FCC - TEST REPORT

Report Number	: 68.950.19.0605.01	Date of Issue:	July 26, 2019
Model	: 3BOX A2		
Product Type	: Wearable on Neck Host		
Applicant	: VR Technology (Shenzhen) Limited		
Address	: Room 201, 12 Gaoxin South Road, Huiheng Building, Nanshan District, Shenzhen		
Manufacturer	: VR Technology (Shenzhen) Limited		
Address	: Room 201, 12 Gaoxin South Road, Huiheng Building, Nanshan District, Shenzhen		
Test Result	: ■ Positive ☐ Negative		
Total pages including Appendices	: 35		

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District Shenzhen 518052 P.R. China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Designation Number:	CA5009
IC Registration No.:	10320A

3 Description of the Equipment Under Test

Product:	Wearable on Neck Host
Model no.:	3BOX A2
FCC ID:	2AKA6-A2
Options and accessories:	Adapter and USB Cable
Rating:	Supplied by 5*3.8Vdc 1100mAh Li-ion Rechargeable battery Charged by 5.0Vdc, 3.0A external adapter
Adapter information:	Adapter Model: A138A-120150U-US2 Input: 100-240Vac, 50/60Hz; 0.5A Output: 5.0Vdc, 3.0A
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	Integrated antenna
Antenna Gain:	3.0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Wearable on Neck Host which support Bluetooth function and Wi-Fi operated at 5GHz and 2.4GHz. Only Bluetooth Low Energy included in this report.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2018 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	---	---	☐	☐	☒
§15.247 (b) (1)	Conducted peak output power	10	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	11	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	14	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	20	Site 1	☒	☐	☐
§15.247(d)	Band edge	28	Site 1	☒	☐	☐
§15.247(d)	Spurious radiated emissions for transmitter	31	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 2		☒	☐	☐

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an Integrated antenna, which gain is 3.0dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AKA6-A2 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: June 13, 2019

Testing Start Date: June 14, 2019

Testing End Date: July 10, 2019

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:	Prepared by:	Tested by:
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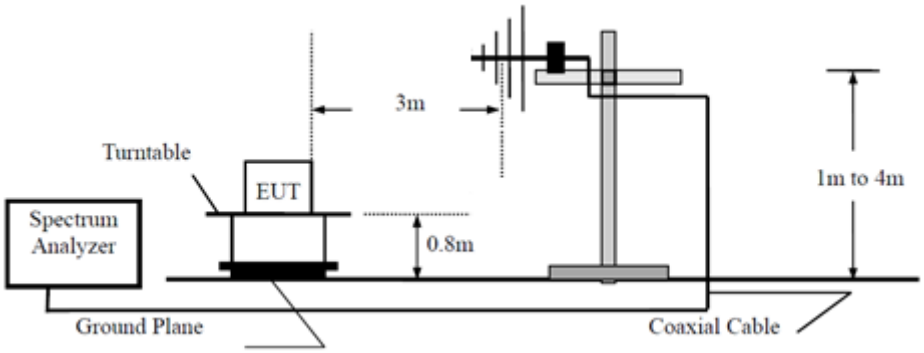
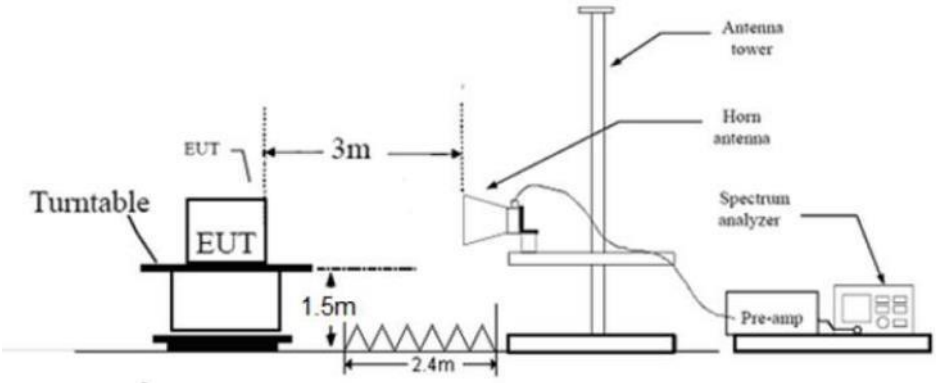
7 Test Setups

7.1 Radiated test setups

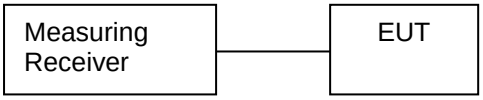
Below 1GHz



Above 1GHz



7.2 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Notebook	Lenovo	X240	---

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9 Technical Requirement

9.1 Conducted peak output power

Test Method

1. The RF output of EUT was connected to the power meter by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following test receiver settings:
   Span = approximately 5 times the 6dB bandwidth, centered on a hopping channel
   RBW > the 6dB bandwidth of the emission being measured, VBW≥3RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were complete.

Limits

According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

Frequency MHz	Mode	Conducted Peak Output Power dBm	Result
Bottom channel 2402MHz	LE 1M	8.43	Pass
Middle channel 2440MHz	LE 1M	7.23	Pass
Top channel 2480MHz	LE 1M	6.75	Pass
Bottom channel 2402MHz	LE 2M	7.42	Pass
Middle channel 2440MHz	LE 2M	7.39	Pass
Top channel 2480MHz	LE 2M	6.82	Pass

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9.2 Power spectral density

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8

Test result

Frequency MHz	Mode	Power spectral density dBm/3KHz	Result
Bottom channel 2402MHz	LE 1M	-6.51	Pass
Middle channel 2440MHz	LE 1M	-7.82	Pass
Top channel 2480MHz	LE 1M	-8.23	Pass
Bottom channel 2402MHz	LE 2M	-11.15	Pass
Middle channel 2440MHz	LE 2M	-11.29	Pass
Top channel 2480MHz	LE 2M	-11.78	Pass

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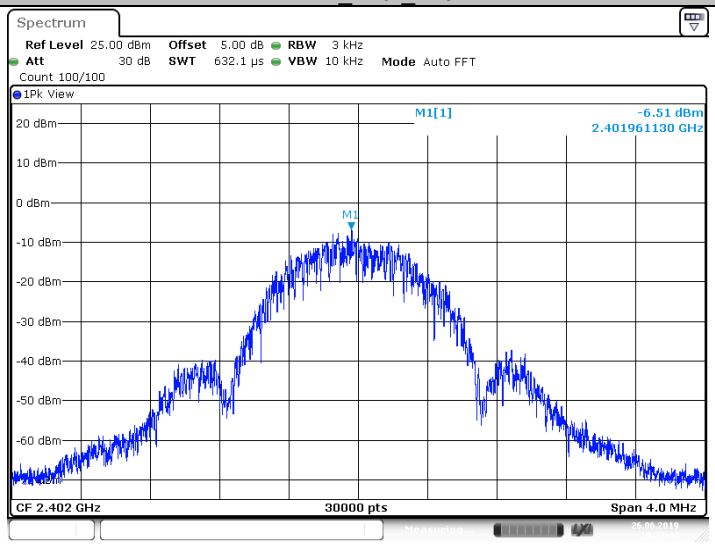
BLE 1M _Ant1_2402



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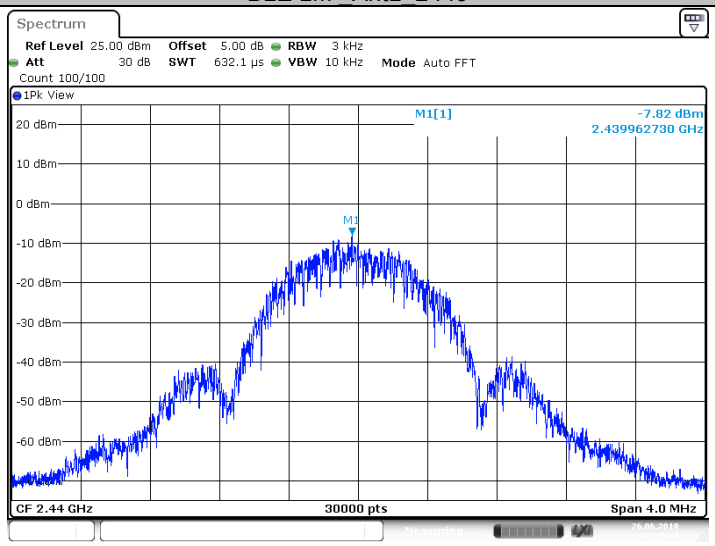

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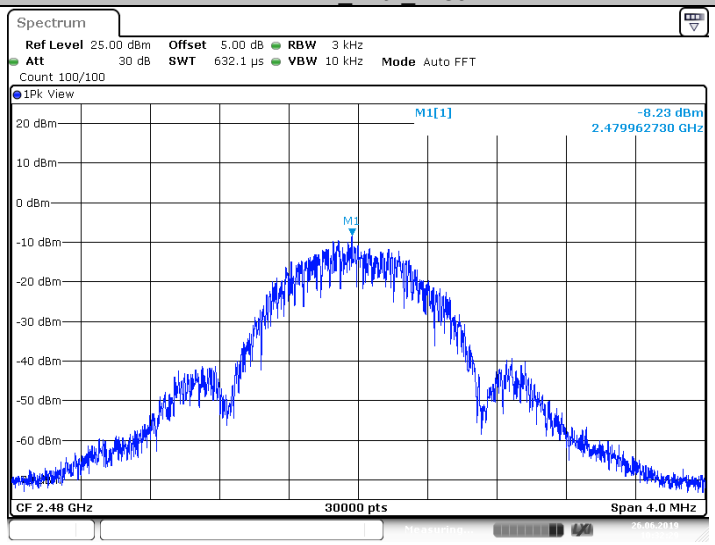

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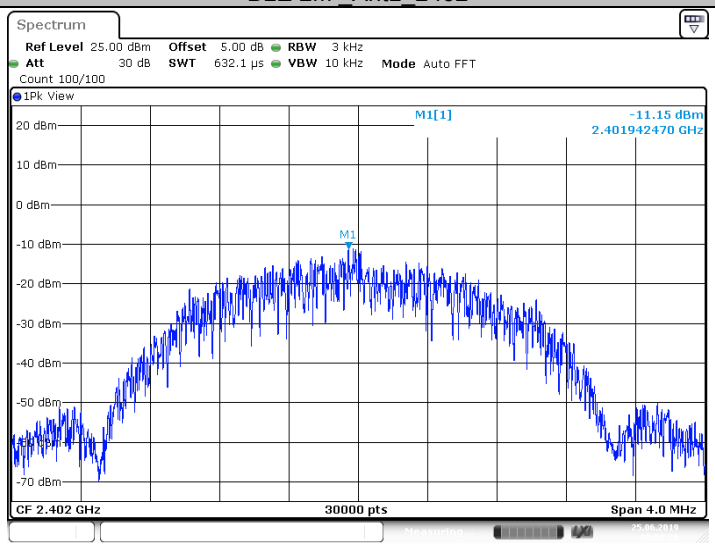

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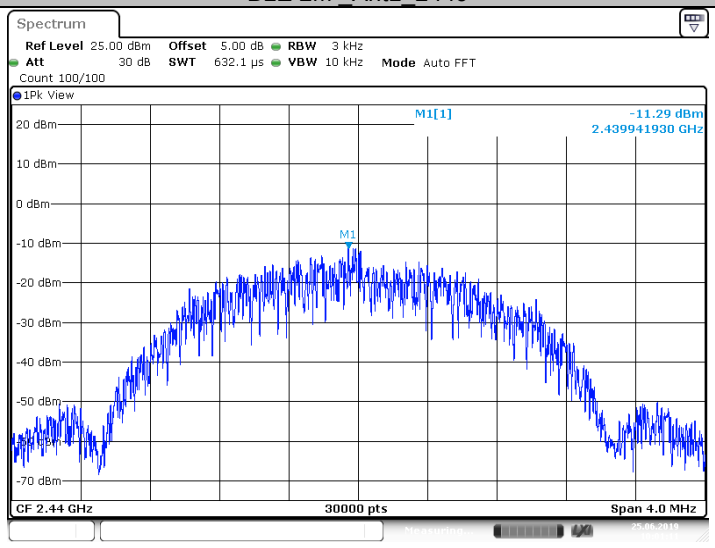

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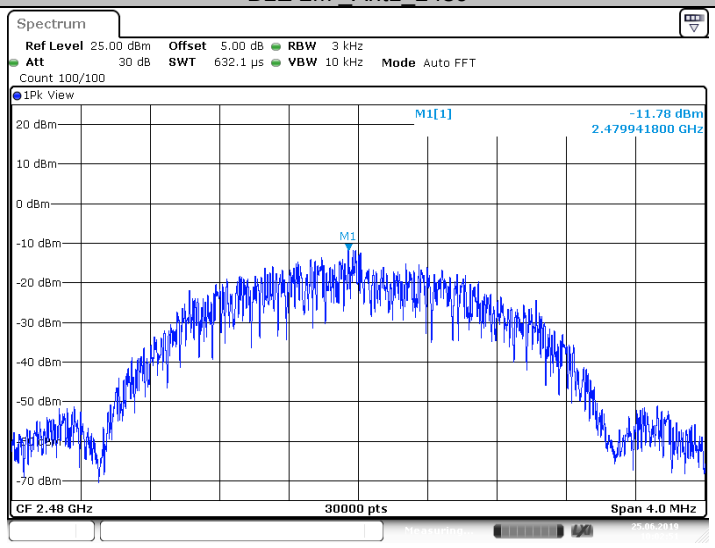

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9.3 6 dB Bandwidth and 99% Occupied Bandwidth

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Use the following test receiver settings:
   Span = approximately 5 times the 6dB bandwidth, centered on a hopping channel
   RBW =100KHz, VBW≥3RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth. Record the results.
5. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]
≥500

Test result

Frequency MHz	Mode	6dB bandwidth kHz	99% bandwidth kHz	Result
Bottom channel 2402MHz	LE 1M	672	1031	Pass
Middle channel 2440MHz	LE 1M	672	1027	Pass
Top channel 2480MHz	LE 1M	672	1031	Pass
Bottom channel 2402MHz	LE 2M	1148	2042	Pass
Middle channel 2440MHz	LE 2M	1152	2046	Pass
Top channel 2480MHz	LE 2M	1152	2046	Pass

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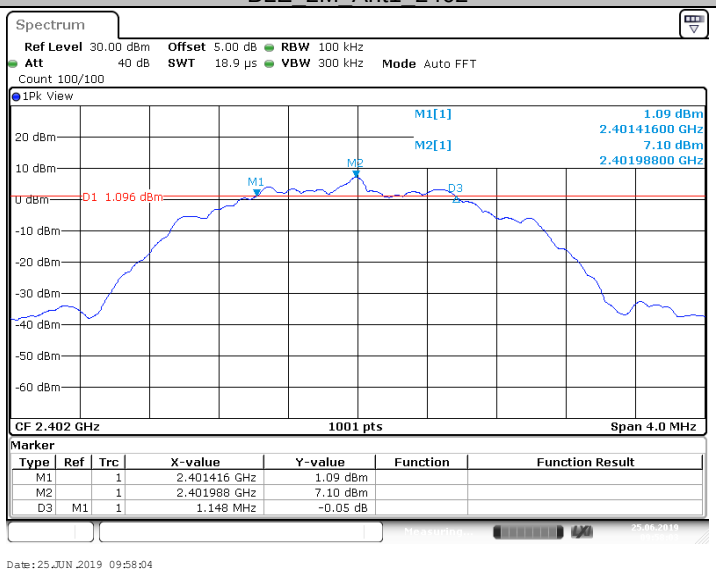
6 dB Bandwidth

BLE_2M_Ant1_2402



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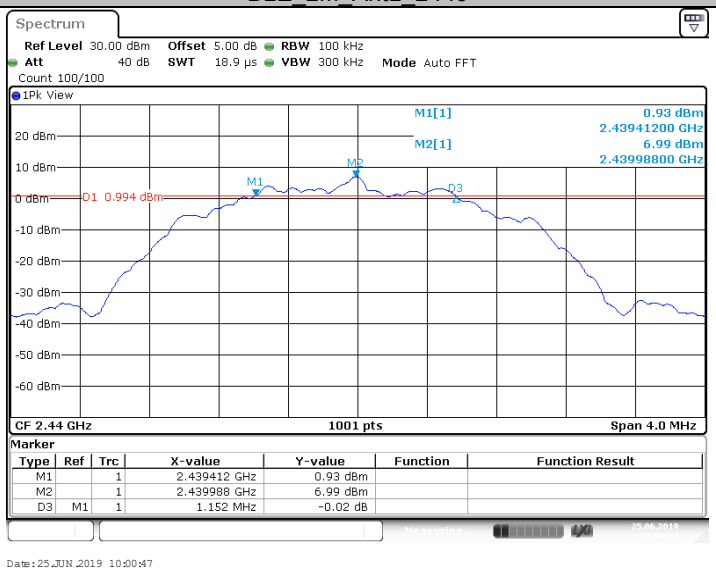

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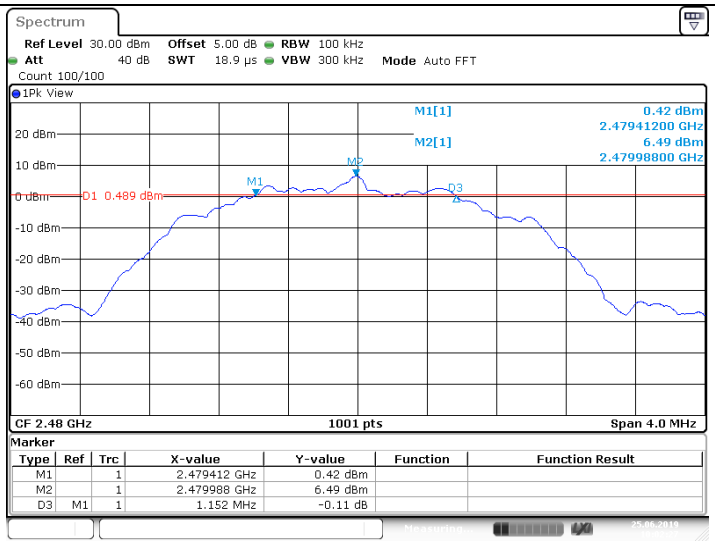

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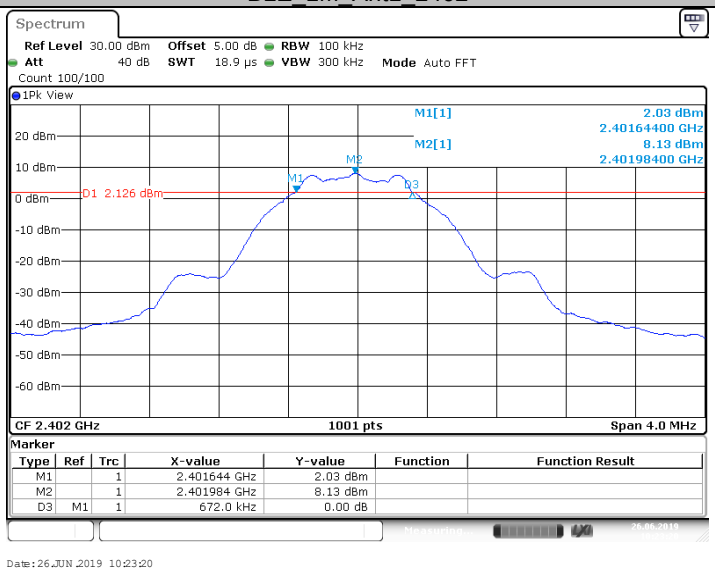

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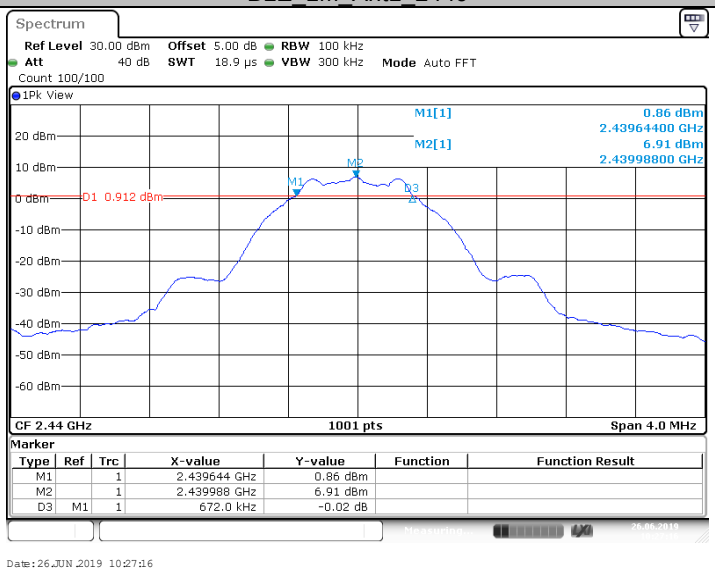

BLE_1M_Ant1_2480

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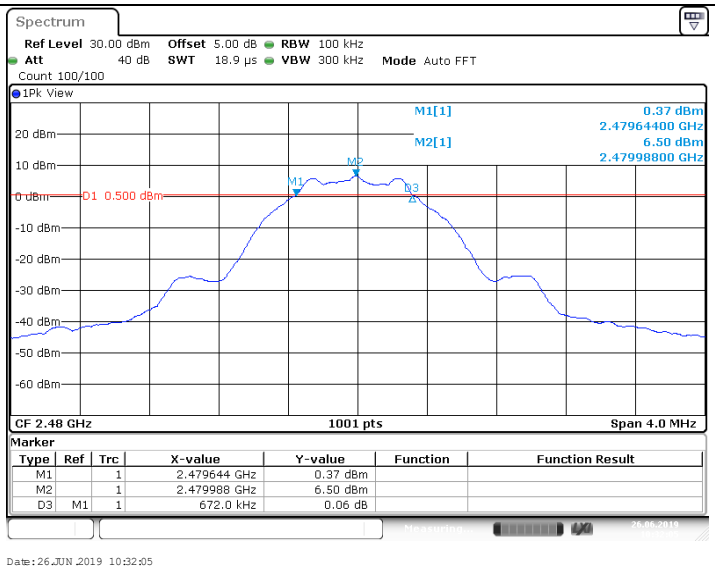
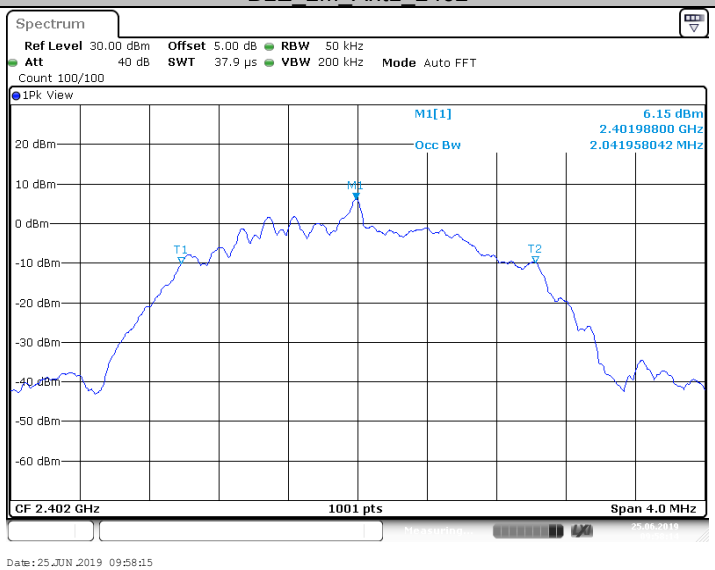


99% Bandwidth

BLE_2M_Ant1_2402



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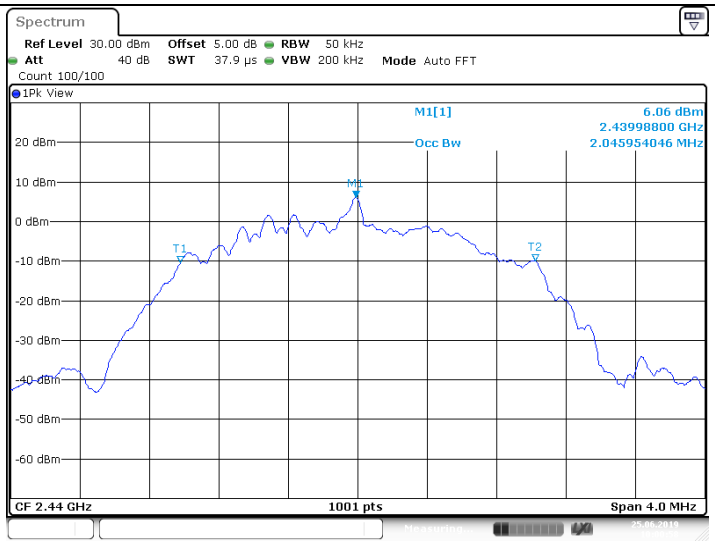

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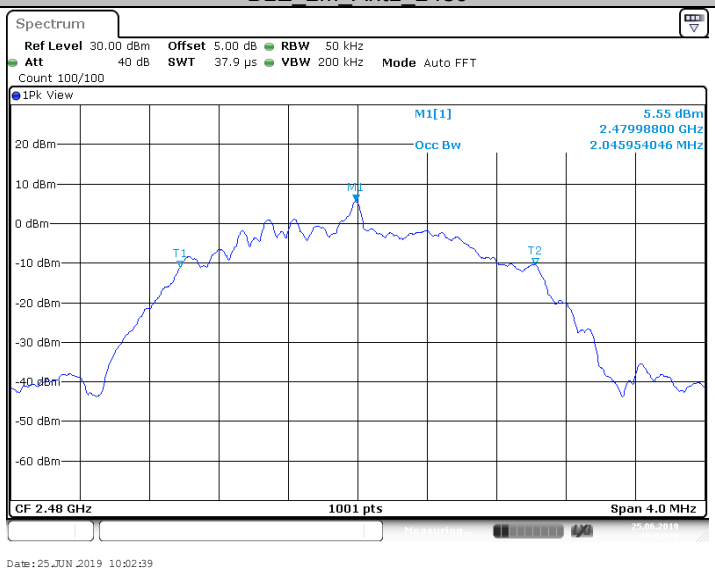

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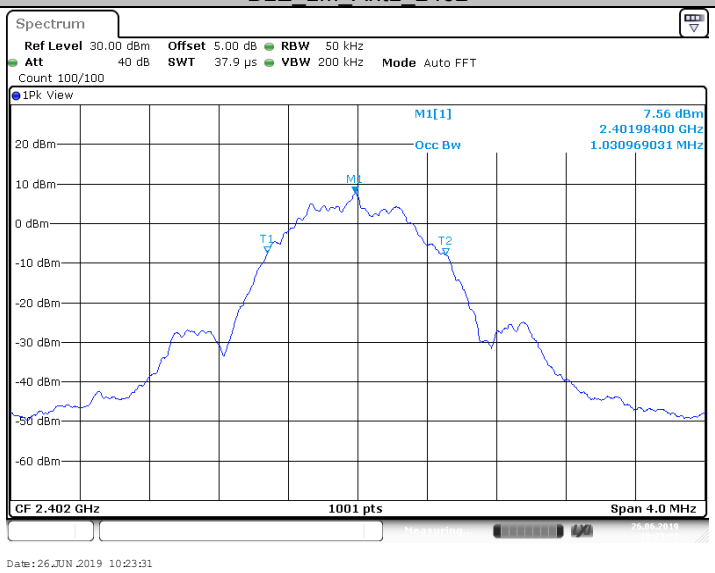

BLE_1M_Ant1_2440

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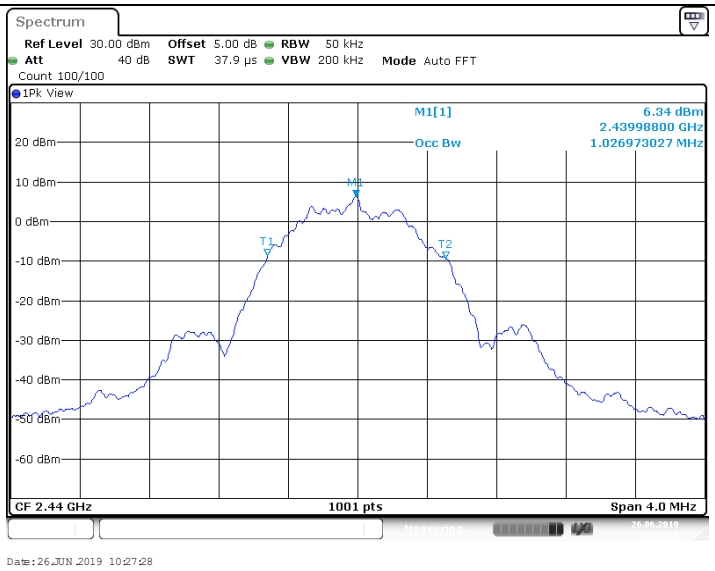

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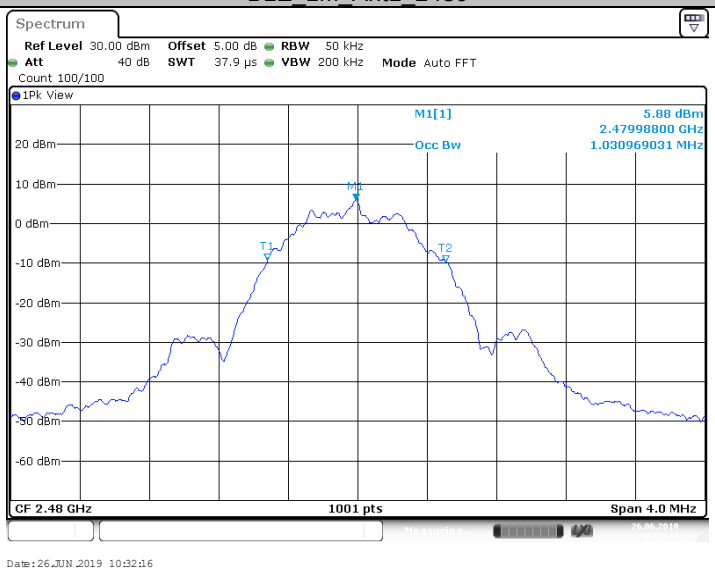

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9.4 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. 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.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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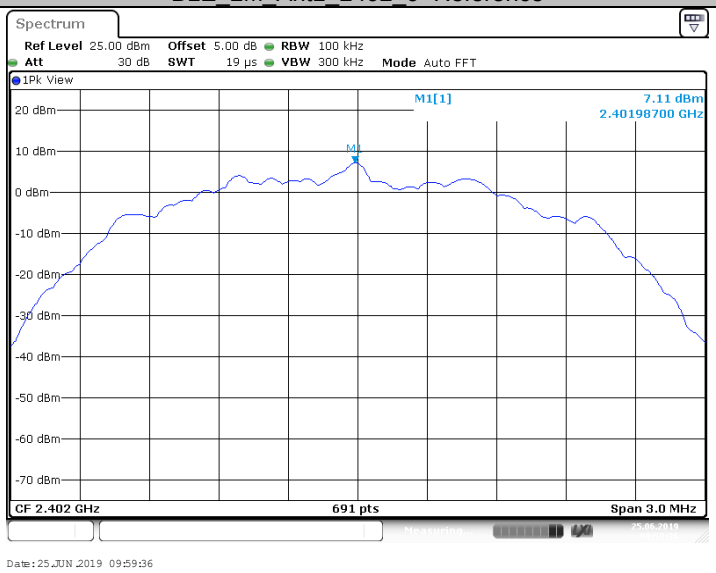
Spurious RF conducted emissions

TestMode	Antenna	Channel (MHz)	FreqRange (dBm)	RefLevel	Result (dBm)	Limit (dBm)	Verdict
BLE_2M	Ant1	2402	Reference	7.11	7.11	---	PASS
		2402	30~1000	30~1000	-64.62	<=-12.89	PASS
		2402	1000~26500	1000~26500	-49.28	<=-12.89	PASS
		2440	Reference	6.98	6.98	---	PASS
		2440	30~1000	30~1000	-64.11	<=-13.02	PASS
		2440	1000~26500	1000~26500	-49.25	<=-13.02	PASS
		2480	Reference	6.50	6.50	---	PASS
		2480	30~1000	30~1000	-64.64	<=-13.5	PASS
		2480	1000~26500	1000~26500	-49.26	<=-13.5	PASS
BLE_1M	Ant1	2402	Reference	8.27	8.27	---	PASS
		2402	30~1000	30~1000	-64.59	<=-11.73	PASS
		2402	1000~26500	1000~26500	-48.81	<=-11.73	PASS
		2440	Reference	6.89	6.89	---	PASS
		2440	30~1000	30~1000	-64.84	<=-13.11	PASS
		2440	1000~26500	1000~26500	-49.03	<=-13.11	PASS
		2480	Reference	6.52	6.52	---	PASS
		2480	30~1000	30~1000	-64.66	<=-13.48	PASS
		2480	1000~26500	1000~26500	-49.12	<=-13.48	PASS

BLE_2M_Ant1_2402_0~Reference



BLE_2M_Ant1_2402_30~1000

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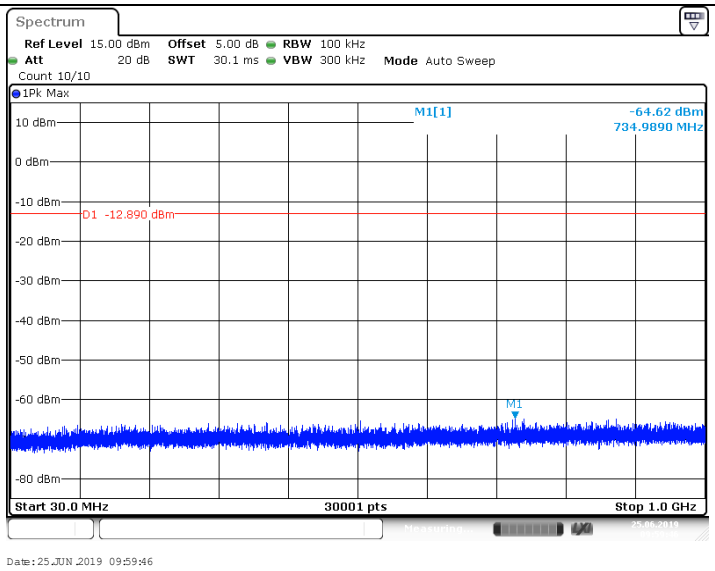
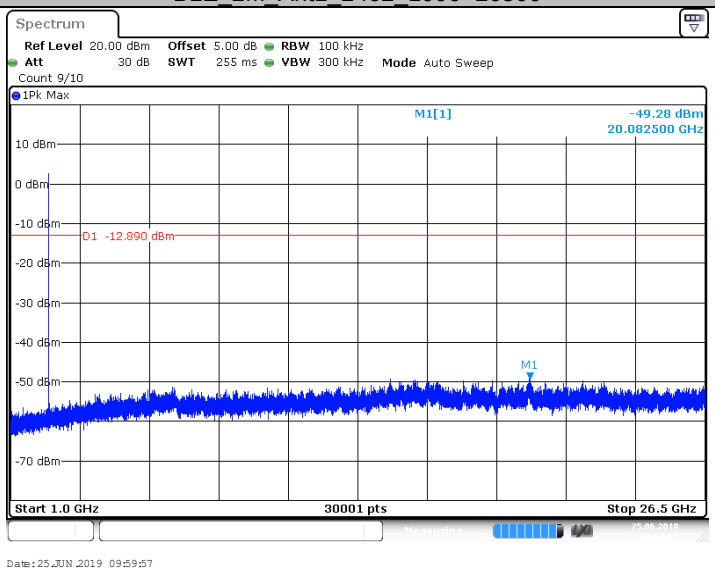
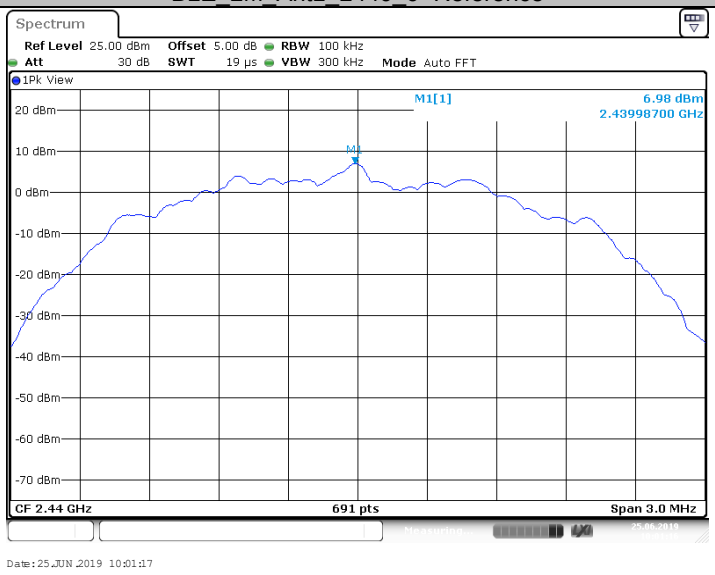


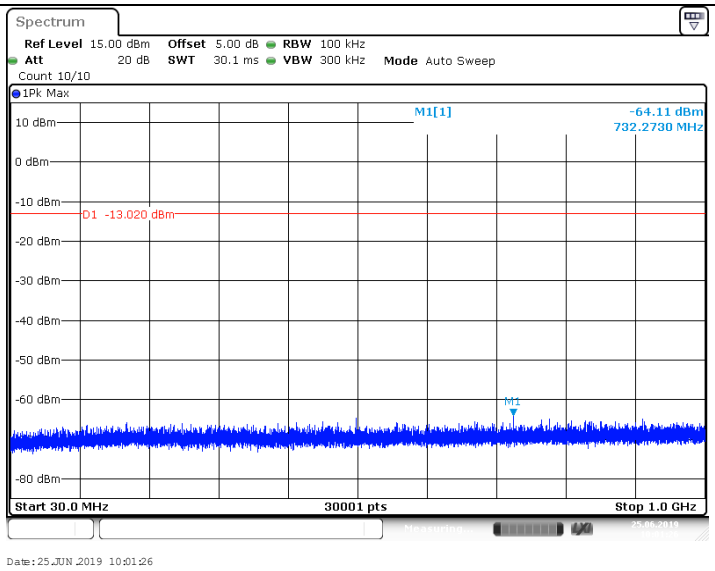
BLE_2M_Ant1_2402_1000~26500



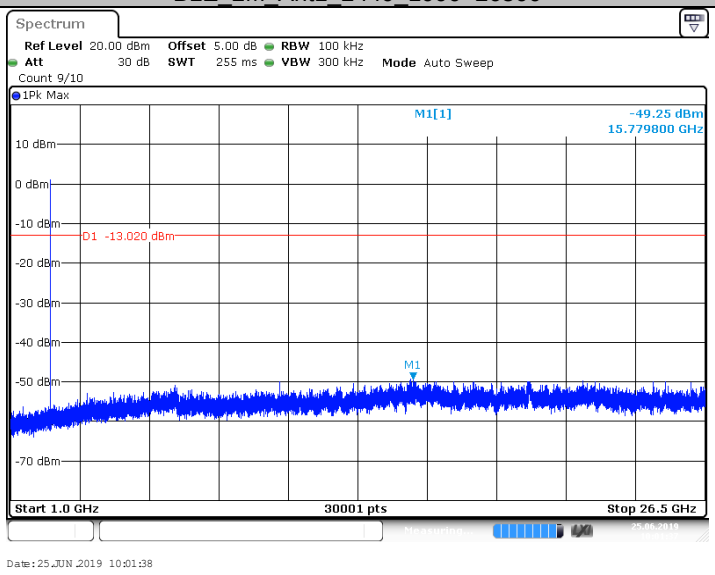
BLE_2M_Ant1_2440_0~Reference



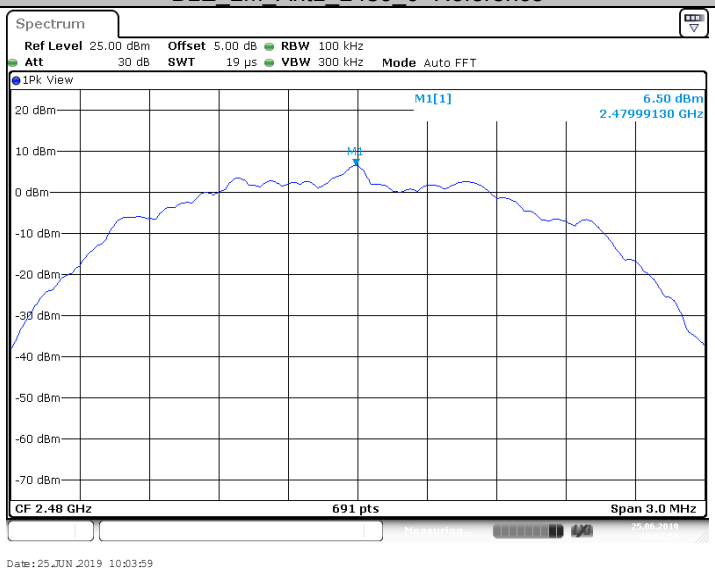
BLE_2M_Ant1_2440_30~1000



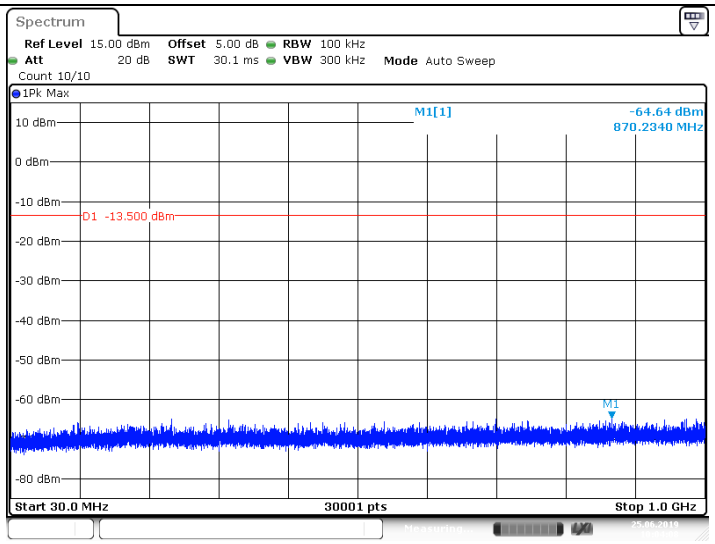
BLE_2M_Ant1_2440_1000~26500



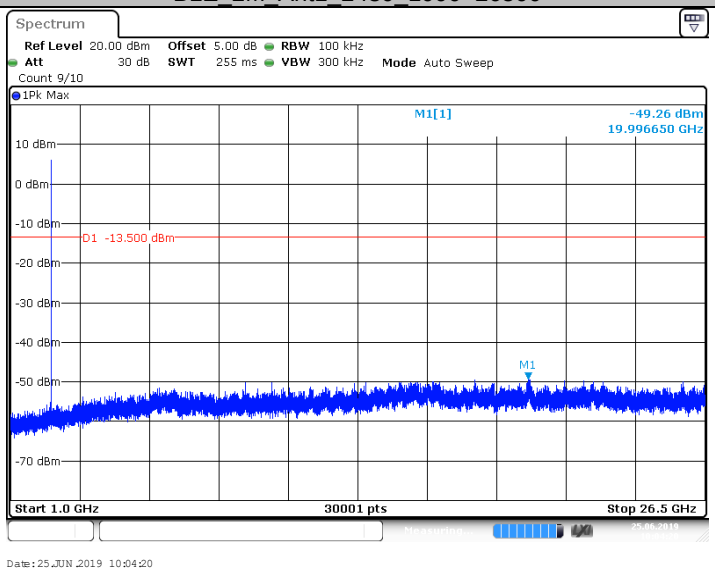
BLE_2M_Ant1_2480_0~Reference



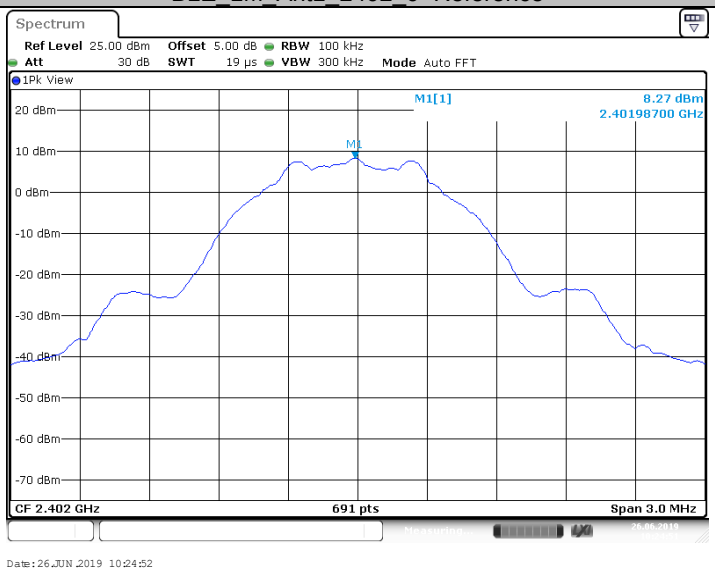
BLE_2M_Ant1_2480_30~1000



BLE_2M_Ant1_2480_1000~26500



BLE_1M_Ant1_2402_0~Reference



BLE_1M_Ant1_2402_30~1000

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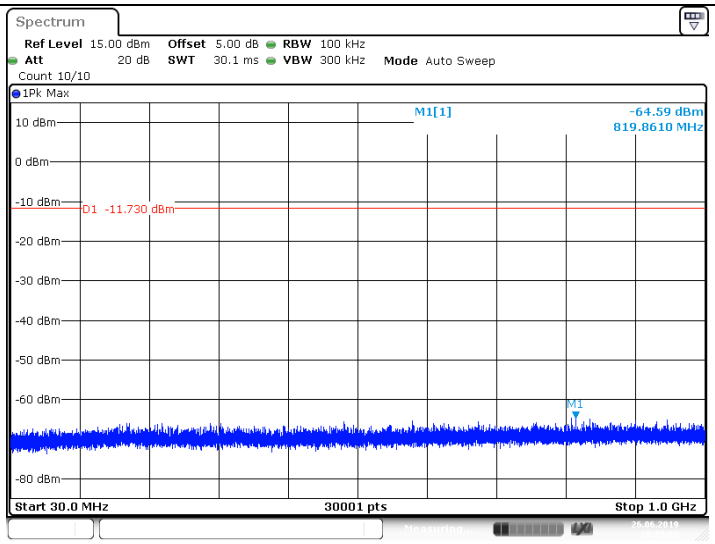
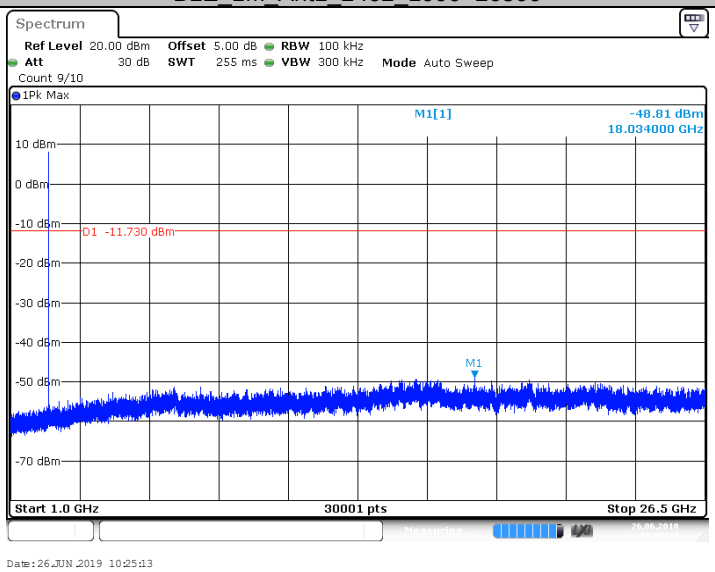
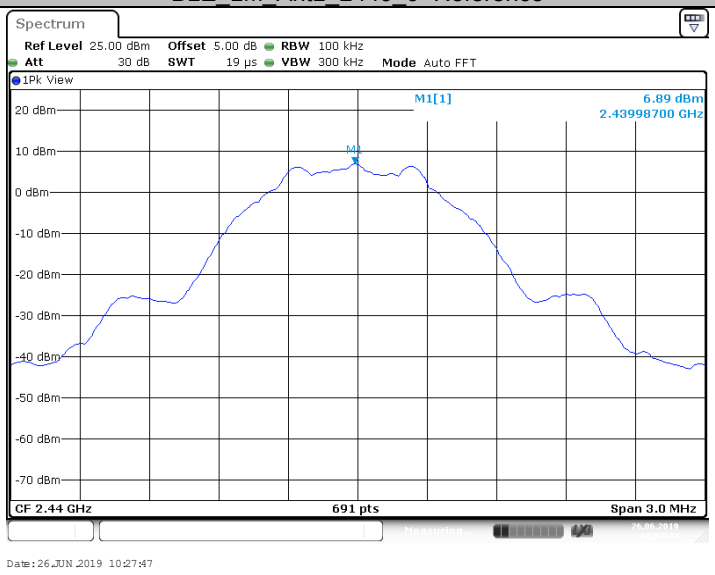


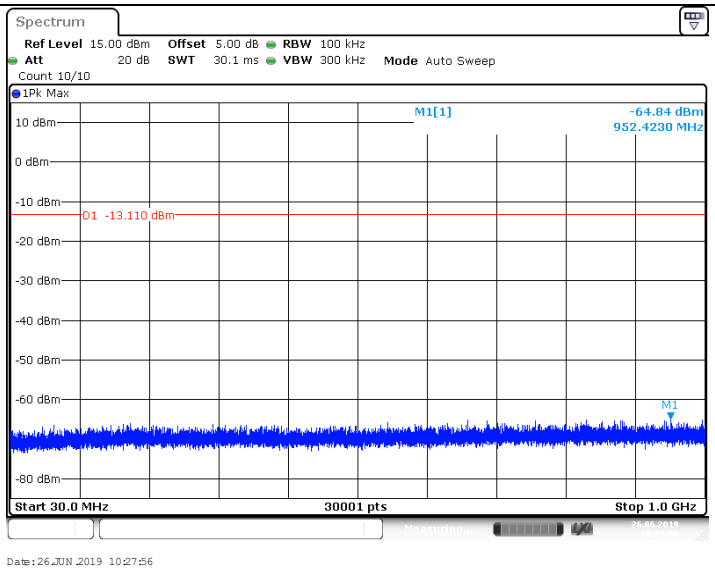
BLE_1M_Ant1_2402_1000~26500



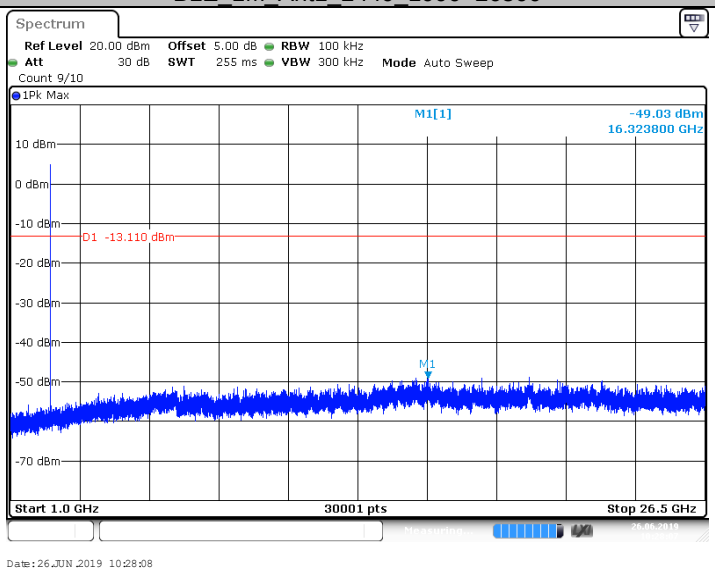
BLE_1M_Ant1_2440_0~Reference



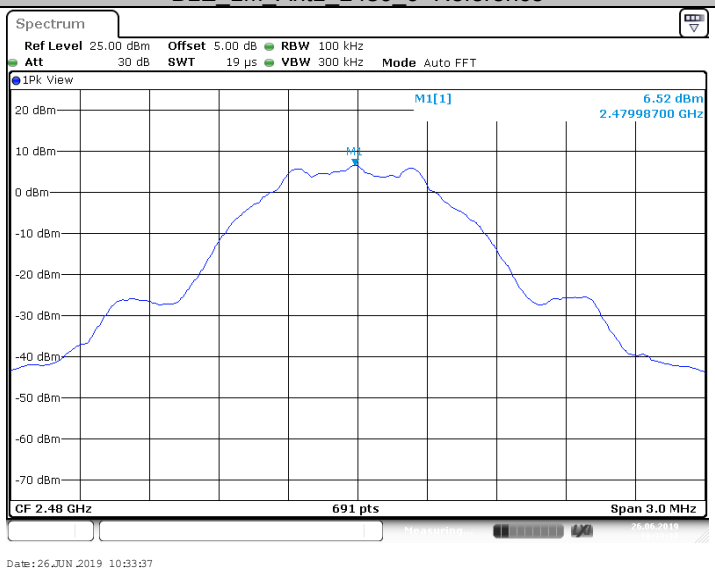
BLE_1M_Ant1_2440_30~1000



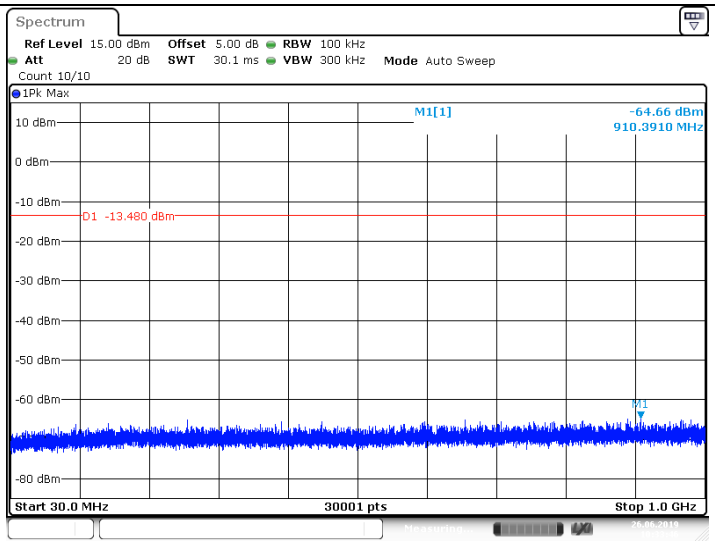
BLE_1M_Ant1_2440_1000~26500



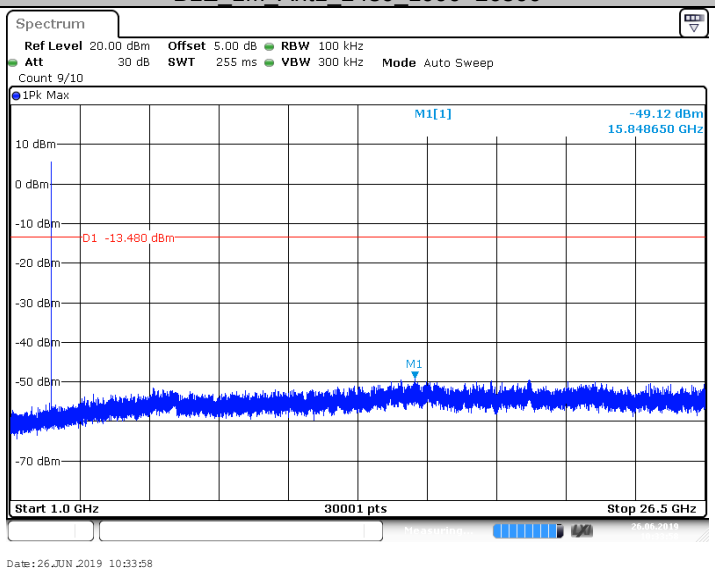
BLE_1M_Ant1_2480_0~Reference



BLE_1M_Ant1_2480_30~1000



BLE_1M_Ant1_2480_1000~26500



9.5 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. 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.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency
6. Set to the maximum power setting and enable the EUT hopping mode, repeat the test.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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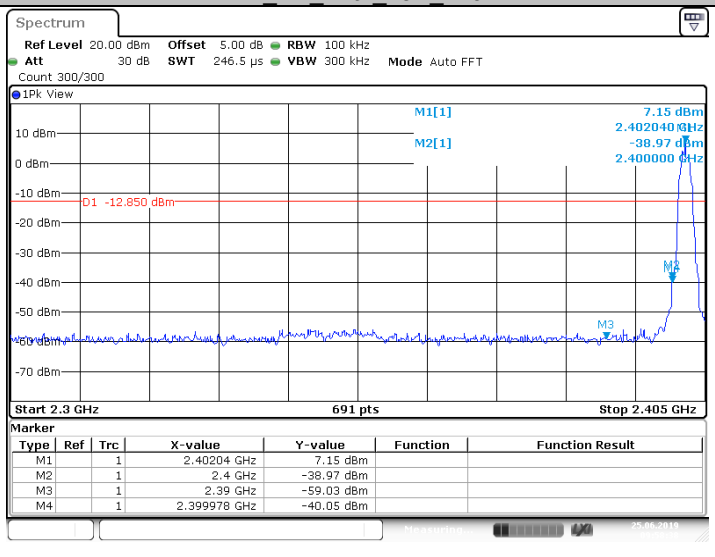
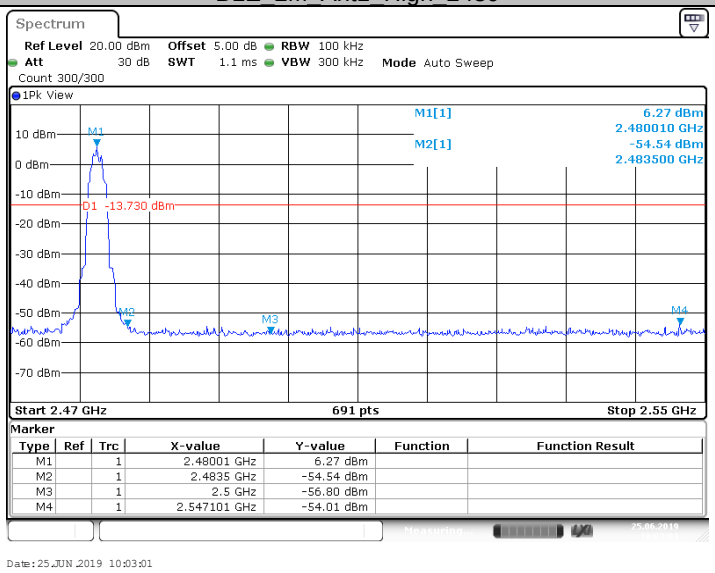
Band edge testing

TestMode	Antenna	ChName	Channel (MHz)	RefLevel (dBm)	Result (dBm)	Limit (dBm)	Verdict
BLE_2M	Ant1	Low	2402	7.15	-40.05	<=-12.85	PASS
		High	2480	6.27	-54.01	<=-13.73	PASS
BLE_1M	Ant1	Low	2402	8.21	-47.09	<=-11.79	PASS
		High	2480	6.31	-54.62	<=-13.69	PASS

BLE_2M_Ant1_Low_2402



BLE_2M_Ant1_High_2480



BLE_1M_Ant1_Low_2402

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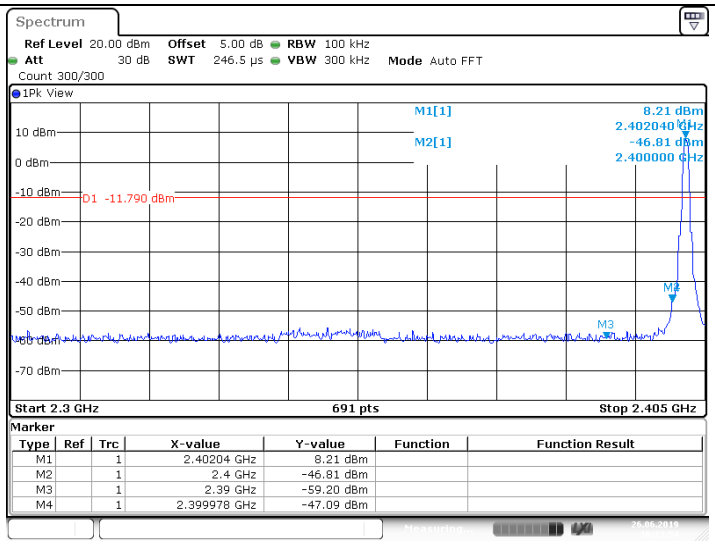
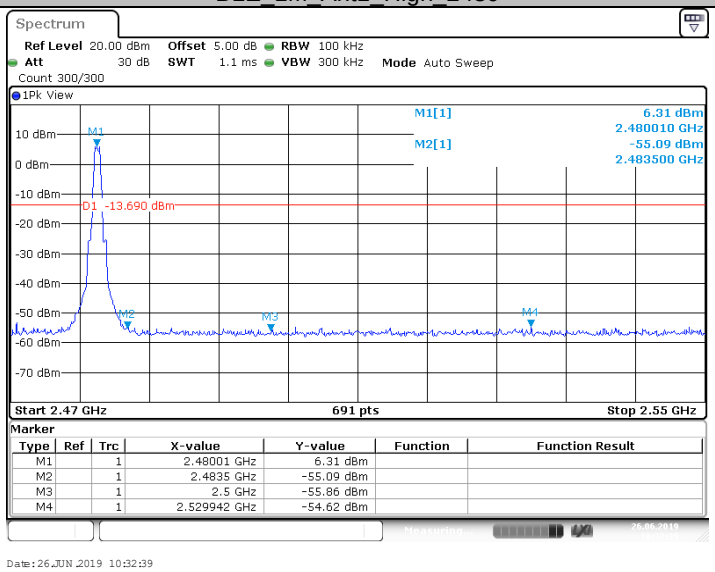


BLE_1M_Ant1_High_2480



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9.6 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
4. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
6. Use the following spectrum analyzer settings According to C63.10:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz, VBW= 300KHz for f < 1 GHz; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW=1 MHz, VBW= 3MHz for f ≥1 GHz for peak measurement.
   For average measurement:
   VBW = 10 Hz, when duty cycle is no less than 98 percent.
   VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
7. Repeat above procedures until all frequencies measured were complete.

Note:

1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).
4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

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Spurious radiated emissions for transmitter

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength µV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Low channel 2402MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBµV/m		dBµV/m		dBµV/m	(dB)	
30-1000MHz	53.60	20.95	H	40	QP	19.05	18.2	Pass
	518.88	27.16	H	46	QP	18.84	23.5	Pass
	745.81	29.89	H	46	QP	16.11	26.3	Pass
	879.29	34.58	H	46	QP	11.42	28.6	Pass
	Other Frequencies	--	H	--	QP	--	--	Pass
	43.80	21.01	V	40	QP	18.99	18.9	Pass
	60.66	24.97	V	40	QP	15.03	17.0	Pass
	631.08	28.21	V	46	QP	17.79	25.3	Pass
	943.26	35.51	V	46	QP	10.49	29.3	Pass
	Other Frequencies	--	V	--	QP	--	--	Pass
1000-25000MHz	1247.88	32.10	H	74	PK	41.90	-12.1	Pass
	2525.06	37.35	H	74	PK	36.65	-5.0	Pass
	Other Frequencies	--	H	--	PK	--	--	Pass
	1251.44	27.52	V	74	PK	46.48	-12.1	Pass
	*2496.88	34.57	V	74	PK	39.43	-5.1	Pass
	Other Frequencies	--	V	--	PK	--	--	Pass

Remark:

(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

(3) We test Low channel, Middle channel and High channel, only the worse case recorded in this report.

(4) Corrected Amplitude = Read level + Corrector factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

List of Test Instruments

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2020-6-28
Horn Antenna	Rohde & Schwarz	HF907	102294	2020-6-22
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100398	2020-7-7
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2020-6-28
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2020-6-28
Attenuator	Agilent	8491A	MY39264334	2020-6-28
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7

Conducted RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2020-6-28
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2020-6-28
Power Splitter	Weinschel	1580	SC319	2020-7-7
Test software	Tonscend	System for BT/WIFI	Version 2.5.77.0418	N/A

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.91dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.80dB; Vertical: 4.79dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10^{-7} or 1%

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