FCC/IC - TEST REPORT

Report Number	:	**68.960.15.009.01**	Date of Issue:	January 19, 2015

Model	:	**100000**
Product Type	:	SP1 Snow Profiler
Applicant	:	AvaTech, Inc.
Address	:	2700 Rasmussen Rd, Park City, UT, USA
Production Facility	:	JDI Electronics Factory
Address	:	Sima Village, Chang Ping Town, DongGuan, GuangDong, China
Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	26

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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
IC Registration Number:	10320A-1
Telephone:	86 755 8828 6998
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3 Description of the Equipment Under Test

Product:	SP1 Snow Profiler
Model no.:	100000
FCC ID:	2ADY4-SP1
IC ID:	12664A-SP1
Brand Name:	AvaTech
Options and accessories:	NIL
Rating:	DC 3.0V by 2*AA Batteries
RF Transmission Frequency:	2402-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	PCB
Antenna Gain:	0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Snow Profiler 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 and Information 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 KDB558074 D01 DTS Meas Guidance v03r02 and ANSI 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 Site	Test Result
§15.207	RSS-GEN A7.2.4	Conducted emission AC power port	---	---	N/A
§15.247(b)(1)	RSS-210 A8.4	Conducted peak output power	10	Site 2	Pass
§15.247(a)(2)	RSS-210 A8.2(a)	6dB bandwidth and 99% Occupied Bandwidth	11	Site 2	Pass
§15.247(a)(1)	RSS-210 A8.1(a) & RSSGEN 4.6.2	20dB bandwidth	---	---	N/A
§15.247(a)(1)	RSS-210 A8.1(b)	Carrier frequency separation	---	---	N/A
§15.247(a)(1)(iii)	RSS-210 A8.1(d)	Number of hopping frequencies	---	---	N/A
§15.247(a)(1)(iii)	RSS-210 A8.1(c)	Dwell Time	---	---	N/A
§15.247(e)	RSS-210 A8.2(b)	Power spectral density*	15	Site 2	Pass
§15.247(d)	RSS-210 A8.5	Spurious RF conducted emissions	16	Site 2	Pass
§15.247(d)	RSS-210 A8.5	Band edge	20	Site 2	Pass
§15.247(d) & §15.209 &	RSS-210 2.5 & RSSGEN 7.2.5 & RSSGEN 6.1	Spurious radiated emissions for transmitter and receiver	22	Site 2	Pass
§15.203	RSSGEN 7.1.2	Antenna requirement	See note 2		Pass

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a permanently ceramic antenna, which gain is 0dBi. In accordance to §15.203 and RSSGEN 8.3, 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: 2ADY4-SP1, IC ID: 12664A-SP1 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: November 11, 2014

Testing Start Date: November 11, 2014

Testing End Date: January 13, 2015

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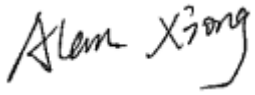
Reviewed by:

John Zhi
EMC Project Manager

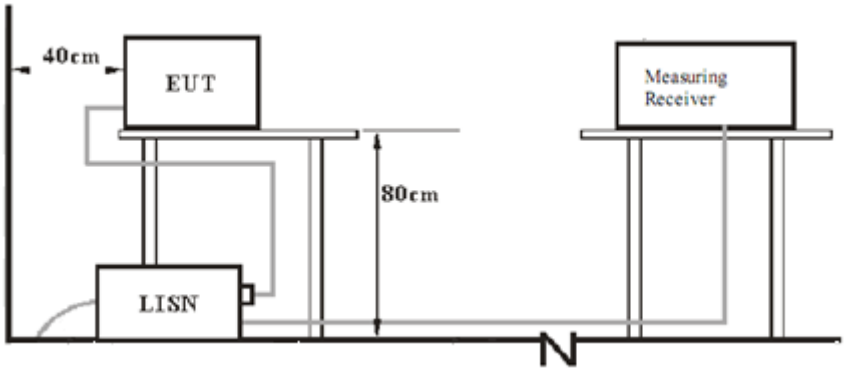
Prepared by:



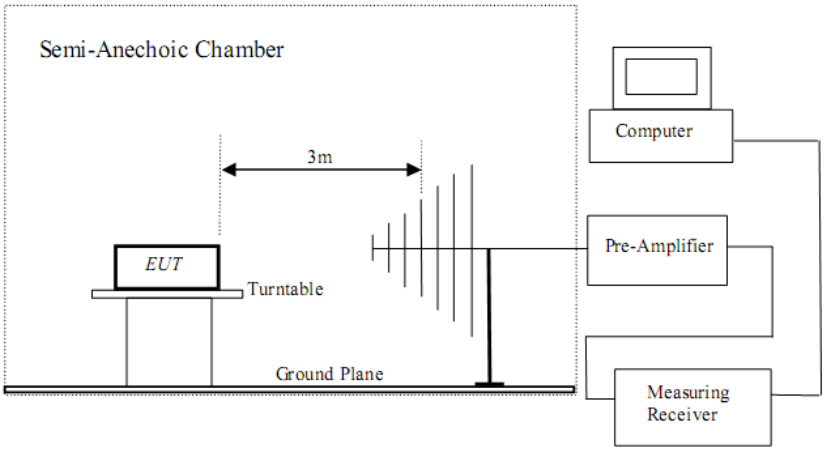
Alan Xiong
EMC Project Engineer

7 Test Setups

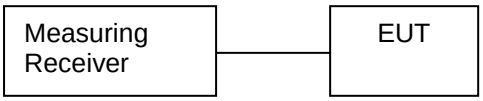
7.1 AC Power Line Conducted Emission test setups



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	X200	---

The system was configured to non-hopping mode.

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

Test Result

GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-5.76	Pass
Middle channel 2440MHz	-5.32	Pass
High channel 2480MHz	-3.88	Pass

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9.2 6dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]
≥500

GFSK modulation Test Result

Frequency MHz	6dB bandwidth kHz	**99% Bandwidth kHz**	Result
Top channel 2402MHz	790.2	1107	Pass
Middle channel 2440MHz	772.8	1085	Pass
Bottom channel 2480MHz	798.8	1090	Pass

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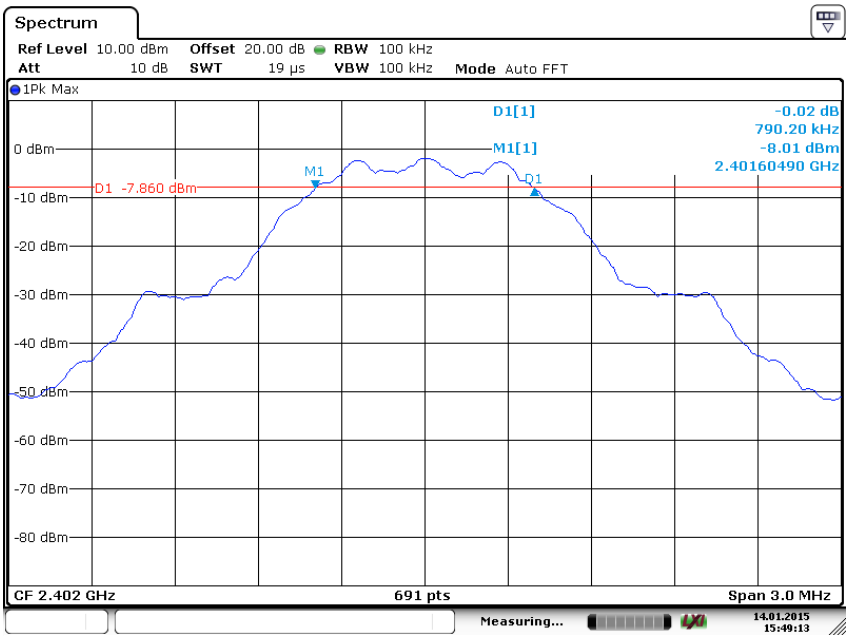
2402MHz



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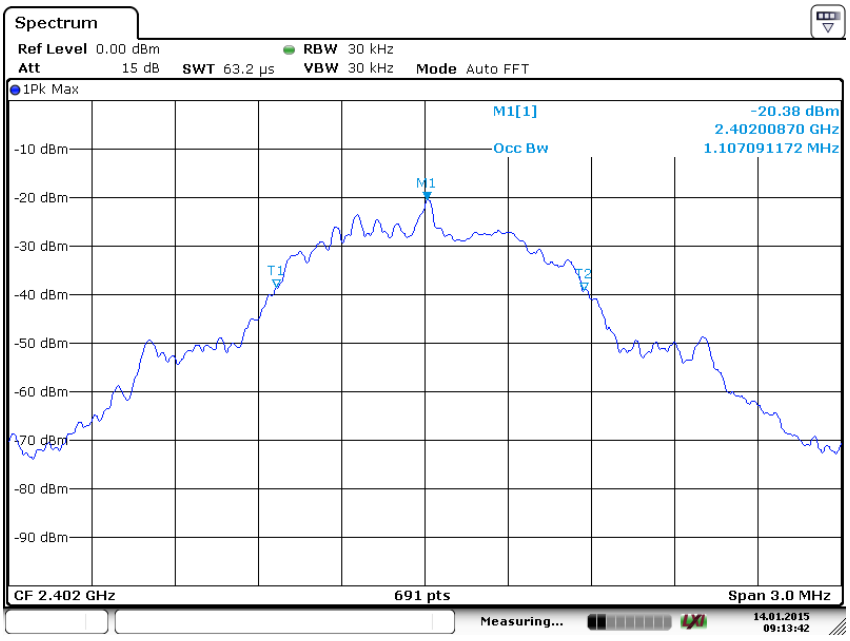

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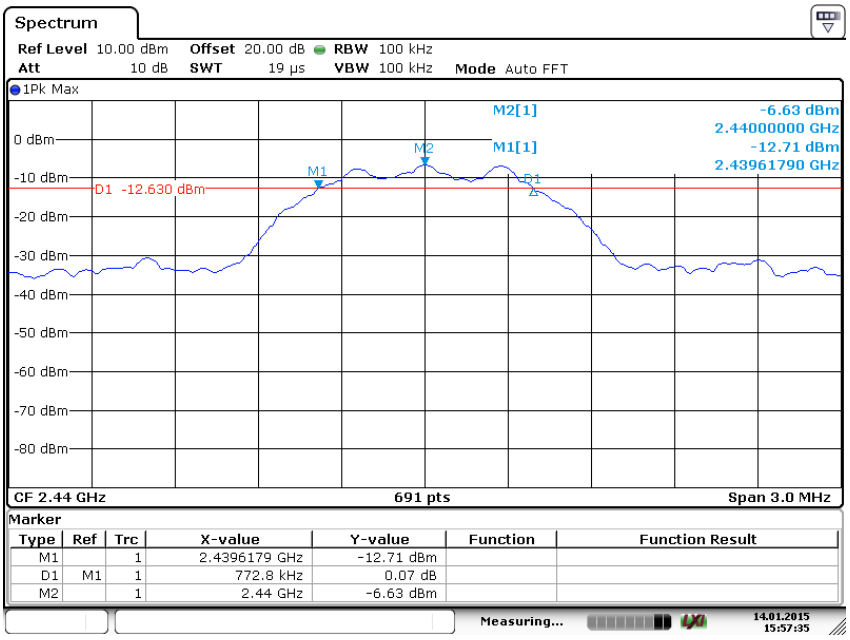
2440MHz



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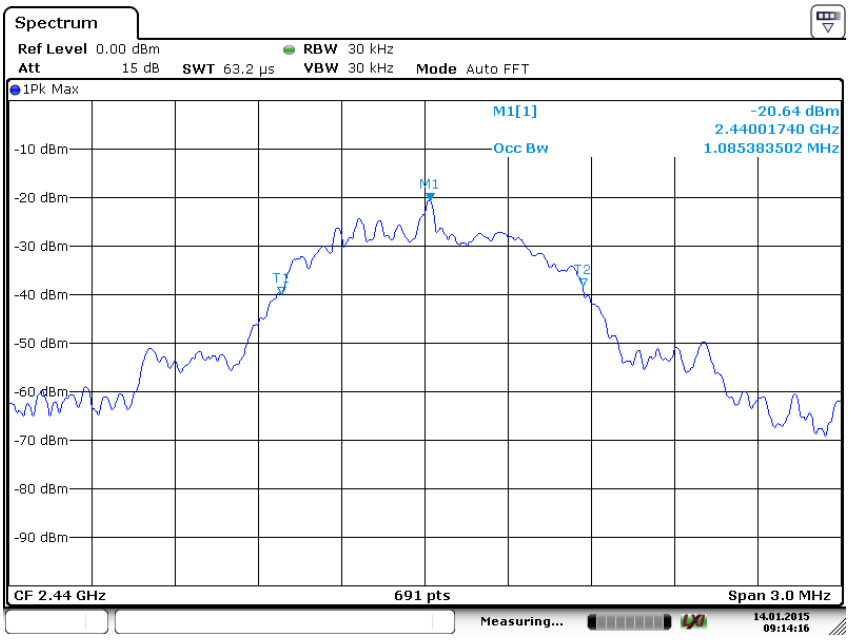

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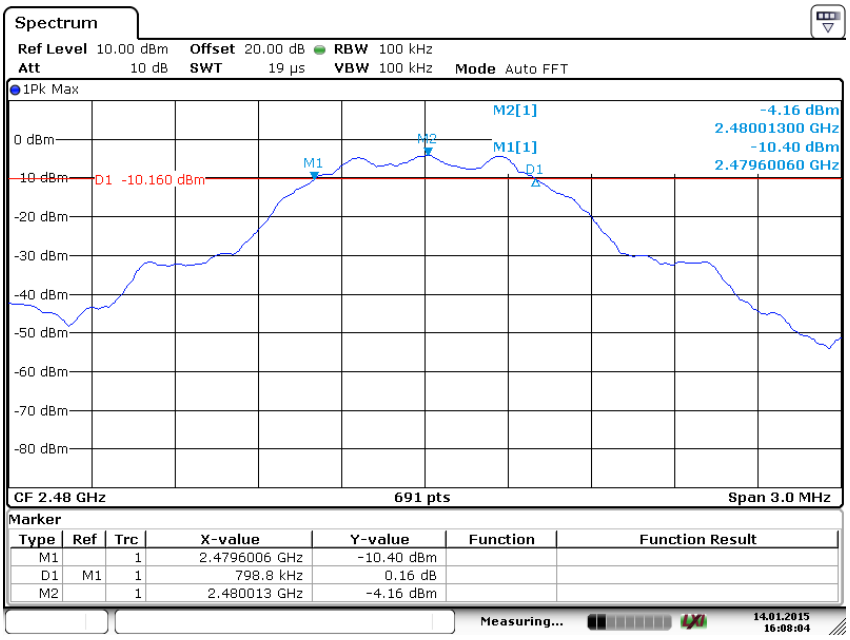
2480MHz



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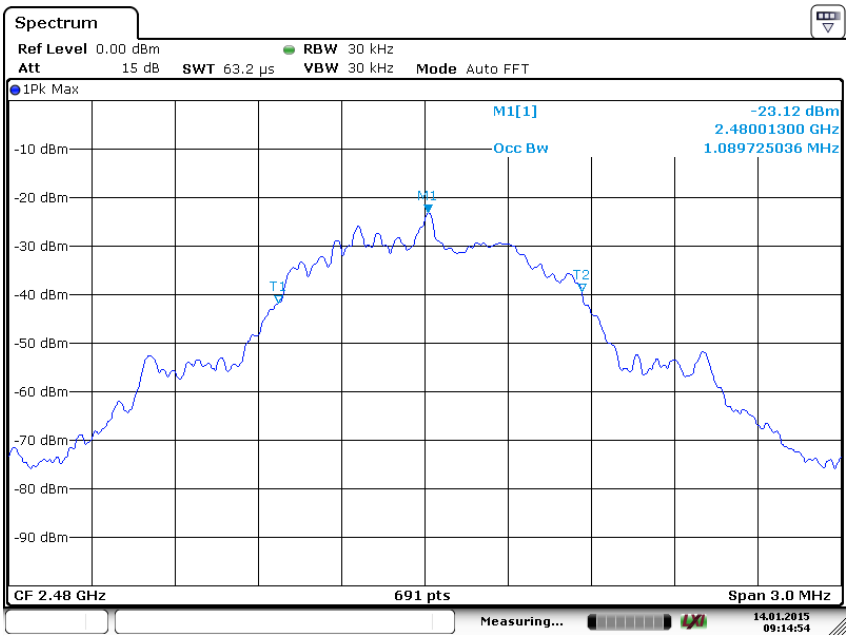

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9.3 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz,VBW≥3RBW,Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8

GFSK modulation Test Result

Frequency MHz	Power spectral density **dBm**	Result
Low channel 2402MHz	-18.68	Pass
Middle channel 2440MHz	-16.68	Pass
High channel 2480MHz	-18.24	Pass

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9.4 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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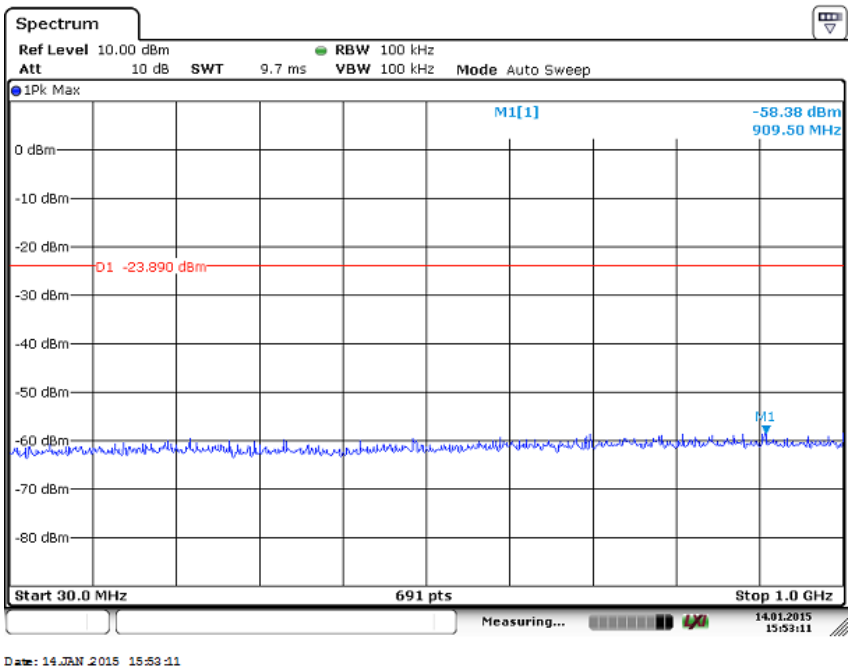
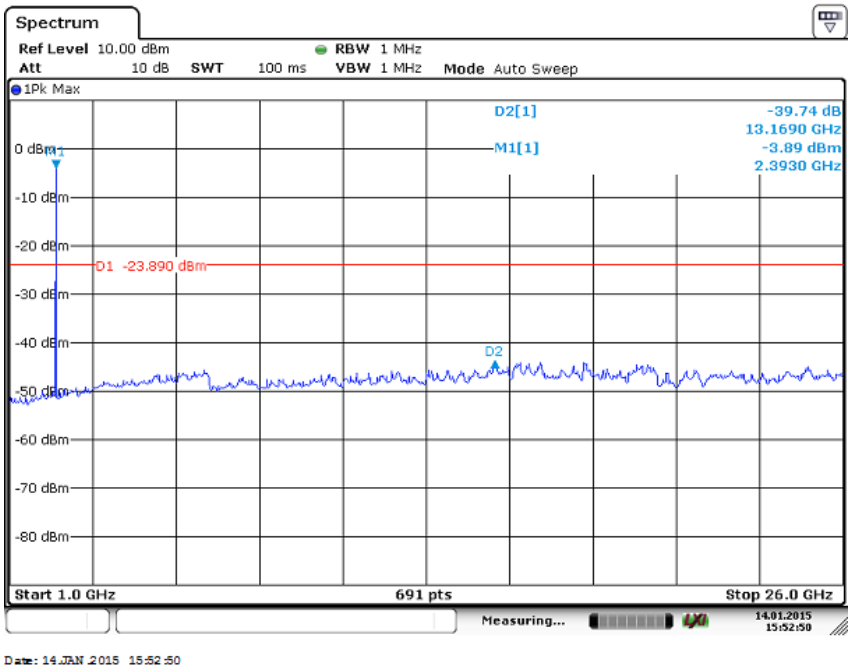
Spurious RF conducted emissions

All modulation test result is listed in the report.

2402MHz





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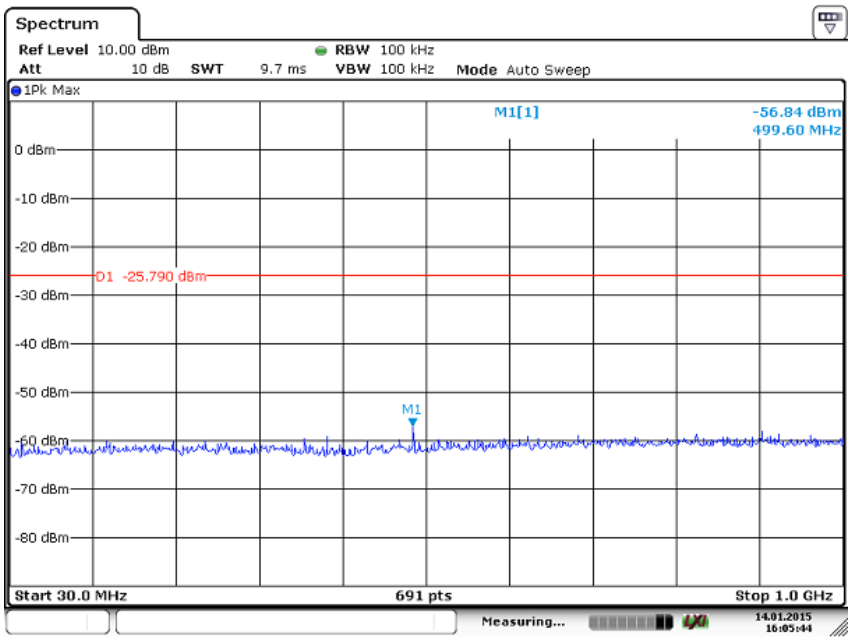
2440MHz



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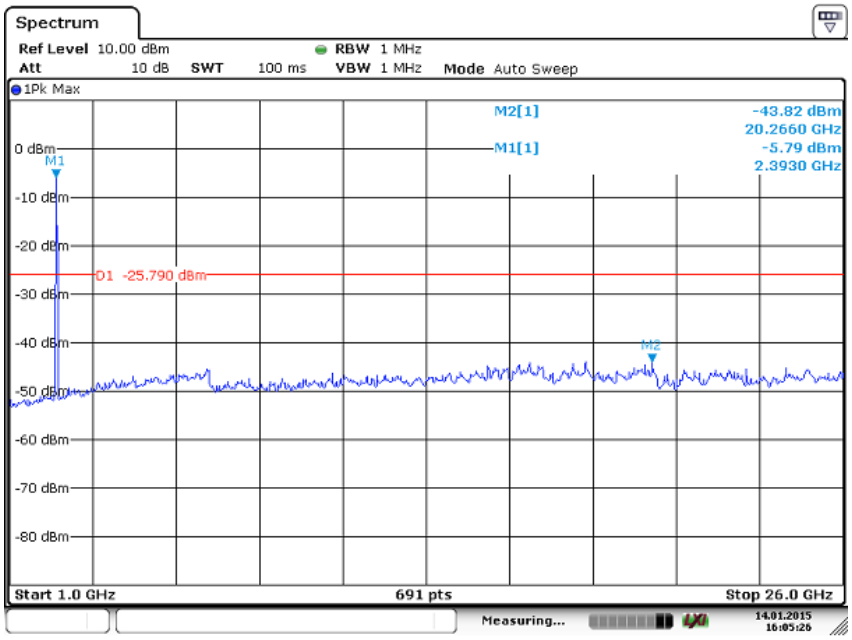

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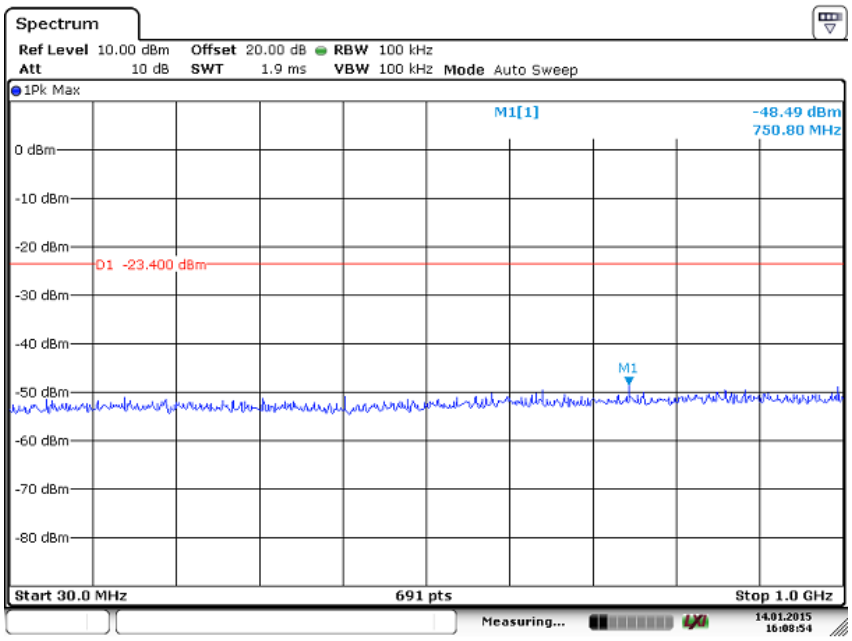
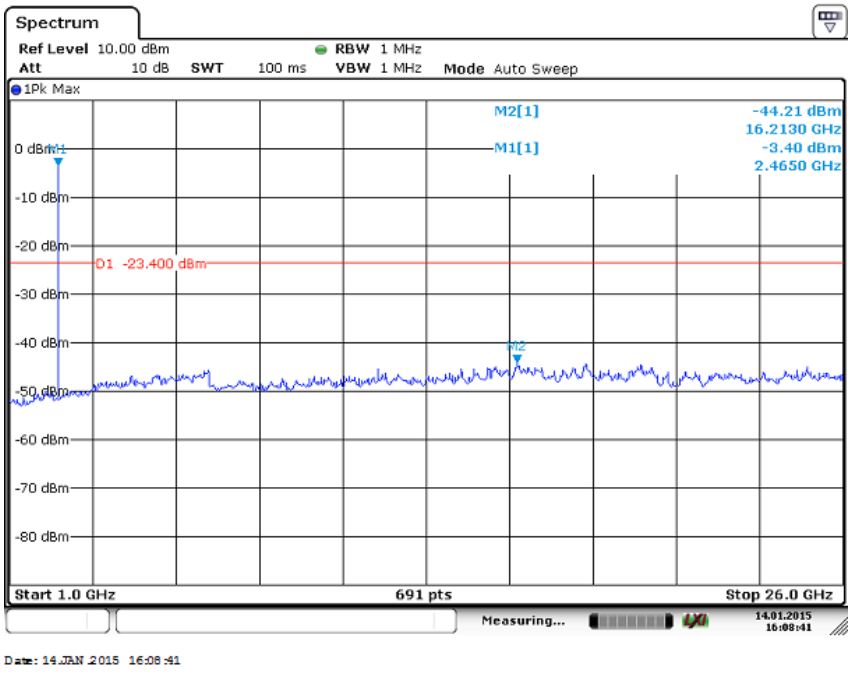
2480MHz





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9.5 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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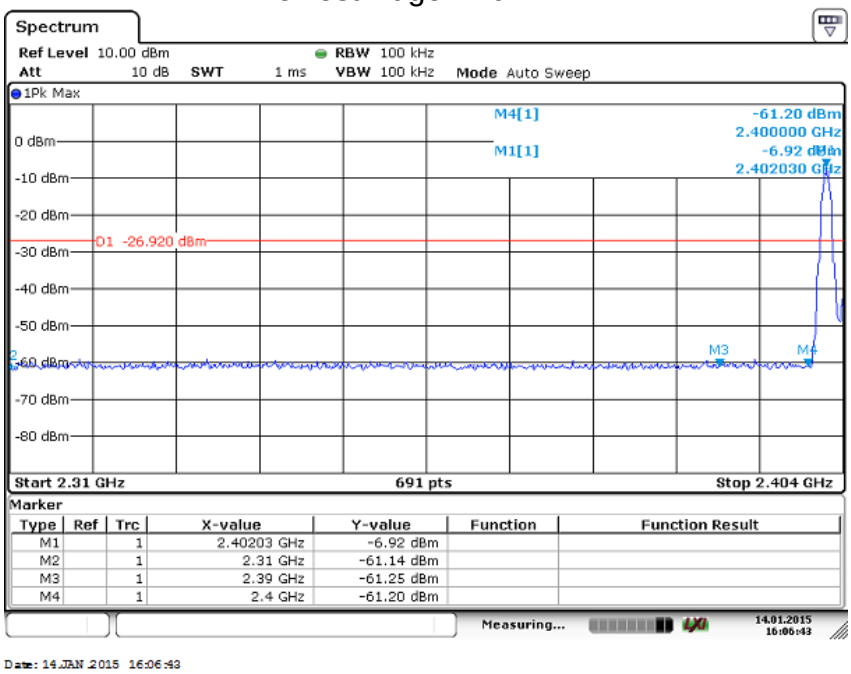
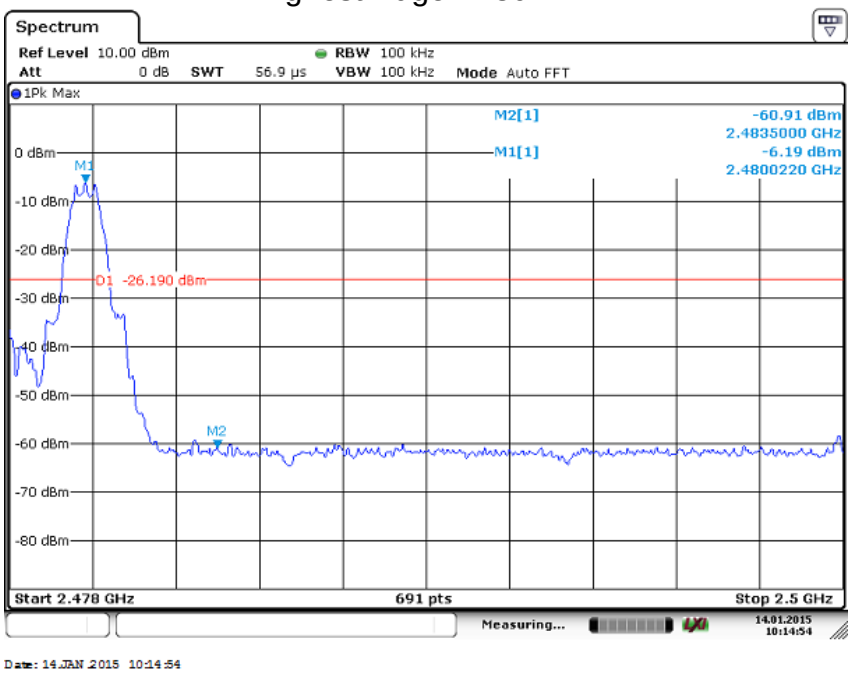
Band edge testing

Test Result:

Lowest Edge-2402MHz



Highest Edge-2480MHz



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9.6 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 C63.4-1992 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 test result is listed in the report.

Transmitting spurious emission test result as below:

GFSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Result
MHz	dBuV/m		dBμV/m	dB		
58.856	18.38	Horizontal	40.0	21.62	QP	Pass
69.831	16.01	Horizontal	40.0	23.99	QP	Pass
45.399	17.66	Vertical	40.0	22.34	QP	Pass
599.997	27.64	Vertical	46.0	18.36	QP	Pass
*7206	44.88	Horizontal	74	29.12	PK	Pass
*7206	40.25	Horizontal	54	13.75	AV	Pass
*7206	49.30	Vertical	74	24.7	PK	Pass
*7206	44.21	Vertical	54	9.79	AV	Pass

GFSK Modulation 2440MHz Test Result

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Result
MHz	dBuV/m		dBμV/m	dB		
*4880	41.4	Horizontal	74	32.6	PK	Pass
*4880	37.9	Horizontal	54	16.1	AV	Pass
*4880	41.3	Vertical	74	32.7	PK	Pass
*4880	37.8	Vertical	54	16.2	AV	Pass

GFSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Result
MHz	dBuV/m		dBμV/m	dB		
*4960	40.2	Horizontal	74	33.8	PK	Pass
*4960	36.7	Horizontal	54	17.3	AV	Pass
*4960	40.0	Vertical	74	34	PK	Pass
*4960	36.5	Vertical	54	17.5	AV	Pass

Remark:

(1) 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(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.

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(3) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
(4) The detected values which are noise floor or below the limit 20dB will not be recorded.

Receiving emission test result as below:

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Result
MHz	dBuV/m		dBμV/m	dB		
58.736	17.98	Horizontal	40.00	22.02	QP	Pass
68.800	17.72	Horizontal	40.00	22.28	QP	Pass
34.789	25.65	Vertical	40.00	14.35	QP	Pass
44.611	24.52	Vertical	40.00	15.48	QP	Pass
1000-25000	--	Horizontal	74	--	PK	Pass
1000-25000	--	Vertical	74	--	PK	Pass

Remark:

(1) 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 (dutycycle)
(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or 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 RSS-Gen.
(4) The detected values which are noise floor or below the limit 20dB will not be recorded.

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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	101031	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 and 99% bandwidth
- 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

Items	Extended Uncertainty
Radiated spurious emission	Horizontal: U=±4.83dB（30MHz~1GHz） Vertical: U=±4.91dB（30MHz~1GHz） Horizontal: U=±4.89dB（1GHz~18GHz） Vertical: U=±4.88dB（1GHz~18GHz）

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