

Test Report

FCC ID.: 2AGCXQ5

Date of issue: Nov. 12, 2015

Sample Description:	Balance of electric car
Model(s):	Q5
Applicant:	Shenzhen Knight Electronics Co., Ltd.
Address:	4th Building, Hongxiang Industrial Park, Hezhou Village, Xixiang Town, Baoan District, Shenzhen, Guangdong, China
Date of Test:	Oct. 12, 2015 to Nov. 11, 2015

Shenzhen Microtest Co., Ltd.
<http://www.mtitest.com>



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TABALE OF CONTENTS

1. General description.....	5
1.1 Feature of equipment under test (EUT).....	5
1.2 operation channel list.....	5
2. Test Configuration of EUT	6
2.1 Test Frequency Channel	6
2.2 EUT operation mode.....	6
2.3 Test conditions.....	6
2.4 Testing site	6
2.5 Ancillary equipment list.....	6
2.6 Measurement uncertainty	6
3. List of test equipment	7
4. Test Result	8
4.1 Conducted emission.....	8
4.2 Antenna requirement.....	11
4.3 Peak output power.....	12
4.4 6dB emission bandwidth.....	14
4.5 Power spectral density.....	16
4.6 Band edge spurious emission, conducted spurious emission	18
4.7 Radiated emission	21

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TEST RESULT CERTIFICATION	
Applicant's name:	Shenzhen Knight Electronics Co., Ltd.
Address:	4th Building, Hongxiang Industrial Park, Hezhou Village, Xixiang Town, Baoan District, Shenzhen, Guangdong, China
Manufacture's Name:	Shenzhen Knight Electronics Co., Ltd.
Address:	4th Building, Hongxiang Industrial Park, Hezhou Village, Xixiang Town, Baoan District, Shenzhen, Guangdong, China
Product description	
Product name:	Balance of electric car
Trademark:	/
Model name:	Q5
Serial Model:	/
Standards:	FCC Part 15.247
Test Procedure:	ANSI C63.4-2009; 558074 D01 DTS Meas Guidance v03r03

This device described above has been tested by Shenzhen Microtest Co., Ltd. and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

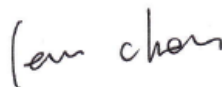
Tested By :



David Chen

Nov. 12, 2015

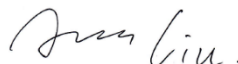
Reviewed By :



Leon Chen

Nov. 12, 2015

Approved By :



Ares Liu

Nov. 12, 2015

SUMMARY OF TEST RESULT

Item	FCC Part No.	Description of Test	Result
1	15.203	Antenna requirement	Pass
2	15.207	AC power line conducted emission	Pass
3	15.247(b)(3)	Peak output power	Pass
4	15.247(a)(2)	6dB emission bandwidth	Pass
5	15.247(e)	Power spectral density (PSD)	Pass
8	15.247(d)	Band edge spurious emission, conducted spurious emission	Pass
9	15.247(d), 15.209	Radiated emission	Pass

1. General description

1.1 Feature of equipment under test (EUT)

Product name:	Balance of electric car
Model name:	Q5
Serial Model:	/
Tx/Rx frequency range:	Tx/Rx: 2402MHz~2480MHz
Bluetooth version:	4.0
Modulation type:	GFSK
Power source:	36VDC (rechargeable Li-on battery)
Adapter information:	Model: JZX-420200 Input: 100-240VAC 50/60Hz Output: DC 42V 2.0A
Antenna designation:	PCBA antenna (Antenna Gain: 0dBi)
Hardware version:	V1.0
Software version:	V1.0

1.2 operation channel list

Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz
1	2404MHz	11	2424MHz	21	2444MHz
---	---	---	---	---	---
---	---	---	---	---	---
8	2418MHz	18	2438MHz	38	2478MHz
9	2420MHz	19	2440MHz	39	2480MHz

2. Test Configuration of EUT

2.1 Test Frequency Channel

Low	2402MHz
Middle	2440MHz
High	2480MHz

2.2 EUT operation mode

During testing, RF test program (SmartRF_Studio) provided by the manufacture to control the Tx/Rx operation followed the test requirement.

2.3 Test conditions

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

- Temperature: 20°C~30°C
- Humidity: 50%~70%
- Atmospheric pressure: 98kPa~101kPa

2.4 Testing site

Test Site	Shenzhen Toby Technology Co., Ltd.
Test Site Location	1 A/F., Bldg.6, Yusheng Industrial Zone The National Road No.107 Xixiang Section 467
FCC Registration No.:	811562

2.5 Ancillary equipment list

Equipment	Model	S/N	Manufacturer
/	/	/	/

2.6 Measurement uncertainty

Measurement Uncertainty for a Level of Confidence of 95 %, $U=2 \times U_c(y)$

RF frequency	1×10^{-7}
RF power, conducted	± 1 dB
Conducted emission of receivers	± 1 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Temperature	± 1 degree
Humidity	± 5 %

3. List of test equipment

For AC power line conducted emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
LISN	R&S	ENV216	101313	2015.12.06
LISN	SCHWARZBECK	NNLK 8129	8129245	2015.12.25
Pulse Limiter	SCHWARZBECK	VTSD 9561F	9716	2015.12.25
Test Cable	N/A	N/A	C01	2015.12.06
EMI Test Receiver	R&S	ESCI	101160	2015.12.06

For Radiated emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
Log-Bicon Antenna	MESS-ELEKTRO NIK	VULB 9160	3058	2015.12.11
Horn Antenna	Schwarzbeck	BBHA 9120D	631	2015.12.05
Horn Antenna	Schwarzbeck	BBHA 9170	373	2015.12.05
Test Cable	United Microwave	57793	1m	2015.12.05
Test Cable	United Microwave	A30A30-5006	10M	2015.12.05
Microwave Pre amplifier	Agilent	8449B	3008A01714	2015.12.05
Pre-Amplifier	Anritsu	MH648A	M09961	2015.12.05
EMI Test Receiver	R&S	ESCI-7	101318	2015.12.05
Spectrum analyzer	Agilent	E4470B	MY41441082	2016.06.01

For RF conducted emission:

Equipment	Manufacturer	Model	Serial No.	Calibration Due
Spectrum analyzer	Agilent	E4470B	MY41441082	2016.06.01

Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

4. Test Result

4.1 Conducted emission

4.1.1 Limit

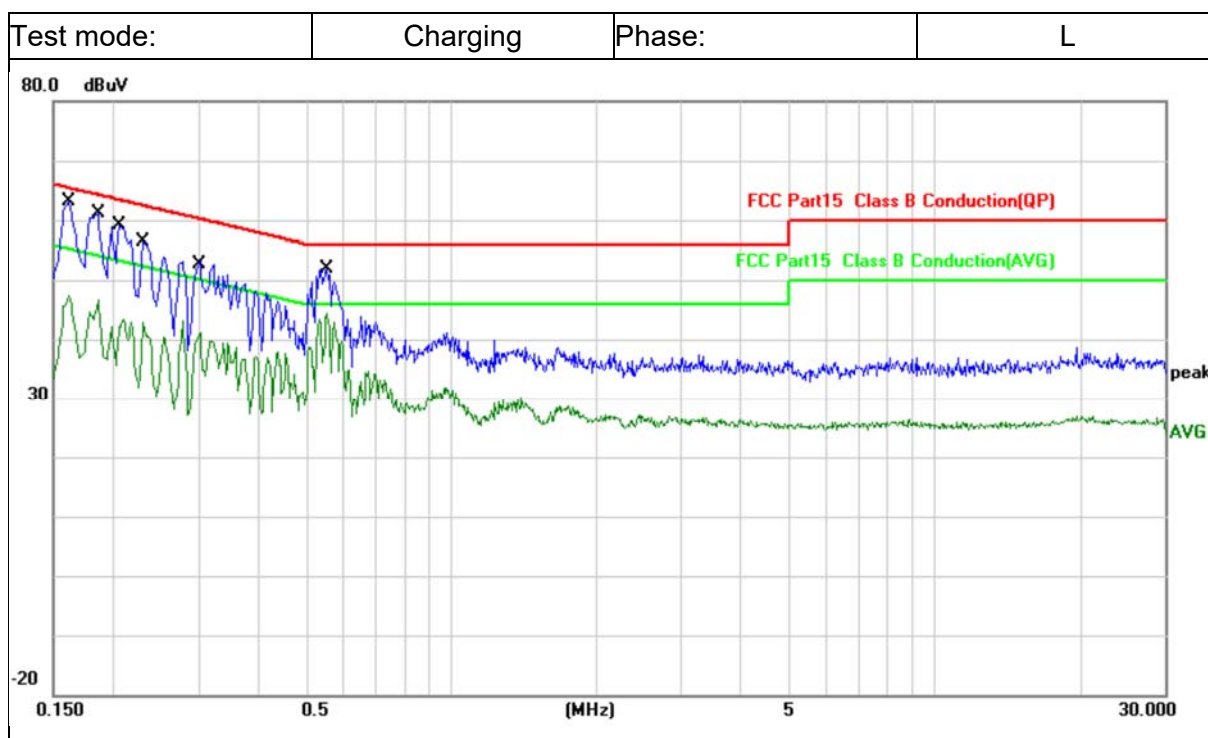
Frequency (MHz)	Limit	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 50 46
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency from 0.15MHz to 0.5MHz.

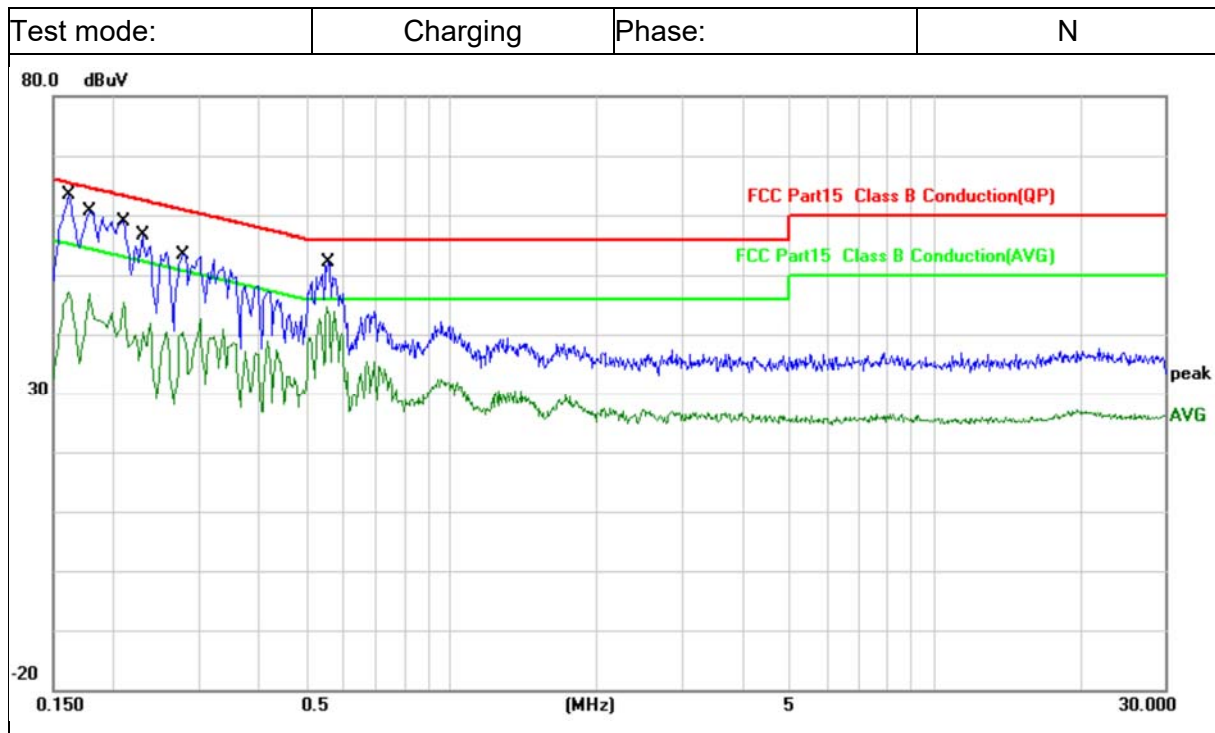
4.1.2 Test method

1. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/50uH of coupling impedance for the measuring instrument.
2. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
3. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
4. LISN at least 80 cm from nearest part of EUT chassis.
5. The resolution bandwidth of EMI test receiver is set at 9kHz.

4.1.3 Test Result



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1631	29.78	30.06	59.84	65.30	-5.46	QP	
2		0.1631	13.80	30.06	43.86	55.30	-11.44	AVG	
3		0.1848	27.65	30.06	57.71	64.26	-6.55	QP	
4		0.1848	11.41	30.06	41.47	54.26	-12.79	AVG	
5		0.2075	25.09	30.06	55.15	63.30	-8.15	QP	
6		0.2075	8.59	30.06	38.65	53.30	-14.65	AVG	
7		0.2289	21.56	30.06	51.62	62.49	-10.87	QP	
8		0.2289	5.29	30.06	35.35	52.49	-17.14	AVG	
9		0.2977	19.61	30.06	49.67	60.30	-10.63	QP	
10		0.2977	9.39	30.06	39.45	50.30	-10.85	AVG	
11		0.5505	18.79	30.06	48.85	56.00	-7.15	QP	
12	*	0.5505	12.13	30.06	42.19	46.00	-3.81	AVG	



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1630	30.09	30.06	60.15	65.30	-5.15	QP	
2		0.1630	13.78	30.06	43.84	55.30	-11.46	AVG	
3		0.1763	26.35	30.06	56.41	64.65	-8.24	QP	
4		0.1763	9.59	30.06	39.65	54.65	-15.00	AVG	
5		0.2099	24.84	30.06	54.90	63.21	-8.31	QP	
6		0.2099	7.59	30.06	37.65	53.21	-15.56	AVG	
7		0.2298	22.24	30.06	52.30	62.45	-10.15	QP	
8		0.2298	6.57	30.06	36.63	52.45	-15.82	AVG	
9		0.2770	20.61	30.06	50.67	60.90	-10.23	QP	
10		0.2770	10.17	30.06	40.23	50.90	-10.67	AVG	
11		0.5552	18.89	30.06	48.95	56.00	-7.05	QP	
12	*	0.5552	13.81	30.06	43.87	46.00	-2.13	AVG	

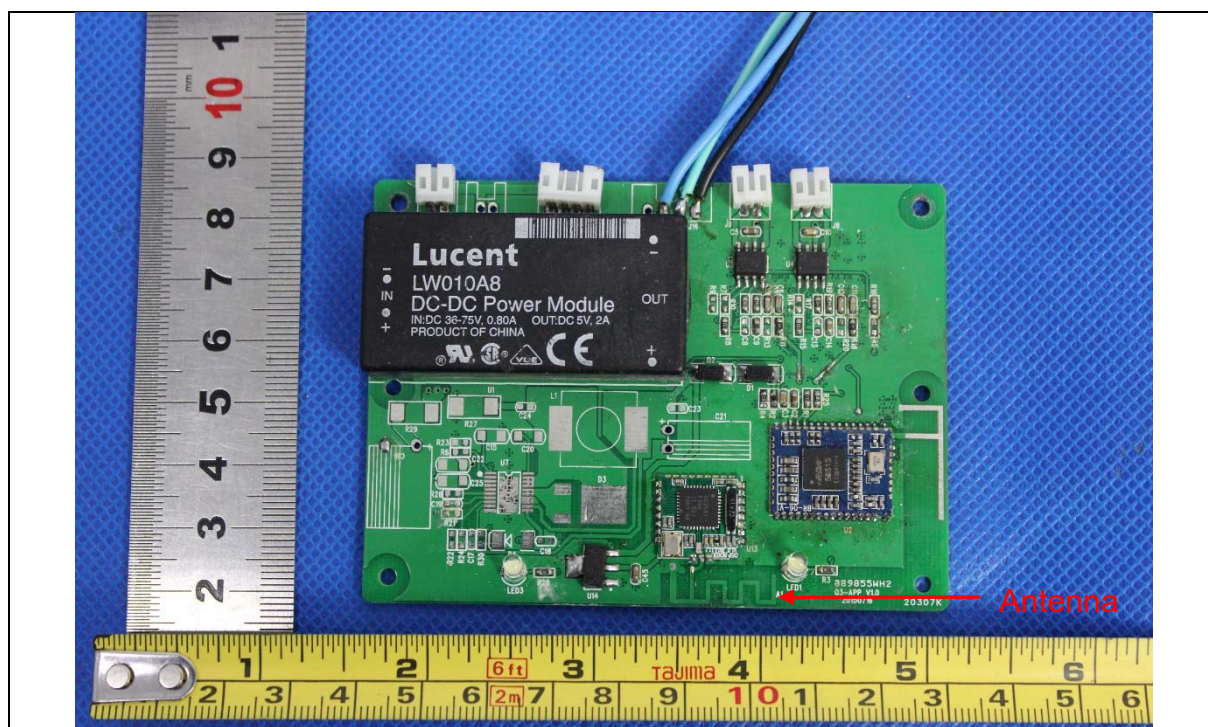
4.2 Antenna requirement

4.2.1 Requirement defined in FCC 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 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.

4.2.2 EUT antenna description

The Bluetooth antenna of EUT is an internal permanently attached antenna, the maximum gain is 0dBi. So the antenna meets the requirement of this part.



4.3 Peak output power

4.3.1 Limits

Conducted peak output power limit is 1W (30dBm).

4.3.2 Test Method

Use the following spectrum analyzer settings:

RBW $\geq$ DTS bandwidth (6dB emission bandwidth, see section 4.4)

VBW $\geq$ RBW

Span $\geq$ 3RBW

Sweep time = auto couple

Detector = peak

Trace mode = max hold

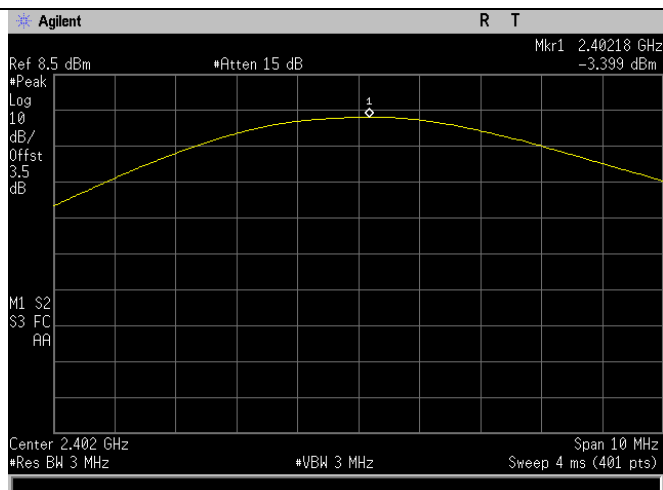
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the amplitude.

4.3.3 Test Result

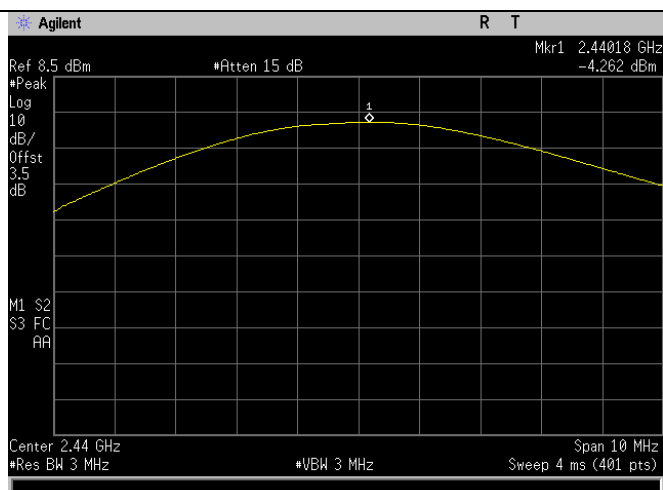
Frequency (MHz)	Peak output power (dBm)	Limit (dBm)
2402	-3.399	30
2440	-4.262	30
2480	-5.264	30

Test plots as below:

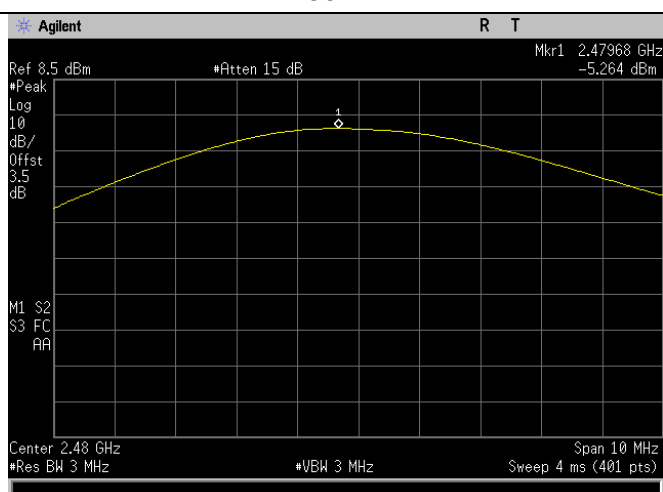
2402MHz



2440MHz



2480MHz



4.4 6dB emission bandwidth

4.4.1 Limits

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.4.2 Test method

Use the following spectrum analyzer settings:

RBW = 100kHz

VBW $\geq$ 3RBW

Detector = peak

Trace mode = max hold

Sweep time = auto couple

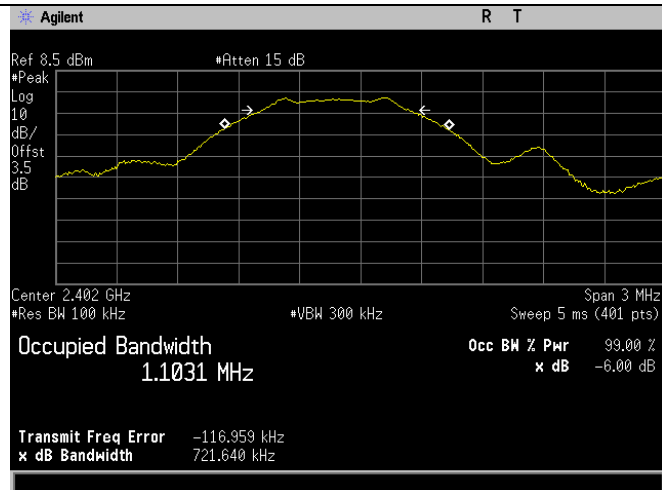
Allow the trace to stabilize, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

4.4.3 Test result

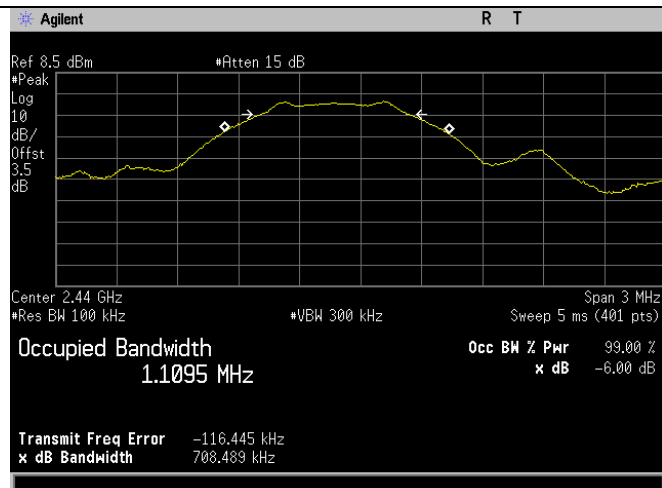
Frequency (MHz)	6dB emission bandwidth (MHz)
2402	0.722
2440	0.708
2480	0.724

Test plots as below:

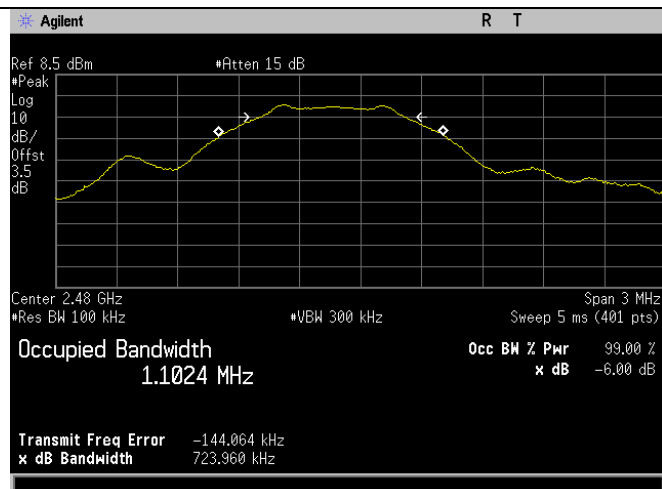
2402MHz



2440MHz



2480MHz



4.5 Power spectral density

4.5.1 Limits

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

4.5.2 Test method

Span = 1.5 times DTS bandwidth (6dB emission bandwidth, see section 4.4)

RBW = 3kHz to 100kHz

VBW $\geq$ 3RBW

Detector = peak

Sweep time = auto

Trace mode = max hold

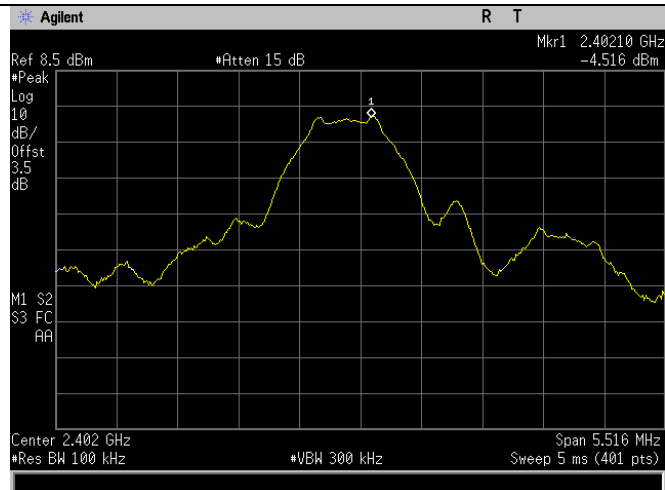
Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.3 Test result

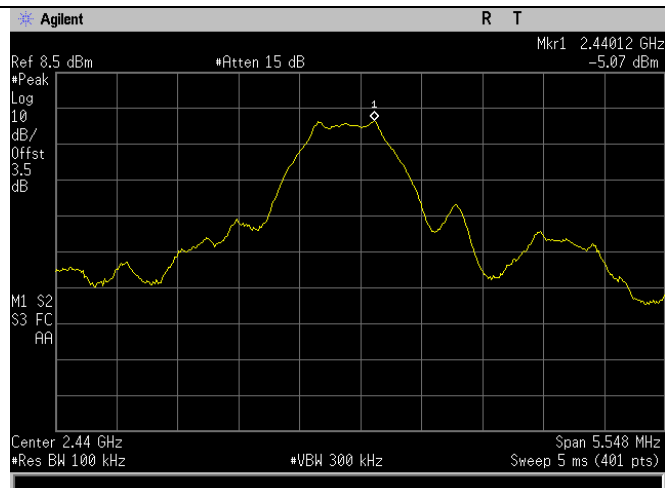
Frequency (MHz)	PSD (dBm/100kHz)	Limit (dBm/3kHz)
2402	-4.516	8
2440	-5.07	8
2480	-5.875	8

Test plots as below:

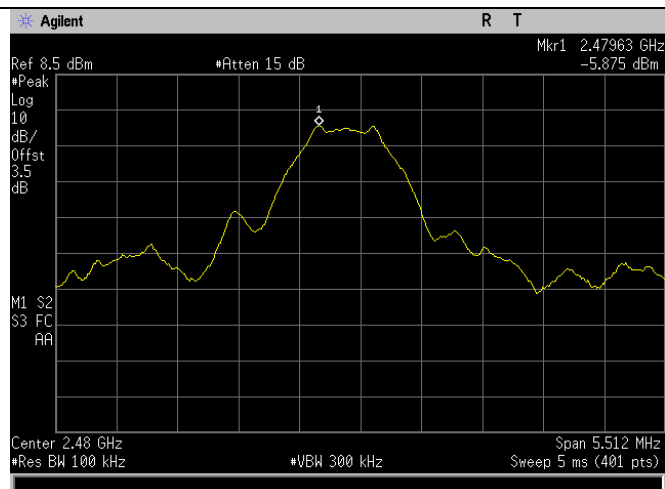
2402MHz



2440MHz



2480MHz



4.6 Band edge spurious emission, conducted spurious emission

4.6.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

4.6.2 Test method

Use the following spectrum analyzer settings:

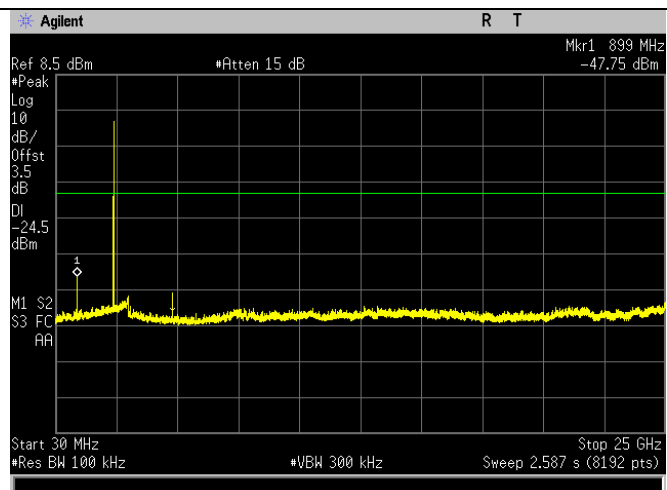
Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.

4.6.3 Test Result

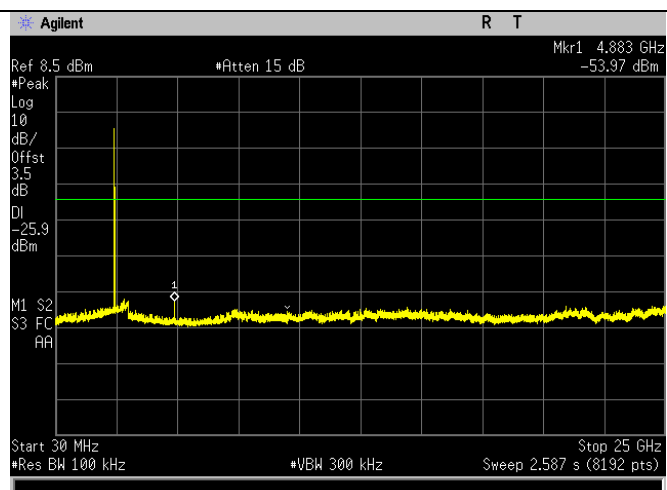
Test plots as below:

Conducted emission

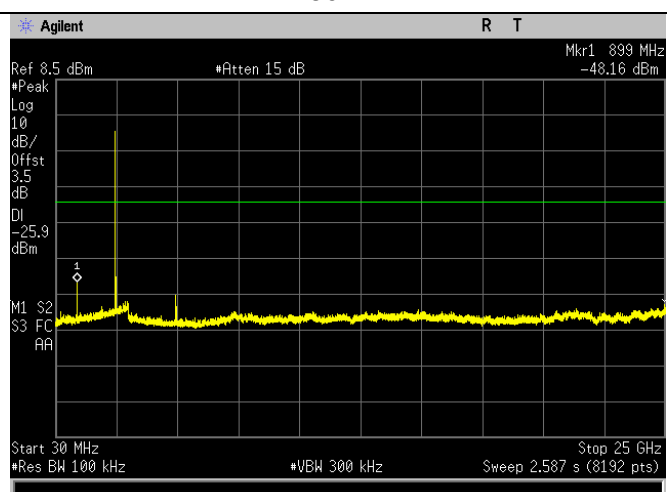
2402MHz



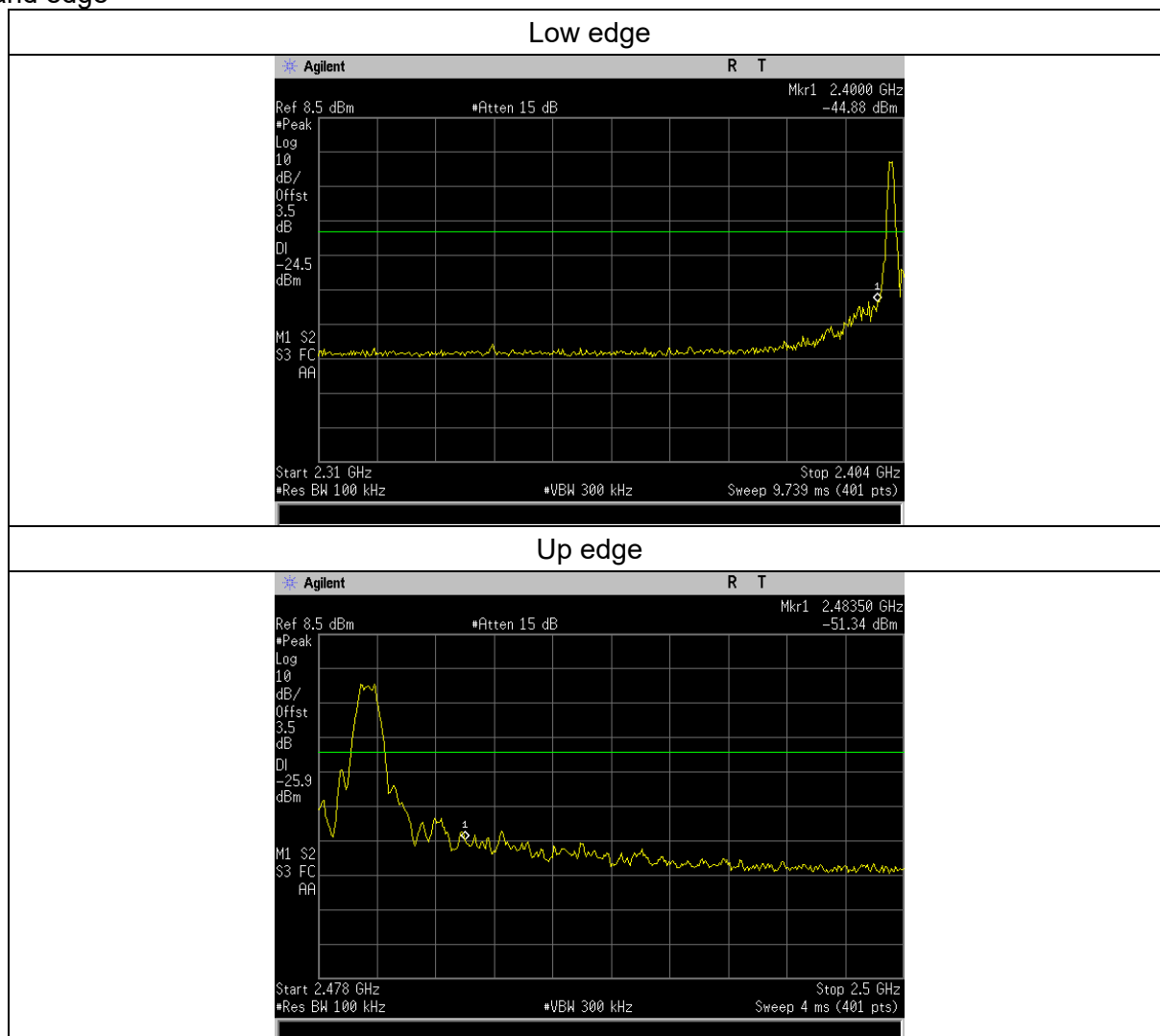
2440MHz



2480MHz



Band edge



4.7 Radiated emission

4.7.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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).

Frequency (MHz)	Field strength $\mu\text{V/m}$	Field strength $\text{dB}\mu\text{V/m}$	Detector	Measurement distance
30-88	100	40	QP	3m
88-216	150	43.5	QP	
216-960	200	46	QP	
960-1000	500	46	QP	
Above 1000	500	54	AV	
Above 1000	5000	74	PK	

4.7.2 Test method

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
3. Use the following spectrum analyzer settings:

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

4. Follow the guidelines in ANSI C63.4-2009 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

5. Set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the duty cycle per channel of the hopping signal is less than 100ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{duty cycle}/100\text{ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

4.7.3 Test Result

Radiated emission

2402MHz

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dBμV/m	dBμV/m		
133.26	V	29.9	43.5	QP	Pass
147.28	H	31.5	43.5	QP	
2400	V	46.15	74	PK	
2400	H	46.57	74	PK	
4804	V	50.19	74	PK	
4804	H	50.42	74	PK	

2440MHz

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dBμV/m	dBμV/m		
133.26	V	29.4	43.5	QP	Pass
147.28	H	31.1	43.5	QP	
4880	V	50.69	74	PK	
4880	H	50.26	74	PK	

2480MHz

Frequency	Ant. Polarization	Emission level	Limits	Detector	Result
(MHz)	H / V	dBμV/m	dBμV/m		
133.26	V	30.2	43.5	QP	Pass
147.28	H	31.8	43.5	QP	
2483.5	V	46.93	74	PK	
2483.5	H	46.02	74	PK	
4960	V	50.33	74	PK	
4960	H	49.57	74	PK	

Note:

QP Emission Level= Antenna Factor +Cable Loss + Reading

PK Emission Level= Antenna Factor +Cable Loss - Amp. Factor + Reading

AV Emission Level= PK Emission Level+20log (duty cycle) or set the RBW/VBW to be 1MHz/10Hz to read the level.

If the PK measured values lower than average mode limit, the EUT shall be deemed to meet average limits and then no additional average mode measurement performed.

----END OF REPORT----