

# TEST REPORT

of

## ARIB STD-T66

Equipment Under Test : BRUSH MONSTER Smart Toothbrush  
Model Name : BMT100  
Applicant : kitten planet Co., Ltd.  
Manufacturer : kitten planet Co., Ltd.  
Date of Receipt : 2018.05.02  
Date of Test(s) : 2018.06.28 ~ 2018.07.03  
Date of Issue : 2018.07.03

In the configuration tested, the EUT complied with the standards specified above.

Tested By:

  
Changhyun Song

Date:

2018.07.03

Technical  
Manager:

  
Hyunchae You

Date:

2018.07.03

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A4(210 mm x 297 mm)

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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>.

Phone No. : +82 31 688 0901

Fax No. : +82 31 688 0921

### 1.2. Details of applicant

Applicant : kitten planet Co., Ltd.

Address : 12, Daewangpangyo-ro 645beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea

Contact Person : Lee, Dong-joon

Phone No. : +82 70 7620 0405

### 1.3. Details of manufacturer

Company : Same as applicant

Address : Same as applicant

### 1.4. Description of EUT

Kind of Product	BRUSH MONSTER Smart Toothbrush
Model Name	BMT100
Power Supply	DC 1.5 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)
Modulation Technique	GFSK
Number of Channels	40 channels
Rated Output Power	0.5 mW
Antenna Type	PCB Pattern Antenna
Antenna Gain	1.72 dB i
H/W Version	BMT100_REV06
S/W Version	V4

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## 1.5. Test Equipment List

Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. Authority	Cal. Authority
Spectrum Analyzer	R&S	FSV30	103453	Nov. 15, 2017	SICT	c)
Signal Generator	R&S	E8257D	MY51501169	Jul. 07, 2017	SICT	c)
DC Power Supply	R&S	HMP2020	MY50020026	Dec. 07, 2017	SICT	c)
Attenuator	AEROFLEX / INMET	26A-10 dB	3	Feb. 22, 2018	SICT	c)
DIGITAL MULTIMETER	HIOKI	DT4211	N0301231	Sep. 22, 2017	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).

## 1.6. 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.

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## 1.7. 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

## 1.8. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL012832	2018.07.03	Initial

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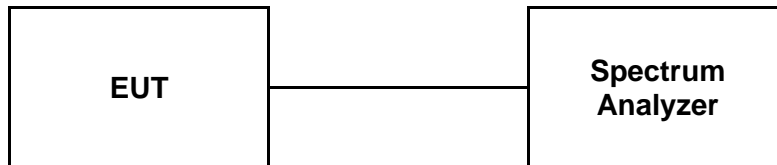
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## 2. Frequency Tolerance

### 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: 1 MHz  
 RBW: 10 kHz  
 VBW: 10 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.

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## 2.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

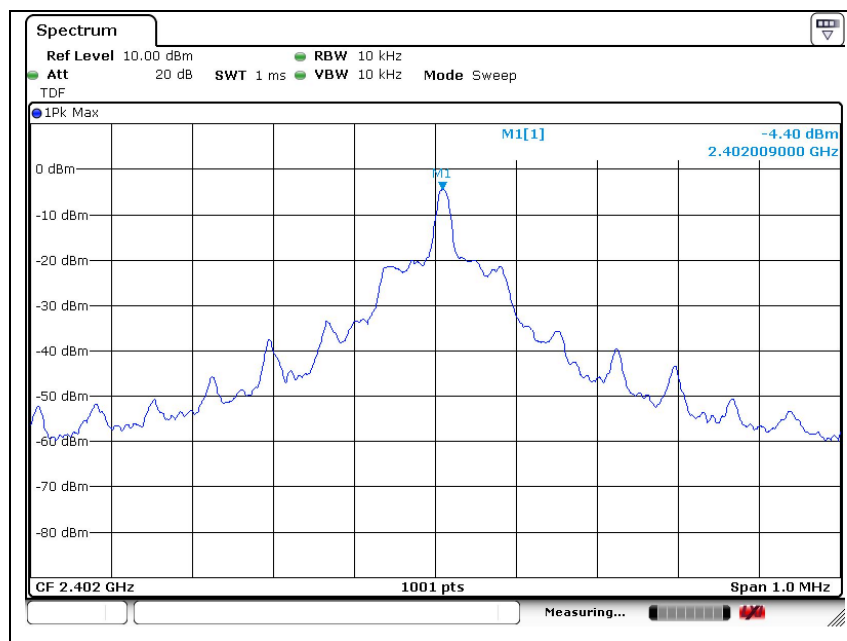
Test voltage (V <sub>d.c.</sub> )	Measured frequency (MHz)	Reading frequency (MHz)	Frequency tolerance [ppm]
V <sub>nom</sub> = 1.5	Low Ch. (2 402)	2 402.009 000	3.75
	Middle Ch. (2 442)	2 442.009 000	3.69
	High Ch. (2 480)	2 480.009 000	3.63

### Note;

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

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

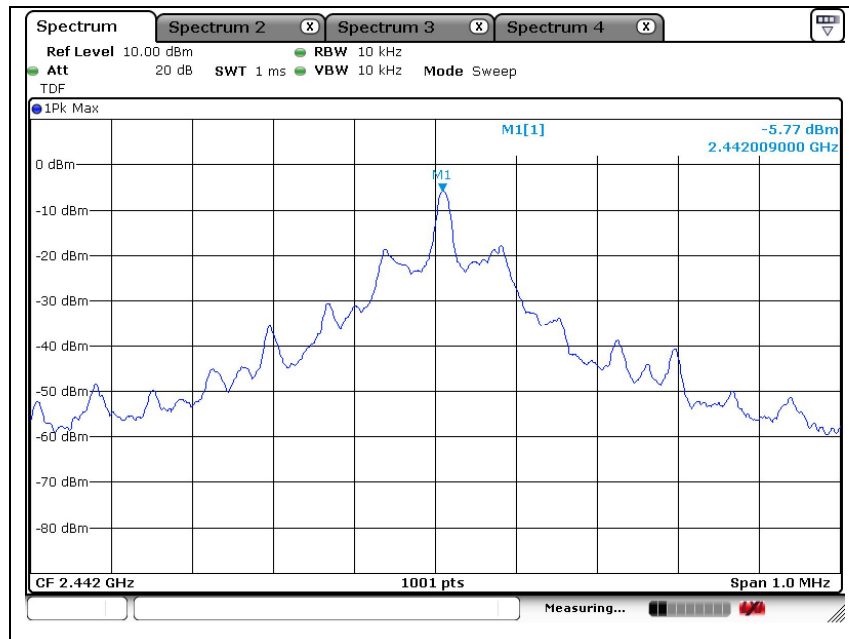
### Low channel



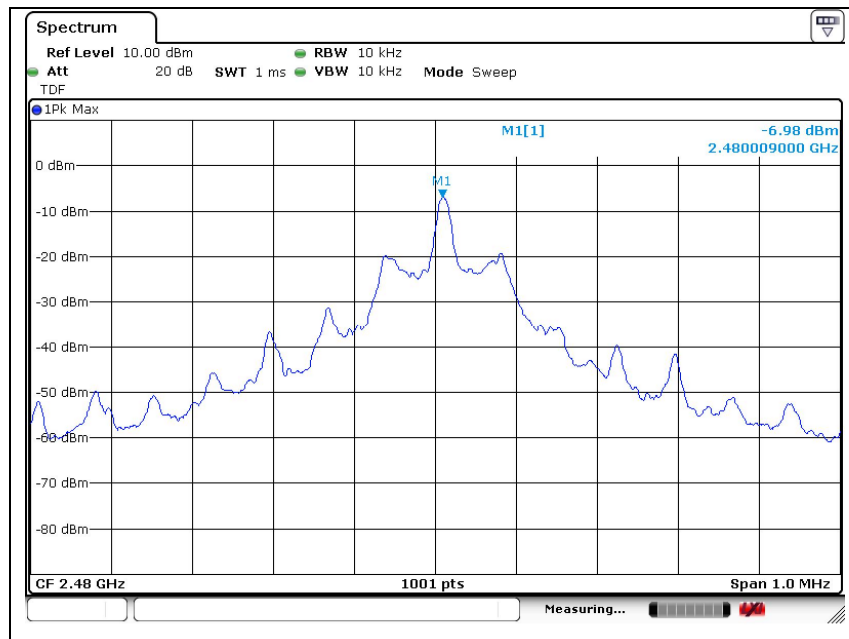
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## Middle channel



## High channel



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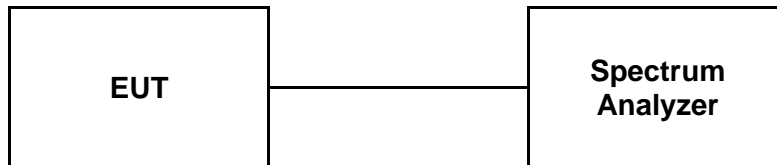
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### 3. Occupied Bandwidth (99 %)

#### 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 %

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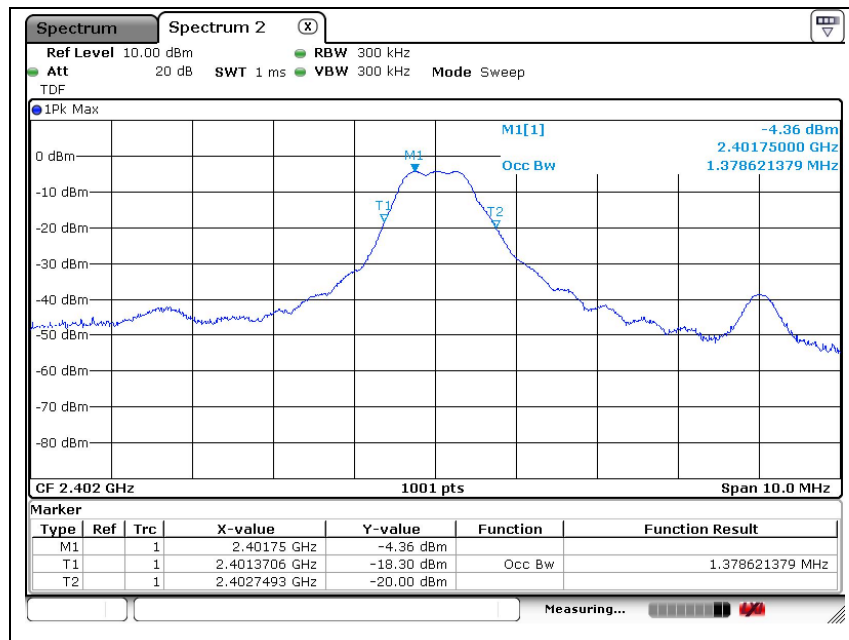
A4(210 mm x 297 mm)

### 3.4. Test result

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

Test voltage (V <sub>d.c.</sub> )	Measured frequency (MHz)	Occupied bandwidth (MHz)
V <sub>nom</sub> = 1.5	Low Ch. (2 402)	1.379
	Middle Ch. (2 442)	1.349
	High Ch. (2 480)	1.339

Low channel



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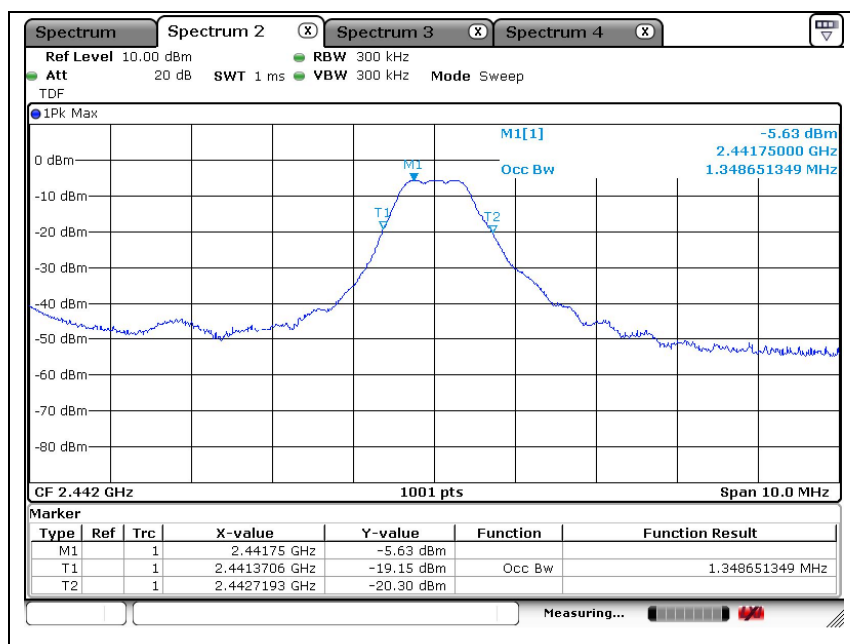
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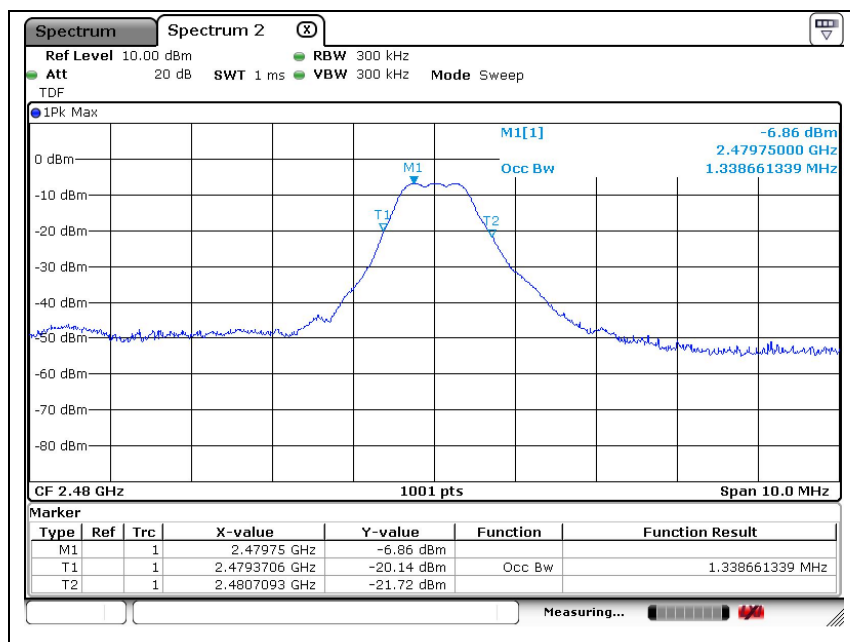
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## Middle channel



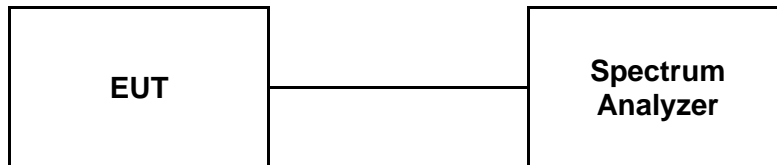
## High channel



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## 4. Spurious Emission Intensity

### 4.1. Test Setup



### 4.2. Limit

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

### 4.3. Test Procedure

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 (see note)

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

Search for spurious emissions from 30 MHz to 12.5 GHz.

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#### 4.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Test voltage (V <sub>d.c.</sub> )	Frequency range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V <sub>nom</sub> = 1.5	Below 2 387	Frequency (GHz)	2.320	1.220	1.240	-
		Level (μW/MHz)	0.261 818	0.024 099	0.024 044	2.5
		Level (dB m/MHz)	-35.82	-46.18	-46.19	-26
	2 387 to 2 400	Frequency (GHz)	2.400	2.396	2.393	-
		Level (μW/MHz)	0.512 861	0.001 641	0.001 626	25
		Level (dB m/MHz)	-32.90	-57.85	-57.89	-16
	2 483.5 to 2 496.5	Frequency (GHz)	2.490	2.497	2.492	-
		Level (μW/MHz)	0.001 535	0.003 890	0.049 431	25
		Level (dB m/MHz)	-58.14	-54.10	-43.06	-16
	Above 2 496.5	Frequency (GHz)	7.207	2.499	2.499	-
		Level (μW/MHz)	0.041 115	0.080 538	0.082 414	2.5
		Level (dB m/MHz)	-43.86	-40.94	-40.84	-26

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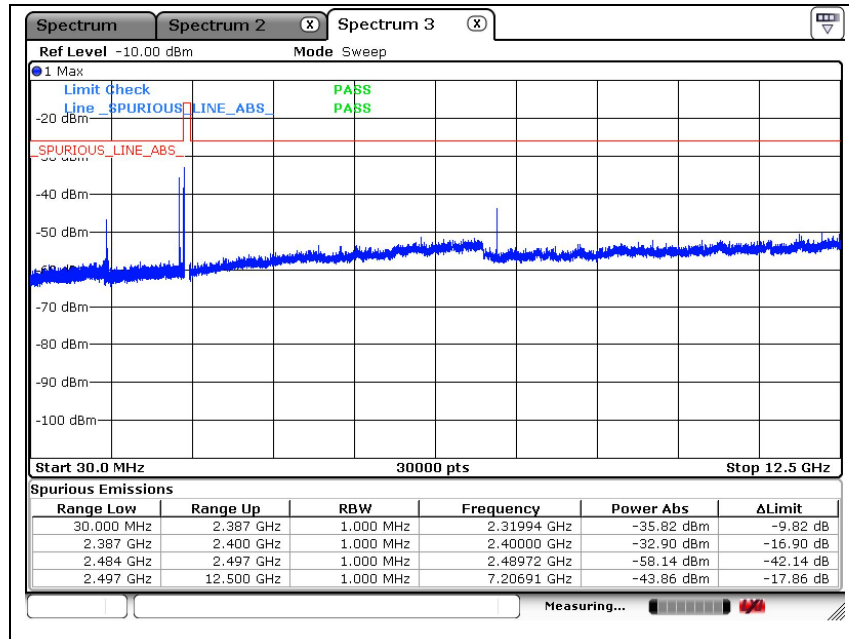
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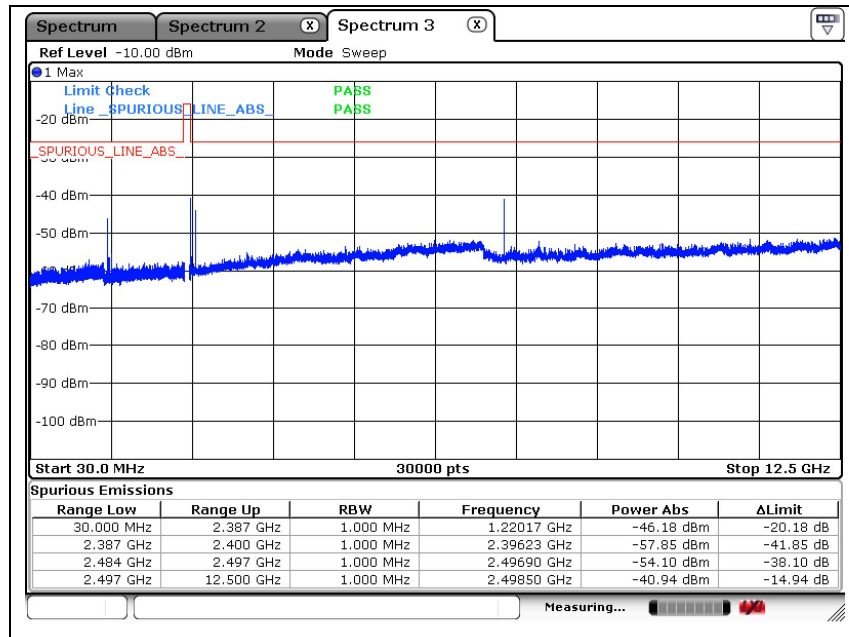
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## Low channel



## Middle channel



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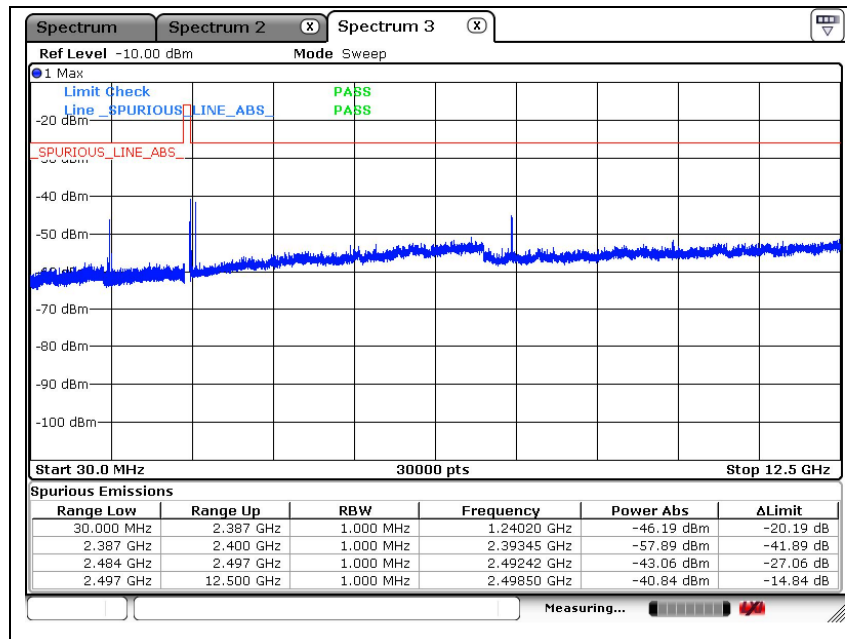
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High channel

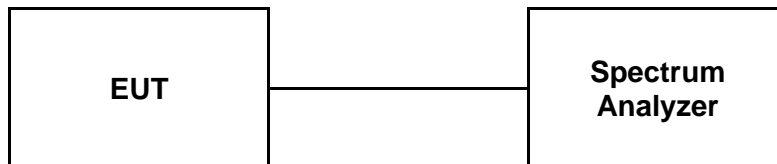


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## 5. Antenna Power

### 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;

#### [Setting 1] Search for peak power frequency

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.

#### [Setting 2] Measurement of average antenna power for LE

Frequency: Frequency of peak power found using [setting1]  
 Span: 0 Hz  
 RBW: 3 MHz  
 VBW: 3 MHz  
 Detector mode: Sample  
 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

Measure the Average Burst Power of the frequency.

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## 5.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Test voltage (V <sub>d.c.</sub> )	Channel	Antenna gain (dB i)	Rated Output Power			E.I.R.P. (dB m)	Average Burst Power		Power Tolerance (%)
V <sub>nom</sub> = 1.5	Low Ch. (2 402 MHz)	1.72	0.5 mW	-3.0	dB m	-1.28	0.35 mW	-4.56 dB m	-30
	Middle Ch. (2 442 MHz)	1.72	0.5 mW	-3.0	dB m	-1.28	0.26 mW	-5.89 dB m	-48
	High Ch. (2 480 MHz)	1.72	0.5 mW	-3.0	dB m	-1.28	0.20 mW	-7.09 dB m	-60

### Note;

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

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

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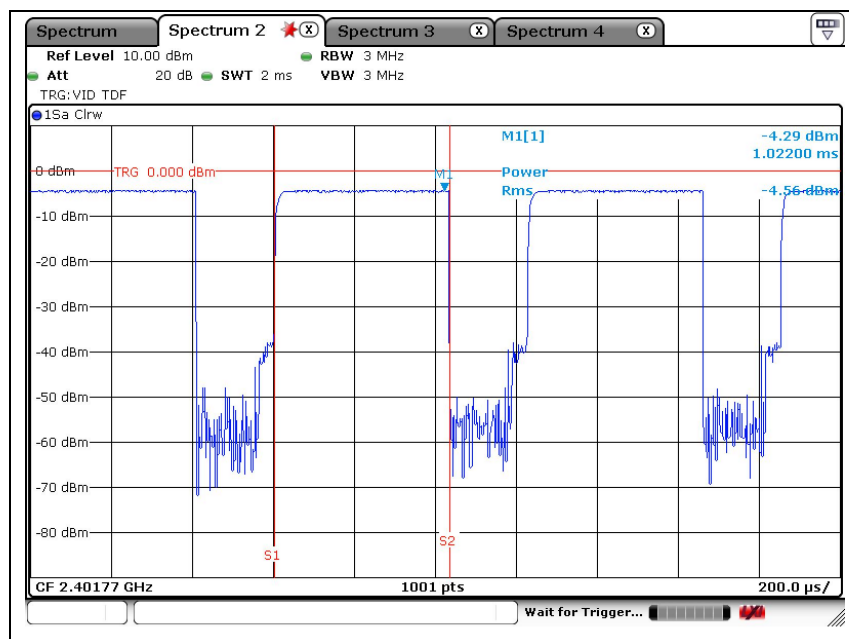
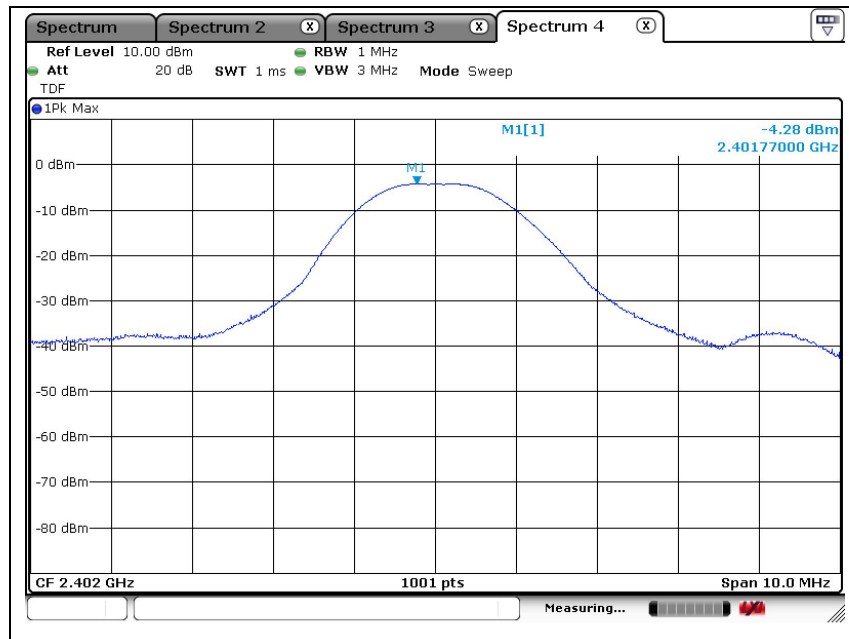
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## Low channel



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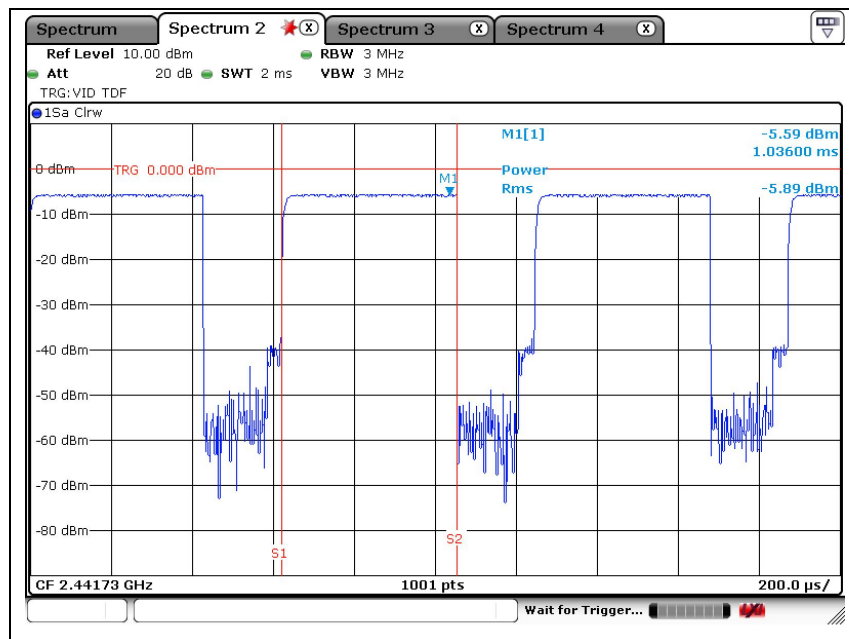
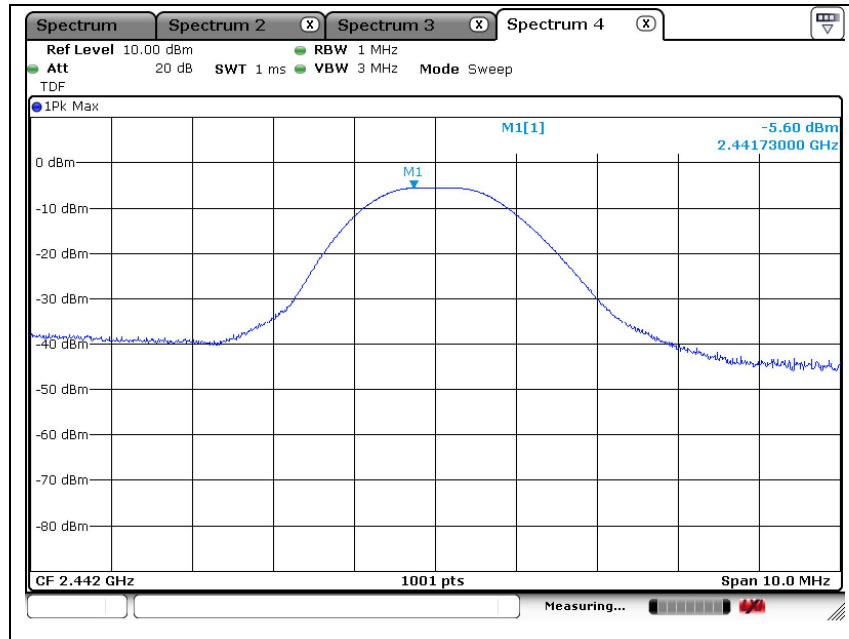
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## Middle channel



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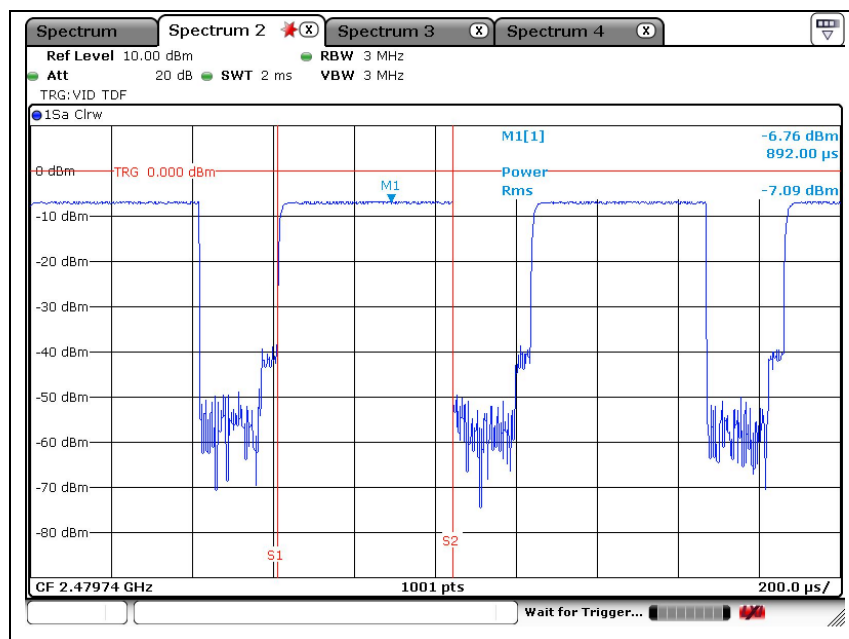
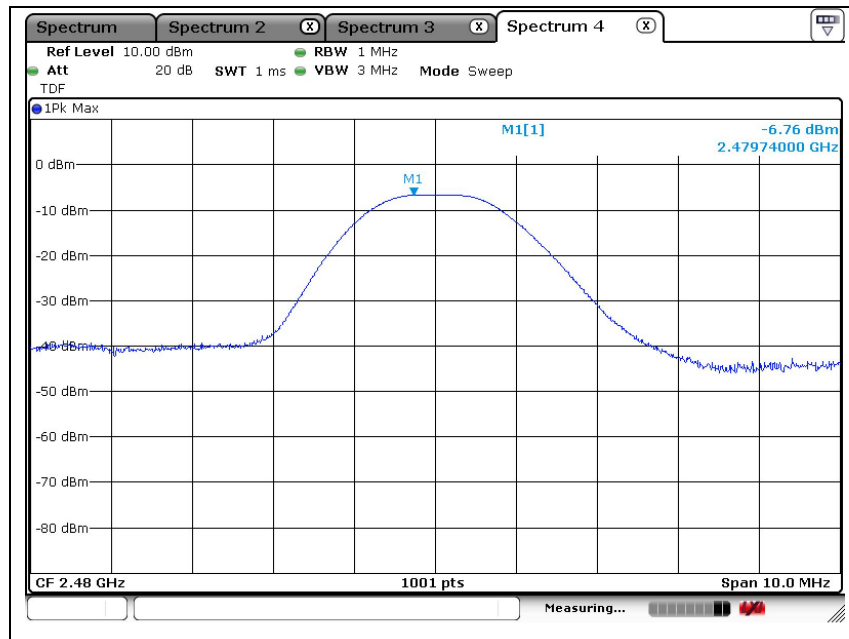
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## High channel



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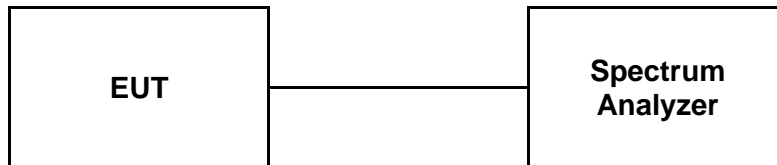
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## 6. Secondary Radiated Emissions

### 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

#### [Setting 1]

Configure the spectrum analyzer as below;

Frequency range: 30 MHz to 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

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

If spurious emissions are found with an amplitude greater than [Limit - 10 dB] then perform further detailed measurements as described in [Setting 2]

#### [Setting 2]

Configure the spectrum analyzer as below;

Frequency range: Frequency of spurious emission  
 Span: 0 Hz  
 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

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A4(210 mm x 297 mm)

## 6.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Test voltage (V <sub>d.c.</sub> )	Frequency Range (MHz)	Measured	Low Ch. (2 402 MHz)	Middle Ch. (2 442 MHz)	High Ch. (2 480 MHz)	Limit
V <sub>nom</sub> = 1.5	30 to 1 000	Frequency (GHz)	0.320	0.320	0.320	-
		Level (nW)	0.037 931	0.041 115	0.037 931	4
		Level (dB m)	-74.21	-73.86	-74.21	-54
	1 000 to 12 500	Frequency (GHz)	*1.374	1.397	1.418	-
		Level (nW)	*2.376 840	2.648 500	2.328 091	20
		Level (dB m)	*-56.24	-55.77	-56.33	-47

- '\*' means [Setting 2] test result.

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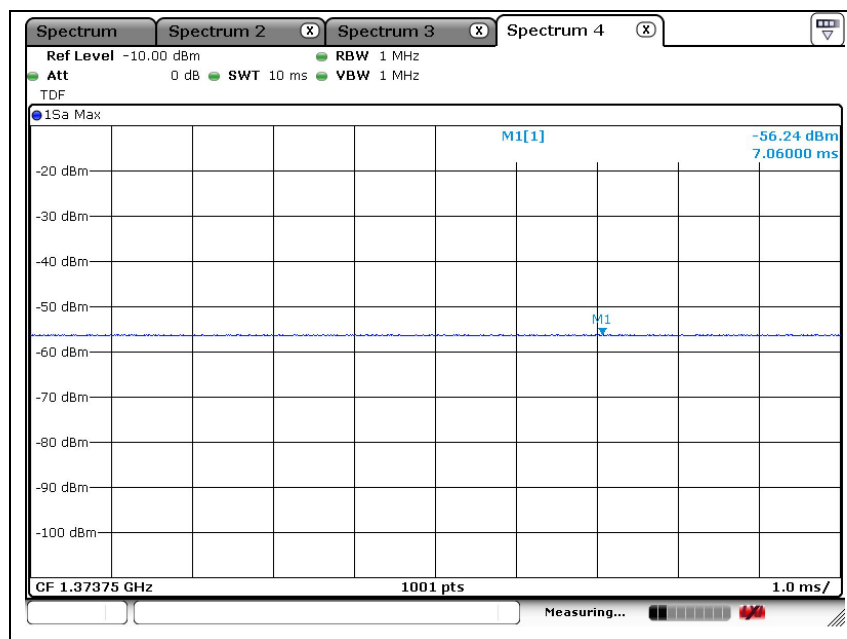
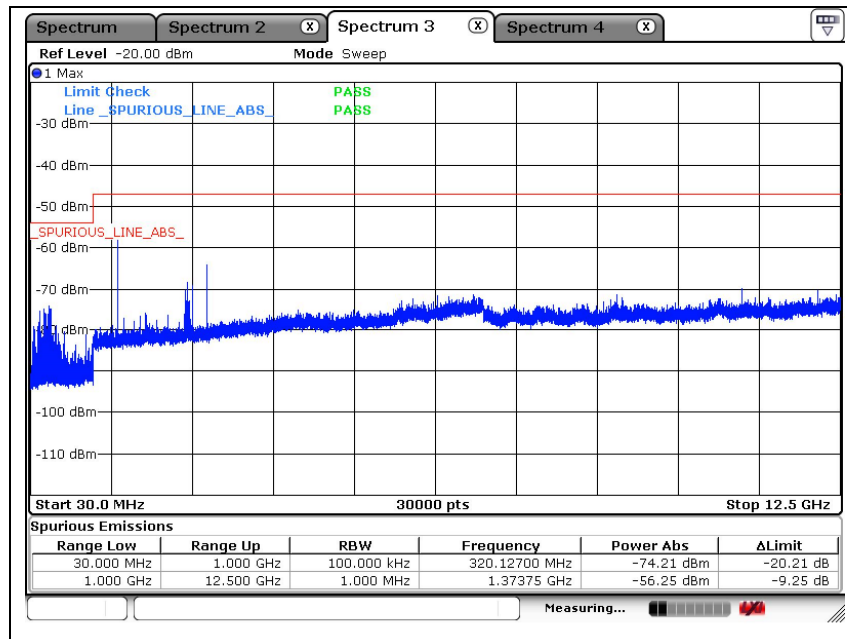
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## Low channel



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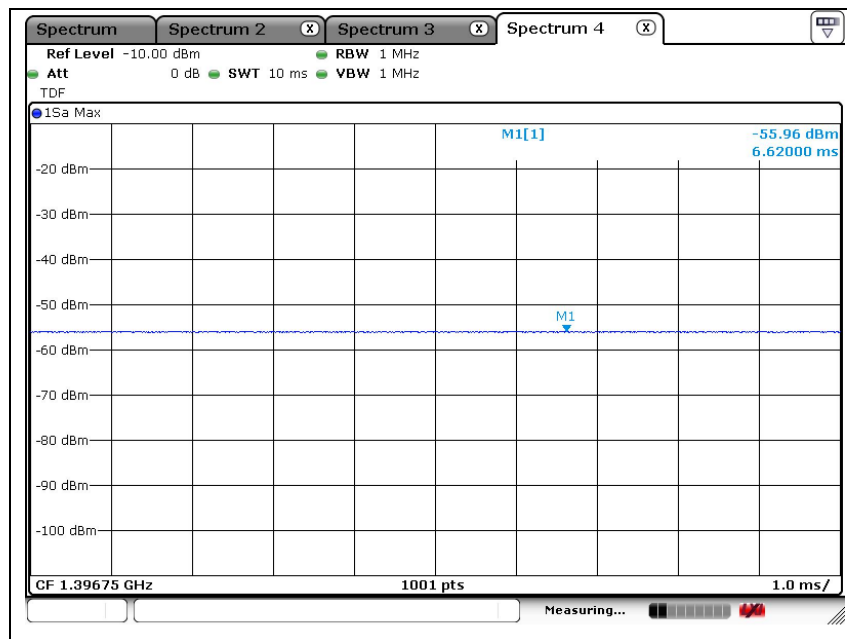
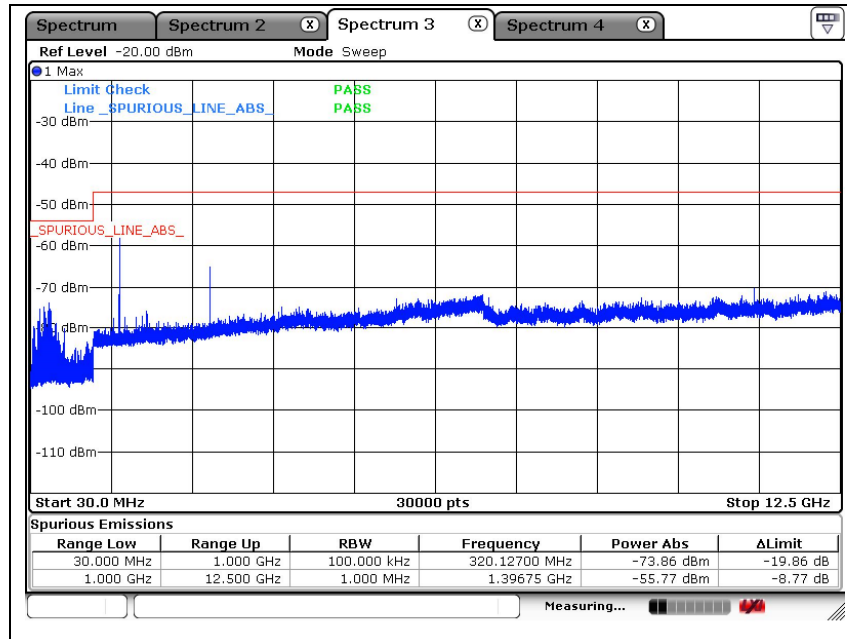
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## Middle channel



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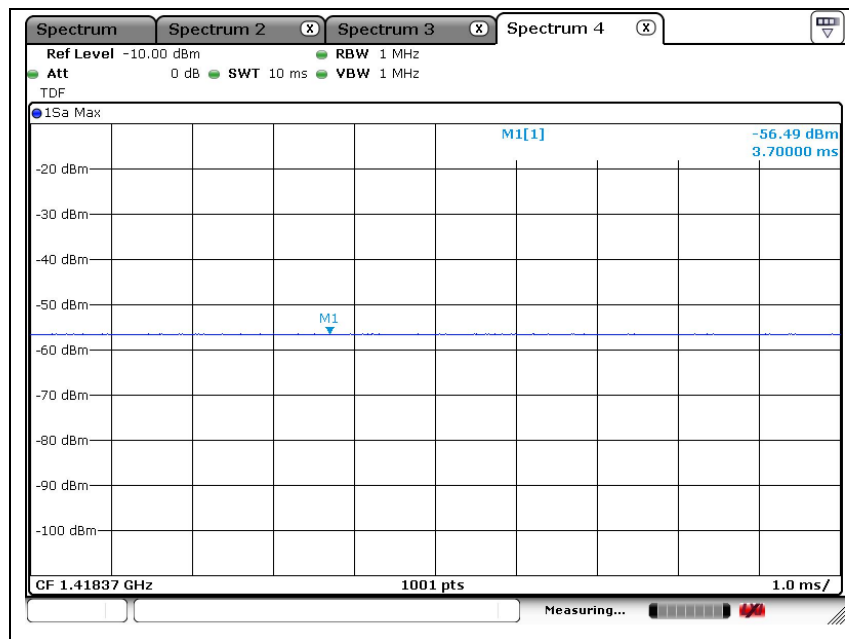
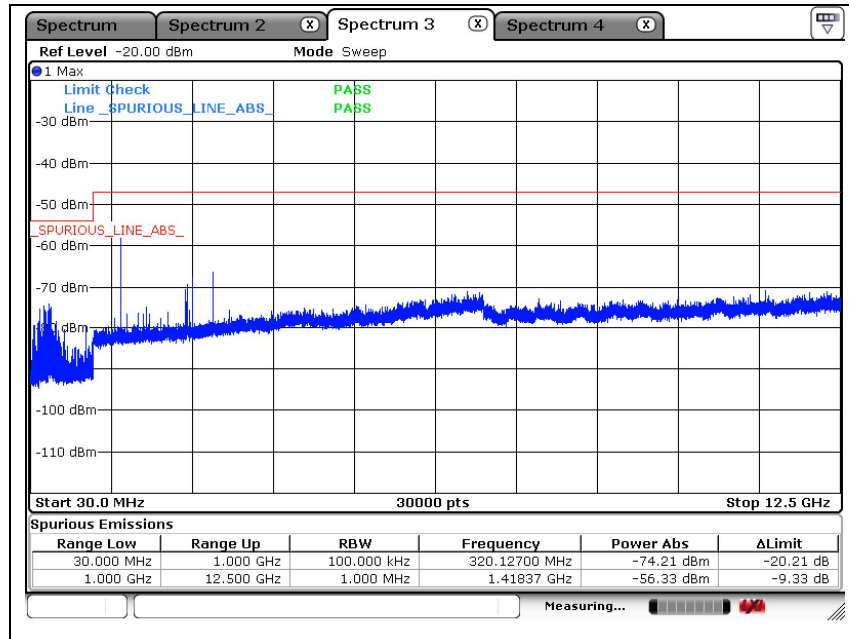
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A4(210 mm x 297 mm)



## High channel



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A4(210 mm x 297 mm)

## 7. Test Methodology & Conditions

### 7.1. Test Condition

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

Voltage Fluctuation Test	Normal Voltage	High voltage + 10 % of normal voltage	Low voltage - 10 % of normal voltage
EUT Input voltage (V <sub>d.c.</sub> )	1.50	1.65	1.35
RF Part Output voltage (V <sub>d.c.</sub> )	3.332	3.333	3.332

Voltage Variation (%) = (Output high or Low Voltage - Output normal voltage) / Output normal voltage \* 100  
During the input supply voltage to the EUT from the external power source is varied by +/- 10 % if output voltage had been confirmed that the fluctuation of power supply to the RF circuit of EUT (excluding power source) is equal to or less than +/- 1 %. Exempt extremely high and low supply voltage condition tests, EUT only operated in normal voltage to test all regulations.

### - End of the Test Report -

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