



**FCC CFR47 PART 15 SUBPART C**

**ANT+**

**CERTIFICATION TEST REPORT**

**FOR**

**GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC**

**MODEL NUMBER : SM-A605FN/DS, SM-A605FN, SM-A605X**

**FCC ID: A3LSMA605FN**

**REPORT NUMBER: 4788372835-E5V2**

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**TL-637**

Revision History

| Rev. | Issue Date | Revisions                         | Revised By  |
|------|------------|-----------------------------------|-------------|
| V1   | 03/20/18   | Initial issue                     | Junwhan Lee |
| V2   | 03/26/18   | Updated to address TCB's question | Junwhan Lee |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SAMSUNG ELECTRONICS CO., LTD.

**EUT DESCRIPTION:** GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC

**MODEL NUMBER:** SM-A605FN/DS, SM-A605FN, SM-A605X

**SERIAL NUMBER:** R38K104PV9X, R38K104R4WF (RADIATED);  
R38K104QEYH (CONDUCTED)

**DATE TESTED:** MAR 07, 2018 - MAR 10, 2018

| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Pass         |

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For  
UL Korea, Ltd. By:



SungGil Park  
Suwon Lab Engineer  
UL Korea, Ltd.

Tested By:



Junwhan Lee  
Suwon Lab Engineer  
UL Korea, Ltd.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. ANSI C63.10-2013.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 218 Maeyeong-ro                     |           |
|-------------------------------------|-----------|
| <input checked="" type="checkbox"/> | Chamber 1 |
| <input type="checkbox"/>            | Chamber 2 |
| <input type="checkbox"/>            | Chamber 3 |

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 2.32 dB     |
| Radiated Disturbance, Below 1GHz      | 3.86 dB     |
| Radiated Disturbance, Above 1 GHz     | 5.97 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC.  
This test report addresses the ANT+ operational mode.

### 5.2. MAXIMUM E-FIELD STRENGTH

The ANT+ mode has maximum output fundamental field strength as follows:

| Frequency Range<br>[MHz] | Mode  | Peak E-field Strength<br>[dBuV/m] | Avg E-field Strength<br>[dBuV/m] | Distance<br>[m] |
|--------------------------|-------|-----------------------------------|----------------------------------|-----------------|
| 2402 - 2480              | ANT + | 93.04                             | 40.92                            | 3.00            |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal antenna, with a maximum gain of -3.25 dBi

### 5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

Note : All radiated and power line conducted tests were performed connected with earphone and charger for evaluation of worst case mode.

## 5.5. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |            |                |        |
|------------------------|--------------|------------|----------------|--------|
| Description            | Manufacturer | Model      | Serial Number  | FCC ID |
| Charger                | SAMSUNG      | EP-TA50EWE | DW3J719AS/A- E | N/A    |
| Data Cable             | SAMSUNG      | ECB-DU68WE | N/A            | N/A    |
| Earphone               | SAMSUNG      | EHS61ASFWE | N/A            | N/A    |

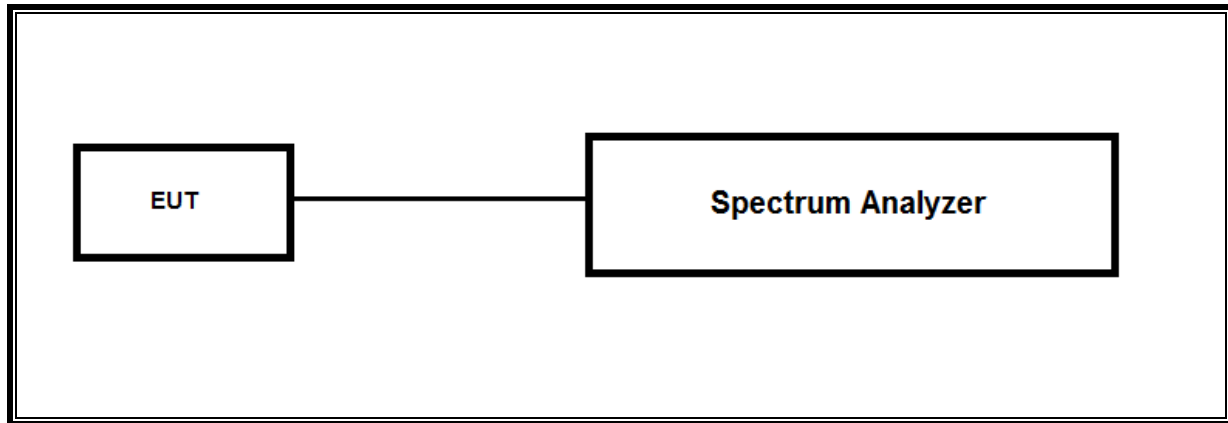
### I/O CABLES

| I/O Cable List |          |                      |                |            |                  |         |
|----------------|----------|----------------------|----------------|------------|------------------|---------|
| Cable No       | Port     | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1              | DC Power | 1                    | Mini-USB       | Shielded   | 1.2m             | N/A     |
| 2              | Audio    | 2                    | Mini-Jack      | Unshielded | 1.2m             | N/A     |

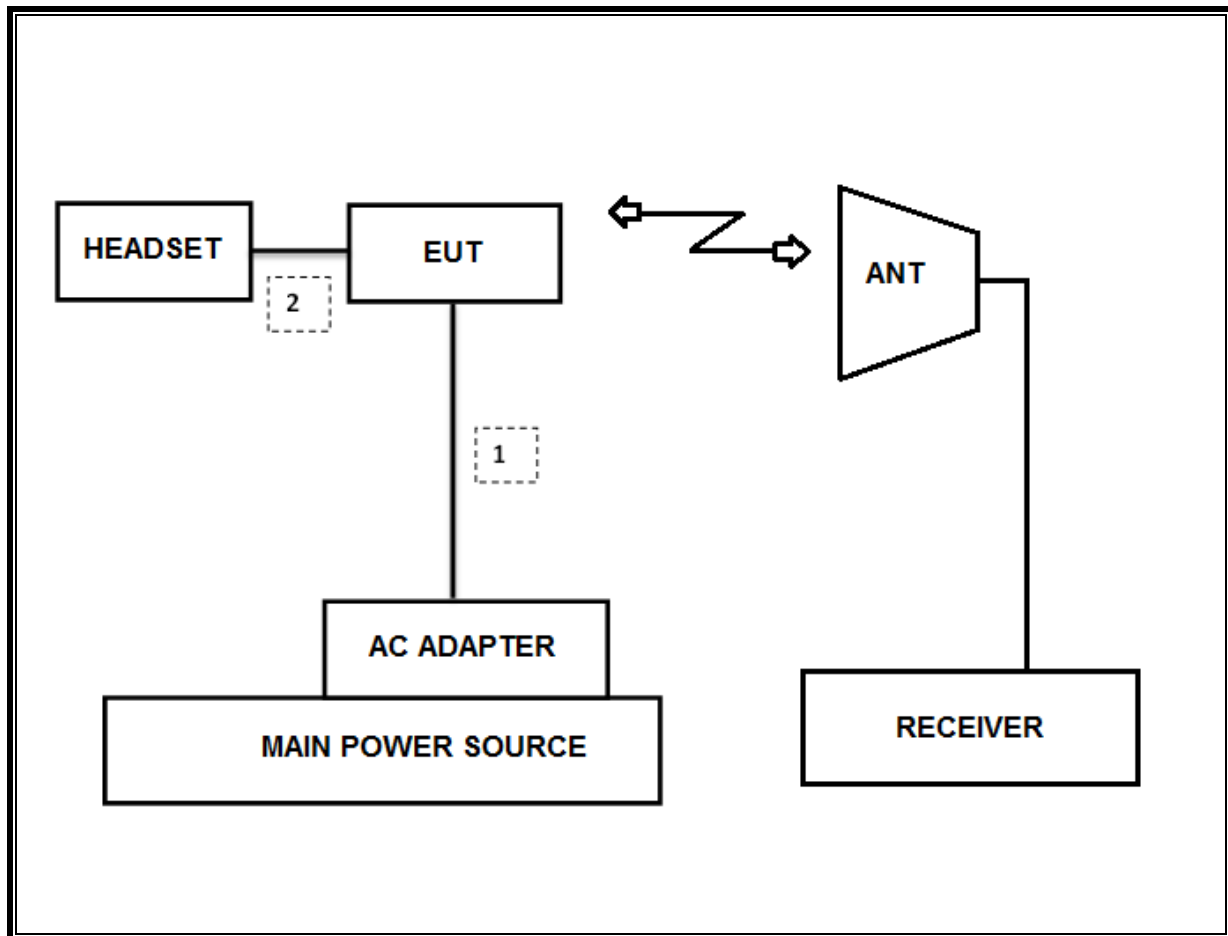
### TEST SETUP

The EUT is set to continuously transmit in ANT + test mode.  
Test software in hidden menu exercised the EUT to enable ANT+ mode.

**SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)**



**SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Test Equipment List        |               |                        |            |          |
|----------------------------|---------------|------------------------|------------|----------|
| Description                | Manufacturer  | Model                  | S/N        | Cal Due  |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK   | VULB9163               | 750        | 08-31-19 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK   | VULB9163               | 749        | 09-14-19 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK   | VULB9163               | 845        | 08-31-19 |
| Antenna, Horn, 18 GHz      | ETS           | 3115                   | 00167211   | 10-14-18 |
| Antenna, Horn, 18 GHz      | ETS           | 3115                   | 00161451   | 03-10-19 |
| Antenna, Horn, 18 GHz      | ETS           | 3117                   | 00168724   | 05-31-19 |
| Antenna, Horn, 18 GHz      | ETS           | 3117                   | 00168717   | 05-31-19 |
| Antenna, Horn, 18 GHz      | ETS           | 3117                   | 00205959   | 11-29-18 |
| Antenna, Horn, 40 GHz      | ETS           | 3116C                  | 00166155   | 12-04-19 |
| Antenna, Horn, 40 GHz      | ETS           | 3116C                  | 00168645   | 12-04-19 |
| Antenna, Horn, 40 GHz      | ETS           | 3116C-PA               | 00168841   | 11-13-19 |
| Preamplifier, 1000 MHz     | Sonoma        | 310N                   | 341282     | 08-09-18 |
| Preamplifier, 1000 MHz     | Sonoma        | 310N                   | 351741     | 08-07-18 |
| Preamplifier, 1000 MHz     | Sonoma        | 310N                   | 370599     | 08-10-18 |
| Preamplifier, 18 GHz       | Miteq         | AFS42-00101800-25-S-42 | 1876511    | 08-08-18 |
| Preamplifier, 18 GHz       | Miteq         | AFS42-00101800-25-S-42 | 1896138    | 08-08-18 |
| Preamplifier, 18 GHz       | Miteq         | AFS42-00101800-25-S-42 | 2029169    | 08-11-18 |
| Spectrum Analyzer, 44 GHz  | Agilent / HP  | N9030A                 | MY54170614 | 08-08-18 |
| Spectrum Analyzer, 44 GHz  | Agilent / HP  | N9030A                 | MY54490312 | 08-08-18 |
| Average Power Sensor       | Agilent / HP  | U2000                  | MY54270007 | 08-08-18 |
| Attenuator                 | PASTERNAK     | PE7087-10              | A001       | 08-08-18 |
| Attenuator                 | PASTERNAK     | PE7087-10              | A008       | 08-08-18 |
| Attenuator                 | PASTERNAK     | PE7087-10              | 2          | 08-10-18 |
| EMI Test Receive, 40 GHz   | R&S           | ESU40                  | 100439     | 08-08-18 |
| EMI Test Receive, 40 GHz   | R&S           | ESU40                  | 100457     | 08-08-18 |
| EMI Test Receive, 44 GHz   | R&S           | ESW44                  | 101590     | 08-09-18 |
| EMI Test Receive, 3 GHz    | R&S           | ESR3                   | 101832     | 08-07-18 |
| Low Pass Filter 5GHz       | Micro-Tronics | LPS17541               | 009        | 08-08-18 |
| Low Pass Filter 5GHz       | Micro-Tronics | LPS17541               | 015        | 08-08-18 |
| Low Pass Filter 5GHz       | Micro-Tronics | LPS17541               | 020        | 08-11-18 |
| High Pass Filter 3GHz      | Micro-Tronics | HPM17543               | 010        | 08-08-18 |
| High Pass Filter 3GHz      | Micro-Tronics | HPM17543               | 015        | 08-08-18 |
| High Pass Filter 3GHz      | Micro-Tronics | HPM17543               | 020        | 08-11-18 |
| High Pass Filter 6GHz      | Micro-Tronics | HPS17542               | 009        | 08-08-18 |
| High Pass Filter 6GHz      | Micro-Tronics | HPS17542               | 016        | 08-08-18 |
| High Pass Filter 6GHz      | Micro-Tronics | HPS17542               | 021        | 08-11-18 |
| LISN                       | R&S           | ENV-216                | 101837     | 08-09-18 |
| UL Software                |               |                        |            |          |
| Description                | Manufacturer  | Model                  | Version    |          |
| Radiated software          | UL            | UL EMC                 | Ver 9.5    |          |
| AC Line Conducted software | UL            | UL EMC                 | Ver 9.5    |          |

## 7. LIMITS AND RESULTS

### 7.1. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

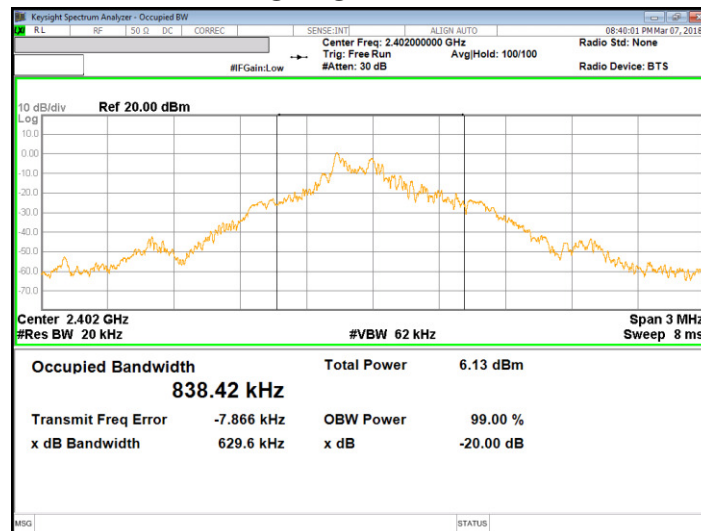
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### RESULTS

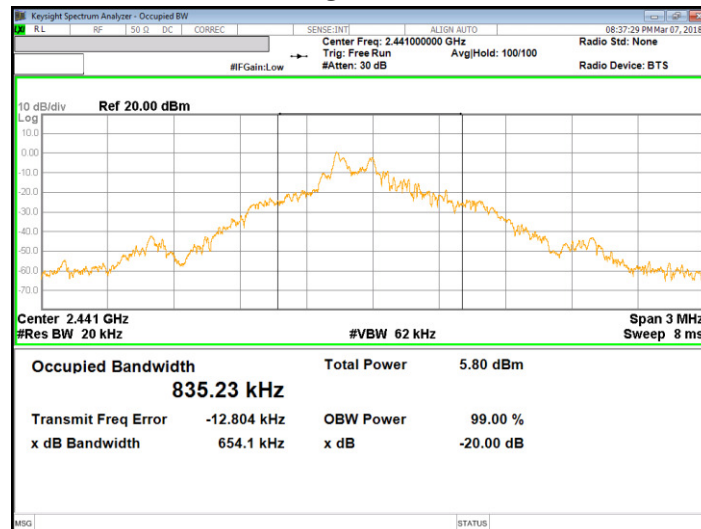
| Channel | Frequency<br>[MHz] | 99% Bandwidth<br>[kHz] | 20 dB Bandwidth<br>[kHz] |
|---------|--------------------|------------------------|--------------------------|
| Low     | 2402               | 838.42                 | 629.60                   |
| Mid     | 2441               | 835.23                 | 654.10                   |
| High    | 2480               | 834.49                 | 586.30                   |
| Worst   |                    | 838.42                 | 654.10                   |

## 99% BANDWIDTH PLOTS

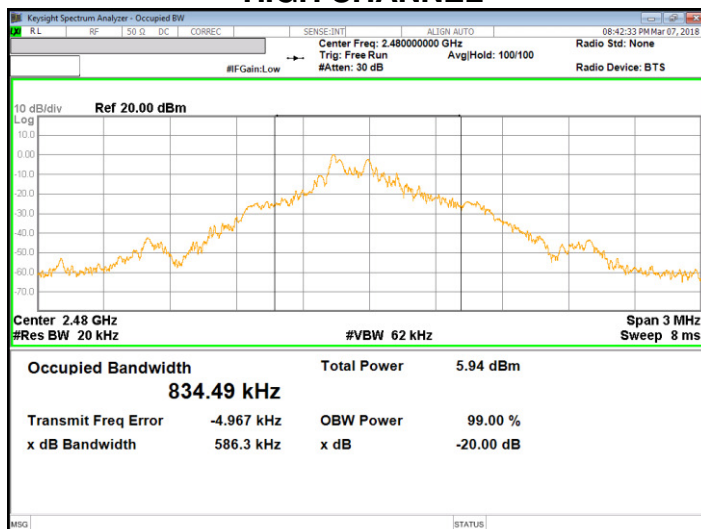
### LOW CHANNEL



### MID CHANNEL



### HIGH CHANNEL



## **7.2. TRANSMITTER RADIATED EMISSIONS**

### **TEST PROCEDURE**

ANSI C63.10: 2013

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements.

Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

**LIMIT**

FCC §15.249

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| <b>Fundamental frequency</b> | <b>Field strength of fundamental (millivolts/meter)</b> | <b>Field strength of harmonics (microvolts/meter)</b> |
|------------------------------|---------------------------------------------------------|-------------------------------------------------------|
| 902-928 MHz                  | 50                                                      | 500                                                   |
| 2400-2483.5 MHz              | 50                                                      | 500                                                   |
| 5725-5875 MHz                | 50                                                      | 500                                                   |
| 24.0-24.25 GHz               | 250                                                     | 2500                                                  |

(d) 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.

(e) As shown in Sec. 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

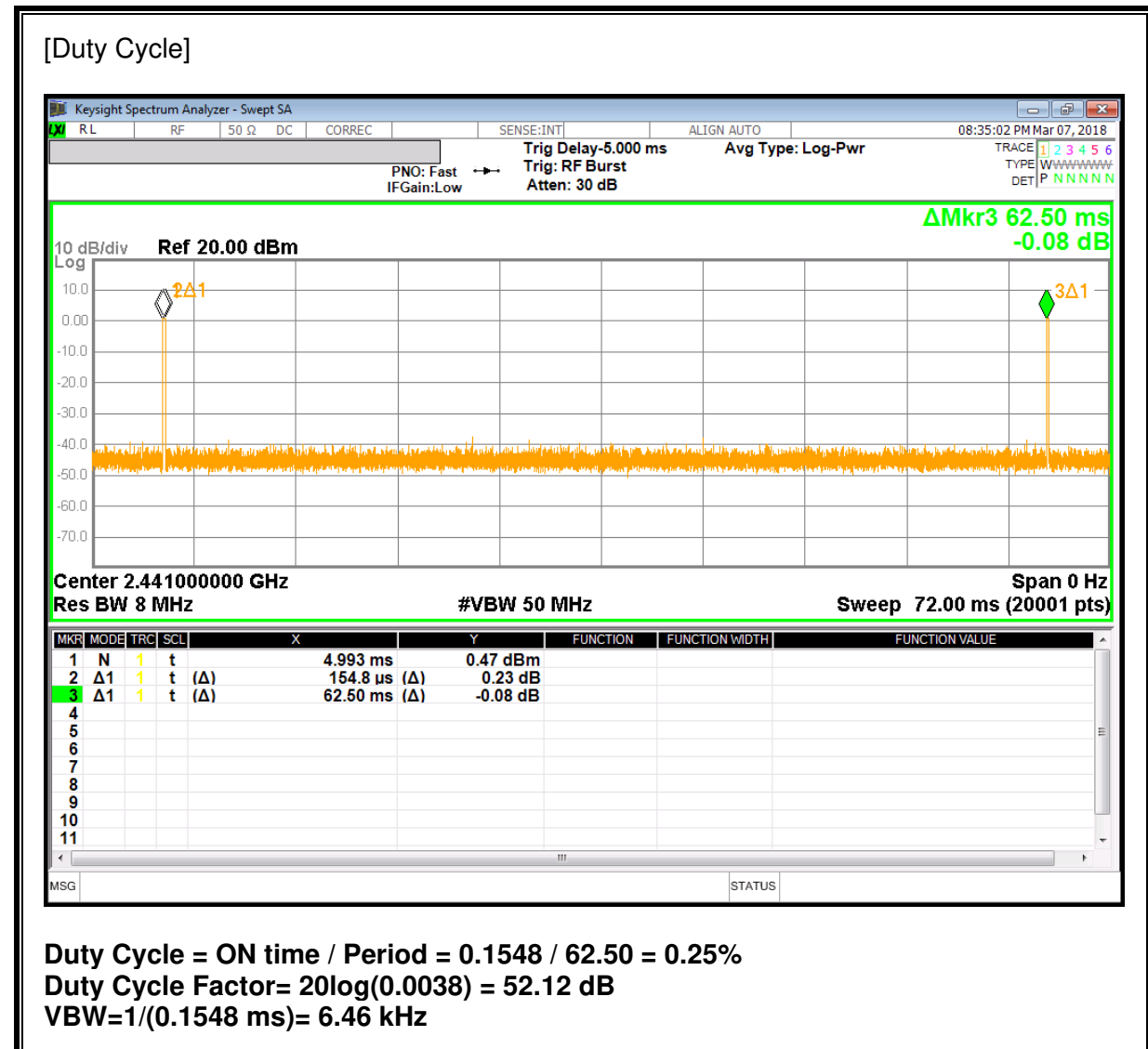
FCC §15.205 and §15.209

| Limits for radiated disturbance of an intentional radiator |                 |                          |
|------------------------------------------------------------|-----------------|--------------------------|
| Frequency range (MHz)                                      | Limits (μV/m)   | Measurement Distance (m) |
| 0.009 – 0.490                                              | 2400 / F (kHz)  | 300                      |
| 0.490 – 1.705                                              | 24000 / F (kHz) | 30                       |
| 1.705 – 30.0                                               | 30              | 30                       |
| 30 – 88                                                    | 100**           | 3                        |
| 88 - 216                                                   | 150**           | 3                        |
| 216 – 960                                                  | 200**           | 3                        |
| Above 960                                                  | 500             | 3                        |

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

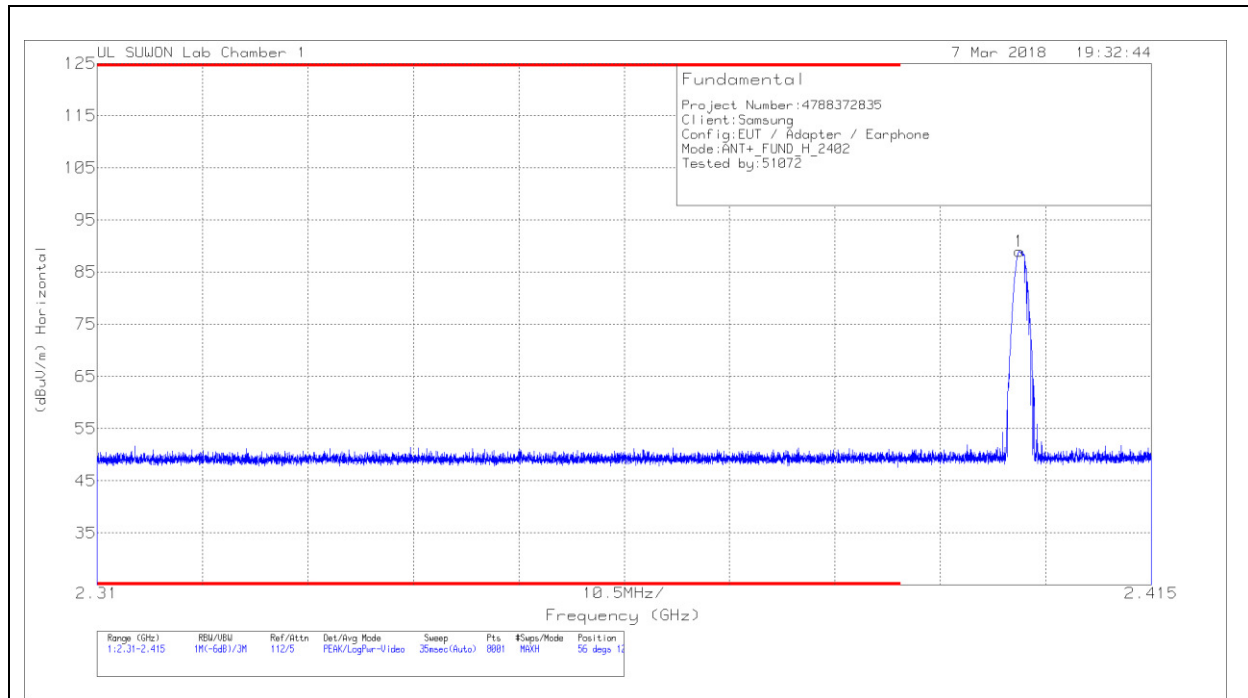
## RESULTS

### 7.2.1. DUTY CYCLE



## 7.2.2. FUNDAMENTAL FIELD STRENGTH LEVEL

### LOW CHANNEL, HORIZONTAL



### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.402           | 83.38                | Pk  | 31.3                    | -25.7                | 0            | 88.98                      | 56             | 126         | H        |

Pk - Peak detector

\*\* Pk Limit : 114dBuV/m

Pk Margin : 25.02dB

\*\*\* For marker 1, used the following method to do averaging:

DCCF=52.12

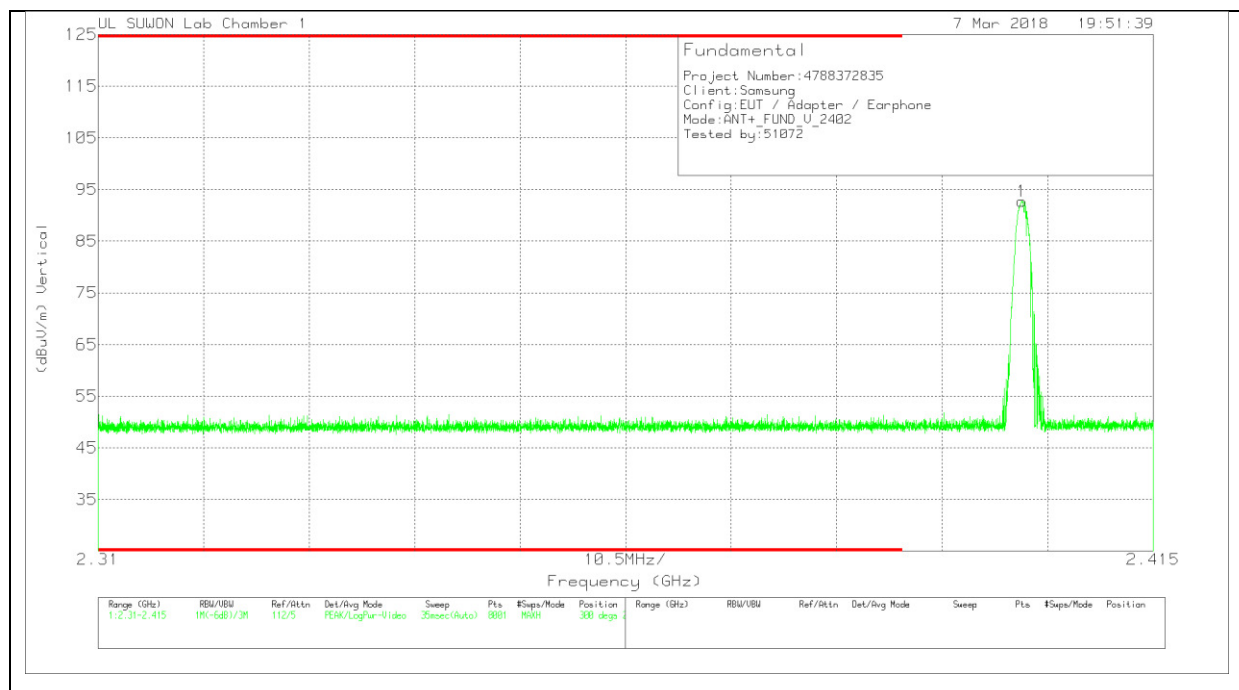
Corrected AV reading = Peak Reading – DCCF

= 88.98 – 52.12= 36.86 dBuV/m

\*\*\*AVG Limit : 94dBuV/m

AVG Margin : 57.14 dB

# LOW CHANNEL, VERTICAL



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.402           | 87.13                | Pk  | 31.3                    | -25.7                | 0            | 92.73                      | 300            | 276         | V        |

Pk - Peak detector

\* Pk Limit : 114dBuV/m

Pk Margin : 21.27 dB

\*\* For marker 1, used the following method to do averaging:

DCCF=52.12

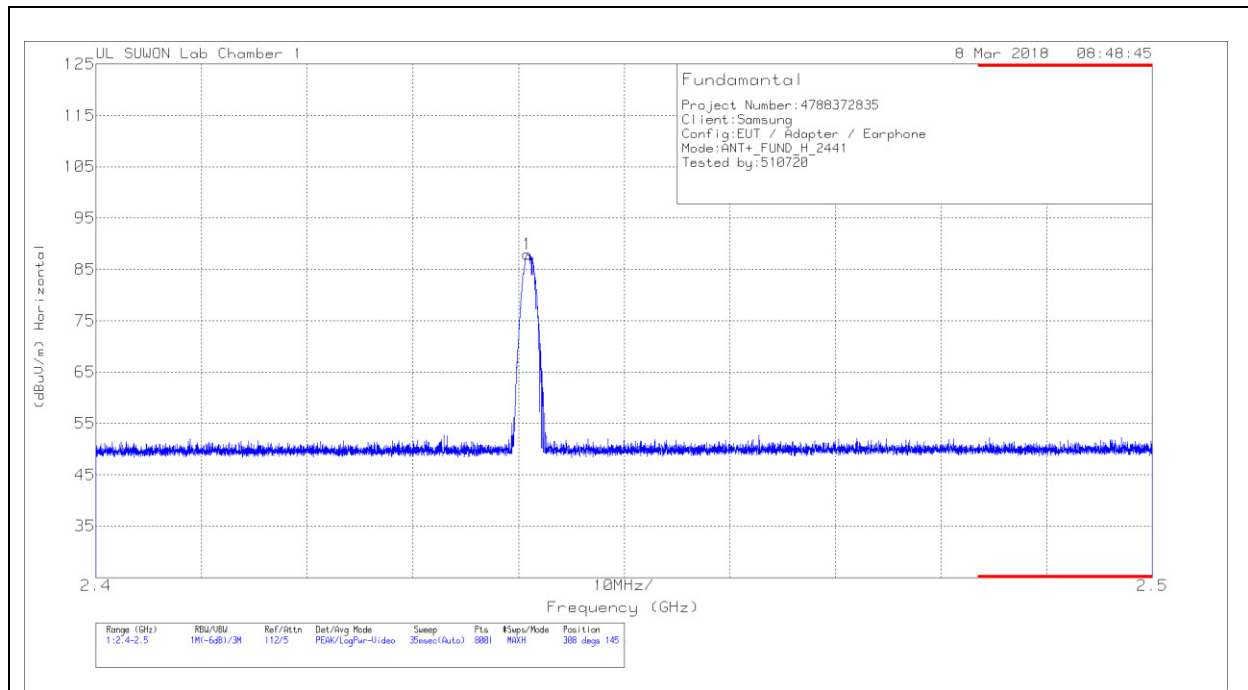
Corrected AV reading = Peak Reading – DCCF

= 92.73 – 52.12= 40.61 dBuV/m

\*\*\*AVG Limit : 94dBuV/m

AVG Margin : 53.39 dB

# MID CHANNEL, HORIZONTAL



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.441           | 82.03                | Pk  | 31.5                    | -25.6                | 0            | 87.93                      | 308            | 145         | H        |

Pk - Peak detector

\* Pk Limit : 114dBuV/m  
Pk Margin : 26.07 dB

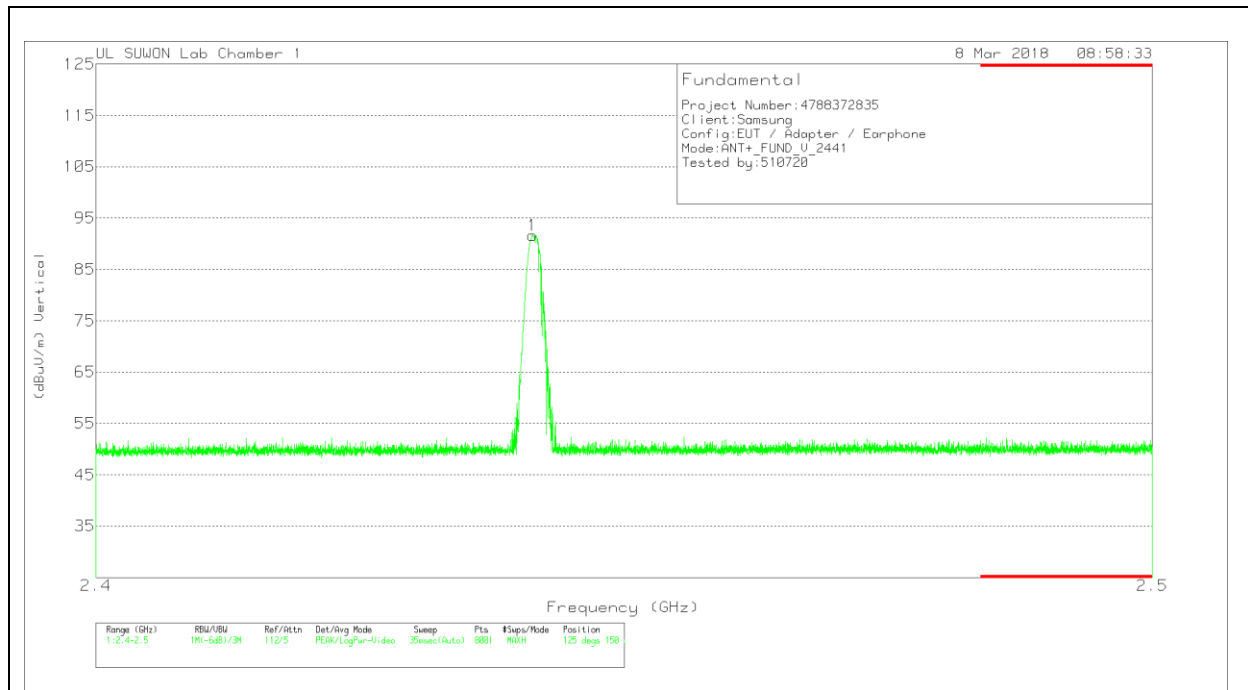
\*\* For marker 1, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF  
= 87.93 – 52.12= 35.81 dBuV/m

\*\*\*AVG Limit : 94dBuV/m  
AVG Margin : 48.48 dB

# **MID CHANNEL, VERTICAL**



## **Trace Markers**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.441           | 85.7                 | Pk  | 31.5                    | -25.6                | 0            | 91.6                       | 125            | 150         | V        |

Pk - Peak detector

\* Pk Limit : 114dBu/Vm  
Pk Margin : 22.4 dB

\*\* For marker 1, used the following method to do averaging:

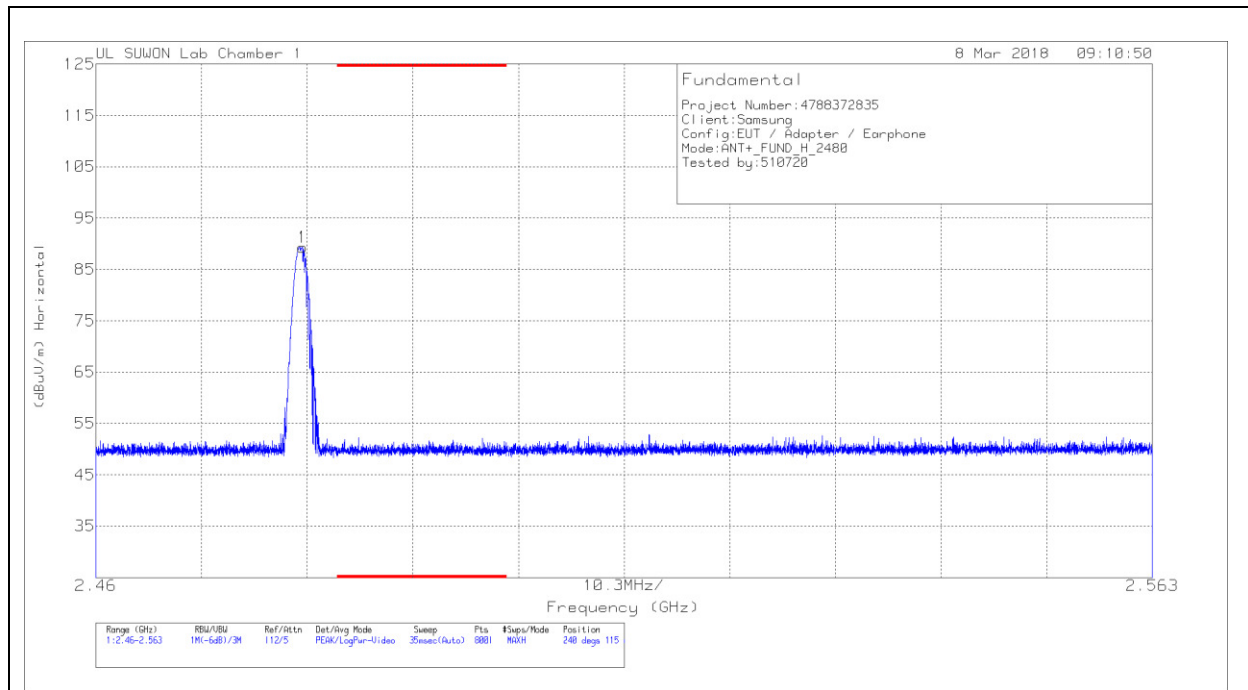
DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 91.6 – 52.12= 39.48 dBuV/m

\*\*\*AVG Limit : 94dBu/Vm  
AVG Margin : 54.52 dB

# **HIGH CHANNEL, HORIZONTAL**



## **Trace Markers**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.48            | 83.08                | Pk  | 31.6                    | -25.4                | 0            | 89.28                      | 240            | 115         | H        |

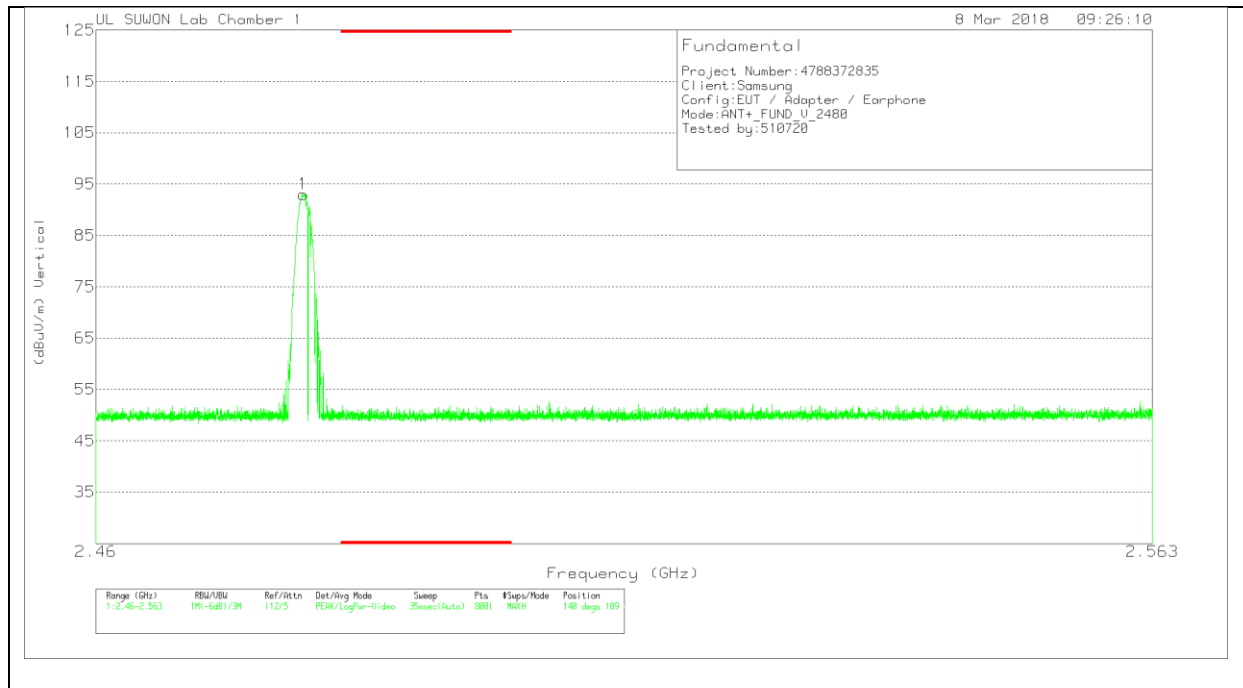
Pk - Peak detector

\* Pk Limit : 114dBu/Vm  
Pk Margin : 24.72 dB

\*\* For marker 1, used the following method to do averaging:  
DCCF=52.12  
Corrected AV reading = Peak Reading – DCCF  
= 89.28 – 52.12= 37.16 dBuV/m

\*\*\*AVG Limit : 94dBu/Vm  
AVG Margin : 56.84 dB

## HIGH CHANNEL, VERTICAL



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_00 168717 | 10dB_ATT(dB)_170 809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|----------------|-------------|----------|
| 1      | 2.48            | 86.84                | Pk  | 31.6                    | -25.4                | 0            | 93.04                      | 140            | 189         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
Pk - Peak detector

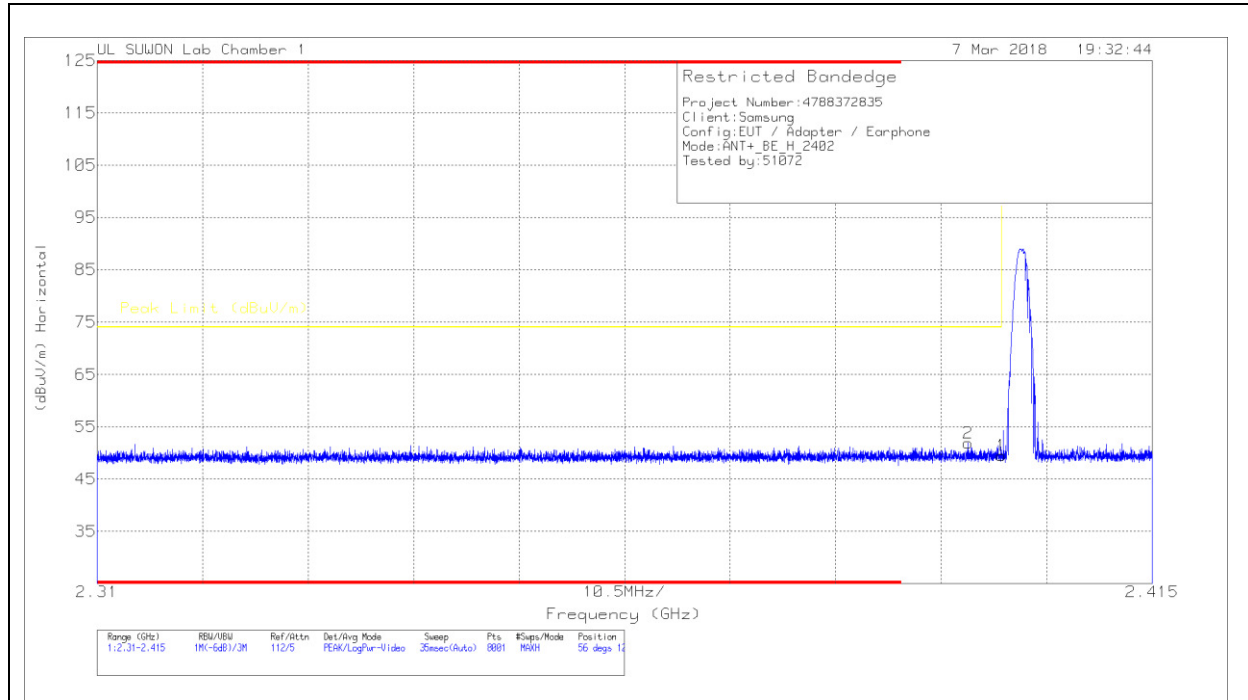
\*\* Pk Limit : 114dBu/Vm  
Pk Margin : 20.96dB

\*\*\* For marker 1, used the following method to do averaging:  
DCCF=52.12  
Corrected AV reading = Peak Reading – DCCF  
= 93.04 – 52.12= 40.92 dBuV/m

\*\*\*AVG Limit : 94dBu/Vm  
AVG Margin : 53.08 dB

## 7.2.3. TRANSMITTER BAND EDGES

### BANDEDGE (LOW CHANNEL, HORIZONTAL)



### HORIZONTAL DATA

#### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_0 0168717 | 10dB_ATT(dB)_17 0809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|---------------------|----------------|----------------|-------------|----------|
| 1      | 2.4             | 43.89                | Pk  | 31.3                    | -25.7                | 0            | 49.49                      | 74                  | -24.51         | 56             | 126         | H        |
| 2      | 2.397           | 46.29                | Pk  | 31.3                    | -25.7                | 0            | 51.89                      | 74                  | -22.11         | 56             | 126         | H        |

Pk - Peak detector

\* For marker 1, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 49.49 – 52.12 = -2.63 dBuV/m [AVG Limit : 54dBuV/m, Margin : 56.63 dB]

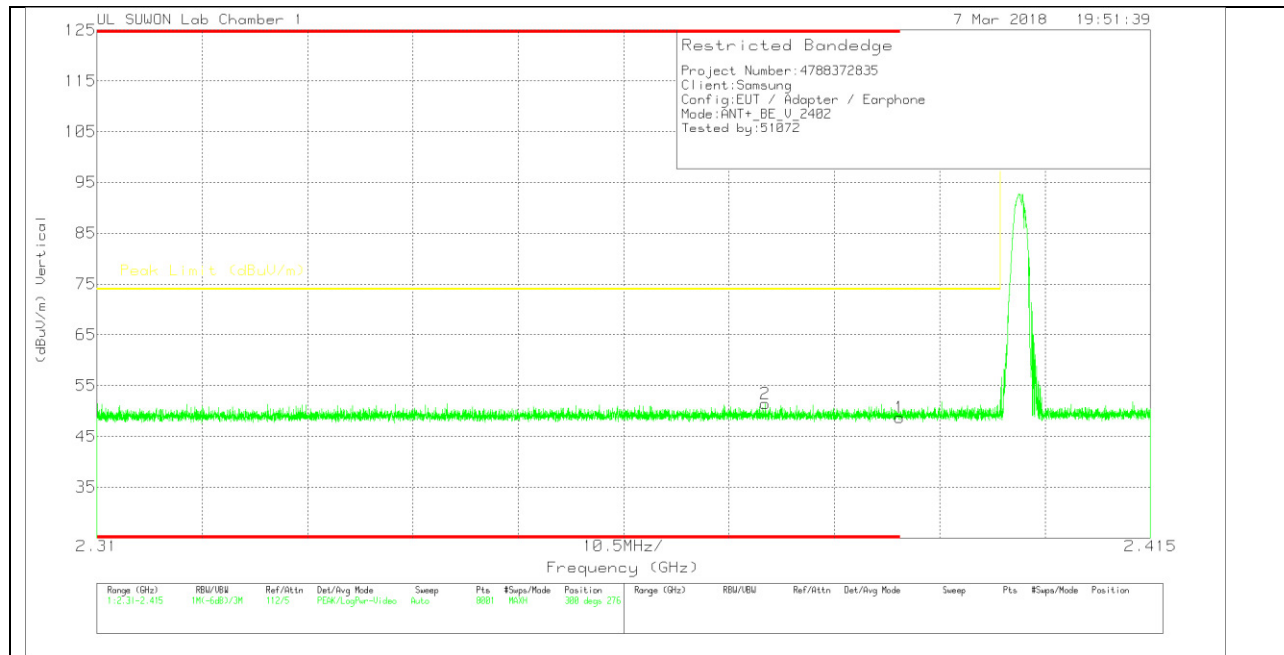
\* For marker 2, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 51.89 – 52.12 = -0.23 dBuV/m [AVG Limit : 54dBuV/m, Margin : 54.23 dB]

## VERTICAL PEAK AND AVERAGE PLOT



## VERTICAL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_0 0168717 | 10dB_ATT(dB)_17 0809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.39          | 43.17                | Pk  | 31.3                    | -25.7                | 0            | 48.77                      | 74                  | -25.23         | 300            | 276         | V        |
| 2      | * 2.377         | 45.99                | Pk  | 31.3                    | -25.8                | 0            | 51.49                      | 74                  | -22.51         | 300            | 276         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
Pk - Peak detector

\* For marker 1, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 48.77 – 52.12 = -3.35 dBuV/m [AVG Limit : 54dBu/Vm, Margin : 57.35 dB]

\* For marker 2, used the following method to do averaging:

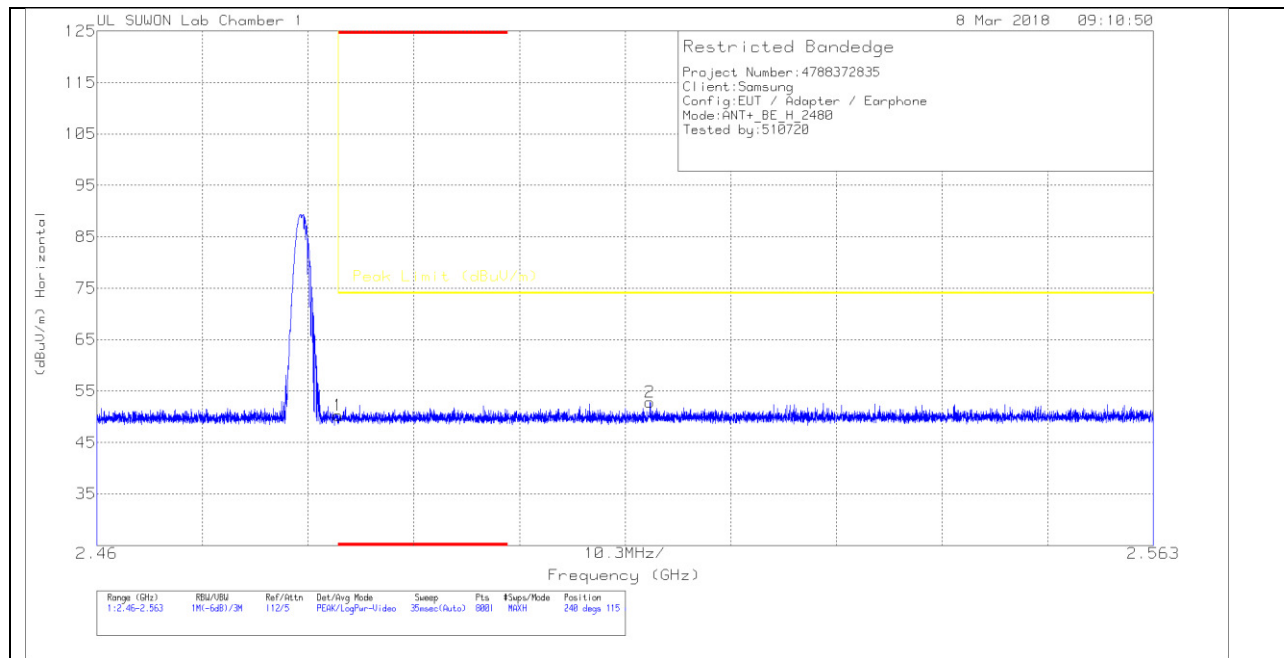
DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 51.49 – 52.12 = -0.63 dBuV/m [AVG Limit : 54dBu/Vm, Margin : 54.63 dB]

## AUTHORIZED BANDEDGE (HIGH CHANNEL)

### HORIZONTAL PEAK AND AVERAGE PLOT



### HORIZONTAL DATA

#### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_0 0168717 | 10dB_ATT(dB)_17 0809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 44.22                | Pk  | 31.6                    | -25.5                | 0            | 50.32                      | 74                  | -23.68         | 240            | 115         | H        |
| 2      | 2.514           | 46.51                | Pk  | 31.6                    | -25.3                | 0            | 52.81                      | 74                  | -21.19         | 240            | 115         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

\* For marker 1, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 50.32 – 52.12 = -1.8 dBuV/m [AVG Limit : 54dBu/Vm, Margin : 55.8 dB]

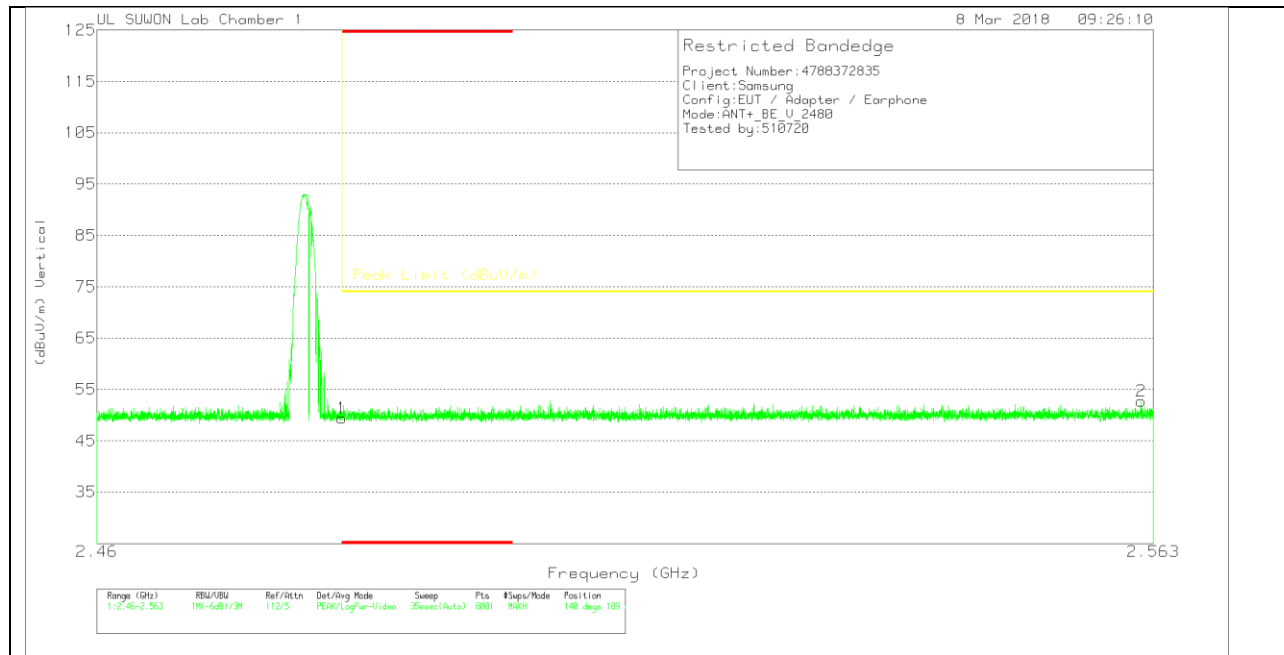
\* For marker 2, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 52.81 – 52.12 = 0.69 dBuV/m [AVG Limit : 54dBu/Vm, Margin : 53.31 dB]

## VERTICAL PEAK AND AVERAGE PLOT



## VERTICAL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_0 0168717 | 10dB_ATT(dB)_17 0809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|----------------------|--------------|----------------------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 43.29                | Pk  | 31.6                    | -25.5                | 0            | 49.39                      | 74                  | -24.61         | 140            | 189         | V        |
| 2      | 2.562           | 46.36                | Pk  | 31.7                    | -25.3                | 0            | 52.76                      | 74                  | -21.24         | 140            | 189         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

\* For marker 1, used the following method to do averaging:

DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

= 49.39 – 52.12 = -2.73 dBuV/m [AVG Limit : 54dBuV/m, Margin : 56.73 dB]

\* For marker 2, used the following method to do averaging:

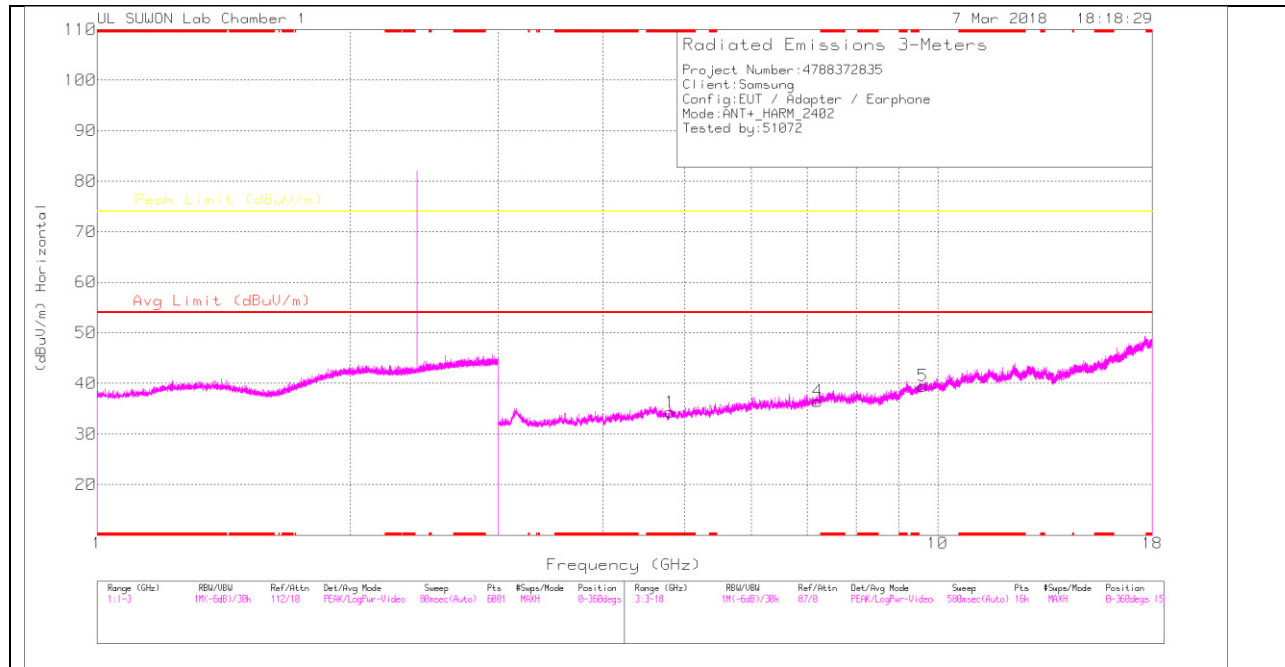
DCCF=52.12

Corrected AV reading = Peak Reading – DCCF

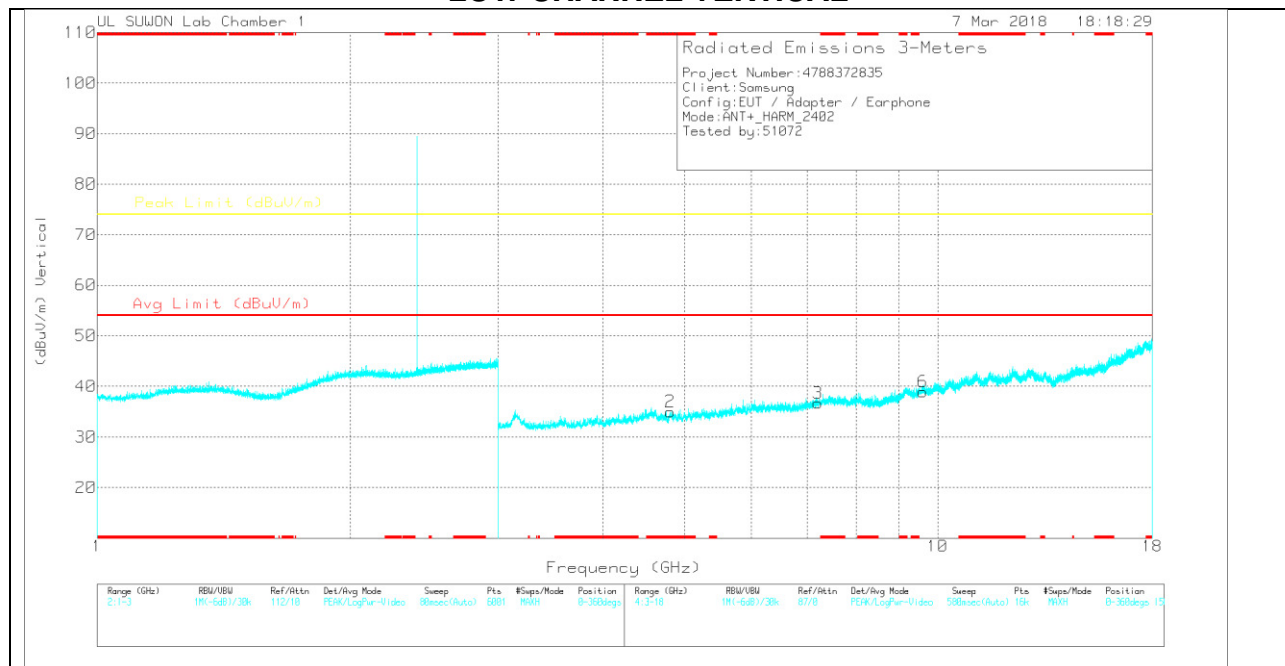
= 52.76 – 52.12 = 0.64 dBuV/m [AVG Limit : 54dBuV/m, Margin : 53.36 dB]

## 7.2.4. HARMONICS AND SPURIOUS EMISSIONS

### LOW CHANNEL HORIZONTAL



### LOW CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## LOW CHANNEL DATA

### Trace Markers

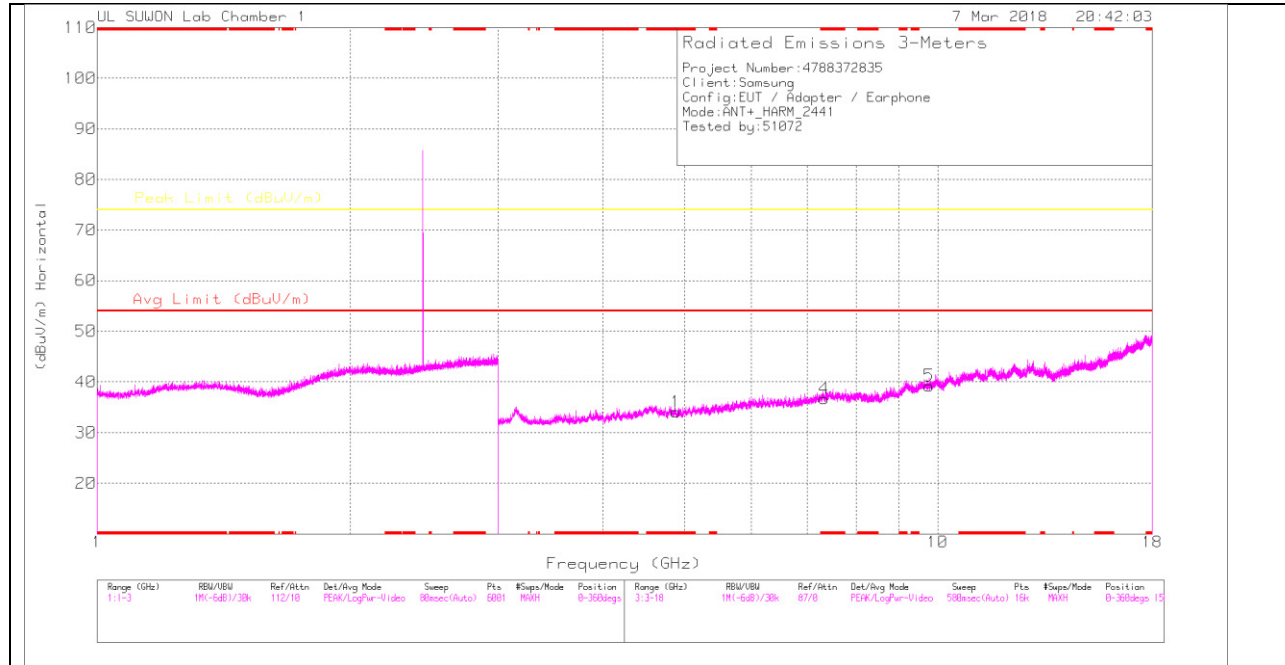
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_001687 17 | 3GHz_HP(dB)_170809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|--------------------|--------------|----------------------------|--------------------|-------------|---------------------|-------------|----------------|-------------|----------|
| 1      | * 4.805         | 32.09                | PK  | 33.8                    | -31.6              | 0            | 34.29                      | -                  | -           | 74                  | -39.71      | 0-360          | 250         | H        |
| 4      | 7.206           | 28.66                | PK  | 35.9                    | -28.1              | 0            | 36.46                      | -                  | -           | 74                  | -37.54      | 0-360          | 250         | H        |
| 5      | 9.608           | 26.28                | PK  | 36.7                    | -23.5              | 0            | 39.48                      | -                  | -           | 74                  | -34.52      | 0-360          | 150         | H        |
| 2      | * 4.805         | 32.79                | PK  | 33.8                    | -31.6              | 0            | 34.99                      | -                  | -           | 74                  | -39.01      | 0-360          | 150         | V        |
| 3      | 7.206           | 28.85                | PK  | 35.9                    | -28.1              | 0            | 36.65                      | -                  | -           | 74                  | -37.35      | 0-360          | 150         | V        |
| 6      | 9.608           | 25.71                | PK  | 36.7                    | -23.5              | 0            | 38.91                      | -                  | -           | 74                  | -35.09      | 0-360          | 250         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

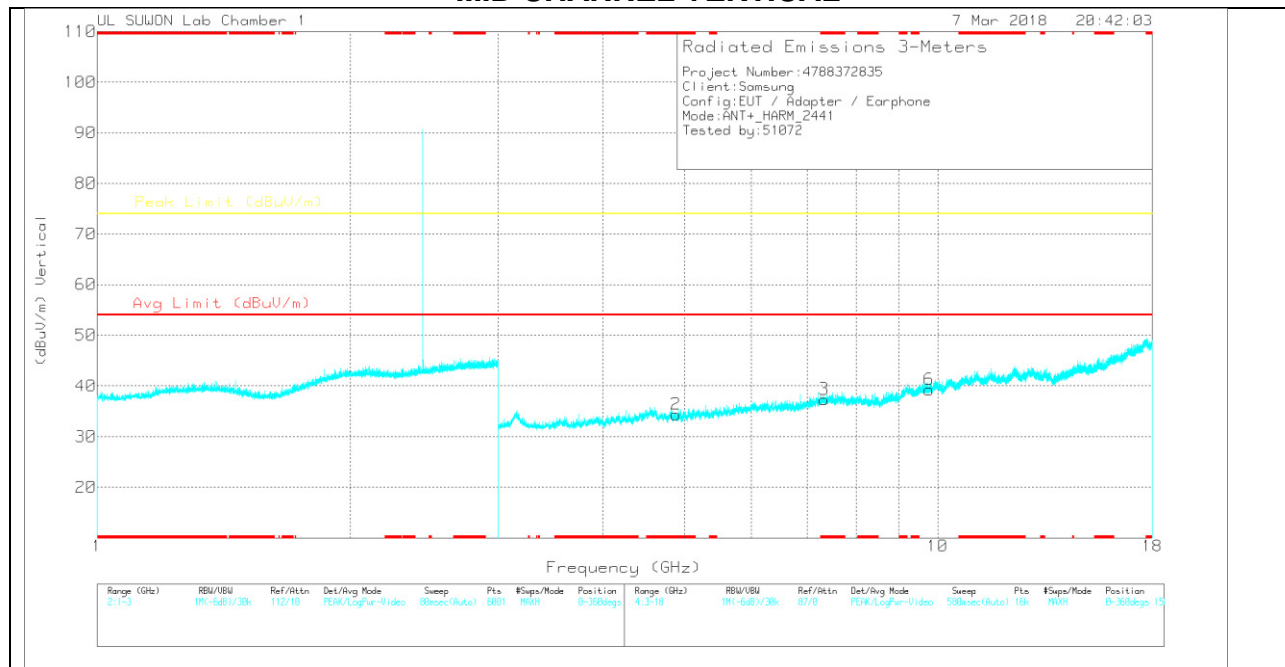
PK – Peak Detector

Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limit (54dBuV/m).

## MID CHANNEL HORIZONTAL



## MID CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## MID CHANNEL DATA

### Trace Markers

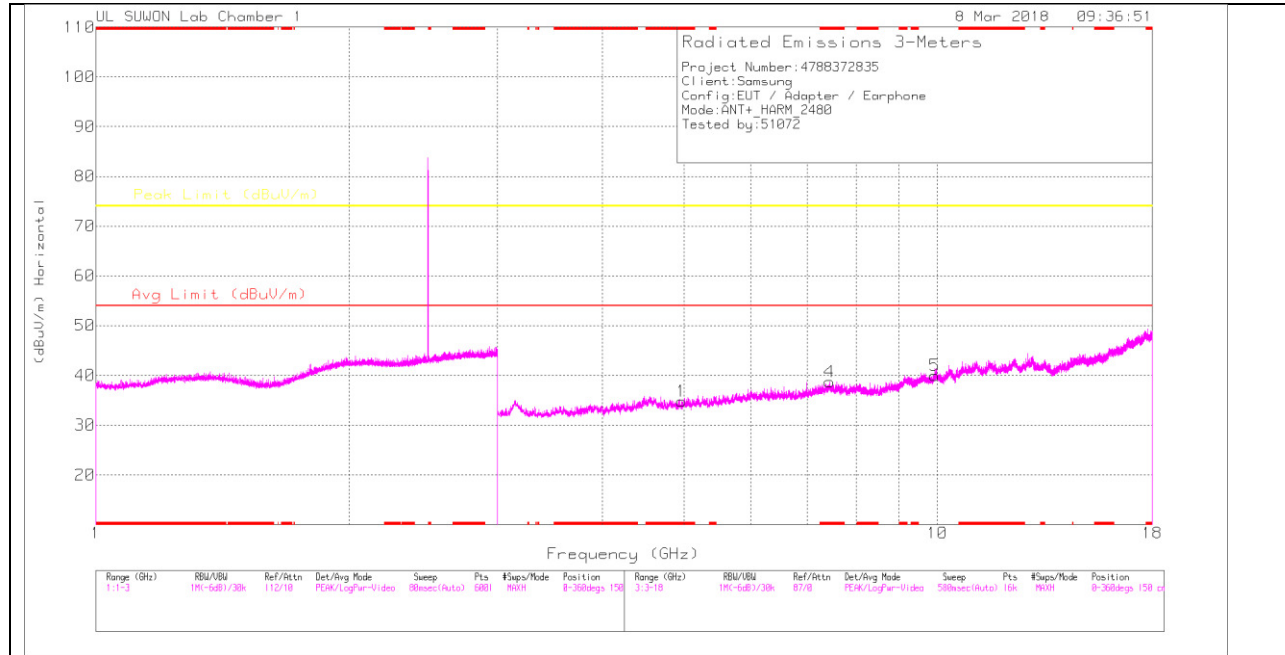
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_001687 17 | 3GHz_HP(dB)_170809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|--------------------|--------------|----------------------------|--------------------|-------------|---------------------|-------------|----------------|-------------|----------|
| 1      | * 4.883         | 31.94                | PK  | 33.8                    | -31.7              | 0            | 34.04                      | -                  | -           | 74                  | -39.96      | 0-360          | 150         | H        |
| 4      | * 7.323         | 28.38                | PK  | 35.9                    | -27.6              | 0            | 36.68                      | -                  | -           | 74                  | -37.32      | 0-360          | 250         | H        |
| 5      | 9.765           | 26.52                | PK  | 36.9                    | -24.2              | 0            | 39.22                      | -                  | -           | 74                  | -34.78      | 0-360          | 250         | H        |
| 2      | * 4.883         | 32.28                | PK  | 33.8                    | -31.7              | 0            | 34.38                      | -                  | -           | 74                  | -39.62      | 0-360          | 250         | V        |
| 3      | * 7.324         | 28.94                | PK  | 35.9                    | -27.5              | 0            | 37.34                      | -                  | -           | 74                  | -36.66      | 0-360          | 250         | V        |
| 6      | 9.765           | 26.55                | PK  | 36.9                    | -24.2              | 0            | 39.25                      | -                  | -           | 74                  | -34.75      | 0-360          | 250         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

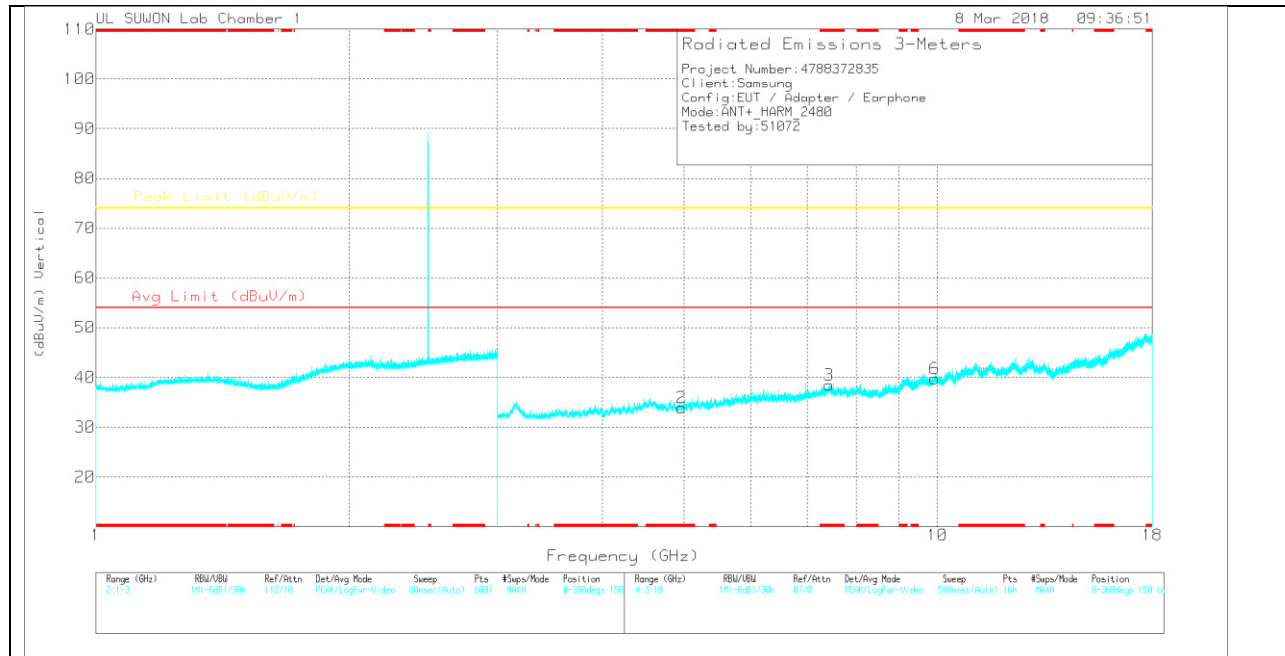
PK – Peak Detector

Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limit (54dBuV/m).

## HIGH CHANNEL HORIZONTAL



## HIGH CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## HIGH CHANNEL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 20170531_3117_001687 17 | 3GHz_HP(dB)_170809 | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|-------------------------|--------------------|--------------|----------------------------|--------------------|-------------|---------------------|-------------|----------------|-------------|----------|
| 1      | * 4.961         | 32.65                | PK  | 33.8                    | -31.7              | 0            | 34.75                      | -                  | -           | 74                  | -39.25      | 0-360          | 150         | H        |
| 4      | * 7.443         | 30.07                | PK  | 35.9                    | -27.2              | 0            | 38.77                      | -                  | -           | 74                  | -35.23      | 0-360          | 150         | H        |
| 5      | 9.921           | 25.15                | PK  | 37.1                    | -22.3              | 0            | 39.95                      | -                  | -           | 74                  | -34.05      | 0-360          | 250         | H        |
| 2      | * 4.96          | 31.76                | PK  | 33.8                    | -31.6              | 0            | 33.96                      | -                  | -           | 74                  | -40.04      | 0-360          | 250         | V        |
| 3      | * 7.44          | 29.76                | PK  | 35.9                    | -27.2              | 0            | 38.46                      | -                  | -           | 74                  | -35.54      | 0-360          | 250         | V        |
| 6      | 9.92            | 24.96                | PK  | 37.1                    | -22.3              | 0            | 39.76                      | -                  | -           | 74                  | -34.24      | 0-360          | 250         | V        |

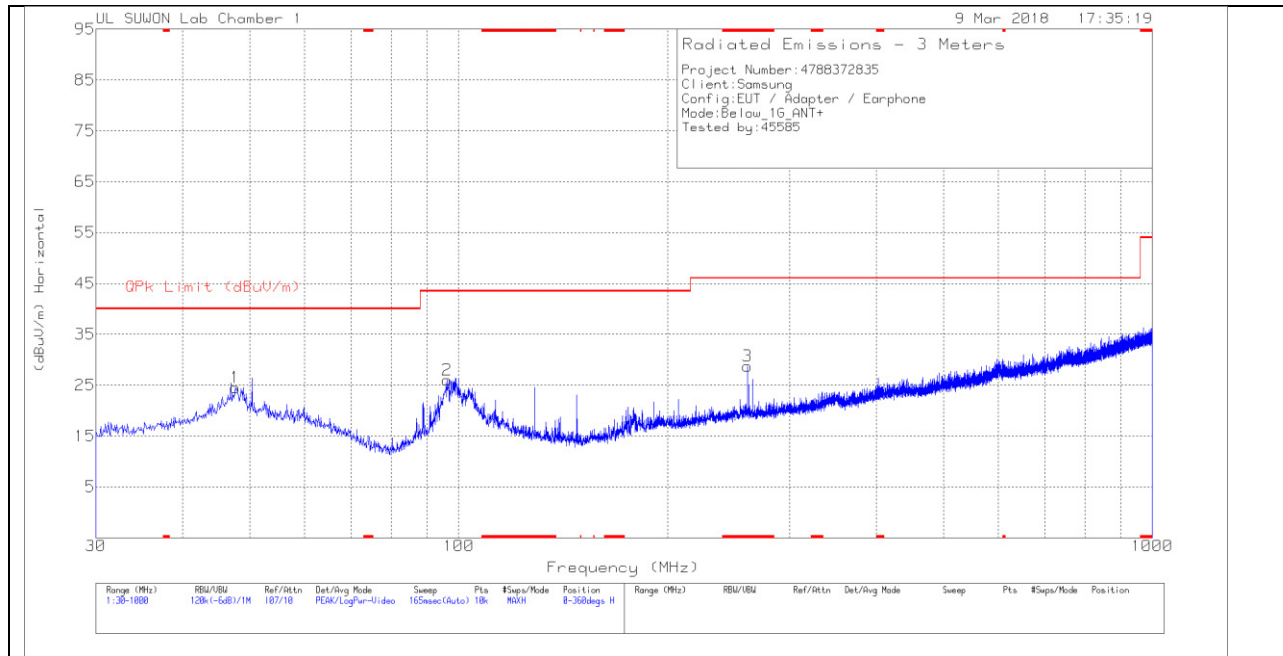
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK – Peak Detector

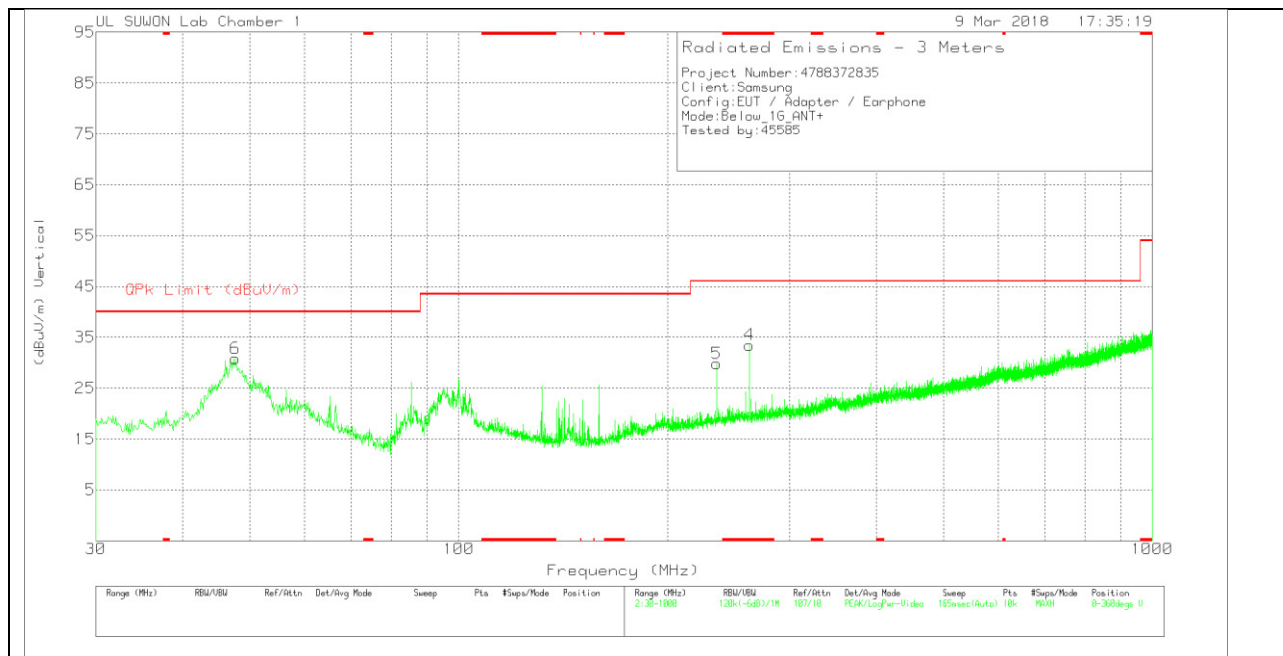
Note: Only peak measurement was performed. Because peak measurement result of unwanted emission is less than average limit (54dBuV/m).

## 7.2.5. SPURIOUS BELOW 1 GHz

### SPURIOUS EMISSIONS 30 TO 1000 MHz (HORIZONTAL)



### SPURIOUS EMISSIONS 30 TO 1000 MHz (VERTICAL)



## BELOW 1 GHz TABLE

### Trace Markers

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 750_20170831 | 30-1000MHz[dB] | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|--------------|----------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 1      | 47.654          | 34.28                | Pk  | 19.8         | -29.5          | 24.58                      | 40                 | -15.42      | 0-360          | 400         | H        |
| 2      | 96.251          | 37.67                | Pk  | 16.9         | -28.5          | 26.07                      | 43.52              | -17.45      | 0-360          | 300         | H        |
| 3      | * 261.054       | 37.47                | Pk  | 18.4         | -27.1          | 28.77                      | 46.02              | -17.25      | 0-360          | 100         | H        |
| 4      | * 262.606       | 42.3                 | Pk  | 18.4         | -27.2          | 33.5                       | 46.02              | -12.52      | 0-360          | 100         | V        |
| 5      | 235.543         | 39.37                | Pk  | 17.9         | -27.4          | 29.87                      | 46.02              | -16.15      | 0-360          | 100         | V        |
| 6      | 47.654          | 40.57                | Pk  | 19.8         | -29.5          | 30.87                      | 40                 | -9.13       | 0-360          | 200         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
Pk - Peak detector

## 8. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | Quasi-peak                   | Average   |
| 0.15-0.5                    | 66 to 56*                    | 56 to 46* |
| 0.5-5                       | 56                           | 46        |
| 5-30                        | 60                           | 50        |

\*Decreases with the logarithm of the frequency.

### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

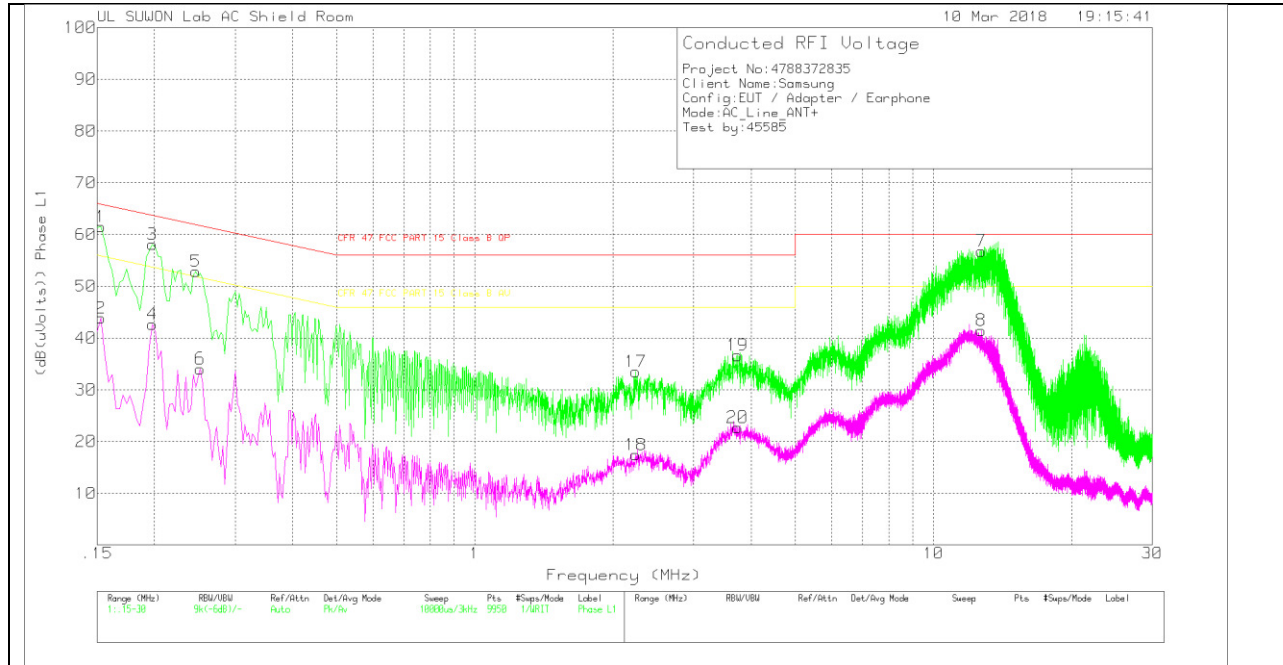
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

## RESULTS

### 6 WORST EMISSIONS

#### LINE 1 PLOT



## LINE 1 RESULTS

### Trace Markers

#### Range 1: Phase L1 .15 - 30MHz

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 101837_L1_with extension | CABLELOSS(dB) | Corrected Reading (dB(uVolts)) | CFR 47 FCC PART 15 Class B QP | Margin (dB) | CFR 47 FCC PART 15 Class B AV | Margin (dB) |
|--------|-----------------|----------------------|-----|--------------------------|---------------|--------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| 1      | .153            | 51.39                | Pk  | 10                       | .1            | 61.49                          | 65.84                         | -4.35       | -                             | -           |
| 2      | .153            | 33.73                | Av  | 10                       | .1            | 43.83                          | -                             | -           | 55.84                         | -12.01      |
| 3      | .198            | 48.09                | Pk  | 9.8                      | .2            | 58.09                          | 63.69                         | -5.6        | -                             | -           |
| 4      | .198            | 32.66                | Av  | 9.8                      | .2            | 42.66                          | -                             | -           | 53.69                         | -11.03      |
| 5      | .246            | 43.14                | Pk  | 9.5                      | .2            | 52.84                          | 61.89                         | -9.05       | -                             | -           |
| 6      | .252            | 24.34                | Av  | 9.5                      | .2            | 34.04                          | -                             | -           | 51.69                         | -17.65      |
| 7      | 12.711          | 46.69                | Pk  | 9.8                      | .3            | 56.79                          | 60                            | -3.21       | -                             | -           |
| 8      | 12.711          | 31.36                | Av  | 9.8                      | .3            | 41.46                          | -                             | -           | 50                            | -8.54       |
| 17     | 2.244           | 23.31                | Pk  | 9.9                      | .3            | 33.51                          | 56                            | -22.49      | -                             | -           |
| 18     | 2.244           | 7.22                 | Av  | 9.9                      | .3            | 17.42                          | -                             | -           | 46                            | -28.58      |
| 19     | 3.735           | 26.54                | Pk  | 9.8                      | .3            | 36.64                          | 56                            | -19.36      | -                             | -           |
| 20     | 3.738           | 12.6                 | Av  | 9.8                      | .3            | 22.7                           | -                             | -           | 46                            | -23.3       |

Pk - Peak detector

Av - Average detection

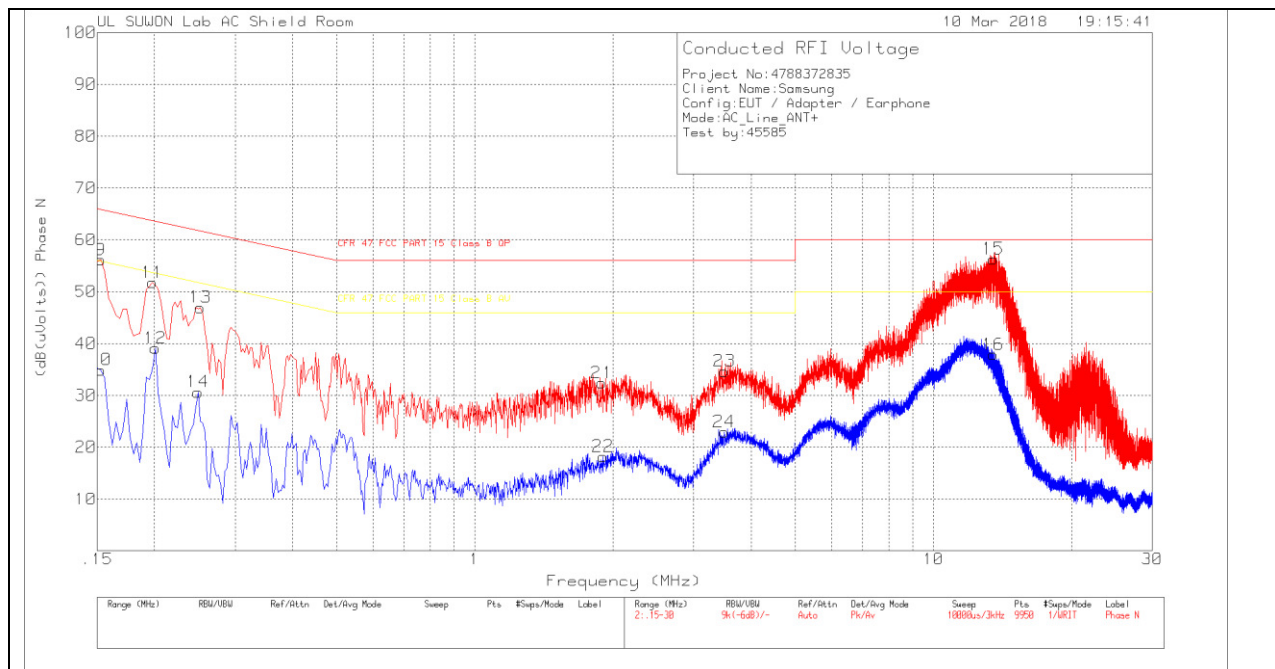
### Quasi-Peak Emissions

#### Range 1: Phase L1 .15 - 30MHz

| Frequency (MHz) | Meter Reading (dBuV) | Det | 101837_L1_with extension | CABLELOSS(dB) | Corrected Reading (dB(uVolts)) | CFR 47 FCC PART 15 Class B QP | Margin (dB) | CFR 47 FCC PART 15 Class B AV | Margin (dB) |
|-----------------|----------------------|-----|--------------------------|---------------|--------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| .15225          | 36.78                | Qp  | 10                       | .1            | 46.88                          | 65.88                         | -19         | -                             | -           |
| .19725          | 35.41                | Qp  | 9.8                      | .2            | 45.41                          | 63.73                         | -18.32      | -                             | -           |
| .24525          | 30.37                | Qp  | 9.5                      | .2            | 40.07                          | 61.92                         | -21.85      | -                             | -           |
| .25125          | 28.27                | Qp  | 9.5                      | .2            | 37.97                          | 61.72                         | -23.75      | -                             | -           |
| 12.7103         | 39.62                | Qp  | 9.8                      | .3            | 49.72                          | 60                            | -10.28      | -                             | -           |

Qp - Quasi-Peak detector

## LINE 2 PLOT



## LINE 2 RESULTS

### Trace Markers

#### Range 2: Phase N .15 - 30MHz

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 101837_N_with extension | CABLELOSS(dB) | Corrected Reading (dB(uVolts)) | CFR 47 FCC PART 15 Class B QP | Margin (dB) | CFR 47 FCC PART 15 Class B AV | Margin (dB) |
|--------|-----------------|----------------------|-----|-------------------------|---------------|--------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| 9      | .153            | 46.03                | Pk  | 10                      | .1            | 56.13                          | 65.84                         | -9.71       | -                             | -           |
| 10     | .153            | 24.81                | Av  | 10                      | .1            | 34.91                          | -                             | -           | 55.84                         | -20.93      |
| 11     | .198            | 41.66                | Pk  | 9.9                     | .2            | 51.76                          | 63.69                         | -11.93      | -                             | -           |
| 12     | .201            | 29.1                 | Av  | 9.8                     | .2            | 39.1                           | -                             | -           | 53.57                         | -14.47      |
| 13     | .252            | 37.16                | Pk  | 9.6                     | .2            | 46.96                          | 61.69                         | -14.73      | -                             | -           |
| 14     | .249            | 20.85                | Av  | 9.6                     | .2            | 30.65                          | -                             | -           | 51.79                         | -21.14      |
| 15     | 13.497          | 46.11                | Pk  | 9.8                     | .4            | 56.31                          | 60                            | -3.69       | -                             | -           |
| 16     | 13.494          | 27.68                | Av  | 9.8                     | .4            | 37.88                          | -                             | -           | 50                            | -12.12      |
| 21     | 1.893           | 22.19                | Pk  | 9.9                     | .3            | 32.39                          | 56                            | -23.61      | -                             | -           |
| 22     | 1.902           | 8.01                 | Av  | 9.9                     | .3            | 18.21                          | -                             | -           | 46                            | -27.79      |
| 23     | 3.501           | 24.57                | Pk  | 9.8                     | .3            | 34.67                          | 56                            | -21.33      | -                             | -           |
| 24     | 3.495           | 12.86                | Av  | 9.8                     | .3            | 22.96                          | -                             | -           | 46                            | -23.04      |

Pk - Peak detector

Av - Average detection

### Quasi-Peak Emissions

#### Range 2: Phase N .15 - 30MHz

| Frequency (MHz) | Meter Reading (dBuV) | Det | 101837_N_with extension | CABLELOSS(dB) | Corrected Reading (dB(uVolts)) | CFR 47 FCC PART 15 Class B QP | Margin (dB) | CFR 47 FCC PART 15 Class B AV | Margin (dB) |
|-----------------|----------------------|-----|-------------------------|---------------|--------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| .15225          | 35.83                | Qp  | 10                      | .1            | 45.93                          | 65.88                         | -19.95      | -                             | -           |
| .19725          | 33.9                 | Qp  | 9.9                     | .2            | 44                             | 63.73                         | -19.73      | -                             | -           |
| .20025          | 33.44                | Qp  | 9.8                     | .2            | 43.44                          | 63.6                          | -20.16      | -                             | -           |
| .25125          | 27.37                | Qp  | 9.6                     | .2            | 37.17                          | 61.72                         | -24.55      | -                             | -           |
| .24825          | 28.24                | Qp  | 9.6                     | .2            | 38.04                          | 61.82                         | -23.78      | -                             | -           |
| 13.4963         | 39.77                | Qp  | 9.8                     | .4            | 49.97                          | 60                            | -10.03      | -                             | -           |
| 13.4948         | 39.62                | Qp  | 9.8                     | .4            | 49.82                          | 60                            | -10.18      | -                             | -           |

Qp - Quasi-Peak detector