# TEST REPORT

**of**

FCC Part 15 Subpart C §15.247
RSS-247 Issue 1, RSS-Gen Issue 4

FCC ID: A3LETYO324
IC Certification: 649E-ETYO324

| | | |
|---|---|---|
| Equipment Under Test | : | Gear VR Controller |
| Model Name | : | ET-YO324 |
| Applicant | : | Samsung Electronics Co., Ltd. |
| Manufacturer | : | Samsung Electronics Co., Ltd. |
| Date of Receipt | : | 2017.01.17 |
| Date of Test(s) | : | 2017.02.03 ~ 2017.02.06 |
| Date of Issue | : | 2017.02.08 |

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

| | | | |
|---|---|---|---|
| **Tested By:** | **Brant Jang** | **Date:** | **2017.02.08** |
| **Technical Manager:** | **Hyunchae You** | **Date:** | **2017.02.08** |

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# 1. General Information

## 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.

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## 1.2. Details of Applicant

Applicant : Samsung Electronics Co., Ltd.
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic of Korea
Contact Person : Lee, Yeong-Geon
Phone No. : +82 10 6477 9502

## 1.3. Description of EUT

| | |
|---|---|
| **Kind of Product** | Gear VR Controller |
| **Model Name** | ET-YO324 |
| **Power Supply** | DC 3.0 V |
| **Frequency Range** | 2 402 ㎒ ~ 2 480 ㎒ |
| **Modulation Technique** | GFSK |
| **Number of Channels** | 40 channels |
| **Antenna Type** | Internal type |
| **Antenna Gain** | 2.65 ㏈i |
| **H/W Version** | REV0.0 |
| **S/W Version** | YO324XXU0AQA1 |

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## 1.4. Test Equipment List

| Equipment | Manufacturer | Model | S/N | Cal Date | Cal Interval | Cal Due. |
|---|---|---|---|---|---|---|
| Signal Generator | Agilent | E8257D | MY51501169 | Jul. 07, 2016 | Annual | Jul. 07, 2017 |
| Signal Generator | R&S | SMBV100A | 255834 | Jun. 20, 2016 | Annual | Jun. 20, 2017 |
| Spectrum Analyzer | R&S | FSW67 | 100637 | Jul. 13, 2016 | Annual | Jul. 13, 2017 |
| Spectrum Analyzer | Agilent | N9020A | MY53421758 | Sep. 23, 2016 | Annual | Sep. 23, 2017 |
| Test Receiver | R&S | ESU26 | 100109 | Mar. 07, 2016 | Annual | Mar. 07, 2017 |
| DC Power Supply | R&S | HMP2020 | 019922876 | Apr. 26, 2016 | Annual | Apr. 26, 2017 |
| Bluetooth Tester | TESCOM | TC-3000C | 3000C000495 | Apr. 26, 2016 | Annual | Apr. 26, 2017 |
| Power Sensor | R&S | NRP-Z81 | 100748 | Jun. 04, 2016 | Annual | Jun. 04, 2017 |
| Directional Coupler | KRYTAR | 152613 | 122660 | Jun. 06, 2016 | Annual | Jun. 06, 2017 |
| High Pass Filter | Wainwright Instrument GmbH | WHK3.0/18G-6SS | 4 | Jun. 18, 2016 | Annual | Jun. 18, 2017 |
| High Pass Filter | Wainwright Instrument GmbH | WHNX7.5/26.5G-6SS | 15 | Jun. 18, 2016 | Annual | Jun. 18, 2017 |
| Low Pass Filter | Mini-Circuits | NLP-1200+ | V9500401023-2 | Jun. 15, 2016 | Annual | Jun. 15, 2017 |
| Preamplifier | H.P. | 8447F | 2944A03909 | Aug. 11, 2016 | Annual | Aug. 11, 2017 |
| Preamplifier | R&S | SCU-18 | 10117 | Apr. 07, 2016 | Annual | Apr. 07, 2017 |
| Preamplifier | MITEQ Inc. | JS44-18004000-35-8P | 1546891 | May 12, 2016 | Annual | May 12, 2017 |
| Loop Antenna | Schwarzbeck Mess-Elektronik | FMZB 1519 | 1519-039 | Aug. 19, 2015 | Biennial | Aug. 19, 2017 |
| Trilog Broadband Antenna | Schwarzbeck Mess-Elektronik | VULB9163 | 396 | Jun. 18, 2015 | Biennial | Jun. 18, 2017 |
| Horn Antenna | R&S | HF906 | 100608 | Feb. 01, 2016 | Biennial | Feb. 01, 2018 |
| Horn Antenna | Schwarzbeck Mess-Elektronik | BBHA 9170 | BBHA9170223 | Aug. 25, 2016 | Biennial | Aug. 25, 2018 |
| Antenna Master | Innco systems GmbH | MA4640-XP-ET | MA4640/536/383 30516/L | N.C.R. | N/A | N.C.R. |
| Turn Table | Innco systems GmbH | MA4640-XP-ET | MA4640/536/383 30516/L | N.C.R. | N/A | N.C.R. |
| Controller | Innco systems GmbH | CONTROLLER CO3000-4P | CO3000/963/383 30516/L | N.C.R. | N/A | N.C.R. |
| Anechoic Chamber | SY Corporation | L × W × H (9.6 m × 6.4 m × 6.6 m) | N/A | N.C.R. | N/A | N.C.R. |

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## 1.5. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part15 Subpart C, RSS-247 Issue 1, RSS-Gen Issue 4 | | | |
|---|---|---|---|
| **Standard section** | | **Test Item(s)** | **Result** |
| 15.205(a)<br>15.209<br>15.247(d) | RSS-247 Issue 1<br>5.5<br>RSS-Gen Issue 4<br>8.9 | Transmitter Radiated Spurious Emissions<br>Conducted Spurious Emission | Complied |
| 15.247(a)(2) | RSS-247 Issue 1<br>5.2(1)<br>RSS-Gen Issue 4<br>6.6 | 6 dB Bandwidth & 99 % Bandwidth | Complied |
| 15.247(b)(3) | RSS-247 Issue 1<br>5.4(4) | Maximum Peak Conducted Output Power | Complied |
| 15.247(e) | RSS-247 Issue 1<br>5.2(2) | Power Spectral Density | Complied |

## 1.6. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074_v03r05 were used in the measurement of the DUT.

## 1.7. Sample calculation

Where relevant, the following sample calculation is provided:

### 1.7.1. Conducted test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

### 1.7.2. Radiation test

Field strength level (dBμV/m) = Measured level (dBμV) + Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)

## 1.8. Test report revision

| Revision | Report number | Date of Issue | Description |
|---|---|---|---|
| 0 | F690501/RF-RTL010819 | 2017.02.08 | Initial |

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## 1.9. Duty Cycle of EUT

Regarding to KDB558074_v03r05, 6.0, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below
Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value, Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

| | |
|---|---|
| Duty Cycle (%) | 64 |
| Correction factor (dB) | 1.94 |

Remark:

1. As measured duty cycles of EUT, all of mode and data rate keep constant period and are converted to log scale (power averaging) to compensate correction factor to result of average test items.
2. Duty cycle (%) = (Tx on time / Tx on + off time) x 100
3. Correction factor (dB) = 10 log (1 / duty cycle)

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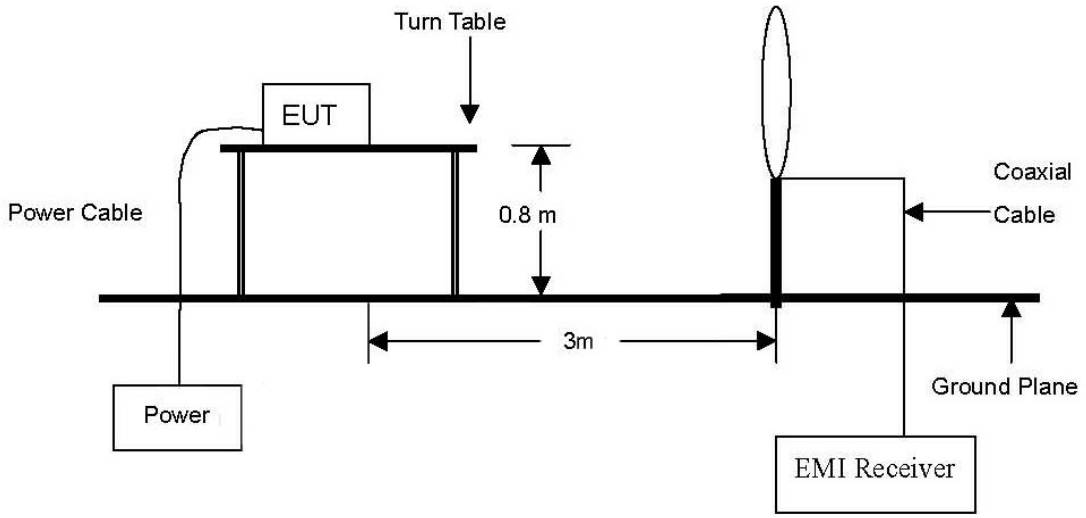
# 2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

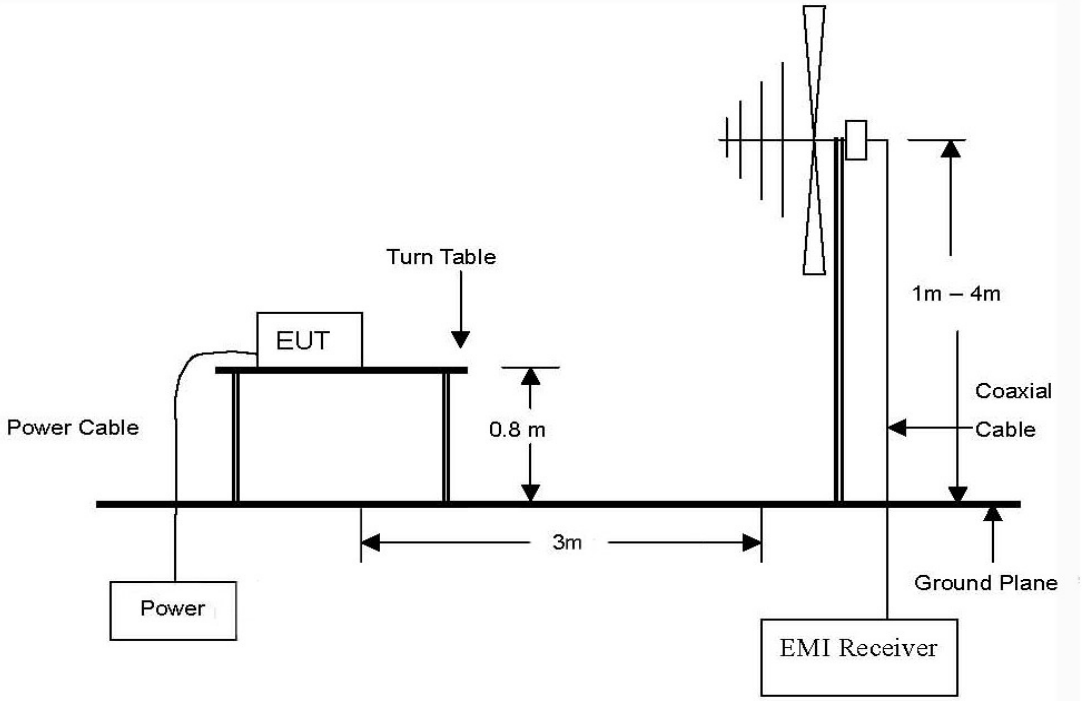
## 2.1. Test Setup

### 2.1.1. Transmitter Radiated Spurious Emissions

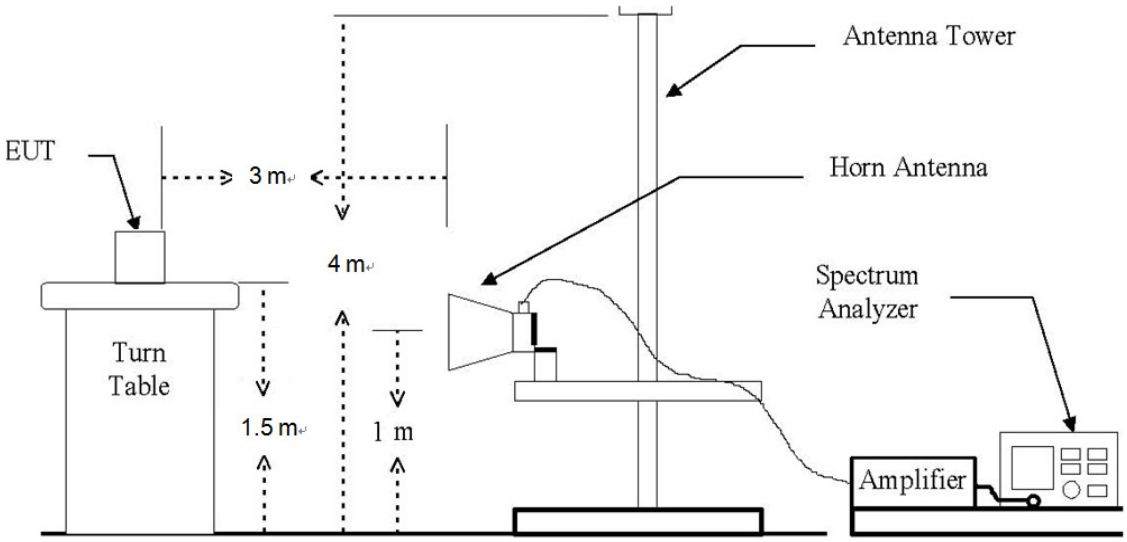
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.




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



The diagram below shows the test setup that is utilized to make the measurements for emission .The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.

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### 2.1.2. Conducted Spurious Emission

## 2.2. Limit

### 2.2.1. FCC

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

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

| Frequency (㎒) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 - 0.490 | 2 400/F(㎑) | 300 |
| 0.490 - 1.705 | 24 000/F(㎑) | 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 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections §15.231 and §15.241

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**2.2.2. IC**

According to RSS-247 Issue 1 5.5, in any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen Issue 4 8.9, except when the requirements applicable to a given device state otherwise, the emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

**Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 ㎒**

| Frequency (㎒) | Field Strength (㎛V/m at 3 metres) |
|---|---|
| 30 - 88 | 100 |
| 88 – 216 | 150 |
| 216 – 960 | 200 |
| Above 960* | 500 |

* Unless otherwise specified, for all frequencies greater than 1 ㎓, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 ㎒. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 ㏈ above the average limit.

**Note:** Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

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**Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 ㎒**

| Frequency | Electric Field Strength (㎶/m) | Magnetic Field Strength (H-Field) (㎂/m) | Measurement Distance (meters) |
|---|---|---|---|
| 9 - 490 ㎑ | 2,400/F (F in ㎑) | 2,400/377F (F in ㎑) | 300 |
| 490 - 1,705 ㎑ | 24,000/F (F in ㎑) | 24,000/377F (F in ㎑) | 30 |
| 1.705 - 30 ㎒ | 30 | N/A | 30 |

**Note:** The emission limits for the bands 9-90 ㎑ and 110-490 ㎑ are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

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## 2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates in section 11.0 & 12.0 of KDB 558074_v03r05 and ANSI C63.10 2013.

### 2.3.1. Test Procedures for emission below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

**Note;**
Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 meter open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

### 2.3.2. Test Procedures for emission from above 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 ㎓ and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 ㎓. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

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NOTE;

1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.2
Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 ㎑ and VBW ≥ 3 x RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.3
Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 ㎑ and VBW ≥ 3 x RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 12.2.4
Set RBW = as specified in Table 1, VBW ≥ 3 x RBW, Detector = Peak, Sweep time = auto, Trace = Max hold.

**Table 1- RBW as a function of frequency**

| Frequency | RBW |
|---|---|
| 9 – 150 ㎑ | 200 – 300 ㎐ |
| 0.15 – 30 ㎒ | 9 – 10 ㎑ |
| 30 – 1 000 ㎒ | 100 – 120 ㎑ |
| > 1 000 ㎒ | 1 ㎒ |

-Average Power measurements procedure refer to section 12.2.5.2
The EUT shall be configured to operate at the maximum achievable duty cycle.
Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.
Set RBW = 1 ㎒, VBW ≥ 3 x RBW, Detector = RMS, if span / (# of points in sweep) ≤ (RBW/2).
Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).
As an alternative the detector and averaging type may be set for linear voltage averaging.
Some instruments require linear display mode in order to use linear voltage averaging. Log or ㎧ averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log (1/x), where x is the duty cycle.

3. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes (X, Y, Z). Worst orthogonal plan of EUT is**X – axis** during radiation test.

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### 2.3.3. Test Procedures for Conducted Spurious Emissions

Per the guidance of KDB 558074_v03r05, section 11.1 & 11.2 & 11.3, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 ㎑. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 2.4.3. The limit for out of band spurious emission at the band edge is 20 ㏈ below the fundamental emission level measured in a 100 ㎑ bandwidth.

1. Conducted Emissions at Band Edge
 - The Measurement refer to section 11.2
   Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 ㎑ and VBW ≥ 3 x RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold, Ensure that the number of measurement points ≥ span/RBW, The trace was allowed to stabilize.

2. Conducted Spurious Emissions
 - The Measurement refer to section 11.3
   Start frequency was set to 9 ㎑ and stop frequency was set to 25 ㎓ (separated into two plots per channel), RBW = 100 ㎑, VBW ≥ 3 x RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold, The trace was allowed to stabilize.

3. TDF function
 - For plots showing conducted spurious emissions from 9 ㎑ to 25 ㎓, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function.
   So, the reading values shown in plots were final result.

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## 2.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

### 2.4.1. Radiated Spurious Emission below 1 000 ㎒

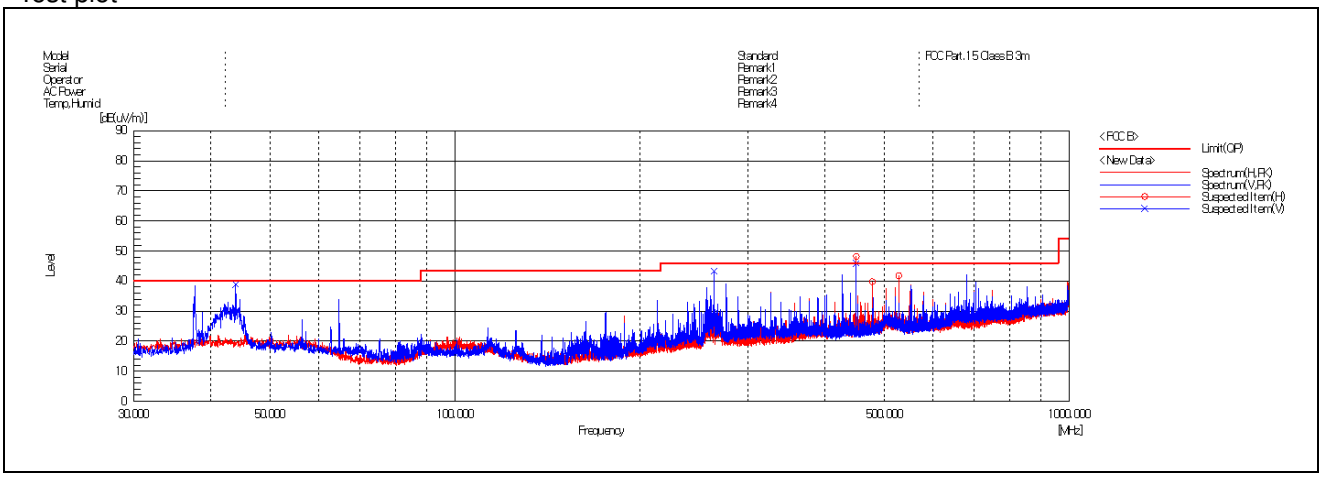
The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

| Radiated Emissions | | | Ant | Correction Factors | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | AMP + CL (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| 43.97 | 33.30 | Qusi-Peak | V | 14.54 | -27.13 | 20.71 | 40.00 | 19.29 |
| 263.97 | 48.60 | Qusi-Peak | V | 14.33 | -25.41 | 37.52 | 46.00 | 8.48 |
| 450.00 | 48.70 | Qusi-Peak | V | 17.29 | -25.78 | 40.21 | 46.00 | 5.79 |
| 450.02 | 43.90 | Qusi-Peak | H | 17.59 | -25.78 | 35.71 | 46.00 | 10.29 |
| 477.66 | 41.30 | Qusi-Peak | H | 18.09 | -25.89 | 33.50 | 46.00 | 12.50 |
| 527.91 | 38.42 | Qusi-Peak | H | 18.62 | -25.88 | 31.16 | 46.00 | 14.84 |
| Above 600.00 | Not detected | - | - | - | - | - | - | - |

Remark:

1. Spurious emissions for all channels were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **Low channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + Antenna Factor + Amp + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

Test plot



### 2.4.2. Radiated Spurious Emission above 1 000 ㎒

The frequency spectrum above 1 000 ㎒ was investigated. All reading values are peak and average values

Low Channel (2 402 ㎒)

| Radiated Emissions | | | Ant. | Correction Factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | CL (dB) | Duty (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *2 310.00 | 13.64 | Peak | H | 28.07 | 5.31 | - | 47.02 | 74.00 | 26.98 |
| *2 310.00 | 3.80 | Average | H | 28.07 | 5.31 | 1.94 | 39.12 | 54.00 | 14.88 |
| *2 341.27 | 16.10 | Peak | H | 28.10 | 5.44 | - | 49.64 | 74.00 | 24.36 |
| *2 362.37 | 4.64 | Average | H | 28.12 | 5.58 | 1.94 | 40.28 | 54.00 | 13.72 |
| *2 390.00 | 14.65 | Peak | H | 28.15 | 5.80 | - | 48.60 | 74.00 | 25.40 |
| *2 390.00 | 4.30 | Average | H | 28.15 | 5.80 | 1.94 | 40.19 | 54.00 | 13.81 |

| Radiated Emissions | | | Ant. | Correction Factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | AMP+CL (dB) | Duty (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *4 804.23 | 45.52 | Peak | H | 32.66 | -25.25 | - | 52.93 | 74.00 | 21.07 |
| *4 803.83 | 33.52 | Average | H | 32.65 | -25.25 | 1.94 | 42.86 | 54.00 | 11.14 |
| Above 4 900.00 | Not detected | - | - | - | - | - | - | - | - |

Middle Channel (2 440 ㎒)

| Radiated Emissions | | | Ant. | Correction Factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | AMP+CL (dB) | Duty (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *4 879.80 | 45.75 | Peak | H | 32.86 | -25.85 | - | 52.76 | 74.00 | 21.24 |
| *4 879.53 | 35.85 | Average | H | 32.86 | -25.85 | 1.94 | 44.80 | 54.00 | 9.20 |
| Above 4 900.00 | Not detected | - | - | - | - | - | - | - | - |

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High Channel (2 480 ㎒)

| Radiated Emissions | | | Ant. | Correction Factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | CL (dB) | Duty (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *2 483.50 | 14.65 | Peak | H | 28.24 | 5.54 | - | 48.43 | 74.00 | 25.57 |
| *2 483.50 | 4.21 | Average | H | 28.24 | 5.54 | 1.94 | 39.93 | 54.00 | 14.07 |
| *2 488.93 | 16.29 | Peak | H | 28.25 | 5.53 | - | 50.07 | 74.00 | 23.93 |
| *2 484.52 | 4.89 | Average | H | 28.24 | 5.54 | 1.94 | 40.61 | 54.00 | 13.39 |
| *2 500.00 | 13.42 | Peak | H | 28.26 | 5.49 | - | 47.17 | 74.00 | 26.83 |
| *2 500.00 | 4.31 | Average | H | 28.26 | 5.49 | 1.94 | 40.00 | 54.00 | 14.00 |

| Radiated Emissions | | | Ant. | Correction Factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m) | AMP+CL (dB) | Duty (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *4 960.44 | 44.51 | Peak | H | 33.07 | -25.24 | - | 52.34 | 74.00 | 21.66 |
| *4 959.81 | 36.48 | Average | H | 33.07 | -25.23 | 1.94 | 46.26 | 54.00 | 7.74 |
| Above 5 000.00 | Not detected | - | - | - | - | - | - | - | - |

Remarks:

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL + (Duty) or Reading + AF + CL + (Duty).
5. According to § 15.31(o), Emission levels are not reported much lower than the limits by over 20 ㏈.

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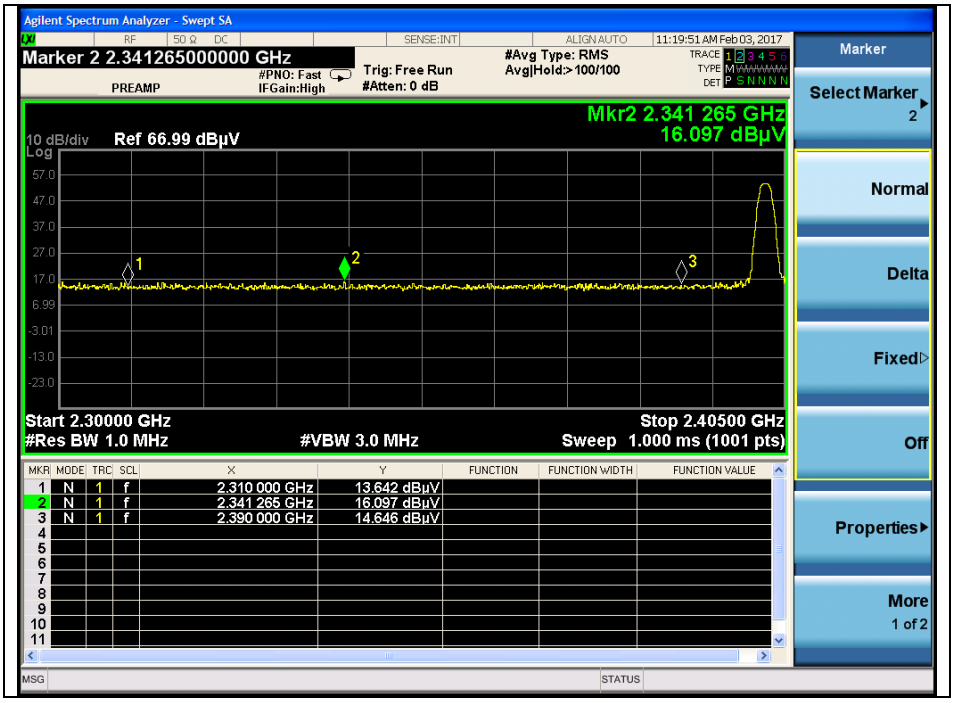
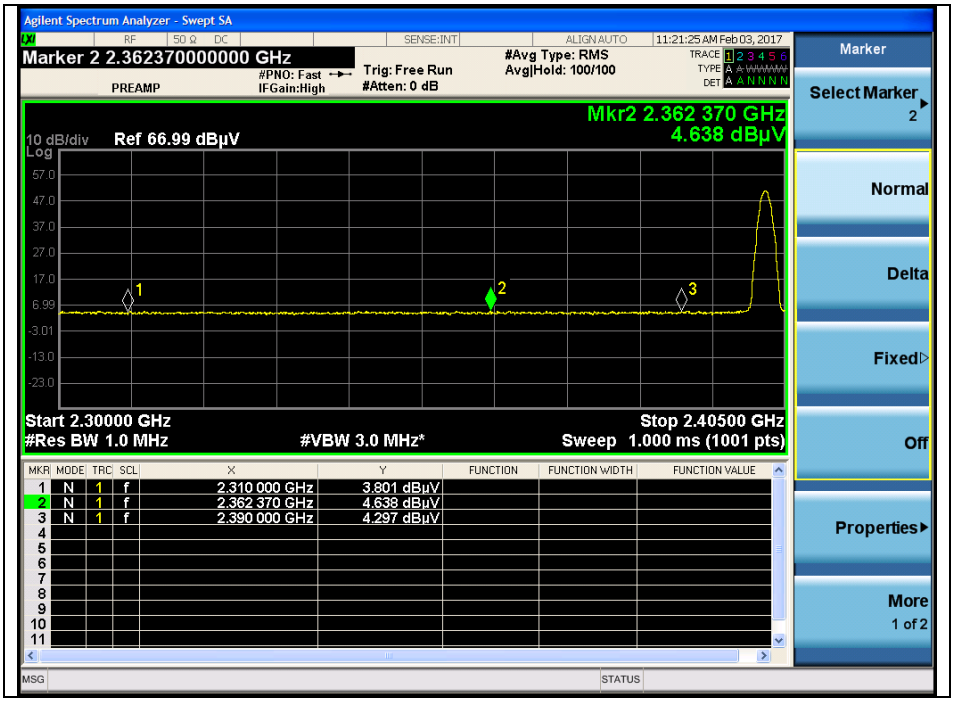
### 2.4.3. Plot of Transmitter Radiated Spurious Emissions

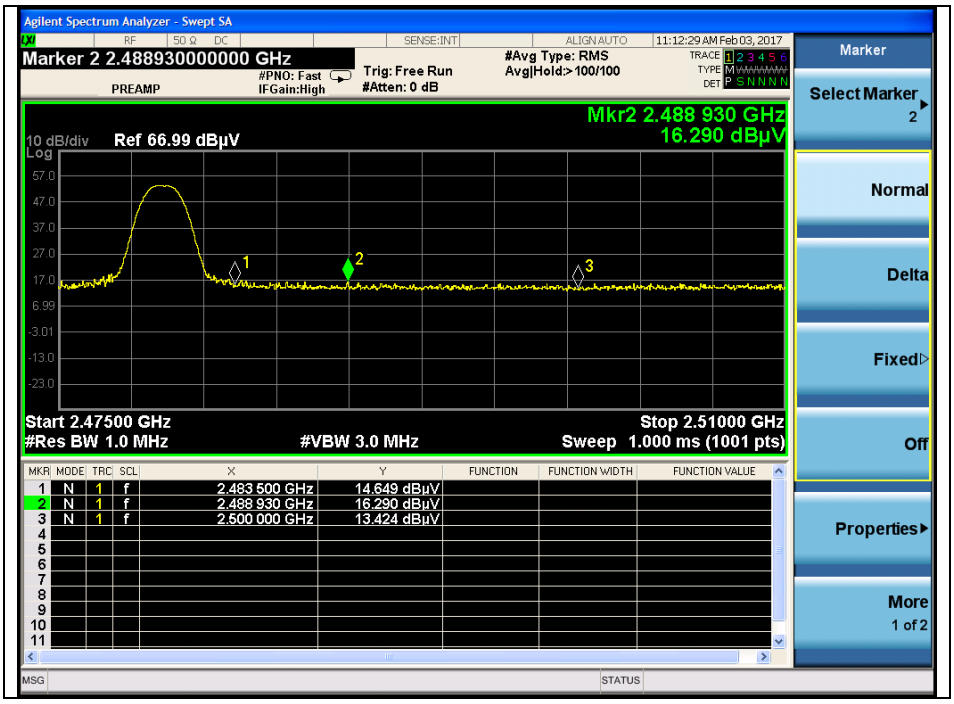
Low channel Band edge (Peak)



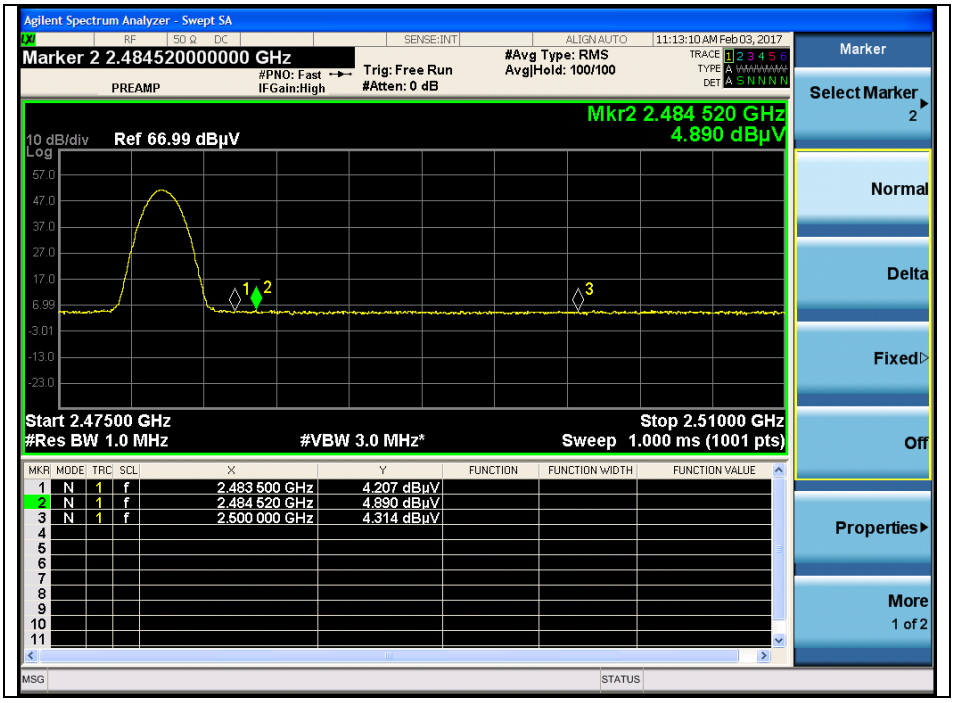

Low channel Band edge (Average)



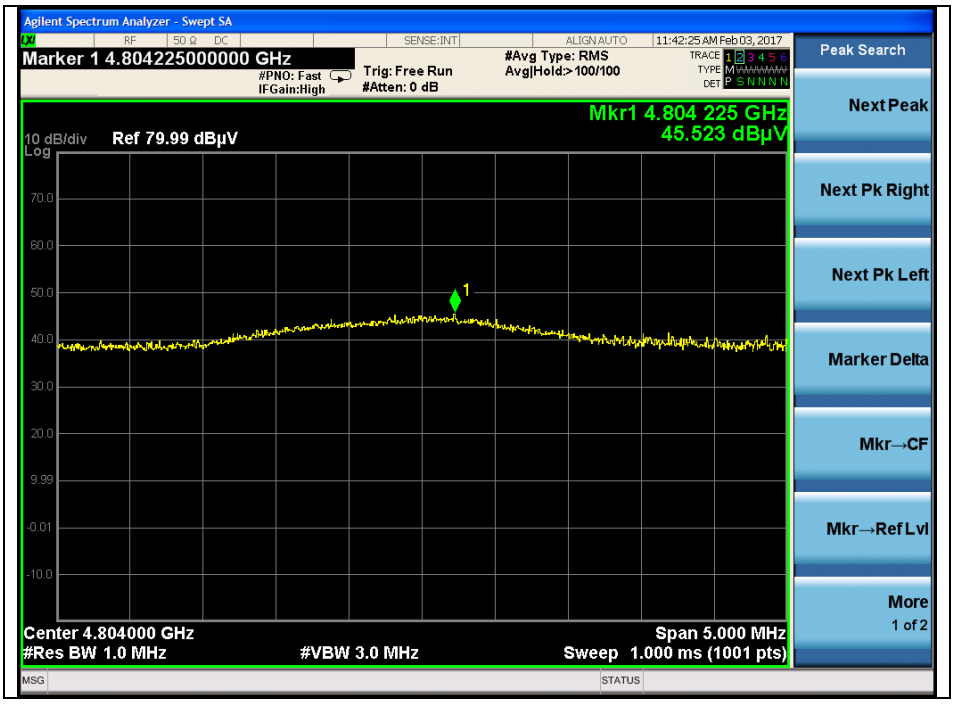
High channel Band edge (Peak)



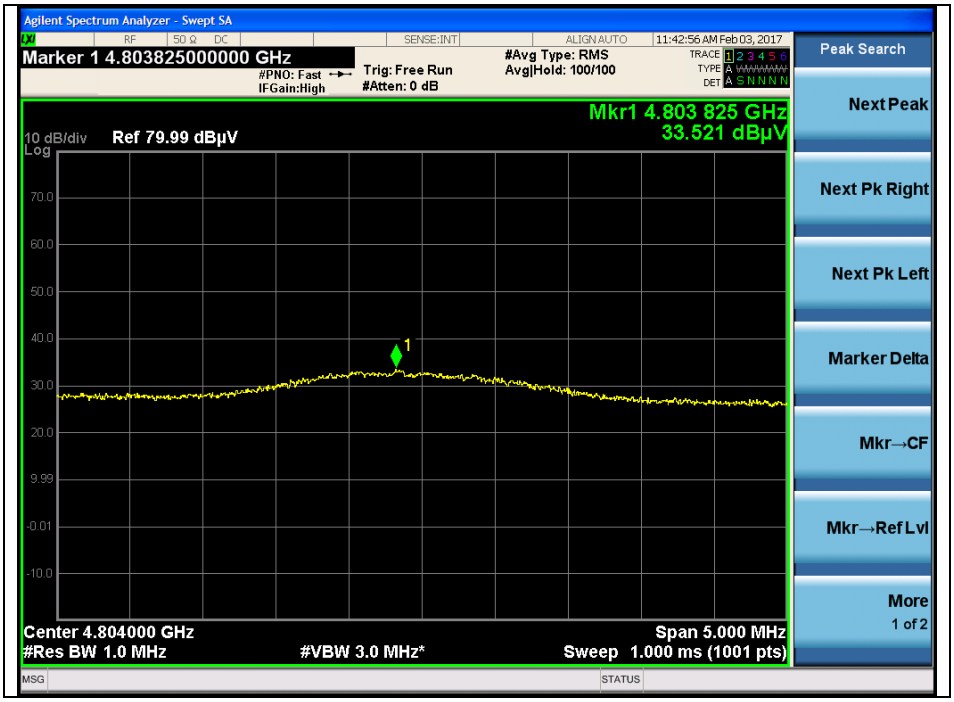

High channel Band edge (Average)



Low channel 2nd harmonic (Peak)




Low channel 2nd harmonic (Average)

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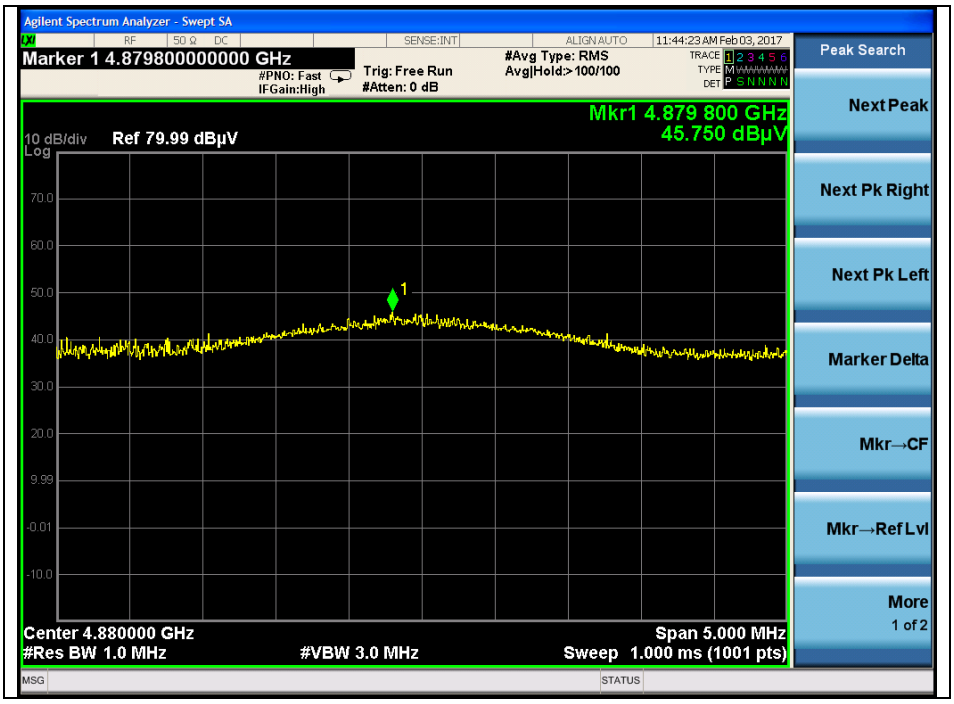
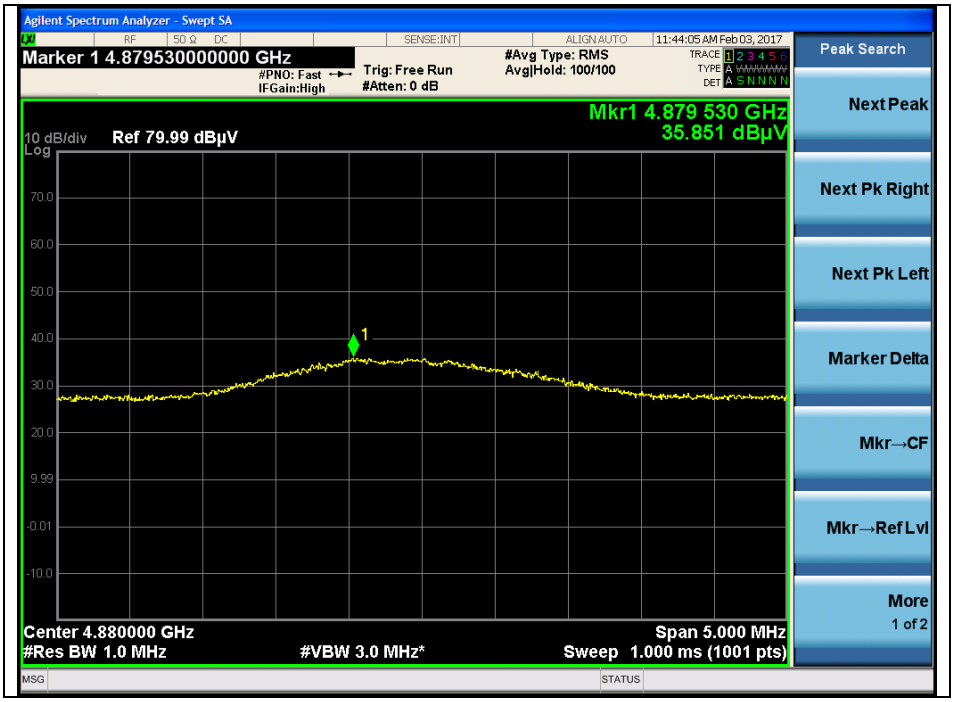
Middle channel 2nd harmonic (Peak)




Middle channel 2nd harmonic (Average)

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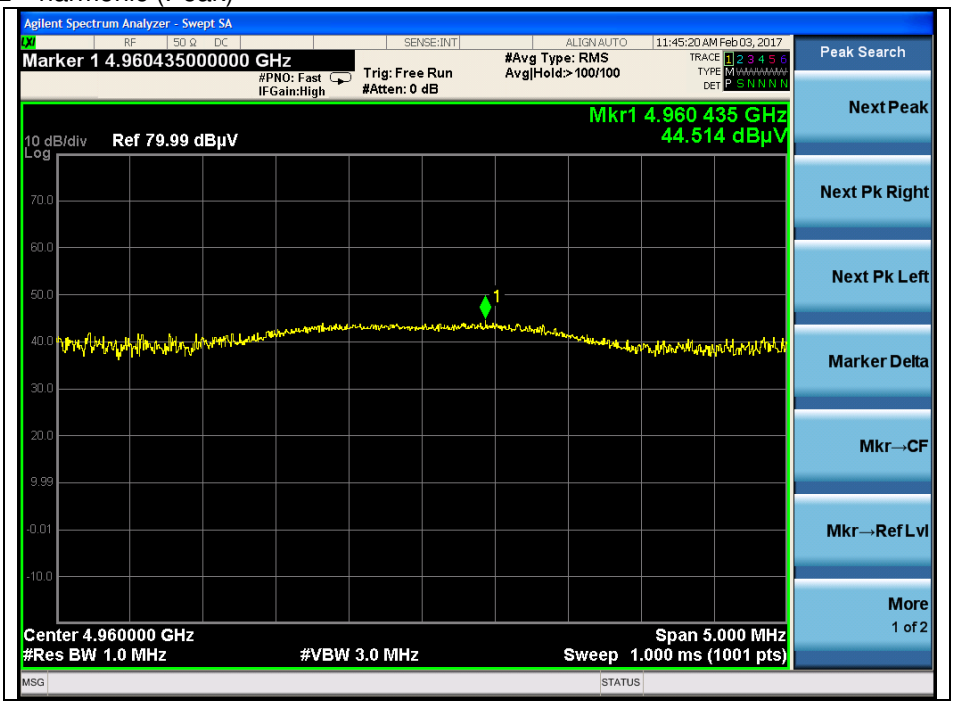
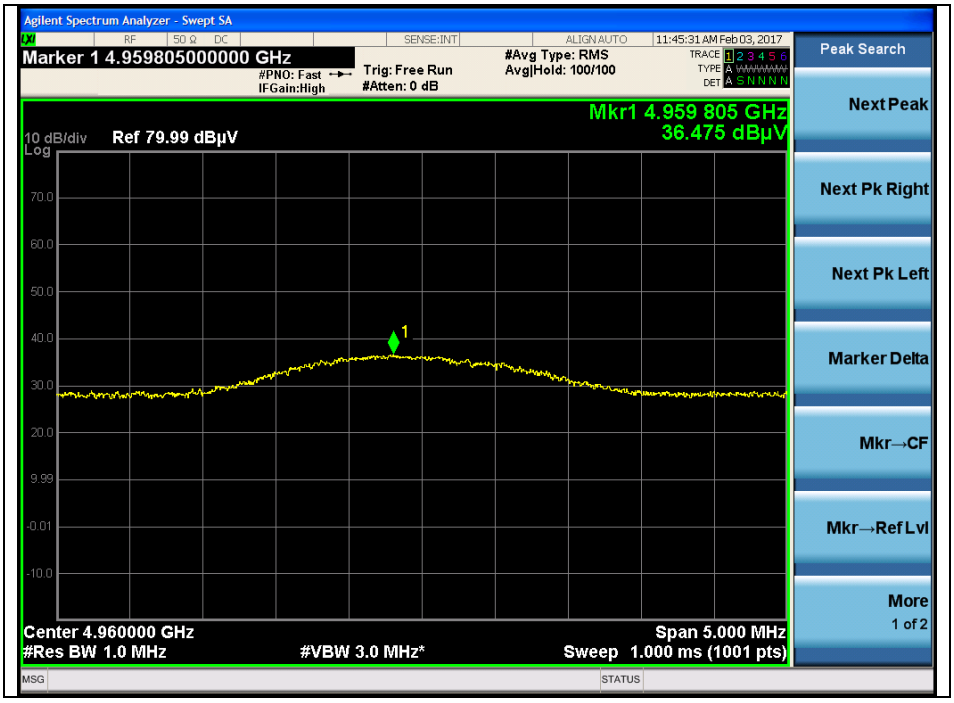
High channel 2nd harmonic (Peak)




High channel 2nd harmonic (Average)

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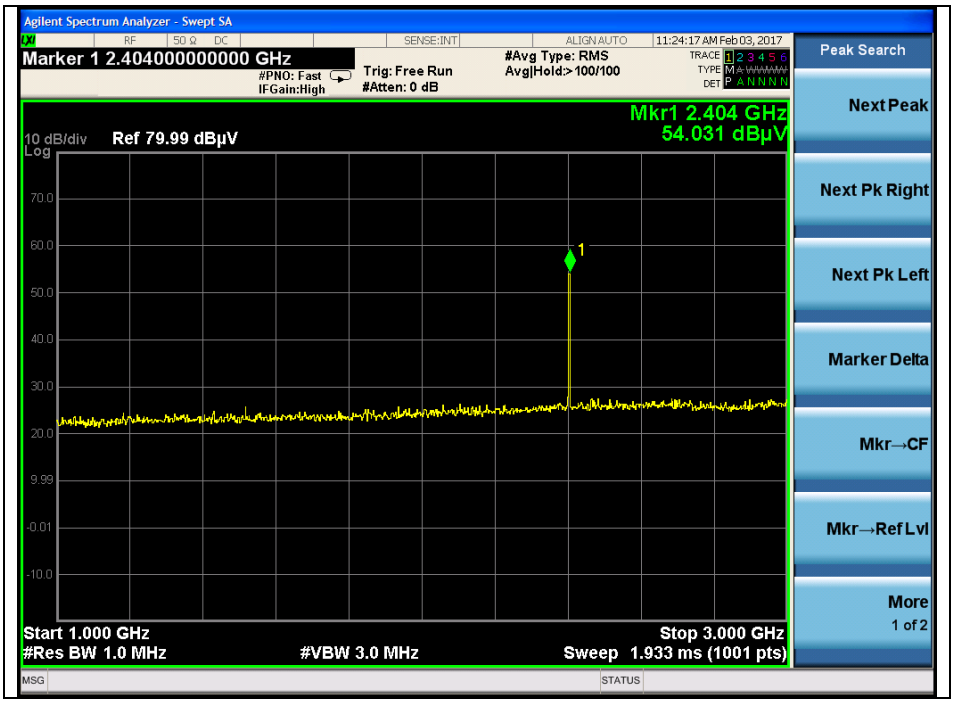
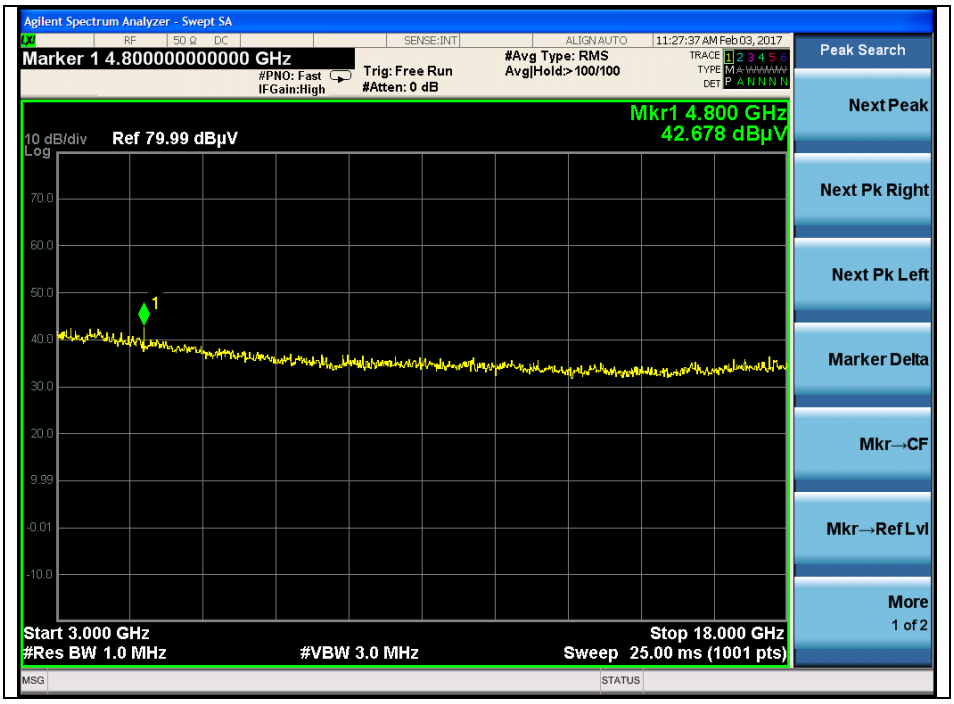
## Scanning Plots

### Low channel

1 ㎓ ~ 3 ㎓




3 ㎓ ~ 18 ㎓

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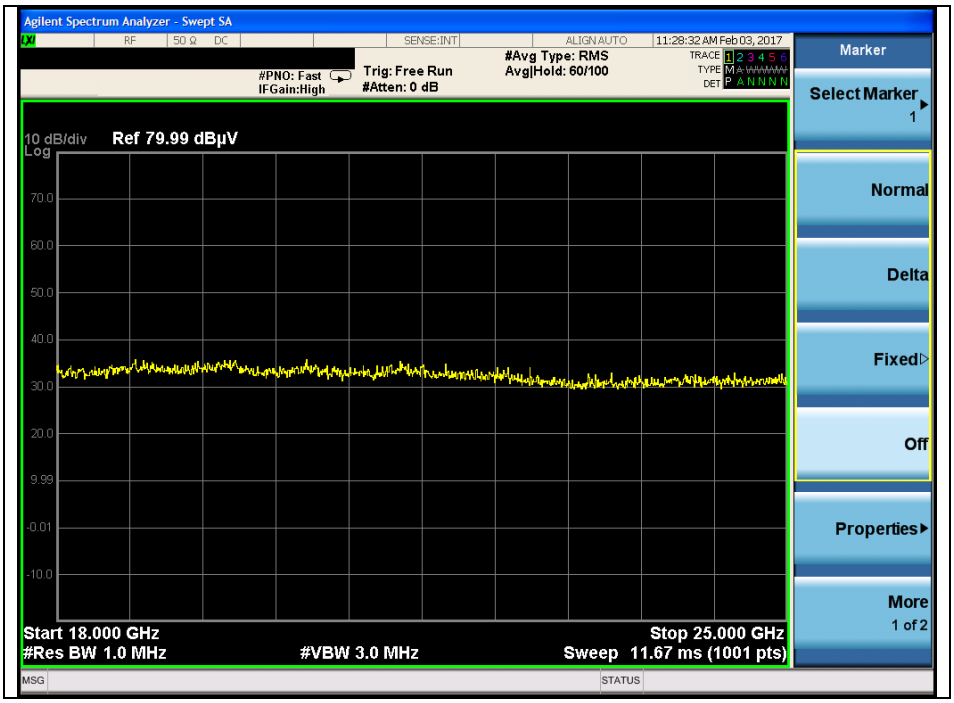
**18 ㎓ ~ 25 ㎓**




**Note:** Emission was scanned up to 25 ㎓.
No emissions were detected above the noise floor which was at least 20 ㏈ below the specification limit.

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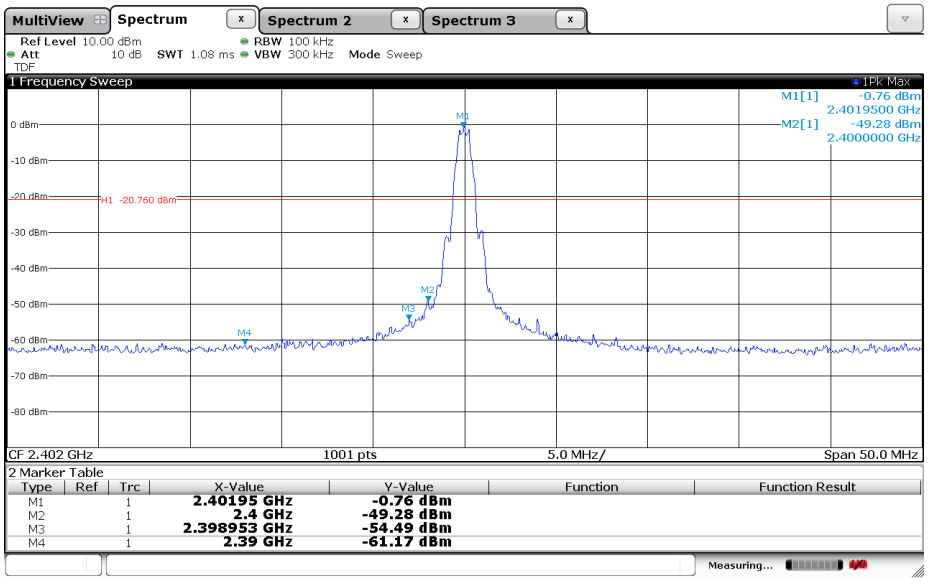
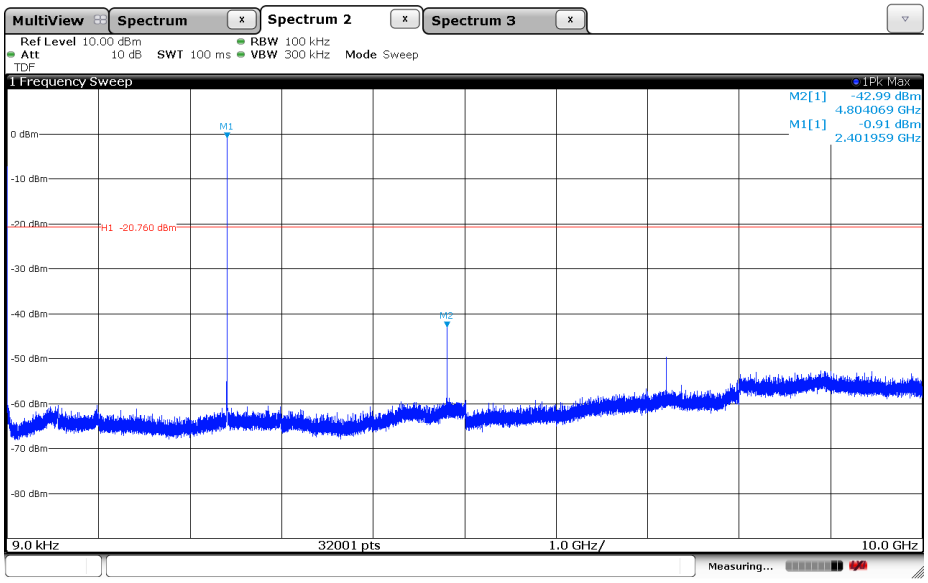
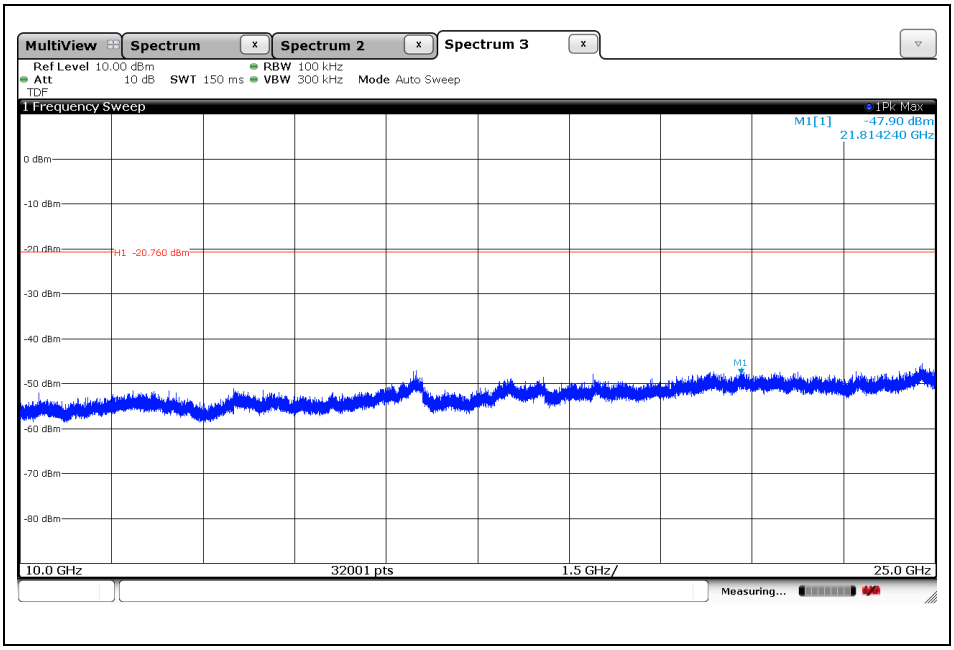
## 2.4.4. Plot of Conducted Spurious Emissions

Low Channel



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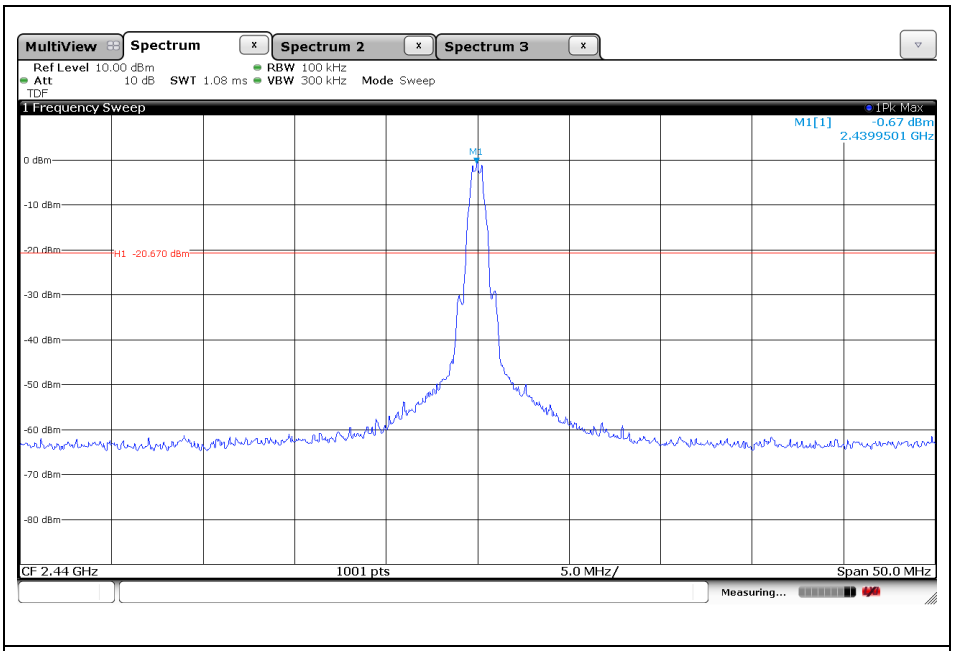
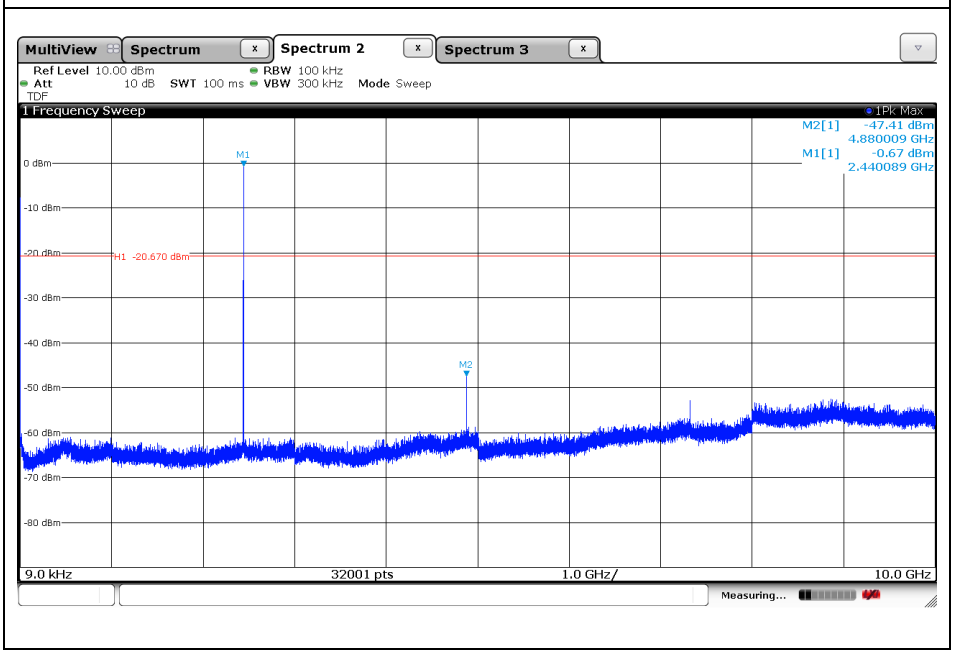
Middle Channel

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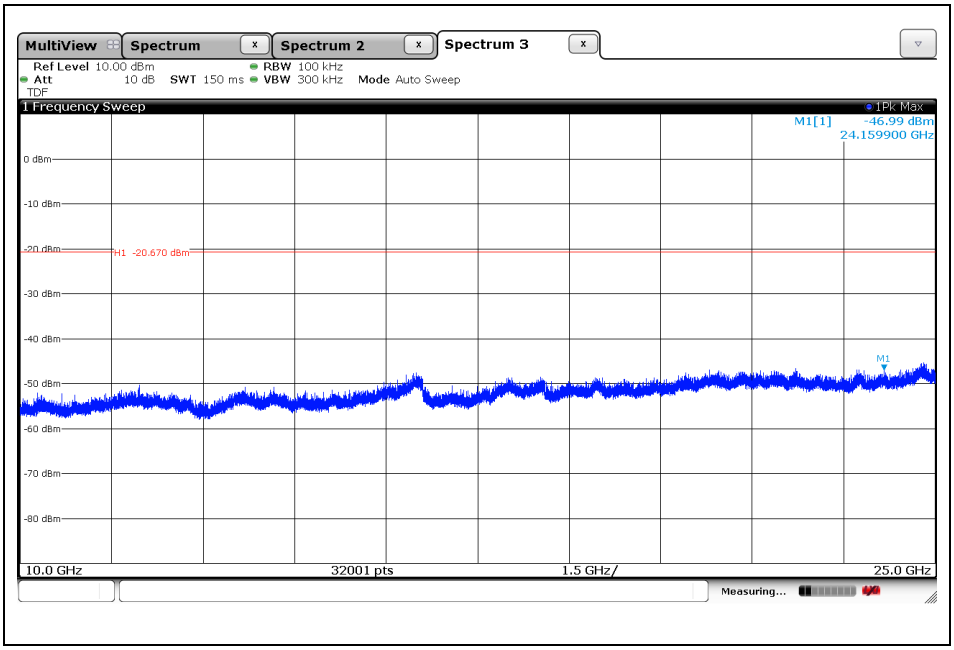
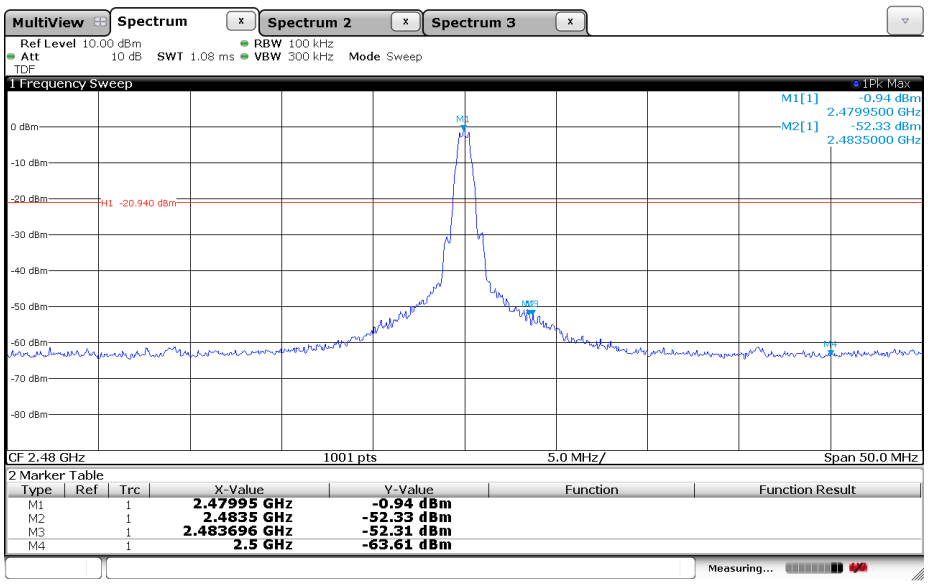
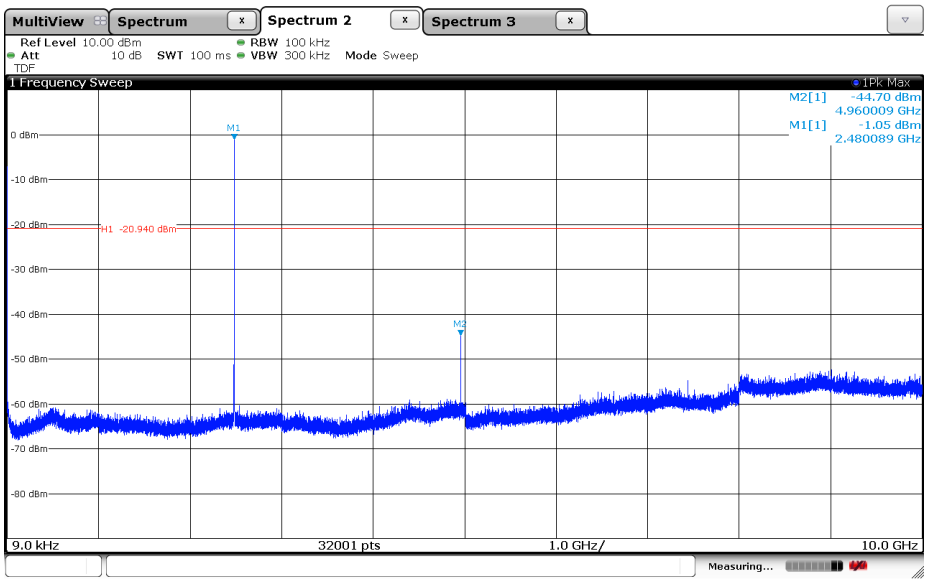
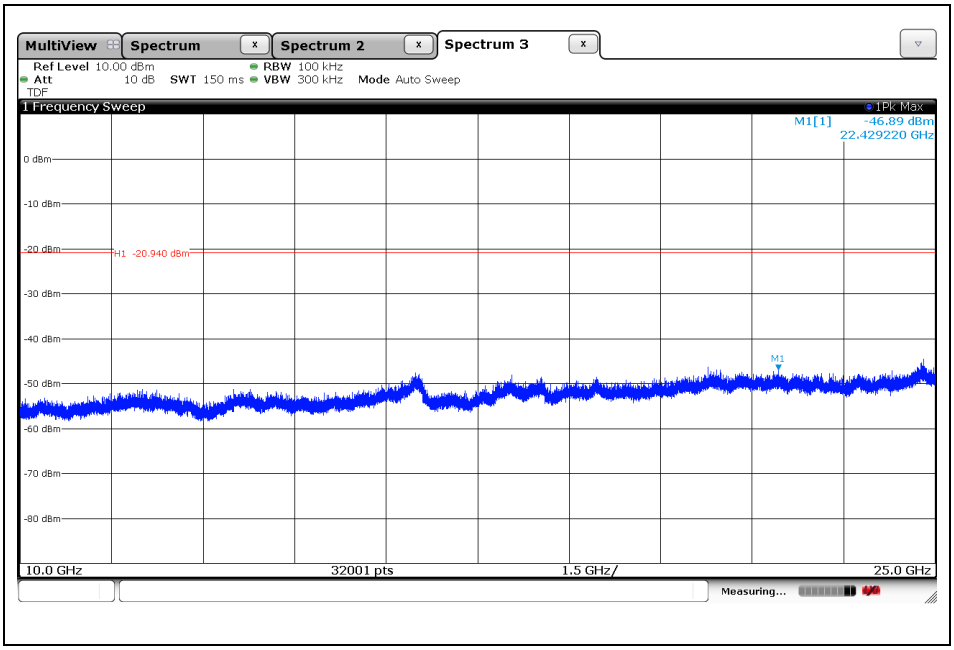

MultiView
Spectrum
Spectrum 2
Spectrum 3
Ref Level 10.00 dBm
RBW 100 kHz
Att 10 dB
SWT 150 ms
VBW 300 kHz
Mode Auto Sweep
TDF
1 Frequency Sweep
1Pk Max
M1[1] -46.99 dBm
24.159900 GHz
0 dBm
-10 dBm
-20 dBm
H1 -20.670 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
10.0 GHz
32001 pts
1.5 GHz/
25.0 GHz
Measuring...

High Channel




*The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.*

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# 3. 6 ㏈ Bandwidth & 99 % Bandwidth

## 3.1. Test Setup

## 3.2. Limit

### 3.2.1. FCC

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902-928 ㎒, 2 400-2 483.5 ㎒, and 5 725-5 850 ㎒ bands. The minimum of 6 ㏈ Bandwidth shall be at least 500 ㎑.

### 3.2.2. IC

According to RSS-247 Issue 1 5.2 (1), the minimum 6 ㏈ Bandwidth shall be 500 ㎑.

## 3.3. Test Procedure

### 3.3.1. 6 ㏈ Bandwidth

The test follows section 8.0 DTS bandwidth of FCC KDB Publication 558074_v03r05.
Tests performed using section 8.1 Option 1.

- Option 1:
1. Set RBW to = 100 ㎑.
2. Set the video bandwidth(VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude point (upper and lower frequencies) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

### 3.3.2. 99 % Bandwidth

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW. Detector = sampling, Trace mode = max hold.
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency).
This frequency is then recorded.

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## 3.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

| Mode | Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | 99 % Bandwidth (MHz) |
|---|---|---|---|---|
| GFSK | Low | 2 402 | 0.692 | 1.052 |
| | Middle | 2 440 | 0.665 | 1.061 |
| | High | 2 480 | 0.701 | 1.058 |

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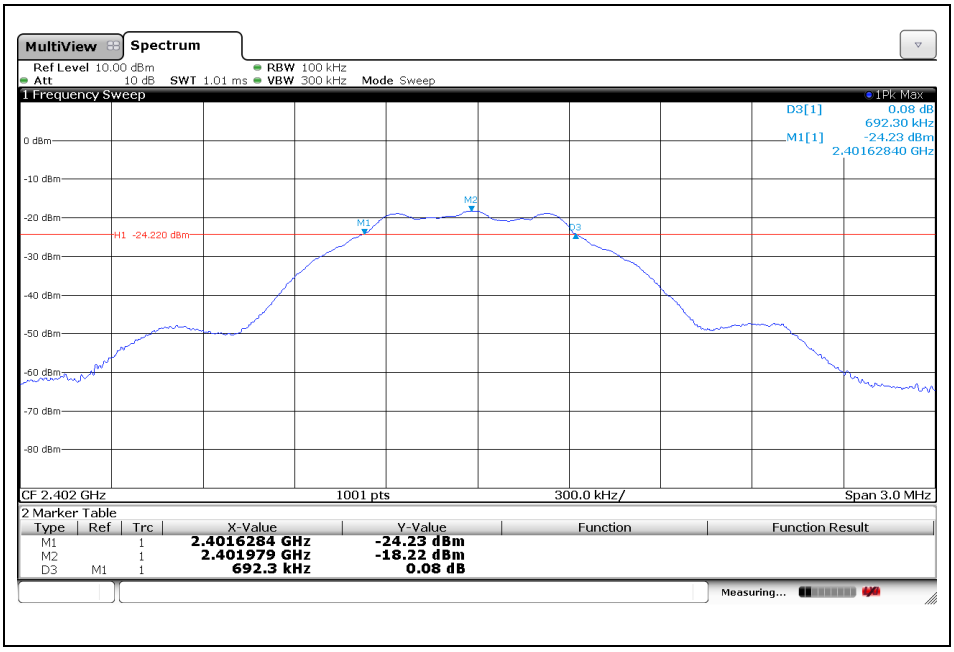
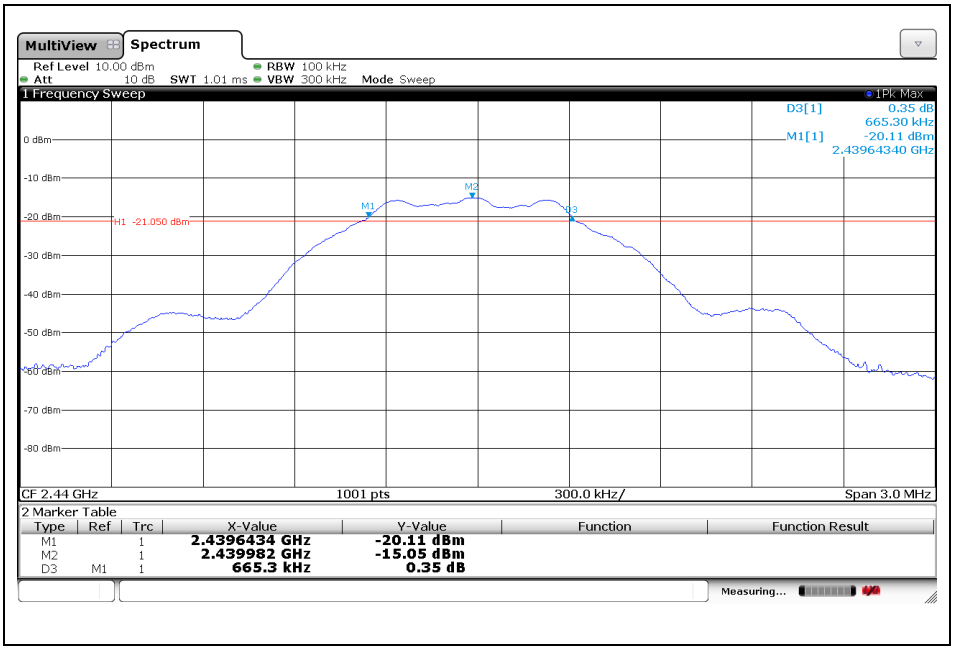
## 6 dB Bandwidth

Low Channel




Middle Channel

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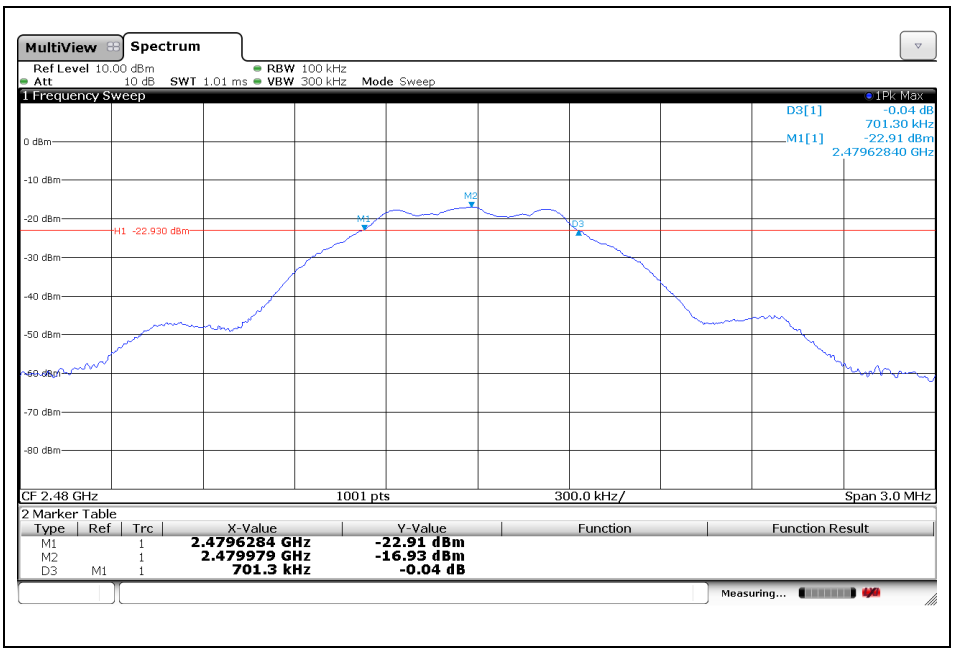
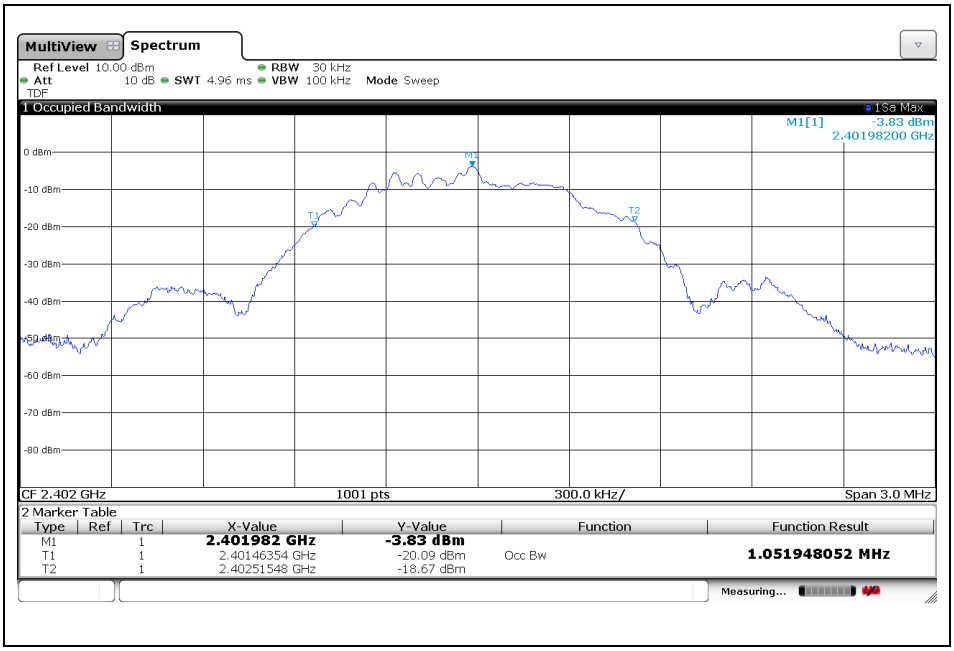
High Channel

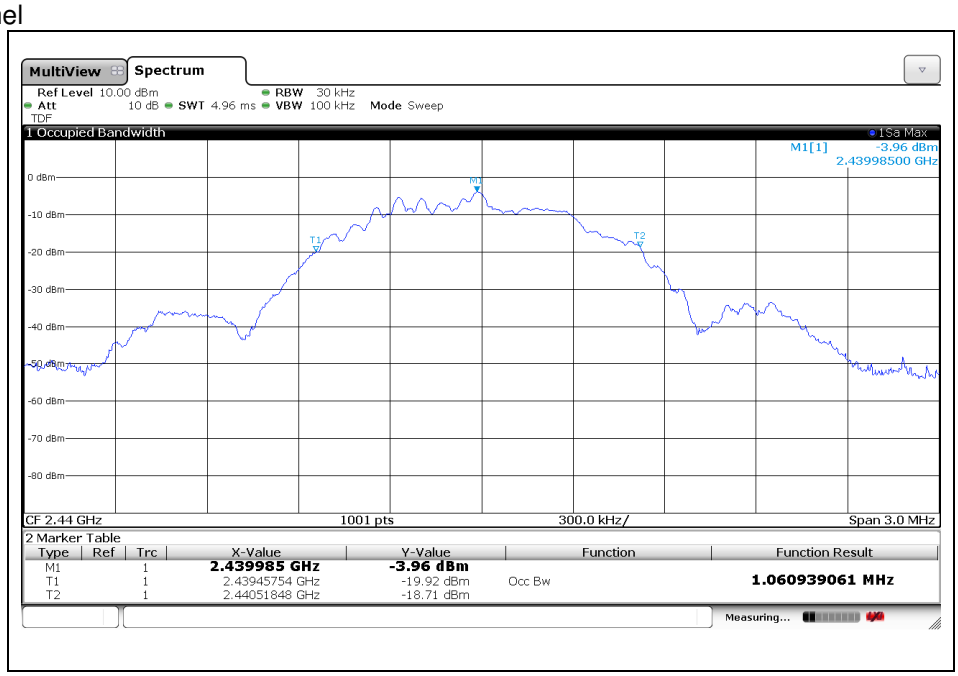



## 99 % Bandwidth

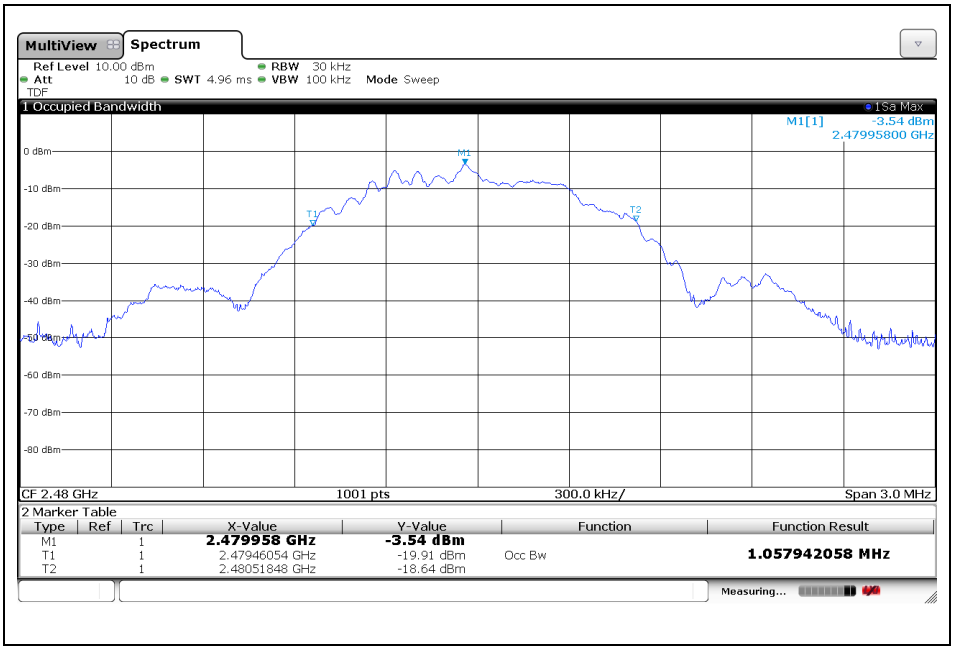
Low Channel



Middle Channel




High Channel

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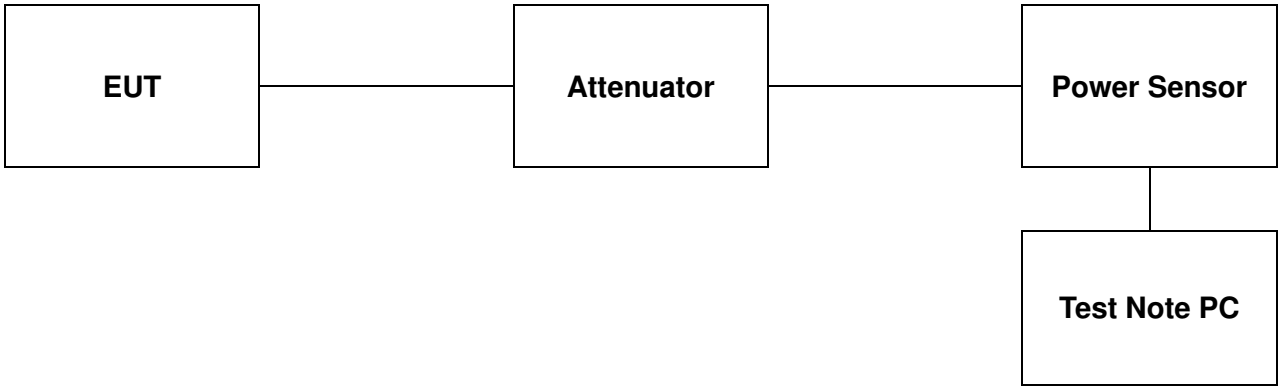
# 4. Maximum Peak Conducted Output Power

## 4.1. Test Setup




## 4.2. Limit

### 4.2.1. FCC

According to §15.247(b)(3), for systems using digital modulation in the 902-928 ㎒, 2 400-2 483.5 ㎒, and 5 725-5 850 ㎒ band : 1 Watt. As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 ㏈i. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 ㏈i are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

### 4.2.2. IC

According to RSS-247 Issue 1, 5.4 (4), for DTSs employing digital modulation techniques operating in the bands 902-928 ㎒ and 2 400-2 483.5 ㎒ the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section 5.4 (5), the e.i.r.p shall not exceed 4 W.

As an alternative to a peak measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

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## 4.3. Test Procedure

The test follows section 9.1.2 of FCC KDB Publication 558074_v03r05.

**- Peak power meter method**

-The maximum peak conducted output power can be measured using a broad band peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

**Test program: (S/W name : R&S Power Viewer, Version : 3.2.0)**

1. Initially overall offset for attenuator and cable loss is measured per frequency.
2. Measured offset is inserted in test program in advance of measurement for output power.
3. Power for each frequency (channel) of device is investigated as final result.
4. Final result reported on this section from R&S power viewer program includes with several factors and test program shows only final result.

*The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.*

## 4.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

| Mode | Channel | Frequency (㎒) | Attenuator + Cable offset (㏈) | Peak Power Result (㏈ m) | Peak Power Limit (㏈ m) |
|---|---|---|---|---|---|
| GFSK | Low | 2 402 | 16.44 | **0.35** | 30 |
| | Middle | 2 440 | 16.47 | 0.31 | 30 |
| | High | 2 480 | 16.49 | 0.22 | 30 |

**Remark:**

Attenuator and cable offset was compensated in test program (R&S Power Viewer) before measuring.

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# 5. Power Spectral Density

## 5.1. Test Setup

## 5.2. Limit

### 5.2.1 FCC

According to §15.247(e) For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 �dB m in any 3 ㎑ band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 5.2.2 IC

According to RSS-247 Issue 1, 5.2 (2), the transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 ㎡B m in any 3 ㎑ band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4 (4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

## 5.3. Test Procedure

The measurements are recorded using the PKPSD measurement procedure in section 10.2 of KDB 558074_v03r05.

- This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to at least 1.5 times the DTS bandwidth.
3. Set the RBW to : 3 ㎑ ≤ RBW ≤ 100 ㎑.
4. Set the VBW ≥ 3 x RBW.
5. Detector = Peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 ㎑) and repeat.

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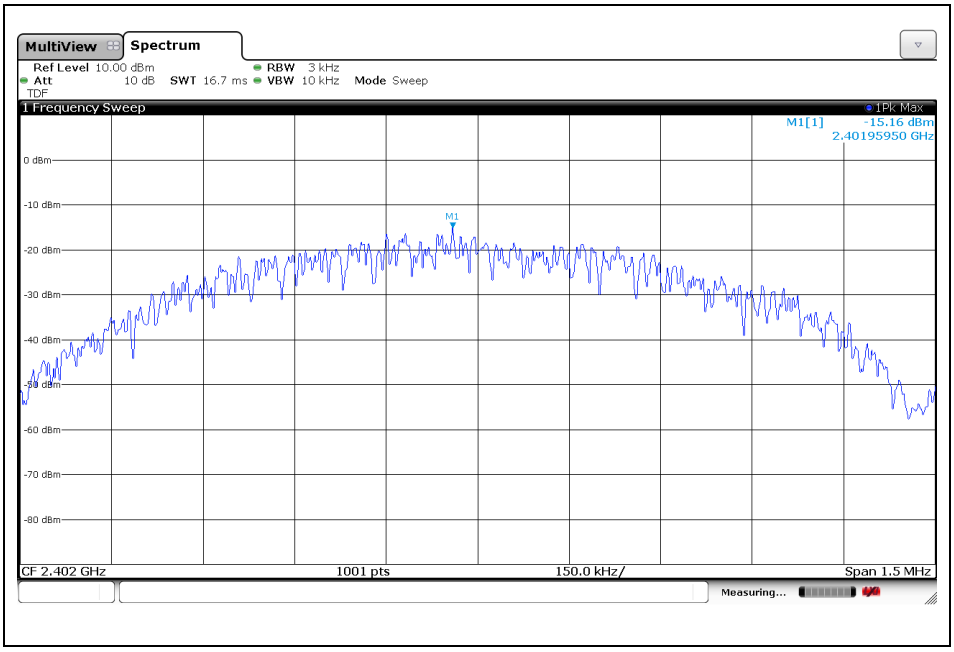
## 5.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

| Mode | Channel | Frequency (㎒) | Measured PSD (㏈ m) | Maximum Limit (㏈ m) |
|---|---|---|---|---|
| GFSK | Low | 2 402 | -15.16 | 8 |
| | Middle | 2 440 | -15.51 | 8 |
| | High | 2 480 | -15.04 | 8 |

Low Channel

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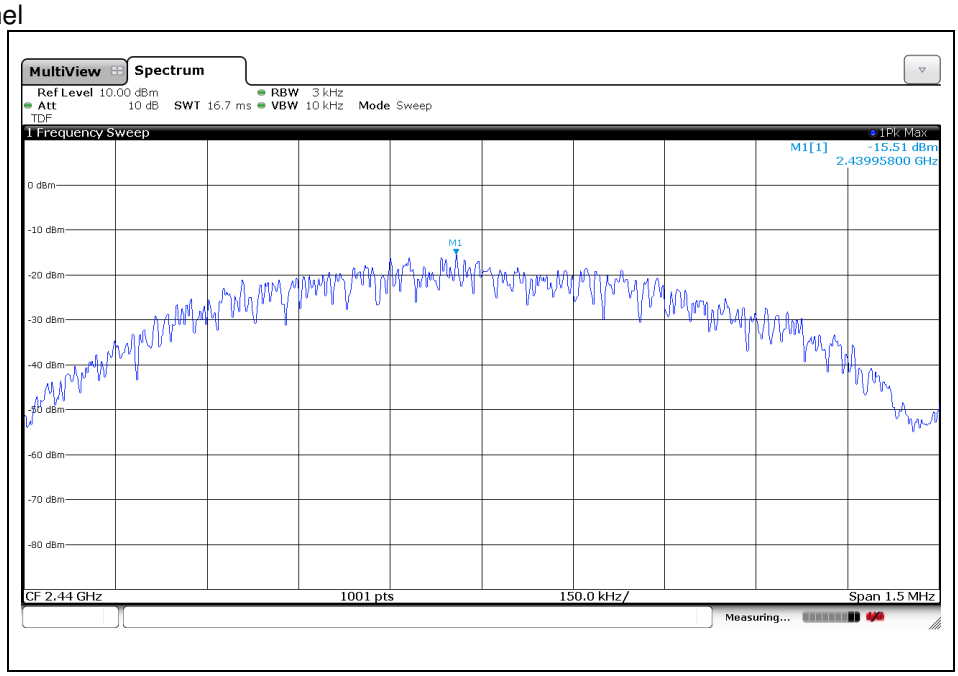
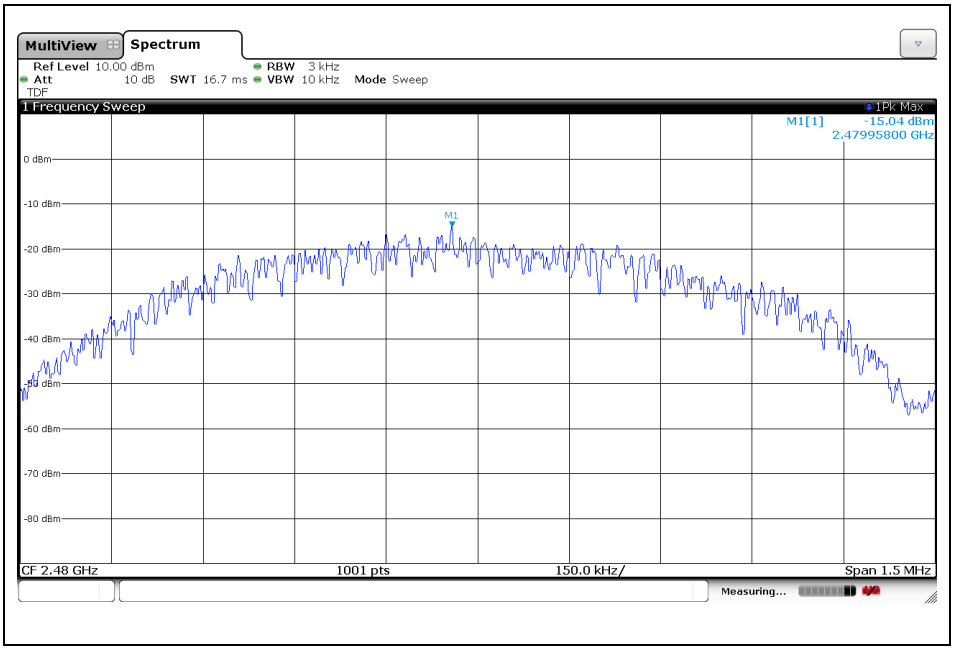
Middle Channel




High Channel

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# 6. Antenna Requirement

## 6.1. Standard Applicable

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

## 6.2. Antenna Connected Construction

Antenna used in this product is internal type with gain of 2.65 dBi.

**- End of the Test Report -**

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