

FCC - TEST REPORT

Report Number : **64.790.19.00122.02-3** Date of Issue: 2020-07-06

Model : D04011

Product Type : Smart Access Point Pro

Applicant : ABB Xiamen Smart Technology Co., Ltd.

Production Facility : ABB Xiamen Smart Technology Co., Ltd.

Address : No.7 Fangshan South Road, Torch High Technology,Development Zone (Xiang An), Industrial Zone, 361000 Xiamen S.E.Z, Fujian Province, PEOPLE'S REPUBLIC OF CHINA

Test Result : ☒ **Positive** ☐ **Negative**



Total pages including Appendices : 36

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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: 86 755 828 5299
FCC Registration No.: 514049

3 Description of the Equipment Under Test

Product:	Smart Access Point Pro
Model no.:	D04011
Options and accessories:	N/A
Rating:	DC 24V
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	Internal Antenna
Antenna Gain:	1.0 dBi (for BLE)
Description of the EUT:	D04011 is a Smart Access Point Pro of a door entry system. It supports Wi-Fi functions: 2412MHz – 2472MHz for 2.4GHz Wi-Fi; 5150 - 5250 MHz, 5250 - 5350 MHz and 5470 - 5725 MHz for 5GHz Wi-Fi; and Bluetooth function (BLE only): 2402-2480MHz. This report is only for the BLE function.

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2019 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB558074 D01 v05r02 DTS Measurement Guidance and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C					
Test Condition		Test Site	Test Result		
			Pass	Fail	N/A
§15.207	Conducted emission AC power port	---	☒	☐	☐
§15.247 (b) (1)	Conducted peak output power	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	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	Site 1	☒	☐	☐
§15.247(d)	Band edge	Site 1	☒	☐	☐
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1	☒	☐	☐

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a Integrated antenna, which gain is 1 dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

D04011 is a Smart Access Point Pro of a door entry system.

It supports Wi-Fi functions: 2412MHz – 2472MHz for 2.4GHz Wi-Fi; 5150 - 5250 MHz, 5250 - 5350 MHz and 5470 - 5725 MHz for 5GHz Wi-Fi; and Bluetooth function (BLE only): 2402-2480MHz.

This report is only for the BLE function.

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: January 9, 2020

Testing Start Date: January 10, 2020

Testing End Date: March 13, 2020

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

Reviewed by:

Prepared by:

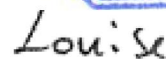
Test by:



Tony Liu



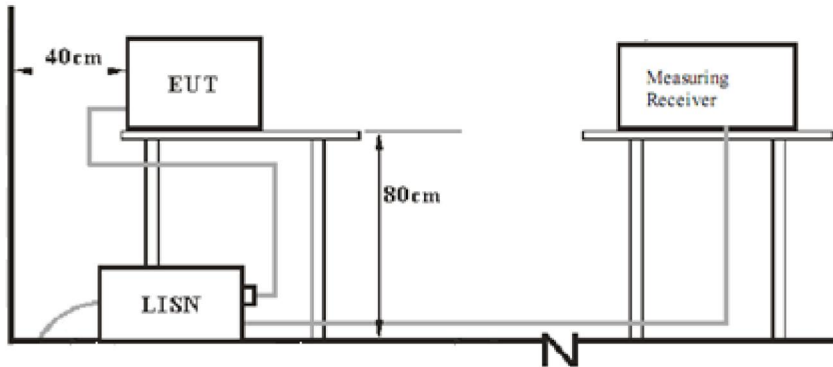
Kevin Ouyang



Louise Liu

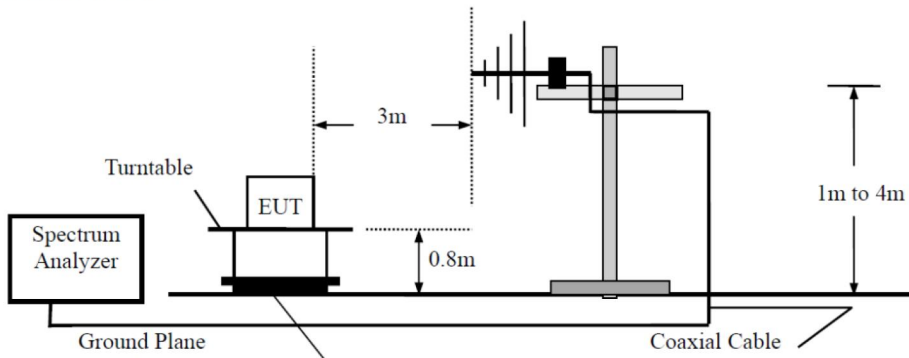
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

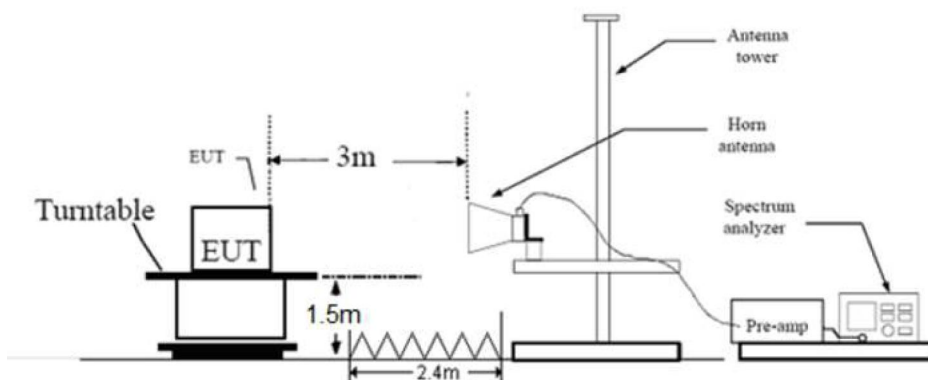


7.2 Radiated test setups

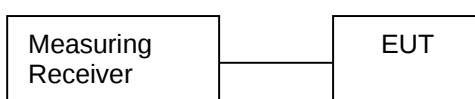
Below 1GHz



Above 1GHz



7.2 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MODEL NO.(SHIELD)	MANUFACTURER
IP touch 7, LAN+WiFi, T-loop	H8236-.	ABB
IP touch 10, LAN / WLAN	H8237-.	ABB
IP touch 7, LAN+LAN, T-loop	H8236-*	ABB
IP touch 10, LAN / LAN	H8237-*	ABB
Outdoor station Bar pushbutton module	5138.SP.	ABB
Outdoor station Round pushbutton module	5138.RP.	ABB
Outdoor station keypad module	5138.K-.	ABB
System controller	YSM01	ABB
POE Switch	TL-SL1218P	TP-LINK
Bluetooth Lock	--	Supplied by ABB

Test software: Blue Gecko BGTool SDK v2.6.1 which used to control the EUT in continues transmitting mode.

The system was configured to channel 0, 19, and 39 for the test.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through an Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

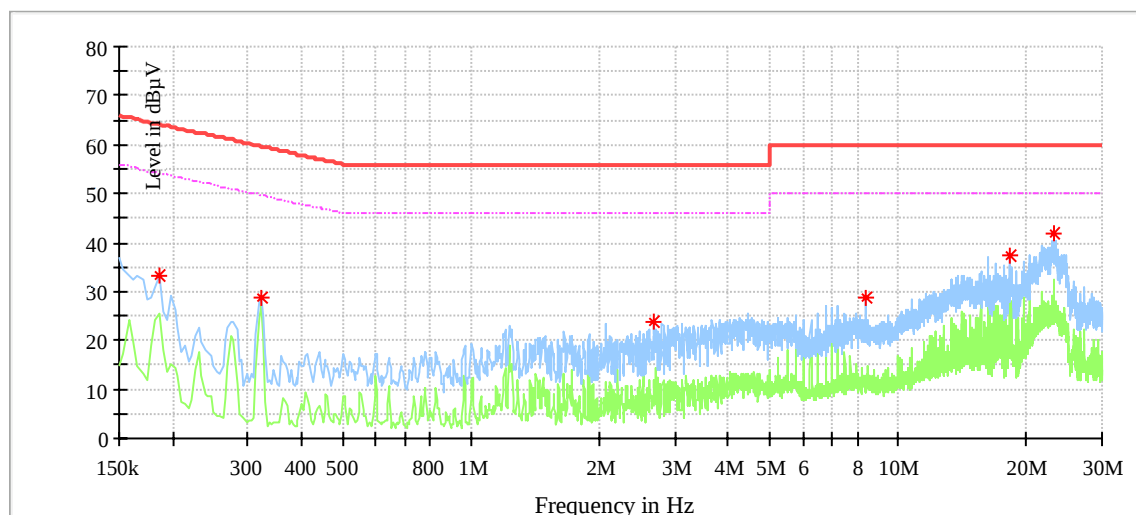
According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*: Decreasing linearly with logarithm of the frequency

Conducted Emission

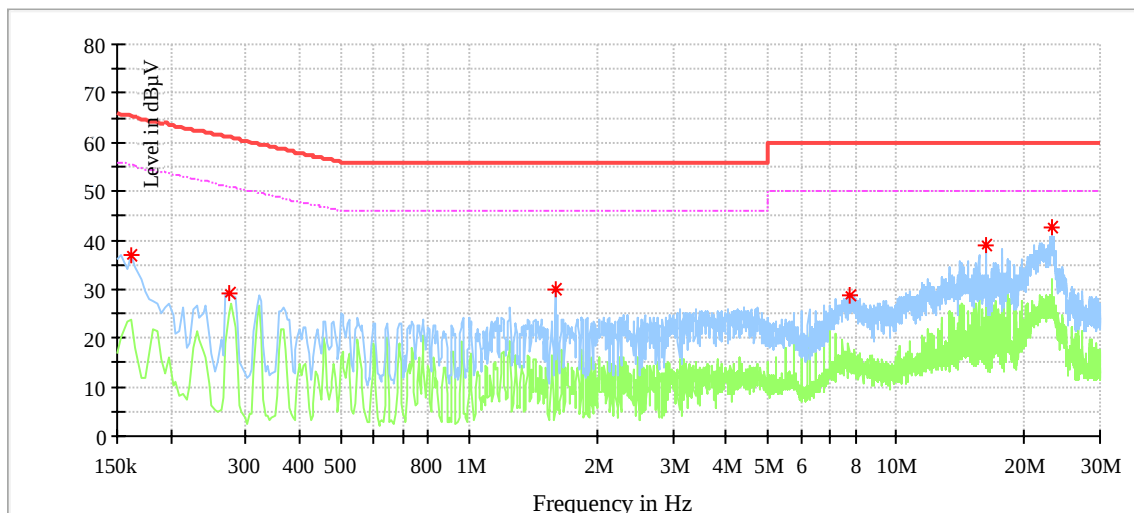
M/N : D04011
 Operating Condition : EUT on with Bluetooth function on.
 Test Specification : N
 Comment : AC 120V/60Hz



Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.186000	33.22	---	64.21	31.00	N	9.5
0.322000	28.61	---	59.66	31.04	N	9.6
2.682000	23.66	---	56.00	32.34	N	9.6
8.370000	28.65	---	60.00	31.35	N	9.7
18.246000	37.29	---	60.00	22.71	N	9.8
23.070000	41.78	---	60.00	18.22	N	9.9

Conducted Emission

M/N : D04011
 Operating Condition : EUT on with Bluetooth function on.
 Test Specification : L
 Comment : AC 120V/60Hz



Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.162000	36.78	---	65.36	28.58	L1	9.5
0.274000	29.06	---	61.00	31.93	L1	9.5
1.586000	29.97	---	56.00	26.03	L1	9.6
7.790000	28.82	---	60.00	31.18	L1	9.7
16.230000	39.16	---	60.00	20.84	L1	9.7
23.130000	42.73	---	60.00	17.27	L1	9.8

Remark:

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
RBW > the 6 dB bandwidth of the emission being measured, VBW $\geq$ 3RBW, Span $\geq$ 3RBW
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. 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.

Limits

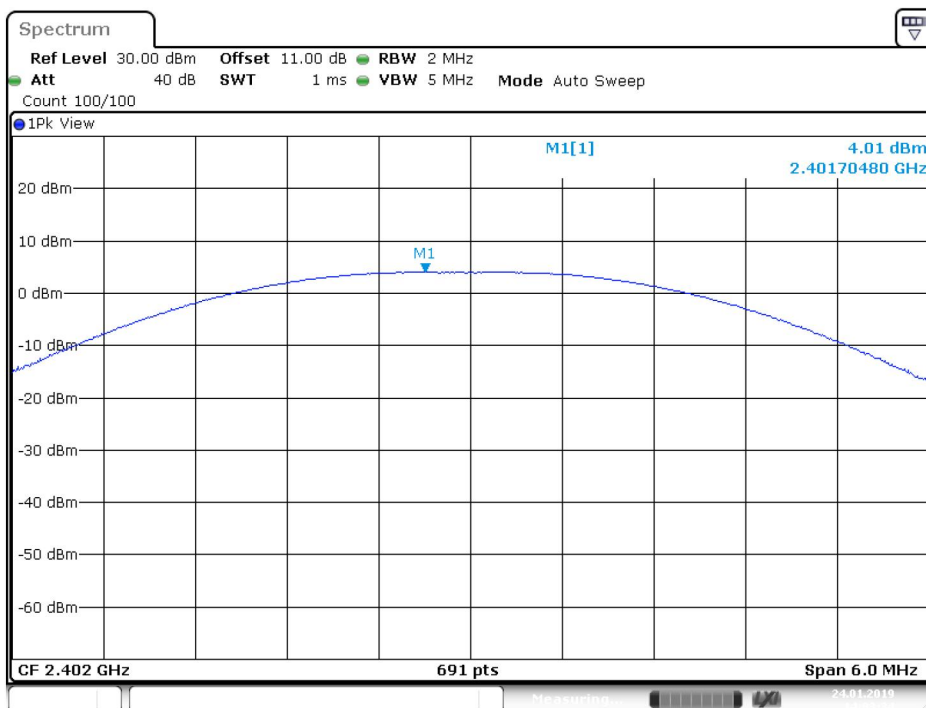
According to §15.247 (b) (1), conducted peak output power limit as below:

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

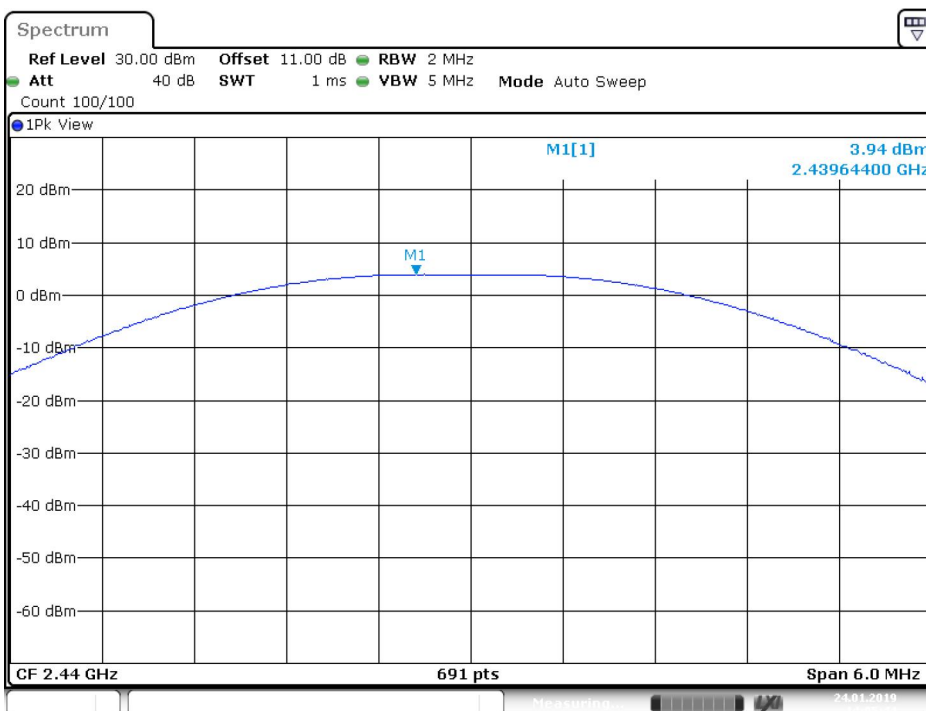
Test result as below table

Frequency MHz	Conducted Peak Output Power dBm	Result
2402	4.01	Pass
2440	3.94	Pass
2480	3.57	Pass

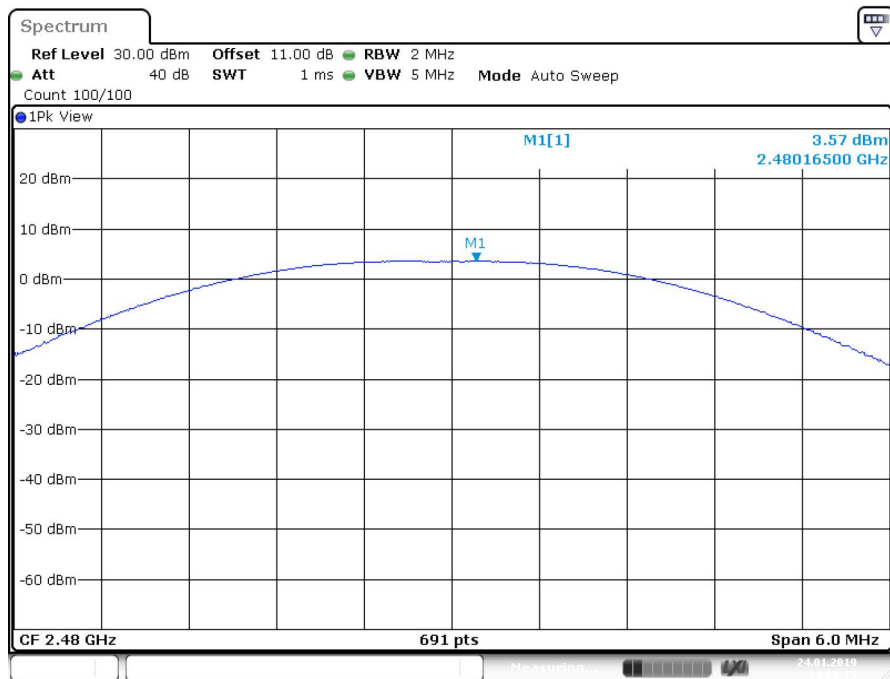
Low channel 2402MHz



Middle channel 2440MHz



High channel 2480MHz



9.3 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW $\geq$ 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

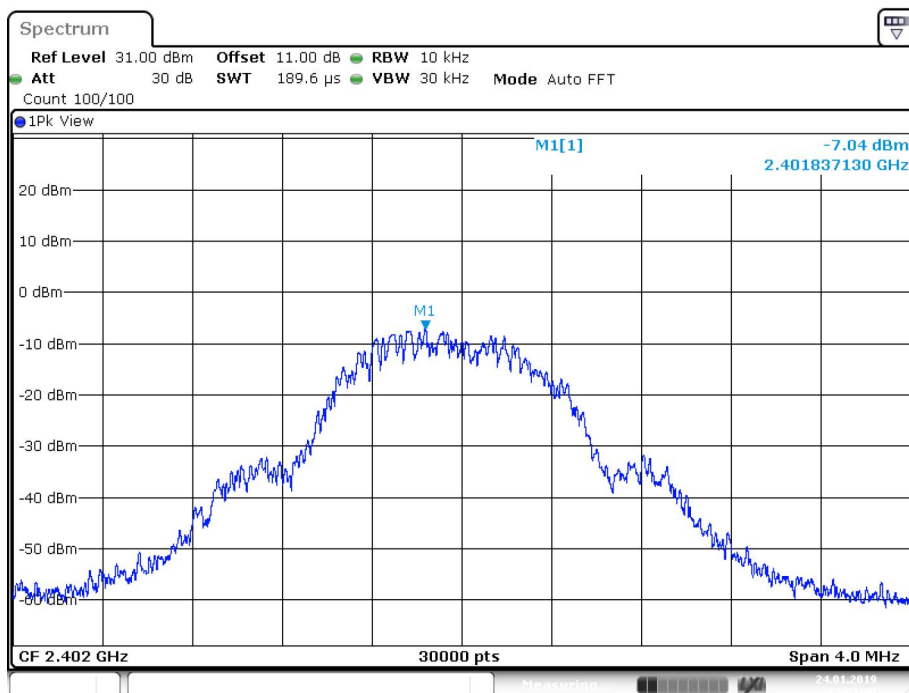
Limit [dBm/3KHz]

≤ 8

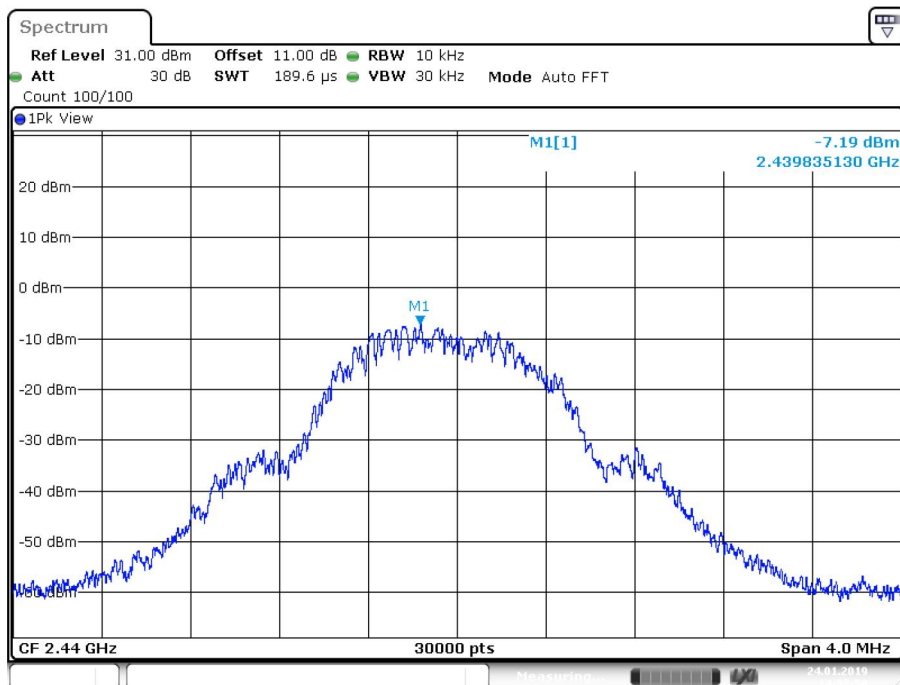
Test result

Frequency MHz	Power spectral density dBm/3KHz	Result
2402	-7.04	Pass
2440	-7.19	Pass
2480	-7.62	Pass

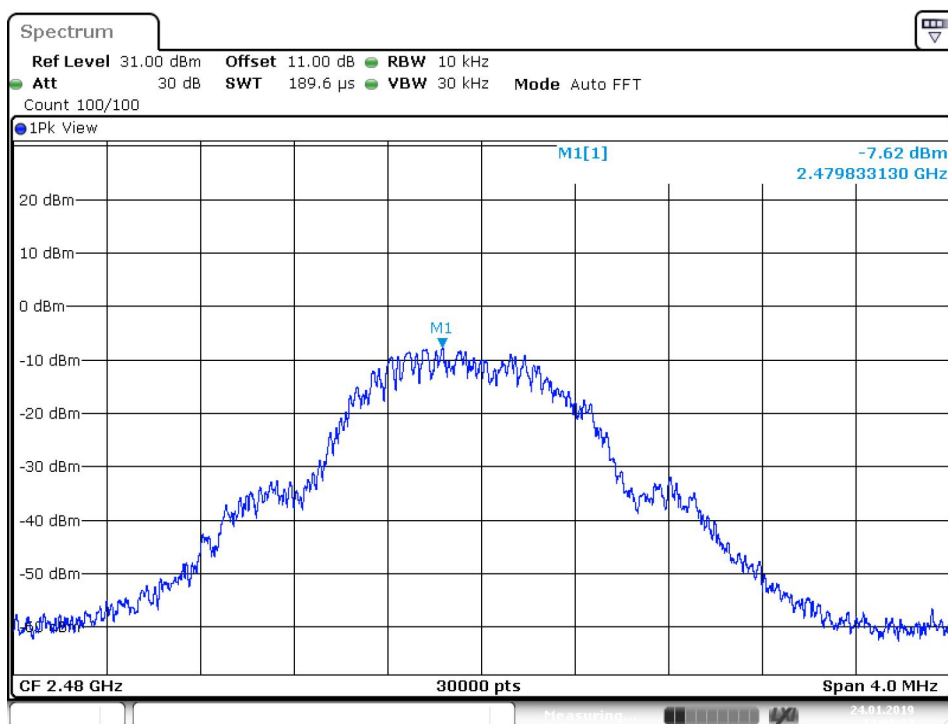
Low channel 2402MHz



Middle channel 2440MHz



High channel 2480MHz



9.4 6 dB Bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
RBW=100K, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be $\geq$ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

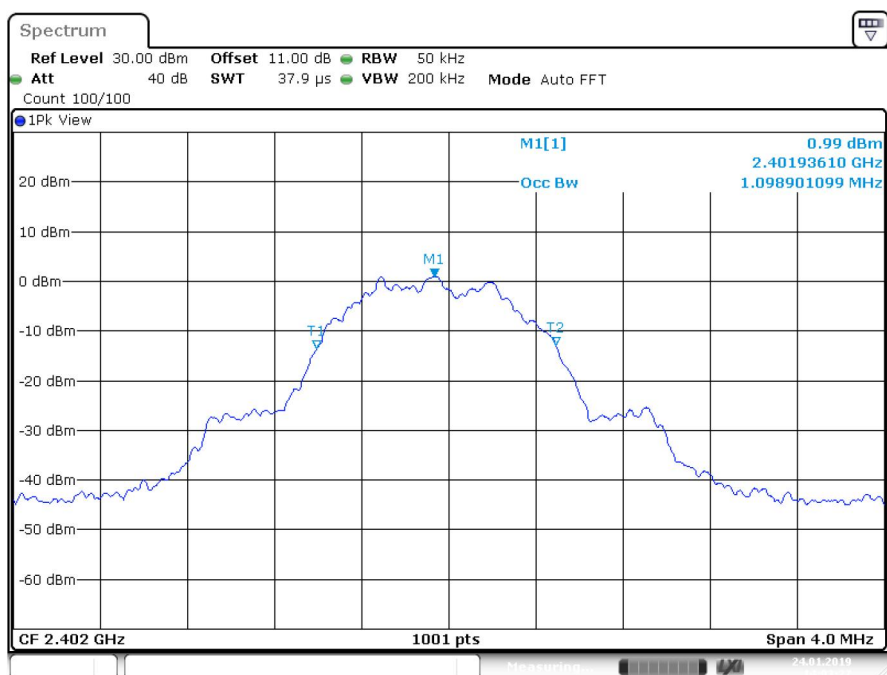
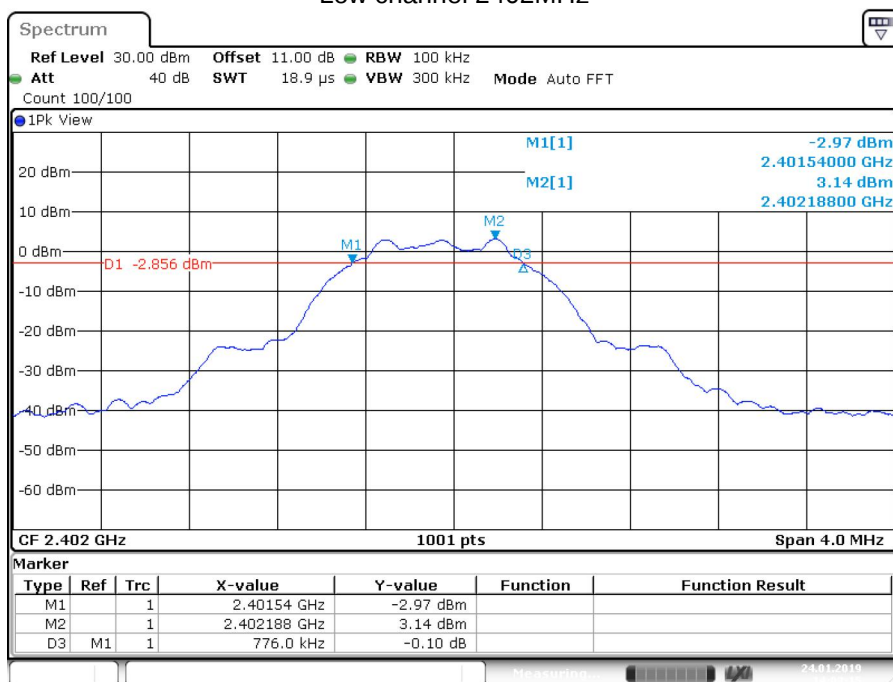
≥ 500

Test result

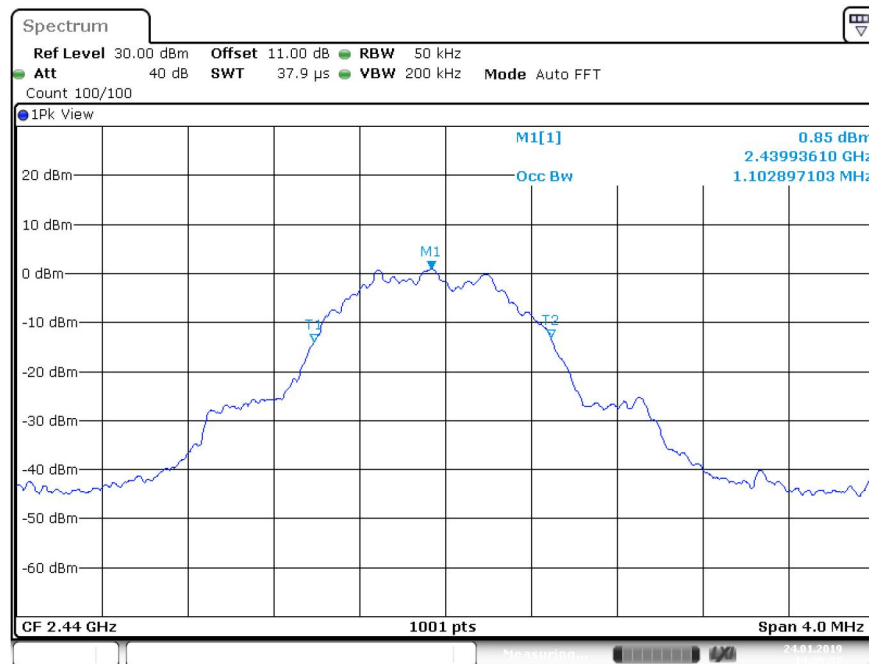
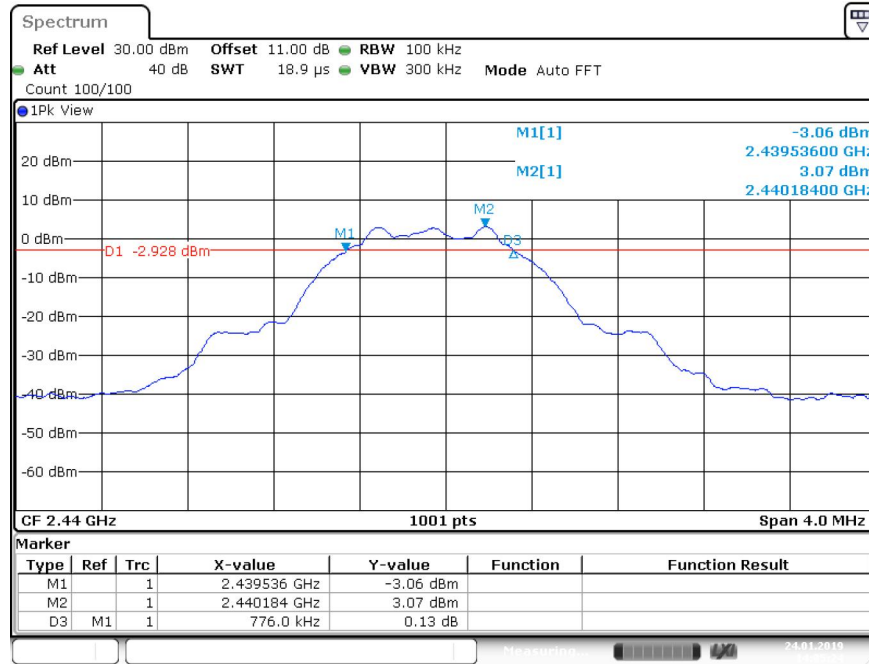
Frequency MHz	6dB bandwidth MHz	99% bandwidth MHz	Result
2402	0.776	1.099	Pass
2440	0.776	1.103	Pass
2480	0.776	1.103	Pass

6 dB Bandwidth

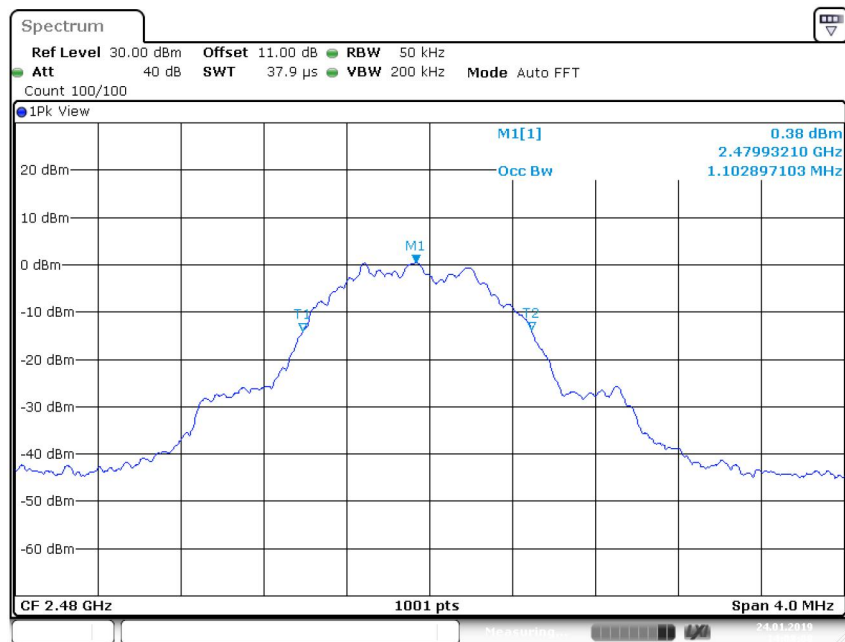
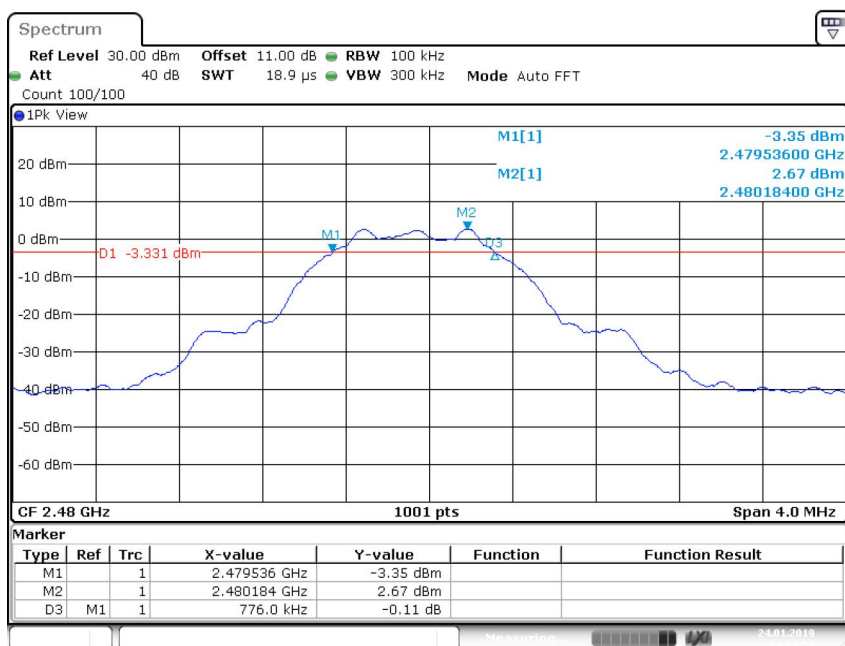
Low channel 2402MHz



Middle channel 2440MHz



High channel 2480MHz



9.5 Spurious RF conducted emissions

Test Method

1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
 - a. Set the center frequency and span to encompass frequency range to be measured.
 - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

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

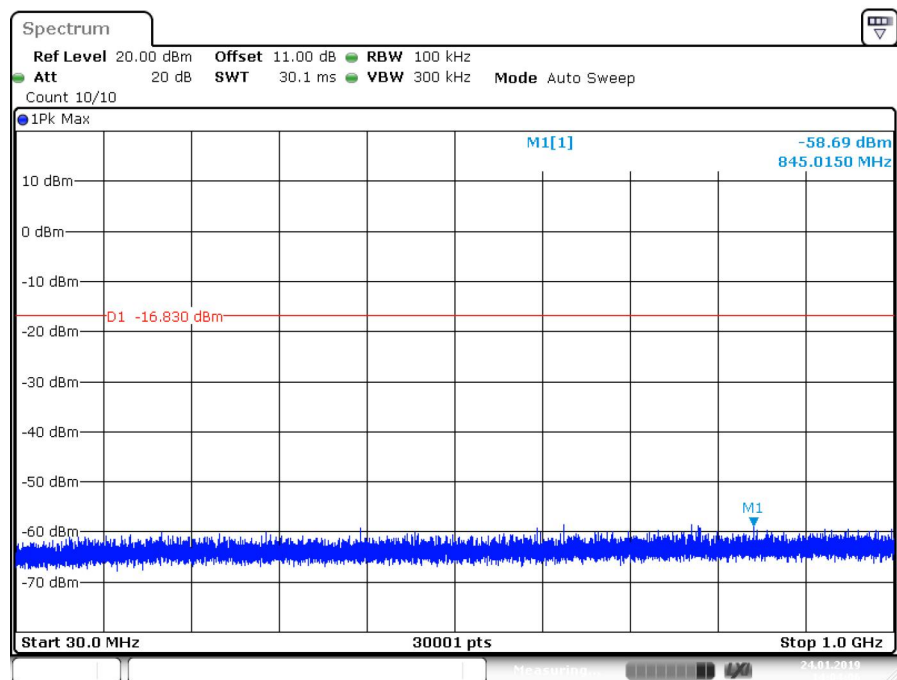
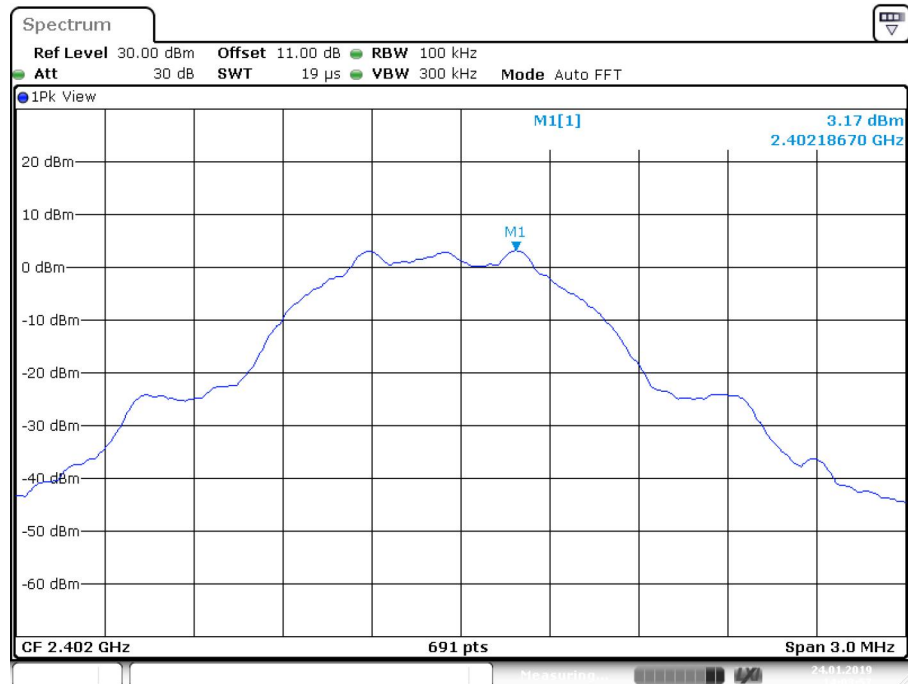
Test result:

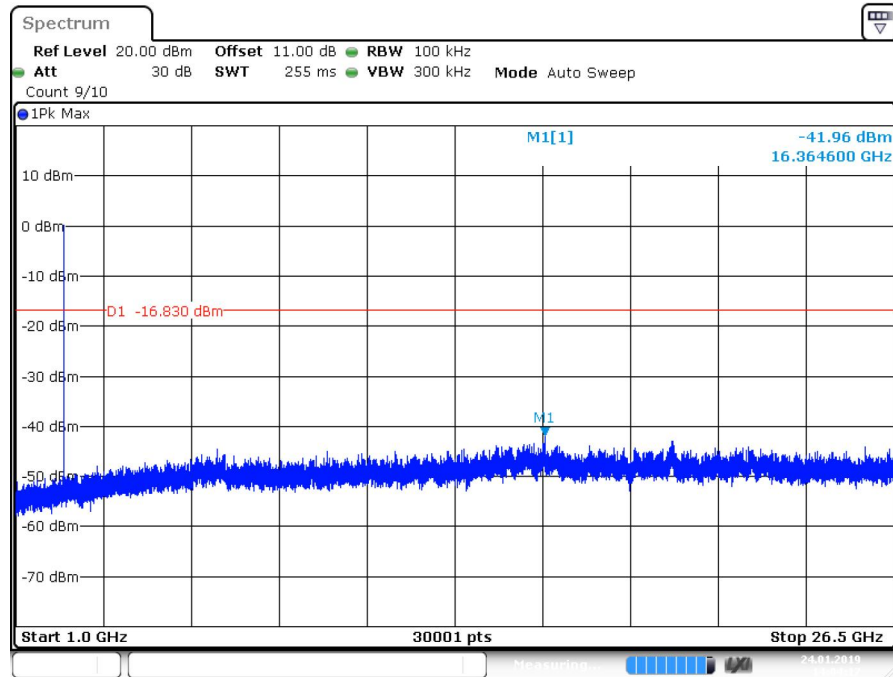
TestMode	Antenna	Channel(MHz)	FreqRange(MHz)	RefLevel(dBm)	Result(dBm)	Limit(dBm)	Verdict
BLE	Ant1	2402	Reference	3.17	3.17	---	PASS
		2402	30~1000	3.17	-58.69	-16.83	PASS
		2402	1000~26500	3.17	-41.96	-16.83	PASS
		2440	Reference	3.05	3.05	---	PASS
		2440	30~1000	3.05	-58.76	-16.95	PASS
		2440	1000~26500	3.05	-42.71	-16.95	PASS
		2480	Reference	2.65	2.65	---	PASS
		2480	30~1000	2.65	-59.03	-17.35	PASS
		2480	1000~26500	2.65	-42.81	-17.35	PASS

Spurious RF conducted emissions

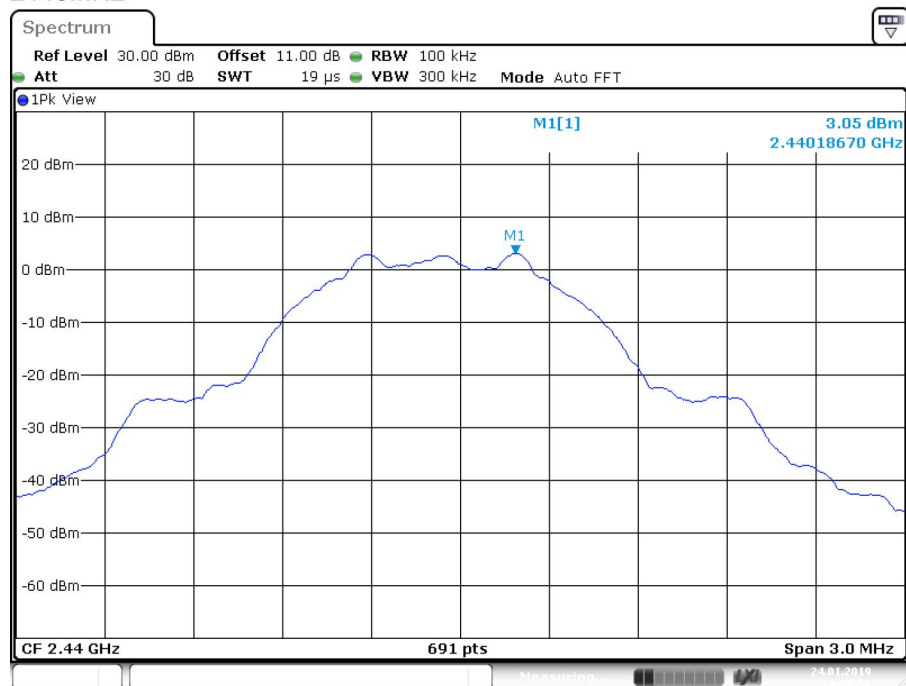
Test Graphs

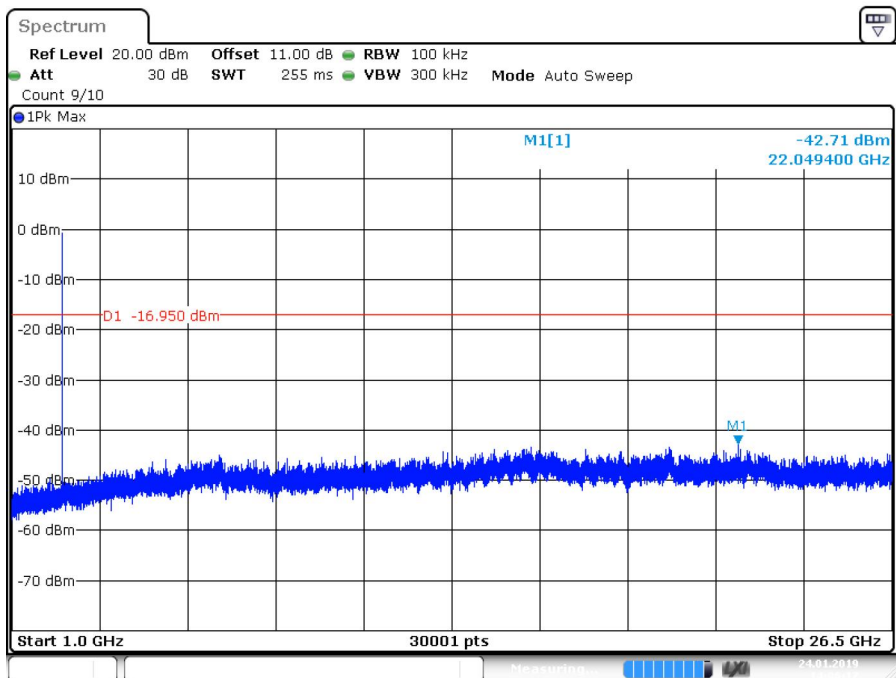
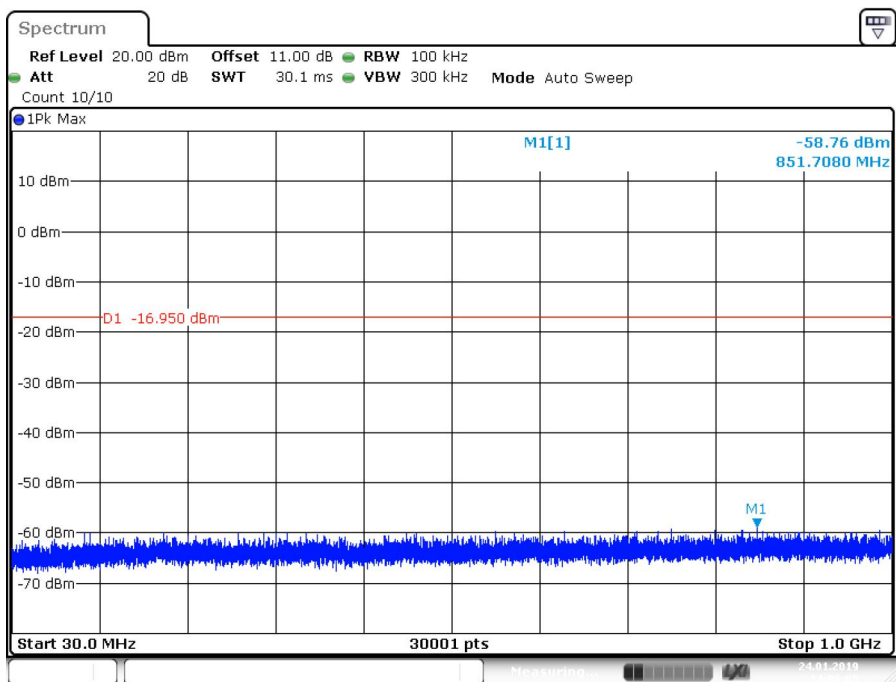
2402MHz



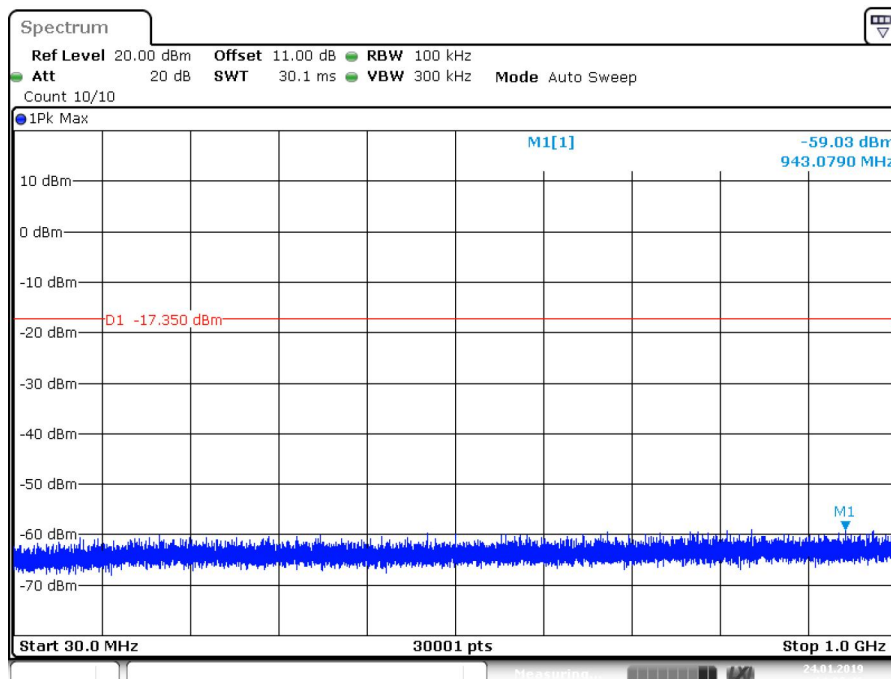
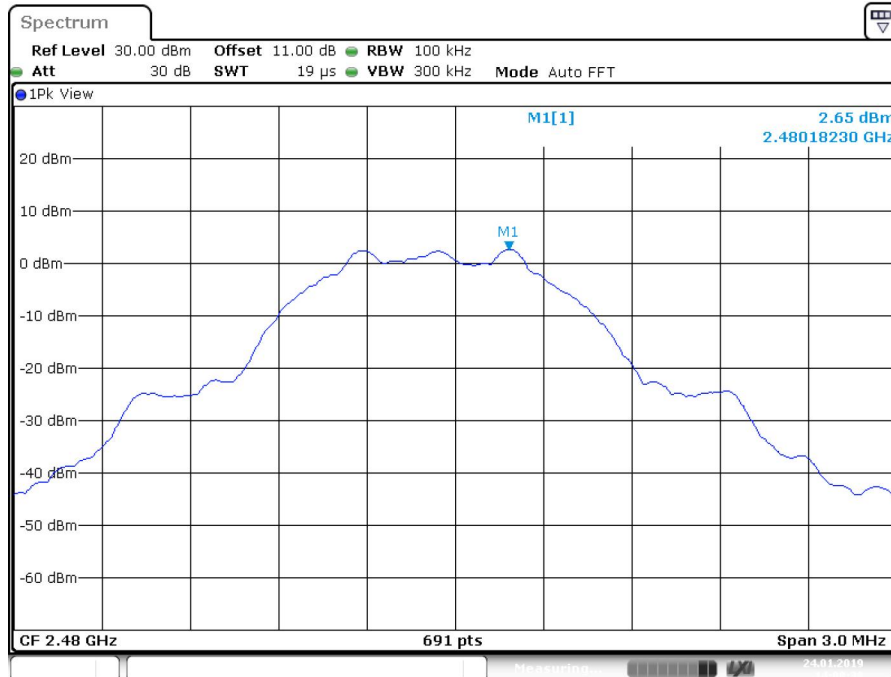


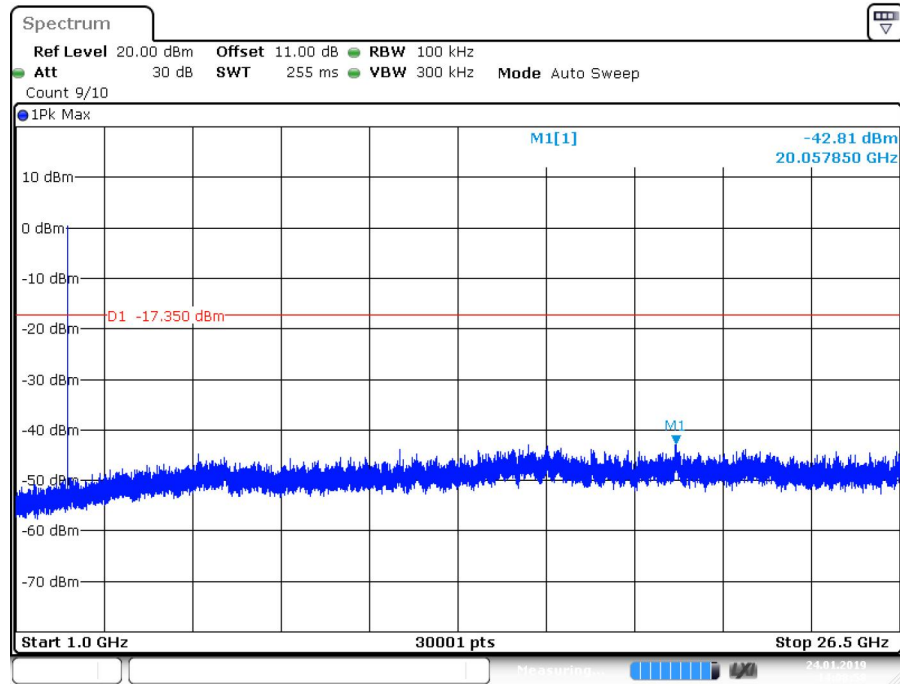
2440MHz





2480MHz





Remark: The emissions exceed the limits is the fundamental working frequency.

9.6 Band edge

Test Method

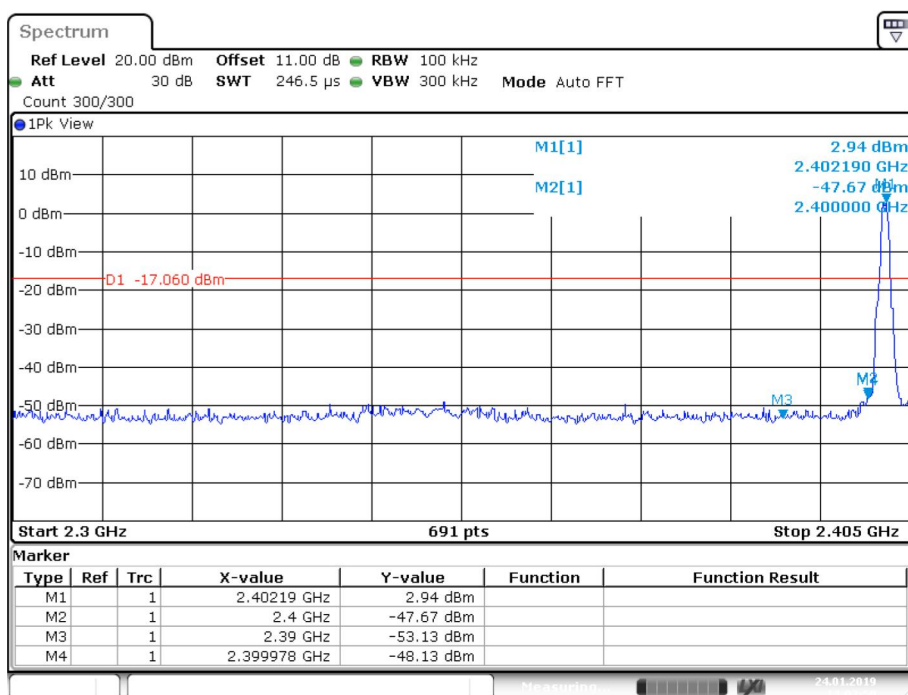
- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

Limit

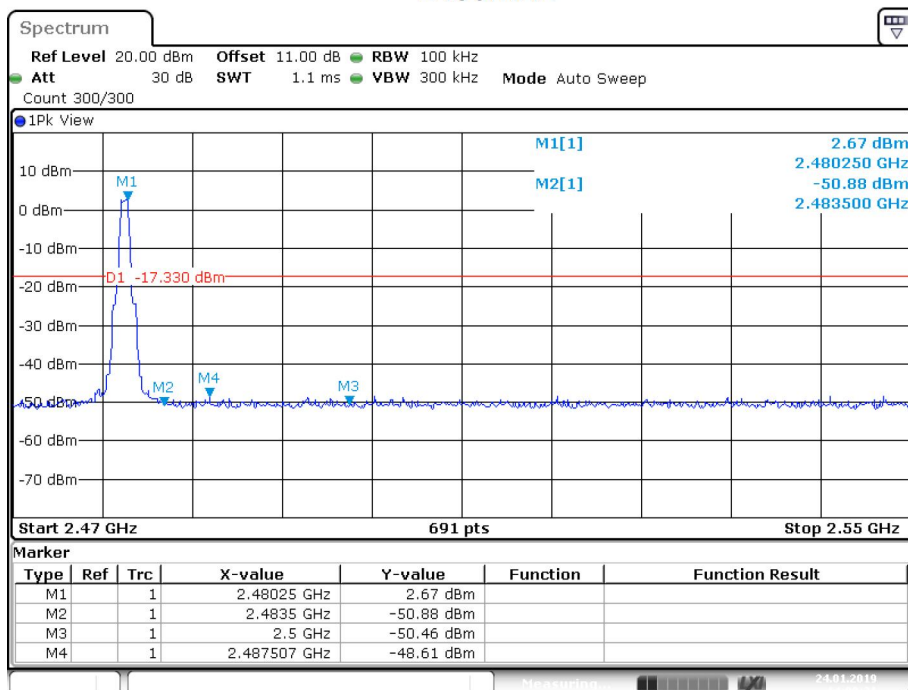
Frequency Range MHz	Limit (dBc)
30-25000	-20

Band edge testing

2402MHz



2480MHz



9.7 Spurious radiated emissions for transmitter

Test Method

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: 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.
- 4: 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.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz to 120KHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1 MHz.
- b) VBW = $[3 \times \text{RBW}]$.
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq \text{RBW} / 2$.
Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty

cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

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 section 15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/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

Spurious radiated emissions for transmitter

Transmitting spurious emission test result as below:

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.

Emission Below 1GHz

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
44.280556	18.39	40.00	21.61	H	-25.0
58.884444	18.38	40.00	21.62	H	-27.0
175.015000	18.62	43.50	24.88	H	-29.6
425.005556	28.19	46.00	17.81	H	-23.7
575.032222	31.07	46.00	14.93	H	-20.3
875.085556	32.16	46.00	13.84	H	-15.9
37.221111	23.33	40.00	16.67	V	-26.9
65.135556	22.87	40.00	17.13	V	-29.6
174.961111	21.00	43.50	22.50	V	-29.6
274.978889	22.98	46.00	23.02	V	-24.9
575.032222	27.97	46.00	18.03	V	-20.3
880.797778	29.64	46.00	16.36	V	-15.9
975.049444	29.22	54.00	24.78	V	-15.0

Emission Above 1GHz

2402MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
37.221111	23.33	40.00	16.67	V	-26.9
65.135556	22.87	40.00	17.13	V	-29.6
174.961111	21.00	43.50	22.50	V	-29.6
274.978889	22.98	46.00	23.02	V	-24.9
575.032222	27.97	46.00	18.03	V	-20.3
880.797778	29.64	46.00	16.36	V	-15.9
975.049444	29.22	54.00	24.78	V	-15.0
4803.281250	39.99	74.00	34.01	V	3.7
7628.437500	41.60	74.00	32.40	V	9.8
14874.37500	47.99	74.00	26.01	V	17.8
1000.000000	21.34	54.00	52.66	H	-12.9
1991.937500	28.15	74.00	45.85	H	-8.9
2402.000000	35.25	74.00	38.75	H	-5.5
2462.937500	35.69	74.00	38.31	H	-4.8
4923.750000	44.76	74.00	29.24	H	4.2
7528.593750	41.89	74.00	32.11	H	9.7
15809.06250	49.34	74.00	24.66	H	19.4

2440MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
1993.500000	27.99	74.00	46.01	H	-8.9
2220.312500	29.42	74.00	44.58	H	-7.0
2565.562500	34.97	74.00	39.03	H	-4.4
4923.750000	43.34	74.00	30.66	H	4.2
10695.46875	43.52	74.00	30.48	H	10.4
14895.46875	47.71	74.00	26.29	H	17.8
1601.750000	26.80	74.00	47.20	V	-10.6

1991.937500	31.20	74.00	42.80	V	-8.9
2536.562500	31.19	74.00	42.81	V	-4.3
5422.500000	39.13	74.00	34.87	V	4.6
7520.625000	42.07	74.00	31.93	V	9.6
13656.09375	46.27	74.00	27.73	V	15.1

2480MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB)
2008.375000	27.92	74.00	46.08	V	-8.9
2480.250000	32.27	74.00	41.73	V	-4.8
2727.750000	30.82	74.00	43.18	V	-4.1
4949.062500	39.60	74.00	34.40	V	4.3
7458.281250	42.10	74.00	31.90	V	8.6
14553.28125	47.67	74.00	26.33	V	17.5
1786.187500	26.74	74.00	47.26	H	-9.8
2200.437500	28.50	74.00	45.50	H	-7.2
2479.750000	31.39	74.00	42.61	H	-4.8
4923.750000	50.73	74.00	23.27	H	4.2
6540.937500	40.98	74.00	33.02	H	6.1
10643.43750	42.67	74.00	31.33	H	10.3

Remark:

- (1) Data of measurement if reading of emissions are attenuated more than 10dB below the permissible limits or the field strength is too small to measured are not showed.
- (2) 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)

10 Test Equipment List

List of Test Instruments

Radiated Spurious Emission Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-003	101031	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	68-4-80-14-003	708	2020-7-5
Horn Antenna	Rohde & Schwarz	HF907	68-4-80-14-004	102295	2020-7-5
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	2020-7-5
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	2020-7-7
Pre-amplifier	Rohde & Schwarz	SCU 18	68-4-29-14-001	102230	2020-6-28
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	2020-7-16
Fully Anechoic Chamber	TDK	8X4X4	68-4-90-14-002	--	2020-7-7
Test software	Rohde & Schwarz	EMC32	68-4-90-14-002-A10	Version 9.15.00	N/A

RF Test System

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	2020-6-28

Conducted Emission Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-14-001	101782	2021-6-29
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	2021-6-12
RF Current Probe	Rohde & Schwarz	EZ-17	68-4-27-14-002	100816	2021-6-28
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	2021-6-21
Test software	Rohde & Schwarz	EMC32	68-4-90-14-003-A10	Version 9.15.00	N/A
Shielding Room	TDK	CSR #1	68-4-90-19-004	----	2020-11-07

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 Conducted Emission 150kHz-30MHz (for test using High Voltage Probe TK9420(VT9420))	2.51 dB
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	Power level test involved: 1.16dB Frequency test involved: 0.6×10 ⁻⁷ or 1%