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FIREBOLT GROUP INC.

TEST REPORT

SCOPE OF WORK
EMC TESTING– SC1000

REPORT NUMBER
200609033GZU-001

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TEST REPORT

Applicant Name & Address	:	FIREBOLT GROUP INC. 28059 Center Oaks Ct., Wixom, MI 48393
Manufacturing Site	:	TEMPTING PRODUCTS INTERNATIONAL LIMITED Room 202, Building No.2, Zone No.5 of Tianfulai International Industrial Area, No.3 Changfu West Road, Ronggui, Shunde, Foshan, Guangdong, China
Intertek Report No:	:	200609033GZU-001
FCC ID:		2AWWZ-SC1000

Test standards

47 CFR PART 15 Subpart C: 2018 section 15.247

Sample Description

Product	:	Scorecast Electronic Scoreboard
Model No.	:	SC1000
Electrical Rating	:	DC6V, 5W
Serial No.	:	Not Labeled
Date Received	:	09 June 2020
Date Test Conducted	:	09 June 2020 to 09 July 2020

Prepared and Checked By

Paul Pang

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Team Leader

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1.0 TEST RESULT SUMMARY

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC PART 15 C section 15.247 (c) and Section 15.203	FCC PART 15 C section 15.247 (c) and Section 15.203	PASS
6 dB Bandwidth (DTS bandwidth)	FCC PART 15 C section 15.247 (a)(2)	ANSI C63.10: Clause 11.8	PASS
Maximum Peak Conducted Output Power	FCC PART 15 C section 15.247(b)(3)	ANSI C63.10: Clause 11.9.1.2	PASS
Peak Power Spectral Density	FCC PART 15 C section 15.247(e)	ANSI C63.10: Clause 11.10.2	PASS
Out of Band Conducted Emissions	FCC PART 15 C section 15.209 & 15.247(d)	ANSI C63.10: Clause 11.11	PASS
Out of Band Radiated Emission	FCC PART 15 C section 15.209 & 15.247(d)	ANSI C63.10: Clause 11.11, 6.4, 6.5 and 6.6	N/A
Radiated Emissions in Restricted Bands	FCC PART 15 C section 15.209 & 15.247(d)	ANSI C63.10: Clause 11.12.1, 6.4, 6.5 and 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.247 (d) & 15.205	ANSI C63.10: Clause 11.11 and 11.13	PASS
Conducted Emissions at Mains Terminals	FCC PART 15 C section 15.207	ANSI C63.10: Clause 6.2	PASS

Remark:
N/A: not applicable. Refer to the relative section for the details.
EUT: In this whole report EUT means Equipment Under Test.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.
ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.

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2.0 General Description

2.1 Product Description

Operating Frequency:	2402 MHz – 2480MHz
Type of Modulation:	GFSK
Number of Channels:	40 Channels
Channel Separation:	2 MHz
Antenna Type:	Integral
Antenna Gain:	4 dBi
Speciality:	Scorecast Electronic Scoreboard with BLE (Bluetooth Low Energy)
Function:	Scorecast Electronic Scoreboard with BLE function
Power Supply:	DC6V, 5W
Power cord:	N/A

EUT modulation and data packet during test:

The EUT has been tested on the Modulation of GFSK with 2 Mbps data rate.

EUT channels and frequencies list:

Test frequencies are lowest channel 0: 2402 MHz, middle channel 19: 2440 MHz and highest channel 39: 2480 MHz.

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	14	2430	28	2458
1	2404	15	2432	29	2460
2	2406	16	2434	30	2462
3	2408	17	2436	31	2464
4	2410	18	2438	32	2466
5	2412	19	2440	33	2468
6	2414	20	2442	34	2470
7	2416	21	2444	35	2472
8	2418	22	2446	36	2474
9	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454	/	/
13	2428	27	2456	/	/

2.2 Related Submittal(s) Grants

This is an application for certification of:
DTS-Digital Transmission System

Remaining portions are subject to the following procedures:
1. Receiver portion of BLE: exempt from technical requirement of this Part.

2.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10. Radiated emission measurement was performed in semi-anechoic chamber. For radiated emission measurement, preliminary scans and final tests were performed in the semi-anechoic chamber to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise.

2.4 Test Facility

All tests were performed at:
Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Room102/104, No 203, KeZhu Road, Science City, GETDD Guangzhou, China
Except Conducted Emissions was performed at:
Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China

A2LA Certificate Number 0078.10
Intertek Testing Services Shenzhen Ltd. Guangzhou Branch is accredited by A2LA and Listed in FCC website. FCC accredited test labs may perform both Certification testing under Parts 15 and 18 and Declaration of Conformity testing.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. It was powered by DC 6V supply.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters

unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. The spurious emissions more than 20 dB below the permissible value are not reported.

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

3.2 EUT Exercising Software

N/A

3.3 Special Accessories

The engineering sample for tests supplied by the manufacturer selects the lowest, middle and highest frequency through a button.

3.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	20 dB Bandwidth	2.3%
	6dB Bandwidth	
	99% Bandwidth	
2	Carrier Frequencies Separated	2.3%
3	Dwell Time	1.2%
4	Maximum Peak Conducted Output Power	1.5dB
5	Peak Power Spectral Density	1.5dB
6	Out of Band Conducted Emissions	1.5dB
7	Band edges measurement	1.5dB
8	Radiated Emissions	4.7 dB (25 MHz-1 GHz)
		4.8 dB (1 GHz-18 GHz)
		5.21dB (18GZH-26GHz)
9	Conducted Emissions at Mains Terminals	2.58dB
10	Temperature	0.5 °C
11	Humidity	0.4 %
12	Time	1.2%

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty is calculated in accordance with ETSI TR 100 028-2001.
The measurement uncertainty is given with a confidence of 95%, k=2.

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance – Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value

3.5 Equipment Modification

Any modifications installed previous to testing by FIREBOLT GROUP INC. will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

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3.6 Support Equipment List and Description

This product was tested with corresponding support equipment as below:

Cable

Description	Model No.	Connector type	Cable length/type	Supplied by
Antenna cable	RF-01	SMA	0.2 m(shielded)	Intertek

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4.0 Measurement Results

4.1 Antenna Requirement

Standard requirement:

15.203 requirement:

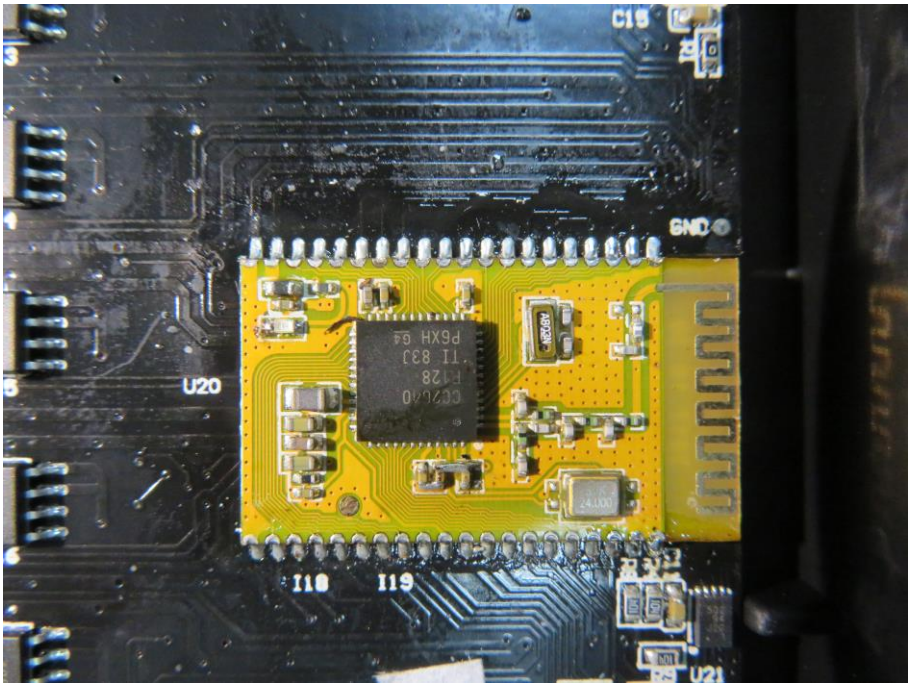
For intentional device. According to 15.203 an intentional radiator shall be designed to Ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna

The antenna is an integral antenna and no consideration of replacement. The best case gain of the antenna is 4 dBi.



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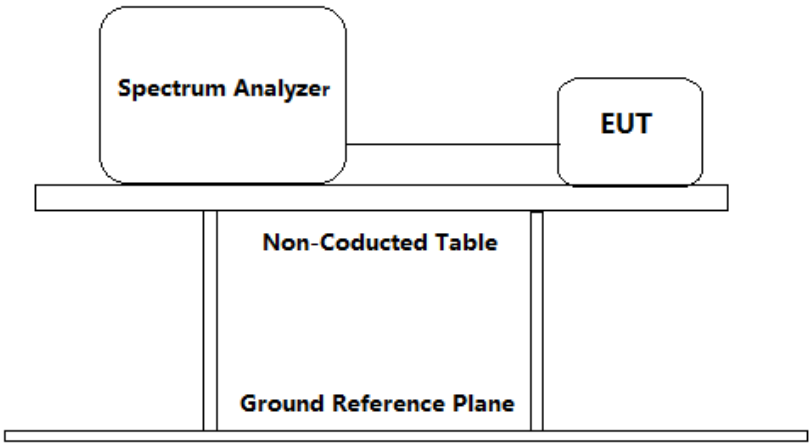
4.2 6 dB Bandwidth (DTS bandwidth)

Test Requirement:	FCC Part 15 C section 15.247 (a)(2)Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
Test Method:	ANSI C63.10: Clause 11.8
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (cable loss =1.0 dB) from the antenna port to the spectrum.
2. Set the spectrum analyzer:
   a) Set RBW = 100 kHz
   b) Set the VBW⩾ [3 × RBW]
   c) Detector = peak.
   d) Trace mode = max hold.
   e) Sweep = auto couple
   f) Allow the trace to stabilize.
   g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
   h) Span=2*BW~5*BW
3. Repeat until all the test status is investigated.
4. Report the worst case.

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Used Test Equipment List

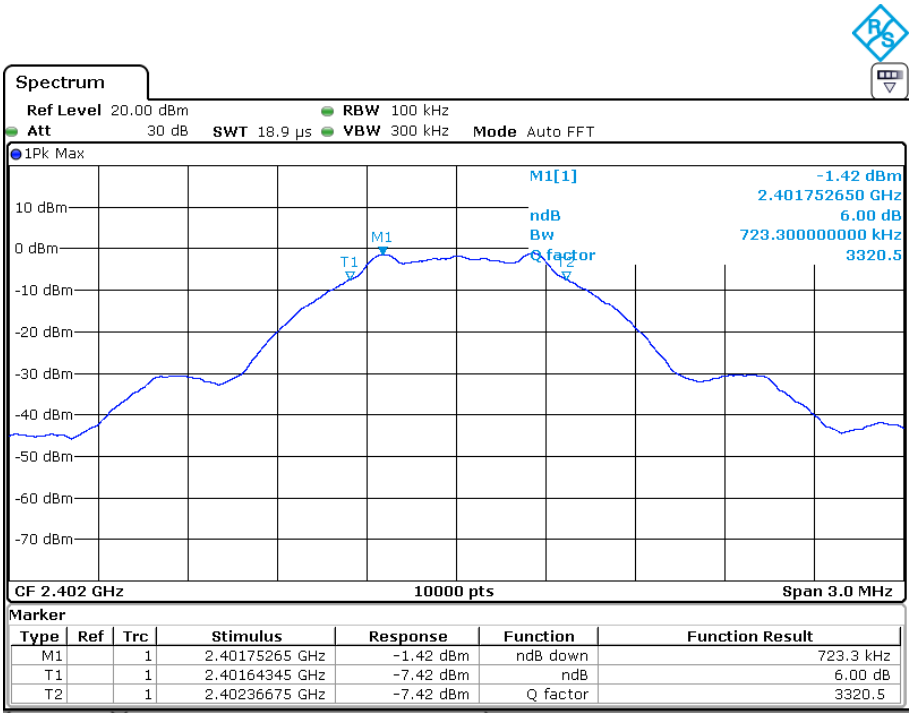
Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

Channel No.	Frequency (MHz)	Measured 6dB bandwidth (kHz)	Limit (kHz)	Result
0	2402	723.3	≥500	Pass
19	2440	719.7		Pass
39	2480	723.0		Pass

Test result: The unit does meet the FCC requirements.

Result plot as follows:

Lowest Channel(2.402 GHz):



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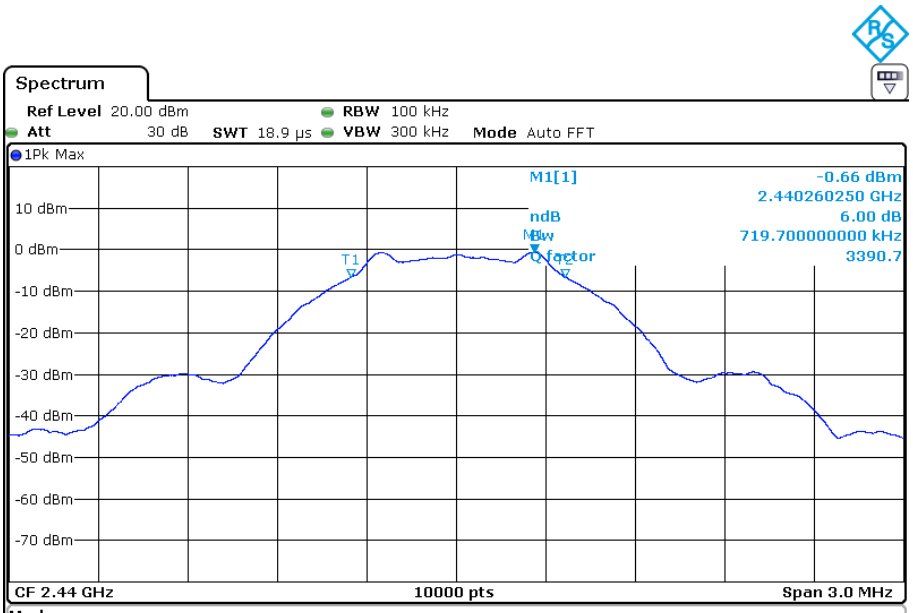
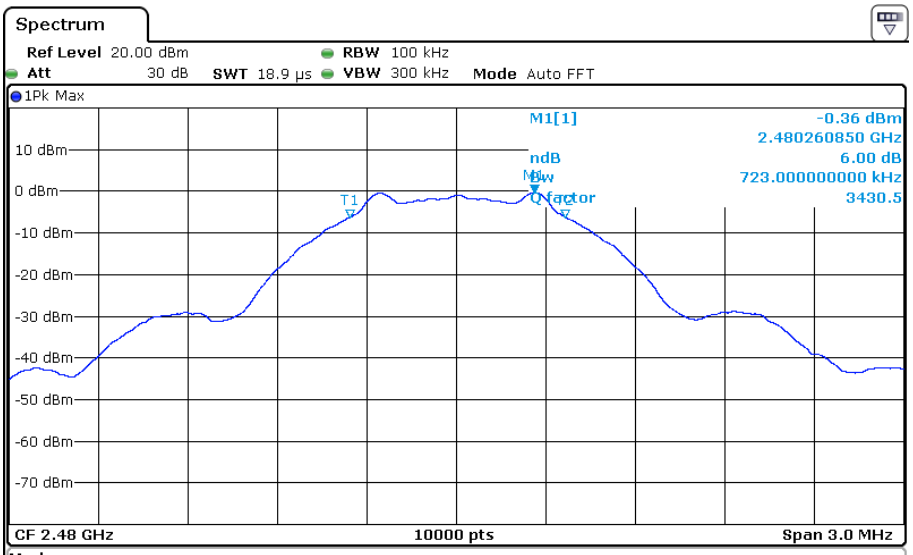
Middle Channel(2.440 GHz):



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	2.44026025 GHz	-0.66 dBm	ndB down	719.7 kHz
T1		1	2.43964525 GHz	-6.66 dBm	ndB	6.00 dB
T2		1	2.44036495 GHz	-6.66 dBm	Q factor	3390.7

Highest Channel(2.480 GHz):



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	2.48026085 GHz	-0.36 dBm	ndB down	723.0 kHz
T1		1	2.47964315 GHz	-6.36 dBm	ndB	6.00 dB
T2		1	2.48036615 GHz	-6.36 dBm	Q factor	3430.5

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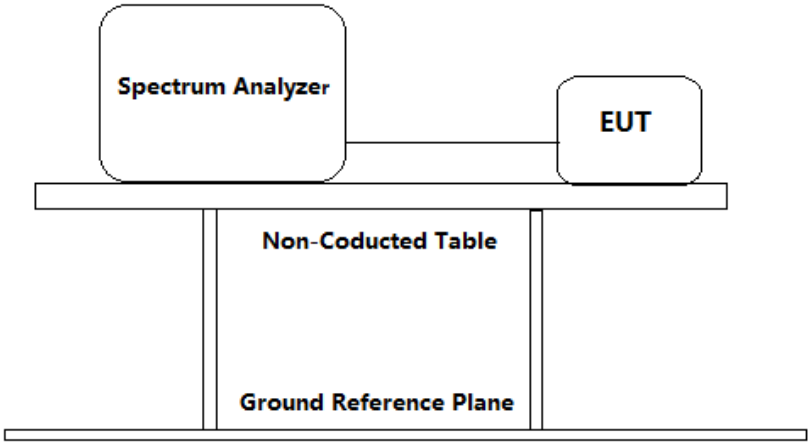
4.3 Maximum Peak Conducted Output Power

Test Requirement:	FCC Part 15 C section 15.247 (b)(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b) (1), (b) (2), and (b) (3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
Test Method:	ANSI C63.10: Clause 11.9.1.1(RBW ≥ DTS bandwidth)
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (cable loss =1.0 dB) from the antenna port to the spectrum.
2. Set the spectrum analyzer:
   a) Set the RBW = 1 MHz（RBW≥DTS bandwidth）.
   b) Set the VBW≥[3 × RBW].
   c) Set the span≥10 MHz[3 × RBW].
   d) Detector = peak.
   e) Sweep time = auto couple.
   f) Trace mode = max hold.
   g) Allow trace to fully stabilize.
   h) Use peak marker function to determine the peak amplitude level.
3. Repeat until all the test status is investigated.
4. Report the worst case.

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Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

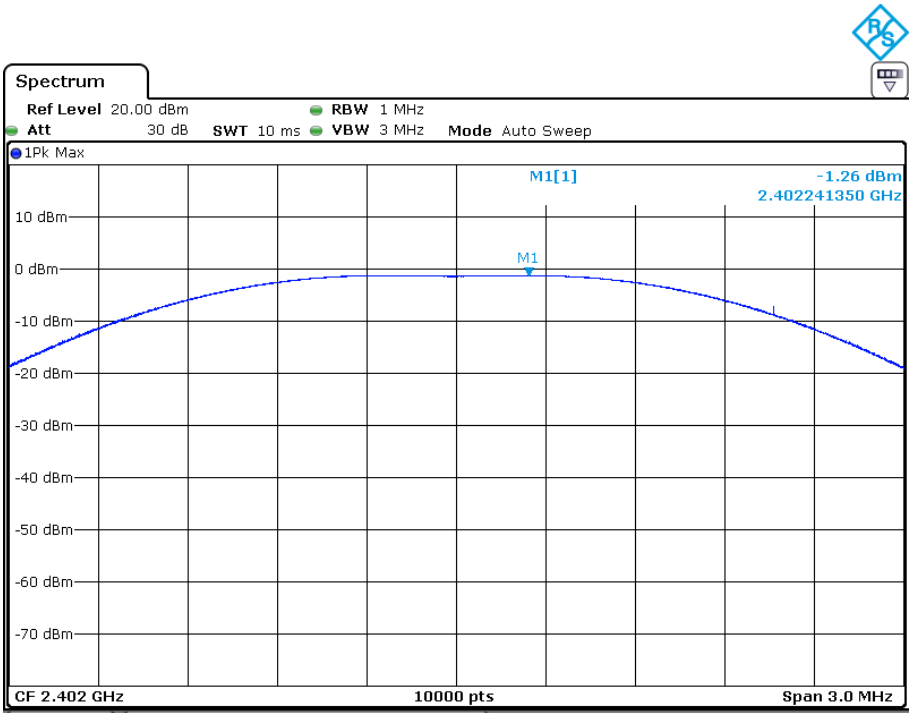
Test result:

Channel No.	Frequency (MHz)	Measured channel Power (dBm)	Limit	Result
0	2402	-0.26	1W (30 dBm)	Pass
19	2440	0.44		Pass
39	2480	0.59		Pass

Remark: Level = Read Level + Cable Loss

Result plot as follows:

Lowest channel (2.402 GHz):



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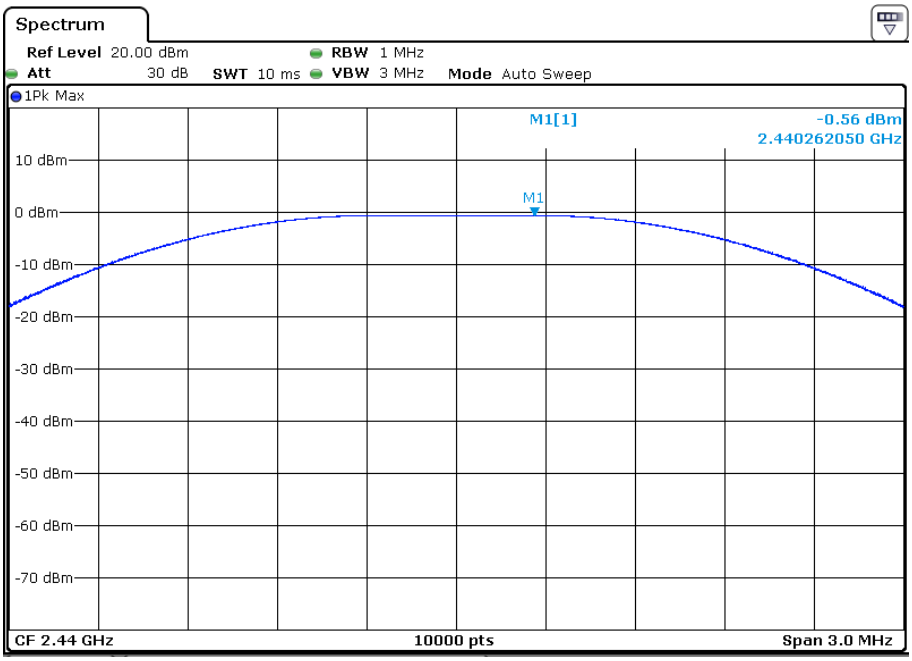
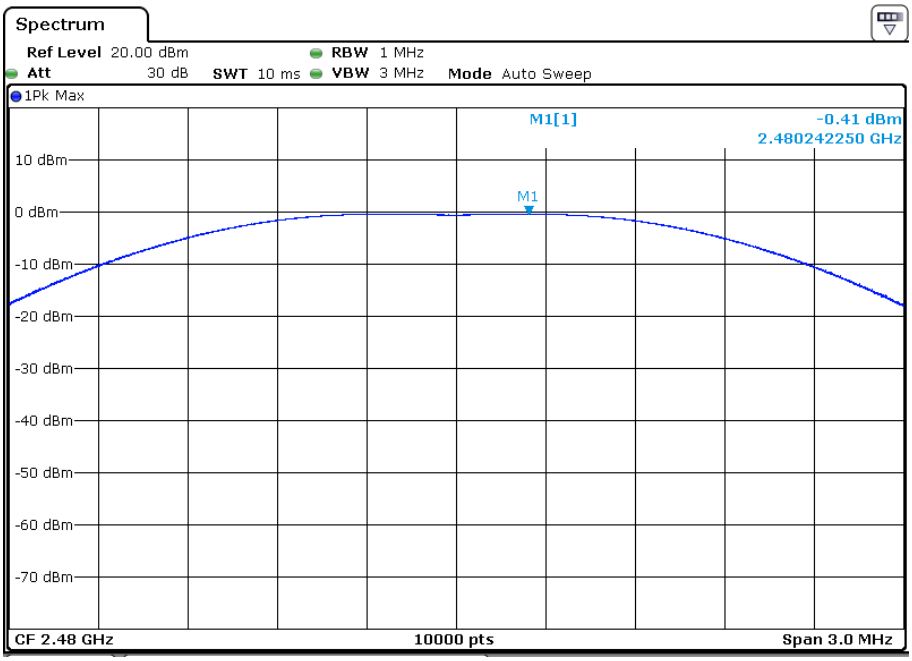
Middle Channel (2.440 GHz):



Highest Channel (2.480 GHz):



Test result: The unit does meet the FCC requirements.

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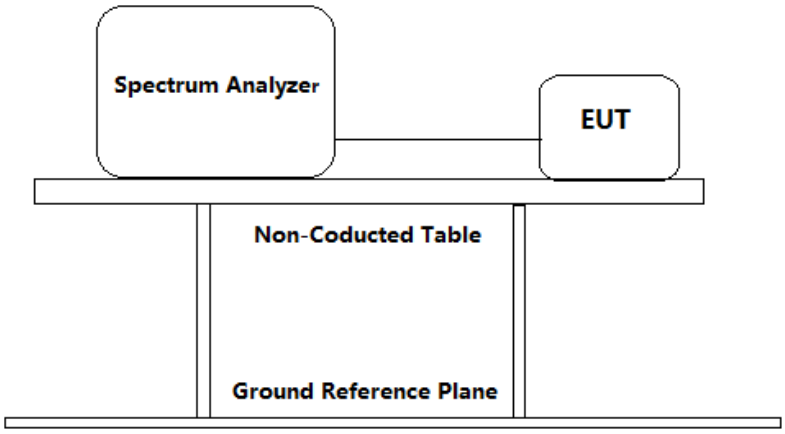
4.4 Peak Power Spectral Density

Test Requirement:	FCC Part 15 C section 15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
Test Method:	ANSI C63.10: Clause 11.10.2
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable(cable loss =1.0 dB) from the antenna port to the spectrum analyzer or power meter.
2. Set the spectrum analyzer:
   a) Set analyzer center frequency to DTS channel center frequency.
   b) Set the span= 1.5 × DTS bandwidth.
   c) Set the RBW to 3 kHz ⩽ RBW ⩽ 100 kHz.
   d) Set the VBW ⩾ [3 × RBW].
   e) Detector = peak.
   f) Sweep time = auto couple.
   g) Trace mode = max hold.
   h) Allow trace to fully stabilize.
   i) Use the peak marker function to determine the maximum amplitude level within the RBW.

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

3. Measure the Power Spectral Density of the test frequency with special test status.
4. Repeat until all the test status is investigated.
5. Report the worst case.

Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

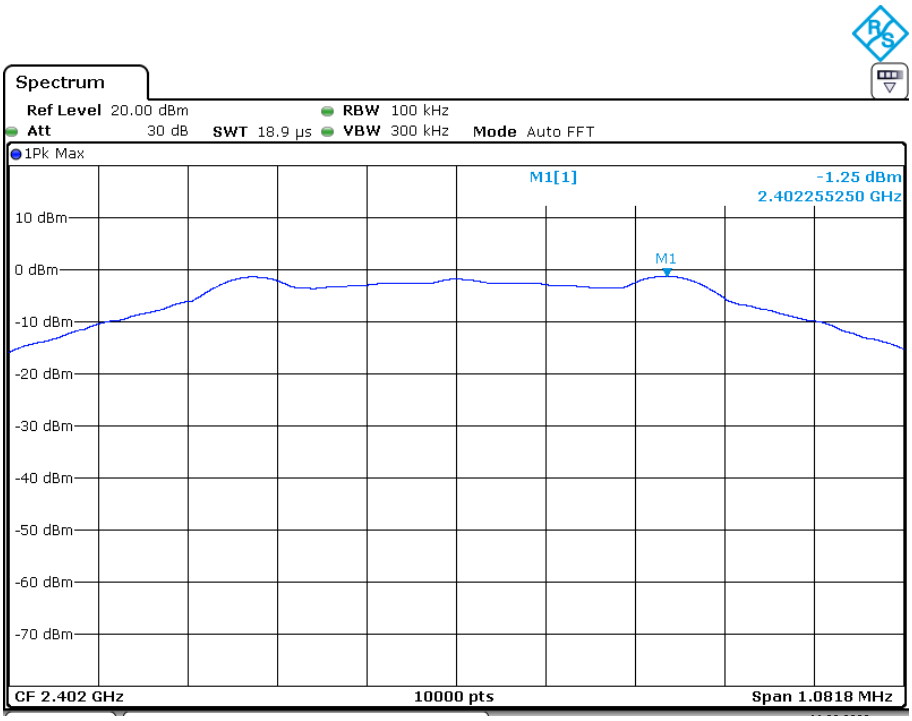
Test result:

Channel No.	Frequency (MHz)	Measured Peak Power Spectral Density (dBm/100 kHz)	Limit	Result
0	2402	0.25	8 dBm/3kHz	Pass
19	2440	0.31		Pass
39	2480	0.56		Pass

Test result: Level = Read Level + Cable Loss.

Result plot as follows:

Lowest channel (2.402 GHz):



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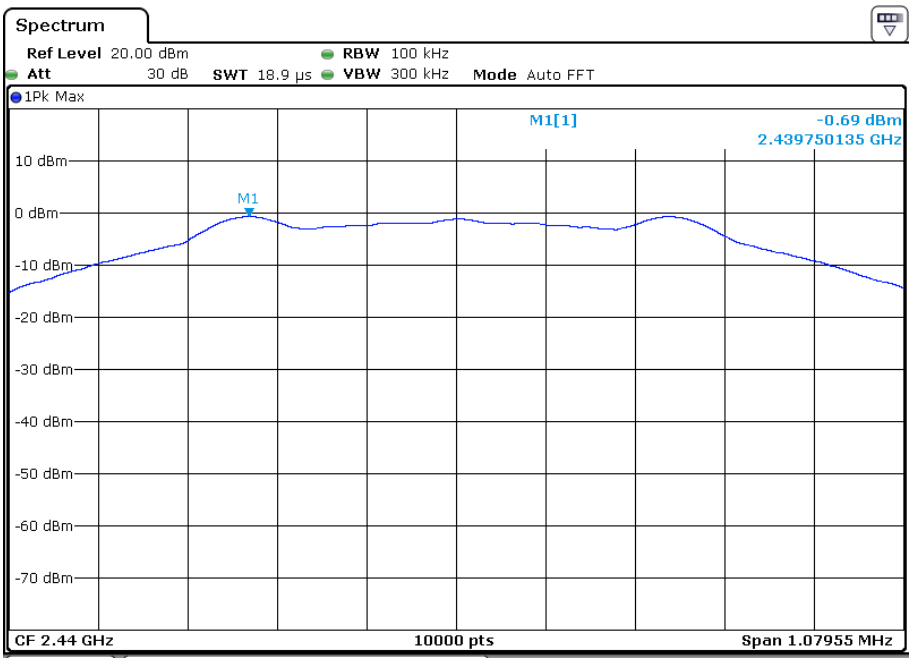
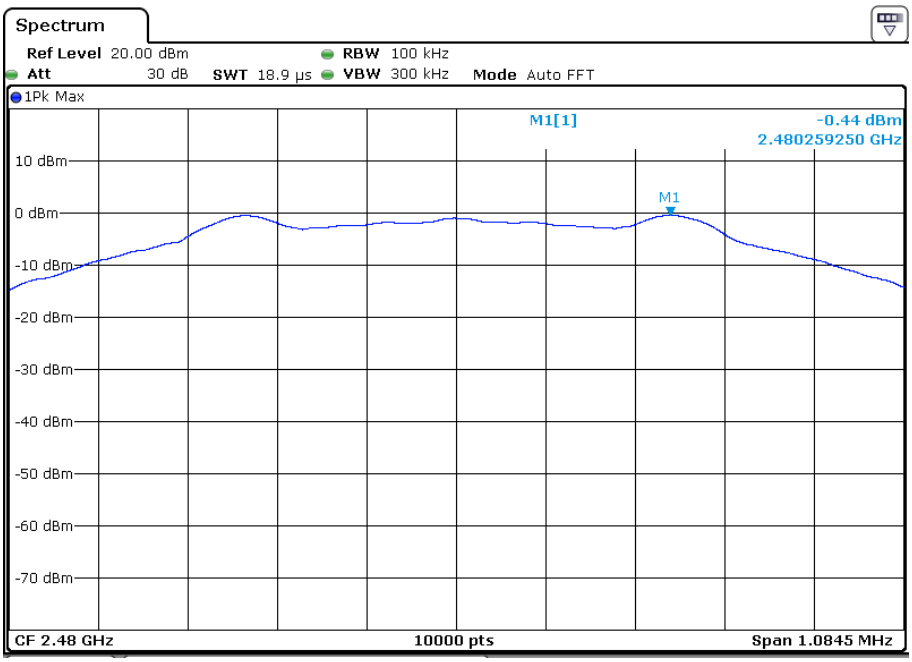
Middle Channel (2.440 GHz):



Highest Channel (2.480 GHz):



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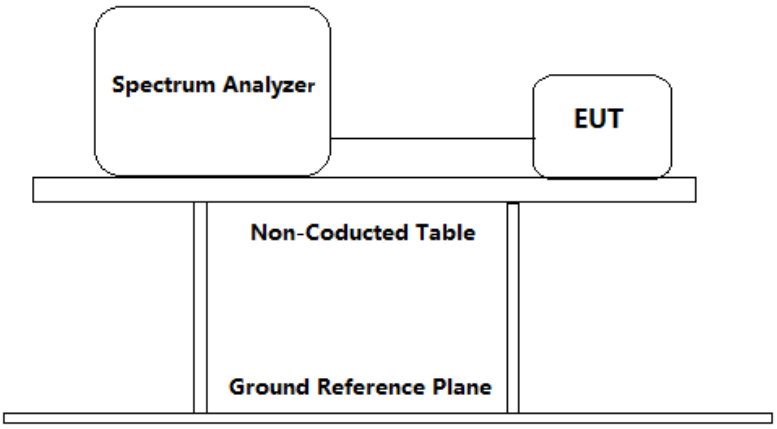
4.5 Out of Band Conducted Emissions

Test Requirement:	FCC Part 15 C section 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Based on either an RF conducted or a radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.
Test Method:	ANSI C63.10: Clause 11.11
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable (cable loss =2dB) from the antenna port to the spectrum analyzer or power meter.
2. Establish a reference level by using the following procedure:
   a) Set instrument center frequency to DTS channel center frequency.
   b) Set the span to ⩾ 1.5 × DTS bandwidth.
   c) Set the RBW = 100 kHz.
   d) Set the VBW ⩾ [3 × RBW].
   e) Detector = peak.
   f) Sweep time = auto couple.
   g) Trace mode = max hold.
   h) Allow trace to fully stabilize.
   i) Use the peak marker function to determine the maximum PSD level.
   Note that the channel found to contain the maximum PSD level can be used to

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establish the reference level

3. Emission level measurement
   a) Set the center frequency and span to encompass frequency range to be measured.
   b) Set the RBW = 100 kHz.
   c) Set the VBW ⩾ [3 × RBW].
   d) Detector = peak.
   e) Sweep time = auto couple.
   f) Trace mode = max hold.
   g) Allow trace to fully stabilize.
   h) Use the peak marker function to determine the maximum amplitude level.
4. Measure the Conducted unwanted Emissions of the test frequency with special test status.
5. Repeat until all the test status is investigated.
6. Report the worst case.

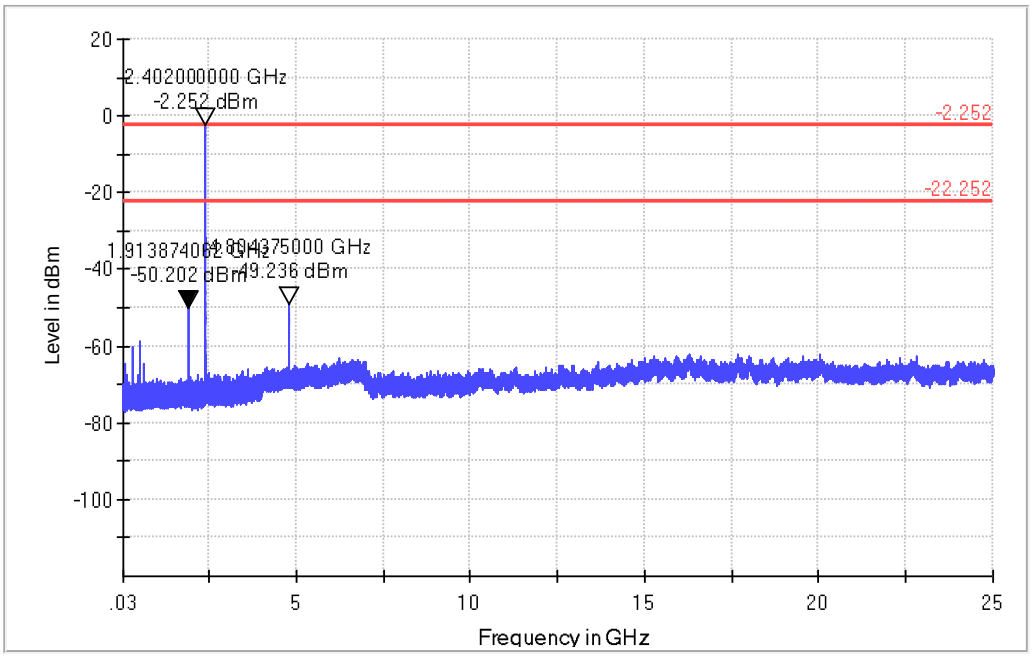
Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

Result plot as follows:

Lowest channel (2.402 GHz):

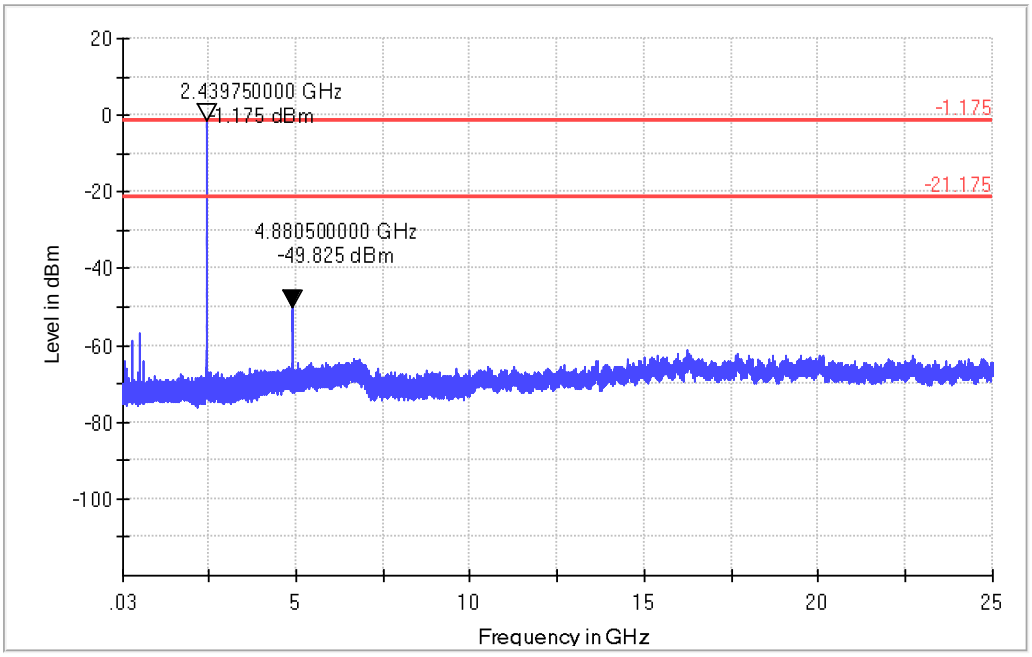
30 MHz to 25 GHz:



TEST REPORT

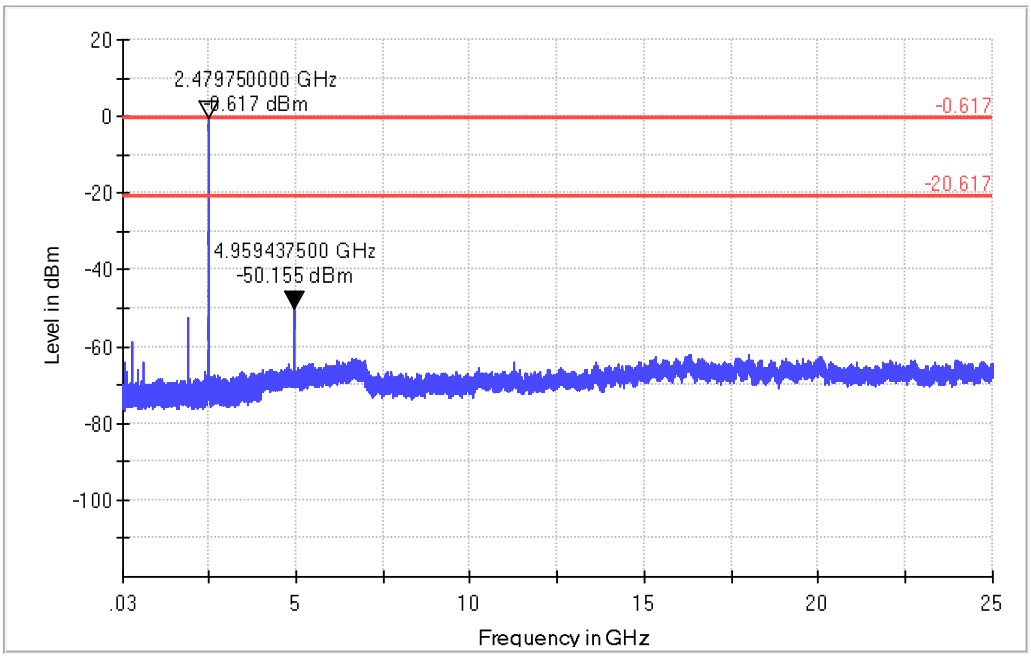
Middle Channel (2.440 GHz):

30 MHz to 25 GHz:



Highest Channel (2.480 GHz):

30 MHz to 25 GHz:



TEST REPORT

4.6 Out of Band Radiated Emissions

For out of band radiated emissions into Non-Restricted Frequency Bands were performed at a 3m separation distance to determine whether these emissions complied with the 20dB attenuation requirement.

[×] Not required, since all emissions are more than 20dB below fundamental
[ ] See attached data sheet

4.7 Radiated Emissions in Restricted Bands

Test Requirement:	FCC Part 15 C section 15.247 (d) In addition, 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)).
Test Method:	ANSI C63.10: Clause 11.12.1, 6.4, 6.5 and 6.6
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Limit:	40.0 dBμV/m between 30MHz & 88MHz; 43.5 dBμV/m between 88MHz & 216MHz; 46.0 dBμV/m between 216MHz & 960MHz; 54.0 dBμV/m above 960MHz.
Detector:	For Peak and Quasi-Peak value: RBW = 1 MHz for f ≥ 1 GHz, 200 Hz for 9 kHz to 150 kHz 9 kHz for 150 kHz to 30 MHz 120 kHz for 30 MHz to 1GHz VBW ≥ RBW Sweep = auto Detector function = peak for f ≥ 1 GHz, QP for f < 1 GHz Trace = max hold For AV value: RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz VBW=10 Hz Sweep = auto

TEST REPORT

Trace = max hold

Field Strength Calculation:

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below:

FS = RA + AF + CF - AG + PD + AV

FS = RA + Correct Factor + AV

Where:

FS = Field Strength in dBµV/m

RA = Receiver Amplitude (including preamplifier) in dBµV

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB

AG = Amplifier Gain in dB

PD = Pulse Desensitization in dB

AV = Average Factor in –dB

Correct Factor = AF + CF – AG + PD

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m.

RA = 62.0 dBµV

AF = 7.4 dB

CF = 1.6 dB

AG = 29.0 dB

PD = 0 dB

AV = -10 dB

Correct Factor = 7.4 + 1.6 – 29.0 + 0 = -20 dB

FS = 62 + (-20) + (-10) = 32 dBµV/m

Section 15.205 Restricted bands of operation.

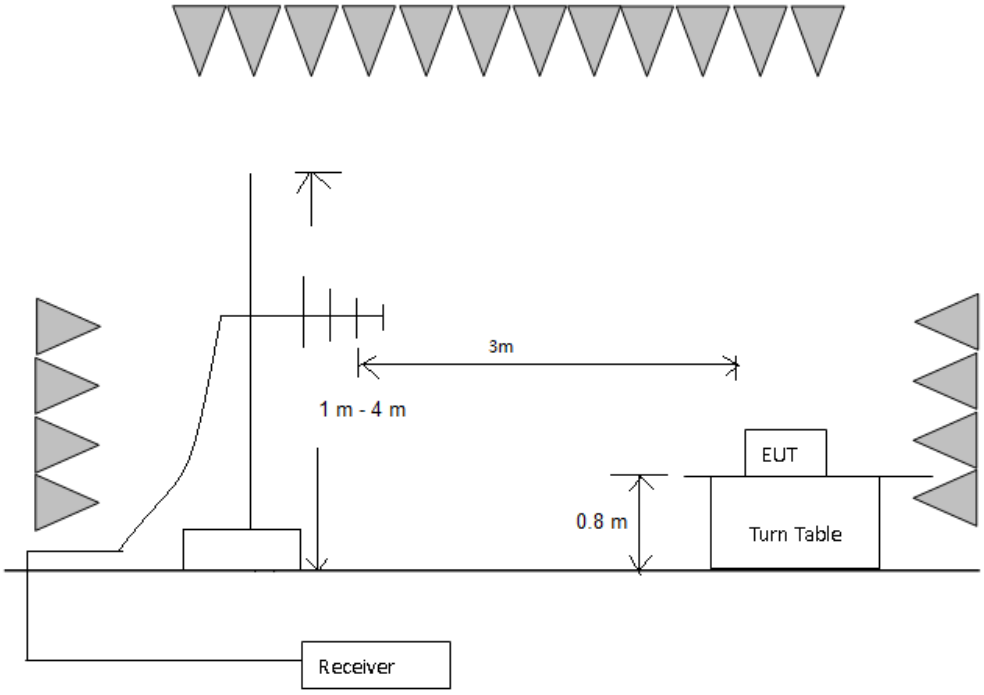
(a) Except as shown in paragraph (d) of this section. Only spurious emissions are permitted in any of the frequency bands listed below:

TEST REPORT

MHz	MHz	MHz	GHz
0.090 - 0.110 10.495 - 0.505 2.1735 - 2.1905 4.125 - 4.128 4.17725 - 4.17775 4.20725 - 4.20775 6.215 - 6.218 6.26775 - 6.26825 6.31175 - 6.31225 8.291 - 8.294 8.362 - 8.366 8.37625 - 8.38675 8.41425 - 8.41475 12.29 - 12.293 12.51975 - 12.52025 12.57675 - 12.57725 13.36 - 13.41	16.42 - 16.423 16.69475 - 16.69525 16.80425 - 16.80475 25.5 - 25.67 37.5 - 38.25 73 - 74.6 74.8 - 75.2 108 - 121.94 123 - 138 149.9 - 150.05 156.52475 - 156.52525 156.7 - 156.9 162.0125 - 167.17 167.72 - 173.2 240 - 285 322 - 335.4	399.9 - 410 608 - 614 960 - 1240 1300 - 1427 1435 - 1626.5 1645.5 - 1646.5 1660 - 1710 1718.8 - 1722.2 2200 - 2300 2310 - 2390 2483.5 - 2500 2655 - 2900 3260 - 3267 3332 - 3339 3345.8 - 3358 3600 - 4400	4.5 - 5.15 5.35 - 5.46 7.25 - 7.75 8.025 - 8.5 9.0 - 9.2 9.3 - 9.5 10.6 - 12.7 13.25 - 13.4 14.47 - 14.5 15.35 - 16.2 17.7 - 21.4 22.01 - 23.12 23.6 - 24.0 31.2 - 31.8 36.43 - 36.5

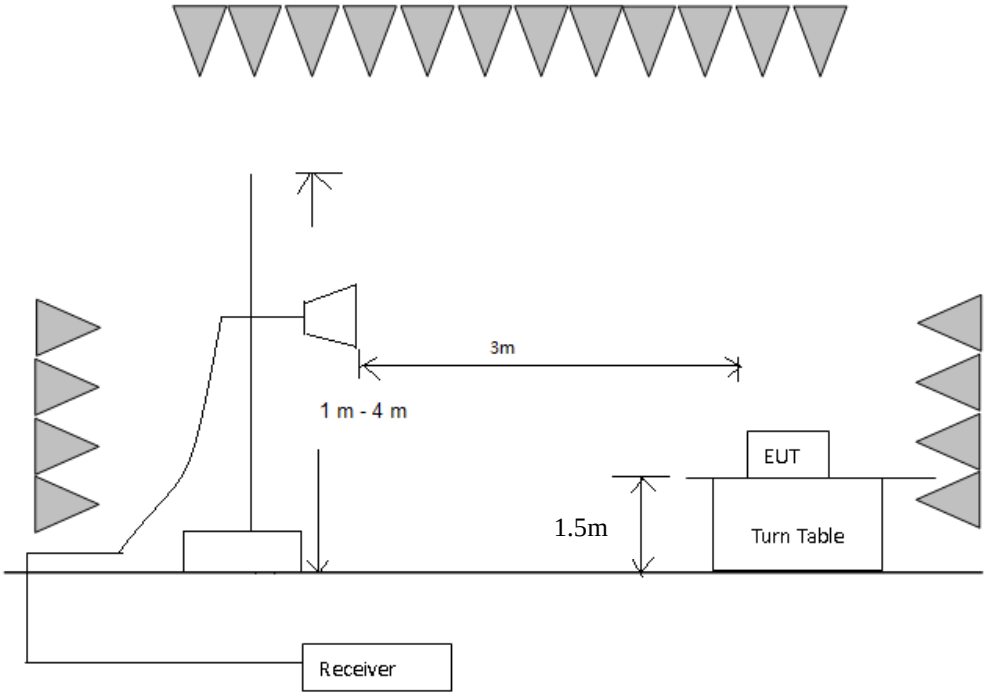
Test Configuration:

1) 30 MHz to 1 GHz emissions:



TEST REPORT

2) 1 GHz to 40 GHz emissions:



Test Procedure:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

The receiver was scanned from 9 kHz to 25 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

Used Test Equipment List:

3m Semi-Anechoic Chamber, EMI Test Receiver (9 kHz~7 GHz), Signal and Spectrum Analyzer (10 Hz~40 GHz), Loop antenna (9 kHz-30 MHz). TRILOG Super Broadband test Antenna(30 MHz-3 GHz）(RX), Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) and High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX). Refer to Clause 5 Test Equipment List for details.

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

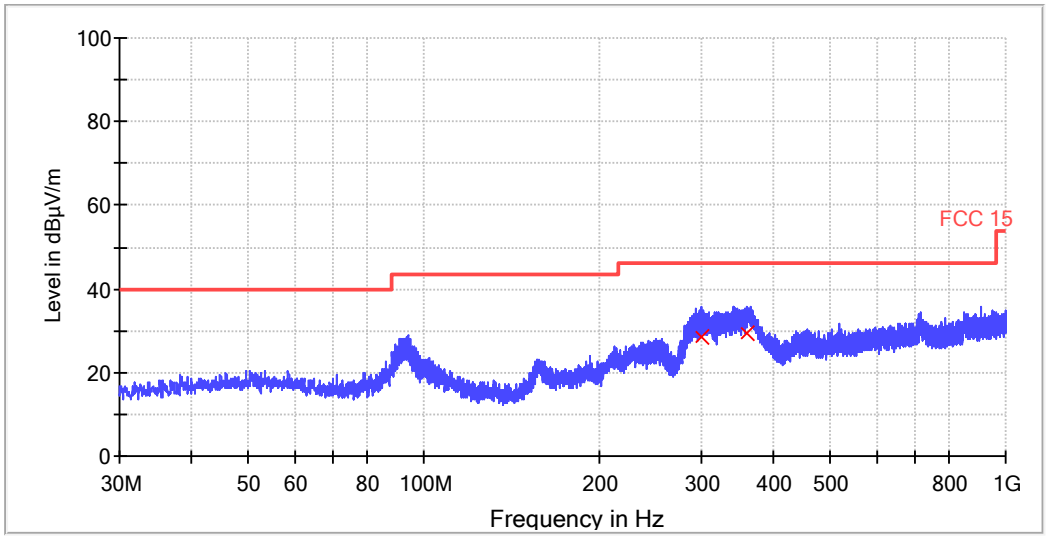
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

TEST REPORT

Test at Channel 0 (2.402 GHz) in transmitting status
30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement Peak scan

Vertical:

Level (dBuV/m)



Quasi-peak measurement

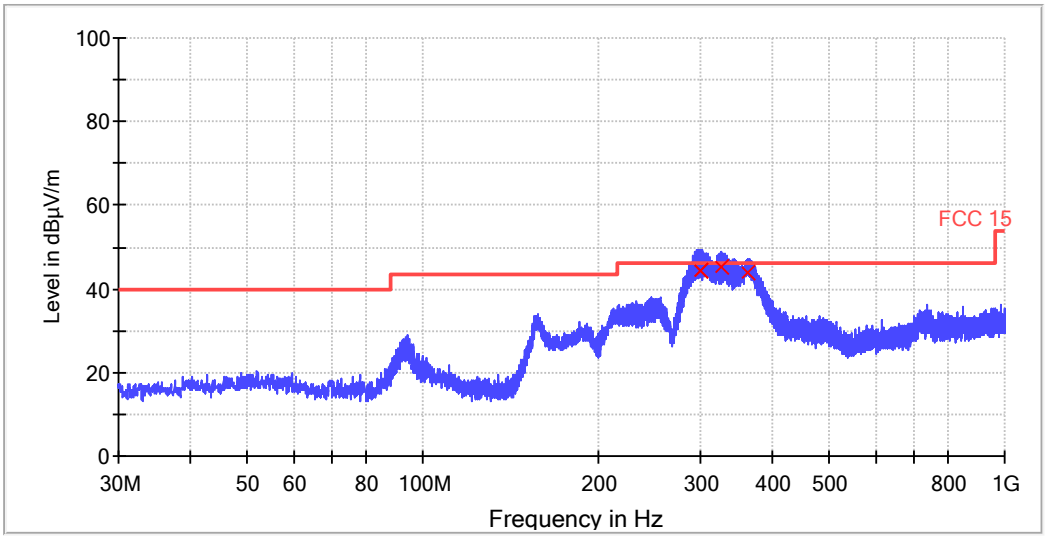
Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
300.040000	28.5	120.000	V	16.0	17.5	46.0
359.600000	29.5	120.000	V	17.0	16.5	46.0

TEST REPORT

Horizontal:

Peak scan

Level (dBuV/m)



Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
299.520000	44.3	120.000	H	16.0	1.7	46.0
299.520000	44.3	120.000	H	16.0	1.7	46.0
326.760000	45.2	120.000	H	16.4	0.8	46.0
362.880000	43.8	120.000	H	17.0	2.2	46.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dBµV)	Correct Factor	Emission Level (dBµV/m)	Limit (dBµV/m)	Antenna polarization
4803.219	44.9	-1.1	43.802	74	V
7205.531	42.0	2.3	44.256	74	V
10062.06	39.3	6.6	45.957	74	V
4803.219	45.7	-1.1	44.627	74	H
7205.000	42.2	2.3	44.479	74	H
12791.63	39.3	7.3	46.683	74	H

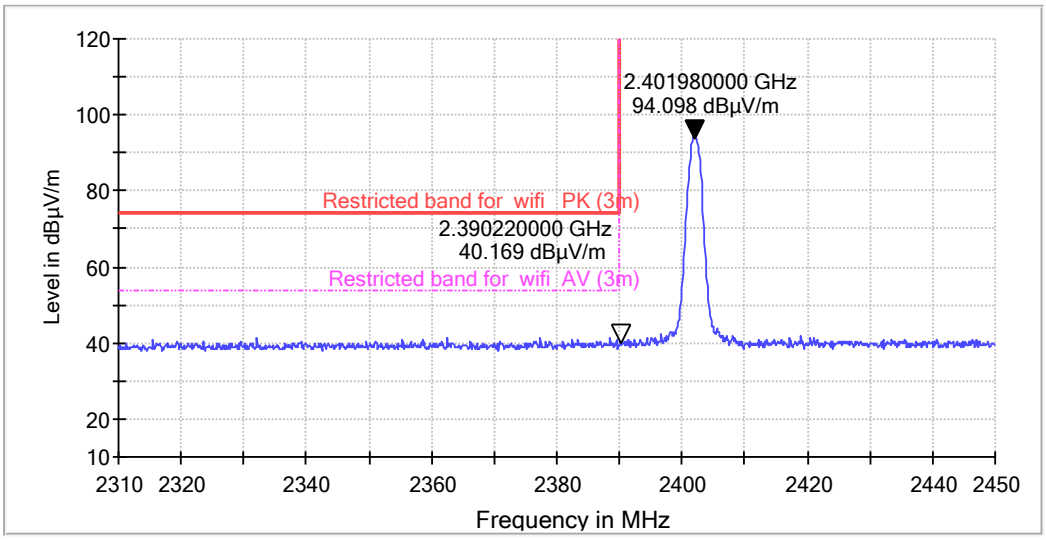
TEST REPORT

Average Measurement:

Frequency (MHz)	Reading Level (dBμV)	Correct Factor	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
4803.219	/	-1.1	/	54	V
7205.531	/	2.3	/	54	V
10062.06	/	6.6	/	54	V
4803.219	/	-1.1	/	54	H
7205.000	/	2.3	/	54	H
12791.63	/	7.3	/	54	H

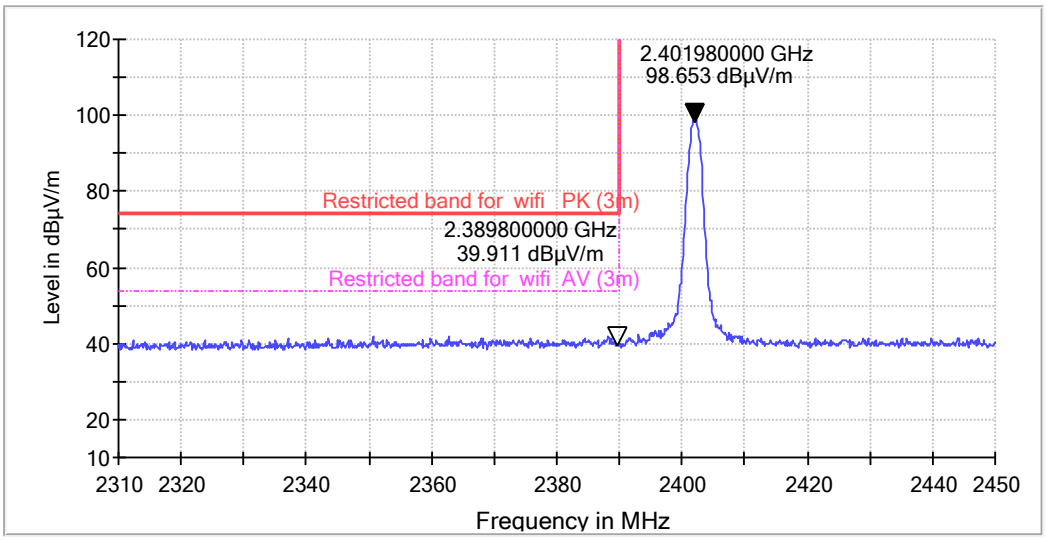
Remark:
When Peak emission level was below AV limit, the AV emission level did not be recorded.

* Band Edges Emission
Vertical



TEST REPORT

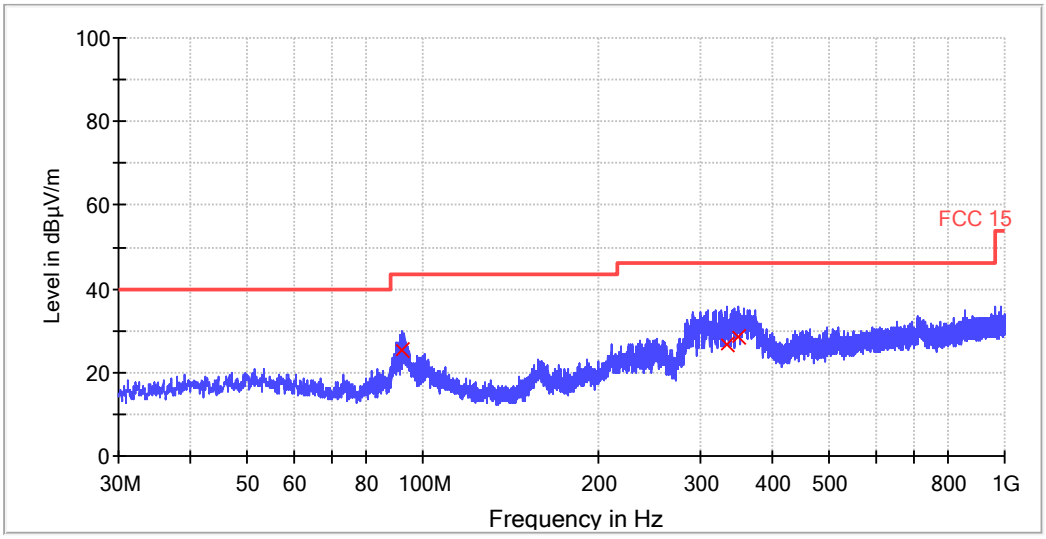
Horizontal



Test at Channel 19 (2.440 GHz) in transmitting status
30 MHz~1 GHz Radiated Emissions. Quasi-Peak Measurement

Vertical:

Peak scan
Level (dBµV/m)



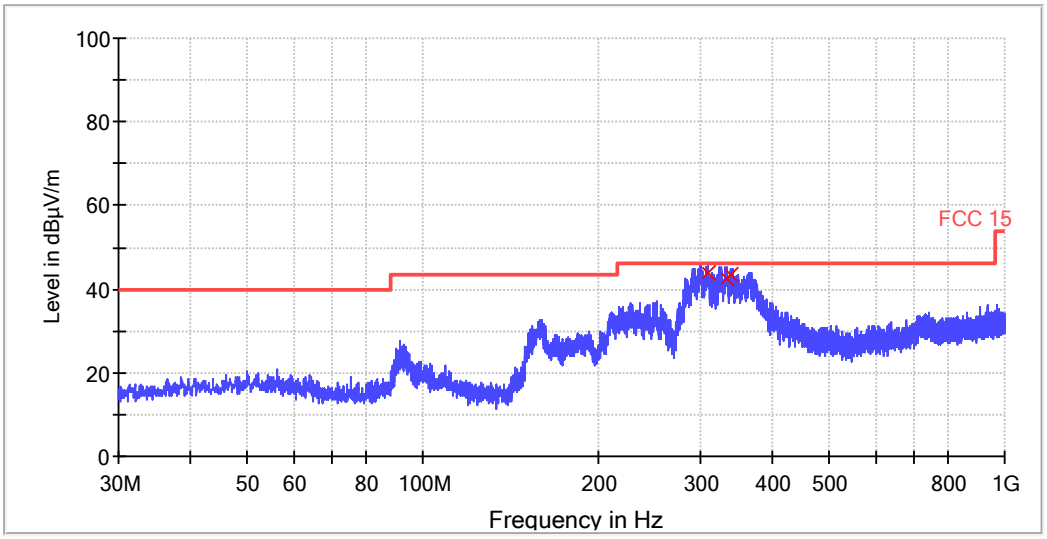
Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
92.160000	25.5	120.000	V	11.4	18.0	43.5
334.200000	26.7	120.000	V	16.6	19.3	46.0
348.920000	28.7	120.000	V	16.8	17.4	46.0

TEST REPORT

Horizontal: Peak scan

Level (dBµV/m)



Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
308.640000	43.8	120.000	H	16.1	2.2	46.0
332.040000	42.6	120.000	H	16.5	3.4	46.0
339.360000	43.7	120.000	H	16.6	2.3	46.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dBµV)	Correct Factor	Emission Level (dBµV/m)	Limit (dBµV/m)	Antenna polarization
4880.25	46.1	-1.0	45.053	74	V
7319.219	43.2	2.4	45.683	74	V
11107.03	40.0	6.6	46.588	74	V
4880.781	45.8	-1.0	44.804	74	H
7301.688	40.8	2.4	43.243	74	H
10449.88	39.3	6.9	46.121	74	H

Average Measurement:

Frequency (MHz)	Reading Level (dBµV)	Correct Factor	Emission Level (dBµV/m)	Limit (dBµV/m)	Antenna polarization
4880.25	/	-1.0	/	54	V
7319.219	/	2.4	/	54	V
11107.03	/	6.6	/	54	V
4880.781	/	-1.0	/	54	H
7301.688	/	2.4	/	54	H
10449.88	/	6.9	/	54	H

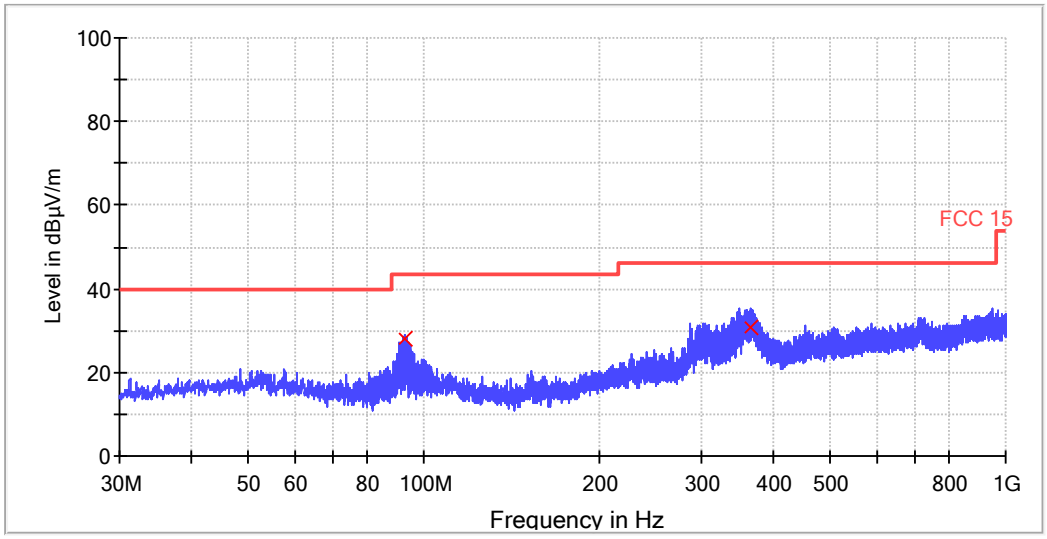
TEST REPORT

Remark:
When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Channel 39 (2.480 GHz) in transmitting status
30 MHz~1 GHz Radiated Emissions. Quasi-Peak Measurement

Vertical:

Peak scan
Level (dBµV/m)



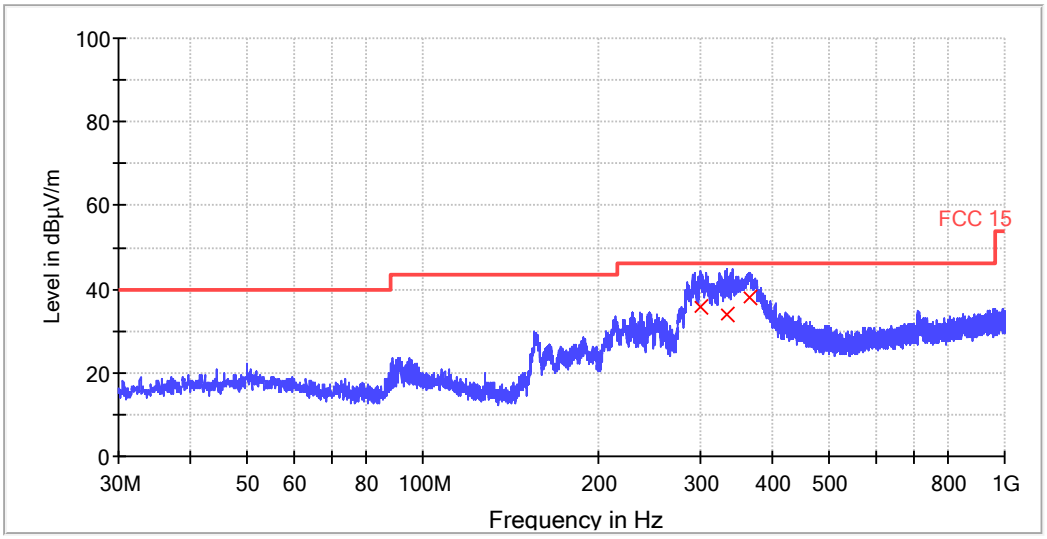
Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
92.760000	27.9	120.000	V	11.5	15.6	43.5
364.200000	30.8	120.000	V	17.0	15.2	46.0

TEST REPORT

Horizontal: Peak scan

Level (dBµV/m)



Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
300.200000	35.8	120.000	H	16.0	10.2	46.0
332.400000	33.8	120.000	H	16.5	12.2	46.0
363.680000	38.0	120.000	H	17.0	8.0	46.0
363.680000	38.0	120.000	H	17.0	8.0	46.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dBµV)	Correct Factor	Emission Level (dBµV/m)	Limit (dBµV/m)	Antenna polarization
4959.938	45.5	-0.9	44.622	74	V
7440.344	44.3	2.6	46.911	74	V
9748.625	39.7	5.7	45.366	74	V
4959.938	48.5	-0.9	47.636	74	H
8019.938	40.2	4.0	44.191	74	H
9700.813	40.0	5.5	45.521	74	H

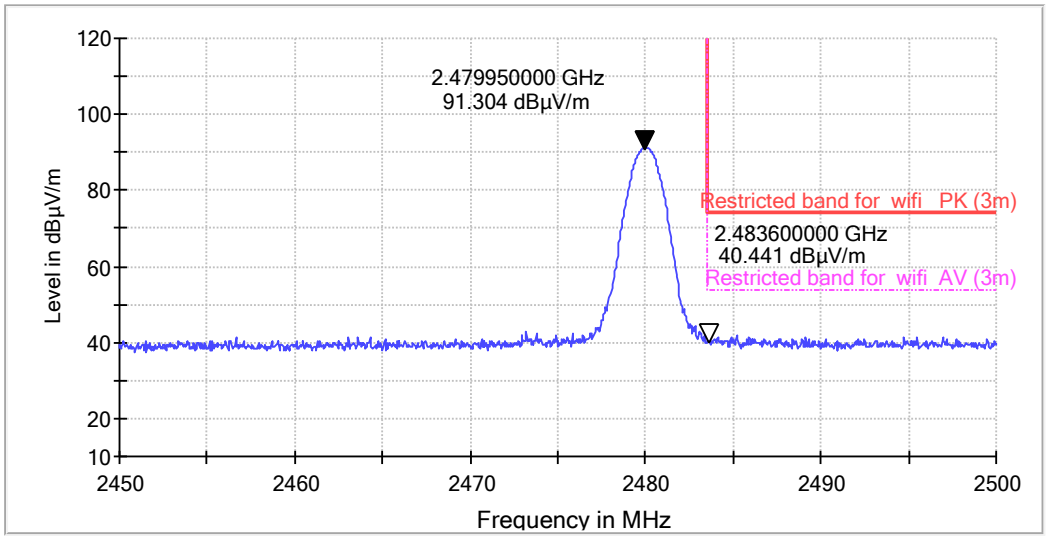
Average Measurement:

Frequency (MHz)	Reading Level (dBµV)	Correct Factor	Emission Level (dBµV/m)	Limit (dBµV/m)	Antenna polarization
4959.938	/	-0.9	/	54	V
7440.344	/	2.6	/	54	V
9748.625	/	5.7	/	54	V
4959.938	/	-0.9	/	54	H
8019.938	/	4.0	/	54	H
9700.813	/	5.5	/	54	H

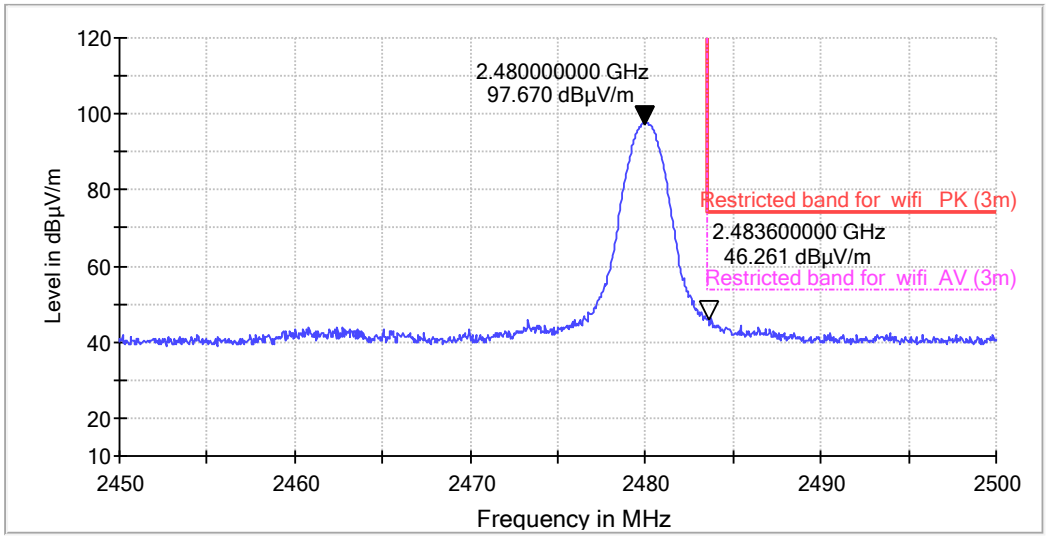
TEST REPORT

Remark:
When Peak emission level was below AV limit, the AV emission level did not be recorded.

* Band Edges Emission
Vertical



Horizontal



TEST REPORT

The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Loss –Preamplifier Factor.

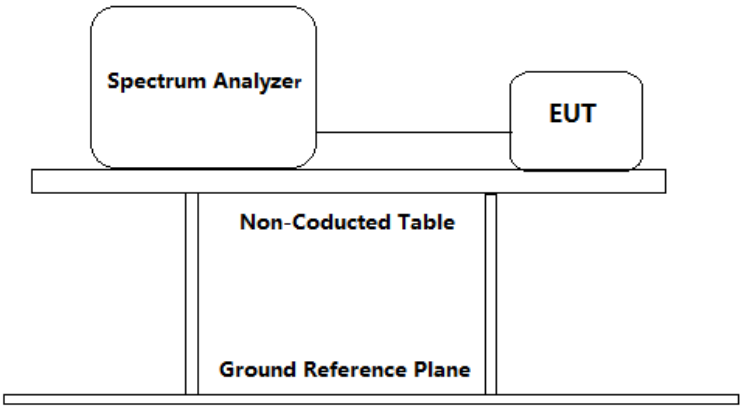
As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

No any other emissions level which are attenuated less than 20dB below the limit.

TEST REPORT

4.8 Band Edges Requirement

Test Requirement:	FCC Part 15 C section 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Based on either an RF conducted or a radiated measurement. Provided the transmitter demonstrates compliance with the peak conducted power limits.
Frequency Band:	2400 MHz to 2483.5 MHz
Test Method:	ANSI C63.10: Clause 11.11 and 11.13
Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	For Band Edges Emission in Radiated mode, Please refer to clause 4.7



Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
   a) Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).
   b) Set the center frequency and span to encompass frequency range to be measured.
   c) RBW = 100 kHz.
   d) VBW ⩾ [3 × RBW].
   e) Detector = peak.
   f) Sweep time = auto.
   g) Trace mode = max hold.
   h) Allow sweep to continue until the trace stabilizes (required measurement time

may increase for low-duty-cycle applications).

i) For radiated Band-edge emissions within a restricted band and within 2 MHz of an authorized band edge, integration method is considered.

2. Repeat until all the test status is investigated.
3. Report the worst case.

Used Test Equipment List:

3m Semi-Anechoic Chamber, EMI Test Receiver (9 kHz~7 GHz), Signal and Spectrum Analyzer (10 Hz~40 GHz), Loop antenna (9 kHz-30 MHz). TRILOG Super Broadband test Antenna(30 MHz-3 GHz）(RX), Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) and High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX). Refer to Clause 5 Test Equipment List for details.

Test result with plots as follows:

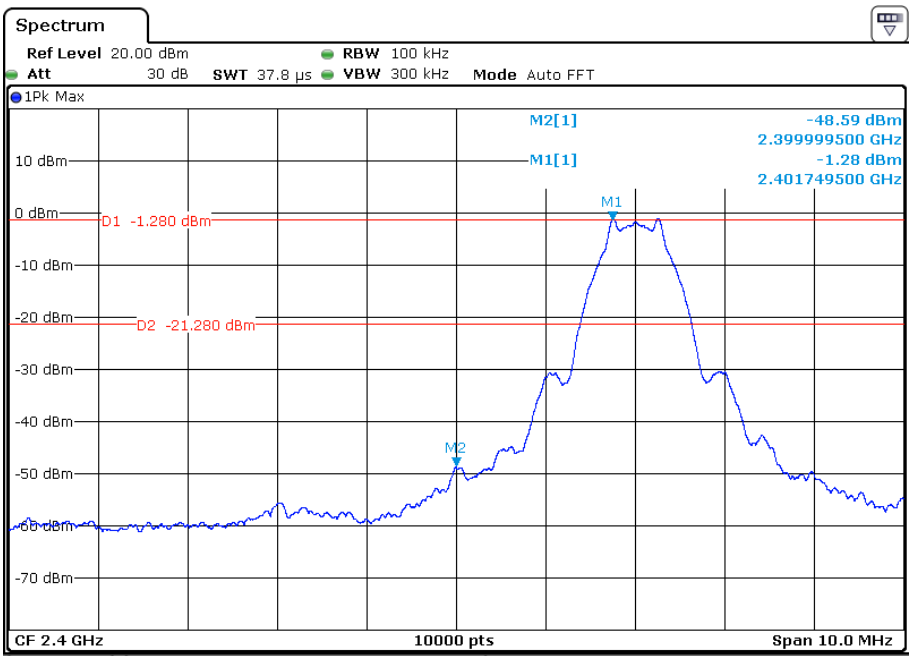
For conduct mode:

The band edges was measured and recorded Result:

The Lower Edges attenuated more than 20dB.

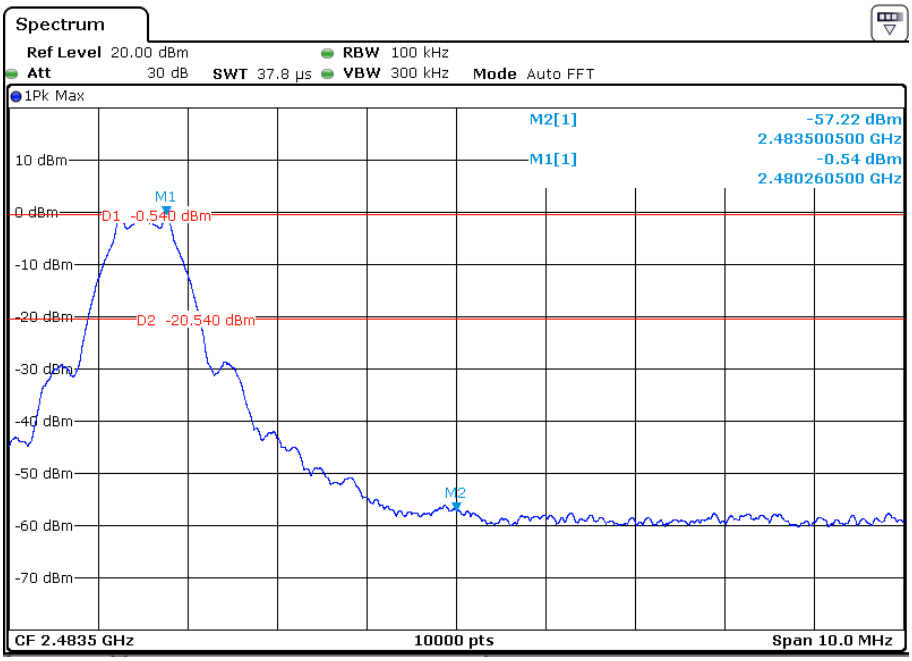
The Upper Edges attenuated more than 20dB.

Channel 0: 2.402 GHz



TEST REPORT

Channel 39: 2.480 GHz



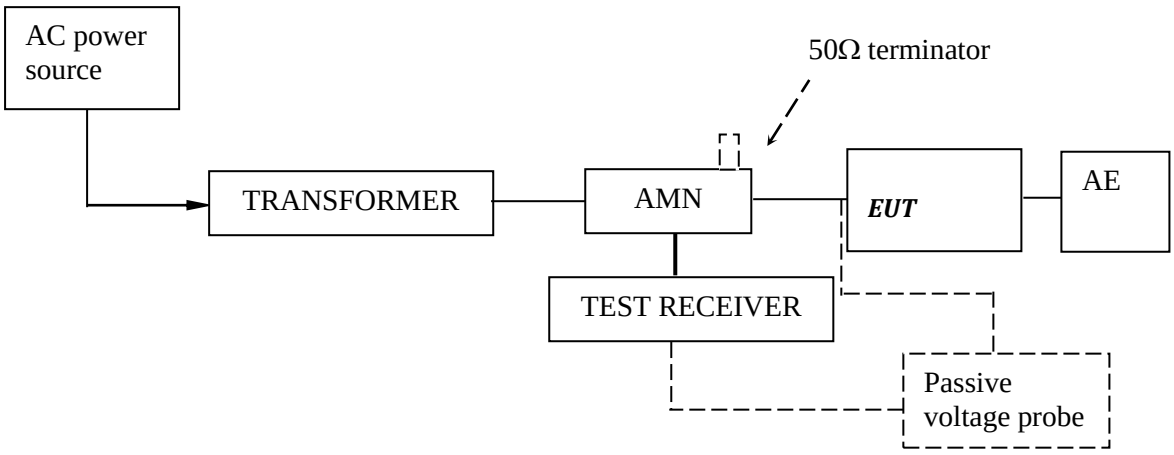
For radiated mode:

Please refer Clause 4.7 Radiated Emissions in Restricted Bands of this test report for more details. The resultant field strength in band edges meet the general radiated emission limit in section 15.209, which does not exceed 74 dBµV/m (Peak Limit) and 54 dBµV/m (Average Limit).

TEST REPORT

4.9 Conducted Emission Test

Test Configuration:



Test Setup and Procedure:
Test was performed according to ANSI C63.10 Clause 6.2. The EUT was set to achieve the maximum emission level. The mains terminal disturbance voltage was measured with the EUT in a shielded room. The EUT was connected to AC power source through an Artificial Mains Network which provides a 50Ω linear impedance Artificial hand is used if appropriate (for handheld apparatus). The load/control terminal disturbance voltage was measured with passive voltage probe if appropriate.

The table-top EUT was placed on a 0.8m high non-metallic table above earthed ground plane (Ground Reference Plane).And for floor standing EUT, was placed on a 0.1m high non-metallic supported on GRP. The EUT keeps a distance of at least 0.8m from any other of the metallic surface. The Artificial Mains Network is situated at a distance of 0.8m from the EUT.

During the test, mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m

The bandwidth of test receiver was set at 9 kHz. The frequency range from 150 kHz to 30MHz was checked.

Test Data and Curve

At main terminal: Not Applicable
Remark: The Product is powered by 4 AA batteries.

TEST REPORT

5.0 Test Equipment List

Radiated Emission/Radio

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (YYYY-MM-DD)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m^3	ETS·LINDGREN	4/10/2021	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	10/22/2020	1Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	9/8/2020	1Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	6/18/2021	1Y
EM061-03	TRILOG Super Broadband test Antenna (30 MHz-1.5 GHz）(TX)	VULB 9161	SCHWARZBECK	6/18/2021	1Y
EM033-01	TRILOG Super Broadband test Antenna(30 MHz-3 GHz）(RX)	VULB 9163	SCHWARZBECK	9/19/2020	1Y
EM033-02	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX)	R&S HF907	R&S	6/18/2021	1Y
EM033-03	High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX)	R&S SCU-26	R&S	4/24/2021	1Y
EM033-04	High Frequency Antenna & preamplifier (26 GHz-40 GHz)	R&S SCU-40	R&S	4/24/2021	1Y
EM031-02-01	Coaxial cable(9 kHz-1 GHz)	N/A	R&S	4/12/2021	1Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	N/A	R&S	4/12/2021	1Y
EM033-04-02	Coaxial cable(18 GHz~40 GHz)	N/A	R&S	4/24/2021	1Y
EM031-01	Signal Generator (9 kHz~6 GHz)	SMB100A	R&S	7/22/2021	1Y
EM040-01	Band Reject/Notch Filter	WRHFV	Wainwright	N/A	1Y
EM040-02	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM040-03	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM022-03	2.45 GHz Filter	BRM50702	Micro-Tronics	5/10/2021	1Y
SA016-16	Programmable Temperature & Humidity Test Chamber	MHU-800LJ	TERCHY	10/13/2020	1Y
SA016-22	Climatic Test Chamber	C7-1500	Vötsch	11/10/2020	1Y
SA012-74	Digital Multimeter	FLUKE175	FLUKE	10/13/2020	1Y
EM010-01	Regulated DC Power supply	PAB-3003A	GUANHUA	N/A	1Y
SA040-22	Regulated DC Power supply	IT6721	ITECH	9/8/2020	1Y
EM084-06	Audio Analyzer	8903B	HP	4/15/2021	1Y
EM045-01-01	EMC32 software (RE/RS)	V10.01.00	R&S	N/A	N/A
EM045-01-09	EMC32 software (328/893)	V9.26.01	R&S	N/A	N/A

Conducted emission at the mains terminals

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (YYYY-MM-DD)	Calibration Interval
EM080-05	EMI receiver	ESCI	R&S	7/19/2021	1Y
EM006-05	LISN	ENV216	R&S	6/7/2021	1Y
EM006-06	LISN	ENV216	R&S	9/8/2020	1Y
EM006-06-01	Coaxial cable	/	R&S	4/12/2021	1Y
EM004-04	EMC shield Room	8m×3m×3m	Zhongyu	1/5/2021	1Y

**********End of the test report**********