

# TEST REPORT

|                                                                                                                                                                          |                                                                                                                                               |                                                        |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|
| <br>CTK Co., Ltd.<br><small>The Prime Leader of Global Regulatory Certification</small> | <b>CTK Co., Ltd.</b><br>(Ho-dong), 113, Yejik-ro, Cheoin-gu,<br>Yongin-si, Gyeonggi-do, Korea<br>Tel: +82-31-339-9970<br>Fax: +82-31-624-9501 | Report No.:<br>CTK-2017-01952<br>Page (1) / (31) Pages |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|

## 1. Client

- Name : SOLUM CO.,LTD.
- Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea
- Data of Receipt : 2017-09-15

## 2. Manufacturer

- Name : SOLUM CO.,LTD.
- Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea

## 3. Use of Report : For FCC Certification

## 4. Test Sample / Model: ESL LABEL / TG-GR29

## 5. Date of Test : 2017-09-25 to 2017-10-17

## 6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

## 7. Testing Environment: Temp.: (23 ± 1) °C, Humidity: (50 ± 1) % R.H.

## 8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

|             |                                                                                                                             |                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Affirmation | Tested by<br>Bongseok, Kim: (Signature)  | Technical Manager<br>Young-taek, Lee: (Signature)  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|

2017-10-18

Republic of KOREA **CTK Co., Ltd.**



**CTK Co., Ltd.**  
(Ho-dong), 113, Yejik-ro, Cheoin-gu,  
Yongin-si, Gyeonggi-do, Korea  
Tel: +82-31-339-9970  
Fax: +82-31-624-9501

Report No.:  
CTK-2017-01952  
Page (2) / (31) Pages

## REPORT REVISION HISTORY

| Date       | Revision                | Page No |
|------------|-------------------------|---------|
| 2017-10-18 | Issued (CTK-2017-01952) | all     |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |
|            |                         |         |

*This report shall not be reproduced except in full, without the written approval of CTK Co., Ltd. This document may be altered or revised by CTK Co., Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by CTK Co., Ltd. will constitute fraud and shall nullify the document.*

## **CONTENTS**

|                                                                |    |
|----------------------------------------------------------------|----|
| 1. General Product Description .....                           | 4  |
| 1.1 Client Information .....                                   | 4  |
| 1.2 Product Information.....                                   | 4  |
| 1.3 Peripheral Devices .....                                   | 4  |
| 2. Facility and Accreditations.....                            | 5  |
| 2.1 Test Facility .....                                        | 5  |
| 2.2 Laboratory Accreditations and Listings.....                | 5  |
| 2.3 Calibration Details of Equipment Used for Measurement..... | 5  |
| 3. Test Specifications .....                                   | 6  |
| 3.1 Standards .....                                            | 6  |
| 3.2 Mode of operation during the test .....                    | 6  |
| 3.3 Maximum Measurement Uncertainty .....                      | 7  |
| 4. Technical Characteristic Test.....                          | 8  |
| 4.1 6dB Bandwidth .....                                        | 8  |
| 4.2 Maximum peak Conducted Output Power .....                  | 12 |
| 4.3 Power Spectral Density .....                               | 15 |
| 4.4 Band Edge & Conducted Spurious emission .....              | 18 |
| 4.5 Radiated Emission .....                                    | 23 |
| APPENDIX A – Test Equipment Used For Tests .....               | 30 |
| APPENDIX B – EUT Photographs .....                             | 31 |

|                                                                                                                                                                              |                                                                                                                                               |                                                        |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|
|  <b>CTK Co., Ltd.</b><br><small>The Prime Leader of Global Regulatory Certification</small> | <b>CTK Co., Ltd.</b><br>(Ho-dong), 113, Yejik-ro, Cheoin-gu,<br>Yongin-si, Gyeonggi-do, Korea<br>Tel: +82-31-339-9970<br>Fax: +82-31-624-9501 | Report No.:<br>CTK-2017-01952<br>Page (4) / (31) Pages |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|

## 1. General Product Description

### 1.1 Client Information

|                       |                                                                                                      |
|-----------------------|------------------------------------------------------------------------------------------------------|
| <b>Company</b>        | SOLUM CO.,LTD.                                                                                       |
| <b>Contact Point</b>  | A-Tower 6th Floor, 357 Guseong-ro,Giheung-gu,Yongin-si,<br>Gyeonggi-do,Republic of Korea (Zip 16914) |
| <b>Contact Person</b> | Name : Kim Jun Young<br>E-mail : jy.kim1216@solu-m.com<br>Tel : +81 31-8006-0960                     |

### 1.2 Product Information

|                                    |                                                                                                                                              |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>FCC ID</b>                      | 2AFWN-TG-GR29                                                                                                                                |
| <b>Product Description</b>         | ESL LABEL                                                                                                                                    |
| <b>Model name</b>                  | TG-GR29                                                                                                                                      |
| <b>Variant model</b>               | TG-GR29AMN<br>(TG-GR29 and TG-GR29AMN are no technical difference from each model only except for model name because of marketing purposes.) |
| <b>Operating Frequency</b>         | 2 405 MHz - 2 480 MHz (DSSS)                                                                                                                 |
| <b>RF Output Power</b>             | 4.00 dBm (2.512 mW)                                                                                                                          |
| <b>Antenna Specification</b>       | Antenna type : PCB Antenna<br>Peak Gain : 2.37 dBi                                                                                           |
| <b>Number of channels</b>          | 16                                                                                                                                           |
| <b>Channel Spacing</b>             | 5 MHz                                                                                                                                        |
| <b>Type of Modulation</b>          | OQPSK                                                                                                                                        |
| <b>Power Source</b>                | DC 3.0 V (Coin Battery CR2450)                                                                                                               |
| <b>RF Power setting in Test SW</b> | Initial value                                                                                                                                |

### 1.3 Peripheral Devices

- For Conducted Measurement

| Device            | Manufacturer | Model No.              | Serial No. |
|-------------------|--------------|------------------------|------------|
| Notebook Computer | Dell         | Dell LBL P/N PG967 A02 | 6L567BX    |
| Adapter           | Dell         | HA65NS0-00             | A02        |

- For Radiated Measurement

| Device            | Manufacturer | Model No. | Serial No.   |
|-------------------|--------------|-----------|--------------|
| Notebook Computer | SAMSUNG      | NT-R540   | NT-R540-PA33 |
| Adapter           | SAMSUNG      | NT01      | 09708530     |

## 2. Facility and Accreditations

### 2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

### 2.2 Laboratory Accreditations and Listings

| Country | Agency | Scope of Accreditation                                                                           | Registration Number                | Logo                                                                                  |
|---------|--------|--------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------------------------------------------------|
| USA     | FCC    | FCC Part 15 & 18<br>EMI (Electromagnetic Interference / Emission)                                | 805871                             |    |
| CANADA  | IC     | IC<br>EMI (3/10m test site)                                                                      | 8737A-2                            |    |
| JAPAN   | VCCI   | VCCI V-3<br>EMI (Electromagnetic Interference / Emission)                                        | C-986<br>T-1843<br>R-3627<br>G-387 |   |
| KOREA   | MSIP   | EMI (Electromagnetic Interference / Emission)<br>EMS (Electromagnetic Susceptibility / Immunity) | KR0025                             |  |

### 2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

### 3. Test Specifications

#### 3.1 Standards

| Section in RSS                                                                                                   | Requirement(s)                      | Status (Note 1) | Test Condition |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------|----------------|
| 15.247(a)                                                                                                        | 6 dB Bandwidth                      | C               | Conducted      |
| 15.247(e)                                                                                                        | Transmitter power spectral density  | C               |                |
| 15.247(b)                                                                                                        | Maximum peak conducted output power | C               |                |
| 15.247(d)                                                                                                        | Unwanted emission                   | C               |                |
| 15.209                                                                                                           | Transmitter emission                | C               | Radiated       |
| 15.207                                                                                                           | AC Conducted Emission               | NA(Note 3)      | Line Conducted |
| <u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable                                        |                                     |                 |                |
| <u>Note 2:</u> The data in this test report are traceable to the national or international standards.            |                                     |                 |                |
| <u>Note 3:</u> The equipment is operated on battery power only.                                                  |                                     |                 |                |
| <u>Note 4:</u> The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013 |                                     |                 |                |
| <u>Note 5:</u> The tests were performed according to the method of measurements prescribed in KDB No.558074.     |                                     |                 |                |

#### 3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.  
 During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.  
 The results are only attached worst cases.

##### Test Frequency

| Lowest channel | Middle channel | Highest channel |
|----------------|----------------|-----------------|
| 2 405 MHz      | 2 445 MHz      | 2 480 MHz       |

##### Test mode

| Modulation | Duty Cycle |
|------------|------------|
| OQPSK      | 100 %      |

### 3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.  
Coverage factor  $k = 2$ , Confidence levels of 95 %

| Description                          | Uncertainty |
|--------------------------------------|-------------|
| Conducted RF Output Power            | 1.5 dB      |
| Occupied Bandwidth                   | 0.1 MHz     |
| Unwanted Emission(conducted)         | 3.0 dB      |
| Radiated Emissions ( $f \leq 1$ GHz) | 4.0 dB      |
| Radiated Emissions ( $f > 1$ GHz)    | 5.0 dB      |

## 4. Technical Characteristic Test

### 4.1 6dB Bandwidth

#### Test Procedures(ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### Test Procedures(ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

#### Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW  $\geq 3 \times$  RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Sweep = auto couple
- f) Allow trace to fully stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### **Limit :**

---

6 dB Bandwidth > 500kHz

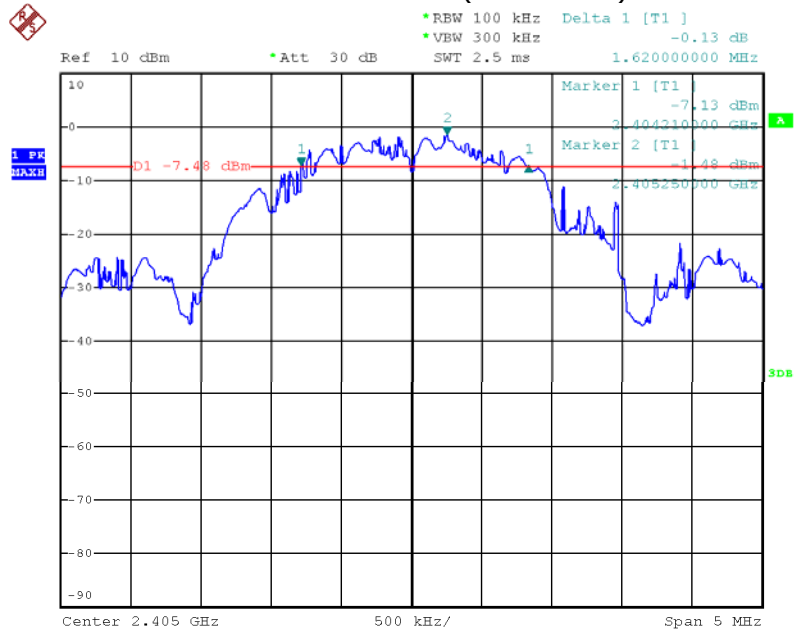
---

**Test Data :**

| Channel | Frequency<br>[MHz] | 6 dB Bandwidth<br>[MHz] | Result   |
|---------|--------------------|-------------------------|----------|
| Low     | 2 405              | 1.62                    | Complies |
| Middle  | 2 445              | 1.82                    | Complies |
| High    | 2 480              | 1.70                    | Complies |

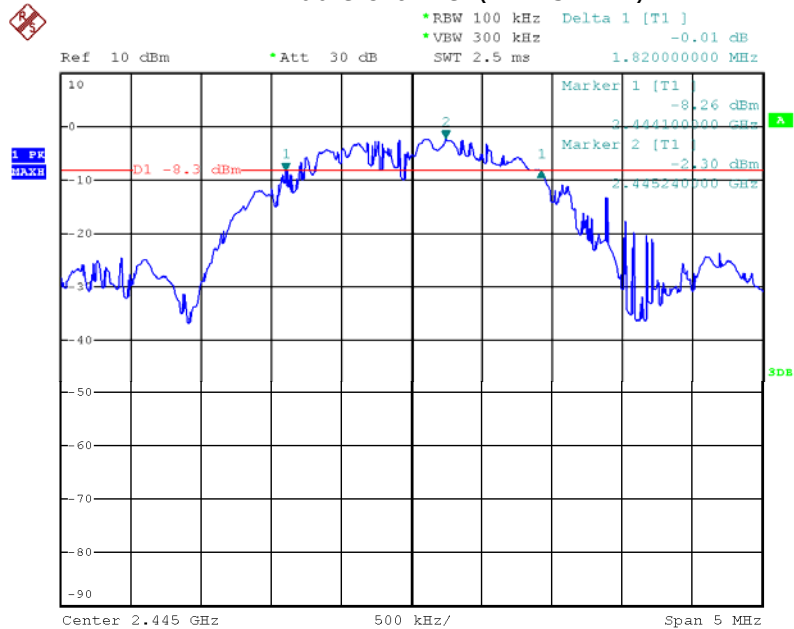
See next pages for actual measured spectrum plots.

### 6dB Bandwidth Low channel (2 405 MHz)

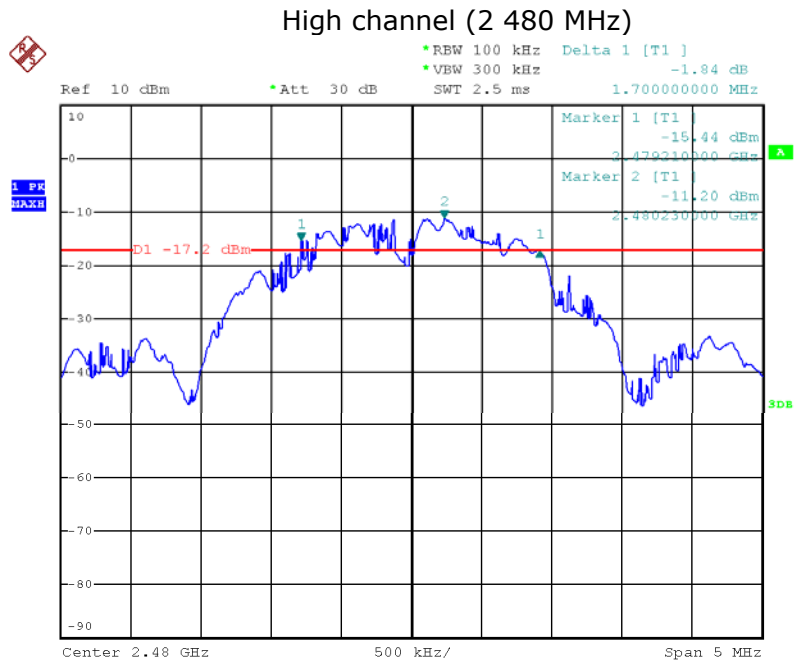


Date: 30.SEP.2017 15:24:39

### Middle channel (2 445 MHz)



Date: 30.SEP.2017 15:26:54



Date: 30.SEP.2017 15:19:05

## 4.2 Maximum peak Conducted Output Power

### Test Procedures(ANSI C63.10-2013 11.9.1)

The following procedure can be used when the maximum available RBW of the instrument is less than the DTS bandwidth:

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

- a)  $RBW \geq DTS \text{ Bandwidth}$
- b)  $VBW \geq 3 \times RBW$
- c)  $span \geq 3 \times RBW$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode= max hold
- g) Allow trace to fully stabilize
- h) Use peak marker function to determine the peak amplitude level.

#### **Limit :**

---

Maximum Output Power < 1 W (30 dBm)

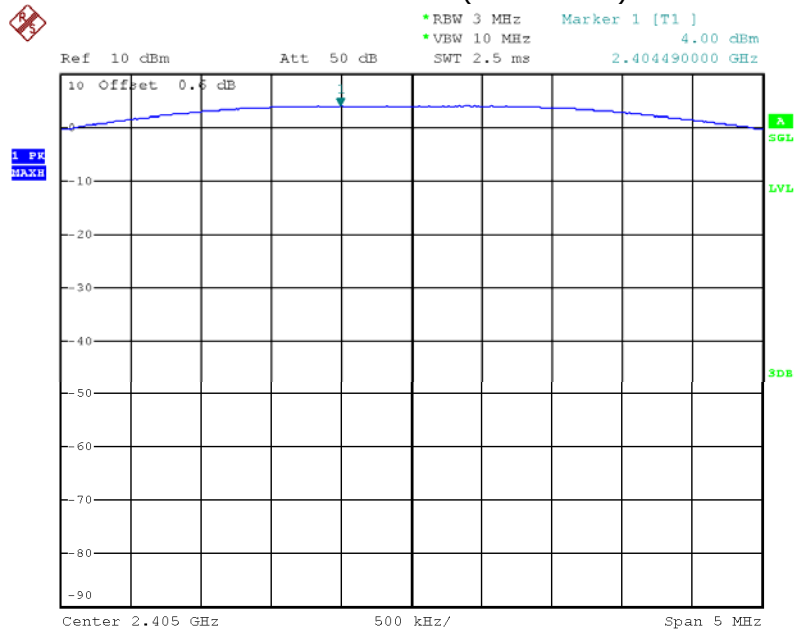
---

#### **Test Data :**

| Channel | Frequency [MHz] | Measurement data [dBm] | Limit [dBm] | Result   |
|---------|-----------------|------------------------|-------------|----------|
| Low     | 2 405           | 4.00                   | 30          | Complies |
| Middle  | 2 445           | 3.66                   | 30          | Complies |
| High    | 2 480           | -4.82                  | 30          | Complies |

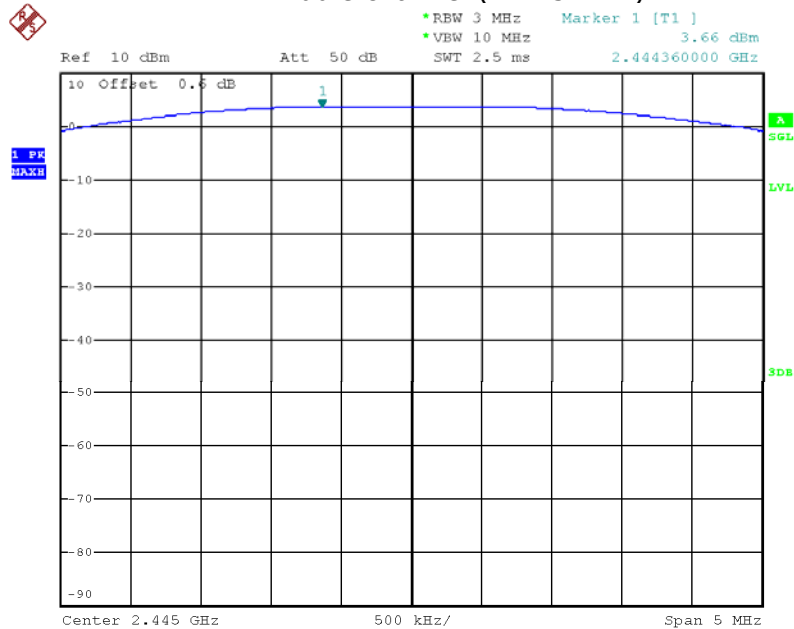
See next pages for actual measured spectrum plots.

### Low channel (2 405 MHz)

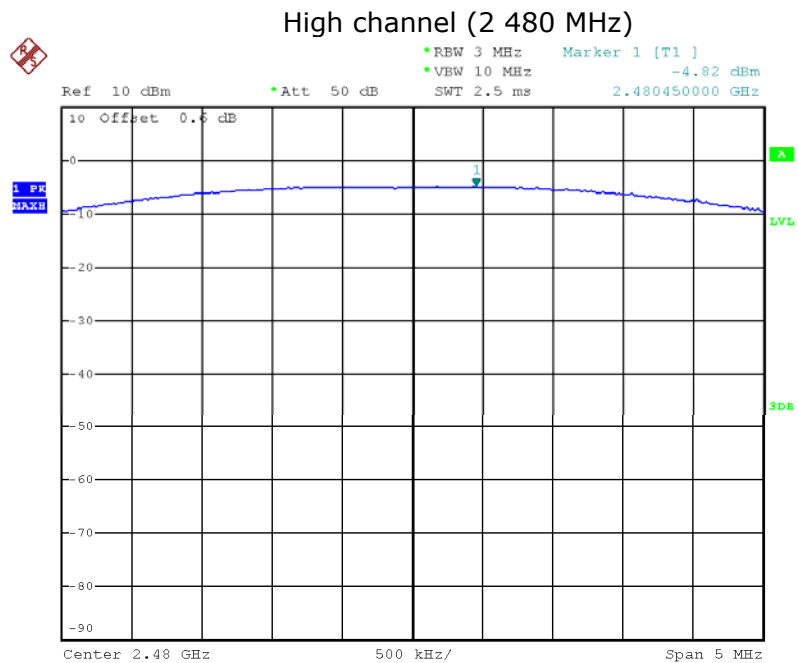


Date: 30.SEP.2017 15:08:51

### Middle channel (2 445 MHz)



Date: 30.SEP.2017 15:11:20



Date: 30.SEP.2017 15:16:01

## 4.3 Power Spectral Density

### Test Procedures(ANSI C63.10-2013 11.10.2)

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

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW :  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW  $\geq 3 \times \text{RBW}$
- c) span  $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode= max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.

#### **Limit :**

---

Power Spectral Density < 8 dBm @ 3 kHz BW

---

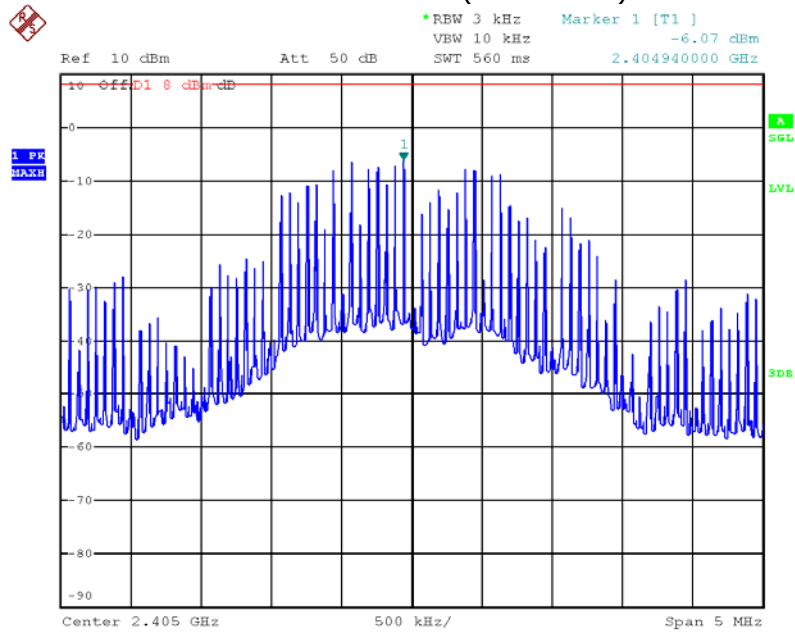
#### **Test Data :**

##### **Test mode**

| Channel | Frequency [MHz] | Measurement data [dBm] | Limit [dBm] | Result   |
|---------|-----------------|------------------------|-------------|----------|
| Low     | 2 405           | -6.07                  | 8           | Complies |
| Middle  | 2 445           | -6.38                  | 8           | Complies |
| High    | 2 480           | -15.30                 | 8           | Complies |

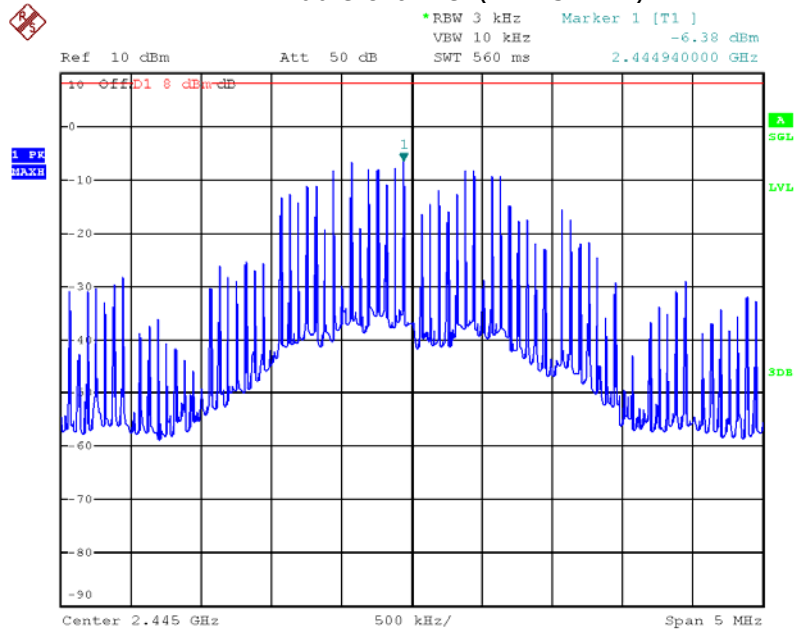
See next pages for actual measured spectrum plots.

### Low channel (2 405 MHz)

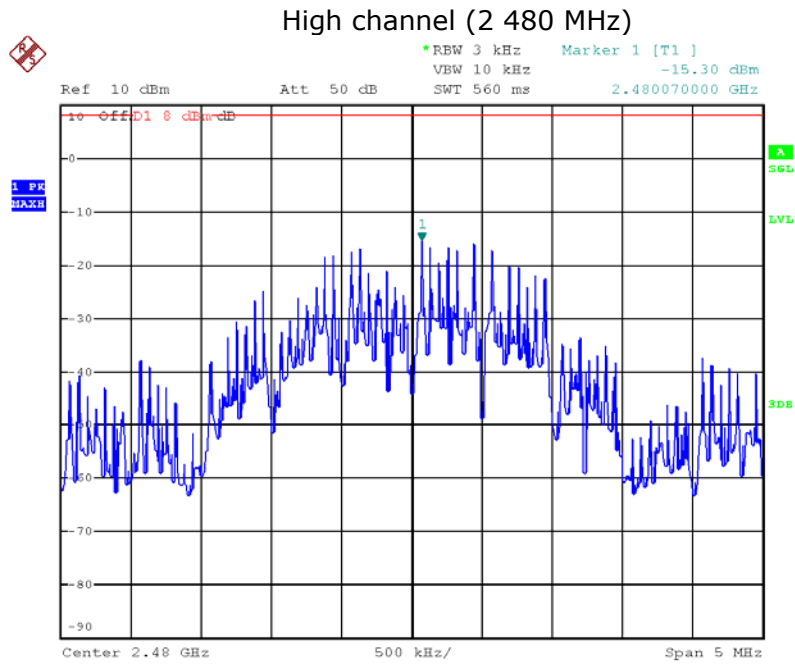


Date: 30.SEP.2017 15:09:08

### Middle channel (2 445 MHz)



Date: 30.SEP.2017 15:11:37



Date: 30.SEP.2017 15:16:18

|                                                                                                                                                                                 |                                                                                                                                               |                                                         |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--|
| <br><b>CTK Co., Ltd.</b><br><small>The Prime Leader of Global Regulatory Certification</small> | <b>CTK Co., Ltd.</b><br>(Ho-dong), 113, Yejik-ro, Cheoin-gu,<br>Yongin-si, Gyeonggi-do, Korea<br>Tel: +82-31-339-9970<br>Fax: +82-31-624-9501 | Report No.:<br>CTK-2017-01952<br>Page (18) / (31) Pages |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--|

## 4.4 Band Edge & Conducted Spurious emission

### Test Procedures(ANSI C63.10-2013 11.11.3)

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW  $\geq 3 \times$  RBW
- c) Detector = peak
- d) Sweep time = auto couple
- e) Trace mode= max hold
- f) Allow trace to fully stabilize
- g) Use the peak marker function to determine the maximum amplitude level.

#### **Limit :**

---

Emission level < 20 dBc

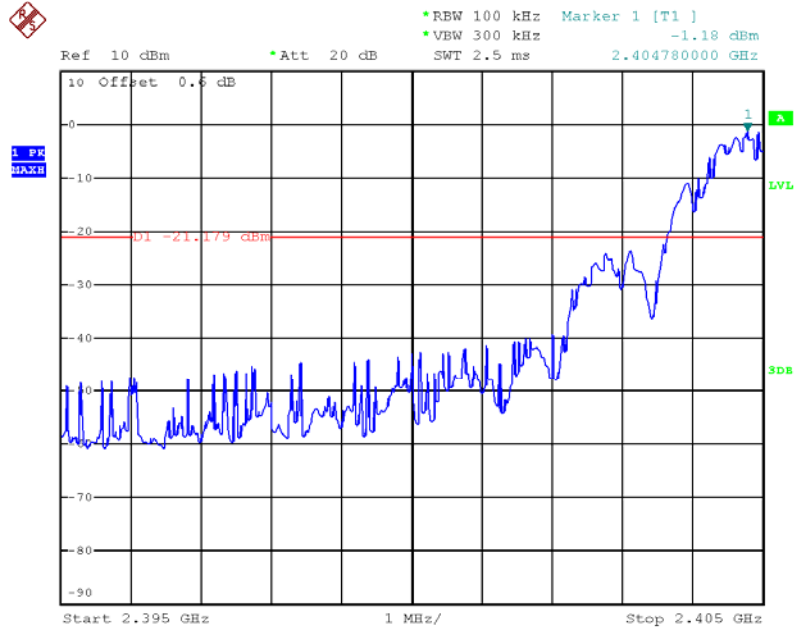
---

#### **Test results: Complies**

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest in-band spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.

## Band-edge



Date: 30.SEP.2017 15:24:56

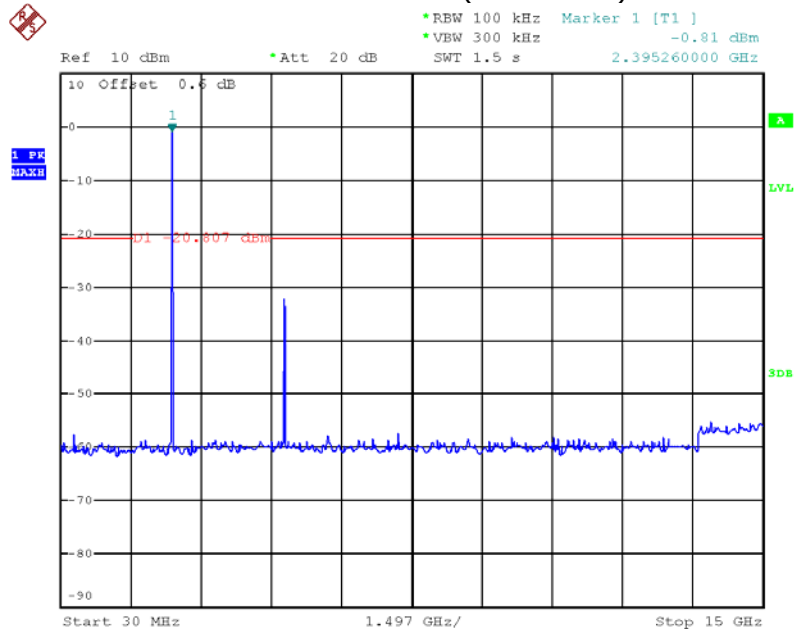


Date: 30.SEP.2017 15:20:41

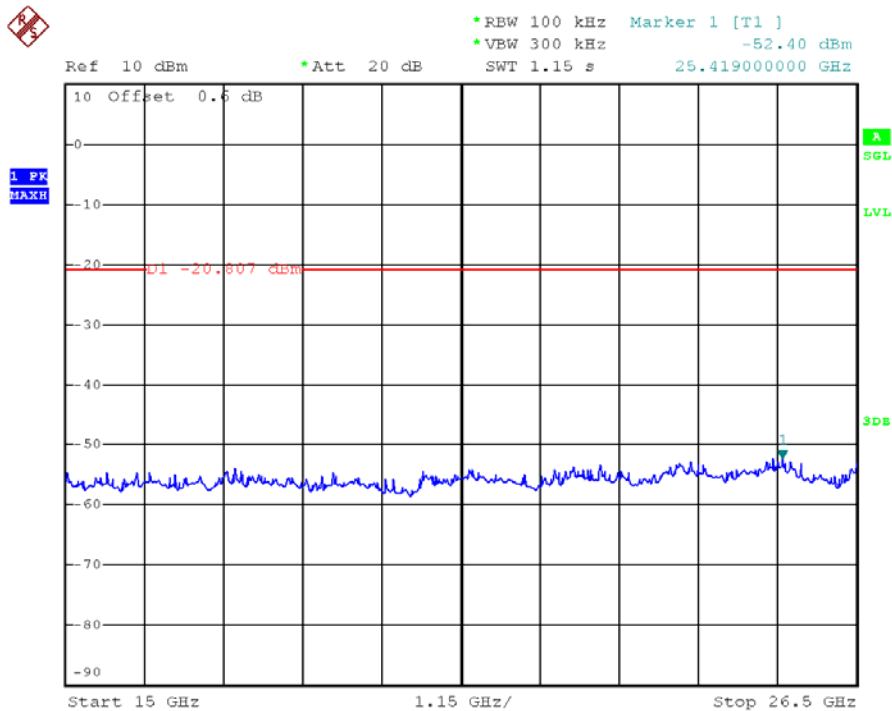
## Conducted Spurious emission

Test mode : Transmit

Low channel (2 405 MHz)

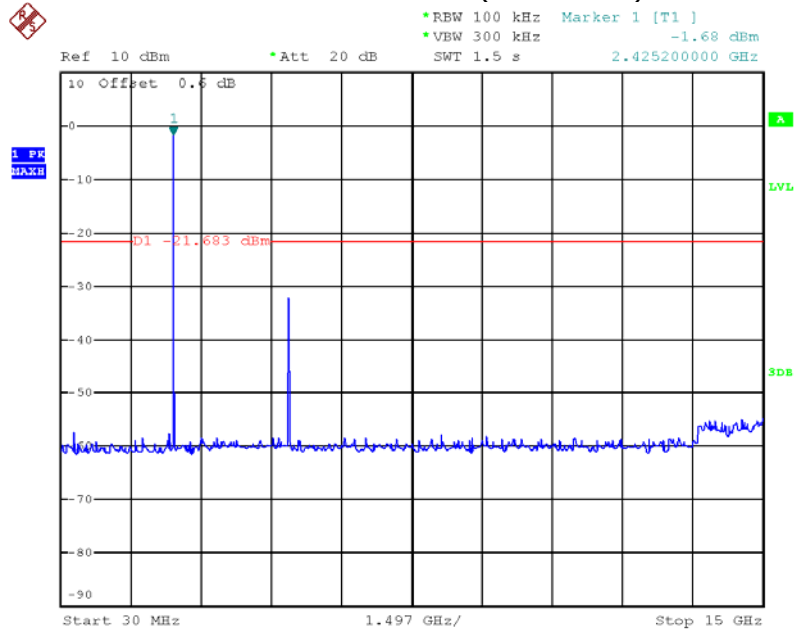


Date: 30.SEP.2017 15:09:52

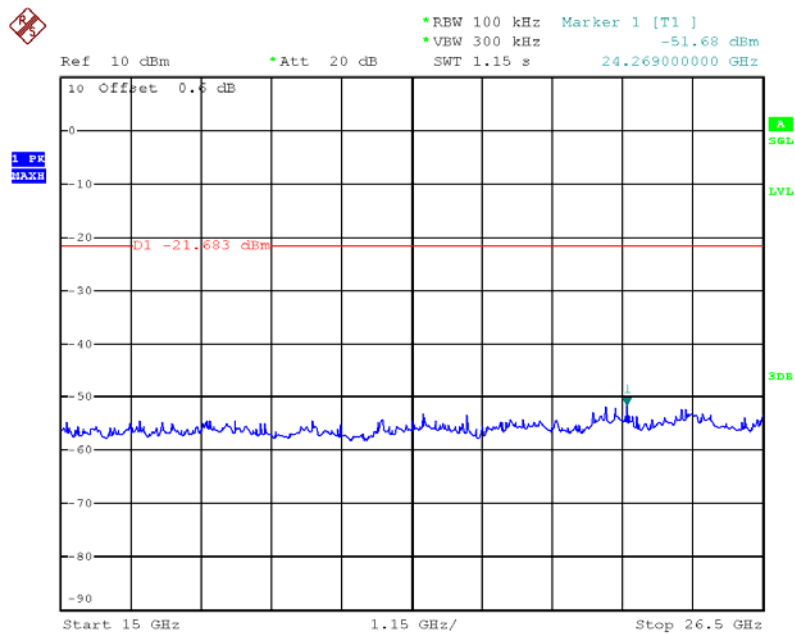


Date: 30.SEP.2017 15:10:06

### Middle channel (2 445 MHz)

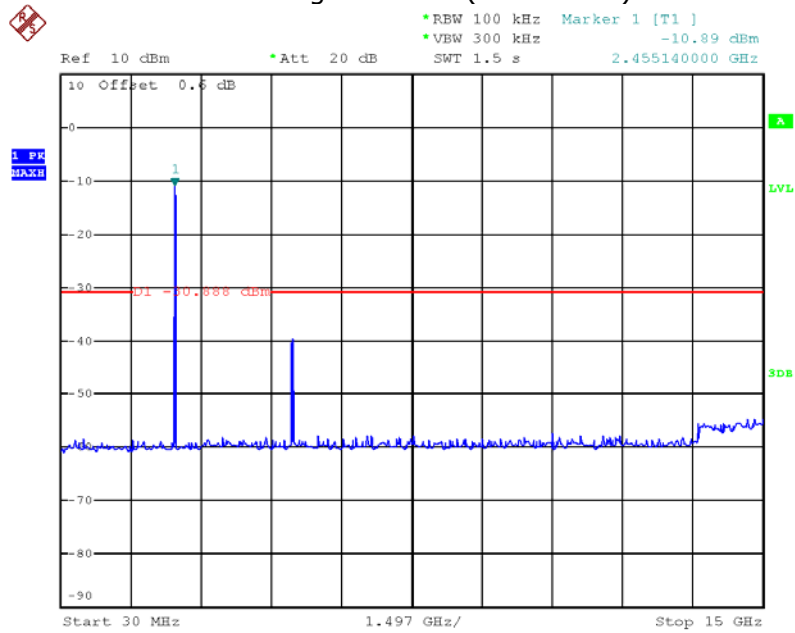


Date: 30.SEP.2017 15:12:21

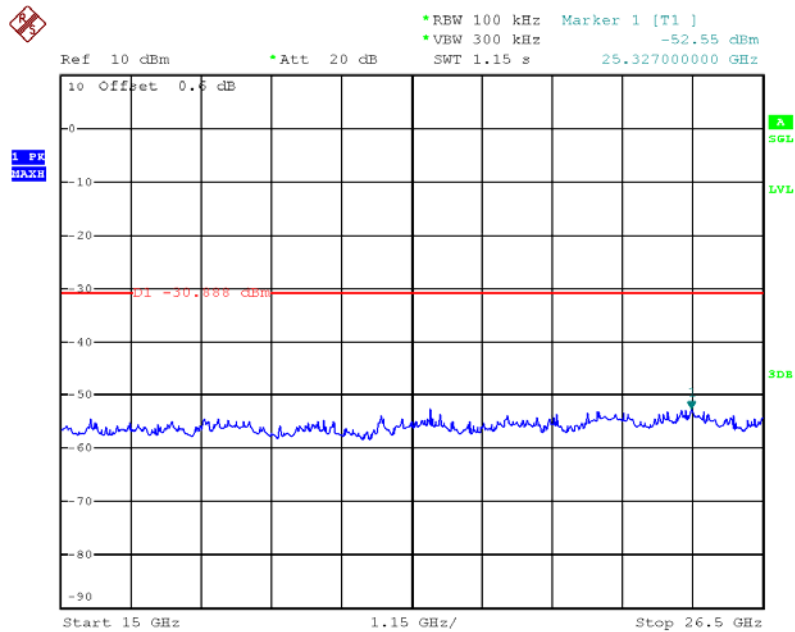


Date: 30.SEP.2017 15:12:35

### High channel (2 480 MHz)



Date: 30.SEP.2017 15:19:59



Date: 30.SEP.2017 15:20:13

|                                                                                                                                                                       |                                                                                                                                                          |                                                                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--|
|  <p><b>CTK Co., Ltd.</b><br/>The Prime Leader of Global Regulatory Certification</p> | <p><b>CTK Co., Ltd.</b><br/>(Ho-dong), 113, Yejik-ro, Cheoin-gu,<br/>Yongin-si, Gyeonggi-do, Korea<br/>Tel: +82-31-339-9970<br/>Fax: +82-31-624-9501</p> | <p>Report No.:<br/>CTK-2017-01952<br/>Page (23) / (31) Pages</p> |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--|

## 4.5 Radiated Emission

### Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)  
☒ 3 m SAC (test distance : 3 m)

### Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

### Instrument Settings

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10<sup>th</sup> harmonic)

- a) RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz, 9 kHz for  $f < 30$  MHz
- b) VBW  $\geq$  RBW
- c) Sweep time = auto couple

## Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

**Table 1. Restricted Frequency Bands**

| MHz                      | MHz               | MHz                 | MHz           | MHz         | GHz                     |
|--------------------------|-------------------|---------------------|---------------|-------------|-------------------------|
| 0.09-0.11                | 8.37626-8.38675   | 73-74.6             | 399.9-410     | 2690-2900   | 10.6-12.7               |
| <sup>1</sup> 0.495-0.505 | 8.41425-8.41475   | 74.8-75.2           | 608-614       | 3260-3267   | 13.25-13.4              |
| 2.1735-2.1905            | 12.29-12.293      | 108-121.94          | 960-1240      | 3332-3339   | 14.47-14.5              |
| 4.125-4.128              | 12.51975-12.52025 | 123-138             | 1300-1427     | 3345.8-3358 | 15.35-16.2              |
| 4.17725-4.17775          | 12.57675-12.57725 | 149.9-150.05        | 1435-1626.5   | 3600-4400   | 17.7-21.4               |
| 4.20725-4.20775          | 13.36-13.41       | 156.52475-156.52525 | 1645.5-1646.5 | 4500-5150   | 22.01-23.12             |
| 6.215-6.218              | 16.42-16.423      | 156.7-156.9         | 1660-1710     | 5350-5460   | 23.6-24                 |
| 6.26775-6.26825          | 16.69475-16.69525 | 162.0125-167.17     | 1718.8-1722.2 | 7250-7750   | 31.2-31.8               |
| 6.31175-6.31225          | 16.80425-16.80475 | 167.72-173.2        | 2200-2300     | 8025-8500   | 36.43-36.5              |
| 8.291-8.294              | 25.5-25.67        | 240-285             | 2310-2390     | 9000-9200   | <sup>2</sup> Above 38.6 |
| 8.362-8.366              | 37.5-38.25        | 322-335.4           | 2483.5-2500   | 9300-9500   |                         |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

| Frequency(MHz) | Field Strength<br>uV/m@3m | Field Strength<br>dBuV/m@3m | Measurement<br>Distance (meters) |
|----------------|---------------------------|-----------------------------|----------------------------------|
| 0.009-0.490    | 2400/F(kHz)               | -                           | 300                              |
| 0.490-1.705    | 24000/F(kHz)              | -                           | 30                               |
| 1.705-30       | 30                        | -                           | 30                               |
| 30-88          | 100**                     | 40                          | 3                                |
| 88-216         | 150**                     | 43.5                        | 3                                |
| 216-960        | 200**                     | 46                          | 3                                |
| Above 960      | 500                       | 54                          | 3                                |

\*\* Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

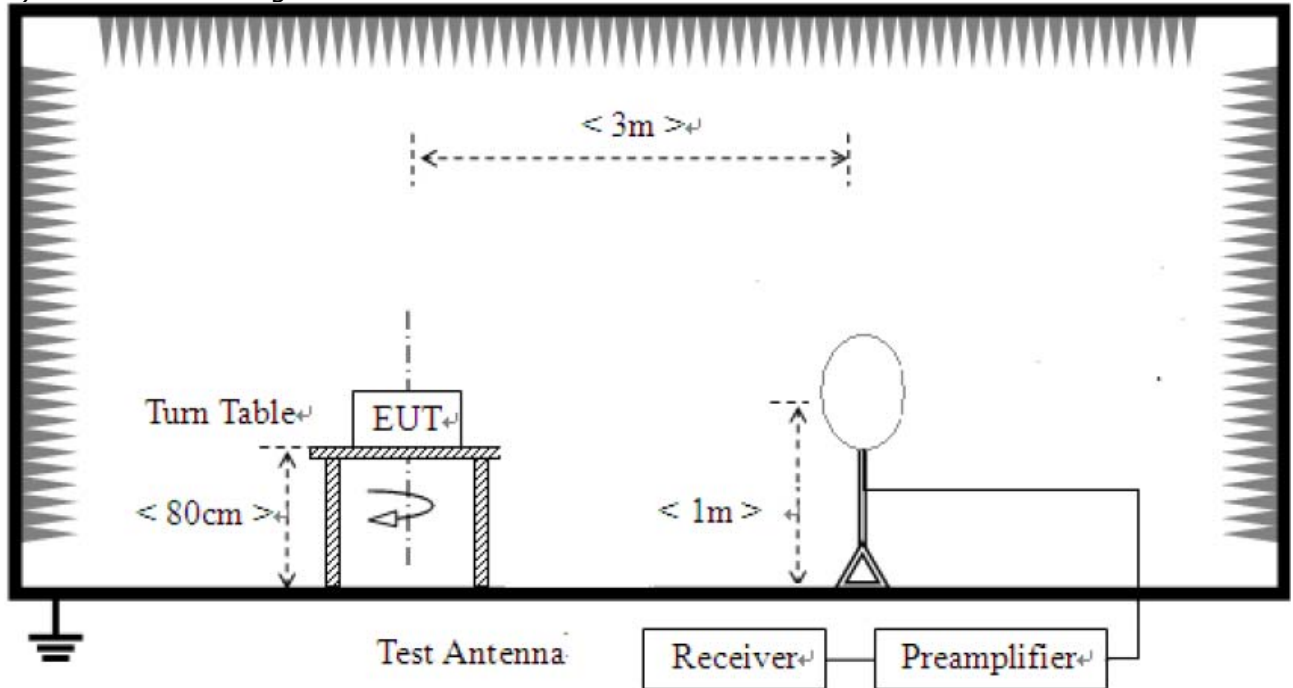
Note :

- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- 3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.(Duty Cycle is > 98%,)

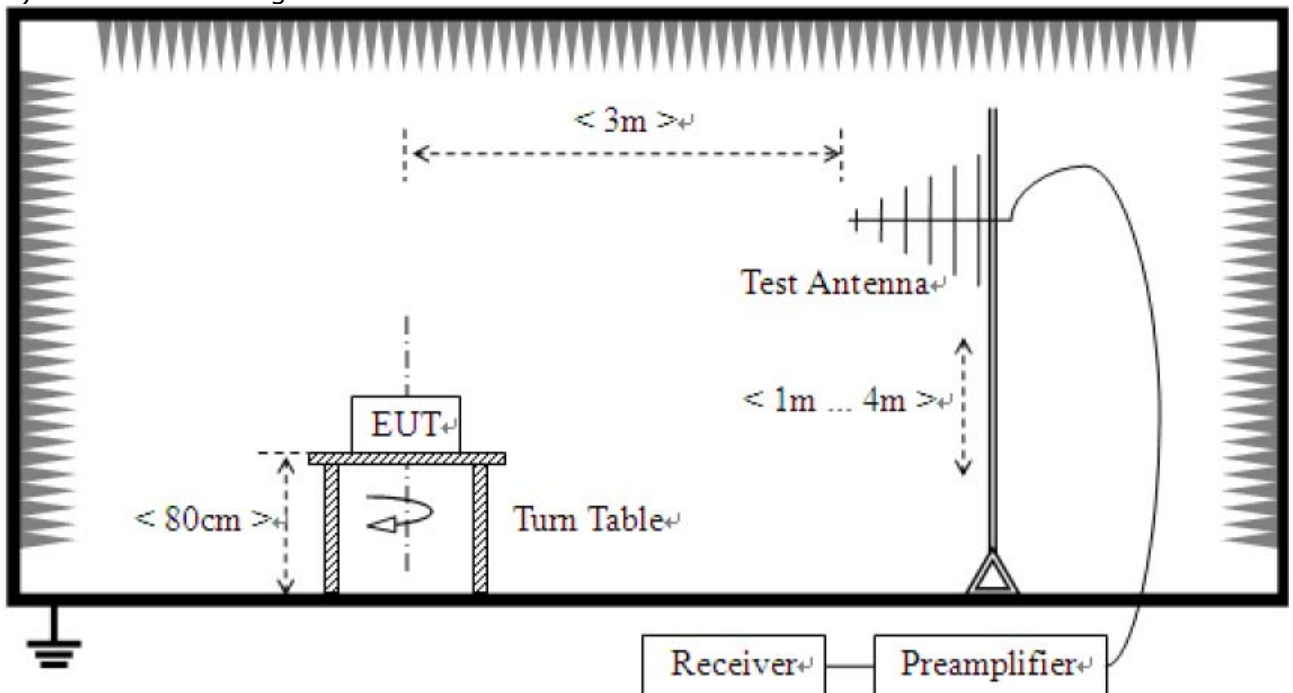
Duty Cycle is < 98%, VBW setting will need to > 1/T.

## Test Setup:

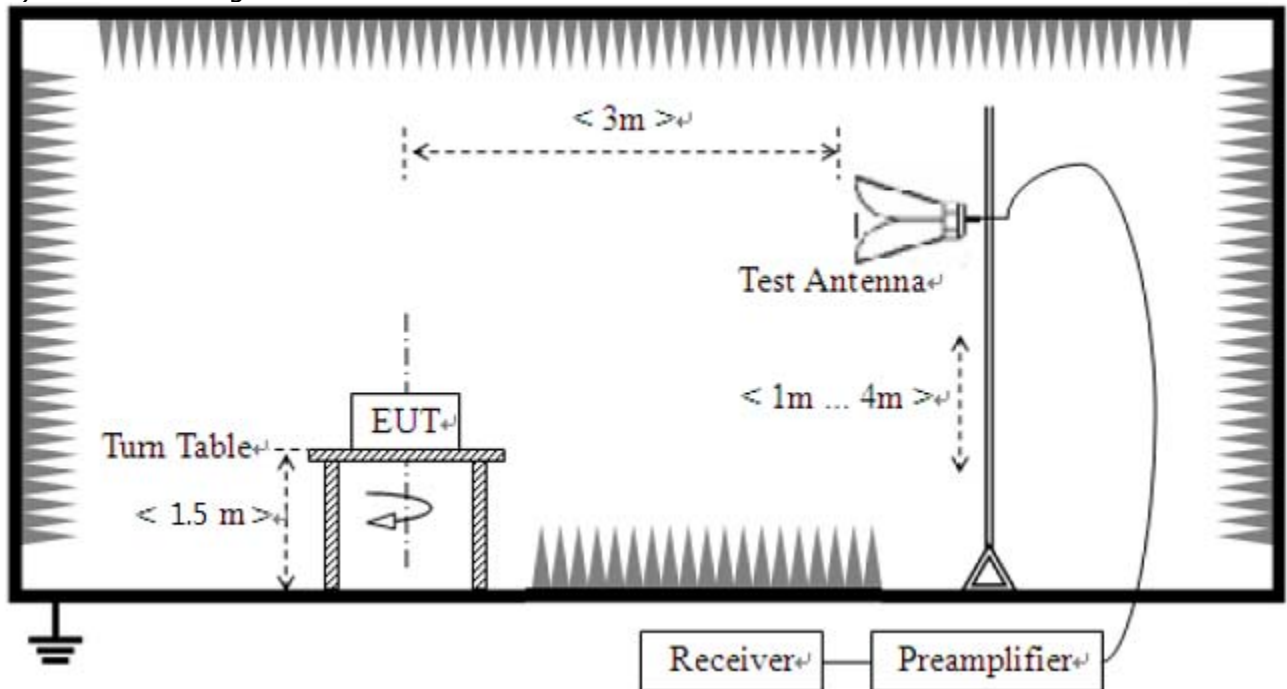
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



**Test results**

**1) 9 kHz to 30 MHz**

The requirements are:

☒ Complies

| Frequency (MHz) | Measured Data (dBuV/m) | Margin (dB) | Remark   |
|-----------------|------------------------|-------------|----------|
| -               | -                      | -           | See note |

**Note :**

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)

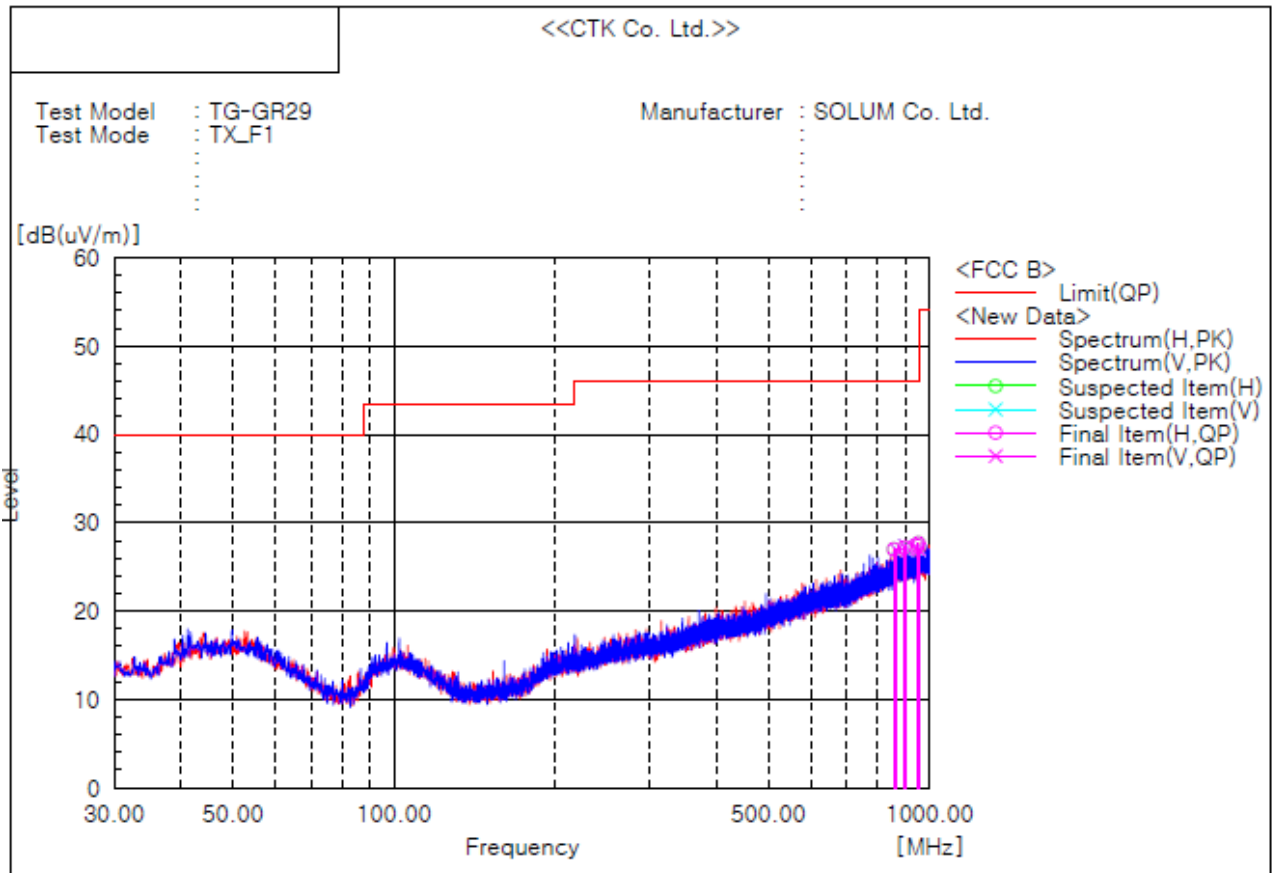
## 2) 30 MHz to 1 GHz

**Test mode : Transmit, Lowest Channel(Worst case)**

The requirements are:

☒ Complies

### Test Data



### Final Result

| No. | Frequency (P) | Reading     | c.f       | Result        | Limit         | Margin  | Angle | Remark |
|-----|---------------|-------------|-----------|---------------|---------------|---------|-------|--------|
|     | [MHz]         | QP [dB(uV)] | [dB(1/m)] | QP [dB(uV/m)] | QP [dB(uV/m)] | QP [dB] | [deg] |        |
| 1   | 856.422       | H 31.6      | -4.6      | 27.0          | 46.0          | 19.0    | 291.3 |        |
| 2   | 866.851       | V 31.3      | -4.4      | 26.9          | 46.0          | 19.1    | 17.9  |        |
| 3   | 896.682       | H 31.3      | -4.1      | 27.2          | 46.0          | 18.8    | 356.1 |        |
| 4   | 899.471       | V 31.4      | -4.0      | 27.4          | 46.0          | 18.6    | 47.9  |        |
| 5   | 944.946       | V 30.6      | -3.5      | 27.1          | 46.0          | 18.9    | 196.5 |        |
| 6   | 949.554       | H 30.9      | -3.5      | 27.4          | 46.0          | 18.6    | 197.7 |        |
| 7   | 952.100       | H 31.2      | -3.5      | 27.7          | 46.0          | 18.3    | 54.5  |        |
| 8   | 954.041       | V 30.5      | -3.5      | 27.0          | 46.0          | 19.0    | 1.8   |        |

### Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(X,Y axis), lie-down position(Z axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

### 3) above 1 GHz

The requirements are:

☒ Complies

#### Test Data

Low(2 405 MHz)

| Frequency<br>[MHz] | (P) | (m) | Reading<br>AV / PK<br>[dBuV / m] | Correction<br>Factor | Result<br>AV / PK<br>[dBuV / m] | Limit<br>AV / PK<br>[dBuV / m] | Margin<br>AV / PK<br>[dB] |
|--------------------|-----|-----|----------------------------------|----------------------|---------------------------------|--------------------------------|---------------------------|
| 2389.20            | V   | 2   | 33.55 / 46.19                    | -3.91                | 29.64 / 42.28                   | 54.00 / 74.00                  | 24.36 / 31.72             |
| 4809.06            | V   | 2   | 45.55 / 53.30                    | 1.32                 | 46.87 / 54.62                   | 54.00 / 74.00                  | 7.13 / 19.38              |

Mid(2 445 MHz)

| Frequency<br>[MHz] | (P) | (m) | Reading<br>AV / PK<br>[dBuV / m] | Correction<br>Factor | Result<br>AV / PK<br>[dBuV / m] | Limit<br>AV / PK<br>[dBuV / m] | Margin<br>AV / PK<br>[dB] |
|--------------------|-----|-----|----------------------------------|----------------------|---------------------------------|--------------------------------|---------------------------|
| 4889.04            | V   | 2   | 45.22 / 53.16                    | 1.32                 | 46.54 / 54.48                   | 54.00 / 74.00                  | 7.46 / 19.52              |

High(2 480 MHz)

| Frequency<br>[MHz] | (P) | (m) | Reading<br>AV / PK<br>[dBuV / m] | Correction<br>Factor | Result<br>AV / PK<br>[dBuV / m] | Limit<br>AV / PK<br>[dBuV / m] | Margin<br>AV / PK<br>[dB] |
|--------------------|-----|-----|----------------------------------|----------------------|---------------------------------|--------------------------------|---------------------------|
| 2483.50            | V   | 2   | 52.56 / 59.06                    | -3.74                | 48.82 / 55.32                   | 54.00 / 74.00                  | 5.18 / 18.68              |
| 4959.06            | V   | 2   | 35.65 / 45.96                    | 1.42                 | 37.07 / 47.38                   | 54.00 / 74.00                  | 16.93 / 26.62             |

#### Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(X, Y axis), lie-down position(Z axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.

## APPENDIX A – Test Equipment Used For Tests

|    | Name of Equipment           | Manufacturer    | Model No. | Serial No.    | Date of Calibration | Due Date   |
|----|-----------------------------|-----------------|-----------|---------------|---------------------|------------|
| 1  | Signal Analyzer             | R&S             | FSP30     | 100994        | 2016-11-01          | 2017-11-01 |
| 2  | MXG Vector Signal Generator | Agilent         | N5182A    | MY50143486    | 2017-02-03          | 2018-02-03 |
| 3  | EMI Test Receiver           | Rohde & Schwarz | ESCI7     | 100814        | 2016-11-01          | 2017-11-01 |
| 4  | Bilog Antenna               | Schaffner       | CBL6111C  | 2551          | 2016-05-13          | 2018-05-13 |
| 5  | Active Loop Antenna         | SCHWARZBECK     | FMZB 1513 | 1513-126      | 2016-05-25          | 2018-05-25 |
| 6  | 6dB Attenuator              | R&S             | DNF       | 272.4110.50-2 | 2016-11-01          | 2017-11-01 |
| 7  | 6dB Attenuator              | R&S             | DNF       | 272.4110.50-1 | 2017-02-03          | 2018-02-03 |
| 8  | AMPLIFIER                   | SONOMA          | 310       | 291721        | 2017-02-02          | 2018-02-02 |
| 9  | EMI Test Receiver           | Rohde & Schwarz | ESU40     | 100336        | 2017-05-12          | 2018-05-12 |
| 10 | Preamplifier                | Agilent         | 8449B     | 3008A02011    | 2016-12-01          | 2017-12-01 |
| 11 | Horn Antenna                | ETS-Lindgren    | 3115      | 00078895      | 2017-04-25          | 2019-04-25 |
| 12 | Horn Antenna                | ETS-Lindgren    | 3116      | 00062916      | 2017-04-25          | 2019-04-25 |
| 13 | Active Loop Antenna         | SCHWARZBECK     | FMZB 1513 | 1513-125      | 2017-05-16          | 2018-05-16 |
| 14 | Band Reject Filter          | Micro Tronics   | BRM50702  | G233          | 2017-02-03          | 2018-02-03 |
| 15 | DC Power Supply             | Agilent         | E3632A    | MY40011638    | 2016-11-01          | 2017-11-01 |

## APPENDIX B – EUT Photographs

