FCC RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Bluetooth Light Bulb

ISSUED TO
HANGZHOU LIFESMART TECHNOLOGY CO., LTD.

1785 Jianghan Road, Building 2, Unit 3, 9th Floor, Binjiang District, Hangzhou, Zhejiang, CHN

Tested by: _____
Cao Shaodong
(Engineer)
Date Sep. 05, 2016

Approved by: _____
Wei Yanquan
(Chief Engineer)
Date Sep. 05, 2016

Report No.:	BL-SZ1680423-601
EUT Type:	Bluetooth Light Bulb
Model Name:	LS030UN
Brand Name:	LifeSmart
Test Standard:	47 CFR Part 15 Subpart C
FCC ID:	2AJMI-00LS030
Test conclusion:	Pass
Test Date:	Aug. 23, 2016 ~ Aug. 30, 2016
Date of Issue:	Sep. 05, 2016

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Sep. 05, 2016	Initial Issue

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20 to 25℃
Ambient Relative Humidity	45% - 55%
Ambient Pressure	100 kPa - 102 kPa

1.4 Announce

(1) The test report reference to the report template version v5.5.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	HANGZHOU LIFESMART TECHNOLOGY CO., LTD.
Address	1785 Jianghan Road, Building 2, Unit 3, 9th Floor, Binjiang District, Hangzhou, Zhejiang, CHN

2.2 Manufacturer Information

Manufacturer	Shenzhen Longtech Electronics Co., Ltd
Address	Zhengfeng Industrial Area, No. 148, donghuan Road, huangpu Village, Shajing Town, Baoan District, Shenzhen, PRC

2.3 Factory Information

Factory	Shenzhen Longtech Electronics Co., Ltd
Address	Zhengfeng Industrial Area, No. 148, donghuan Road, huangpu Village, Shajing Town, Baoan District, Shenzhen, PRC

2.4 General Description for Equipment under Test (EUT)

EUT Type	Bluetooth Light Bulb
Model Name	LS030UN
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A
Network and Wireless connectivity	Bluetooth 4.0 Low Energy (BLE)

2.5 Ancillary Equipment

N/A

2.6 Technical Information

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	GFSK
Transfer Rate	1 Mbps
Frequency Range	The frequency range used is 2402 MHz – 2480 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of channel	40 (at intervals of 2 MHz)
Tested Channel	0 (2402 MHz), 19 (2440 MHz), 39 (2480 MHz).
Antenna Type	PCB Antenna
Antenna Gain	0 dBi
About the Product	The equipment is Bluetooth Light Bulb, it contains Bluetooth module operating at 2.4 GHz ISM band. Only the Bluetooth 4.0 Low Energy (BLE) was tested in this report.

2.7 Additional Instructions

EUT Software Settings:

Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

Power level setup in software			
Test Software Version	UARTASSIST		
Mode	Channel	Frequency (MHz)	Soft Set
GFSK	CH0	2402	TX LEVEL is built-in set parameters and cannot be changed and selected.
	CH19	2440	
	CH39	2480	

Run Software:

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C (10-1-15 Edition)	Miscellaneous Wireless Communications Services
2	KDB Publication 558074 D01v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	Channel (BLE)	Test Result	Verdict	Remark
1	Antenna Requirement	15.203	N/A	--	Pass	Note1
2	Output Power	15.247(b)	Low/Middle/High	ANNEX A.1	Pass	
3	Occupied Bandwidth	15.247(a)	Low/Middle/High	ANNEX A.2	Pass	
4	Conducted Spurious Emission	15.247(d)	Low/Middle/High	ANNEX A.3	Pass	
5	Band Edge(Authorized-band band-edge)	15.247(d)	Low/ High	ANNEX A.4	Pass	
6	Conducted Emission	15.207	Low/Middle/High	ANNEX A.5	Pass	
7	Radiated Spurious Emission	15.209 15.247(d)	Low/Middle/High	ANNEX A.6	Pass	
8	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	Low/Middle/High	ANNEX A.7	Pass	
9	Power spectral density (PSD)	15.247(e)	Low/Middle/High	ANNEX A.8	Pass	
Note 1: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.						

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% - 55%	
Atmospheric Pressure	100 kPa -102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
	LT (Low Temperature)	-20℃
	HT (High Temperature)	+40℃
Working Voltage of the EUT	NV (Normal Voltage)	110 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2016.07.13	2017.07.12
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	177746	2016.07.13	2017.07.12
Signal Generator	ROHDE&SCHWARZ	SMB100A	260592	2016.07.13	2017.07.12
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2016.07.13	2017.07.12
Spectrum Analyzer	AGILENT	E4440A	MY45304434	2015.10.15	2016.10.14
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2016.07.05	2017.07.04
LISN	SCHWARZBECK	NSLK 8127	8127-687	2016.07.05	2017.07.04
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2016.07.13	2017.07.12
Power Splitter	KMW	DCPD-LDC	1305003215	2016.07.13	2017.07.12
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2016.07.13	2017.07.12
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2016.07.13	2017.07.12
Temperature Chamber	ANGELANTIONI SCIENCE	NTH64-40A	1310	2015.08.07	2016.08.06
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2015.07.22	2017.07.21
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2015.07.22	2017.07.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2015.07.22	2017.07.21
Test Antenna-Horn(15-26.5 GHz)	SCHWARZBECK	BBHA 9170	9170-305	2015.07.22	2017.07.21
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2015.02.28	2017.02.27
Shielded Enclosure	ChangNing	CN-130701	130703	--	--

4.3 MEASUREMENT UNCERTAINTY

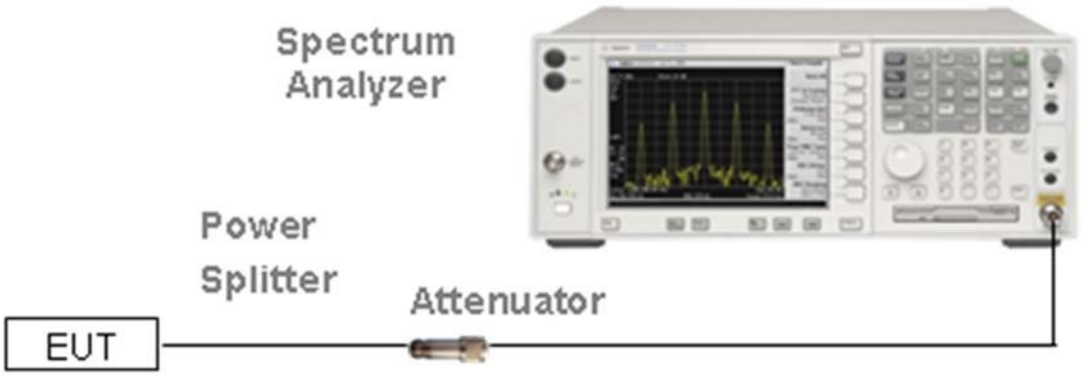
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

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

Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

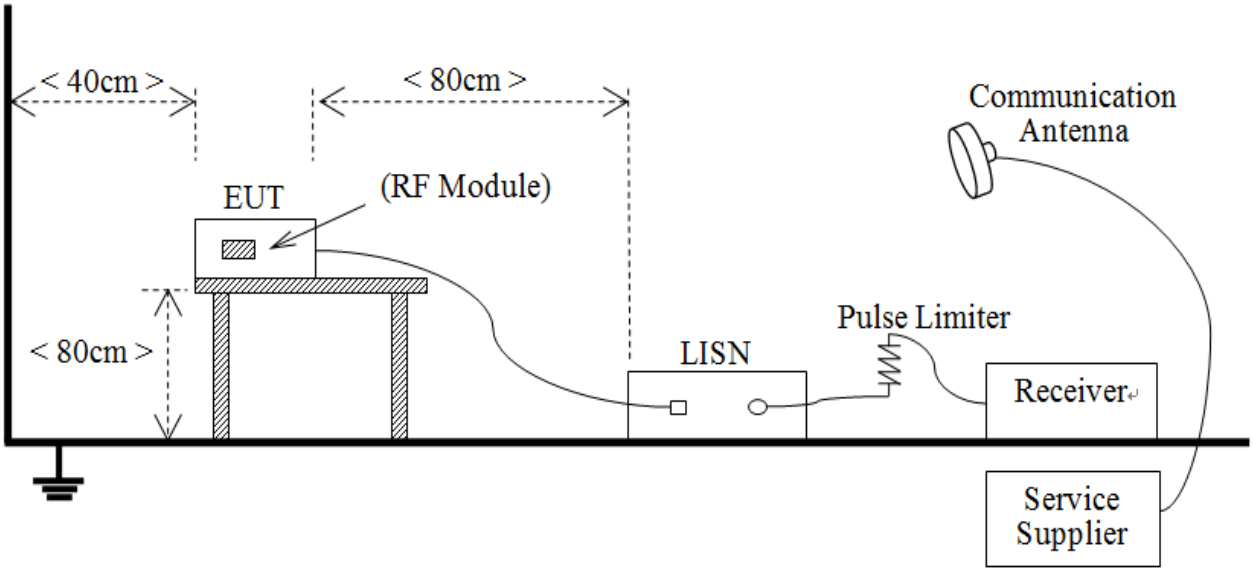
4.4 Description of Test Setup

4.4.1 For Antenna Port Test



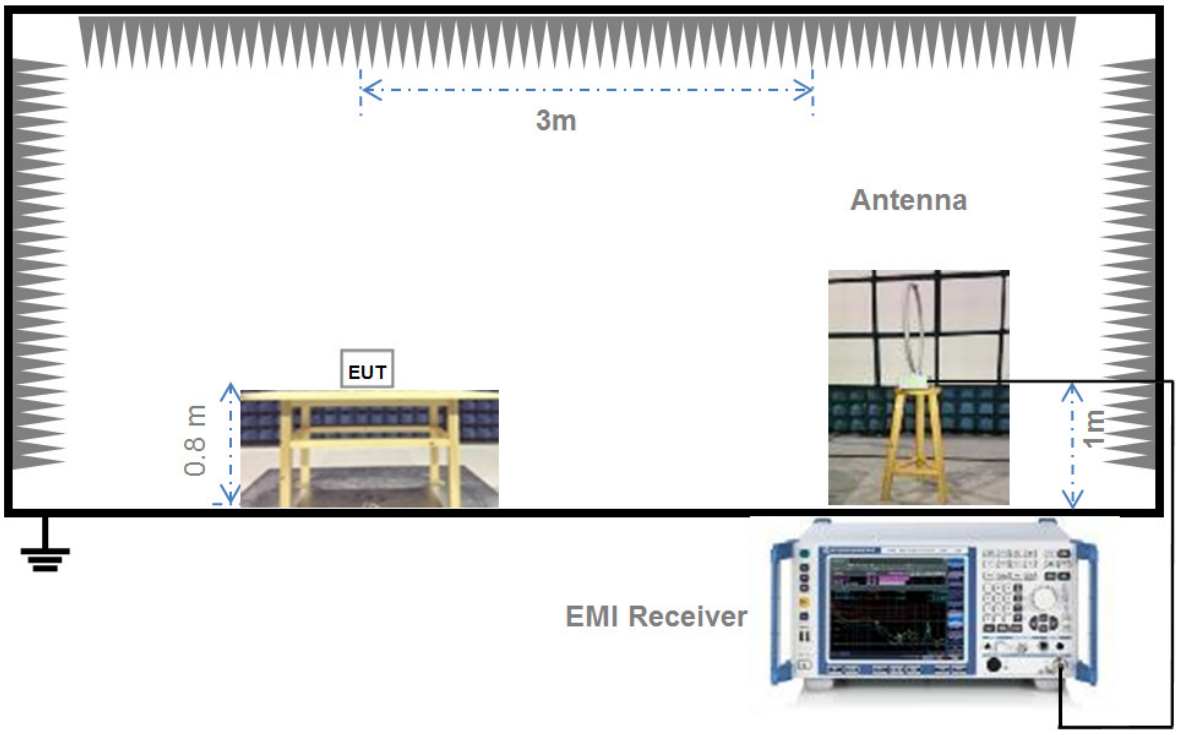
(Diagram 1)

4.4.2 For AC Power Supply Port Test



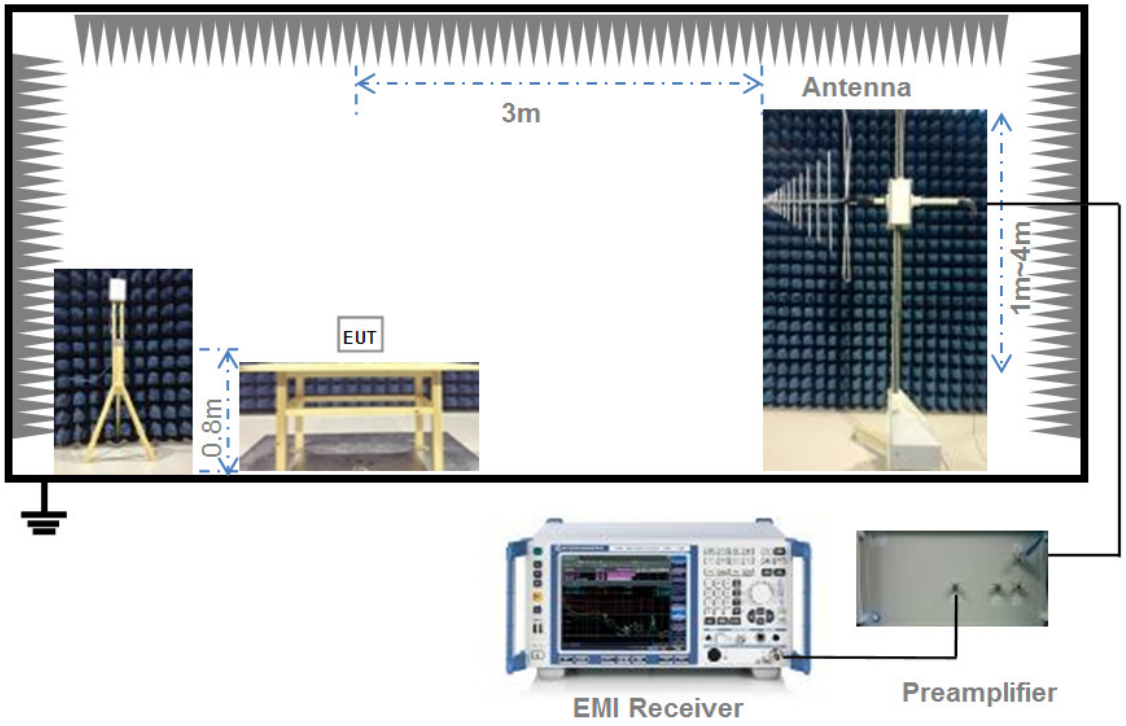
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



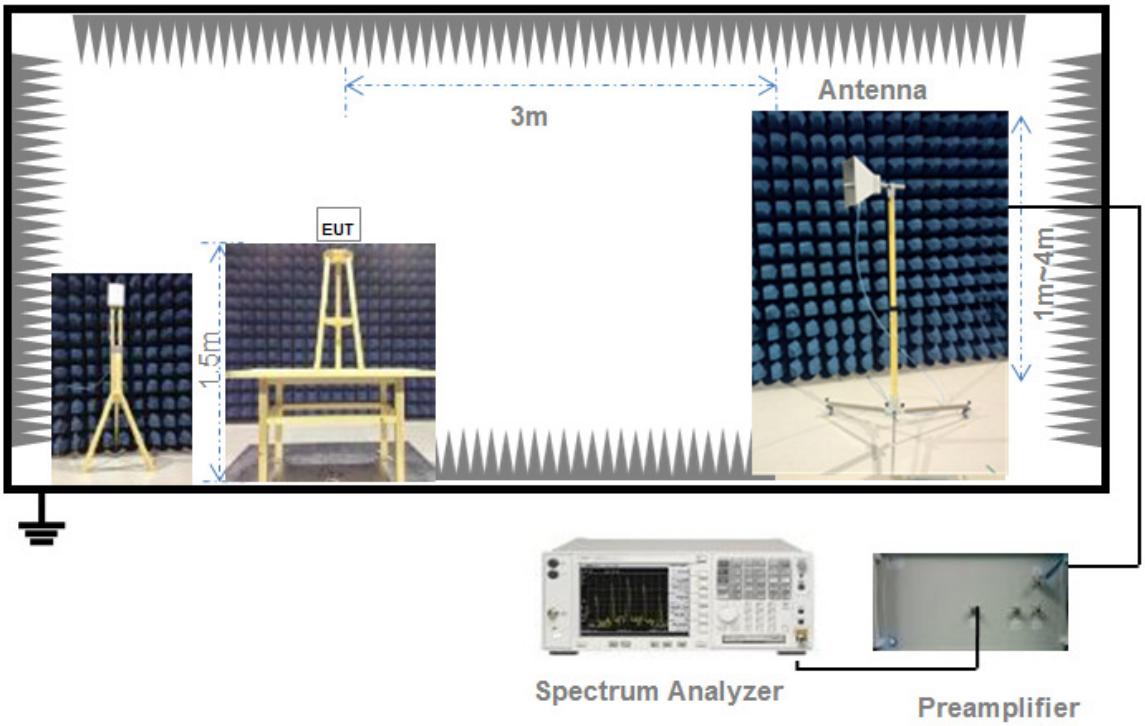
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Standard Applicable

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

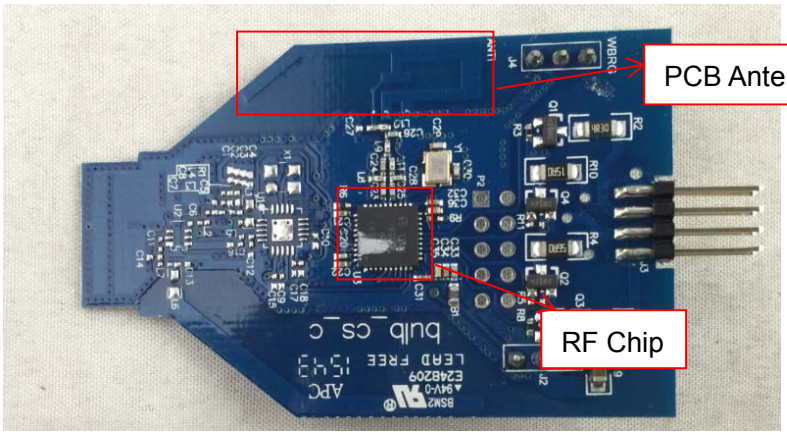
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced 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 § 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 § 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.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is An embedded-in	An embedded-in antenna design is used.

Reference Documents	Item
Photo	

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Output Power

5.2.1 Test Limit

FCC § 15.247(b)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements.

RSS-247, 5.4 (4)

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. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

5.2.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

Maximum peak conducted output power

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

Set the RBW ≥ DTS bandwidth.

Set VBW ≥ 3 x RBW.

Set span ≥ 3 x RBW

Sweep time = auto couple.

Detector = peak.

Trace mode = max hold.

Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level.

Measurements of duty cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission.

Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.

Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a); RSS-247, 5.1 (1); RSS-GEN, 6.6

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

5.3.2 Test Setup

See section 4.4.1(Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Set RBW = 100 kHz.

Set the video bandwidth (VBW) ≥ 3 RBW.

Detector = Peak.

Trace mode = max hold.

Sweep = auto couple.

Allow the trace to stabilize.

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.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Conducted Spurious Emission

5.4.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

5.4.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

The following procedures shall be used to demonstrate compliance to these limits. Note that these procedures can be used in either an antenna-port conducted or radiated test set-up. Radiated tests must conform to the test site requirements and utilize maximization procedures defined herein.

Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Emission level measurement

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

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.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Band Edge (Authorized-band band-edge)

5.5.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

This Method apply to the equipment is using FHSS.

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak /AV

Trace = max hold

Allow the trace to stabilize.

E [dBμV/m] =UR + AT + AFactor [dB]; AT =LCable loss [dB] - Gpreamp [dB]

AT: Total correction Factor except Antenna

UR: Receiver Reading

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

This Method apply to the equipment is using wide band modulations other than FHSS.

The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is utilized, use the procedure described in 13.2.1. Use the procedure described in 13.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., duty cycle ≥ 98%). Use the procedure described in 13.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent). Use the procedure described in 13.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2 percent).

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used.

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

Set span to 2 MHz

RBW = 100 kHz.

VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweep to continue until the trace stabilizes (required measurement time may increase for low duty cycle applications)

Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Emission

5.6.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that 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 within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.6.2 Test Setup

See section 4.4.2 (Diagram 2) for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.6.4 Test Result

Please refer to ANNEX A.5.

5.7 Radiated Spurious Emission

5.7.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.9; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
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

Note:

1. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
2. For above 1000 MHz, limit field strength of harmonics: 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK).

5.7.2 Test Setup

See section4.4.3，4.4.4，4.4.5 (Diagram 3，4，5) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak

Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Band Edge (Restricted-band band-edge)

5.8.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.9; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.8.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Power Spectral density (PSD)

5.9.1 Limit

FCC §15.247(e); RSS-247, 5.2 (2)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

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(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.9.2 Test Setup

See section 4.4.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

Set the VBW ≥ 3 RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.9.4 Test Result

Please refer to ANNEX A.8.

ANNEX A TEST RESULT

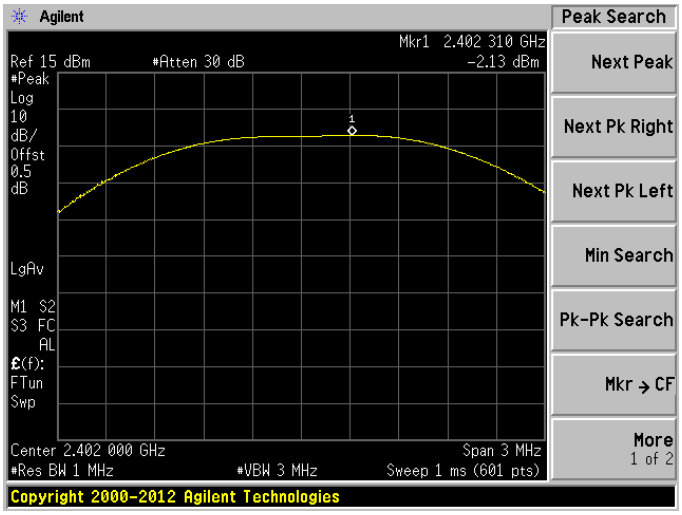
A.1 Output Power

Peak Power Test Data

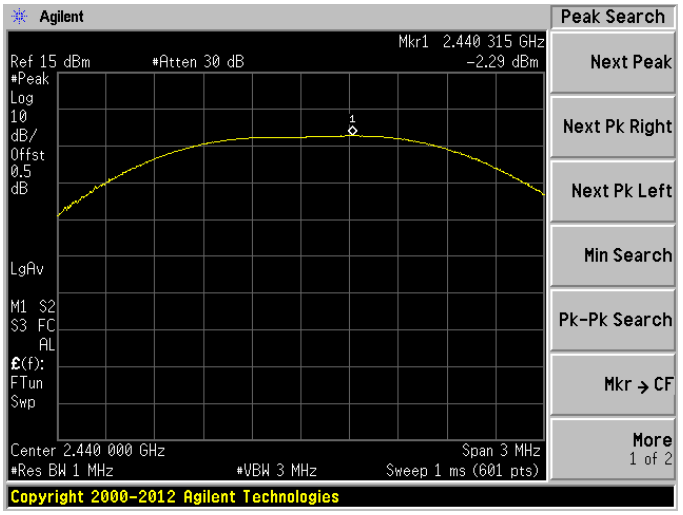
Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	-2.13	0.61	30	1000	Pass
Middle	-2.29	0.59			Pass
High	-2.51	0.56			Pass

Test Plots

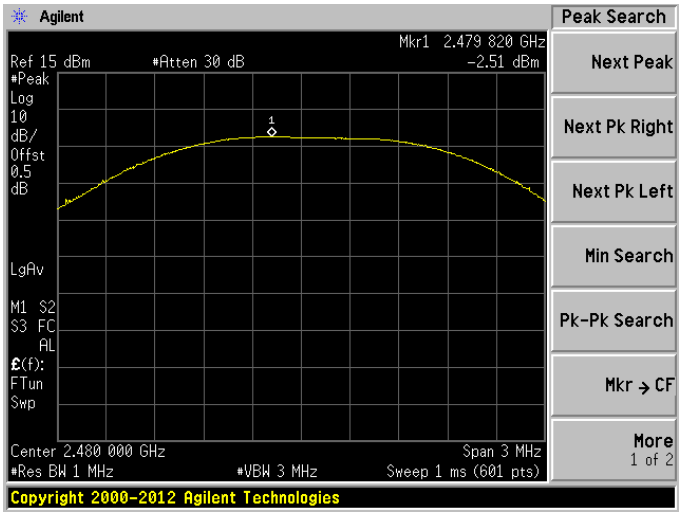
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



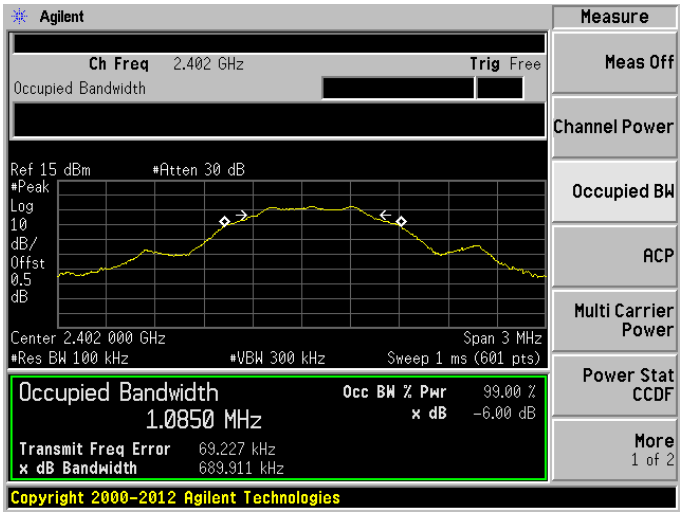
A.2 Occupied Bandwidth

Test Data

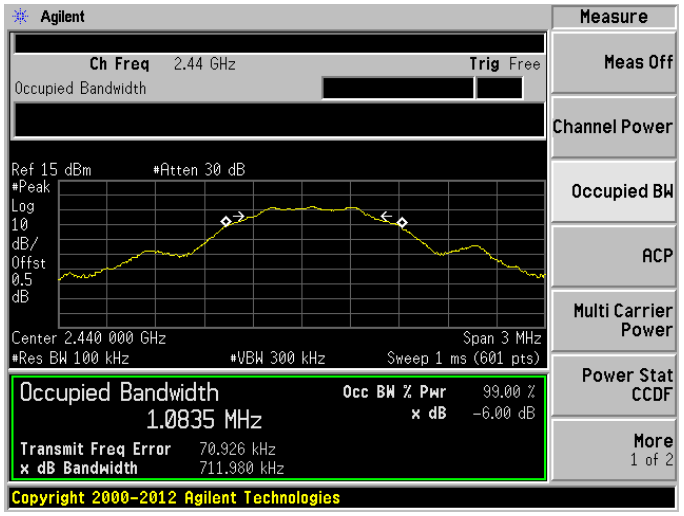
Channel	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limits (kHz)
Low Channel	0.6899	1.0850	≥500
Middle Channel	0.7119	1.0835	≥500
High Channel	0.7147	1.0838	≥500

Test plots

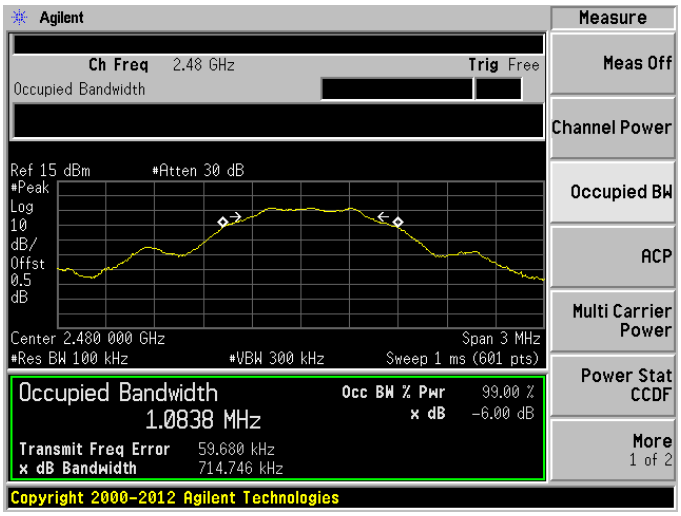
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



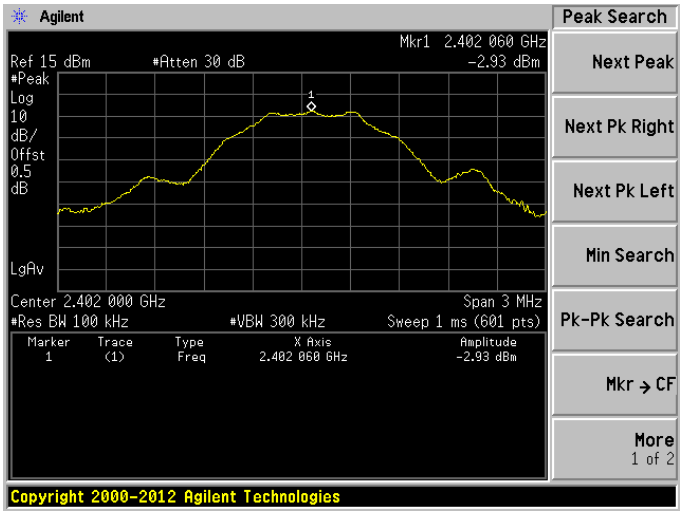
A.3 Conducted Spurious Emissions

Test Data

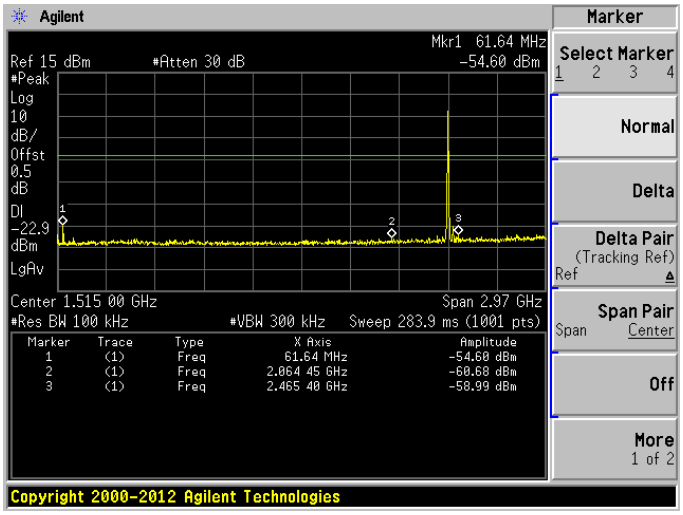
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-50.08	-2.93	-22.93	Pass
Middle Channel	-53.53	-3.10	-23.10	Pass
High Channel	-54.54	-3.30	-23.30	Pass

Test Plots

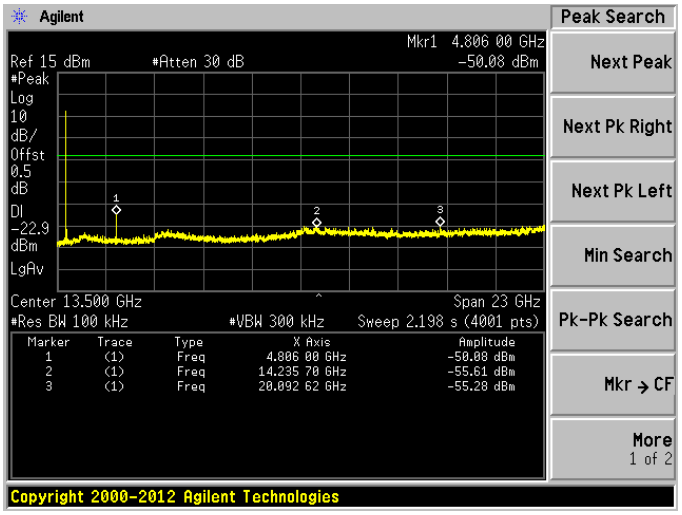
LOW CHANNEL CARRIER LEVEL



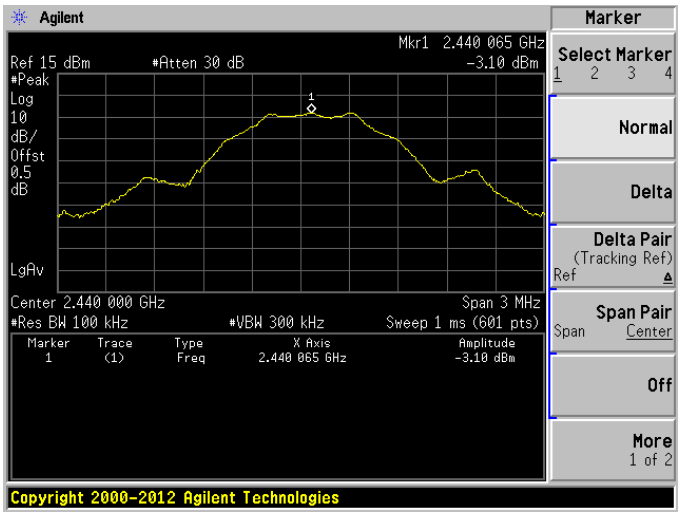
LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



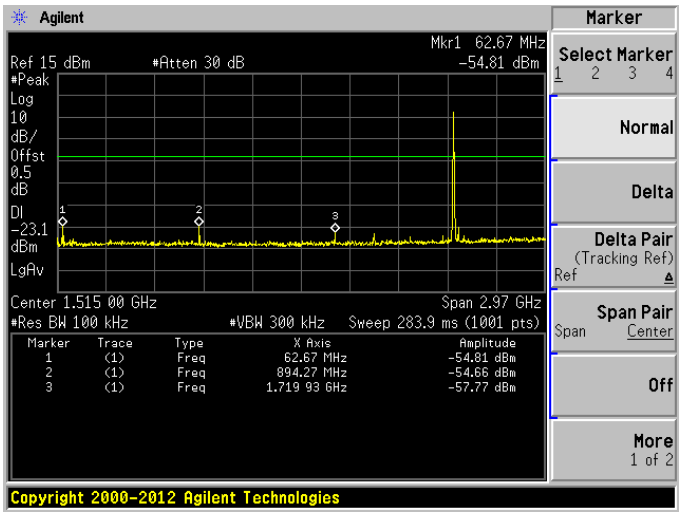
LOW CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



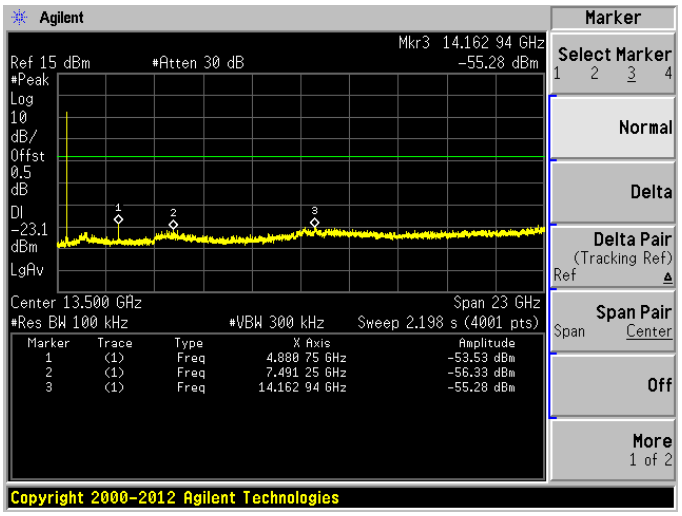
MIDDLE CHANNEL CARRIER LEVEL



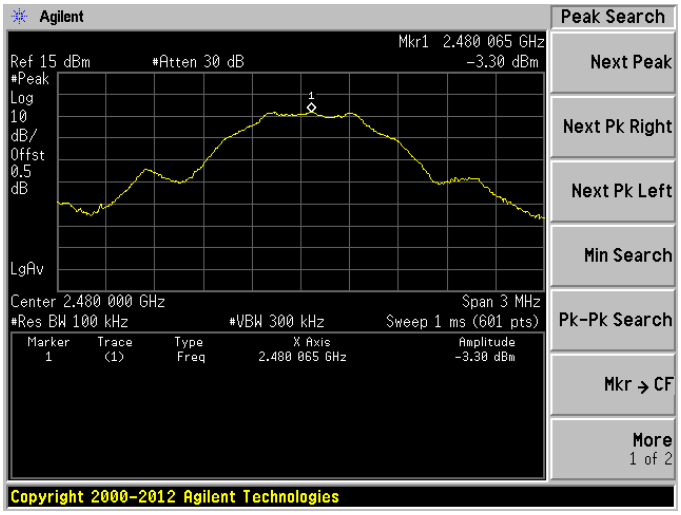
MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



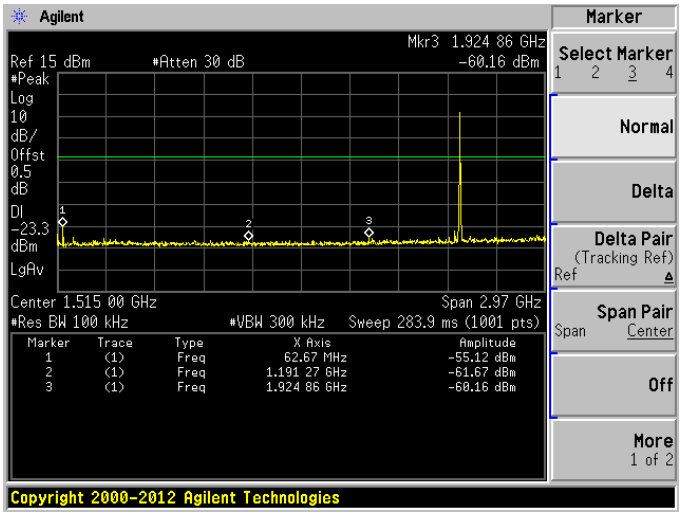
MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



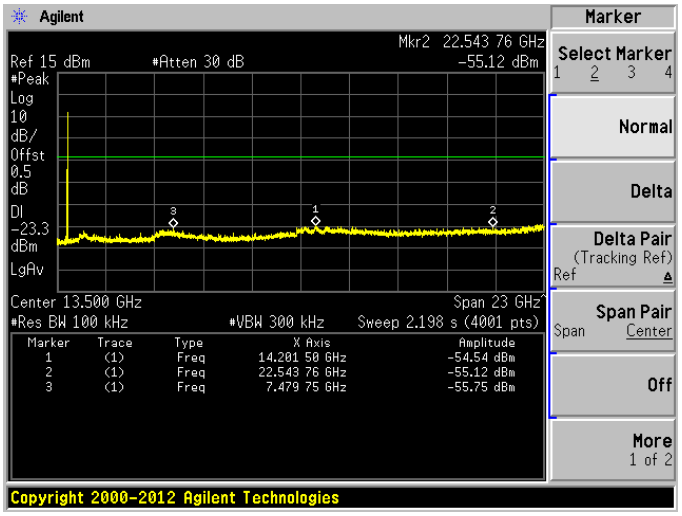
HIGH CHANNEL CARRIER LEVEL



HIGH CHANNEL, SPURIOUS 30 MHz ~ 3GHz



HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



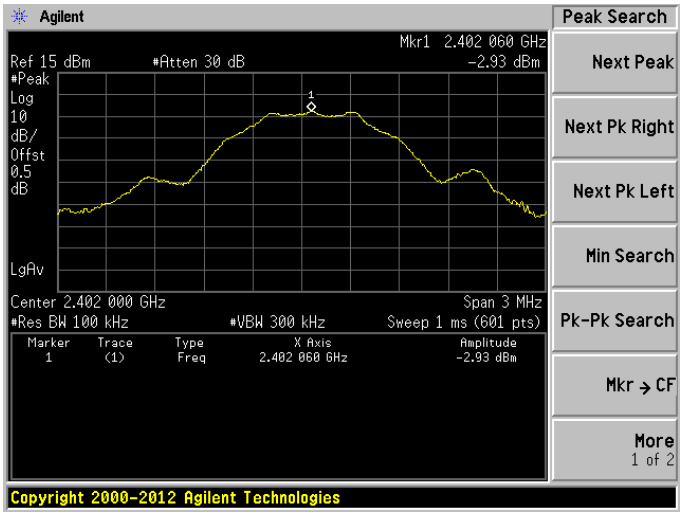
A.4 Band Edge (Authorized-band band-edge)

Note: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

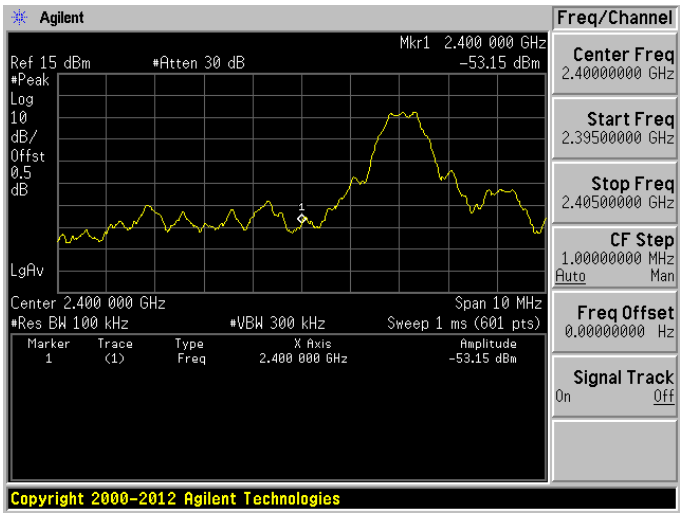
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-42.57	-2.93	-22.93	Pass
High Channel	-45.26	-3.30	-23.30	Pass

Test Plots

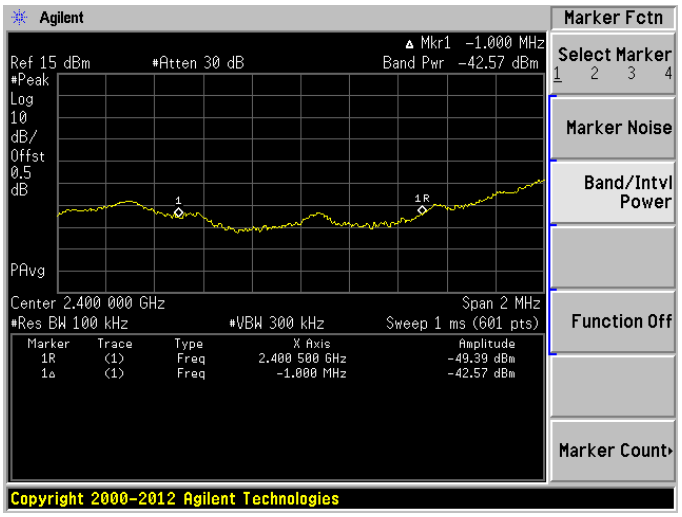
LOW CHANNEL, Carrier level



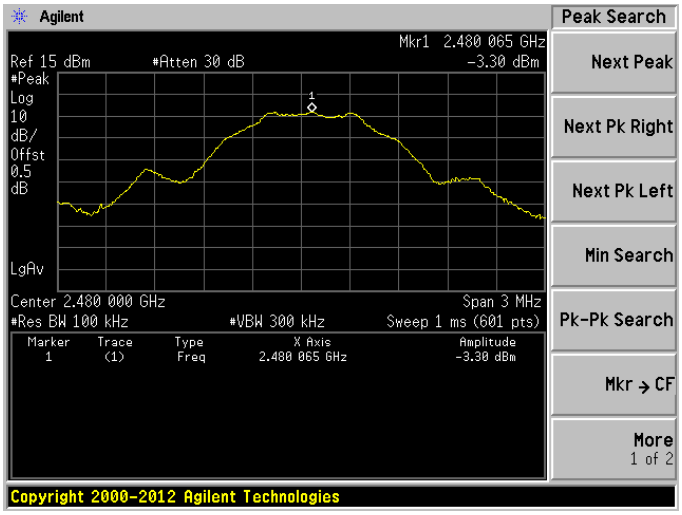
LOW CHANNEL, Reference level



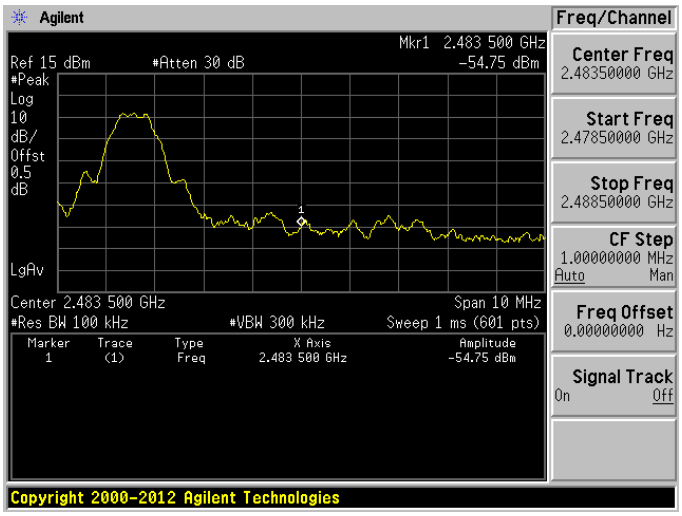
LOW CHANNEL, Band Edge



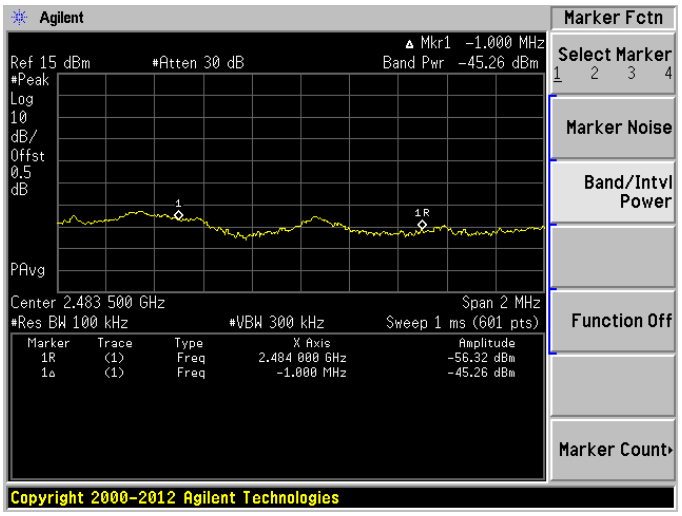
High CHANNEL, Carrier level



HIGH CHANNEL, Reference level



HIGH CHANNEL, Band Edge

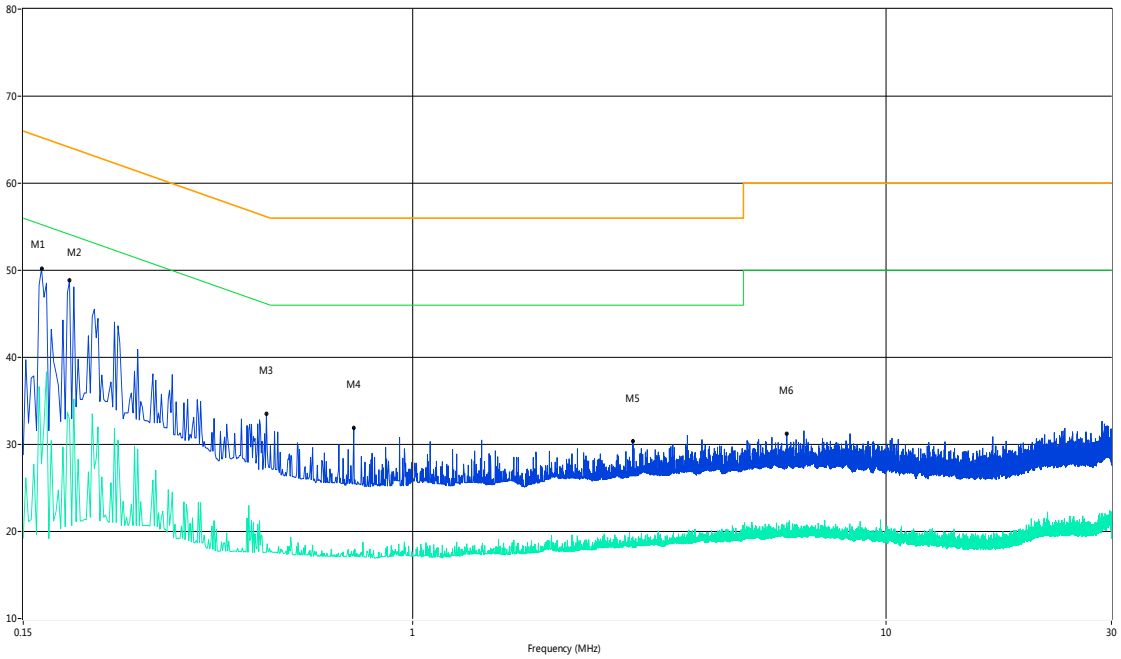


A.5 Conducted Emissions

Note 1: The EUT is working in the Normal link mode.

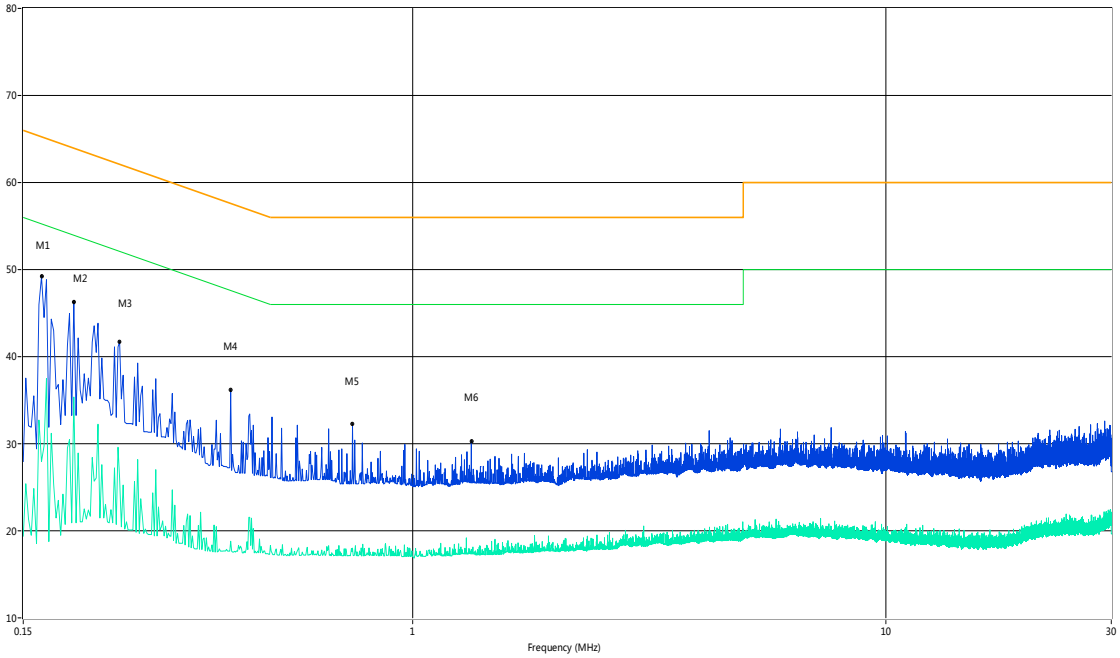
Test Data and Test Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.16	50.2	11.00	65.6	15.40	Peak	L Line	Pass
1**	0.16	27.8	11.00	55.6	27.80	AV	L Line	Pass
2	0.19	48.8	11.00	64.9	16.10	Peak	L Line	Pass
2**	0.19	32.9	11.00	54.9	22.00	AV	L Line	Pass
3	0.49	33.5	11.00	56.3	22.80	Peak	L Line	Pass
3**	0.49	17.2	11.00	46.3	29.10	AV	L Line	Pass
4	0.75	31.9	11.00	56.0	24.10	Peak	L Line	Pass
4**	0.75	17.8	11.00	46.0	28.20	AV	L Line	Pass
5	2.92	30.4	11.00	56.0	25.60	Peak	L Line	Pass
5**	2.92	19.4	11.00	46.0	26.60	AV	L Line	Pass
6	6.18	31.2	11.00	60.0	28.80	Peak	L Line	Pass
6**	6.18	21.0	11.00	50.0	29.00	AV	L Line	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.16	49.2	11.00	65.6	16.40	Peak	N Line	Pass
1**	0.16	28.0	11.00	55.6	27.60	AV	N Line	Pass
2	0.19	46.3	11.00	64.8	18.50	Peak	N Line	Pass
2**	0.19	35.4	11.00	54.8	19.40	AV	N Line	Pass
3	0.24	41.7	11.00	63.4	21.70	Peak	N Line	Pass
3**	0.24	26.0	11.00	53.4	27.40	AV	N Line	Pass
4	0.41	36.2	11.00	58.5	22.30	Peak	N Line	Pass
4**	0.41	18.8	11.00	48.5	29.70	AV	N Line	Pass
5	0.75	32.3	11.00	56.0	23.70	Peak	N Line	Pass
5**	0.75	18.0	11.00	46.0	28.00	AV	N Line	Pass
6	1.33	30.3	11.00	56.0	25.70	Peak	N Line	Pass
6**	1.33	17.9	11.00	46.0	28.10	AV	N Line	Pass

A.6 Radiated Spurious Emission

Note 1: The symbol of "--" in the table which means not application.

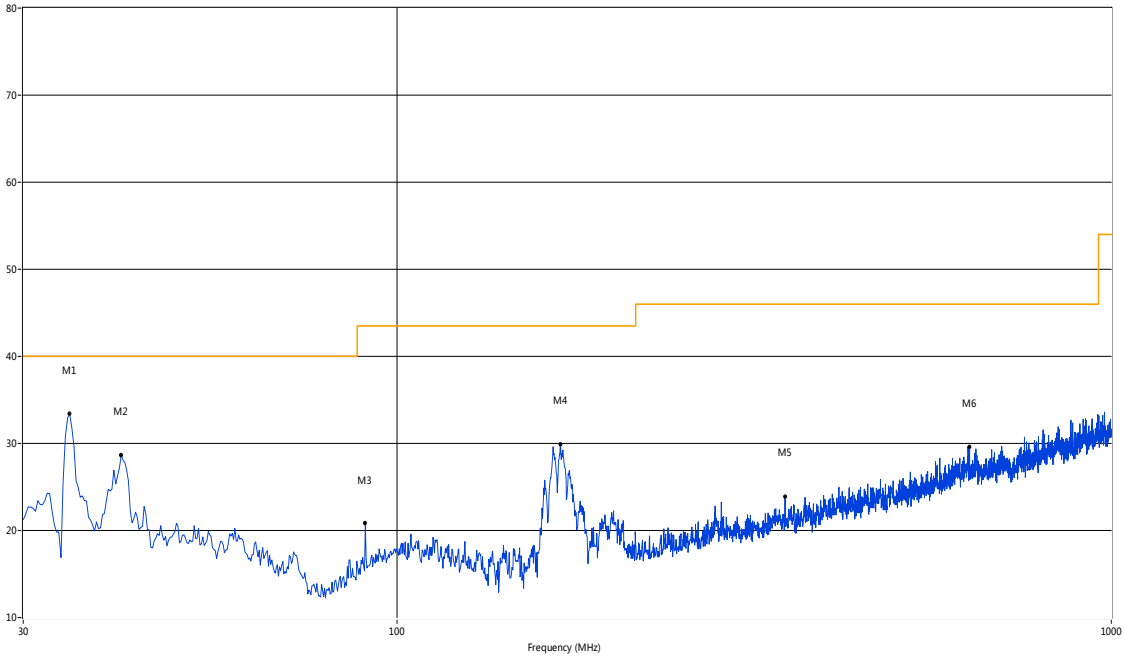
Note 2: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note 3: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Note 4: The EUT is working in the Normal link mode below 1 GHz.

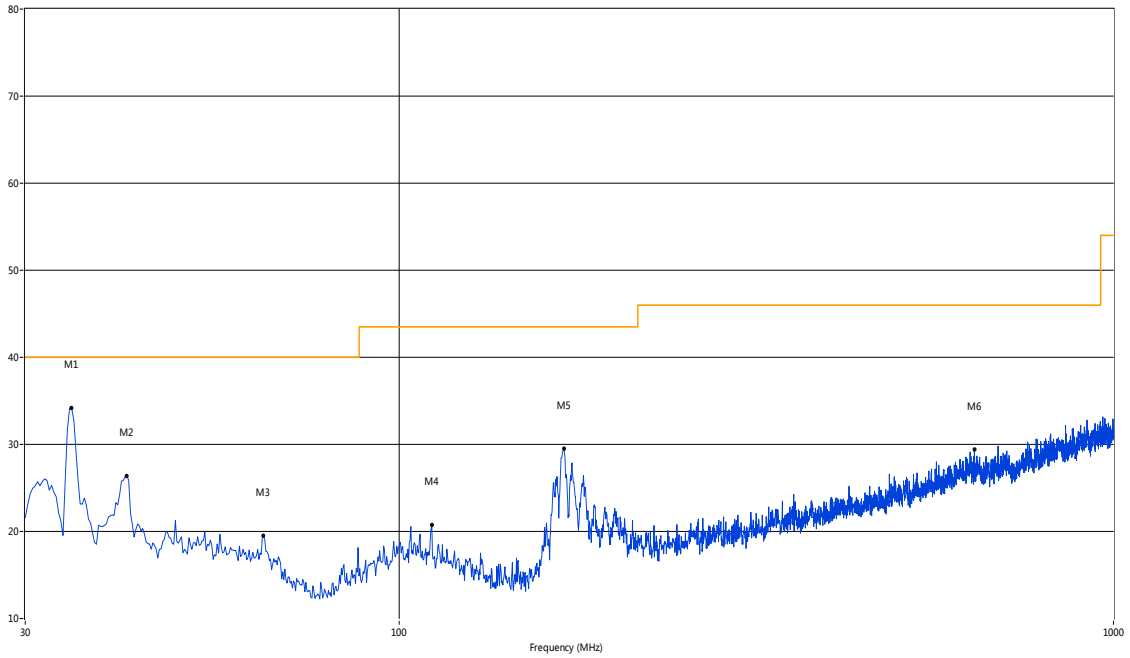
Test data and Plots

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	34.85	33.42	-21.41	40.0	6.58	Peak	295.70	100	Vertical	Pass
2	41.15	28.68	-19.34	40.0	11.32	Peak	354.40	100	Vertical	Pass
3	90.37	20.82	-21.82	43.5	22.68	Peak	359.90	100	Vertical	Pass
4	169.40	29.93	-22.67	43.5	13.57	Peak	14.20	100	Vertical	Pass
5	349.54	23.93	-16.24	46.0	22.07	Peak	320.80	100	Vertical	Pass
6	633.67	29.65	-10.22	46.0	16.35	Peak	199.70	100	Vertical	Pass

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	34.85	34.17	-21.41	40.0	5.83	Peak	111.40	100	Horizontal	Pass
2	41.64	26.37	-19.07	40.0	13.63	Peak	111.40	100	Horizontal	Pass
3	64.67	19.49	-20.61	40.0	20.51	Peak	338.10	100	Horizontal	Pass
4	111.22	20.79	-20.46	43.5	22.71	Peak	323.00	100	Horizontal	Pass
5	170.13	29.51	-22.74	43.5	13.99	Peak	0.70	100	Horizontal	Pass
6	639.01	29.39	-10.27	46.0	16.61	Peak	277.50	100	Horizontal	Pass

GFSK Low Channel 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1992.98	48.90	0.10	74	25.11	Peak	304.1	150	Vertical	Pass
2	2402.23	86.06	1.70	74	-12.06	Peak	133	150	Vertical	N/A
3	4803.79	54.00	13.77	74	20.00	Peak	321.2	150	Vertical	Pass
3**	4803.79	41.93	13.77	54	12.07	AV	321.2	150	Vertical	Pass
4	11099.00	40.33	17.34	74	33.67	Peak	105.8	150	Vertical	Pass
5	14330.70	47.43	9.03	74	26.57	Peak	267.7	150	Vertical	Pass
6	22214.64	48.38	8.29	74	25.62	Peak	268.7	150	Vertical	Pass

GFSK Low Channel 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	2390.00	49.80	1.48	74	24.20	Peak	63.3	150	Horizontal	Pass
2	2402.21	94.01	1.68	74	-20.01	Peak	90	150	Horizontal	N/A
3	4805.97	61.98	13.74	74	12.02	Peak	104.2	150	Horizontal	Pass
3**	4805.97	51.10	13.74	54	2.90	AV	104.2	150	Horizontal	Pass
4	10806.99	45.78	14.26	74	28.22	Peak	58.4	150	Horizontal	Pass
5	14434.69	46.46	9.69	74	27.54	Peak	147.2	150	Horizontal	Pass
6	19698.84	48.69	10.77	74	25.31	Peak	28.8	150	Horizontal	Pass

GFSK Middle Channel 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	2280.97	48.65	2.48	74	25.35	Peak	323.6	150	Vertical	Pass
2	2440.40	86.18	1.50	74	-12.18	Peak	258.3	150	Vertical	N/A
3	5179.98	52.73	14.83	74	21.27	Peak	193.4	150	Vertical	Pass
4	10368.97	42.78	20.00	74	31.22	Peak	268	150	Vertical	Pass
5	15797.01	46.81	9.23	74	27.19	Peak	188.1	150	Vertical	Pass
6	18084.86	44.18	13.40	74	29.82	Peak	249.1	150	Vertical	Pass

GFSK Middle Channel 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	2242.52	48.55	2.66	74	25.45	Peak	265.8	150	Horizontal	Pass
2	2440.57	93.36	1.45	74	-19.36	Peak	72.3	150	Horizontal	N/A
3	4880.97	59.72	13.62	74	14.28	Peak	179.3	150	Horizontal	Pass
3**	4880.97	48.33	13.62	54	5.67	AV	179.3	150	Horizontal	Pass
4	9526.62	45.57	16.96	74	28.43	Peak	52.2	150	Horizontal	Pass
5	13176.37	44.67	9.30	74	29.33	Peak	139.8	150	Horizontal	Pass
6	19209.65	45.64	9.50	74	28.37	Peak	223.1	150	Horizontal	Pass

GFSK High Channel 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1994.10	51.19	0.15	74	22.81	Peak	253.8	150	Vertical	Pass
2	2480.33	87.36	1.89	74	-13.36	Peak	54.4	150	Vertical	N/A
3	4498.11	54.72	12.71	74	19.28	Peak	35.4	150	Vertical	Pass
3**	4498.11	36.92	12.71	54	17.08	AV	35.4	150	Vertical	Pass
4	7673.46	44.58	14.38	74	29.42	Peak	169.6	150	Vertical	Pass
5	16691.35	44.37	9.67	74	29.64	Peak	18.7	150	Vertical	Pass
6	21775.37	46.07	13.31	74	27.93	Peak	296.3	150	Vertical	Pass

GFSK High Channel 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	2309.89	50.08	2.33	74	23.92	Peak	122.6	150	Horizontal	Pass
2	2480.48	92.18	1.91	74	-18.18	Peak	128.4	150	Horizontal	N/A
3	4959.44	56.99	14.22	74	17.01	Peak	115.6	150	Horizontal	Pass
3**	4959.44	45.52	14.22	54	8.48	AV	115.6	150	Horizontal	Pass
4	8392.26	46.70	14.81	74	27.30	Peak	17.1	150	Horizontal	Pass
5	17076.12	45.37	11.56	74	28.63	Peak	10.3	150	Horizontal	Pass
6	21855.24	48.20	11.23	74	25.80	Peak	31.9	150	Horizontal	Pass

A.7 Band Edge (Restricted-band band-edge)

Test Data

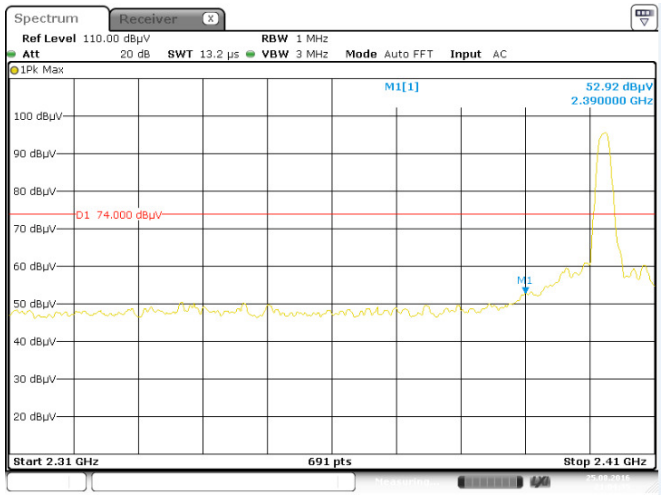
Note 1: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note 2: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

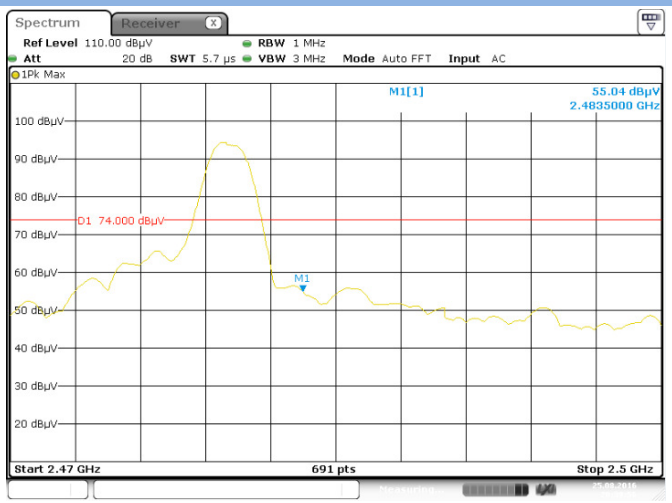
Note 3：According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
GFSK	Low	2390	52.92	74	21.08	PEAK	Pass
		2390	--	54	--	AVERAGE	Pass
GFSK	HIGH	2483.5	55.04	74	18.96	PEAK	Pass
		2483.5	38.45	54	15.55	AVERAGE	Pass

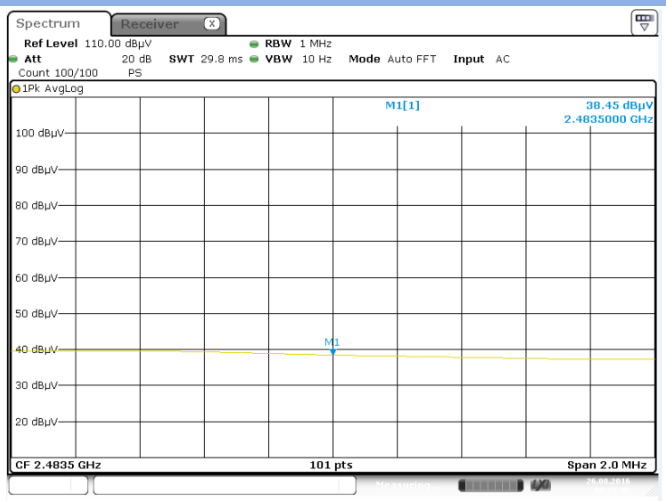
LOW CHANNEL, PEAK



HIGH CHANNEL, PEAK



HIGH CHANNEL, AV



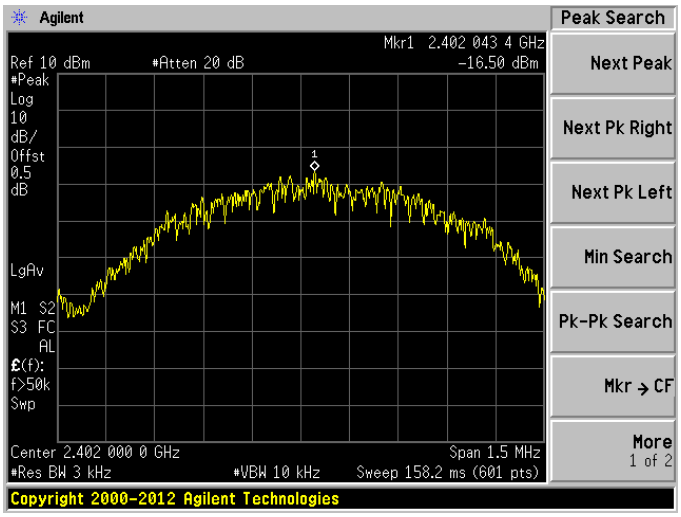
A.8 Power Spectral Density (PSD)

Test Data

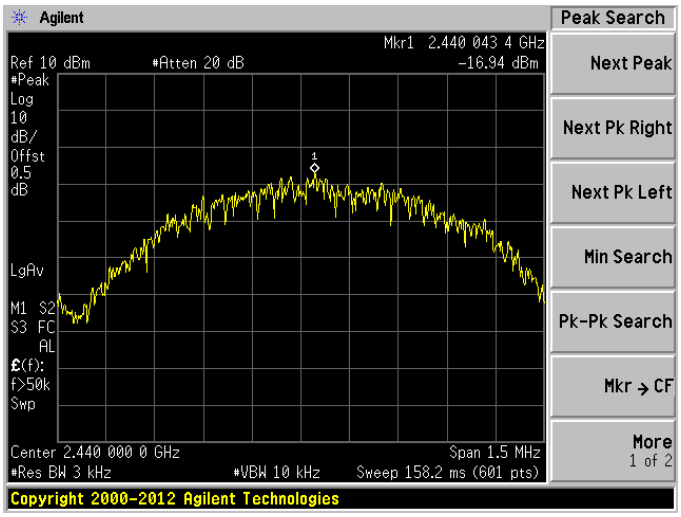
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-16.50	8	Pass
Middle Channel	-16.94	8	Pass
High Channel	-17.08	8	Pass

Test plots

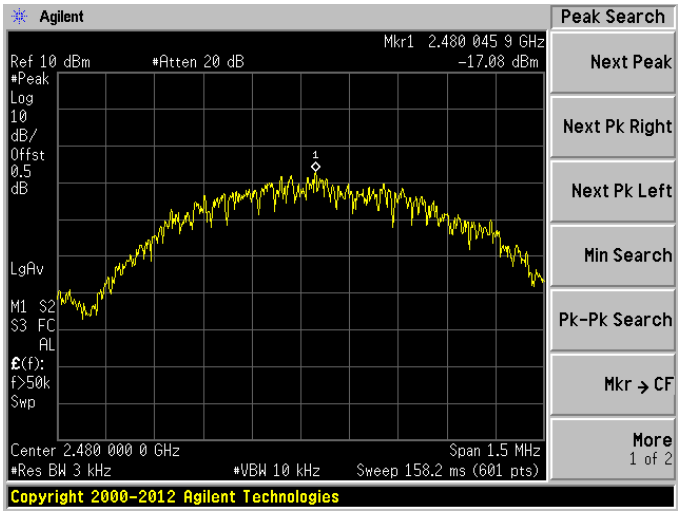
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ1680423-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ1680423-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ1680423-AI.PDF”.

--END OF REPORT--