FCC/IC - TEST REPORT

Report Number	:	**68.950.15.092.01**	Date of Issue:	July 11, 2015

Model	:	SPE101
Product Type	:	Coolest Outdoor Bluetooth Speaker
Applicant	:	Coolest LLC
Address	:	1355 NW Everett St. Suite 100 Portland, Oregon USA
Production Facility	:	Charter Media (Dongguan) Co., Ltd.
Address	:	Dabandi Industrial Zone, Daning District, Humen Town, 523930 Dongguan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA

Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	43

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1 Table of Contents

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
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3 Description of the Equipment Under Test

Product:	Coolest Outdoor Bluetooth Speaker
Model no.:	SPE101
FCC ID:	2AEZT-SPE101
IC	20298-SPE101
Options and accessories:	Nil
Rating:	DC3.6V Supplied by NI-MH rechargeable battery DC5.0V Charged by the USB port
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8-DPSK
Antenna Type:	PIFA
Antenna Gain:	3dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Bluetooth Speaker operated at 2.4GHz

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2014 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-247 Issue 1 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure released by FCC on March 30, 2000 and C63.10 (2013).

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5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition			Pages	Test Result
§15.207	RSS-GEN A7.2.4	Conducted emission AC power port	10	Pass
§15.247(b)(1)	RSS-247 Clause 5.4(2)	Conducted peak output power	13	Pass
§15.247(e)	RSS-247 Clause 5.2(2)	Power spectral density*	--	N/A
§15.247(a)(2)	RSS-247 Clause 5.2(1)	6dB bandwidth	--	N/A
§15.247(a)(1)	RSS-247 Clause 5.1(1)	20dB bandwidth and 99% Occupied Bandwidth	15	Pass
§15.247(a)(1)	RSS-247 Clause 5.1(2)	Carrier frequency separation	22	Pass
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(4)	Number of hopping frequencies	25	Pass
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(4)	Dwell Time	27	Pass
§15.247(d)	RSS-247 Clause 5.5	Spurious RF conducted emissions	30	Pass
§15.247(d)	RSS-247 Clause 5.5	Band edge	34	Pass
§15.247(d) & §15.209 &	& RSSGEN 7.2.5	Spurious radiated emissions for transmitter and receiver	39	Pass
§15.203	RSSGEN 7.1.2	Antenna requirement	See note 1	Pass

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a patch antenna, which gain is 0dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AEZT-SPE101, IC: 20298-SPE101 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C, RSS 247 and RSS-Gen rules.

This report is for the BT3.0 part.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: May 19, 2015

Testing Start Date: May 19, 2015

Testing End Date: June 10, 2015

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Reviewed by:	Prepared by:	Tested by:
Phoebe Hu	Felix Li	Leon Zhang
EMC Project Manager	EMC Project Engineer	EMC Test Engineer

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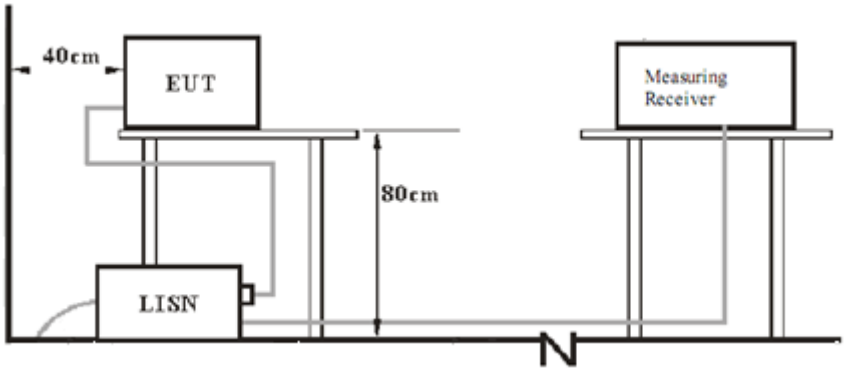
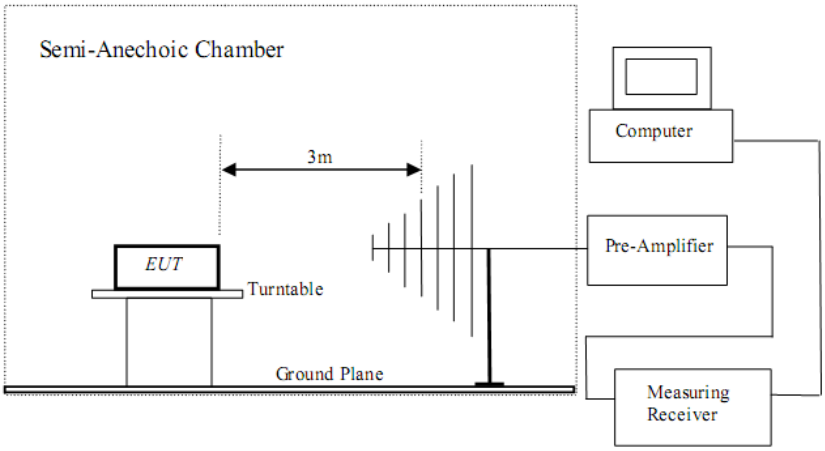
7 Test Setups

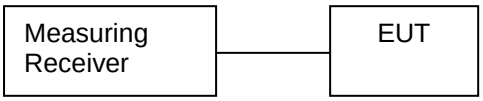
7.1 AC Power Line Conducted Emission test setups



7.2 Radiated test setups



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
---	---	---	---

Test software: Blue test 3.0, which used to control the EUT in continues transmitting mode

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

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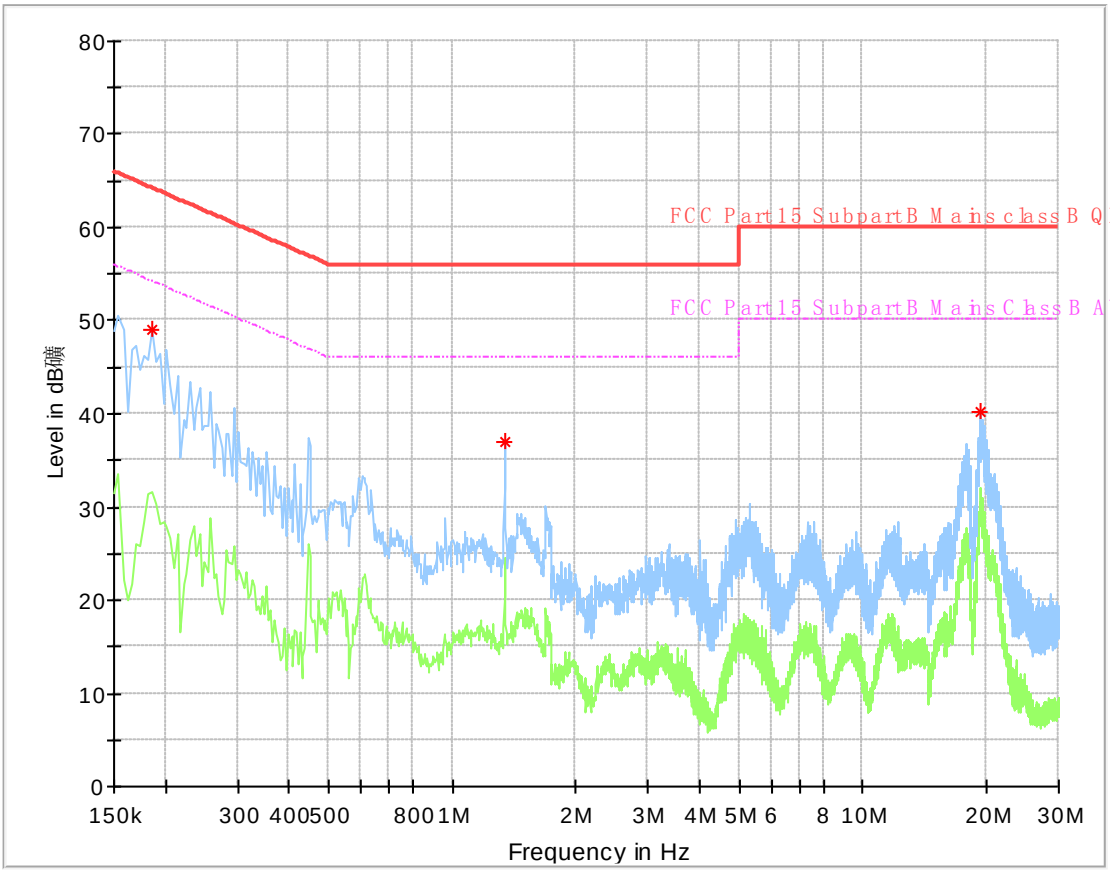
Conducted Emission

Product Type	:	Coolest Outdoor Bluetooth Speaker
M/N	:	SPE101
Operating Condition	:	Charging & TX
Test Specification	:	Live
Comment	:	AC 120V/60Hz



Frequency (MHz)	MaxPeak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.186000	48.96	64.21	15.26	L1	9.7
1.342000	37.01	56.00	18.99	L1	9.8
19.450000	40.12	60.00	19.88	L1	10.2

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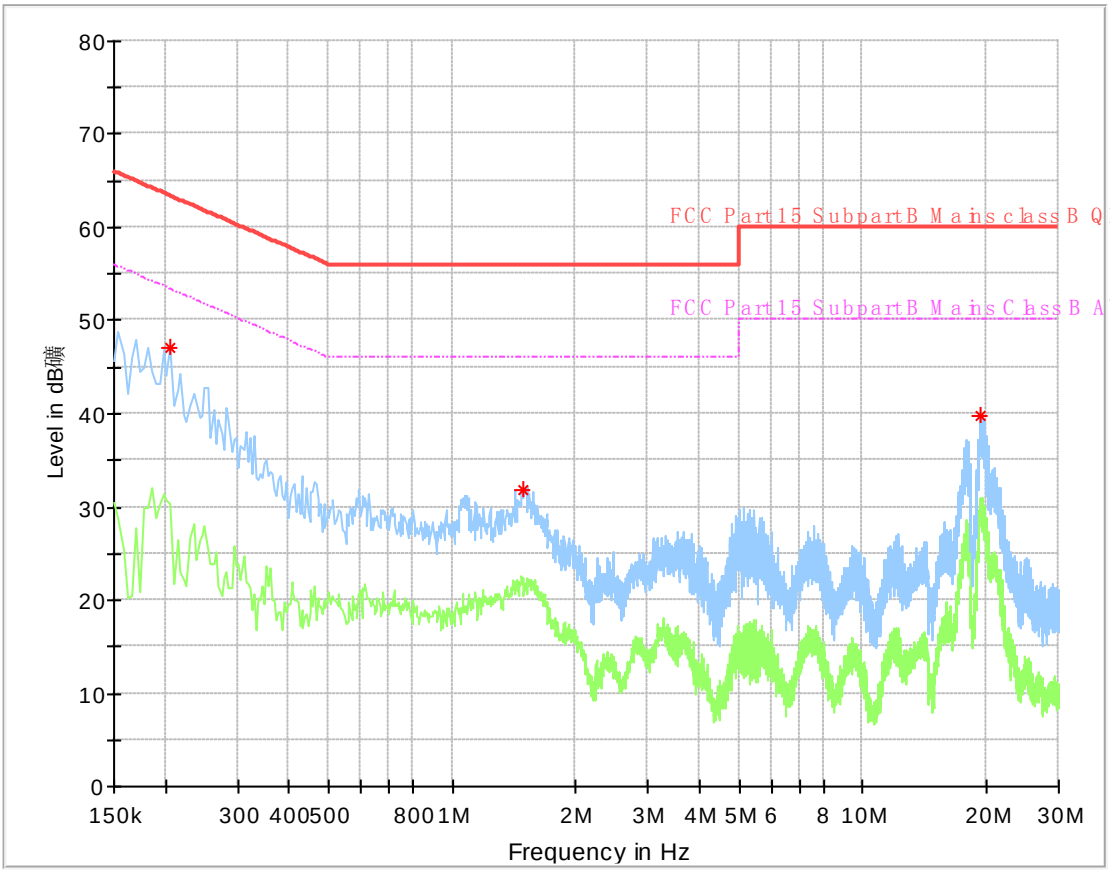
Conducted Emission

Product Type	:	Coolest Outdoor Bluetooth Speaker
M/N	:	SPE101
Operating Condition	:	Charging & TX
Test Specification	:	Neutral
Comment	:	AC 120V/60Hz



Frequency (MHz)	MaxPeak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.206000	47.10	63.37	16.27	N	9.8
1.490000	31.91	56.00	24.09	N	9.8
19.294000	39.71	60.00	20.29	N	10.1

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9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
   RBW > the 20 dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

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Conducted peak output power

BT 3.0 Bluetooth Mode GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	6.38	Pass
Middle channel 2441MHz	7.26	Pass
High channel 2480MHz	7.44	Pass

BT3.0 Bluetooth Mode π/4-DQPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	4.43	Pass
Middle channel 2441MHz	5.84	Pass
High channel 2480MHz	6.29	Pass

BT3.0 Bluetooth Mode 8DPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	4.79	Pass
Middle channel 2441MHz	6.09	Pass
High channel 2480MHz	6.48	Pass

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9.3 20 dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]
N/A

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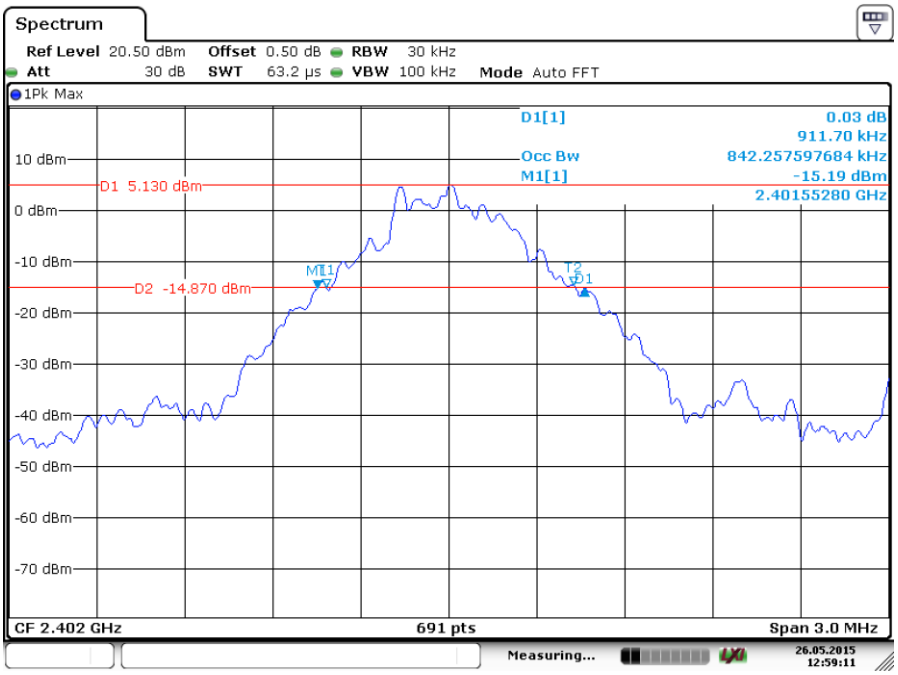
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	911.70	842.26	--	Pass
2441	916.10	846.60	--	Pass
2480	872.60	842.25	--	Pass

2402MHz



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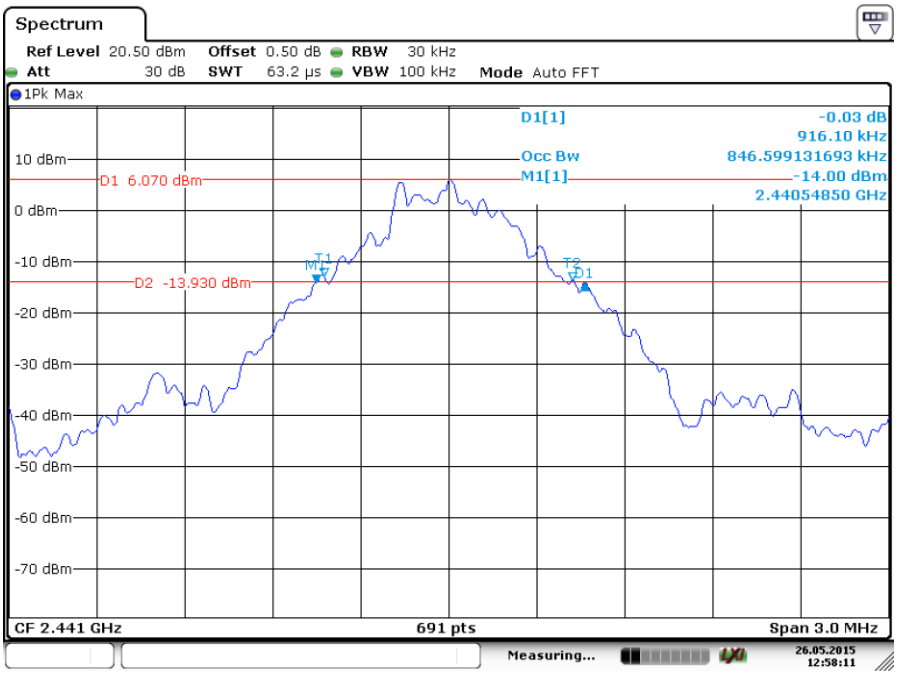
2441MHz



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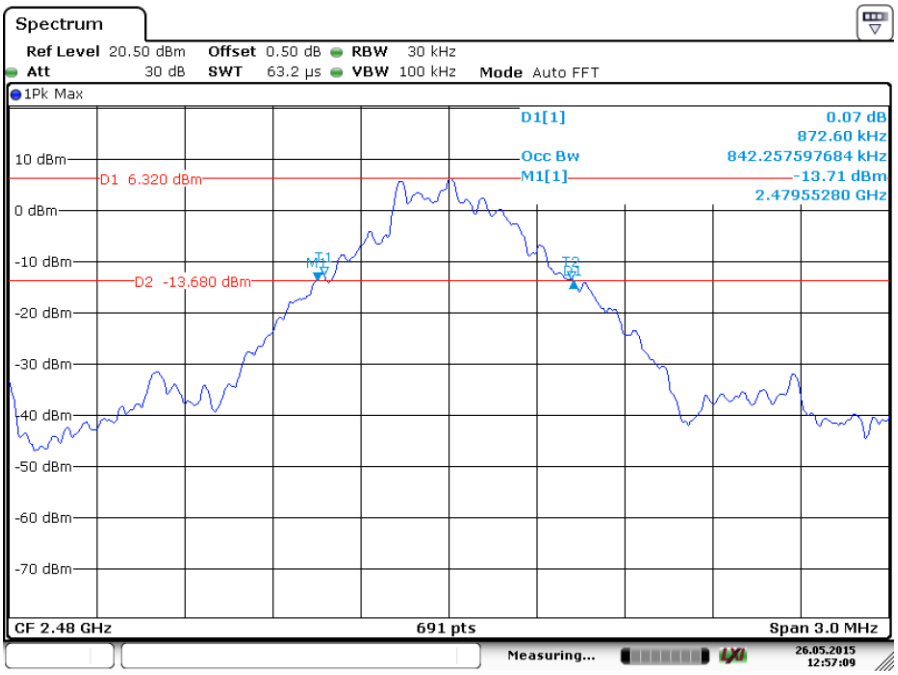
2480MHz



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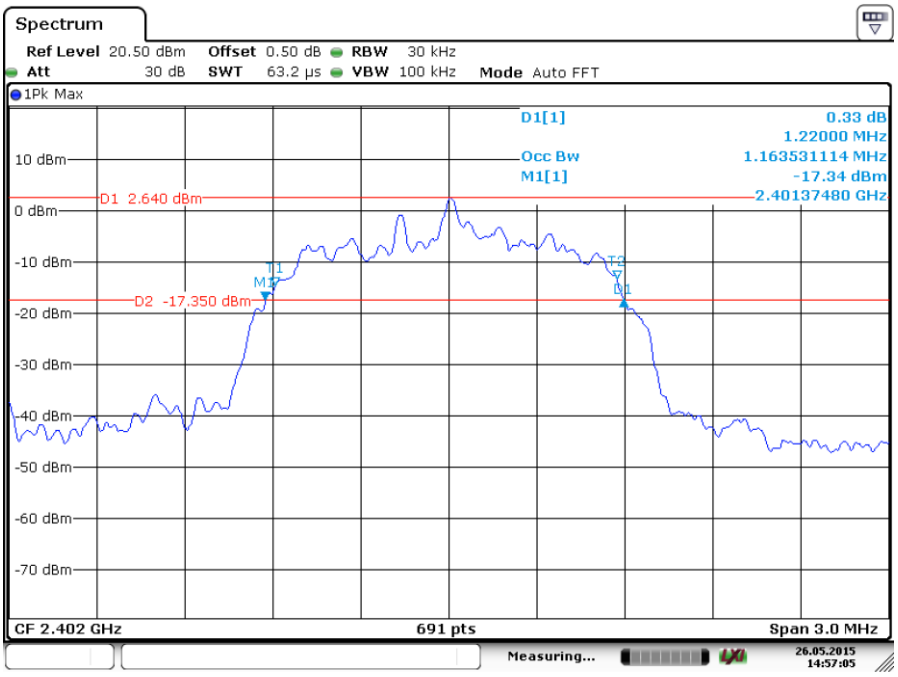
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode π/4-DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1220	1163.31	--	Pass
2441	1220	1159.19	--	Pass
2480	1220	1167.87	--	Pass

2402MHz



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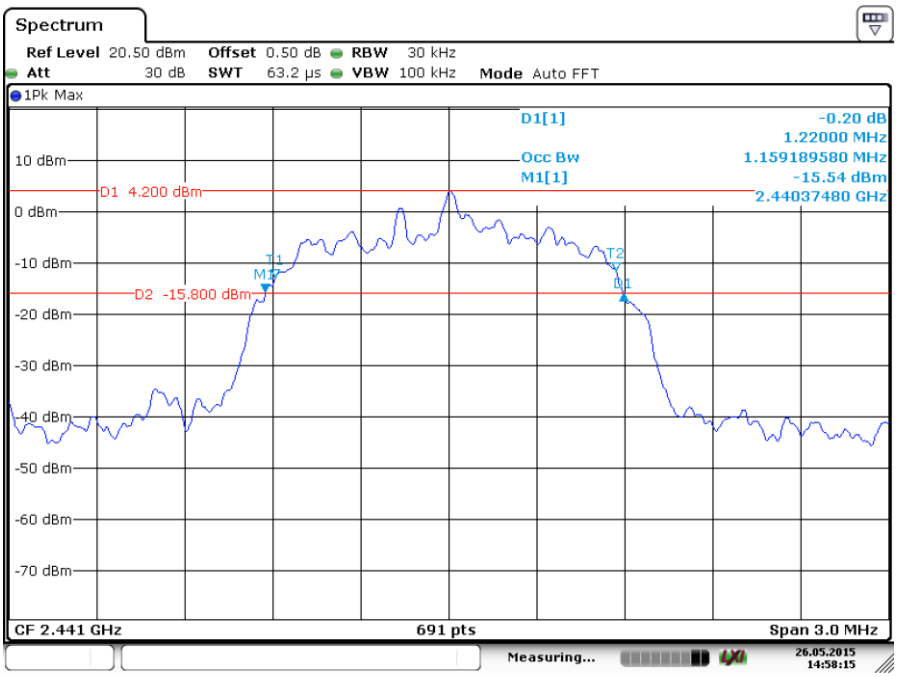
2441MHz



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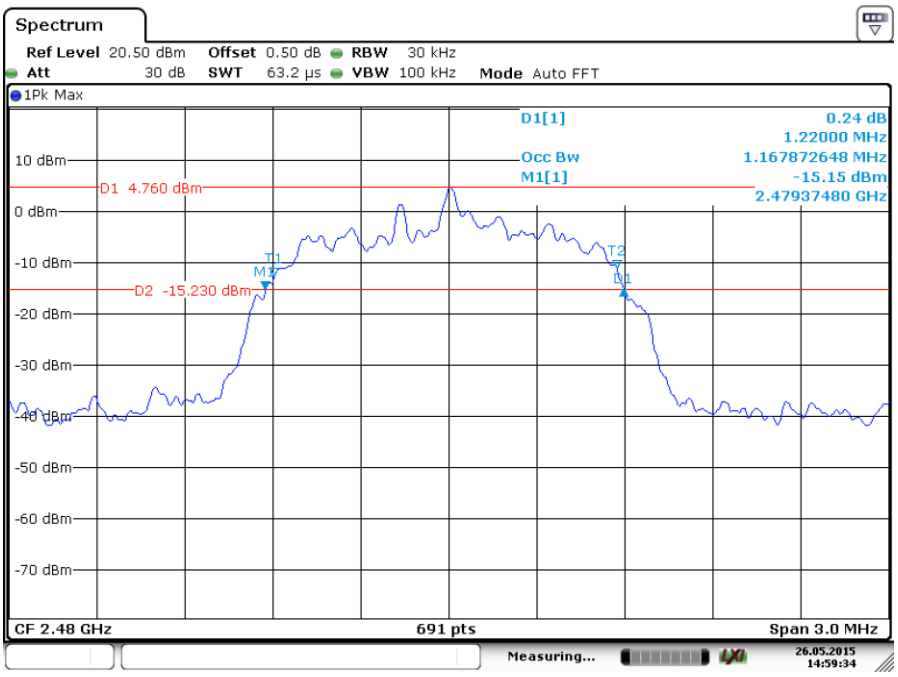
2480MHz



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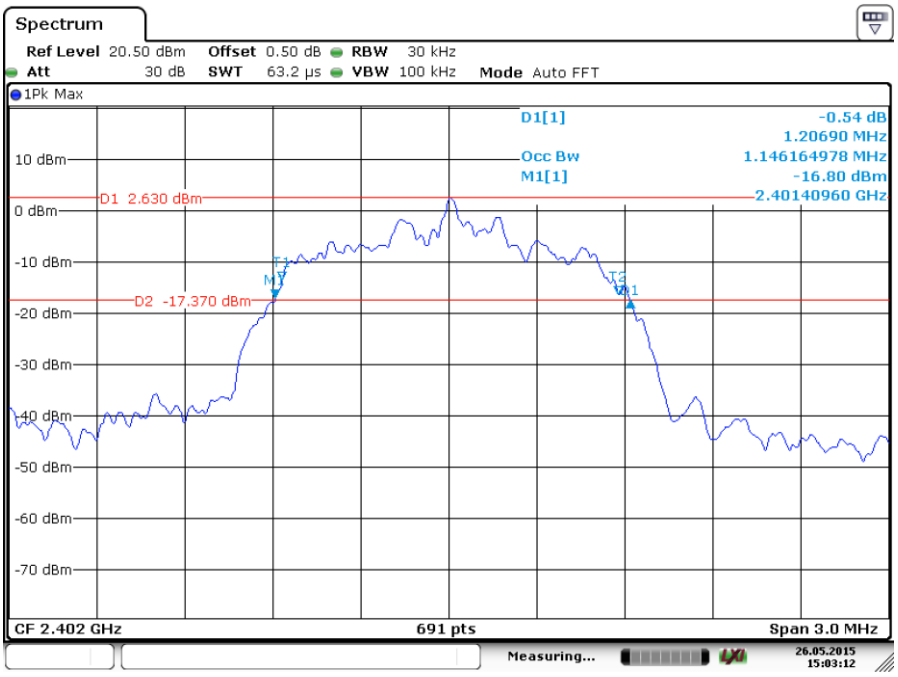
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1206.9	1146.16	--	Pass
2441	1211.3	1141.82	--	Pass
2480	1211.3	1151.56	--	Pass

2402MHz



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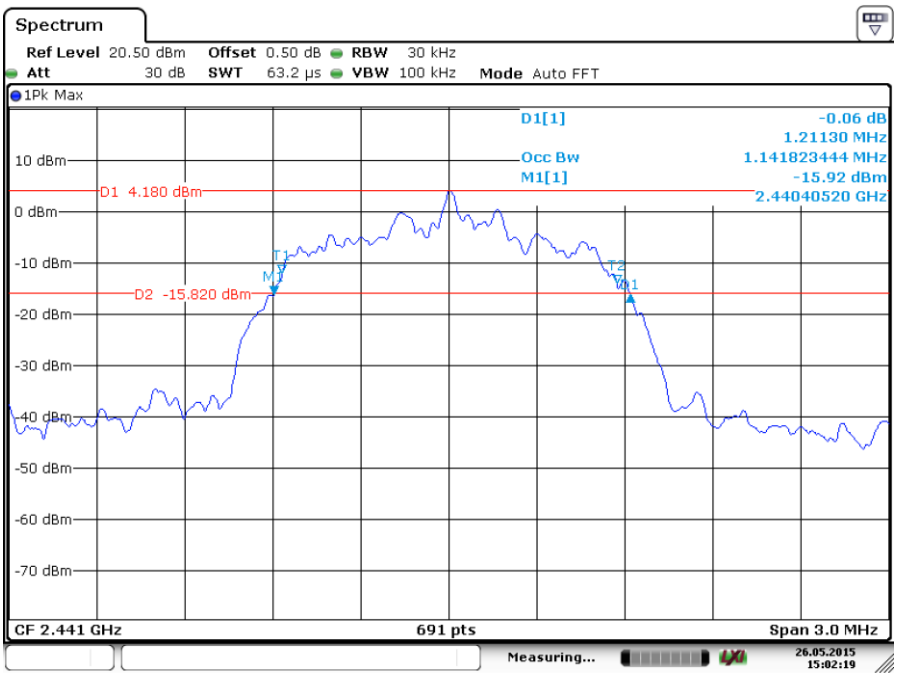
2441MHz



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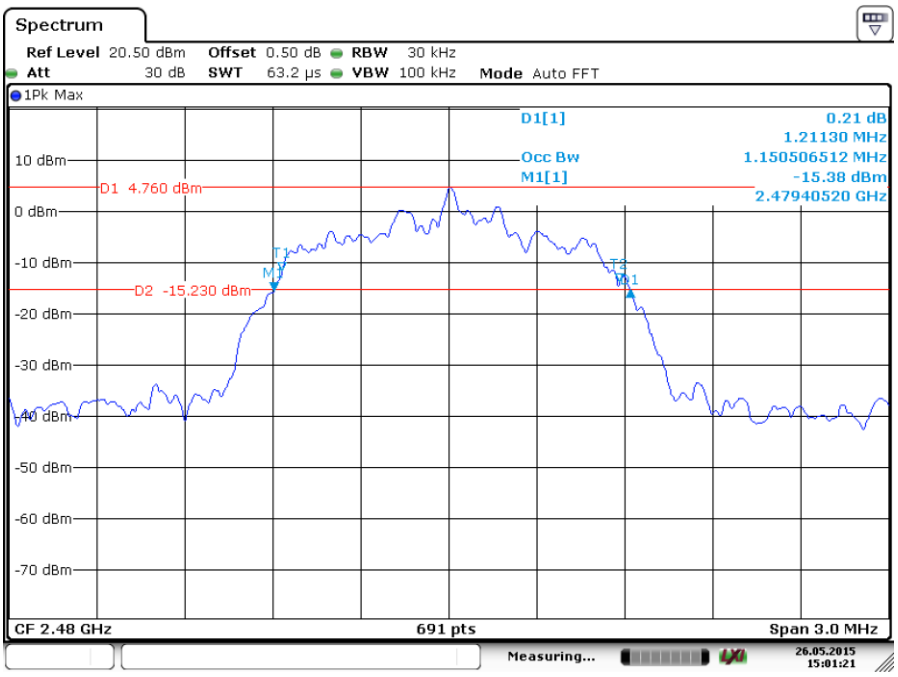
2480MHz



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9.4 Carrier Frequency Separation

Test Method

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit kHz
≥25KHz or 2/3 of the 20 dB bandwidth which is greater

GFSK Modulation Limit

Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	607.80
2441	610.73
2480	581.73

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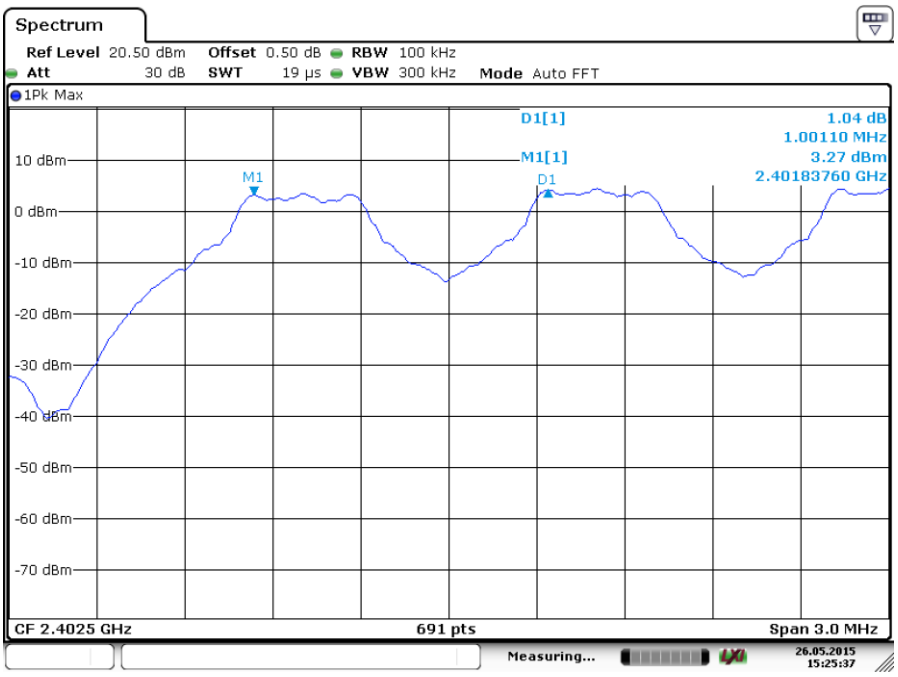
Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here GFSK modulation mode was used to show compliance.

GFSK Modulation test result

Frequency MHz	Carrier Frequency Separation kHz	Result
2402	1001.1	Pass
2441	1002.9	Pass
2480	1002.9	Pass

Low Channel



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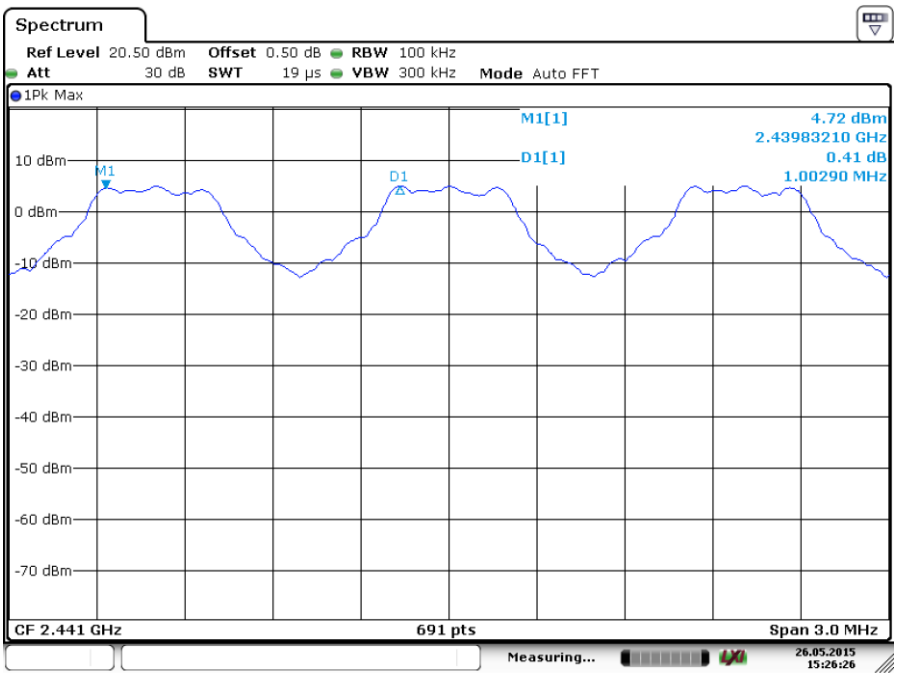
Middle channel



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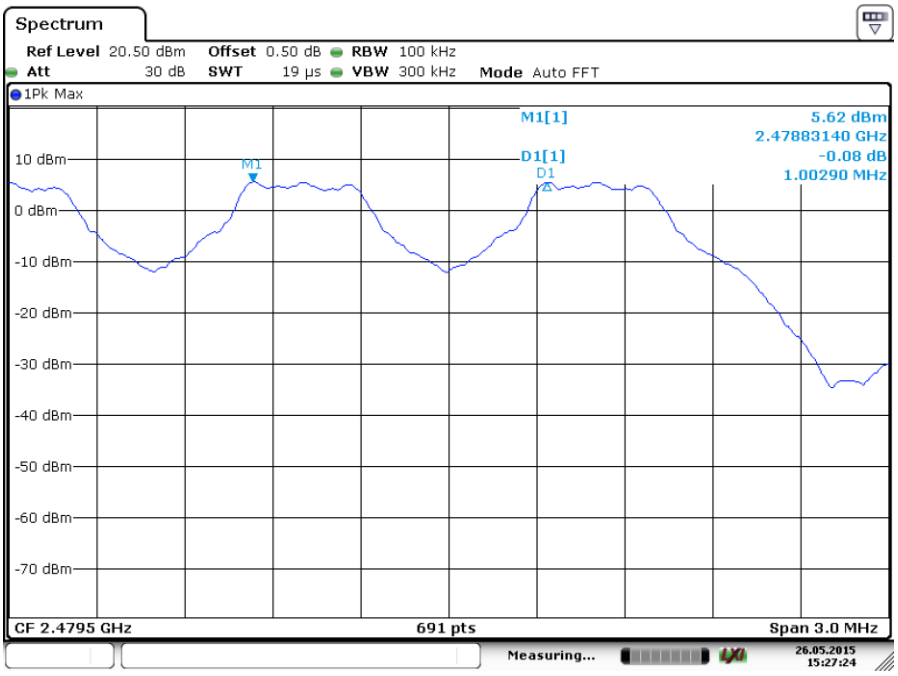
High Channel



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9.5 Number of hopping frequencies

Test Method

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit number
≥ 15

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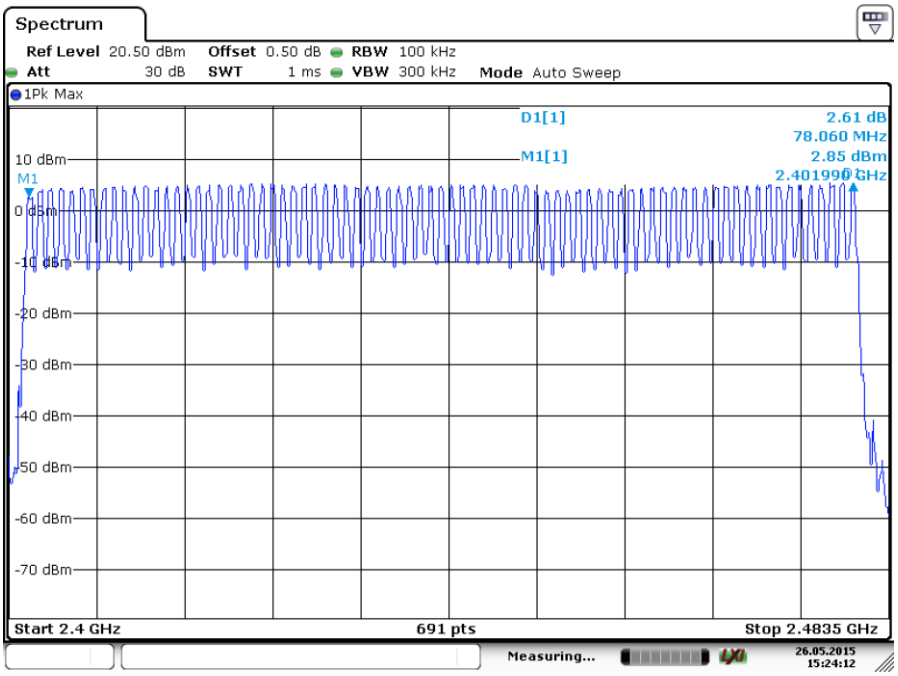
Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here GFSK modulation mode was used to show compliance.

Number of hopping frequencies	Result
79	Pass



Date: 26.MAY.2015 15:24:12

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9.6 Dwell Time

Test Method

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable. Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

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Dwell Time

Dwell time

The maximum dwell time shall be 0.4 s.
According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

The burst width, which is directly measured, refers to the duration on one channel hop.

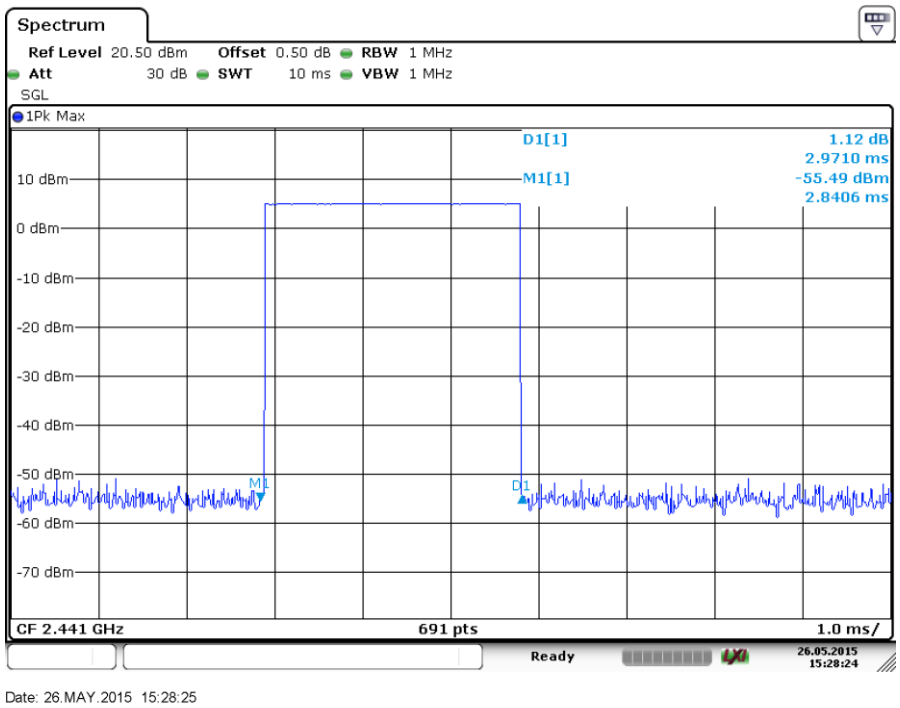
The maximum number of hopping channels in 31.6s for DH5=1600 / 6 / 79 *31.6=106.67

Test Result

Modulation	Mode	Reading (ms)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2971	106.67	316.92	< 400	Pass
π/4-DQPSK	2DH5	2971	106.67	316.92	< 400	Pass
8-DPSK	3DH5	2971	106.67	316.92	< 400	Pass

GFSK Modulation

DH5



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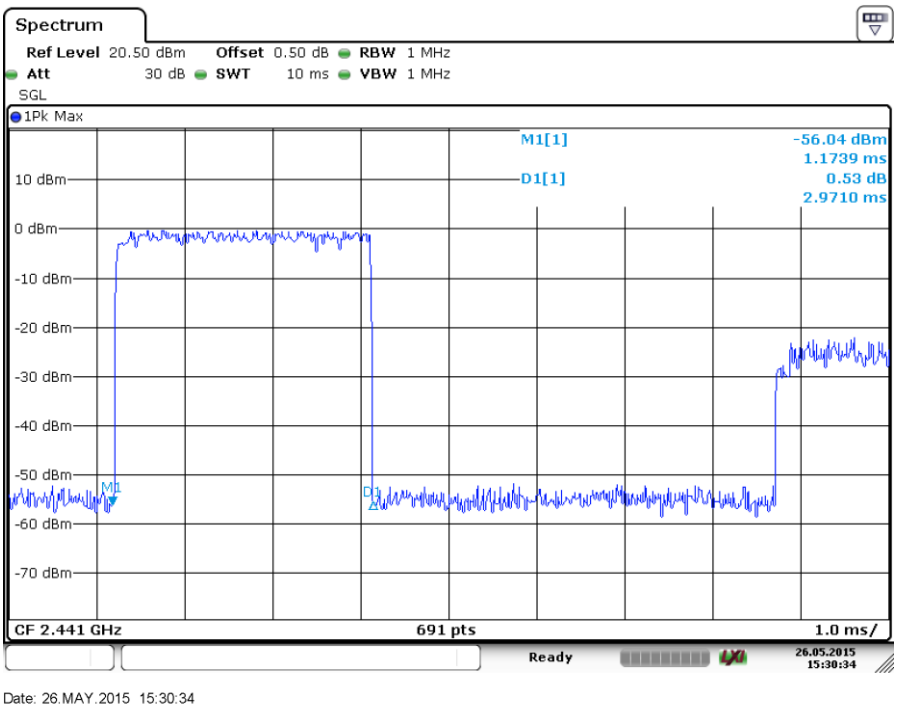
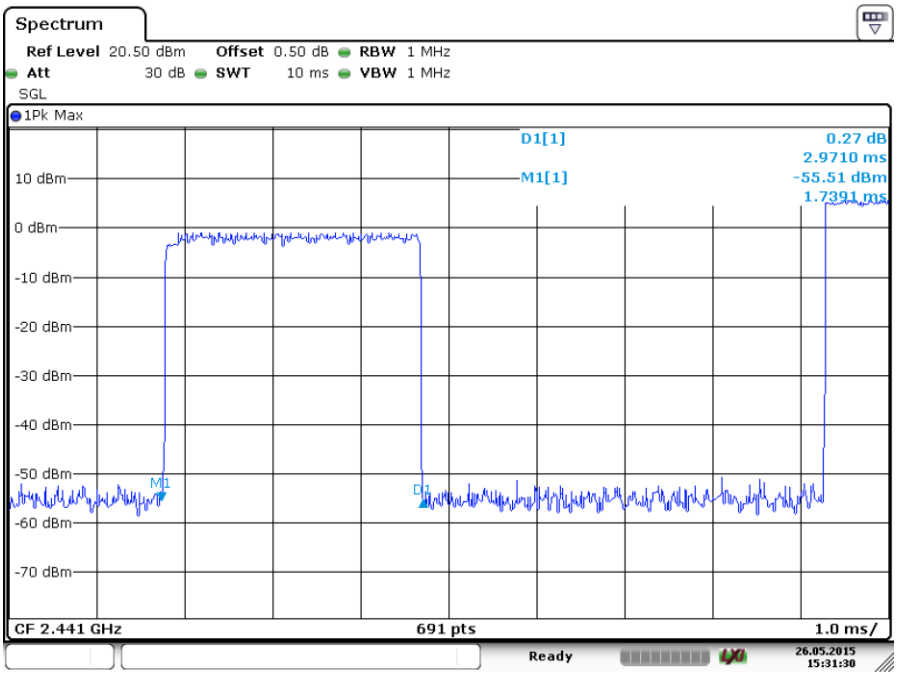
π/4-DQPSK Modulation



Date: 26.MAY.2015 15:30:34

2DH5

8-DPSK Modulation



Date: 26.MAY.2015 15:31:30

3DH5

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9.7 Spurious RF conducted emissions

Test Method

1. 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.
   RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. The level displayed must comply with the limit specified in this Section. Submit these plots.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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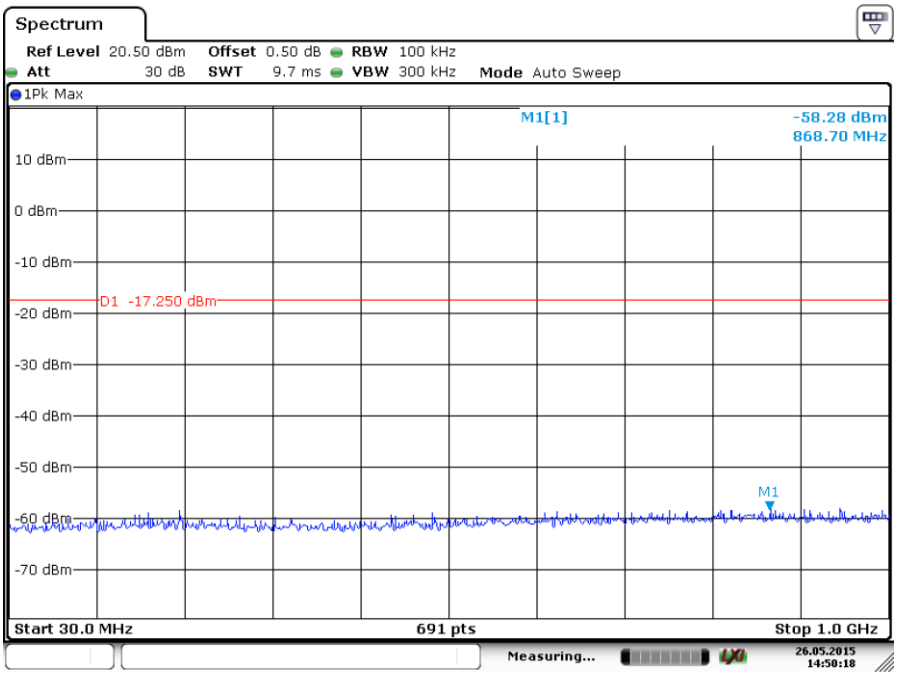
Spurious RF conducted emissions

Only the worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.
BT3.0 GFSK Modulation:
2402MHz



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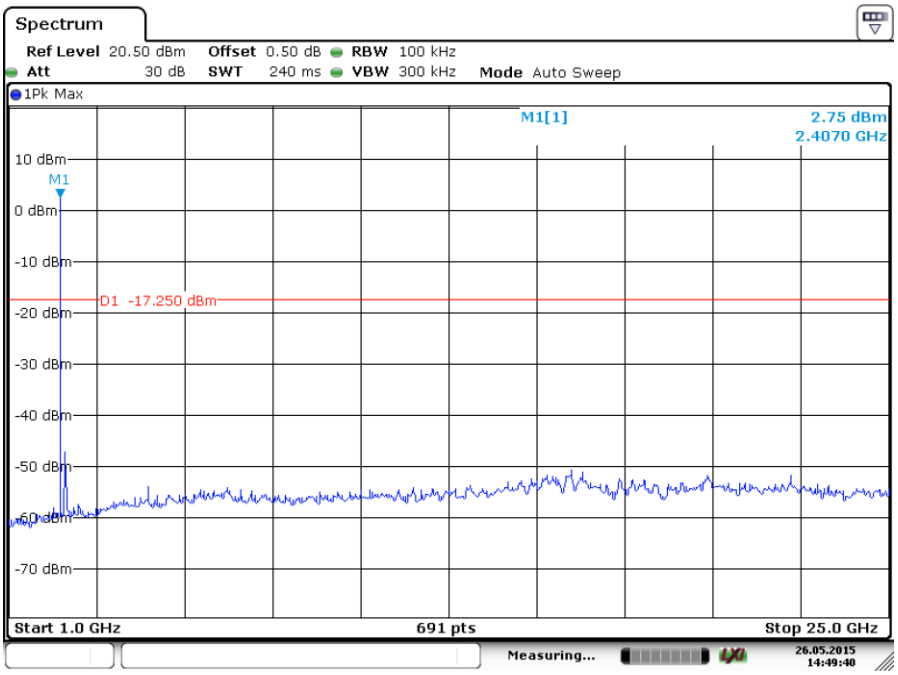

Date: 26.MAY.2015 14:49:41

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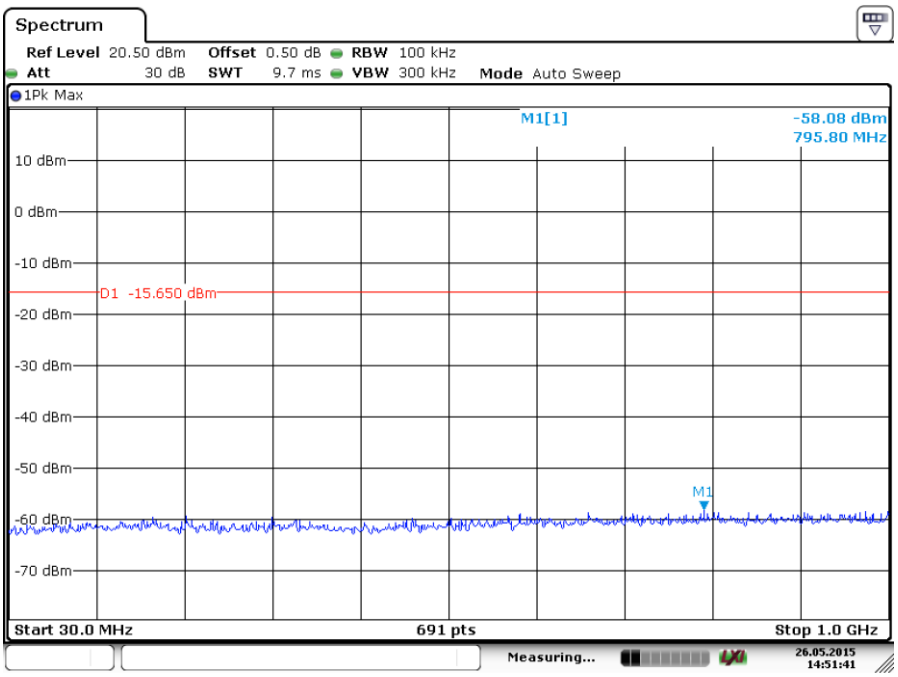
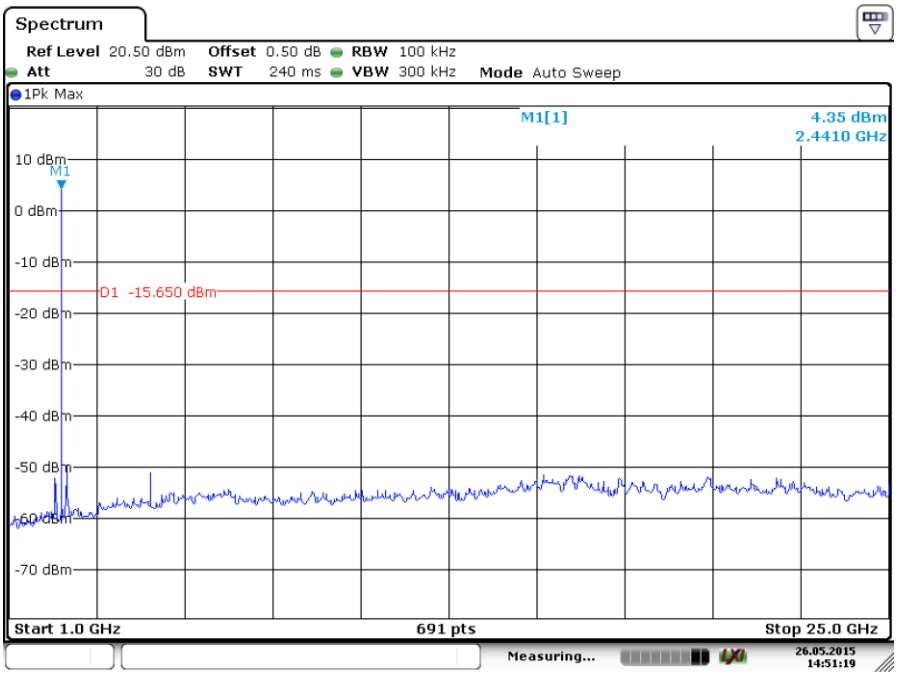
2441MHz



Date: 26.MAY.2015 14:51:41



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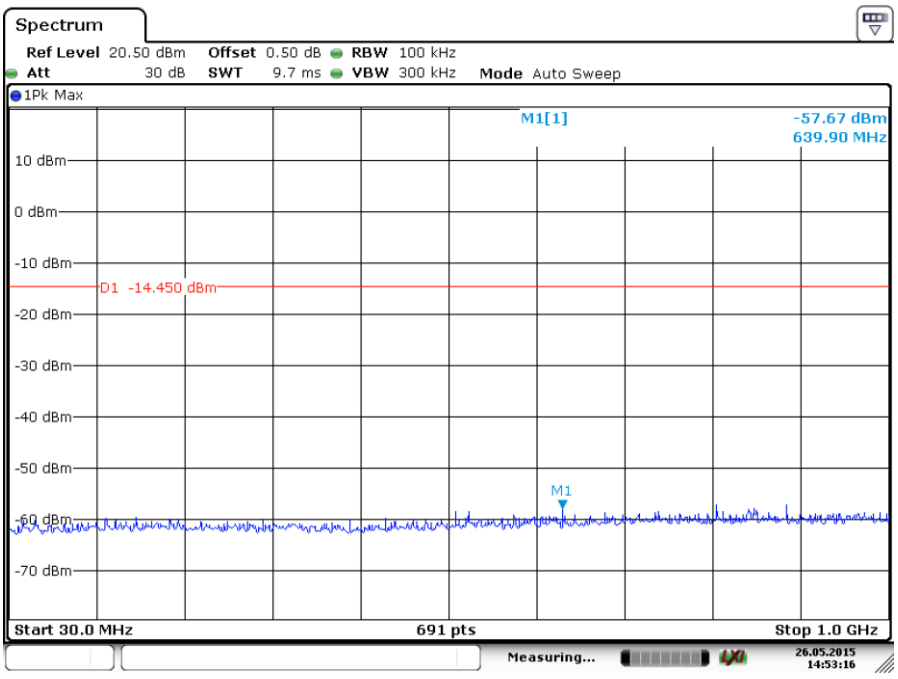
2480MHz



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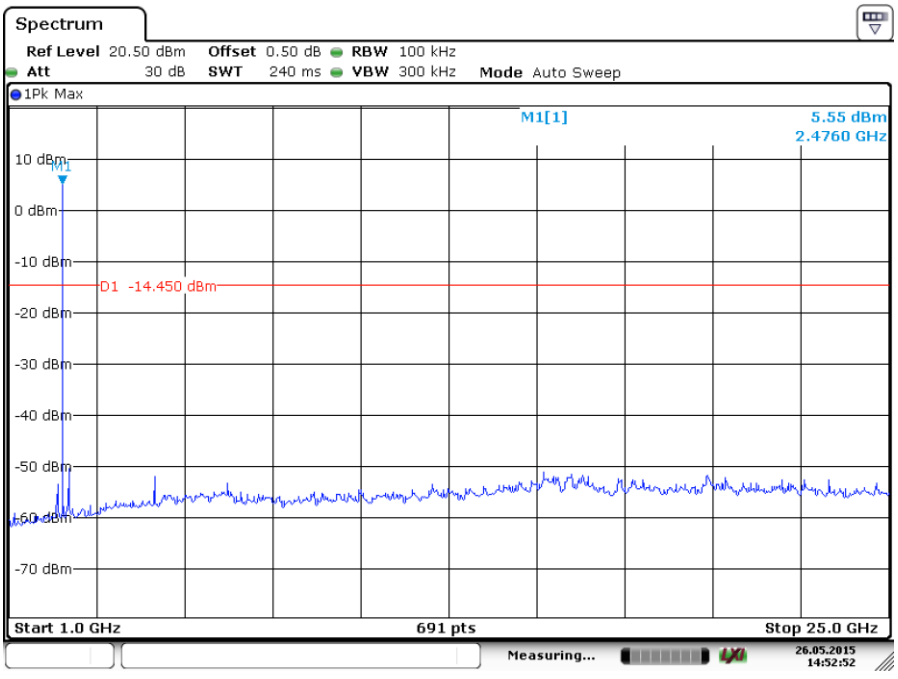

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9.8 Band edge testing

Test Method

1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section. .
4 Repeat the test at the hopping off and hopping on mode, submit all the plots.

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

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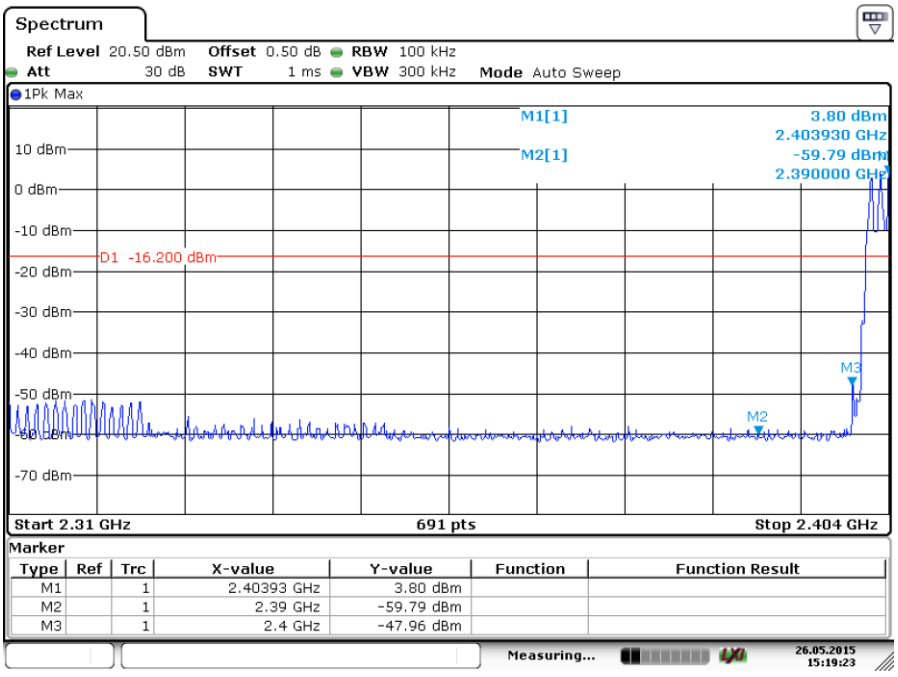
Band edge testing

BT3.0 GFSK Modulation Test Result:
Hopping on mode:



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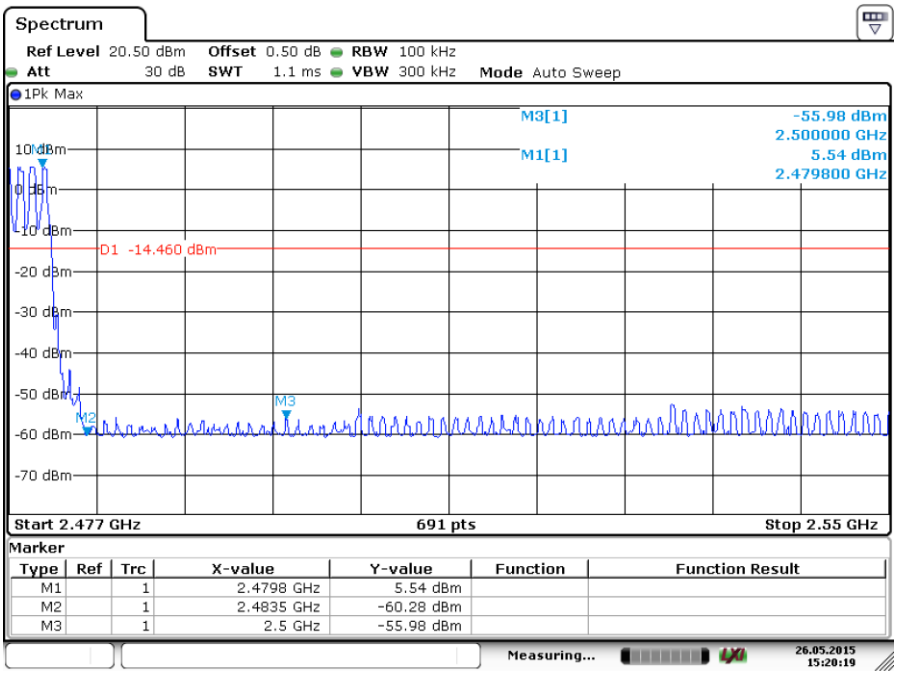

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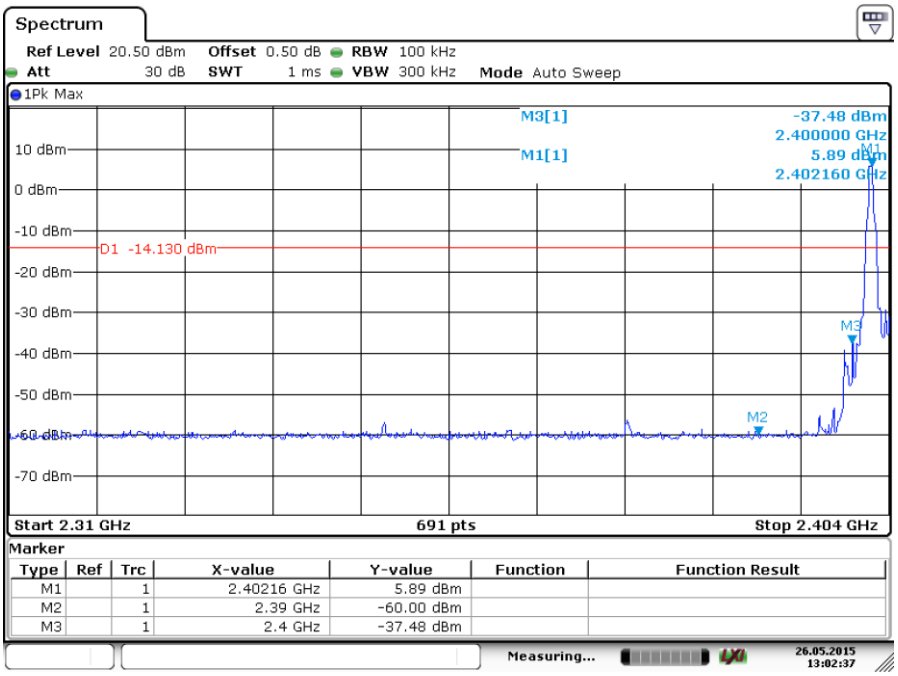
Hopping off mode:



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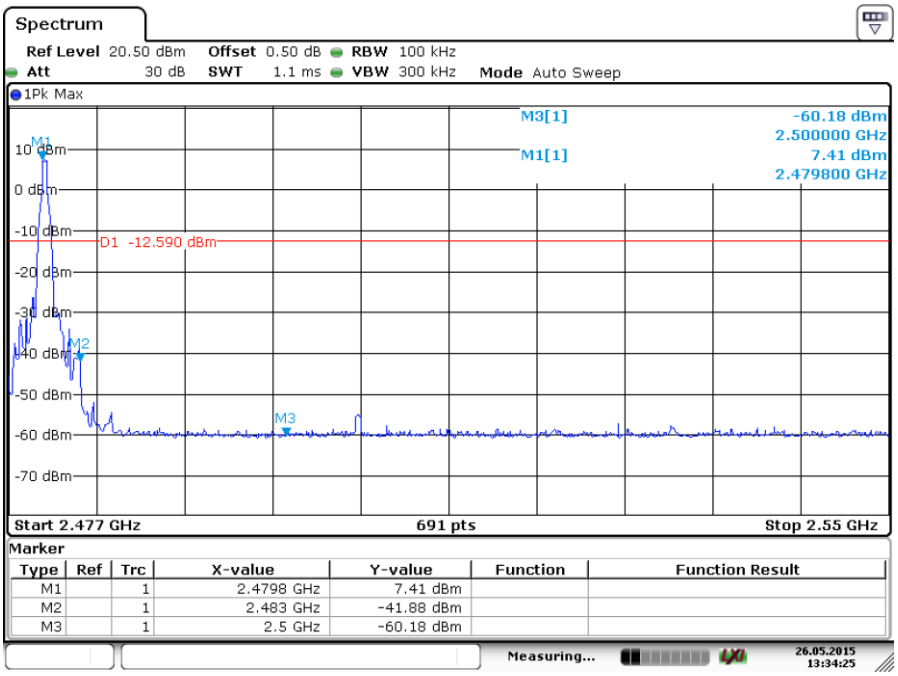

Date: 26.MAY.2015 13:34:25

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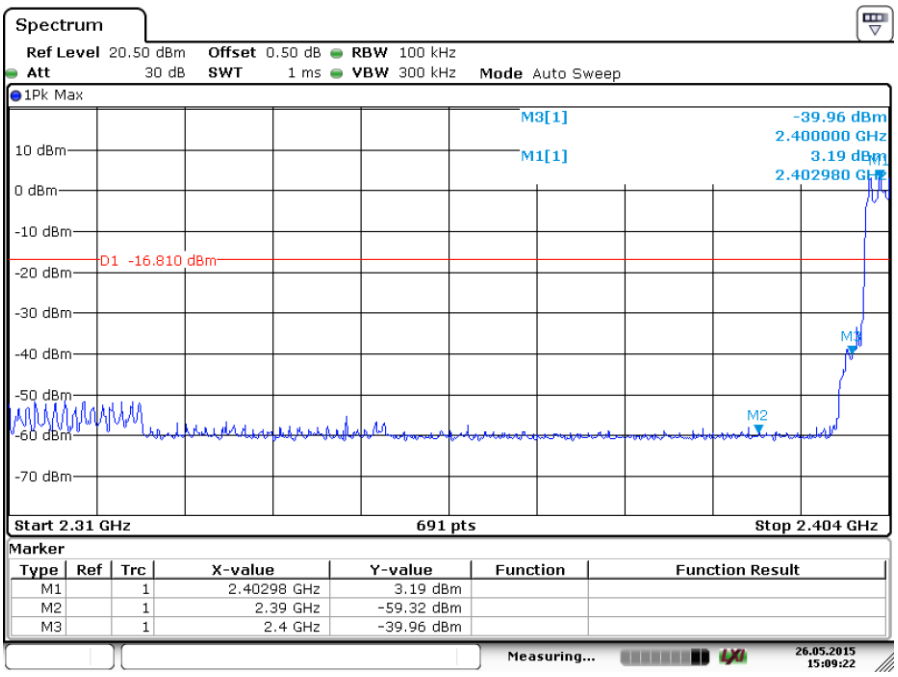
8DPSK Modulation Test Result:
Hopping on mode:



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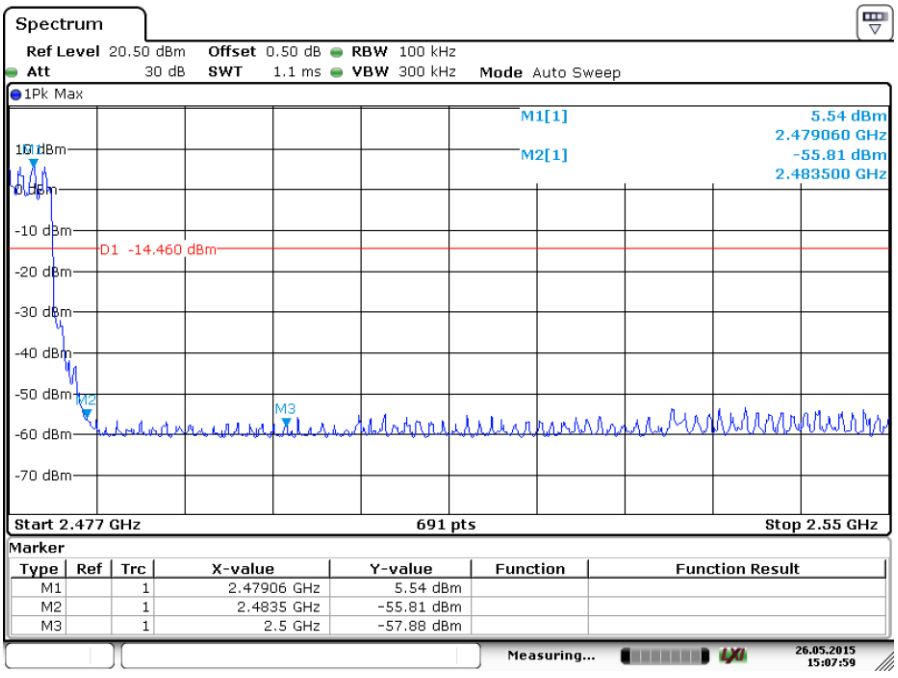

Date: 26.MAY.2015 15:07:59

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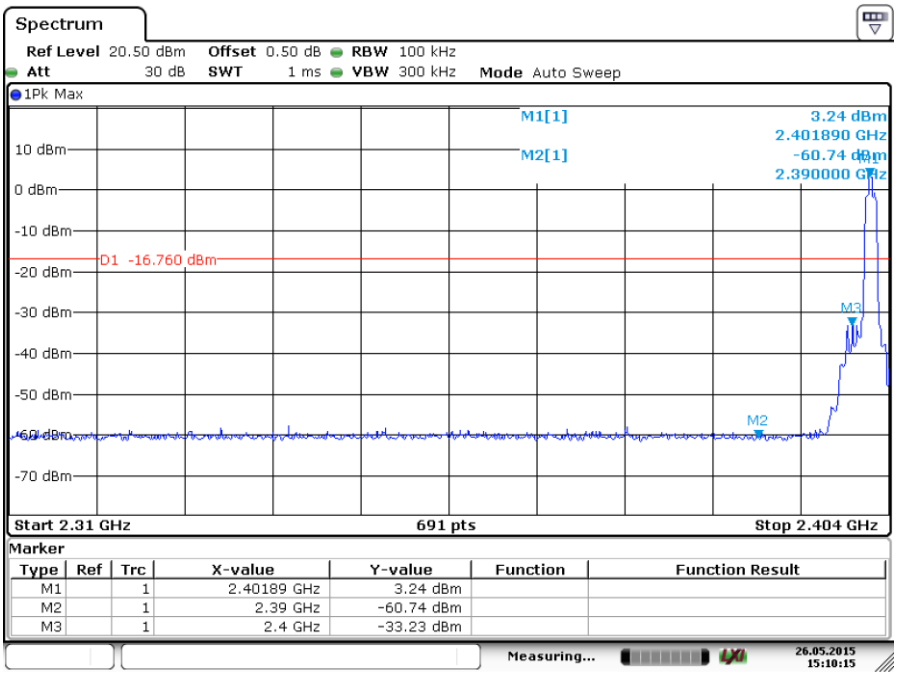
Hopping off mode:



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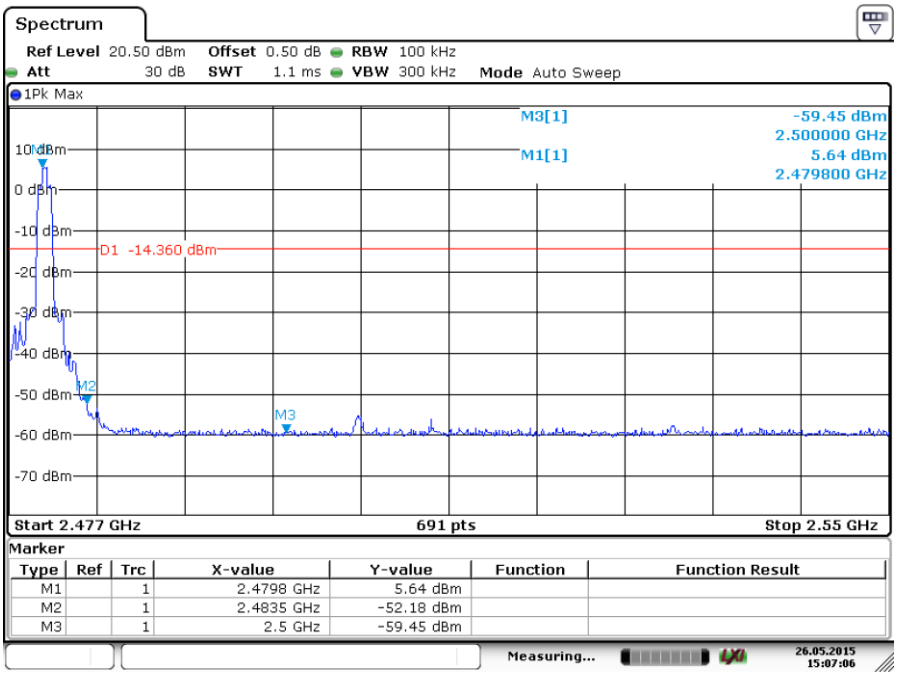

Date: 26.MAY.2015 15:07:05

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9.9 Spurious radiated emissions for transmitter

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 ≥ 1GHz, 100 kHz for f < 1 GHz, VBW ≥ 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 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(duty cycle/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

Transmitting spurious emission test result as below:

BT3.0 GFSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
212.37	34.68	H	43.5	PK	8.82	Pass
731.79	36.61	H	46	PK	9.39	Pass
4804	53.89	H	74	PK	20.11	Pass
4804	45.02	H	54	AV	8.98	Pass
7206	42.13	H	74	PK	31.87	Pass
213.87	33.02	V	43.5	PK	10.48	Pass
4804	55.68	V	74	PK	18.32	Pass
4804	46.81	V	54	AV	7.19	Pass
7206	44.10	V	74	PK	29.9	Pass

BT3.0 GFSK Modulation 2441MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
4882	49.78	H	74	PK	24.22	Pass
7323	42.59	H	74	PK	31.41	Pass
4882	54.76	V	74	PK	19.24	Pass
4882	45.89	V	54	AV	8.11	Pass
7323	44.92	V	74	PK	29.08	Pass

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BT3.0 GFSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
4960	56.49	H	74	PK	17.51	Pass
4960	47.62	H	54	AV	6.38	Pass
7440	43.45	H	74	PK	30.55	Pass
4960	53.13	V	74	PK	20.87	Pass
4960	44.26	V	54	AV	9.74	Pass
7440	43.95	V	74	PK	30.05	Pass

Remark:

(1) AV Emission Level= PK Emission Level+20log(dutycycle)

(2) 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.

(3) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

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10 Test Equipment List

List of Test Instruments

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
CE	EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2015-8-17
	LISN	Rohde & Schwarz	ENV4200	100249	2015-8-17
	LISN	Rohde & Schwarz	ENV216	100326	2015-8-17
	ISN	Rohde & Schwarz	ENY81	100177	2015-8-17
	ISN	Rohde & Schwarz	ENY81-CAT6	101664	2015-8-17
	High Voltage Proble	Rohde & Schwarz	TK9420(VT9420)	9420-58	2015-8-17
	RF Current probe	Rohde & Schwarz	EZ-17	100816	2015-8-17
C	Signal Generator	Rohde & Schwarz	SMB100A	108272	2015-8-17
	Signal Analyzer	Rohde & Schwarz	FSV40	101030	2015-8-17
	Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2015-8-17
	RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2015-8-17
RE	EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2015-8-17
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2017-8-17
	Horn Antenna	Rohde & Schwarz	HF907	102294	2017-8-17
	Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2015-8-17
	3m Semi-anechoic chamber	TDK	9X6X6	----	2019-5-29

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth
- 20dB bandwidth and 99% Occupied Bandwidth
- Carrier frequency separation
- Number of hopping frequencies
- Dwell Time
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.83dB; Vertical: 4.91dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz	Horizontal: 4.89dB; Vertical: 4.88dB;
Uncertainty for Conducted Emission 150KHz-30MHz	U=3.5dB(k=2)

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