FCC TEST REPORT

For

Shenzhen KingBoard Technology Co., Ltd.

BLUETOOTH SPEAKER

Model No.: PS-151

Additional Model NO. : NAT-500

Prepared for	:	Shenzhen KingBoard Technology Co., Ltd.
Address	:	Bldg. A, Dakanglong Industry Zone Dabuxiang, Guanlan, Shenzhen, China
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	May 10, 2016
Number of tested samples	:	1
Serial number	:	/
Date of Test	:	May 10, 2016 - May 26, 2016
Date of Report	:	May 26, 2016

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FCC TEST REPORT
FCC CFR 47 PART 15 C(15.247): 2015

Report Reference No.	**:**	**LCS1605120990E**
Date of Issue.....	:	May 26, 2016
Testing Laboratory Name	**:**	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards ☐ Other standard testing method ☐
Applicant's Name	**:**	**Shenzhen KingBoard Technology Co., Ltd.**
Address.....	:	Bldg. A, Dakanglong Industry Zone Dabuxiang, Guanlan, Shenzhen, China
Test Specification		
Standard.....	:	FCC CFR 47 PART 15 C(15.247): 2015
Test Report Form No.	**:**	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	:	Dated 2011-03

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Test Item Description.....	**:**	**BLUETOOTH SPEAKER**
Trade Mark.....	:	N/A
Model/ Type reference	:	PS-151
Ratings.....	:	See more details at section 1.1
Result	:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Dick Su		Gavin Liang
Dick Su/ File administrators	Glin Lu / Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : LCS1605120990E	May 26, 2016 Date of issue

Type / Model.....	: PS-151
EUT.....	: BLUETOOTH SPEAKER
Applicant.....	**: Shenzhen KingBoard Technology Co., Ltd.**
Address.....	: Bldg. A, Dakanglong Industry Zone Dabuxiang, Guanlan, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen KingBoard Technology Co., Ltd.**
Address.....	: Bldg. A, Dakanglong Industry Zone Dabuxiang, Guanlan, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Factory.....	**: Shenzhen KingBoard Technology Co., Ltd.**
Address.....	: Bldg. A, Dakanglong Industry Zone Dabuxiang, Guanlan, Shenzhen, China
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
00	May 26, 2016	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT : BLUETOOTH SPEAKER
(***Note: The EUT consists of one hand shank, one bed plate, the bed plate is a loudspeaker.)

Model No. : PS-151

Hardware Version : V4

Software Version : V 1.1

Additional Model No.: NAT-500

Frequency Range : 2.402-2.480GHz

Channel Number : 40 channels

Channel frequency : 2402.00-2480.00MHz (Channel Number: 40,
Channel Frequency=2402+2(K-1), K=1, 2, 3 ……40);

Channel Spacing : 2MHz

Modulation Type : GFSK

Bluetooth Version : V4.0

Antenna Gain : Internal antenna, -1.0 dBi (Max.)

Power Supply : hand shank: DC 3.7 V by Lithium ion polymer Battery (500mAh)
Recharge Voltage: 5V⎓, 1A
bed plate: DC 3.7 V by Lithium ion polymer Battery (1000mAh)
Recharge Voltage: 5V⎓, 1A

Additional models No.			
NAT-500	--	--	--
Remark: PCB board, structure and internal of these model(s) are the same, So no additional models were tested.			

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
--	--	--	--	--

1.3. External I/O

I/O Port Description	Quantity	Cable
Micro USB Port	1	N/A
A USB Port	1	N/A
Audio Out	1	N/A
TF Card Slot	1	N/A

1.4. Description of Test Facility

Site Description

EMC Lab. : CNAS Registration Number. is L4595.
FCC Registration Number. is 899208.
Industry Canada Registration Number. is 9642A-1.
VCCI Registration Number. is C-4260 and R-3804.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001

Name of Firm : Shenzhen LCS Compliance Testing Laboratory Ltd.

Site Location : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	3.10dB	(1)
		30MHz~200MHz	2.96dB	(1)
		200MHz~1000MHz	3.10dB	(1)
		1GHz~26.5GHz	3.80dB	(1)
		26.5GHz~40GHz	3.90dB	(1)
Conduction Uncertainty	:	170kHz~30MHz	1.63dB	(1)
Power disturbance	:	30MHz~300MHz	1.60dB	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7. Description of Test Modes

Bluetooth operates in the unlicensed ISM Band at 2.4GHz. The following operating modes were applied for the related test items.
This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position. During test, the EUT is set to transmit in 100% duty cycle. And its related average correction factor is 0.
All test modes were tested, only the result of the worst case was recorded in the report.

Mode of Operations	Frequency Range (MHz)	Data Rate (Mbps)
GFSK	2402	1
	2440	1
	2480	1
For Conducted Emission		
Test Mode	TX Mode	
For Radiated Emission		
Test Mode	TX Mode	

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013 and KDB558074 D01 v03r03, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements of ANSI C63.10:2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, The EUT was placed on the top of the turntable 0.8 meter above ground below 1GHz and above 1GHz test at 1.5 mete above ground. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements of ANSI C63.10-2013.

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

N/A

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	**Description of Test**	**Result**
§15.247(b)	Maximum Conducted Output Power	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	6dB Bandwidth	Compliant
§15.247(a)	Occupied Bandwidth	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	Compliant
§15.205	Emissions at Restricted Band	Compliant
§15.207(a)	Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant

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5. SUMMARY OF TEST EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	EMC Receiver	R&S	ESCS 30	100174	2015-06-18	2016-06-17
2	Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	2015-07-16	2016-07-15
3	LISN	MESS Tec	NNB-2/16Z	99079	2015-06-18	2016-06-17
4	LISN (Support Unit)	EMCO	3819/2NM	9703-1839	2015-06-18	2016-06-17
5	RF Cable-CON	UTIFLEX	3102-26886-4	CB049	2015-06-18	2016-06-17
6	ISN	SCHAFFNER	ISN ST08	21653	2015-06-18	2016-06-17
7	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2015-06-18	2016-06-17
8	Amplifier	SCHAFFNER	COA9231A	18667	2015-06-18	2016-06-17
9	Amplifier	Agilent	8449B	3008A02120	2015-07-16	2016-07-15
10	Amplifier	MITEQ	AMF-6F-260400	9121372	2015-07-16	2016-07-15
11	Spectrum Analyzer	Agilent	E4407B	MY41440292	2015-07-16	2016-07-15
12	Loop Antenna	R&S	HFH2-Z2	860004/001	2015-06-18	2016-06-17
13	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2015-06-10	2016-06-09
14	Horn Antenna	EMCO	3115	6741	2015-06-10	2016-06-09
15	Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	2015-06-10	2016-06-09
16	RF Cable-R03m	Jye Bao	RG142	CB021	2015-06-18	2016-06-17
17	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2015-06-18	2016-06-17
18	Spectrum Meter	R&S	FSP 30	100023	2015-07-16	2016-07-15
19	Power Meter	R&S	NRVS	100444	2015-06-18	2016-06-17
20	Power Sensor	R&S	NRV-Z51	100458	2015-06-18	2016-06-17
21	Power Sensor	R&S	NRV-Z32	10057	2015-06-18	2016-06-17
22	AC Power Source	HPC	HPA-500E	HPA-9100024	2015-06-18	2016-06-17
23	DC power Soure	GW	GPC-6030D	C671845	2015-06-18	2016-06-17
24	Temp. and Humidigy Chamber	Giant Force	GTH-225-20-S	MAB0103-00	2015-06-18	2016-06-17
25	RF CABLE-1m	JYE Bao	RG142	CB034-1m	2015-06-18	2016-06-17
26	RF CABLE-2m	JYE Bao	RG142	CB)35-2m	2015-06-18	2016-06-17
27	Vector signal Generator	R&S	SMU200A	102098	2015-06-18	2016-06-17
28	Signal Generator	R&S	SMR40	10016	2015-07-16	2016-07-15

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29	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2015-10-27	2016-10-26
30	Temporary Antenna Connector	ALT	E203950	N/A	2015-07-18	2016-07-17

6. TEST RESULT

6.1. Maximum Conducted Output Power Measurement

6.1.1. Standard Applicable

According to §15.247(b) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.

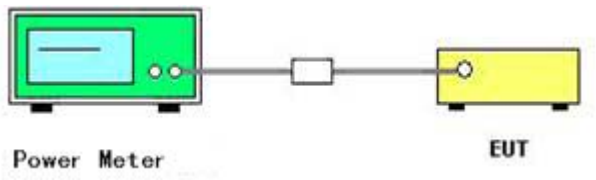
6.1.2. Measuring Instruments

Please refer to section 6 of equipments list in this report.

6.1.3. Test Procedures

The transmitter output (antenna port) was connected to the power meter.

6.1.4. Test Setup Layout



6.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.1.6. Test Result of Maximum Conducted Output Power (Peak)

Modulation	Frequency (MHz)	Peak Output Power (dBm)	Peak Output Power (mW)	Limit (mW)	Result
GFSK	2402	-2.68	0.539	1000	Pass
	2440	-2.14	0.611	1000	Pass
	2480	-2.88	0.515	1000	Pass

6.2. Power Spectral Density Measurement

6.2.1. Standard Applicable

According to §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.

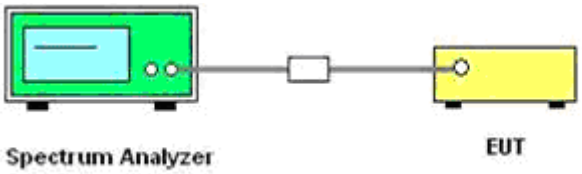
6.2.2. Measuring Instruments

Please refer to section 6 of equipments list in this report.

6.2.3. Test Procedures

1. The transmitter was connected directly to a Spectrum Analyzer through a directional couple.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 3 kHz.
4. Set the VBW ≥ 3*RBW.
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental EBW.

6.2.4. Test Setup Layout



6.2.5. EUT Operation during Test

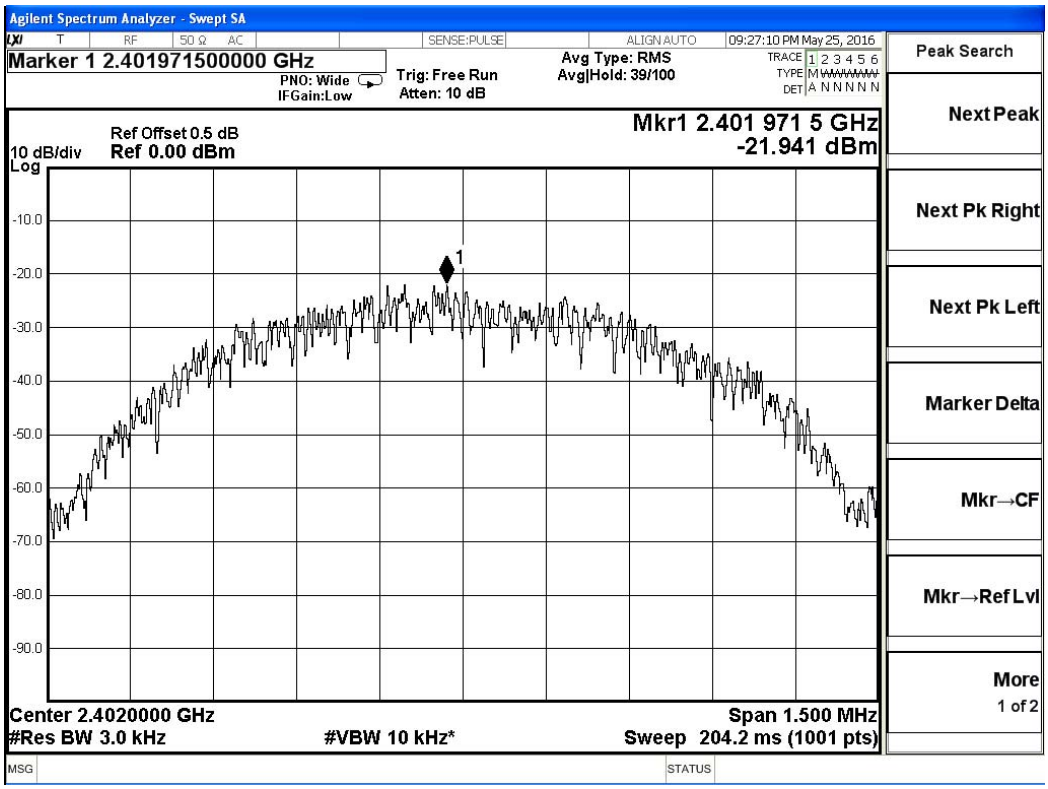
The EUT was programmed to be in continuously transmitting mode.

6.2.6. Test Result of Power Spectral Density

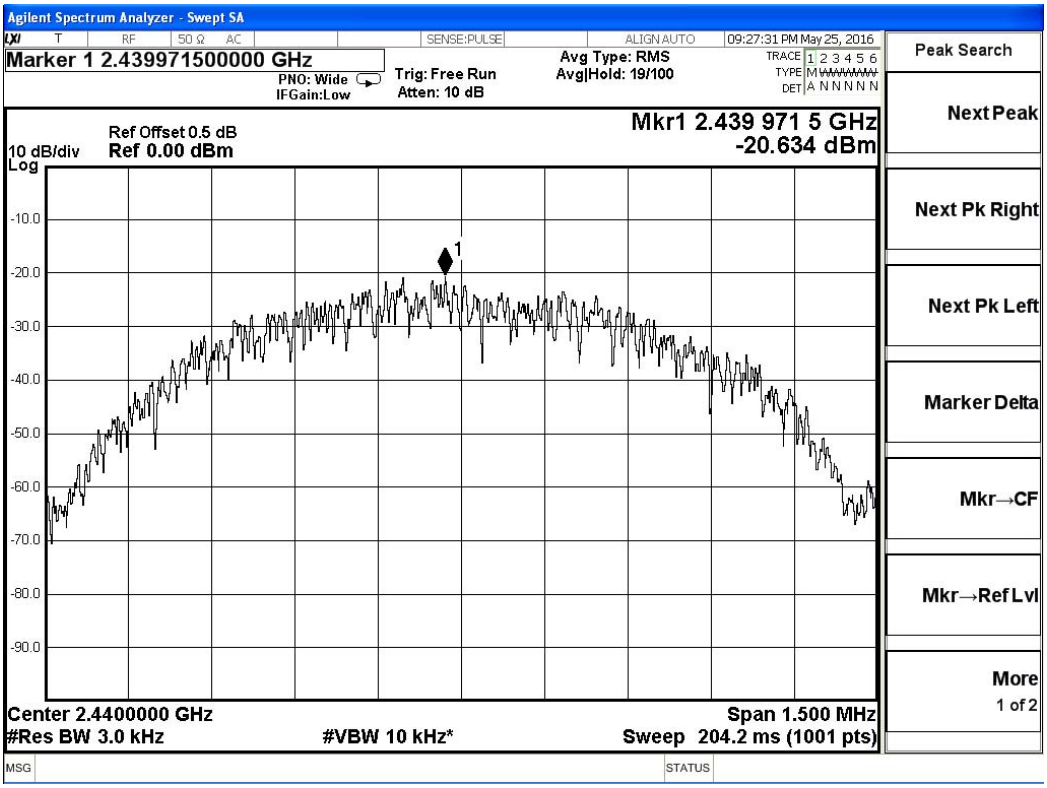
Modulation	Frequency (MHz)	Reading Level (dBm/3KHz)	Max. Limit (dBm/3KHz)	Result
GFSK	2402	-21.941	8	Pass
	2440	-20.634	8	Pass
	2480	-19.882	8	Pass

The test data refer to the following page.

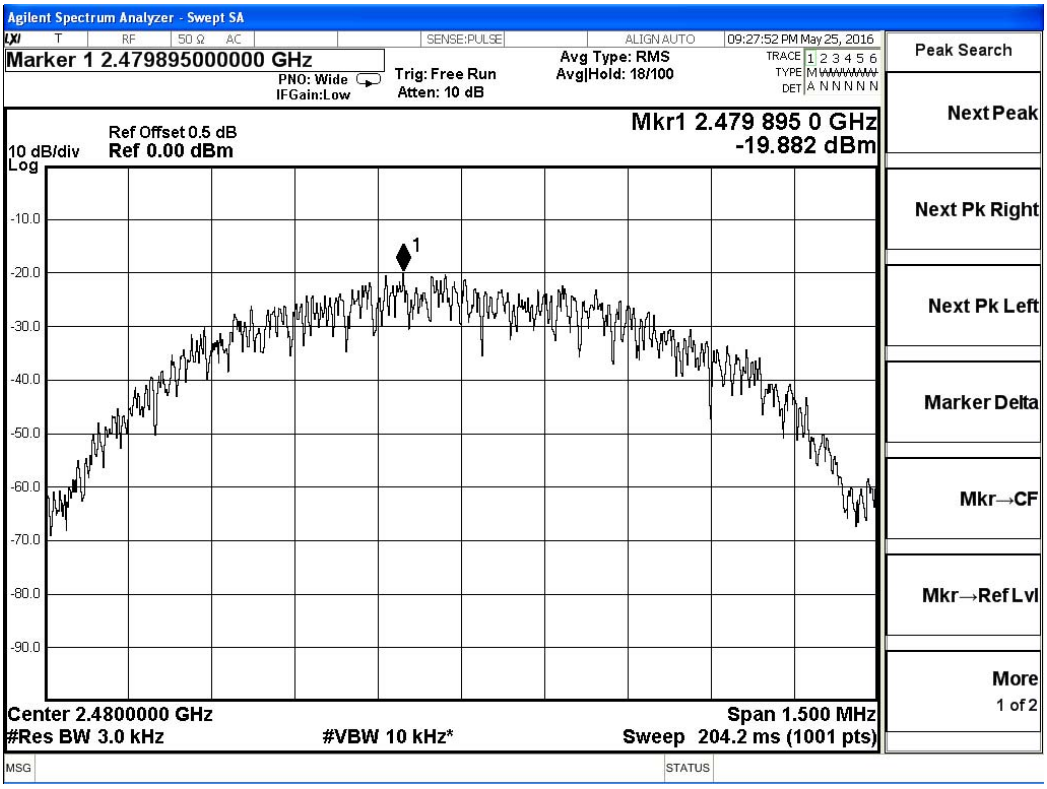
Low Channel, 2402MHz



Middle Channel, 2440MHz



High Channel, 2480MHz



6.3. 6 dB Spectrum Bandwidth Measurement

6.3.1. Standard Applicable

According to §15.247(a)(2) For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

6.3.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> RBW
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

6.3.3. Test Procedures

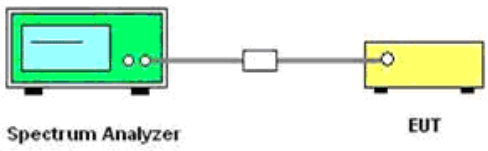
1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.

2. The resolution bandwidth and the video bandwidth were set according to ANSI C63.10:2013 bandwidth measurement method.

RBW=1%-5% OBW, VBW≥3RBW

3. Measured the spectrum width with power higher than 6dB below carrier.

6.3.4. Test Setup Layout



6.3.5. EUT Operation during Test

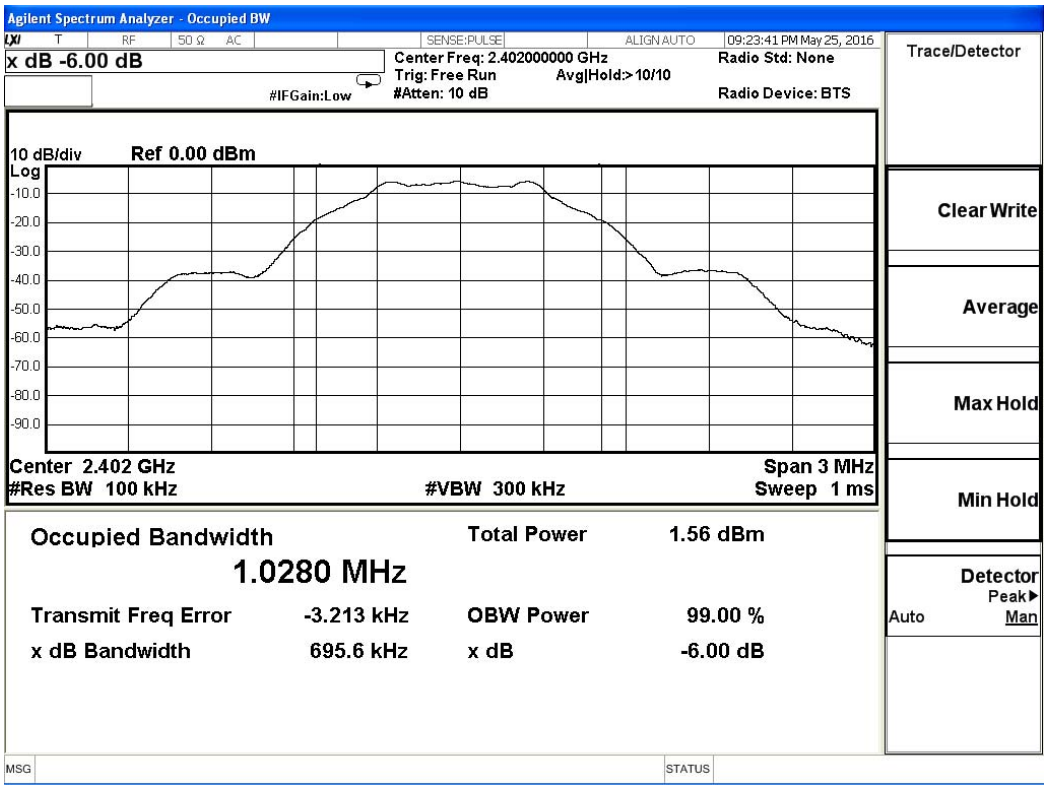
The EUT was programmed to be in continuously transmitting mode.

6.3.6. Test Result of 6dB Spectrum Bandwidth

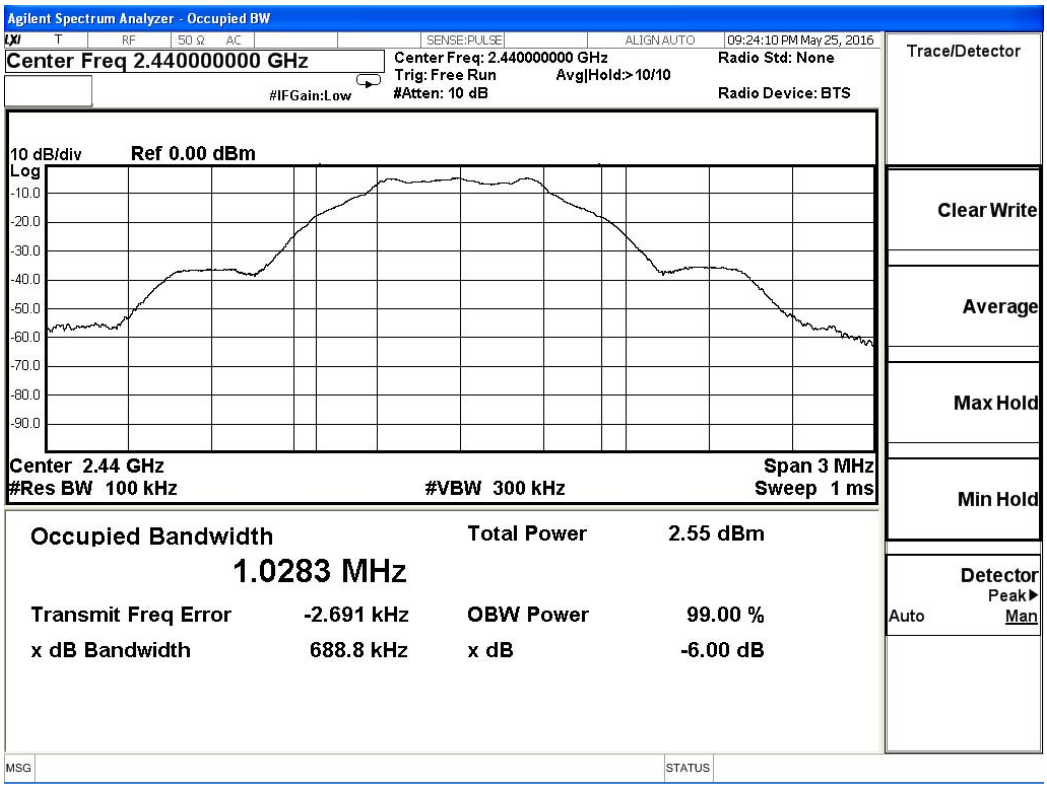
Modulation	Frequency (MHz)	6dB Bandwidth (KHz)	Min. Limit (KHz)	Result
GFSK	2402	695.6	500	Complies
	2440	688.8	500	Complies
	2480	692.8	500	Complies

The test data refer to the following page.

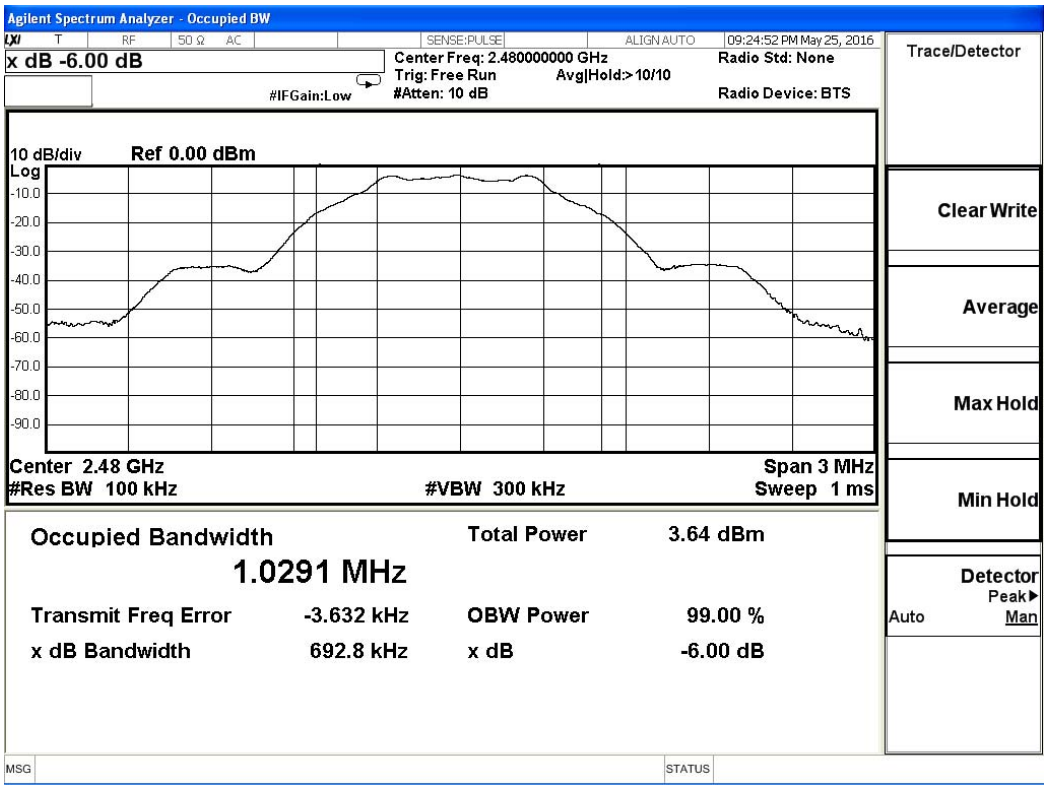
Low Channel, 2402MHz



Middle Channel, 2440MHz

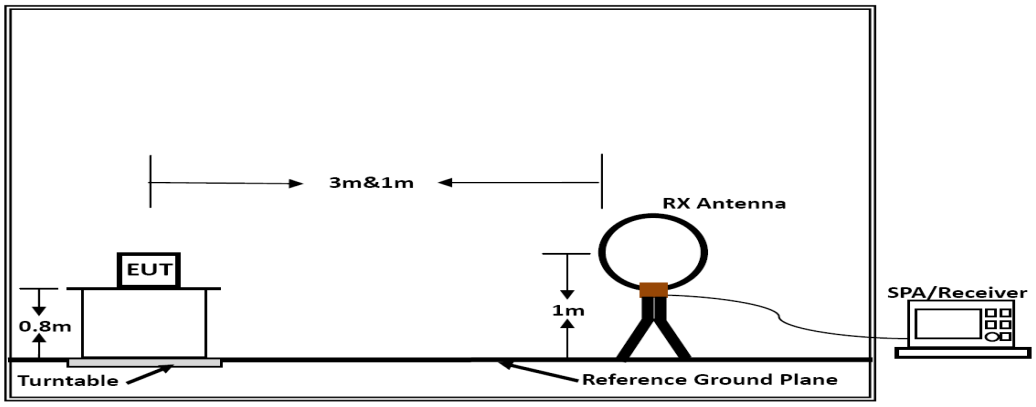


High Channel, 2480MHz

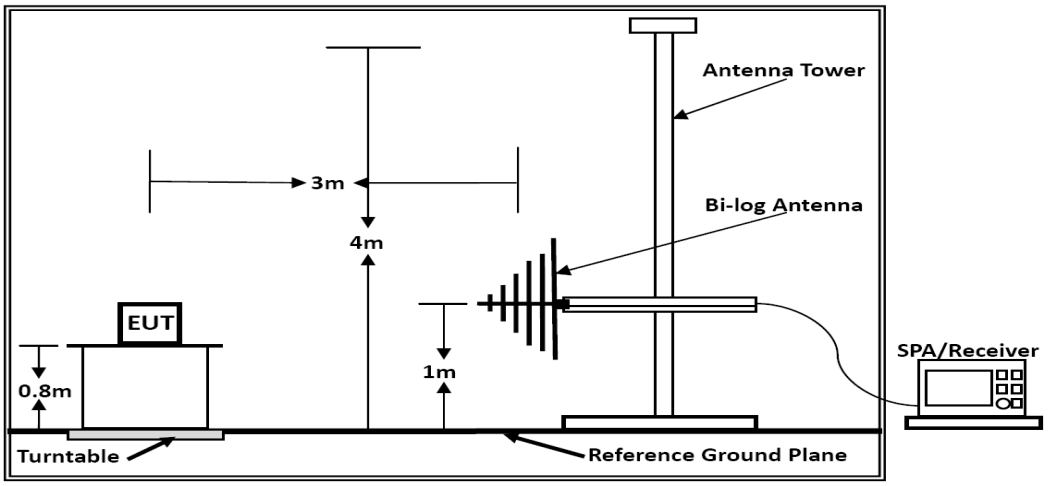


6.4. Radiated Emissions Measurement

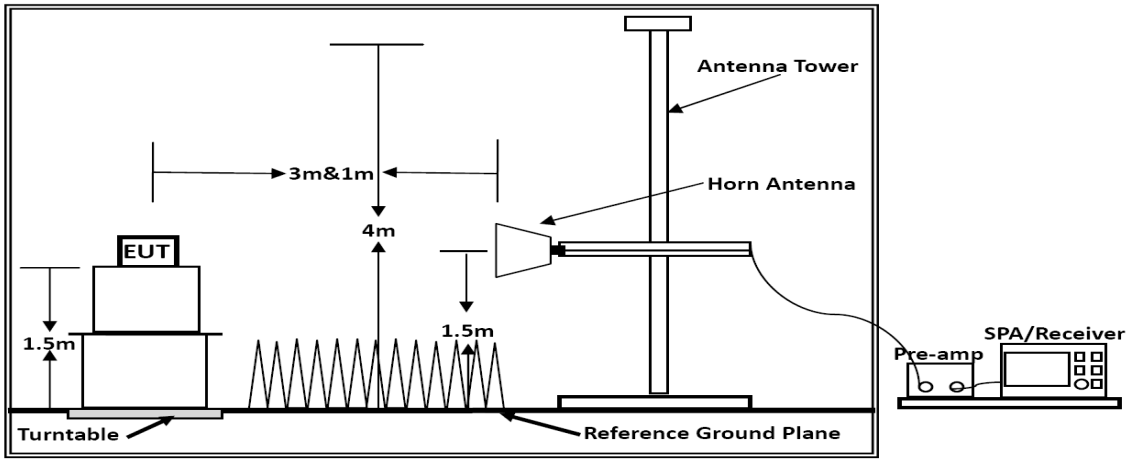
6.4.1. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1.5m.

Distance extrapolation factor = 20 log (specific distanc [3m] / test distance [1.5m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

6.4.2. Standard Applicable

According to §15.247 (d) 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

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	170	3
216~960	200	3
Above 960	500	3

6.4.3. Measuring Instruments and Setting

Please refer to section 6 of equipment's list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average

Spectrum Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

6.4.4 Test Procedures

1) **Sequence of testing 9 kHz to 30 MHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 1.5 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

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2) **Sequence of testing 30 MHz to 1 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) **Sequence of testing 1 GHz to 18 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

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4) **Sequence of testing above 18 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

6.4.5 Results for Radiated Emissions

PASS.

Only record the worst test result in this report.
The test data please refer to following page:

6.4.6. Results of Radiated Emissions (9 kHz~30MHz)

Temperature	25℃	Humidty	60%
Test Engineer	Dick	Configurations	BT V4.0

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

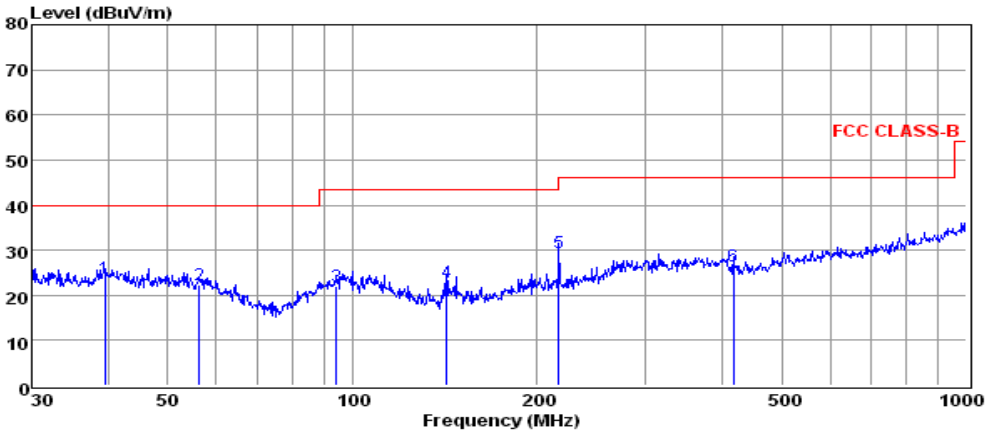
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

6.4.7. Results of Radiated Emissions (30MHz~1GHz)

PASS.

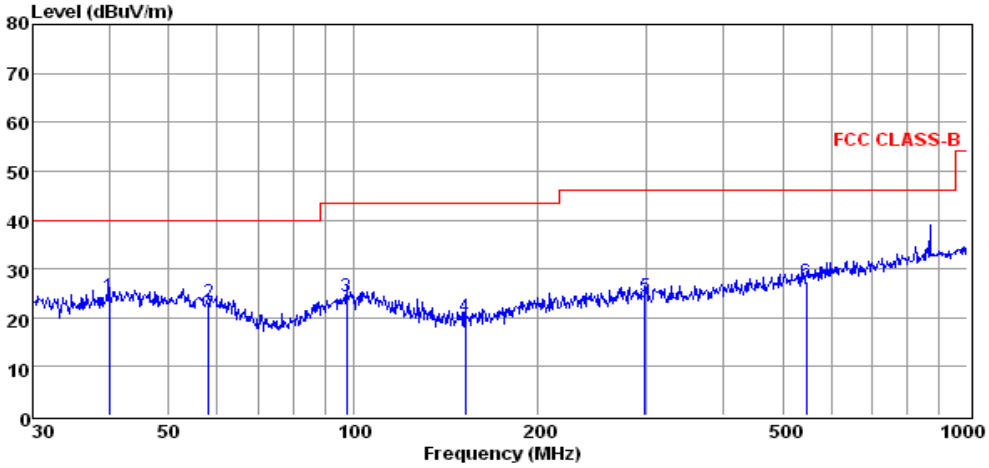
The test data please refer to following page:



Env./Ins: 24℃/56%
pol: HORIZONTAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	39.44	9.97	0.38	13.44	23.79	40.00	-16.21	QP
2	56.20	8.75	0.47	12.94	22.16	40.00	-17.84	QP
3	94.10	8.83	0.58	12.67	22.08	43.50	-21.42	QP
4	142.32	13.83	0.71	8.21	22.75	43.50	-20.75	QP
5	216.78	17.52	0.88	11.10	29.50	46.00	-16.50	QP
6	417.64	9.73	1.32	15.42	26.47	46.00	-19.53	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported



Env./Ins: 24℃/56%
pol: VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	39.99	10.29	0.38	13.58	24.25	40.00	-15.75	QP
2	58.00	9.82	0.47	12.82	23.11	40.00	-16.89	QP
3	97.46	10.84	0.61	13.00	24.45	43.50	-19.05	QP
4	152.13	11.24	0.73	8.35	20.32	43.50	-23.18	QP
5	298.27	10.24	1.12	13.03	24.39	46.00	-21.61	QP
6	547.10	8.58	1.45	17.46	27.49	46.00	-18.51	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that ate 20db blow the offficial limit are not reported

****Note: Pre-scan all modes and recorded the worst case results in this report.*

6.4.8. Results for Radiated Emissions (Above 1GHz)

Channel 1

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4804.00	43.35	33.06	35.04	3.94	45.31	74	-28.69	Peak	Horizontal
4804.00	36.01	33.06	35.04	3.94	37.97	54	-16.03	Average	Horizontal
4804.00	41.06	33.06	35.04	3.94	43.02	74	-30.98	Peak	Vertical
4804.00	33.39	33.06	35.04	3.94	35.35	54	-18.65	Average	Vertical

Channel 20

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4880.00	42.81	33.16	35.15	3.96	44.78	74	-29.22	Peak	Horizontal
4880.00	36.99	33.16	35.15	3.96	38.96	54	-15.04	Average	Horizontal
4880.00	37.82	33.16	35.15	3.96	39.79	74	-34.21	Peak	Vertical
4880.00	36.78	33.16	35.15	3.96	38.75	54	-15.25	Average	Vertical

Channel 40

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4960.00	39.06	33.26	35.14	3.98	41.16	74	-32.84	Peak	Horizontal
4960.00	27.18	33.26	35.14	3.98	29.28	54	-24.72	Average	Horizontal
4960.00	46.97	33.26	35.14	3.98	49.07	74	-24.93	Peak	Vertical
4960.00	38.89	33.26	35.14	3.98	40.99	54	-13.01	Average	Vertical

Notes:

1. *Measuring frequencies from 9k~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.*
2. *Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.*
3. *Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*

6.4.9. Results for Band edge Testing (Radiated)

Tx-2402

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
2365.05	44.93	32.89	35.16	3.51	46.17	74	-27.83	Peak	Horizontal
2364.66	32.15	32.90	35.16	3.51	33.40	54	-20.60	Average	Horizontal
2400.00	47.61	32.92	35.16	3.54	48.91	74	-25.09	Peak	Horizontal
2400.00	38.28	32.92	35.16	3.54	39.58	54	-14.42	Average	Horizontal
2380.07	41.53	32.89	35.16	3.51	42.77	74	-31.23	Peak	Vertical
2381.71	34.22	32.90	35.16	3.51	35.47	54	-18.53	Average	Vertical
2400.00	49.32	32.92	35.16	3.54	50.62	74	-23.38	Peak	Vertical
2400.00	38.48	32.92	35.16	3.54	39.78	54	-14.22	Average	Vertical

Tx-2480

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
2483.50	53.17	33.06	35.18	3.60	54.65	74	-19.35	Peak	Horizontal
2483.50	36.43	33.08	35.18	3.60	37.93	54	-16.07	Average	Horizontal
2490.60	44.33	33.08	35.18	3.62	45.85	74	-28.15	Peak	Horizontal
2490.68	36.62	33.08	35.18	3.62	38.14	54	-15.86	Average	Horizontal
2483.50	49.98	33.06	35.18	3.60	51.46	74	-22.54	Peak	Vertical
2483.50	32.49	33.08	35.18	3.60	33.99	54	-20.01	Average	Vertical
2497.62	42.92	33.08	35.18	3.62	44.44	74	-29.56	Peak	Vertical
2497.76	32.85	33.08	35.18	3.62	34.37	54	-19.63	Average	Vertical

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6.5. Conducted Spurious Emissions and Band Edges Test

6.5.1. Standard Applicable

According to §15.247 (d) & A8.5: 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. Attenuation below the general limits specified in Section 15.209(a) is not required. 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)).

6.5.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
RB / VB (Emission in restricted band)	100KHz/300KHz
RB / VB (Emission in non-restricted band)	100KHz/300KHz

6.5.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

6.5.4. Test Setup Layout

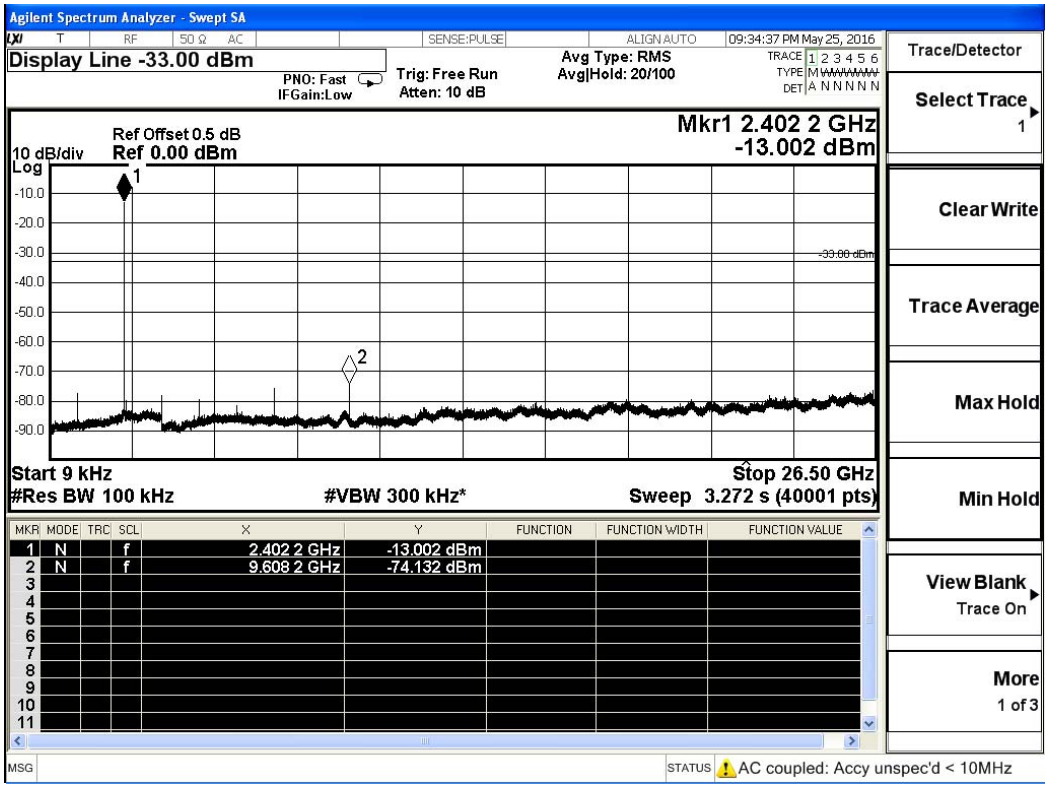
This test setup layout is the same as that shown in section 5.4.4.

6.5.5. EUT Operation during Test

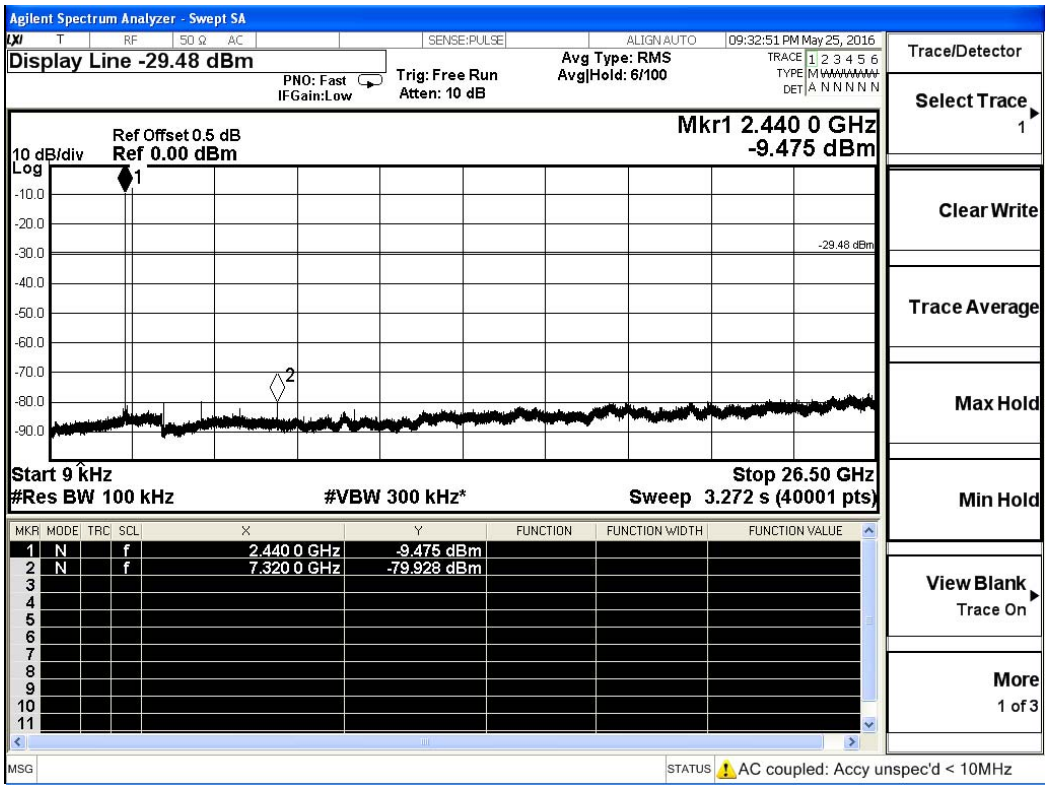
The EUT was programmed to be in continuously transmitting mode.

6.5.6. Test Results of Conducted Spurious Emissions

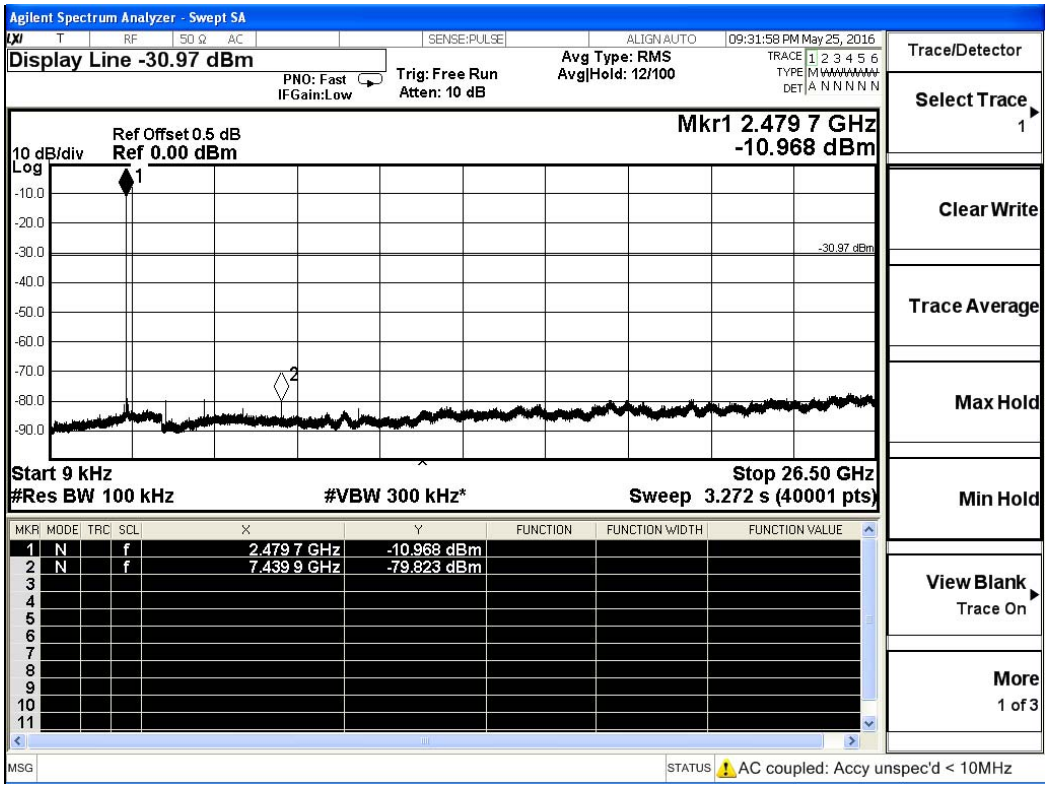
Test Result of Low Channel:



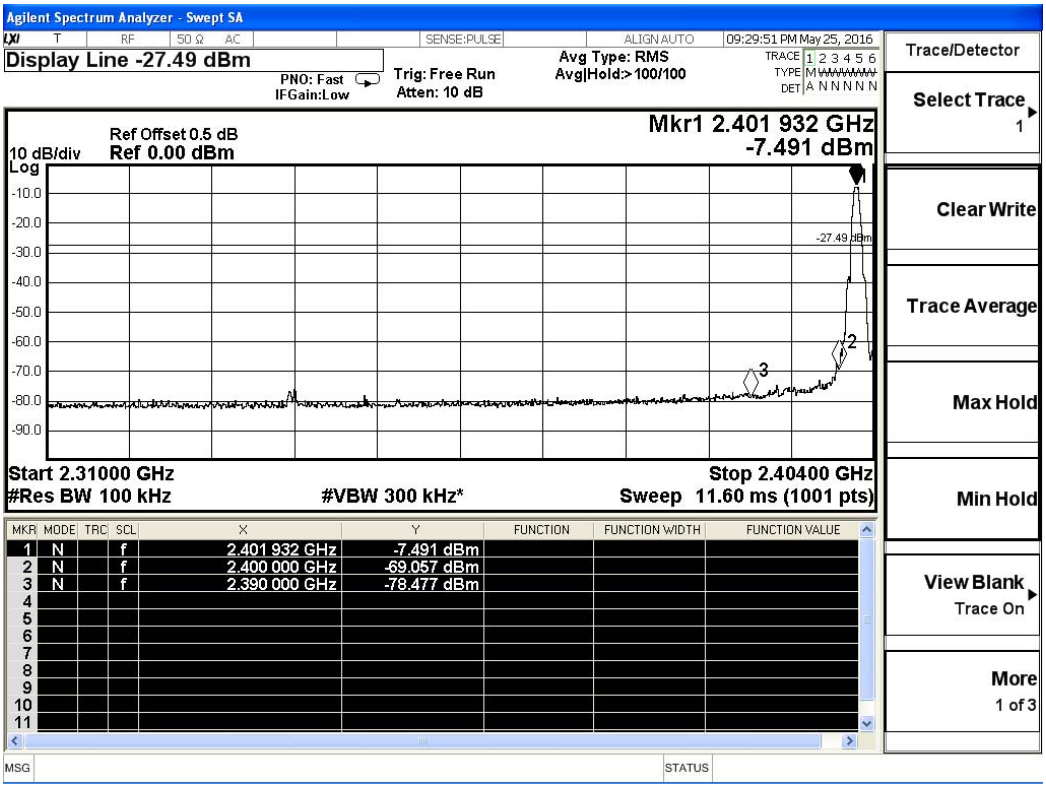
Test Result of Middle Channel:

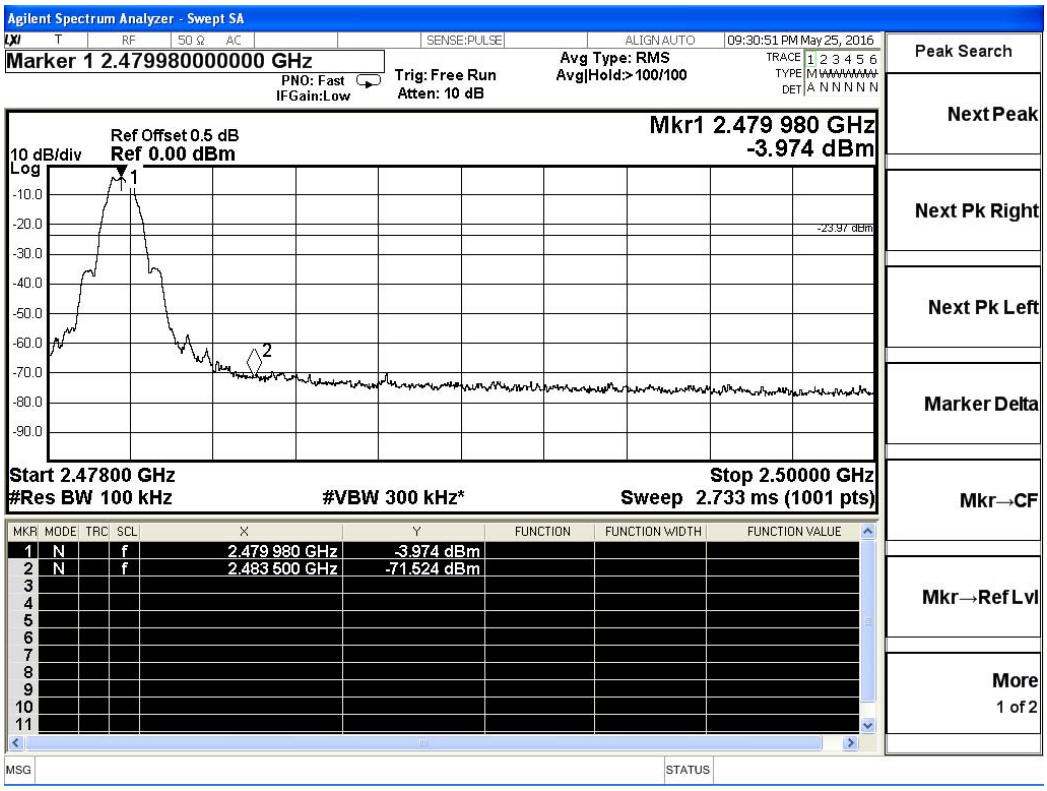


Test Result of High Channel:



6.5.7. Test Results of Band Edges Test





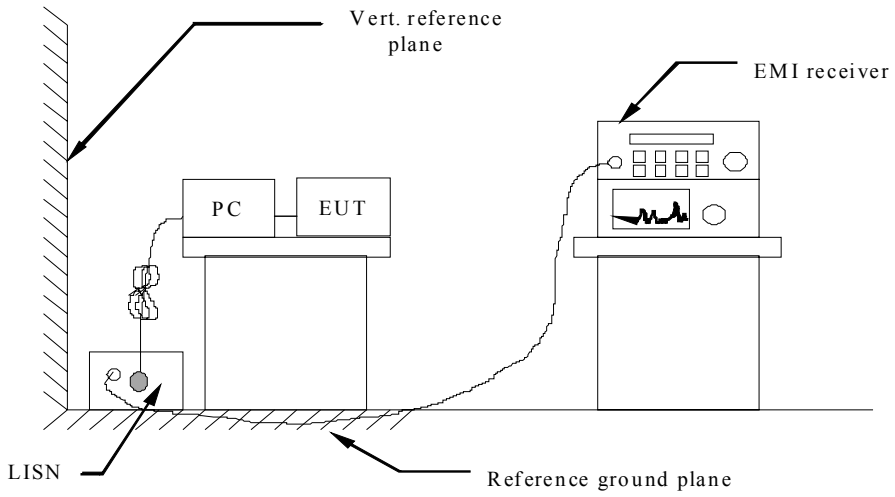
6.6. Power line conducted emissions

6.6.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 170 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

6.6.2 Block Diagram of Test Setup

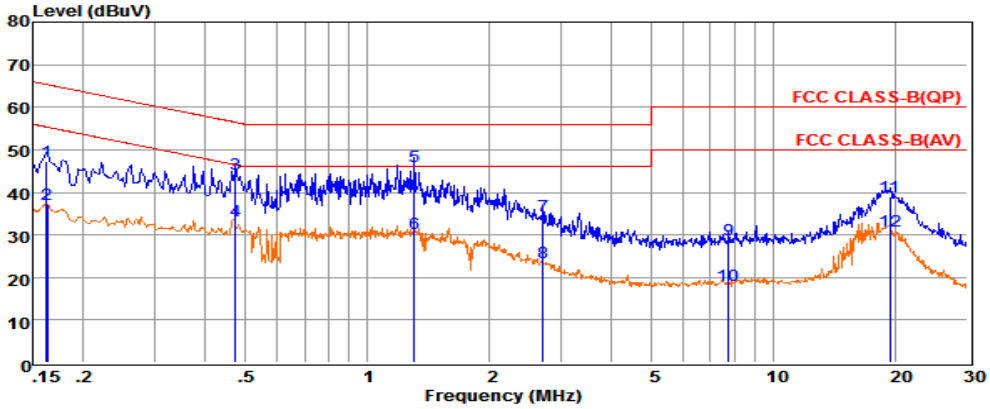


6.6.3 Test Results

PASS.

The test data please refer to following page.

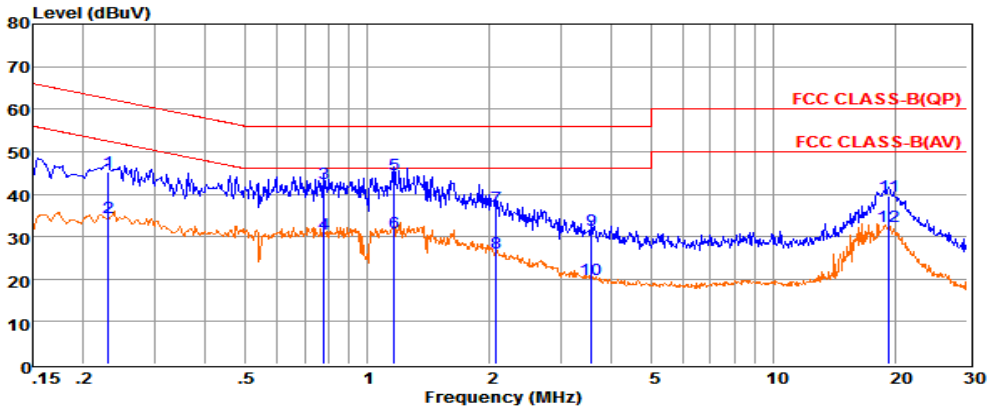
Test result for GFSK (High Channel) 120V/60Hz



Env. Ins: 24*/56%
Pol: NEUTRAL

	Freq MHz	Reading dBuV	LisnFac dB	CabLos dB	Atten_Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.16241	27.64	9.67	0.02	10.00	47.33	65.34	-18.01	QP
2	0.16261	17.37	9.67	0.02	10.00	37.06	55.33	-18.27	Average
3	0.47360	24.56	9.62	0.04	10.00	44.22	56.45	-12.23	QP
4	0.47370	13.79	9.62	0.04	10.00	33.45	46.45	-13.00	Average
5	1.30290	26.42	9.63	0.05	10.00	46.10	56.00	-9.90	QP
6	1.30390	10.73	9.63	0.05	10.00	30.41	46.00	-15.59	Average
7	2.70678	14.83	9.64	0.05	10.00	34.52	56.00	-21.48	QP
8	2.70778	3.91	9.64	0.05	10.00	23.60	46.00	-22.40	Average
9	7.76888	9.04	9.70	0.07	10.00	28.81	60.00	-31.19	QP
10	7.76988	-1.49	9.70	0.07	10.00	18.28	50.00	-31.72	Average
11	19.32572	18.98	9.86	0.12	10.00	38.96	60.00	-21.04	QP
12	19.32672	11.09	9.86	0.12	10.00	31.07	50.00	-18.93	Average

Remarks: 1. Measured = Reading + Lisn Factor +Cable Loss+Atten_Fac.
2. The emission levels that are 20dB below the official limit are not reported.

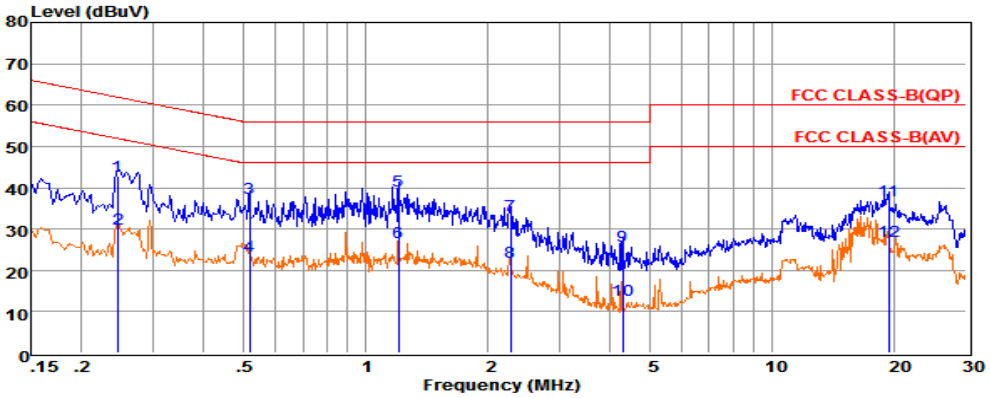


Env. Ins: 24*/56%
Pol: LINE

	Freq MHz	Reading dBuV	LisnFac dB	CabLos dB	Atten_Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.23040	25.51	9.59	0.03	10.00	45.13	62.44	-17.31	QP
2	0.23050	14.89	9.59	0.03	10.00	34.51	52.43	-17.92	Average
3	0.78345	22.95	9.63	0.04	10.00	42.62	56.00	-13.38	QP
4	0.78355	11.06	9.63	0.04	10.00	30.73	46.00	-15.27	Average
5	1.16571	24.81	9.63	0.05	10.00	44.49	56.00	-11.51	QP
6	1.16671	11.37	9.63	0.05	10.00	31.05	46.00	-14.95	Average
7	2.07684	17.31	9.63	0.05	10.00	36.99	56.00	-19.01	QP
8	2.07784	6.39	9.63	0.05	10.00	26.07	46.00	-19.93	Average
9	3.56539	11.87	9.65	0.06	10.00	31.58	56.00	-24.42	QP
10	3.56639	0.16	9.65	0.06	10.00	19.87	46.00	-26.13	Average
11	19.22360	19.69	9.86	0.12	10.00	39.67	60.00	-20.33	QP
12	19.22460	12.37	9.86	0.12	10.00	32.35	50.00	-17.65	Average

Remarks: 1. Measured = Reading + Lisn Factor +Cable Loss+Atten_Fac.
2. The emission levels that are 20dB below the official limit are not reported.

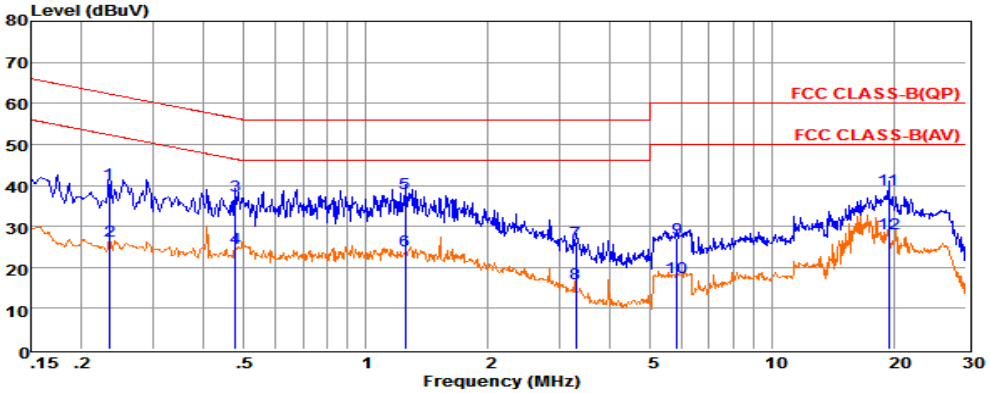
Test result for GFSK (High Channel) 240V/60Hz



Env. Ins: 24*/56%
Pol: LINE

	Freq MHz	Reading dBuV	LisnFac dB	CabLos dB	Atten_Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.24552	23.08	9.60	0.03	10.00	42.71	61.91	-19.20	QP
2	0.24562	10.38	9.60	0.03	10.00	30.01	51.90	-21.89	Average
3	0.51824	17.69	9.62	0.04	10.00	37.35	56.00	-18.65	QP
4	0.51834	3.73	9.62	0.04	10.00	23.39	46.00	-22.61	Average
5	1.20336	19.57	9.63	0.05	10.00	39.25	56.00	-16.75	QP
6	1.20436	7.16	9.63	0.05	10.00	26.84	46.00	-19.16	Average
7	2.27258	13.67	9.63	0.05	10.00	33.35	56.00	-22.65	QP
8	2.27358	2.39	9.63	0.05	10.00	22.07	46.00	-23.93	Average
9	4.29184	6.19	9.65	0.06	10.00	25.90	56.00	-30.10	QP
10	4.29284	-6.80	9.66	0.06	10.00	12.92	46.00	-33.08	Average
11	19.32572	16.89	9.86	0.12	10.00	36.87	60.00	-23.13	QP
12	19.32672	7.15	9.86	0.12	10.00	27.13	50.00	-22.87	Average

Remarks: 1. Measured = Reading + Lisn Factor +Cable Loss+Atten_Fac.
2. The emission levels that are 20dB below the official limit are not reported.



Env. Ins: 24*/56%
Pol: NEUTRAL

	Freq MHz	Reading dBuV	LisnFac dB	CabLos dB	Atten_Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.23409	20.86	9.63	0.03	10.00	40.52	62.30	-21.78	QP
2	0.23419	6.80	9.63	0.03	10.00	26.46	52.30	-25.84	Average
3	0.47865	17.70	9.62	0.04	10.00	37.36	56.36	-19.00	QP
4	0.47875	4.88	9.62	0.04	10.00	24.54	46.36	-21.82	Average
5	1.24883	18.39	9.63	0.05	10.00	38.07	56.00	-17.93	QP
6	1.24983	4.30	9.63	0.05	10.00	23.98	46.00	-22.02	Average
7	3.29300	6.43	9.65	0.06	10.00	26.14	56.00	-29.86	QP
8	3.29400	-3.79	9.65	0.06	10.00	15.92	46.00	-30.08	Average
9	5.83584	7.37	9.66	0.06	10.00	27.09	60.00	-32.91	QP
10	5.83684	-2.30	9.66	0.06	10.00	17.42	50.00	-32.58	Average
11	19.32572	19.22	9.75	0.12	10.00	39.09	60.00	-20.91	QP
12	19.32672	8.49	9.75	0.12	10.00	28.36	50.00	-21.64	Average

Remarks: 1. Measured = Reading + Lisn Factor +Cable Loss+Atten_Fac.
2. The emission levels that are 20dB below the official limit are not reported.

7. ANTENNA REQUIREMENT

7.1 Standard Applicable

According to antenna requirement of §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

7.2 Antenna Connected Construction

7.2.1. Standard Applicable

According to § 15.203 & RSS-Gen, 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.

7.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is -1.0dBi, and the antenna is connect to PCB board and no consideration of replacement. Please see EUT photo for details.

7.2.3. Results: Compliance.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Conducted power refers ANSI C63.10:2013 Output power test procedure for DTS devices.

Radiated power refers to ANSI C63.10:2013 Radiated emissions tests.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep Time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	IC
Antenna Gain	
6 dBi	

Note: The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Limits:

FCC	IC
Antenna Gain	
6dBi	

T_{nom}	V_{nom}	Lowest Channel 2402 MHz	Middle Channel 2440 MHz	Highest Channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		-2.52	-2.09	-2.97
Radiated power [dBm] Measured with GFSK modulation		-4.75	-3.44	-5.81
Gain [dBi] Calculated		-2.23	-1.35	-2.84
Measurement uncertainty			± 1.6 dB (cond.) / ± 3.8 dB (rad.)	

Result: -/-

----------THE END OF REPORT----------