

# TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID: TQ8-VCSA0ZZZXX

Equipment Under Test : Car Infotainment System  
Model Name : VCSA0ZZZXX  
Variant Model Name(s) : Refer to page 4  
Applicant : HYUNDAI MOBIS CO., LTD.  
Manufacturer : Hyundai Mobis Co., Ltd.  
Date of Receipt : 2025.12.04  
Date of Test(s) : 2025.12.08 ~ 2026.05.08  
Date of Issue : 2026.05.21

In the configuration tested, the EUT complied with the standards specified above.  
This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
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- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(※) provided by the customer

Tested by:



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Technical  
Manager:



Jinhyoung Cho

**SGS Korea Co., Ltd. Gunpo Laboratory**

# INDEX

## Table of contents

|                                                                                   |    |
|-----------------------------------------------------------------------------------|----|
| 1. General Information -----                                                      | 3  |
| 2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emissions ----- | 10 |
| 3. 6 dB Bandwidth and 99 % Bandwidth -----                                        | 33 |
| 4. Maximum Peak Conducted Output Power -----                                      | 40 |
| 5. Power Spectral Density -----                                                   | 45 |
| 6. Antenna Requirement -----                                                      | 49 |

## 1. General Information

### 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

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- Designation number: KR0150

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### 1.2. Details of Applicant

Applicant : HYUNDAI MOBIS CO., LTD.

Address : 203, Teheran-ro Gangnam-gu Seoul South Korea, 135-977

Contact Person : Choe, Seung-hoon

Phone No. : +82 31 899 1788

### 1.3. Details of Manufacturer

Company : Hyundai Mobis Co., Ltd.

Address : 203, Teheran-ro, Gangnam-gu, Seoul, 06141, Republic of Korea

#### 1.4. Description of EUT

|                                 |                                                                                                                                                                                                                                                                                    |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Kind of Product</b>          | Car Infotainment System                                                                                                                                                                                                                                                            |
| <b>Model Name</b>               | VCSA0ZZZXX                                                                                                                                                                                                                                                                         |
| <b>Variant Model Names</b>      | VCS40ZZZXX, VCS50ZZZXX, VCS60ZZZXX, VCS80ZZZXX, VCS90ZZZXX, VCSA0ZZZAN, VCS40ZZZAN, VCS50ZZZAN, VCS60ZZZAN, VCS80ZZZAN, VCS90ZZZAN, VCSA0ZZZKN, VCS40ZZZKN, VCS50ZZZKN, VCS60ZZZKN, VCS80ZZZKN, VCS90ZZZKN, VCSA0ZZZFN, VCS40ZZZFN, VCS50ZZZFN, VCS60ZZZFN, VCS80ZZZFN, VCS90ZZZFN |
| <b>Serial Number</b>            | Conducted: C-0001<br>Radiated: R-0001                                                                                                                                                                                                                                              |
| <b>Power Supply</b>             | DC 14.4 V                                                                                                                                                                                                                                                                          |
| <b>Frequency Range</b>          | 2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)                                                                                                                                                                                                                                       |
| <b>Modulation Technique</b>     | GFSK                                                                                                                                                                                                                                                                               |
| <b>Number of Channels</b>       | 40 channels (Bluetooth Low Energy)                                                                                                                                                                                                                                                 |
| <b>Antenna Type</b>             | Ant.1: PCB Pattern Antenna<br>Ant.2: PCB Pattern Antenna<br>Ant.3: PCB Pattern Antenna                                                                                                                                                                                             |
| <b>Antenna Gain<sup>※</sup></b> | Ant. 1<br>BT&BLE: 2 402 MHz ~ 2 480 MHz: 3.90 dB i<br>WLAN5: 5 180 MHz ~ 5 240 MHz: 2.80 dB i<br>5 745 MHz ~ 5 805 MHz: 0.40 dB i                                                                                                                                                  |
|                                 | Ant. 2<br>BT&BLE: 2 402 MHz ~ 2 480 MHz: 2.70 dB i<br>WLAN5: 5 180 MHz ~ 5 240 MHz: 2.00 dB i<br>5 745 MHz ~ 5 805 MHz: 3.70 dB i                                                                                                                                                  |
|                                 | Ant. 3<br>WLAN2: 2 412 MHz ~ 2 462 MHz: -0.20 dB i<br>WLAN5: 5 180 MHz ~ 5 240 MHz: 3.90 dB i<br>5 745 MHz ~ 5 805 MHz: 2.00 dB i                                                                                                                                                  |
| <b>H/W Version</b>              | 1.0                                                                                                                                                                                                                                                                                |
| <b>S/W Version</b>              | 1.0                                                                                                                                                                                                                                                                                |

## 1.5. Test Equipment List

| Equipment                              | Manufacturer                | Model                                | S/N                    | Cal. Date                | Cal. Interval | Cal. Due                 |
|----------------------------------------|-----------------------------|--------------------------------------|------------------------|--------------------------|---------------|--------------------------|
| Signal Generator                       | R&S                         | SMA100B                              | 106887                 | 10/20/2025               | Annual        | 10/20/2026               |
| Spectrum Analyzer <sup>1)</sup>        | R&S                         | FSV30                                | 101004                 | 12/18/2024<br>12/17/2025 | Annual        | 12/18/2025<br>12/17/2026 |
| Spectrum Analyzer                      | Agilent                     | N9020A                               | MY53421758             | 09/10/2025               | Annual        | 09/10/2026               |
| Spectrum Analyzer                      | Agilent                     | N9030A                               | US51350132             | 12/03/2025               | Annual        | 12/03/2026               |
| Attenuator                             | MCLI                        | FAS-12-10                            | A1                     | 06/10/2025               | Annual        | 06/10/2026               |
| High Pass Filter                       | Wainwright Instrument GmbH  | WHKX3.0/18G-10SS                     | 21                     | 06/17/2025               | Annual        | 06/17/2026               |
| High Pass Filter                       | Wainwright Instrument GmbH  | WHNX7.5/26.5G-6SS                    | 15                     | 06/09/2025               | Annual        | 06/09/2026               |
| Low Pass Filter                        | MINI-CIRCUITS               | NLP-1200+                            | V8979400903-1          | 05/23/2025               | Annual        | 05/23/2026               |
| Power Sensor                           | R&S                         | NRP-Z81                              | 100669                 | 05/24/2025               | Annual        | 05/24/2026               |
| DC Power Supply                        | Agilent                     | U8002A                               | MY50020026             | 12/02/2025               | Annual        | 12/02/2026               |
| Preamplifier                           | H.P.                        | 8447F                                | 2944A03909             | 08/07/2025               | Annual        | 08/07/2026               |
| Signal Conditioning Unit <sup>2)</sup> | R&S                         | SCU-18F                              | 100959                 | 07/13/2023<br>01/05/2026 | Annual        | 07/13/2024<br>01/05/2027 |
| Preamplifier <sup>3)</sup>             | TESTEK                      | TK-PA1840H                           | 130016                 | 03/13/2025<br>03/06/2026 | Annual        | 03/13/2026<br>03/06/2027 |
| Loop Antenna                           | Schwarzbeck Mess-Elektronik | FMZB 1519                            | 1519-039               | 10/01/2025               | Biennial      | 10/01/2027               |
| Bilog Antenna                          | Schwarzbeck Mess-Elektronik | VULB9163                             | 01126                  | 03/05/2025               | Biennial      | 03/05/2027               |
| Horn Antenna <sup>4)</sup>             | R&S                         | HF906                                | 100326                 | 02/24/2025<br>03/03/2026 | Annual        | 02/24/2026<br>03/03/2027 |
| Horn Antenna                           | Schwarzbeck Mess-Elektronik | BBHA 9170                            | 9170-540               | 12/05/2025               | Annual        | 12/05/2026               |
| EMI Test Receiver <sup>5)</sup>        | R&S                         | ESU26                                | 100109                 | 01/13/2025<br>01/21/2026 | Annual        | 01/13/2026<br>01/21/2027 |
| Turn Table                             | Innco systems GmbH          | DS 1200 S                            | N/A                    | N.C.R.                   | N/A           | N.C.R.                   |
| Controller                             | Innco systems GmbH          | CONTROLLER CO3000-4P                 | CO3000/963/383305 16/L | N.C.R.                   | N/A           | N.C.R.                   |
| Antenna Mast                           | Innco systems GmbH          | MA4640-XP-ET                         | MA4640/536/383305 16/L | N.C.R.                   | N/A           | N.C.R.                   |
| Anechoic Chamber                       | SY Corporation              | L × W × H<br>(9.6 m × 6.4 m × 6.6 m) | N/A                    | N.C.R.                   | N/A           | N.C.R.                   |
| Coaxial Cable <sup>6)</sup>            | SENSORVIEW                  | NMST-13A26-NMST-5 m                  | TPC2402190004          | 10/13/2025<br>04/17/2026 | Semi-Annual   | 04/13/2026<br>10/17/2026 |
| Coaxial Cable <sup>6)</sup>            | SENSORVIEW                  | NMST-13A26-NMST-10 m                 | TPC2402190001          | 10/13/2025<br>04/17/2026 | Semi-Annual   | 04/13/2026<br>10/17/2026 |
| Coaxial Cable <sup>7)</sup>            | RADIALL                     | TESTPRO 3                            | 152289                 | 10/10/2025<br>04/10/2026 | Semi-Annual   | 04/10/2026<br>10/10/2026 |

**Note;**

- 1) The equipment was not used for testing during the period from 12/15/2025 to 12/19/2025
- 2) The equipment was used for testing only after its calibration was completed on 01/05/2026
- 3) The equipment was not used for testing during the period from 03/03/2026 to 03/09/2026
- 4) The equipment was not used for testing during the period from 02/24/2026 to 03/05/2026
- 5) The equipment was not used for testing during the period from 01/13/2026 to 01/22/2026
- 6) The equipment was not used for testing during the period from 04/12/2026 to 04/17/2026
- 7) The equipment was not used for testing during the period from 04/09/2026 to 04/10/2026

## 1.6. Declaration by the Manufacturer

- The EUT supports BLE version 5.4

## 1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part 15 Subpart C |                                                                         |                   |
|-----------------------------------------|-------------------------------------------------------------------------|-------------------|
| Section                                 | Test Item(s)                                                            | Result            |
| 15.205(a)<br>15.209<br>15.247(d)        | Transmitter Radiated Spurious Emissions and Conducted Spurious Emission | Pass              |
| 15.247(a)(2)                            | 6 dB Bandwidth & 99 % Bandwidth                                         | Pass              |
| 15.247(b)(3)                            | Maximum Peak Conducted Output Power                                     | Pass              |
| 15.247(e)                               | Power Spectral Density                                                  | Pass              |
| 15.207                                  | AC Power Line Conducted Emission                                        | N/A <sup>1)</sup> |

### Note;

1) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

## 1.8. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2020), as well as the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02, were used in the measurement of the DUT.

## 1.9. Sample Calculation

Where relevant, the following sample calculation is provided:

### 1.9.1. Conducted Test

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

### 1.9.2. Radiation Test

Field strength level (dB $\mu$ V/m) = Measured level (dB $\mu$ V) + Antenna factor (dB/m) + Cable loss (dB) - Amplifier gain (dB) + Duty factor (dB)

## 1.10. Information of power setting and software for test

- The operating software of the EUT has an integrated test interface and transmits at its maximum rated output power setting.

## 1.11. Measurement Uncertainty

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

| Parameter                           | Uncertainty |         |
|-------------------------------------|-------------|---------|
| Maximum Peak Conducted Output Power | 0.35 dB     |         |
| Power Spectral Density              | 0.64 dB     |         |
| 99 % Bandwidth                      | 0.01 MHz    |         |
| 6 dB Bandwidth                      | 0.02 MHz    |         |
| Conducted Spurious Emission         | 0.86 dB     |         |
| Radiated Emission, 9 kHz to 30 MHz  | H           | 3.60 dB |
|                                     | V           | 3.60 dB |
| Radiated Emission, below 1 GHz      | H           | 5.50 dB |
|                                     | V           | 5.10 dB |
| Radiated Emission, above 1 GHz      | H           | 3.50 dB |
|                                     | V           | 3.40 dB |

All measurement uncertainty values are shown with a coverage factor of  $k=2$  to indicate a 95 % level of confidence.

## 1.12. Test Report Revision

| Revision | Report number        | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501-RF-RTL006994 | 2026.05.21    | Initial     |

### 1.13. Description of variant model

| Model Name    |            | DMB / DAB | HUD | HUD | Internal AMP 4ch | Internal AMP 2ch | Internal AMP 1ch | External AMP | RVM / SVM | Built-in Cam | ICMU | ICMC (cargo view) |
|---------------|------------|-----------|-----|-----|------------------|------------------|------------------|--------------|-----------|--------------|------|-------------------|
| Basic Model   | VCSA0ZZZX  | ○         | ○   | ○   | ○                | ○                | ○                | ○            | ○         | ○            | ○    | ○                 |
| Variant Model | VCS40ZZZX  |           | X   | X   | ○                | X                | X                | X            | ○         | ○            | ○    | X                 |
|               | VCS50ZZZX  |           | X   | X   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS60ZZZX  |           | X   | X   | X                | X                | X                | ○            | ○         | ○            | ○    | X                 |
|               | VCS80ZZZX  |           | ○   | ○   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS90ZZZX  |           | ○   | ○   | X                | X                | X                | ○            | ○         | ○            | ○    | X                 |
|               | VCSA0ZZZAN | X         | ○   | ○   | ○                | ○                | ○                | ○            | ○         | ○            | ○    | ○                 |
|               | VCS40ZZZAN |           | X   | X   | ○                | X                | X                | X            | ○         | ○            | ○    | X                 |
|               | VCS50ZZZAN |           | X   | X   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS60ZZZAN |           | X   | X   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |
|               | VCS80ZZZAN |           | ○   | ○   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS90ZZZAN |           | ○   | ○   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |
|               | VCSA0ZZZKN |           | ○   | ○   | ○                | ○                | ○                | ○            | ○         | ○            | ○    | ○                 |
|               | VCS40ZZZKN |           | X   | X   | ○                | X                | X                | X            | ○         | ○            | ○    | X                 |
|               | VCS50ZZZKN |           | X   | X   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS60ZZZKN |           | X   | X   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |
|               | VCS80ZZZKN |           | ○   | ○   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS90ZZZKN |           | ○   | ○   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |
|               | VCSA0ZZZFN |           | ○   | ○   | ○                | ○                | ○                | ○            | ○         | ○            | ○    | ○                 |
|               | VCS40ZZZFN |           | X   | X   | ○                | X                | X                | X            | ○         | ○            | ○    | X                 |
|               | VCS50ZZZFN |           | X   | X   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS60ZZZFN |           | X   | X   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |
|               | VCS80ZZZFN |           | ○   | ○   | ○                | ○                | ○                | X            | ○         | ○            | ○    | X                 |
|               | VCS90ZZZFN |           | ○   | ○   | X                | ○                | ○                | ○            | ○         | ○            | ○    | X                 |

**Note;**

- The all test items performed with basic model

## 1.14. Device Capabilities

| Mode                 | SISO   |        |        | CDD / MIMO      |
|----------------------|--------|--------|--------|-----------------|
|                      | Ant. 1 | Ant. 2 | Ant. 3 | Ant. 1 + Ant. 2 |
| Bluetooth Low Energy | O      | O      | X      | X               |
| Bluetooth            | O      | O      | X      | X               |
| WLAN 2 GHz           | X      | X      | O      | X               |
| WLAN 5 GHz           | O      | O      | O      | O               |

### Note;

- The EUT has three ports and supports MIMO operation only for ANT 1+2 in the WLAN 5GHz band, while IEEE 802.11a operates in SISO mode only.
- The EUT supported PHY 1M only For Bluetooth Low Energy.

## 1.15. Duty Cycle of EUT

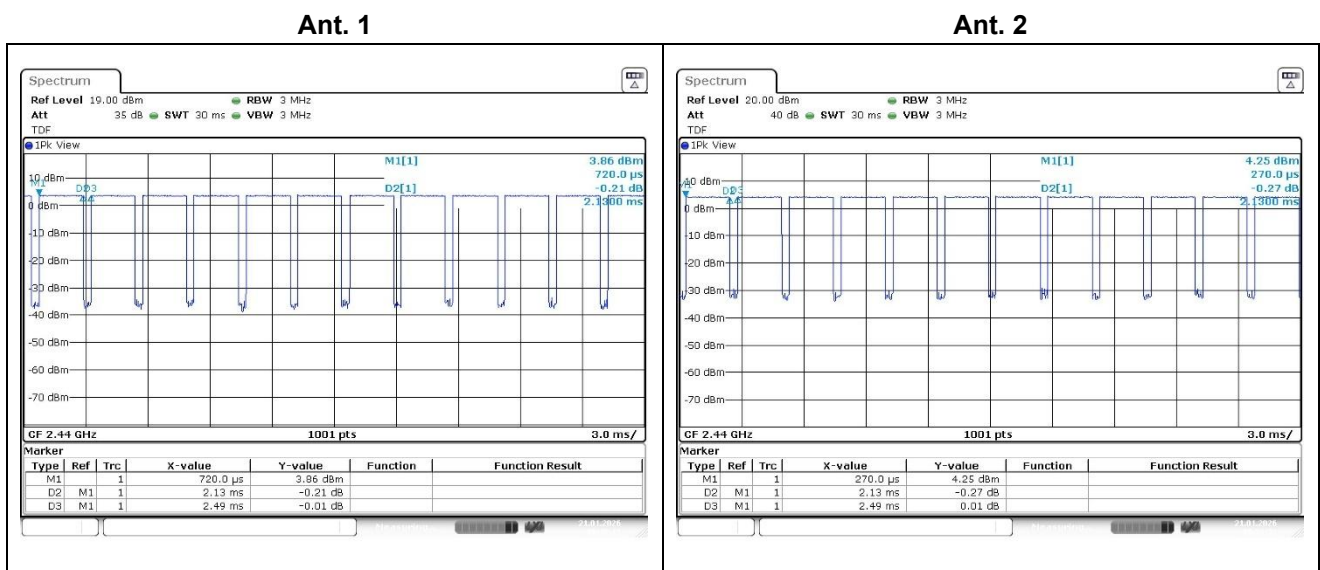
Regarding to KDB 558074 D01 15.247 Meas Guidance v05r02, 6, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below;  
 Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

| Antenna Port | Tx on time (ms) | Tx on+off time (ms) | Duty Cycle (%) | Correction Factor (dB) |
|--------------|-----------------|---------------------|----------------|------------------------|
| Ant. 1       | 2.13            | 2.49                | 85.54          | 0.68                   |
| Ant. 2       | 2.13            | 2.49                | 85.54          | 0.68                   |

### Remark;

- Duty Cycle (%) = (Tx on time / Tx on + off time) x 100
- Correction Factor (dB) = 10 log (1 / Duty Cycle)

### - Test plots

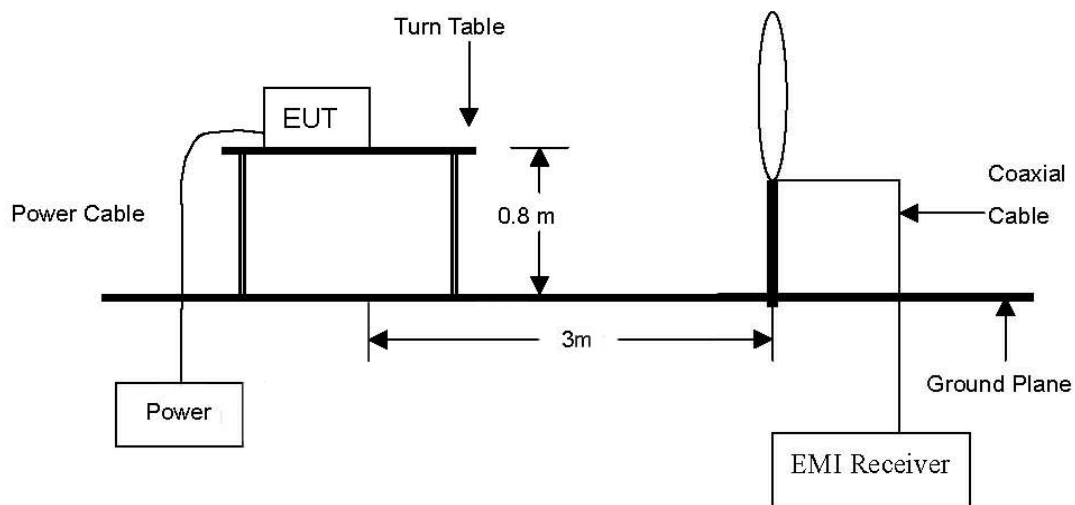


## 2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emissions

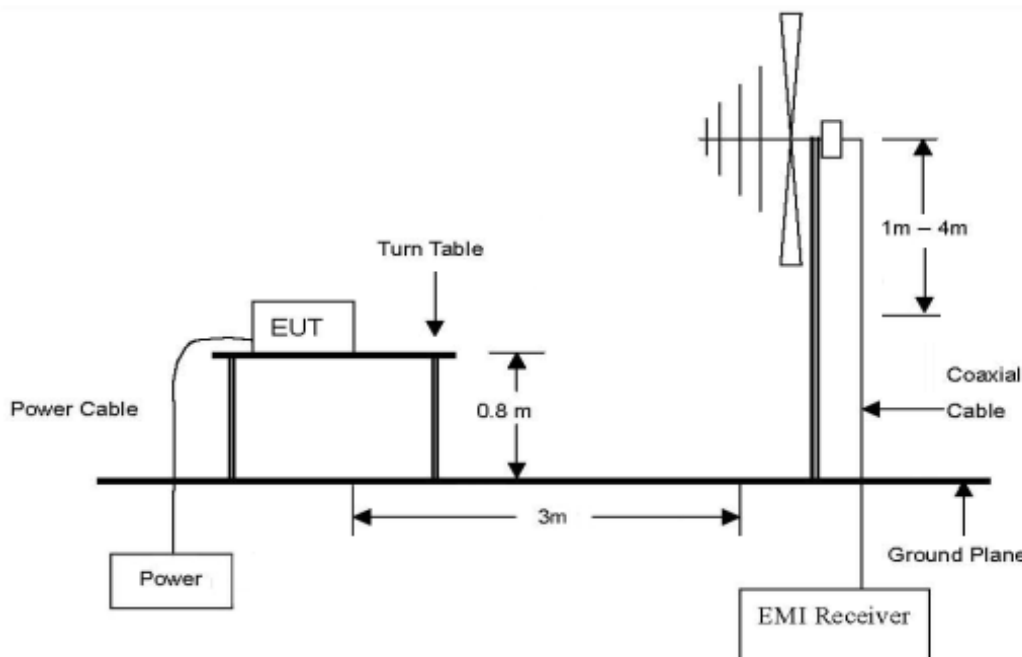
### 2.1. Test Setup

#### 2.1.1. Transmitter Radiated Spurious Emissions

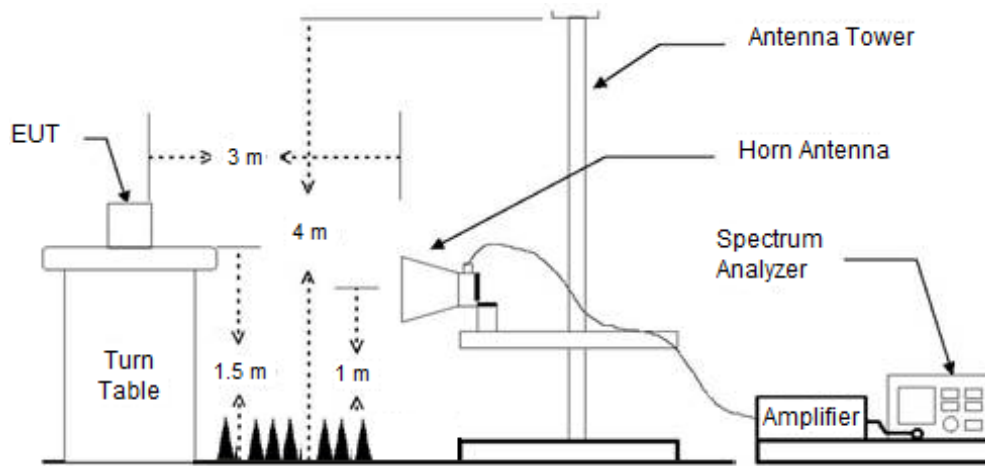
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz emissions.



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



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



### 2.1.2. Conducted Spurious Emissions



## 2.2. Limit

According to §15.247(d), 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. In addition, radiated emission which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §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<br>(MHz) | Field Strength<br>( $\mu\text{V/m}$ ) | Measurement Distance<br>(Meters) |
|--------------------|---------------------------------------|----------------------------------|
| 0.009-0.490        | 2 400/F(kHz)                          | 300                              |
| 0.490-1.705        | 24 000/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.

## 2.3. Test Procedures

Radiated emissions from the EUT were measured in accordance with sections 11.11 & 11.12 of ANSI C63.10-2020.

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

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.

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

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 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, 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 GHz, 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. For measurements below 1 GHz 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.
6. For measurements Above 1 GHz resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

### 2.3.3. Test Procedures for Radiated Spurious Emissions

#### 1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.11.2

Set analyzer center frequency to DTS channel center frequency, SPAN  $\geq 1.5$  times the DTS bandwidth, the RBW = 100 kHz and VBW  $\geq 3 \times$  RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW  $\geq 3 \times$  RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

#### 2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 11.12.2.4

Set RBW = as specified in Table 16, VBW  $\geq 3 \times$  RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

**Table 16 – RBW as a function of frequency**

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

If the peak – detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

- Average Power measurements procedure refer to section 11.12.2.5.2

The EUT shall be configured to operate at the maximum achievable duty cycle.

Measure the duty cycle D of the transmitter output signal as described in section 11.6.

Set RBW = 1 MHz, VBW  $\geq 3 \times$  RBW, Detector = Power averaging (rms), if span / (# of points in sweep)  $\leq$  (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 dB 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  $[10 \log (1 / D)]$ , where D is the duty cycle.
- 2) If a specific emission is demonstrated to be continuous (D  $\geq 98\%$ ) rather than turning ON and OFF with the transmit cycle, then no duty cycled correction is required for that emission.

#### 3. Definition of DUT Axis.

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z described in the test setup photo. All radiated testing of EUT was performed with worst case axis.

### 2.3.4. Test Procedures for Conducted Spurious Emissions

Per the guidance of ANSI C63.10-2020, 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 kHz. 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 dB below the fundamental emission level measured in a 100 kHz bandwidth.

#### 1. Conducted Emissions at Band Edge

- The Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW  $\geq 3 \times$  RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace mode = Max hold, The trace was allowed to stabilize.

#### 2. Conducted Spurious Emissions

- The Measurement refer to section 11.11.3

Start frequency was set to 9 kHz and stop frequency was set to 25 GHz (separated plots per channel), RBW = 1 MHz, VBW  $\geq 3 \times$  RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold, The trace was allowed to stabilize.

#### 3. TDF function

- For plots showing conducted spurious emissions from 9 kHz to 25 GHz, 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.

## 2.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 %

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

The frequency spectrum from 9 kHz to 1 000 MHz was investigated.

#### Ant. 1

| Radiated Emissions |                   |                 | Ant. | Correction<br>(dB/m) | Total              | Limit             |                |
|--------------------|-------------------|-----------------|------|----------------------|--------------------|-------------------|----------------|
| Frequency<br>(MHz) | Reading<br>(dBμV) | Detect<br>Mode  | Pol. |                      | Actual<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
| 50.26              | 27.95             | Quasi -<br>Peak | H    | -7.49                | 20.46              | 40.00             | 19.54          |
| 58.67              | 29.35             | Quasi -<br>Peak | H    | -8.41                | 20.94              | 40.00             | 19.06          |
| above<br>100.00    | Not<br>detected   | -               | -    | -                    | -                  | -                 | -              |

#### Ant. 2

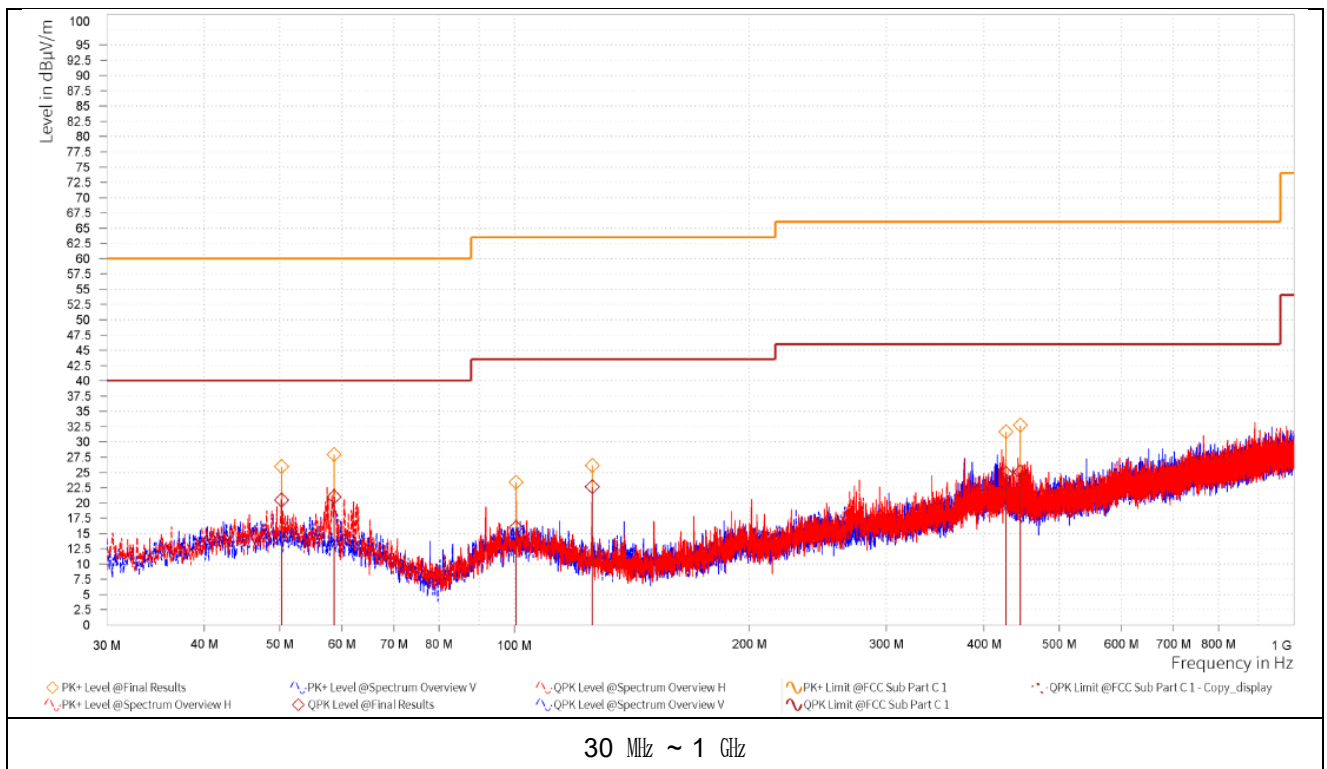
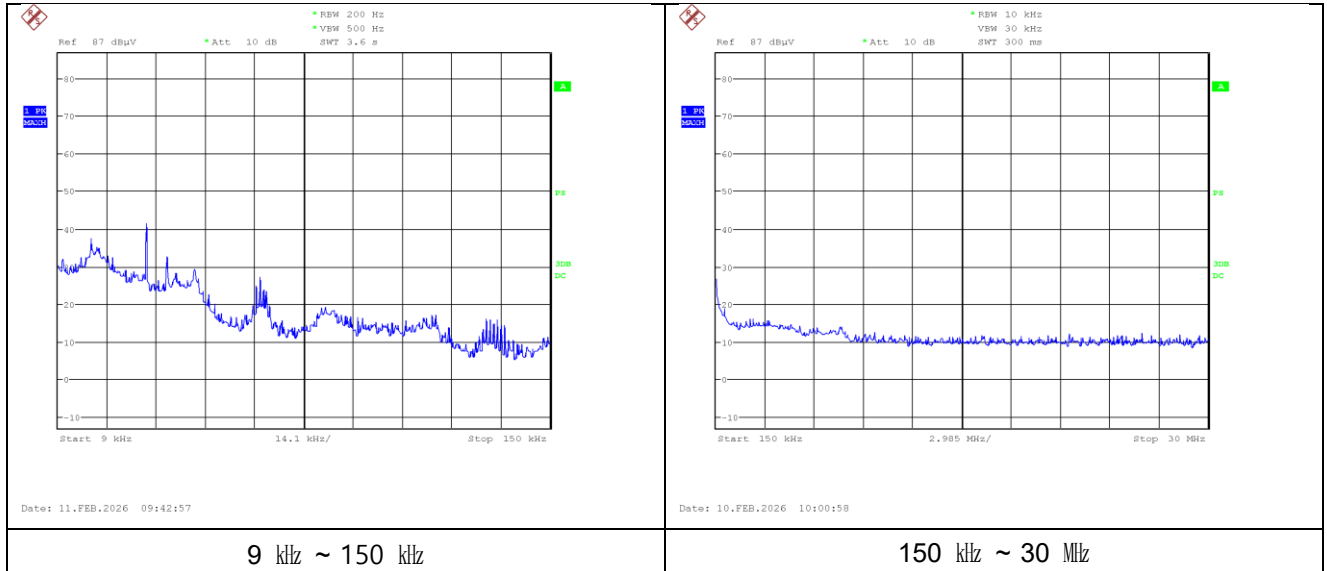
| Radiated Emissions |                   |                | Ant. | Correction<br>(dB/m) | Total              | Limit             |                |
|--------------------|-------------------|----------------|------|----------------------|--------------------|-------------------|----------------|
| Frequency<br>(MHz) | Reading<br>(dBμV) | Detect<br>Mode | Pol. |                      | Actual<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
| Below<br>30.00     | Not<br>detected   | -              | -    | -                    | -                  | -                 | -              |
| above<br>30.00     | Not<br>detected   | -              | -    | -                    | -                  | -                 | -              |

#### Remark;

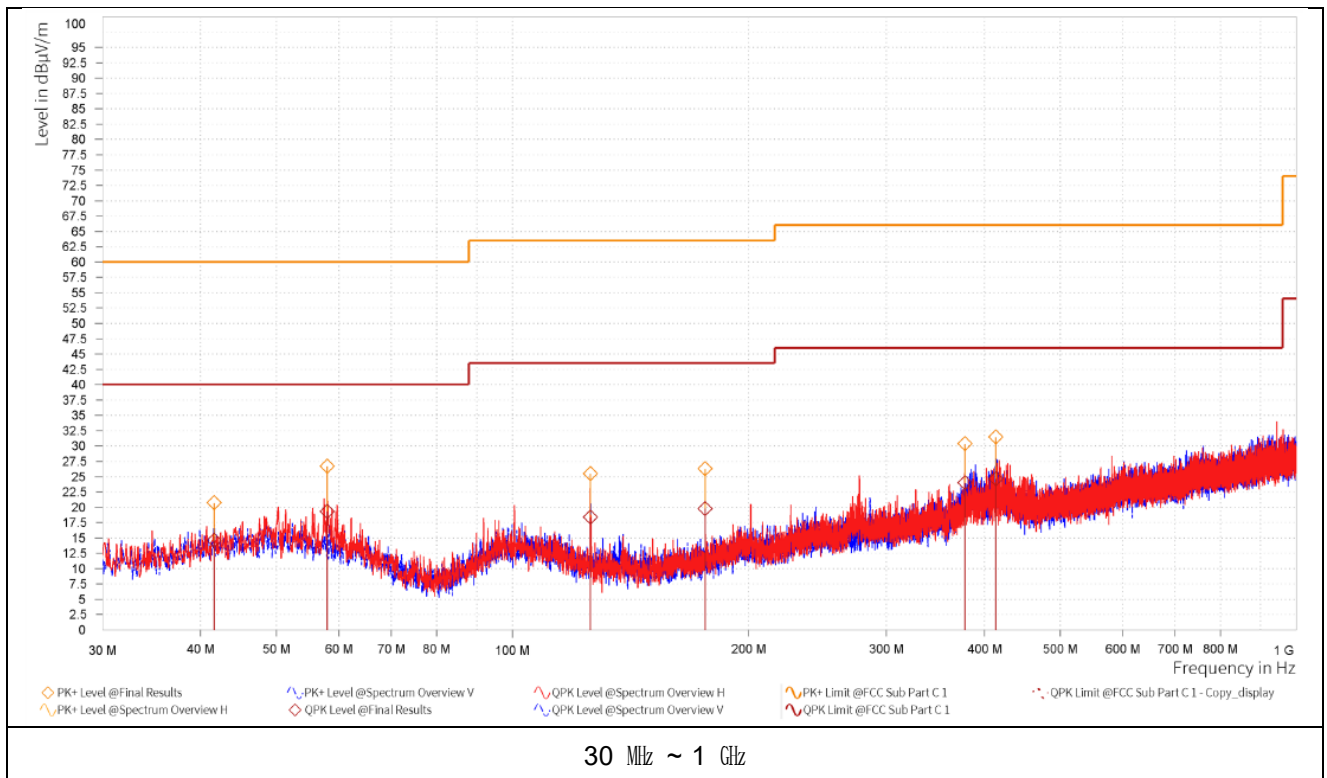
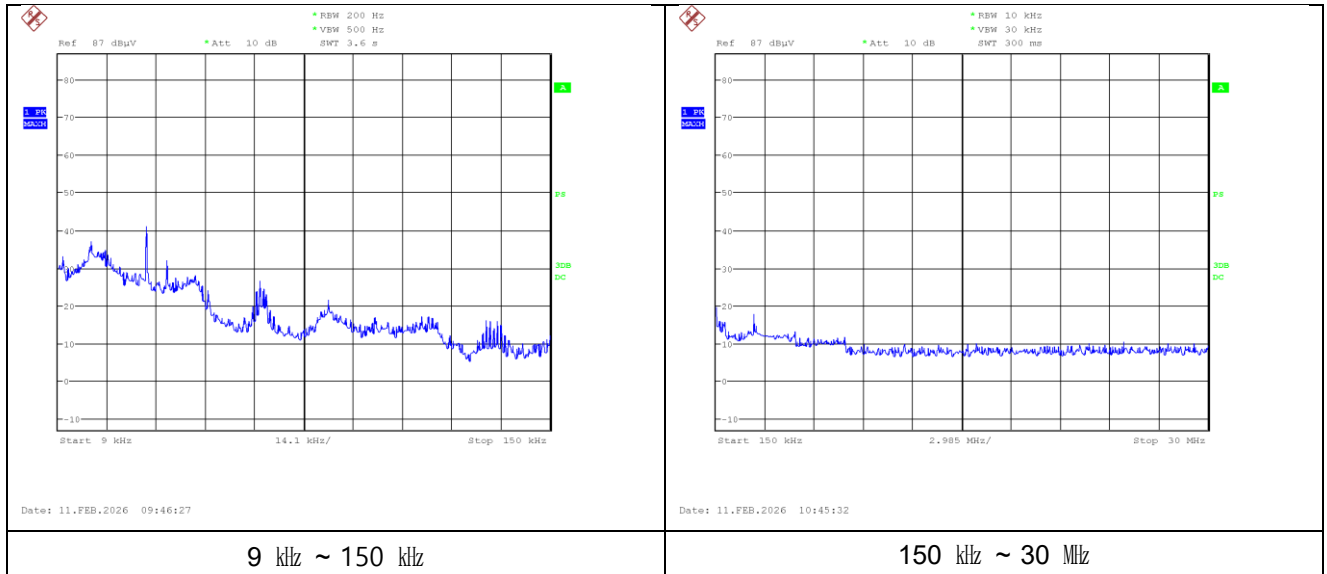
1. Spurious emissions for all channels were investigated and almost the same below 1 GHz.
2. Test from 30 MHz to 1 000 MHz was performed using the software of ELEKTRA(V5.02) from Rohde & Schwarz GmbH & Co. KG.
3. Reported spurious emissions are in **PHY 1M / Middle channel** as worst case among other mode and channels.
4. Radiated spurious emission measurement as below.  
(Actual = Reading + Correction)  
(Correction = Antenna Factor + AMP Factor + Cable Loss)
5. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

## - Test plots

### Ant. 1



## Ant. 2



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

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

#### -Ant. 1

Low Channel (2 402 MHz)

| Radiated Emissions |                      |             | Ant. | Correction Factors |         |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|---------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 310.00          | 18.31                | Peak        | V    | 27.94              | 7.33    | -       | 53.58                 | 74.00                | 20.42       |
| *2 310.00          | 8.00                 | Average     | V    | 27.94              | 7.33    | 0.68    | 43.95                 | 54.00                | 10.05       |
| *2 325.25          | 20.21                | Peak        | V    | 28.00              | 7.29    | -       | 55.50                 | 74.00                | 18.50       |
| *2 389.24          | 8.06                 | Average     | V    | 28.18              | 7.58    | 0.68    | 44.50                 | 54.00                | 9.50        |
| *2 390.00          | 18.91                | Peak        | V    | 28.18              | 7.59    | -       | 54.68                 | 74.00                | 19.32       |
| *2 390.00          | 8.04                 | Average     | V    | 28.18              | 7.59    | 0.68    | 44.49                 | 54.00                | 9.51        |

| Radiated Emissions |                      |             | Ant. | Correction Factors |             |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Above 1 000.00     | Not detected         | -           | -    | -                  | -           | -       | -                     | -                    | -           |

Middle Channel (2 440 MHz)

| Radiated Emissions |                      |             | Ant. | Correction Factors |             |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Above 1 000.00     | Not detected         | -           | -    | -                  | -           | -       | -                     | -                    | -           |

High Channel (2 480 MHz)

| Radiated Emissions |                      |             | Ant. | Correction Factors |         |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|---------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 483.50          | 19.21                | Peak        | V    | 28.34              | 7.58    | -       | 55.13                 | 74.00                | 18.87       |
| *2 483.50          | 8.62                 | Average     | V    | 28.34              | 7.58    | 0.68    | 45.22                 | 54.00                | 8.78        |
| *2 488.29          | 20.97                | Peak        | V    | 28.38              | 7.63    | -       | 56.98                 | 74.00                | 17.02       |
| *2 483.53          | 8.45                 | Average     | V    | 28.34              | 7.58    | 0.68    | 45.05                 | 54.00                | 8.95        |
| *2 500.00          | 18.69                | Peak        | V    | 28.50              | 7.74    | -       | 54.93                 | 74.00                | 19.07       |
| *2 500.00          | 8.33                 | Average     | V    | 28.50              | 7.74    | 0.68    | 45.25                 | 54.00                | 8.75        |

| Radiated Emissions |                      |             | Ant. | Correction Factors |             |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Above 1 000.00     | Not detected         | -           | -    | -                  | -           | -       | -                     | -                    | -           |

**-Ant. 2**

Low Channel (2 402 MHz)

| Radiated Emissions |                      |             | Ant. | Correction Factors |         |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|---------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 310.00          | 17.44                | Peak        | V    | 27.94              | 7.33    | -       | 52.71                 | 74.00                | 21.29       |
| *2 310.00          | 7.88                 | Average     | V    | 27.94              | 7.33    | 0.68    | 43.83                 | 54.00                | 10.17       |
| *2 378.43          | 21.57                | Peak        | V    | 28.16              | 7.50    | -       | 57.23                 | 74.00                | 16.77       |
| *2 389.45          | 8.03                 | Average     | V    | 28.18              | 7.58    | 0.68    | 44.47                 | 54.00                | 9.53        |
| *2 390.00          | 18.24                | Peak        | V    | 28.18              | 7.59    | -       | 54.01                 | 74.00                | 19.99       |
| *2 390.00          | 7.89                 | Average     | V    | 28.18              | 7.59    | 0.68    | 44.34                 | 54.00                | 9.66        |

| Radiated Emissions |                      |             | Ant. | Correction Factors |             |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Above 1 000.00     | Not detected         | -           | -    | -                  | -           | -       | -                     | -                    | -           |

Middle Channel (2 440 MHz)

| Radiated Emissions |                      |             | Ant. | Correction Factors |             |         | Total                 | Limit                |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Above 1 000.00     | Not detected         | -           | -    | -                  | -           | -       | -                     | -                    | -           |

High Channel (2 480 MHz)

| Radiated Emissions |                |             | Ant. | Correction Factors |         |         | Total           | Limit          |             |
|--------------------|----------------|-------------|------|--------------------|---------|---------|-----------------|----------------|-------------|
| Frequency (MHz)    | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | DF (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| *2 483.50          | 28.73          | Peak        | V    | 28.34              | 7.58    | -       | 64.65           | 74.00          | 9.35        |
| *2 483.50          | 8.54           | Average     | V    | 28.34              | 7.58    | 0.68    | 45.14           | 54.00          | 8.86        |
| *2 484.13          | 30.20          | Peak        | V    | 28.34              | 7.59    | -       | 66.13           | 74.00          | 7.87        |
| *2 483.63          | 8.32           | Average     | V    | 28.34              | 7.58    | 0.68    | 44.92           | 54.00          | 9.08        |
| *2 500.00          | 19.00          | Peak        | V    | 28.50              | 7.74    | -       | 55.24           | 74.00          | 18.76       |
| *2 500.00          | 8.34           | Average     | V    | 28.50              | 7.74    | 0.68    | 45.26           | 54.00          | 8.74        |

| Radiated Emissions |                |             | Ant. | Correction Factors |             |         | Total           | Limit          |             |
|--------------------|----------------|-------------|------|--------------------|-------------|---------|-----------------|----------------|-------------|
| Frequency (MHz)    | Reading (dBμV) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | DF (dB) | Actual (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
| Above 1 000.00     | Not detected   | -           | -    | -                  | -           | -       | -               | -              | -           |

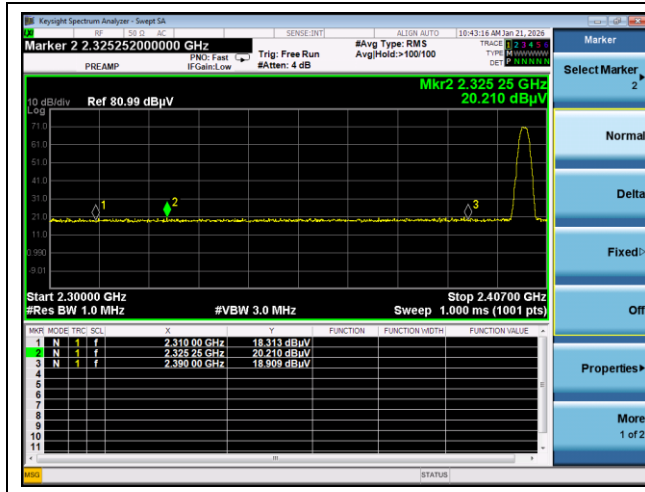
**Remarks;**

1. "\*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10<sup>th</sup> harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.
7. AF = Antenna Factor, CL = Cable Loss, DF = Duty Correction Factor.

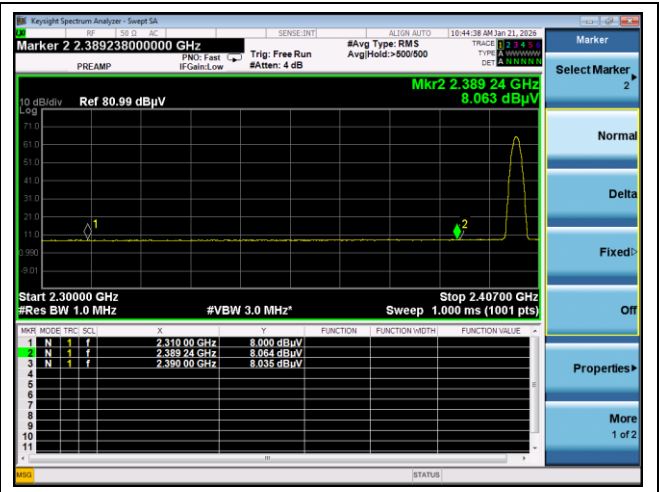
## - Test plots

### Ant. 1

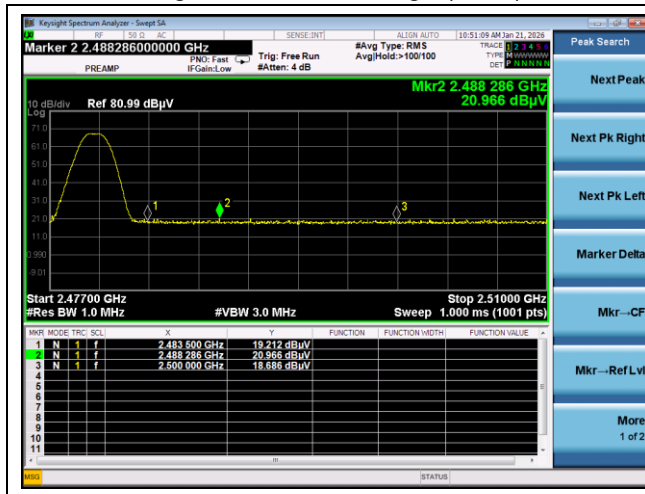
Low channel band edge (Peak)



Low channel band edge (Average)



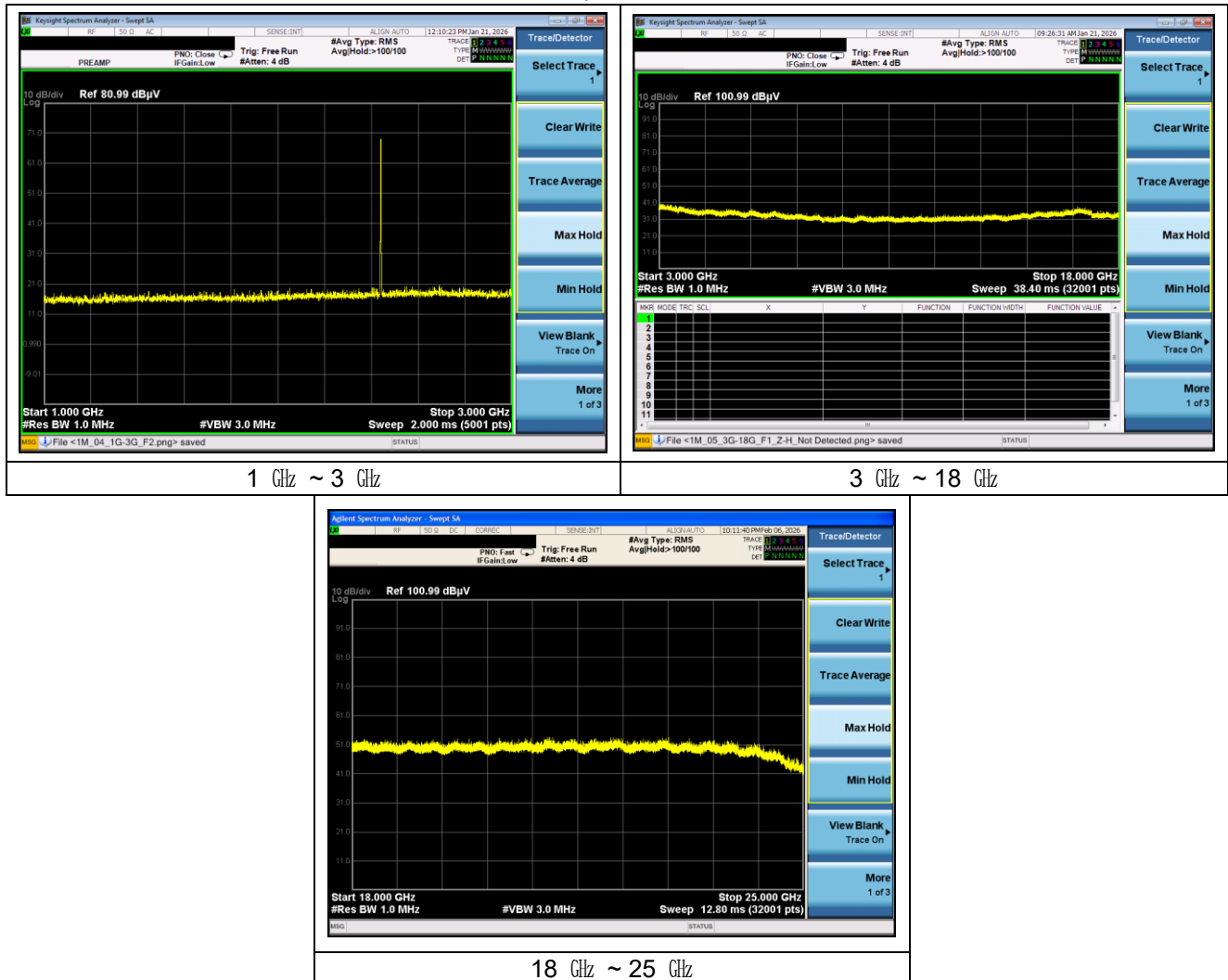
High channel band edge (Peak)



High channel band edge (Average)

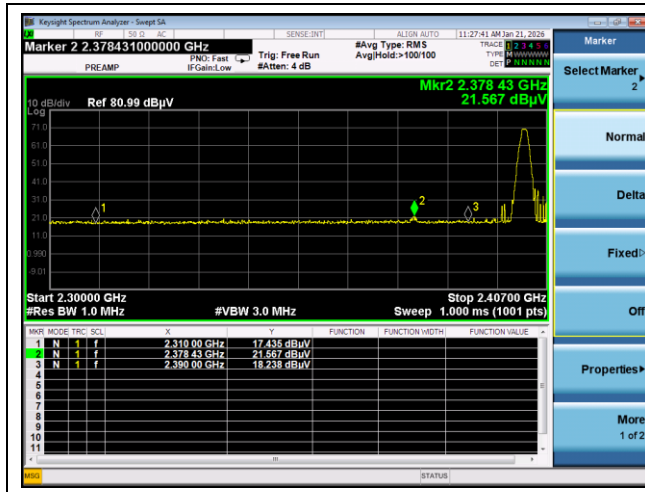


### Radiated Spurious Emissions

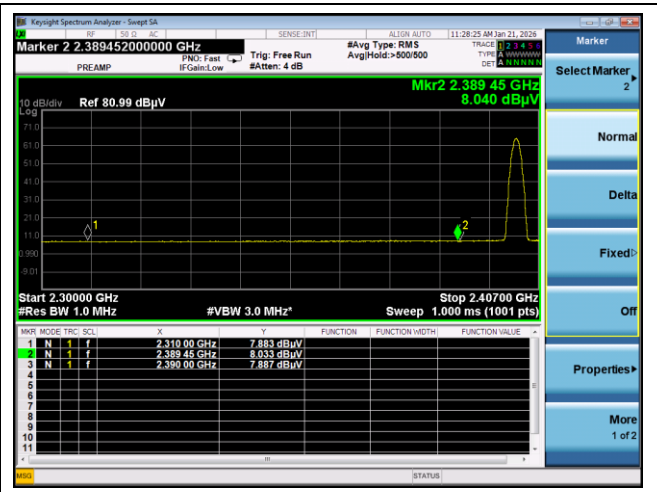


## Ant. 2

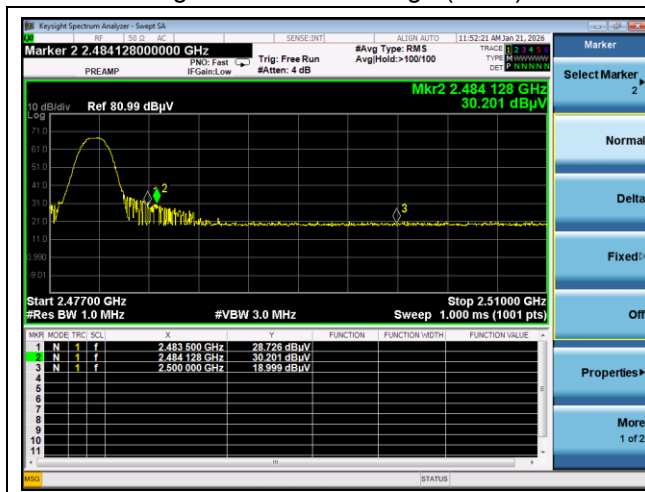
Low channel band edge (Peak)



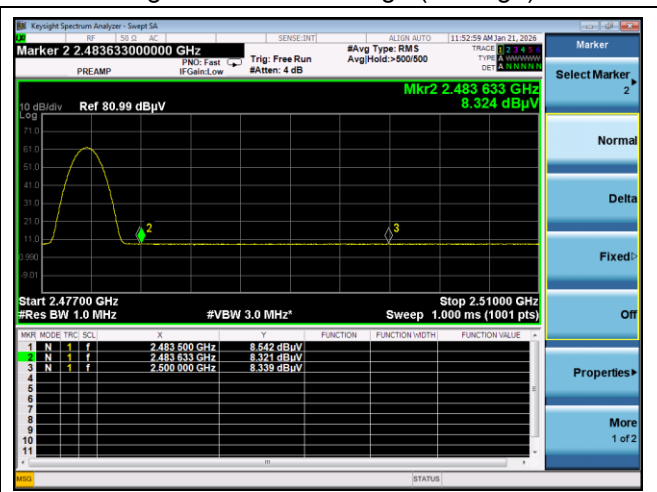
Low channel band edge (Average)



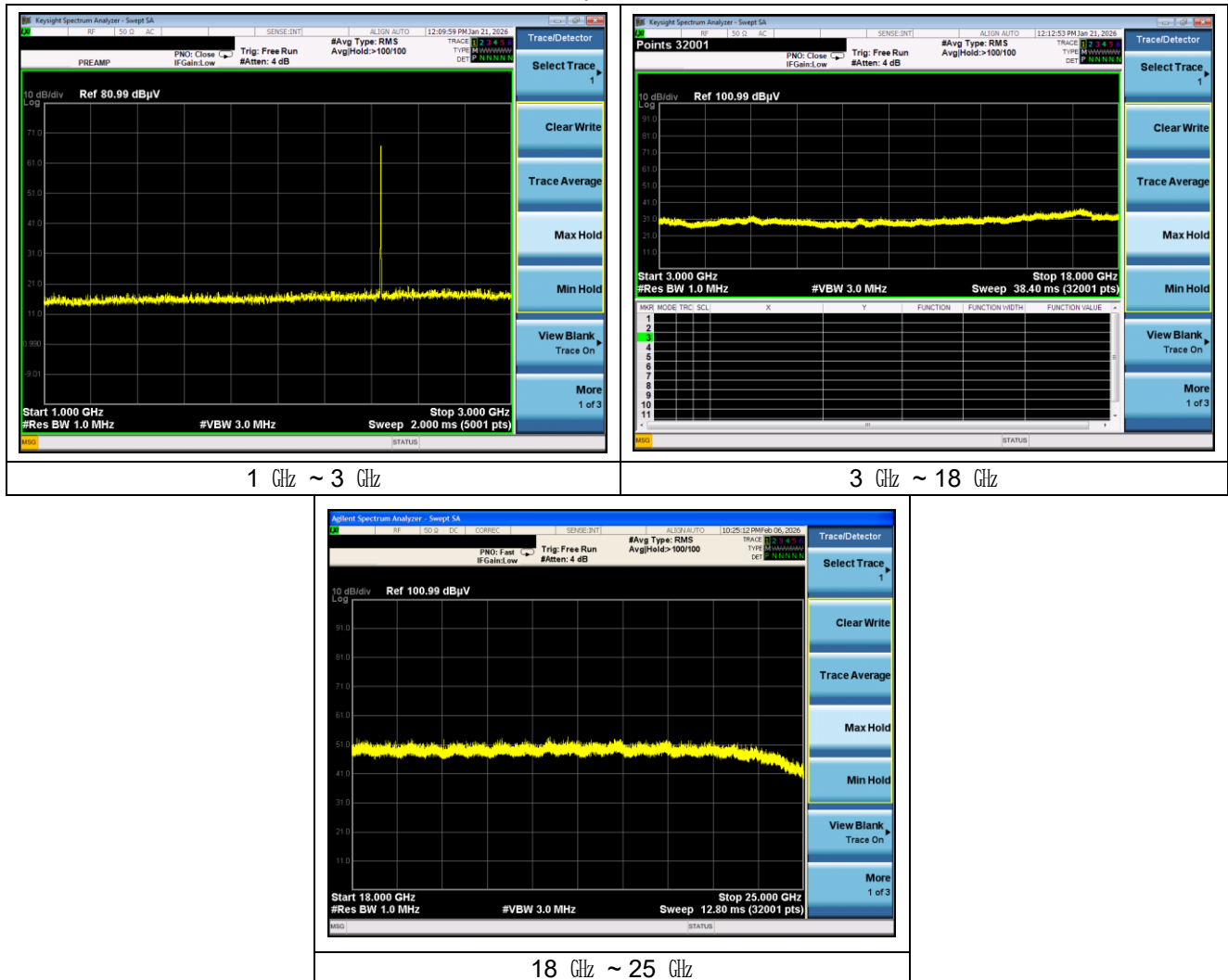
High channel band edge (Peak)



High channel band edge (Average)



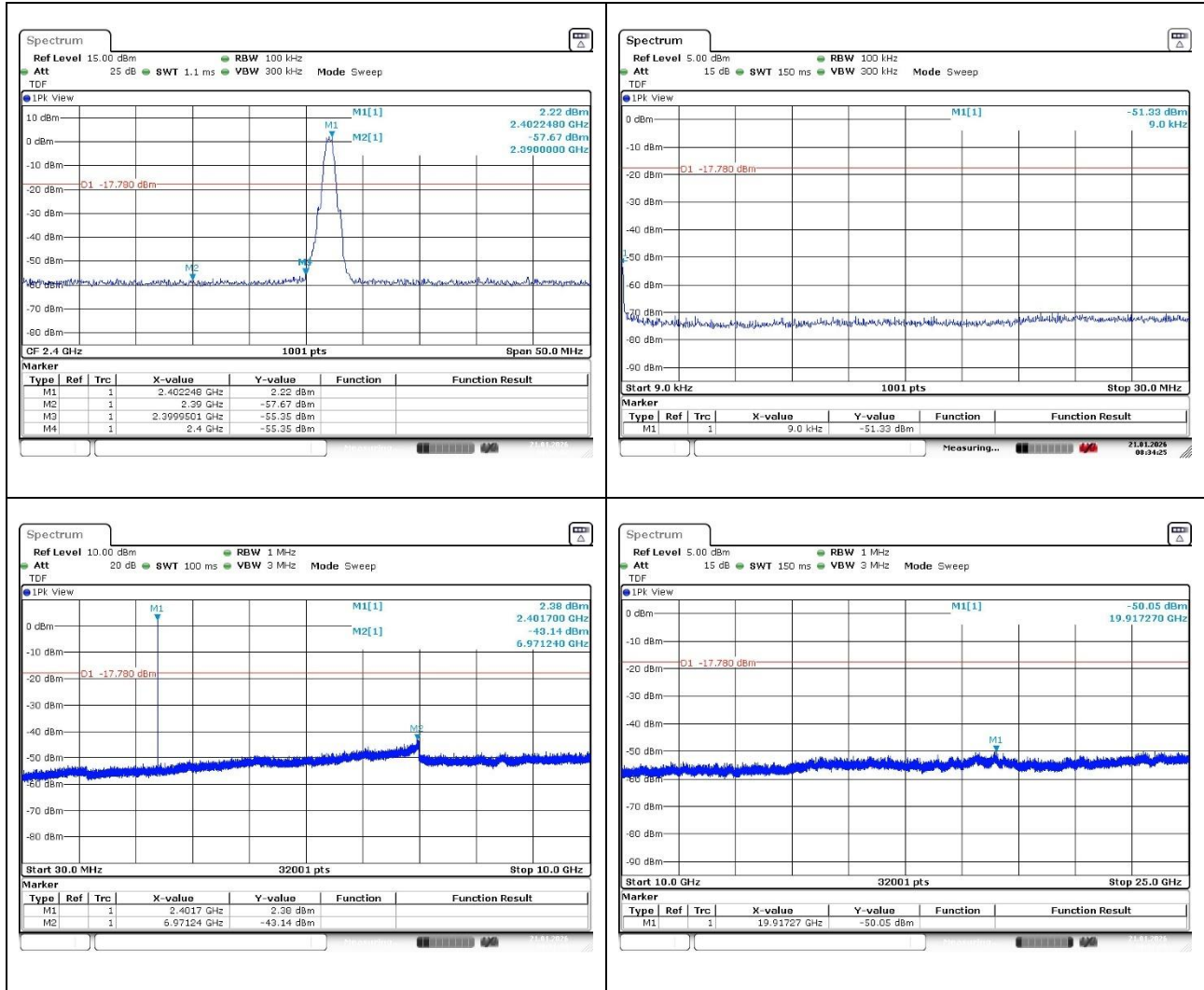
### Radiated Spurious Emissions



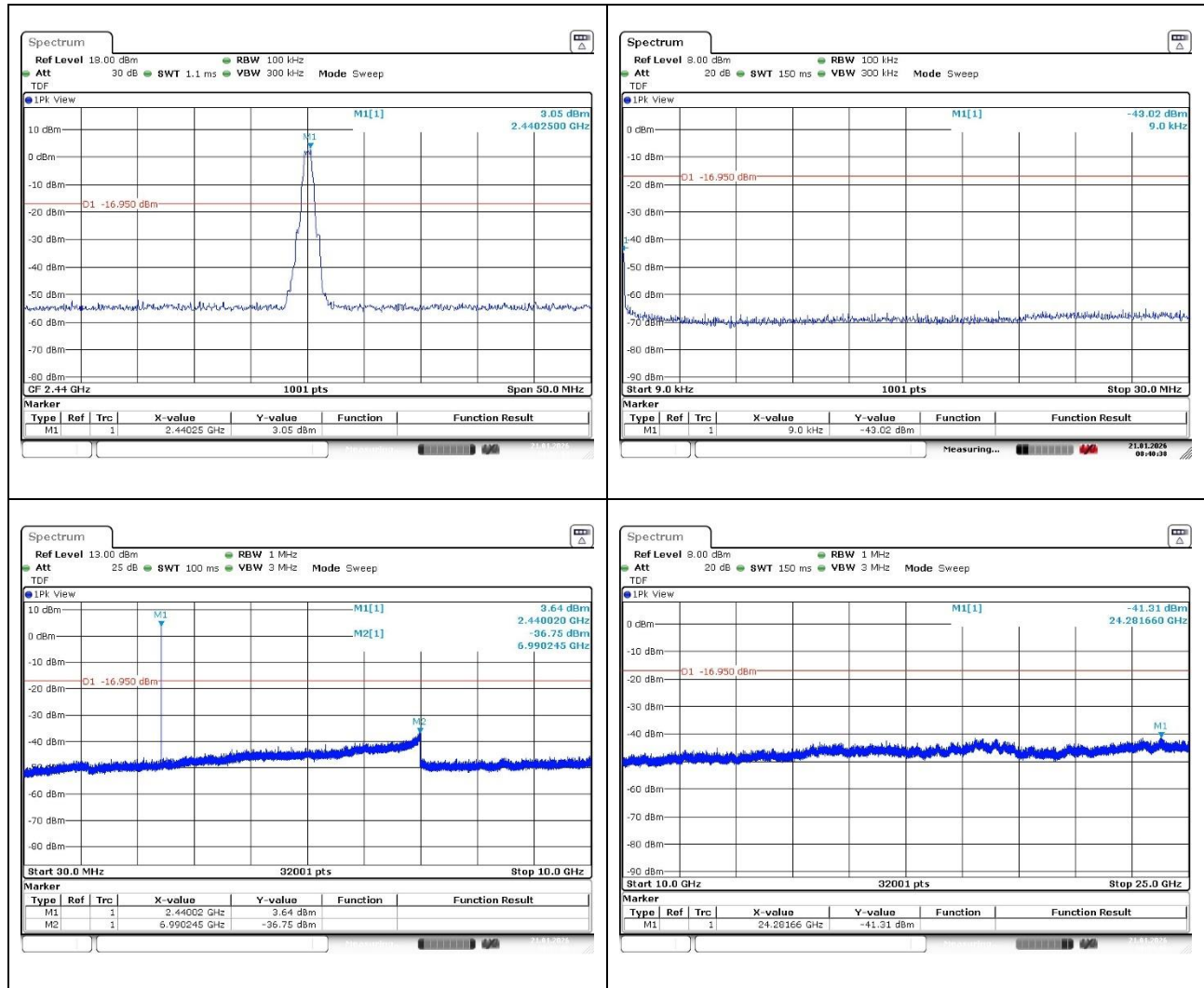
### 2.4.3. Plot of Conducted Spurious Emissions

#### - Ant. 1

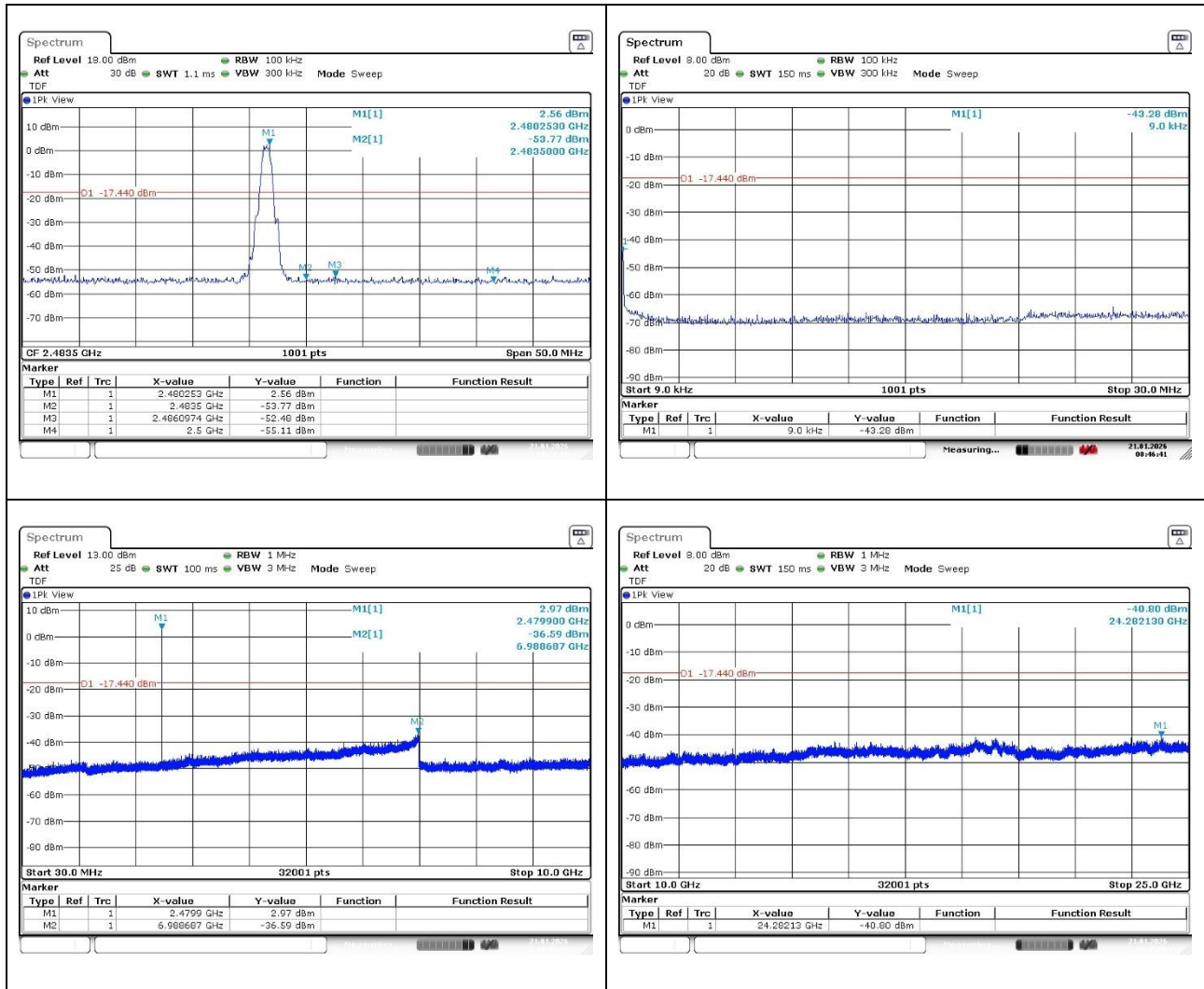
#### Low Channel



## Middle Channel



## High Channel



## - Ant. 2

### Low Channel

