6dB (50-A-MFN-06) att.	00816+1531	22.1.2024	22.1.2027
G4C292	Rohde & Schwarz	TS-LNA 1840	RF Preamplifier 18 to 40 GHz	100841	9.6.2022	9.6.2024
G4C469	Rohde & Schwarz	TS_PRE2	RF Preamplifier	101541	9.6.2022	9.6.2024
G4C294	Rohde & Schwarz	Antenna	Horn Antenna -> 40GHz	101067	4.11.2022	4.11.2025
G4C576	Rohde & Schwarz	HF907	Double-Ridged Waveguide Horn Antenna 800MHz-18GHz	100163	9.8.2022	9.8.2025

Test software

Description	Manufacturer	Name	Version
EMC Software	Rohde & Schwarz	EMC32	10.60.20
RF Software	Rohde & Schwarz	WMS32	11.60.00

5. Uncertainties

Description	Expanded Uncertainty (k=2)
RF Output Power	0,99
Peak Power	0,80
Power Spectral Density	0,99
Accumulated Transmit Time	0,01%
Minimum Frequency Occupation Time	0,01%
Hopping Frequency Separation	0,60%
Occupied Channel Bandwidth	2,08 %
Out-of-band emissions	0,89
Transmitter unwanted emissions in the spurious domain	1,76
AC conducted emission	2,24
Radiated emission ≤ 1 GHz	4,62
Radiated emission > 1 GHz	5,72

6. Sample emission level calculation

The following is a description of term and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBuV.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strength to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. RF path losses, including RF cables and preamplifiers, have been included with the A.F to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dBuV)} + \text{A.F. (dB/m)} = \text{Net field strength (dBuV/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBuV/m). The FCC limits are given in units of uV/m. The following formula is used to convert the units of uV/m to dbuV/m:

$$\text{Limit (dBuV/m)} = 20 * \log(\text{uV/m})$$

Margin :

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading :	Net reading – FCC limit	= Margin
+ 21.5 dBuV + 26 dB/m	= 47.5 dBuV/m :	47.5 dBuV/m – 57.0 dBuV/m	= -9.5 dB

7. Test conditions

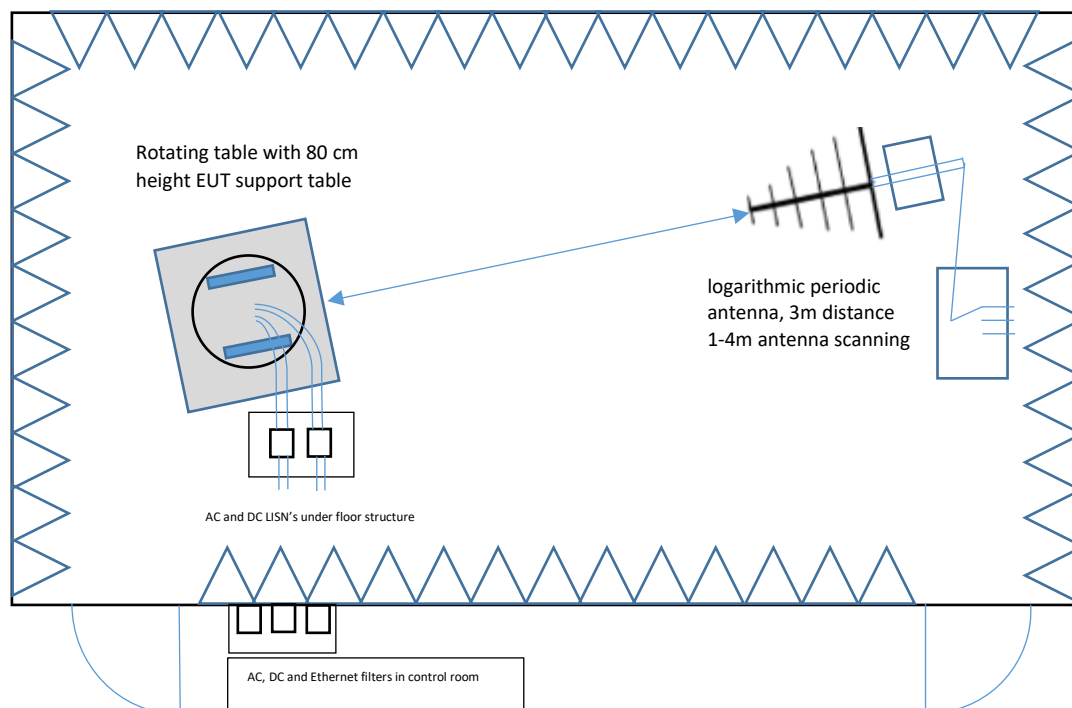
All radiated tests were performed in a semi-anechoic chamber, where the measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz, 1 GHz-18 GHz Double-ridged horn antenna and 18 GHz-40 GHz horn antenna) is located at a distance of 3 m.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (all antennas) was varied from 1 to 4 meters to find the maximum radiated emission.

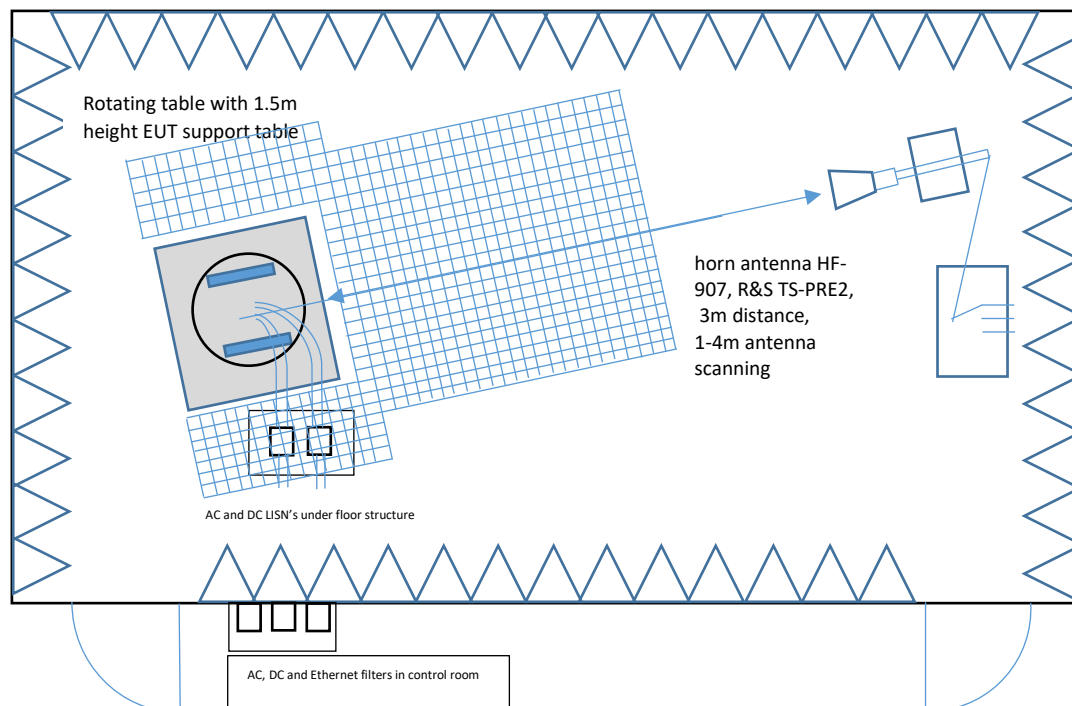
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

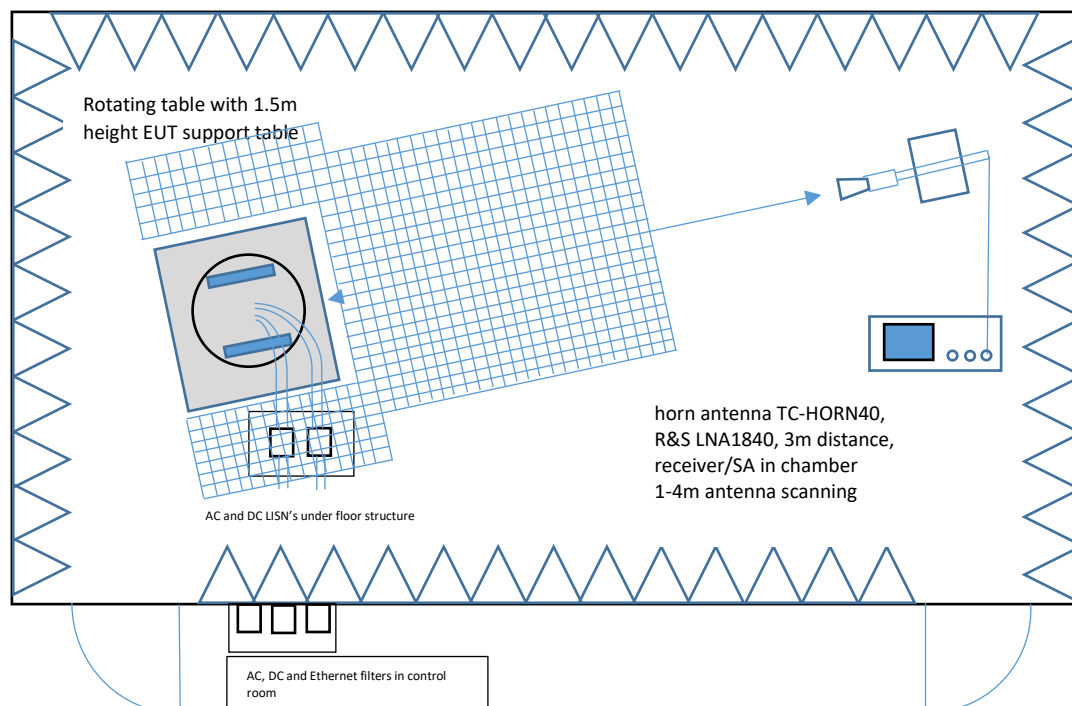
Radiated measurements setup from 30 MHz to 1 GHz:



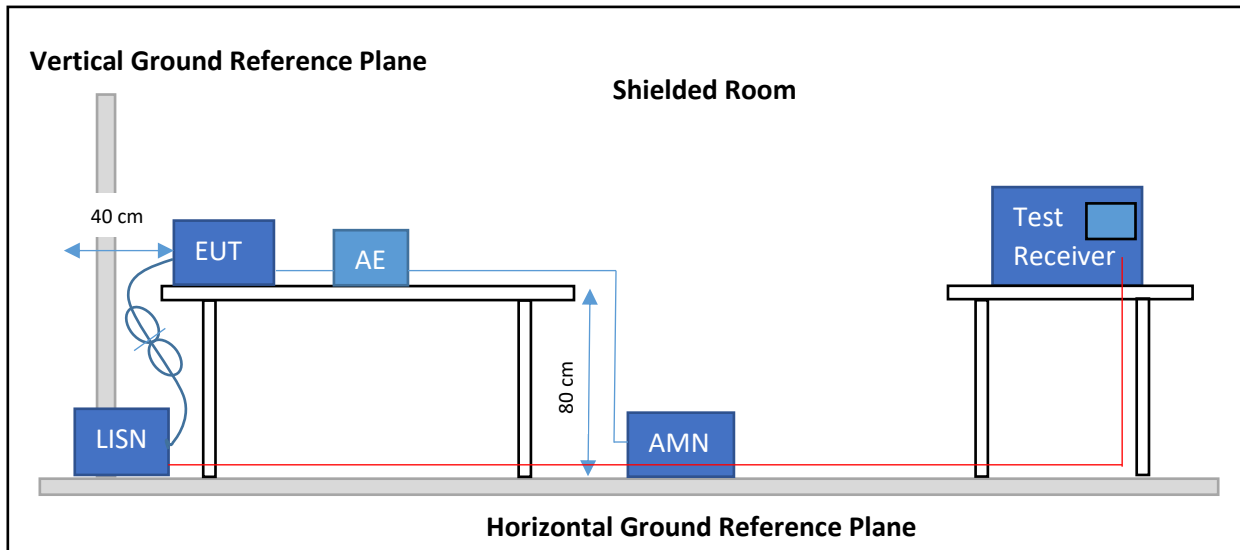
Radiated measurements setup from 1 GHz to 18 GHz:



Radiated measurements setup from 18 GHz to 26 / 40 GHz:



Conducted emission setup



Conducted RF measurement system:



8. Summary

Bluetooth LE

FCC/ISED Requirement (15.247 / RSS-247)		Reference method	Result	Remark
Occupied Bandwidth	ISED RSS-Gen, Issue 5 A2 (section 6.7)	ANSI C63.10-2013	PASS	Informational only
6 dB Bandwidth	FCC § 15.247(a)(2) / RSS-247, Issue 3 (section 5.2 (a))	ANSI C63.10-2013	PASS	
Maximum peak conducted power	FCC § 15.247(b) / RSS-247, Issue 3 (section 5.4 (d))	ANSI C63.10-2013	PASS	
Power spectral density	FCC § 15.247(e) / RSS-247, Issue 3 (section 5.2)	ANSI C63.10-2013	PASS	
AC power line conducted emissions	FCC § 15.207 / RSS-247, Issue 3 (section 3.1)	ANSI C63.10-2013	PASS	Note #1
Band edge compliance	FCC § 15.247(d) / RSS-247, Issue 3 (section 5.5)	ANSI C63.10-2013	PASS	
Conducted spurious emissions	FCC § 15.247(d) / RSS-247, Issue 3 (section 5.5)	ANSI C63.10-2013	PASS	
Transmitter radiated spurious emissions	FCC § 15.247(d), FCC § 15.209 / RSS-Gen, Issue 5 A2 (section 6.13)	ANSI C63.10-2013	PASS	
Receiver radiated spurious emissions	ISED RSS-247, Issue 3 (section 3.1)	ANSI C63.4-2014	PASS	
Possible test case verdicts: PASS = Tested device meets the requirements FAIL = Tested device does not meet the requirements N/A = Test requirement not applicable for tested device N/T = Test requirement applicable for tested device, but not tested				
Applicable FCC KDB(s): KDB 558074 DO1: DTS measurement guidance v 0502 (Apr 2, 2019)				

Note #1: Transmission at one channel measured because only host board is AC powered and radio module is DC powered by host board.

9. Occupied bandwidth

Reference: ISED RSS-Gen, Issue 5 A2 (section 6.7)

Test method: ANSI C63.10 (6.9.3)

Limits
None (Informational only)

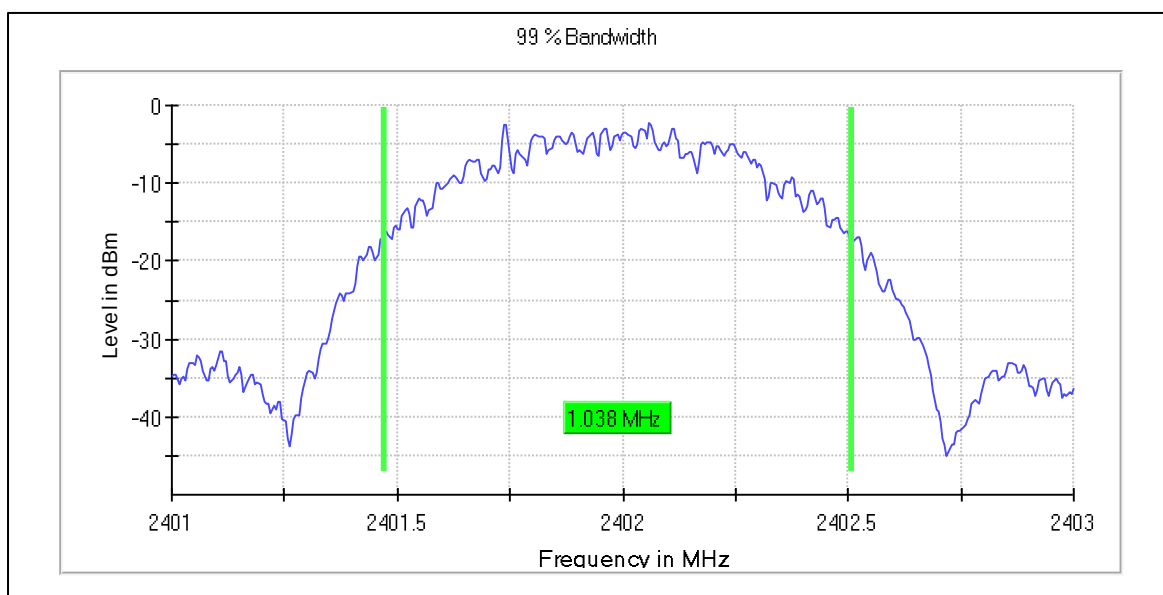
Procedure
1. EUT transmitter is activated in test mode under normal conditions 2. Spectrum analyzer is set to peak detection and maximum hold with a span twice the emission spectrum 3. The resolution bandwidth is set to the range of 1% to 5% of the occupied bandwidth 4. The occupied bandwidth is measured with the build-in analyzer function

Summary:

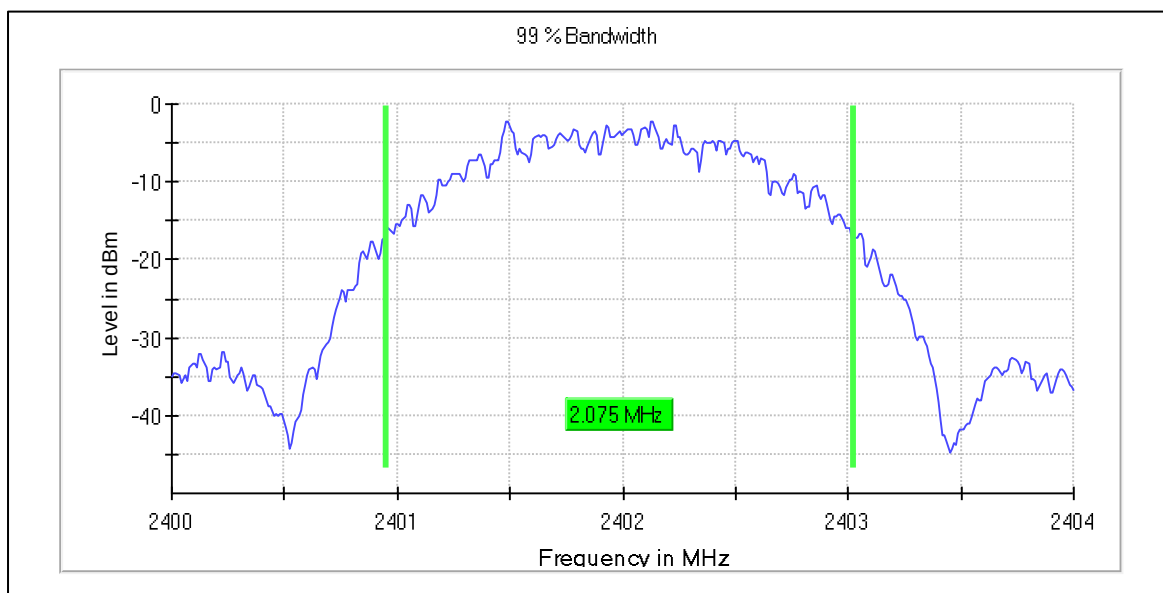
Summary		
Mode / modulation	Frequency (MHz)	Bandwidth (MHz)
Bluetooth LE, 1 Mbps	2402	1.037594
Bluetooth LE, 1 Mbps	2442	1.037594
Bluetooth LE, 1 Mbps	2480	1.037594
Bluetooth LE, 2 Mbps	2402	2.075188
Bluetooth LE, 2 Mbps	2442	2.085213
Bluetooth LE, 2 Mbps	2480	2.075188
Bluetooth LE, Coded PHY (S=2)	2402	1.032582
Bluetooth LE, Coded PHY (S=2)	2442	1.022557
Bluetooth LE, Coded PHY (S=2)	2480	1.032582
Bluetooth LE, Coded PHY (S=8)	2402	1.072682
Bluetooth LE, Coded PHY (S=8)	2442	1.072682
Bluetooth LE, Coded PHY (S=8)	2480	1.072682

Occupied bandwidth, low channel

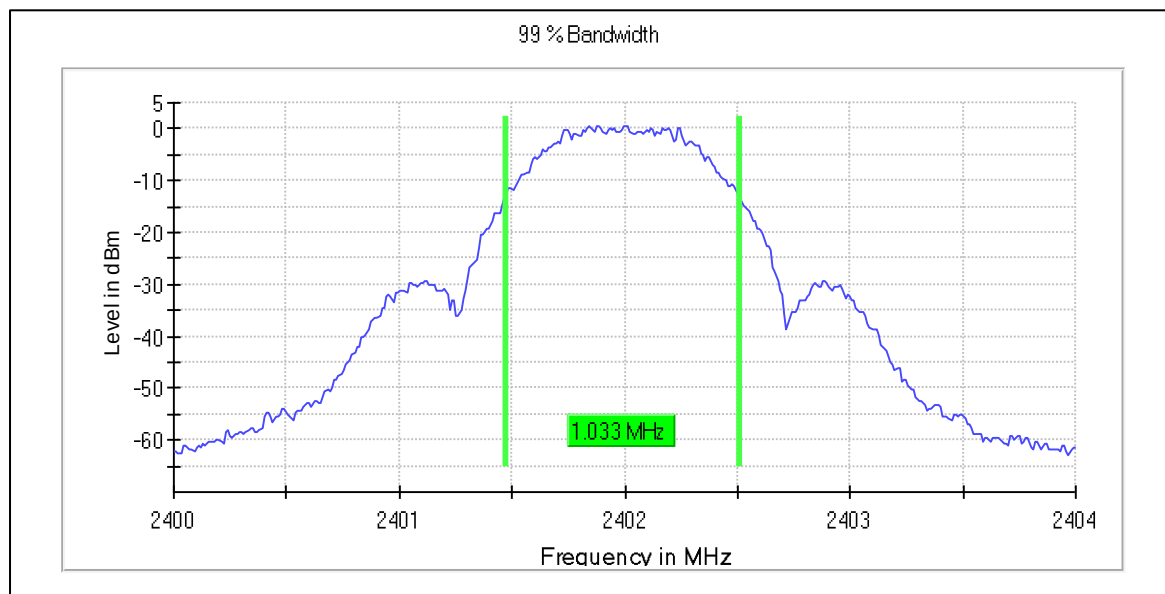
Bluetooth LE, 1 Mbps



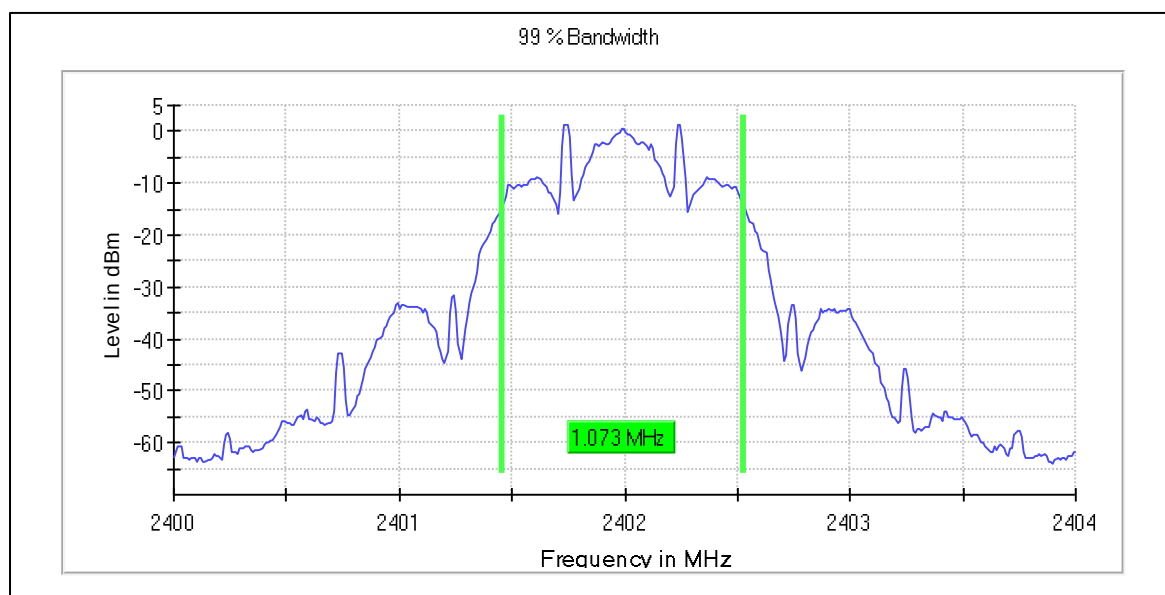
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

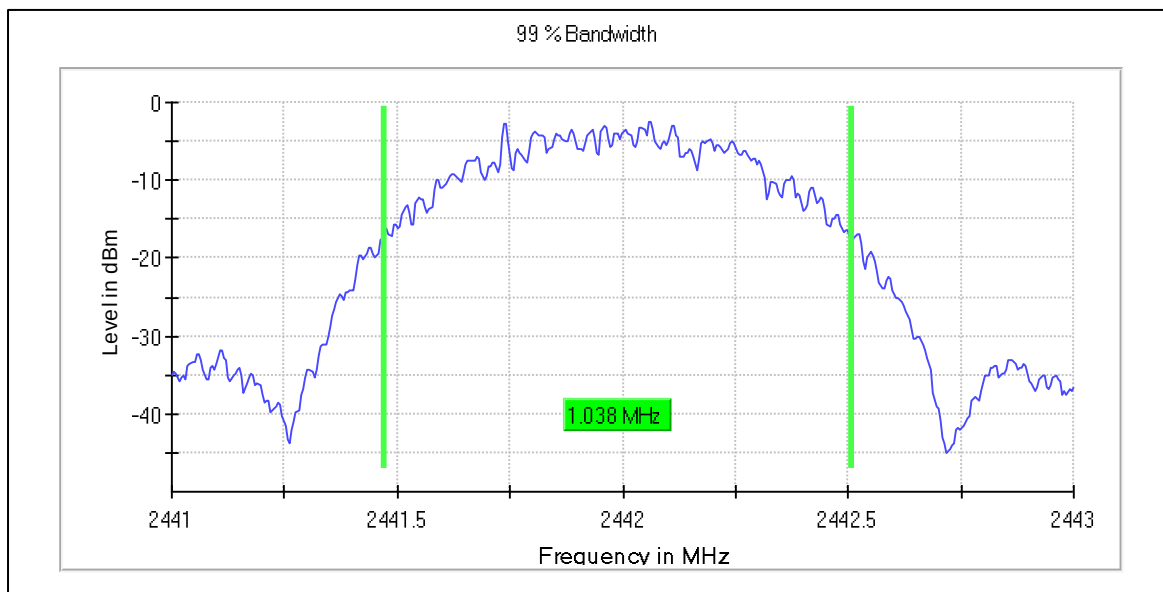


Bluetooth LE, Coded PHY (S=8)

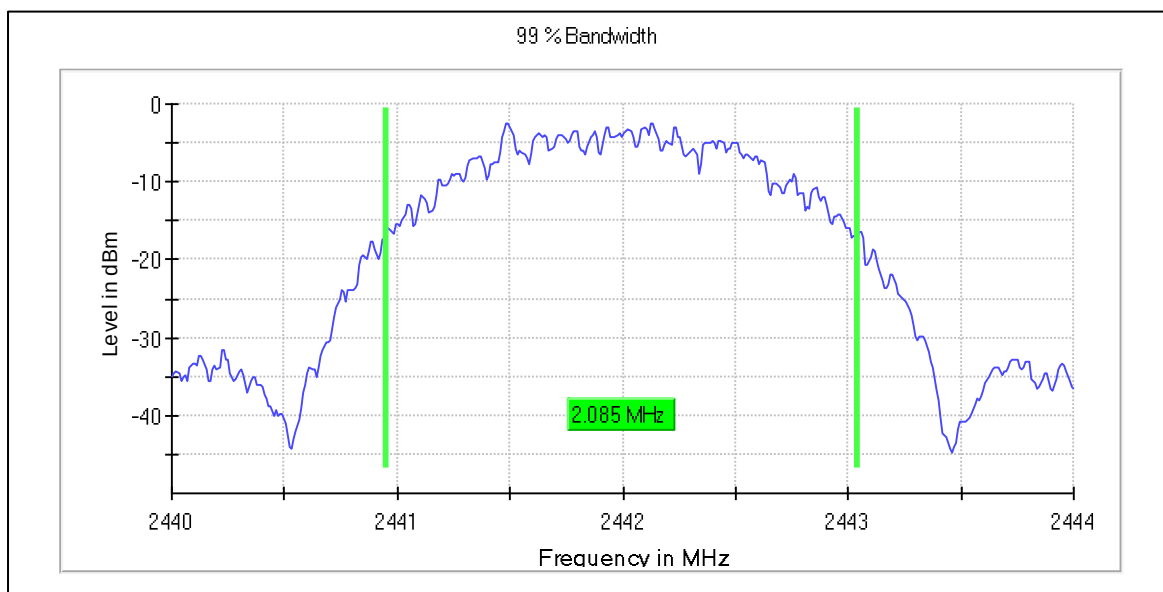


Occupied bandwidth, middle channel

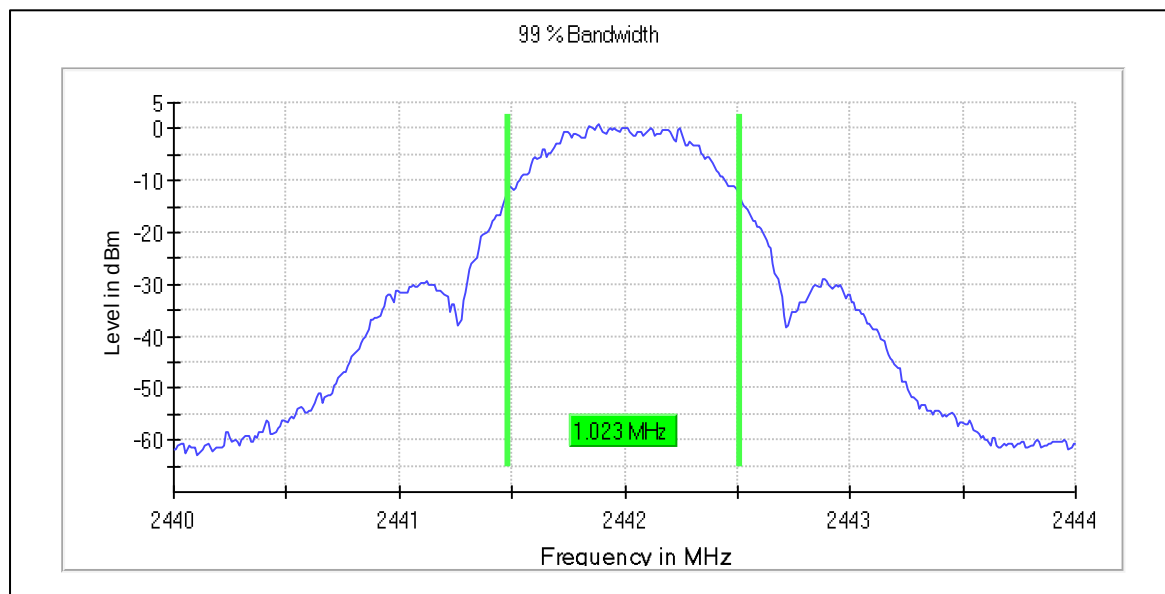
Bluetooth LE, 1 Mbps



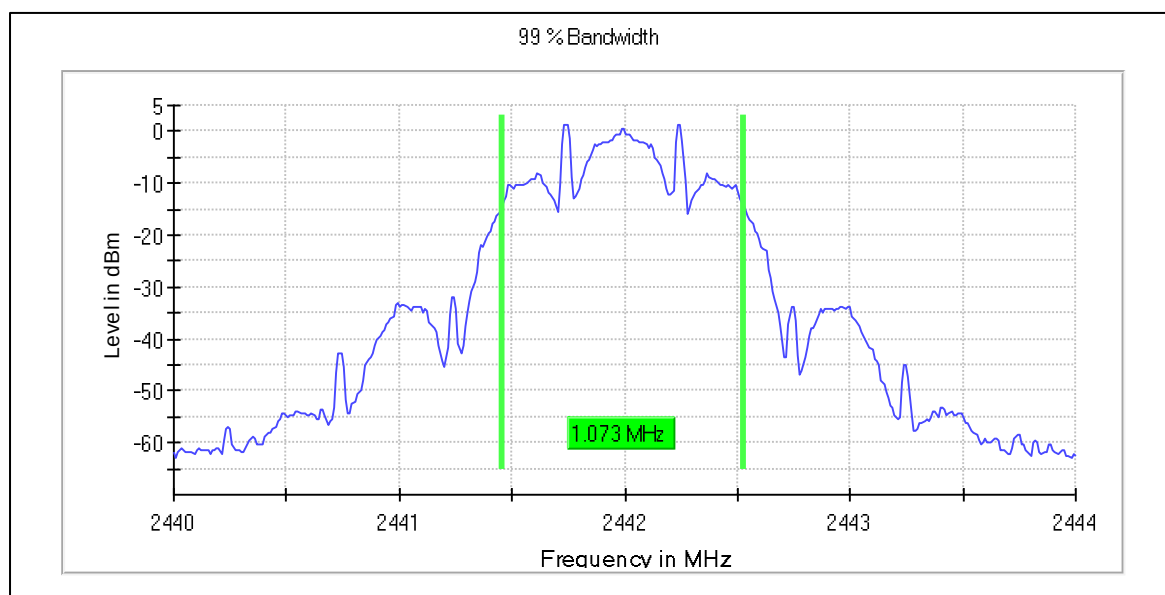
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

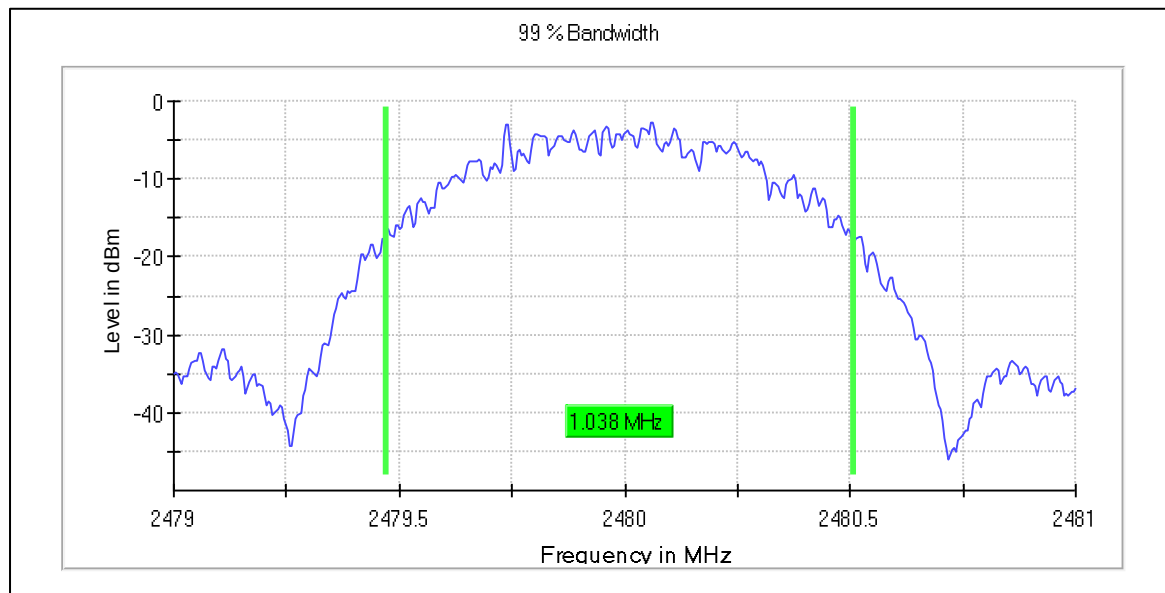


Bluetooth LE, Coded PHY (S=8)

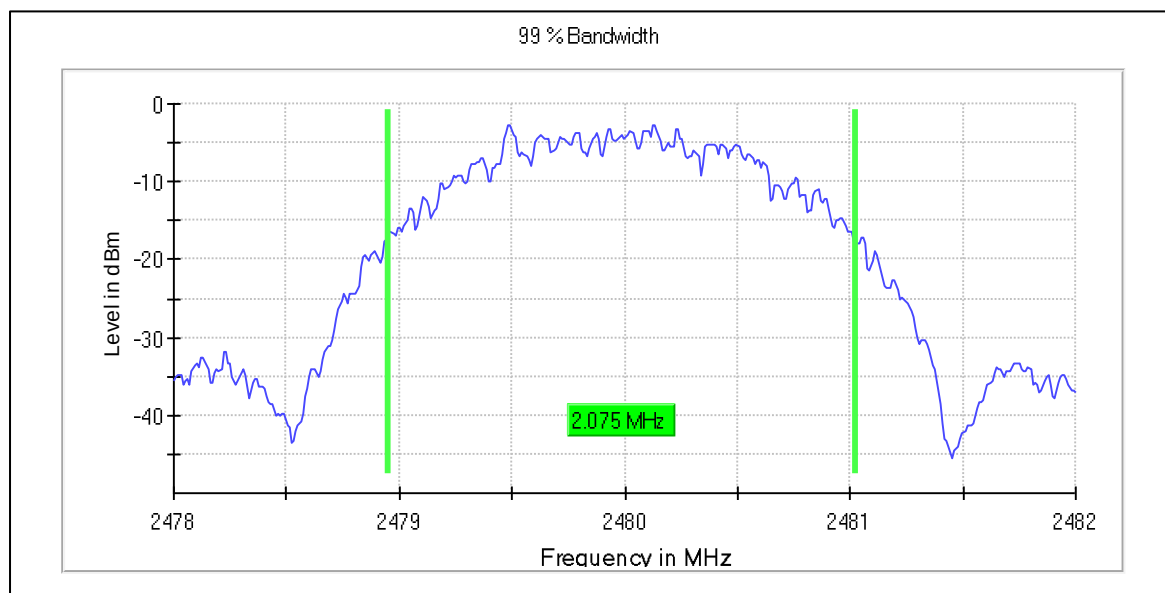


Occupied bandwidth, high channel

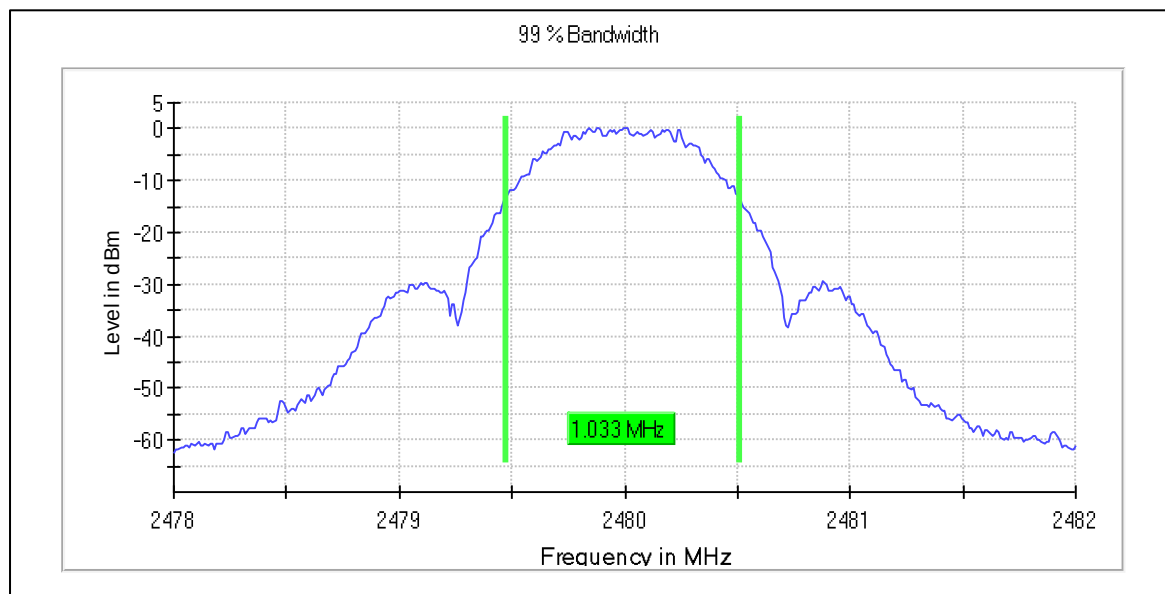
Bluetooth LE, 1 Mbps



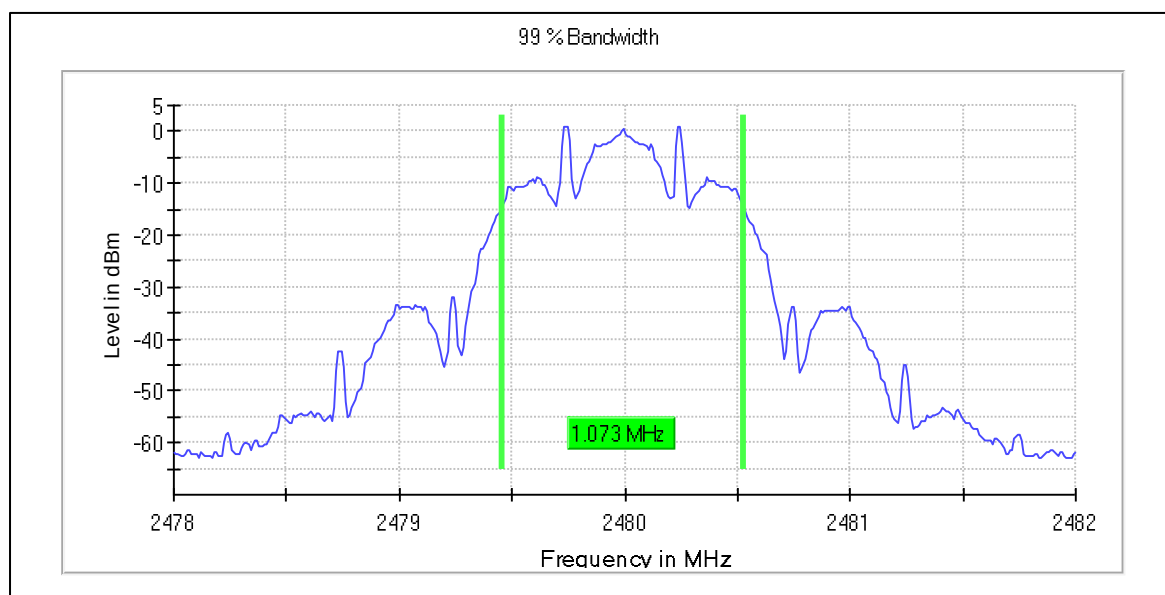
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)



Bluetooth LE, Coded PHY (S=8)



10. 6 dB bandwidth

Reference: FCC title 47 part 15 §15.247(a), ISED RSS-247, Issue 3 (section 5.2)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10-2013 (11.8.1)

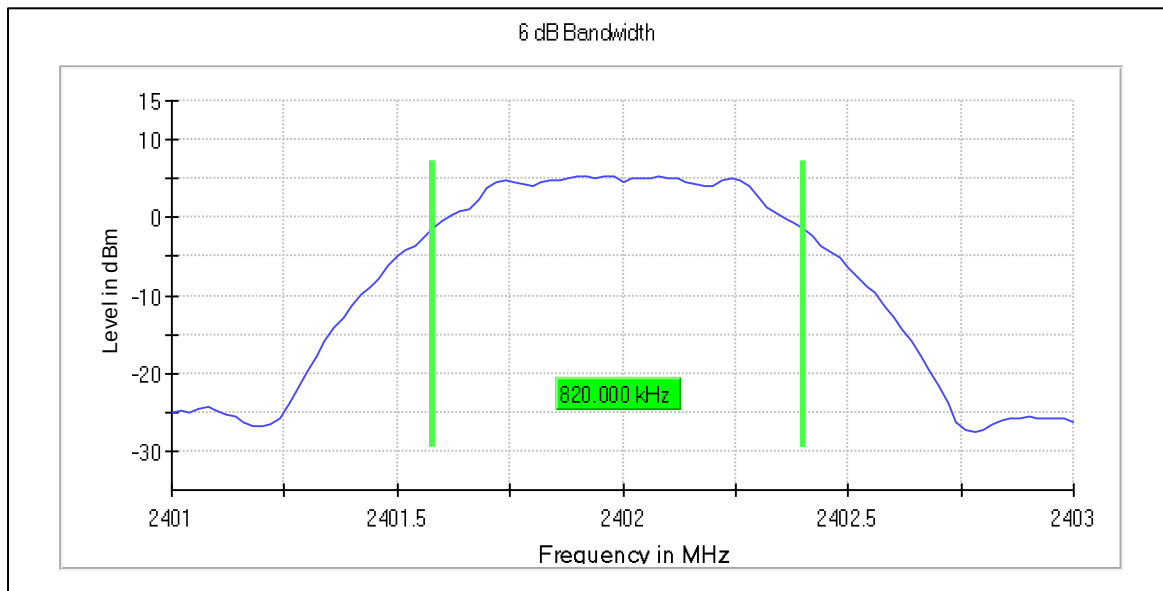
Limits
The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure
1. EUT set to test mode 2. Span set to at least twice the emission spectrum 3. Detector set to peak and max hold and BW is set to 100 kHz 4. Envelope peak value of emission spectrum is selected 5. Marker on envelope of spectrum is set to level of -6 dB to the left of the peak 6. Marker on envelope of spectrum is set to level of -6 dB to the right of the peak 7. 6 dB bandwidth is determined by marker frequency separation

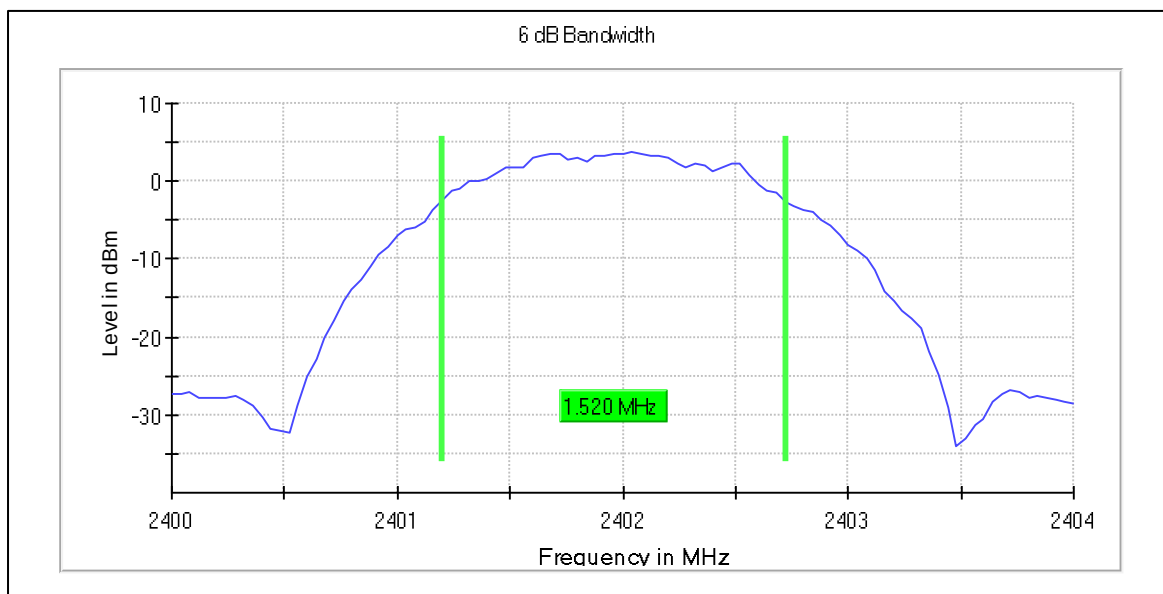
Mode / modulation	DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
Bluetooth LE, 1 Mbps	2402.000000	0.820000	0.500000	---	2401.580000	2402.400000	5.4	PASS
Bluetooth LE, 1 Mbps	2442.000000	0.820000	0.500000	---	2441.580000	2442.400000	5.0	PASS
Bluetooth LE, 1 Mbps	2480.000000	0.820000	0.500000	---	2479.580000	2480.400000	4.8	PASS
Bluetooth LE, 2 Mbps	2402.000000	1.520000	0.500000	---	2401.200000	2402.720000	3.8	PASS
Bluetooth LE, 2 Mbps	2442.000000	1.520000	0.500000	---	2441.200000	2442.720000	3.5	PASS
Bluetooth LE, 2 Mbps	2480.000000	1.520000	0.500000	---	2479.200000	2480.720000	3.4	PASS
Bluetooth LE, Coded PHY (S=2)	2402.000000	0.840000	0.500000	---	2401.560000	2402.400000	5.4	PASS
Bluetooth LE, Coded PHY (S=2)	2442.000000	0.840000	0.500000	---	2441.560000	2442.400000	5.3	PASS
Bluetooth LE, Coded PHY (S=2)	2480.000000	0.840000	0.500000	---	2479.560000	2480.400000	4.9	PASS
Bluetooth LE, Coded PHY (S=8)	2402.000000	0.760000	0.500000	---	2401.600000	2402.360000	3.7	PASS
Bluetooth LE, Coded PHY (S=8)	2442.000000	0.760000	0.500000	---	2441.600000	2442.360000	3.7	PASS
Bluetooth LE, Coded PHY (S=8)	2480.000000	0.760000	0.500000	---	2479.600000	2480.360000	3.4	PASS

6 dB Bandwidth, low channel:

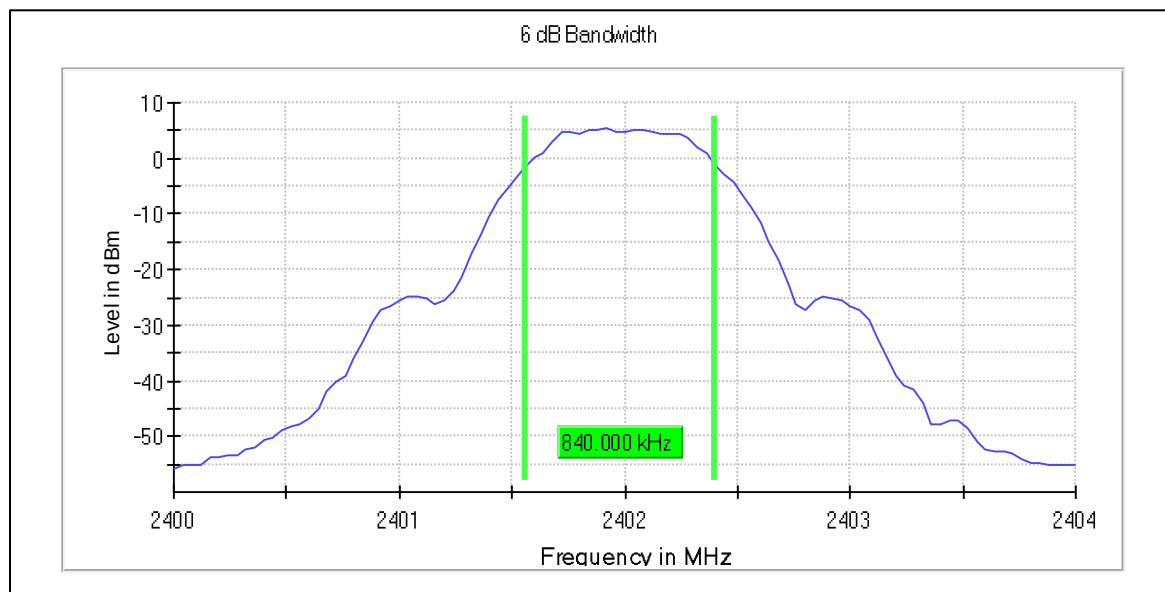
Bluetooth LE, 1 Mbps



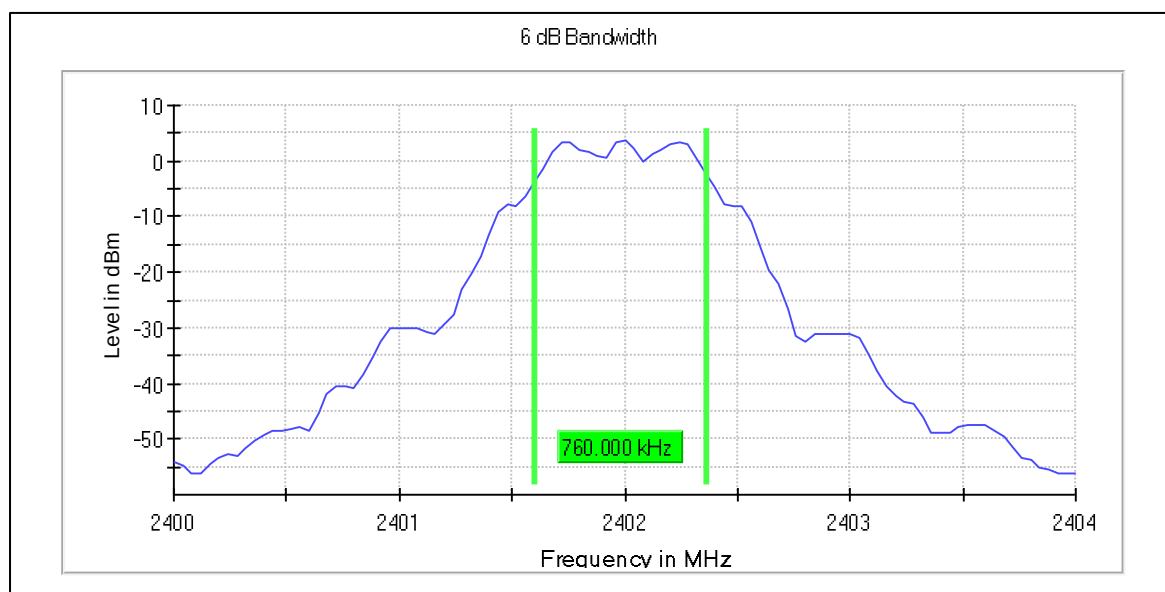
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

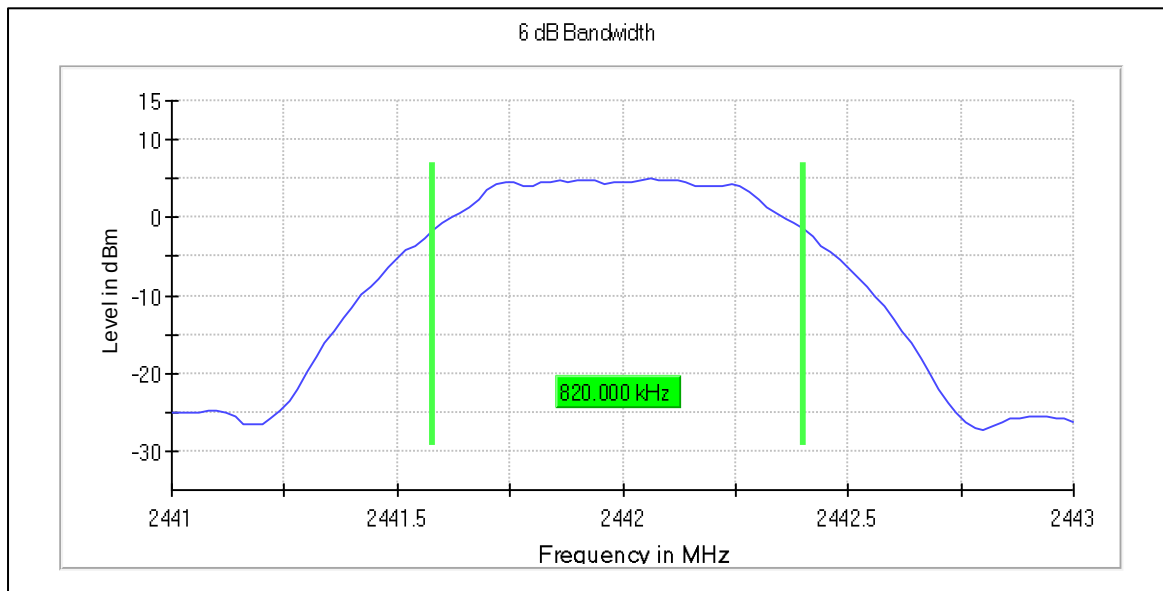


Bluetooth LE, Coded PHY (S=8)

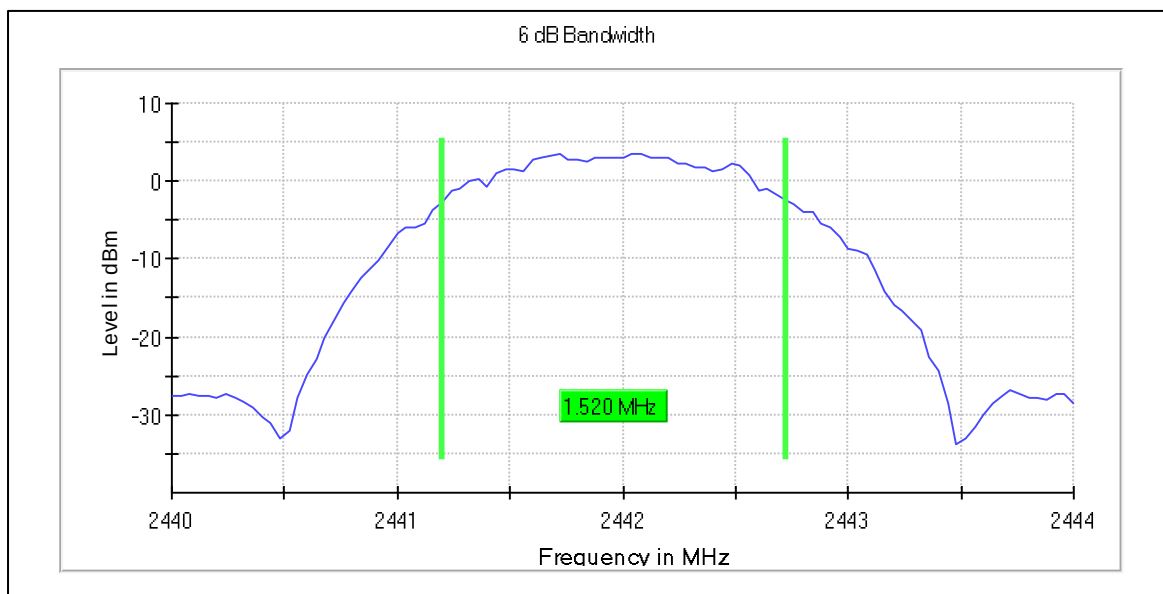


6 dB Bandwidth, middle channel:

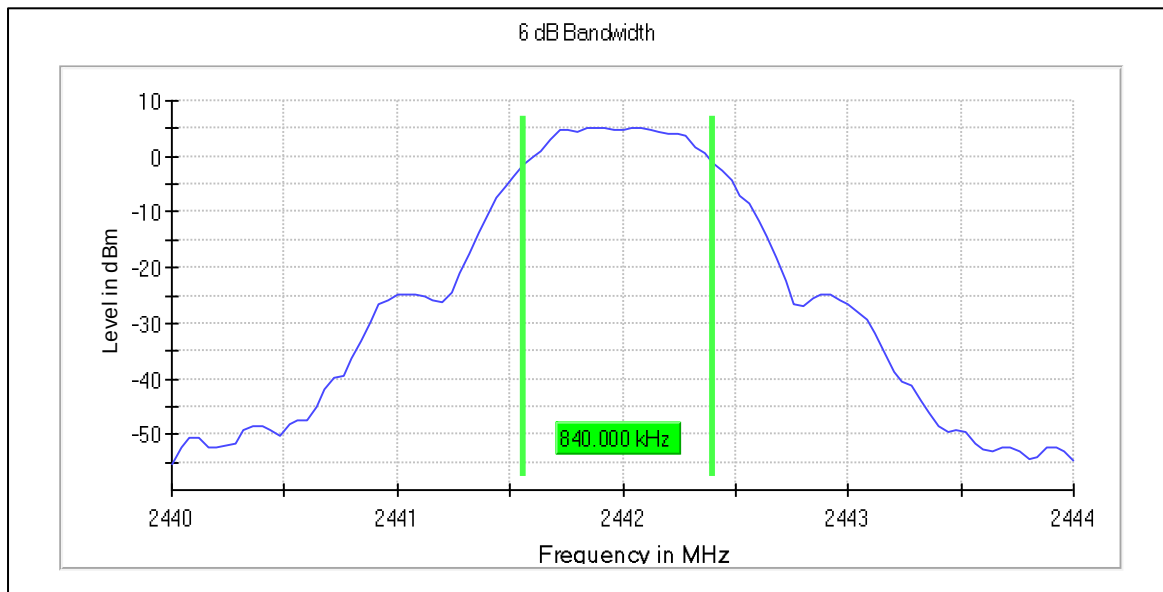
Bluetooth LE, 1 Mbps



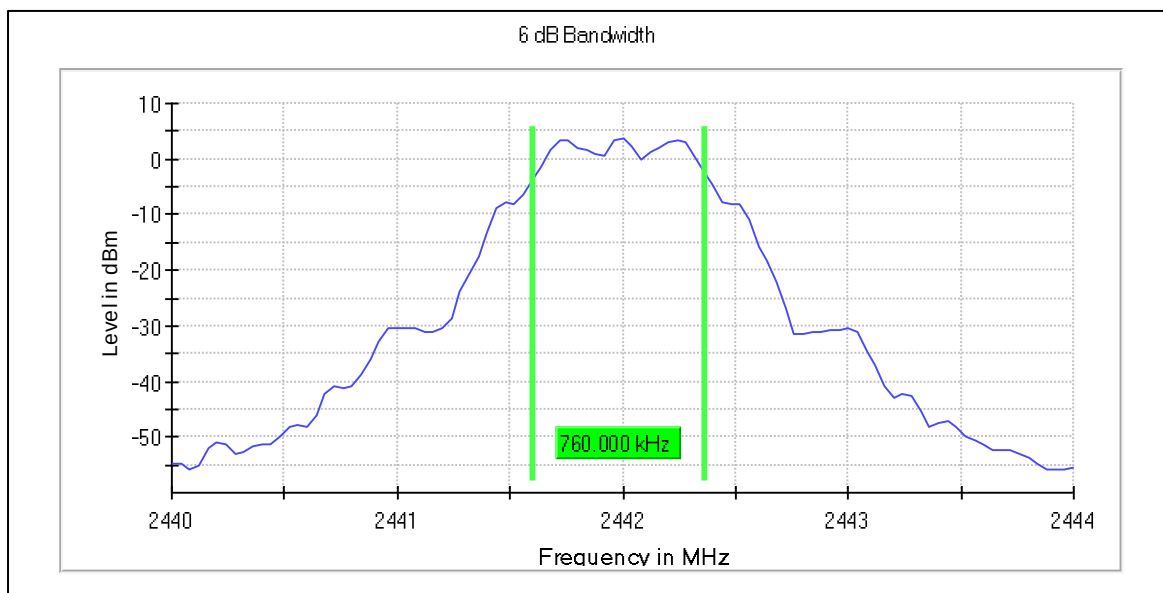
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

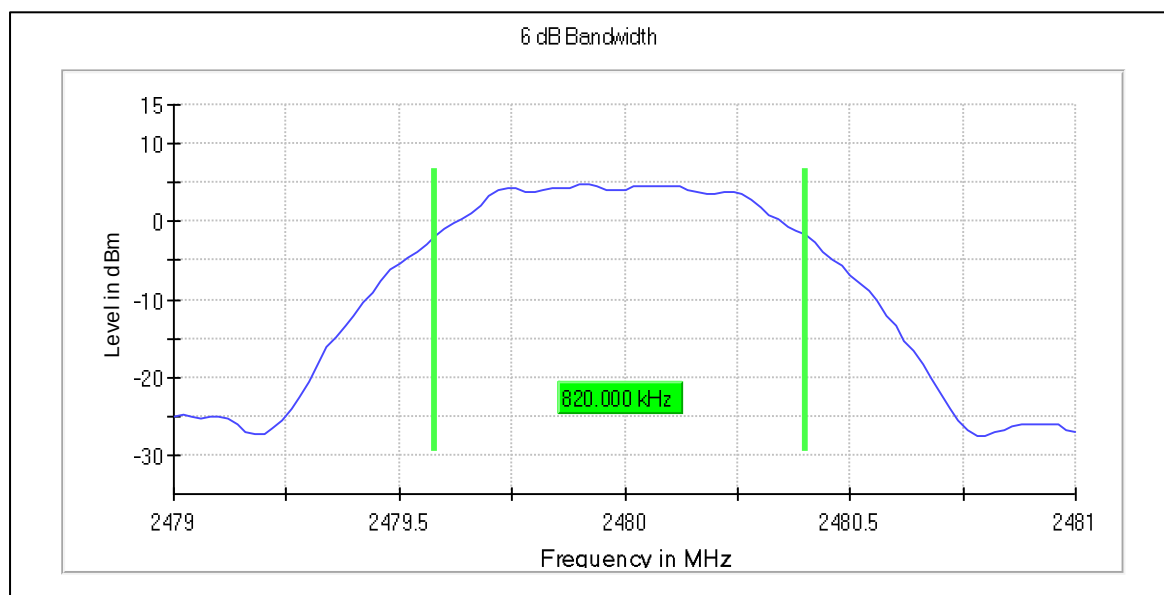


Bluetooth LE, Coded PHY (S=8)

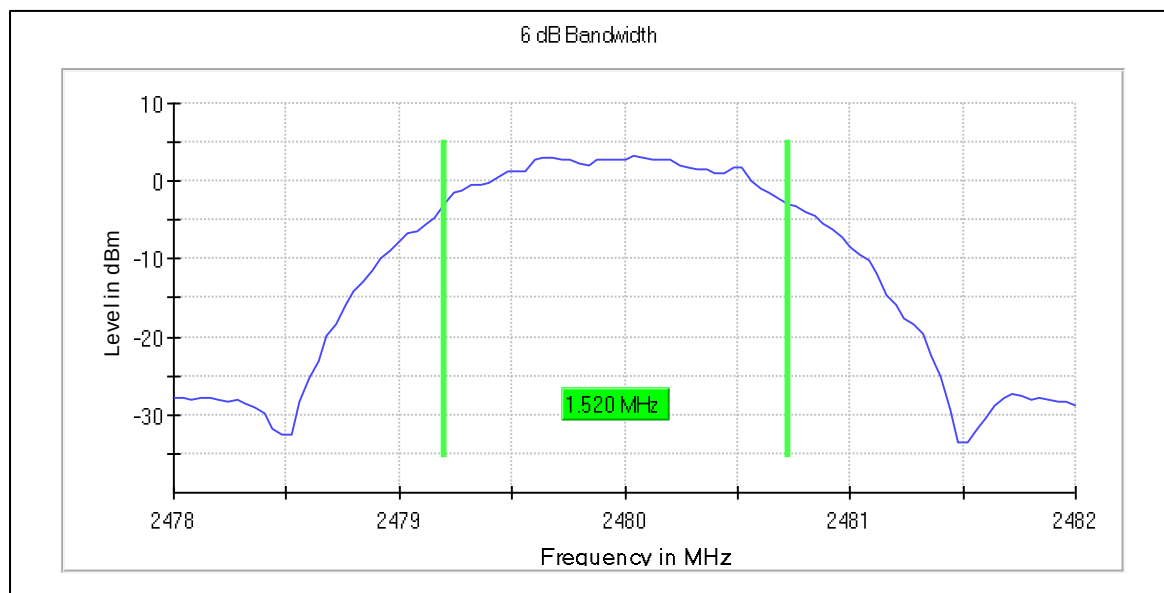


6 dB Bandwidth, high channel:

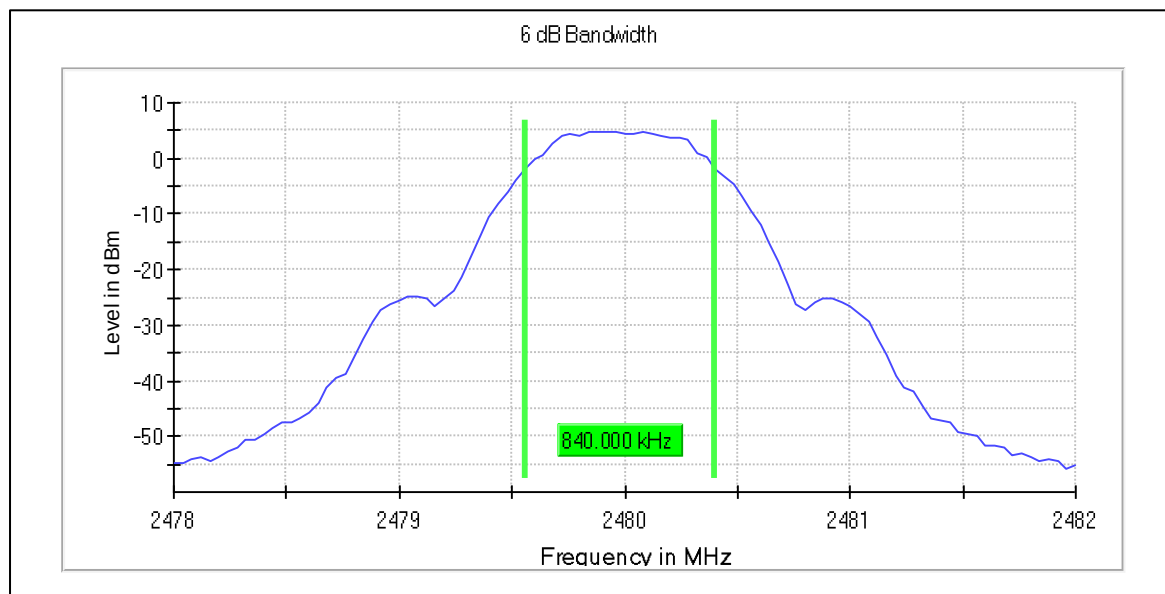
Bluetooth LE, 1 Mbps



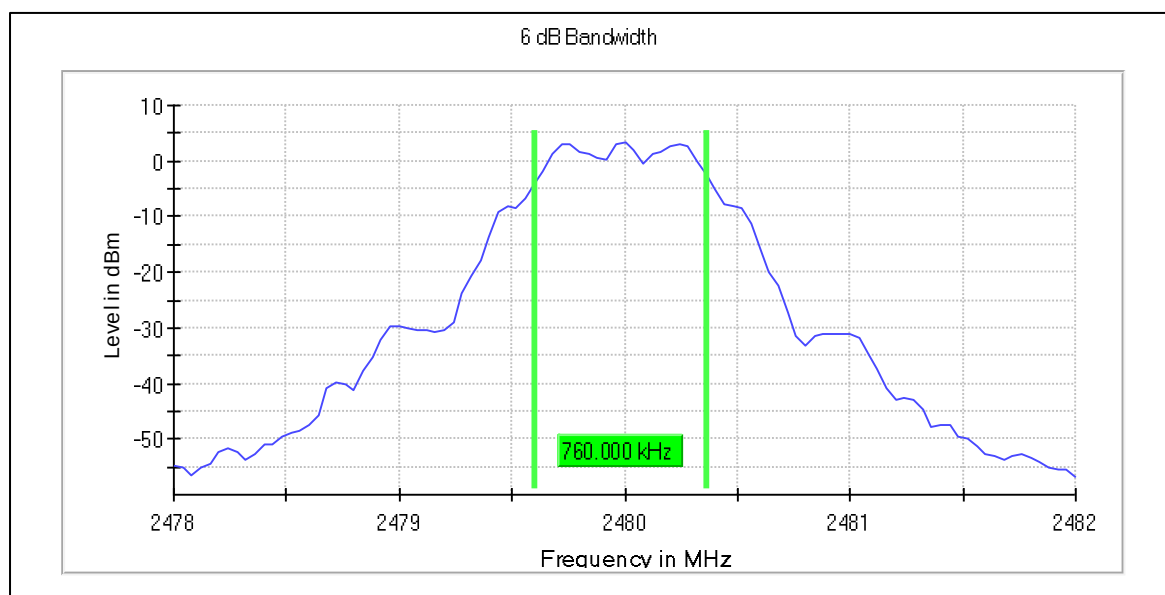
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)



Bluetooth LE, Coded PHY (S=8)



11. Peak conducted output power

Reference: FCC part 15 §15.247(b), ISSED RSS-247, Issue 3 (section 5.4)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10-2013 (11.9.1.1)

Limits
For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).
The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi. 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 the table, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test procedure
1. EUT set to test mode (communication tested is used if needed) 2. Analyzer resolution bandwidth is set $\geq$ DTS bandwidth 3. Detector set to peak and max hold 4. Sweep time is set to auto 5. After trace has stabilized a marker is set to peak envelope

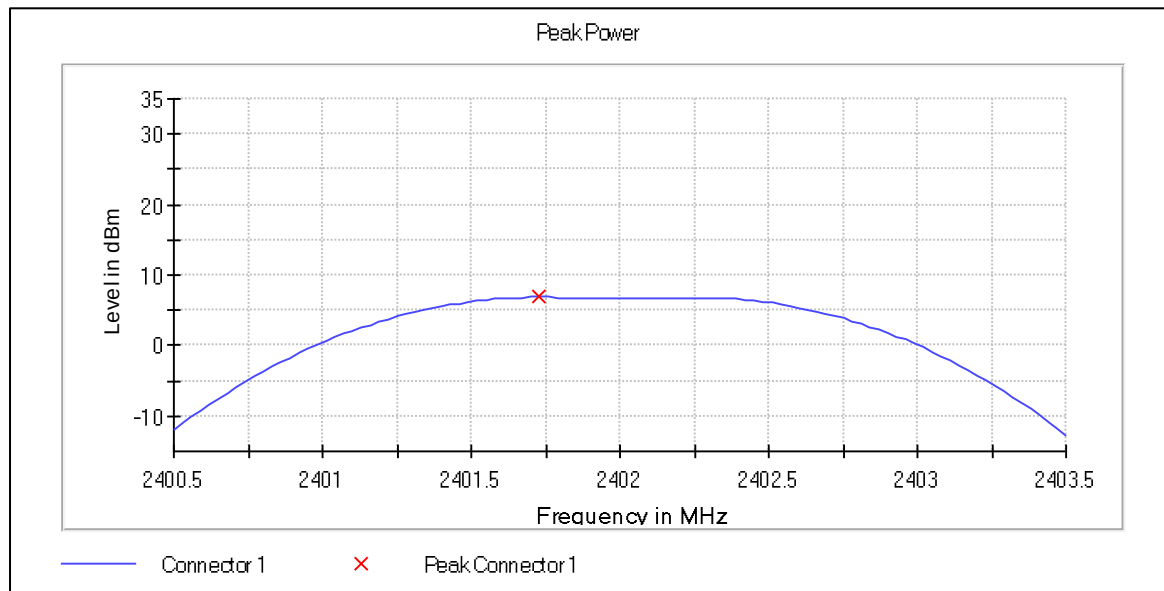
The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

Maximum Declared Antenna Gain: 5.2 dBi

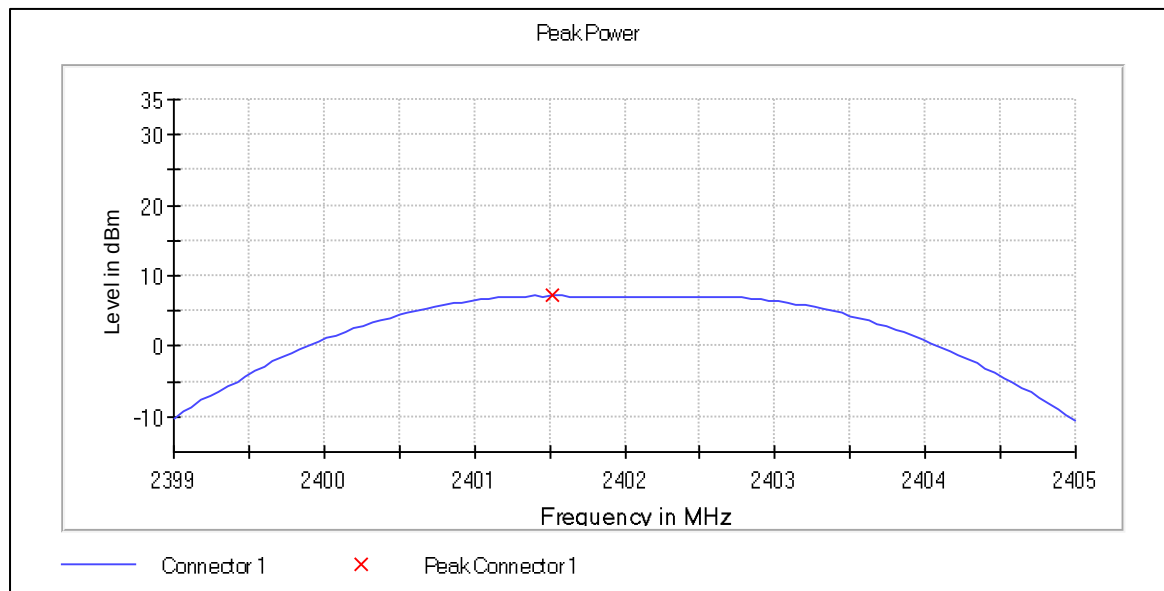
Mode / modulation	DUT Frequency (MHz)	Peak Power (dBm)	EIRP Power	Result
Bluetooth LE, 1 Mbps	2402.000000	6.9	12.1	PASS
Bluetooth LE, 1 Mbps	2442.000000	6.7	11.9	PASS
Bluetooth LE, 1 Mbps	2480.000000	6.4	11.6	PASS
Bluetooth LE, 2 Mbps	2402.000000	7.1	12.3	PASS
Bluetooth LE, 2 Mbps	2442.000000	7.0	12.2	PASS
Bluetooth LE, 2 Mbps	2480.000000	6.8	12.0	PASS
Bluetooth LE, Coded PHY (S=2)	2402.000000	7.2	12.4	PASS
Bluetooth LE, Coded PHY (S=2)	2442.000000	7.2	12.4	PASS
Bluetooth LE, Coded PHY (S=2)	2480.000000	6.8	12.0	PASS
Bluetooth LE, Coded PHY (S=8)	2402.000000	7.1	12.3	PASS
Bluetooth LE, Coded PHY (S=8)	2442.000000	7.1	12.3	PASS
Bluetooth LE, Coded PHY (S=8)	2480.000000	6.8	12.0	PASS

Peak power, low channel

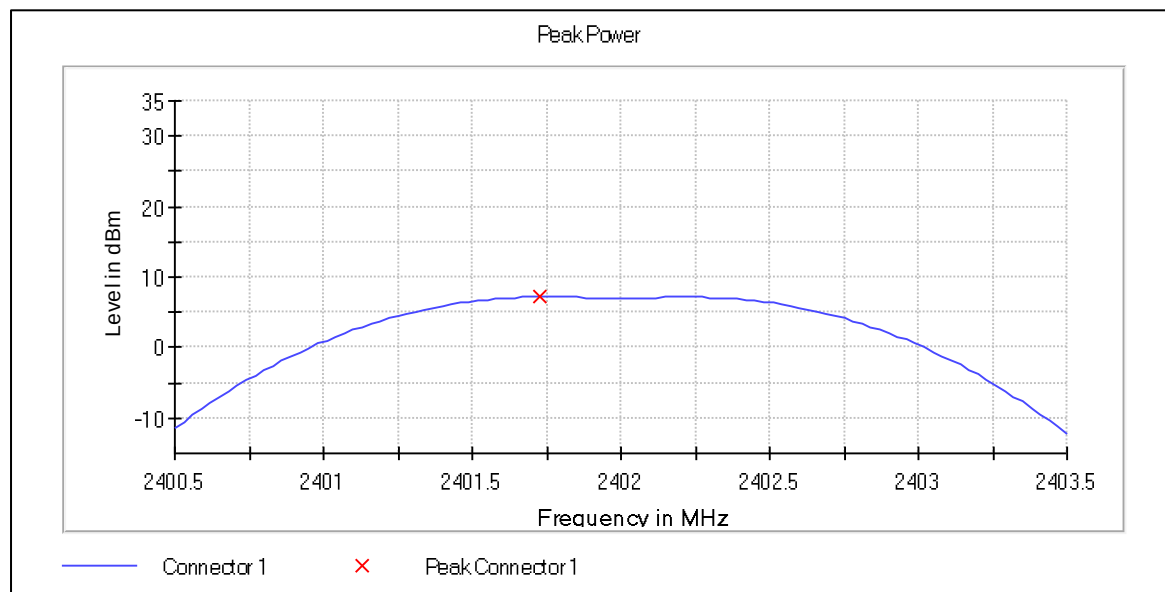
Bluetooth LE, 1 Mbps



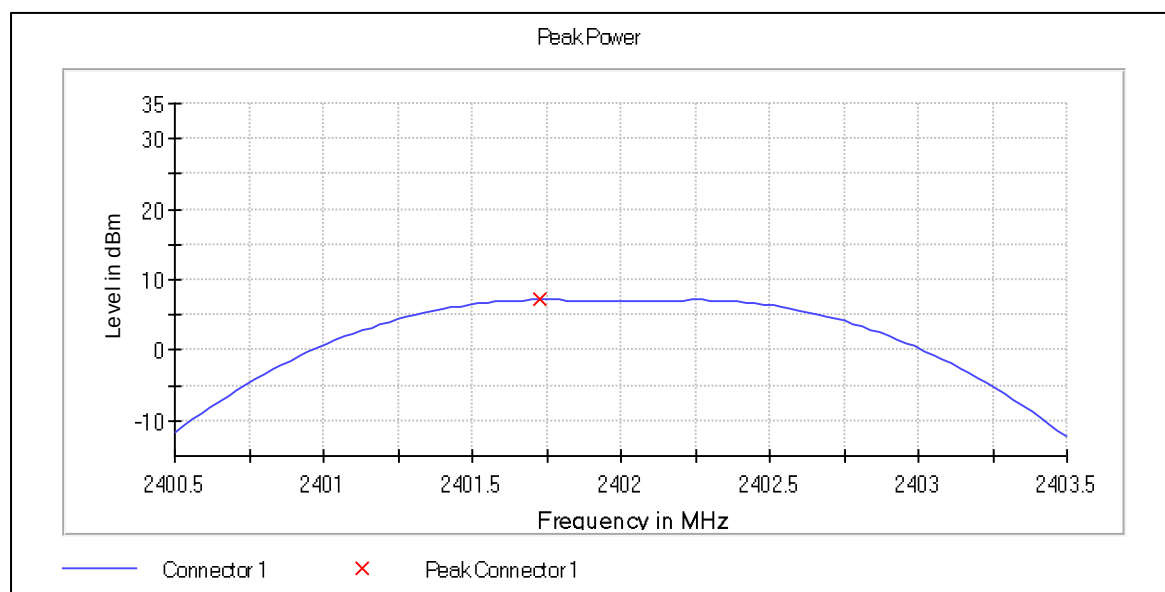
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

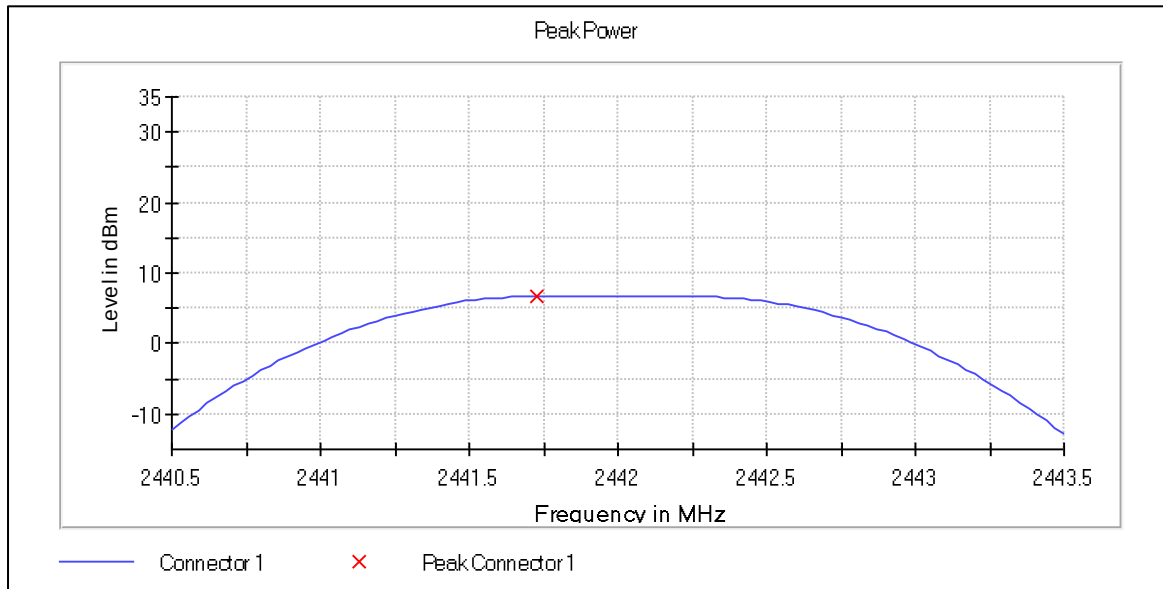


Bluetooth LE, Coded PHY (S=8)

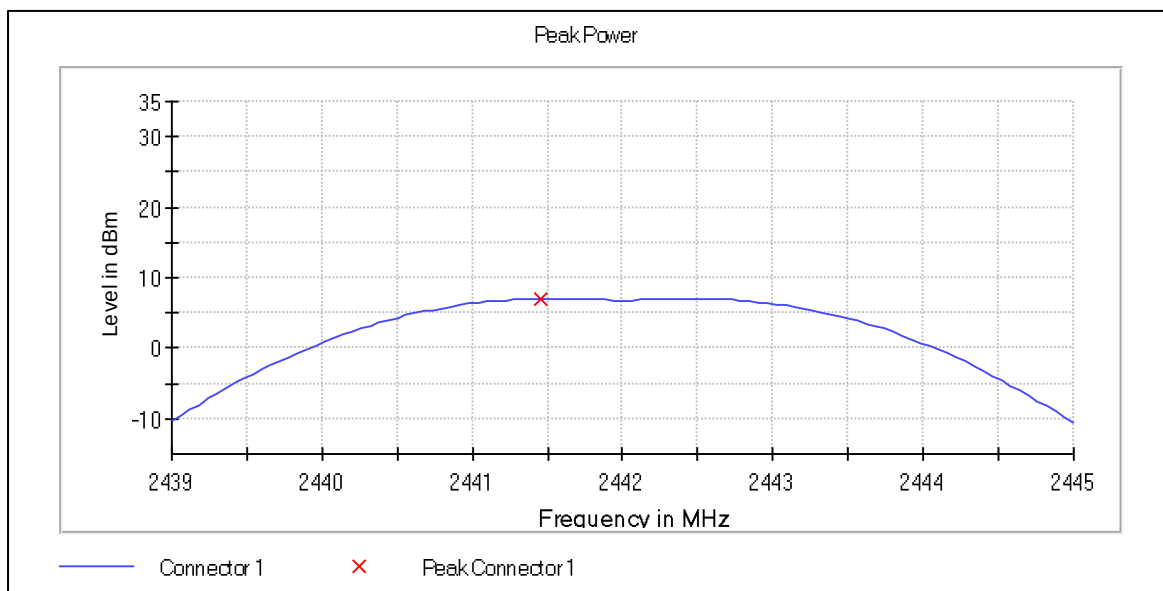


Peak power, middle channel

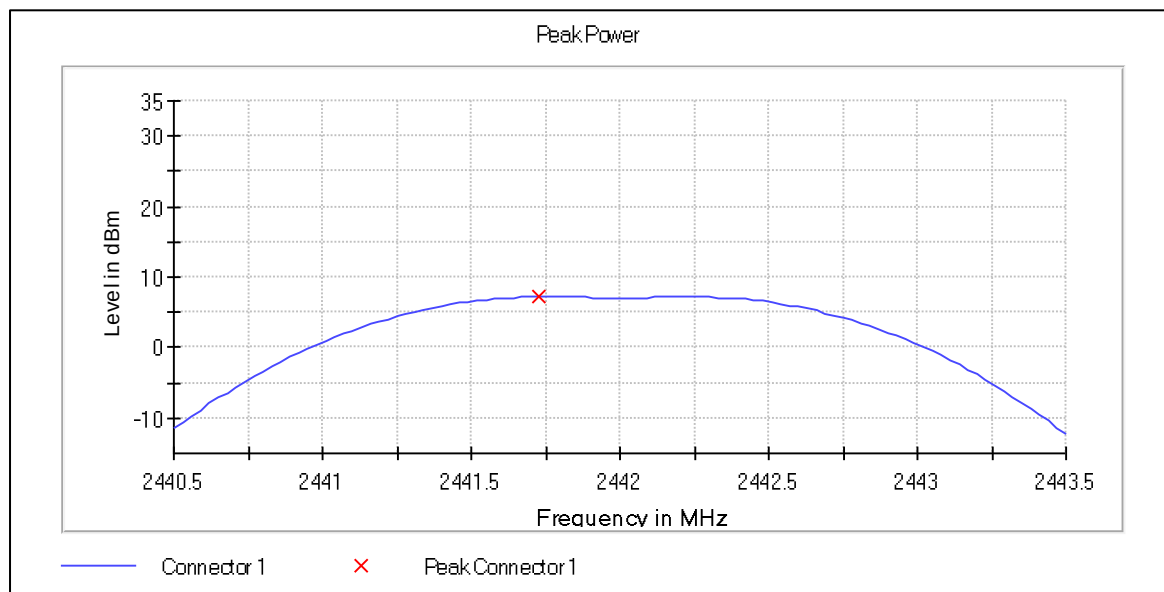
Bluetooth LE, 1 Mbps



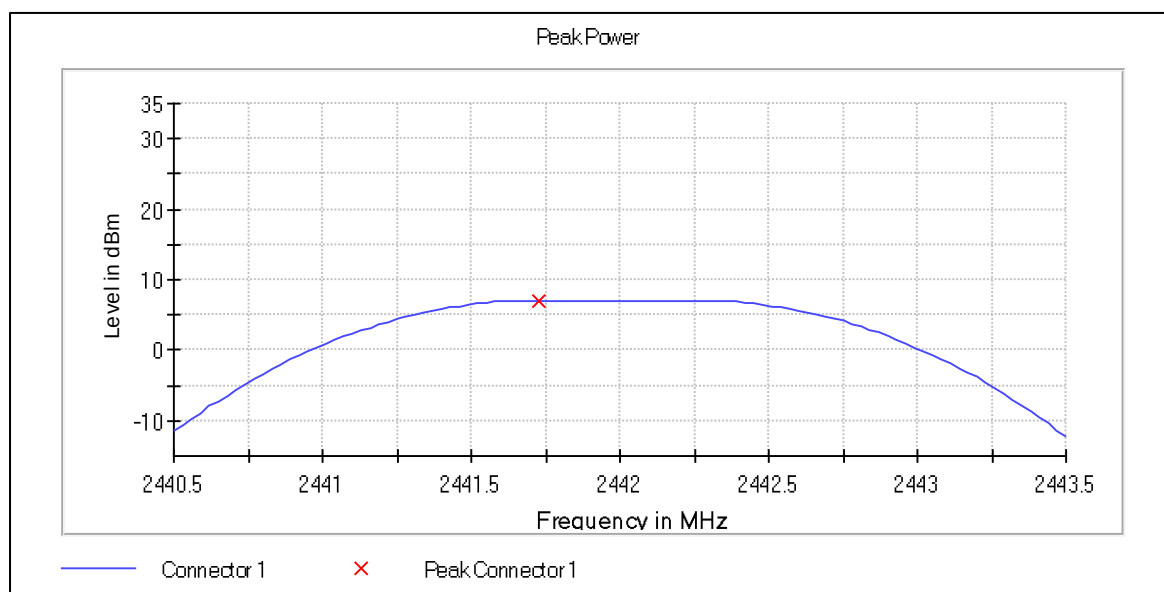
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

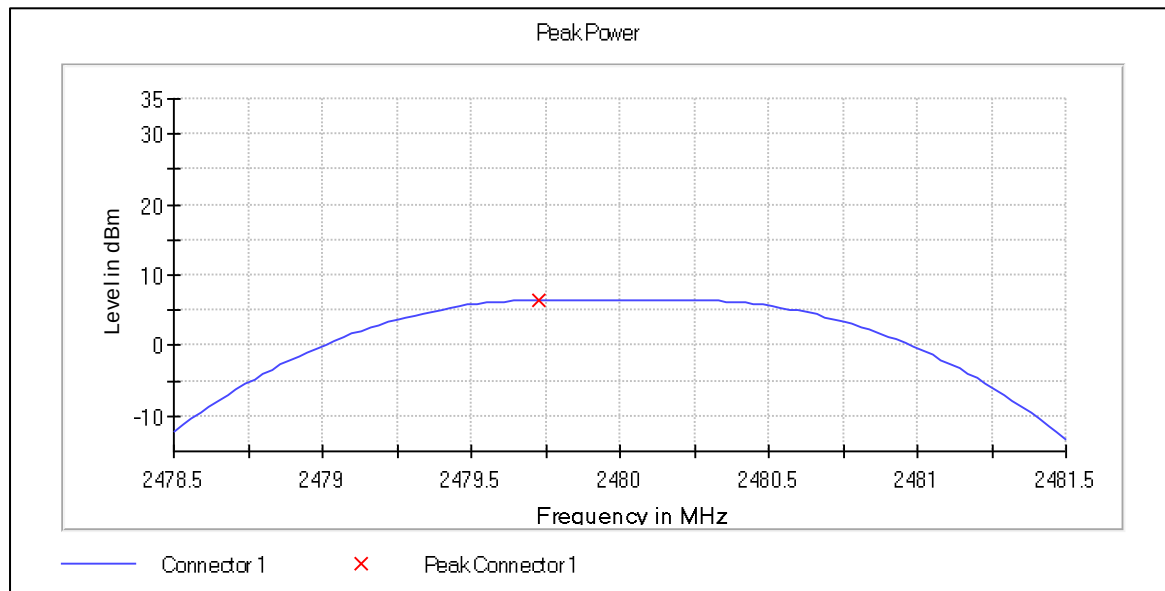


Bluetooth LE, Coded PHY (S=8)

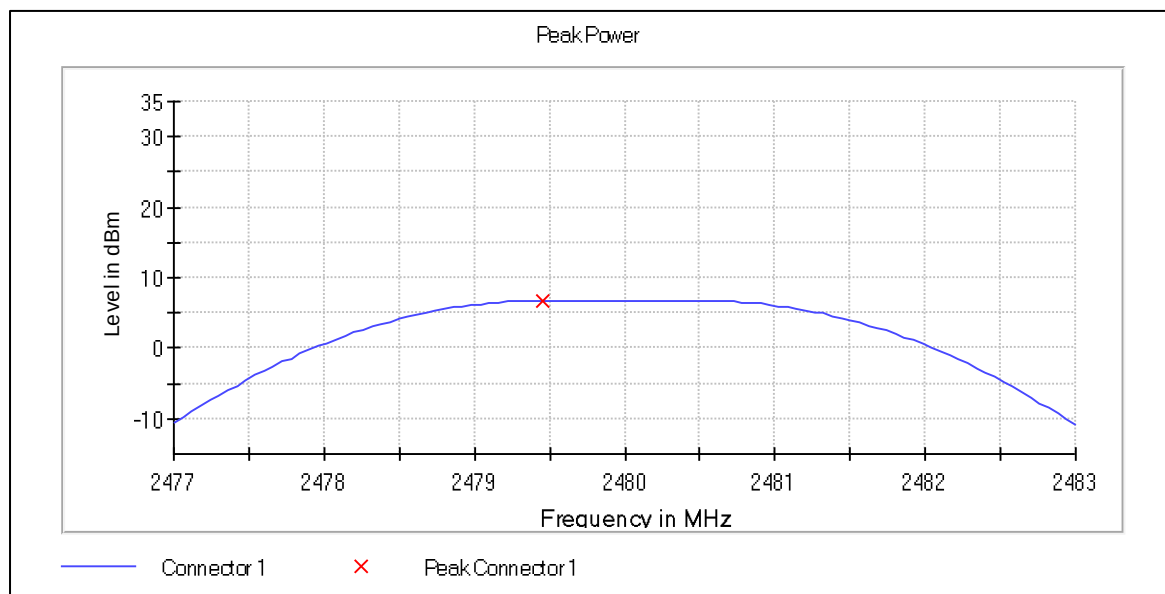


Peak power, high channel

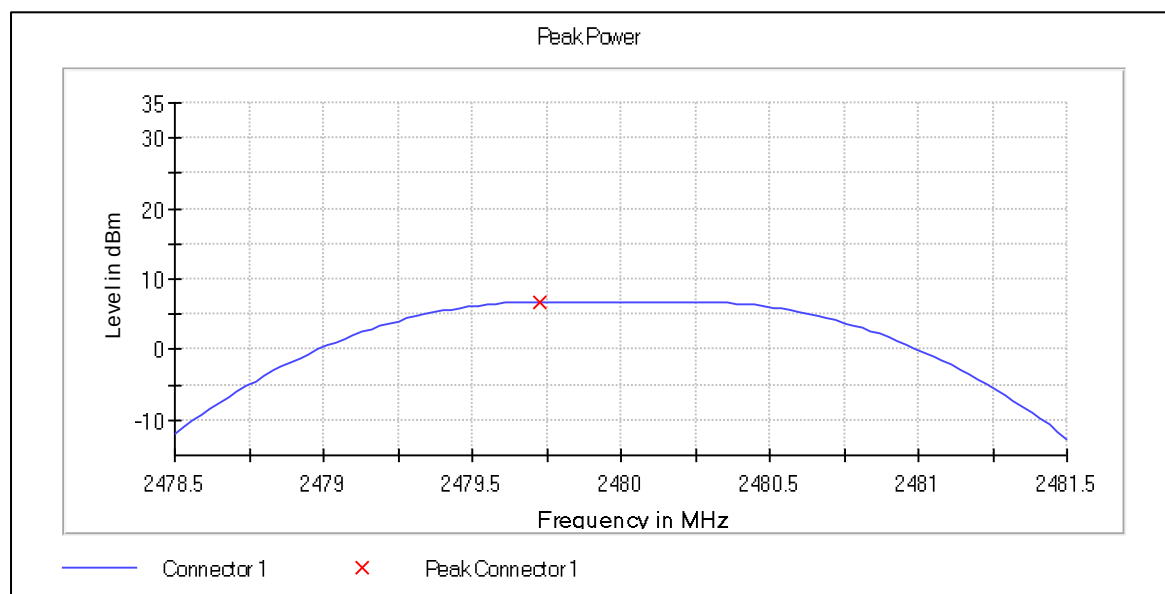
Bluetooth LE, 1 Mbps



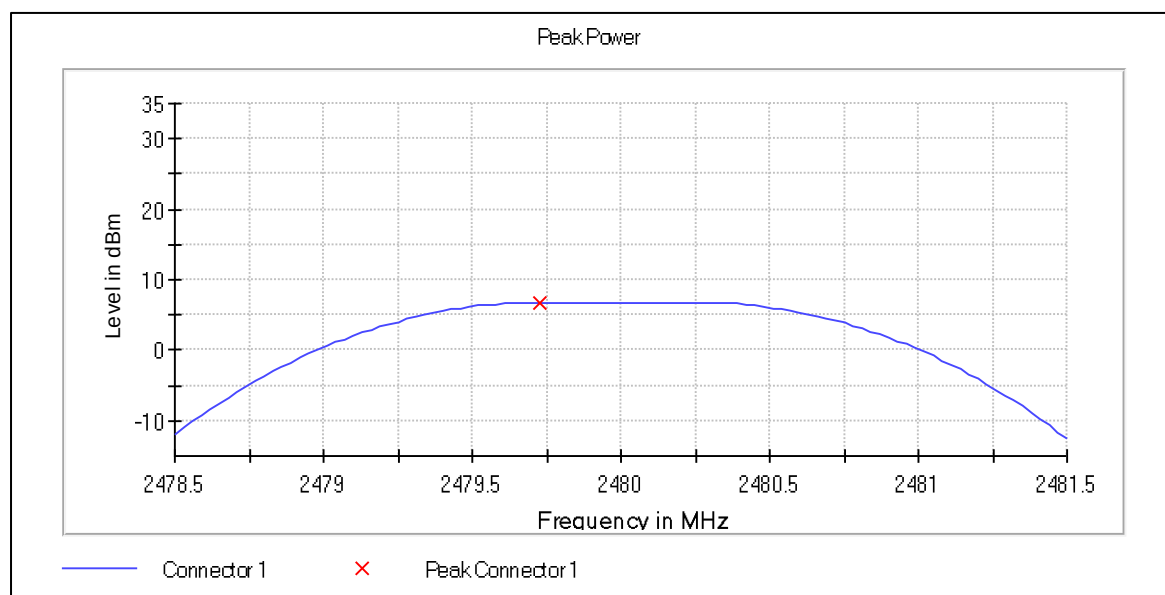
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)



Bluetooth LE, Coded PHY (S=8)



12. Peak Power Spectral Density

Reference: FCC §15.247(a),(e), ISSED RSS-247, Issue 3 (section 5.2)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10-2013 (11.10.2, 14.3.2)

Specification: 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.

Limits
≤ 8 dBm / 3 kHz

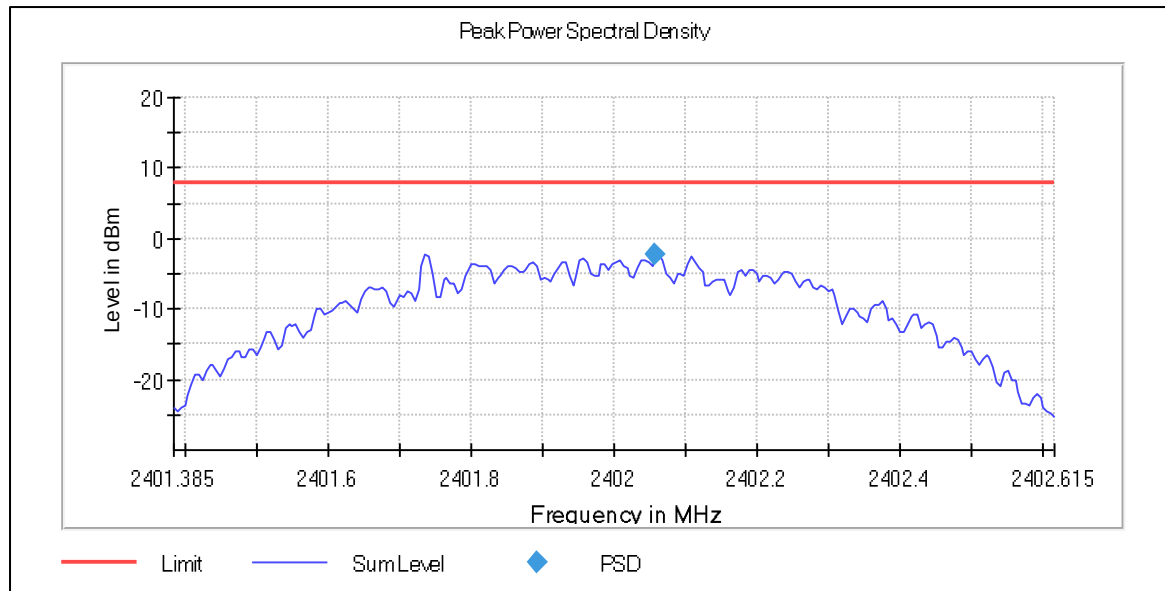
Test procedure
1. EUT set to test mode 2. The analyser is set to DTS channel center frequency with a span of 1.5 times the DTS bandwidth 3. The analyzer is set to 100 kHz with VBW ≥ RBW and the detector is set to peak with max hold 4. After trace has stabilized a marker is set to the envelope maximum 5. If the power spectral density is above the limit the RBW is reduces (not lower than 3 kHz) and the measurement is repeated 6. If the EUT has more than one transmit chain the procedure is repeated for each chain

Summary

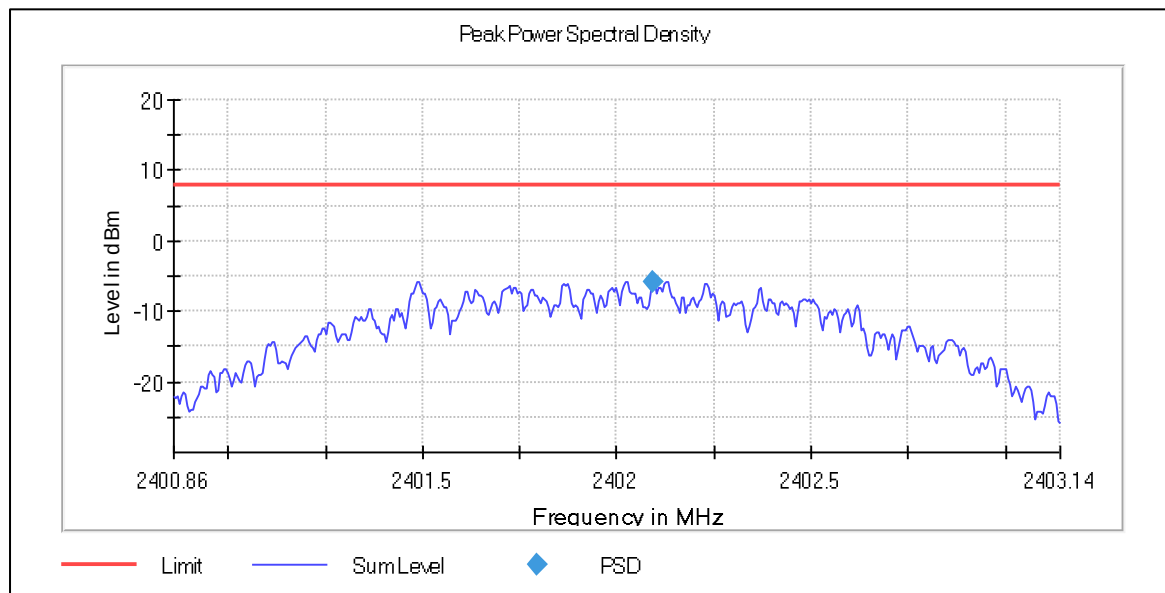
Mode / modulation	DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
Bluetooth LE, 1 Mbps	2402.000000	2402.057735	-2.230	8.0	PASS
Bluetooth LE, 1 Mbps	2442.000000	2442.057735	-2.256	8.0	PASS
Bluetooth LE, 1 Mbps	2480.000000	2480.057735	-2.682	8.0	PASS
Bluetooth LE, 2 Mbps	2402.000000	2402.092703	-5.758	8.0	PASS
Bluetooth LE, 2 Mbps	2442.000000	2442.092703	-5.769	8.0	PASS
Bluetooth LE, 2 Mbps	2480.000000	2480.092703	-6.118	8.0	PASS
Bluetooth LE, Coded PHY (S=2)	2402.000000	2401.741474	1.787	8.0	PASS
Bluetooth LE, Coded PHY (S=2)	2442.000000	2441.741474	1.724	8.0	PASS
Bluetooth LE, Coded PHY (S=2)	2480.000000	2479.741474	1.477	8.0	PASS
Bluetooth LE, Coded PHY (S=8)	2402.000000	2401.987445	1.666	8.0	PASS
Bluetooth LE, Coded PHY (S=8)	2442.000000	2441.987445	2.685	8.0	PASS
Bluetooth LE, Coded PHY (S=8)	2480.000000	2479.987445	2.364	8.0	PASS

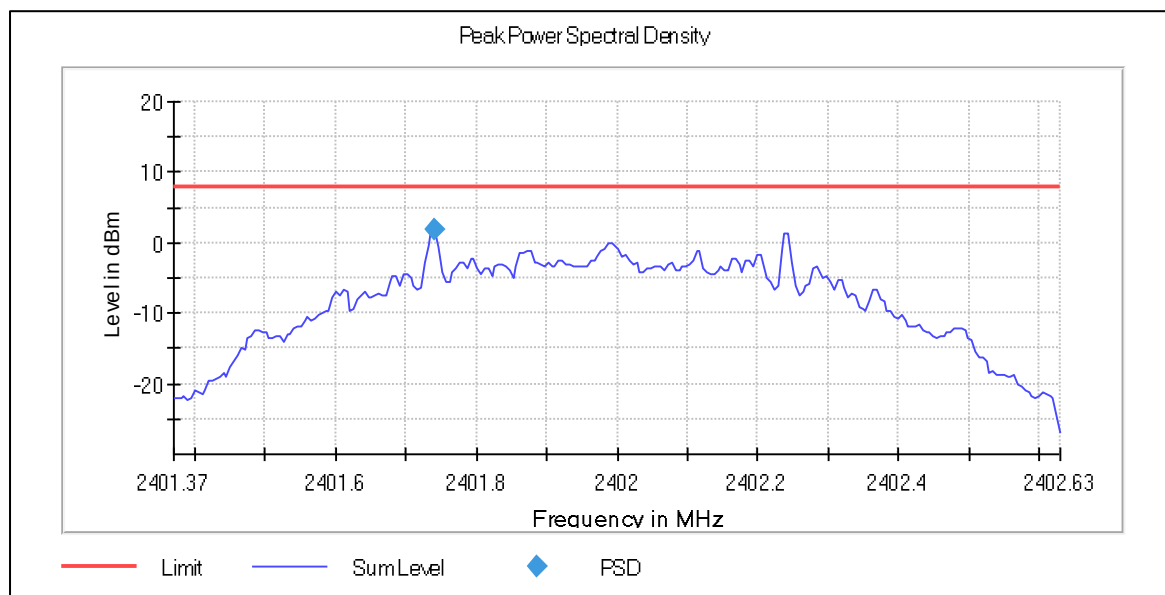
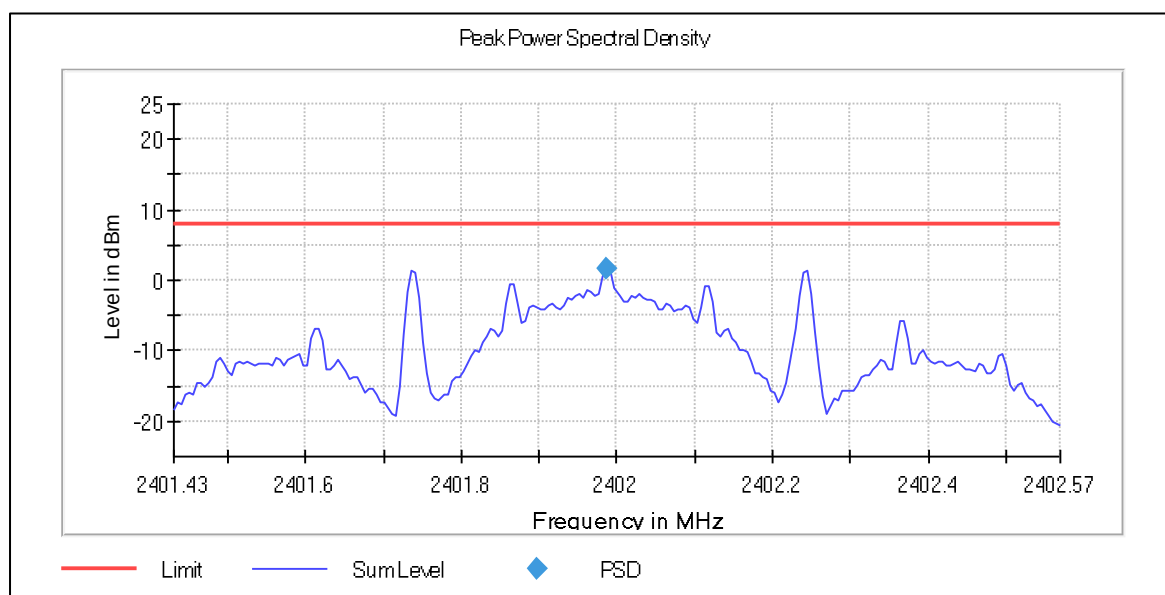
Peak power spectral density, low channel

Bluetooth LE, 1 Mbps



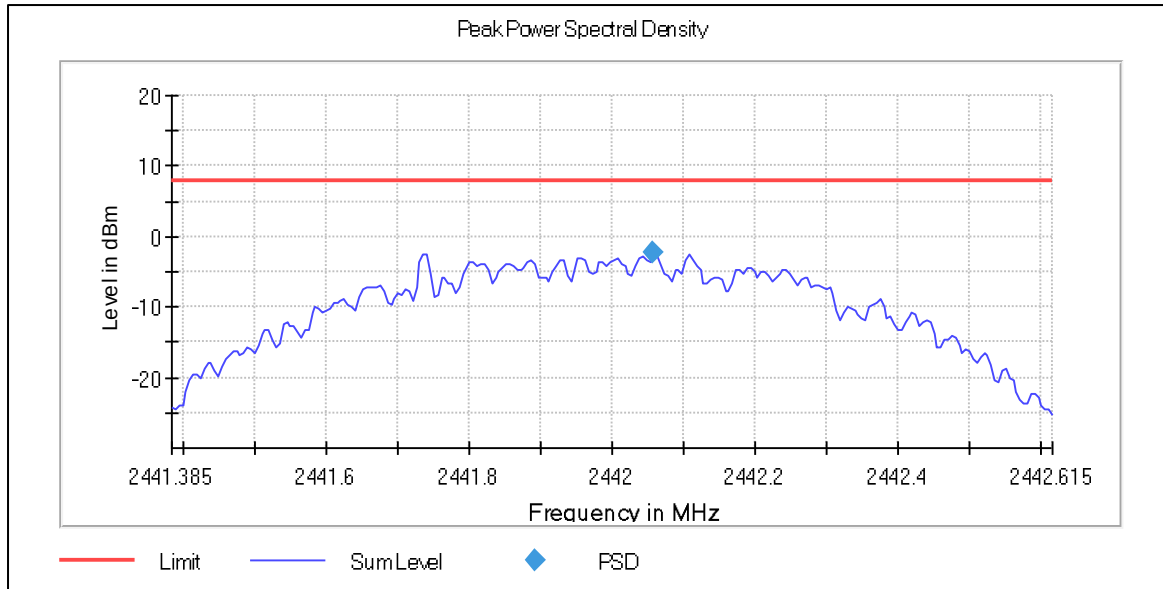
Bluetooth LE, 2 Mbps



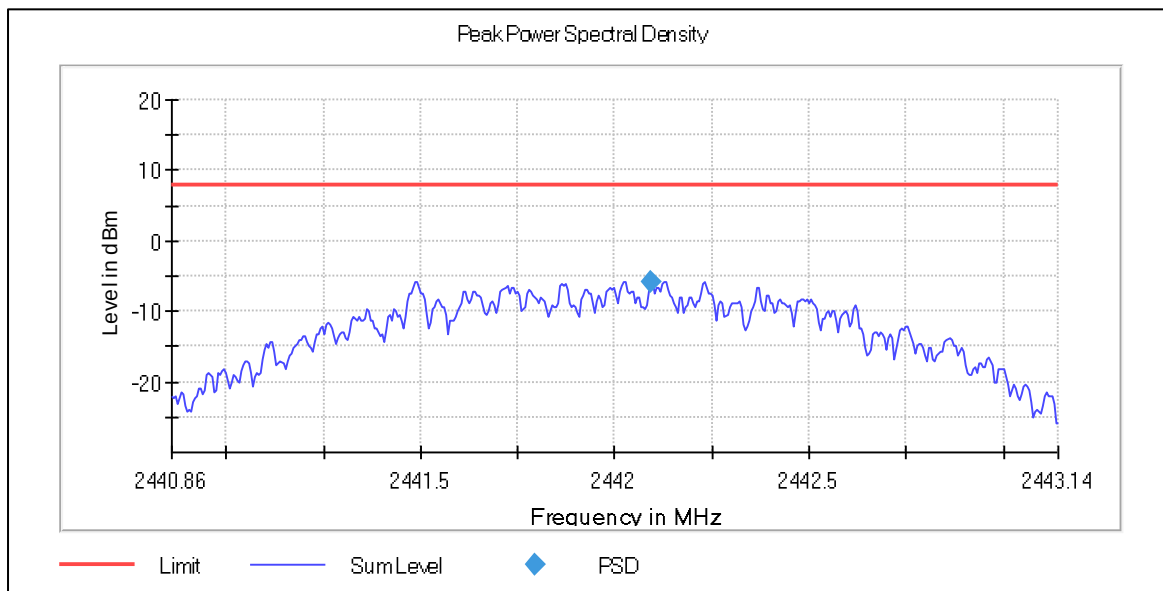
Bluetooth LE, Coded PHY (S=2)

Bluetooth LE, Coded PHY (S=8)


Peak power spectral density, mid channel

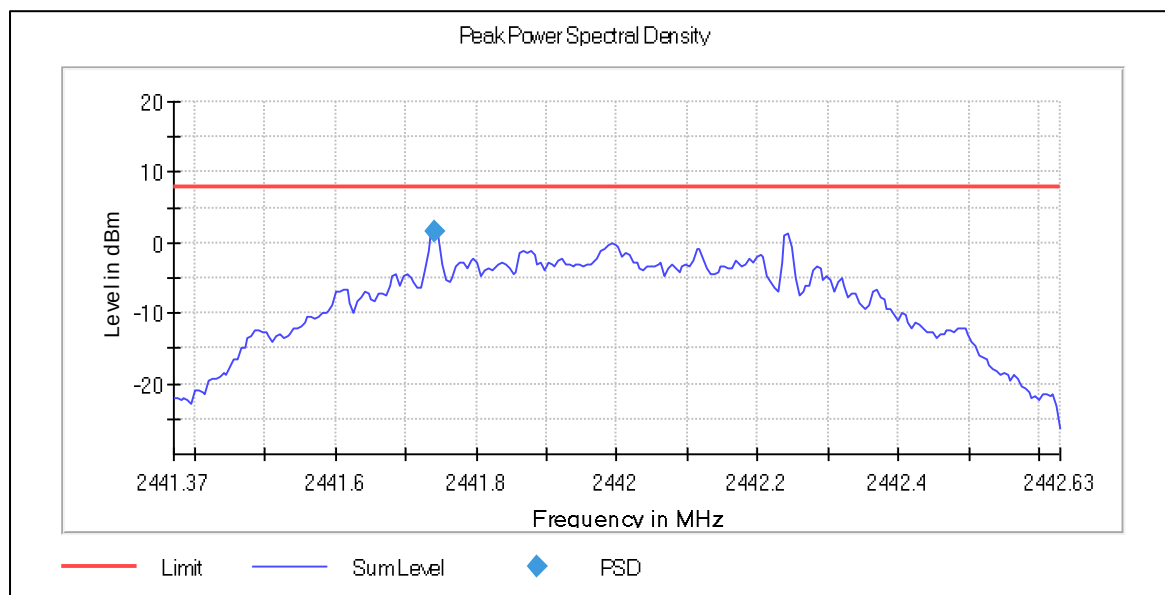
Bluetooth LE, 1 Mbps



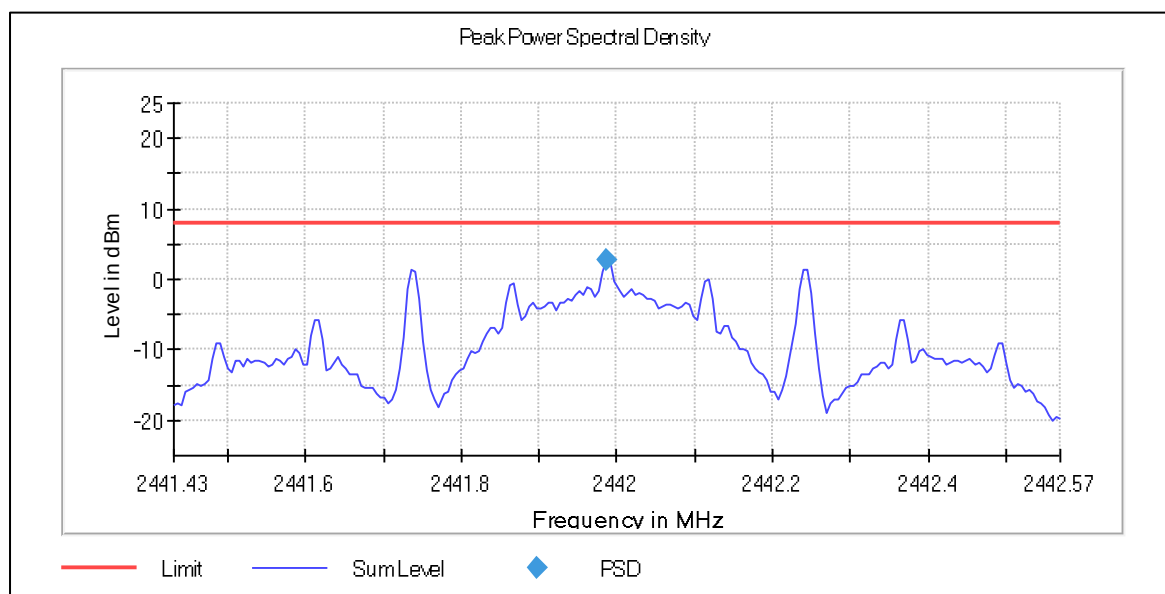
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)

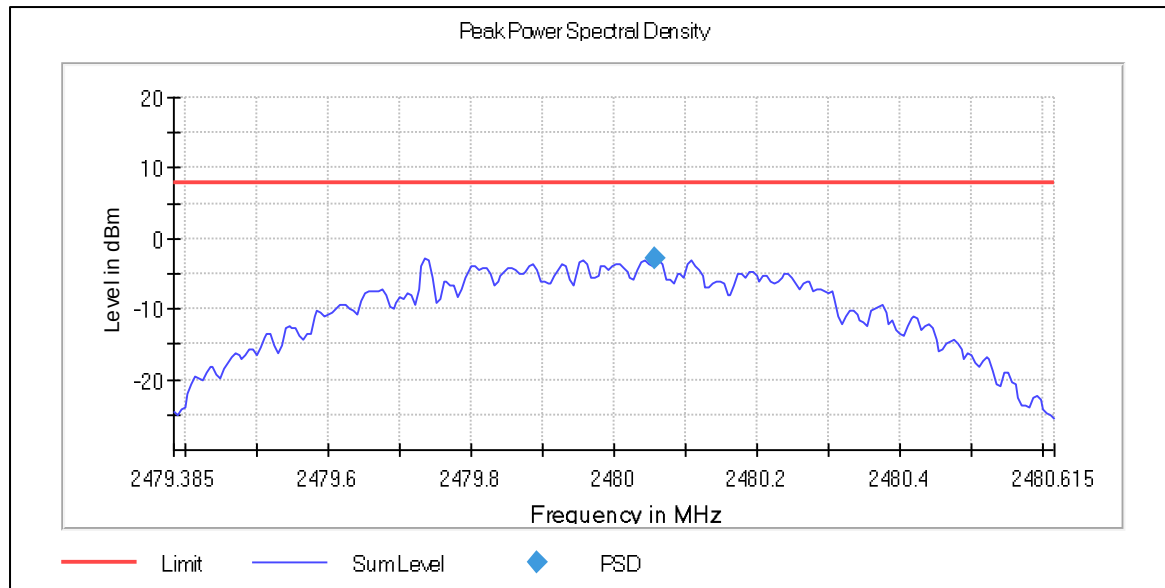


Bluetooth LE, Coded PHY (S=8)

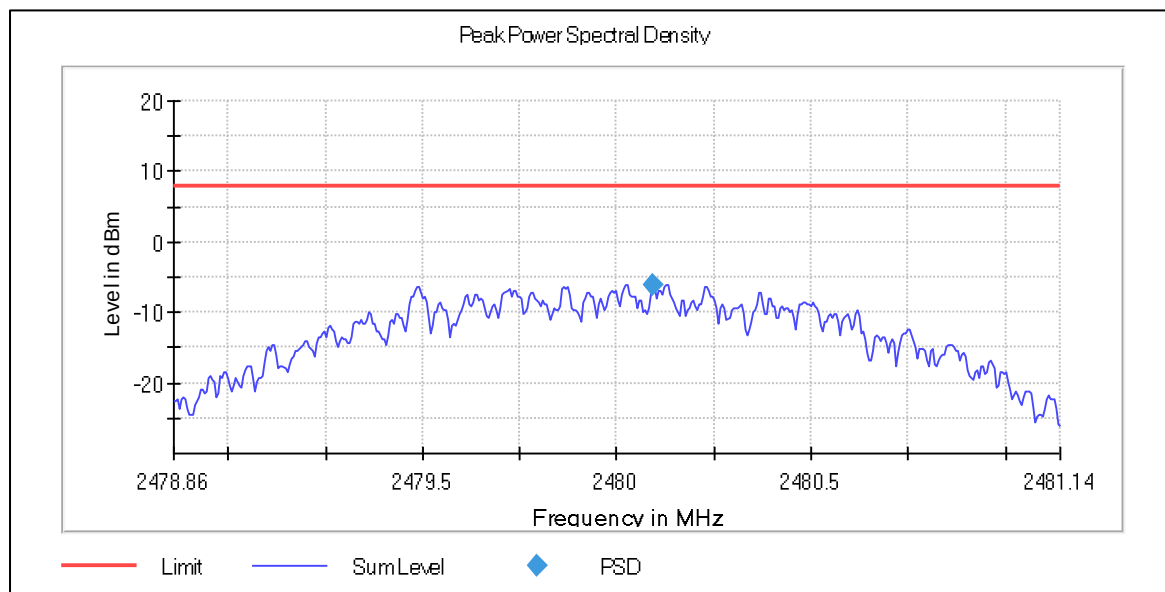


Peak power spectral density, high channel

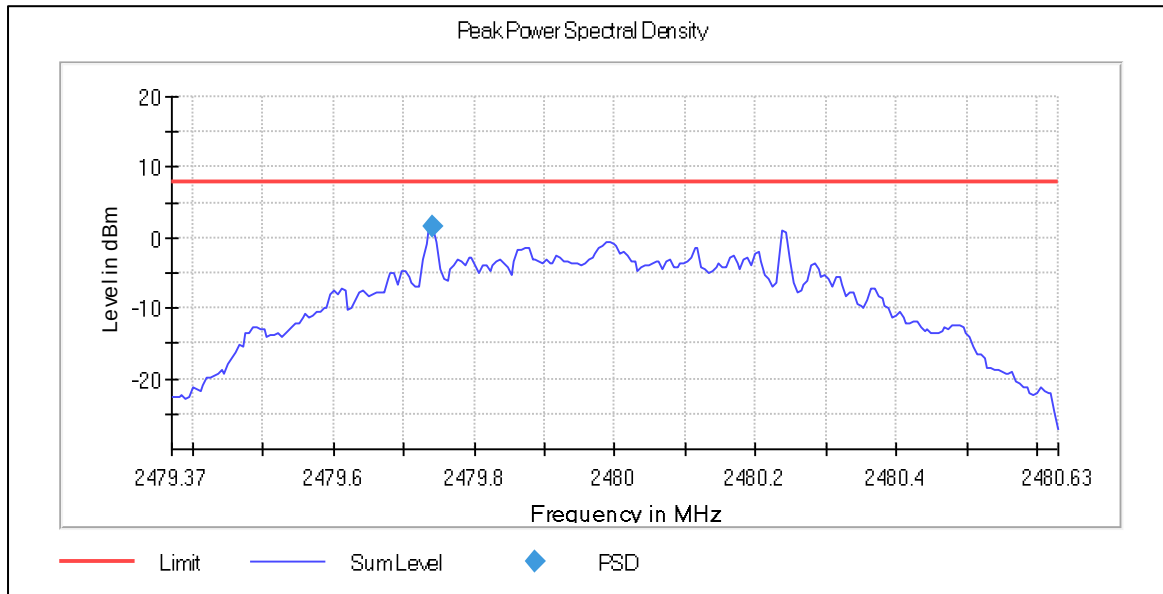
Bluetooth LE, 1 Mbps



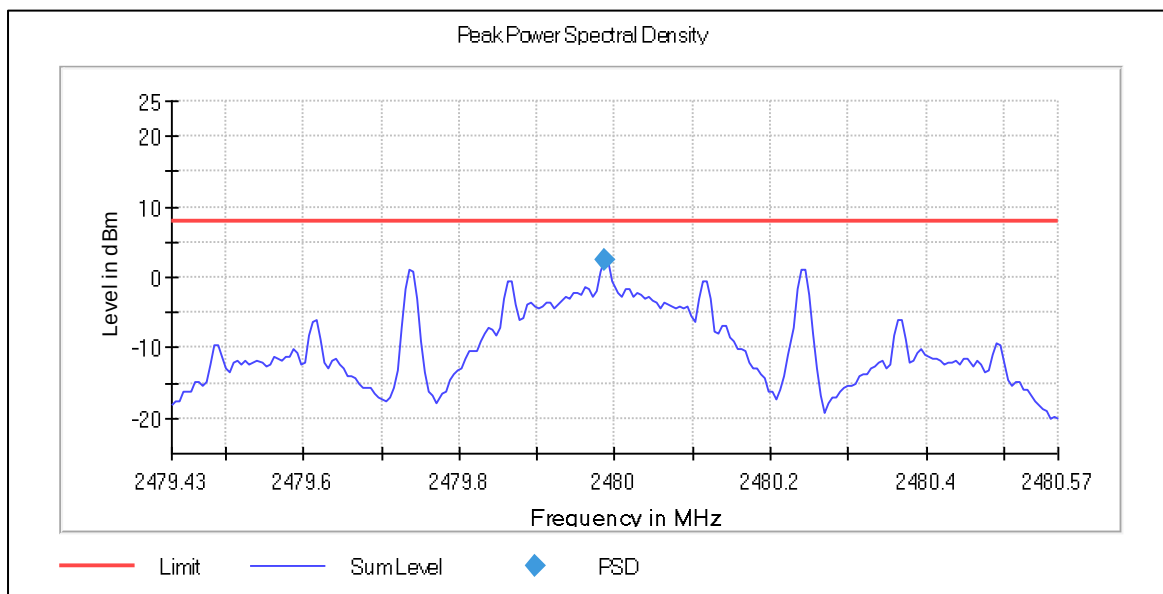
Bluetooth LE, 2 Mbps



Bluetooth LE, Coded PHY (S=2)



Bluetooth LE, Coded PHY (S=8)



13. AC power line conducted emissions

Reference: FCC §15.207, ISED RSS-247, Issue 3 (section 3.1)

Test method: ANSI C63.10-2013 (6.2)

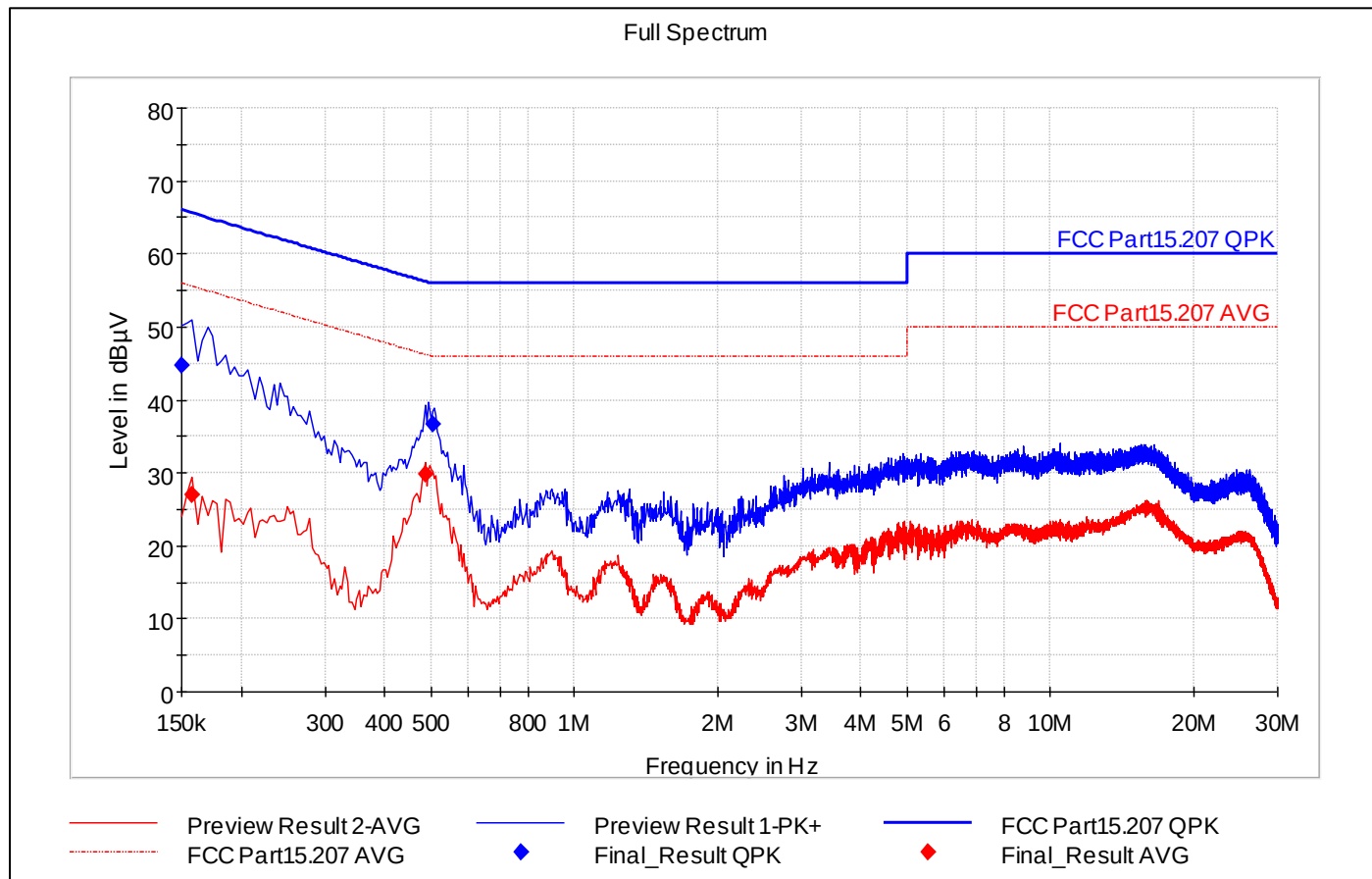
Limits		
Frequency (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 – 0.5	66 -56*	56 – 46*
0.5 – 5	56	46
5 - 30	60	50
*Limit decreases linearly with the logarithm of the frequency		

Operation mode(s)	Configuration	Test Verdict
Bluetooth LE TX, 2 Mbps, mains supply voltage 110VAC/60Hz	Mid channel, 2440 MHz	PASS

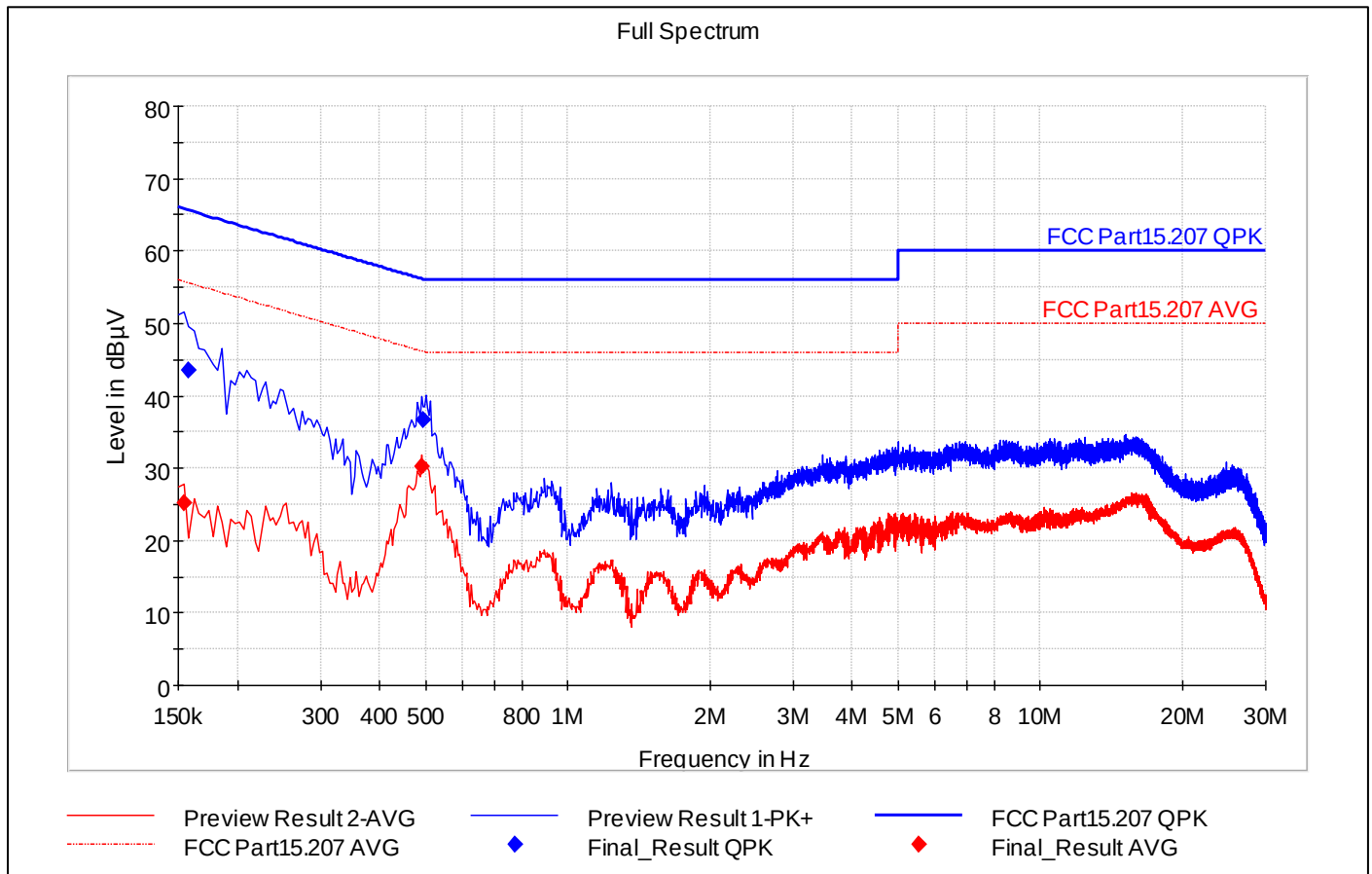
Conducted emission at the mains power port according to 47 CFR Part 15.207, Bluetooth LE (2442 MHz)

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Line	Filter	Corr, (dB)	Comment
0,15	44,83	---	66,00	21,17	15000	9,00	L1	ON	9,50	PASS
0,158	---	27,01	55,57	28,56	15000	9,00	L1	ON	9,50	PASS
0,486	---	29,89	46,24	16,35	15000	9,00	L1	ON	9,60	PASS
0,506	36,59	---	56,00	19,41	15000	9,00	L1	ON	9,60	PASS
0,154	---	25,27	55,78	30,51	15000	9,00	N	ON	9,50	PASS
0,158	43,62	---	65,57	21,95	15000	9,00	N	ON	9,50	PASS
0,49	---	30,13	46,17	16,04	15000	9,00	N	ON	9,60	PASS
0,494	36,75	---	56,10	19,36	15000	9,00	N	ON	9,60	PASS

Conducted emission graph L1 line:



Conducted emission graph Neutral line:



14. Band edge emissions compliance (transmitter)

Reference: FCC §15.247(d), ISED RSS-247, Issue 3 (section 5.5)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 8.7 and ANSI C63.10-2013 (11.13)

Specification: In any 100 kHz bandwidths outside the frequency band in which the 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.

Limits	
Power measurement	Out-of-band attenuation (dB)
Peak	20
RMS	30

Limits
1. EUT set to test mode (communication tester is used if needed)
2. Span set around lower band edge and detector is set to peak and max hold
3. Resolution bandwidth is set to 100 kHz
4. Peak emission level(s) within frequency band and outside frequency band is measured
5. Band edge attenuation is determined from level difference

Summary

Mode / modulation	DUT Frequency (MHz)	Result
Bluetooth LE, 1 Mbps	2402.000000	PASS
Bluetooth LE, 1 Mbps	2480.000000	PASS
Bluetooth LE, 2 Mbps	2402.000000	PASS
Bluetooth LE, 2 Mbps	2480.000000	PASS
Bluetooth LE, Coded PHY (S=2)	2402.000000	PASS
Bluetooth LE, Coded PHY (S=2)	2480.000000	PASS
Bluetooth LE, Coded PHY (S=8)	2402.000000	PASS
Bluetooth LE, Coded PHY (S=8)	2480.000000	PASS

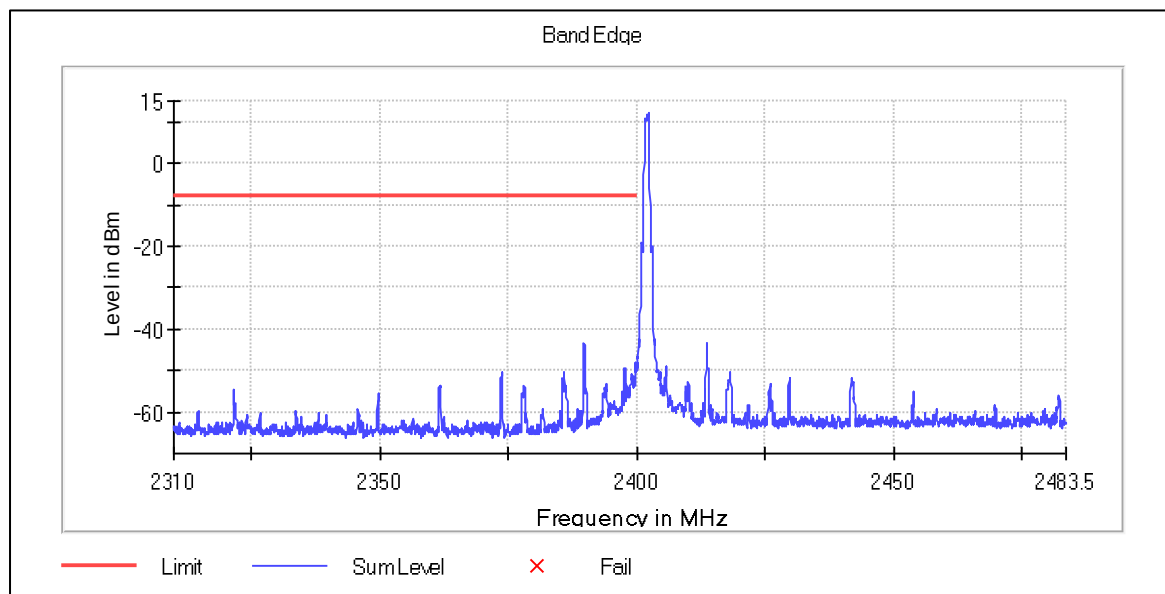
Measurements, band edge low, Bluetooth LE 1 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2389.744302	-43.2	35.4	-7.8	PASS
2389.794330	-43.2	35.4	-7.8	PASS
2389.844358	-43.7	35.9	-7.8	PASS
2389.694275	-44.1	36.3	-7.8	PASS
2389.644247	-45.0	37.2	-7.8	PASS
2389.894386	-45.6	37.8	-7.8	PASS
2389.594219	-47.2	39.3	-7.8	PASS
2399.799889	-48.1	40.3	-7.8	PASS
2389.944414	-48.2	40.4	-7.8	PASS
2399.849917	-48.3	40.5	-7.8	PASS
2399.749861	-48.5	40.7	-7.8	PASS
2397.648694	-49.5	41.7	-7.8	PASS
2397.698722	-49.7	41.9	-7.8	PASS
2399.949972	-50.1	42.3	-7.8	PASS
2399.899944	-50.3	42.4	-7.8	PASS

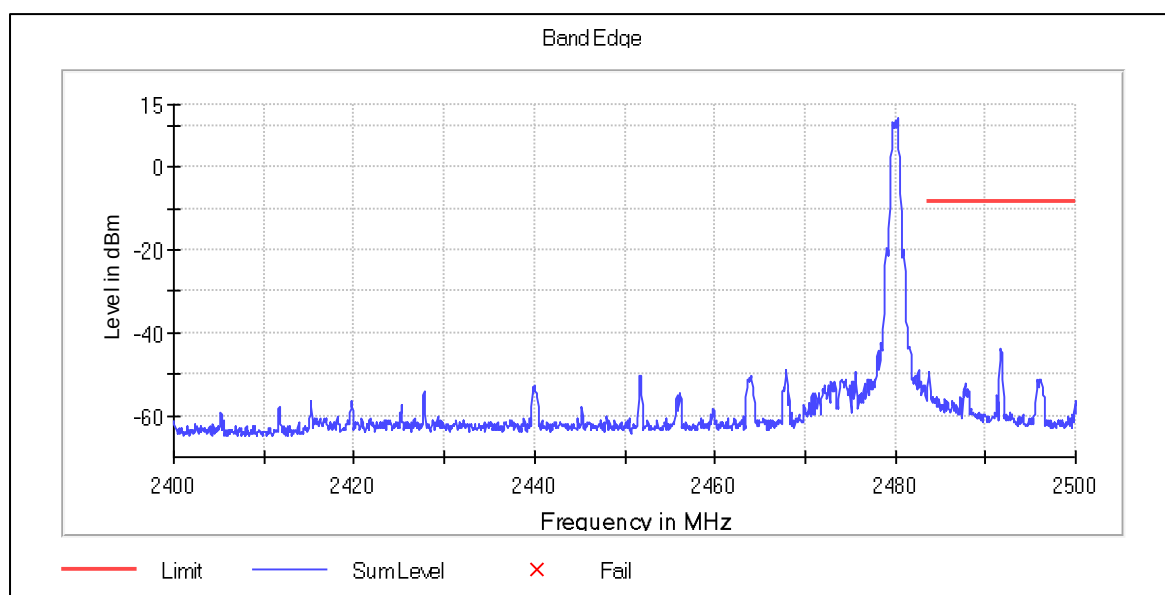
Measurements, band edge high, Bluetooth LE 1 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2491.674772	-44.1	35.7	-8.4	PASS
2491.724924	-44.5	36.1	-8.4	PASS
2491.775076	-44.6	36.2	-8.4	PASS
2491.624620	-44.7	36.3	-8.4	PASS
2491.825228	-45.4	37.0	-8.4	PASS
2491.574468	-46.5	38.1	-8.4	PASS
2491.875380	-47.4	39.0	-8.4	PASS
2483.750760	-49.4	41.0	-8.4	PASS
2483.700608	-49.8	41.4	-8.4	PASS
2483.800912	-50.0	41.6	-8.4	PASS
2483.650456	-50.2	41.8	-8.4	PASS
2491.524316	-51.2	42.8	-8.4	PASS
2495.737082	-51.3	42.9	-8.4	PASS
2496.188450	-51.3	42.9	-8.4	PASS
2495.787234	-51.3	42.9	-8.4	PASS

Band edge, low channel, 1 Mbps



Band edge, high channel, 1 Mbps



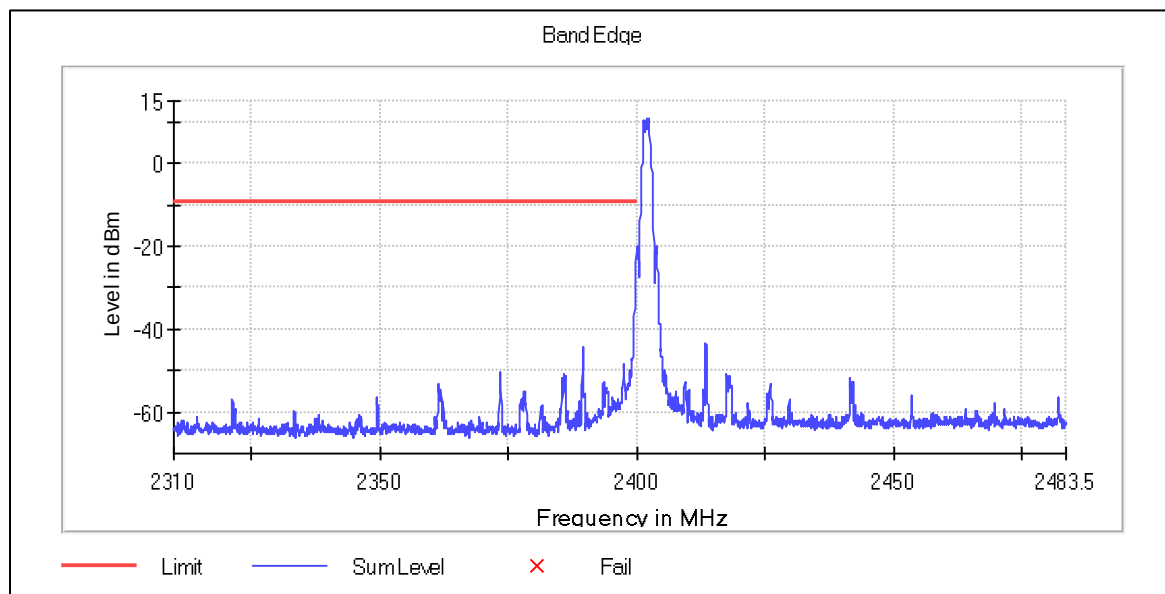
Measurements, band edge low, Bluetooth LE 2 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.949972	-20.6	11.5	-9.1	PASS
2399.899944	-23.8	14.7	-9.1	PASS
2399.849917	-26.6	17.5	-9.1	PASS
2399.799889	-28.2	19.1	-9.1	PASS
2399.749861	-29.7	20.6	-9.1	PASS
2399.699833	-31.3	22.2	-9.1	PASS
2399.649805	-33.8	24.7	-9.1	PASS
2399.599778	-35.1	26.0	-9.1	PASS
2399.549750	-36.9	27.8	-9.1	PASS
2399.499722	-38.0	28.9	-9.1	PASS
2399.449694	-40.0	30.9	-9.1	PASS
2399.399666	-42.9	33.8	-9.1	PASS
2399.349639	-44.4	35.2	-9.1	PASS
2389.594219	-44.5	35.4	-9.1	PASS
2389.544191	-44.5	35.4	-9.1	PASS

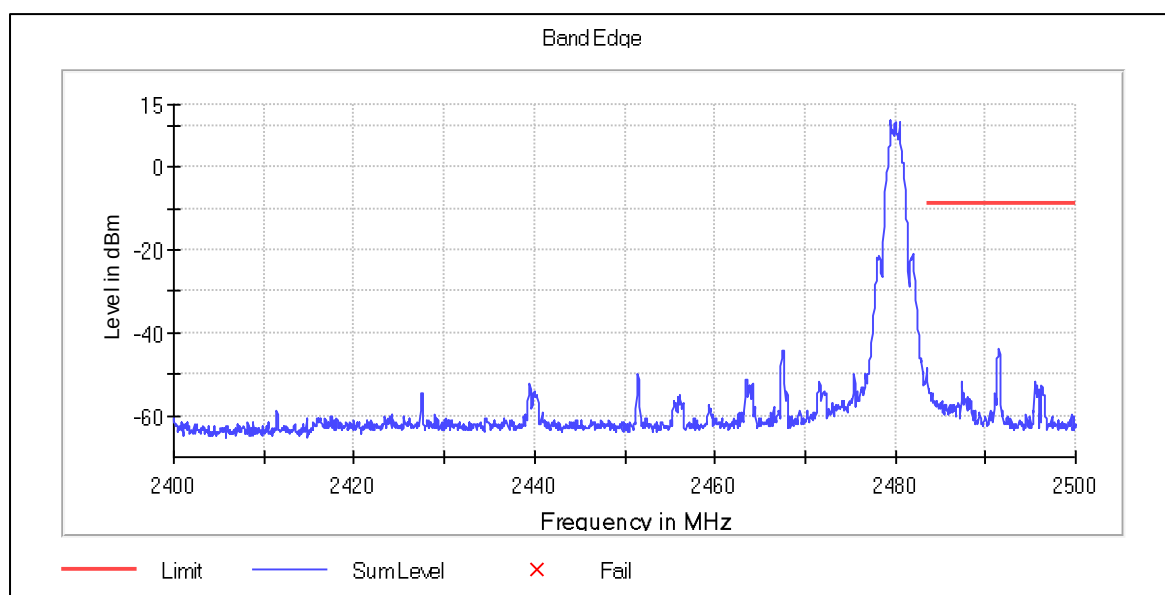
Measurements, band edge high, Bluetooth LE 2 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2491.424012	-43.7	34.7	-8.9	PASS
2491.474164	-43.7	34.8	-8.9	PASS
2491.524316	-44.1	35.1	-8.9	PASS
2491.574468	-45.4	36.5	-8.9	PASS
2491.373860	-45.9	37.0	-8.9	PASS
2491.323708	-46.2	37.3	-8.9	PASS
2483.550152	-48.8	39.9	-8.9	PASS
2491.624620	-49.8	40.8	-8.9	PASS
2491.273556	-51.6	42.7	-8.9	PASS
2495.486322	-51.8	42.9	-8.9	PASS
2487.361702	-51.9	43.0	-8.9	PASS
2483.600304	-52.0	43.1	-8.9	PASS
2495.436170	-52.1	43.2	-8.9	PASS
2487.411854	-52.3	43.4	-8.9	PASS
2496.238602	-52.6	43.7	-8.9	PASS

Band edge, low channel, Bluetooth LE, 2 Mbps



Band edge, high channel, Bluetooth LE, 2 Mbps

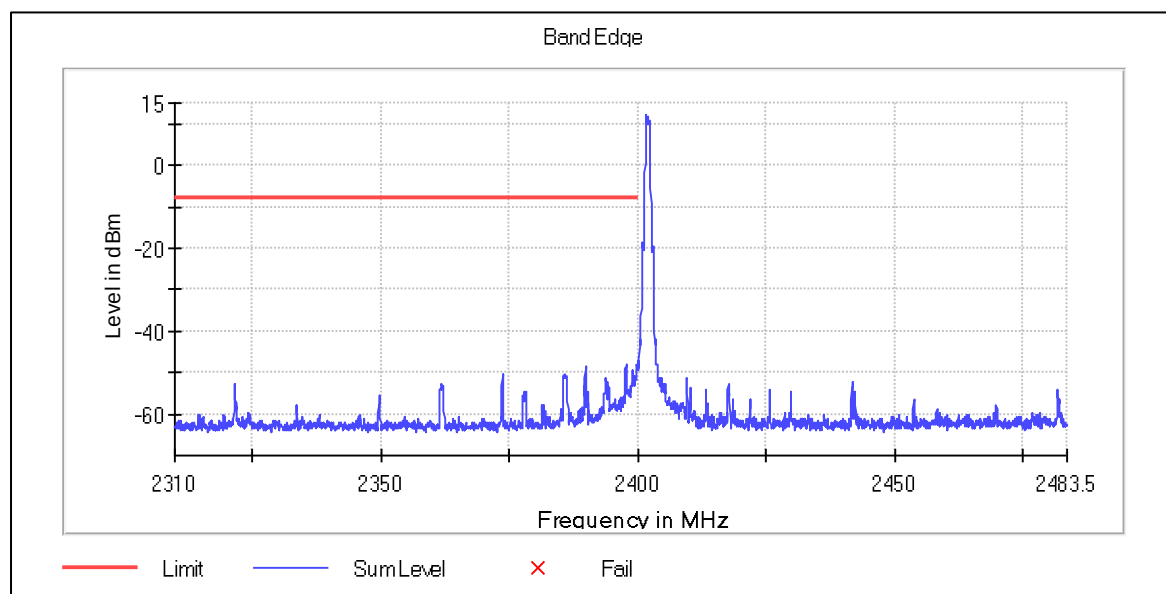
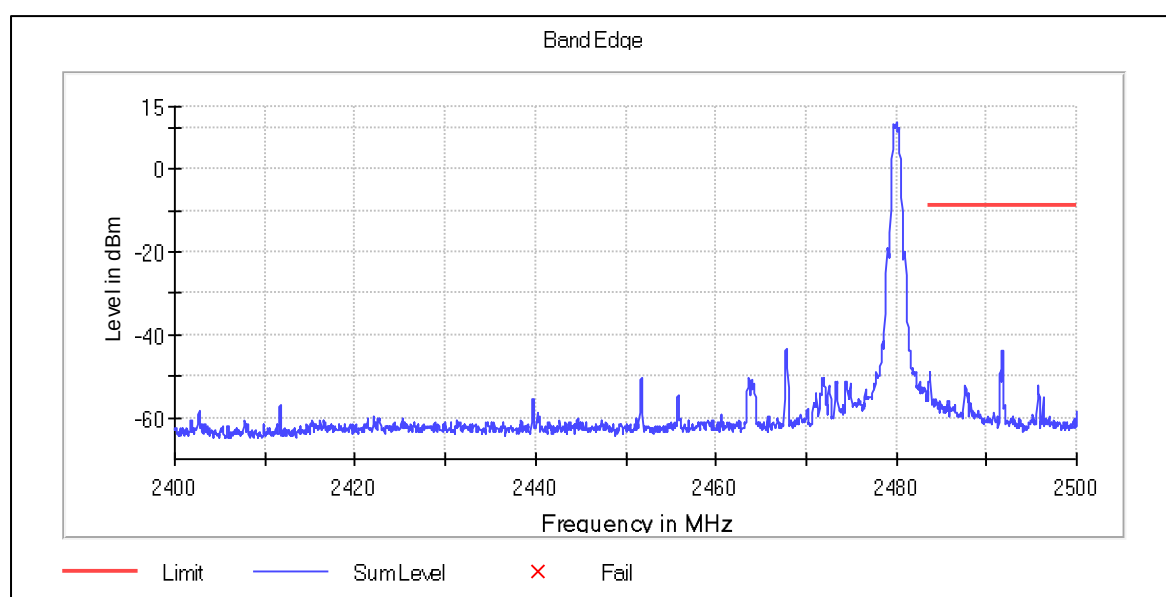


Measurements, band edge low, Bluetooth LE, Coded PHY (S=2)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2397.748749	-47.8	40.1	-7.8	PASS
2399.849917	-47.8	40.1	-7.8	PASS
2399.899944	-47.9	40.2	-7.8	PASS
2397.798777	-48.2	40.4	-7.8	PASS
2397.698722	-48.3	40.5	-7.8	PASS
2399.799889	-48.5	40.8	-7.8	PASS
2389.894386	-48.6	40.9	-7.8	PASS
2389.844358	-49.0	41.2	-7.8	PASS
2397.648694	-49.1	41.3	-7.8	PASS
2397.848805	-49.2	41.4	-7.8	PASS
2399.749861	-49.3	41.5	-7.8	PASS
2389.944414	-49.3	41.6	-7.8	PASS
2399.949972	-49.5	41.7	-7.8	PASS
2398.899389	-49.5	41.8	-7.8	PASS
2398.949416	-49.6	41.8	-7.8	PASS

Measurements, band edge high, Bluetooth LE, Coded PHY (S=2)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2491.724924	-43.9	35.2	-8.7	PASS
2491.775076	-44.0	35.3	-8.7	PASS
2491.825228	-45.7	37.0	-8.7	PASS
2491.574468	-48.5	39.8	-8.7	PASS
2491.674772	-48.7	40.0	-8.7	PASS
2483.750760	-48.9	40.2	-8.7	PASS
2491.524316	-49.5	40.8	-8.7	PASS
2483.700608	-50.1	41.4	-8.7	PASS
2483.800912	-50.8	42.1	-8.7	PASS
2491.624620	-51.4	42.7	-8.7	PASS
2483.600304	-51.5	42.9	-8.7	PASS
2483.650456	-51.5	42.9	-8.7	PASS
2495.686930	-52.1	43.4	-8.7	PASS
2487.612462	-52.2	43.6	-8.7	PASS
2487.662614	-52.3	43.6	-8.7	PASS

Band edge, low channel, Bluetooth LE, Coded PHY (S=2)

Band edge, high channel, Bluetooth LE, Coded PHY (S=2)


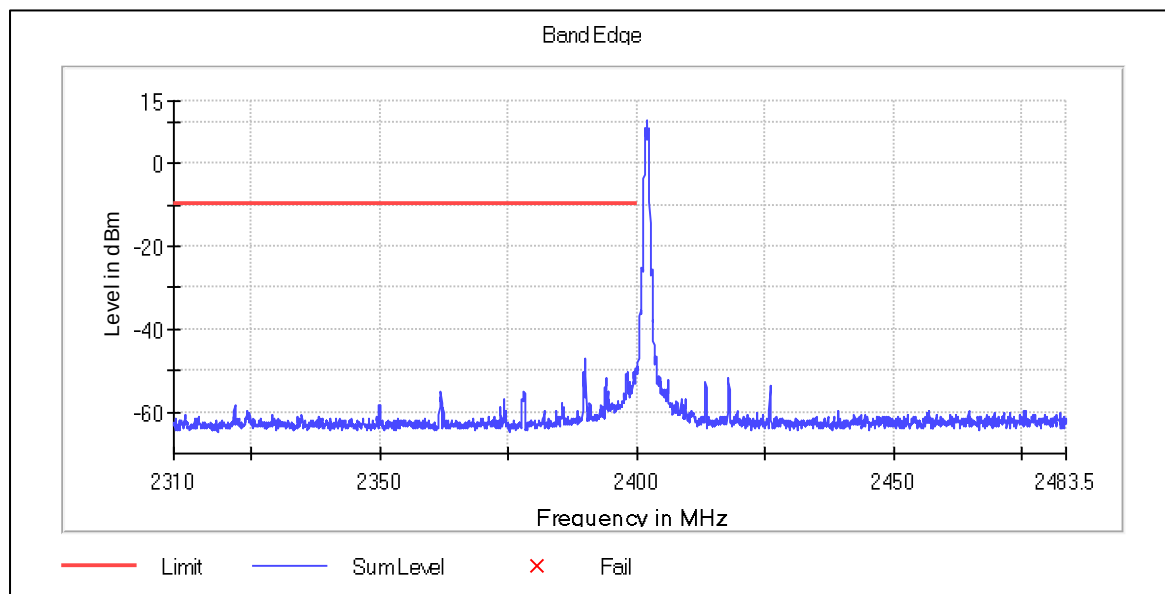
Measurements, band edge low, Bluetooth LE, Coded PHY (S=8)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2390.044469	-47.2	37.7	-9.5	PASS
2389.994441	-47.4	37.9	-9.5	PASS
2390.094497	-47.8	38.3	-9.5	PASS
2399.899944	-49.7	40.1	-9.5	PASS
2399.749861	-49.7	40.2	-9.5	PASS
2399.949972	-49.9	40.4	-9.5	PASS
2399.699833	-50.1	40.6	-9.5	PASS
2389.644247	-50.2	40.7	-9.5	PASS
2389.944414	-50.2	40.7	-9.5	PASS
2389.694275	-50.3	40.7	-9.5	PASS
2399.399666	-50.4	40.9	-9.5	PASS
2398.249027	-50.5	41.0	-9.5	PASS
2399.849917	-50.6	41.1	-9.5	PASS
2398.098944	-50.7	41.2	-9.5	PASS
2398.299055	-50.8	41.2	-9.5	PASS

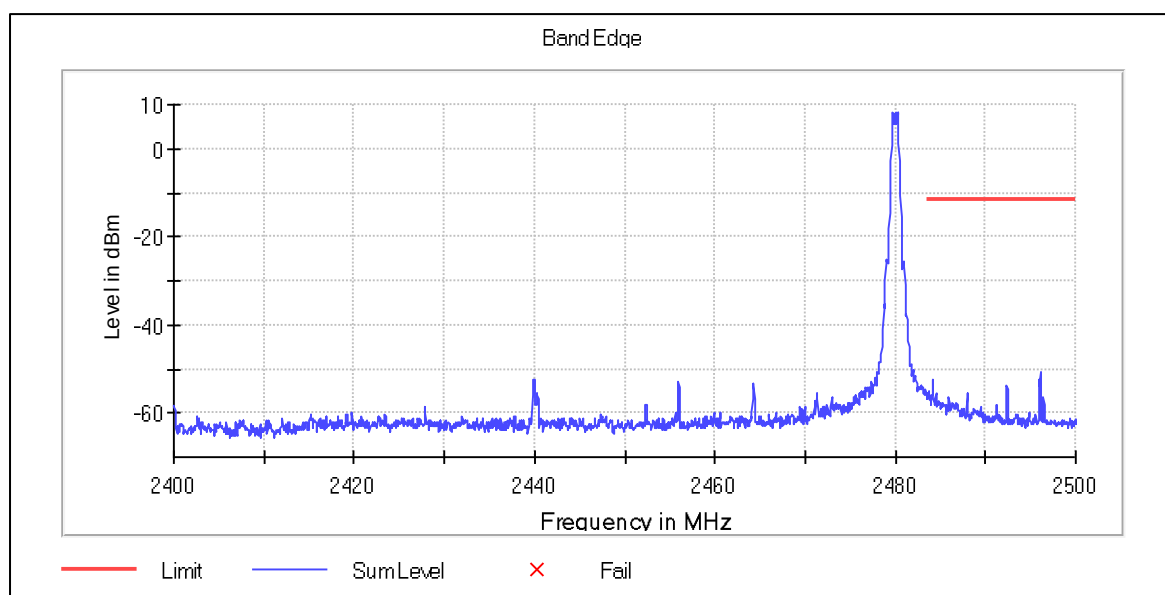
Measurements, band edge high, Bluetooth LE, Coded PHY (S=8)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2496.088146	-50.8	39.2	-11.6	PASS
2496.138298	-50.8	39.2	-11.6	PASS
2495.987842	-52.2	40.6	-11.6	PASS
2484.151976	-52.3	40.7	-11.6	PASS
2484.202128	-53.1	41.5	-11.6	PASS
2492.376900	-53.6	42.0	-11.6	PASS
2496.037994	-53.7	42.1	-11.6	PASS
2484.101824	-53.8	42.2	-11.6	PASS
2495.937690	-54.1	42.5	-11.6	PASS
2492.427052	-54.4	42.8	-11.6	PASS
2483.700608	-54.9	43.3	-11.6	PASS
2483.750760	-55.0	43.4	-11.6	PASS
2487.963526	-55.4	43.8	-11.6	PASS
2484.503040	-55.7	44.1	-11.6	PASS
2483.600304	-55.8	44.2	-11.6	PASS

Band edge, low channel, Bluetooth LE, Coded PHY (S=8)



Band edge, high channel, Bluetooth LE, Coded PHY (S=8)



15. Tx spurious emissions, conducted

Reference: FCC §15.247(d), ISED RSS-247, Issue 3 (section 5.5)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 8.5 and ANSI C63.10-2013 (11.11.2 & 11.11.3)

Limits	
Power measurement	Out-of-band attenuation (dB)
Peak	20
RMS	30

Test procedure
1. EUT set to test mode (communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels outside frequency band

Mode / modulation	DUT Frequency (MHz)	Result
Bluetooth LE, 1 Mbps	2402.000000	PASS
Bluetooth LE, 1 Mbps	2440.000000	PASS
Bluetooth LE, 1 Mbps	2480.000000	PASS
Bluetooth LE, 2 Mbps	2402.000000	PASS
Bluetooth LE, 2 Mbps	2440.000000	PASS
Bluetooth LE, 2 Mbps	2480.000000	PASS
Bluetooth LE, Coded PHY (S=2)	2402.000000	PASS
Bluetooth LE, Coded PHY (S=2)	2440.000000	PASS
Bluetooth LE, Coded PHY (S=2)	2480.000000	PASS
Bluetooth LE, Coded PHY (S=8)	2402.000000	PASS
Bluetooth LE, Coded PHY (S=8)	2440.000000	PASS
Bluetooth LE, Coded PHY (S=8)	2480.000000	PASS

Premeasurements, low channel, Bluetooth LE, 1 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2330.000000	-59.7	49.3	-10.4
2280.000000	-61.7	51.3	-10.4
2310.000000	-62.2	51.8	-10.4
2503.497024	-62.4	52.0	-10.4
2290.000000	-62.8	52.4	-10.4
2390.000000	-62.9	52.4	-10.4
2493.498512	-62.9	52.5	-10.4
600.000000	-63.0	52.6	-10.4
2350.000000	-63.2	52.8	-10.4
2260.000000	-63.3	52.9	-10.4
680.000000	-63.4	53.0	-10.4
560.000000	-63.4	53.0	-10.4
2340.000000	-63.5	53.1	-10.4
2060.000000	-63.5	53.1	-10.4
750.000000	-63.5	53.1	-10.4

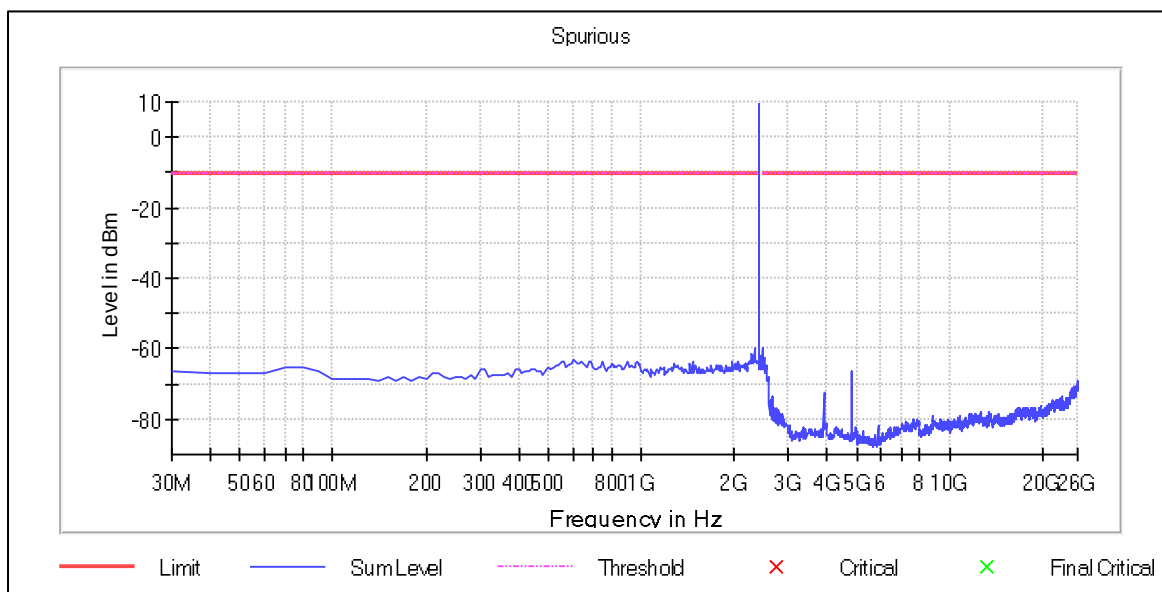
Pre-measurements, middle channel, Bluetooth LE, 1 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2523.494048	-57.2	47.2	-10.0
2320.000000	-58.7	48.7	-10.0
2543.491071	-59.4	49.4	-10.0
2360.000000	-59.6	49.5	-10.0
2390.000000	-59.8	49.8	-10.0
2300.000000	-59.9	49.9	-10.0
2330.000000	-61.0	51.0	-10.0
2503.497024	-61.4	51.3	-10.0
2380.000000	-61.4	51.3	-10.0
2563.488095	-61.8	51.8	-10.0
2350.000000	-62.1	52.1	-10.0
2573.486607	-62.5	52.5	-10.0
2583.485119	-63.0	52.9	-10.0
2553.489583	-63.2	53.1	-10.0
2340.000000	-63.4	53.4	-10.0

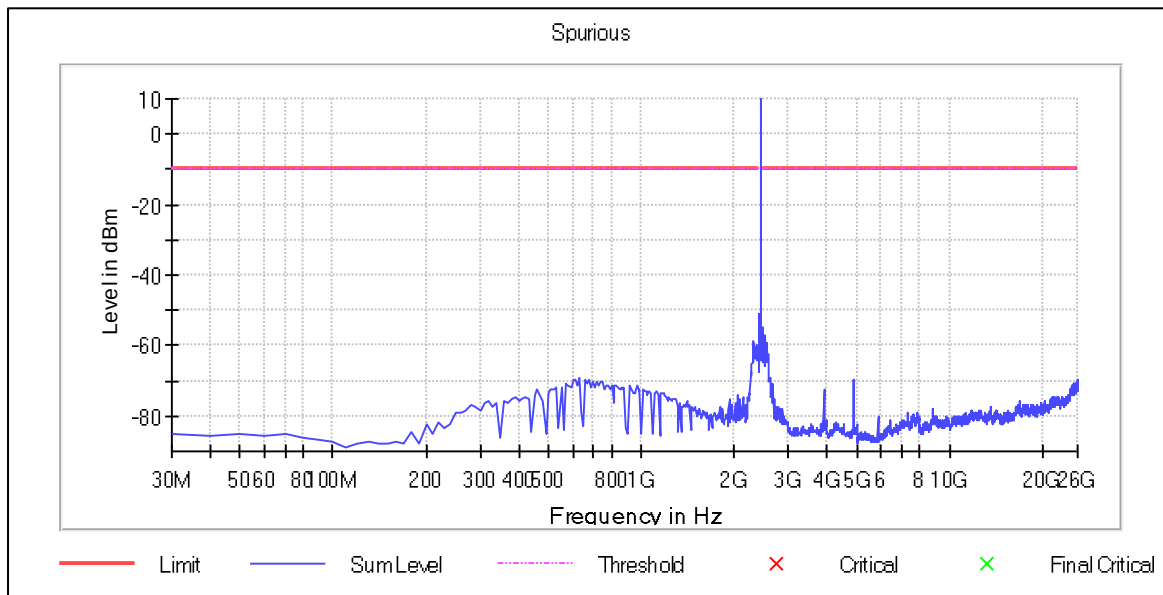
Pre-measurements, top channel, Bluetooth LE, 1 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2573.486607	-55.6	46.0	-9.6
2533.492560	-56.7	47.1	-9.6
2593.483631	-57.6	48.0	-9.6
2380.000000	-58.4	48.8	-9.6
2360.000000	-58.9	49.2	-9.6
25890.016369	-59.4	49.7	-9.6
25930.010417	-59.9	50.3	-9.6
2390.000000	-60.0	50.4	-9.6
2543.491071	-60.0	50.4	-9.6
25360.095238	-60.1	50.4	-9.6
25860.020833	-60.3	50.6	-9.6
25370.093750	-60.5	50.9	-9.6
25440.083333	-60.6	51.0	-9.6
25410.087798	-60.6	51.0	-9.6
25400.089286	-60.7	51.0	-9.6

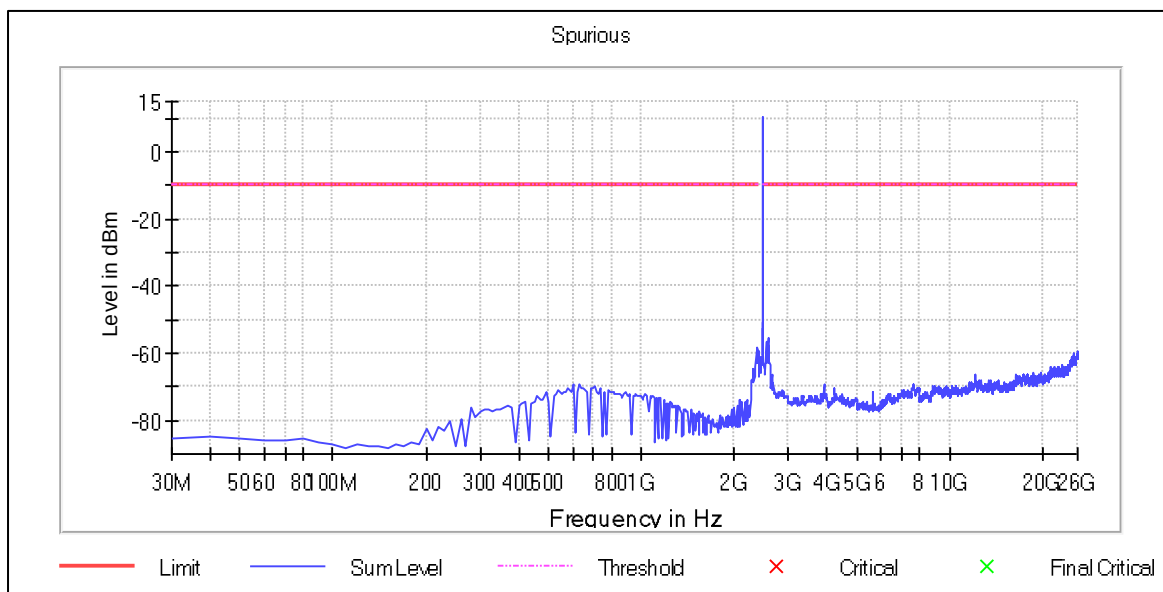
TX spurious emissions, conducted, low channel, Bluetooth LE, 1 Mbps



TX spurious emissions, conducted, mid channel, Bluetooth LE, 1 Mbps



TX spurious emissions, conducted, high channel, Bluetooth LE, 1 Mbps



Pre-measurements, low channel, Bluetooth LE, 2 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2370.000000	-61.0	50.2	-10.8
2290.000000	-61.9	51.1	-10.8
2350.000000	-62.6	51.8	-10.8
670.000000	-62.8	51.9	-10.8
2320.000000	-63.2	52.3	-10.8
550.000000	-63.2	52.3	-10.8
2300.000000	-63.3	52.4	-10.8
2360.000000	-63.3	52.4	-10.8
1870.000000	-63.3	52.4	-10.8
600.000000	-63.3	52.4	-10.8
2280.000000	-63.3	52.5	-10.8
540.000000	-63.6	52.7	-10.8
2250.000000	-63.7	52.8	-10.8
570.000000	-63.7	52.9	-10.8
620.000000	-63.8	53.0	-10.8

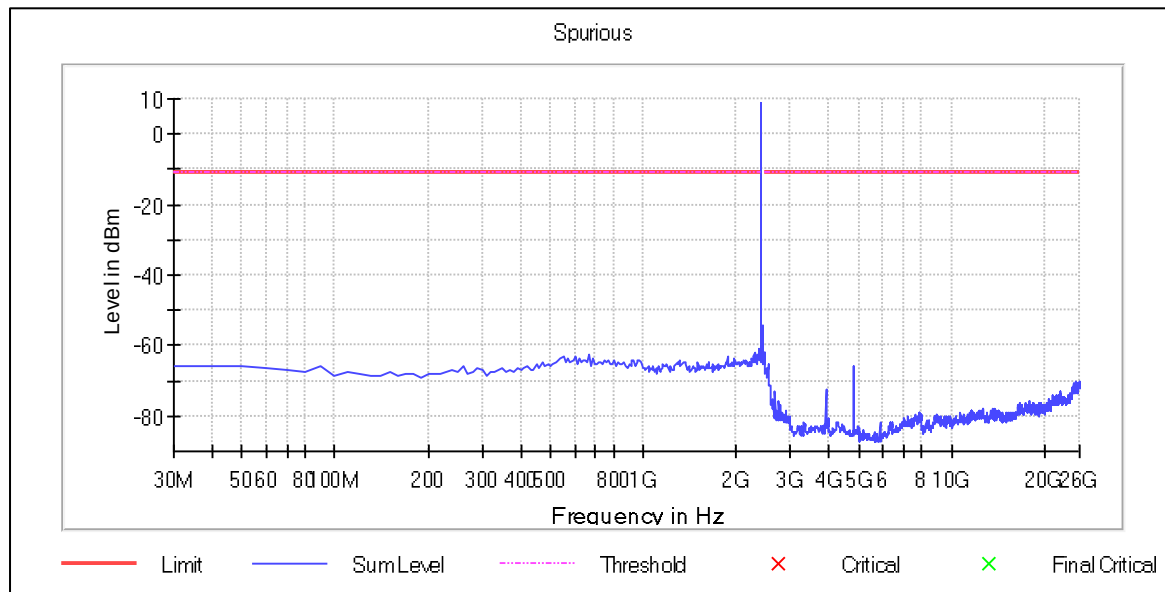
Pre-measurements, middle channel, Bluetooth LE, 2 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2380.000000	-61.3	49.4	-11.9
2370.000000	-61.7	49.8	-11.9
2390.000000	-62.5	50.7	-11.9
2340.000000	-62.7	50.8	-11.9
2300.000000	-64.1	52.2	-11.9
2360.000000	-64.2	52.4	-11.9
2553.489583	-64.4	52.6	-11.9
2330.000000	-65.1	53.2	-11.9
2543.491071	-65.1	53.2	-11.9
2350.000000	-65.1	53.2	-11.9
2310.000000	-65.8	53.9	-11.9
2533.492560	-66.5	54.6	-11.9
2503.497024	-67.2	55.4	-11.9
2563.488095	-67.3	55.4	-11.9
2523.494048	-67.3	55.4	-11.9

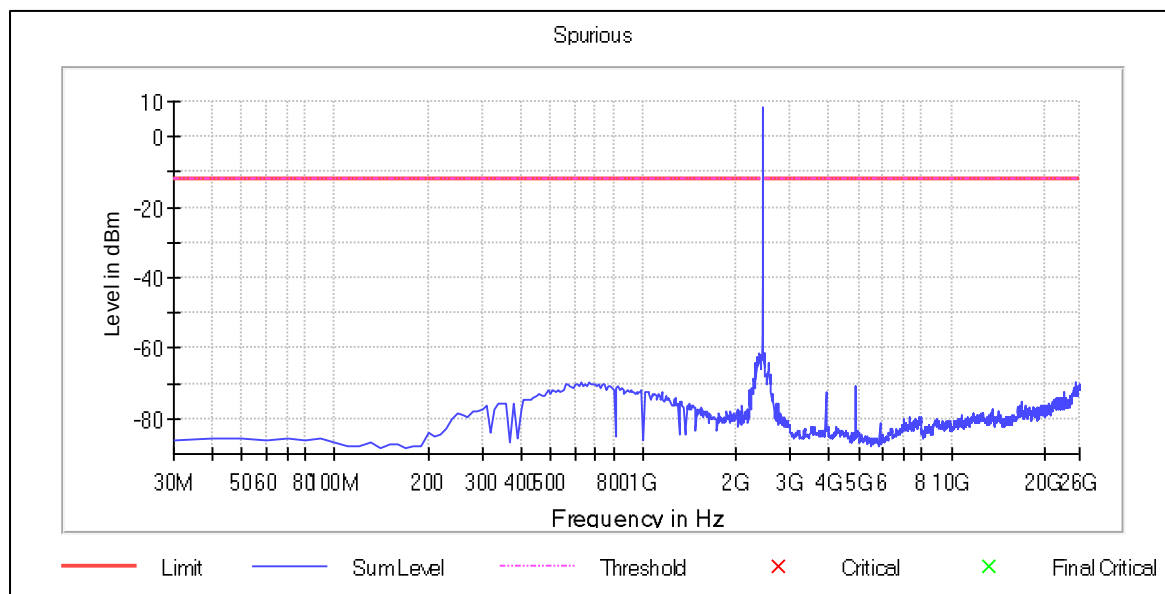
Pre-measurements, top channel, Bluetooth LE, 2 Mbps

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2360.000000	-57.6	44.8	-12.9
25880.017857	-60.4	47.5	-12.9
25900.014881	-60.7	47.9	-12.9
25490.075893	-60.9	48.0	-12.9
25390.090774	-61.3	48.4	-12.9
25850.022321	-61.3	48.4	-12.9
25960.005952	-61.5	48.6	-12.9
25320.101190	-61.5	48.6	-12.9
26000.000000	-61.5	48.6	-12.9
2380.000000	-61.6	48.8	-12.9
25440.083333	-61.8	48.9	-12.9
25940.008929	-61.8	48.9	-12.9
25910.013393	-62.0	49.1	-12.9
25820.026786	-62.0	49.1	-12.9
25920.011905	-62.0	49.1	-12.9

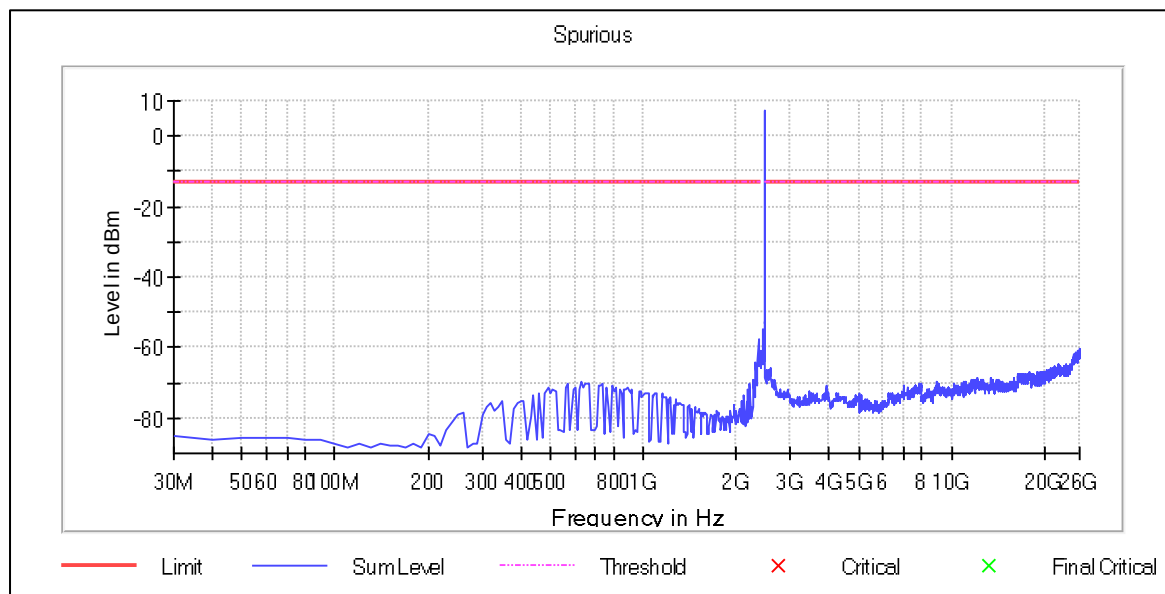
TX spurious emissions, conducted, low channel, Bluetooth LE, 2 Mbps



TX spurious emissions, conducted, mid channel, Bluetooth LE, 2 Mbps



TX spurious emissions, conducted, high channel, Bluetooth LE, 2 Mbps



Pre-Measurements, low channel, Coded PHY (S=2)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2290.000000	-53.9	44.4	-9.5
2553.489583	-56.8	47.3	-9.5
2330.000000	-57.7	48.1	-9.5
4803.154762	-58.1	48.6	-9.5
2250.000000	-61.6	52.1	-9.5
2513.495536	-62.3	52.8	-9.5
2270.000000	-62.5	53.0	-9.5
2300.000000	-63.1	53.5	-9.5
2533.492560	-64.0	54.4	-9.5
2523.494048	-64.1	54.6	-9.5
2360.000000	-64.6	55.1	-9.5
2390.000000	-64.8	55.2	-9.5
2320.000000	-64.8	55.3	-9.5
2280.000000	-64.9	55.4	-9.5
2310.000000	-65.0	55.5	-9.5

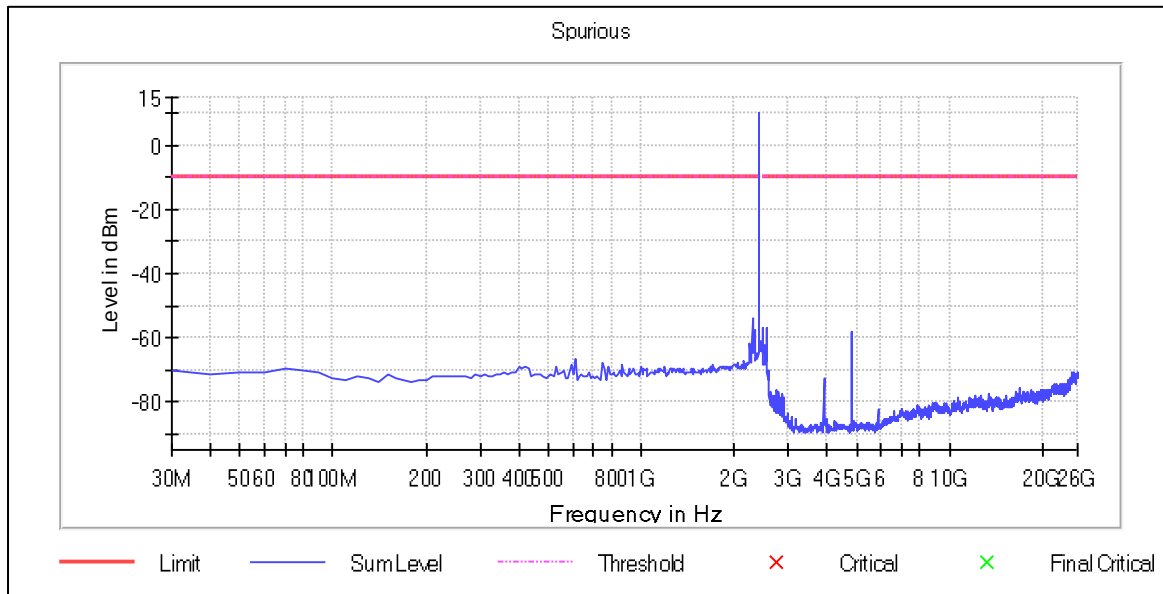
Pre-Measurements, middle channel, Coded PHY (S=2)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4883.142857	-59.3	49.1	-10.2
2523.494048	-59.3	49.1	-10.2
2300.000000	-60.2	49.9	-10.2
2360.000000	-60.5	50.2	-10.2
2533.492560	-60.5	50.3	-10.2
2370.000000	-60.6	50.3	-10.2
2543.491071	-60.8	50.5	-10.2
2340.000000	-62.1	51.9	-10.2
2390.000000	-63.0	52.8	-10.2
2563.488095	-63.1	52.9	-10.2
2330.000000	-63.5	53.3	-10.2
2310.000000	-63.8	53.6	-10.2
2503.497024	-63.9	53.7	-10.2
2350.000000	-64.3	54.0	-10.2
2593.483631	-64.3	54.1	-10.2

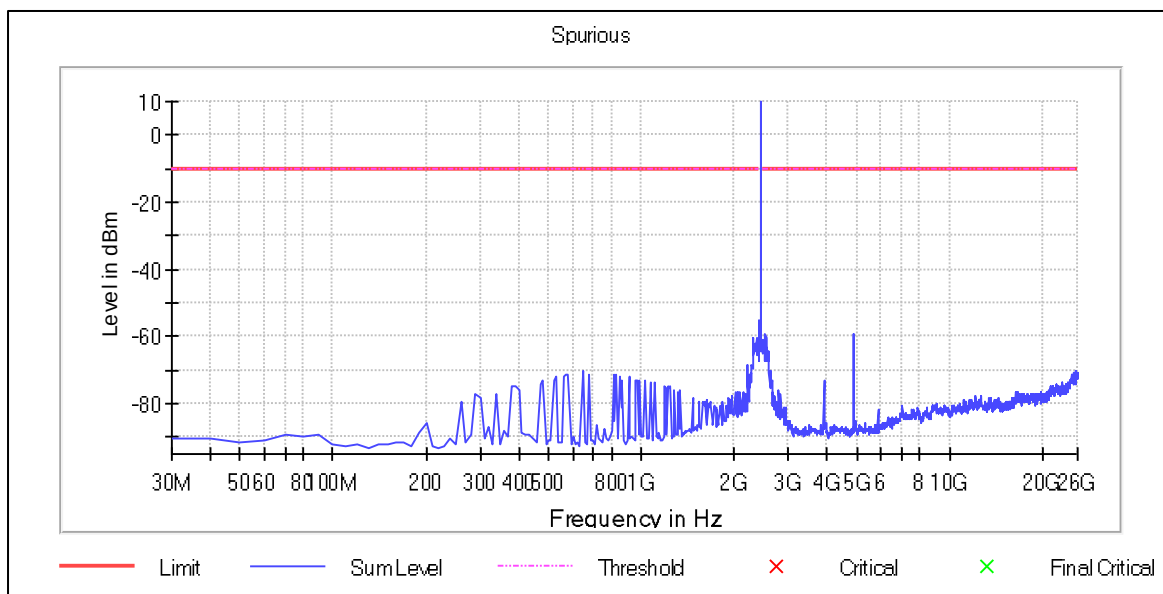
Pre-Measurements, top channel, Coded PHY (S=2)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
25930.010417	-49.9	41.1	-8.8
25850.022321	-50.1	41.3	-8.8
25970.004464	-50.2	41.4	-8.8
25960.005952	-50.3	41.5	-8.8
25920.011905	-50.3	41.5	-8.8
25890.016369	-50.4	41.6	-8.8
25410.087798	-50.4	41.6	-8.8
25400.089286	-50.4	41.6	-8.8
25390.090774	-50.5	41.7	-8.8
25380.092262	-50.6	41.8	-8.8
25490.075893	-50.6	41.8	-8.8
25910.013393	-50.8	42.0	-8.8
25350.096726	-50.8	42.0	-8.8
25880.017857	-50.9	42.1	-8.8
25840.023810	-50.9	42.1	-8.8

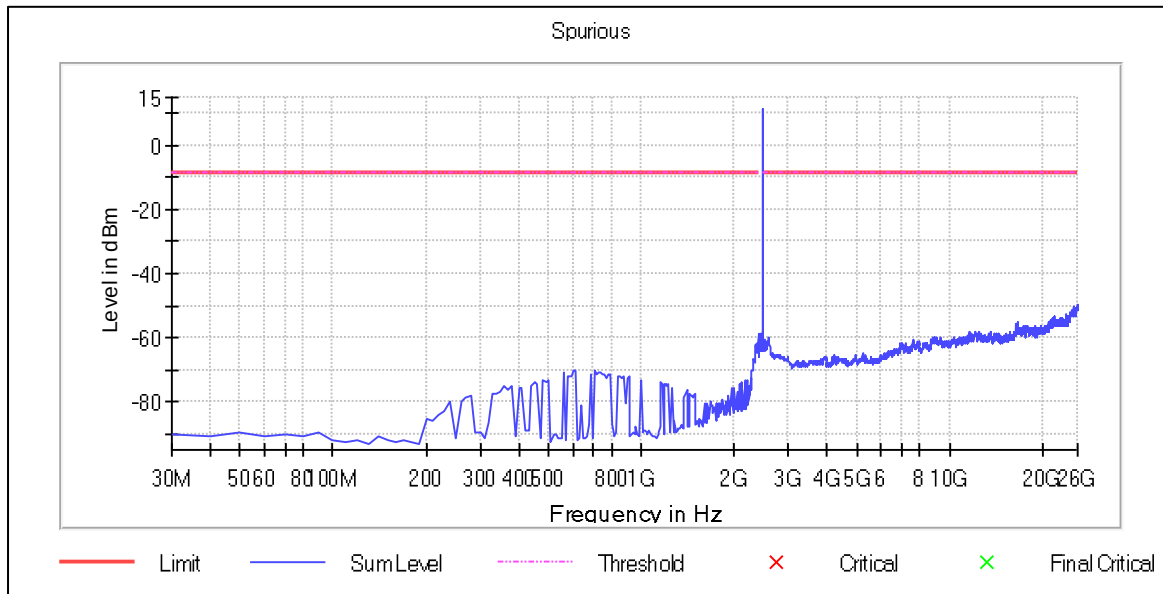
TX spurious emissions, conducted, low channel, Bluetooth LE, Coded PHY (S=2)



TX spurious emissions, conducted, mid channel, Bluetooth LE, Coded PHY (S=2)



TX spurious emissions, conducted, high channel, Bluetooth LE, Coded PHY (S=2)



Pre-Measurements, low channel, Bluetooth LE, Coded PHY (S=8)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4803.154762	-60.9	49.7	-11.2
2390.000000	-64.5	53.3	-11.2
2290.000000	-64.7	53.5	-11.2
2330.000000	-64.8	53.6	-11.2
2310.000000	-64.8	53.6	-11.2
2300.000000	-65.0	53.8	-11.2
2270.000000	-65.1	53.9	-11.2
2260.000000	-65.3	54.1	-11.2
2320.000000	-65.4	54.2	-11.2
2350.000000	-65.6	54.4	-11.2
2493.498512	-65.9	54.7	-11.2
2240.000000	-65.9	54.7	-11.2
2280.000000	-65.9	54.7	-11.2
2523.494048	-65.9	54.8	-11.2
2360.000000	-66.2	55.0	-11.2

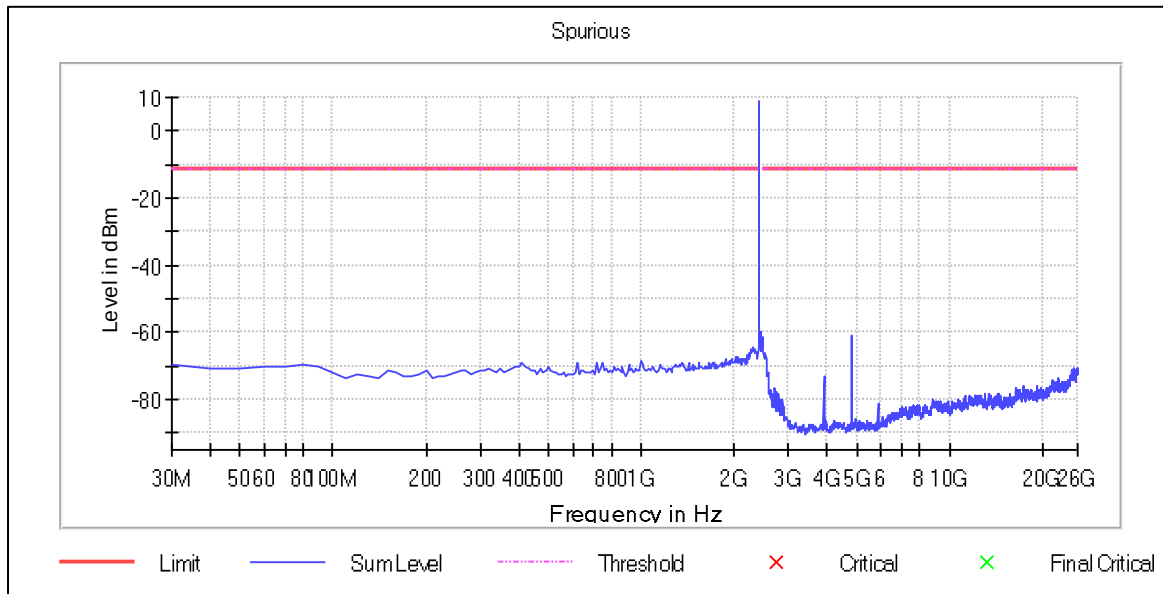
Pre-Measurements, middle channel, Bluetooth LE, Coded PHY (S=8)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2360.000000	-60.2	48.8	-11.3
2523.494048	-61.4	50.1	-11.3
2340.000000	-62.2	50.9	-11.3
4883.142857	-62.4	51.1	-11.3
2300.000000	-63.2	51.8	-11.3
2350.000000	-63.3	51.9	-11.3
2533.492560	-63.3	52.0	-11.3
2543.491071	-63.4	52.1	-11.3
2330.000000	-63.6	52.2	-11.3
2320.000000	-63.7	52.3	-11.3
2563.488095	-63.9	52.6	-11.3
2583.485119	-63.9	52.6	-11.3
2390.000000	-64.3	53.0	-11.3
2513.495536	-64.4	53.1	-11.3
2310.000000	-64.6	53.3	-11.3

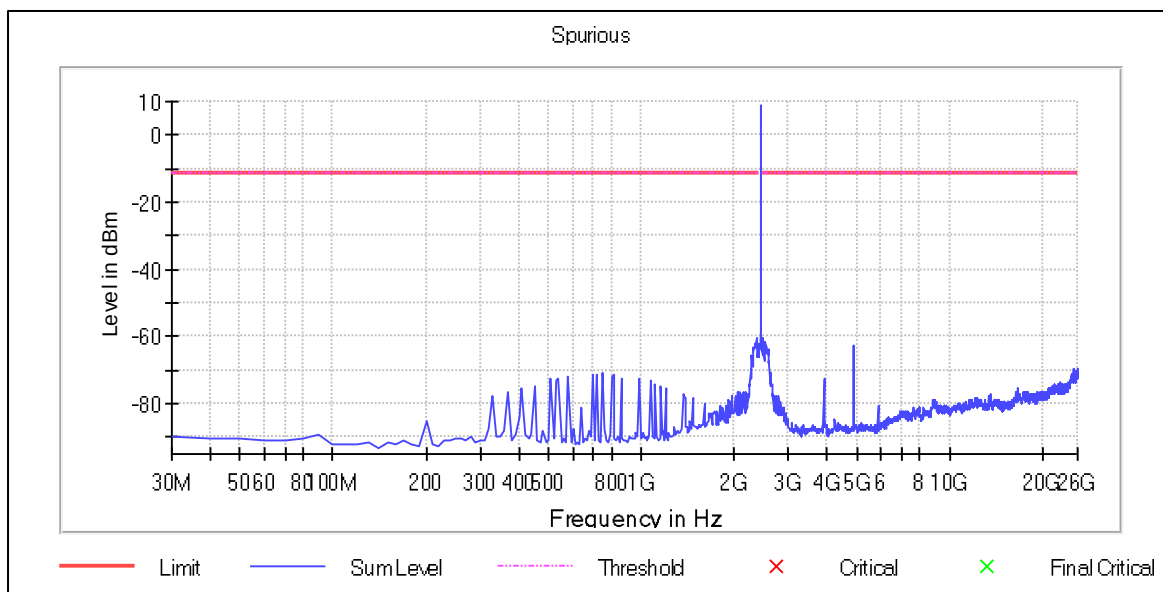
Pre-Measurements, top channel, Bluetooth LE, Coded PHY (S=8)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
25830.025298	-50.2	38.4	-11.8
25860.020833	-50.2	38.4	-11.8
25980.002976	-50.3	38.5	-11.8
25840.023810	-50.3	38.5	-11.8
25820.026786	-50.3	38.5	-11.8
25910.013393	-50.3	38.5	-11.8
25880.017857	-50.5	38.7	-11.8
25870.019345	-50.6	38.8	-11.8
25320.101190	-50.6	38.8	-11.8
25890.016369	-50.6	38.8	-11.8
25970.004464	-50.7	38.9	-11.8
25380.092262	-50.7	38.9	-11.8
25940.008929	-50.7	38.9	-11.8
24850.171131	-50.8	39.0	-11.8
25900.014881	-50.8	39.0	-11.8

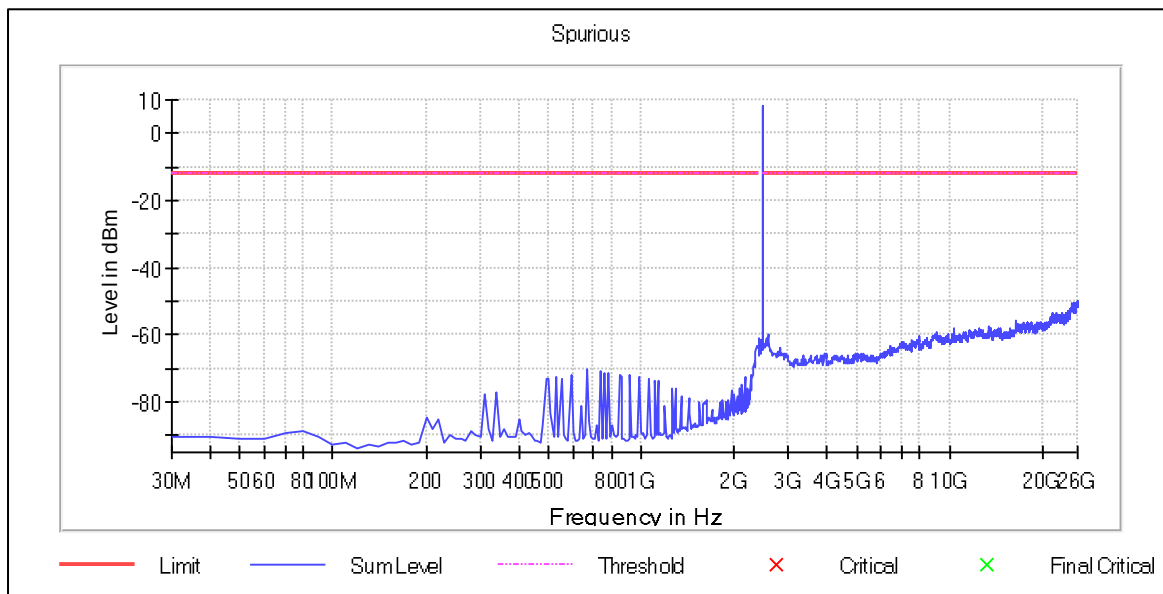
TX spurious emissions, conducted, low channel, Bluetooth LE, Coded PHY (S=8)



TX spurious emissions, conducted, mid channel, Bluetooth LE, Coded PHY (S=8)



TX spurious emissions, conducted, high channel, Bluetooth LE, Coded PHY (S=8)



16. Tx spurious emissions, radiated

Reference: FCC §15.247(d), FCC §15.209, ISSED RSS-Gen Issue 5 A2 (section 6.13)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 8.5 and ANSI C63.10-2013 (6.4, 6.5, 6.6 & 11.12)

Specification: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)/RSS-Gen):

Limits				
Frequency range (MHz)	Detector	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
0.009 – 0.09	Average	2400/F(kHz)	-	300
0.09 – 0.110	Quasi-Peak	2400/F(kHz)	-	300
0.110 – 0.490	Average	2400/F(kHz)	-	300
0.490 – 1.705	Quasi-Peak	24000/F(kHz)	-	30
1.705 – 30.0	Quasi-Peak	30	-	30
30 - 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 - 1000	Quasi-Peak	500	54	3
>1000	Average	500	54	3

Test procedure 30 MHz -1 GHz
1. EUT is placed on a non conducting support at the center of a turn table 0.8m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360 degrees (orientation varied), measurements were made in both horizontal and vertical planes of polarization 5. Found peak values were further maximized by adjusting turntable position $\pm 22,5$ degrees around detected value and scanning the antenna height 1 to 4m 6. For maximized values, final measurement was done with the corresponding final detector.

Test procedure > 1 GHz
1. EUT is placed on a non conducting support at the center of a turn table 1.5m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360 degrees (orientation varied), measurements were made in both horizontal and vertical planes of polarization. 5. Found peak values were further maximized by adjusting turntable position $\pm 22,5$ degrees around detected value and scanning the antenna height 1 to 4m 6. For maximized values, final measurement was done with the corresponding final detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function. RSS-247: Attenuation below the general field strength limits specified in RSS-Gen is not required.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Operation mode(s)	Configuration	Test Verdict
Bluetooth LE TX, 2 Mbps	Low channel, 2402 MHz	PASS
Bluetooth LE TX, 2 Mbps	Mid channel, 2442 MHz	PASS
Bluetooth LE TX, 2 Mbps	High channel, 2480 MHz	PASS
Bluetooth LE TX, S2 PHY	Low channel, 2402 MHz	PASS
Bluetooth LE TX, S2 PHY	Mid channel, 2442 MHz	PASS
Bluetooth LE TX, S2 PHY	High channel, 2480 MHz	PASS

Test data Bluetooth LE 2 Mbps

Channel	Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
37	59,01	34,51	40	5,49	15000	120	98	V	43	0	20,10	PASS
37	200,01	38,86	44	4,64	15000	120	128	H	218	180	20,10	PASS
37	399,99	31,72	46	14,28	15000	120	98	V	337	0	25,20	PASS
37	599,97	30,68	46	15,32	15000	120	255	H	20	90	29,80	PASS
37	724,11	22,15	46	23,85	15000	120	327	V	-8	0	30,90	PASS
37	799,98	34,94	46	11,06	15000	120	98	H	232	90	32,10	PASS
37	999,99	36,26	54	17,74	15000	120	138	V	196	90	34,30	PASS
18	58,65	34,66	40	5,34	15000	120	117	V	16	0	20,20	PASS
18	200,01	37,79	44	5,71	15000	120	139	H	247	180	20,10	PASS
18	399,99	32,56	46	13,44	15000	120	101	V	337	0	25,20	PASS
18	600,00	30,03	46	15,97	15000	120	162	V	158	0	29,80	PASS
18	799,98	33,41	46	12,59	15000	120	145	H	236	90	32,10	PASS
18	999,99	32,27	54	21,73	15000	120	126	V	105	180	34,30	PASS
39	58,11	35,70	40	4,30	15000	120	100	V	22	0	20,30	PASS
39	200,01	38,98	44	4,52	15000	120	139	H	213	180	20,10	PASS
39	399,99	30,18	46	15,82	15000	120	101	V	22	0	25,20	PASS
39	600,00	31,74	46	14,26	15000	120	138	H	263	180	29,80	PASS
39	799,98	35,08	46	10,92	15000	120	164	H	118	180	32,10	PASS
39	999,99	35,56	54	18,44	15000	120	131	V	168	90	34,30	PASS

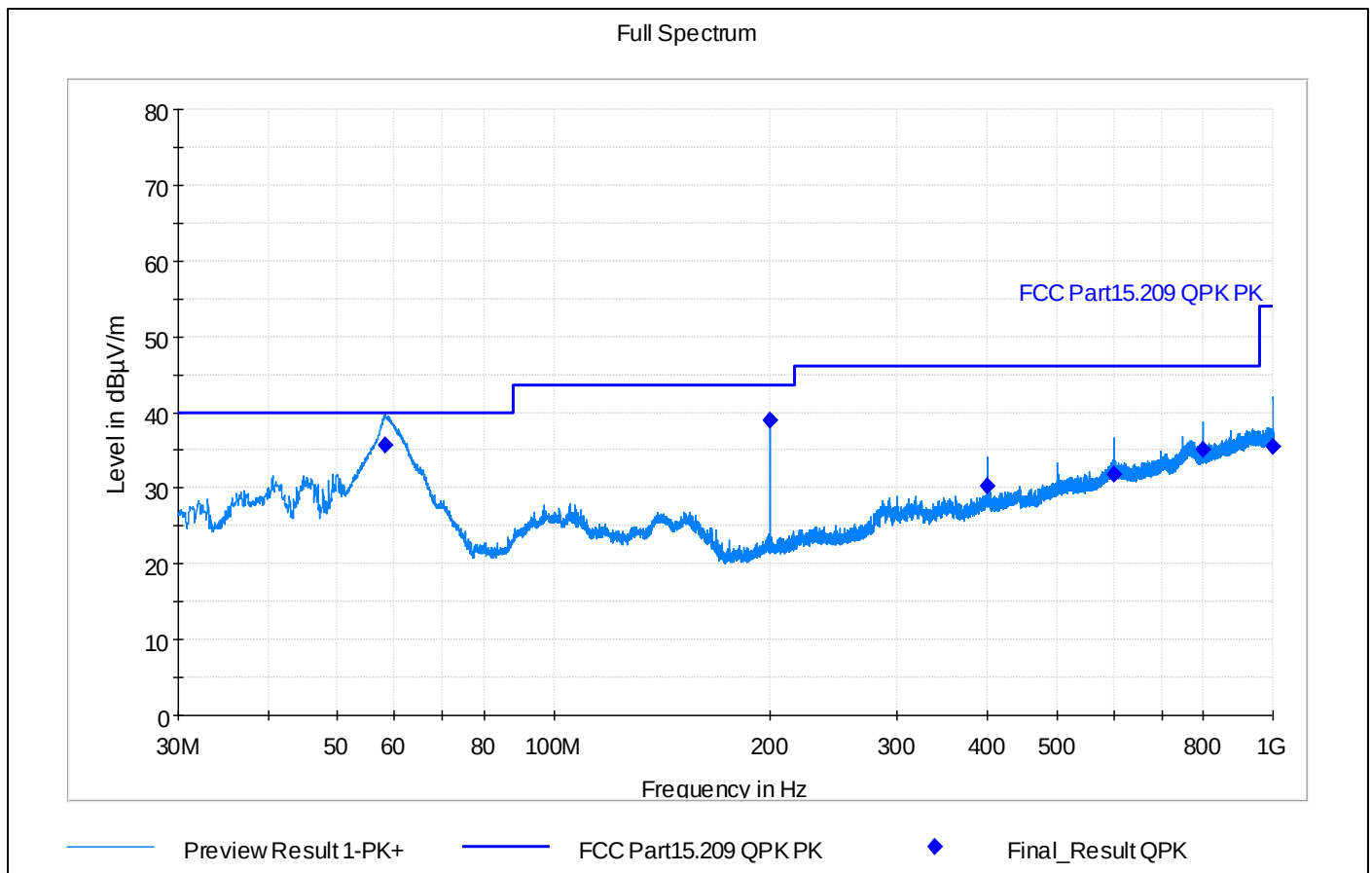
Channel	Freq (MHz)	MaxPeak (dBμV/m)	CAve (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	RBW (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr (dB)	Comment
37	1369,70	---	25,96	54	28,04	15000	1000	283	H	119	90	32,30	PASS
37	1369,70	43,21	---	74	30,79	15000	1000	283	H	119	90	32,30	PASS
37	2075,80	---	33,58	54	20,42	15000	1000	379	H	321	180	37,60	PASS
37	2075,80	50,29	---	74	23,71	15000	1000	379	H	321	180	37,60	PASS
37	2389,30	51,36	---	74	22,64	15000	1000	280	H	270	0	38,50	PASS
37	2389,30	---	34,68	54	19,32	15000	1000	280	H	270	0	38,50	PASS
37	2397,60	---	34,88	54	19,12	15000	1000	142	H	65	0	38,60	PASS
37	2397,60	53,41	---	74	20,59	15000	1000	142	H	65	0	38,60	PASS
37	2397,80	61,44	---	74	12,56	15000	1000	159	V	30	0	38,60	PASS
37	2397,80	---	36,11	54	17,89	15000	1000	159	V	30	0	38,60	PASS
37	2398,70	---	35,68	54	18,32	15000	1000	102	H	310	0	38,60	PASS
37	2398,70	55,02	---	74	18,98	15000	1000	102	H	310	0	38,60	PASS
37	2401,60	107,15	---	74	-33,15	15000	1000	147	H	7	180	38,60	TX signal
37	2401,60	---	95,47	54	-41,47	15000	1000	147	H	7	180	38,60	TX signal
18	1000,00	44.07	---	74.00	29.93	15000	1000	114.0	V	114	180.0	29,70	PASS
18	1200,05	---	30.18	54.00	23.82	15000	1000	114.0	V	114	180.0	29,70	PASS
18	1200,05	44.96	---	74.00	29,40	15000	1000	237.0	V	222	90.0	31,30	PASS
18	2068,35	---	31,12	54.00	22,88	15000	1000	237.0	V	222	90.0	31,30	PASS
18	2068,35	---	33.50	54.00	20,50	15000	1000	163.0	V	82	180.0	37,60	PASS
18	2426,00	50.00	---	74.00	24,00	15000	1000	163.0	V	82	180.0	37,60	PASS
18	2426,00	58.03	---	74.00	15,97	15000	1000	128.0	V	326	0.0	38,80	PASS
18	2429,60	---	35.25	54.00	18,75	15000	1000	128.0	V	326	0.0	38,80	PASS
18	2429,60	59.72	---	74.00	14,28	15000	1000	136.0	V	249	0.0	38,90	PASS
18	2442,40	---	35.42	54.00	18,58	15000	1000	136.0	V	249	0.0	38,90	PASS
18	2442,40	---	95.10	54.00	-41,10	15000	1000	297.0	H	101	90.0	38,90	TX signal
18	2981,30	107.09	---	74.00	-33,09	15000	1000	297.0	H	101	90.0	38,90	TX signal
18	2981,30	55.75	---	74.00	18,25	15000	1000	318.0	V	114	180.0	41,40	PASS
18	1000,00	---	39.75	54.00	14,25	15000	1000	318.0	V	114	180.0	41,40	PASS
39	2105,00	49,53	---	74	24,47	15000	1000	276	V	287	180	37,70	PASS
39	2105,00	---	33,57	54	20,43	15000	1000	276	V	287	180	37,70	PASS
39	2480,50	107,19	---	74	-33,19	15000	1000	139	H	6	180	39,20	TX signal
39	2480,50	---	94,03	54	-40,03	15000	1000	139	H	6	180	39,20	TX signal
39	2483,30	---	39,75	54	14,25	15000	1000	228	H	9	180	39,20	PASS
39	2483,30	59,15	---	74	14,85	15000	1000	228	H	9	180	39,20	PASS
39	2488,00	56,93	---	74	17,07	15000	1000	234	H	99	90	39,20	PASS

39	2488,00	---	36,07	54	17,93	15000	1000	234	H	99	90	39,20	PASS
39	2996,20	---	39,87	54	14,13	15000	1000	150	V	163	0	41,70	PASS
39	2996,20	55,38	---	74	18,62	15000	1000	150	V	163	0	41,70	PASS
37	3400,00	---	33,81	54	20,19	15000	1000	252	V	292	180	6,00	PASS
37	3400,00	43,36	---	74	30,64	15000	1000	252	V	292	180	6,00	PASS
37	3799,75	42,50	---	74	31,50	15000	1000	352	H	265	180	7,70	PASS
37	3799,75	---	29,74	54	24,26	15000	1000	352	H	265	180	7,70	PASS
37	11891,50	---	33,59	54	20,41	15000	1000	346	H	84	90	22,60	PASS
37	11891,50	47,12	---	74	26,88	15000	1000	346	H	84	90	22,60	PASS
37	17975,00	57,39	---	74	16,61	15000	1000	158	V	289	90	39,10	PASS
37	17975,00	---	43,46	54	10,54	15000	1000	158	V	289	90	39,10	PASS
18	3799,75	---	35,39	54	18,61	15000	1000	191	V	-9	90	7,70	PASS
18	3799,75	44,73	---	74	29,27	15000	1000	191	V	-9	90	7,70	PASS
18	6519,00	44,28	---	74	29,72	15000	1000	131	V	354	180	13,50	PASS
18	6519,00	---	30,26	54	23,74	15000	1000	131	V	354	180	13,50	PASS
18	17966,25	57,09	---	74	16,91	15000	1000	346	V	11	180	39,10	PASS
18	17966,25	---	43,53	54	10,47	15000	1000	346	V	11	180	39,10	PASS
39	3000,00	---	32,19	54	21,81	15000	1000	228	V	-10	90	5,00	PASS
39	3000,00	44,49	---	74	29,51	15000	1000	228	V	-10	90	5,00	PASS
39	6073,75	43,27	---	74	30,73	15000	1000	134	H	-8	0	12,00	PASS
39	6073,75	---	29,18	54	24,82	15000	1000	134	H	-8	0	12,00	PASS
39	11567,50	---	33,84	54	20,16	15000	1000	407	V	179	0	22,50	PASS
39	11567,50	48,12	---	74	25,88	15000	1000	407	V	179	0	22,50	PASS
39	17957,75	56,95	---	74	17,05	15000	1000	402	H	4	0	39,10	PASS
39	17957,75	---	43,46	54	10,54	15000	1000	402	H	4	0	39,10	PASS
37	18777,50	45,34	---	74	28,66	3000	1000	333	V	186	0	23,50	PASS
37	18777,50	---	32,35	54	21,65	3000	1000	333	V	186	0	23,50	PASS
37	24013,00	46,05	---	74	27,95	3000	1000	220	V	90	0	25,90	PASS
37	24013,00	---	32,47	54	21,53	3000	1000	220	V	90	0	25,90	PASS
18	18773,00	---	32,31	54	21,69	3000	1000	310	H	184	0	23,50	PASS
18	18773,00	46,07	---	74	27,93	3000	1000	310	H	184	0	23,50	PASS
18	21779,00	45,29	---	74	28,71	3000	1000	196	V	311	180	24,90	PASS
18	21779,00	---	32,16	54	21,84	3000	1000	196	V	311	180	24,90	PASS
18	25977,50	47,22	---	74	26,78	3000	1000	196	H	275	90	27,00	PASS
18	25977,50	---	34,29	54	19,71	3000	1000	196	H	275	90	27,00	PASS
39	18807,25	46,43	---	74	27,57	3000	1000	324	V	157	90	23,50	PASS

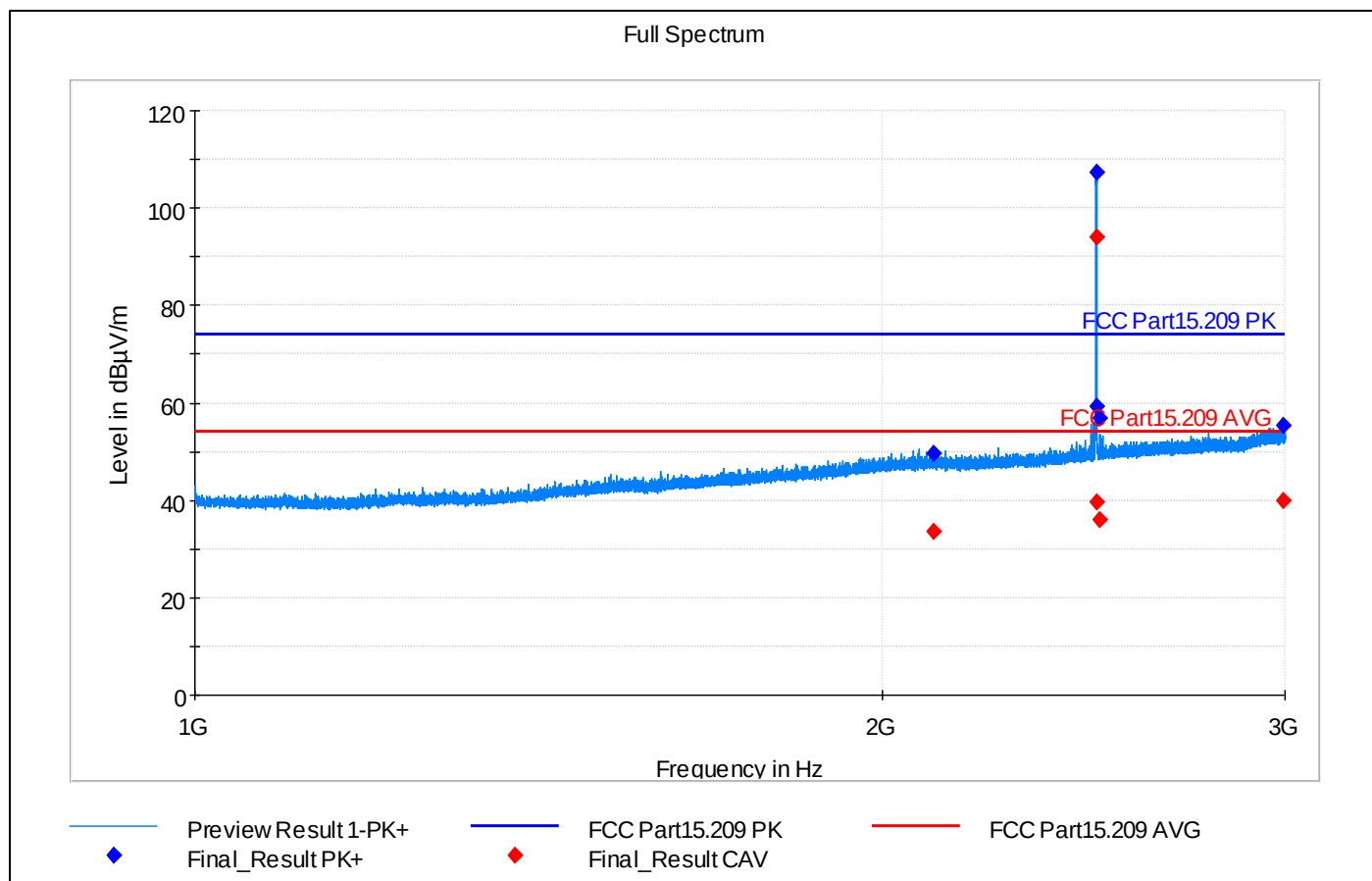
39	18807,25	---	32,52	54	21,48	3000	1000	324	V	157	90	23,50	PASS
39	19739,50	44,66	---	74	29,34	3000	1000	98	V	146	180	23,90	PASS
39	19739,50	---	31,04	54	22,96	3000	1000	98	V	146	180	23,90	PASS
39	23066,50	---	32,60	54	21,40	3000	1000	347	V	53	0	25,60	PASS
39	23066,50	45,30	---	74	28,70	3000	1000	347	V	53	0	25,60	PASS

Graphical data:

High channel, 30 MHz – 1 GHz

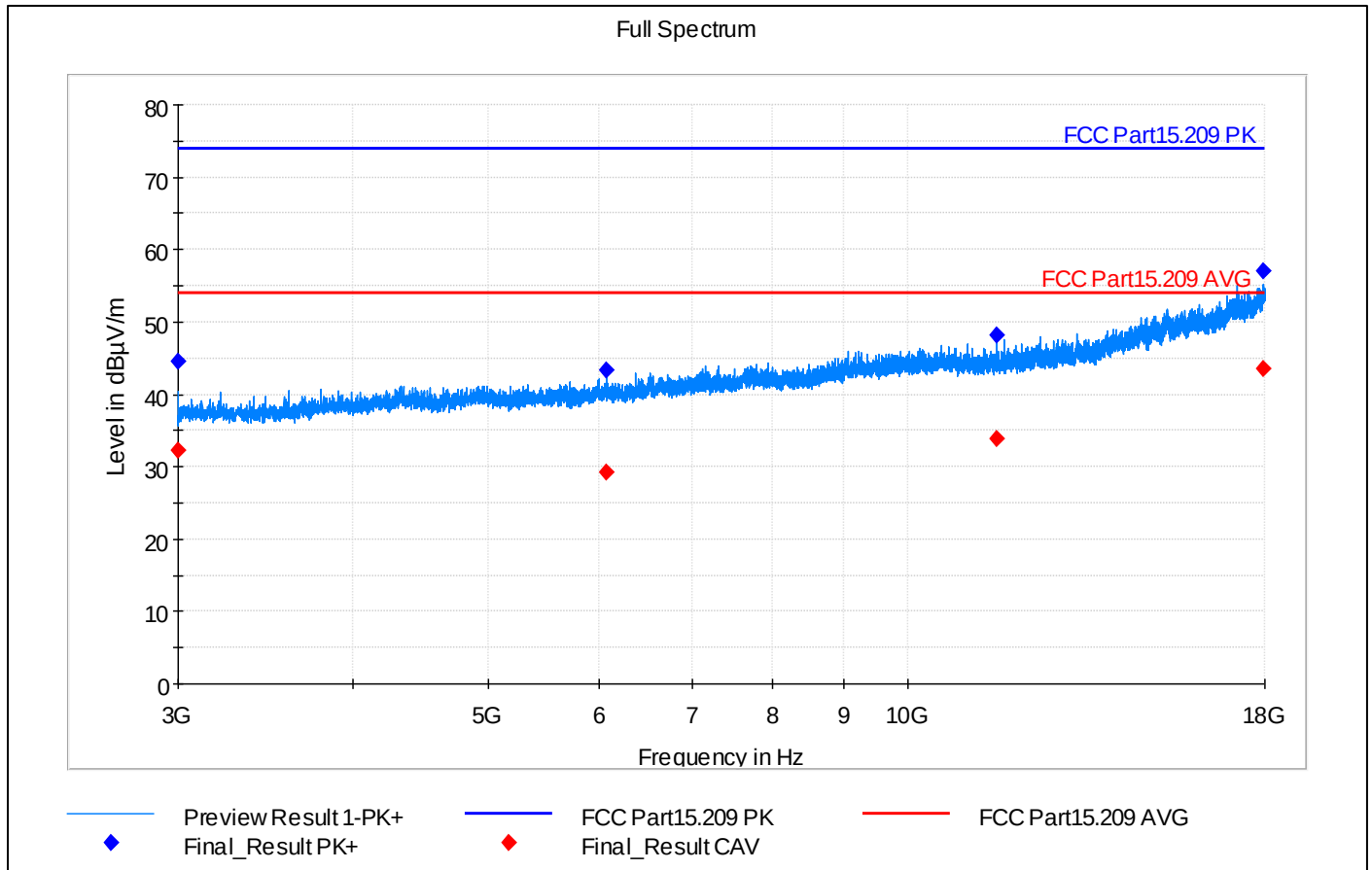


High channel, 1 – 3 GHz

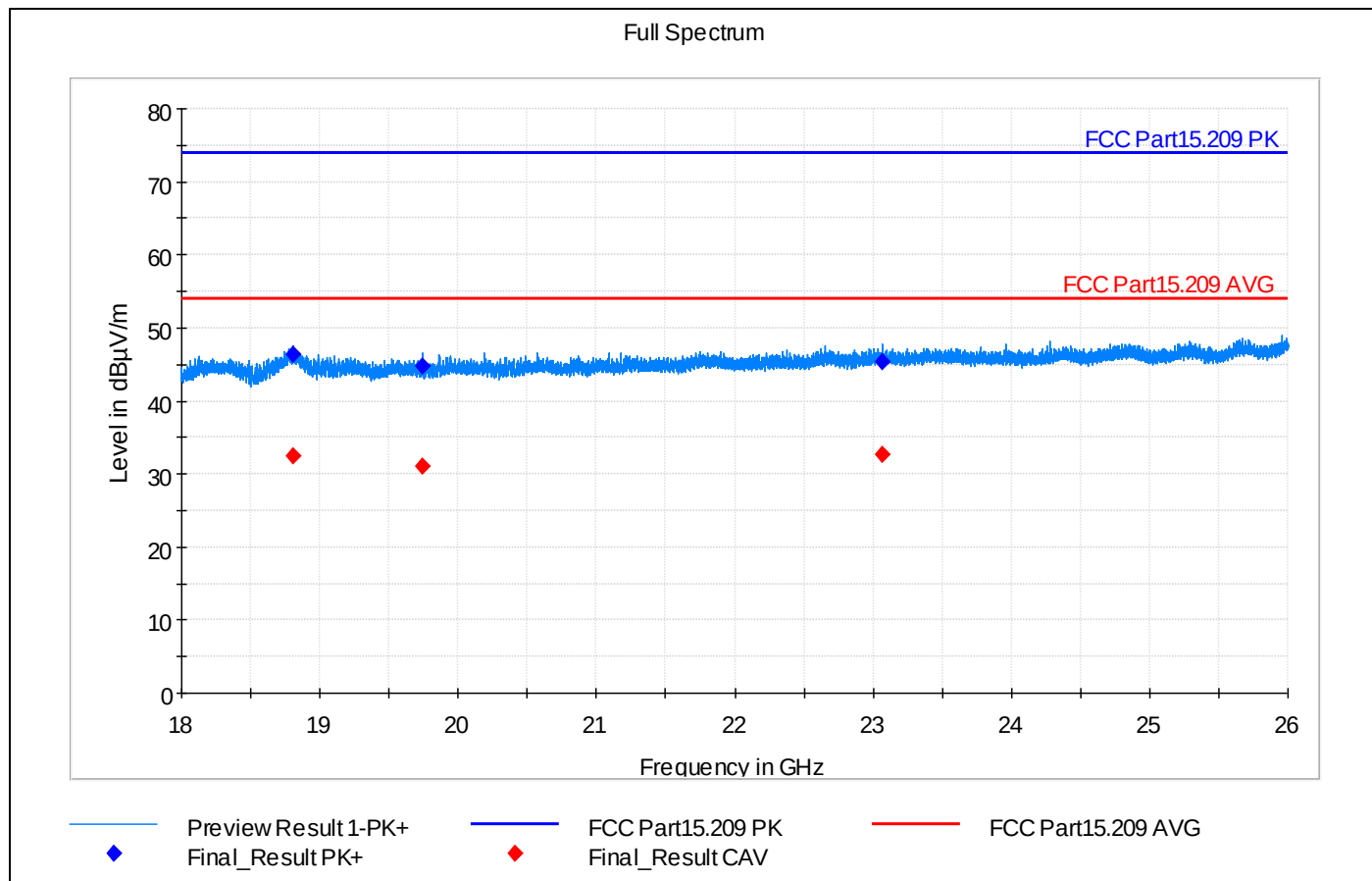


Note: Fundamental TX frequency 2480,50 MHz is excluded from spurious domain measurements and ignored.

High channel, 3 – 18 GHz



High channel, 18 – 26 GHz



Test data Bluetooth LE S2 PHY

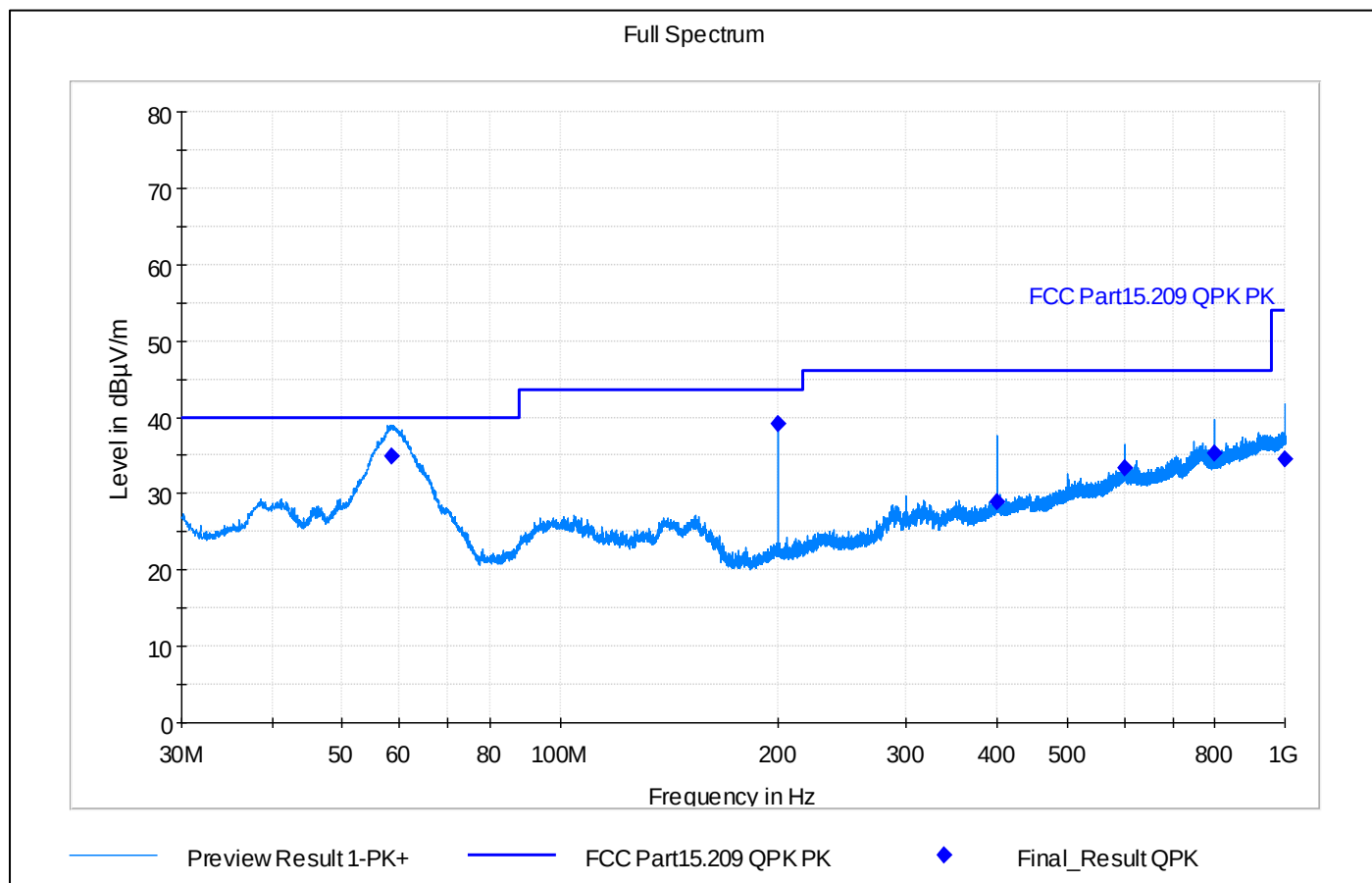
Channel	Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
37	58,38	34,92	40	5,08	15000	120	116	V	6	0	20,20	PASS
37	200,01	39,18	44	4,32	15000	120	140	H	292	90	20,10	PASS
37	399,99	28,96	46	17,04	15000	120	98	H	118	90	25,20	PASS
37	600,00	33,30	46	12,70	15000	120	112	H	262	180	29,80	PASS
37	799,98	35,33	46	10,67	15000	120	152	H	128	180	32,10	PASS
37	999,99	34,54	54	19,46	15000	120	141	V	212	0	34,30	PASS
18	58,14	35,70	40	4,30	15000	120	101	V	-11	0	20,30	PASS
18	60,84	32,99	40	7,01	15000	120	101	V	67	0	19,70	PASS
18	200,01	39,22	44	4,28	15000	120	140	H	213	180	20,10	PASS
18	399,99	29,76	46	16,24	15000	120	101	V	-22	0	25,20	PASS
18	600,00	29,28	46	16,72	15000	120	276	H	7	90	29,80	PASS
18	799,98	34,87	46	11,13	15000	120	98	H	230	90	32,10	PASS
18	999,99	37,29	54	16,71	15000	120	101	V	213	0	34,30	PASS
39	58,95	35,55	40	4,45	15000	120	100	V	22	0	20,10	PASS
39	200,01	39,17	44	4,33	15000	120	125	H	208	180	20,10	PASS
39	399,99	29,99	46	16,01	15000	120	128	V	335	0	25,20	PASS
39	600,00	32,61	46	13,39	15000	120	118	H	272	180	29,80	PASS
39	799,98	34,01	46	11,99	15000	120	153	H	218	90	32,10	PASS
39	999,99	40,01	54	13,99	15000	120	98	V	96	180	34,30	PASS

Channel	Freq (MHz)	MaxPeak (dBμV/m)	CAve (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	RBW (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr (dB)	Comment
37	1200,15	44,86	---	74	29,14	15000	1000	98	V	116	180	31,30	PASS
37	1200,15	---	32,19	54	21,81	15000	1000	98	V	116	180	31,30	PASS
37	1715,55	46,89	---	74	27,11	15000	1000	348	V	147	90	34,80	PASS
37	1715,55	---	30,04	54	23,96	15000	1000	348	V	147	90	34,80	PASS
37	2385,90	57,81	---	74	16,19	15000	1000	147	V	1	0	38,50	PASS
37	2385,90	---	34,63	54	19,37	15000	1000	147	V	1	0	38,50	PASS
37	2399,50	---	37,76	54	16,24	15000	1000	150	H	7	180	38,60	PASS
37	2399,50	62,48	---	74	11,52	15000	1000	150	H	7	180	38,60	PASS
37	2401,80	---	98,60	54	-44,60	15000	1000	148	H	5	180	38,60	TX signal
37	2401,80	107,06	---	74	-33,06	15000	1000	148	H	5	180	38,60	TX signal
37	2417,95	---	35,07	54	18,93	15000	1000	112	V	31	0	38,80	PASS
37	2417,95	58,67	---	74	15,33	15000	1000	112	V	31	0	38,80	PASS
18	1199,90	---	31,75	54	22,25	15000	1000	249	V	94	180	31,30	PASS
18	1199,90	44,85	---	74	29,15	15000	1000	249	V	94	180	31,30	PASS
18	2425,90	---	35,18	54	18,82	15000	1000	148	V	51	0	38,80	PASS
18	2425,90	57,14	---	74	16,86	15000	1000	148	V	51	0	38,80	PASS
18	2441,80	---	104,51	54	-50,51	15000	1000	268	H	104	90	38,90	TX signal
18	2441,80	106,94	---	74	-32,94	15000	1000	268	H	104	90	38,90	TX signal
18	2975,95	55,52	---	74	18,48	15000	1000	369	V	316	0	41,30	PASS
18	2975,95	---	39,63	54	14,37	15000	1000	369	V	316	0	41,30	PASS
39	1200,00	---	29,54	54	24,46	15000	1000	166	H	145	180	31,30	PASS
39	1200,00	44,82	---	74	29,18	15000	1000	166	H	145	180	31,30	PASS
39	1599,90	---	37,60	54	16,40	15000	1000	126	H	334	90	34,20	PASS
39	1599,90	47,96	---	74	26,04	15000	1000	126	H	334	90	34,20	PASS
39	2479,80	---	98,35	54	-44,35	15000	1000	208	H	108	90	39,20	TX signal
39	2479,80	106,82	---	74	-32,82	15000	1000	208	H	108	90	39,20	TX signal
39	2483,75	58,01	---	74	15,99	15000	1000	105	V	286	0	39,20	PASS
39	2483,75	---	36,47	54	17,53	15000	1000	105	V	286	0	39,20	PASS
39	2986,90	---	39,74	54	14,26	15000	1000	176	V	322	0	41,50	PASS
39	2986,90	55,39	---	74	18,61	15000	1000	176	V	322	0	41,50	PASS
37	3906,50	---	27,21	54	26,79	15000	1000	378	H	21	90	7,50	PASS
37	3906,50	41,04	---	74	32,96	15000	1000	378	H	21	90	7,50	PASS
37	10473,50	47,20	---	74	26,80	15000	1000	400	H	149	180	20,80	PASS
37	10473,50	---	33,68	54	20,32	15000	1000	400	H	149	180	20,80	PASS

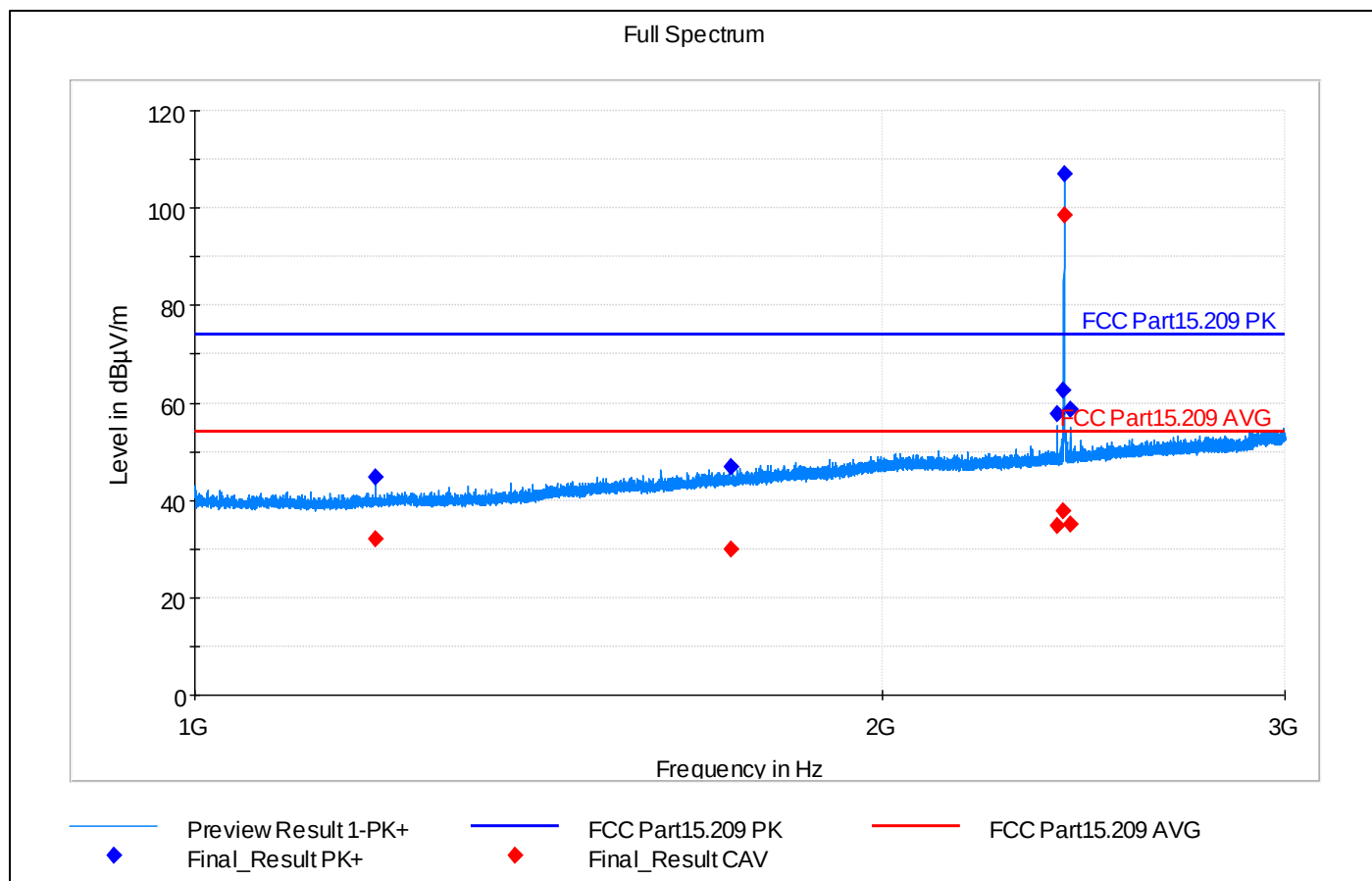
37	17993,50	56,99	---	74	17,01	15000	1000	350	V	166	90	39,20	PASS
37	17993,50	---	43,01	54	10,99	15000	1000	350	V	166	90	39,20	PASS
18	3799,75	44,79	---	74	29,21	15000	1000	200	V	343	90	7,70	PASS
18	3799,75	---	35,39	54	18,61	15000	1000	200	V	343	90	7,70	PASS
18	10568,75	47,49	---	74	26,51	15000	1000	108	H	127	180	21,50	PASS
18	10568,75	---	34,22	54	19,78	15000	1000	108	H	127	180	21,50	PASS
18	17799,50	---	42,44	54	11,56	15000	1000	243	H	237	90	38,20	PASS
18	17799,50	56,32	---	74	17,68	15000	1000	243	H	237	90	38,20	PASS
39	3799,75	---	34,67	54	19,33	15000	1000	203	V	271	180	7,70	PASS
39	3799,75	43,86	---	74	30,14	15000	1000	203	V	271	180	7,70	PASS
39	6000,50	45,23	---	74	28,77	15000	1000	221	V	202	0	11,90	PASS
39	6000,50	---	32,14	54	21,86	15000	1000	221	V	202	0	11,90	PASS
39	17988,25	56,41	---	74	17,59	15000	1000	100	H	3	180	39,10	PASS
39	17988,25	---	42,96	54	11,04	15000	1000	100	H	3	180	39,10	PASS
37	18809,50	---	32,46	54	21,54	3000	1000	241	V	266	180	23,50	PASS
37	18809,50	46,06	---	74	27,94	3000	1000	241	V	266	180	23,50	PASS
37	20917,50	44,40	---	74	29,60	3000	1000	311	H	123	90	24,40	PASS
37	20917,50	---	31,23	54	22,77	3000	1000	311	H	123	90	24,40	PASS
37	25933,50	47,37	---	74	26,63	3000	1000	127	H	331	180	27,00	PASS
37	25933,50	---	33,91	54	20,09	3000	1000	127	H	331	180	27,00	PASS
18	18781,75	---	32,34	54	21,66	3000	1000	234	H	94	0	23,50	PASS
18	18781,75	45,61	---	74	28,39	3000	1000	234	H	94	0	23,50	PASS
39	22980,00	45,98	---	74	28,02	3000	1000	221	H	180	0	25,40	PASS
39	22980,00	---	32,19	54	21,81	3000	1000	221	H	180	0	25,40	PASS
39	23593,50	46,11	---	74	27,89	3000	1000	407	H	96	0	25,80	PASS
39	23593,50	---	32,62	54	21,38	3000	1000	407	H	96	0	25,80	PASS
39	25691,75	---	33,65	54	20,35	3000	1000	395	V	186	0	26,70	PASS
39	25691,75	47,11	---	74	26,89	3000	1000	395	V	186	0	26,70	PASS

Graphical data:

Low channel, 30 MHz – 1 GHz

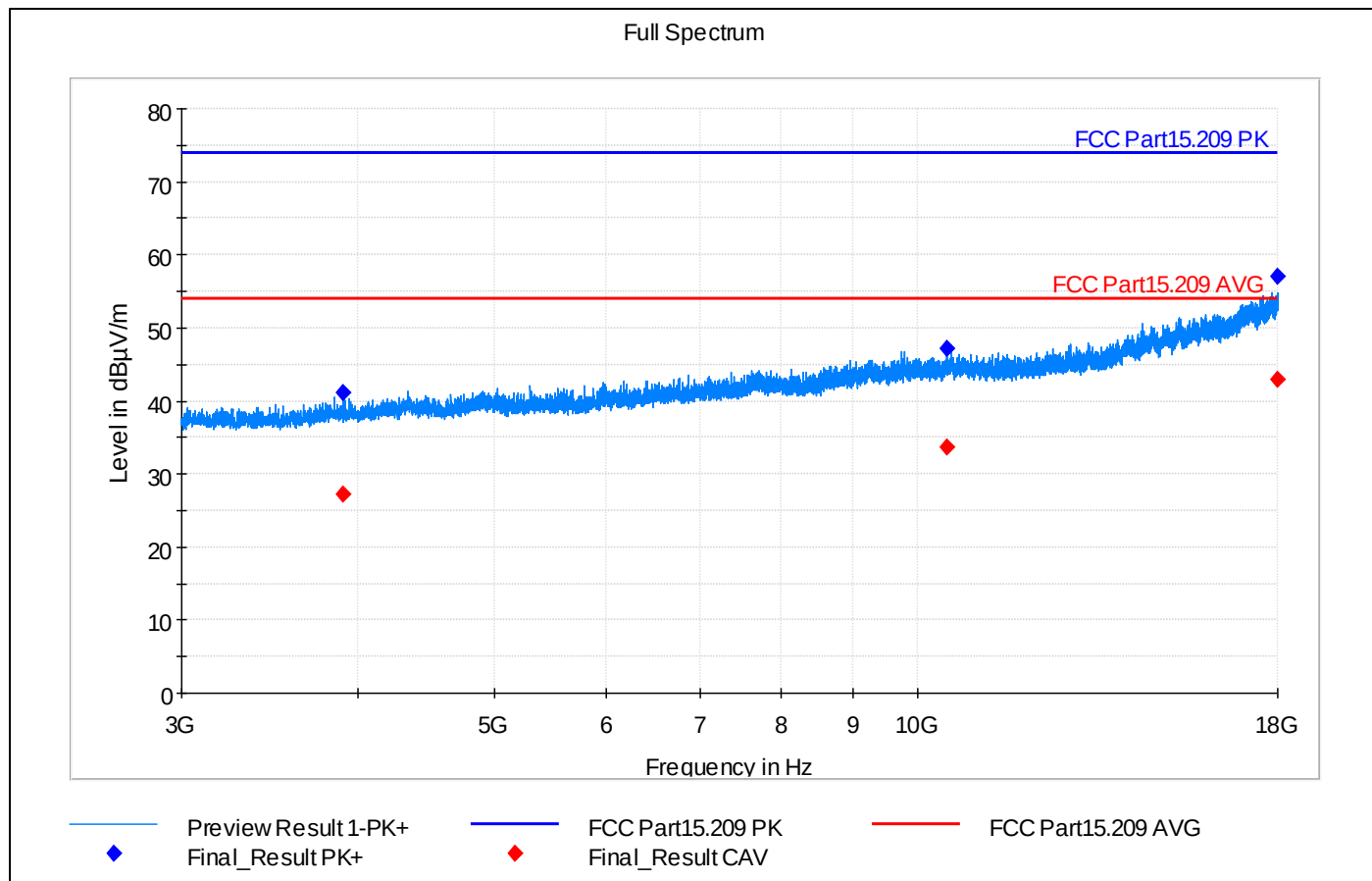


Low channel, 1 – 3 GHz

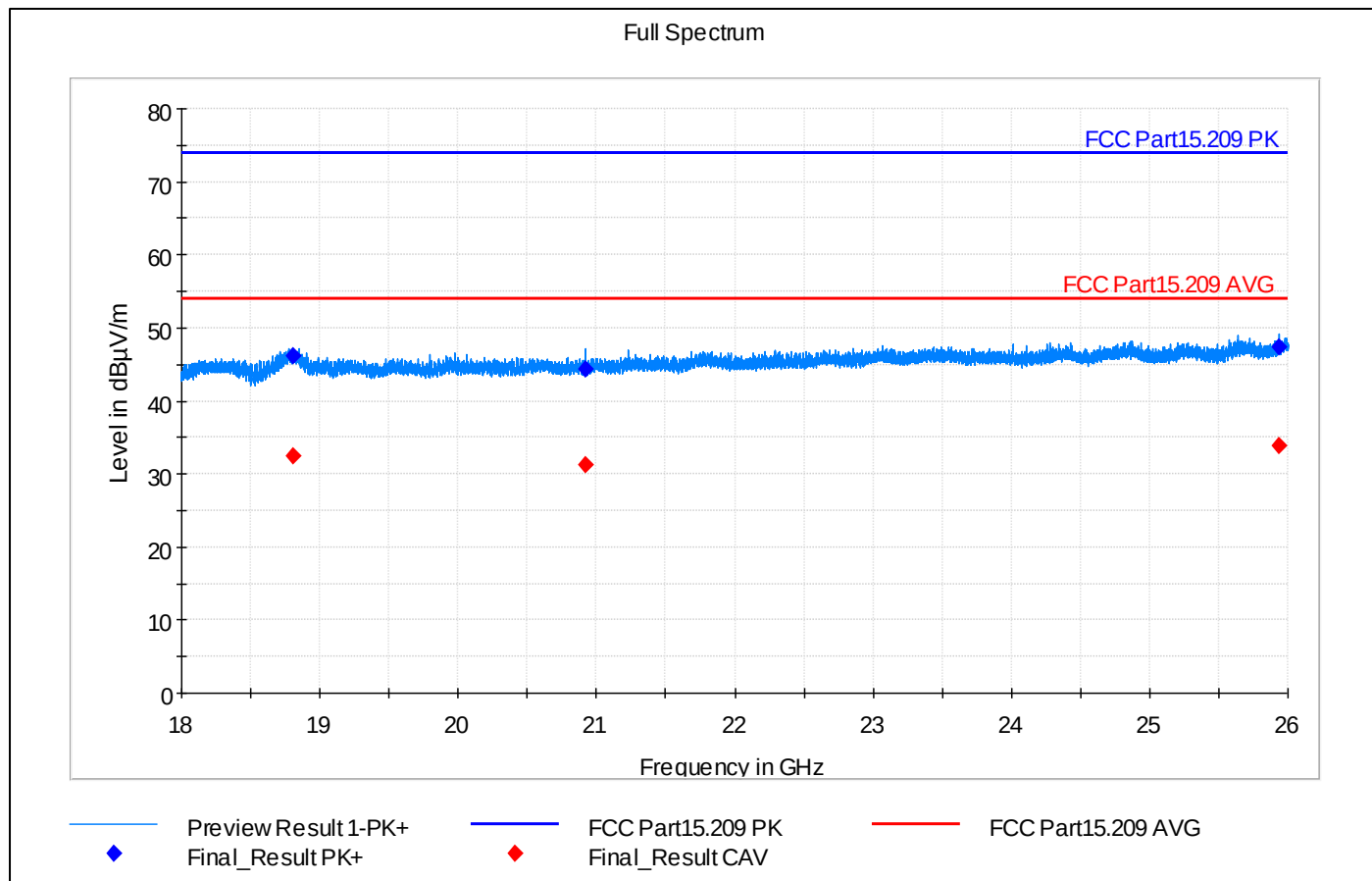


Note: Fundamental TX frequency 2401,80 MHz is excluded from spurious domain measurements and ignored.

Low channel, 3 – 18 GHz



Low channel, 18 – 26 GHz



17. Optional antenna spot check results

Reference: FCC §15.247(d), FCC §15.209, ISED RSS-Gen Issue 5 A2 (section 6.13)

Test method: KDB 558074 D01 DTS Meas Guidance v05r02 8.5 and ANSI C63.10-2013 (6.4, 6.5, 6.6 & 11.12)

Specification: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)/RSS-Gen):

Limits				
Frequency range (MHz)	Detector	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
0.009 – 0.09	Average	2400/F(kHz)	-	300
0.09 – 0.110	Quasi-Peak	2400/F(kHz)	-	300
0.110 – 0.490	Average	2400/F(kHz)	-	300
0.490 – 1.705	Quasi-Peak	24000/F(kHz)	-	30
1.705 – 30.0	Quasi-Peak	30	-	30
30 - 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 - 1000	Quasi-Peak	500	54	3
>1000	Average	500	54	3

Test procedure 30 MHz -1 GHz
7. EUT is placed on a non conducting support at the center of a turn table 0.8m above the ground 8. EUT set to test mode 9. The receiver is set to peak detection with max hold 10. The EUT is rotated through 360 degrees (orientation varied), measurements were made in both horizontal and vertical planes of polarization 11. Found peak values were further maximized by adjusting turntable position $\pm 22,5$ degrees around detected value and scanning the antenna height 1 to 4m 12. For maximized values, final measurement was done with the corresponding final detector.

Test procedure > 1 GHz
7. EUT is placed on a non conducting support at the center of a turn table 1.5m above the ground 8. EUT set to test mode 9. The receiver is set to peak detection with max hold 10. The EUT is rotated through 360 degrees (orientation varied), measurements were made in both horizontal and vertical planes of polarization. 11. Found peak values were further maximized by adjusting turntable position $\pm 22,5$ degrees around detected value and scanning the antenna height 1 to 4m 12. For maximized values, final measurement was done with the corresponding final detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function. RSS-247: Attenuation below the general field strength limits specified in RSS-Gen is not required.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

For the modular integration test of the Panasonic module on the M2 host, only the mode that created the worse-case spurious emission from the original modular approval test reports will be required. The host integration should only affect the coupling efficiency of spurious signals as well as antenna performance. The

worse-case modulation is not expected to be different. So, this typically requires only testing 1 worse-case frequency.

According to radiated modular tests with highest gain antenna, highest output power was with 2 Mbps data rate. Thus data rate 2 Mbps was selected as a worst case for spot check test and middle channel was measured.

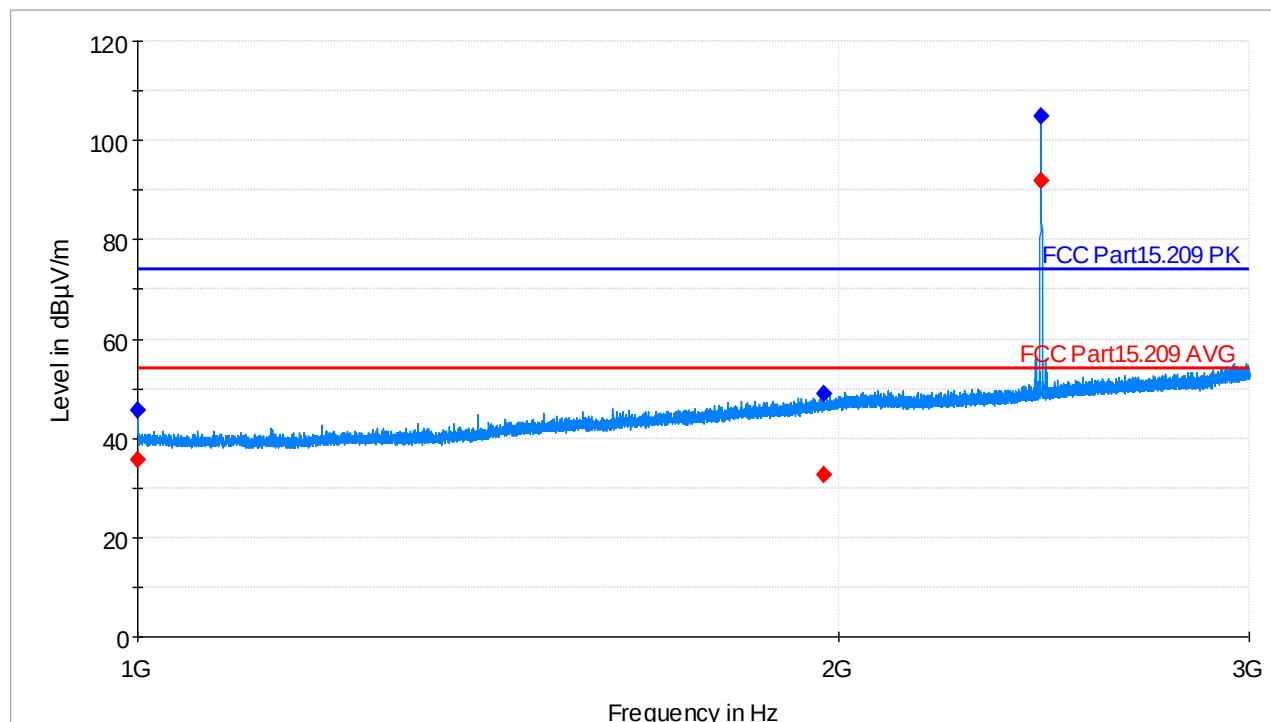
Spot check has been done at frequency range 1 – 18 GHz thus modulation has no effect below 1 GHz and no spurious emissions closer than 6 dB to limits detected at 18 – 26 GHz frequency range in main antenna measurements.

Operation mode(s)	Configuration	Test Verdict	Note
Bluetooth LE TX 2 Mbps	3938ER004 + 3938ER008. Mid channel 18, 2442 MHz	PASS	2JF1002P antenna
Bluetooth LE TX 2 Mbps	3938ER003 + 3938ER008. Mid channel 18, 2442 MHz	PASS	ANT162442DT-2001A2 antenna

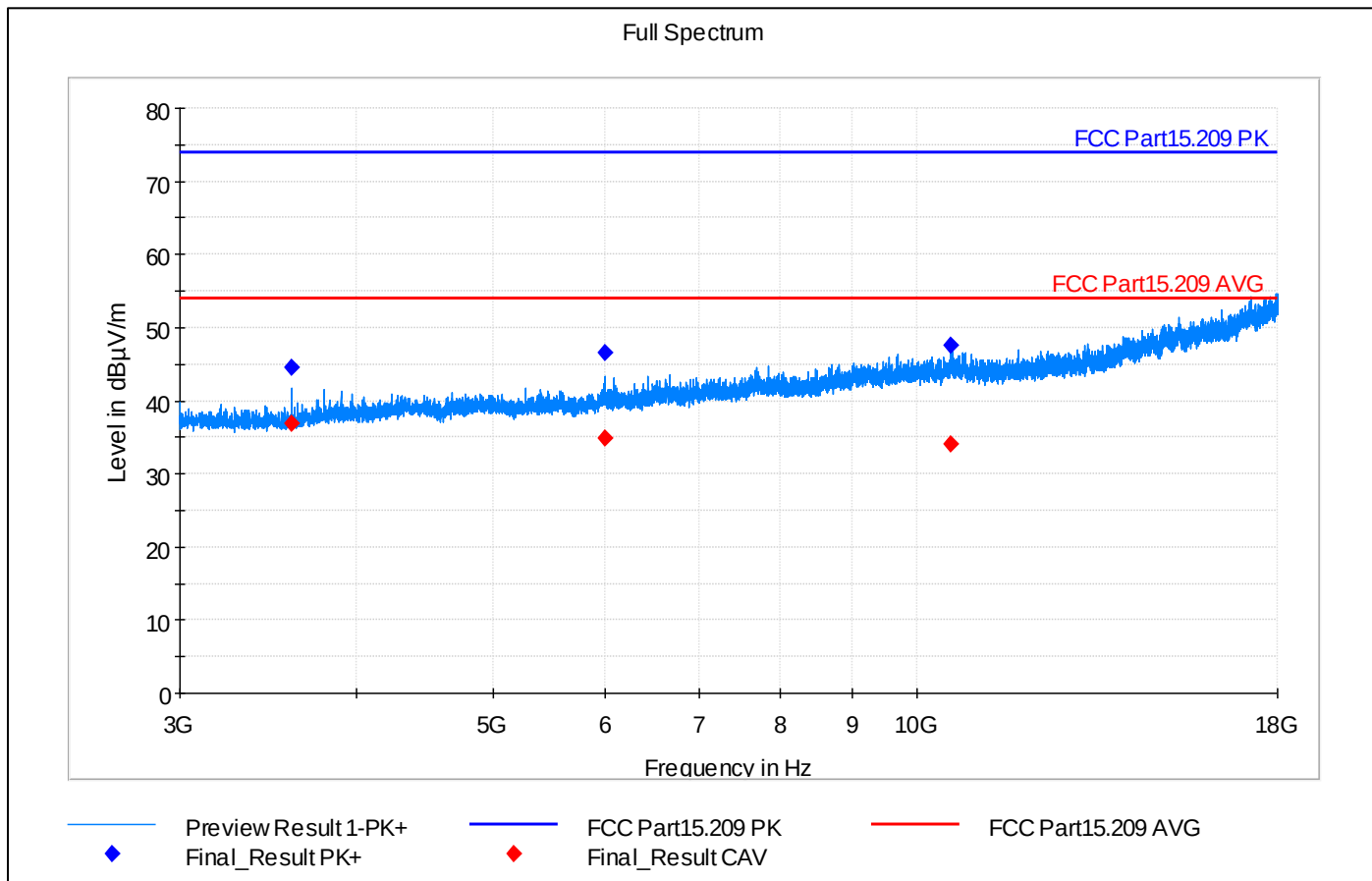
Test data for sample with 2JF1002P antenna, BLE 2 Mbps, channel 18

Bluetooth LE 2 Mbps													
Channel	Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr, (dB)	Comment
18	1000,00	45,57	---	74	28,43	15000	1000	150	H	174	180	28,80	PASS
18	1000,00	---	35,60	54	18,40	15000	1000	150	H	174	180	28,80	PASS
18	1969,10	49,07	---	74	24,93	15000	1000	330	V	285	180	37,00	PASS
18	1969,10	---	32,50	54	21,50	15000	1000	330	V	285	180	37,00	PASS
18	2442,50	104,99	---	74	-30,99	15000	1000	146	V	186	180	38,90	TX signal
18	2442,50	---	91,78	54	-37,78	15000	1000	146	V	186	180	38,90	TX signal
18	3599,75	44,55	---	74	29,45	15000	1000	224	V	252	90	6,30	PASS
18	3599,75	---	36,97	54	17,03	15000	1000	224	V	252	90	6,30	PASS
18	5999,50	46,51	---	74	27,49	15000	1000	186	H	197	90	11,90	PASS
18	5999,50	---	34,83	54	19,17	15000	1000	186	H	197	90	11,90	PASS
18	10558,50	---	34,02	54	19,98	15000	1000	395	V	325	180	21,50	PASS
18	10558,50	47,54	---	74	26,46	15000	1000	395	V	325	180	21,50	PASS

Full Spectrum

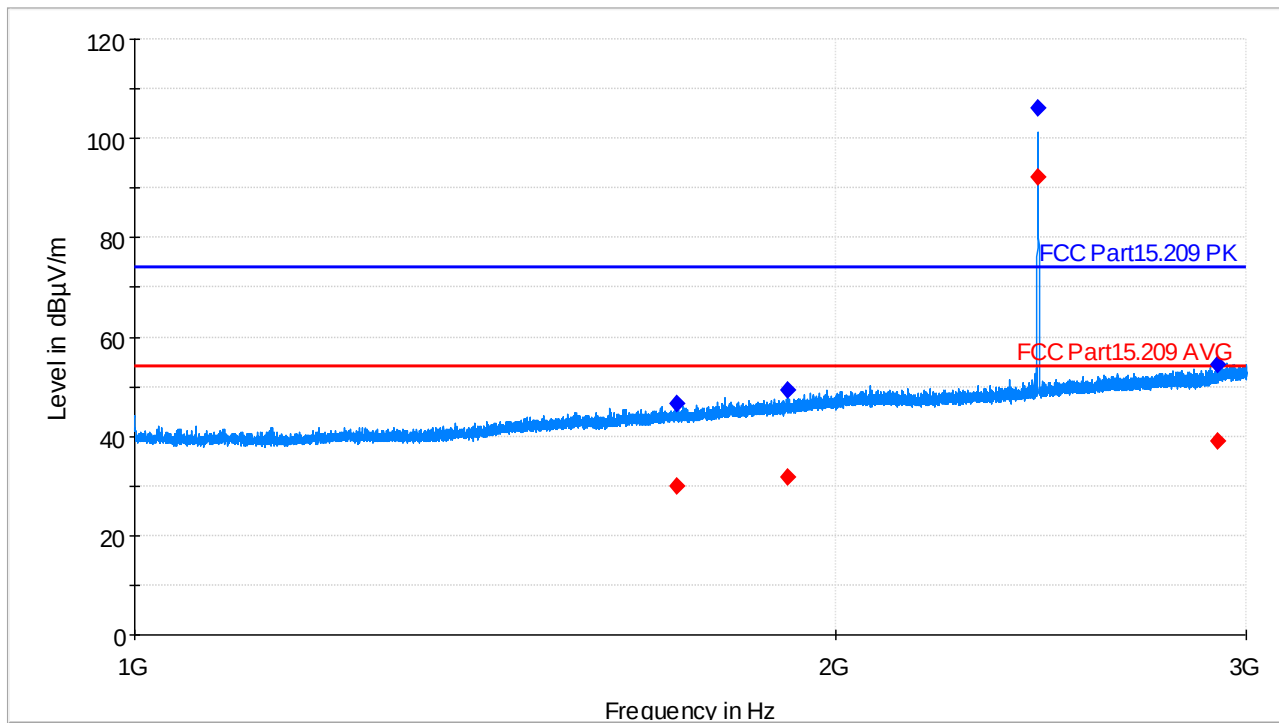


—◆ Preview Result 1-PK+ Final_Result PK+
 —◆ FCC Part15.209 PK Final_Result CAV
 —◆ FCC Part15.209 AVG


Testdata for sample with ANT162442DT-2001A2 antenna, BLE 2 Mbps, channel 18

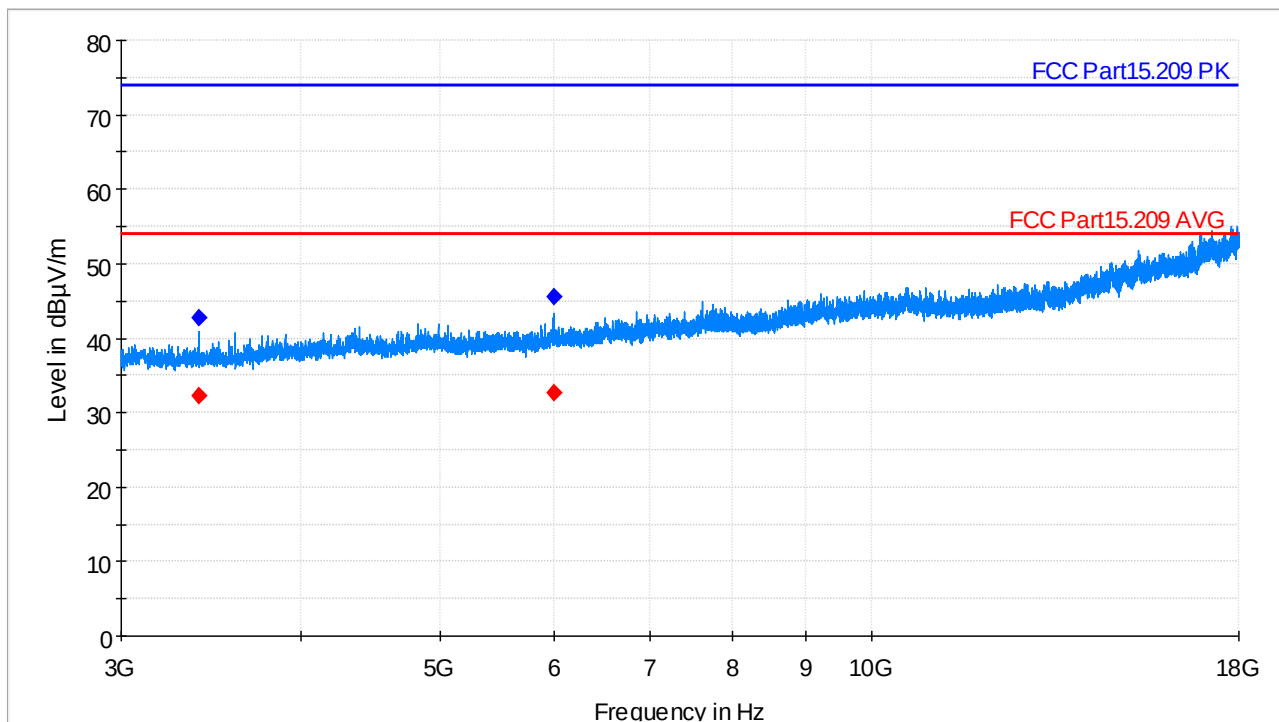
Bluetooth LE 2 Mbps													
Channel	Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Comment
18	Frequency	MaxPeak	CAverage	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Elevation	Corr.	Comment
18	(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(deg)	(dB)	
18	1707,90	---	29,87	54	24,13	15000	1000	193	V	161	0	34,80	PASS
18	1707,90	46,58	---	74	27,42	15000	1000	193	V	161	0	34,80	PASS
18	1907,65	---	31,61	54	22,39	15000	1000	209	H	30	0	36,20	PASS
18	1907,65	49,33	---	74	24,67	15000	1000	209	H	30	0	36,20	PASS
18	2442,60	106,24	---	74	-32,24	15000	1000	148	H	290	0	38,90	TX signal
18	2442,60	---	92,20	54	-38,20	15000	1000	148	H	290	0	38,90	TX signal
18	2914,80	---	38,96	54	15,04	15000	1000	390	V	177	0	40,70	PASS
18	2914,80	54,52	---	74	19,48	15000	1000	390	V	177	0	40,70	PASS
18	3399,50	42,65	---	74	31,35	15000	1000	247	V	178	180	6,00	PASS
18	3399,50	---	32,22	54	21,78	15000	1000	247	V	178	180	6,00	PASS
18	5999,00	45,51	---	74	28,49	15000	1000	100	H	110	180	11,90	PASS
18	5999,00	---	32,71	54	21,29	15000	1000	100	H	110	180	11,90	PASS

Full Spectrum



◆ Preview Result 1-PK+ Final_Result PK+
 — FCC Part15.209 PK
 — FCC Part15.209 AVG
 ◆ Final_Result CAV

Full Spectrum



◆ Preview Result 1-PK+ Final_Result PK+
 — FCC Part15.209 PK
 — FCC Part15.209 AVG
 ◆ Final_Result CAV

18. Receiver spurious emissions, radiated

Reference: ISED RSS-247, Issue 3 (section 3.1)

Test method: ANSI C63.4-2014 (8.1 – 8.3)

Limits			
Frequency (MHz)	Detector	Field strength (uV/m)	Measurement distance (m)
30 – 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
> 1000	Average	500	3

Test procedure	
1. EUT is placed on a non conducting support at the center of a turn table 0.8m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360 degrees (orientation varied), measurements were made in both horizontal and vertical planes of polarization 5. Found peak values were further maximized by adjusting turntable position $\pm 22,5$ degrees around detected value and scanning the antenna height 1 to 4m 6. For maximized values, final measurement was done with the corresponding final detector.	

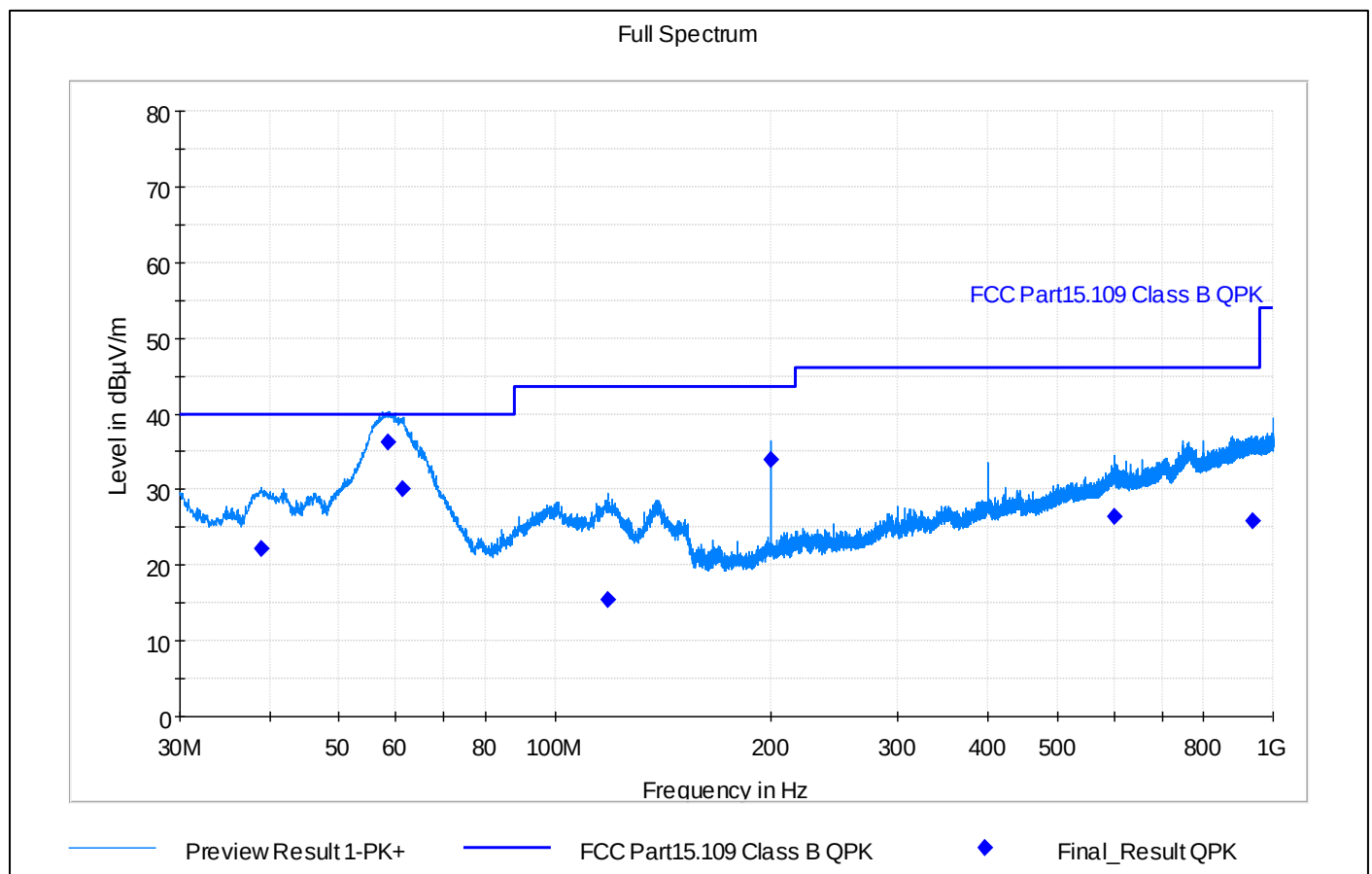
Operation mode(s)	Configuration	Test Verdict
Bluetooth LE RX, 2Mbps	Mid channel, 2442 MHz	PASS

Test data Bluetooth LE, 2 Mbps

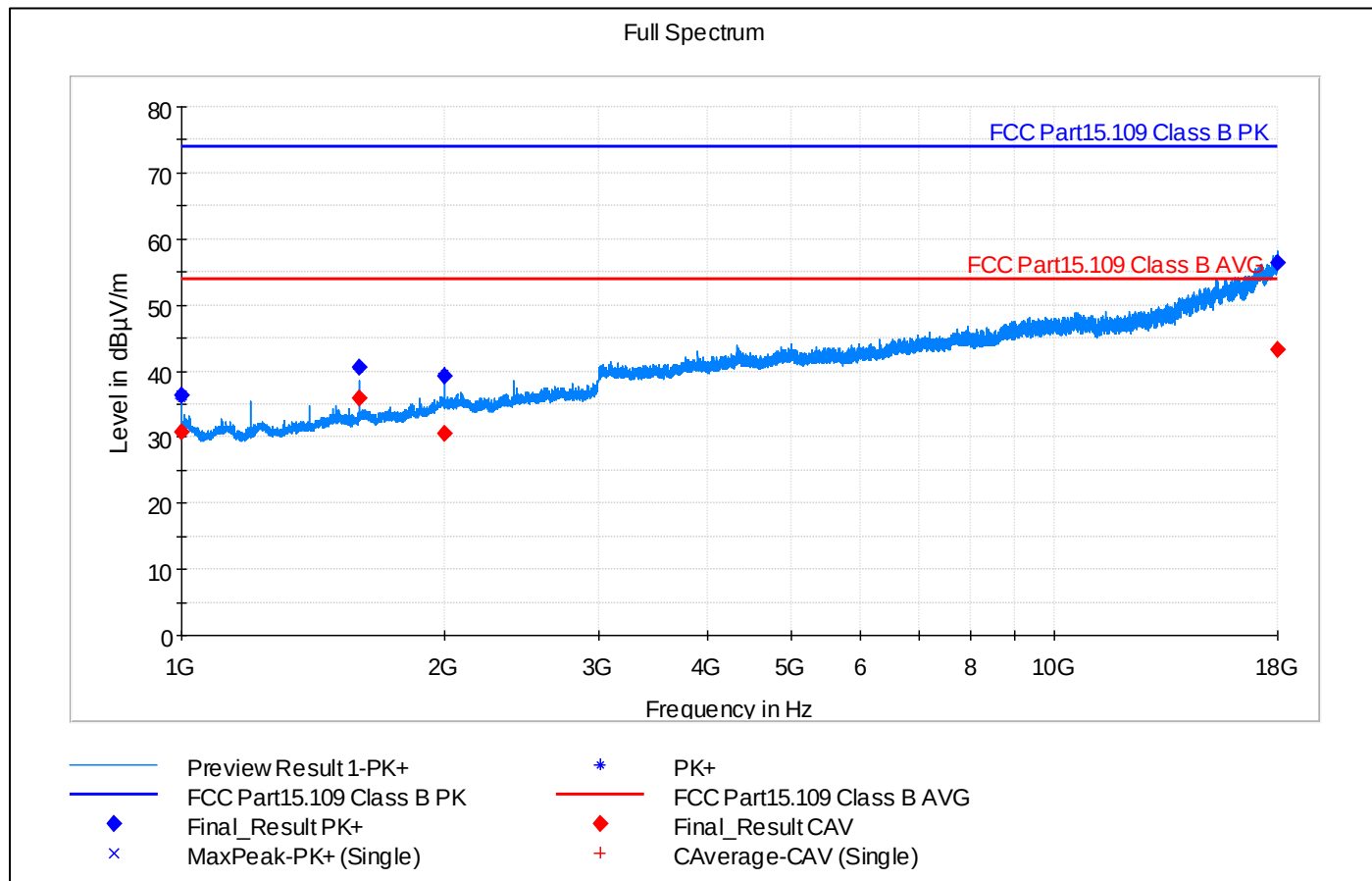
Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr, (dB/m)	Comment
39	22,09	40,00	17,91	15000,00	120	126	V	301	0	19,20	PASS
59	36,21	40,00	3,79	15000,00	120	144	V	23	0	20,20	PASS
61	30,09	40,00	9,91	15000,00	120	170	V	323	0	19,60	PASS
118	15,51	43,50	27,99	15000,00	120	119	V	270	0	18,10	PASS
200	33,93	43,50	9,57	15000,00	120	100	V	65	0	20,10	PASS
600	26,46	46,00	19,54	15000,00	120	242	V	12	0	29,80	PASS
935	25,92	46,00	20,08	15000,00	120	207	H	139	0	34,10	PASS

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas, Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr, (dB/m)	Comment
1000	36,43	---	74	37,57	500	1000	180	V	220	-9,9	PASS
1000	---	30,74	54	23,26	500	1000	180	V	220	-9,9	PASS
1600	---	35,81	54	18,19	500	1000	221	V	194	-4,8	PASS
1600	40,59	---	74	33,41	500	1000	221	V	194	-4,8	PASS
2000	---	30,46	54	23,54	500	1000	210	H	310	-1,5	PASS
2000	39,23	---	74	34,77	500	1000	210	H	310	-1,5	PASS
17968,25	56,46	---	74	17,54	500	1000	315	H	315	39,1	PASS
17968,25	---	43,33	54	10,67	500	1000	315	H	315	39,1	PASS

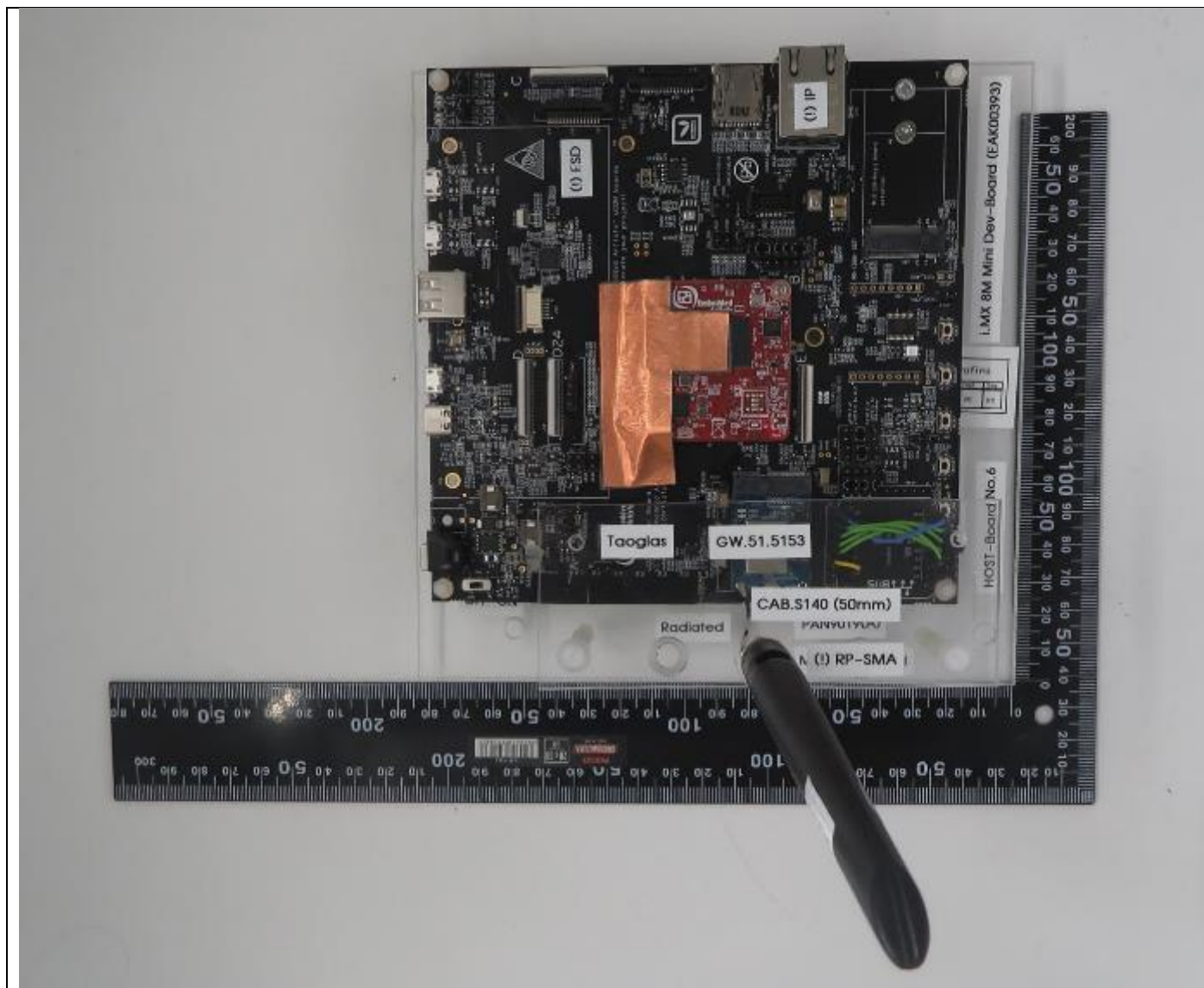
Mid channel, 30 MHz – 1 GHz



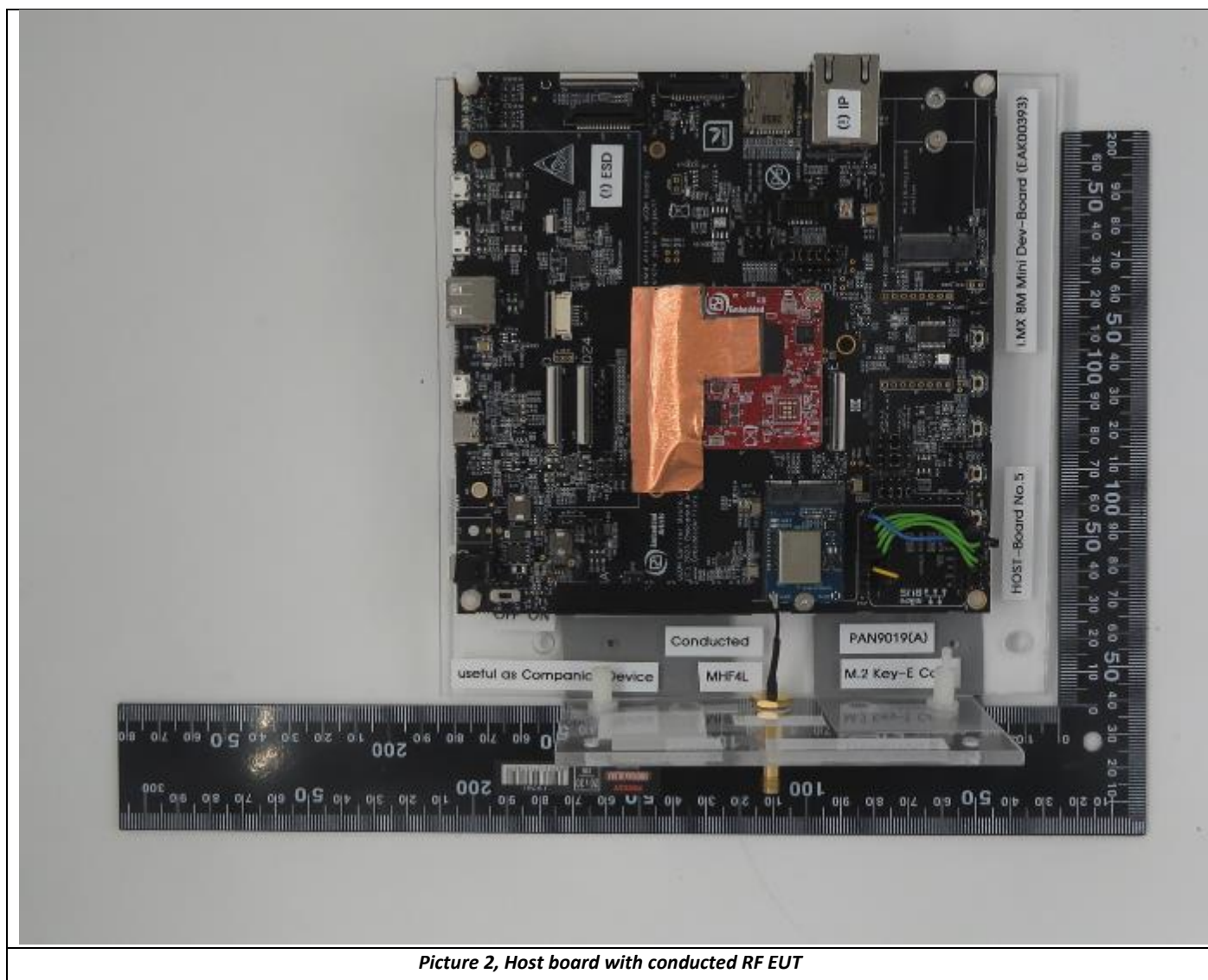
Mid channel, 1 GHz – 18 GHz



19. Photographs – Equipment External



Picture 1, Host board with EUT Top view

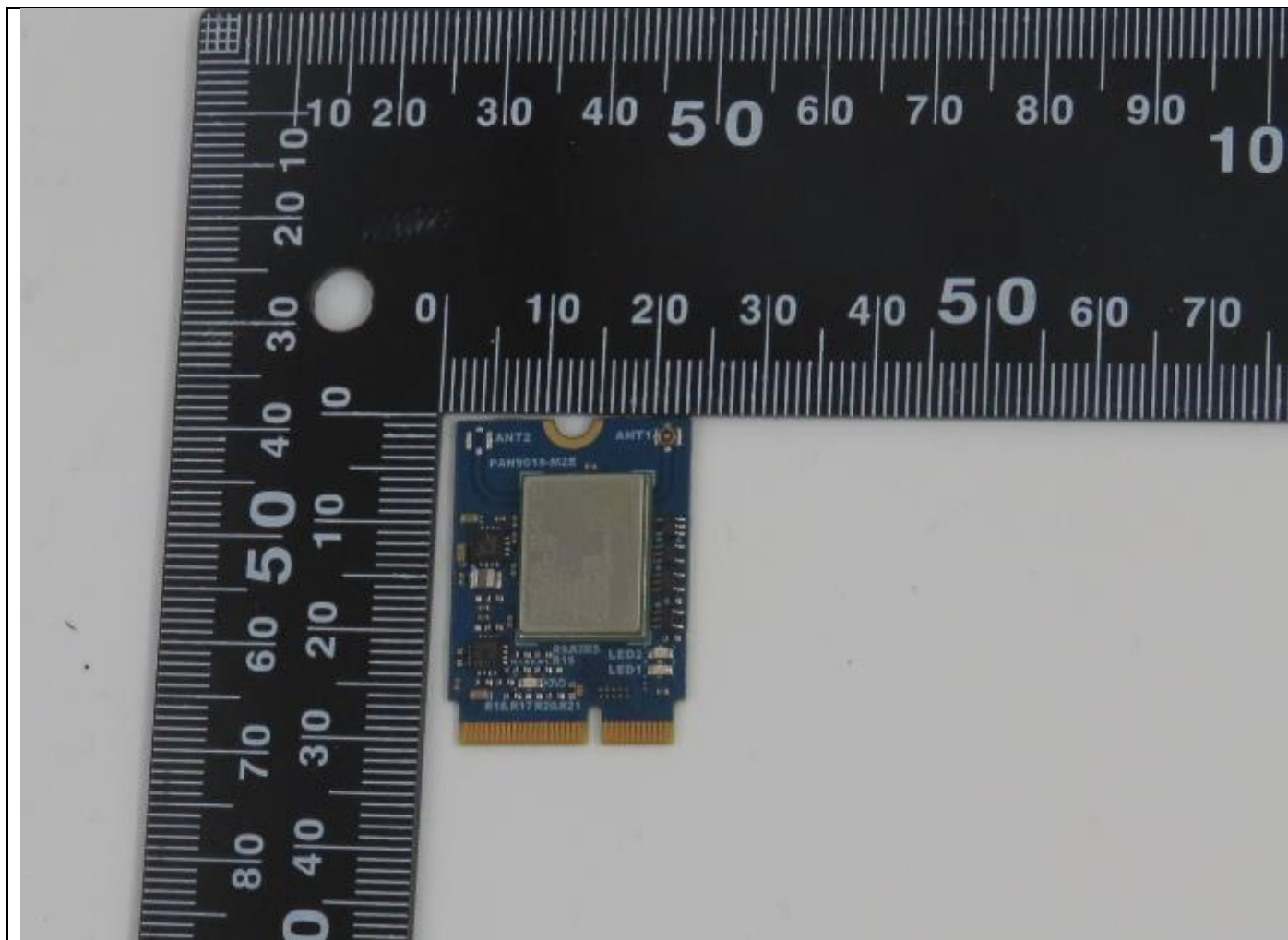


Picture 2, Host board with conducted RF EUT

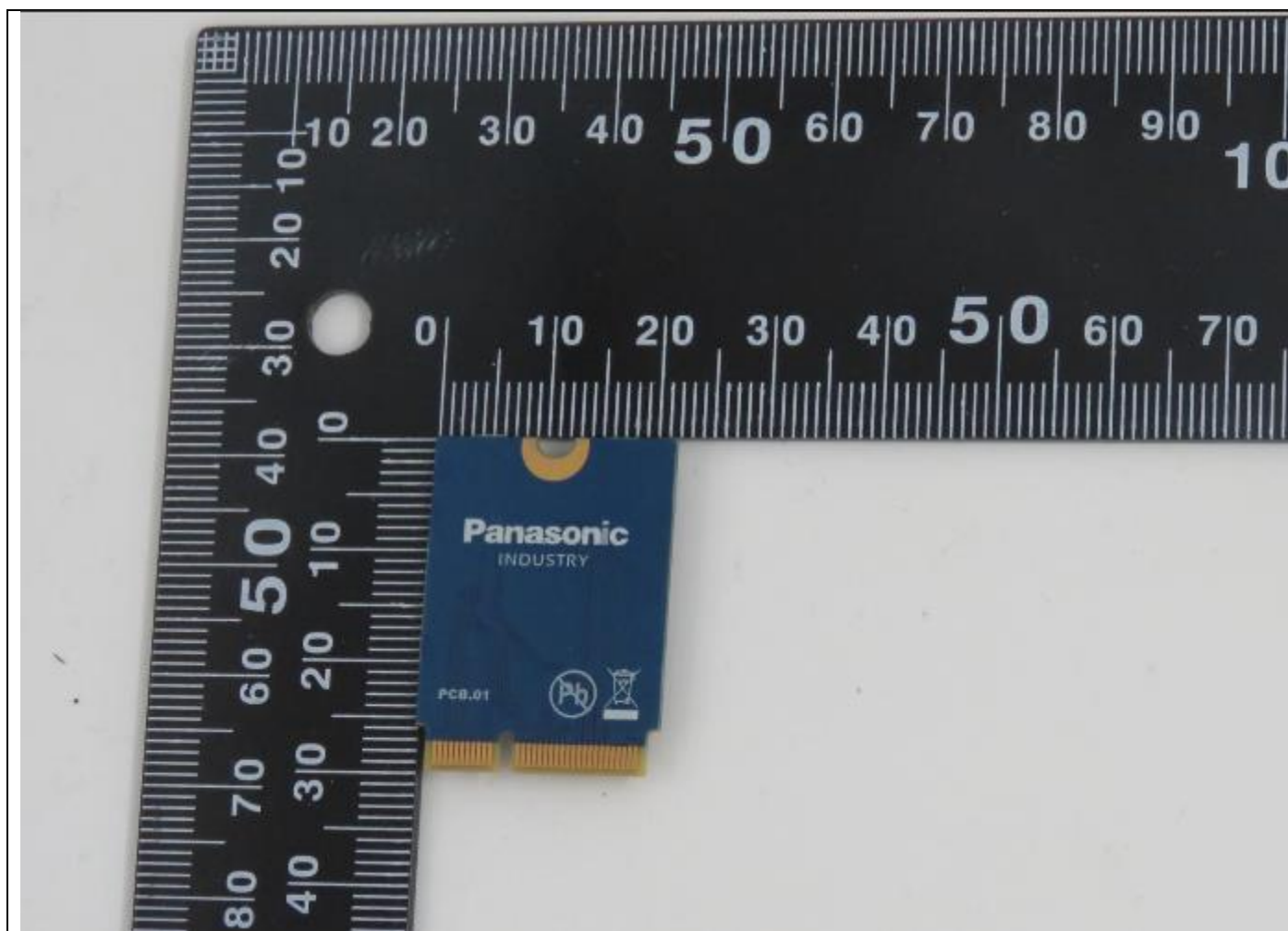


Picture 3, Radiated EUT with auxiliary equipment

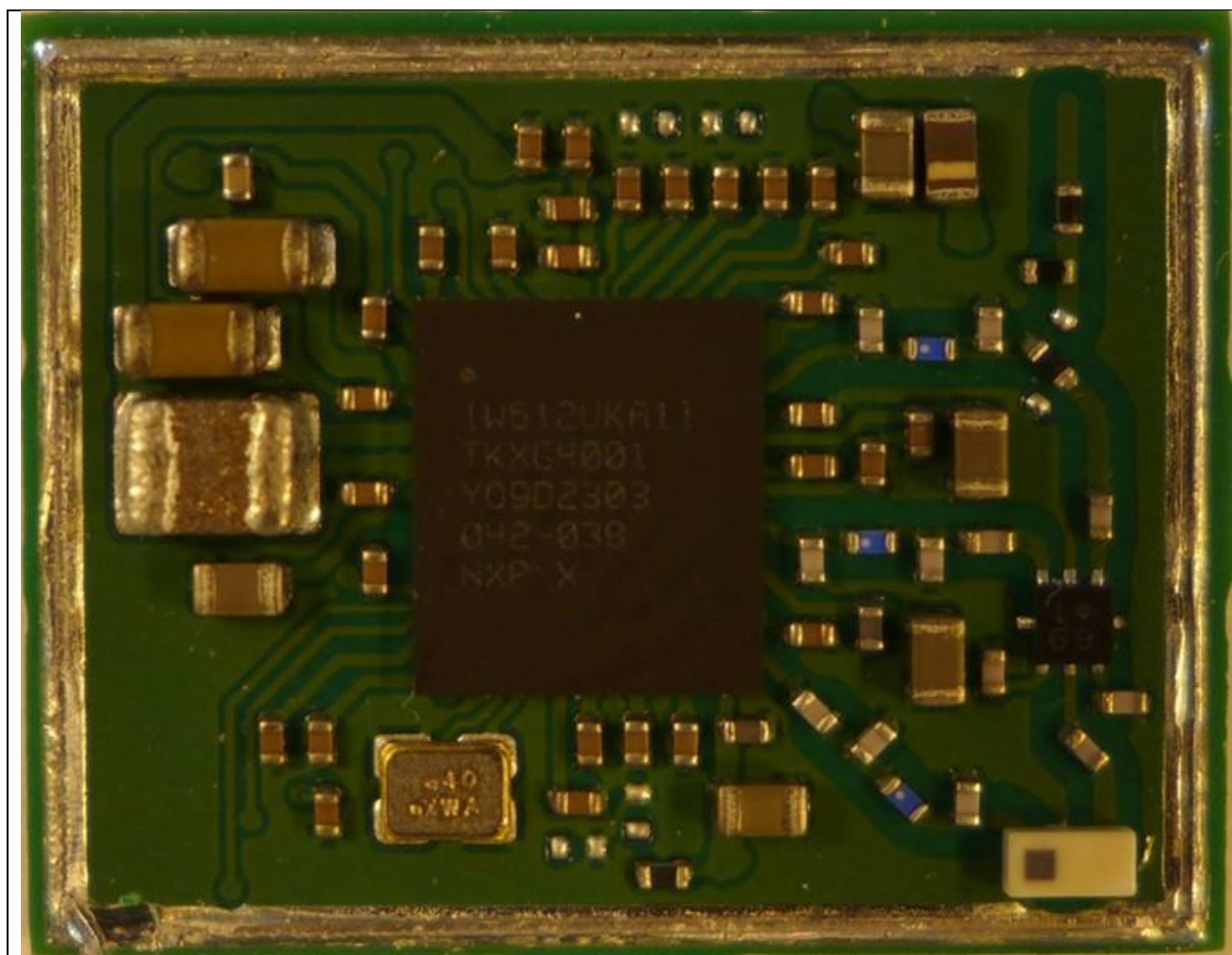
20. Photographs – Equipment Internal



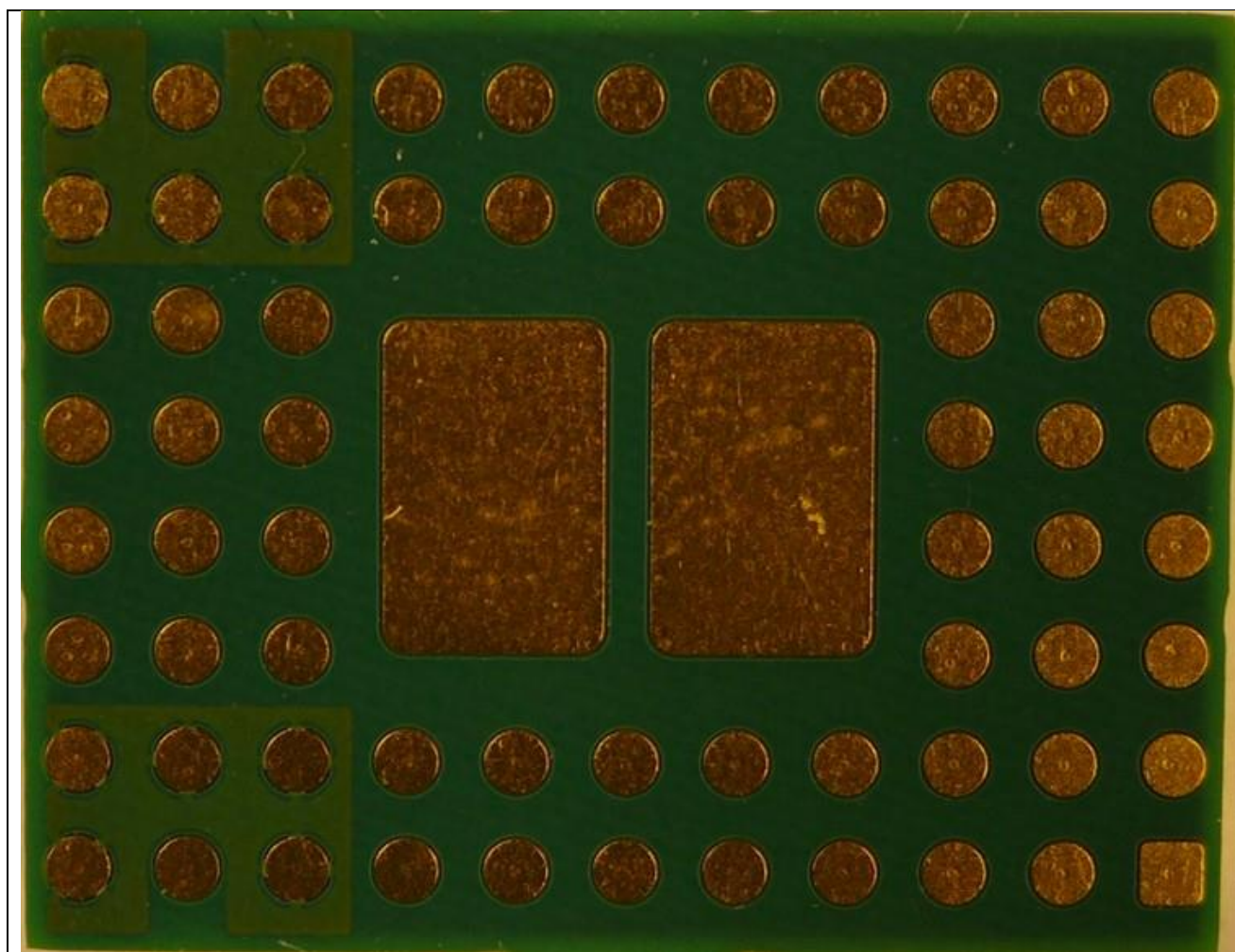
Picture 4, EUT PCB top



Picture 5, EUT PCB bottom

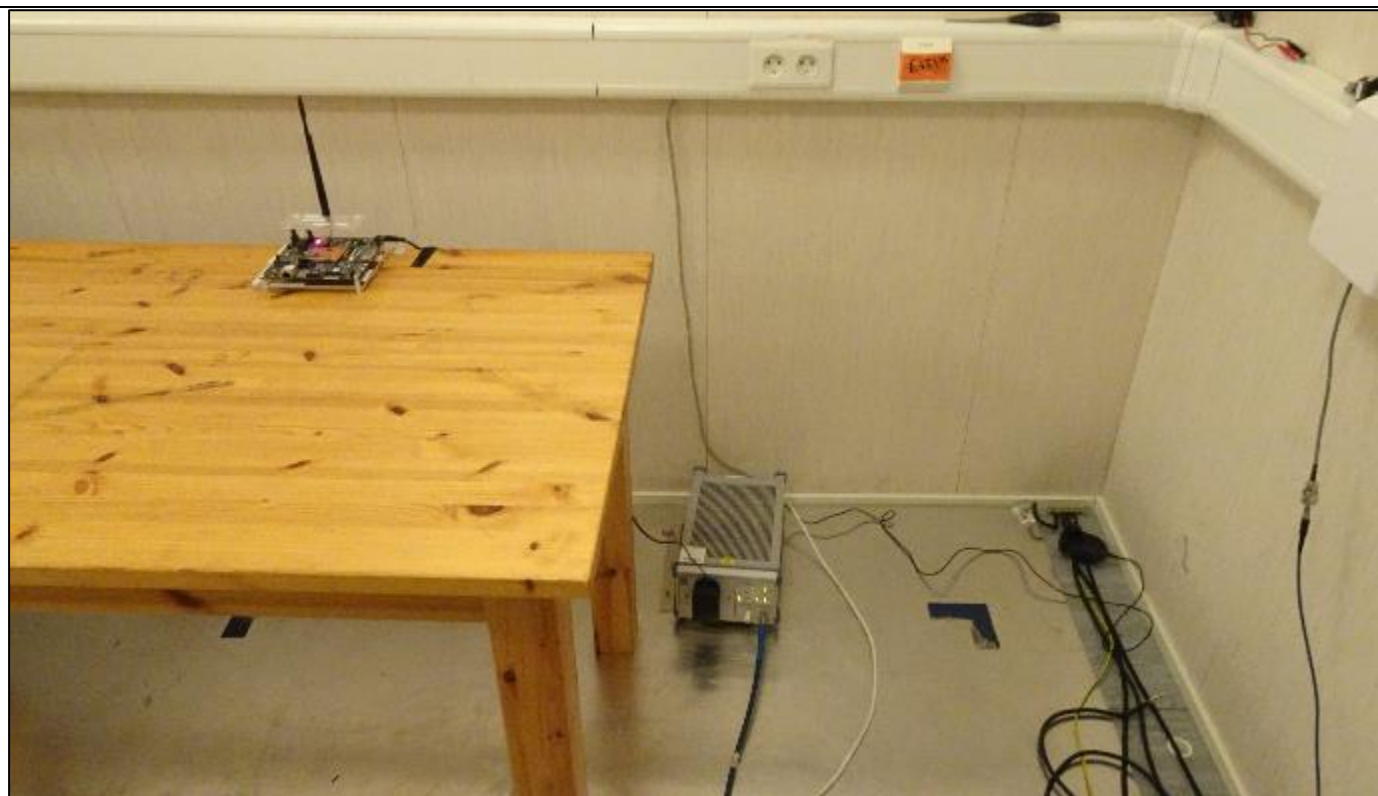


Picture 6, EUT Module internal



Picture 7, EUT Module bottom

21. Photographs – Test Setups



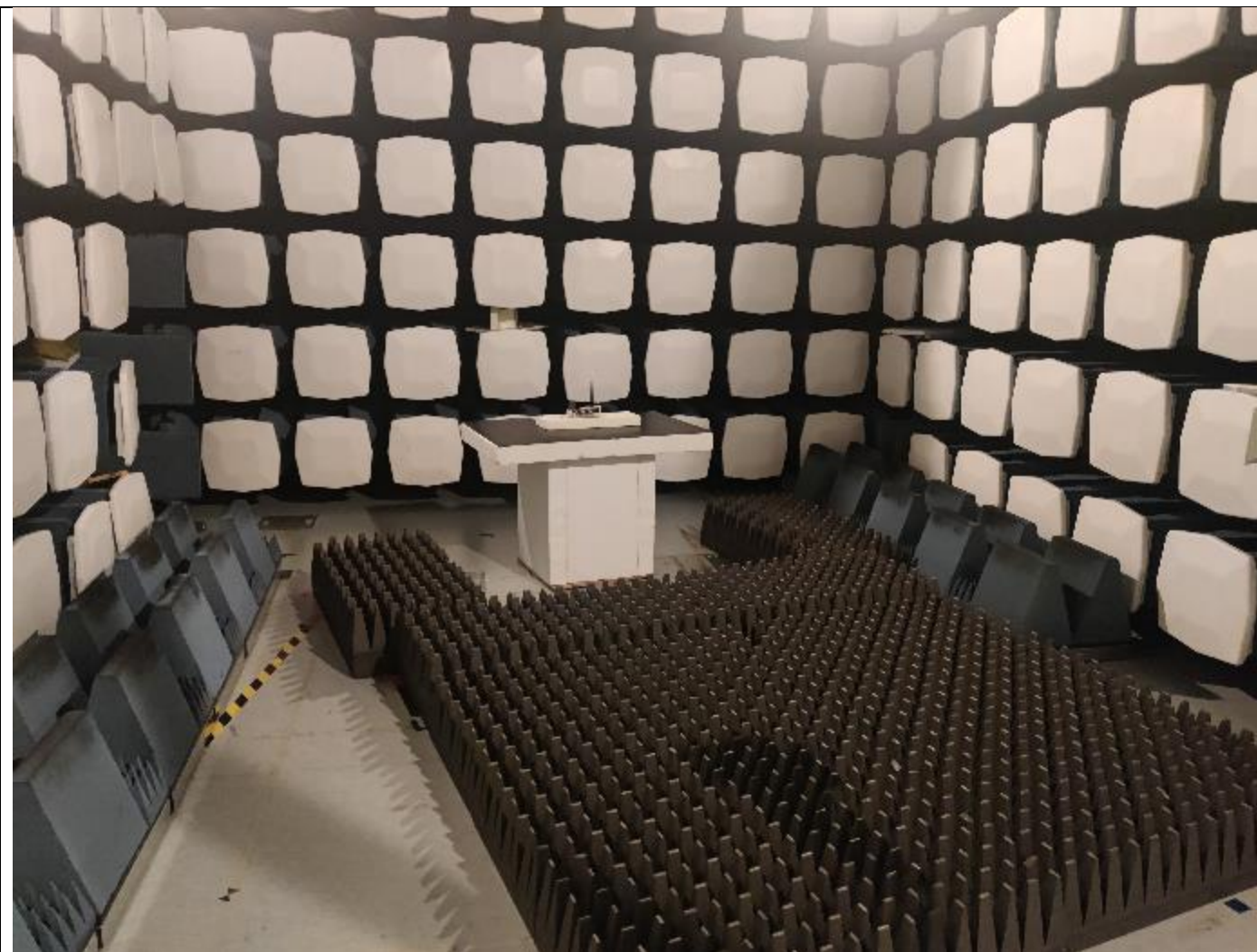
Picture 8, AC Power Line Conducted Emissions



Picture 9, Radiated Spurious Emissions, common setup, TX and RX 30 - 1000 MHz



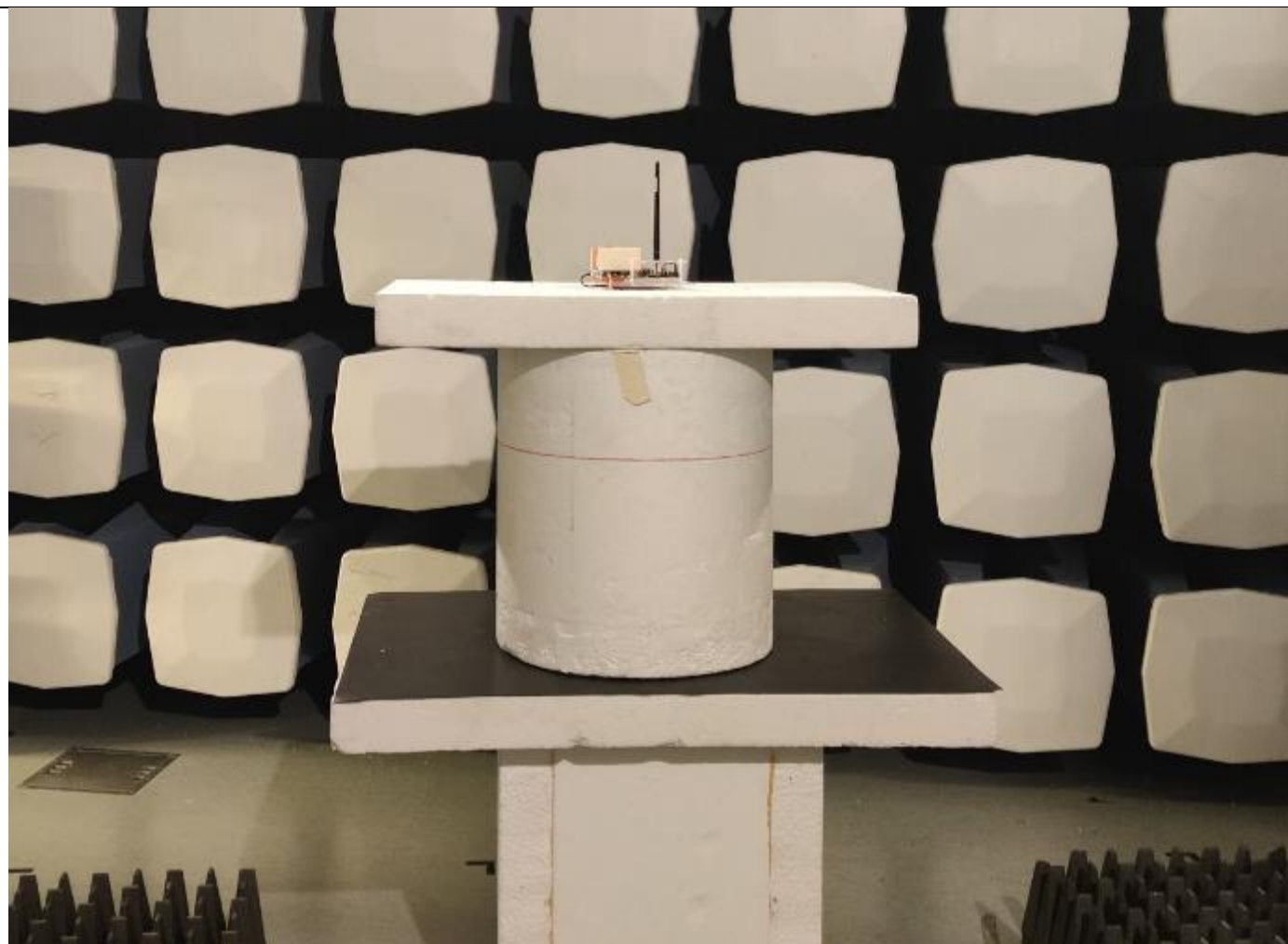
Picture 10, Radiated Spurious Emissions, common setup, TX, 1 – 26 GHz



Picture 11, Radiated Spurious Emissions, common setup, RX, 1 – 12,75 MHz



Picture 12, Radiated Spurious Emissions, EUT setup, TX and RX 30 – 1000 MHz



Picture 13, Radiated Spurious Emissions, EUT setup, TX 1 – 26 GHz



Picture14, Radiated Spurious Emissions, EUT setup, RX 1 – 12,75 GHz