FCC/IC - TEST REPORT

Report Number	:	**68.960.15.019.01**	Date of Issue:	April 22, 2015

Model	:	**WAG-UNI, WAG-WPTT-UNI, WAG-WPTT-M26, WAG-WPTT-M26-MTM, WAG-WPTT-M15, WAG-WPTT-K-D15, WAG-WPTT-K-D25, WAG-WPTT-CASSIDIAN, WAG-WPTT-ENTEL, WAG-WPTT-HYTERA, WAG-WPTT-HARRIS, WAG-WPTT-ICOM, WAG-WPTT-KENWOOD, WAG-WPTT-MOTOROLA, WAG-WPTT-SEPURA, WAG-WPTT-SIMOCO, WAG-WPTT-TAIT, WAG-WPTT-TELTRONICS, WAG-WPTT-TP, WAG-WPTT-VERTEX, WAG-WPTT-YAESU, W-BB, W-BB-HRS**
Product Type	:	Wireless audio gateway with wireless PTT
Applicant	:	Titan Communication systems Aps
Address	:	Skovlytoften 26B, st. DK – 2840 Holte Denmark.
Production Facility	:	Vintech Corp.
Address	:	12B Jinshun Building, No.287, Ruyi Road, Longgang, Shenzhen, China
Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	39

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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 Building 12&13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District, Shenzhen City, 518052, P. R. China
FCC Registration Number:	502708
Telephone:	86 755 8828 6998
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3 Description of the Equipment Under Test

Product:	Wireless audio gateway with wireless PTT
Model no.:	WAG-UNI, WAG-WPTT-UNI, WAG-WPTT-M26, WAG-WPTT-M26-MTM, WAG-WPTT-M15, WAG-WPTT-K-D15, WAG-WPTT-K-D25, WAG-WPTT-CASSIDIAN, WAG-WPTT-ENTEL, WAG-WPTT-HYTERA, WAG-WPTT-HARRIS, WAG-WPTT-ICOM, WAG-WPTT-KENWOOD, WAG-WPTT-MOTOROLA, WAG-WPTT-SEPURA, WAG-WPTT-SIMOCO, WAG-WPTT-TAIT, WAG-WPTT-TELTRONICS, WAG-WPTT-TP, WAG-WPTT-VERTEX, WAG-WPTT-YAESU, W-BB, W-BB-HRS
FCC ID:	2ACD5WAG-WPT-UNI
Options and accessories:	BlueTest 3
Rating:	DC 12V
RF Transmission Frequency:	2402-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8DPSK
Duty Cycle:	78.6% for DH5
Antenna Type:	Internal Antenna
Antenna Gain:	2.66dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Wireless audio gateway with wireless PTT 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-Gen Issue 4 November 2014	General Requirements for the Certification of Radio Apparatus
RSS-210 Issue 8 December 2010	RSS-210 — Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

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, RSS-Gen, RSS-210				
Test Condition			Pages	Test Result
§15.207	RSS-GEN A8.8	Conducted emission AC power port	---	N/A
§15.247(b)(1)	RSS-210 A8.4	Conducted peak output power	10	Pass
§15.247(a)(2)	RSS-210 A8.2(a)	6dB bandwidth	---	N/A
§15.247(a)(1)	RSS-210 A8.1(a) & RSSGEN 6.6	20dB bandwidth and 99% Occupied Bandwidth	12	Pass
§15.247(a)(1)	RSS-210 A8.1(b)	Carrier frequency separation	18	Pass
§15.247(a)(1)(iii)	RSS-210 A8.1(d)	Number of hopping frequencies	21	Pass
§15.247(a)(1)(iii)	RSS-210 A8.1(c)	Dwell Time	23	Pass
§15.247(e)	RSS-210 A8.2(b)	Power spectral density	---	N/A
§15.247(d)	RSS-210 A8.5	Spurious RF conducted emissions	26	Pass
§15.247(d)	RSS-210 A8.5	Band edge	30	Pass
§15.247(d) & §15.209 &	RSS-210 2.5 & RSSGEN 6.13	Spurious radiated emissions for transmitter and receiver	35	Pass
§15.203	RSSGEN 8.3	Antenna requirement	See note 2	Pass

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a Embedded Type antenna, which gain is 2.66dBi. 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: 2ACD5WAG-WPT-UNI complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-210.

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: March 13, 2015

Testing Start Date: April 1, 2015

Testing End Date: April 16, 2015

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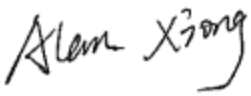
Reviewed by:

John Zhi
EMC Project Manager

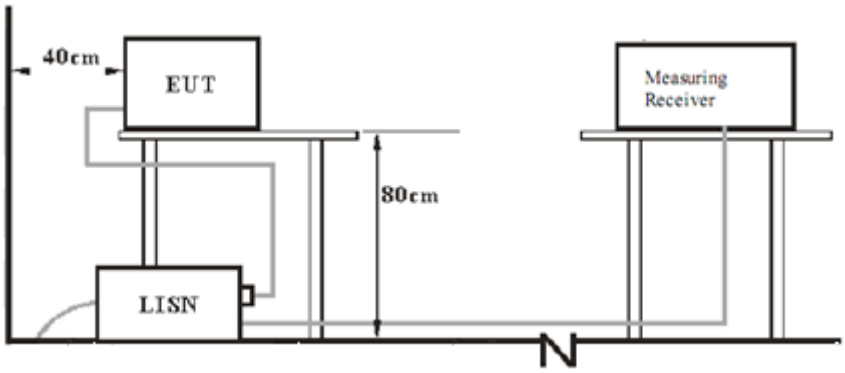
Prepared by:



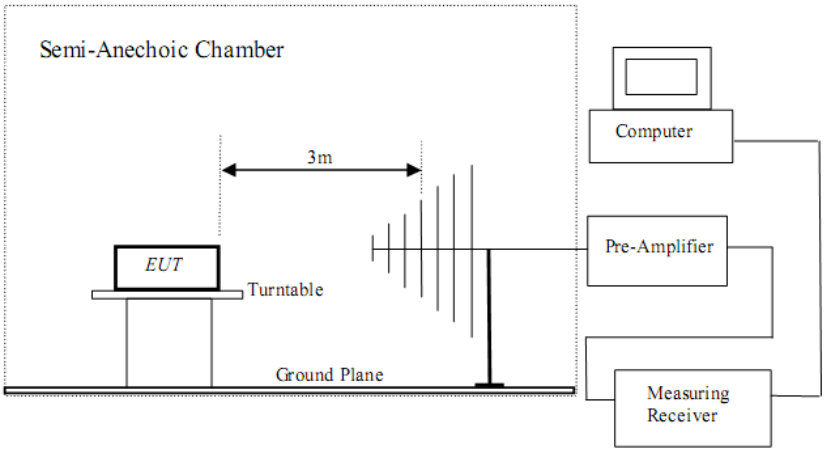
Alan Xiong
EMC Project Engineer

7 Test Setups

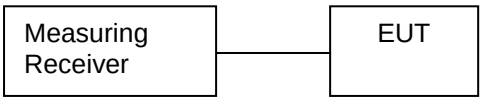
7.1 AC Power Line Conducted Emission test setups



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)
Notebook	Lenovo	X240	---

Test software: BlueTest 3, 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 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

According to §15.247 (b) (1) and RSS-210 A8.4, conducted peak output power limit as below:

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

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Conducted peak output power

Bluetooth Mode GFSK-DH1 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-4.75	Pass
Middle channel 2441MHz	-4.44	Pass
High channel 2480MHz	-4.01	Pass

Bluetooth Mode π/4-DQPSK-2DH1 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-5.04	Pass
Middle channel 2441MHz	-4.98	Pass
High channel 2480MHz	-4.61	Pass

Bluetooth Mode 8DPSK-3DH1 modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-4.99	Pass
Middle channel 2441MHz	-4.90	Pass
High channel 2480MHz	-4.52	Pass

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9.2 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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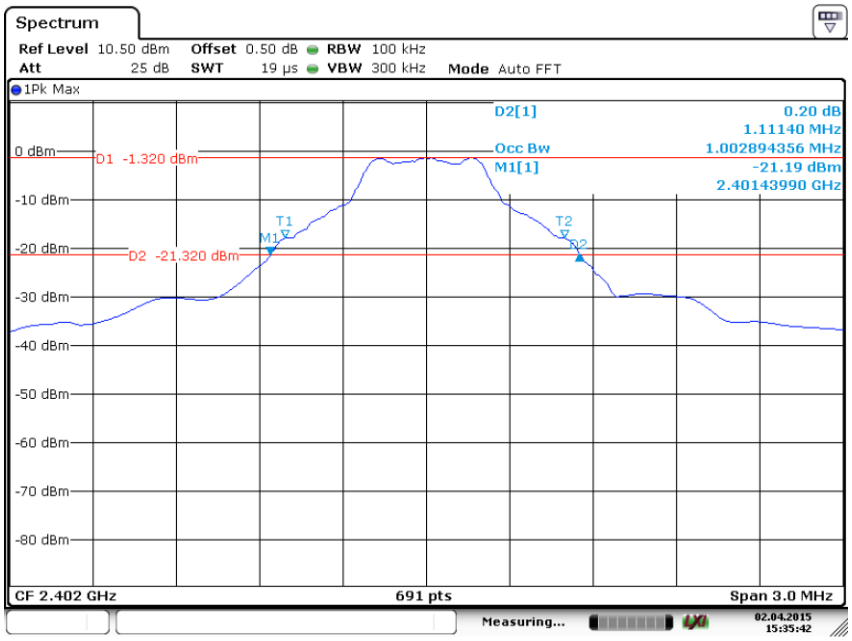
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1111.4	1002.9	--	Pass
2441	1115.8	1020.3	--	Pass
2480	1120.1	1024.6	--	Pass



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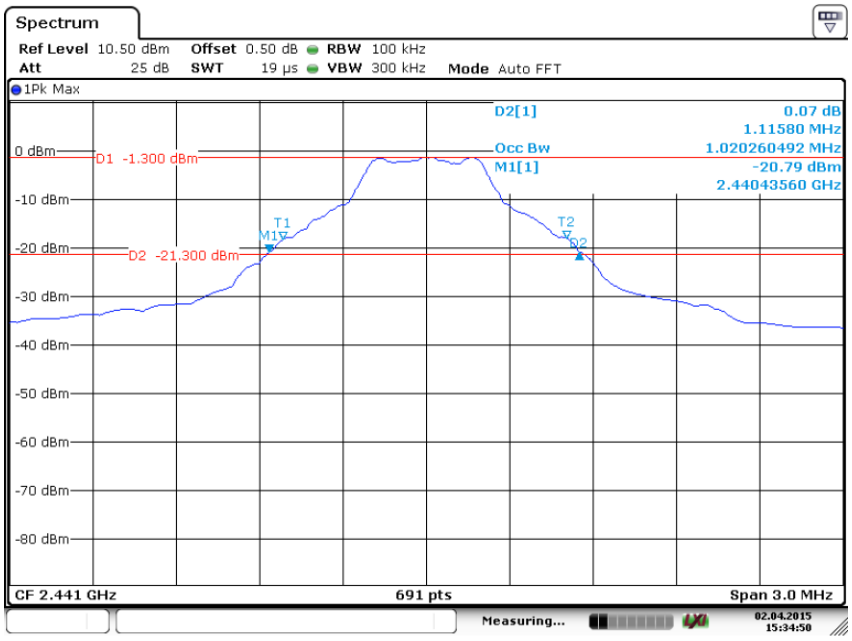

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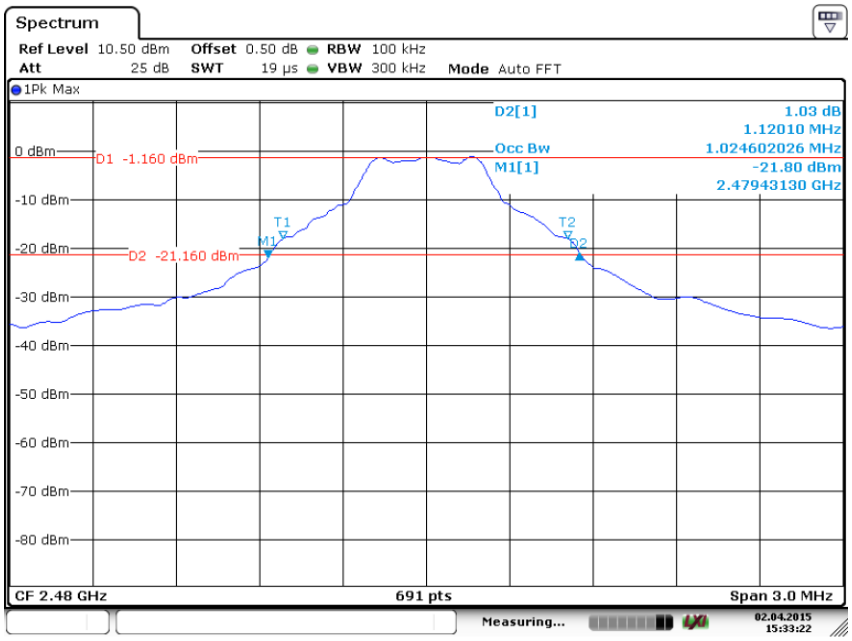
20 dB bandwidth and 99% Occupied Bandwidth



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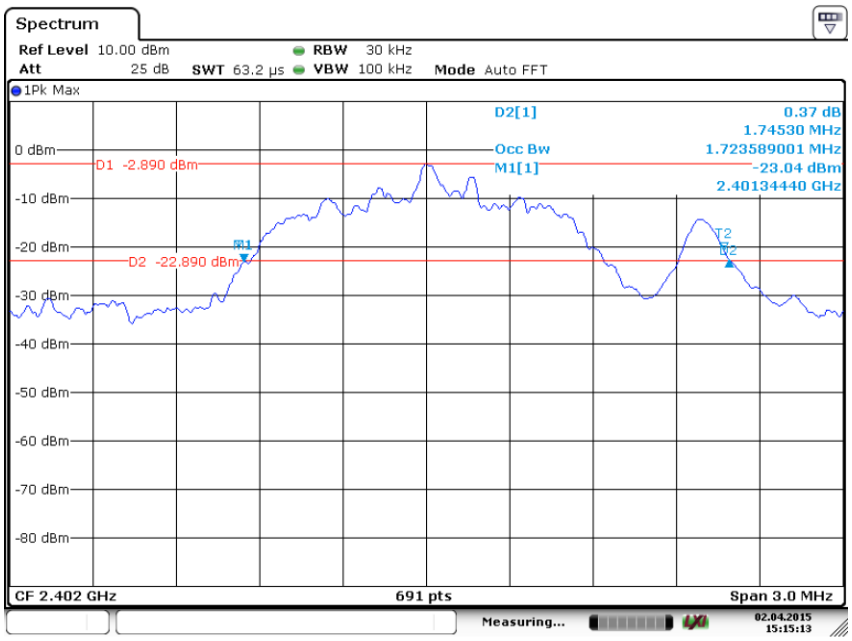
Bluetooth Mode π/4-DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1745.3	1723.6	--	Pass
2441	2062.2	1892.9	--	Pass
2480	2010.1	1840.8	--	Pass



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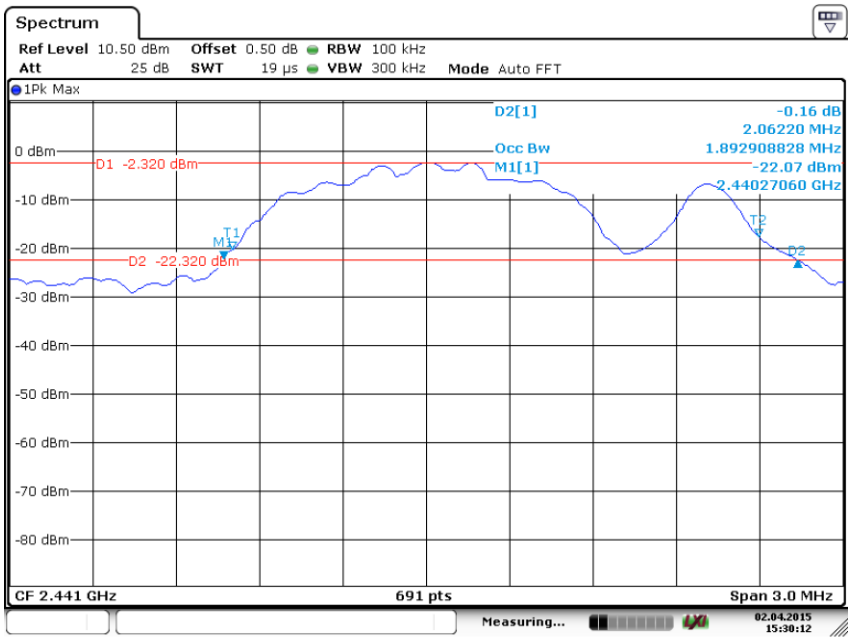
20 dB bandwidth and 99% Occupied Bandwidth



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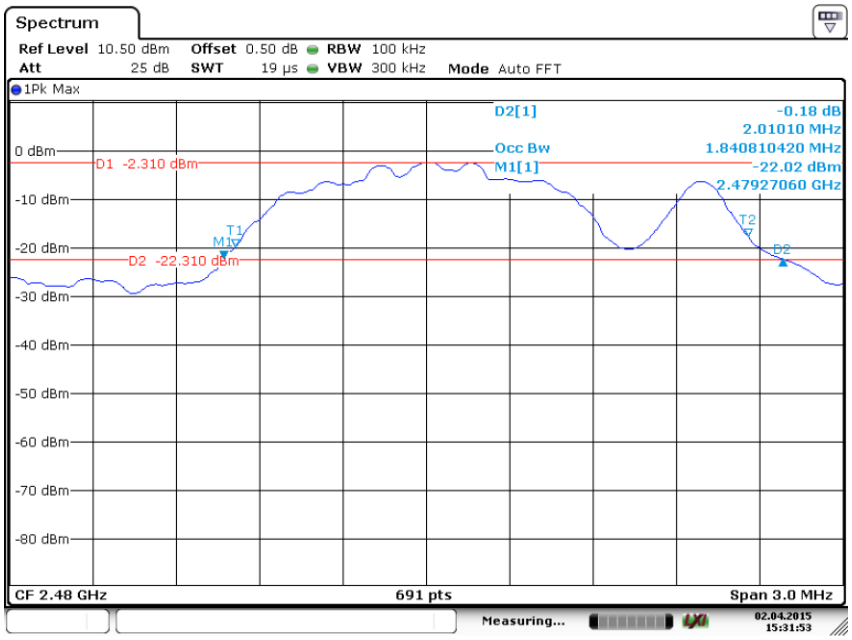

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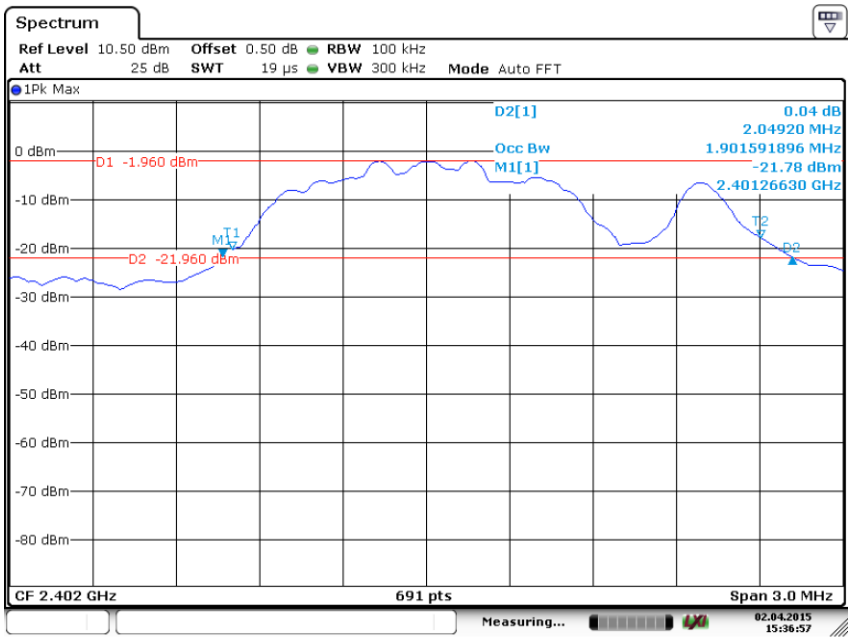
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	2049.2	1901.6	--	Pass
2441	1966.7	1853.8	--	Pass
2480	1988.4	1832.1	--	Pass



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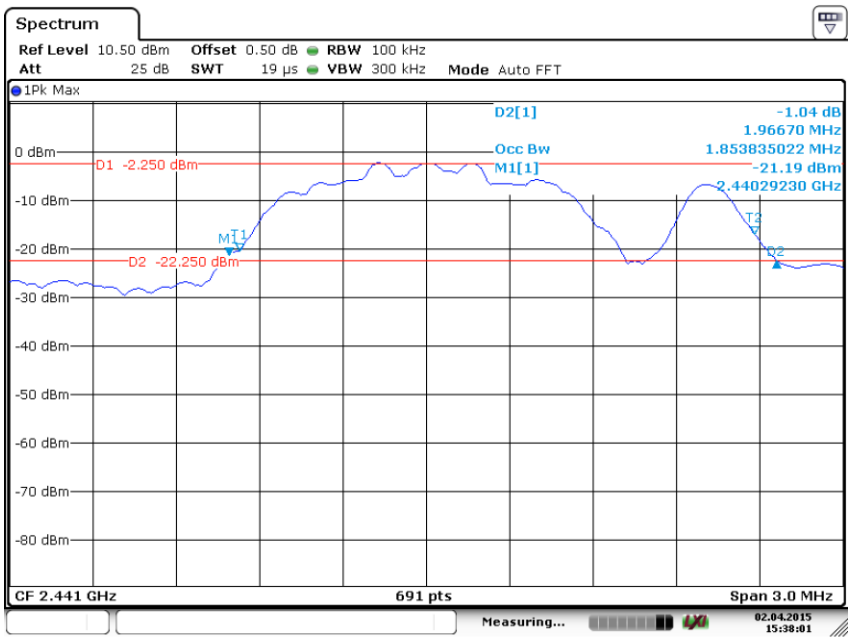

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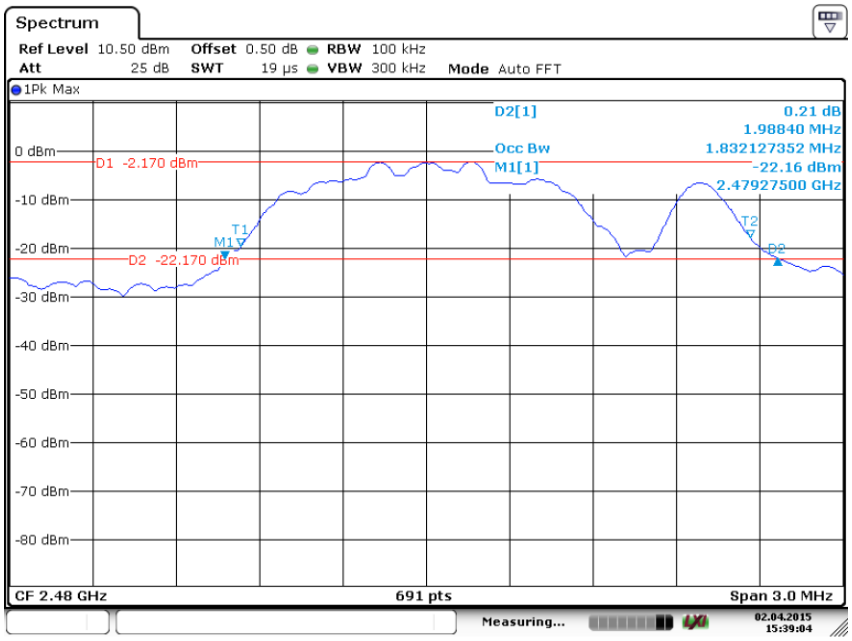
20 dB bandwidth and 99% Occupied Bandwidth



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9.3 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	740.9
2441	743.9
2480	746.7

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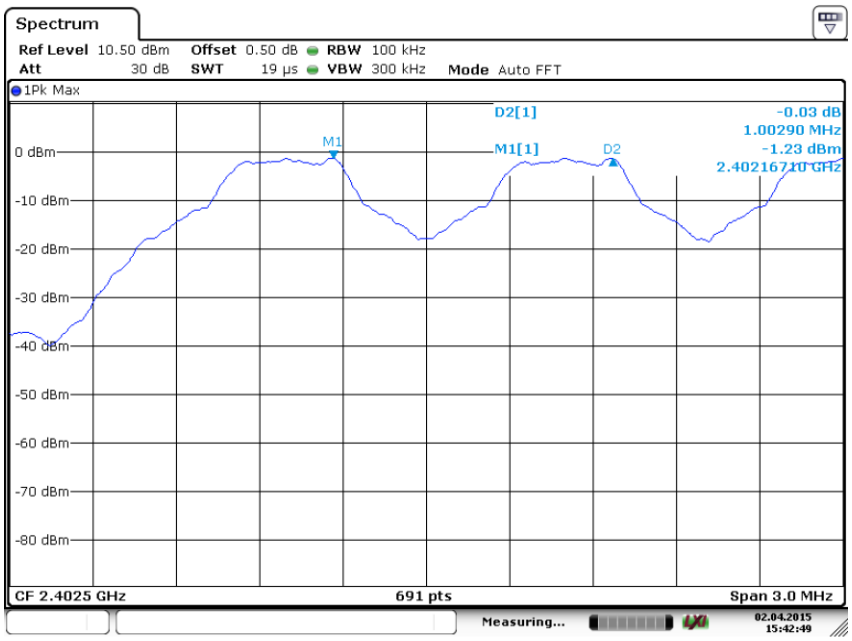
Carrier Frequency Separation

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	1002.9	Pass
2441	1011.6	Pass
2480	1004.3	Pass



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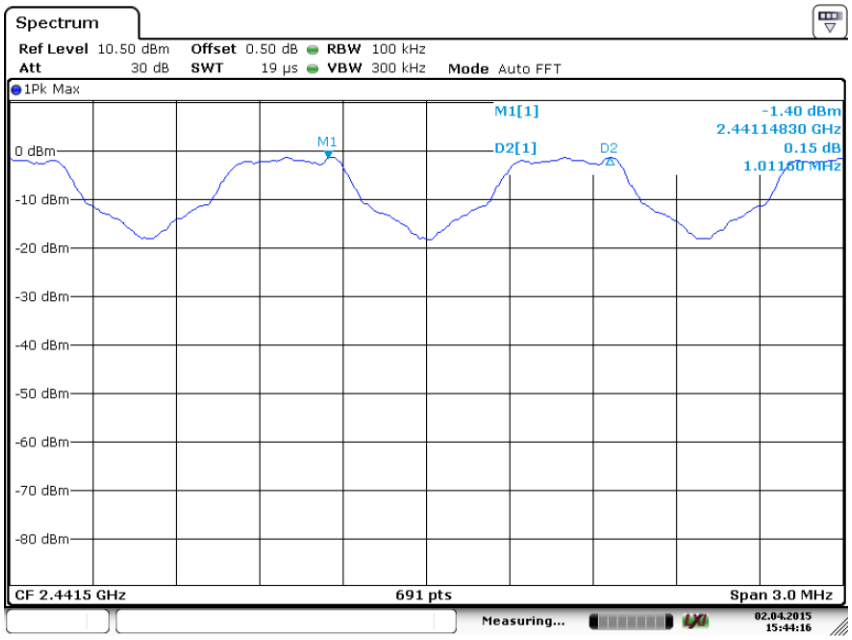

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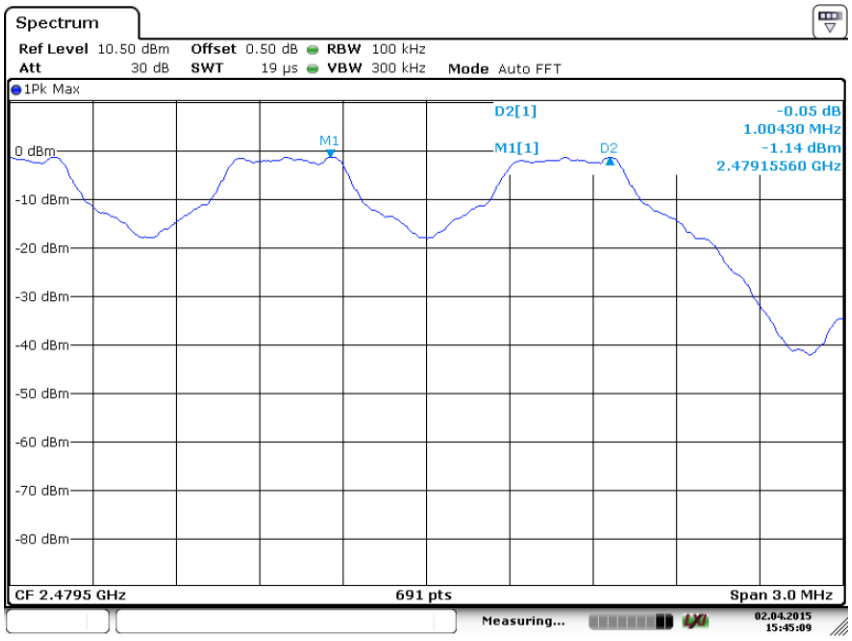

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9.4 Number of hopping frequencies

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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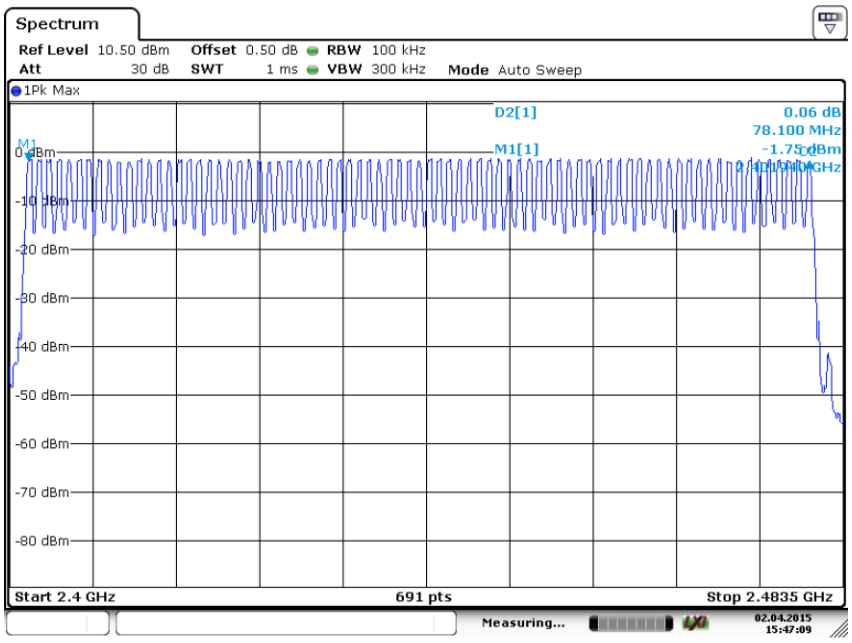
Number of hopping frequencies

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



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9.5 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

According to §15.247(a)(1)(iii) & RSS-210 A8.1(c) 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];

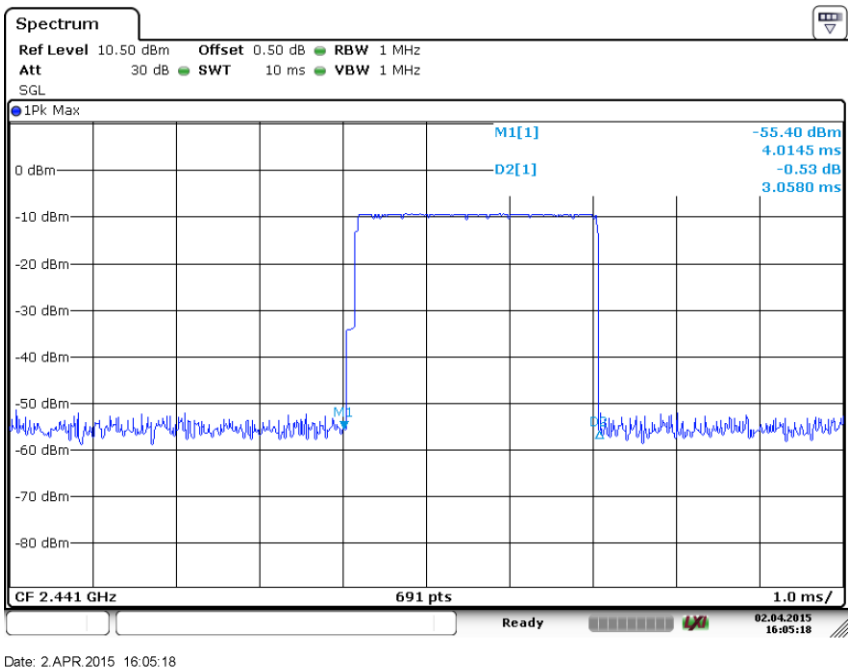
The burst width, which is directly measured, refers to the duration on one channel hop.

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

Test Result

Modulation	Mode	Reading (µs)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	3058.0	106.67	326.2	< 400	Pass
π/4-DQPSK	2DH5	3072.5	106.67	327.7	< 400	Pass
8-DPSK	3DH5	2956.5	106.67	315.4	< 400	Pass

GFSK Modulation



DH5

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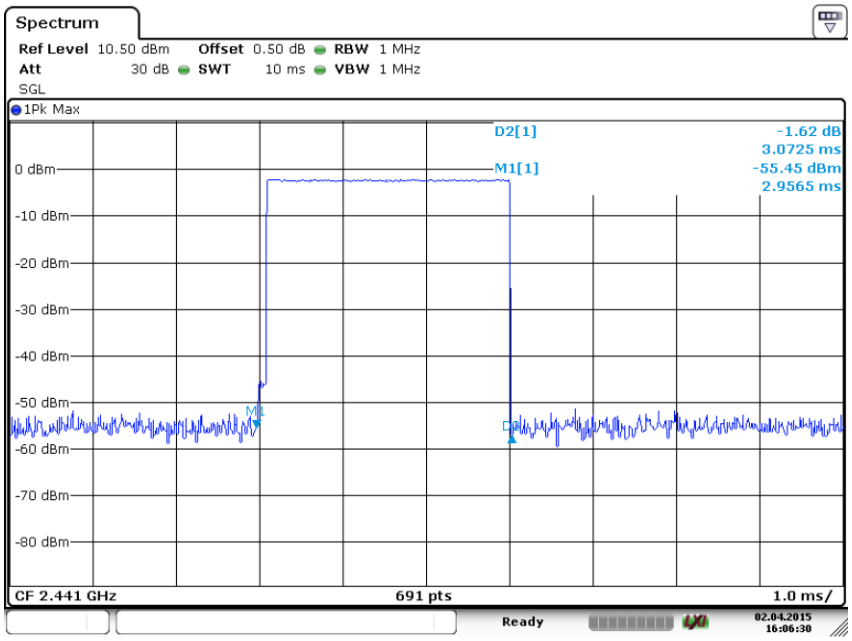
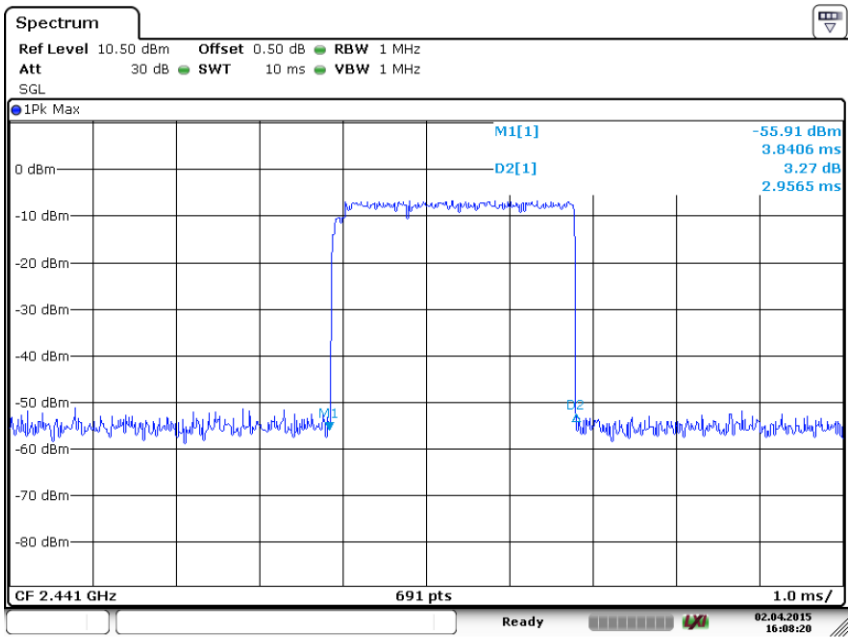
π/4-DQPSK Modulation



Date: 2.APR.2015 16:06:31

2DH5

8-DPSK Modulation



Date: 2.APR.2015 16:08:20

3DH5

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9.6 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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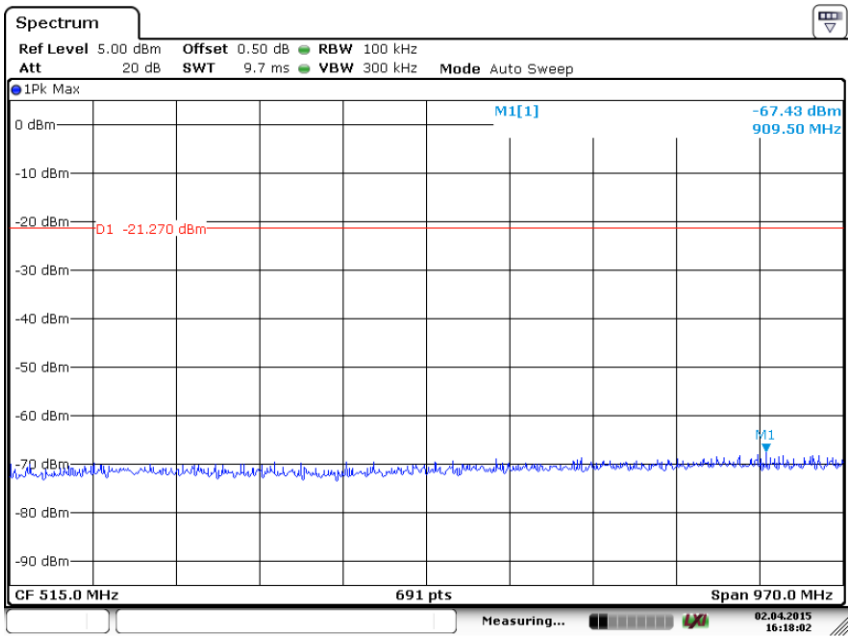
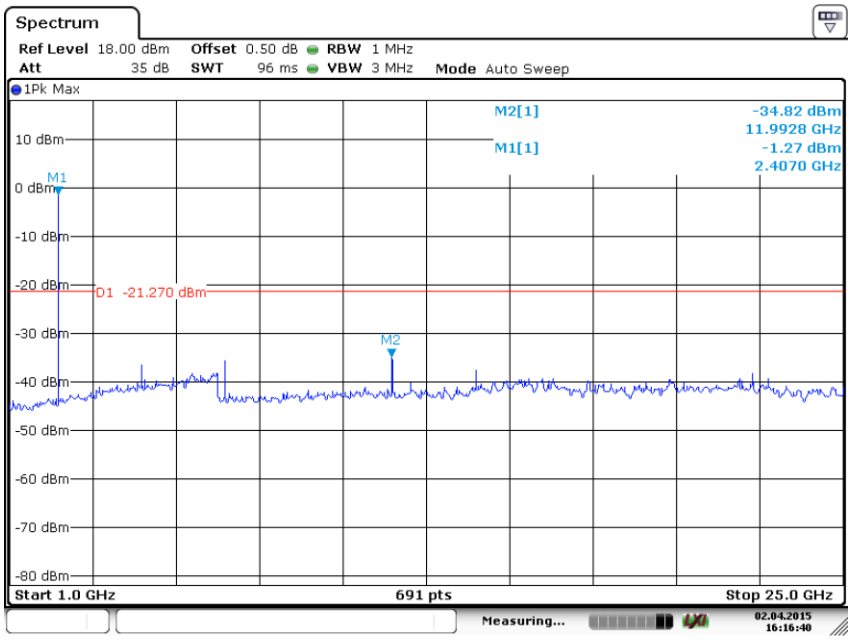
Spurious RF conducted emissions

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

2402MHz



Date: 2.APR.2015 16:18:02



Date: 2.APR.2015 16:16:40

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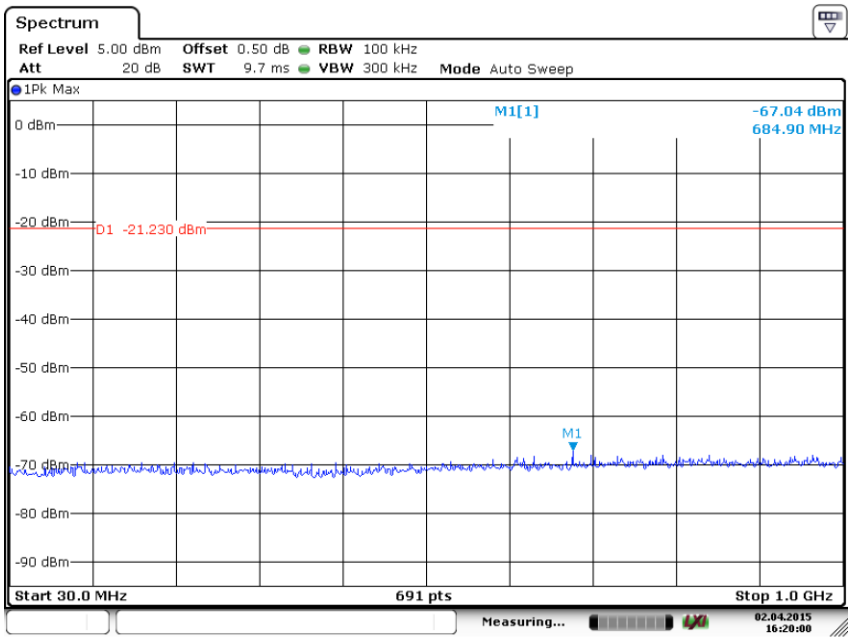
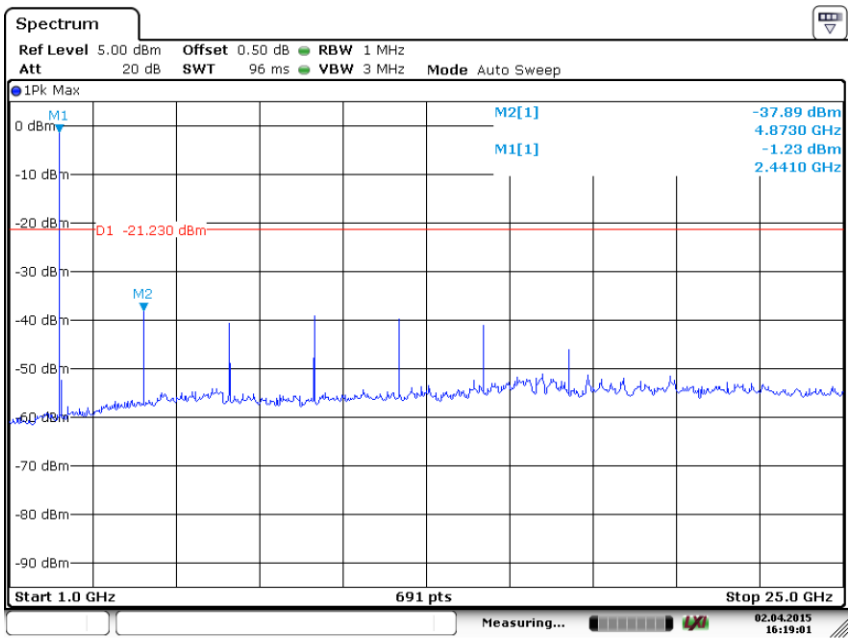
Spurious RF conducted emissions

2441MHz



Date: 2.APR.2015 16:19:59



Date: 2.APR.2015 16:19:01

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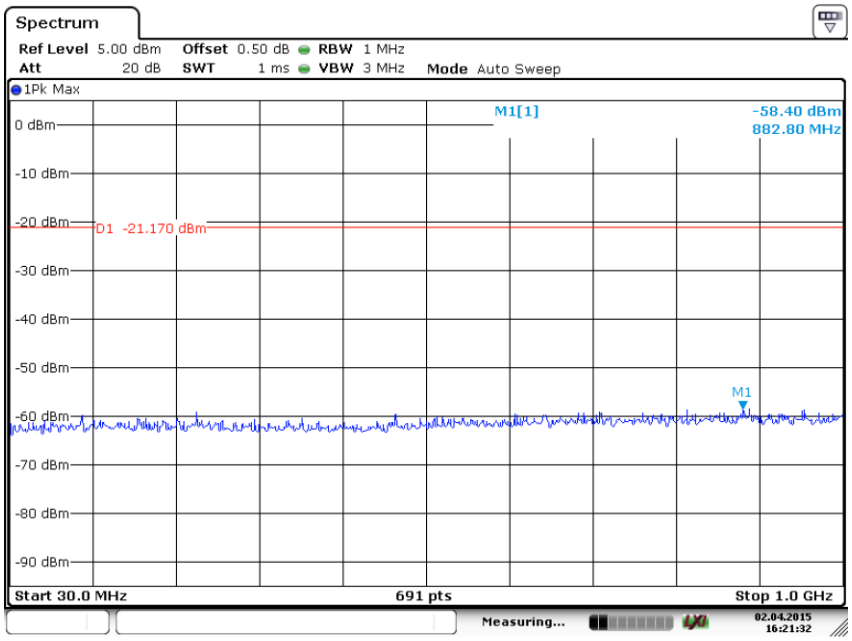
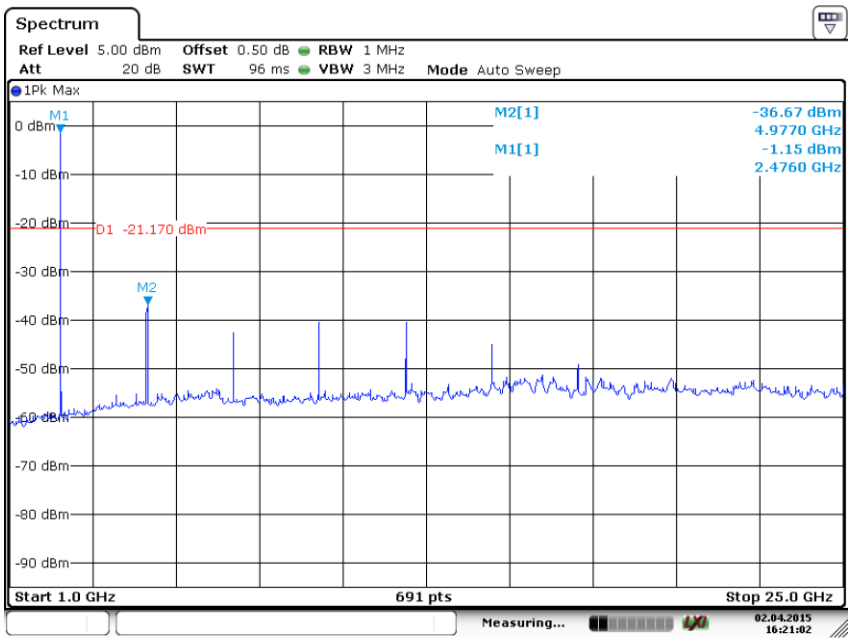
Spurious RF conducted emissions

2480MHz



Date: 2.APR.2015 16:21:32



Date: 2.APR.2015 16:21:02

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9.7 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:

According to §15.247(d) and RSS-210 A8.5, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen7.2.2, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

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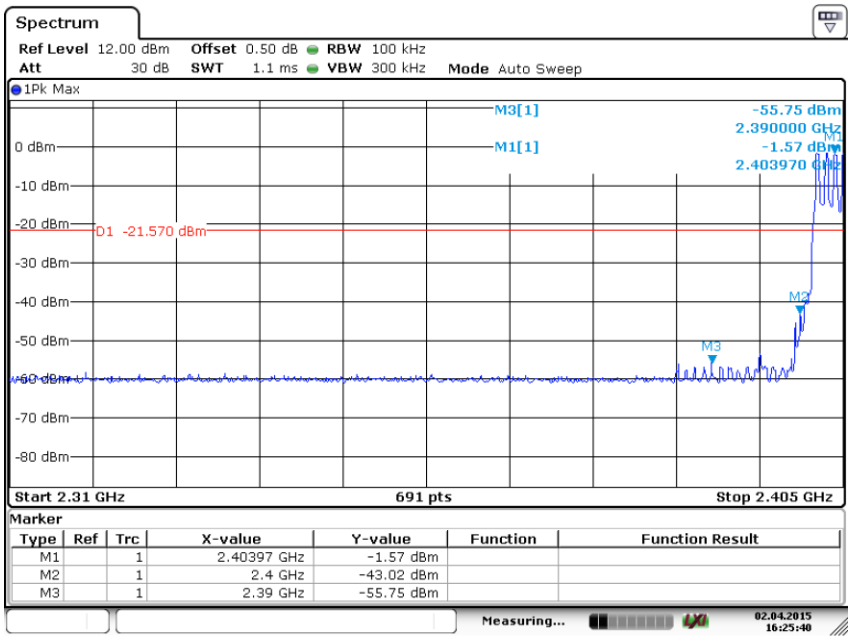
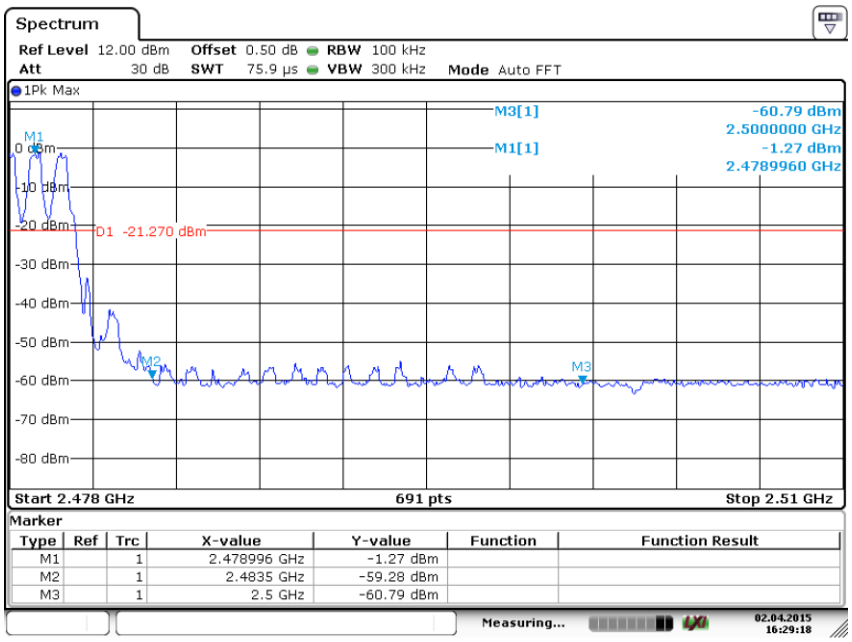
Band edge testing

GFSK Modulation Test Result:
Hopping on mode:



Date: 2.APR.2015 16:25:40



Date: 2.APR.2015 16:29:18

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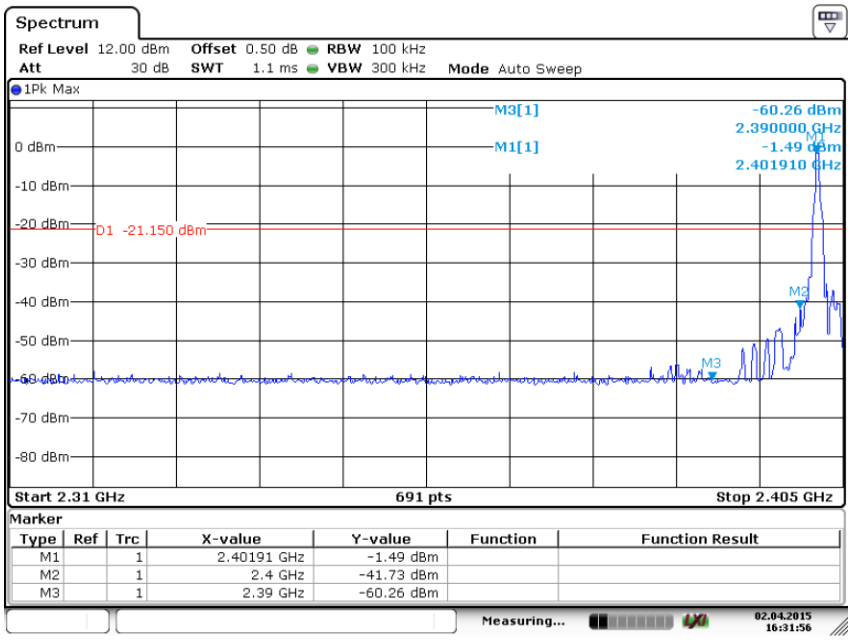
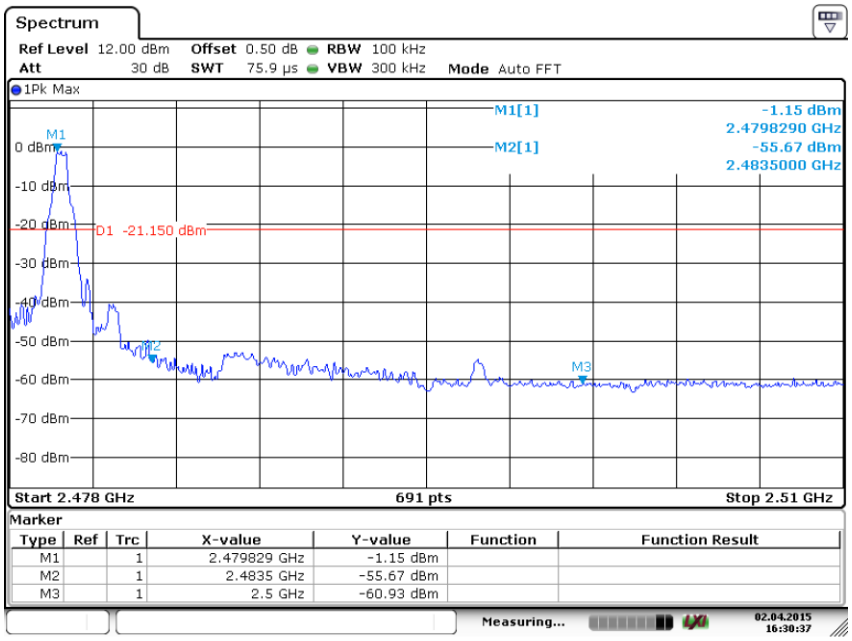
Band edge testing

Hopping off mode:



Date: 2.APR.2015 16:31:55



Date: 2.APR.2015 16:30:37

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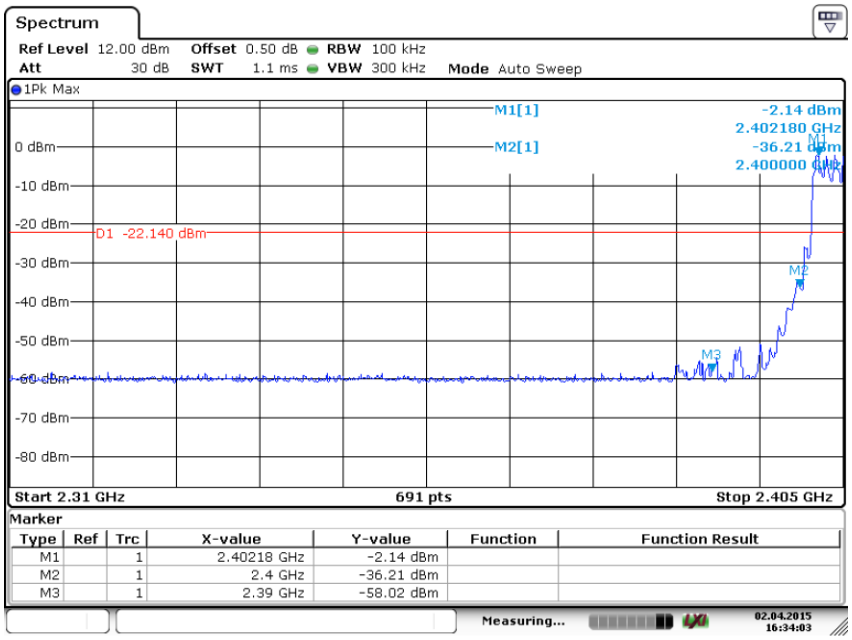
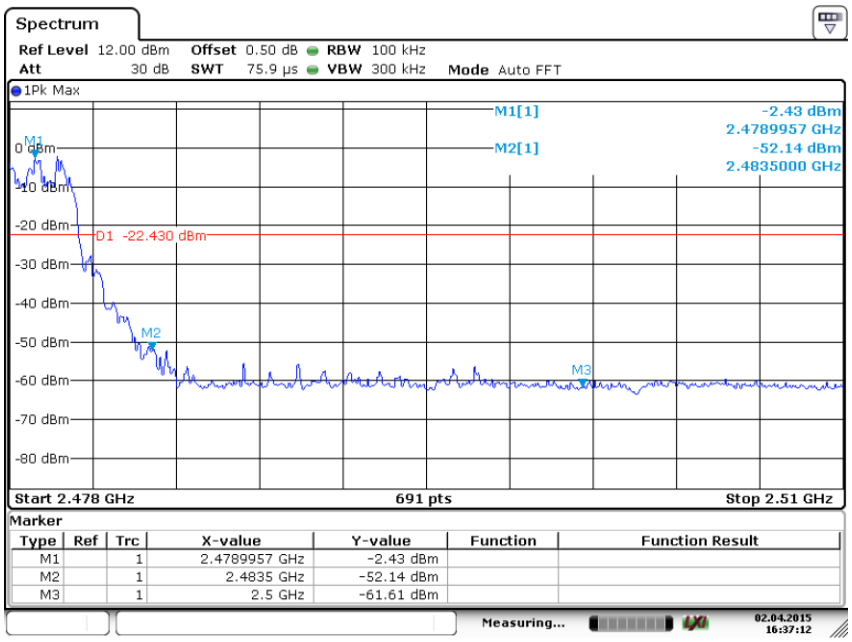
Band edge testing

8DPSK Modulation Test Result:
Hopping on mode:



Date: 2.APR.2015 16:34:03



Date: 2.APR.2015 16:37:12

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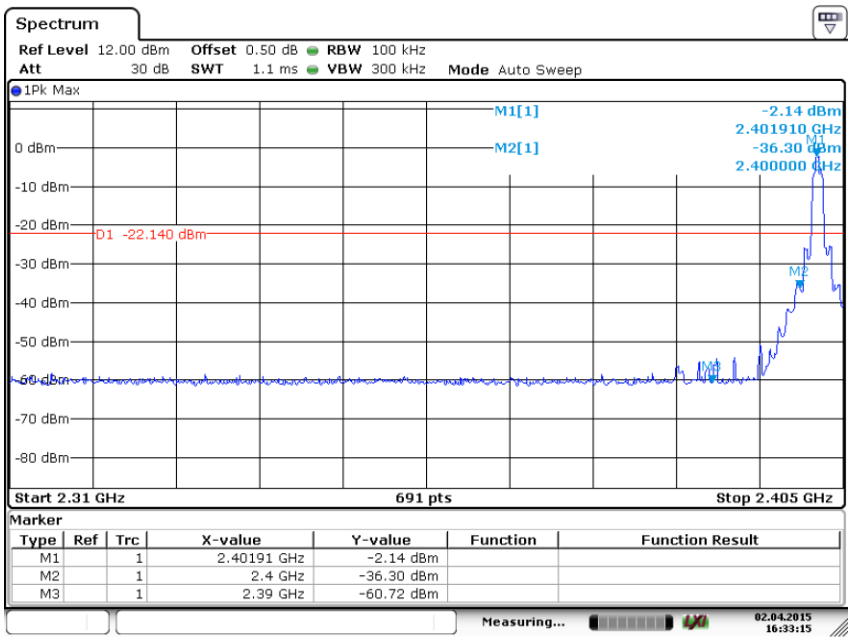
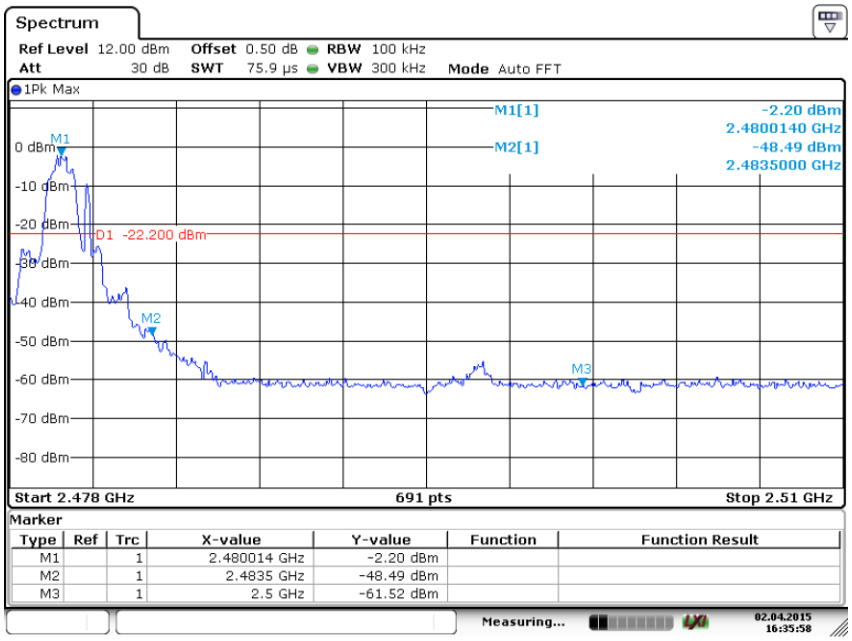
Band edge testing

Hopping off mode:



Date: 2.APR.2015 16:33:15



Date: 2.APR.2015 16:35:58

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9.8 Spurious radiated emissions for transmitter and receiver

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

According to part 15.247(d), 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 and receiver

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:

Bluetooth Mode GFSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
160.04	28.39	Horizontal	43.5	QP	15.11	Pass
399.51	39.56	Horizontal	46	QP	6.44	Pass
111.97	25.78	Vertical	43.5	QP	17.72	Pass
399.51	30.46	Vertical	46	QP	15.54	Pass
*4804	53.80	Vertical	74	PK	20.2	Pass
*4804	51.70	Vertical	54	AV	2.30	Pass
*4804	54.41	Horizontal	74	PK	19.59	Pass
*4804	52.21	Horizontal	54	AV	1.79	Pass
7206	44.07	Vertical	74	PK	29.93	Pass
7206	41.97	Vertical	54	AV	12.03	Pass
7206	51.21	Horizontal	74	PK	22.79	Pass
7206	49.11	Horizontal	54	AV	4.89	Pass

Bluetooth Mode GFSK Modulation 2441MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBuV/m	
*4882	54.12	Vertical	74	PK	19.88	Pass
*4882	52.02	Vertical	54	AV	1.98	Pass
*4882	53.43	Horizontal	74	PK	20.57	Pass
*4882	51.33	Horizontal	54	AV	2.67	Pass
*7323	48.99	Vertical	74	PK	25.01	Pass
*7323	46.89	Vertical	54	AV	7.11	Pass
*7323	42.18	Horizontal	74	PK	31.82	Pass
*7323	40.08	Horizontal	54	AV	13.92	Pass

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Bluetooth Mode GFSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBμV/m		dBuV/m	
*4960	53.63	Vertical	74	PK	20.37	Pass
*4960	51.53	Vertical	54	AV	2.47	Pass
*4960	51.55	Horizontal	74	PK	22.45	Pass
*4960	49.45	Horizontal	54	AV	4.55	Pass
*7440	47.25	Vertical	74	PK	26.75	Pass
*7440	45.15	Vertical	54	AV	8.85	Pass
*7440	43.02	Horizontal	74	PK	30.98	Pass
*7440	40.92	Horizontal	54	AV	13.08	Pass

Remark:

(1) AV Emission Level= PK Emission Level+20log(dutycycle); AV Factor=2.1

(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
C	Signal Analyzer	Rohde & Schwarz	FSV40	101030	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
- 20dB bandwidth and 99% Occupied Bandwidth
- Carrier frequency separation
- Number of hopping frequencies
- Dwell Time
- 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;

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