



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-247 ISSUE 2**

Bluetooth Low Energy

CERTIFICATION TEST REPORT

FOR

BT/BLE and DTS b/g/n Tablet

MODEL NUMBER : SM-T230NZ

FCC ID: A3LSMT230NZ

IC : 649E-SMT230NZ

REPORT NUMBER: 4788321149-E1V1

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Testing
Laboratory

TL-637

Revision History

| <u>Rev.</u> | <u>Issue Date</u> | <u>Revisions</u> | <u>Revised By</u> |
|-------------|-------------------|------------------|-------------------|
| V1 | 02/22/18 | Initial issue | Junwhan Lee |

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION: BT/BLE and DTS b/g/n Tablet
MODEL NUMBER: SM-T230NZ
SERIAL NUMBER: R32K100140R (CONDUCTED);
R32K100146E (RADIATED);
DATE TESTED: FEB 02, 2018 - FEB 20, 2018

| APPLICABLE STANDARDS | |
|---------------------------------|--------------|
| STANDARD | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Pass |
| INDUSTRY CANADA RSS-247 Issue 2 | Pass |
| INDUSTRY CANADA RSS-GEN Issue 4 | 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:

Tested By:



SungGil Park
Suwon Lab Engineer
UL Korea, Ltd.

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. IC RSS-GEN Issue 4
4. IC RSS-247 Issue 2
5. KDB 558074 D01 DTS Meas Guidance v04.
6. 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 type="checkbox"/> | Chamber 1 |
| <input type="checkbox"/> | Chamber 2 |
| <input checked="" 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:

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

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 BT/BLE and DTS b/g/n Tablet.
This test report addresses the DTS (BLE) operational mode.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted output power as follows:

| Frequency Range [MHz] | Mode | Power Mode | Output Power [dBm] | Output Power [mW] |
|-----------------------|------|------------|--------------------|-------------------|
| 2402 - 2480 | BLE | Peak | 4.347 | 2.72 |
| | | Average | 4.133 | 2.59 |

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal antenna, with a maximum gain of 0 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 X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X 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 | ETA0U83EWE | DK2K109VS/A -E | N/A |
| Data Cable | SAMSUNG | EP-DN930CWE | N/A | N/A |
| Earphone | SAMSUNG | EHS64AVFWE | N/A | N/A |

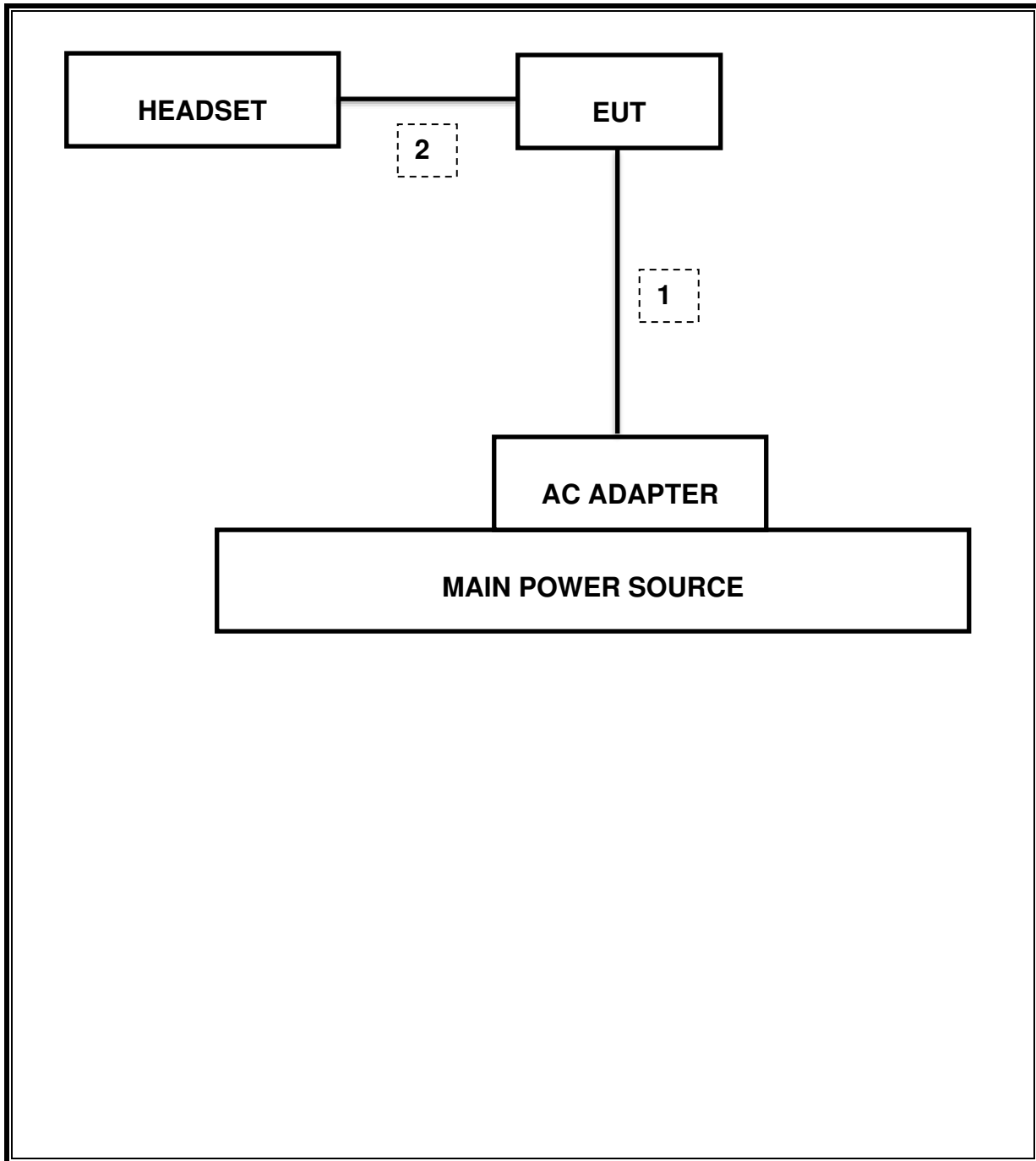
I/O CABLES

| 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 a stand-alone unit during the tests.
 Test software in hidden menu exercised the EUT to enable BLE mode.

SETUP DIAGRAM FOR TESTS



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 | 04-14-19 |
| 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 | 11-29-18 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00205959 | 05-31-19 |
| 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. REFERENCE MEASUREMENT RESULTS

7.1. ON TIME AND DUTY CYCLE RESULTS

LIMITS

None: for reporting purposes only.

| Mode | ON Time B [msec] | Period [msec] | Duty Cycle x [linear] | Duty Cycle [%] | Duty Cycle Correction Factor [dB] | 1/T Minimum VBW [kHz] |
|----------------------|------------------------|------------------|-----------------------------|----------------------|---|-----------------------------|
| 2400MHz Bands | | | | | | |
| BLE | 0.389 | 0.625 | 0.623 | 62.3% | 2.05 | 2.568 |



7.2. 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 and to 1% of the span. The VBW is set to ≥ 3 times the RBW. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

| Channel | Frequency [MHz] | 99% Bandwidth [MHz] |
|---------|-----------------|---------------------|
| Low | 2402 | 1.065 |
| Mid | 2440 | 1.058 |
| High | 2480 | 1.064 |
| Worst | | 1.065 |

99% BANDWIDTH PLOTS

| | | | | | | | | | | | | | | | | | | | |
|---------------------|--|--------------------|-------------|----------|-------------------|--|--|---------------------|------------|-----------|----------------|-----------|------|--|--|---------|--|--|-----------|
| <p>Low CH</p> | <p>KeySight Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.40200000 GHz Trig: Free Run #Atten: 30 dB Radio Std: None Radio Device: BTS</p> <p>10 dB/div Ref 20.00 dBm</p> <p>Center 2.402 GHz Span 3 MHz #Res BW 30 kHz VBW 300 kHz #Sweep 100 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>1.36 dBm</td> </tr> <tr> <td>1.0647 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>12.786 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.248 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> | Occupied Bandwidth | Total Power | 1.36 dBm | 1.0647 MHz | | | Transmit Freq Error | 12.786 kHz | OBW Power | x dB Bandwidth | 1.248 MHz | x dB | | | 99.00 % | | | -26.00 dB |
| Occupied Bandwidth | Total Power | 1.36 dBm | | | | | | | | | | | | | | | | | |
| 1.0647 MHz | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | 12.786 kHz | OBW Power | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 1.248 MHz | x dB | | | | | | | | | | | | | | | | | |
| | | 99.00 % | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | |
| <p>Middle CH</p> | <p>KeySight Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.44000000 GHz Trig: Free Run #Atten: 30 dB Radio Std: None Radio Device: BTS</p> <p>10 dB/div Ref 20.00 dBm</p> <p>Center 2.44 GHz Span 3 MHz #Res BW 30 kHz VBW 300 kHz #Sweep 100 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>2.23 dBm</td> </tr> <tr> <td>1.0576 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>16.274 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.248 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> | Occupied Bandwidth | Total Power | 2.23 dBm | 1.0576 MHz | | | Transmit Freq Error | 16.274 kHz | OBW Power | x dB Bandwidth | 1.248 MHz | x dB | | | 99.00 % | | | -26.00 dB |
| Occupied Bandwidth | Total Power | 2.23 dBm | | | | | | | | | | | | | | | | | |
| 1.0576 MHz | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | 16.274 kHz | OBW Power | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 1.248 MHz | x dB | | | | | | | | | | | | | | | | | |
| | | 99.00 % | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | |
| <p>High CH</p> | <p>KeySight Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.48000000 GHz Trig: Free Run #Atten: 30 dB Radio Std: None Radio Device: BTS</p> <p>10 dB/div Ref 20.00 dBm</p> <p>Center 2.48 GHz Span 3 MHz #Res BW 30 kHz VBW 300 kHz #Sweep 100 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>1.09 dBm</td> </tr> <tr> <td>1.0641 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>20.328 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>1.248 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>99.00 %</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> | Occupied Bandwidth | Total Power | 1.09 dBm | 1.0641 MHz | | | Transmit Freq Error | 20.328 kHz | OBW Power | x dB Bandwidth | 1.248 MHz | x dB | | | 99.00 % | | | -26.00 dB |
| Occupied Bandwidth | Total Power | 1.09 dBm | | | | | | | | | | | | | | | | | |
| 1.0641 MHz | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | 20.328 kHz | OBW Power | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 1.248 MHz | x dB | | | | | | | | | | | | | | | | | |
| | | 99.00 % | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | |

8. SUMMARY TABLE

| FCC Part Section | IC Section | Test Description | Test Limit | Test Condition | Test Result | Worst Case |
|--------------------|------------------------|---|------------|----------------------|-------------|-------------------|
| 15.247 (a)(2) | RSS-247 5.2(a) | Occupied Band width (6dB) | >500KHz | Conducted | Pass | 698.6 kHz |
| 2.1051, 15.247 (d) | RSS-247 5.5 | Band Edge / Conducted Spurious Emission | -20dBc | | Pass | -53.085 dBm |
| 15.247 (b)(3) | RSS-247 5.4(d) | TX conducted output power | <30dBm | | Pass | 4.347 dBm (Peak) |
| 15.247 (e) | RSS-247 5.2(b) | PSD | <8dBm | | Pass | -9.95 dBm (Peak) |
| 15.207 (a) | RSS-GEN Clause 7 & 8.9 | AC Power Line conducted emissions | Section 10 | Power Line conducted | Pass | 40.29 dBuV (Pk) |
| 15.205, 15.209 | RSS-GEN Clause 8.8 | Radiated Spurious Emission | < 54dBuV/m | Radiated | Pass | 43.99 dBuV/m (Av) |

9. ANTENNA PORT TEST RESULTS

9.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)
IC RSS-247 §5.2 (1)

The minimum 6 dB bandwidth shall be at least 500 kHz.

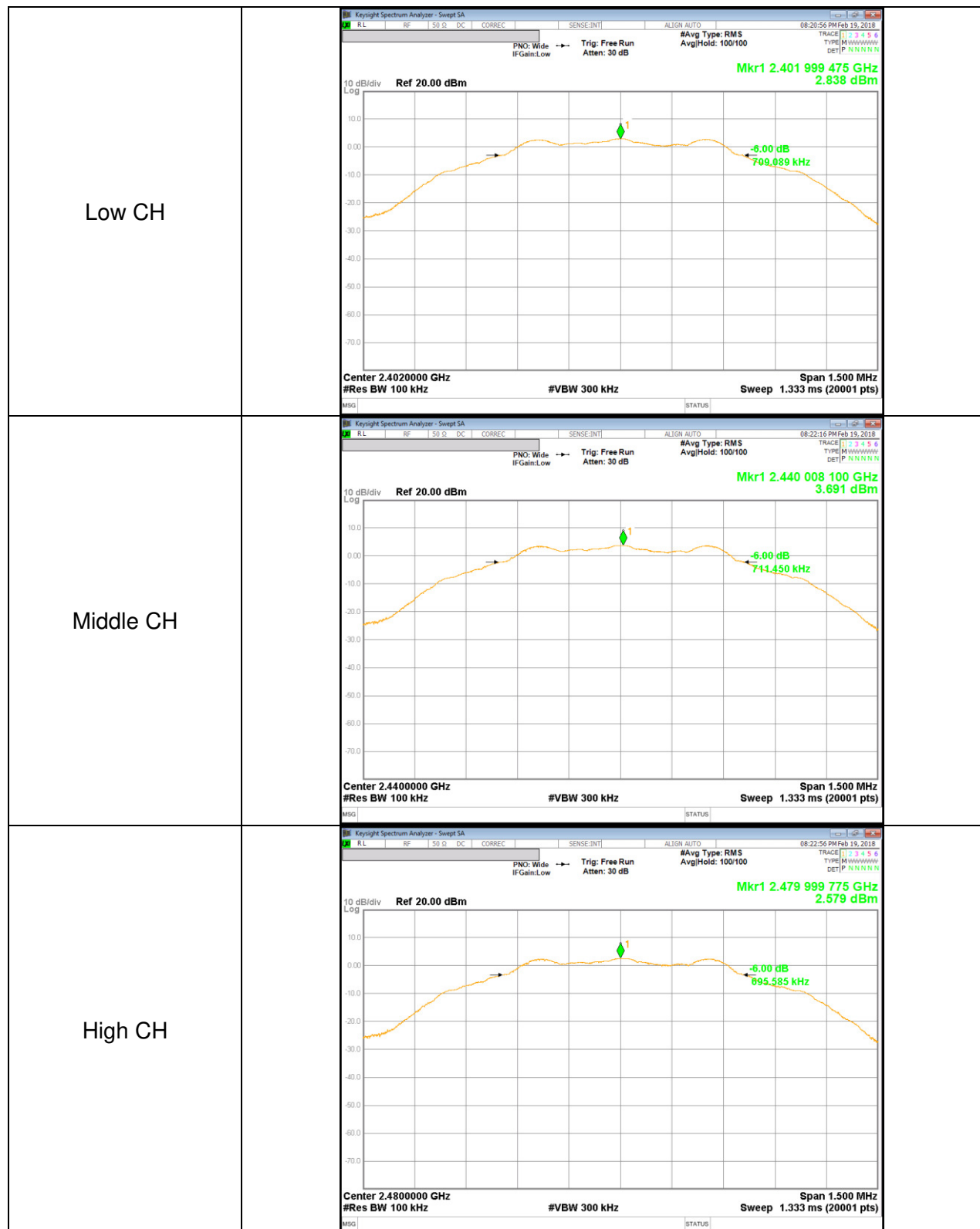
TEST PROCEDURE

Reference to KDB 558074 D01 DTS Meas Guidance v04: The transmitter output is connected to a spectrum analyzer with the RBW set to 100kHz, the VBW $\geq 3 \times$ RBW, peak detector and max hold.

RESULTS

| Channel | Frequency [MHz] | 6 dB Bandwidth [kHz] | Minimum Limit [kHz] |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 709.1 | 500.0 |
| Mid | 2440 | 711.5 | 500.0 |
| High | 2480 | 698.6 | 500.0 |
| Worst | | 698.6 | 500.0 |

6 dB BANDWIDTH PLOTS



9.2. OUTPUT POWER

LIMITS

FCC §15.247 (b)
IC RSS-247 §5.4 (4)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

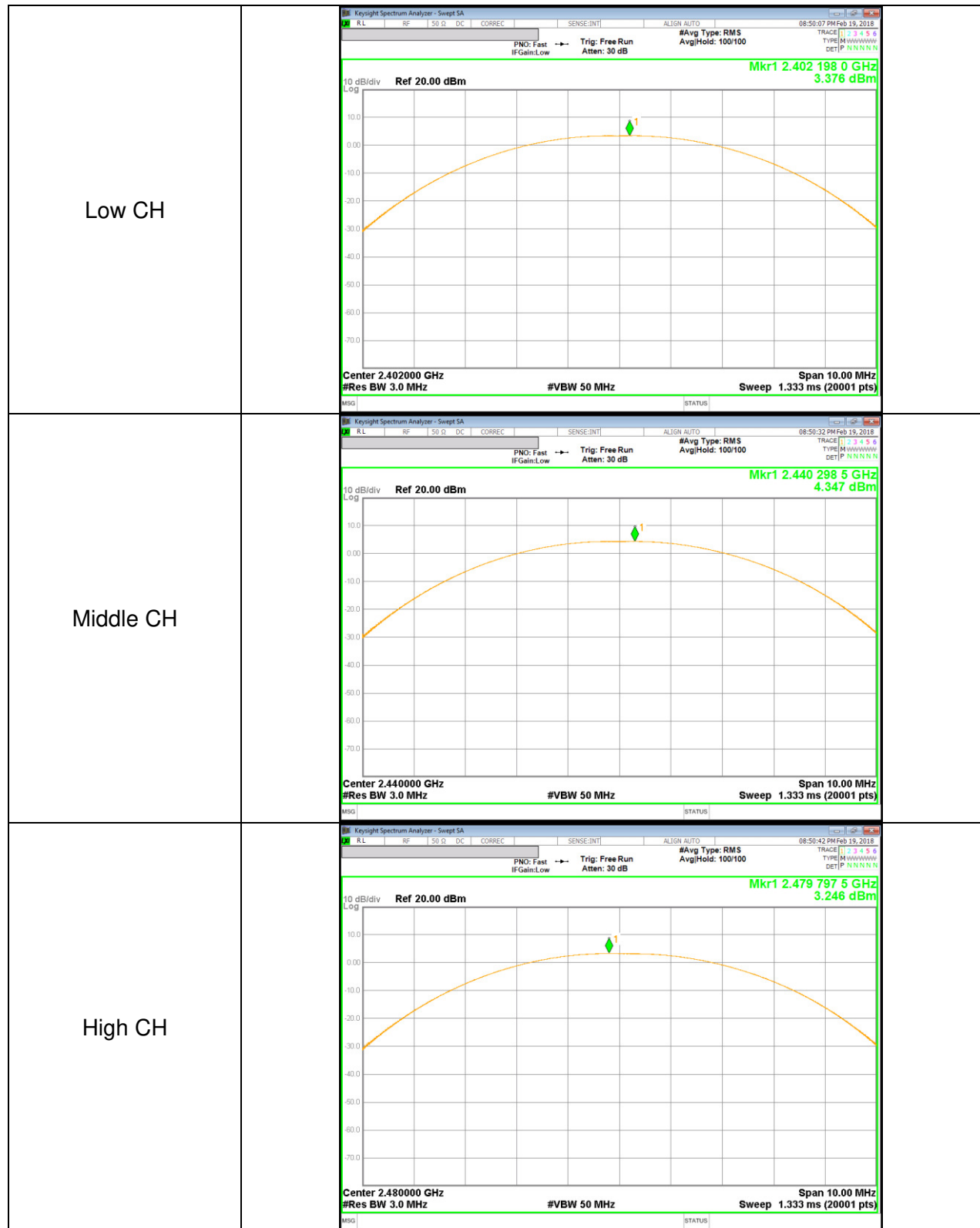
TEST PROCEDURE

Peak power is measured using KDB558074 D01 DTS Meas Guidance v04 under section 9.1.1 utilizing spectrum analyzer.

RESULTS

| Channel | Frequency [MHz] | Peak Power Reading [dBm] | Limit [dBm] | Margin [dB] |
|---------|-----------------|--------------------------|-------------|-------------|
| Low | 2402 | 3.376 | 30.000 | -26.624 |
| Mid | 2440 | 4.347 | 30.000 | -25.653 |
| High | 2480 | 3.246 | 30.000 | -26.754 |
| Worst | | 4.347 | | -25.653 |

OUTPUT POWER PLOTS



9.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency [MHz] | AV power [dBm] | AV power [mW] |
|---------|-----------------|----------------|---------------|
| Low | 2402 | 3.211 | 2.095 |
| Middle | 2440 | 4.133 | 2.590 |
| High | 2480 | 3.010 | 2.000 |

9.4. PSD

LIMITS

FCC §15.247
IC RSS-247 §5.2 (2)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

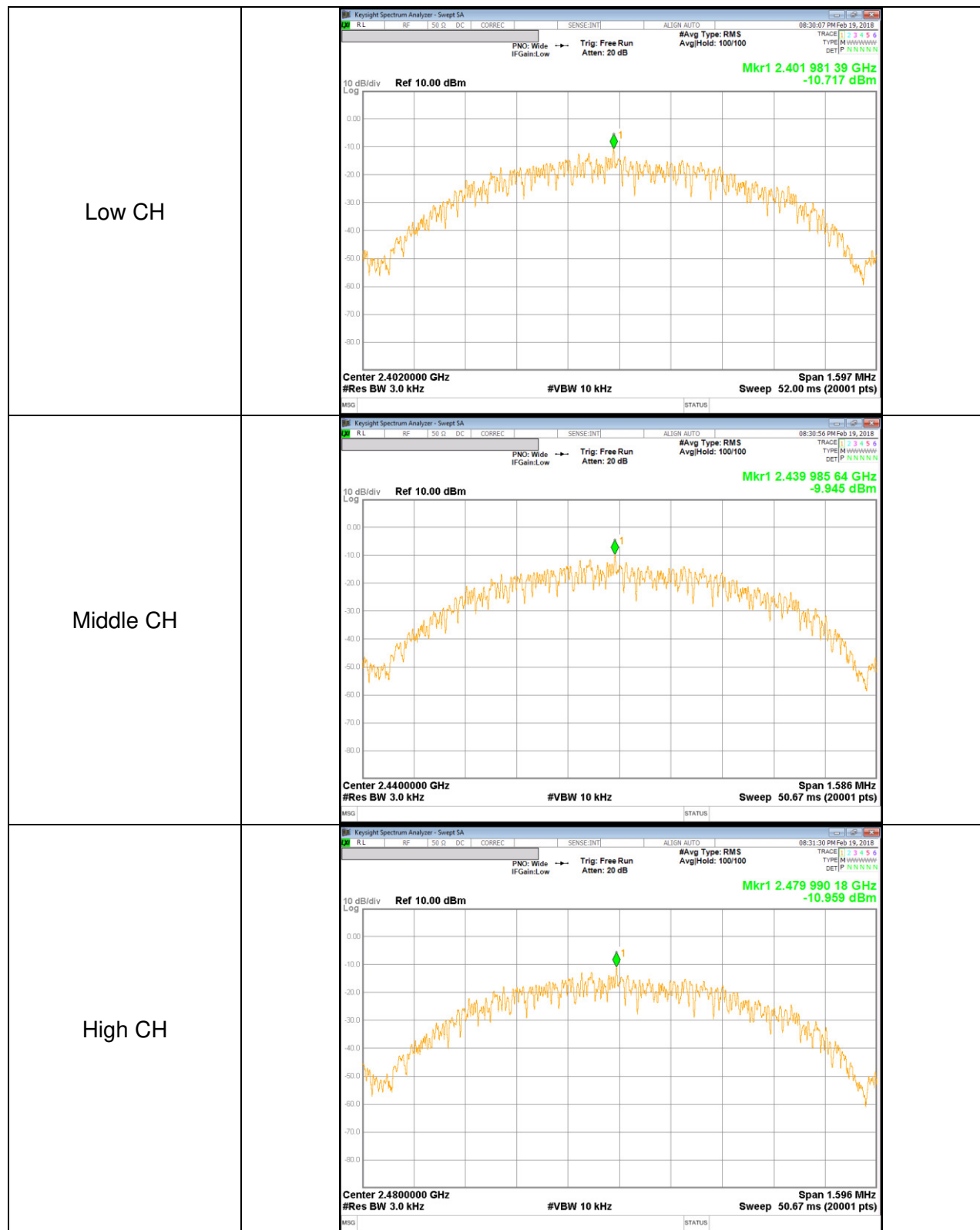
TEST PROCEDURE

Power Spectral Density was performed utilizing the “§10.2 Method PKPSD (Peak PSD)” under KDB558074 D01 DTS Meas Guidance v04

RESULTS

| Channel | Frequency [MHz] | PSD [dBm] | Limit [dBm] | Margin [dB] |
|---------|-----------------|-----------|-------------|-------------|
| Low | 2402 | -10.72 | 8.00 | -18.72 |
| Mid | 2440 | -9.95 | 8.00 | -17.95 |
| High | 2480 | -10.96 | 8.00 | -18.96 |

POWER SPECTRAL DENSITY PLOTS



9.5. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)
IC RSS-247 §5.5

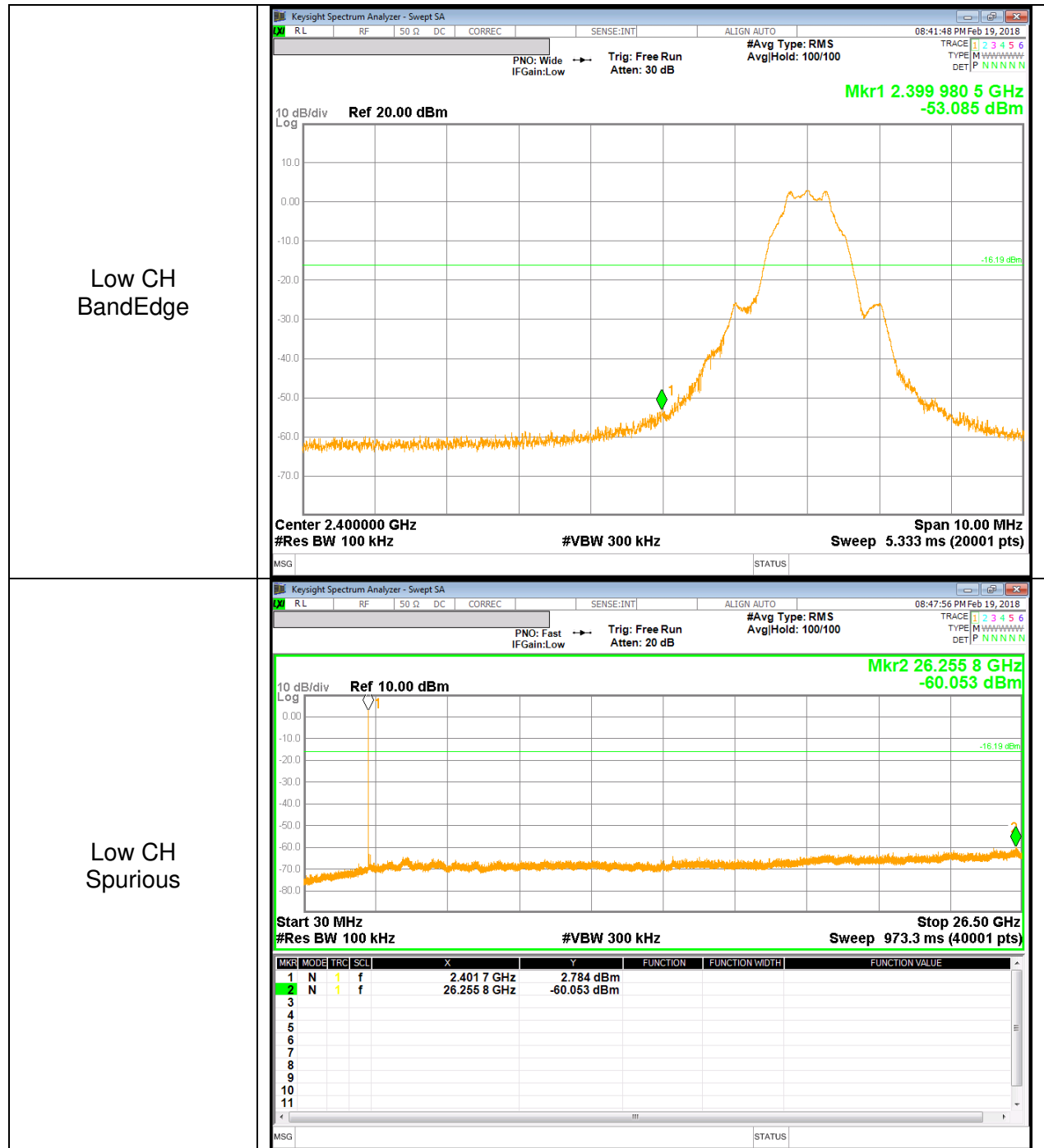
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

TEST PROCEDURE

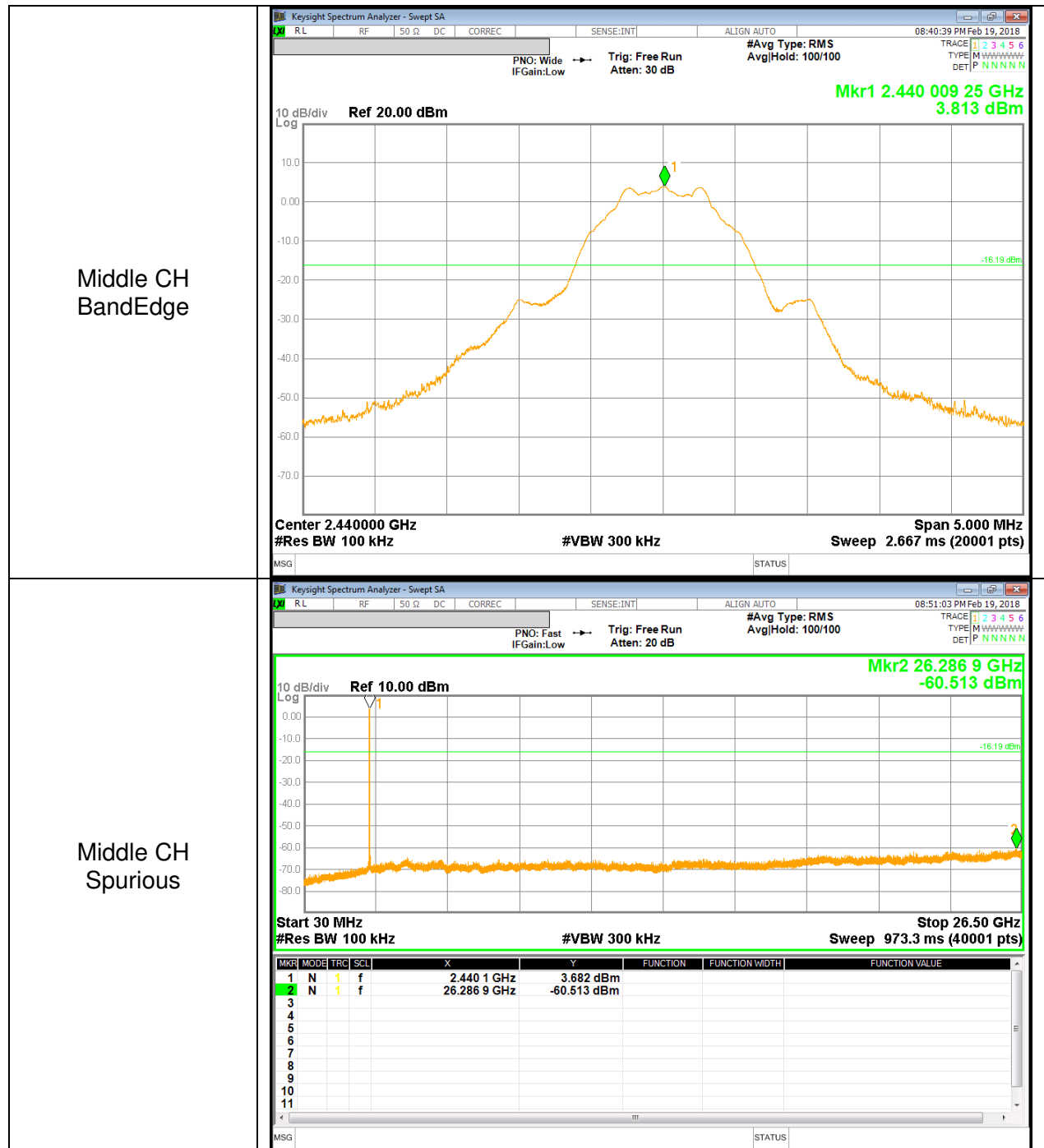
The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

RESULTS

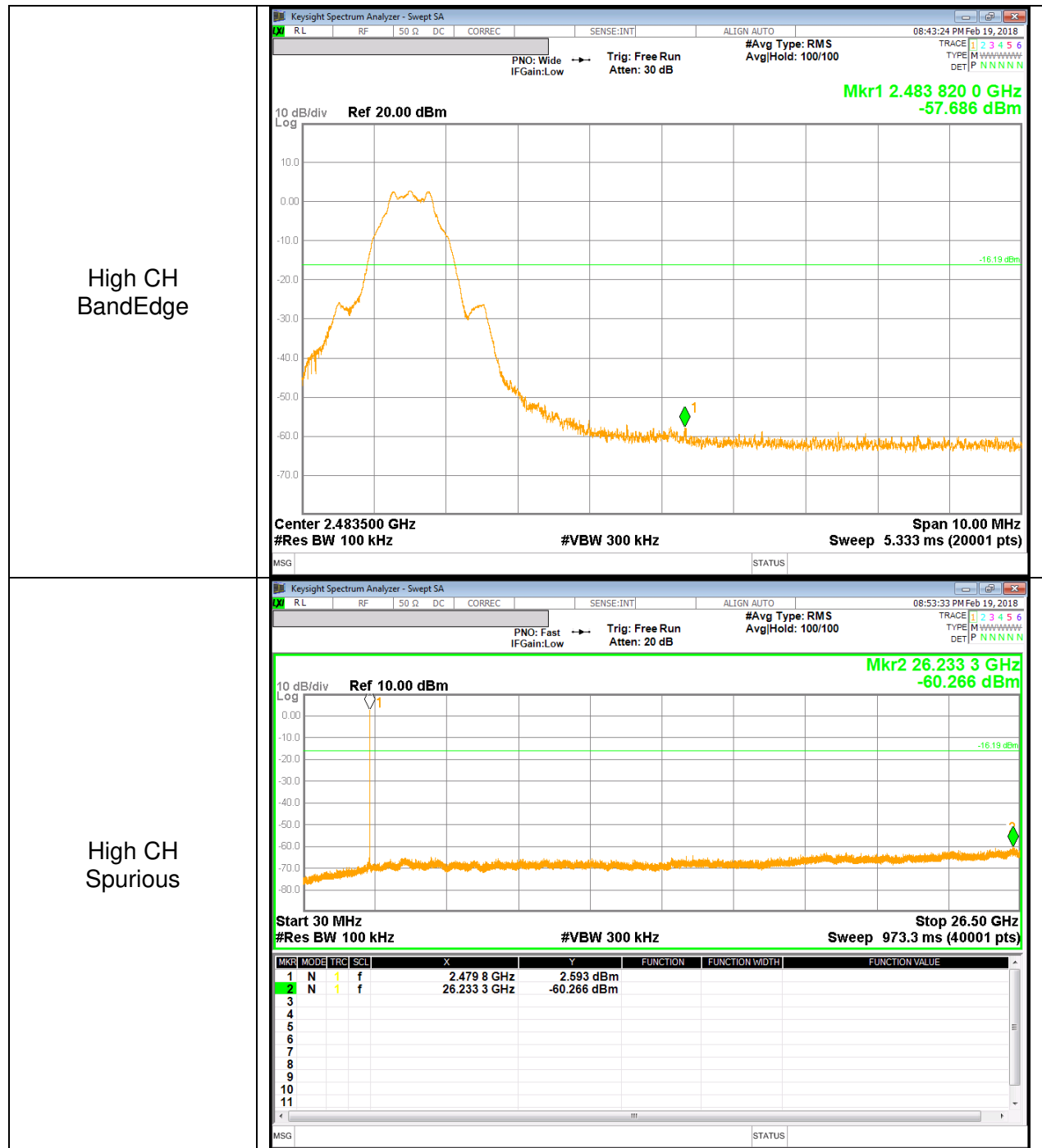
BANDEDGE & SPURIOUS EMISSIONS, LOW CHANNEL



SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
 IC RSS-GEN Clause 8.9 (Transmitter)
 IC RSS-GEN Clause 7 (Receiver)

| 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.

TEST PROCEDURE

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. (Restricted bandedge, Final detection of spurious harmonic emissions) Duty cycle factor = $10 \log(1/x)$. For this sample: DCF = $10 \log(1/0.623) = 2.05 \text{dB}$ (Spectrum Analyzer round it up to 2.05dB)

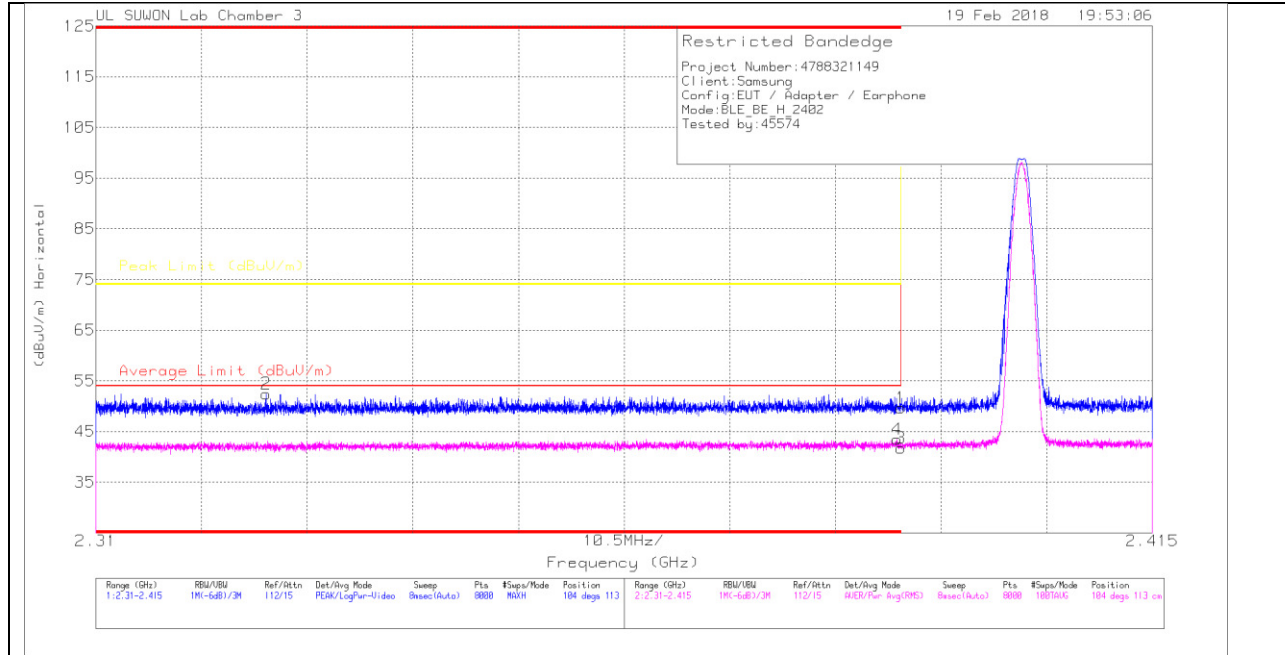
Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

The spectrum from 1 GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.
(From 30MHz to 1GHz, test was performed with the EUT set to transmit at the channel with highest output power)

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

10.2. TRANSMITTER ABOVE 1 GHz RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

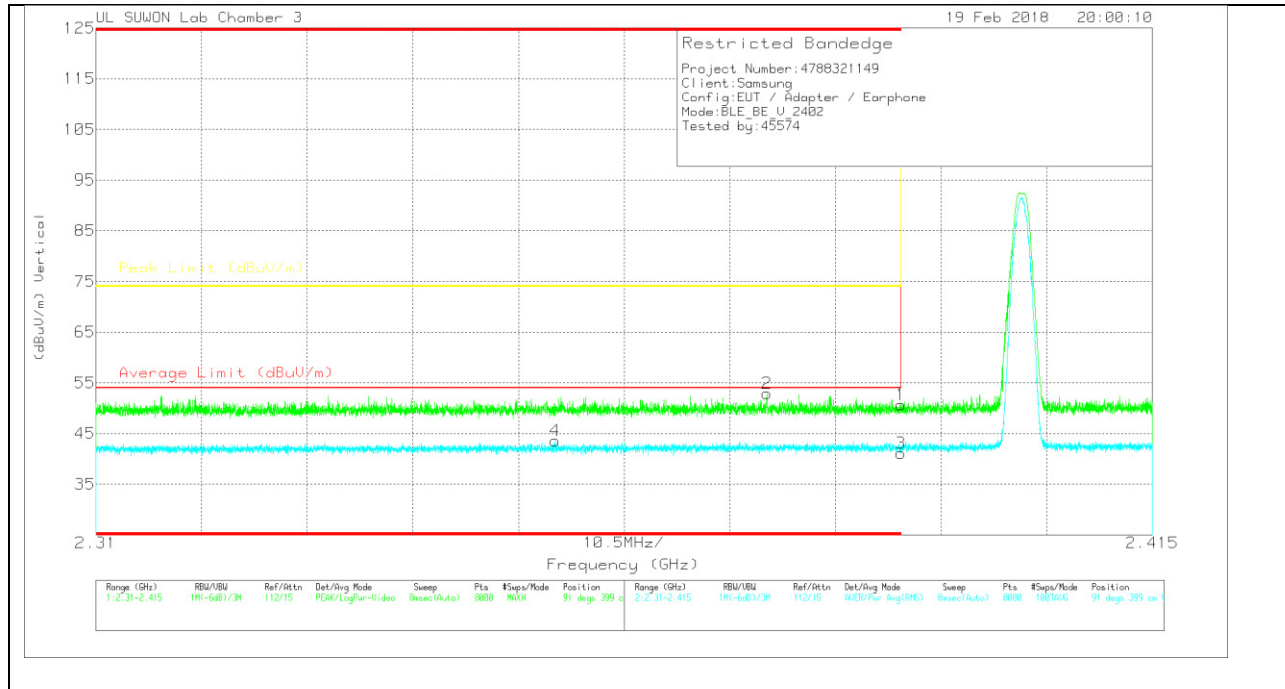
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205959) | 10dB_ATT[dB] | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|--------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.39 | 41.19 | Pk | 31.8 | -23.3 | 0 | 49.69 | - | - | 74 | -24.31 | 104 | 113 | H |
| 2 | * 2.327 | 44.16 | Pk | 31.6 | -23.3 | 0 | 52.46 | - | - | 74 | -21.54 | 104 | 113 | H |
| 3 | * 2.39 | 31.16 | RMS | 31.8 | -23.3 | 2.05 | 41.71 | 54 | -12.29 | - | - | 104 | 113 | H |
| 4 | * 2.39 | 32.91 | RMS | 31.8 | -23.3 | 2.05 | 43.46 | 54 | -10.54 | - | - | 104 | 113 | H |

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

Pk - Peak detector

RMS - RMS detection

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

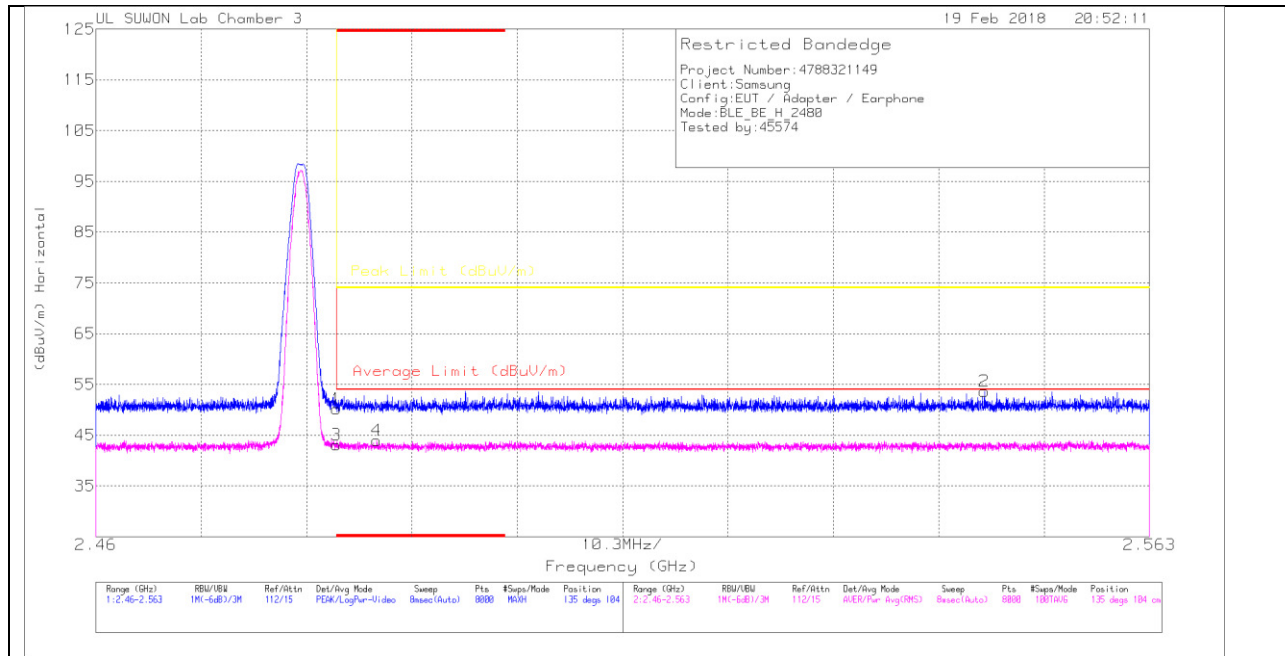
Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205959) | 10dB_ATT[dB] | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|--------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.39 | 42.2 | Pk | 31.8 | -23.3 | 0 | 50.7 | - | - | 74 | -23.3 | 91 | 399 | V |
| 2 | * 2.377 | 44.32 | Pk | 31.8 | -23.2 | 0 | 52.92 | - | - | 74 | -21.08 | 91 | 399 | V |
| 3 | * 2.39 | 30.59 | RMS | 31.8 | -23.3 | 2.05 | 41.14 | 54 | -12.86 | - | - | 91 | 399 | V |
| 4 | * 2.356 | 33.07 | RMS | 31.7 | -23.2 | 2.05 | 43.62 | 54 | -10.38 | - | - | 91 | 399 | V |

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

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

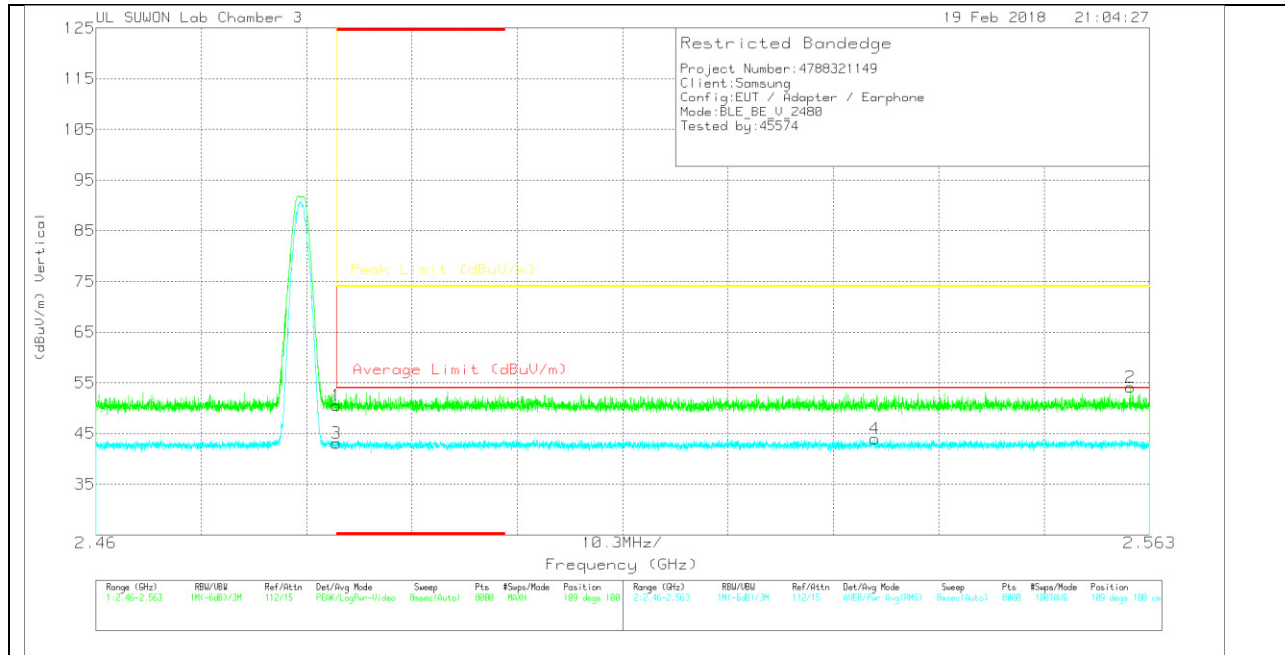
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205959) | 10dB_ATT[dB] | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Pk Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|--------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.484 | 41.1 | Pk | 32.1 | -23 | 0 | 50.2 | - | - | 74 | -23.8 | 135 | 104 | H |
| 2 | 2.547 | 44.54 | Pk | 32.1 | -23 | 0 | 53.64 | - | - | 74 | -20.36 | 135 | 104 | H |
| 3 | * 2.484 | 31.95 | RMS | 32.1 | -23 | 2.05 | 43.1 | 54 | -10.9 | - | - | 135 | 104 | H |
| 4 | * 2.487 | 32.94 | RMS | 32.1 | -23.1 | 2.05 | 43.99 | 54 | -10.01 | - | - | 135 | 104 | H |

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

Pk - Peak detector

RMS - RMS detection

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205959) | 10dB_ATT[dB] | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|--------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * 2.484 | 41.47 | Pk | 32.1 | -23 | 0 | 50.57 | - | - | 74 | -23.43 | 109 | 100 | V |
| 2 | 2.561 | 44.87 | Pk | 32.1 | -22.8 | 0 | 54.17 | - | - | 74 | -19.83 | 109 | 100 | V |
| 3 | * 2.484 | 31.95 | RMS | 32.1 | -23 | 2.05 | 43.1 | 54 | -10.9 | - | - | 109 | 100 | V |
| 4 | 2.536 | 32.82 | RMS | 32.1 | -23 | 2.05 | 43.97 | 54 | -10.03 | - | - | 109 | 100 | V |

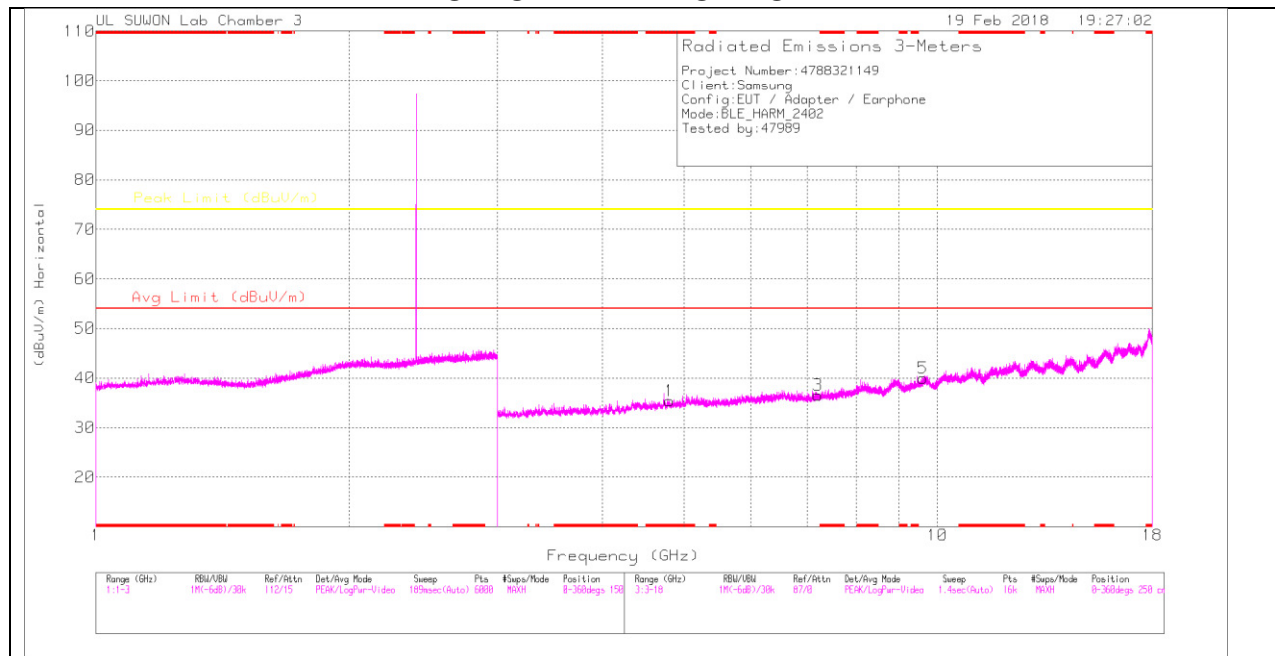
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

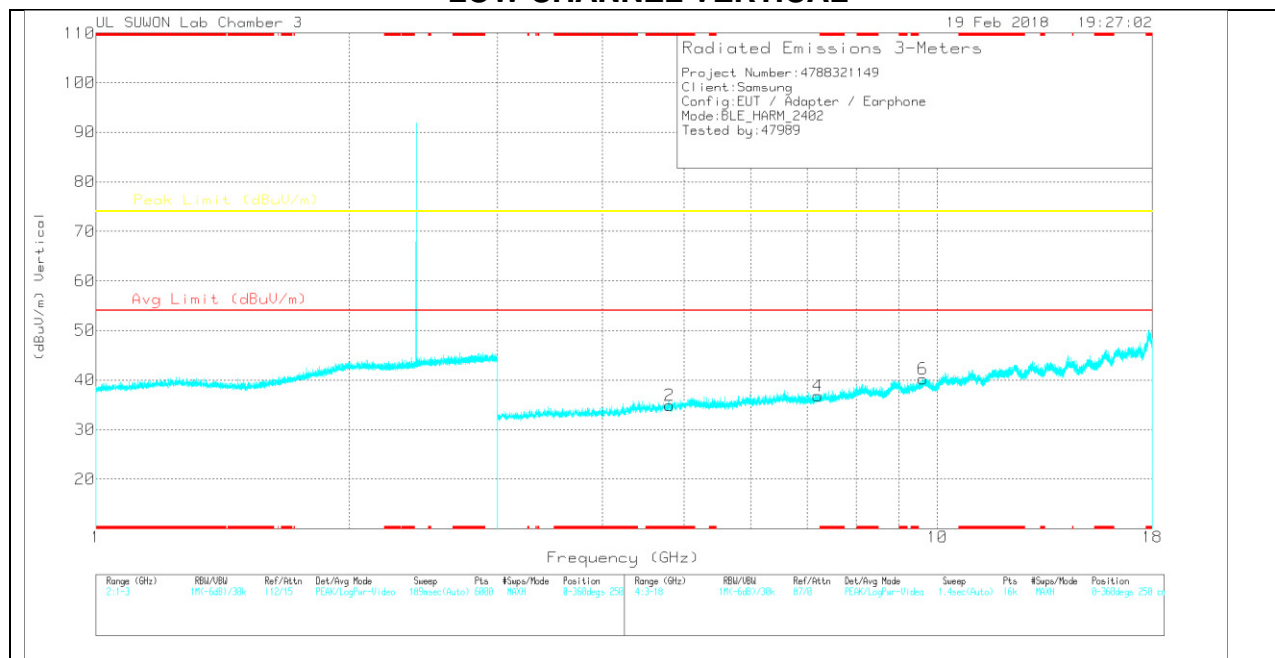
RMS - RMS detection

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

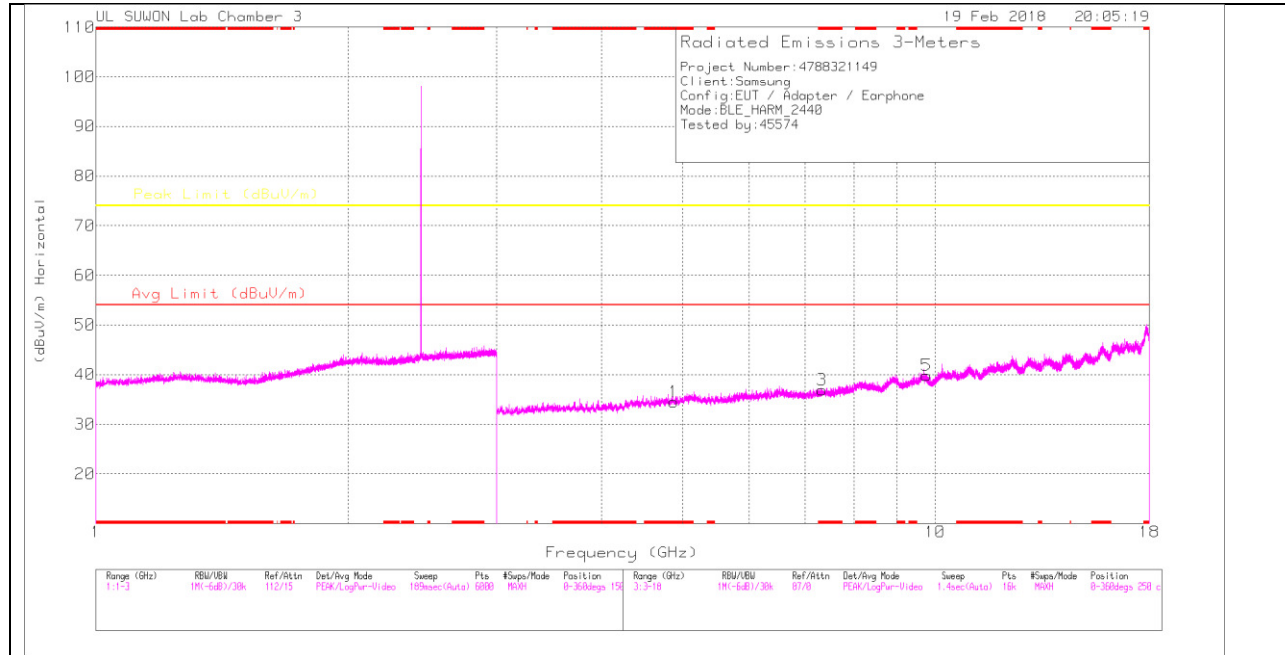
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205955) | 3GHz_HP(dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|-------------|--------------|----------------------------|--------------------|-------------|---------------------|-------------|----------------|-------------|----------|
| 1 | * 4.802 | 29.74 | PK | 33.9 | -28.2 | 0 | 35.44 | - | - | 74 | -38.56 | 0-360 | 250 | H |
| 3 | 7.207 | 24.92 | PK | 35.6 | -24 | 0 | 36.52 | - | - | 74 | -37.48 | 0-360 | 250 | H |
| 5 | 9.61 | 23.22 | PK | 36.7 | -19.9 | 0 | 40.02 | - | - | 74 | -33.98 | 0-360 | 250 | H |
| 2 | * 4.803 | 29.24 | PK | 33.9 | -28.2 | 0 | 34.94 | - | - | 74 | -39.06 | 0-360 | 250 | V |
| 4 | 7.205 | 25.15 | PK | 35.6 | -23.9 | 0 | 36.85 | - | - | 74 | -37.15 | 0-360 | 150 | V |
| 6 | 9.608 | 23.45 | PK | 36.7 | -19.9 | 0 | 40.25 | - | - | 74 | -33.75 | 0-360 | 250 | V |

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

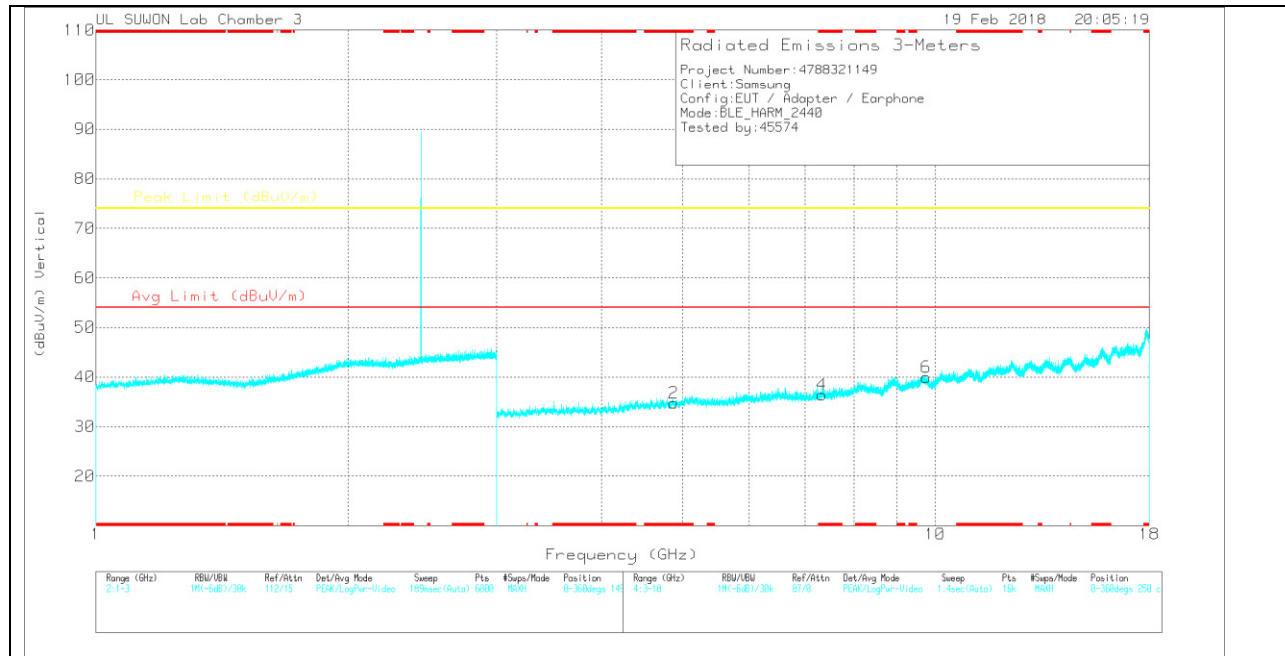
PK – Peak Detector

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

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

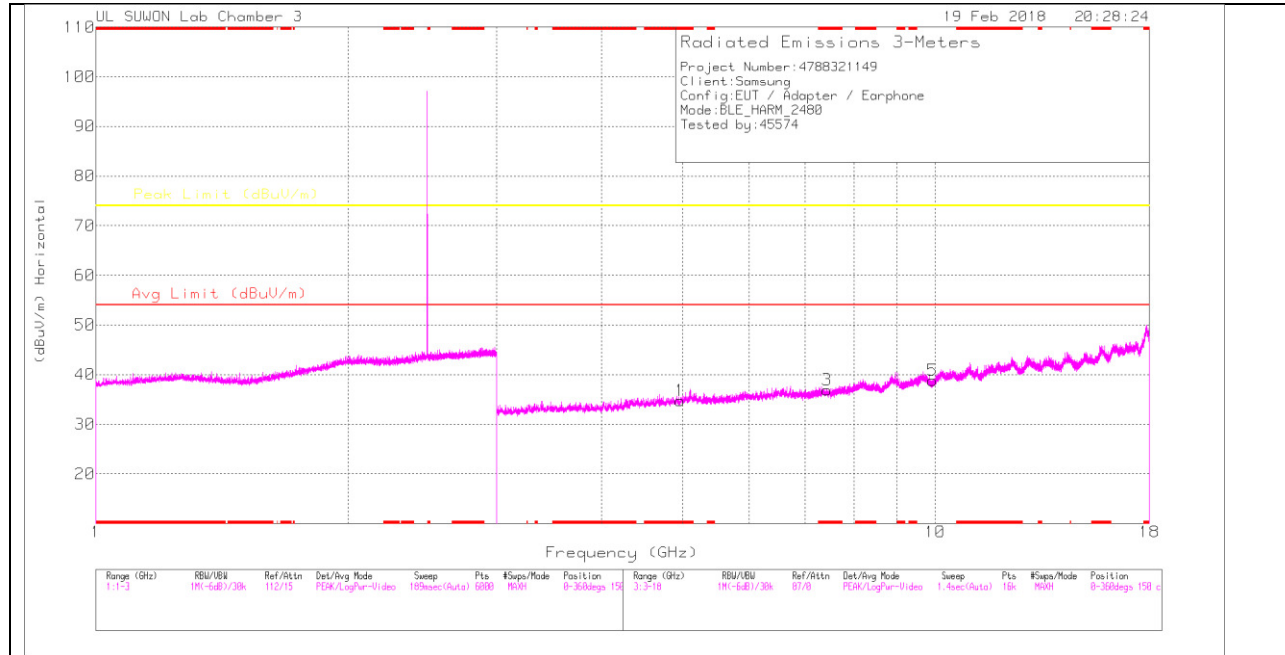
Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 3117(00205959) | 3GHz_HP(dB) | 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 | * 4.878 | 29.36 | PK | 34 | -28.8 | 0 | 34.56 | - | - | 74 | -39.44 | 0-360 | 150 | H |
| 3 | * 7.324 | 24.68 | PK | 35.6 | -23.4 | 0 | 36.88 | - | - | 74 | -37.12 | 0-360 | 150 | H |
| 5 | 9.764 | 22.42 | PK | 36.9 | -19.5 | 0 | 39.82 | - | - | 74 | -34.18 | 0-360 | 150 | H |
| 2 | * 4.877 | 29.59 | PK | 34 | -28.8 | 0 | 34.79 | - | - | 74 | -39.21 | 0-360 | 250 | V |
| 4 | * 7.325 | 24.25 | PK | 35.6 | -23.4 | 0 | 36.45 | - | - | 74 | -37.55 | 0-360 | 250 | V |
| 6 | 9.764 | 22.53 | PK | 36.9 | -19.5 | 0 | 39.93 | - | - | 74 | -34.07 | 0-360 | 149 | V |

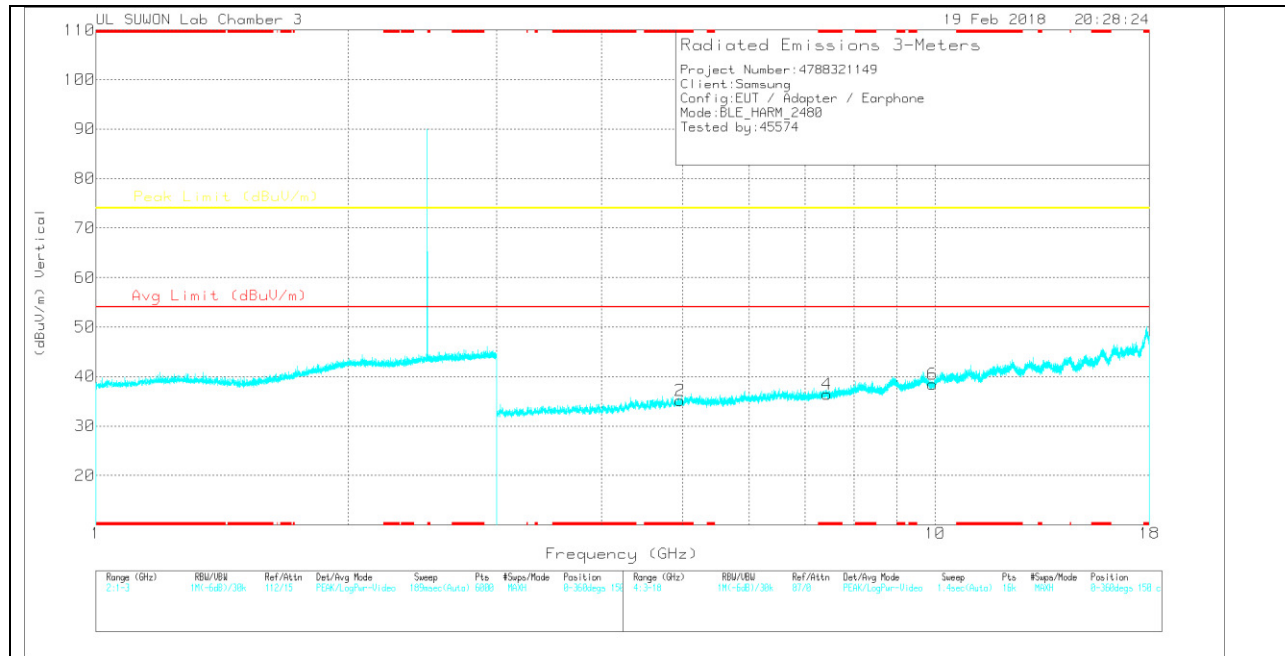
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 PK – Peak Detector

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 | 317(00205955) | 3GHz_HP(dB) | 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 | 29.21 | PK | 34.1 | -28.5 | 0 | 34.81 | - | - | 74 | -39.19 | 0-360 | 150 | H |
| 3 | * 7.437 | 24.53 | PK | 35.6 | -23.2 | 0 | 36.93 | - | - | 74 | -37.07 | 0-360 | 150 | H |
| 5 | 9.921 | 21.51 | PK | 37 | -19.7 | 0 | 38.81 | - | - | 74 | -35.19 | 0-360 | 150 | H |
| 2 | * 4.961 | 29.51 | PK | 34.1 | -28.5 | 0 | 35.11 | - | - | 74 | -38.89 | 0-360 | 250 | V |
| 4 | * 7.437 | 24.02 | PK | 35.6 | -23.2 | 0 | 36.42 | - | - | 74 | -37.58 | 0-360 | 250 | V |
| 6 | 9.921 | 21.09 | PK | 37 | -19.7 | 0 | 38.39 | - | - | 74 | -35.61 | 0-360 | 250 | V |

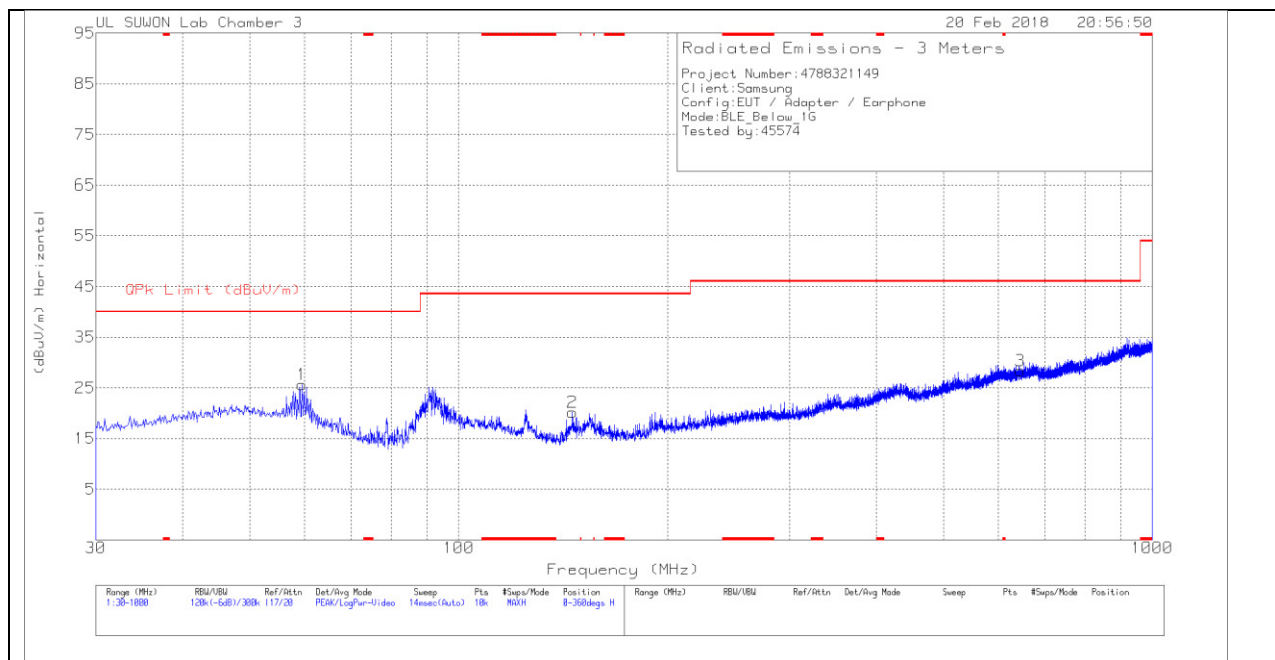
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 PK – Peak Detector

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

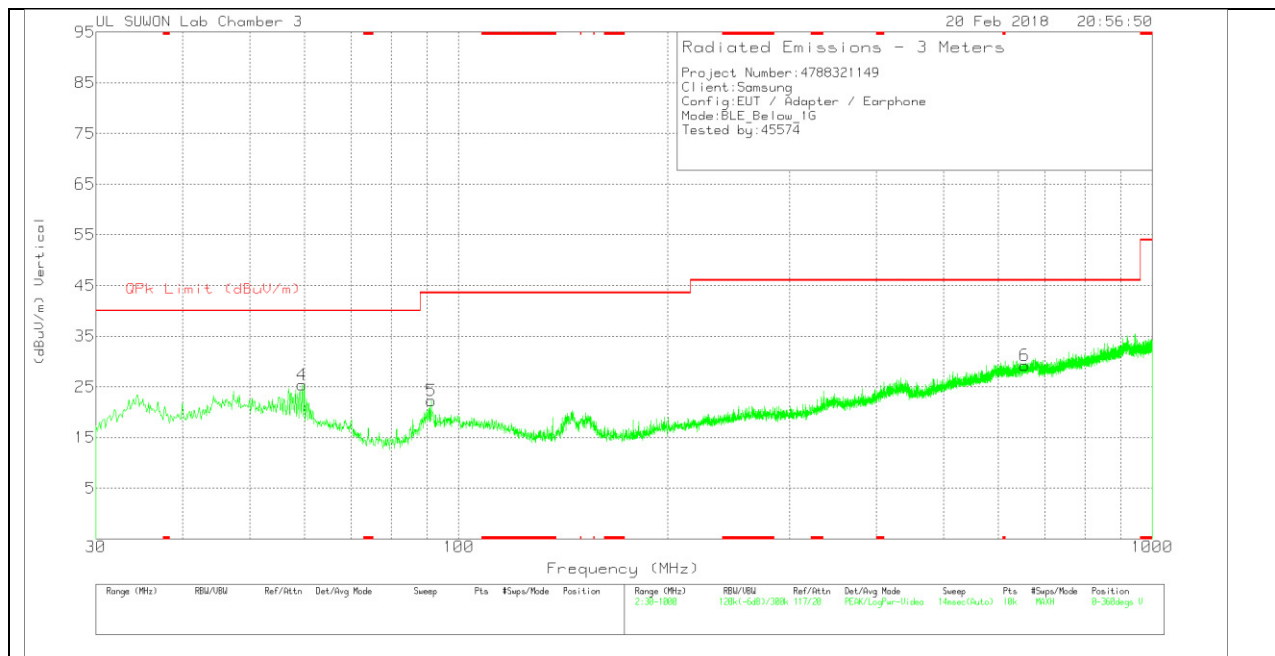
10.3. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)

HORIZONTAL PLOT



VERTICAL PLOT



BELOW 1 GHz TABLE

Trace Markers

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | VULB9163-845 | 30-1000MHz[dB] | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|--------------|----------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 1 | 59.4425 | 38.85 | Pk | 18.7 | -31.9 | 25.65 | 40 | -14.35 | 0-360 | 400 | H |
| 2 | 145.927 | 37.47 | Pk | 14 | -31.3 | 20.17 | 43.52 | -23.35 | 0-360 | 200 | H |
| 3 | 644.6554 | 33.12 | Pk | 25.2 | -30 | 28.32 | 46.02 | -17.7 | 0-360 | 300 | H |
| 4 | 59.491 | 38.55 | Pk | 18.6 | -31.8 | 25.35 | 40 | -14.65 | 0-360 | 300 | V |
| 5 | 91.3103 | 37.76 | Pk | 16.1 | -31.6 | 22.26 | 43.52 | -21.26 | 0-360 | 100 | V |
| 6 | 654.0653 | 33.13 | Pk | 25.3 | -29.2 | 29.23 | 46.02 | -16.79 | 0-360 | 200 | V |

Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)
IC RSS-GEN Clause 8.8

| Frequency of Emission (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 |

*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.

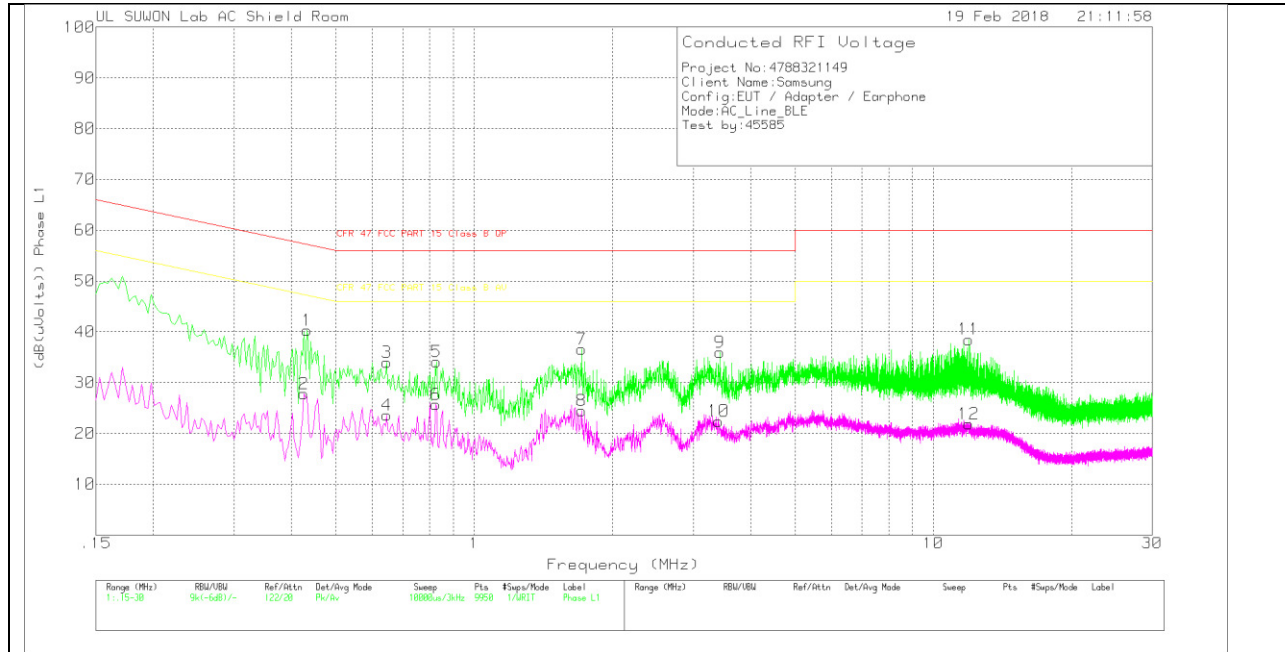
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

WORST EMISSIONS

LINE 1 PLOT



LINE 1 RESULTS

Trace Markers

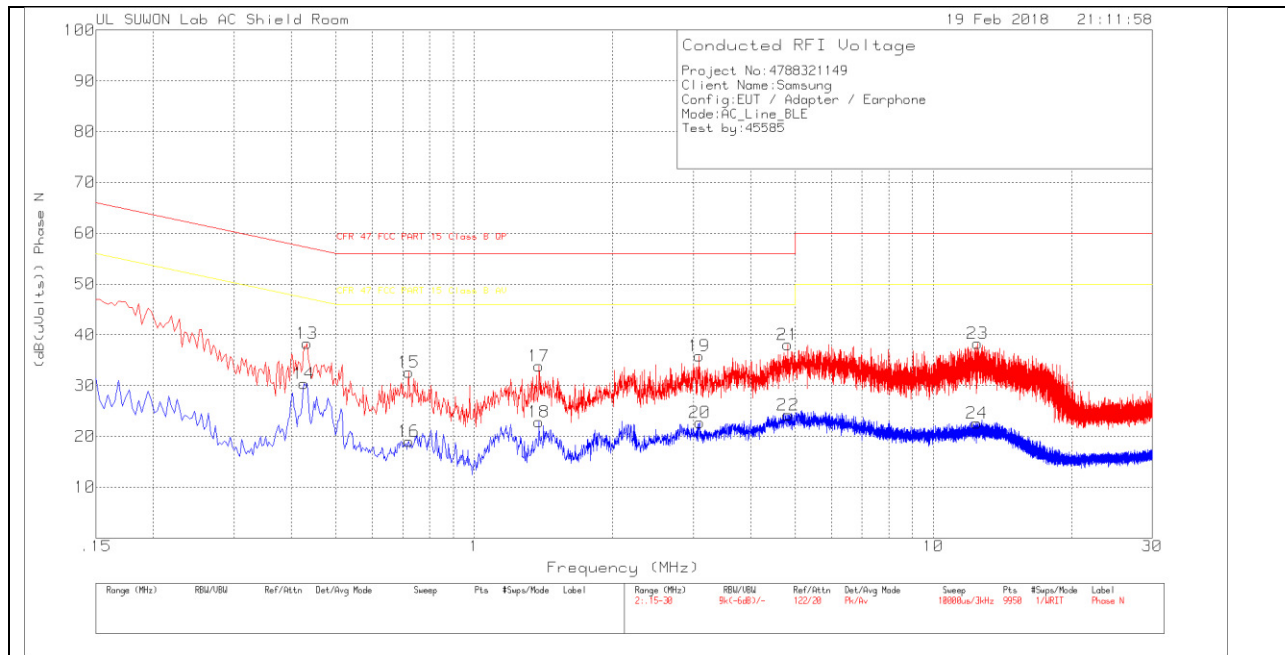
Range 1: Phase L1 .15 - 30MHz

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 101837_L1_wit h 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 | .432 | 30.39 | Pk | 9.7 | .2 | 40.29 | 57.21 | -16.92 | - | - |
| 2 | .426 | 17.91 | Av | 9.7 | .2 | 27.81 | - | - | 47.33 | -19.52 |
| 3 | .645 | 23.94 | Pk | 9.8 | .2 | 33.94 | 56 | -22.06 | - | - |
| 4 | .645 | 13.55 | Av | 9.8 | .2 | 23.55 | - | - | 46 | -22.45 |
| 5 | .828 | 24.06 | Pk | 9.7 | .3 | 34.06 | 56 | -21.94 | - | - |
| 6 | .825 | 15.71 | Av | 9.7 | .3 | 25.71 | - | - | 46 | -20.29 |
| 7 | 1.713 | 26.41 | Pk | 9.9 | .3 | 36.61 | 56 | -19.39 | - | - |
| 8 | 1.713 | 14.21 | Av | 9.9 | .3 | 24.41 | - | - | 46 | -21.59 |
| 9 | 3.429 | 25.87 | Pk | 9.8 | .3 | 35.97 | 56 | -20.03 | - | - |
| 10 | 3.408 | 12.32 | Av | 9.8 | .3 | 22.42 | - | - | 46 | -23.58 |
| 11 | 11.931 | 28.4 | Pk | 9.8 | .3 | 38.5 | 60 | -21.5 | - | - |
| 12 | 11.931 | 11.74 | Av | 9.8 | .3 | 21.84 | - | - | 50 | -28.16 |

Pk - Peak detector

Av - Average detection

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) |
|--------|-----------------|----------------------|-----|-------------------------|---------------|--------------------------------|-------------------------------|-------------|-------------------------------|-------------|
| 13 | .432 | 28.3 | Pk | 9.8 | .2 | 38.3 | 57.21 | -18.91 | - | - |
| 14 | .426 | 20.44 | Av | 9.8 | .2 | 30.44 | - | - | 47.33 | -16.89 |
| 15 | .72 | 22.62 | Pk | 9.8 | .2 | 32.62 | 56 | -23.38 | - | - |
| 16 | .72 | 9.06 | Av | 9.8 | .2 | 19.06 | - | - | 46 | -26.94 |
| 17 | 1.383 | 23.61 | Pk | 9.9 | .3 | 33.81 | 56 | -22.19 | - | - |
| 18 | 1.383 | 12.6 | Av | 9.9 | .3 | 22.8 | - | - | 46 | -23.2 |
| 19 | 3.093 | 25.76 | Pk | 9.8 | .3 | 35.86 | 56 | -20.14 | - | - |
| 20 | 3.099 | 12.67 | Av | 9.8 | .3 | 22.77 | - | - | 46 | -23.23 |
| 21 | 4.821 | 28 | Pk | 9.8 | .3 | 38.1 | 56 | -17.9 | - | - |
| 22 | 4.827 | 14.14 | Av | 9.8 | .3 | 24.24 | - | - | 46 | -21.76 |
| 23 | 12.468 | 28.27 | Pk | 9.8 | .3 | 38.37 | 60 | -21.63 | - | - |
| 24 | 12.438 | 12.54 | Av | 9.8 | .3 | 22.64 | - | - | 50 | -27.36 |

Pk - Peak detector

Av - Average detection