FCC TEST REPORT
No. 170201360SHA-001

Applicant	:	LEEDARSON LIGHTING CO., LTD. Xingda Road, Xingtai Industrial Zone, Changtai County, Zhangzhou, Fujian
Manufacturer site	:	LEEDARSON LIGHTING CO., LTD. Xingda Road, Xingtai Industrial Zone, Changtai County, , Zhangzhou, Fujian
Product Name	:	Gateway
Type/Model	:	5aA-GW-ZB-H0
TEST RESULT	**:**	**PASS**

SUMMARY

The equipment complies with the requirements according to the following standard(s) or specification:

47CFR Part 15 (2015): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Date of issue: May 17, 2017

Prepared by: Reviewed by:

Jesse Xu (*Project Engineer*) Daniel Zhao (*Reviewer*)

FCC ID: 2AB2Q5AA-GW-ZB-H0

Description of Test Facility

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1 GENERAL INFORMATION

1.1 Description of Client

Applicant	:	LEEDARSON LIGHTING CO., LTD. Xingda Road, Xingtai Industrial Zone, Changtai County, Zhangzhou, Fujian
Manufacturer site	:	LEEDARSON LIGHTING CO., LTD. Xingda Road, Xingtai Industrial Zone, Changtai County, Zhangzhou, Fujian

1.2 Identification of the EUT

Product Name	:	Gateway
Type/model	:	5aA-GW-ZB-H0
FCC ID	:	2AB2Q5AA-GW-ZB-H0

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1.3 Technical Specification

Operation Frequency Band	:	2405 - 2480 MHz
Protocol	:	IEEE 802.15.4
Type of Modulation	:	O-QPSK
Channel Number	:	16 channels
Description of EUT	:	EUT is a Getway and has only one model.
Antenna		PCB antenna, 0.3dBi max
Rating		DC 5V 1W
Category of EUT	:	Class B
EUT type	:	☒ Table top ☐ Floor standing
Sample received date	:	Feb 13, 2017
Date of test	:	Feb 18, 2017 ~ May 17, 2017

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2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2015)
ANSI C63.10 (2013)
KDB 558074 (v04)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The lowest, middle and highest channel were tested as representatives.

Freq. Band (MHz)	Modulation	Lowest (MHz)	Middle (MHz)	Highest (MHz)
2400-2483.5	O-QPSK	2405	2445	2480

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Laptop computer	HP, EliteBook 2530P	-
2	AC adapter	HUAWEI	

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2.5 Instrument list

Selected	Instrument	EC no.	Model	Valid until date
☐	Shielded room	EC 2838	GB88	2018-1-8
☐	EMI test receiver	EC 2107	ESCS 30	2017-10-19
☐	A.M.N.	EC 3119	ESH2-Z5	2017-12-16
☐	A.M.N.	EC 3394	ENV 216	2017-8-1
☒	Semi anechoic chamber	EC 3048	-	2017-5-11
☒	EMI test receiver	EC 3045	ESIB26	2017-10-19
☒	Broadband antenna	EC 4206	CBL 6112D	2018-4-27
☒	Horn antenna	EC 3049	HF906	2018-4-27
☐	Horn antenna	EC 4792-1	3117	2018-4-21
☐	Horn antenna	EC 4792-3	HAP18-26W	2017-6-11
☒	Pre-amplifier	EC 5262	pre-amp 18	2017-5-25
☐	Pre-amplifier	EC 4792-2	TPA0118-40	2018-4-10
☐	Test Receiver	EC 4501	ESCI 7	2018-1-13
☒	PXA Signal Analyzer	EC5338	N9030A	2017-11-17
☒	Power sensor/Power meter	EC4318	N1911A/N1921A	2018-4-8
☐	Power sensor	EC5338-1	U2021XA	2018-3-5
☐	MXG Analog Signal Generator	EC5338-2	N5181A	2018-3-5
☐	MXG Vector Signal Generator	EC5175	N51812B	2018-1-8

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2.6 Test Summary

This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	Pass
Maximum peak output power	15.247(b)	Pass
Power spectrum density	15.247(e)	Pass
Radiated Emissions in restricted frequency bands	15.205 & 15.209	Pass
Emission outside the frequency band	15.247(d)	Pass
Power line conducted emission	15.207	Pass
Antenna requirement	15.203	Pass

Notes: 1: NA =Not Applicable

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2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

TEST ITEM	MEASUREMENT UNCERTAINTY
Maximum peak output power	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

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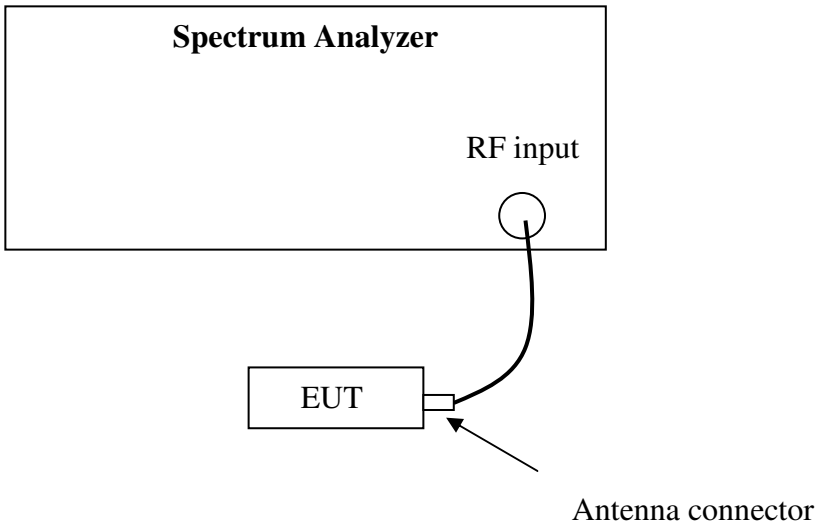
3 Minimum 6dB Bandwidth

Test result: Pass

3.1 Limit

For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2 Test Configuration



3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" for compliance to FCC 47CFR 15.247 requirements(clause 8.2).

a) Set RBW = 100 kHz.
b) Set the video bandwidth (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.

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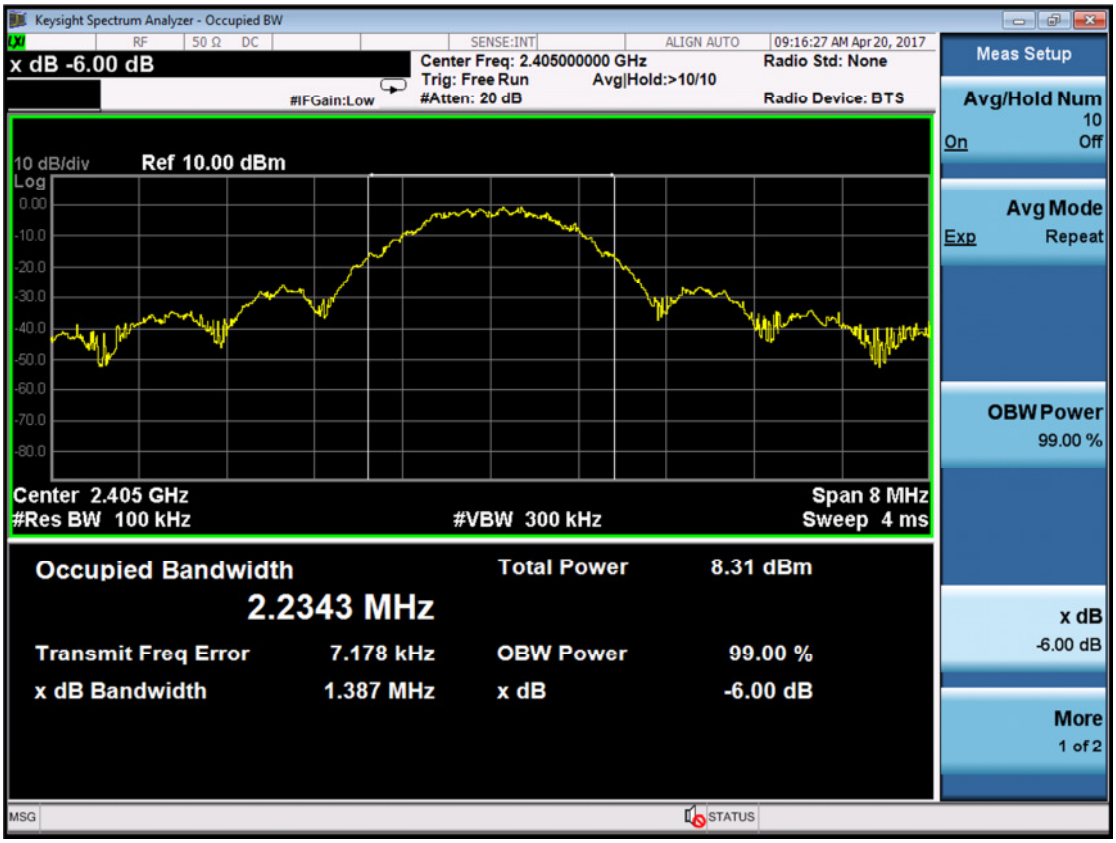
3.4 Test Protocol

Temperature: 22°C
Relative Humidity: 54%

Mode	Channel	Minimum 6dB Bandwidth (MHz)	Limits (MHz)
-	L	1.387	≥ 0.5
	M	1.379	≥ 0.5
	H	1.599	≥ 0.5

Channel L



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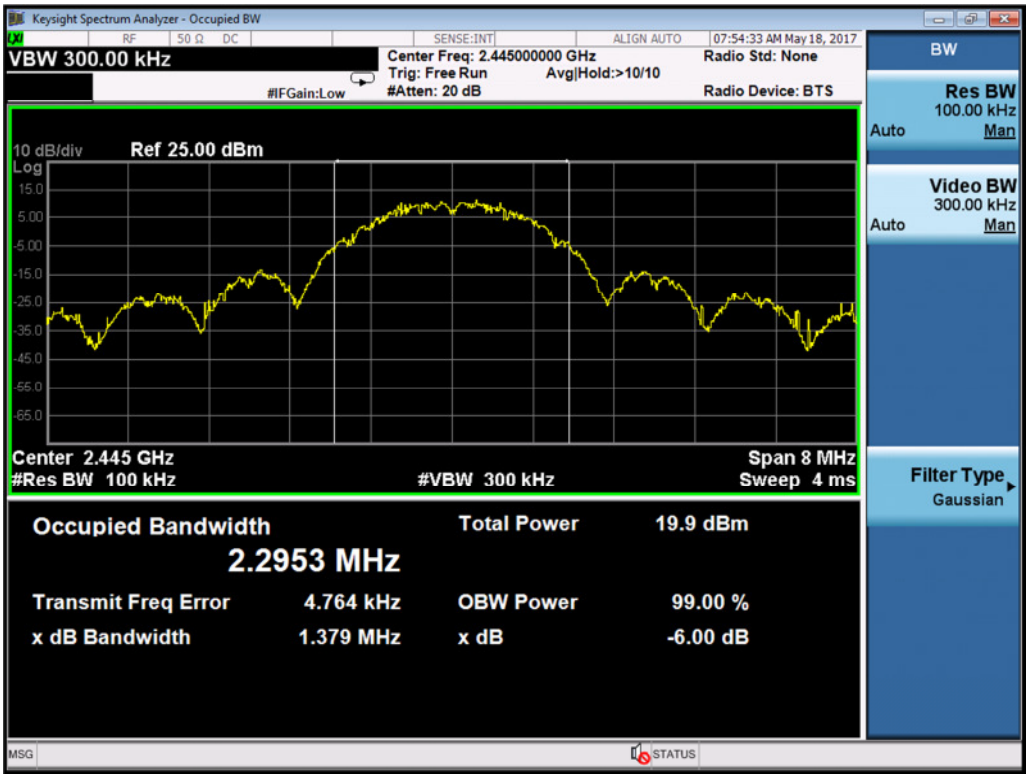
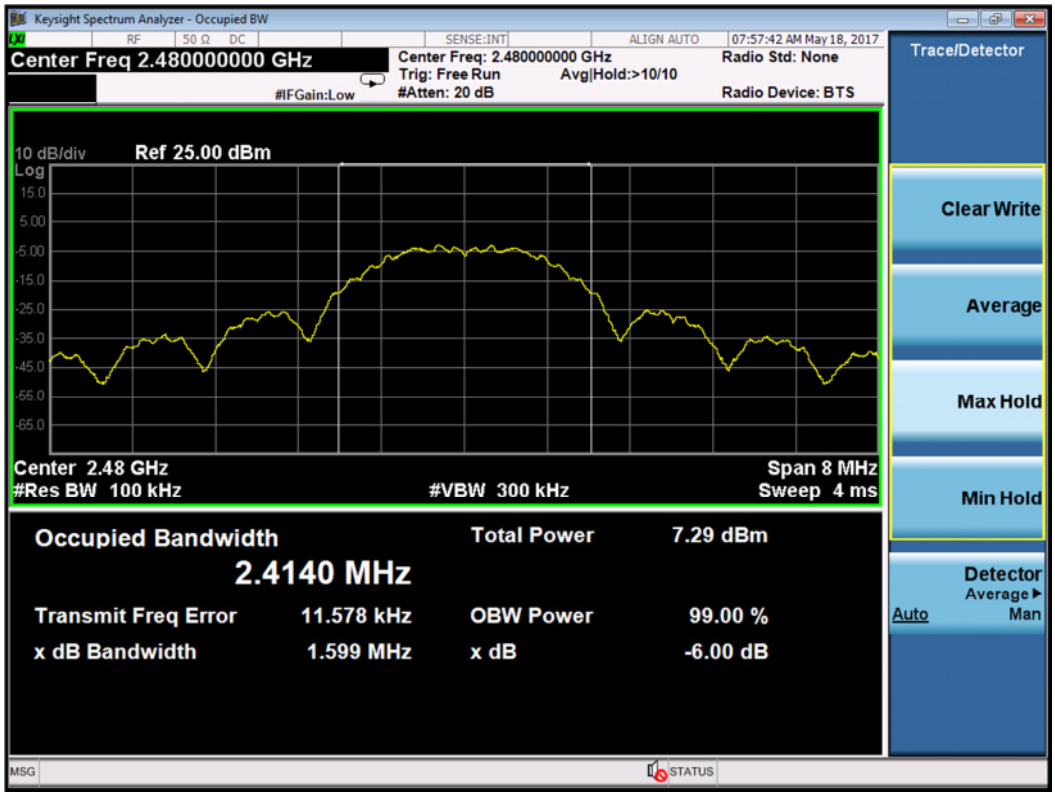
Channel M



Channel H



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4 Maximum Conducted Output power

Test result: Pass

4.1 Test limit

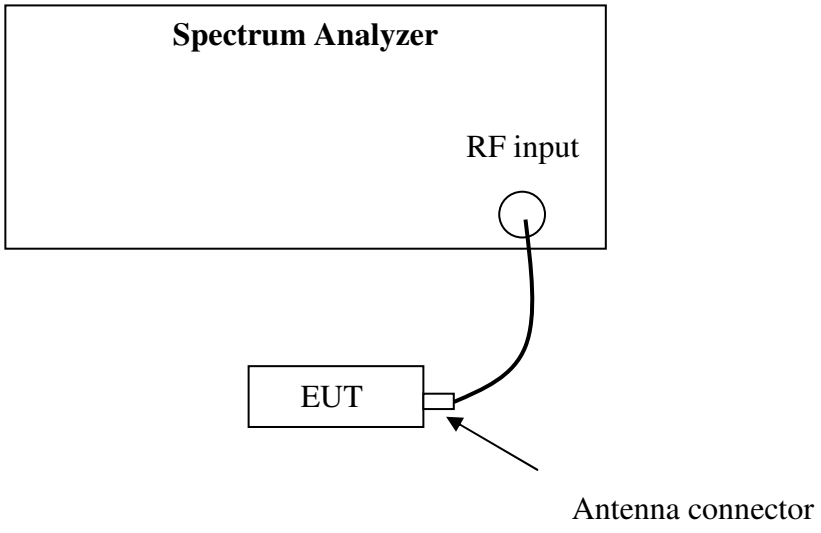
☐ For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

☐ For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

☒ For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt (EIRP: 4 watt).

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

4.2 Test Configuration



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4.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v04” for compliance to FCC 47CFR 15.247 requirements (clause 9.2.3.2).

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4.4 Test protocol

Temperature: 22 °C
Relative Humidity: 54 %

Mode	Channel	Conducted Power (dBm)	Limit (dBm)
-	L	14.20	30
	M	14.80	30
	H	2.50	30

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5 Power spectrum density

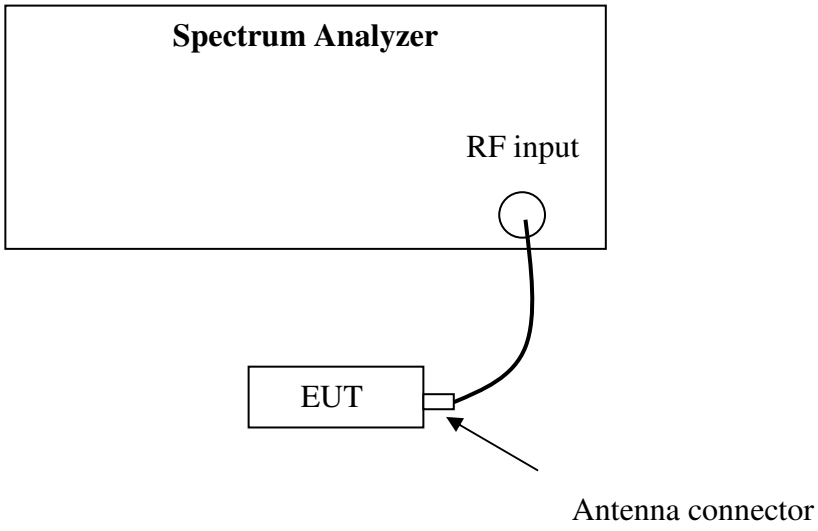
Test result: **Pass**

5.1 Test limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 8dBm/MHz and 8+ (6 –antenna gain-beam forming gain).

5.2 Test Configuration



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5.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the *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 limit, reduce RBW (no less than 3 kHz) and repeat.

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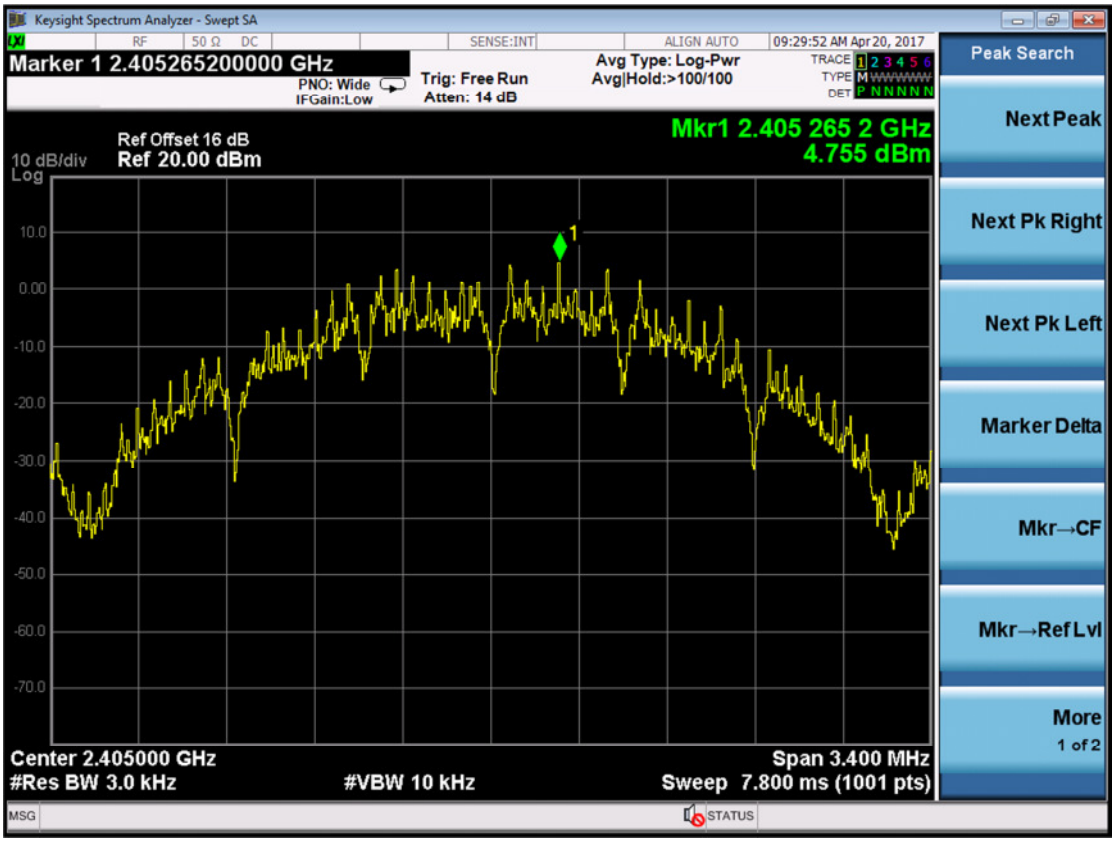
5.4 Test Protocol

Temperature: 22°C
Relative Humidity: 54%

Mode	Channel	PSD (dBm)	RBW (kHz)	Limit (dBm)
-	L	4.755	10	8
	M	6.258	10	8
	H	-2.507	100	8

Channel L



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Channel M

Channel H

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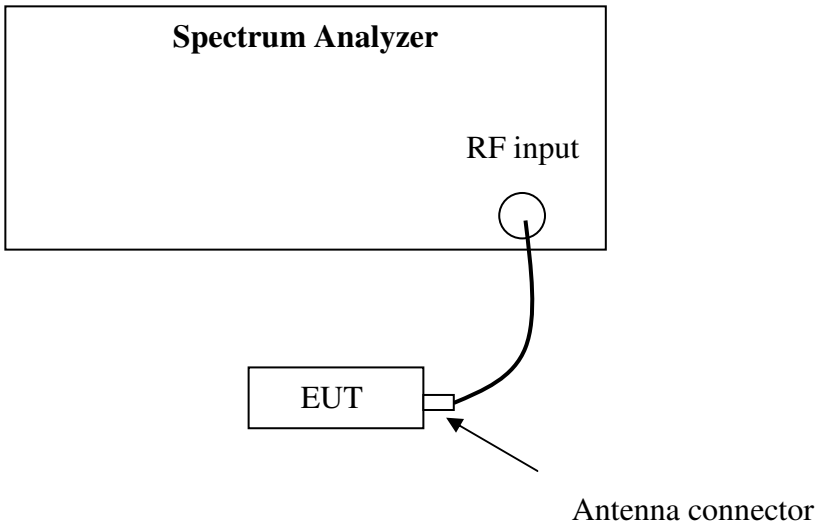
6 Emission outside the frequency band

Test result: **Pass**

6.1 Test limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

6.2 Test Configuration



6.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

Reference level measurement

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 times the *DTS bandwidth*.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x 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.

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 x 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.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

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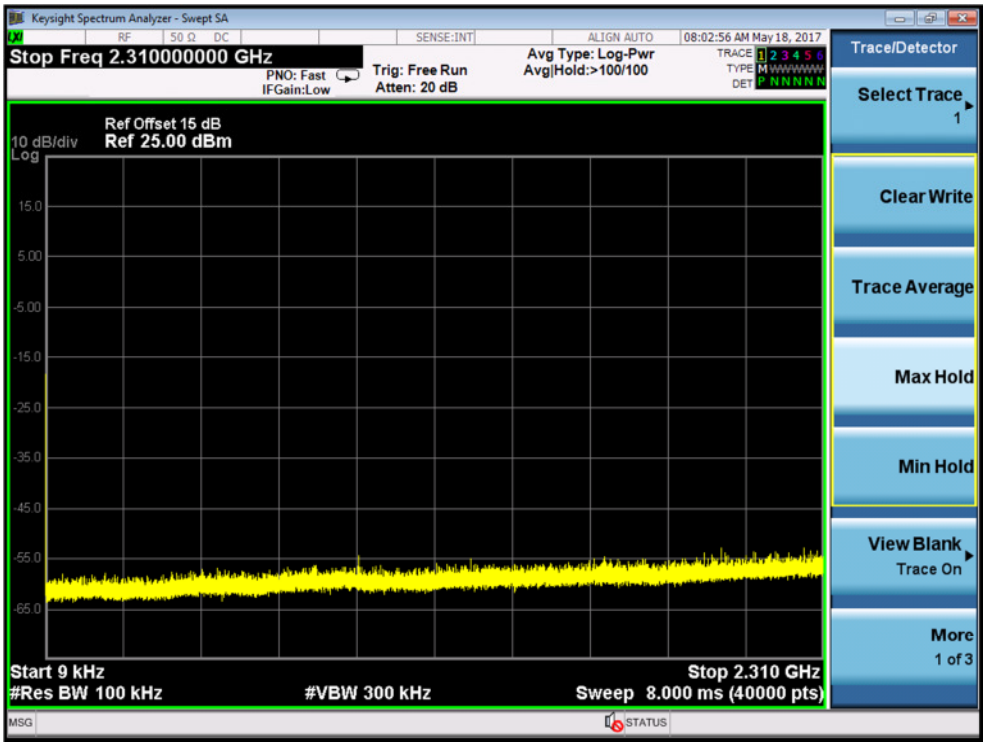
6.4 Test Protocol

Temperature: 22°C
Relative Humidity: 54%

Modulation	Channel	The most restrict Attenuation outside band (dB)	Result
O-QPSK	L	≥20	Pass
	M	≥20	Pass
	H	≥20	Pass

Channel L



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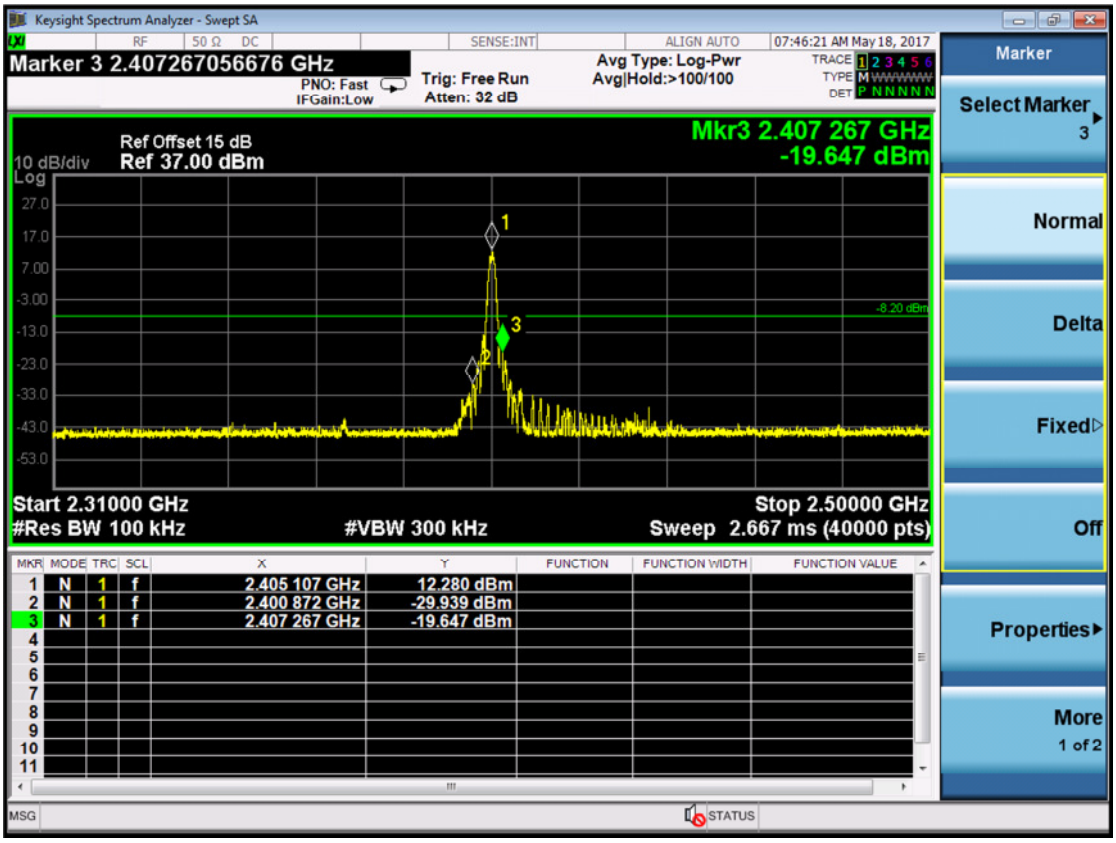
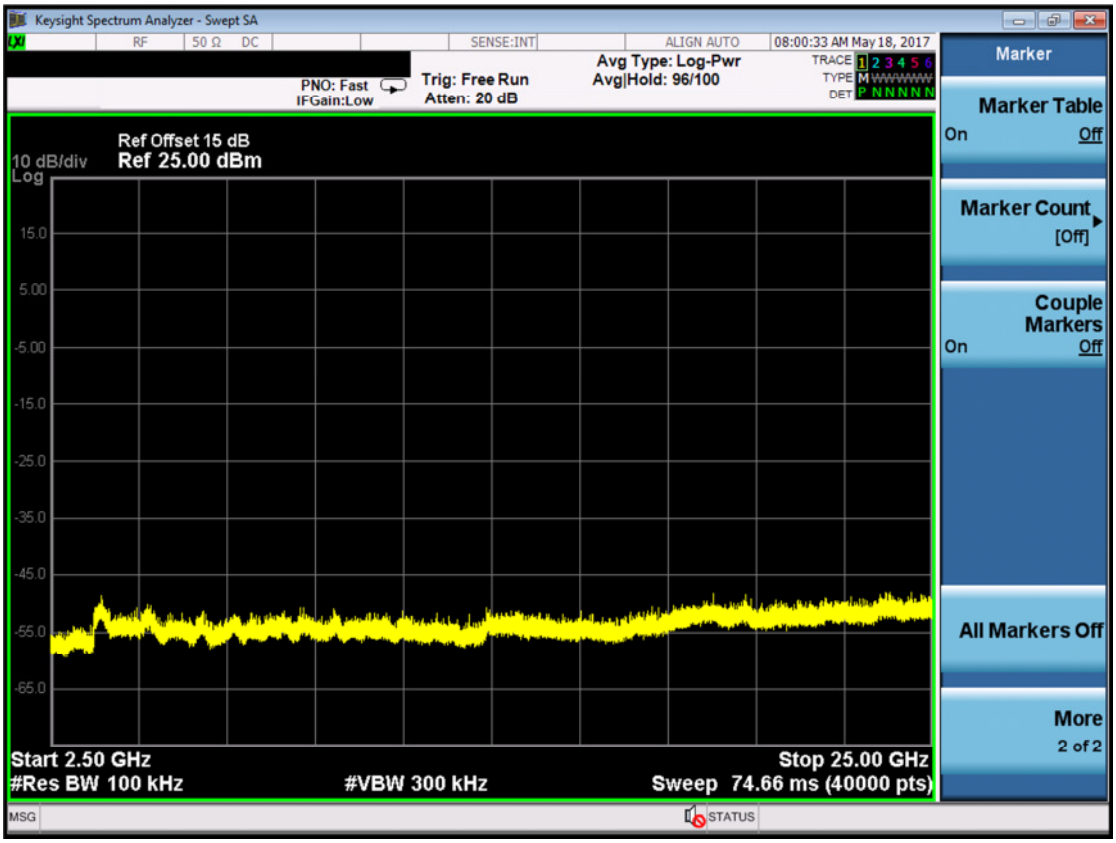
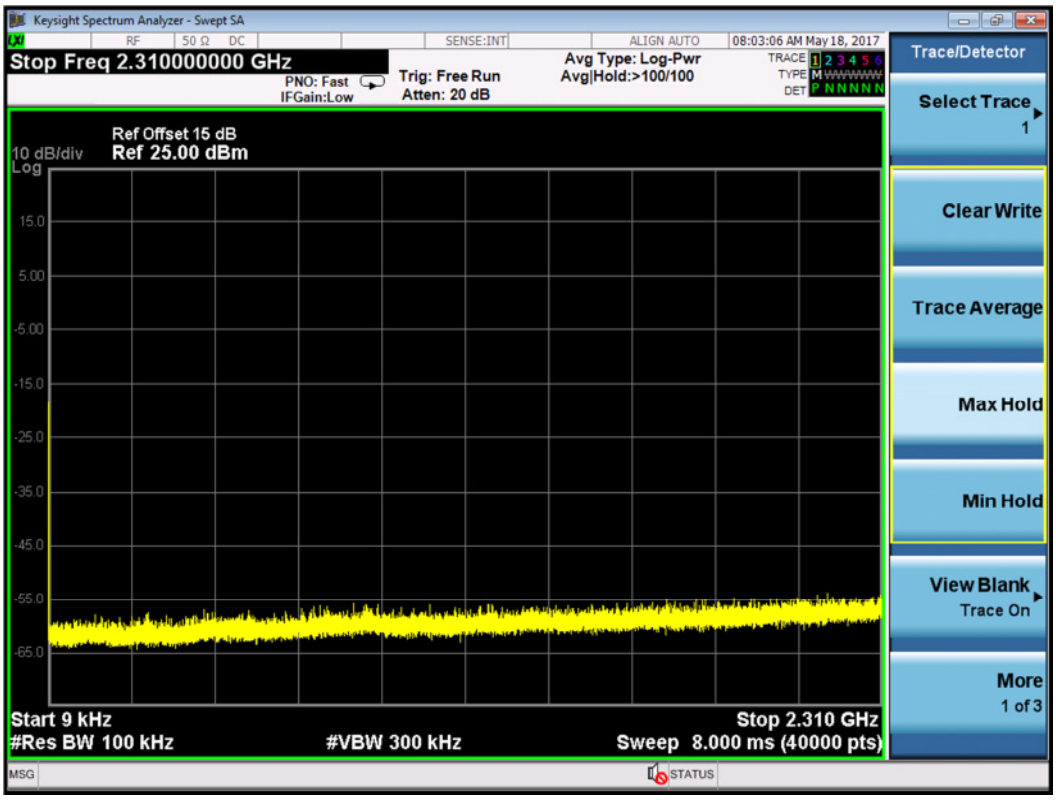
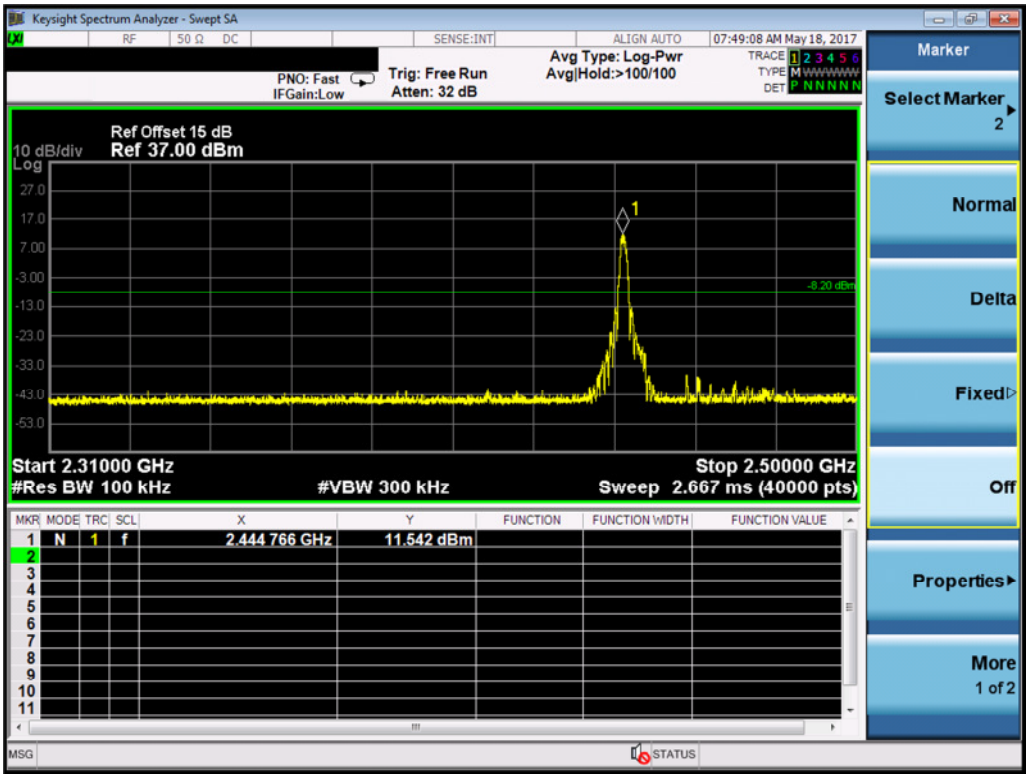
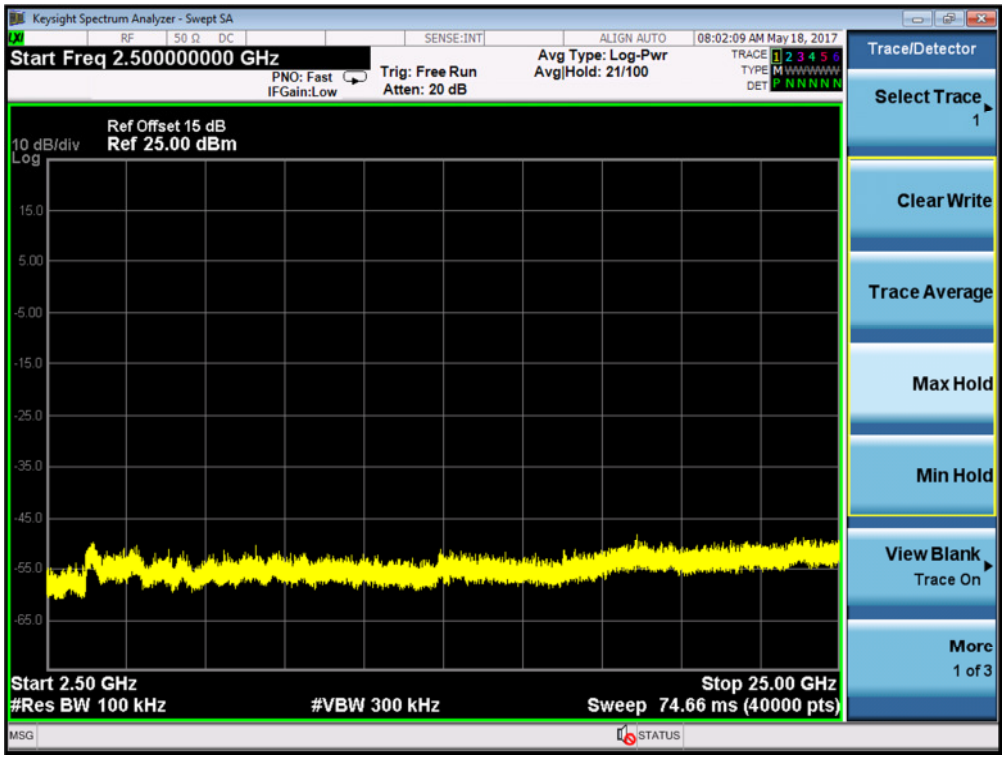

Keysight Spectrum Analyzer - Swept SA
Marker 3 2.407267056676 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 32 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
07:46:21 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 37.00 dBm
Mkr3 2.407 267 GHz
-19.647 dBm
-8.20 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40000 pts)
1 N 1 f 2.405 107 GHz 12.280 dBm
2 N 1 f 2.400 872 GHz -29.939 dBm
3 N 1 f 2.407 267 GHz -19.647 dBm
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More 1 of 2


Keysight Spectrum Analyzer - Swept SA
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 96/100
08:00:33 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 25.00 dBm
Start 2.50 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 74.66 ms (40000 pts)
Marker
Marker Table On Off
Marker Count [Off]
Couple Markers On Off
All Markers Off
More 2 of 2

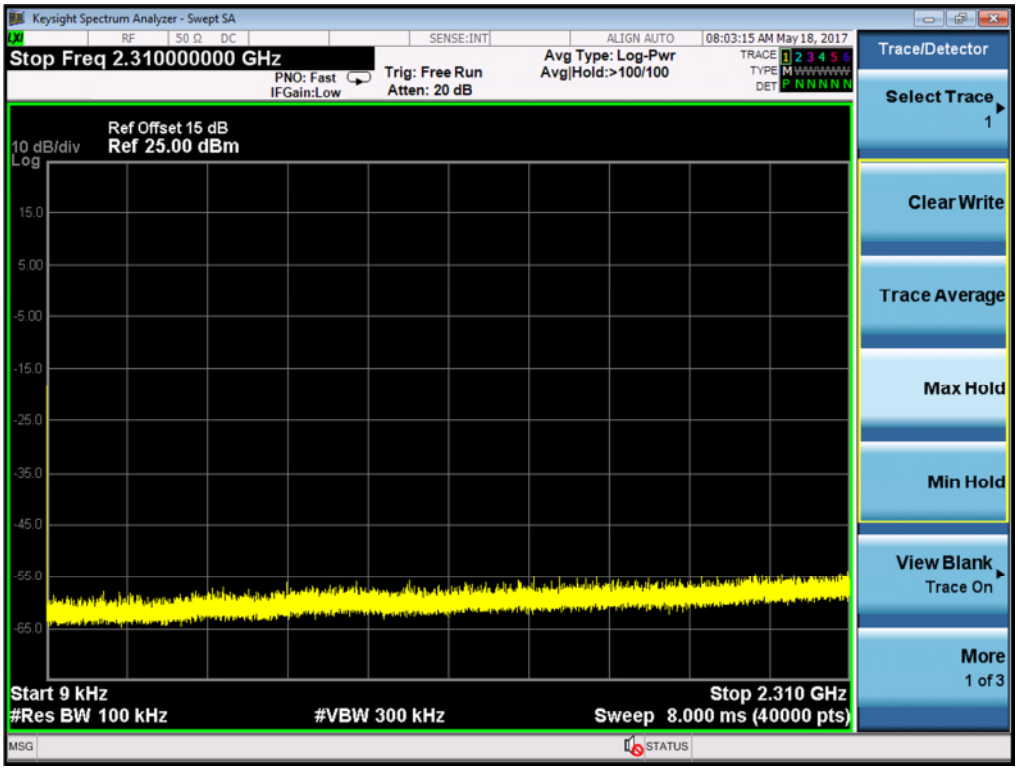
Channel M

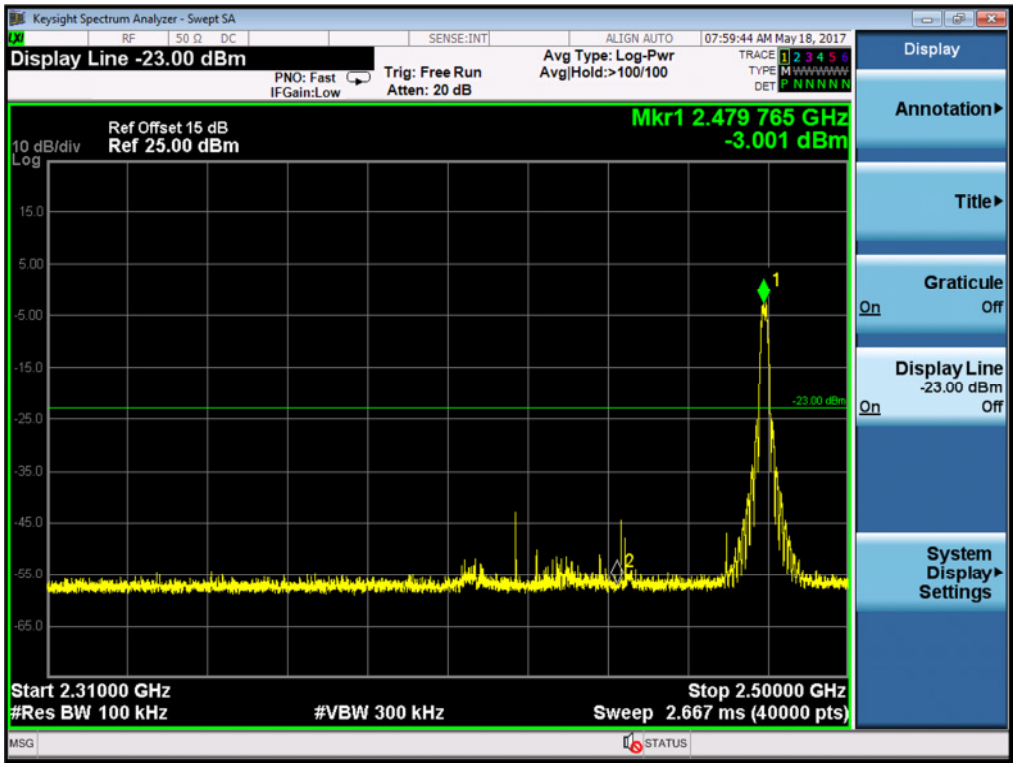

Keysight Spectrum Analyzer - Swept SA
Stop Freq 2.310000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
08:03:06 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 25.00 dBm
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40000 pts)
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3

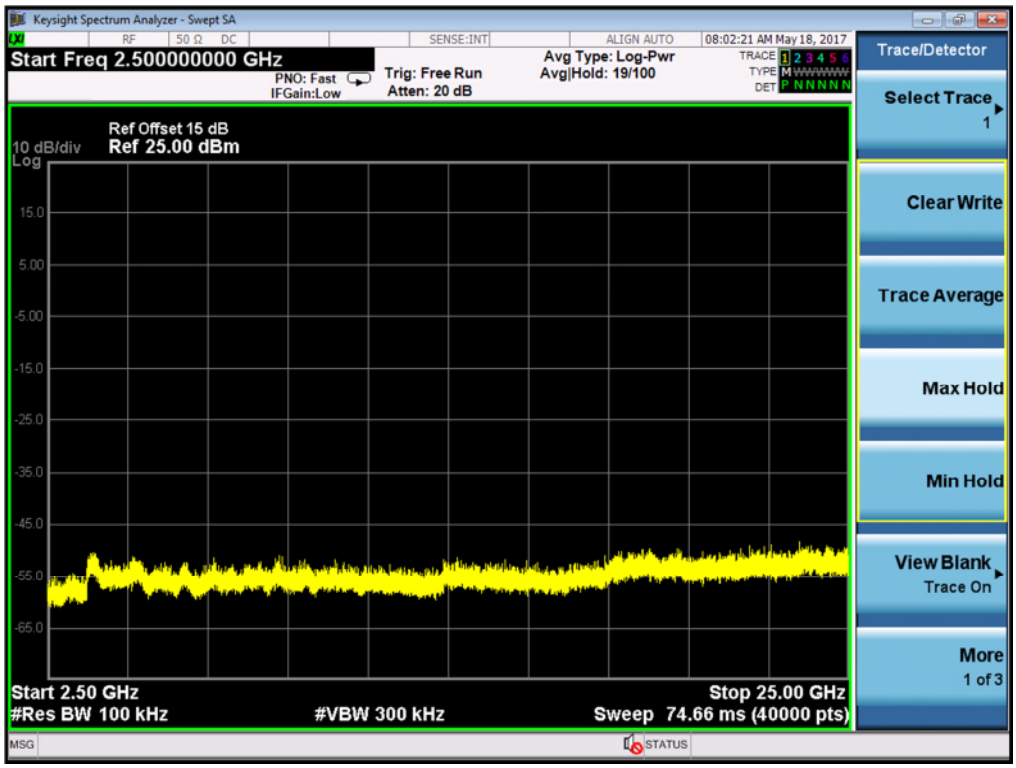

Keysight Spectrum Analyzer - Swept SA
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 32 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
07:49:08 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 37.00 dBm
Start 2.31000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.667 ms (40000 pts)
1 N 1 f 2.444 766 GHz 11.542 dBm
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Start Freq 2.500000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 21/100
08:02:09 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 25.00 dBm
Log
Start 2.50 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 74.66 ms (40000 pts)
Trace/Detector
Select Trace
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3

Channel H


Keysight Spectrum Analyzer - Swept SA
Stop Freq 2.310000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
08:03:15 AM May 18, 2017
Ref Offset 15 dB
10 dB/div
Ref 25.00 dBm
Log
Start 9 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.310 GHz
Sweep 8.000 ms (40000 pts)
Trace/Detector
Select Trace
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3





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7 Radiated Emissions in restricted frequency bands

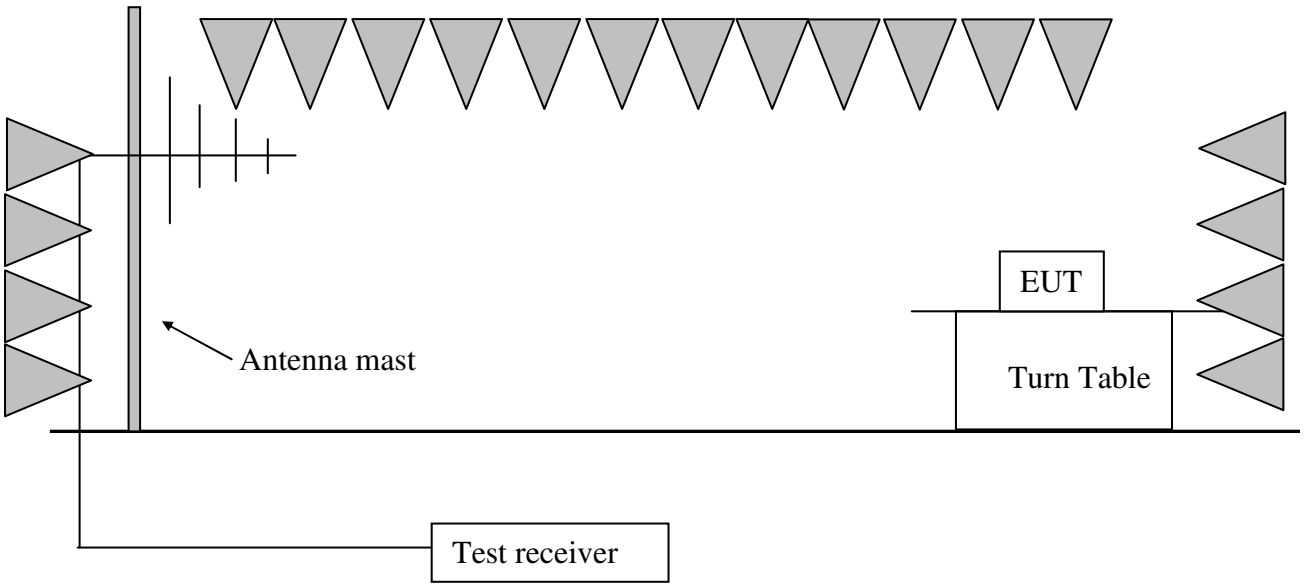
Test result: Pass

7.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

7.2 Test Configuration



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7.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DTS test procedure of KDB558074 D01 DTS "Meas Guidance" for compliance to FCC 47CFR 15.247 requirements.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

Remark:
1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Example:

Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Measured level = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m,
Measured level = 10.20dBuV/m, then Margin = 54 - 10.20 = 43.80dBuV/m.

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7.4 Test Protocol

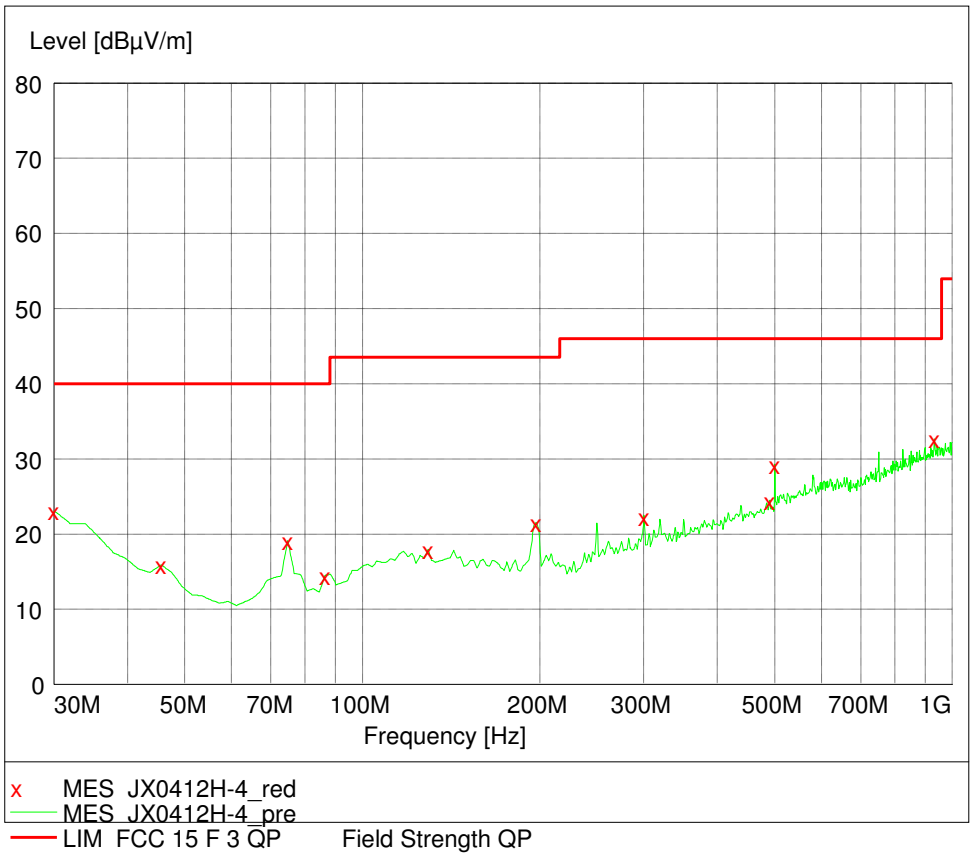
Temperature: 22°C
Relative Humidity: 54%

All the two models of product were tested and the worst data was listed in the report.

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



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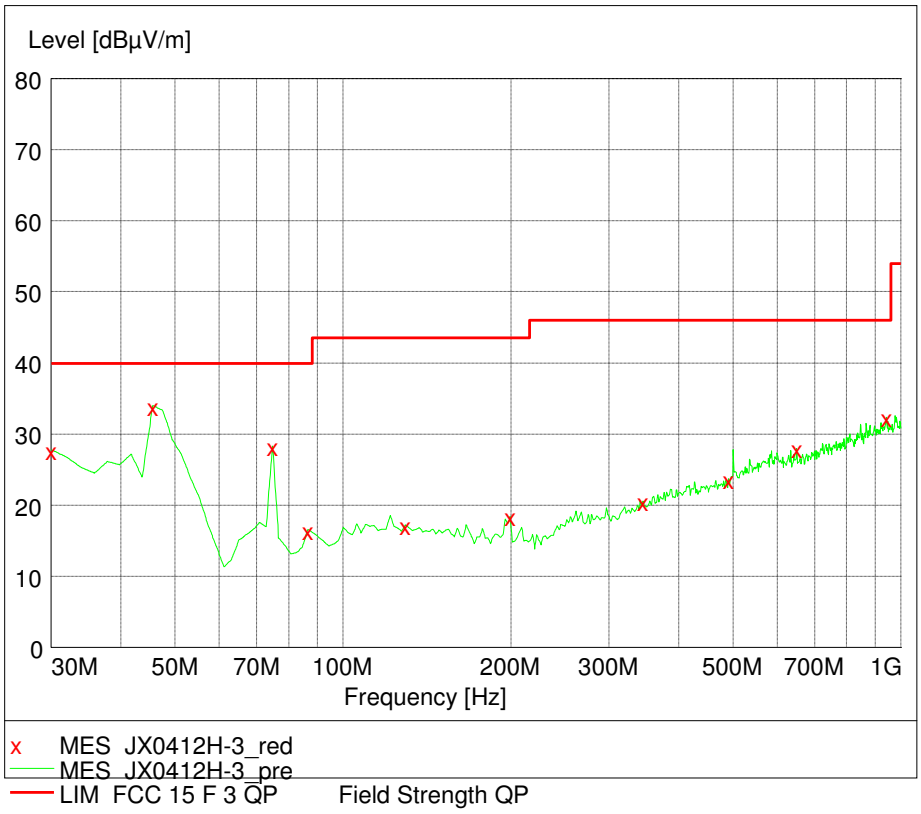
Vertical



Note: The worst test result (30MHz to 1GHz) of channel L (2405MHz) chosen to list in the report as representative.

Test result from 30MHz to 1000MHz:

Polarization	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	*	20.4	40.0	18.60	PK
	687.03	*	22.2	46.0	19.50	PK
	930.02	*	24.9	46.0	15.10	PK
V	45.55	34.00	20.4	40.0	6.00	PK
	74.70	28.3	21.4	46.0	11.70	PK
	955.29	*	25.1	46.0	*	PK

Remark: If the margin higher than 10dB, it would be marked as *.

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Test result above 1GHz:

Channel	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2405.20	107.20	34.34	Fundamental	/	PK
	H	2373.60	47.80	34.29	74.00	26.20	PK
	H	7215.42	45.70	2.30	74.00	18.02	PK
M	H	2445.28	108.00	34.48	Fundamental	/	PK
	H	7320.85	46.10	2.30	74.00	27.90	PK
H	H	2480.20	94.90	34.62	Fundamental	/	PK
	H	2483.50	61.60	34.63	74.00	12.40	PK
	H	2483.50	50.00	34.63	54.00	4.00	AV

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit – Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then
Margin = 54 -10.20 = 43.80dBuV/m

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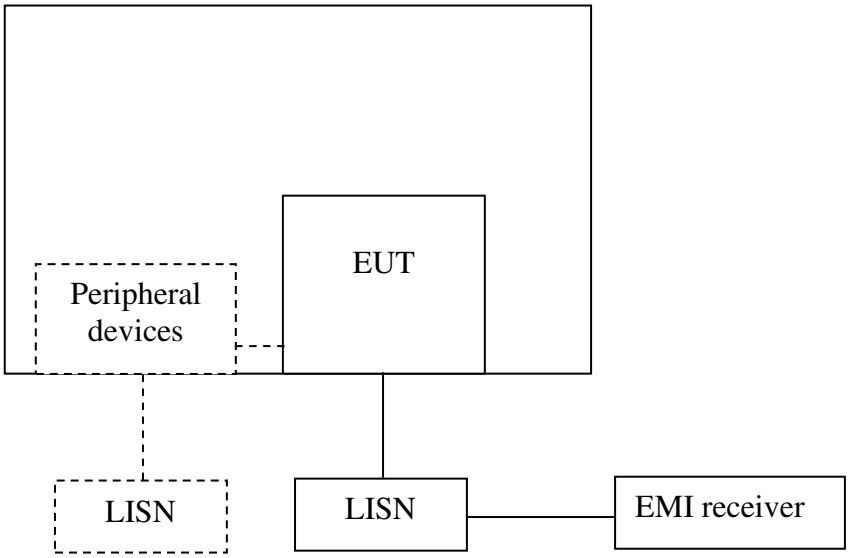
8 Power line conducted emission

Test result: **Pass**

8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

8.2 Test configuration



☐ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

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8.3 Test procedure and test set up

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

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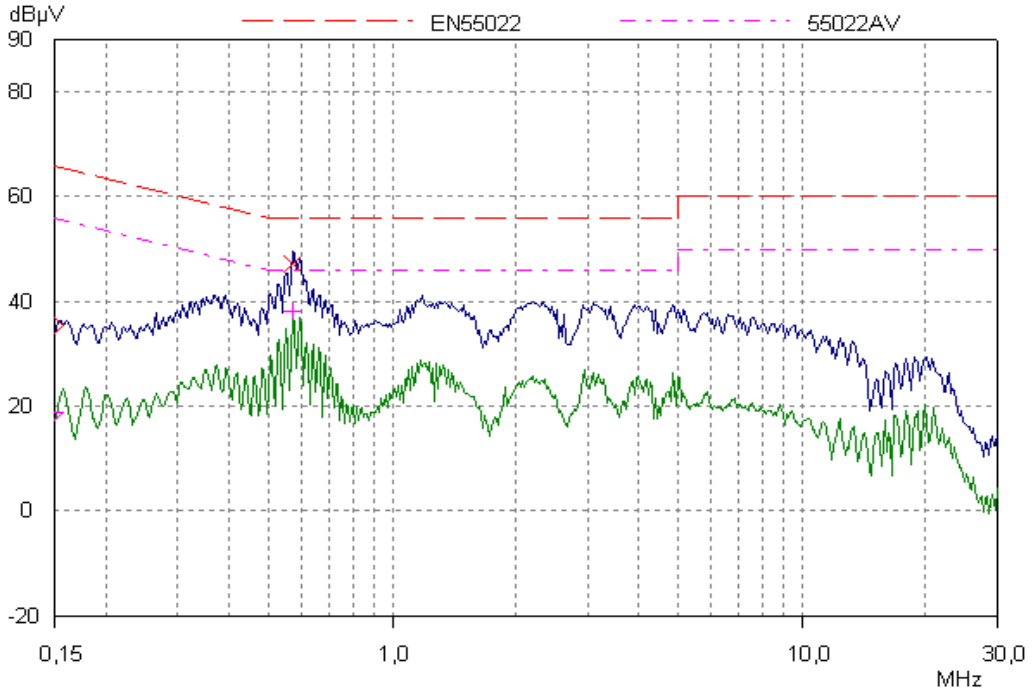
8.4 Test protocol

Temperature: 23 °C
Relative Humidity: 55 %

L line:



Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
0.38	*	*	*	*	*	*
0.57	47.07	56.00	8.93	38.10	46.00	7.90
1.50	*	*	*	*	*	*
2.65	*	*	*	*	*	*
3.41	*	*	*	*	*	*
15.26	*	*	*	*	*	*
Remark: If the margin higher than 15dB, it would be marked as *.						

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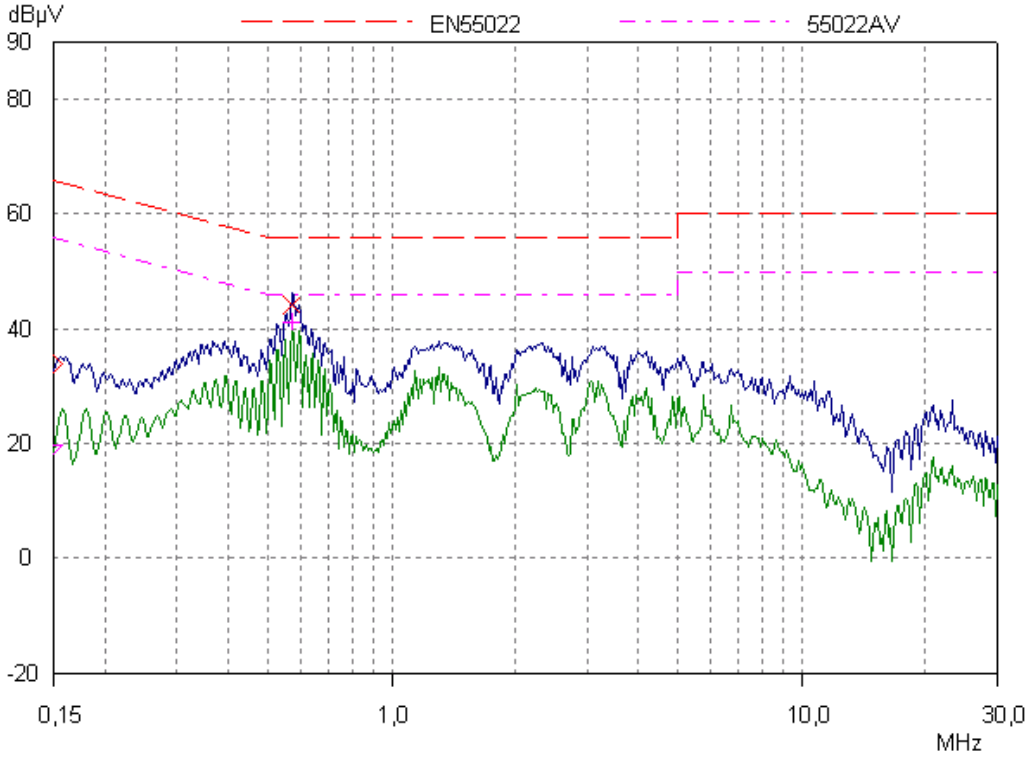
N line:



Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
0.38	*	*	*	*	*	*
0.57	44.06	56.00	11.94	41.17	46.00	4.83
1.50	*	*	*	*	*	*
2.65	*	*	*	*	*	*
3.41	*	*	*	*	*	*
15.26	*	*	*	*	*	*
Remark: If the margin higher than 20dB, it would be marked as *.						

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