

# TEST REPORT



**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-2020-00939  
Page (1) / (30) Pages

## 1. Client

- Name : SOLUM CO.,LTD.
- Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea
- Date of Receipt : 2020-02-04

## 2. Manufacturer

- Name #1 : SOLUM CO.,LTD.
- Address #1 : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea
- Name #2 : SOLUM VINA CO., LTD
- Address #2 : Plot B3, Ba Thien 2 Industrial park, Thien Ke Ward, Binh Xuyen District, Vinh Phuc Province, 281200., People's Republic of Vietnam

**3. Use of Report :** For FCC Certification & Canadian Certification

**4. Test Sample / Model :** ESL Gateway / SLG-EP101S

**5. Date of Test :** 2020-02-08 to 2020-02-25

**6. Test Standard(method) used :** FCC 47 CFR part 15 subpart C 15.249,  
RSS-210, RSS-Gen

**7. Testing Environment :** Temp.: (23 ± 2) °C, Humidity: (51 ± 3) % 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                  | Technical Manager           |
|             | Bong-seok Kim: (Signature) | Young-taek Lee: (Signature) |

2020-02-25

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

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**REPORT REVISION HISTORY**

| Date       | Revision                | Page No |
|------------|-------------------------|---------|
| 2020-02-25 | Issued (CTK-2020-00939) | all     |
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## 1. General Product Description

### 1.1 Client Information

|                       |                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------|
| <b>Company</b>        | SOLUM CO.,LTD.                                                                    |
| <b>Contact Point</b>  | 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea |
| <b>Contact Person</b> | Name : YANG CHANG SOO<br>E-mail : cs.yang@solu-m.com<br>Tel : +82-31-8006-7650    |

### 1.2 Product Information

|                                         |                                                                                                                                                      |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>FCC ID</b>                           | 2AFWN-SLG-EP101S                                                                                                                                     |
| <b>IC</b>                               | 22800-SLGEP101S                                                                                                                                      |
| <b>Product Description</b>              | ESL Gateway                                                                                                                                          |
| <b>Basic Model name</b>                 | SLG-EP101S                                                                                                                                           |
| <b>Variant Model name</b>               | SLG-EN101S, SLG-ES101S<br>(Variant models have no technical differences with each model except for the model name and color for marketing purposes.) |
| <b>Operating Frequency</b>              | 902.4 - 927.6 MHz                                                                                                                                    |
| <b>RF Output Power</b>                  | Below 94 dBuV/m @ 3 m                                                                                                                                |
| <b>Antenna type</b>                     | Antenna 1 type : PCB antenna<br>Antenna 2 type : PCB antenna                                                                                         |
| <b>Antenna gain</b>                     | Antenna 1 : 3.3 dBi<br>Antenna 2 : 3.3 dBi                                                                                                           |
| <b>Channel Spacing</b>                  | 0.4 MHz                                                                                                                                              |
| <b>Number of channels</b>               | 64                                                                                                                                                   |
| <b>Type of Modulation</b>               | 2-GFSK                                                                                                                                               |
| <b>Power Source</b>                     | DC 48 V(PoE), DC 5 V(Adaptor)                                                                                                                        |
| <b>Firmware Version Id Number(FVIN)</b> | V1.0                                                                                                                                                 |

### 1.3 Peripheral Devices

| Device            | Manufacturer | Model No.         | Serial No.    |
|-------------------|--------------|-------------------|---------------|
| Notebook Computer | HP           | HP Probook 650 G1 | 5CG5114K13    |
| AC Adapter        | HP           | PPP012D-S         | 677777-003    |
| PoE               | NEXT NETWORK | NEXT-PEG4806JT    | -             |
| AC Adapter        | SAMSUNG      | ETA-U90KBK        | DK4F528TS/B-E |

## 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 | Registration Number |
|---------|--------|---------------------|
| USA     | FCC    | 805871              |
| CANADA  | ISED   | 8737A-2             |
| KOREA   | NRRA   | 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

| FCC Part Section(s)                                                                                                                                    | Section in RSS       | Requirement(s)                                              | Status (Note 1) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------|-----------------|
| 15.249(a)                                                                                                                                              | RSS-210 Annex F.1(a) | Field Strength of emissions from intentional radiators      | C               |
| 15.249(d)                                                                                                                                              | RSS-210 Annex F.1(b) | Emissions radiated outside of the specified frequency bands | C               |
| 15.209                                                                                                                                                 | RSS-210 Annex F.1(a) | Radiated Emissions                                          | C               |
| 15.207                                                                                                                                                 | RSS-Gen 8.8          | AC Conducted Emission                                       | C               |
| -                                                                                                                                                      | RSS-Gen              | Occupied bandwidth                                          | C               |
| <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 sample was tested according to the following specification: FCC Part 15.249, ANSI C63.10-2013.<br>RSS-210 Issue 10, RSS-Gen Issue 5 |                      |                                                             |                 |

### 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 |
|----------------|----------------|-----------------|
| 902.4 MHz      | 915.2 MHz      | 927.6 MHz       |

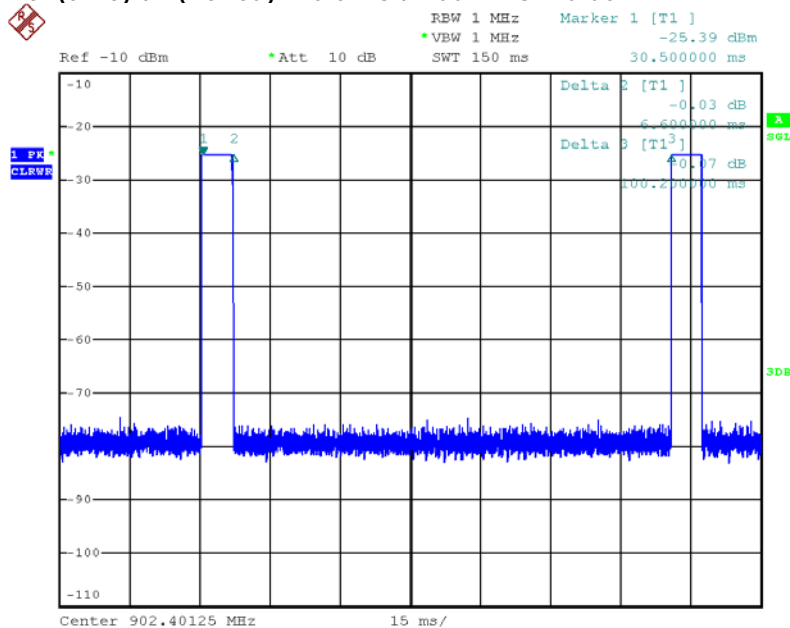
#### Test antenna

| Antenna 1 | Antenna 2 |
|-----------|-----------|
| ANT1      | ANT2      |

#### Test mode

| TX mode    | Duty cycle * |
|------------|--------------|
| Continuous | 0.06 (6%)    |

\*Duty cycle = TX on(time) / T(Period) = 6.6 ms / 100.2 ms = 0.06



Date: 24.FEB.2020 17:13:14

### 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      |
| 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 Band Edge

#### Requirement

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

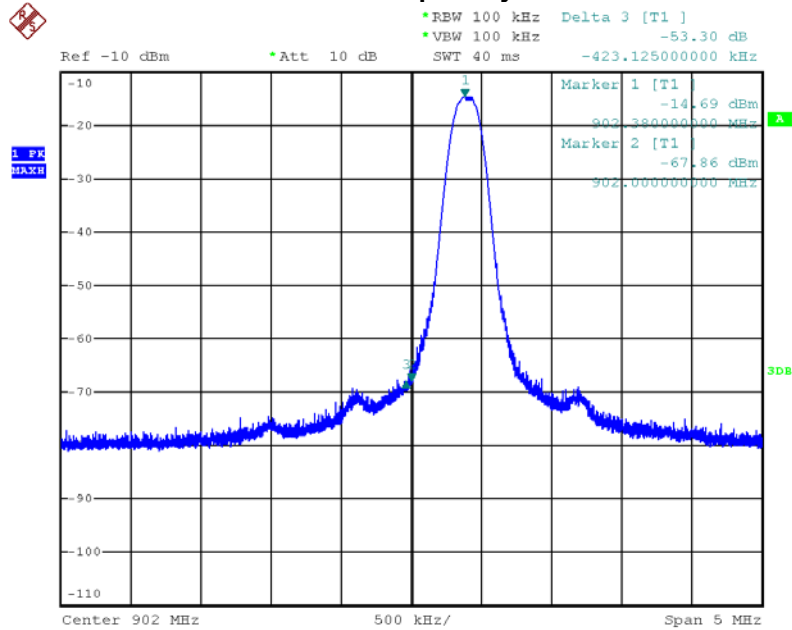
#### Test Procedures(ANSI C63.10-2013 6.10)

- a) Connect the spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).
- b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
- c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation”.
- d) Perform the test as follows:
  - 1) Span : Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
  - 2) RBW : 100 kHz
  - 3) VBW : 300 kHz
  - 4) Detector : Peak
  - 5) Sweep time = Coupled
  - 6) Trace : Max hold
  - 7) Attenuation : Auto(at least 10 dB preferred)
  - 8) Allow trace to fully stabilize
- e) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- f) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).
- g) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

#### Test results: Complies

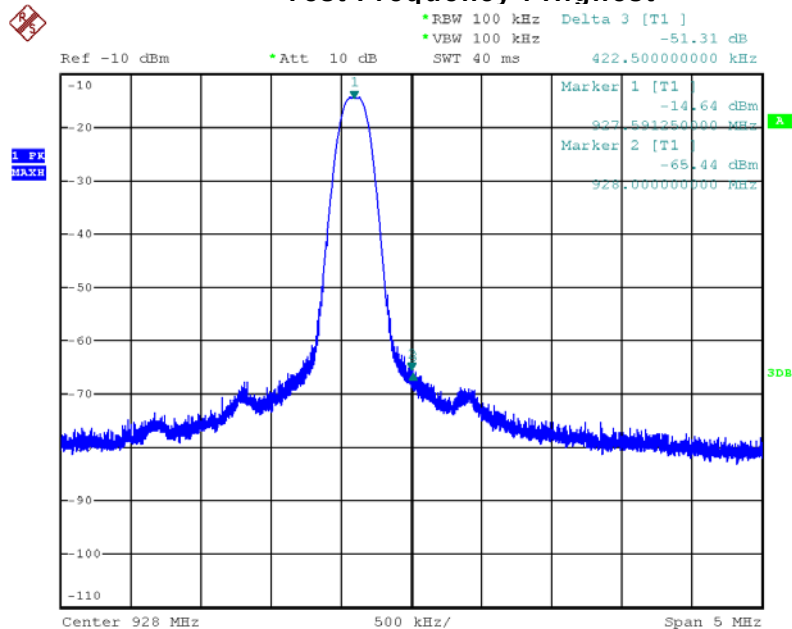
See next pages for actual measured spectrum plots.

**Band-edge**  
**Test Mode : ANT1**  
**Test Frequency : Lowest**



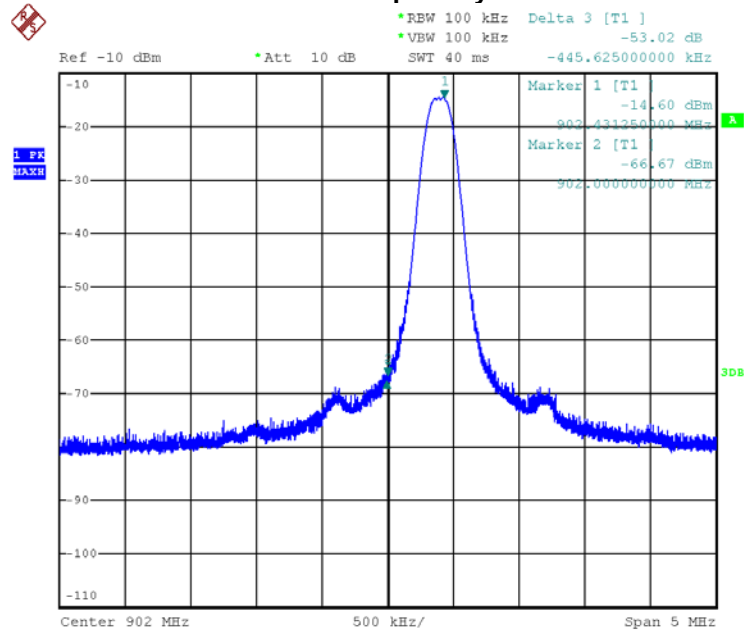
Date: 24.FEB.2020 15:45:36

**Test Frequency : Highest**



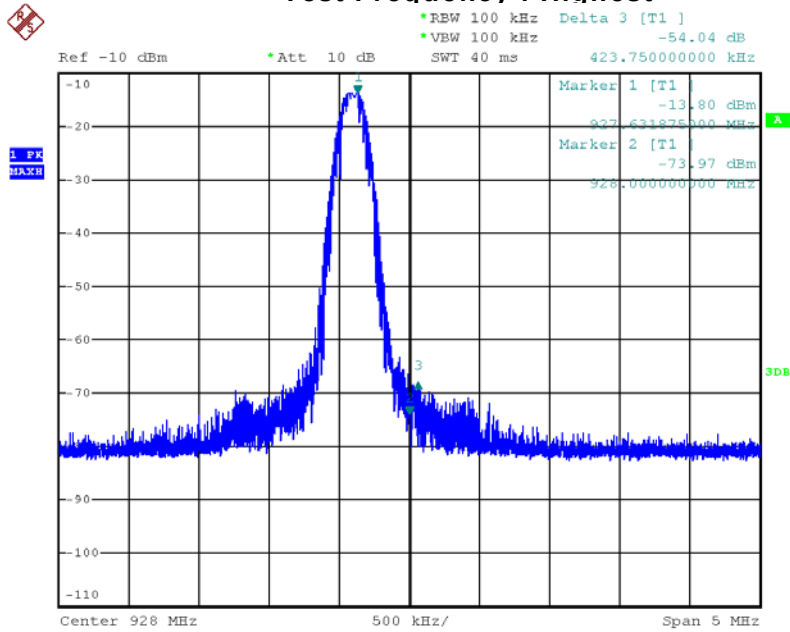
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**Test Mode : ANT2**  
**Test Frequency : Lowest**



Date: 24.FEB.2020 15:59:09

**Test Frequency : Highest**



Date: 24.FEB.2020 15:56:38

|                                                                                                                                                                       |                                                                                                                                                          |                                                                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--|
|  <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-2020-00939<br/>Page (12) / (30) Pages</p> |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--|

## 4.2 Field strength

### 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 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.

#### Test Settings:

Frequency Range = 9 kHz ~ 12.75 GHz (10<sup>th</sup> harmonic)

- a) RBW = 1 MHz for  $f \geq 1$  GHz, 120 kHz for  $f < 1$  GHz, 9 kHz for  $f < 30$  MHz
- b) VBW  $\geq$  RBW
- c) Sweep time = auto couple

## Requirement :

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental | Field strength of harmonics |
|-----------------------|-------------------------------|-----------------------------|
| 902-928 MHz           | 50 mV/m (94 dBuV/m)           | 500 uV/m (54 dBuV/m)        |

Field strength limits are specified at a distance of 3 meters.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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 uV / m | Field Strength dBuV / m | Measurement 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) Average value = Peak value + Duty cycle correction factor(For pulse timing characteristics such as fundamental and harmonic emissions)

Unwanted emissions that do not fall within the restricted frequency bands of Table 1 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

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   |                         |

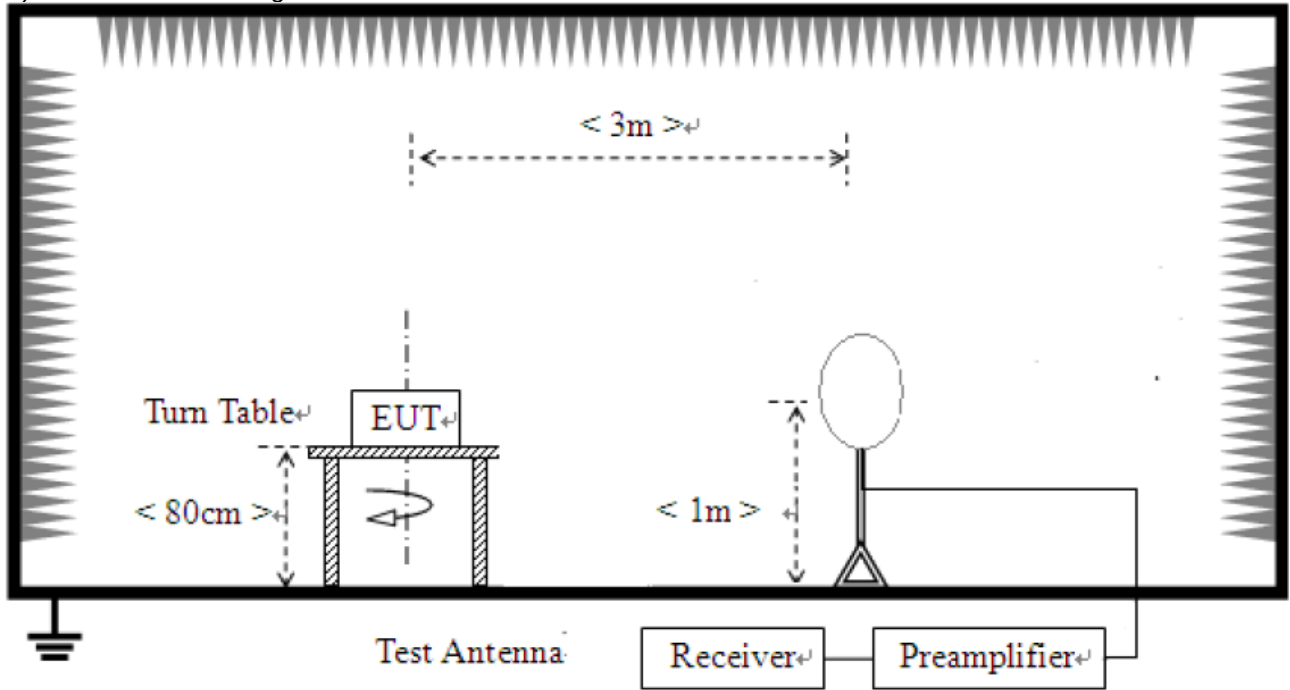
<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

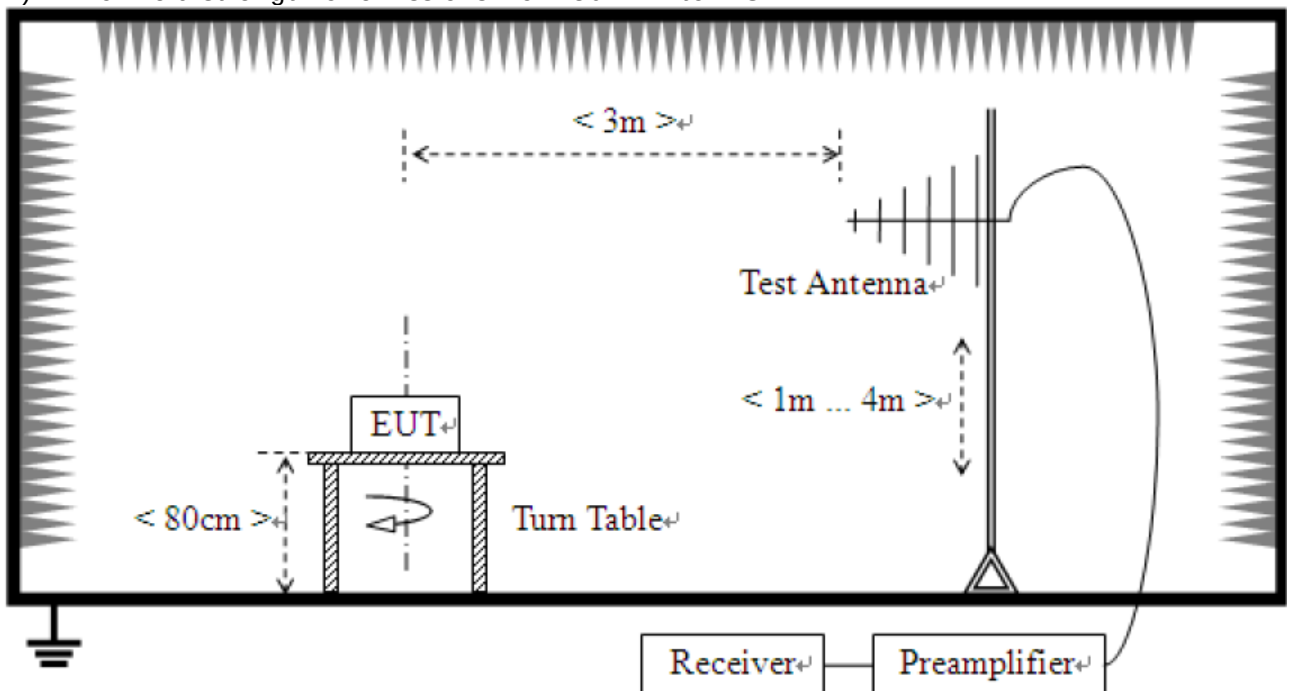
§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using 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.

## Test Setup:

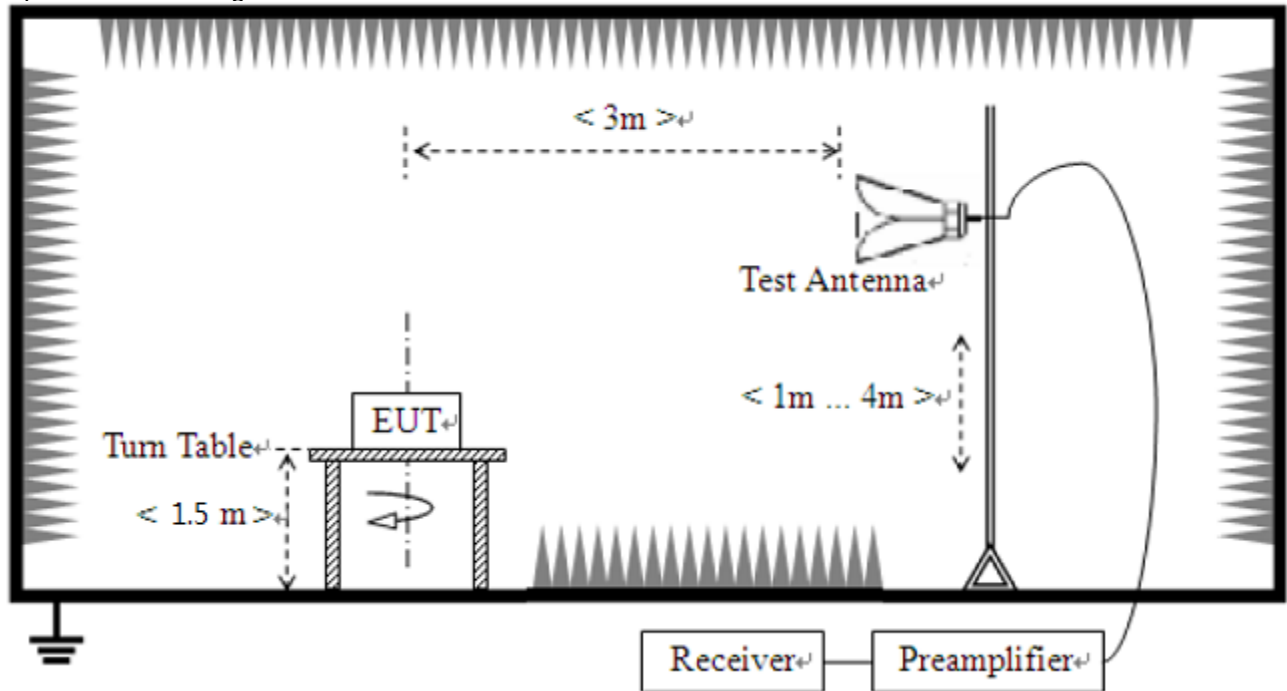
- 1) For field strength of emissions from 9 kHz to 30 MHz



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



3) For field strength of emissions above 1 GHz



## Test Data :

### 1) Field strength of fundamental

The requirements are:

☒ Complies

#### Test mode : Transmit, ANT1

| Frequency [MHz] | Ant. Pol. (V/H) | Reading * [dBuV/m] | C.F [dB/m] | Duty Cycle c.f [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|-----------------|-----------------|--------------------|------------|---------------------|-----------------|----------------|-------------|--------|
| 902.4           | V               | 106.4              | 5.9        | -24.44              | <b>87.86</b>    | 94             | 6.14        |        |
| 915.2           | V               | 105.5              | 6.4        | -24.44              | <b>87.46</b>    | 94             | 6.54        |        |
| 927.6           | V               | 104.6              | 7.2        | -24.44              | <b>87.36</b>    | 94             | 6.64        |        |

#### Test mode : Transmit, ANT2

| Frequency [MHz] | Ant. Pol. (V/H) | Reading * [dBuV/m] | C.F [dB/m] | Duty Cycle c.f [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|-----------------|-----------------|--------------------|------------|---------------------|-----------------|----------------|-------------|--------|
| 902.4           | V               | 105.9              | 5.9        | -24.44              | <b>87.36</b>    | 94             | 6.64        |        |
| 915.2           | V               | 104.9              | 6.4        | -24.44              | <b>86.86</b>    | 94             | 7.14        |        |
| 927.6           | V               | 103.4              | 7.2        | -24.44              | <b>86.16</b>    | 94             | 7.84        |        |

1. Result = Reading + c.f(correction factor) + Duty cycle c.f
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
3. Duty cycle c.f =  $20\log(\text{Duty cycle}) = 20\log(0.06) = -24.44 \text{ dB}$
4. 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.

\* Reading data is the peak value.

## 2) Field strength of outside of the specified frequency bands – 9 kHz to 30 MHz

The requirements are:

☒ Complies

| Frequency<br>(MHz) | Measured Data<br>(dBuV / m) | Margin<br>(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.

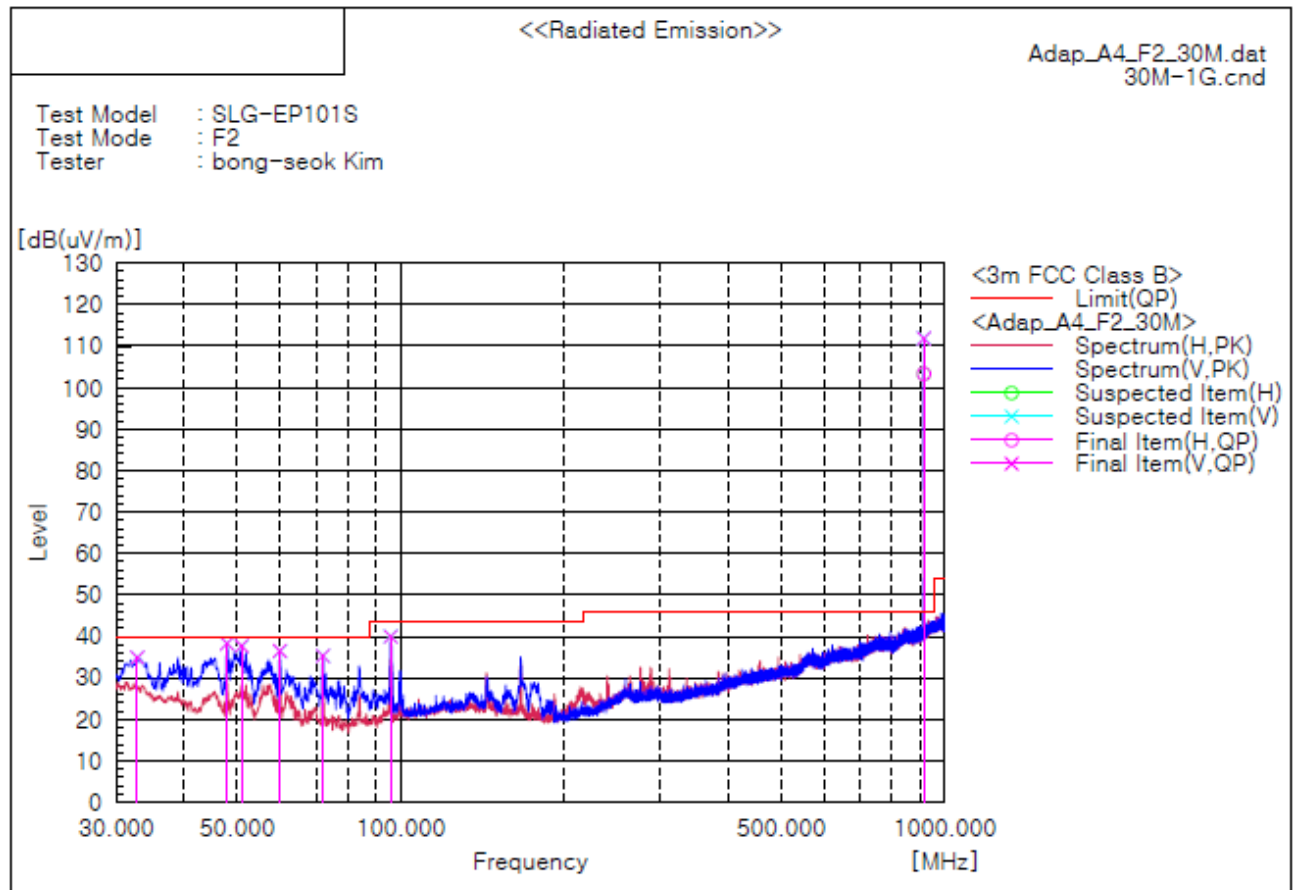
Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)

**3) Field strength of outside of the specified frequency bands – 30 MHz to 1 GHz**  
**Test mode : Transmit, ANT1**

The requirements are:

☒ Complies

**Test Frequency : Middle channel(worst case)**



**Final Result**

| No. | Frequency [MHz] | (P) | Reading QP [dB(uV)] | c.f [dB(1/m)] | Result QP [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] |
|-----|-----------------|-----|---------------------|---------------|----------------------|---------------------|----------------|-------------|-------------|
| 1   | 32.789          | V   | 42.8                | -7.9          | 34.9                 | 40.0                | 5.1            | 101.0       | 263.0       |
| 2   | 47.945          | V   | 53.2                | -14.9         | 38.3                 | 40.0                | 1.7            | 101.0       | 214.0       |
| 3   | 50.976          | V   | 53.9                | -16.2         | 37.7                 | 40.0                | 2.3            | 101.0       | 181.0       |
| 4   | 59.949          | V   | 55.0                | -18.5         | 36.5                 | 40.0                | 3.5            | 101.0       | 267.0       |
| 5   | 71.953          | V   | 52.9                | -17.6         | 35.3                 | 40.0                | 4.7            | 101.0       | 290.0       |
| 6   | 95.839          | V   | 54.4                | -14.4         | 40.0                 | 43.5                | 3.5            | 101.0       | 184.0       |
| 7   | 915.246         | V   | 105.5               | 6.4           | 111.9                | 46.0                | -65.9          | 101.0       | 15.0        |
| 8   | 915.246         | H   | 96.9                | 6.4           | 103.3                | 46.0                | -57.3          | 101.0       | 262.0       |

**Remark :**

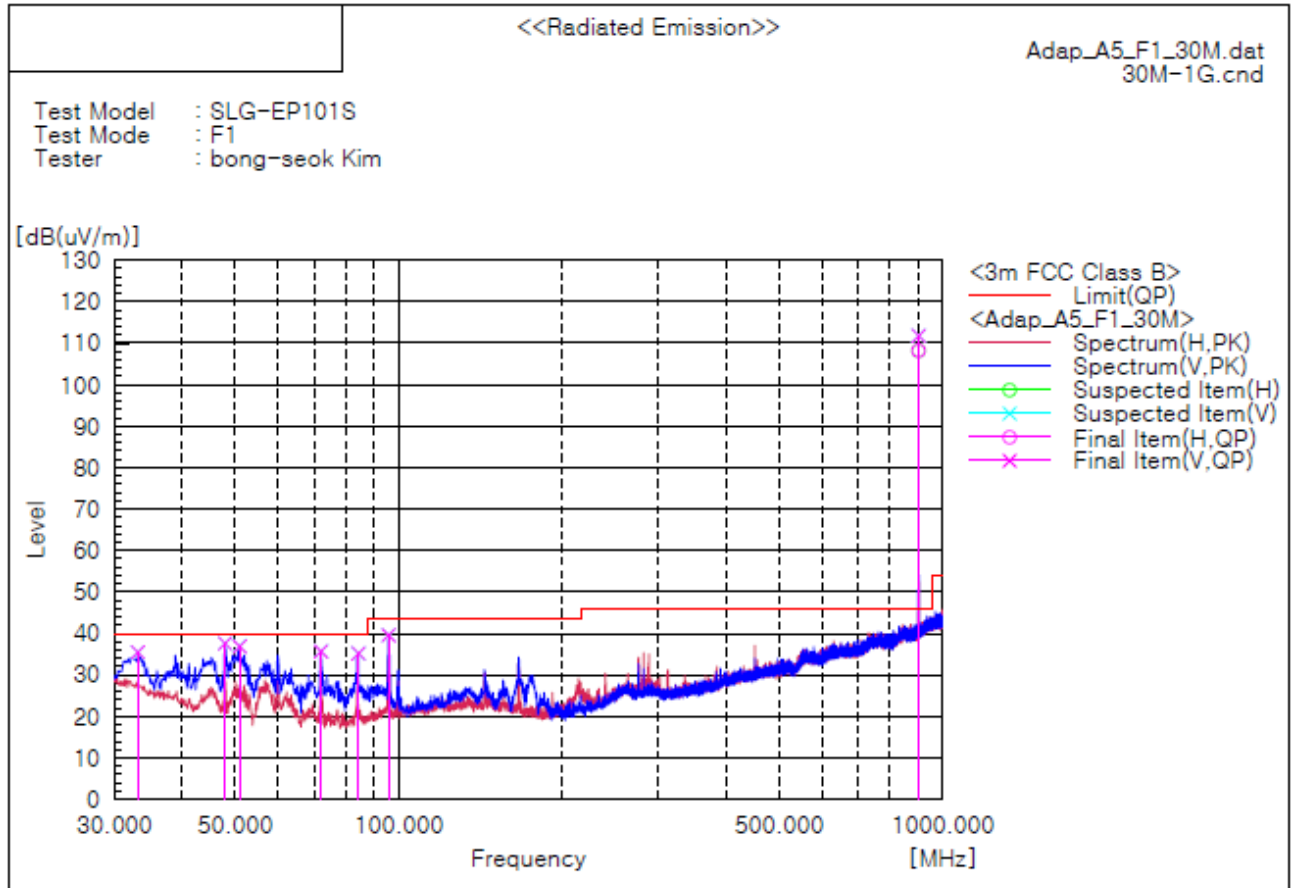
- Result = Reading + c.f(Correction factor)
  - Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
  - No.7 and No.8 are the carrier frequencies.
  - The Unwanted emission was measured in the following position: EUT stand-up position(X, Y axis), lie-down position(Z axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
  - Radiation emission was considered in the co-located mode of 2.4 GHz and 900 MHz.
- \* Reading data is the peak value.

**Test mode : Transmit, ANT2**

The requirements are:

☒ Complies

**Test Frequency : Low channel(worst case)**



**Final Result**

| No. | Frequency (P) | Reading  | c.f       | Result     | Limit      | Margin | Height | Angle |
|-----|---------------|----------|-----------|------------|------------|--------|--------|-------|
|     | [MHz]         | [dB(uV)] | [dB(1/m)] | [dB(uV/m)] | [dB(uV/m)] | [dB]   | [cm]   | [deg] |
| 1   | 33.153        | V 43.6   | -8.1      | 35.5       | 40.0       | 4.5    | 101.0  | 254.0 |
| 2   | 47.945        | V 52.5   | -14.9     | 37.6       | 40.0       | 2.4    | 101.0  | 235.0 |
| 3   | 50.976        | V 53.1   | -16.2     | 36.9       | 40.0       | 3.1    | 101.0  | 194.0 |
| 4   | 71.953        | V 53.3   | -17.6     | 35.7       | 40.0       | 4.3    | 101.0  | 251.0 |
| 5   | 84.320        | V 51.0   | -15.8     | 35.2       | 40.0       | 4.8    | 205.0  | 354.0 |
| 6   | 95.839        | V 54.0   | -14.4     | 39.6       | 43.5       | 3.9    | 101.0  | 247.0 |
| 7   | 902.394       | V 105.9  | 5.9       | 111.8      | 46.0       | -65.8  | 101.0  | 170.0 |
| 8   | 902.515       | H 102.3  | 5.9       | 108.2      | 46.0       | -62.2  | 101.0  | 89.0  |

**Remark :**

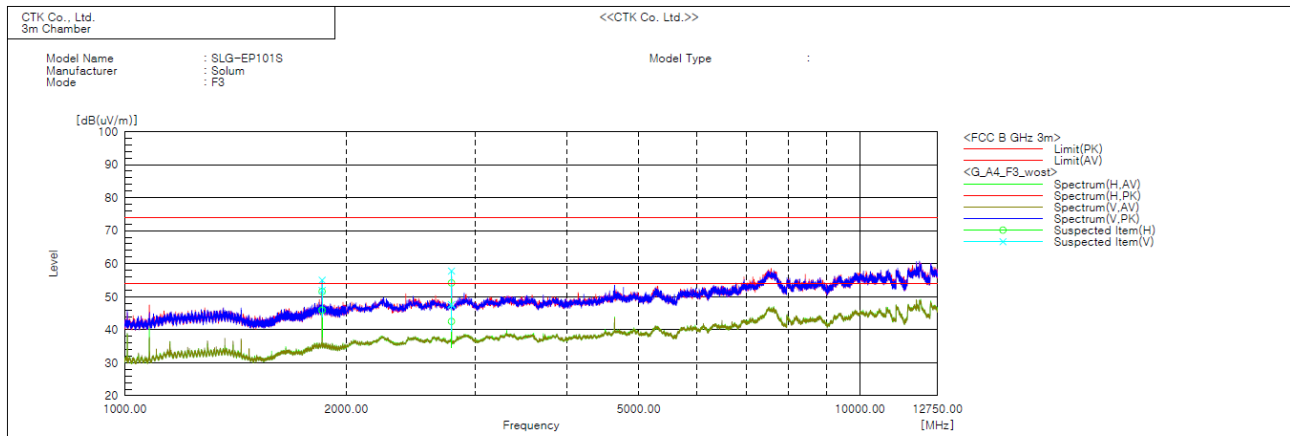
1. Result = Reading + c.f(Correction factor)
  2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
  3. No.7 and No.8 are the carrier frequencies.
  4. The Unwanted emission was measured in the following position: EUT stand-up position(X, Y axis), lie-down position(Z axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
  5. Radiation emission was considered in the co-located mode of 2.4 GHz and 900 MHz.
- \* Reading data is the peak value.

#### 4) Field strength of outside of the specified frequency bands – 1 GHz to 12.75 GHz

The requirements are:

☒ Complies

#### Test mode : Transmit, ANT1, Highest(Worst case)



#### Spectrum Selection

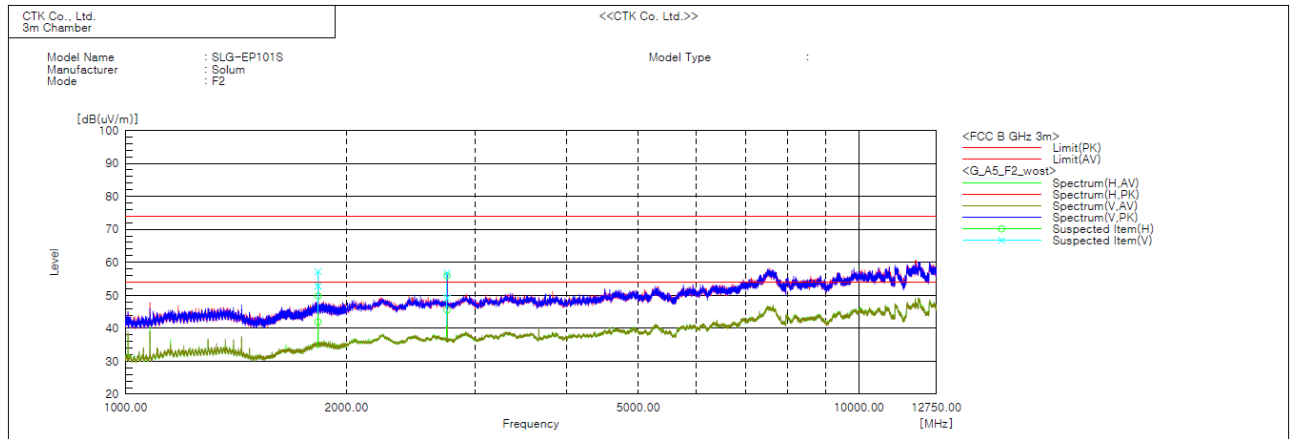
| No. | Frequency [MHz] | (P) | Reading [dB(uV)] | c.f [dB(1/m)] | Result PK [dB(uV/m)] | Result AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Margin PK [dB] | Margin AV [dB] | Height [cm] | Angle [deg] |
|-----|-----------------|-----|------------------|---------------|----------------------|----------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|
| 1   | 1855.000        | H   | 48.2             | 3.4           | 51.6                 | 45.9                 | 74.0                | 54.0                | 22.4           | 8.1            | 99.8        | 1.8         |
| 2   | 1855.125        | H   | 42.5             | 3.4           | 45.9                 | 45.9                 | 74.0                | 54.0                | 19.0           | 2.1            | 99.8        | 0.0         |
| 3   | 1855.375        | V   | 51.6             | 3.4           | 55.0                 | 51.9                 | 74.0                | 54.0                | 19.0           | 2.1            | 345.6       | 273.0       |
| 4   | 1855.250        | V   | 48.5             | 3.4           | 51.9                 | 42.5                 | 74.0                | 54.0                | 19.8           | 11.5           | 356.2       | 4.5         |
| 5   | 2782.063        | H   | 48.1             | 6.1           | 54.2                 | 42.5                 | 74.0                | 54.0                | 19.8           | 11.5           | 99.8        | 196.3       |
| 6   | 2782.063        | H   | 36.4             | 6.1           | 42.5                 | 42.5                 | 74.0                | 54.0                | 16.2           | 6.4            | 464.2       | 0.0         |
| 7   | 2782.063        | V   | 51.7             | 6.1           | 57.8                 | 47.6                 | 74.0                | 54.0                | 16.2           | 6.4            | 464.2       | 102.9       |
| 8   | 2782.063        | V   | 41.5             | 6.1           | 47.6                 | 47.6                 | 74.0                | 54.0                | 16.2           | 6.4            | 344.8       | 46.2        |

#### Remarks

- Result = Reading + c.f(correction factor) + Duty cycle c.f
- Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
- 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.
- Radiation emission was considered in the co-located mode of 2.4 GHz and 900 MHz.

\* Reading data is the peak value.

**Test mode : Transmit, ANT2, Middle (Worst case)**



Spectrum Selection

| No. | Frequency [MHz] | (P) | Reading [dB(uV)] | c.f [dB(1/m)] | Result PK [dB(uV/m)] | Result AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Margin PK [dB] | Margin AV [dB] | Height [cm] | Angle [deg] |
|-----|-----------------|-----|------------------|---------------|----------------------|----------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|
| 1   | 1830.250        | V   | 53.9             | 3.3           | 57.2                 | 52.8                 | 74.0                | 54.0                | 16.8           | 1.2            | 99.8        | 245.3       |
| 2   | 1830.375        | V   | 49.5             | 3.3           | 52.8                 | 52.8                 | 74.0                | 54.0                | 21.2           | 1.2            | 344.0       | 0.0         |
| 3   | 1830.625        | H   | 46.5             | 3.3           | 49.8                 | 41.9                 | 74.0                | 54.0                | 24.2           | 12.1           | 236.2       | 13.4        |
| 4   | 1830.625        | H   | 38.6             | 3.3           | 41.9                 | 45.6                 | 74.0                | 54.0                | 32.4           | 8.4            | 99.8        | 0.0         |
| 5   | 2744.438        | H   | 39.4             | 6.2           | 45.6                 | 49.1                 | 74.0                | 54.0                | 28.4           | 8.4            | 238.3       | 8.4         |
| 6   | 2744.438        | V   | 50.6             | 6.2           | 56.8                 | 49.1                 | 74.0                | 54.0                | 22.2           | 4.9            | 464.1       | 347.2       |
| 7   | 2744.438        | V   | 42.9             | 6.2           | 49.1                 | 49.1                 | 74.0                | 54.0                | 24.9           | 4.9            | 464.1       | 351.7       |
| 8   | 2744.438        | H   | 49.7             | 6.2           | 55.9                 | 49.1                 | 74.0                | 54.0                | 19.1           | 4.9            | 464.1       | 324.7       |

**Remarks**

1. Result = Reading + c.f(correction factor) + Duty cycle c.f
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
3. 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.
4. Radiation emission was considered in the co-located mode of 2.4 GHz and 900 MHz.

\* Reading data is the peak value.

### 4.3 AC Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

#### Instrument Settings

IF Band Width: 9 kHz

#### Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

#### Limit

| Frequency<br>(MHz) | Conducted Limit (dBuV) |            |
|--------------------|------------------------|------------|
|                    | Quasi-peak             | Average ** |
| 0.15 ~ 0.5         | 66 to 56*              | 56 to 46*  |
| 0.5 ~ 5            | 56                     | 46         |
| 5 ~ 30             | 60                     | 50         |

\* The level decreases linearly with the logarithm of the frequency.

\*\* A linear average detector is required.

#### Test Results

The requirements are:

☒ Complies

**Test mode : Transmit, PoE, ANT2, lowest channel(Worst case)**

| Frequency<br>[MHz] | Measured Data<br>[dBuV] | Margin<br>[dB] | Remark  |
|--------------------|-------------------------|----------------|---------|
| 0.717              | 44.4                    | 1.6            | Average |

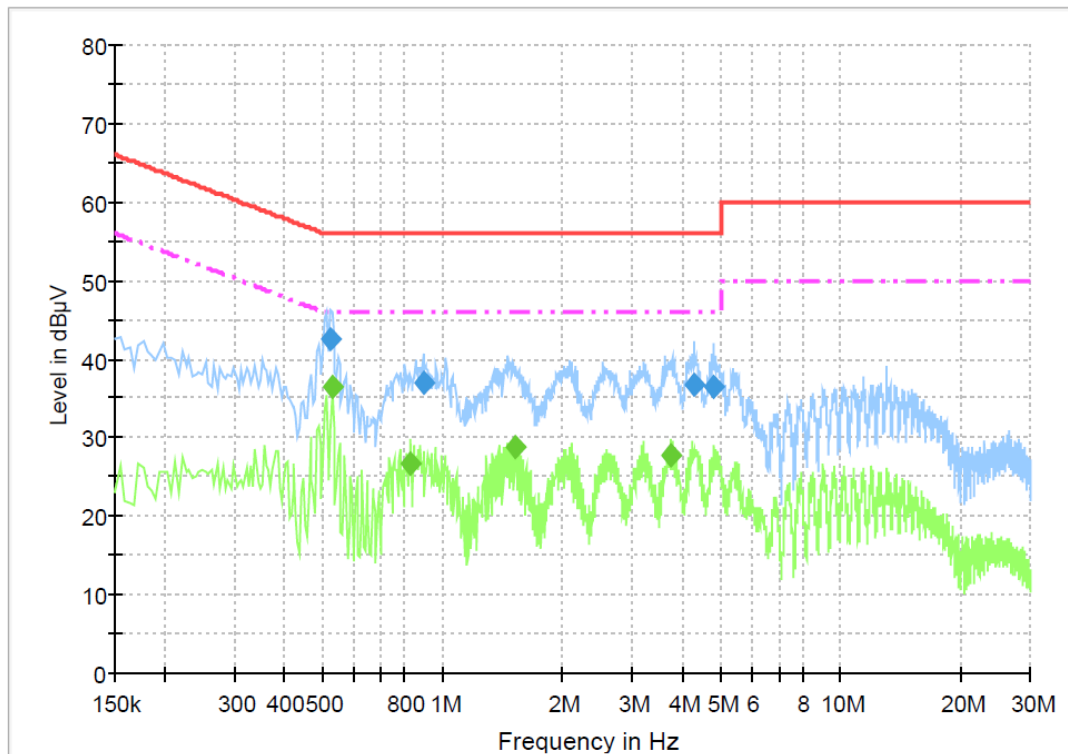
## Test Results

The requirements are:

☒ Complies

## Test Data

Test mode : Adaptor, Transmit  
[L1]



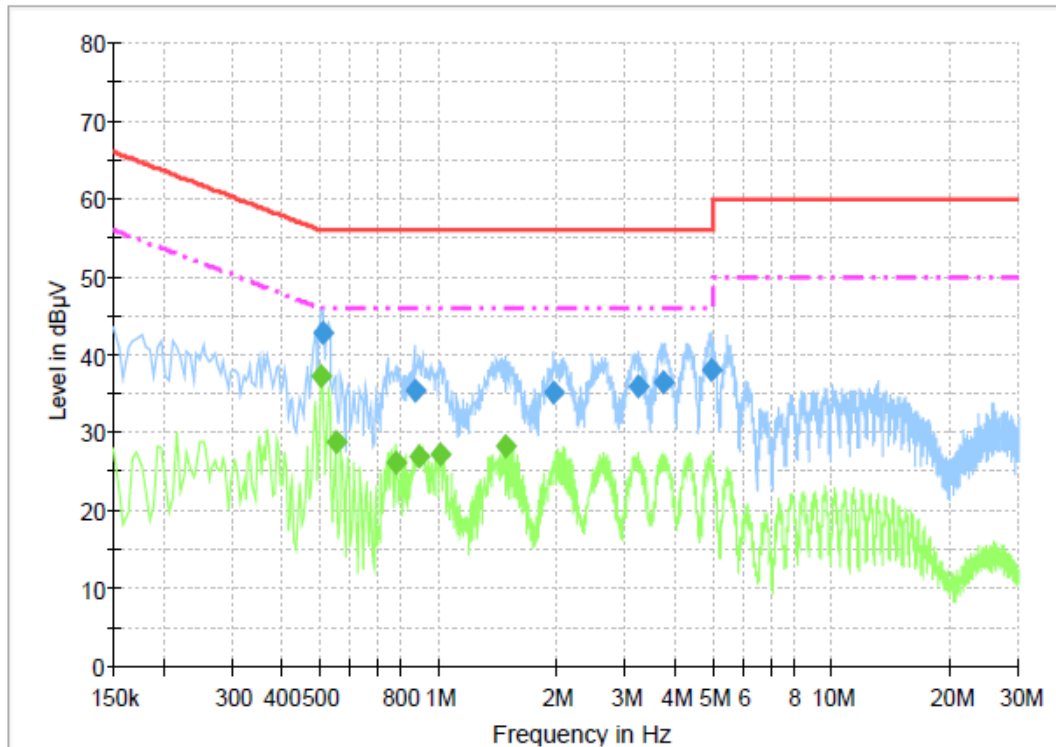
### Final Result 1

| Frequency (MHz) | QuasiPeak (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.523500        | 42.6             | 1000.0          | 9.000           | On     | L1   | 10.0       | 13.4        | 56.0         |
| 0.892500        | 36.8             | 1000.0          | 9.000           | On     | L1   | 9.8        | 19.2        | 56.0         |
| 4.267500        | 36.6             | 1000.0          | 9.000           | On     | L1   | 9.9        | 19.4        | 56.0         |
| 4.785000        | 36.4             | 1000.0          | 9.000           | On     | L1   | 9.9        | 19.6        | 56.0         |

### Final Result 2

| Frequency (MHz) | CAverage (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.528000        | 36.5            | 1000.0          | 9.000           | On     | L1   | 10.0       | 9.5         | 46.0         |
| 0.829500        | 26.6            | 1000.0          | 9.000           | On     | L1   | 9.8        | 19.4        | 46.0         |
| 1.527000        | 28.9            | 1000.0          | 9.000           | On     | L1   | 9.8        | 17.1        | 46.0         |
| 3.754500        | 27.8            | 1000.0          | 9.000           | On     | L1   | 9.9        | 18.2        | 46.0         |

[NEUTRAL]



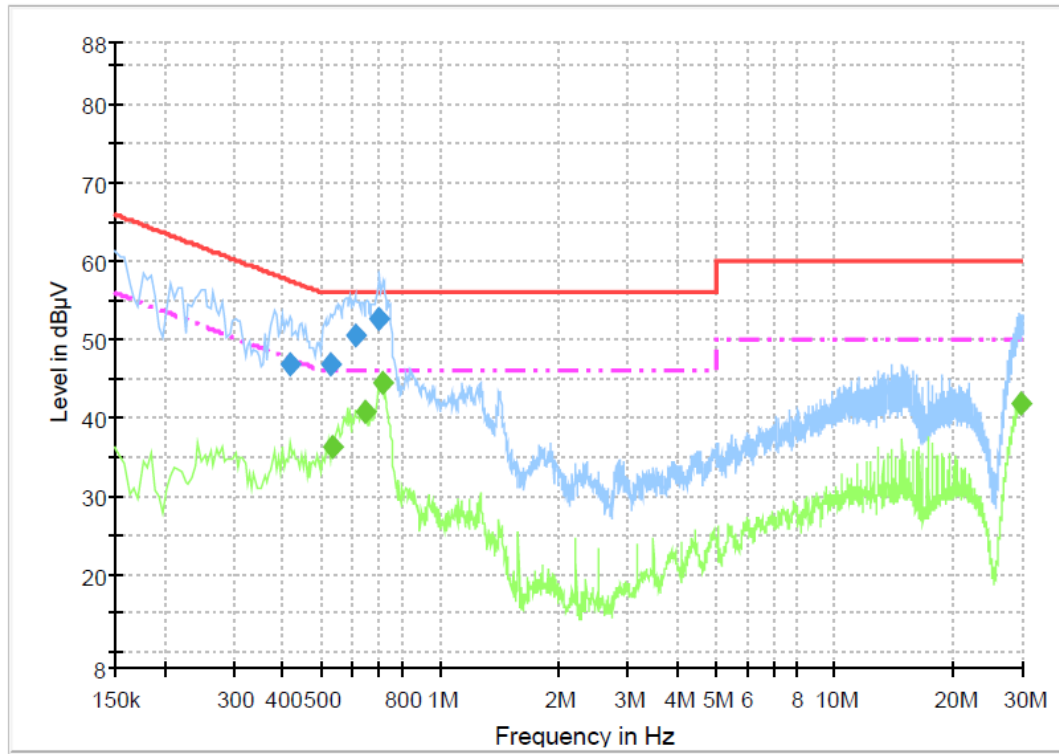
**Final Result 1**

| Frequency (MHz) | QuasiPeak (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.510000        | 42.7             | 1000.0          | 9.000           | On     | N    | 10.0       | 13.3        | 56.0         |
| 0.874500        | 35.4             | 1000.0          | 9.000           | On     | N    | 9.8        | 20.6        | 56.0         |
| 1.972500        | 35.2             | 1000.0          | 9.000           | On     | N    | 9.8        | 20.8        | 56.0         |
| 3.250500        | 35.9             | 1000.0          | 9.000           | On     | N    | 9.8        | 20.1        | 56.0         |
| 3.727500        | 36.3             | 1000.0          | 9.000           | On     | N    | 9.9        | 19.7        | 56.0         |
| 4.933500        | 37.9             | 1000.0          | 9.000           | On     | N    | 9.9        | 18.1        | 56.0         |

**Final Result 2**

| Frequency (MHz) | CAverage (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.505500        | 37.3            | 1000.0          | 9.000           | On     | N    | 10.0       | 8.7         | 46.0         |
| 0.550500        | 28.8            | 1000.0          | 9.000           | On     | N    | 10.0       | 17.2        | 46.0         |
| 0.784500        | 26.2            | 1000.0          | 9.000           | On     | N    | 9.9        | 19.8        | 46.0         |
| 0.901500        | 26.9            | 1000.0          | 9.000           | On     | N    | 9.8        | 19.1        | 46.0         |
| 1.018500        | 27.3            | 1000.0          | 9.000           | On     | N    | 9.8        | 18.7        | 46.0         |
| 1.486500        | 28.4            | 1000.0          | 9.000           | On     | N    | 9.8        | 17.6        | 46.0         |

**Test mode : PoE, Transmit**  
**[L1]**



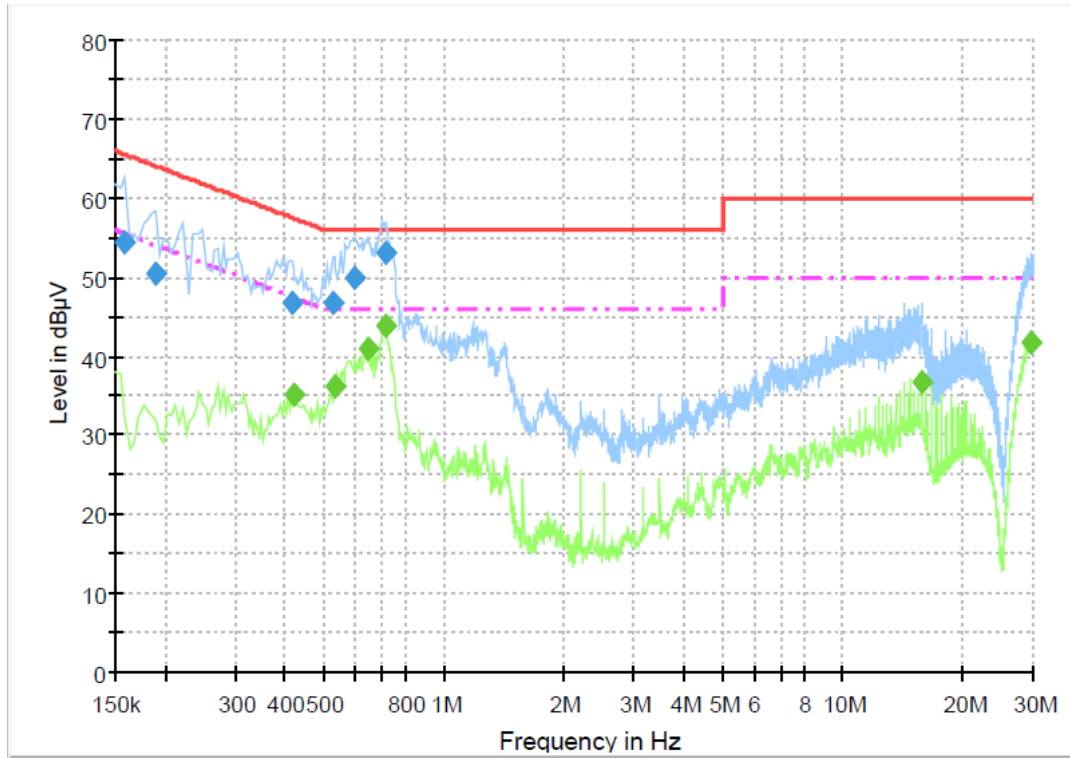
**Final Result 1**

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.415500        | 46.8             | 1000.0          | 9.000           | On     | L1   | 10.0       | 10.7        | 57.5         |
| 0.528000        | 46.7             | 1000.0          | 9.000           | On     | L1   | 10.0       | 9.3         | 56.0         |
| 0.609000        | 50.4             | 1000.0          | 9.000           | On     | L1   | 9.9        | 5.6         | 56.0         |
| 0.703500        | 52.6             | 1000.0          | 9.000           | On     | L1   | 9.9        | 3.4         | 56.0         |

**Final Result 2**

| Frequency (MHz) | CAverage (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.532500        | 36.4            | 1000.0          | 9.000           | On     | L1   | 10.0       | 9.6         | 46.0         |
| 0.649500        | 40.6            | 1000.0          | 9.000           | On     | L1   | 9.9        | 5.4         | 46.0         |
| 0.717000        | 44.4            | 1000.0          | 9.000           | On     | L1   | 9.9        | 1.6         | 46.0         |
| 29.652000       | 41.8            | 1000.0          | 9.000           | On     | L1   | 10.1       | 8.2         | 50.0         |

[NEUTRAL]



**Final Result 1**

| Frequency (MHz) | QuasiPeak (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.159000        | 54.4             | 1000.0          | 9.000           | On     | N    | 9.8        | 11.1        | 65.5         |
| 0.190500        | 50.5             | 1000.0          | 9.000           | On     | N    | 9.8        | 13.5        | 64.0         |
| 0.415500        | 46.6             | 1000.0          | 9.000           | On     | N    | 10.0       | 10.9        | 57.5         |
| 0.528000        | 46.6             | 1000.0          | 9.000           | On     | N    | 10.0       | 9.4         | 56.0         |
| 0.595500        | 49.8             | 1000.0          | 9.000           | On     | N    | 9.9        | 6.2         | 56.0         |
| 0.717000        | 52.9             | 1000.0          | 9.000           | On     | N    | 9.9        | 3.1         | 56.0         |

**Final Result 2**

| Frequency (MHz) | CAverage (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.424500        | 35.2            | 1000.0          | 9.000           | On     | N    | 10.0       | 12.2        | 47.4         |
| 0.532500        | 36.3            | 1000.0          | 9.000           | On     | N    | 10.0       | 9.7         | 46.0         |
| 0.649500        | 40.8            | 1000.0          | 9.000           | On     | N    | 9.9        | 5.2         | 46.0         |
| 0.717000        | 43.8            | 1000.0          | 9.000           | On     | N    | 9.9        | 2.2         | 46.0         |
| 15.792000       | 36.7            | 1000.0          | 9.000           | On     | N    | 10.0       | 13.3        | 50.0         |
| 29.575500       | 41.8            | 1000.0          | 9.000           | On     | N    | 10.2       | 8.2         | 50.0         |

#### 4.4 Occupied bandwidth

##### 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.

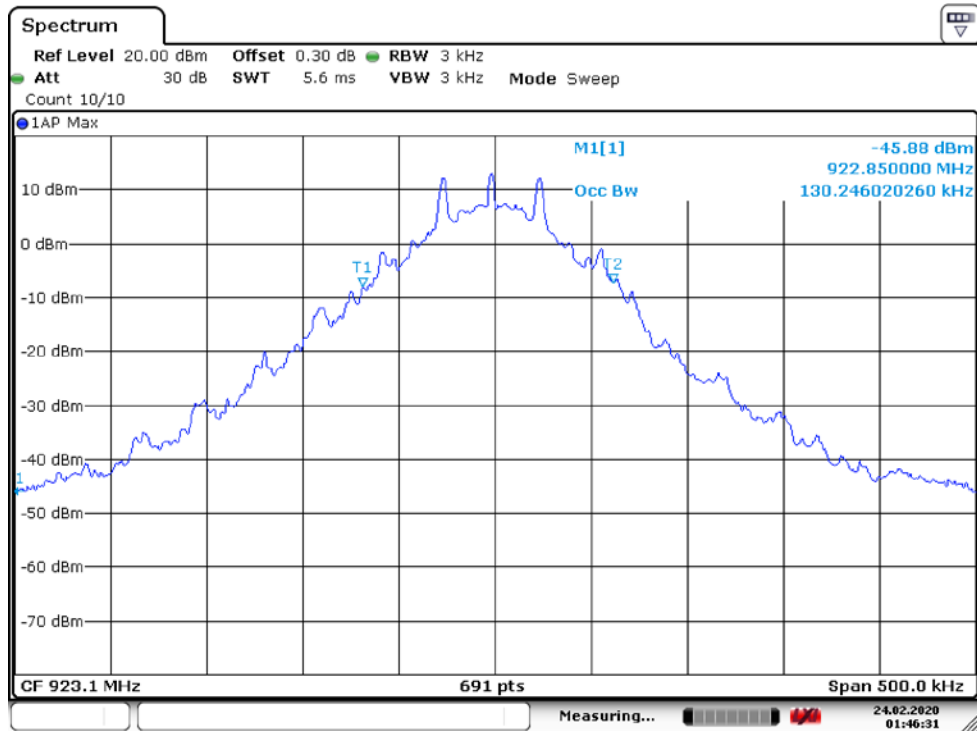
The following procedure shall be used for measuring 99% power bandwidth:

- 1) Center frequency : Nominal EUT channel center frequency
- 2) Frequency span : between 1.5 times and 5.0 times the OBW
- 3) RBW : in the range of 1 % to 5 % of the OBW
- 4) VBW  $\geq 3 \times$  RBW
- 5) Detection : Peak
- 6) Use the 99% power bandwidth function of the instrument

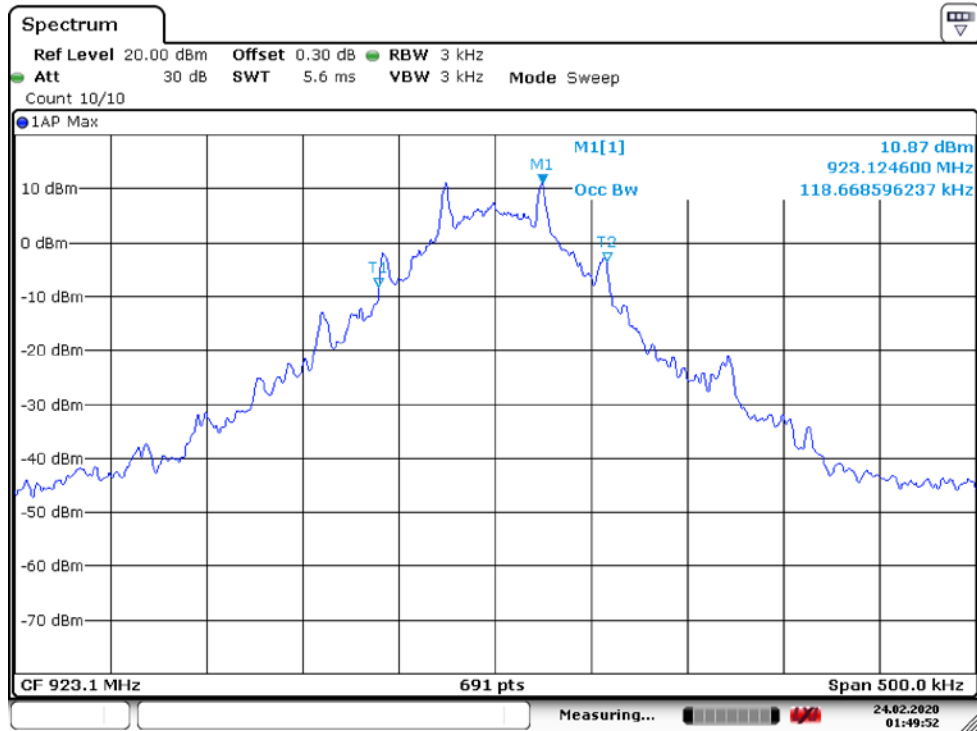
##### Test data

| Mode | Center Frequency [MHz] | OBW [kHz] | Remark |
|------|------------------------|-----------|--------|
| ANT1 | 923.1                  | 130       | -      |
| ANT2 | 923.1                  | 119       | -      |

### Test mode : ANT1



### Test mode : ANT2



## APPENDIX A – Test Equipment Used For Tests

| No. | Name of Equipment           | Manufacturer    | Model No. | Serial No.    | Cal Date   | Due Date   |
|-----|-----------------------------|-----------------|-----------|---------------|------------|------------|
| 1   | SPECTRUM ANALYZER           | R&S             | FSP-30    | 100994        | 2019-10-16 | 2020-10-16 |
| 2   | EMI Test Receiver           | Rohde & Schwarz | ESCI7     | 100814        | 2019-10-22 | 2020-10-22 |
| 3   | Active Loop Antenna         | SCHWARZBECK     | FMZB 1513 | 1513-126      | 2019-01-17 | 2021-01-17 |
| 4   | Bilog Antenna               | Schaffner       | CBL6111C  | 2551          | 2019-04-17 | 2021-04-17 |
| 5   | AMPLIFIER                   | SONOMA          | 310       | 291721        | 2020-01-22 | 2021-01-22 |
| 6   | 6dB Attenuator              | R&S             | DNF       | 272.4110.50-2 | 2019-10-25 | 2020-10-25 |
| 7   | EMI Test Receiver           | Rohde & Schwarz | ESU40     | 100336        | 2020-01-17 | 2021-01-17 |
| 8   | Double Ridged Guide Antenna | ETS-Lindgren    | 3117      | 00154525      | 2019-02-22 | 2021-02-22 |
| 9   | Preamplifier                | Agilent         | 8449B     | 3008A02011    | 2018-11-25 | 2020-11-25 |
| 10  | Signal Generator            | R&S             | SMB100A   | 175528        | 2019-10-16 | 2020-10-16 |
| 11  | LISN                        | Rohde & Schwarz | ENV216    | 101235        | 2020-01-17 | 2021-01-17 |
| 12  | Signal Analyzer             | Rohde & Schwarz | FSV30     | 100925        | 2020-01-17 | 2021-01-17 |

| No. | Name of Equipment    | Manufacturer  | Model No.    | Serial No.          | Check Date |
|-----|----------------------|---------------|--------------|---------------------|------------|
| 1   | RF Cable (conducted) | Junkosha Inc. | MWX221       | 1510S087            | 2020-02-02 |
| 2   | RF Cable (Radiated)  | HUBER+SUHNER  | SUCOFLEX 104 | MY27558/4           | 2020-02-02 |
| 3   | RF Cable (Radiated)  | HUBER+SUHNER  | SUCOFLEX 104 | N/A<br>(below 1GHz) | 2020-02-02 |
| 4   | RF Cable (Radiated)  | HUBER+SUHNER  | SUCOFLEX 104 | MY27573/4           | 2019-11-30 |