

Dialog Semiconductor B.V.

TEST REPORT

SCOPE OF WORK

EMC TESTING–DA14531MOD-00F0100

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TEST REPORT

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Intertek Report No: : 200330213GZU-003
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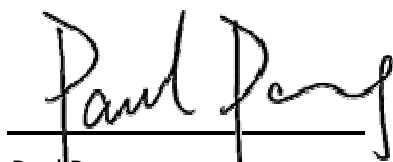
Test standards

RSS-247 Issue 2: February 2017
RSS-Gen Issue 5 Amendment 1: March 2019

Sample Description

Product : DA14531 TINY Module
Model No. : DA14531MOD-00F0100
Electrical Rating : DC 3.3V
Serial No. : Not Labeled
Date Received : 02 April 2020
Date Test : 02 April 2020 to 08 May 2020
Conducted

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1.0 TEST RESULT SUMMARY

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	RSS-Gen Clause 8.3	RSS-Gen Clause 6.8	PASS
6 dB Bandwidth (DTS bandwidth)	RSS-247 Clause 5.2(a)	RSS-Gen clause 6.7 & ANSI C63.10: Clause 11.8	PASS
Maximum Peak Conducted Output Power and E.I.R.P	RSS-247 Clause 5.4(d)	RSS-Gen clause 6.12 & & ANSI C63.10: Clause 11.9.1.1	PASS
Peak Power Spectral Density	RSS-247 Clause 5.2(b)	ANSI C63.10: Clause 11.10.2	PASS
Out of Band Conducted Emissions	RSS-247 Clause 5.5	RSS-Gen clause 6.13 & ANSI C63.10: Clause 11.11	PASS
Out of Band Radiated Emission	RSS-247 Clause 5.5	RSS-Gen clause 6.13 & ANSI C63.10: Clause 11.11, 6.4, 6.5 and 6.6	N/A
Radiated Emissions in Restricted Bands	RSS-247 Clause 3.3	RSS-Gen clause 8.10 & ANSI C63.10: Clause 11.12.1, 6.4, 6.5 and 6.6	PASS
Band Edges Measurement	RSS-247 Clause 5.5	RSS-Gen clause 6.13 & ANSI C63.10: Clause 11.11 and 11.13	PASS
Conducted Emissions at Mains Terminals	RSS-Gen Clause 8.8	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: -0.5 dBi
 Speciality: Bluetooth 5.1 with BLE (Bluetooth Low Energy)
 Function: Bluetooth 5.1 with BLE (Bluetooth Low Energy)
 Power Supply: DC 3.3V

Power cord: N/A

EUT modulation and data packet during test:

The EUT has been tested on the Modulation of GFSK with 1 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	/	/

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2.2 Related Submittal(s) Grants

This is an application for certification of:
DTS- Part 15 Digital Transmission Systems

Remaining portions are subject to the following procedures:

1. Receiver portion of BLE: exempt from technical requirement of this Part.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. 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:

Room102/104, No 203, KeZhu Road, Science City, GETDD Guangzhou, China

Except Conducted Emissions was performed at:

Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD Guangzhou, China

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch is recognized by ISED, the ISED Conformity Assessment Body Identification Number (CAB ID) is CN0024.

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. During testing, AC power line was manipulated to produce worst case emissions. It was powered by DC 3.3V 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.

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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

Description	Manufacturer	Model No.	SN/Version	Supplied by
For normal operation	HP	Compaq 6710b	SN:CNU8240LF9	Intertek
For fixing frequency	SmartSnippets	RFmaster	Version:1.2	Dialog

3.3 Special Accessories

No special accessories used.

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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 Dialog Semiconductor B.V. 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:

Support Equipment

Description	Manufacturer	Model No.	SN/Version	Supplied by
For normal operation	HP	Compaq 6710b	SN:CNU8240LF9	Intertek
For fixing frequency	SmartSnippets	RFmaster	Version:1.2	Dialog

Cable

Description	Model No.	Connector type	Cable length/type	Supplied by
Antenna cable	RF-01	SMA	0.1 m(shielded)	Dialog
USB extension cord	USB-01	USB	1.0 m(shielded)	Dialog

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4.0 Measurement Results

4.1 Antenna Requirement

Standard requirement:

RSS-GEN section 6.8

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.⁹ When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

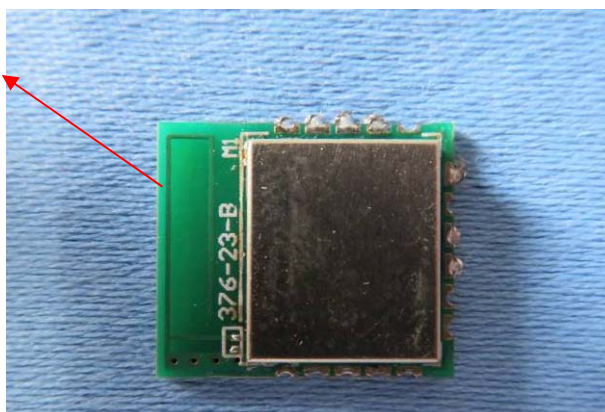
This radio transmitter (identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

EUT Antenna

The antenna is an integral antenna and no consideration of replacement. The best case gain of the antenna is -0.5 dBi.

Antenna

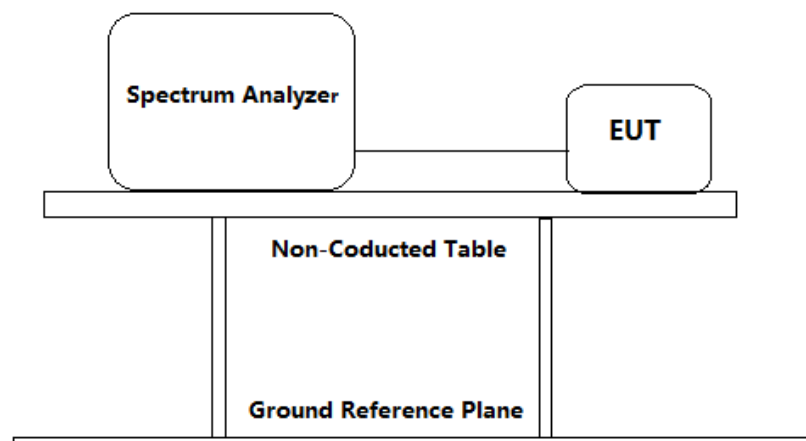


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4.2 6 dB Bandwidth (DTS bandwidth)

Test Requirement:	RSS-247 Clause 5.2(a) The minimum 6 dB bandwidth shall be 500 kHz.
Test Method:	RSS-Gen clause 6.7 & 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). The lowest, middle and highest 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 =0.3 dB) from the antenna port to the spectrum.
2. Set the spectrum analyzer:
 - a) Set RBW = 100 kHz
 - b) Set the VBW $\geq [3 \times \text{RBW}]$
 - 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.

Used Test Equipment List

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

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99% bandwidth

Channel No.	Frequency (MHz)	Measured 99% bandwidth (kHz)	Limit (kHz)	Result
0	2402	1147.8	/	Pass
19	2440	1122.6		Pass
39	2480	1082.4		Pass

6 dB bandwidth:

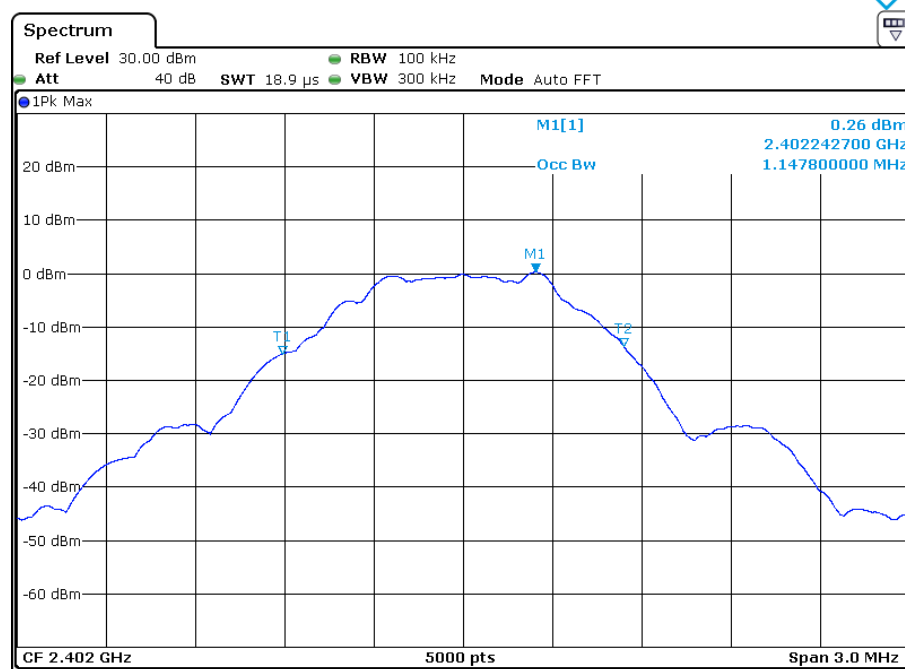
Channel No.	Frequency (MHz)	Measured 6dB bandwidth (kHz)	Limit (kHz)	Result
0	2402	799.2	≥ 500	Pass
19	2440	767.4		Pass
39	2480	760.8		Pass

Test result: The unit does meet the RSS requirements.

99% bandwidth:

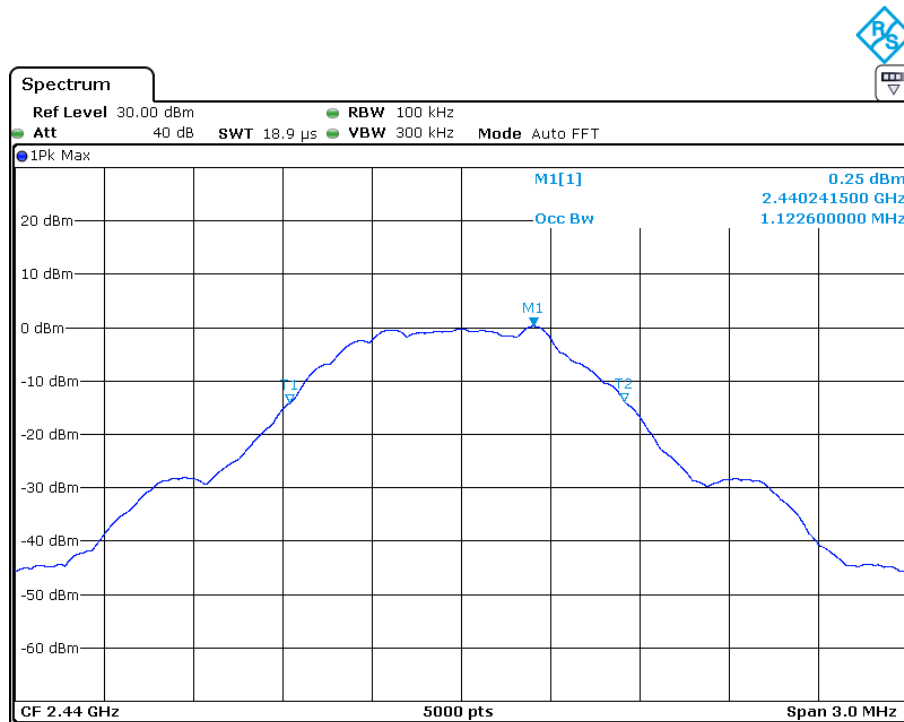
Result plot as follows:

Lowest channel (2.402 GHz):

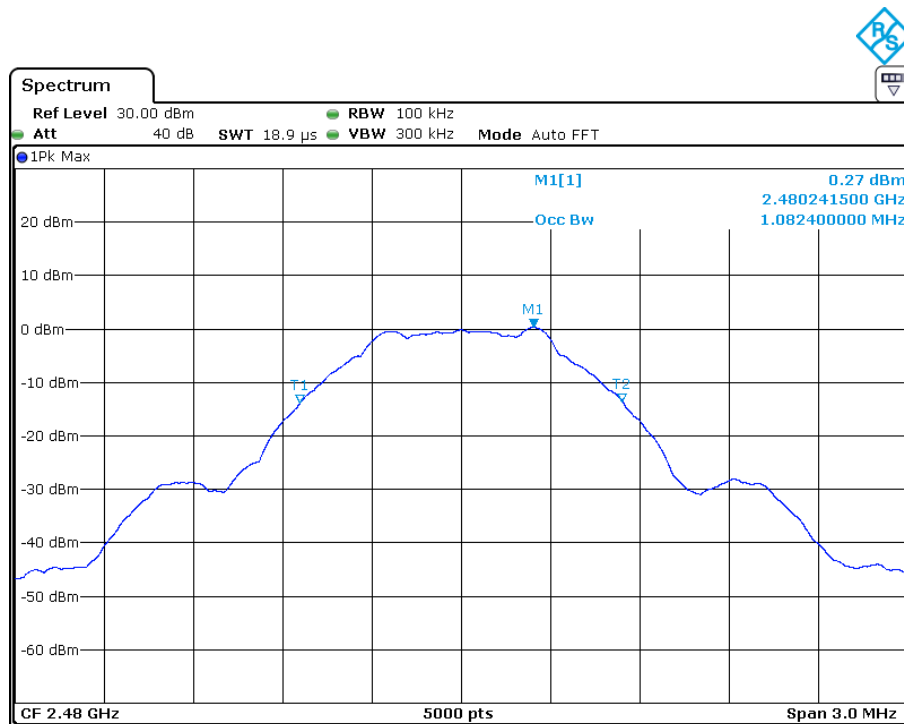


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Middle Channel (2.440 GHz):



Highest Channel (2.480 GHz):

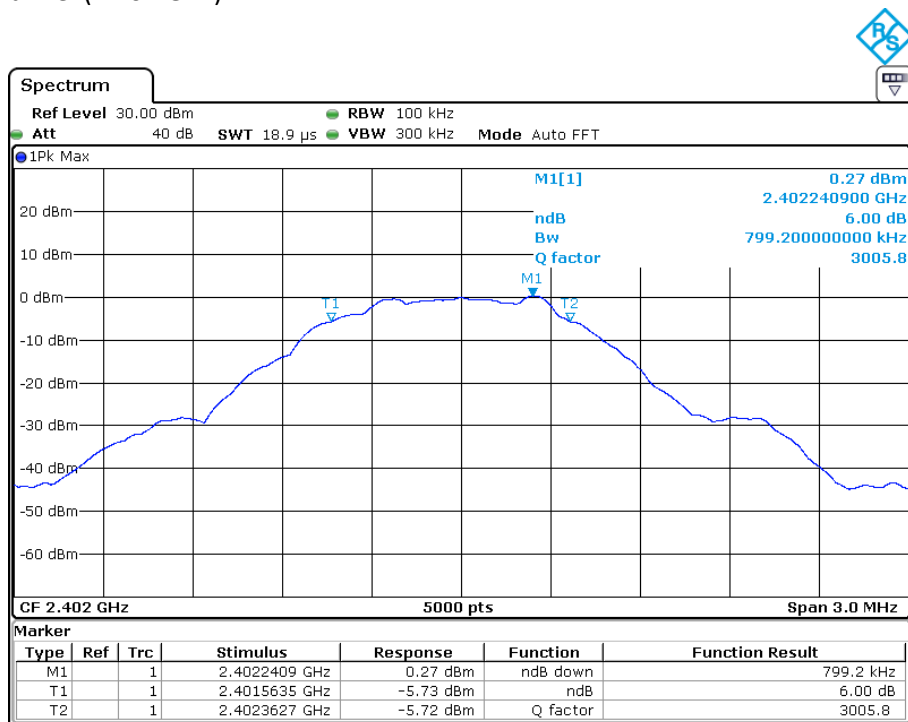


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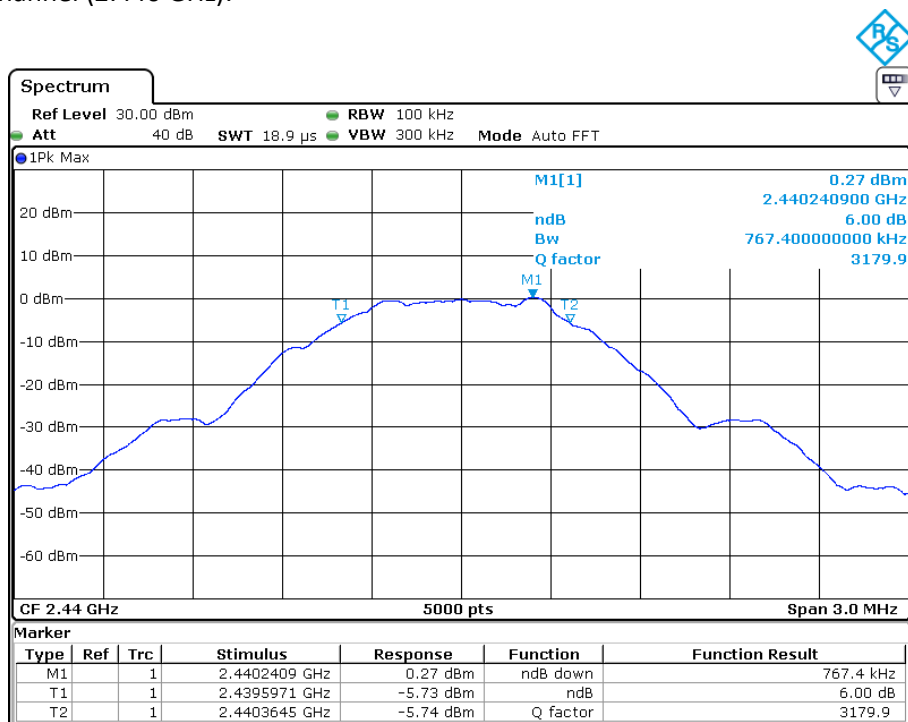
6 dB bandwidth

Result plot as follows:

Lowest channel (2.402 GHz):

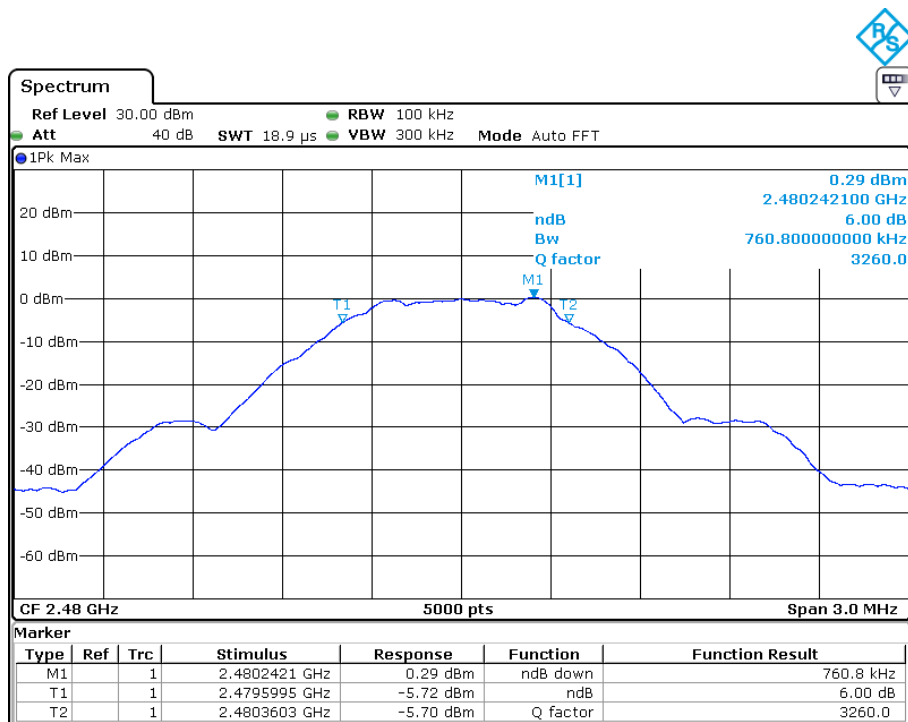


Middle Channel (2.440 GHz):



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Highest Channel (2.480 GHz):

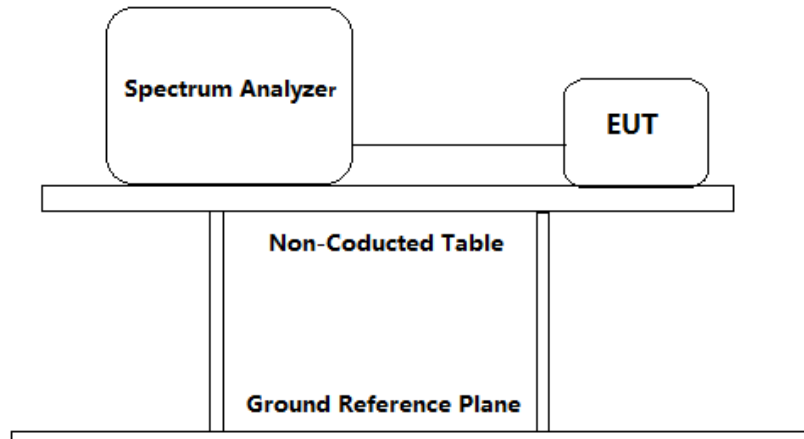


4.3 Maximum Peak Conducted Output Power

Test Requirement:	RSS-247 Clause 5.4(d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).
Test Method:	RSS-Gen clause 6.12 & ANSI C63.10: Clause 11.9.1.1(RBW \geq 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). The lowest, middle and highest channel(s) was (were) selected for the final test as listed below.

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Test Configuration:



Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable (cable loss =0.3 dB) from the antenna port to the spectrum.
2. Set the spectrum analyzer:
 - a) Set the RBW = 2 MHz (RBW \geq DTS bandwidth) .
 - b) Set the VBW \geq [3 \times RBW].
 - c) Set the span \geq 10 MHz[3 \times 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.

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)	e.i.r.p (dBm)	Limit		Result
				Output Power	e.i.r.p	
0	2402	1.27	0.77	1W (30dBm)	4W (36dBm)	Pass
19	2440	1.28	0.78			Pass
39	2480	1.28	0.78			Pass

Remark:

cable lose=0.3 dB

Antenna gain=-0.5 dBi

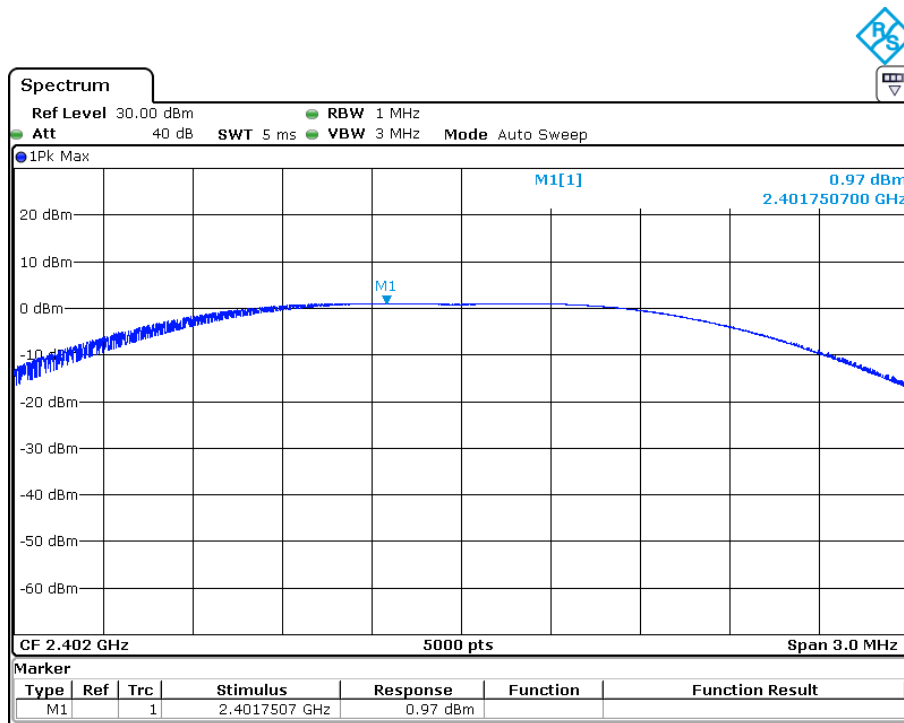
e.i.r.p=output power + antenna gain

The unit does meet the RSS requirements.

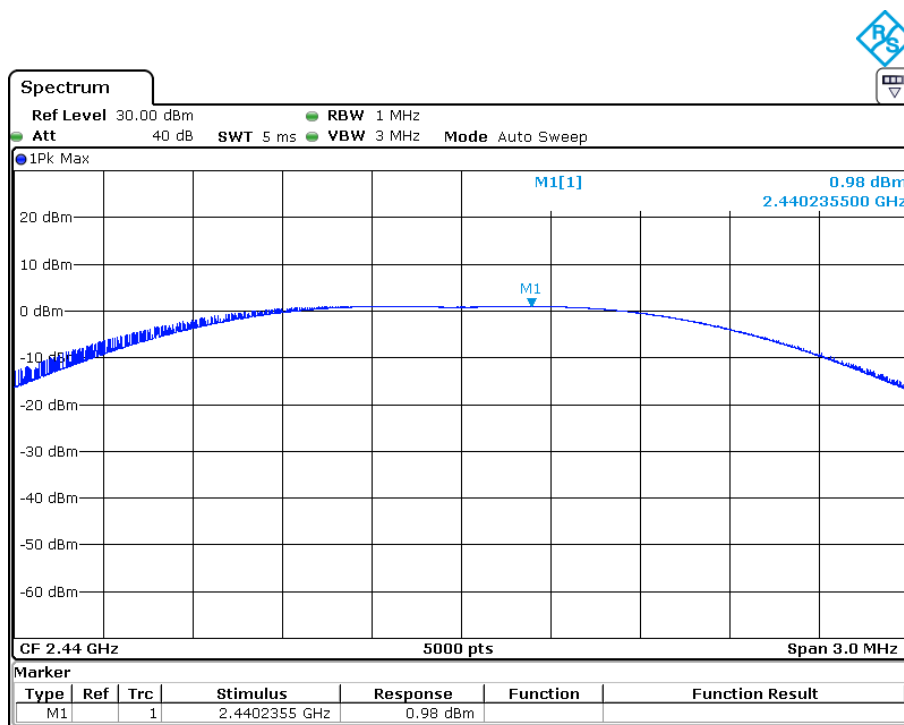
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Result plot as follows:

Lowest channel (2.402 GHz):

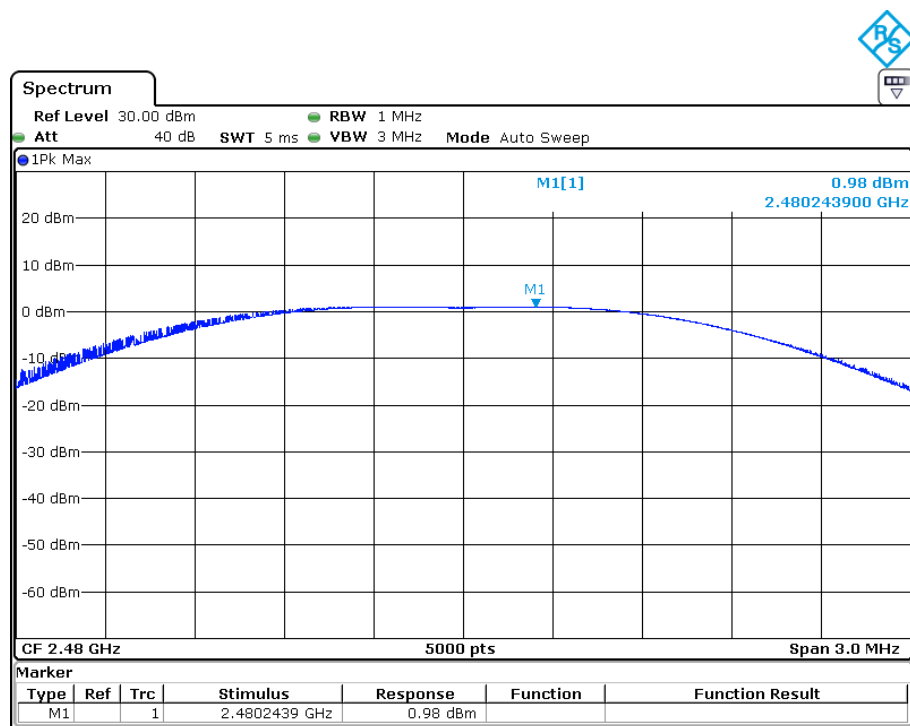


Middle Channel (2.440 GHz):



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Highest Channel (2.480 GHz):

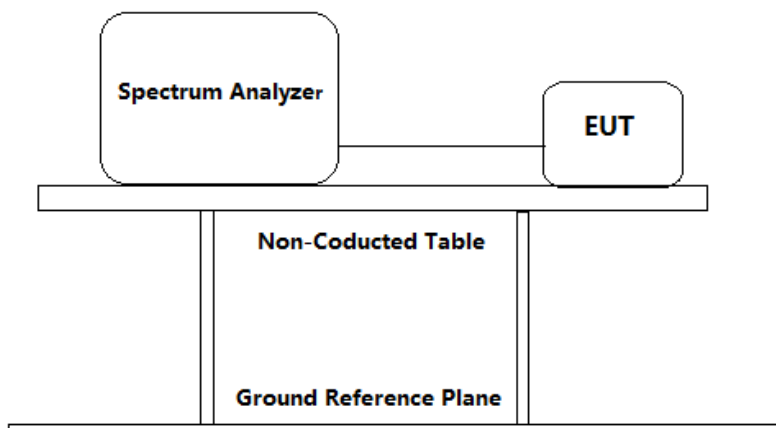


Test result: The unit does meet the RSS requirements.

4.4 Peak Power Spectral Density

Test Requirement:	RSS-247 Clause 5.2(b) The transmitter power spectral density conducted from the transmitter 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 section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).
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). The lowest, middle and highest channel(s) was (were) selected for the final test as listed below.
Test Configuration:	

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Test Procedure:

1. Remove the antenna from the EUT and then connect a low attention attenuation RF cable(cable loss =0.3 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= $1.5 \times \text{DTS bandwidth}$.
 - c) Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
 - d) Set the VBW $\geq [3 \times \text{RBW}]$.
 - 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:

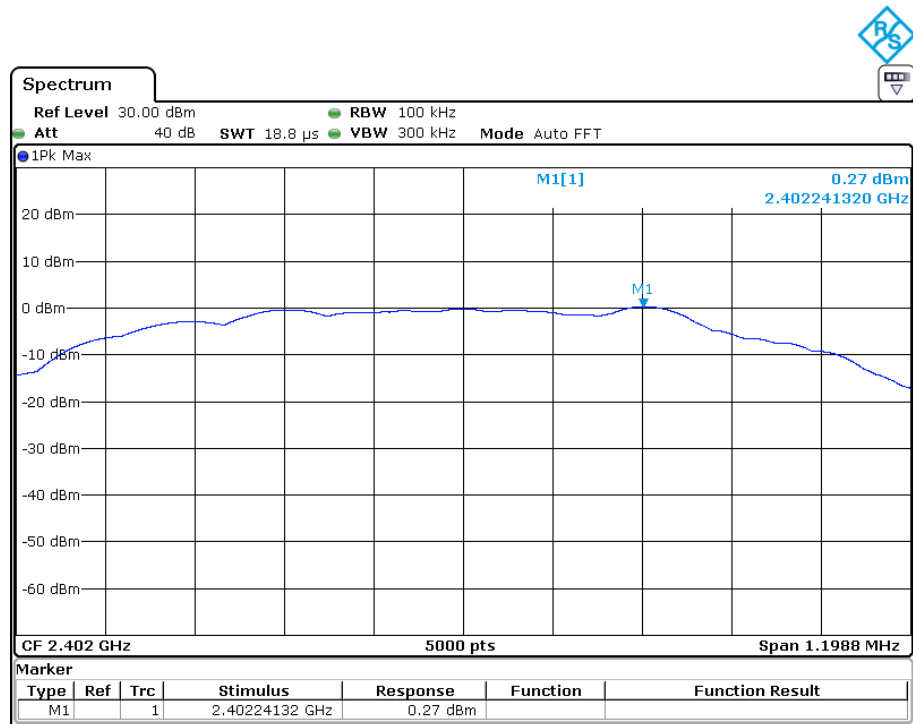
Channel No.	Frequency (MHz)	Measured Peak Power Spectral Density (dBm/100 kHz)	Limit	Result
0	2402	0.57	8 dBm/3kHz	Pass
19	2440	0.50		Pass
39	2480	0.56		Pass

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Test result: Level = Read Level + Cable Loss.
The unit does meet the RSS requirements.

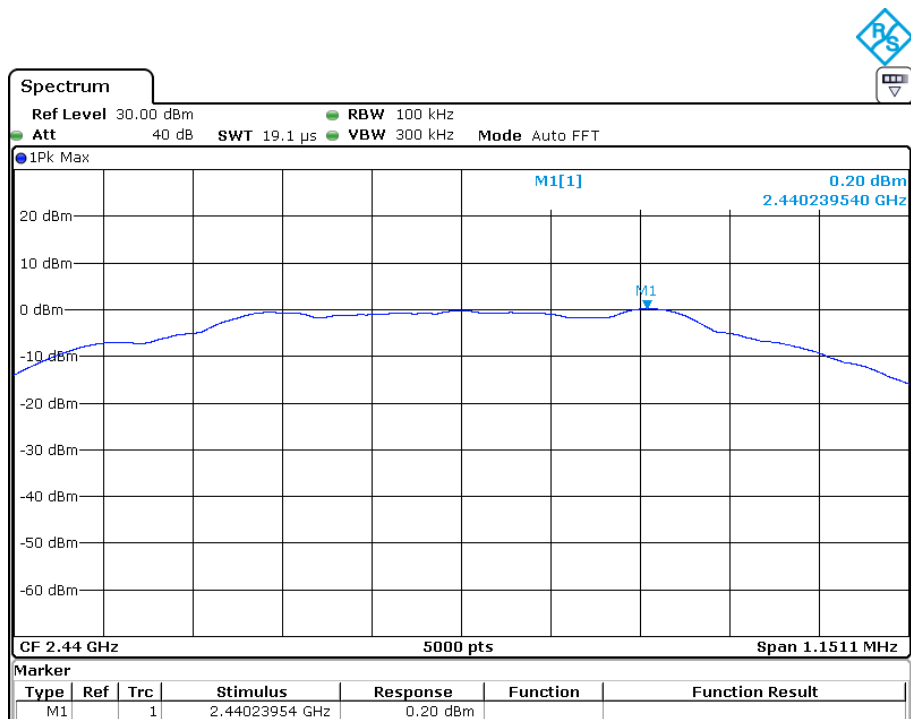
Result plot as follows:

Lowest channel (2.402 GHz):

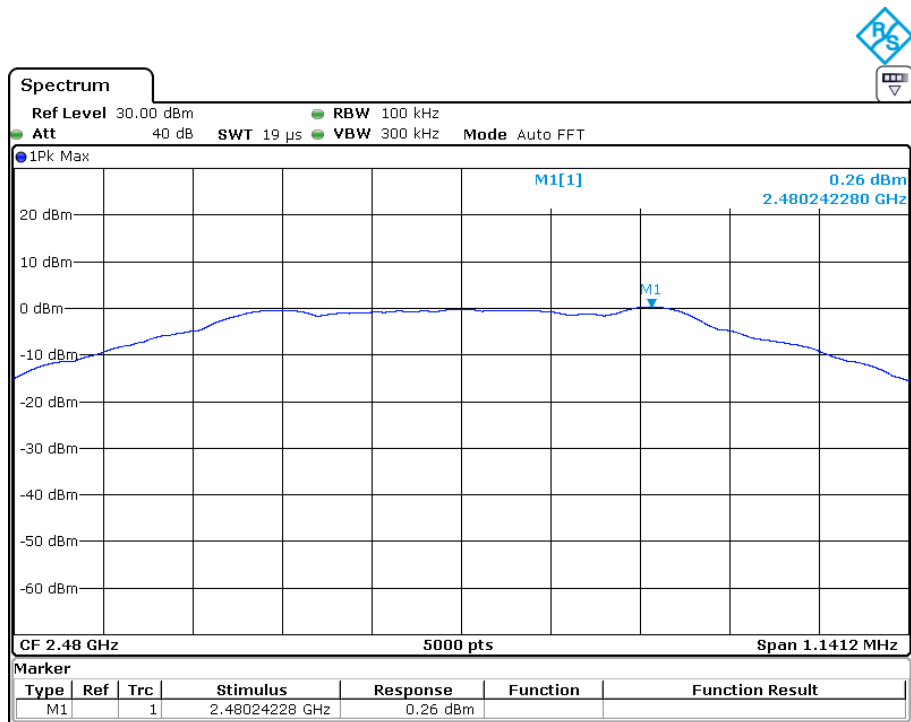


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Middle Channel (2.440 GHz):



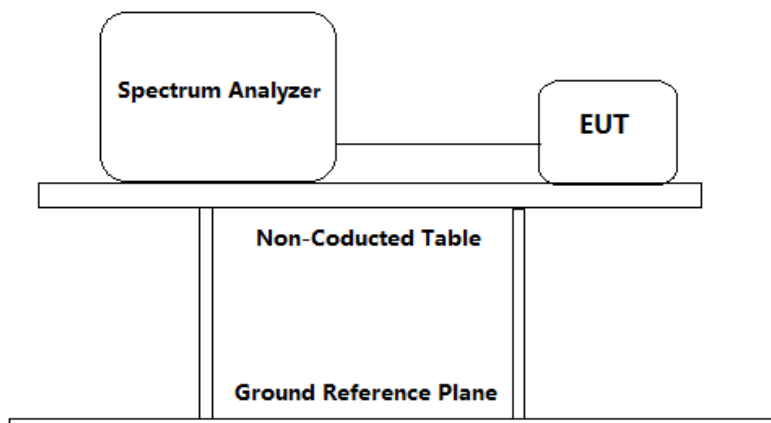
Highest Channel (2.480 GHz):



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4.5 Out of Band Conducted Emissions

Test Requirement:	<p>RSS-247 Clause 5.5</p> <p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.</p>
Test Method:	RSS-Gen clause 6.13 & 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). The lowest, middle and highest 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 = 0.3 dB) 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 $\geq 1.5 \times$ DTS bandwidth.
 - c) Set the RBW = 100 kHz.
 - d) Set the VBW $\geq [3 \times \text{RBW}]$.
 - e) Detector = peak.
 - f) Sweep time = auto couple.
 - g) Trace mode = max hold.

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- 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 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 $\geq [3 \times \text{RBW}]$.
 - 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.

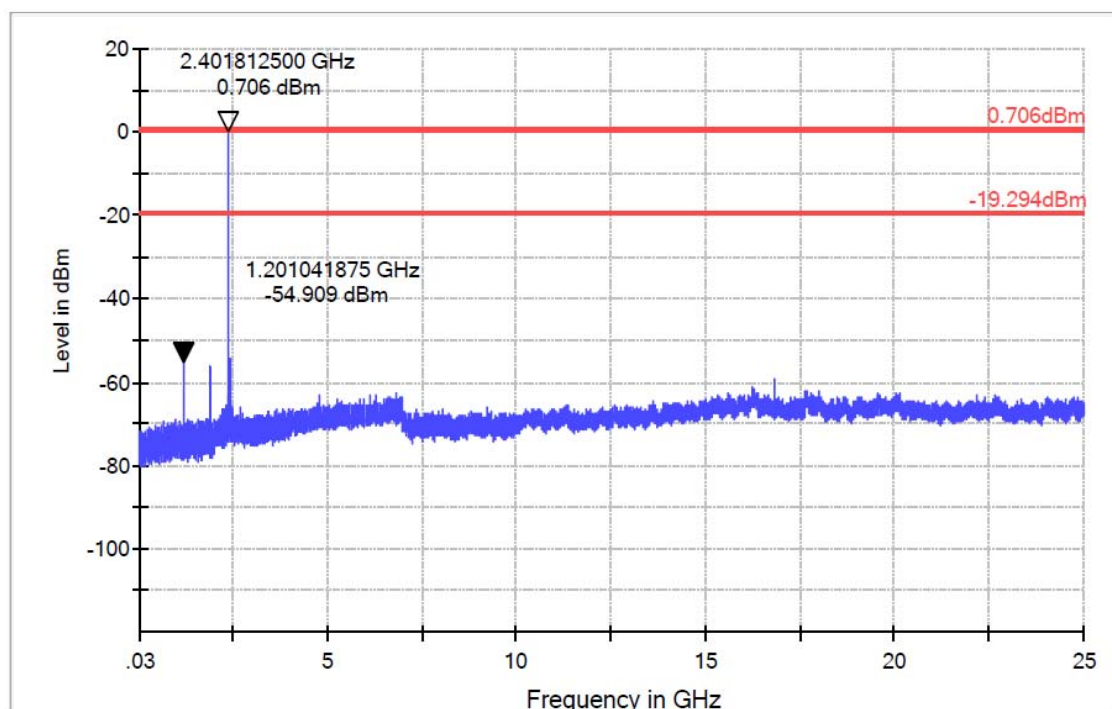
Used Test Equipment List

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

Result plot as follows:

Lowest channel (2.402 GHz):

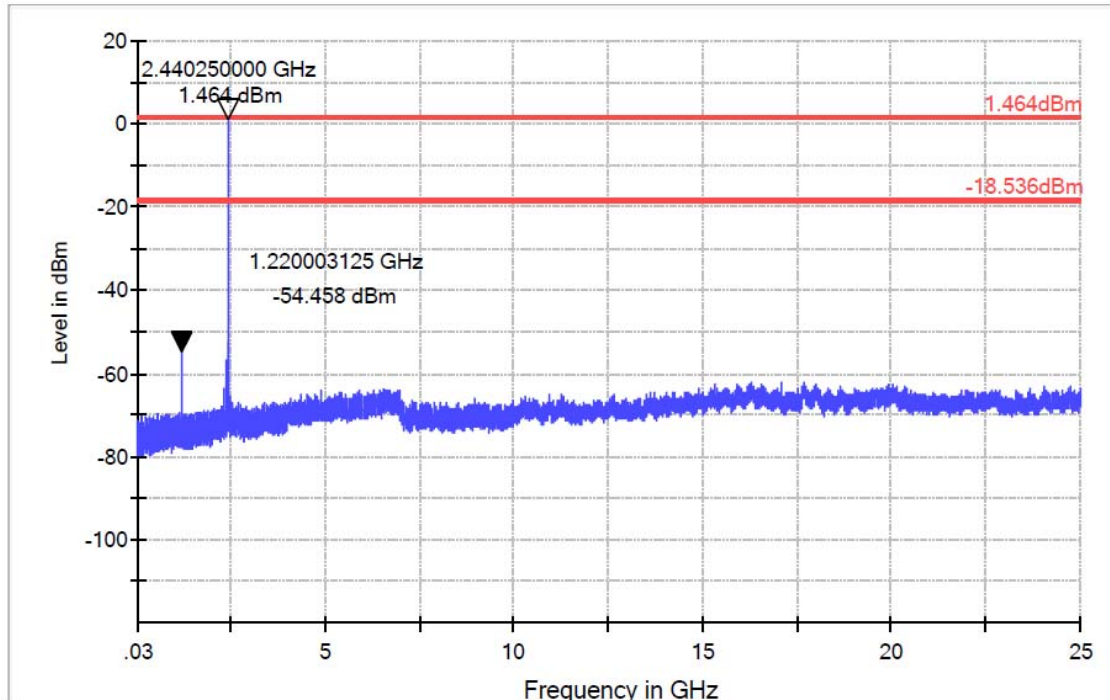
30 MHz to 25 GHz:



TEST REPORT

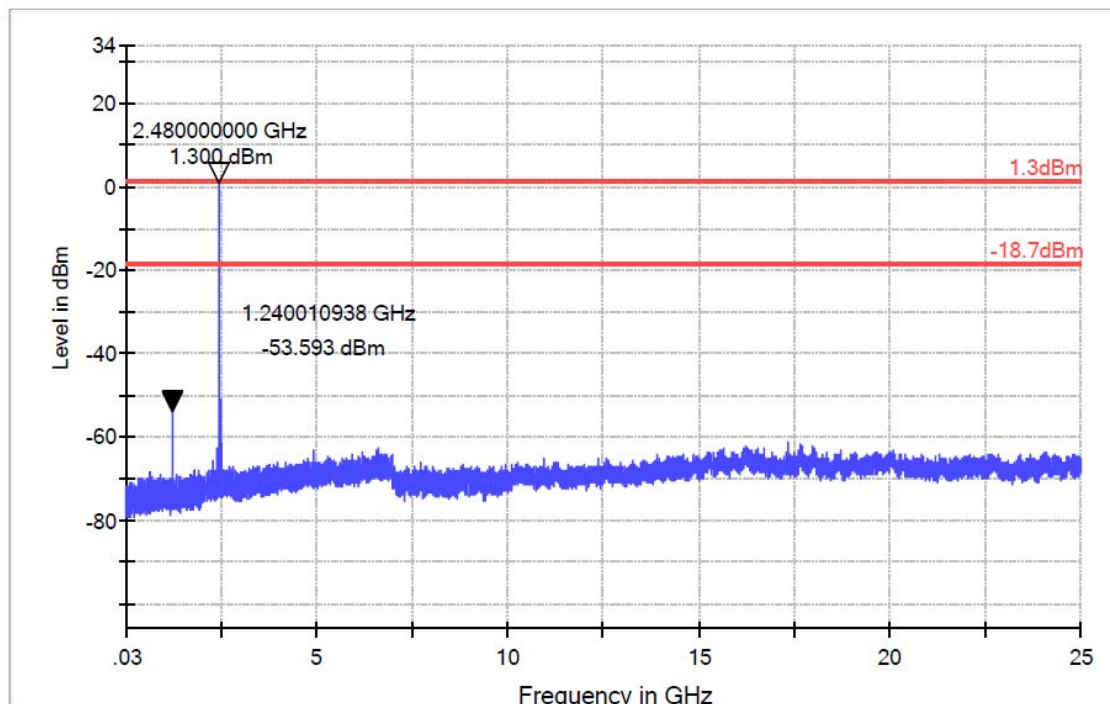
Middle Channel (2.440 GHz):

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:	RSS-247 Clause 3.3 Equipment certified under this standard is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands. These restricted frequency bands are listed in RSS-Gen.
Test Method:	RSS-Gen clause 8.10 & 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). The lowest, middle and highest channel(s) was (were) selected for the final test as listed below.
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Limit:	40.0 dB μ V/m between 30MHz & 88MHz; 43.5 dB μ V/m between 88MHz & 216MHz; 46.0 dB μ V/m between 216MHz & 960MHz; 54.0 dB μ V/m above 960MHz.
Detector:	For Peak and Quasi-Peak value: RBW = 1 MHz for $f \geq 1$ 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 \geq RBW Sweep = auto Detector function = peak for $f \geq 1$ GHz, QP for $f < 1$ GHz Trace = max hold For AV value: RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz VBW=10 Hz Sweep = auto Trace = max hold

TEST REPORT

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:

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

$$FS = RA + \text{Correct Factor} + AV$$

Where:

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

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 dB μ V 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 dB μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

$$\text{Correct Factor} = 7.4 + 1.6 - 29.0 + 0 = -20 \text{ dB}$$

$$FS = 62 + (-20) + (-10) = 32 \text{ dB}\mu\text{V/m}$$

Restricted bands of operation:

TEST REPORT

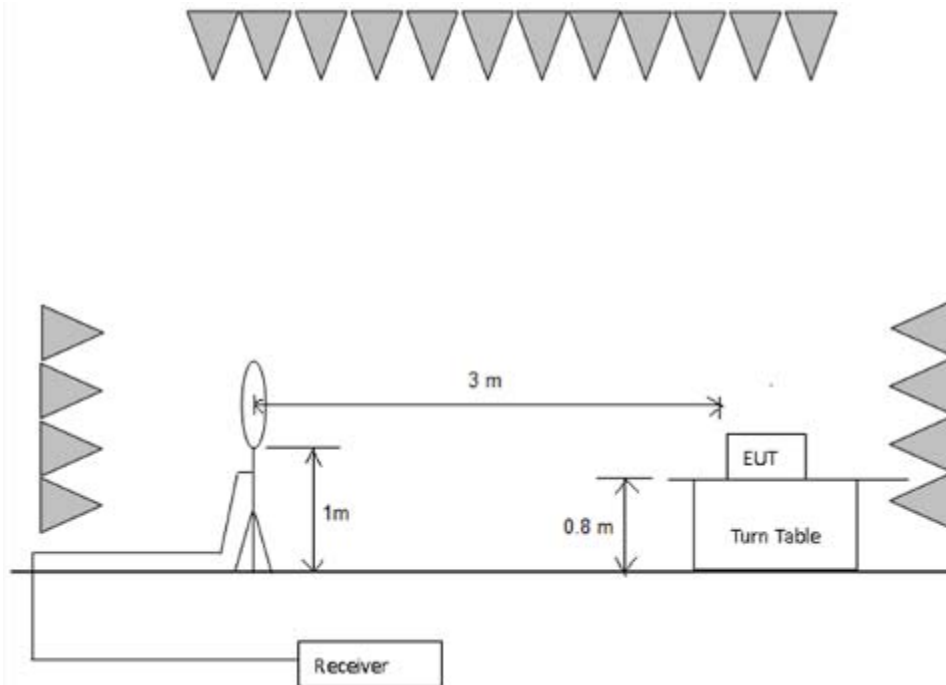
MHz	MHz	GHz
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 - 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 - 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 - 8500	
108 - 138	--	

* Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

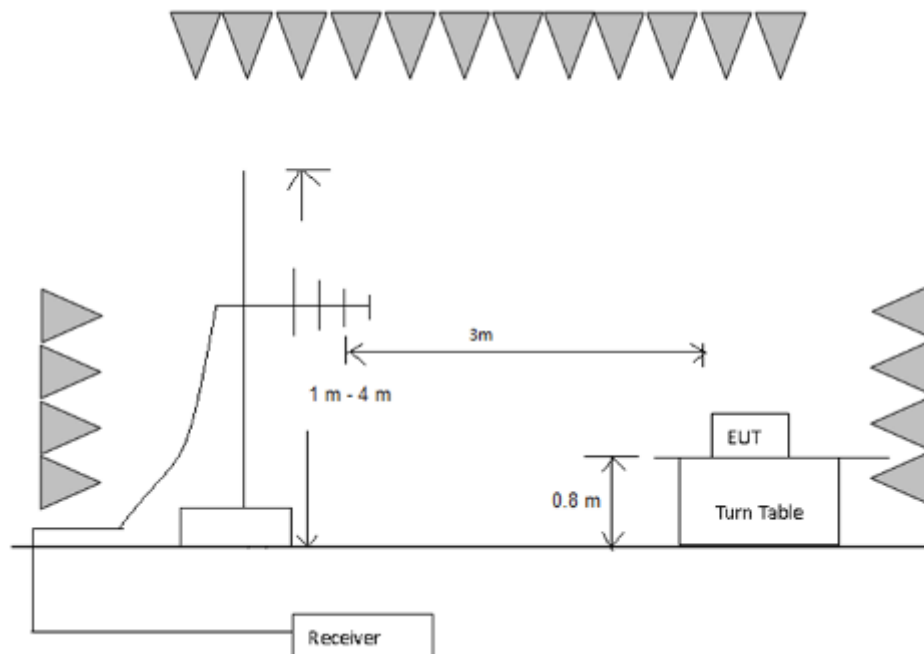
TEST REPORT

Test Configuration:

1) 9 kHz to 30 MHz emissions:

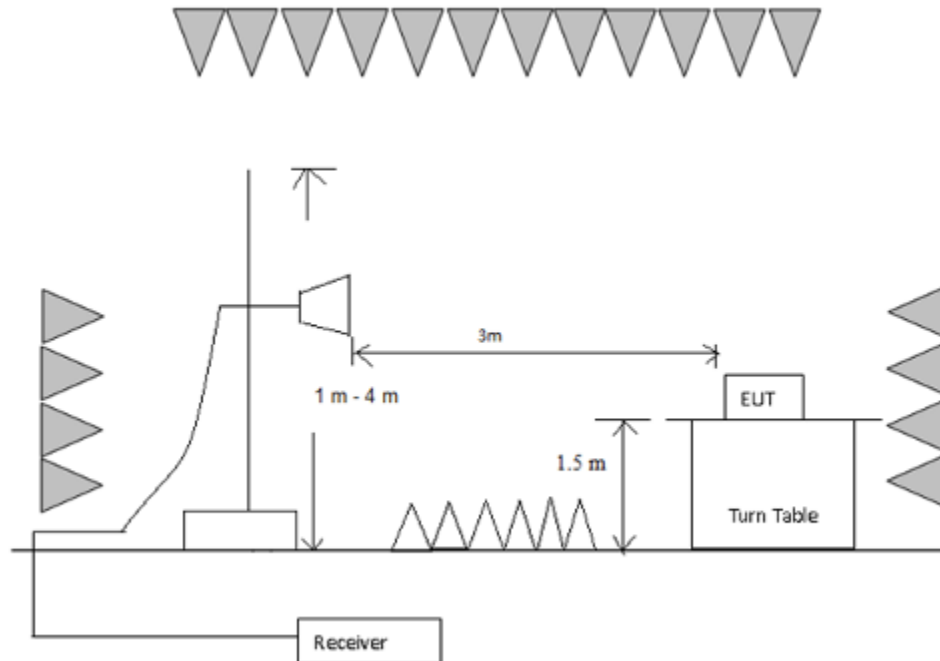


2) 30 MHz to 1 GHz emissions:



TEST REPORT

3) 1 GHz to 40 GHz emissions:



1) 9 kHz to 30 MHz emissions:

For testing performed with the loop antenna. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2) 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement was performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3) 1 GHz to 25 GHz emissions:

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.

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

4) 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.

TEST REPORT

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), Double-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.

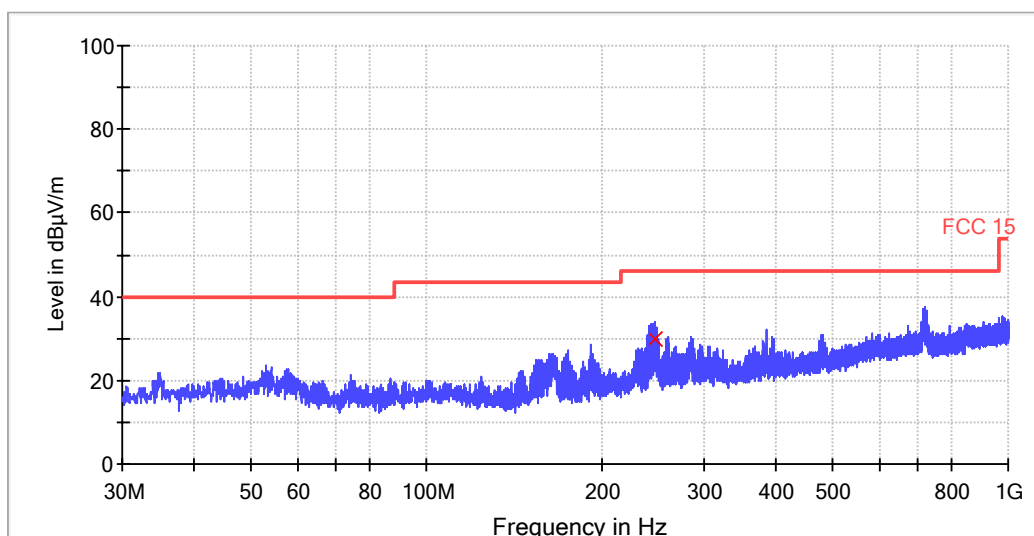
Test at Channel 0 (2.402 GHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBuV/m)



Quasi-peak measurement

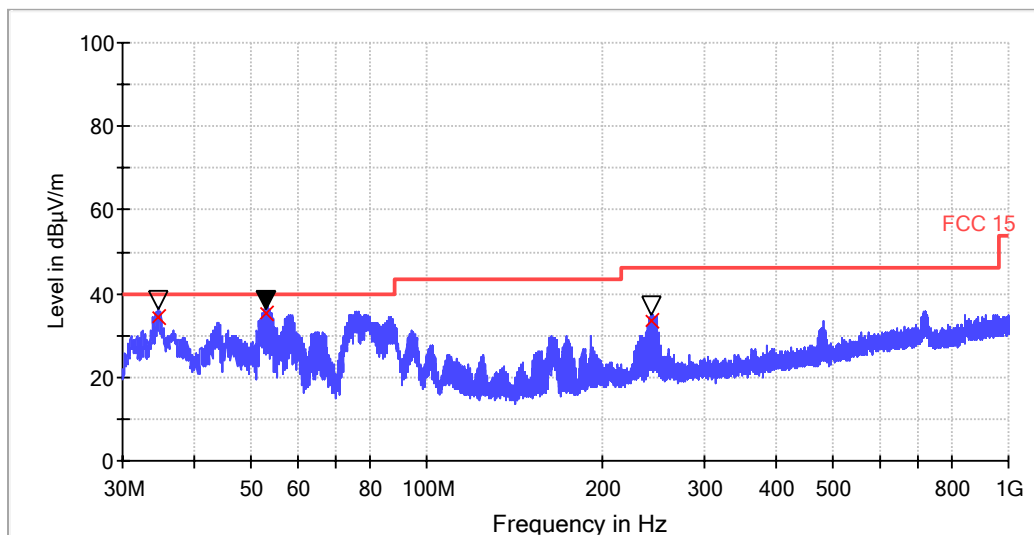
Frequency (MHz)	QuasiPeak (dBuV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
246.360000	29.8	120.000	H	14.3	16.2	46.0

TEST REPORT

Vertical:

Peak scan

Level (dBuV/m)



Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dBuV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
34.560000	34.4	120.000	V	11.4	5.6	40.0
52.920000	35.4	120.000	V	13.8	4.6	40.0
244.200000	33.4	120.000	V	14.2	12.6	46.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dBuV)	Correct Factor	Emission Level (dBuV/m)	Limit (dBuV/m)	Antenna polarization
1912.1563	47.132	-10.1	37.032	74	V
4804.2813	51.29	-1.1	50.19	74	V
16260.156	37.929	14.5	52.429	74	V
2389.52	55.16	-9.8	45.36	74	V
1592.875	47.497	-11.6	35.897	74	V
4803.2188	47.538	-1.1	46.438	74	H
16770.688	36.388	15.6	51.988	74	H
2390.08	54.771	-9.8	44.971	74	H

TEST REPORT

Average Measurement:

Frequency (MHz)	Reading Level (dBμV)	Correct Factor	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
1912.1563	/	-10.1	/	54	V
4804.2813	/	-1.1	/	54	V
16260.156	/	14.5	/	54	V
2389.52	/	-9.8	/	54	V
1592.875	/	-11.6	/	54	V
4803.2188	/	-1.1	/	54	H
16770.688	/	15.6	/	54	H
2390.08	/	-9.8	/	54	H

Remark:

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

* Band Edges Emission

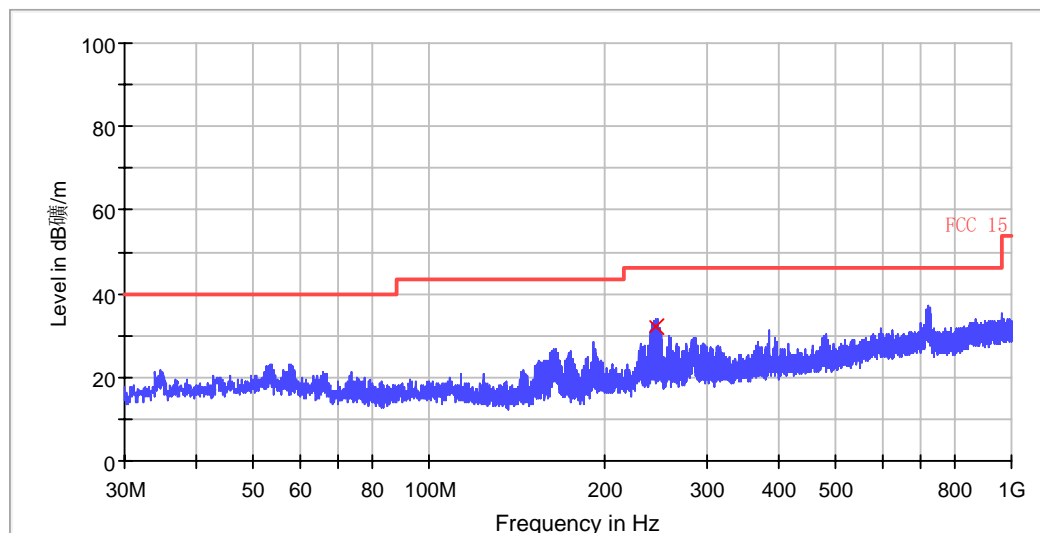
Test at Channel 19 (2.440 GHz) in transmitting status

30 MHz~1 GHz Radiated Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

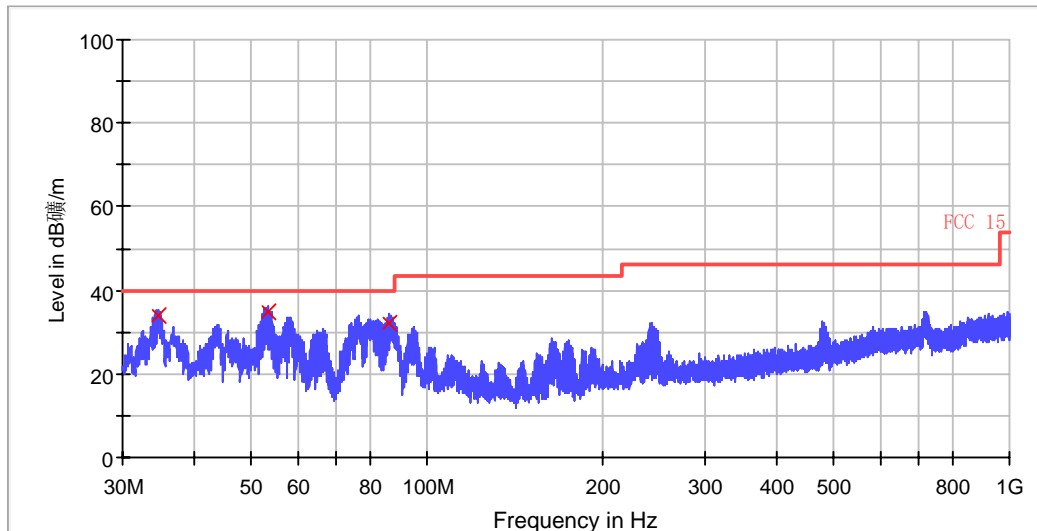
Frequency (MHz)	Quasi Peak (dBμV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
245.280000	32.0	120.000	H	14.3	14.0	46.0
245.280000	32.0	120.000	H	14.3	14.0	46.0

TEST REPORT

Vertical:

Peak scan

Level (dB μ V/m)



Quasi-peak measurement

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dB μ V/m)
34.560000	34.0	120.000	V	11.4	6.1	40.0
53.280000	34.9	120.000	V	13.8	5.1	40.0
86.080000	32.3	120.000	V	10.6	7.7	40.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dB μ V)	Correct Factor	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
2439.6875	46.324	-8	38.324	74	H
4880.25	48.196	-1	47.196	74	H
15565.813	38.574	12.7	51.274	74	H
1777.75	50.186	-10.7	39.486	74	V
4880.25	44.302	-1	43.302	74	V
15903.156	37.693	13.6	51.293	74	V

Average Measurement:

Frequency (MHz)	Reading Level (dB μ V)	Correct Factor	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
2439.6875	/	-8	/	54	H
4880.25	/	-1	/	54	H
15565.813	/	12.7	/	54	H
1777.75	/	-10.7	/	54	V

TEST REPORT

4880.25	/	-1	/	54	V
15903.156	/	13.6	/	54	V

Remark:

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

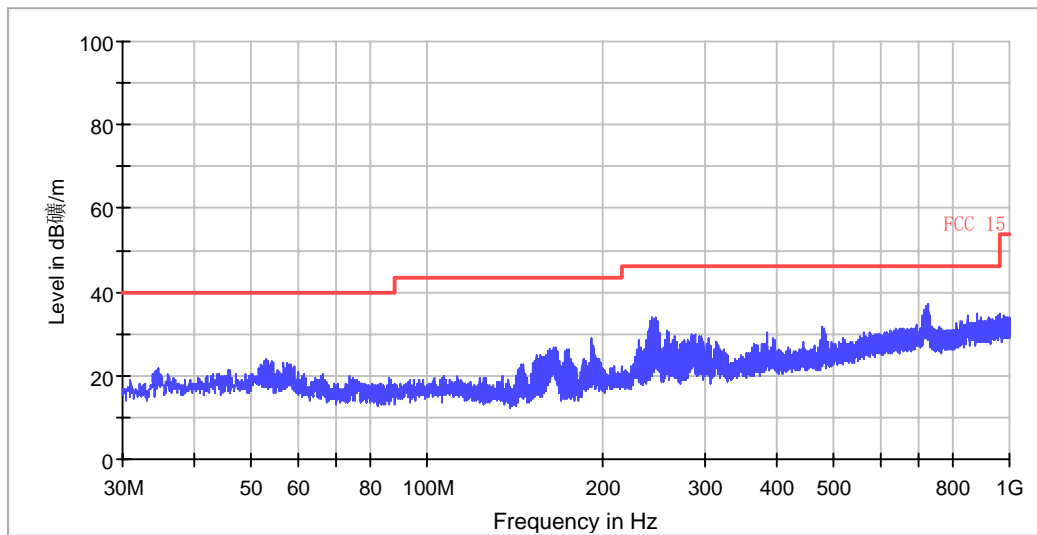
Test at Channel 39 (2.480 GHz) in transmitting status

30 MHz~1 GHz Radiated Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dB μ V/m)

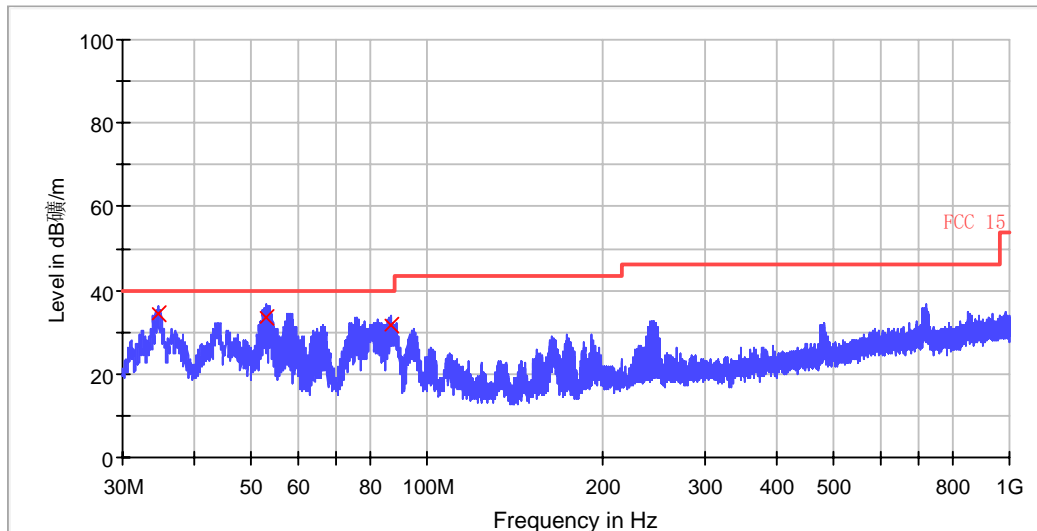


TEST REPORT

Vertical:

Peak scan

Level (dB μ V/m)



Quasi-peak measurement

Frequency (MHz)	Quasi Peak (dB μ V/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dB μ V/m)
34.560000	34.4	120.000	V	11.4	5.6	40.0
52.920000	33.3	120.000	V	13.8	6.7	40.0
86.440000	31.6	120.000	V	10.7	8.4	40.0
86.440000	31.6	120.000	V	10.7	8.4	40.0

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Reading Level (dB μ V)	Correct Factor	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Antenna polarization
1726.2188	48.322	-10.7	37.622	74	H
4959.9375	45.129	-1	44.129	74	H
9810.25	41.249	4.3	45.549	74	H
2483.7	60.546	-8	52.546	74	H
1902.0625	50.423	-10.7	39.723	74	V
4685.8125	42.172	-1	41.172	74	V
10441.906	42.545	4.3	46.845	74	V
2483.85	49.158	-8	41.158	74	V
2484.35	53.899	-8	45.899	74	V

TEST REPORT

Average Measurement:

Frequency (MHz)	Reading Level (dBμV)	Correct Factor	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
1726.2188	/	-10.7	/	54	H
4959.9375	/	-1	/	54	H
9810.25	/	4.3	/	54	H
2483.7	/	-8	/	54	H
1902.0625	/	-10.7	/	54	V
4685.8125	/	-1	/	54	V
10441.906	/	4.3	/	54	V
2483.85	/	-8	/	54	V
2484.35	/	-8	/	54	V

Remark:

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

* Band Edges Emission

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.

4.8 Band Edges Requirement

Test Requirement: RSS-247 Clause 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

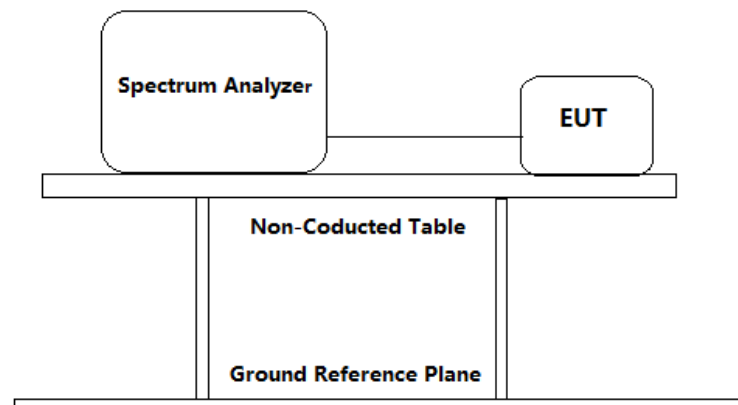
Frequency Band: 2400 MHz to 2483.5 MHz

TEST REPORT

Test Method: RSS-Gen clause 6.13 & 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 \geq [3 \times 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), Double-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 REPORT

Test result with plots as follows:

For conduct mode:

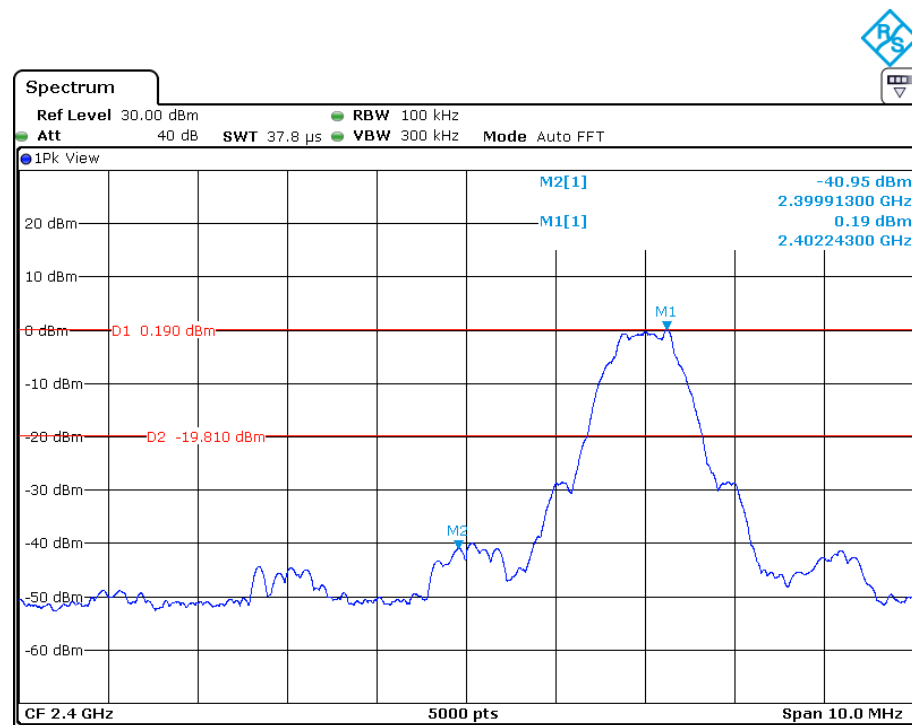
The band edges was measured and recorded Result:

The Lower Edges attenuated more than 20dB.

The Upper Edges attenuated more than 20dB.

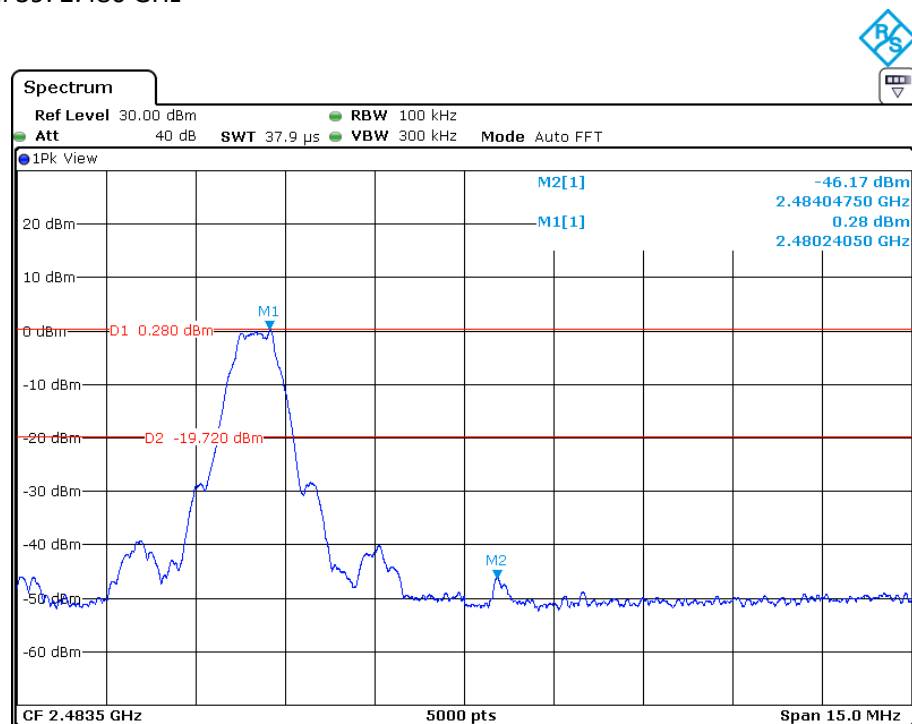
Result plot as follows:

Channel 0: 2.402 GHz



TEST REPORT

Channel 39: 2.480 GHz

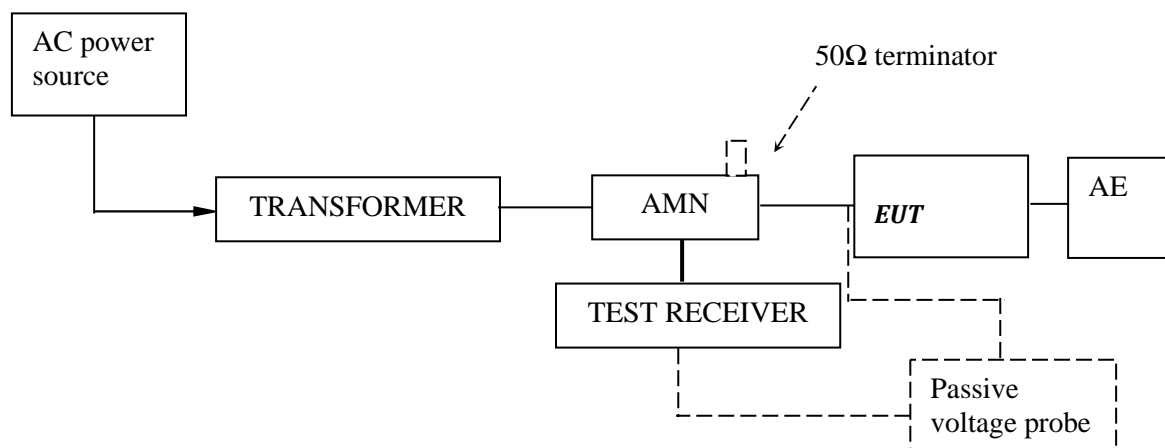


For radiated mode:

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 dB μ V/m (Peak Limit) and 54 dB μ V/m (Average Limit).

4.9 Conducted Emission Test

Test Configuration:



TEST REPORT

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.

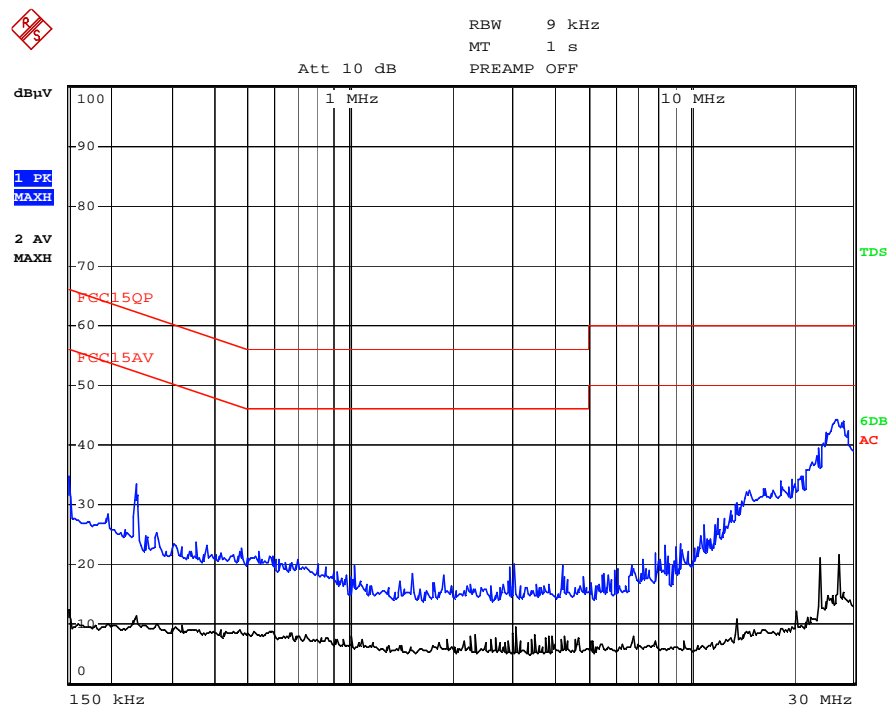
TEST REPORT

Test Data and Curve

At main terminal: Pass

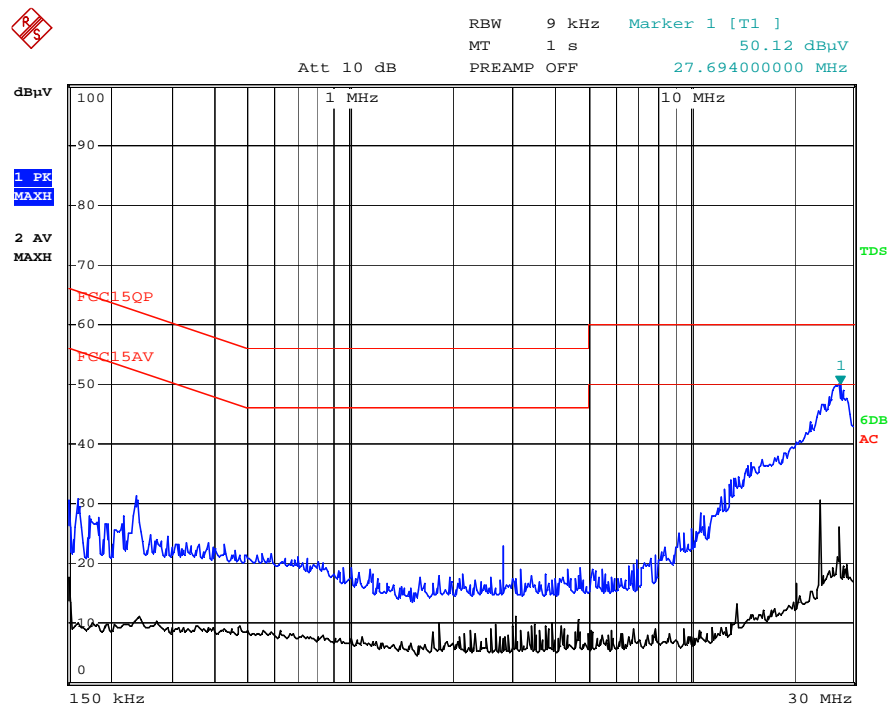
Tested Wire: Live

Operation Mode: Continuously transmitting



Tested Wire: Neutral

Operation Mode: Continuously transmitting



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	1 Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	10/22/2020	1 Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	9/8/2020	1 Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	6/24/2020	1 Y
EM061-03	TRILOG Super Broadband test Antenna (30 MHz-1.5 GHz) (TX)	VULB 9161	SCHWARZBECK	6/22/2020	1 Y
EM033-01	TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX)	VULB 9163	SCHWARZBECK	9/19/2020	1 Y
EM033-02	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX)	R&S HF907	R&S	6/22/2020	1 Y
EM033-03	High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX)	R&S SCU-26	R&S	4/24/2021	1 Y
EM033-04	High Frequency Antenna & preamplifier (26 GHz-40 GHz)	R&S SCU-40	R&S	4/24/2021	1 Y
EM031-02-01	Coaxial cable(9 kHz-1 GHz)	N/A	R&S	4/12/2021	1 Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	N/A	R&S	4/12/2021	1 Y
EM033-04-02	Coaxial cable(18 GHz~40 GHz)	N/A	R&S	4/24/2021	1 Y
EM031-01	Signal Generator (9 kHz~6 GHz)	SMB100A	R&S	7/18/2020	1 Y
EM040-01	Band Reject/Notch Filter	WRHFV	Wainwright	N/A	1 Y
EM040-02	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1 Y
EM040-03	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1 Y
EM022-03	2.45 GHz Filter	BRM50702	Micro-Tronics	5/10/2021	1 Y
SA016-16	Programmable Temperature & Humidity Test Chamber	MHU-800LJ	TERCHY	10/13/2020	1 Y
SA016-22	Climatic Test Chamber	C7-1500	Vötsch	11/10/2020	1 Y
SA012-74	Digital Multimeter	FLUKE175	FLUKE	10/13/2020	1 Y
EM010-01	Regulated DC Power supply	PAB-3003A	GUANHUA	N/A	1 Y
SA040-22	Regulated DC Power supply	IT6721	ITECH	9/8/2020	1 Y
EM084-06	Audio Analyzer	8903B	HP	4/15/2021	1 Y
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	7/17/2020	1 Y
EM006-05	LISN	ENV216	R&S	6/16/2020	1 Y
EM006-06	LISN	ENV216	R&S	9/8/2020	1 Y
EM006-06-01	Coaxial cable	/	R&S	4/12/2021	1 Y
EM004-04	EMC shield Room	8m×3m×3m	Zhongyu	1/5/2021	1 Y

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