

TEST REPORT

of

ARIB STD-T66

1. Equipment Under Test : Bluetooth Speaker
2. Model Name : PL2
3. Variant Model Name(s) : -
4. Applicant : LG Electronics Inc.
5. Manufacturer : LG Electronics Inc.
6. Date of Receipt : 2020.08.19
7. Date of Test(s) : 2020.09.03 ~ 2020.09.11
8. Date of Issue : 2020.09.11

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

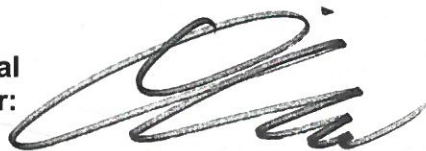
- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.

Tested by:



Lily Jung

Technical
Manager:



Hyunchae You

SGS Korea Co., Ltd. Gunpo Laboratory



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1. General information

1.1. Testing laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

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1.2. Details of applicant

Applicant : LG Electronics Inc.

Address : 222 LG-ro Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea

Contact Person : Yeo, So-young

Phone No. : +82 10 2996 9505

1.3. Details of manufacturer

Company : LG Electronics Inc.

Address : 222 LG-ro Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea

1.4. Description of EUT

Kind of Product	Bluetooth Speaker
Model Name	PL2
Power Supply	DC 3.7 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth, Bluetooth Low Energy)
Modulation Technique	GFSK, $\pi/4$ DQPSK
Number of Channels	79 channels (Bluetooth), 40 channels (Bluetooth Low Energy)
Rated Output Power	Bluetooth: 0.05 ~ 0.25 mW/MHz Bluetooth Low Energy: 2.8 mW
Antenna Type	Internal Antenna
Antenna Gain	3.40 dB i

1.5. Declaration of manufacturer

- The EUT only operates PHY 1M, 37 ~ 250 bytes

1.6. Test Equipment List

Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. Authority	Cal. Method
Spectrum Analyzer	R&S	FSV30	103102	Jun. 01, 2020	SICT	c)
Signal Generator	Agilent	E8257D	MY51501169	Nov. 21, 2019	SICT	c)
Attenuator	MCLI	FAS-12-10	1	Jun. 07, 2020	SICT	c)
DC Power Supply	R&S	HMP2020	019922876	Apr. 27, 2020	SICT	c)
DIGITAL MULTIMETER	HIOKI	DT4211	N0301231	Sep. 18, 2019	SICT	c)

Note;

a): Calibration conducted by the National Institute of Information and Communications Technology or a designated calibration agency under Article 102-18 paragraph (1).

b): Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law. (Law No. 51 of 1992)

c): Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).

d): Calibration conducted by using other equipment that listed above from a) to c).

1.7. Test method

Measurement was conducted by the following test method:

The test method of Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment in Annex 1, the Ministry of Internal Affairs and Communication notification in Annex 43 of Article 88, Paragraph 1 or the test method more than equivalent.

1.8. Summary of test results

The EUT has been tested according to the following specifications:

Applied Standard : Radio equipment regulations and ARIB STD-T66		
Article Reference	Test item	Result
STD-T66 3.2	Frequency Tolerance	Complied
STD-T66 3.2	Occupied Bandwidth (99 %)	Complied
STD-T66 3.2	Spurious Emission Intensity	Complied
STD-T66 3.2	Antenna Power	Complied
STD-T66 3.3	Secondary Radiated Emissions	Complied
STD-T66 3.4	Interference Prevention Function	Complied

1.9. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL001156	2020.09.11	Initial

2. Frequency Tolerance

2.1. Test Setup



2.2. Limit

Tolerance of frequency: $\pm 50 \times 10^{-6}$ or less.

2.3. Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be transmitting at low, middle and high channels.
3. Set the spectrum analyzer as below;

Center frequency: 2 402 MHz, 2 442 MHz, 2 480 MHz (Bluetooth Low Energy)

Span: 5 MHz

RBW: 30 kHz

VBW: 300 kHz

Sweep time: Auto

Sweep data points: 1 001 or greater

Detector mode: Positive peak

Indication mode: Max hold

4. Find the peak carrier signal and measure its frequency.

2.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

- Test mode: Modulated

Low voltage

Test voltage(V _{d.c.})	Measured frequency (MHz)	Reading frequency (MHz)	Frequency tolerance [ppm]
V _{min} = 3.33	Low Ch. (2 402)	2 401.985 000	-6.24
	Middle Ch. (2 442)	2 441.985 000	-6.14
	High Ch. (2 480)	2 479.985 000	-6.05

Normal voltage

Test voltage(V _{d.c.})	Measured frequency (MHz)	Reading frequency (MHz)	Frequency tolerance [ppm]
V _{Nom} = 3.70	Low Ch. (2 402)	2 401.985 000	-6.24
	Middle Ch. (2 442)	2 441.985 000	-6.14
	High Ch. (2 480)	2 479.985 000	-6.05

High voltage

Test voltage(V _{d.c.})	Measured frequency (MHz)	Reading frequency (MHz)	Frequency tolerance [ppm]
V _{max} = 4.07	Low Ch. (2 402)	2 401.985 000	-6.24
	Middle Ch. (2 442)	2 441.985 000	-6.14
	High Ch. (2 480)	2 479.985 000	-6.05

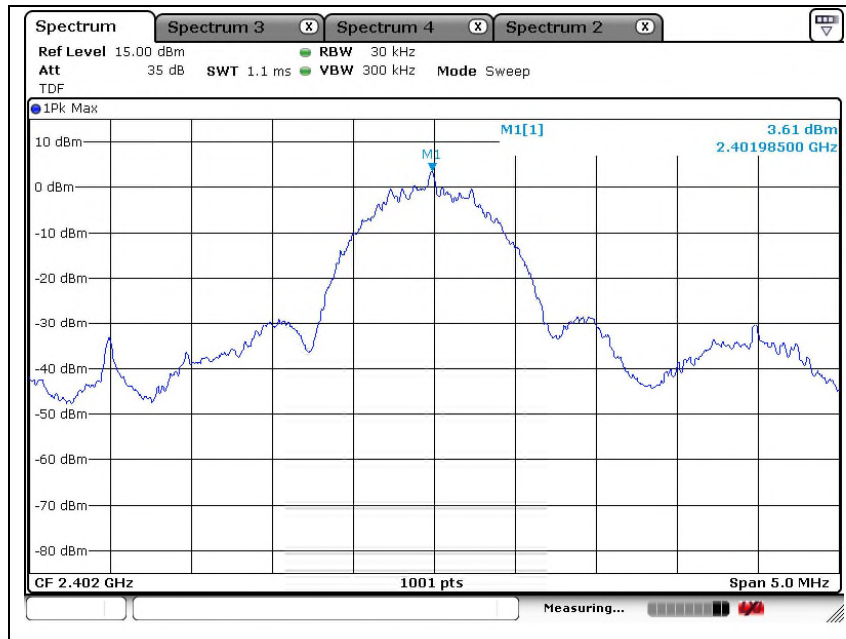
Note;

$$1. FT (ppm) = [(RF-MF)/MF] \times 10^6$$

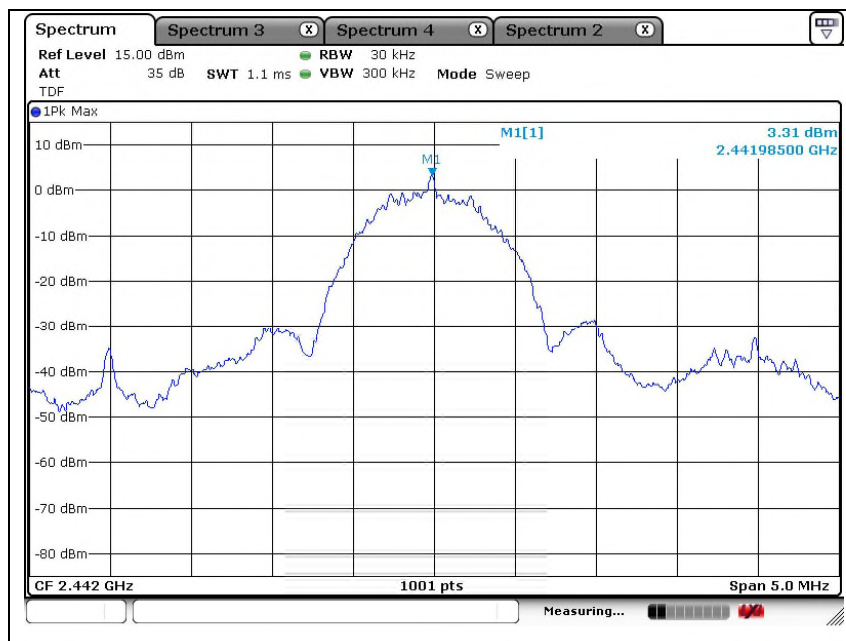
- FT: Frequency Tolerance, RF: Reading Frequency and MF: Measurement Frequency

Low voltage

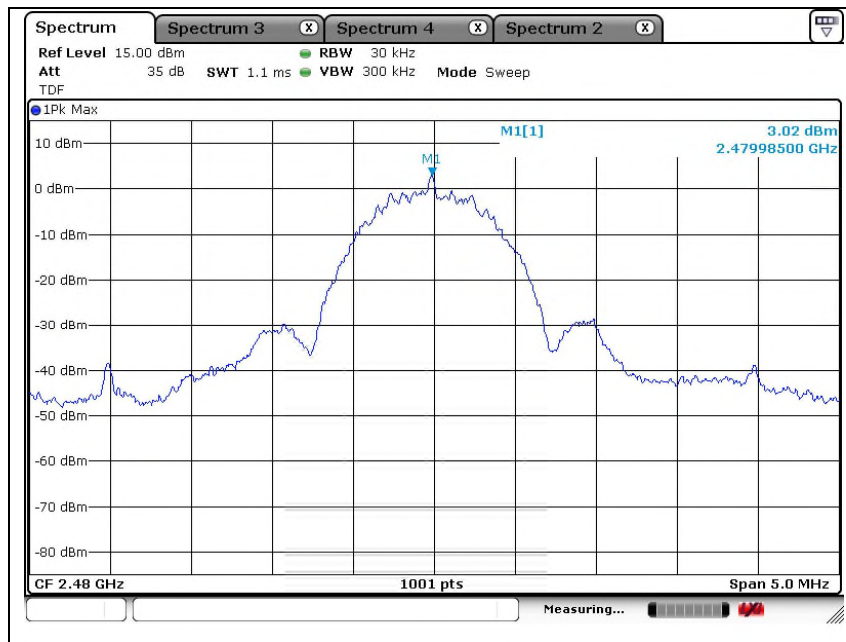
Low channel



Middle channel

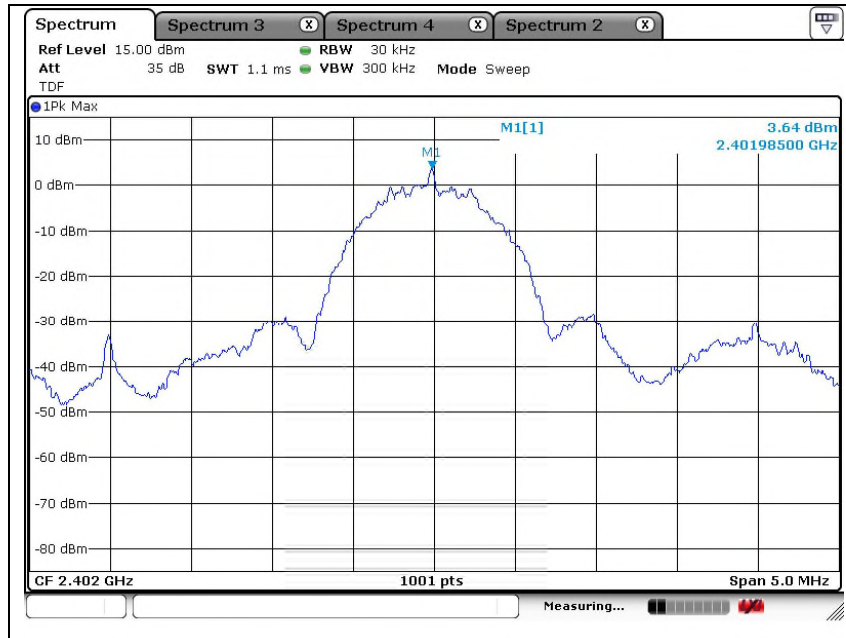


High channel

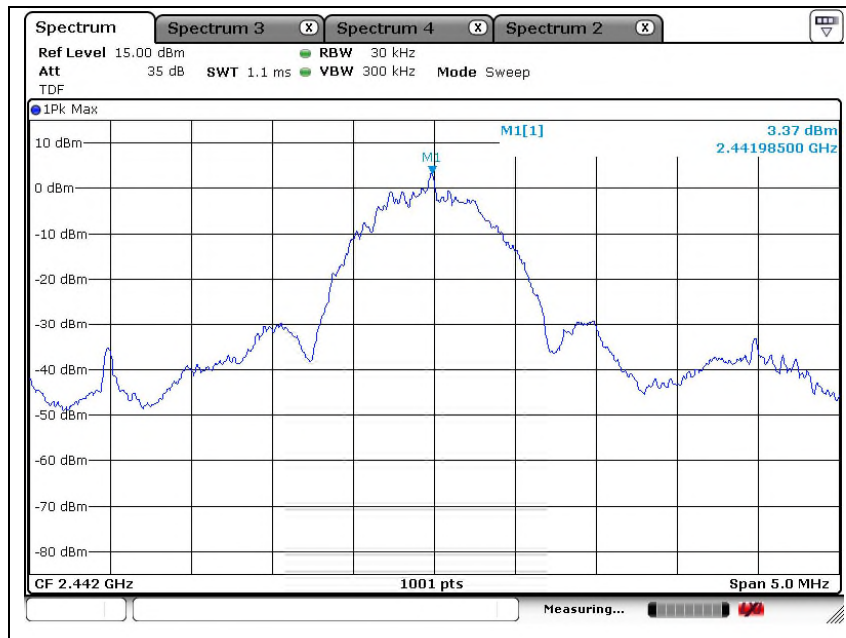


Normal voltage

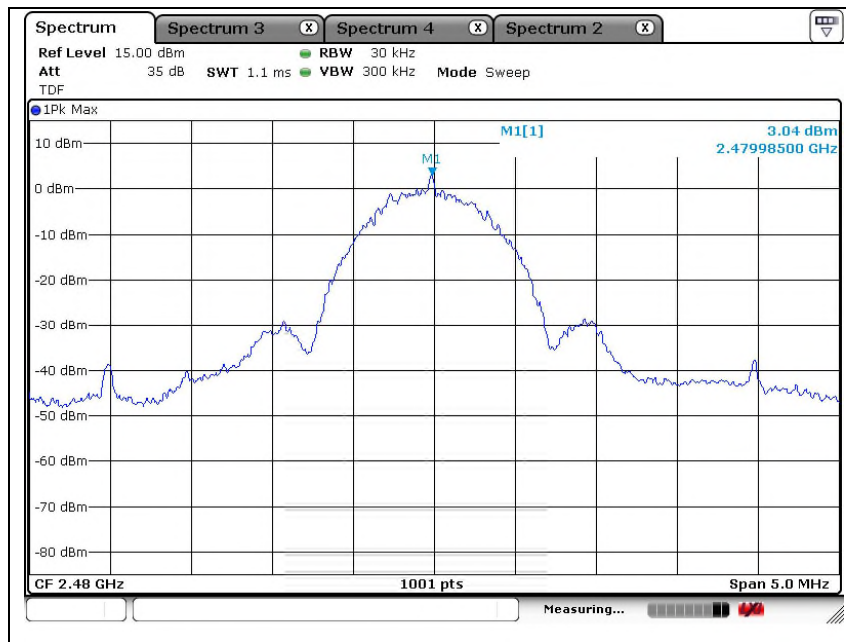
Low channel



Middle channel

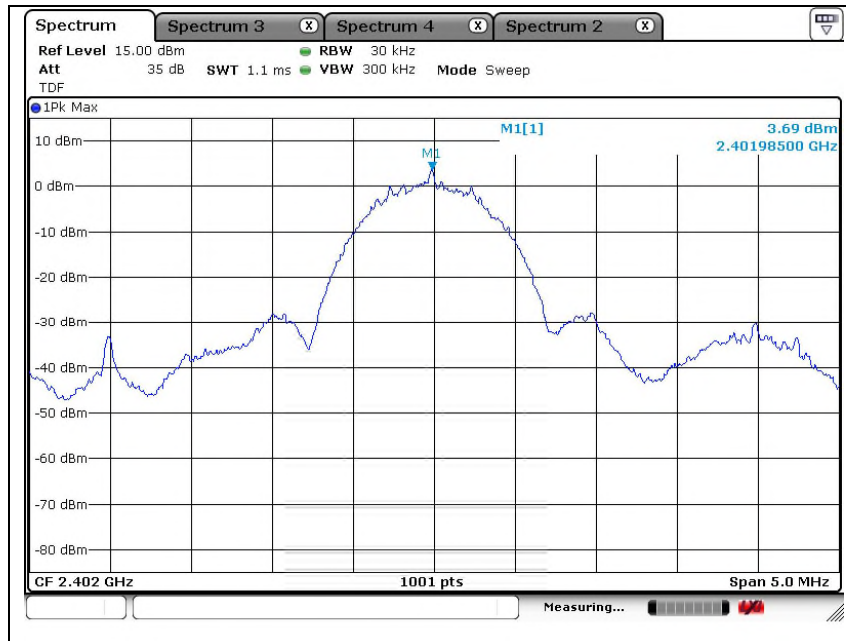


High channel

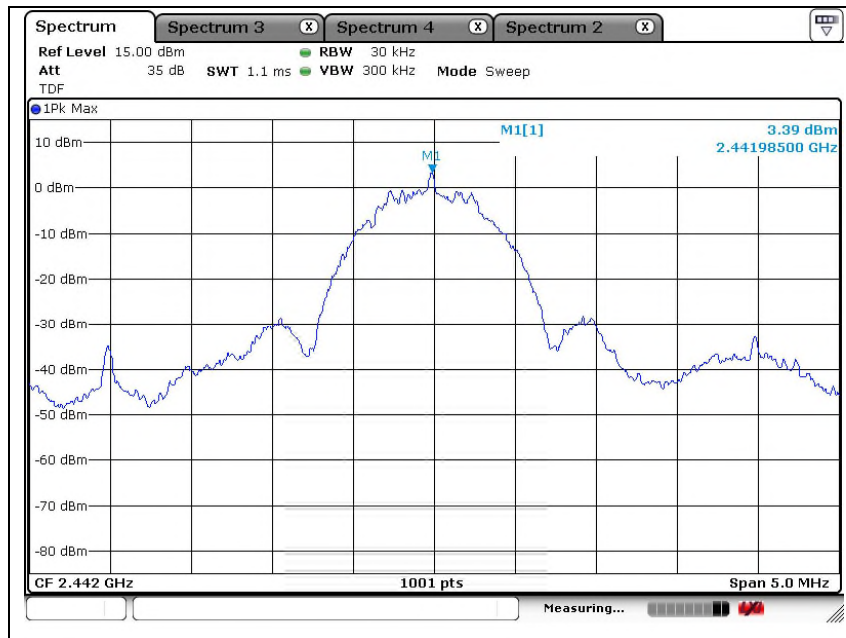


High voltage

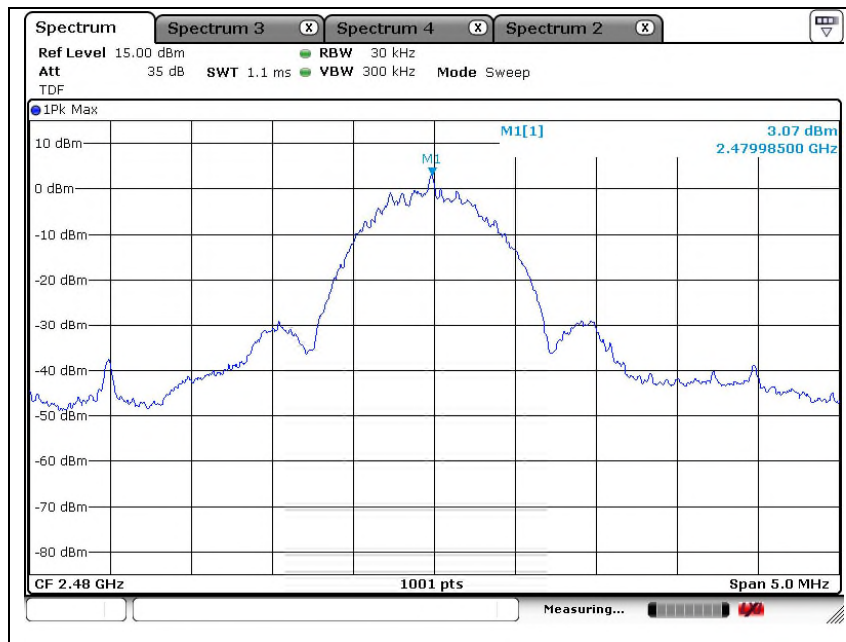
Low channel



Middle channel



High channel



3. Occupied Bandwidth (99 %)

3.1. Test Setup



3.2. Limit

26 MHz or less

3.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. Measure the signal bandwidth using a spectrum analyzer.
3. Set the spectrum analyzer as below;

Center frequency:	2 402 MHz, 2 442 MHz, 2 480 MHz
Span:	10 MHz
RBW:	300 kHz
VBW:	300 kHz
Sweep time:	Auto
Sweep data points:	1 001 or greater
Detector mode:	Positive peak
Indication mode:	Max hold
BW setting:	99 %

3.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

Low voltage

Test voltage (V _{d.c.})	Measured frequency (MHz)	Occupied bandwidth (MHz)
V _{min} = 3.33	Low Ch. (2 402)	1.35
	Middle Ch. (2 442)	1.33
	High Ch. (2 480)	1.33

Normal voltage

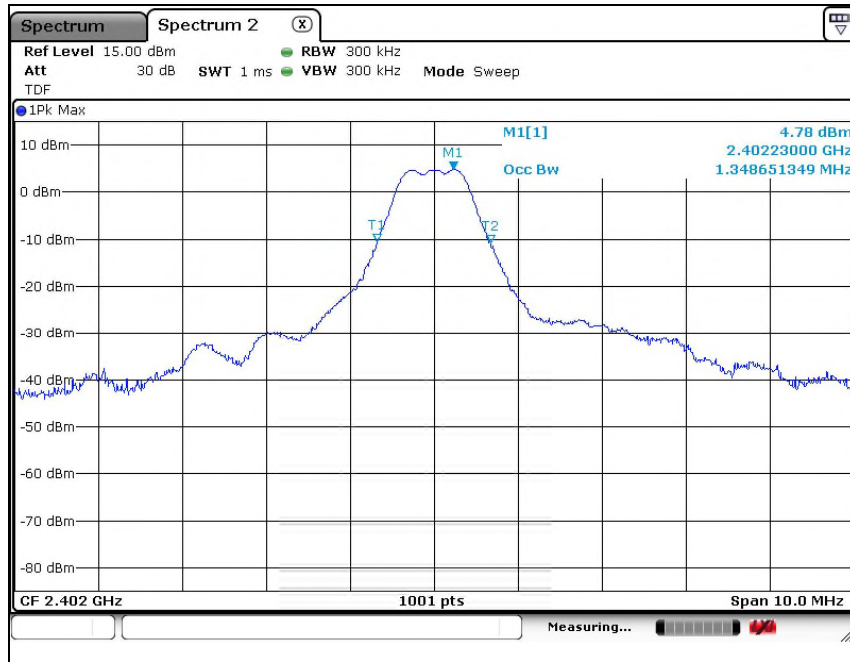
Test voltage (V _{d.c.})	Measured frequency (MHz)	Occupied bandwidth (MHz)
V _{nom} = 3.70	Low Ch. (2 402)	1.35
	Middle Ch. (2 442)	1.33
	High Ch. (2 480)	1.33

High voltage

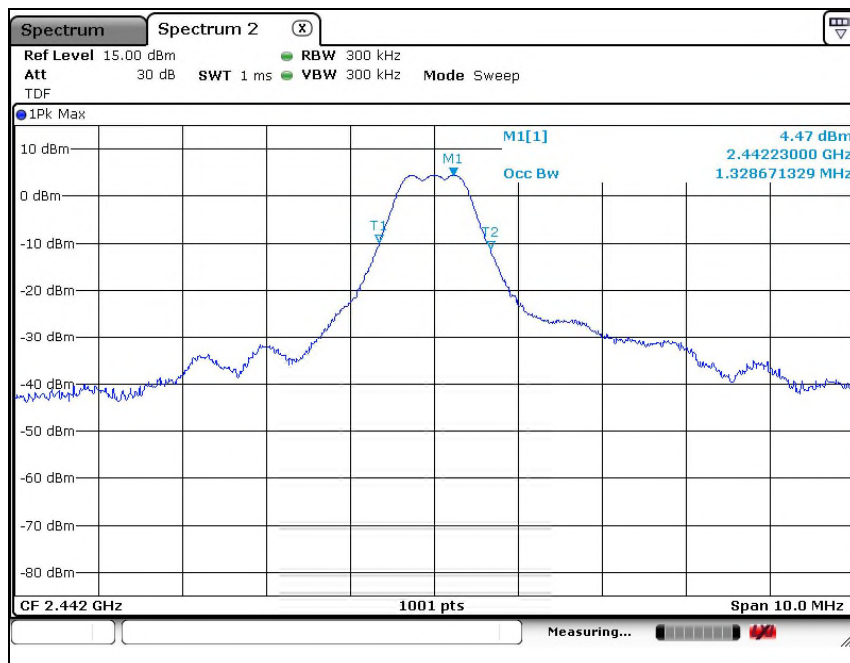
Test voltage (V _{d.c.})	Measured frequency (MHz)	Occupied bandwidth (MHz)
V _{max} = 4.07	Low Ch. (2 402)	1.35
	Middle Ch. (2 442)	1.34
	High Ch. (2 480)	1.33

Low voltage

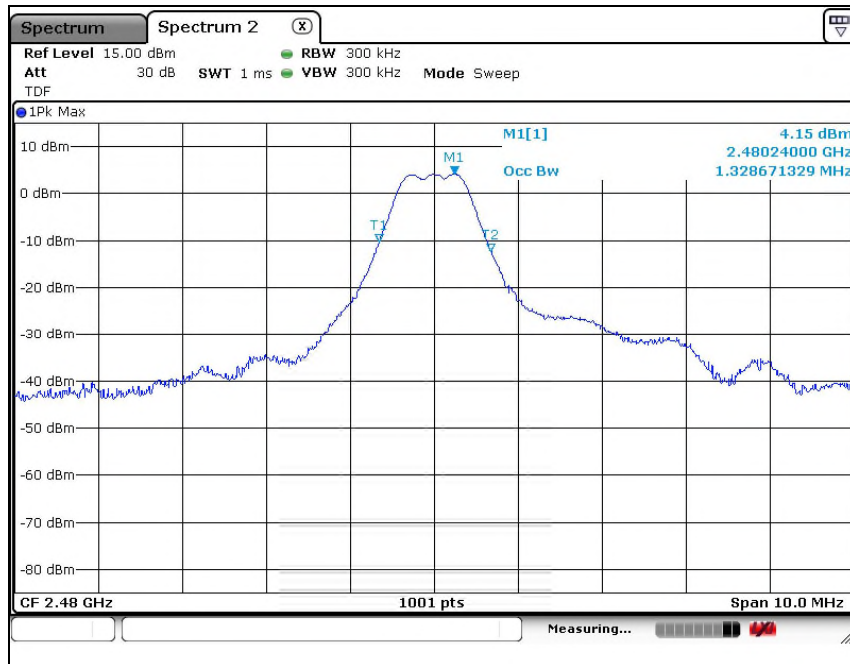
Low channel



Middle channel

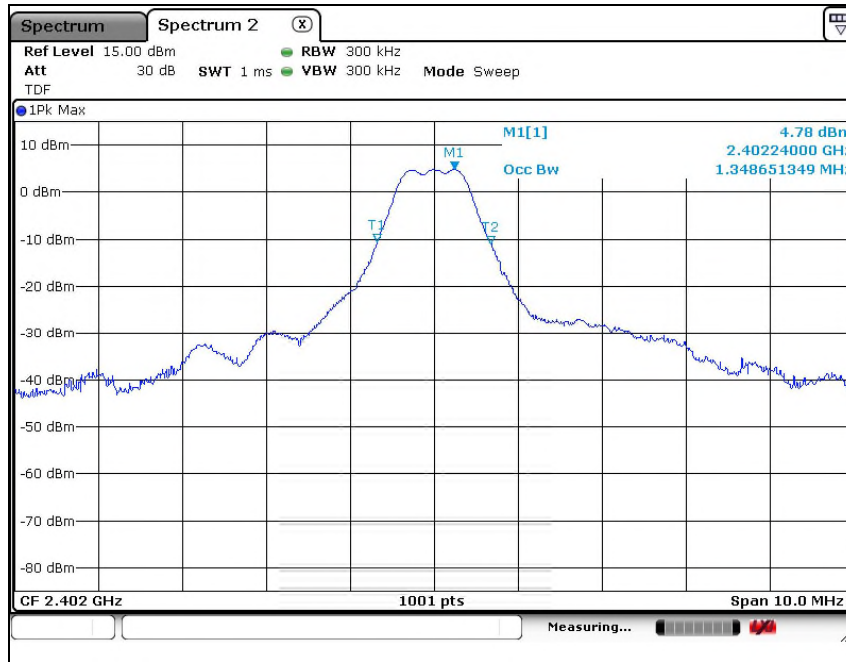


High channel

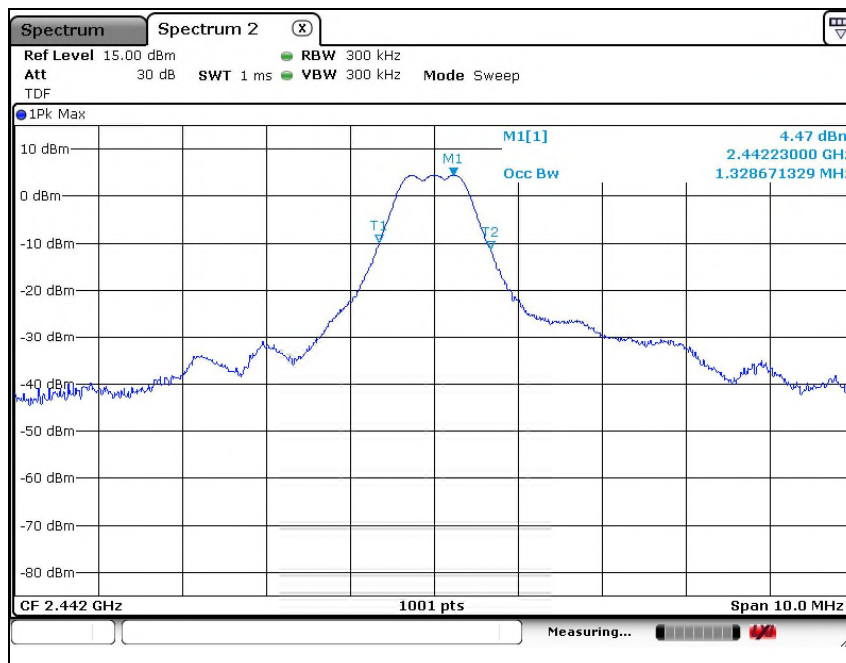


Normal voltage

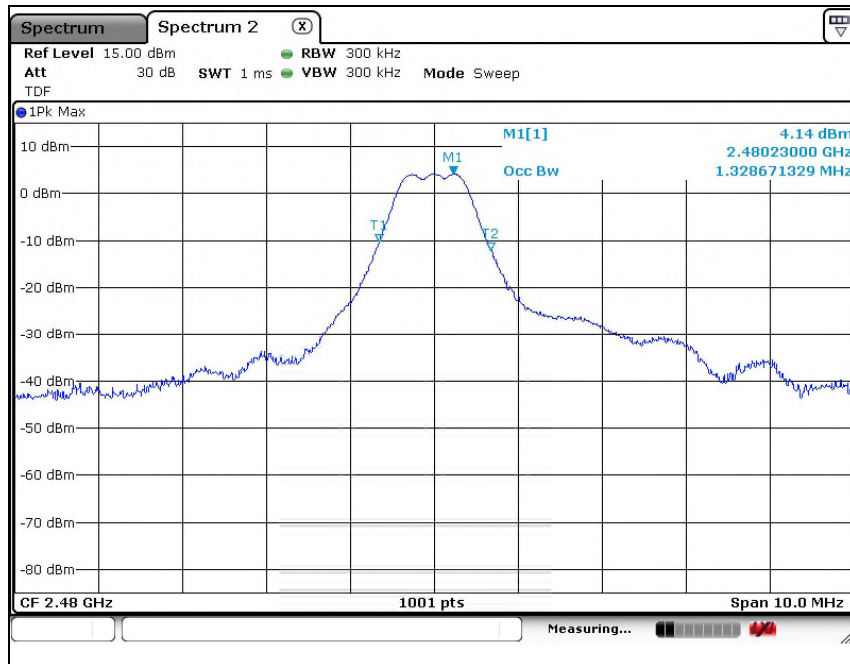
Low channel



Middle channel

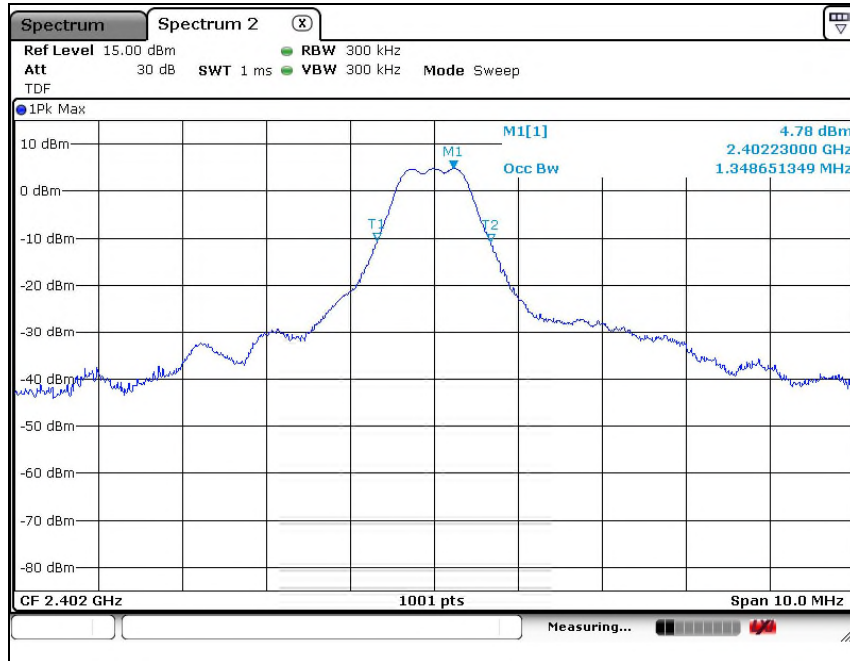


High channel

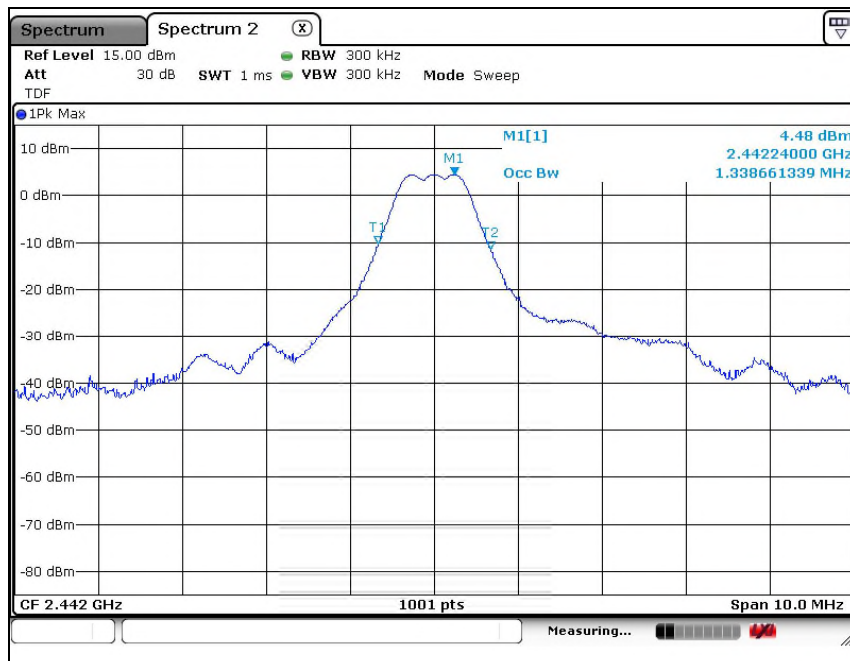


High voltage

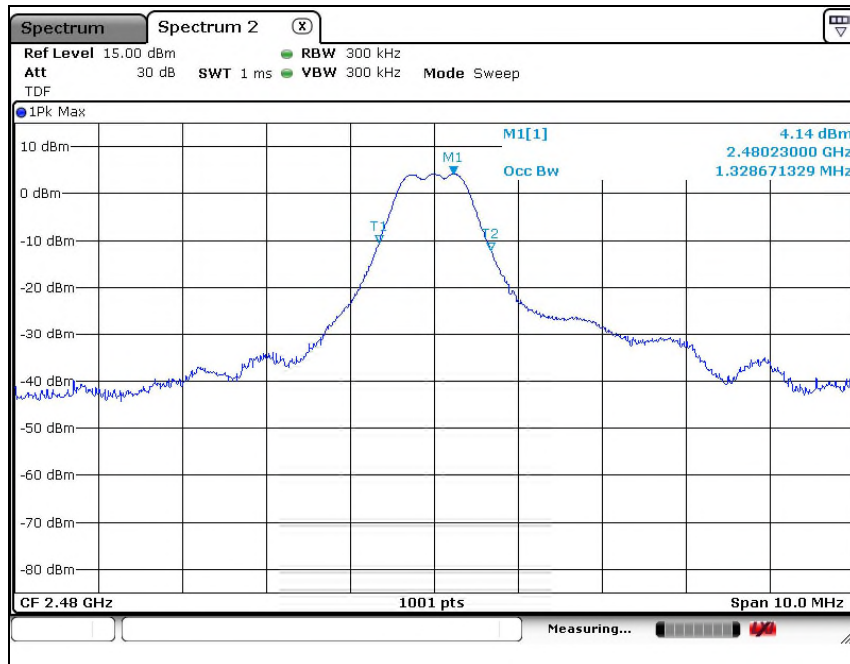
Low channel



Middle channel



High channel



4. Spurious Emission Intensity

4.1. Test Setup



4.2. Limit

Below 2 387 MHz:	2.5 μ W (-26 dB m)/MHz or less
2 387 to 2 400 MHz:	25.0 μ W (-16 dB m)/MHz or less
2 483.5 to 2 496.5 MHz:	25.0 μ W (-16 dB m)/MHz or less
Over 2 496.5 MHz:	2.5 μ W (-26 dB m)/MHz or less

4.3. Test Procedure

[Setting 1]

1. Connect transmitter output to the spectrum analyzer input port.
2. Configure the EUT
 - Test channels: low, middle, high

Frequency range:	30 MHz to 12.5 GHz, except for 2 400 MHz to 2 483.5 MHz
RBW:	1 MHz
VBW:	1 MHz
Sweep time:	Minimum time required to make an accurate measurement
Sweep data points:	1 001 or greater
Detector mode:	Positive peak
Indication mode:	Max hold

Note: sweep shall be repeated until the max hold waveform is stable.

3. Search for spurious emissions from 30 MHz to 12.5 GHz

4.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Low voltage

Test voltage (V _{d.c.})	Frequency range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V min = 3.33	Below 2 387	Frequency (GHz)	2.386	2.282	2.352	-
		Level (dB m/MHz)	-53.44	-53.78	-53.87	-26
		Level (μW/MHz)	0.004 529	0.004 188	0.004 102	2.5
	2 387 to 2 400	Frequency (GHz)	2.400	2.392	2.390	-
		Level (dB m/MHz)	-20.75	-54.83	-55.54	-16
		Level (μW/MHz)	8.413 951	0.003 289	0.002 793	25
	2 483.5 to 2 496.5	Frequency (GHz)	2.492	2.487	2.484	-
		Level (dB m/MHz)	-56.08	-51.56	-28.11	-16
		Level (μW/MHz)	0.002 466	0.006 982	1.545 254	25
	Above 2 496.5	Frequency (GHz)	7.207	7.327	7.441	-
		Level (dB m/MHz)	-34.93	-32.13	-29.80	-26
		Level (μW/MHz)	0.321 366	0.612 350	1.047 129	2.5

Normal voltage

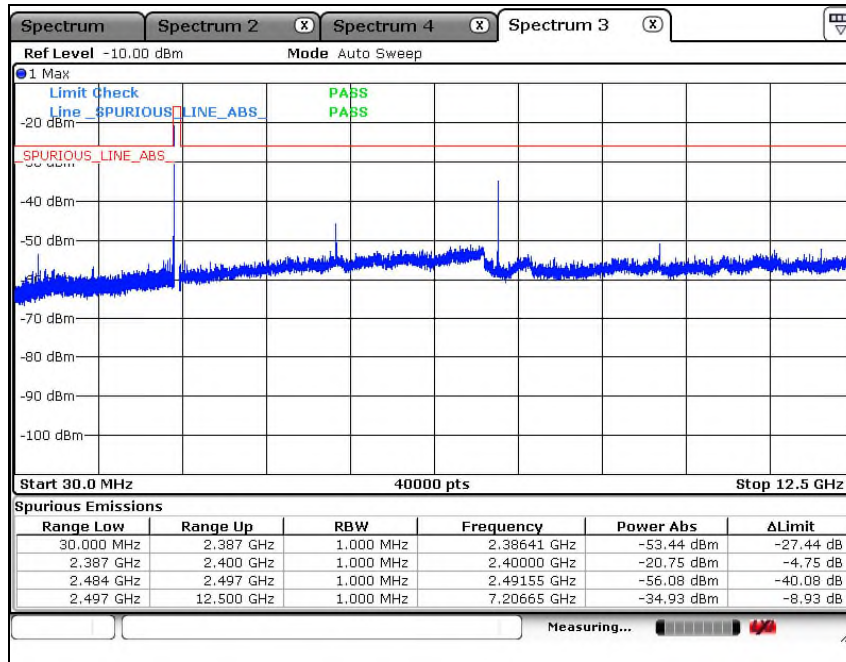
Test voltage (V _{d.c.})	Frequency range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V nom = 3.70	Below 2 387	Frequency (GHz)	2.387	2.250	2.320	-
		Level (dB m/MHz)	-52.87	-51.68	-53.59	-26
		Level (μW/MHz)	0.005 164	0.006 792	0.004 375	2.5
	2 387 to 2 400	Frequency (GHz)	2.400	2.388	2.396	-
		Level (dB m/MHz)	-20.94	-54.40	-55.54	-16
		Level (μW/MHz)	8.053 784	0.003 631	0.002 858	25
	2 483.5 to 2 496.5	Frequency (GHz)	2.486	2.489	2.484	-
		Level (dB m/MHz)	-55.23	-51.93	-28.23	-16
		Level (μW/MHz)	0.002 999	0.006 412	1.503 142	25
	Above 2 496.5	Frequency (GHz)	7.207	7.327	7.441	-
		Level (dB m/MHz)	-34.86	-31.89	-29.67	-26
		Level (μW/MHz)	0.326 588	0.647 143	1.078 947	2.5

High voltage

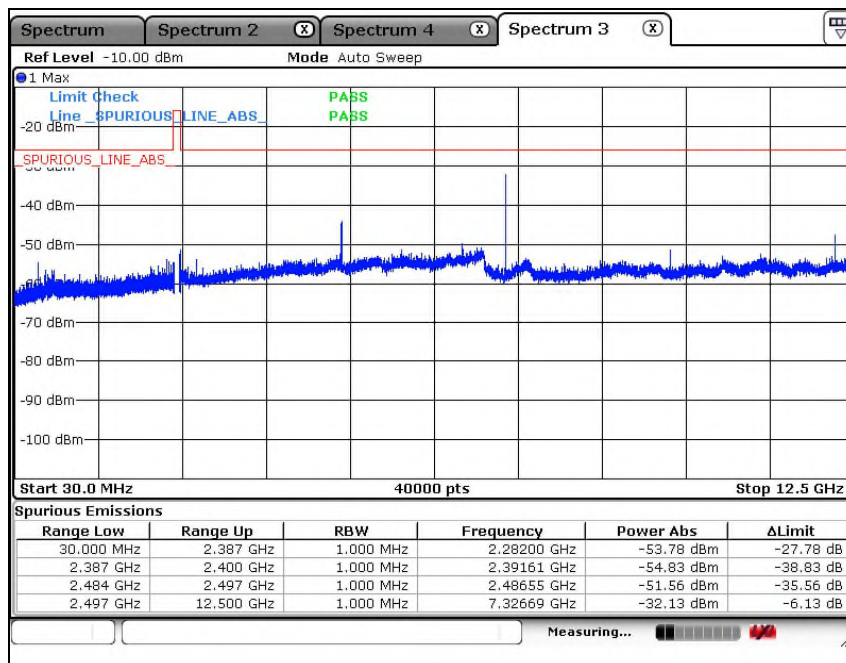
Test voltage (V _{d.c.})	Frequency range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 440 MHz)	High Ch. (2 480 MHz)	Limit
V max = 4.07	Below 2 387	Frequency (GHz)	2.387	2.314	2.352	-
		Level (dB m/MHz)	-51.36	-54.16	-53.91	-26
		Level (μW/MHz)	0.007 311	0.003 837	0.004 064	2.5
	2 387 to 2 400	Frequency (GHz)	2.400	2.395	2.396	-
		Level (dB m/MHz)	-21.09	-55.34	-55.87	-16
		Level (μW/MHz)	7.780 366	0.002 924	0.002 588	25
	2 483.5 to 2 496.5	Frequency (GHz)	2.490	2.489	2.484	-
		Level (dB m/MHz)	-55.88	-52.39	-28.00	-16
		Level (μW/MHz)	0.002 582	0.005 768	1.584 893	25
	Above 2 496.5	Frequency (GHz)	7.206	7.326	7.441	-
		Level (dB m/MHz)	-34.87	-32.11	-29.64	-26
		Level (μW/MHz)	0.325 837	0.615 177	1.086 426	2.5

Low voltage

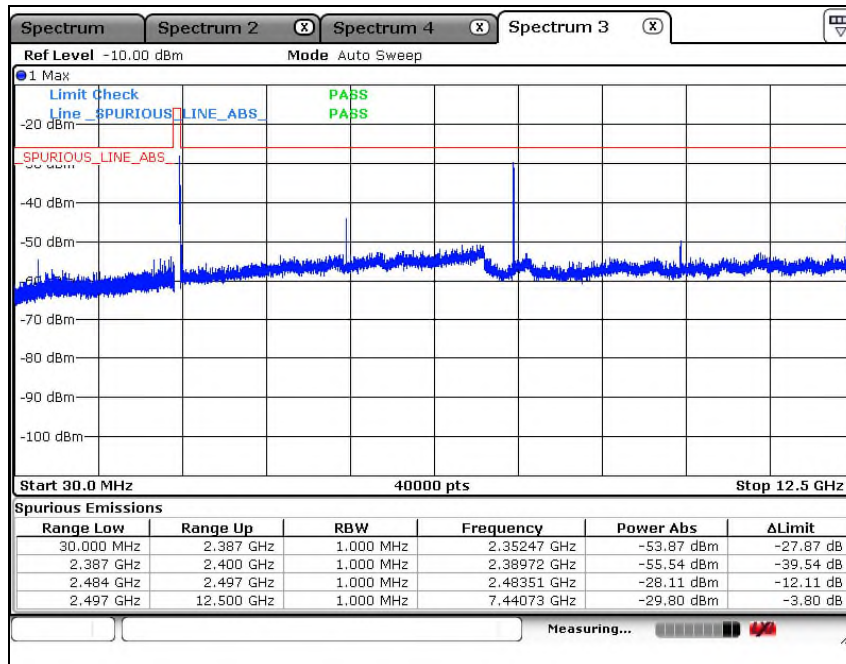
Low channel



Middle channel

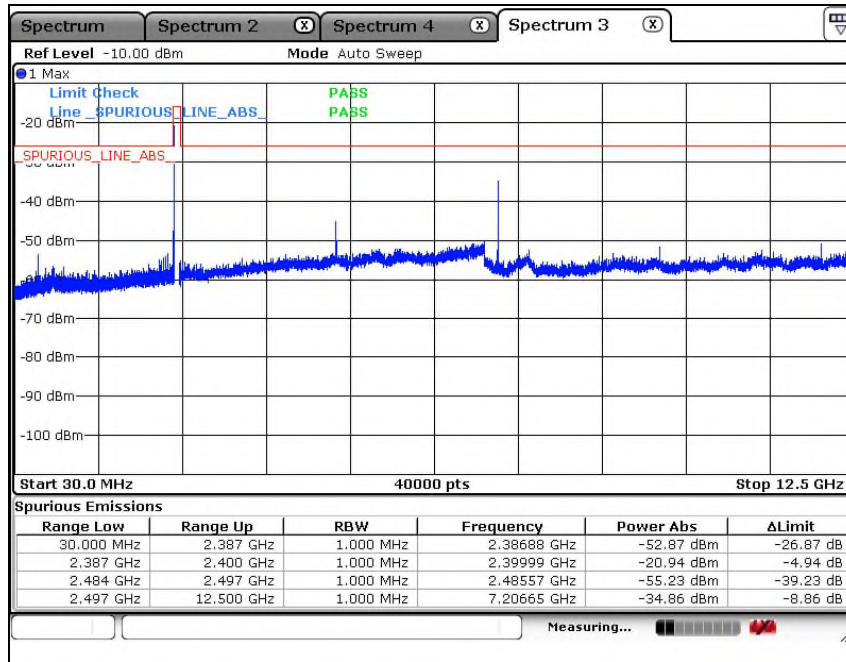


High channel

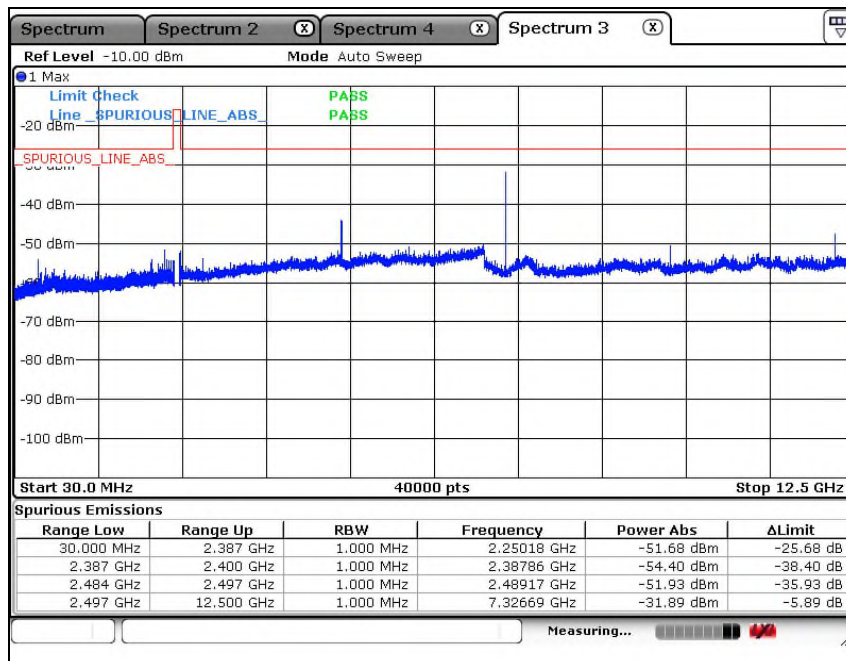


Normal voltage

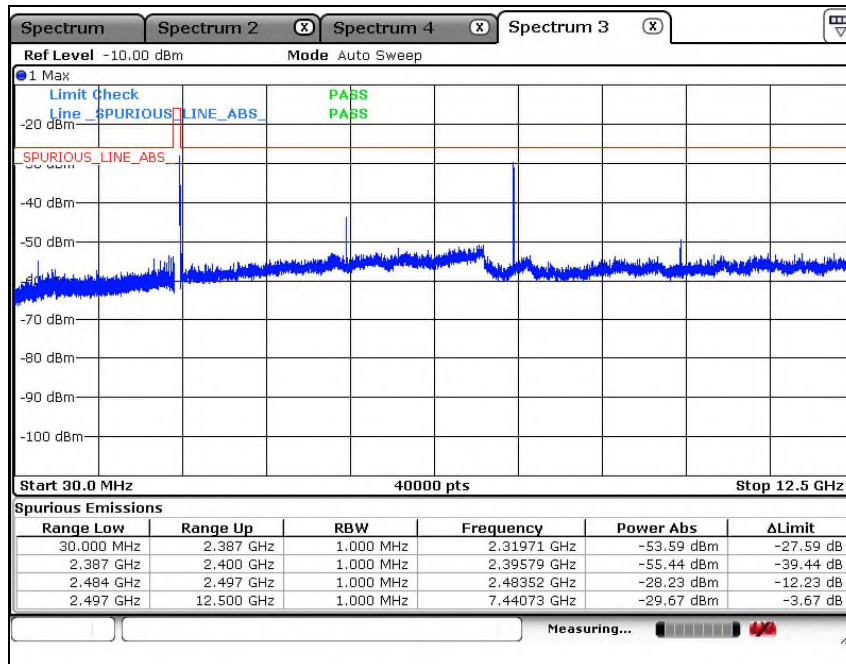
Low channel



Middle channel

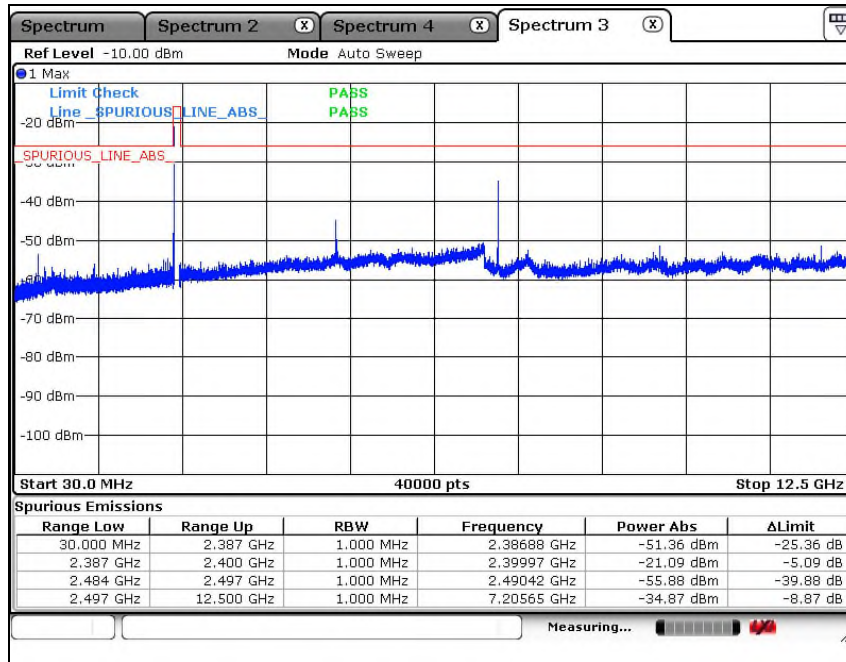


High channel

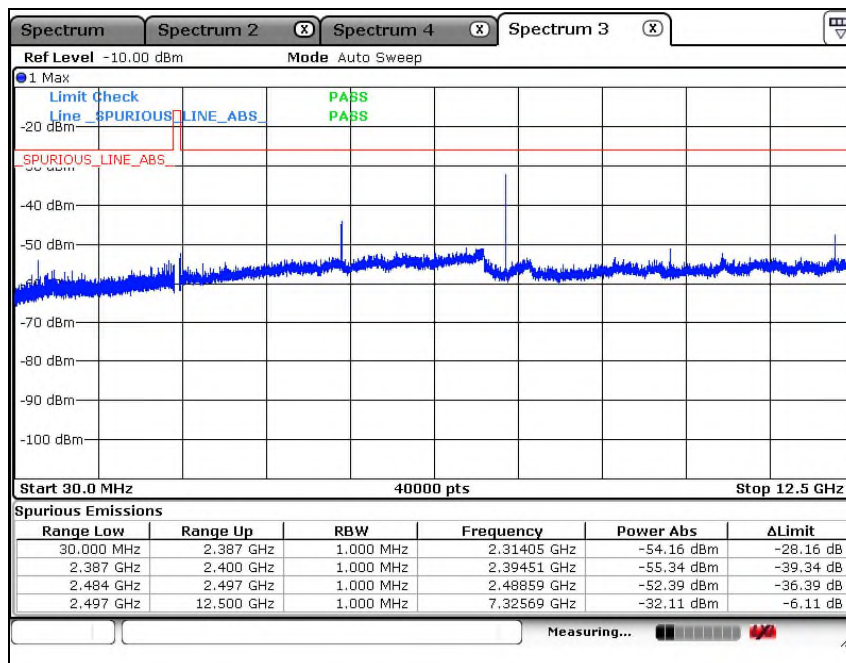


High voltage

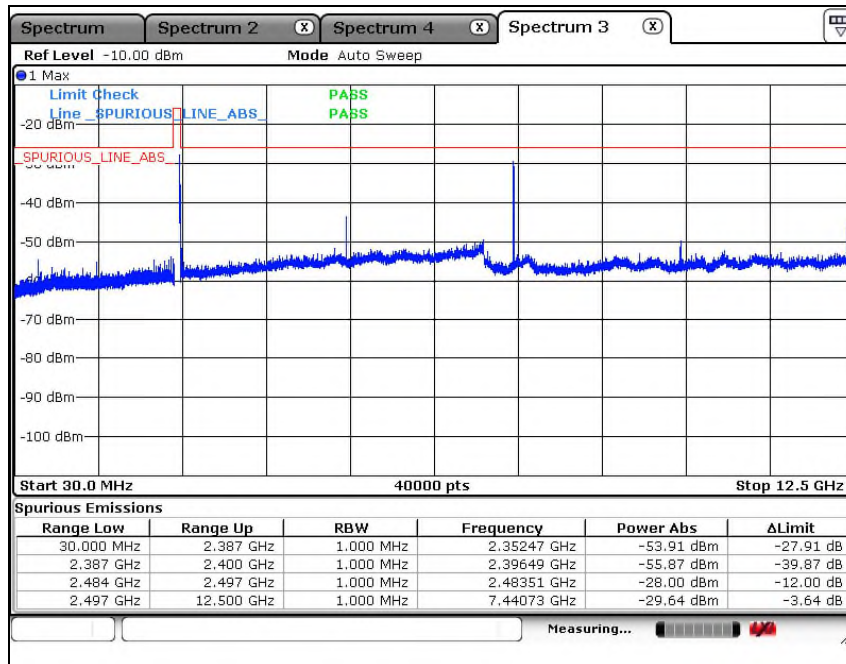
Low channel



Middle channel

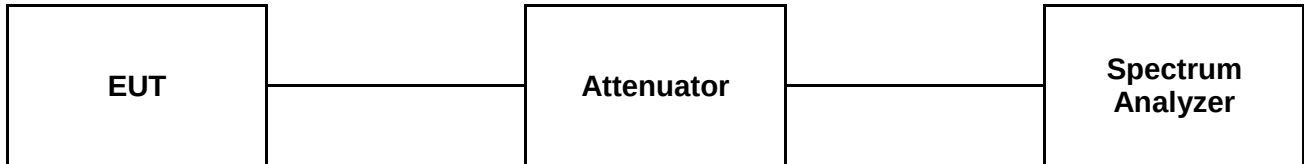


High channel



5. Antenna Power

5.1. Test setup



5.2. Limit

The difference between measured output power and the rated output power shall be within a tolerance of +20 % to -80 %. In addition, the rated output power shall not be over the limits shown below.

Limit (rated output power, upper limit)

- 10 mW or less

5.3. Test procedure

1. Connect transmitter output to the spectrum analyzer input port.

2. Configure the spectrum analyzer as below;

–Search for peak power frequency according to below settings

Center frequency: 2 402 MHz, 2 442 MHz, 2 480 MHz

Span: 10 MHz

RBW: 1 MHz

VBW: 3 MHz

Sweep time: Auto

Sweep data points: 1 001 or greater

Detector mode: Positive peak

Indication mode: Max hold

Find the frequency of maximum transmitted power

–Measurement of average antenna power according to below settings

Center frequency: Frequency of peak power

Span: 0 Hz

RBW: 3 MHz

VBW: 3 MHz

Sweep: Minimum time required to make an accurate measurement.

For burst type (intermittent) transmission, sweep time shall be greater than one burst Interval.

Sweep data points: 1 001 or greater

Detector mode: Sample

Measure the Average Burst Power of the frequency

5.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Low voltage

Test voltage (V _{d.c.})	Channel	Antenna gain (dB i)	Rated Output Power		E.I.R.P. (dB m)	Average Burst Power		Power Tolerance (%)
V _{min} = 3.33	Low Ch. (2 402 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.88 mW	4.59 dB m	2.86
	Middle Ch. (2 442 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.69 mW	4.30 dB m	-3.93
	High Ch. (2 480 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.51 mW	3.99 dB m	-10.36

Normal voltage

Test voltage (V _{d.c.})	Channel	Antenna gain (dB i)	Rated Output Power		E.I.R.P. (dB m)	Average Burst Power		Power Tolerance (%)
V _{nom} = 3.70	Low Ch. (2 402 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.88 mW	4.60 dB m	2.86
	Middle Ch. (2 442 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.71 mW	4.33 dB m	-3.21
	High Ch. (2 480 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.52 mW	4.01 dB m	-10.00

High voltage

Test voltage (V _{d.c.})	Channel	Antenna gain (dB i)	Rated Output Power		E.I.R.P. (dB m)	Average Burst Power		Power Tolerance (%)
V _{max} = 4.07	Low Ch. (2 402 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.88 mW	4.59 dB m	2.86
	Middle Ch. (2 442 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.68 mW	4.28 dB m	-4.29
	High Ch. (2 480 MHz)	3.40	2.80 mW	4.47 dB m	7.87	2.50 mW	3.98 dB m	-10.71

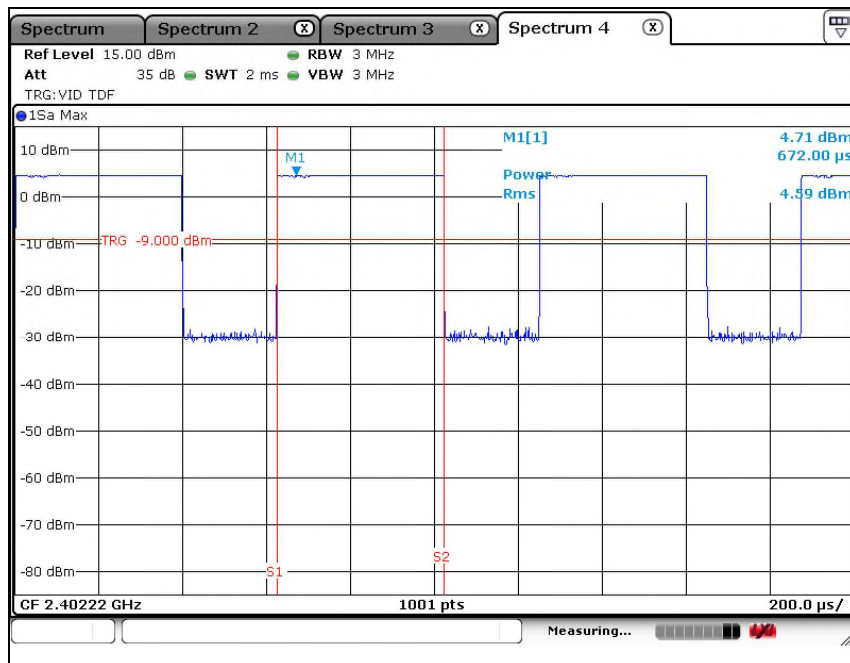
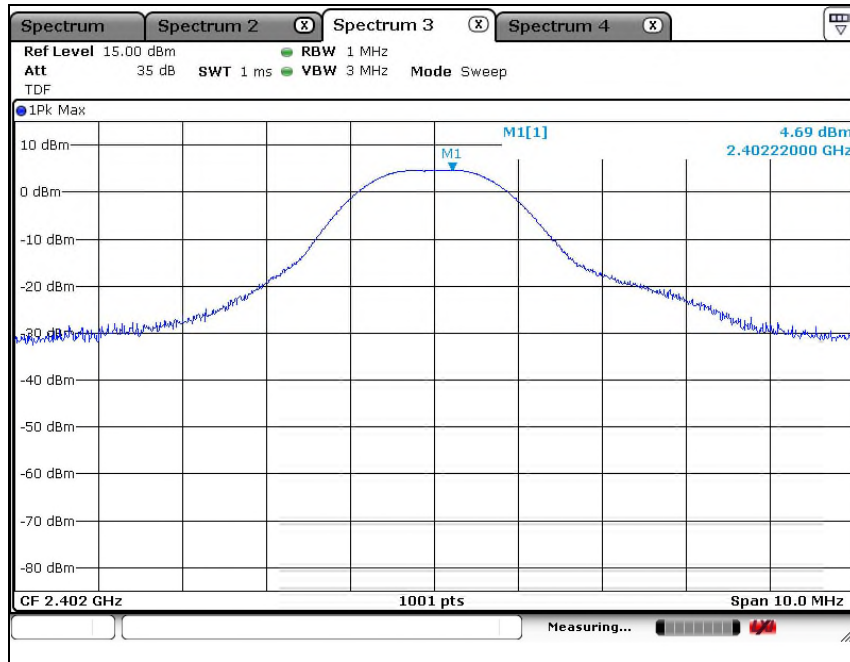
Note;

Antenna Power (mW) = Average Burst Power (mW)

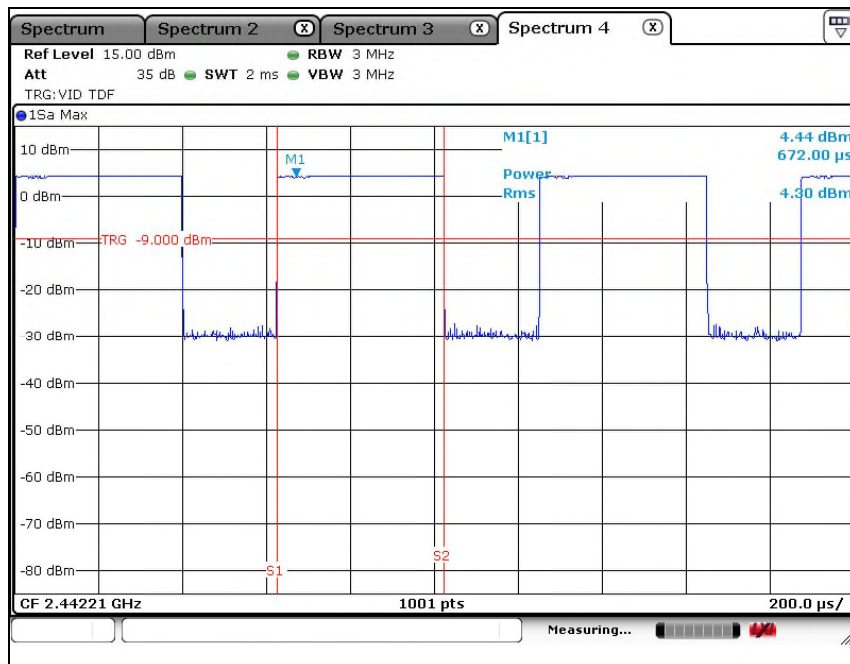
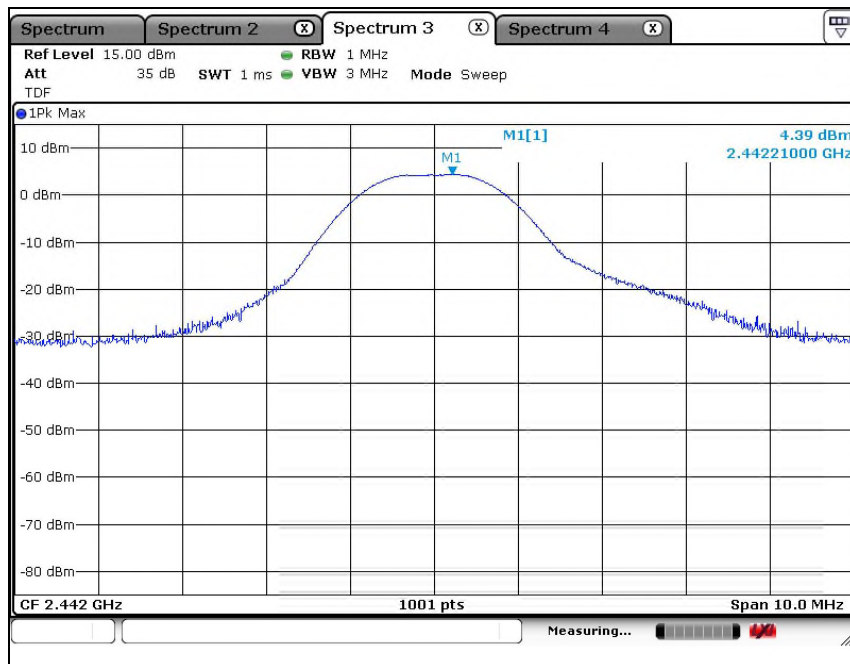
Power Tolerance (%) = {[Antenna Power (mW) - Rated Output Power (mW)] ÷ Rated Output Power (mW)} × 100

Low voltage

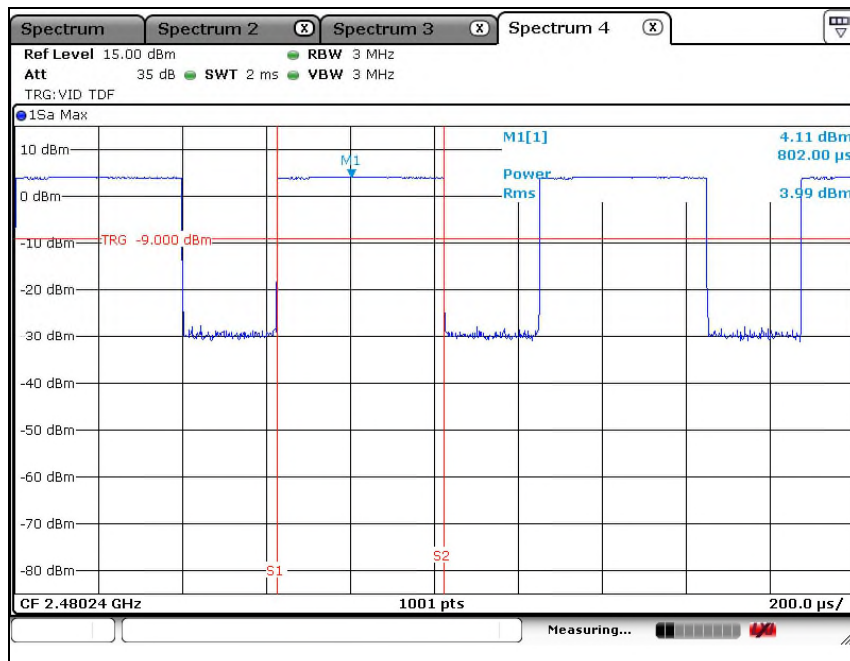
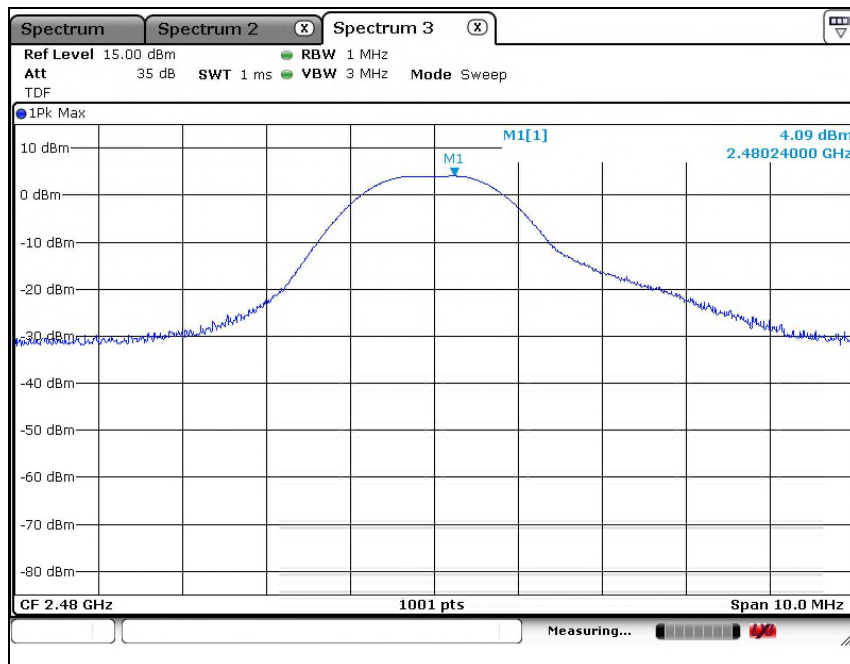
Low channel



Middle channel

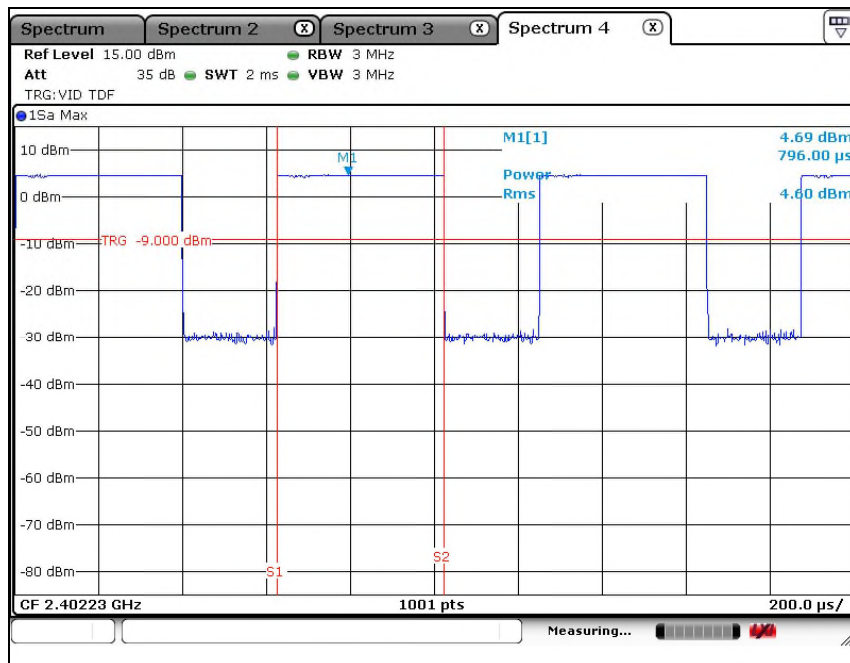
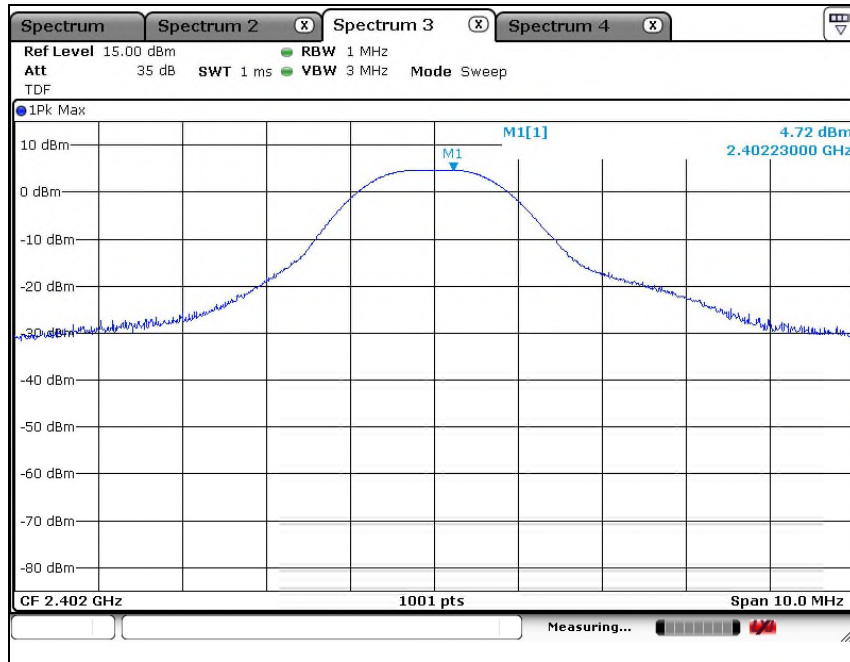


High channel

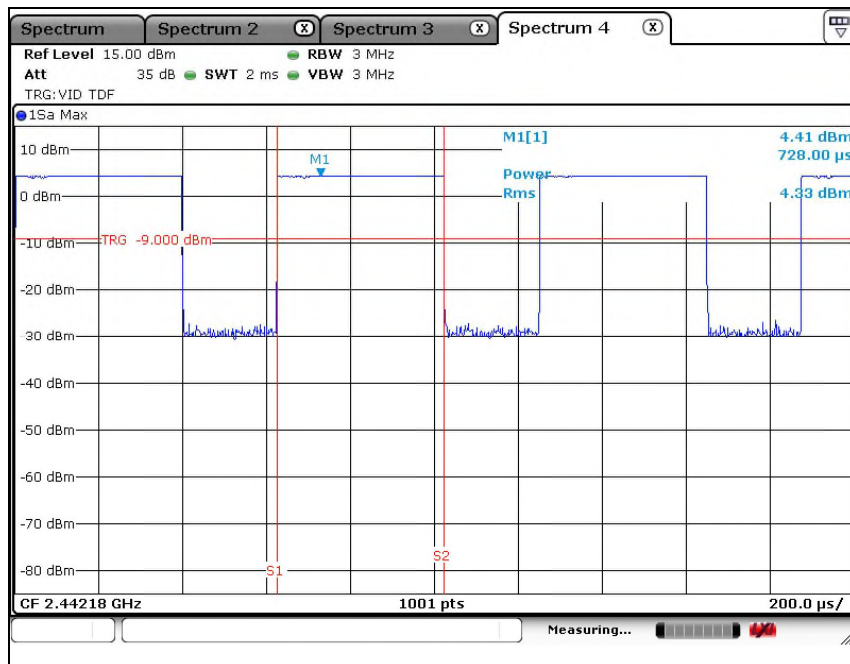
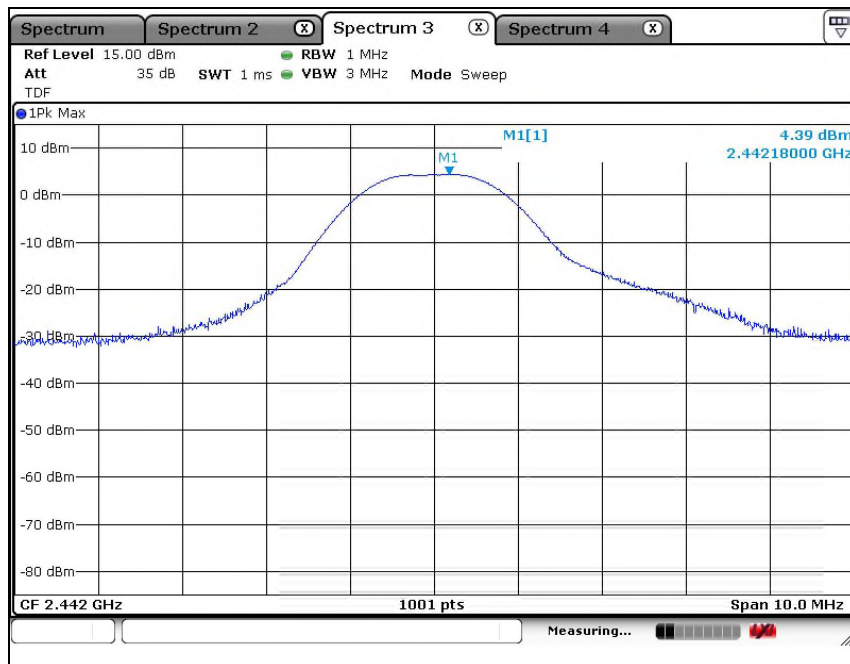


Normal voltage

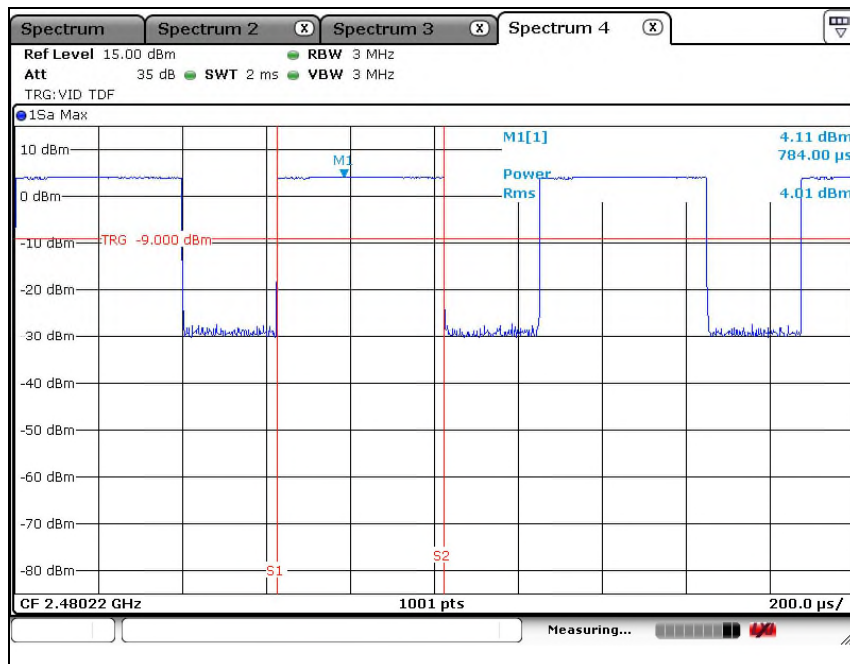
Low channel



Middle channel

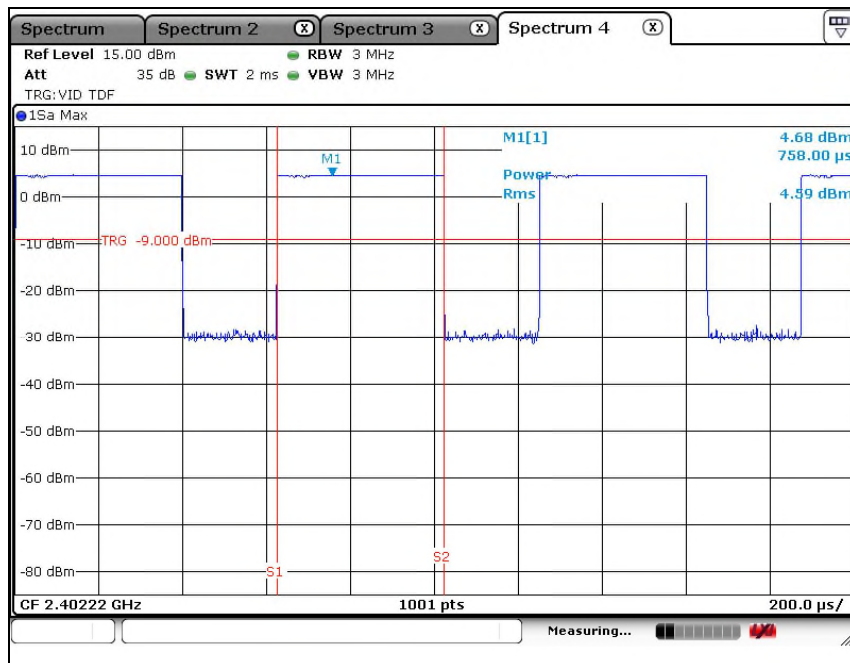
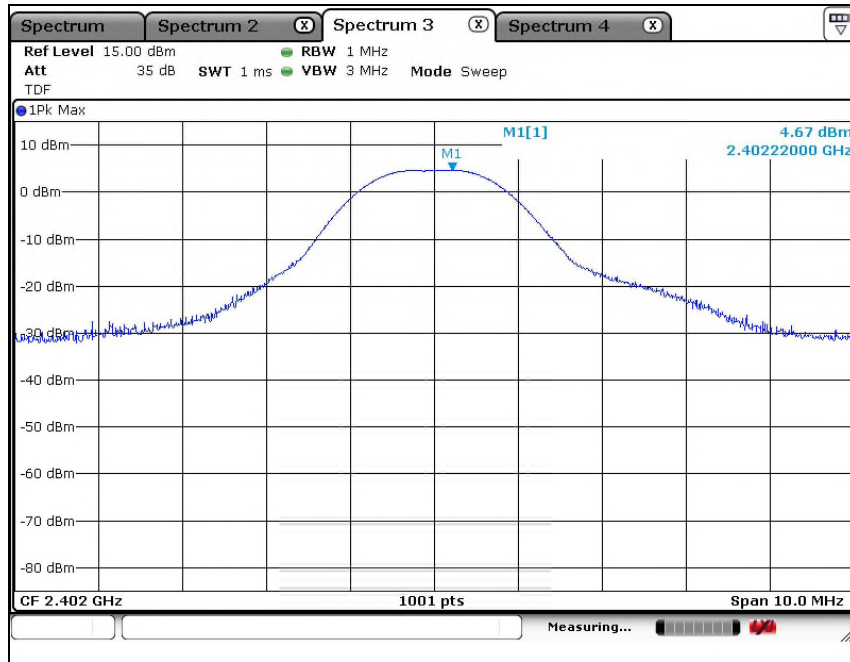


High channel

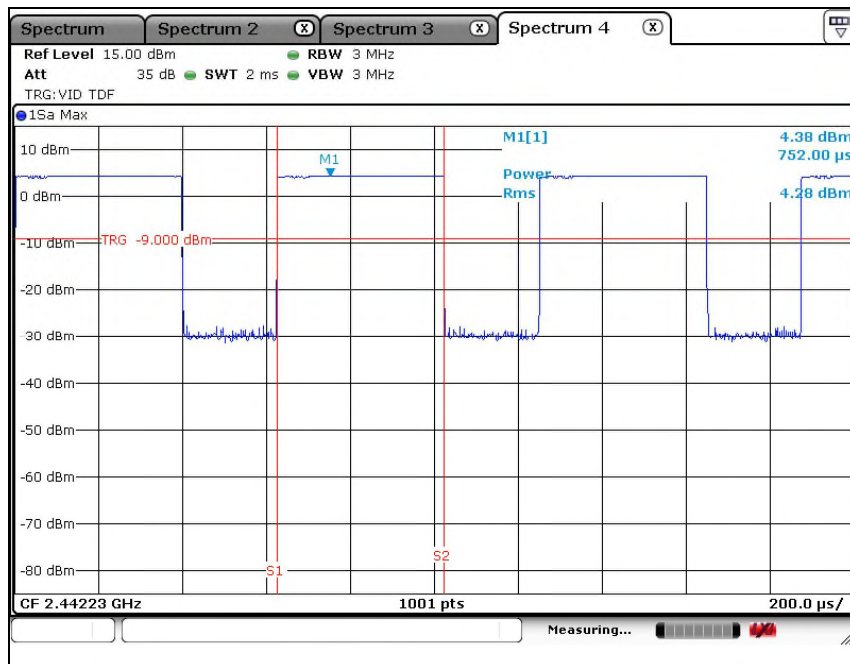
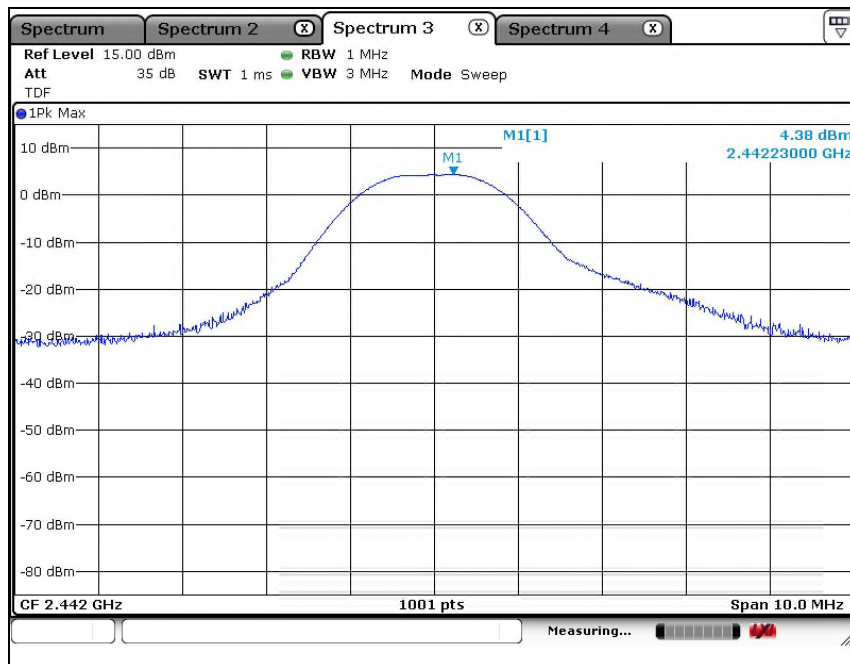


High voltage

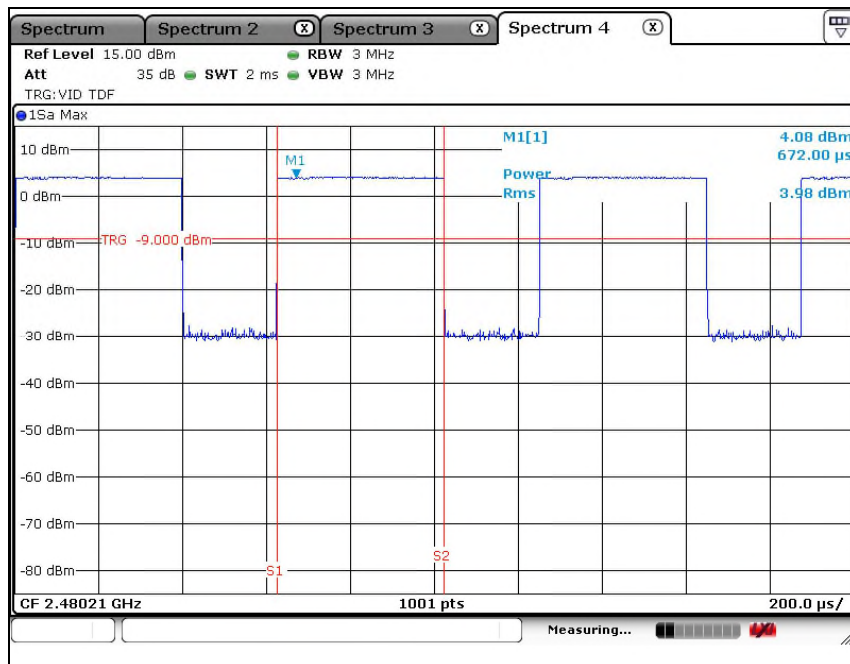
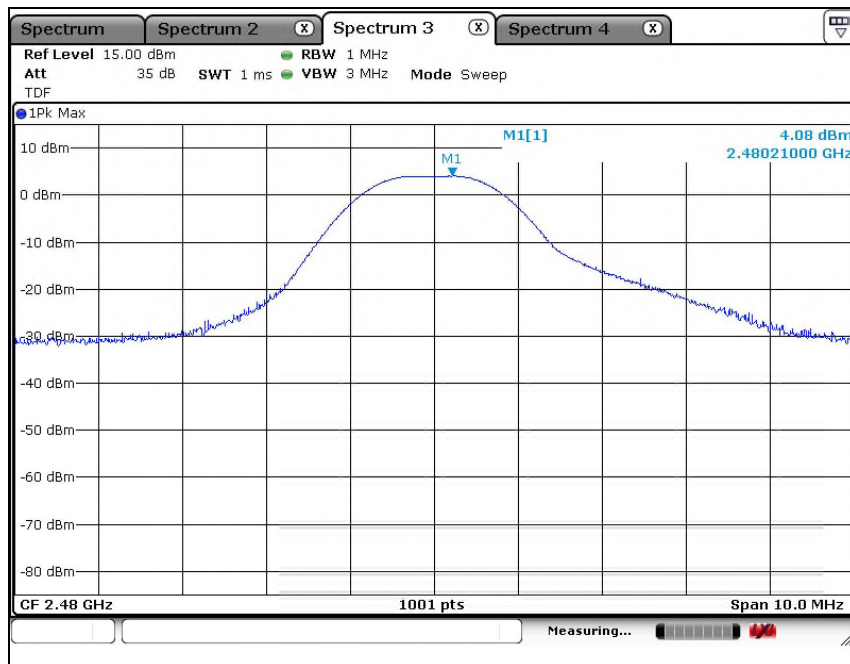
Low channel



Middle channel

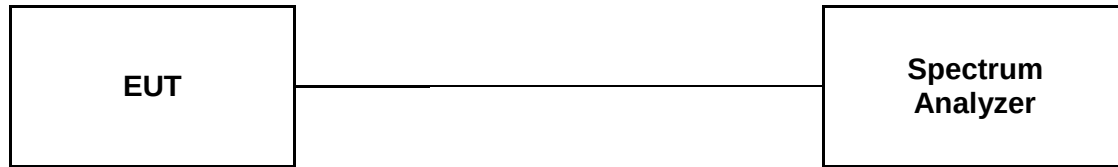


High channel



6. Secondary Radiated Emissions

6.1. Test Setup



6.2. Limit

Below 1 GHz : 4 nW (-54 dB m) or less

Above 1 GHz : 20 nW (-47 dB m) or less

6.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be receiver at low, middle and high channel.
3. Secondary Radiated Emissions is measured by following setting:

[Setting 1]

Frequency range: 30 MHz - 12.5 GHz
 RBW: Below 1 GHz: 100 kHz
 Above 1 GHz: 1 MHz
 VBW: Below 1 GHz: 100 kHz
 Above 1 GHz: 1 MHz
 Sweep time: Auto
 Sweep data points: 1 001 or greater
 Detector mode: Positive peak
 Indication mode: Max hold

[Setting 2]

Center Frequency: Frequency of spurious emission found using [Setting 1]
 Span: 0Hz
 RBW: Below 1 GHz: 100 kHz
 Above 1 GHz: 1 MHz
 VBW: Below 1 GHz: 100 kHz
 Above 1 GHz: 1 MHz
 Sweep time: Auto
 Sweep data points: 1 001 or greater
 Detector mode: Sample

4. Search for spurious emissions in the range 30 MHz to 12.5 GHz.

5. (1) After configuring the spectrum analyzer to [Setting 1], search for spurious emissions from 30 MHz to 12.5 GHz. If the sweep range does not cover the required measurement frequency range then the measurement range will need to be divided into sufficient sections of size [RBW x Sweep Data Points]. If spurious emissions greater than [Limit 10 dB] are found, then more detailed measurements are required, go to step (2)
- (2) Configure the spectrum analyzer using [Setting 2] and measure average signal amplitude. If the spurious emission is burst type (intermittent), then the average value shall not include signal OFF time.

6.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Low voltage

Test voltage (V _{d.c.})	Frequency Range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V _{min} = 3.33	30 to 1 000	Frequency (GHz)	0.384	0.384	0.384	-
		Level (dB m/100 kHz)	*-57.85	*-58.13	*-57.93	-53.98
		Level (nW/100 kHz)	1.640 590	1.538 155	1.610 646	4.00
	1 000 to 12 500	Frequency (GHz)	1.201	1.220	1.240	-
		Level (dB m/MHz)	-66.84	-68.15	-67.60	-46.99
		Level (nW/MHz)	0.207 014	0.153 109	0.173 780	20.00

Normal voltage

Test voltage (V _{d.c.})	Frequency Range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V _{nom} = 3.70	30 to 1 000	Frequency (GHz)	0.384	0.384	0.384	-
		Level (dB m/100 kHz)	*-57.86	*-58.13	*-57.93	-53.98
		Level (nW/100 kHz)	1.636 817	1.538 155	1.610 646	4.00
	1 000 to 12 500	Frequency (GHz)	1.201	1.220	1.240	-
		Level (dB m/MHz)	-66.75	-68.49	-68.04	-46.99
		Level (nW/MHz)	0.211 349	0.141 579	0.157 036	20.00

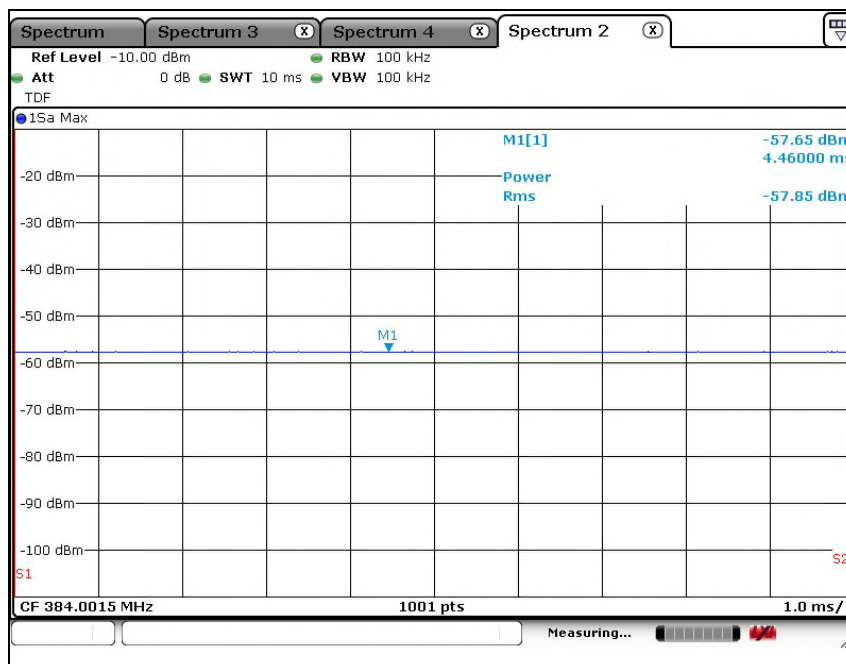
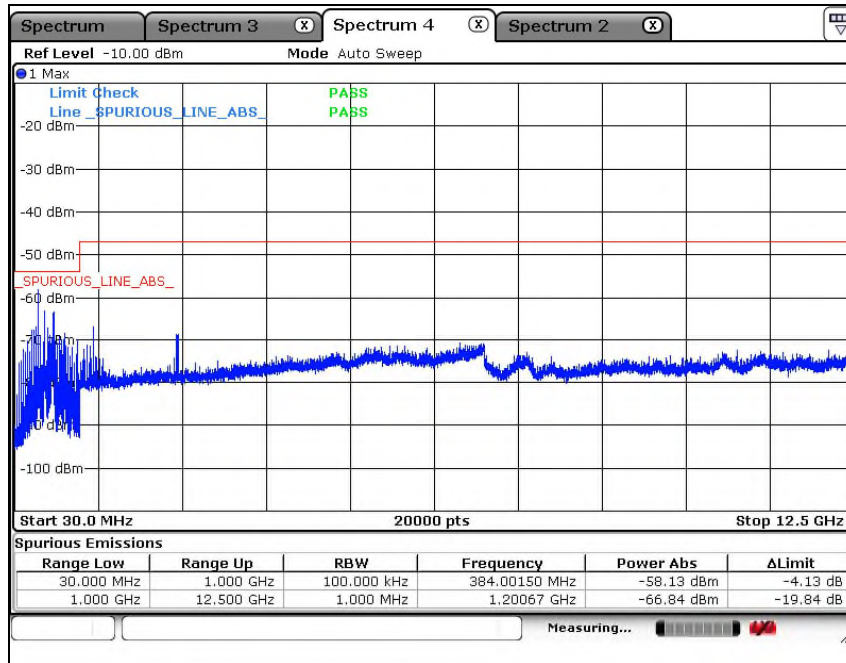
High voltage

Test voltage (V _{d.c.})	Frequency Range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V _{max} = 4.07	30 to 1 000	Frequency (GHz)	0.384	0.384	0.384	-
		Level (dB m/100 kHz)	*-57.86	*-58.13	*-57.94	-53.98
		Level (nW/100 kHz)	1.636 817	1.538 155	1.606 941	4.00
	1 000 to 12 500	Frequency (GHz)	1.200	1.220	1.142	-
		Level (dB m/MHz)	-66.86	-68.70	-64.97	-46.99
		Level (nW/MHz)	0.206 063	0.134 896	0.318 420	20.00

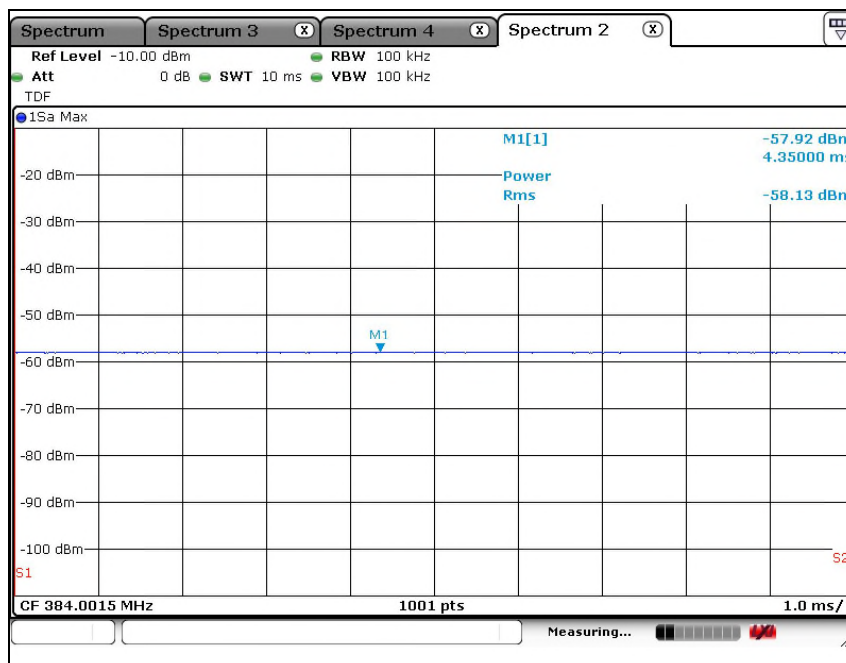
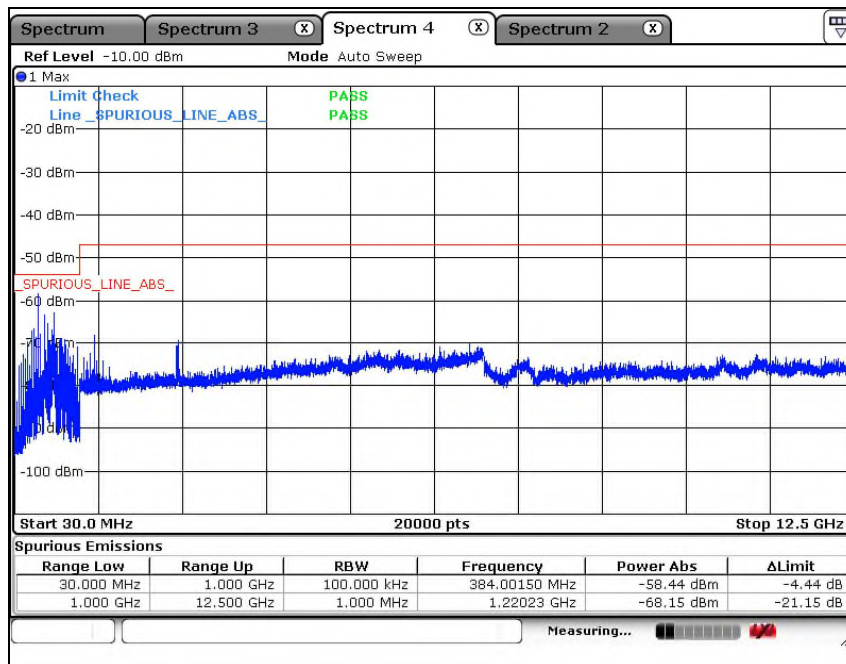
- '*' means [Setting 2] test result

Low voltage

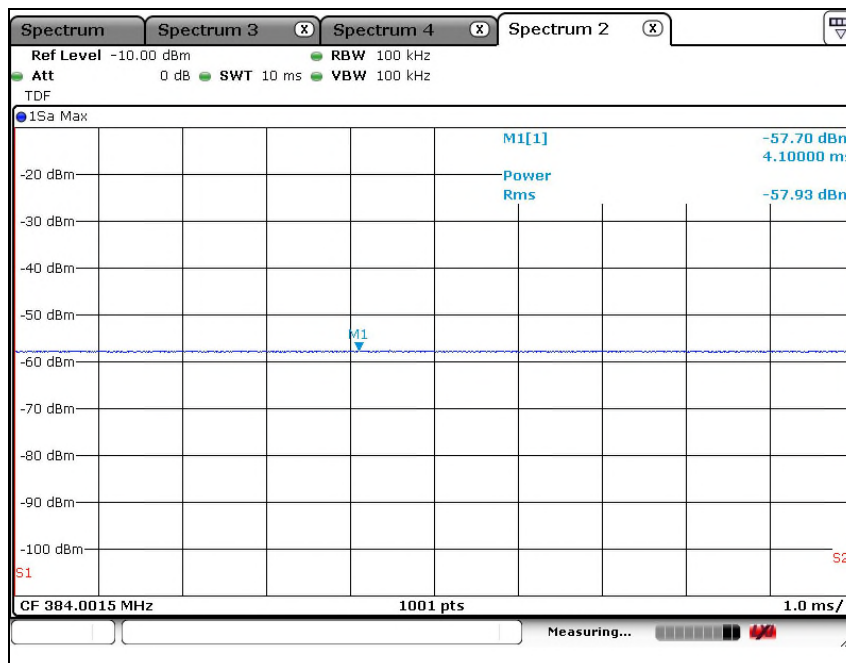
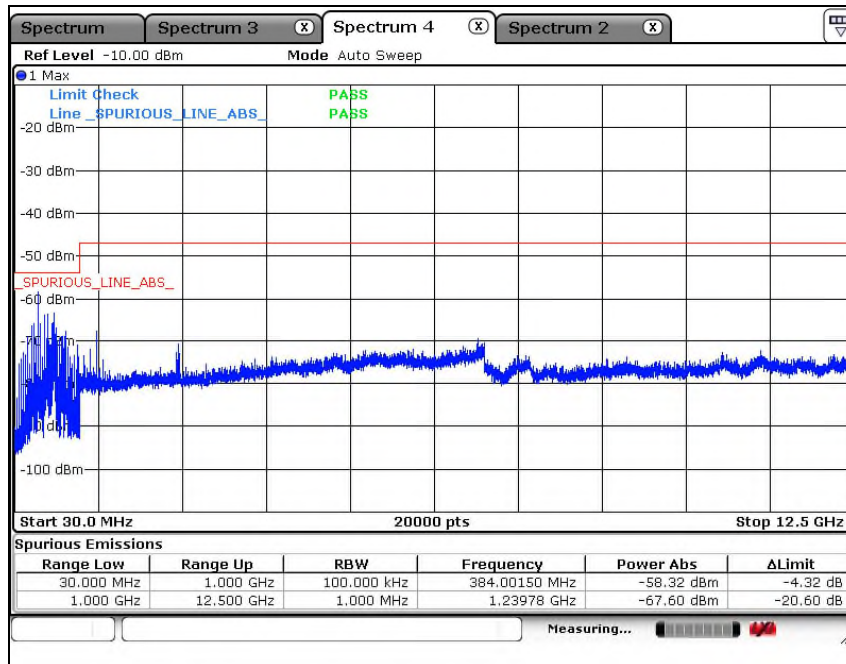
Low channel



Middle channel

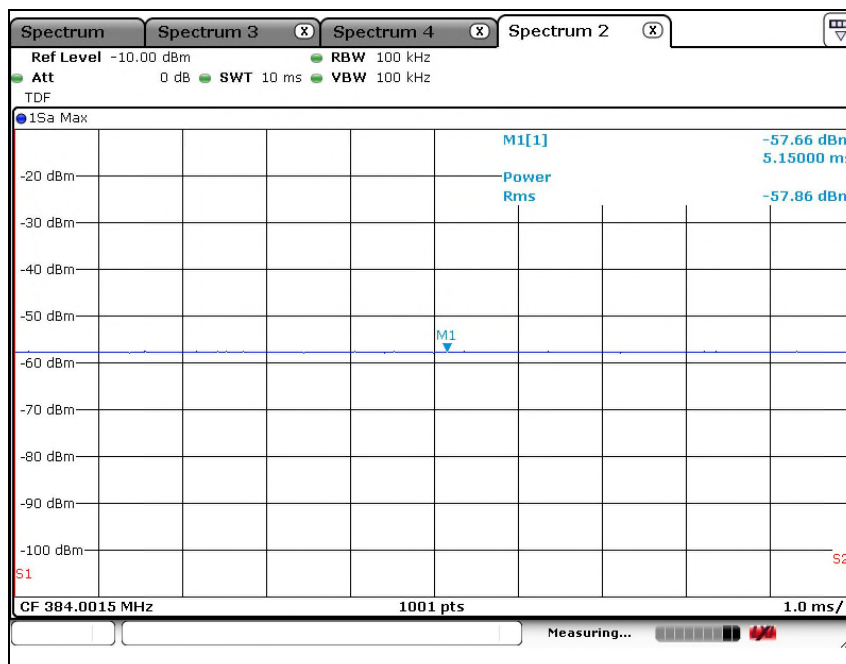
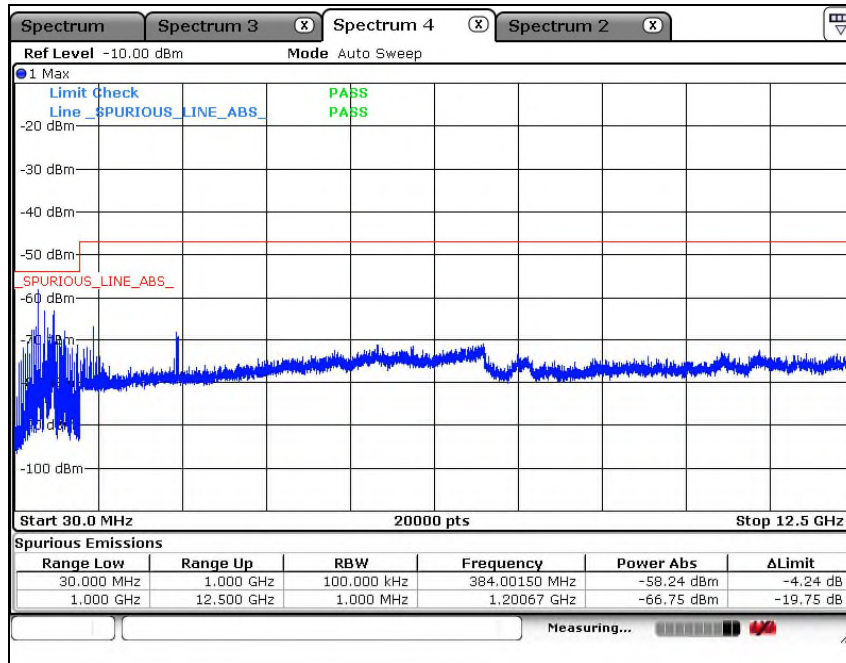


High channel

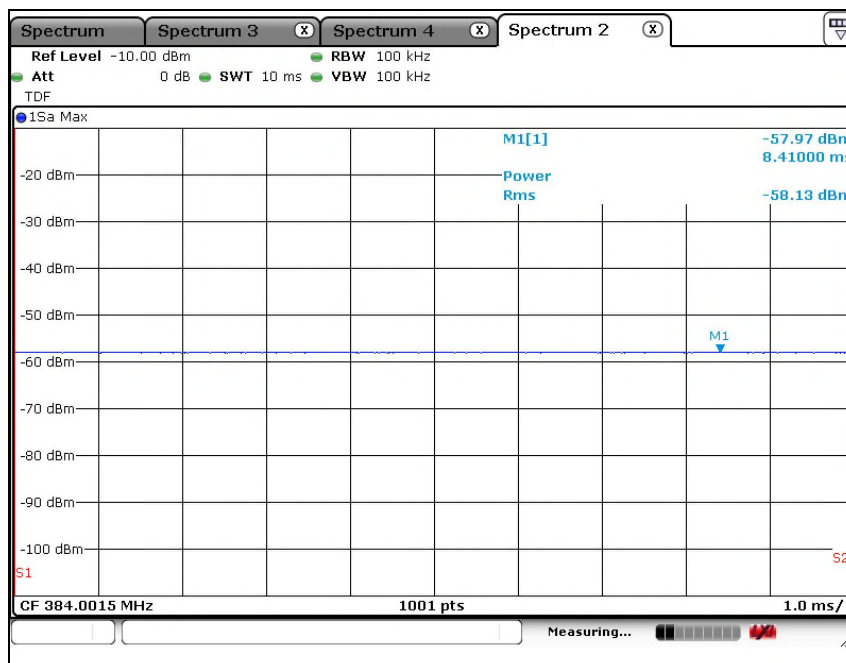
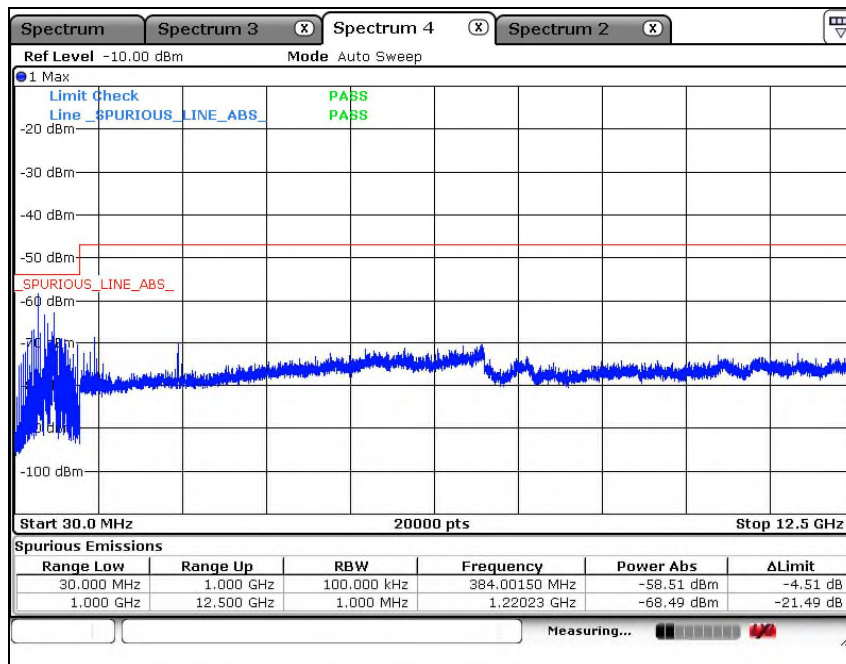


Normal voltage

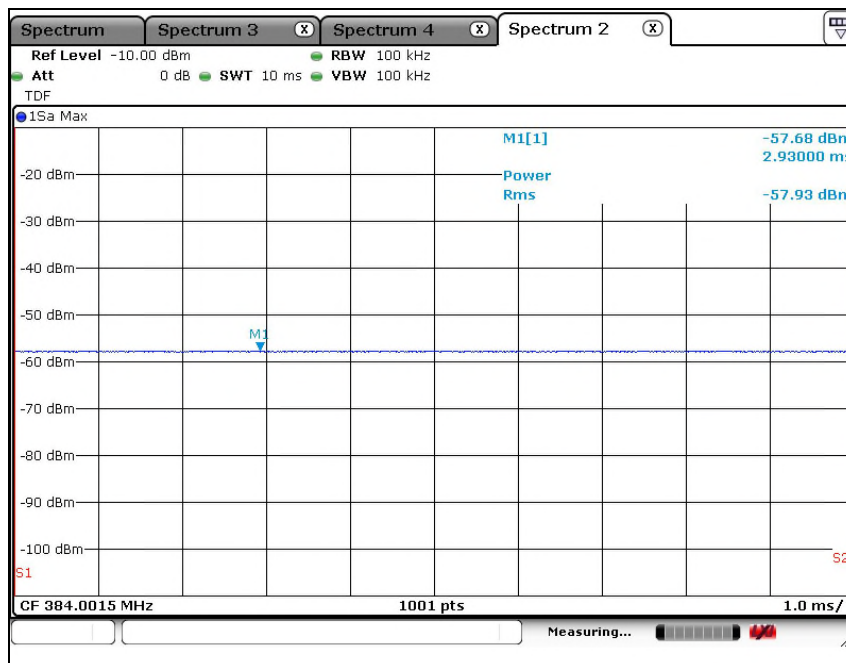
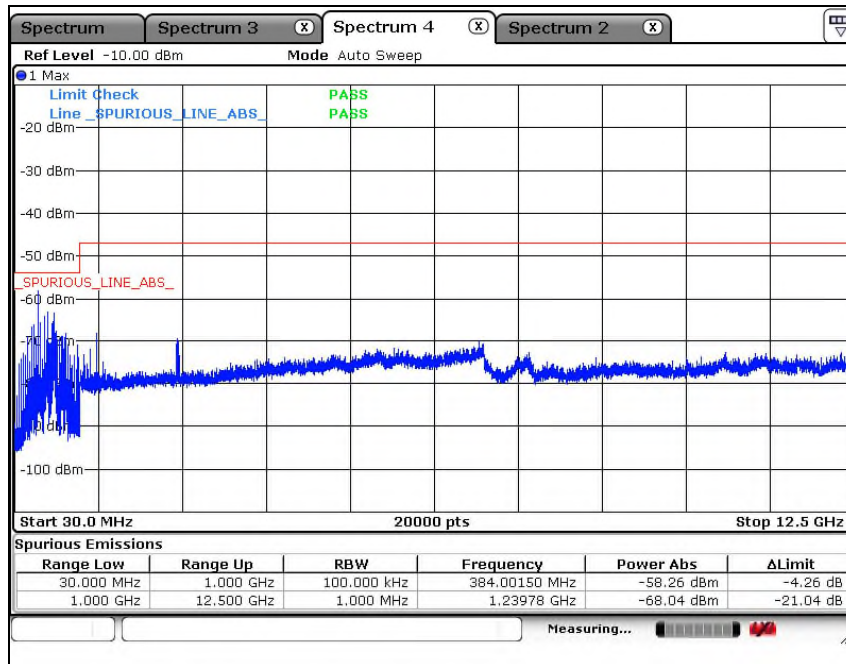
Low channel



Middle channel

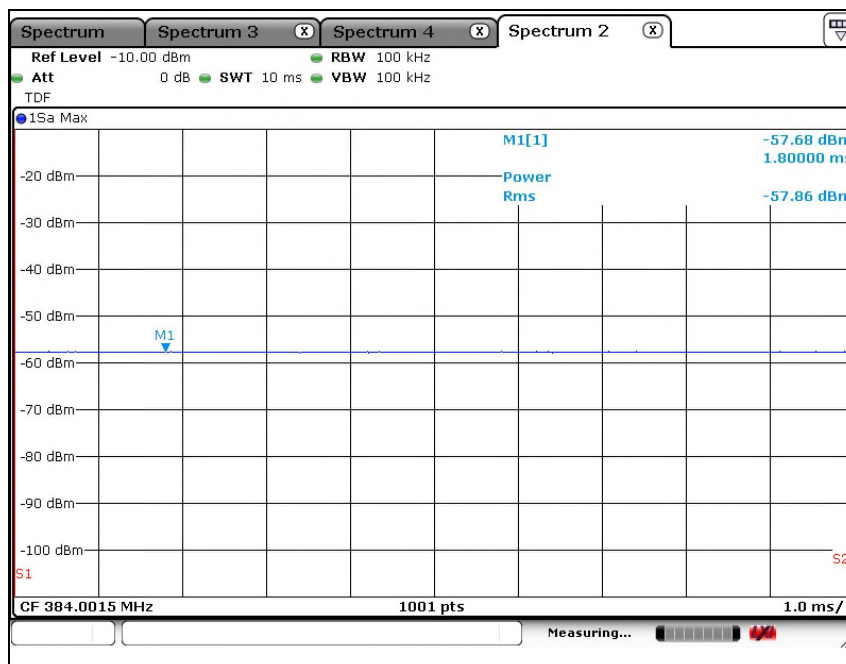
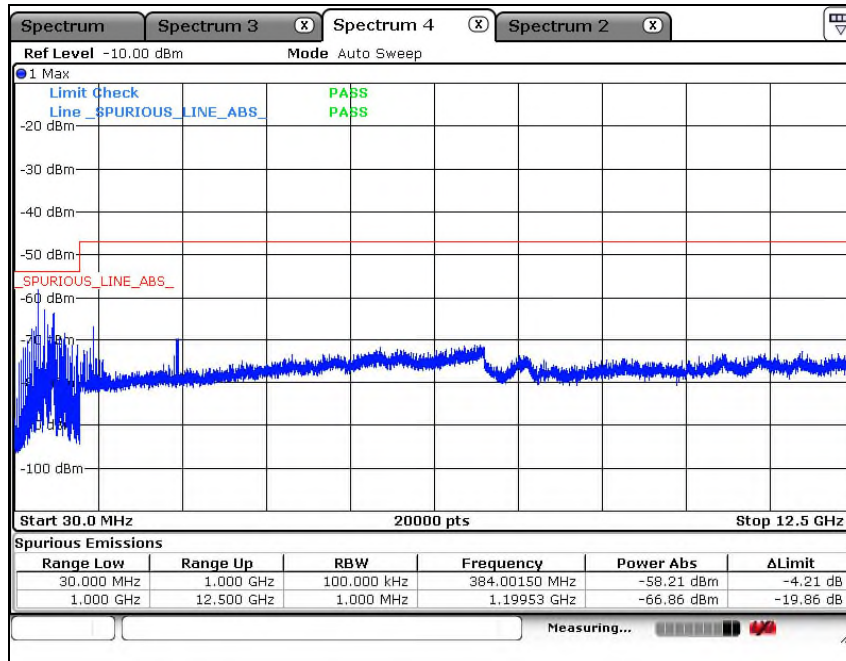


High channel

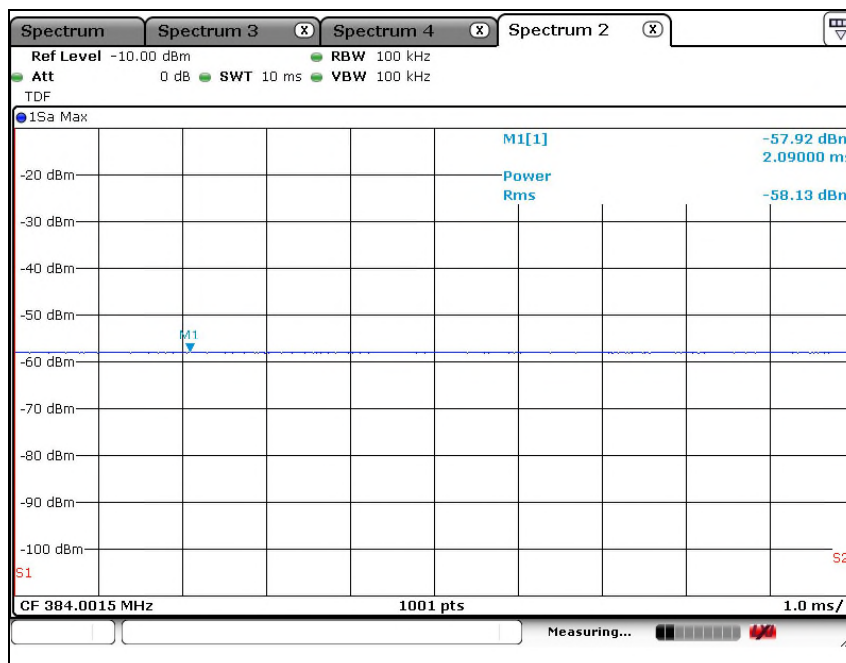
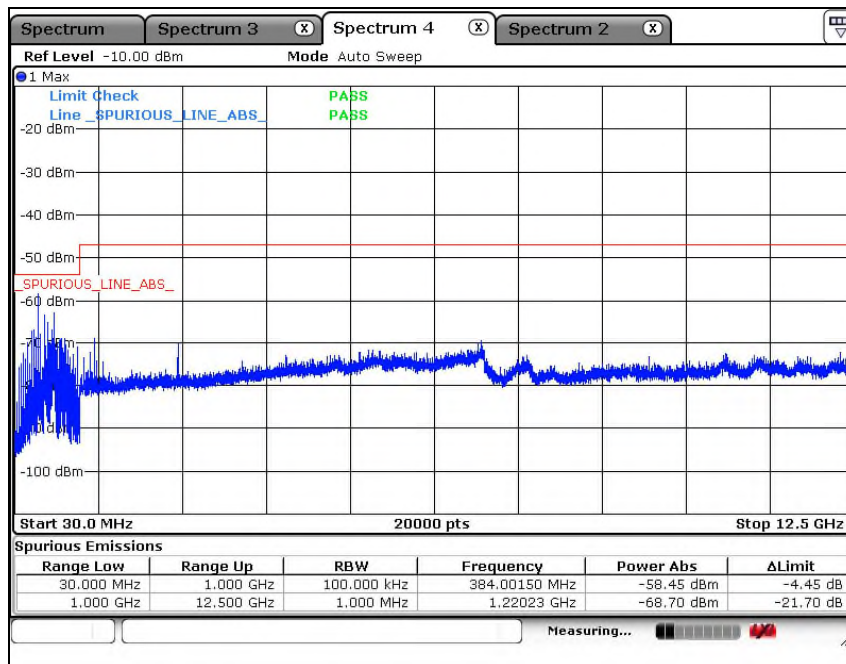


High voltage

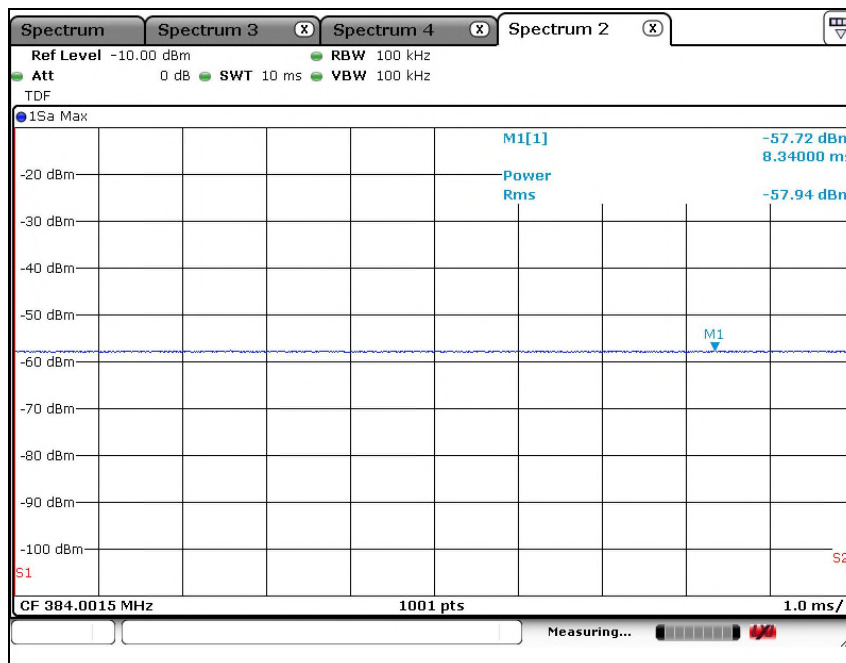
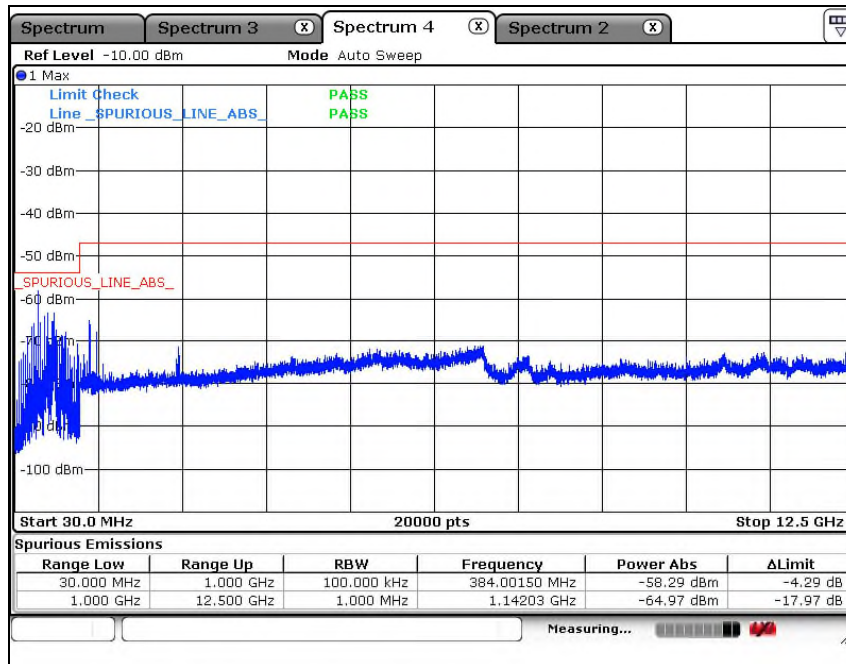
Low channel



Middle channel



High channel



7. Interference Prevention Function

7.1. Test Procedure

- (1) For EUTs capable of automatically transmitting identification data
 - a. Transmit identification data from EUT to Demodulator
 - b. Confirm identification data is correctly received by Demodulator
- (2) For EUTs capable of automatically receiving identification data
 - c. Transmit identification data from Link Partner to EUT
 - d. Confirm communication link is established
 - e. Link Partner shall respond by transmitting different identification data back to the EUT
 - f. Confirm EUT stops transmitting, or confirm EUT recognizes that the two identification data are different

If the applicant has documentary evidence to show that their EUT complies with the requirements of the Interference Prevent Function then the EUT can be exempt from this test.

7.2. Test result

EUT Details :

98:93:CC:EE:1F:36

The unit does meet the requirements. (Pass)

- End of the Test Report -