

# FCC Part 15 Subpart B&C§15.247 RSS-247 ISSUE No.:2

## Test Report

|                             |                             |
|-----------------------------|-----------------------------|
| <b>Equipment Under Test</b> | TUFFTALK M                  |
| <b>Model Name</b>           | SP64                        |
| <b>Applicant (FCC)</b>      | Sena Technologies,Inc.      |
| <b>Applicant (IC)</b>       | Sena Technologies, Inc.     |
| <b>Date of Test(s)</b>      | 2018. 11. 20 ~ 2018. 12. 17 |
| <b>Date of Issue</b>        | 2018. 12. 18                |

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

| <b>Issue to</b>   | <b>Issue by</b>   |
|---|---|
| <p><b>Sena Technologies,Inc.</b></p> <p>19, Heolleung-ro 569-gil, Gangnam-gu,<br/>Seoul, 06376, Republic of Korea</p> <p>Tel.: +82-2-571-8283<br/>Fax: +82-2-573-7710</p> | <p><b>MOVON CORPORATION</b></p> <p>498-2, Geumeo-ro, Pogok-eup,<br/>Cheoin-gu, Yongin-si, Gyeonggi-do,<br/>Korea, 17030</p> <p>Tel.: +82-31-338-8837<br/>Fax: +82-31-338-8847</p> |

### Revision history

| Revision | Date of issue | Description                           | Revised by |
|----------|---------------|---------------------------------------|------------|
| --       | Dec 06, 2018  | Initial                               | --         |
| 1        | Dec 18, 2018  | Add Test AC Conducted power line test | Kin Son    |

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## 1. Applicant Information & Laboratory Information

### 1.1.1 Details of applicant & Manufacturer

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Telephone : +82-2-571-8283  
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Contact Person : Kim Seunghyeon  
Telephone : +82-2-571-8283  
Fax : -

### 1.1.2 Laboratory Information

Applicant : MOVON Corporation

Telephone : + 82-31-338-8837

Fax : + 82-31-338-8847

Test Site Number : *FCC(KR0151)*

Address : 498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, South Korea

Test Site Number : *IC(6432B-3)*

Address : 194-1 Geumeo-ri, Pogok-eup  
Cheoin-gu, Yongin-si, Gyeonggi-do 449-812 Korea

Test Site Number : *IC(21313-1)*

Address : 494, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea,  
170-30  
Yongin IP 17030 Korea

**1.3. Summary of test results**

The EUT has been tested according to the following specifications;

| Section in FCC part 15           | Section in RSS-GEN, RSS-247 | Description   | Result |
|----------------------------------|-----------------------------|---|--------|
| §15.205<br>§15.209<br>§15.247(d) | 5.5                         | Transmitter radiated spurious emissions,<br>Conducted spurious emission | C      |
| §15.109(a)                       | RSS-Gen 6                   | Receiver radiated spurious emission                                     | C      |
| §15.247(a)(2)                    | A8.2(a)                     | 6 dB Bandwidth and 99 % bandwidth                                       | C      |
| §15.247(b)(e)                    | A8.4(4)                     | Maximum Conducted Output Power  | C      |
| §15.247(e)                       | A8.2(b)                     | Transmitter Power Spectral Density                                      | C      |
| §15.207(a)                       | 7.2.2                       | Conducted power line test   | C      |

*The sample was tested according to the following specification:*

**FCC Parts 15.247; ANSI C63.4:2014, ANSI C63.10:2013**

**FCC Public Notice KDB 558074 D01v05**

**RSS-247 ISSUE No.: 2**

**RSS-GEN ISSUE 5**

**TEST SITE REGISTRATION NUMBER: FCC(KR0151), IC(6432B-3), IC(21313-1)**

**※ Abbreviation**

- C Complied
- N/A Not applicable
- F Fail

**Approval Signatories**

| Test and Report Completed by :                | Report Approval by :                                |
|---|---|
|   |   |
| Kin Son<br>Test Engineer<br>MOVON CORPORATION | Issac Jin<br>Technical Manager<br>MOVON CORPORATION |

## 2. EUT Description

|                               |                                       |
|-------------------------------|---------------------------------------|
| Kind of product               | TUFFTALK M                            |
| Model                         | SP64                                  |
| FCC ID                        | S7A-SP64                              |
| IC Number                     | 8154A-SP64                            |
| Serial Number                 | N/A                                   |
| Power supply                  | DC 3.7V                               |
| Frequency range               | 2 402 MHz ~ 2 480 MHz                 |
| Modulation technique          | GFSK(BLE)                             |
| Number of channels            | 40                                    |
| Antenna gain                  | 0.3 dB i                              |
| Test Site Registration Number | FCC(KR0151), IC(6432B-3), IC(21313-1) |

### 2.1. Declarations by the manufacturer

None

### 2.2. Details of modification

None

**3. Measurement equipment.**

| Equipment                           | Manufacturer      | Model          | Serial number        | Calibration Interval | Calibration date | Calibration due. |
|-------------------------------------|-------------------|----------------|----------------------|----------------------|------------------|------------------|
| Test Receiver                       | R&S               | ESVS30         | 829673/015           | 1 year               | 2018-12-06       | 2019-12-06       |
| Signal Generator                    | R&S               | SMB100A        | 178128               | 1 year               | 2019-12-07       | 2019-12-07       |
| Spectrum Analyzer                   | R&S               | FSV-40         | 100832               | 1 year               | 2018-05-28       | 2019-05-28       |
| Power Meter                         | Agilent           | E4416A         | GB41290645           | 1 year               | 2018-05-29       | 2019-05-29       |
| Power Sensor                        | Agilent           | 9327A          | US40441490           | 1 year               | 2018-05-29       | 2019-05-29       |
| Horn Antenna                        | R&S               | HF906          | 100236               | 2 year               | 2017-04-25       | 2019-04-25       |
| Horn Antenna                        | AH Systems        | SAS-572        | 269                  | 2 year               | 2017-08-01       | 2020-08-01       |
| Horn Antenna                        | AH Systems        | SAS-573        | 164                  | 2 year               | 2018-04-26       | 2020-04-26       |
| Bi-Log Ant.                         | S/B               | VULB 9161SE    | 4159                 | 2 year               | 2018-06-11       | 2020-06-11       |
| Power Amplifier                     | MITEQ             | AFS43-01002600 | 2048519              | 1 year               | 2018-10-29       | 2019-10-29       |
| Step Attenuator                     | Agilent           | 8494B          | US37181955           | 1 year               | 2018-05-29       | 2019-05-29       |
| Controller                          | INNCO             | CO2000         | co200/064/6961003/L  | N/A                  | N/A              | N/A              |
| Antenna Master                      | INNCO             | MA4000         | MA4000/038/6961003/L | N/A                  | N/A              | N/A              |
| Loop Antenna                        | ETS LINDGREN      | 6502           | 00118166             | 2 year               | 2018-10-30       | 2020-10-30       |
| TWO LINE-V-NETWORK                  | R&S               | ESH3-Z5        | 100296               | 1 year               | 2018-03-07       | 2019-03-07       |
| Low Noise Amplifier                 | TESTEK            | TK-PA18H       | 170013-L             | 1 year               | 2018-05-28       | 2019-05-28       |
| Power Amplifie                      | SONOMA INSTRUMENT | 310N           | 185428               | 1 year               | 2018-12-07       | 2019-12-07       |
| WIDEBAND RADIO COMMUNICATION TESTER | R&S               | CMW500         | 154160               | 1 year               | 2018-05-29       | 2019-05-29       |
| EMI TEST RECEIVER                   | R&S               | ESR3           | 101873               | 1 year               | 2018-05-28       | 2019-05-28       |
| PULSE LIMITER                       | R&S               | ESH3-Z2        | 100288               | 1 year               | 2018-05-28       | 2019-05-28       |
| Power Divider                       | HP                | 11636B         | 12481                | 1 year               | 2018-05-31       | 2019-05-31       |
| RF Cable                            | SUHNER            | SUCOFLEX100    | 84047746             | N/A                  | N/A              | N/A              |
| RF Cable                            | SUHNER            | SUCOFLEX102    | 801270/2             | N/A                  | N/A              | N/A              |
| RF Cable                            | SUHNER            | SUCOFLEX102    | 801270/2             | N/A                  | N/A              | N/A              |

**※ Remark;  
Support equipment**

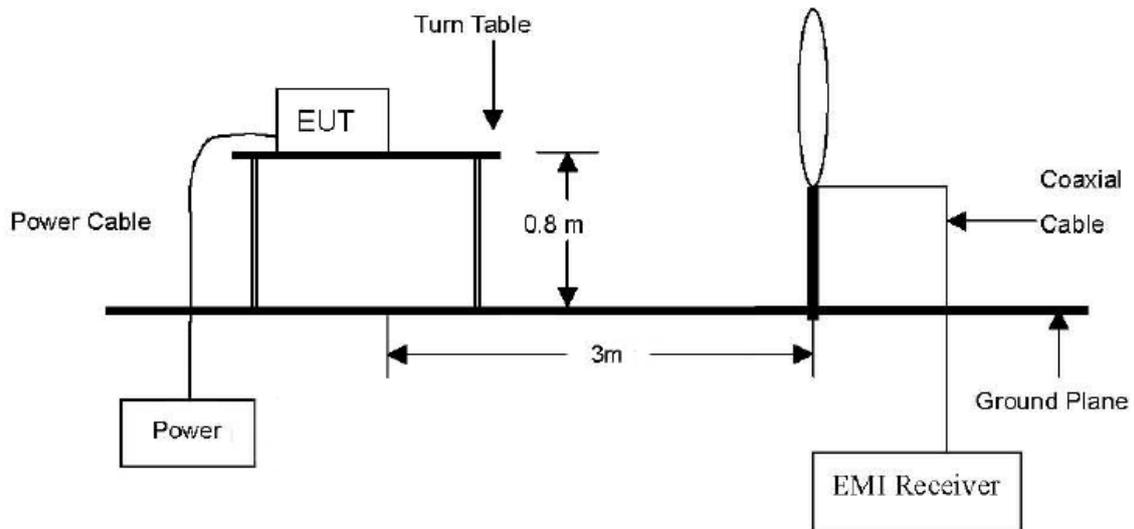
| Description       | Manufacturer | Model          | Serial number |
|-------------------|--------------|----------------|---------------|
| Notebook computer | DELL         | Lattitude D510 | -             |

#### 4. Transmitter radiated spurious emissions and conducted spurious emissions

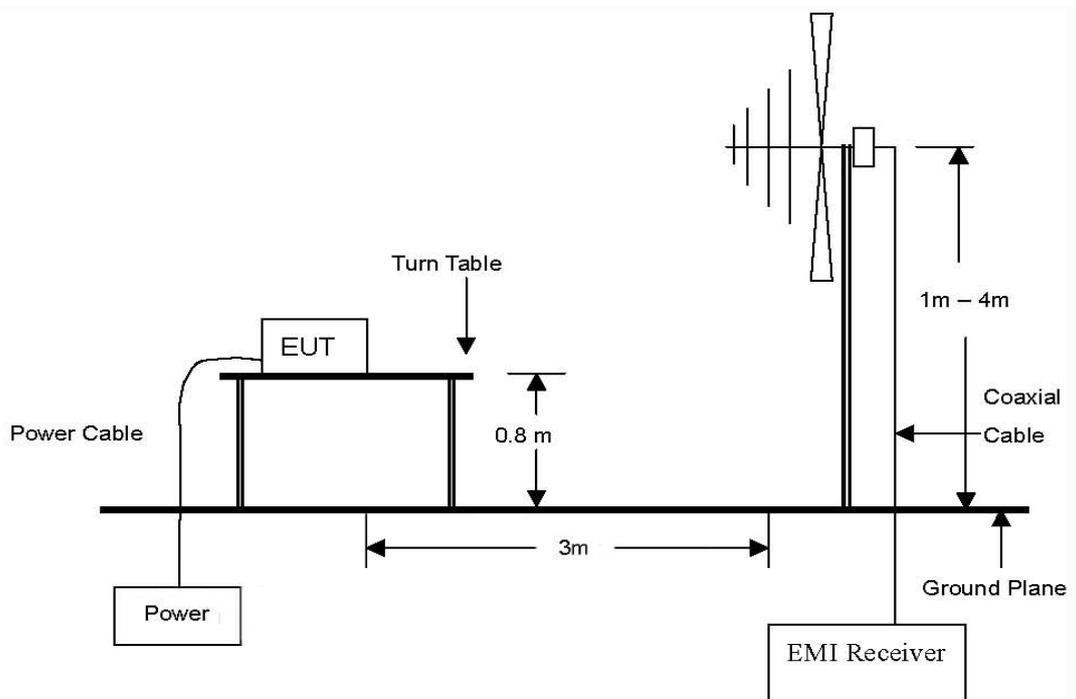
##### 4.1. Test setup

##### 4.1.1. Transmitter radiated spurious emissions

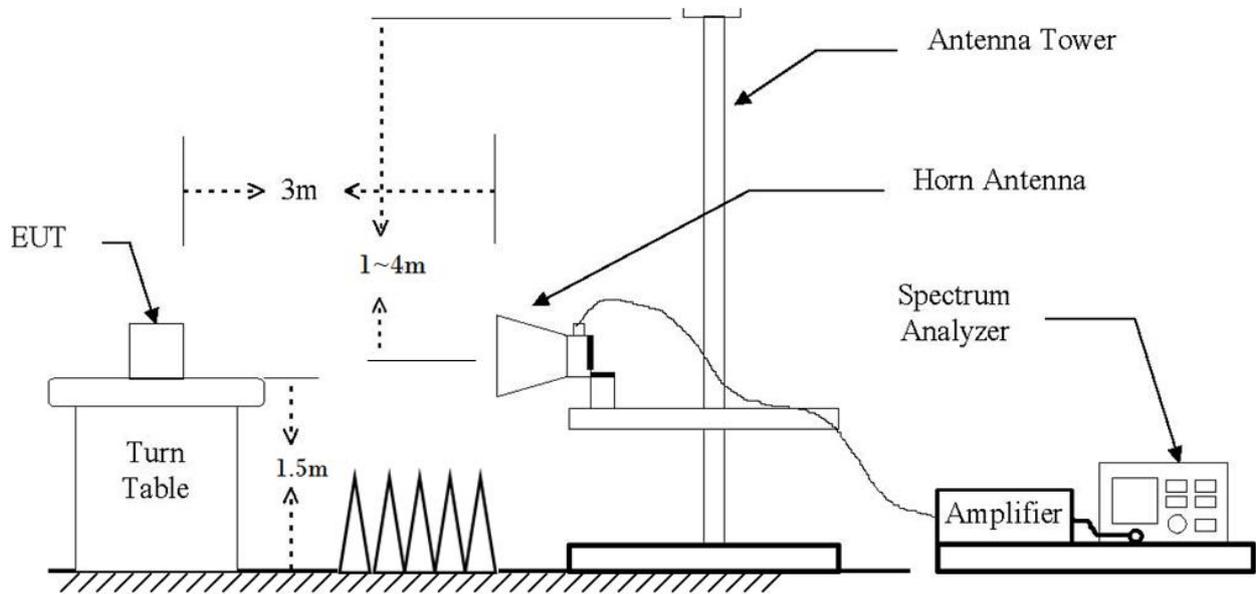
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 40 GHz emissions.



#### 4.2. Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

| Frequency (MHz) | Distance (Meters) | Radiated at 3M (dBµV/m) | Radiated (µV/m) |
|-----------------|-------------------|-------------------------|-----------------|
| 0.009–0.490     | 300               | See the remark          | 2400/F(kHz)     |
| 0.490–1.705     | 30                |                         | 24000/F(kHz)    |
| 1.705–30.0      | 30                |                         | 30              |
| 30 - 88         | 3                 | 40.0                    | 100             |
| 88 – 216        | 3                 | 43.52                   | 150             |
| 216 – 960       | 3                 | 46.02                   | 200             |
| Above 960       | 3                 | 53.97                   | 500             |

**\*Remark**

1. Emission level in dB uV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor =40log(Specific distance/ test distance)(dB)  
 Limit line=Specific limits(dB uV) + distance extrapolation factor.

### 4.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10:2013. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately.

#### 4.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m (Below 1 GHz)/ 1.5 m (Above 1 GHz) above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※ **Remark;**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for Peak detection (PK) at frequency below 30 MHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

#### 4.3.2. Test procedures for conducted spurious emissions

All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 4.4.4. The limit for out of band spurious emission at the band edge is 30 dB below the fundamental emission level measured in a 100 kHz bandwidth.

#### 4.4. Test result

Ambient temperature: 20°C

Relative humidity: 45% R.H.

##### 4.4.1. Spurious radiated emission

The frequency spectrum from 9kHz to 30MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

##### A. Low channel (2 402 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

##### B. Middle channel (2 440 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

##### C. High channel (2 480 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

#### ※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dB $\mu$ V) + Distance extrapolation factor
4. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

#### 4.4.2. Spurious radiated emission

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

##### A. Low channel (2 402 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

##### B. Middle channel (2 441 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

##### C. High channel (2 480 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

※ **Remark**

- Actual = Reading + Ant. factor + CL (Cable loss)
- 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

#### 4.4.3. Spurious radiated emission

The frequency spectrum above 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

##### A. Low channel (2 402 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

##### B. Middle channel (2 441 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

##### C. High channel (2 480 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |          | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|----------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | C.L (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |          |                       |                      |             |

#### ※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor - Amp + CL (Cable loss)
5. 15.31 Measurement standards.

**THE AMPLITUDE OF SPURIOUS EMISSIONS FROM INTENTIONAL RADIATORS AND EMISSIONS FROM UNINTENTIONAL RADIATORS WHICH ARE ATTENUATED MORE THAN 20 DB BELOW THE PERMISSIBLE VALUE NEED NOT BE REPORTED UNLESS SPECIFICALLY REQUIRED ELSEWHERE IN THIS PART.**

#### 4.4.4 Band Edge

##### A. 2 310 - 2 390 MHz measurement (2 402MHz)

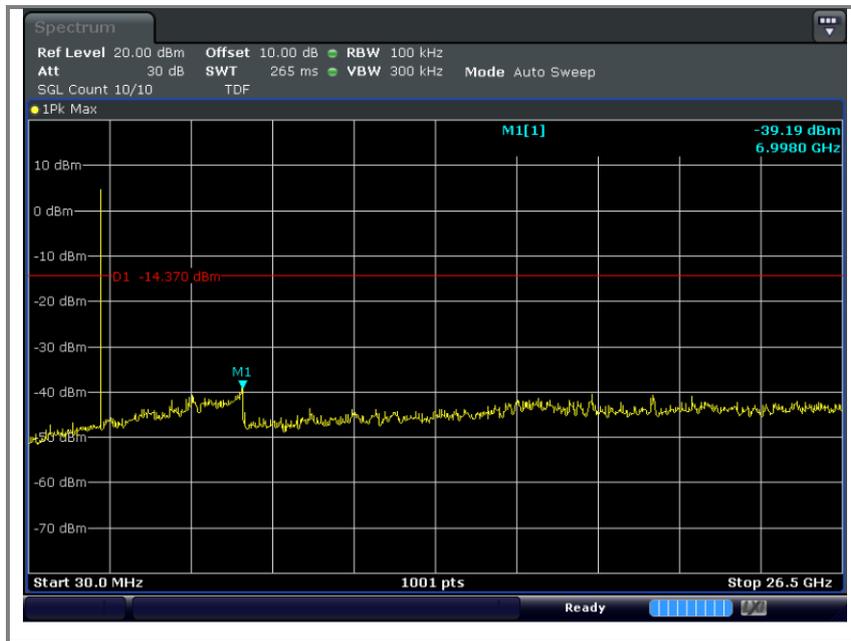
| Radiated emissions |                      |               | Ant. | Correction factors |             |                  | Total                 | Limit                |             |
|--------------------|----------------------|---------------|------|--------------------|-------------|------------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | Amp+CL (dB) | Duty factor (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| 2327.30            | 60.18                | Peak          | V    | 28.09              | 39.03       |                  | 49.24                 | 74.00                | 24.76       |
| 2337.45            | 52.23                | Average       | V    | 28.09              | 39.03       | 1.61             | 42.90                 | 54.00                | 11.10       |
| 2342.73            | 59.84                | Peak          | H    | 28.09              | 39.03       |                  | 48.90                 | 74.00                | 25.10       |
| 2337.29            | 51.36                | Average       | H    | 28.09              | 39.03       | 1.61             | 42.03                 | 54.00                | 11.97       |

##### B. 2 483.5 – 2 500 MHz measurement (2 480MHz)

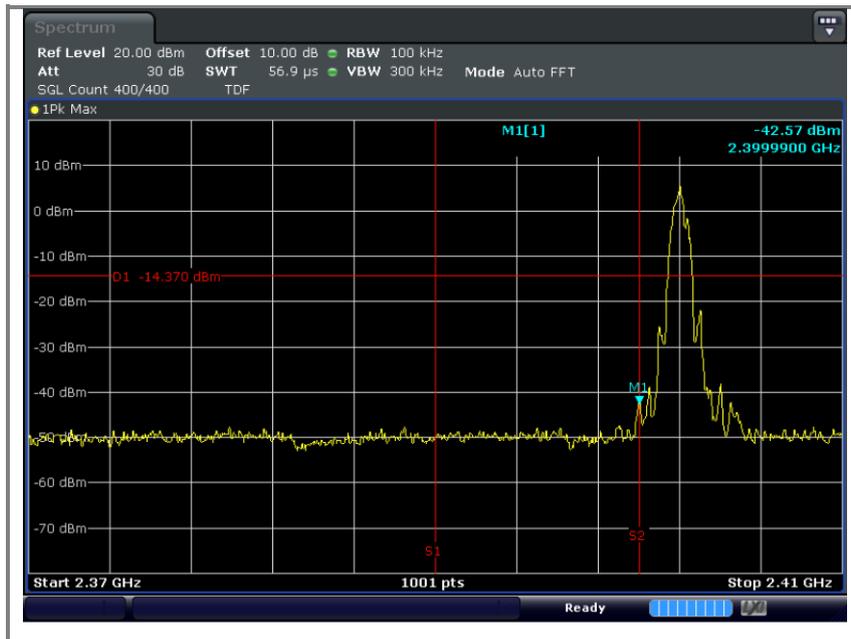
| Radiated emissions |                      |               | Ant. | Correction factors |             |                  | Total                 | Limit                |             |
|--------------------|----------------------|---------------|------|--------------------|-------------|------------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | Amp+CL (dB) | Duty factor (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| 2489.92            | 63.15                | Peak          | V    | 28.09              | 39.03       |                  | 52.21                 | 74.00                | 21.79       |
| 2499.98            | 56.28                | Average       | V    | 28.09              | 39.03       | 1.61             | 46.95                 | 54.00                | 7.05        |
| 2490.93            | 60.29                | Peak          | H    | 28.09              | 39.03       |                  | 49.35                 | 74.00                | 24.65       |
| 2499.32            | 53.33                | Average       | H    | 28.09              | 39.03       | 1.61             | 44.00                 | 54.00                | 10.00       |

### A. Low channel(2 402 MHz)

#### Unwanted Emission data

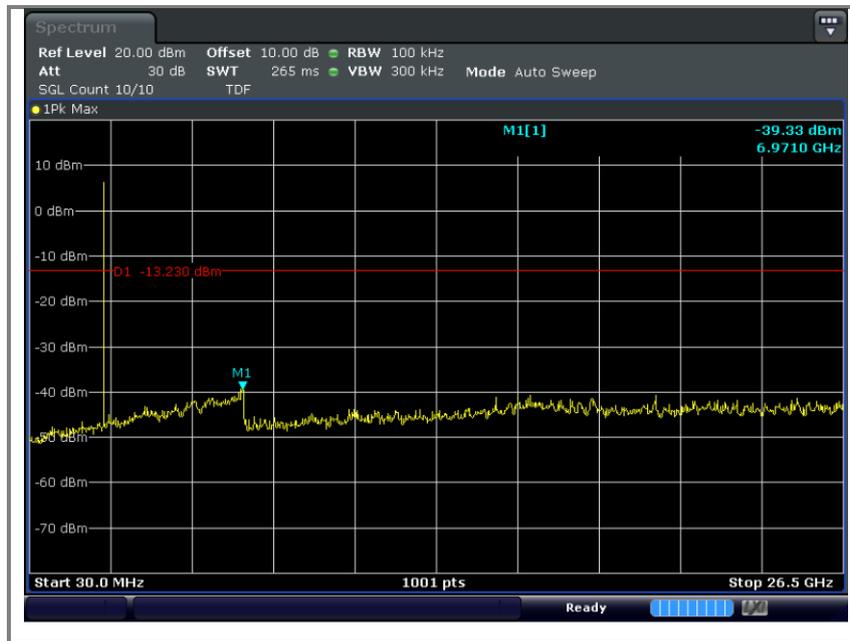


#### Band-edge data



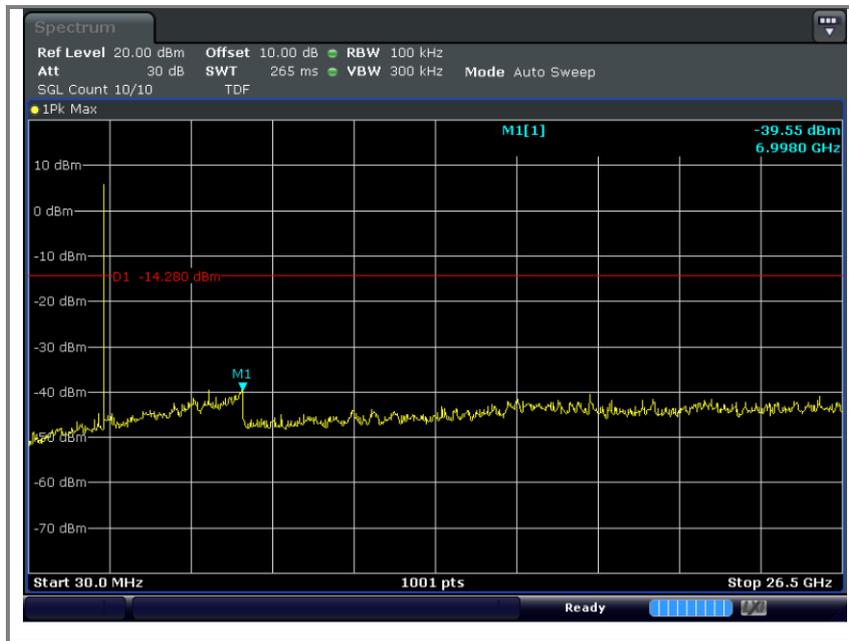
## B. Middle channel(2 440 MHz)

### Unwanted Emission data

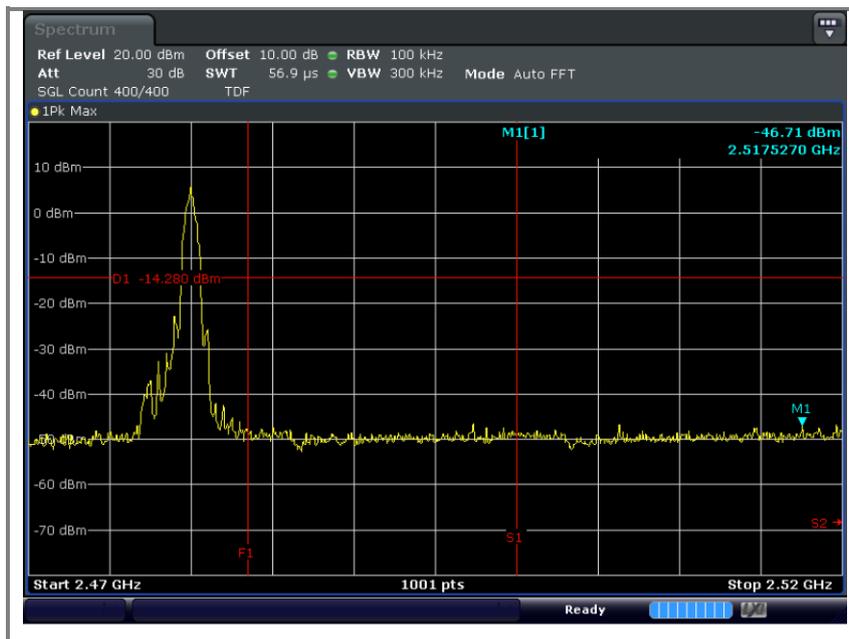


### C. High channel(2 480 MHz)

#### Unwanted Emission data



#### Band-edge data



## 5. Receiver radiated spurious emissions

### 5.1. Test setup

Same as clause 5.1.

#### 5.1.1. Receiver radiated spurious emissions

Same as clause 5.1.1

### 5.2. Limit

According to §15.109(a), Except for Class A digital devices, the field strength of radiated emission from unintentional radiator at a distance of 3 m shall not exceed the following values:

| Frequency (MHz) | Distance (Meters) | Radiated (dB $\mu$ V/m) | Radiated ( $\mu$ V/m) |
|-----------------|-------------------|-------------------------|-----------------------|
| 0.009–0.490     | 300               | See the remark          | 2400/F (kHz)          |
| 0.490–1.705     | 30                |                         | 24000/F (kHz)         |
| 1.705–30.0      | 30                |                         | 30                    |
| 30 - 88         | 3                 | 40.0                    | 100                   |
| 88 – 216        | 3                 | 43.5                    | 150                   |
| 216 – 960       | 3                 | 46.0                    | 200                   |
| Above 960       | 3                 | 54.0                    | 500                   |

### 5.3. Test procedures

Same as clause 5.3.

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately.

#### 5.3.1. Test procedures for radiated spurious emissions

Same as Clause 5.3.1.

### 5.4. Test results

Ambient temperature: 20 °C

Relative humidity: 45% R.H.

#### 5.4.1. Spurious radiated emission.

The frequency spectrum from 30 MHz to 26GHz was investigated. Emission levels are not reported much lower than the limits by over 30 dB. All reading values are peak values.

##### A. Low channel (2 402 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

##### B. Middle channel (2 440 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

##### C. High channel (2 480 MHz)

| Radiated emissions   |                      |               | Ant. | Correction factors |         | Total                 | Limit                |             |
|--|----------------------|---------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)  | Reading (dB $\mu$ V) | Detector mode | Pol. | Ant. factor (dB/m) | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| No other emissions were detected at a level greater than 20dB below limit. |                      |               |      |                    |         |                       |                      |             |

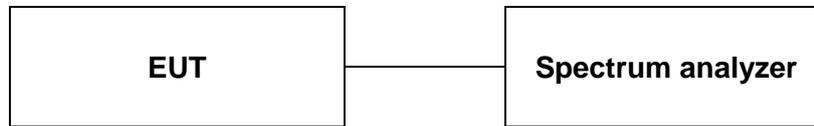
#### ※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

## 6. 6 dB bandwidth & 99% bandwidth measurement

### 6.1. Test setup



### 6.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 825 MHz bands. The minimum of 6 dB Bandwidth shall be at least 500 kHz

### 6.3. Test procedure

1. The 6dB band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate centerfrequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.Display Line and Marker Delta functions, the 6dB band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100kHz, VBW ≥ 3 x RBW, Span= 2times the DTS bandwidth  
Detector= peak, Trace = max hold, Sweep=auto couple

### 6.4. Test results

Ambient temperature: 22°C

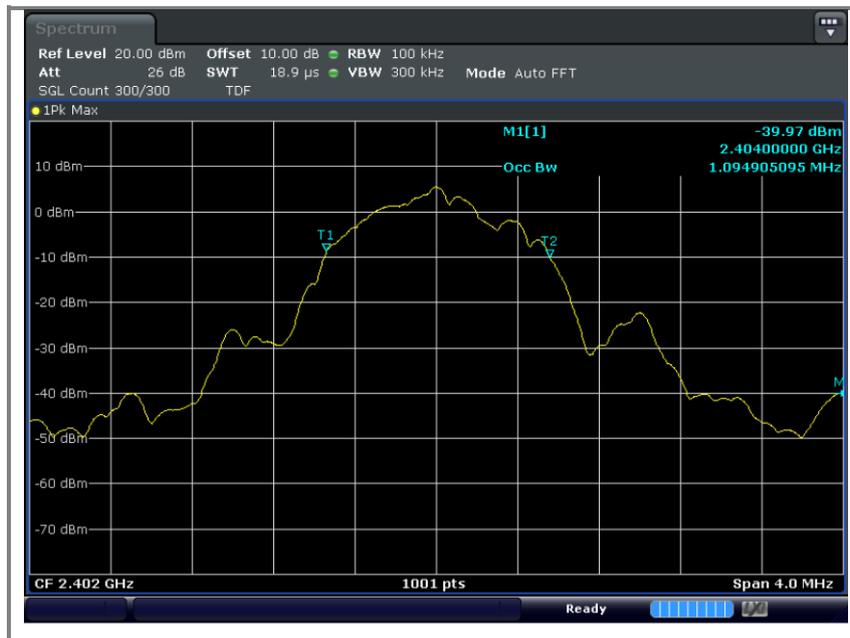
Relative humidity: 45% R.H.

| Frequency(MHz) | 6 dB bandwidth(MHz) | 99% bandwidth(MHz) |
|----------------|---------------------|--------------------|
| 2 402          | 0.52                | 1.10               |
| 2 440          | 0.58                | 1.10               |
| 2 480          | 0.56                | 1.09               |

**A. Low channel(2 402 MHz) - 6 dB bandwidth**



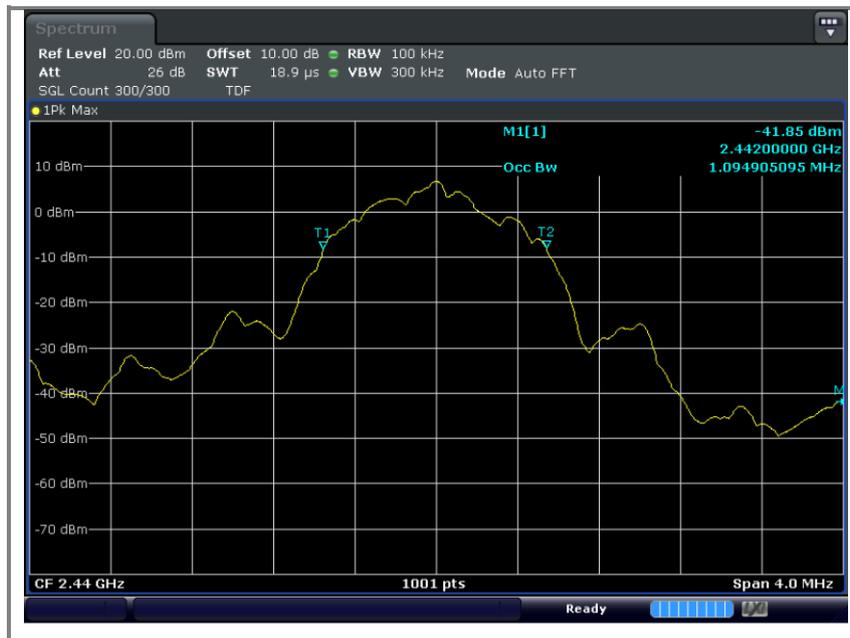
**A. Low channel(2 402 MHz)-99 % bandwidth**



**B. Middle channel(2 440 MHz)- 6 dB bandwidth**



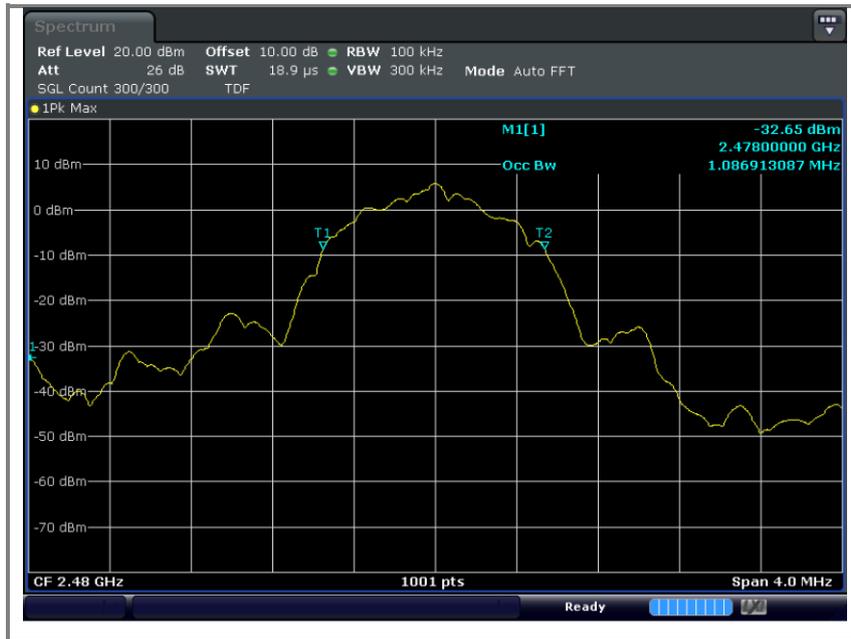
**B. Middle channel(2 440 MHz)-99 % bandwidth**



**C. High channel(2 480 MHz) -6 dB bandwidth**



**C. High channel(2 480 MHz)-99 % bandwidth**



## 7. Maximum Output Power Measurement

### 7.1. Test setup.



### 7.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 6 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW
2. §15.247(b)(1), For frequency hopping systems operating in the 2400–2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5805 MHz band: 1 Watt.

### 7.3 Test procedure

Maximum Peak Conducted Output Power is measured using the following procedure (RBW ≥ DTS bandwidth).

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW. / Set span ≥ 3 x RBW.
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

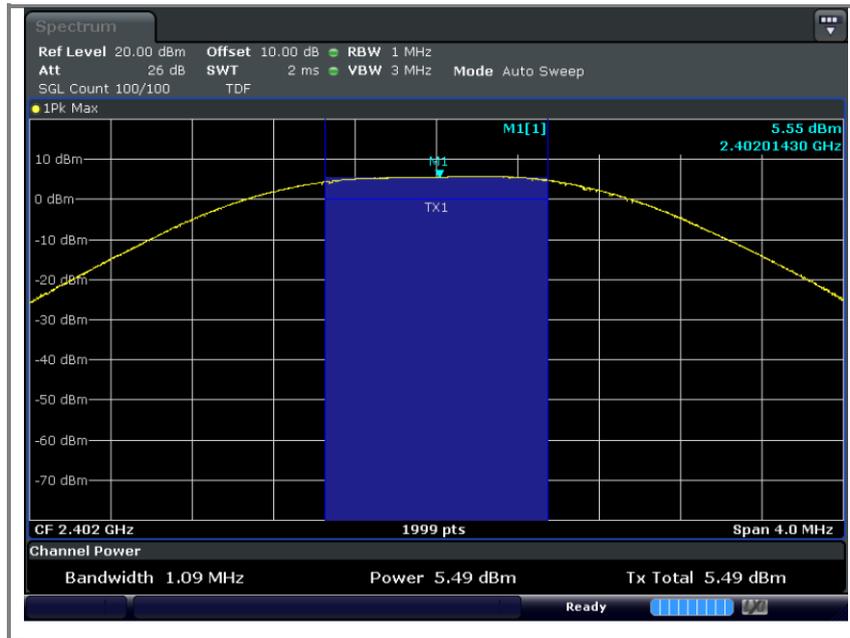
### 7.4 Test results

Ambient temperature: 22°C

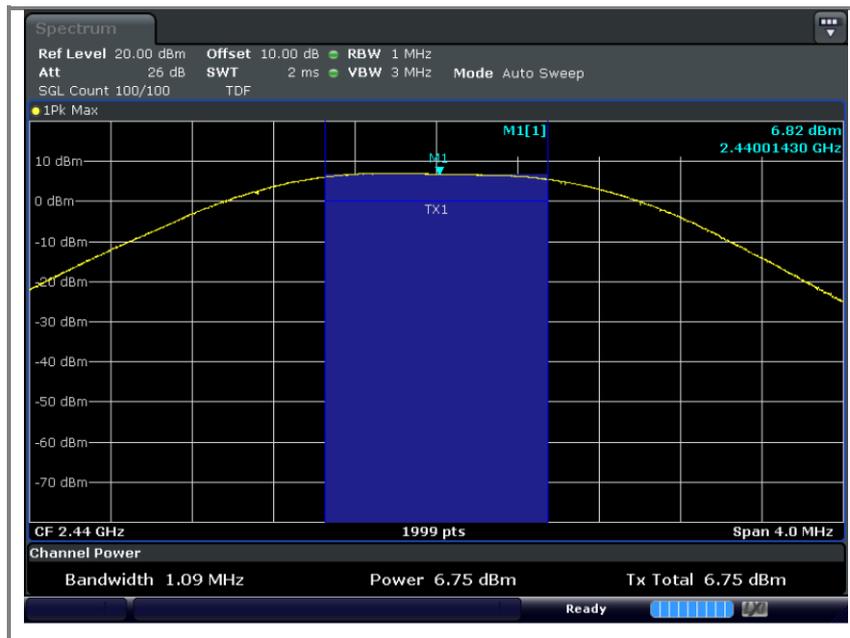
Relative humidity: 45% R.H.

| Frequency(MHz) | Conducted power (dBm) | Limit (dBm) |
|----------------|-----------------------|-------------|
| 2 402          | 5.49                  | 30          |
| 2 440          | 6.75                  |             |
| 2 480          | 5.75                  |             |

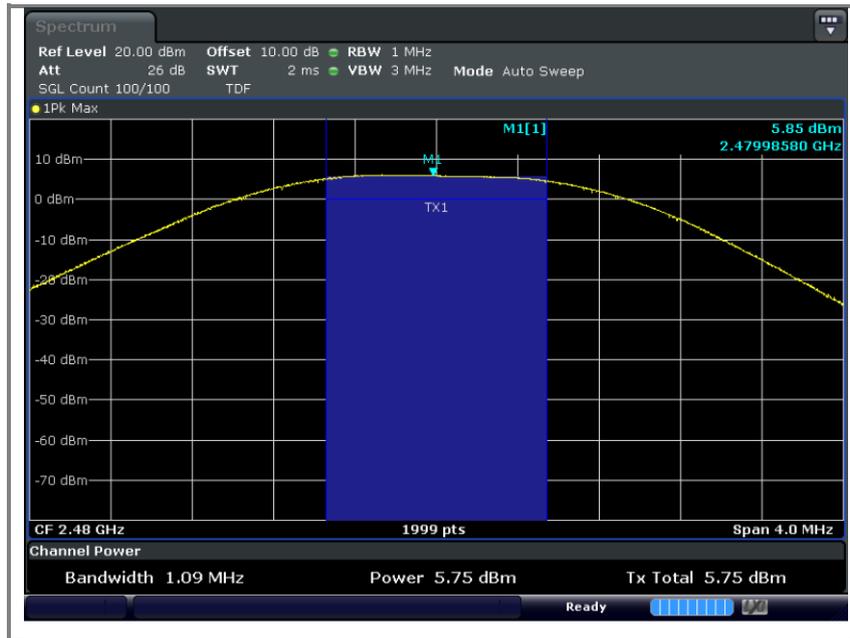
**A. Low channel(2 402 MHz)**



**B. Middle channel(2 440 MHz)**

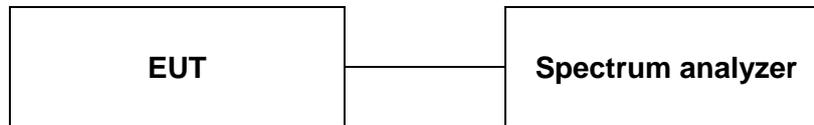


C. High channel(2 480 MHz)



## 8. Power Spectral Density Measurement

### 8.1. Test setup



### 8.2. Limit

< 8dBm @ 3kHz BW

### 8.3. Test procedure (PKPSD)

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency,A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
  - Span = 1.5 times the DTS bandwidth
  - RBW = 3kHz ≤ RBW ≤ 100kHz
  - VBW ≥ 3 x RBW, Sweep = Auto couple
  - Detectorfunction = peak, Trace = max hold

### 8.4. Test results

Ambient temperature: 22°C

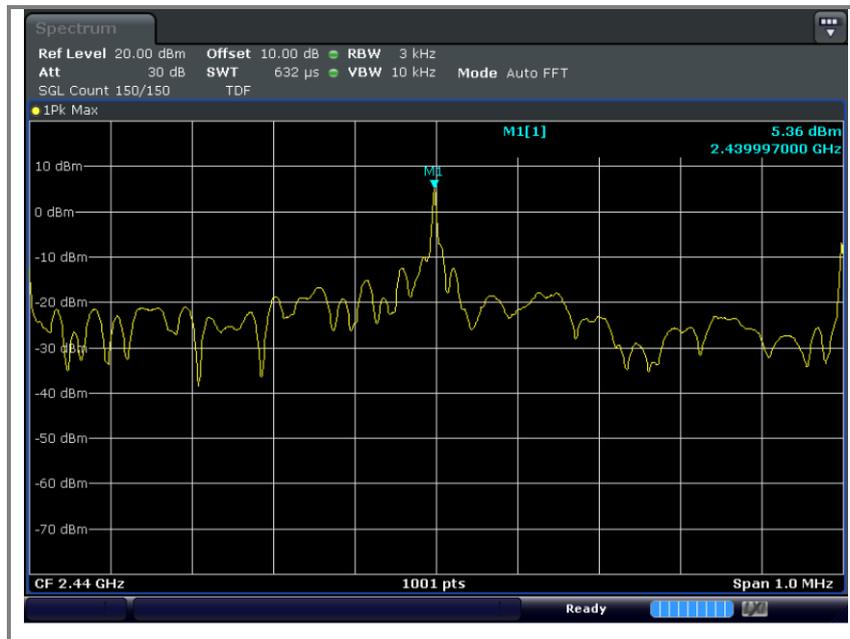
Relative humidity: 45% R.H.

| Frequency(MHz) | Peak output power(dBm) | Limit (dBm) |
|----------------|------------------------|-------------|
| 2 402          | 4.19                   | 8           |
| 2 440          | 5.36                   |             |
| 2 480          | 4.30                   |             |

**A. Low channel(2 402 MHz)**



**B. Middle channel(2 440 MHz)**

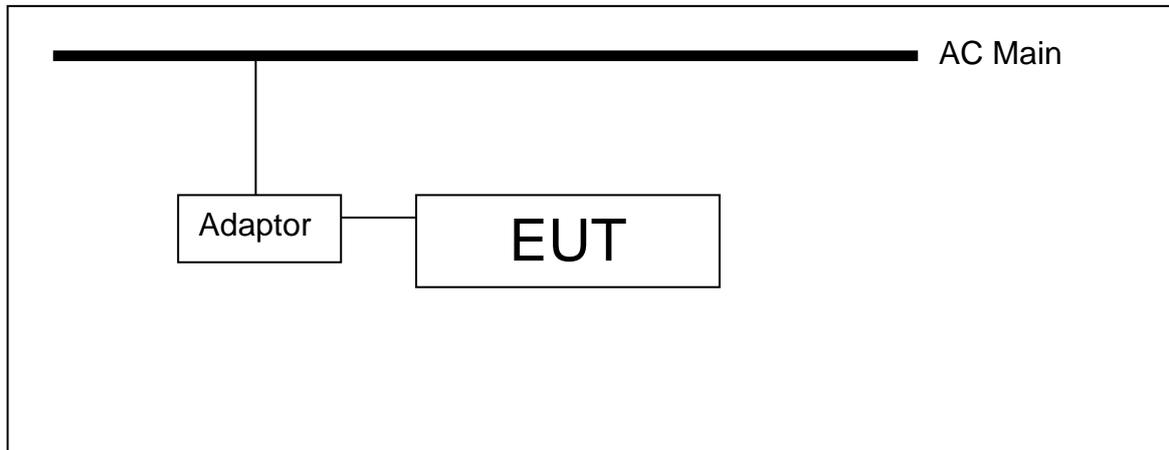


C. High channel(2 480 MHz)



## 9. AC Conducted power line test

### 9.1 Test setup



### 9.2 Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall be on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower value applies at the boundary between the frequency ranges.

| Frequency of Emission (MHz) | Conducted limit (dB $\mu$ V/m) |         |
|-----------------------------|--------------------------------|---------|
|                             | Quasi-peak                     | Average |
| 0.15 – 0.50                 | 66-56*                         | 56-46*  |
| 0.50 – 5.00                 | 56                             | 46      |
| 5.00 – 30.0                 | 60                             | 50      |

※ **Remark**

Decreases with the logarithm of the frequency.

### 9.3 Test procedures

The test procedure is performed in a 6.5 m × 3.6 m × 3.6 m (L×W×H) shielded room. The EUT along with its peripherals were placed on a 1.0m(W)× 1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

### 9.4 Test results

Ambient temperature: 23°C

Relative humidity: 45% R.H.

Frequency range: 0.15 MHz ~ 30 MHz

Measured bandwidth: 9 kHz

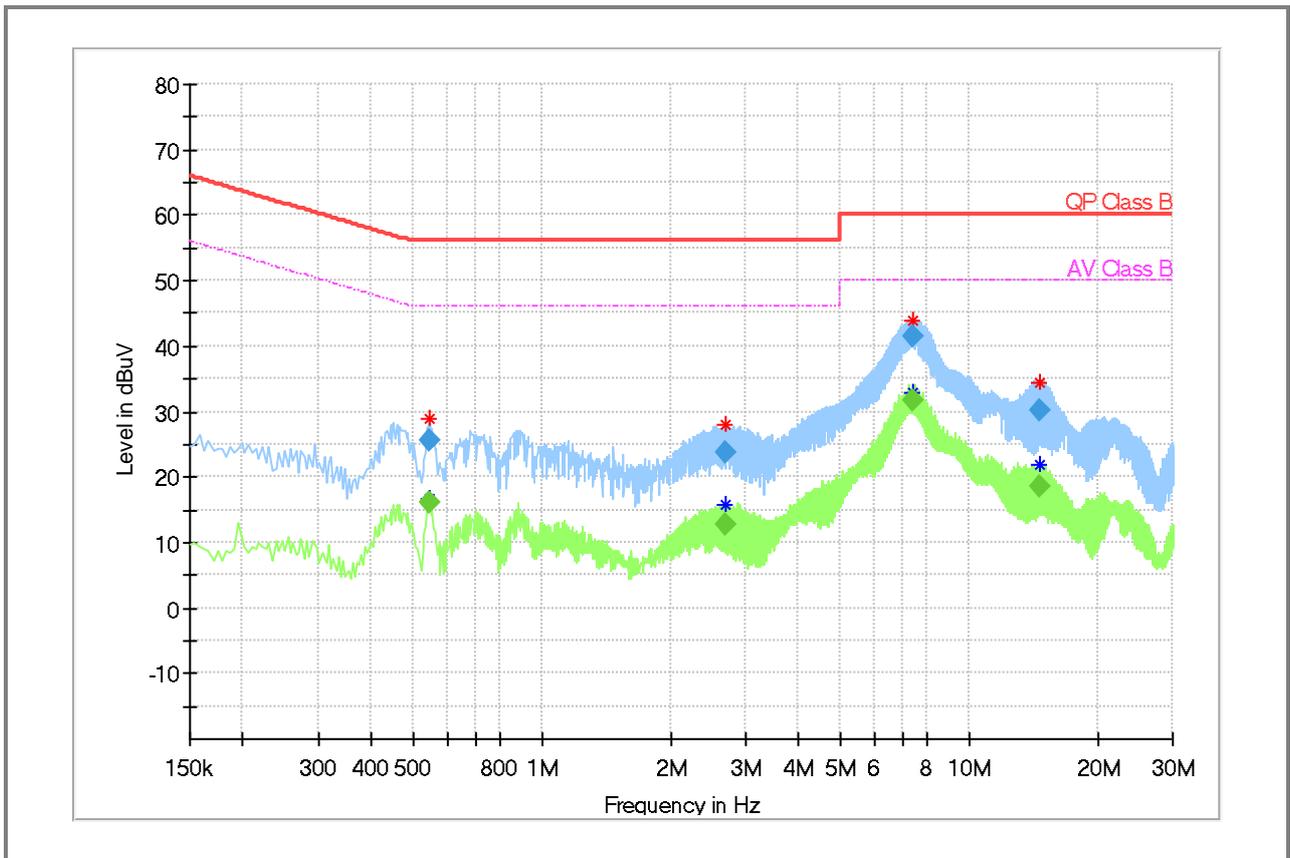
| Frequency (MHz) | QuasiPeak (dBuV) | C Average (dBuV) | Limit (dBuV) | Margin (dB) | Line |
|-----------------|------------------|------------------|--------------|-------------|------|
| 0.55            | ---              | 16.17            | 46.00        | 29.83       | L1   |
| 0.55            | 25.64            | ---              | 56.00        | 30.36       | L1   |
| 2.71            | ---              | 12.62            | 46.00        | 33.38       | L1   |
| 2.71            | 23.79            | ---              | 56.00        | 32.21       | L1   |
| 7.39            | 41.32            | ---              | 60.00        | 18.68       | L1   |
| 7.41            | ---              | 31.74            | 50.00        | 18.26       | L1   |
| 14.71           | ---              | 18.57            | 50.00        | 31.43       | L1   |
| 14.71           | 30.04            | ---              | 60.00        | 29.96       | L1   |

※ Remark

Line(L1): Hot

Line(N): Neutral

Plot of conducted power line



## **10. Antenna requirement**

### **10.1. Standard Applicable**

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6dBi are used.

### **10.2. Antenna Connected Construction**

Antenna used in this product is PCB antenna,  
Antenna gain is 0.3 dBi.