

# TEST REPORT

of

FCC Part 15 Subpart C §15.225  
 RSS-210 Issue 10 and RSS-Gen Issue 5

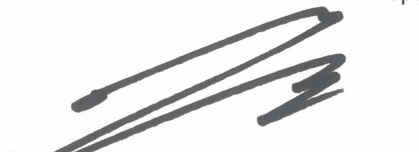
FCC ID: IYZNR3  
 IC Certification: 2701A-NR3

Equipment Under Test : Stellantis NFC Reader  
 Model Name : NR3  
 Variant Model Name(s) : -  
 FCC Applicant : Marquardt GmbH  
 IC Applicant : MARQUARDT GMBH  
 Manufacturer : Marquardt GmbH  
 Date of Receipt : 2024.05.10  
 Date of Test(s) : 2024.05.17 ~ 2024.05.30  
 Date of Issue : 2024.06.04


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.
- 3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
- 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:

  
 \_\_\_\_\_  
 Murphy Kim

Technical Manager:

  
 \_\_\_\_\_  
 JinHyung Cho

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



# INDEX

## Table of contents

|   |    |
|---|----|
| 1. General Information -----              | 3  |
| 2. Radiated Emissions -----               | 7  |
| 3. Frequency Stability -----              | 18 |
| 4. 20 dB Bandwidth & 99 % Bandwidth ----- | 23 |

## 1. General Information

### 1.1. Testing Laboratory

- SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
  - 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
  - Designation number: KR0150

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>.

Phone No. : +82 31 688 0901  
 Fax No. : +82 31 688 0921

### 1.2. Details of Applicant

FCC Applicant : Marquardt GmbH  
 FCC Address : Schloss - Str. 16, Rietheim - Weilheim, Germany, 78604  
 IC Applicant : MARQUARDT GMBH  
 IC Address : Schloss-Str. 16, Rietheim-Weilheim, Germany (Federal Republic Of), 78604  
 Contact Person : Gerd, Villing  
 Phone No. : 49 74 2499 1747

### 1.3. Details of manufacturer

Company : Marquardt GmbH  
 Address : Schloss - Str. 16, 78604 Rietheim - Weilheim, Germany, 78604

### 1.4. Description of EUT

|                             |                       |
|-----------------------------|-----------------------|
| <b>Kind of Product</b>      | Stellantis NFC Reader |
| <b>Model Name</b>           | NR3                   |
| <b>Serial Number</b>        | 124101094590834       |
| <b>Power Supply</b>         | DC 12 V               |
| <b>Frequency Range</b>      | 13.56 MHz (NFC)       |
| <b>Modulation Technique</b> | ASK                   |
| <b>Number of Channels</b>   | 1 channel             |
| <b>Antenna Type</b>         | PCB loop antenna      |
| <b>Antenna Part Number</b>  | N/A                   |
| <b>H/W Version</b>          | 243.761.011           |
| <b>S/W Version</b>          | 24.16                 |
| <b>FVIN</b>                 | N/A                   |

### 1.5. Test Equipment List

| Equipment           | Manufacturer                   | Model                                | S/N                       | Cal. Date     | Cal. Interval | Cal. Due      |
|---------------------|--------------------------------|--------------------------------------|---------------------------|---------------|---------------|---------------|
| Signal Generator    | R&S                            | SMBV100A                             | 259067                    | Jun. 15, 2023 | Annual        | Jun. 15, 2024 |
| DC Power Supply     | R&S                            | HMP2020                              | 102130                    | May 02, 2024  | Annual        | May 02, 2025  |
| DC Power Supply     | Agilent                        | U8002A                               | MY49030063                | Jan. 17, 2024 | Annual        | Jan. 17, 2025 |
| Temperature Chamber | ESPEC CORP.                    | PL-1J                                | 15000796                  | Dec. 01, 2023 | Annual        | Dec. 01, 2024 |
| Spectrum Analyzer   | R&S                            | FSW8                                 | 101660                    | May 23, 2024  | Annual        | May 23, 2025  |
| Spectrum Analyzer   | Agilent                        | N9020A                               | MY53421758                | Sep. 01, 2023 | Annual        | Sep. 01, 2024 |
| Amplifier           | H.P.                           | 8447F                                | 2944A03909                | Aug. 04, 2023 | Annual        | Aug. 04, 2024 |
| Loop Antenna        | Schwarzbeck<br>Mess-Elektronik | FMZB 1519                            | 1519-039                  | Aug. 21, 2023 | Biennial      | Aug. 21, 2025 |
| Bilog Antenna       | Schwarzbeck<br>Mess-Elektronik | VULB 9163                            | 9163-437                  | May 29, 2024  | Biennial      | May 29, 2026  |
| EMI Test Receiver   | R&S                            | ESU26                                | 100109                    | Jan. 16, 2024 | Annual        | Jan. 16, 2025 |
| Turn Table          | Innco systems<br>GmbH          | DS 1200 S                            | N/A                       | N.C.R.        | N/A           | N.C.R.        |
| Controller          | Innco systems<br>GmbH          | CONTROLLER<br>CO3000-4P              | CO3000/963/3833<br>0516/L | N.C.R.        | N/A           | N.C.R.        |
| Antenna Mast        | Innco systems<br>GmbH          | MA4640-XP-ET                         | MA4640/536/3833<br>0516/L | N.C.R.        | N/A           | N.C.R.        |
| Anechoic Chamber    | SY Corporation                 | L x W x H<br>(9.6 m x 6.4 m x 6.6 m) | N/A                       | N.C.R.        | N/A           | N.C.R.        |
| Coaxial Cable       | SENSORVIEW                     | NMST-13A26-NMST-5 m                  | TPC2402190004             | Apr. 03, 2024 | Semi-Annual   | Oct. 03, 2024 |
| Coaxial Cable       | SENSORVIEW                     | NMST-13A26-NMST-10 m                 | TPC2402190001             | Apr. 03, 2024 | Semi-Annual   | Oct. 03, 2024 |
| Coaxial Cable       | RADIALL                        | TESTPRO 3                            | 182287                    | Apr. 12, 2024 | Semi-Annual   | Oct. 12, 2024 |

### 1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

| Applied standard : FCC Part15 subpart C, IC RSS-210 Issue 10, RSS-Gen Issue 5 |  |  |                   |
|---|--|--|-------------------|
| Section in FCC  | Section in IC                                      | Test item(s)   | Result            |
| 15.225(a)(b)(c)(d)<br>15.209  | RSS-210 Issue 10<br>B.6<br>RSS-Gen Issue 5<br>8.9  | Radiated Emission,<br>Spurious Emission and<br>Field Strength of Fundamental | Complied          |
| 15.225(e)   | RSS-210 Issue 10<br>B.6<br>RSS-Gen Issue 5<br>6.11 | Frequency Stability  | Complied          |
| 15.215(c)   | RSS-Gen Issue 5<br>6.7                             | 20 dB Bandwidth & 99 % Bandwidth   | Complied          |
| 15.207  | RSS-Gen Issue 5<br>8.8                             | AC Power Line Conducted Emissions  | 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.

### 1.7. Sample calculation

Where relevant, the following sample calculation is provided:

#### 1.7.1. Radiation test

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

### 1.8. Information of software for test.

Using the software of Internal to testing of EUT.

### 1.9. Measurement Uncertainty

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

| Parameter                          | Uncertainty |         |
|------------------------------------|-------------|---------|
| 99 % Bandwidth                     | 0.04 kHz    |         |
| 20 dB Bandwidth                    | 0.04 kHz    |         |
| Frequency Stability                | 0.11 kHz    |         |
| Radiated Emission, 9 kHz to 30 MHz | H           | 3.60 dB |
|                                    | V           | 3.60 dB |
| Radiated Emission, below 1 GHz     | H           | 4.60 dB |
|                                    | V           | 4.90 dB |

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

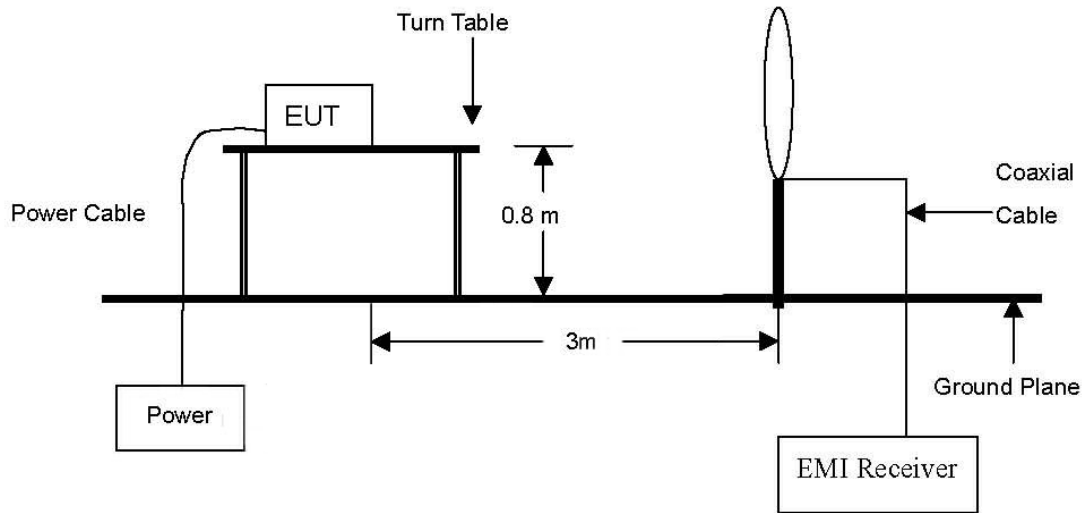
### 1.10. Test report revision

| Revision | Report number        | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501-RF-RTL005125 | 2024.06.04    | Initial     |

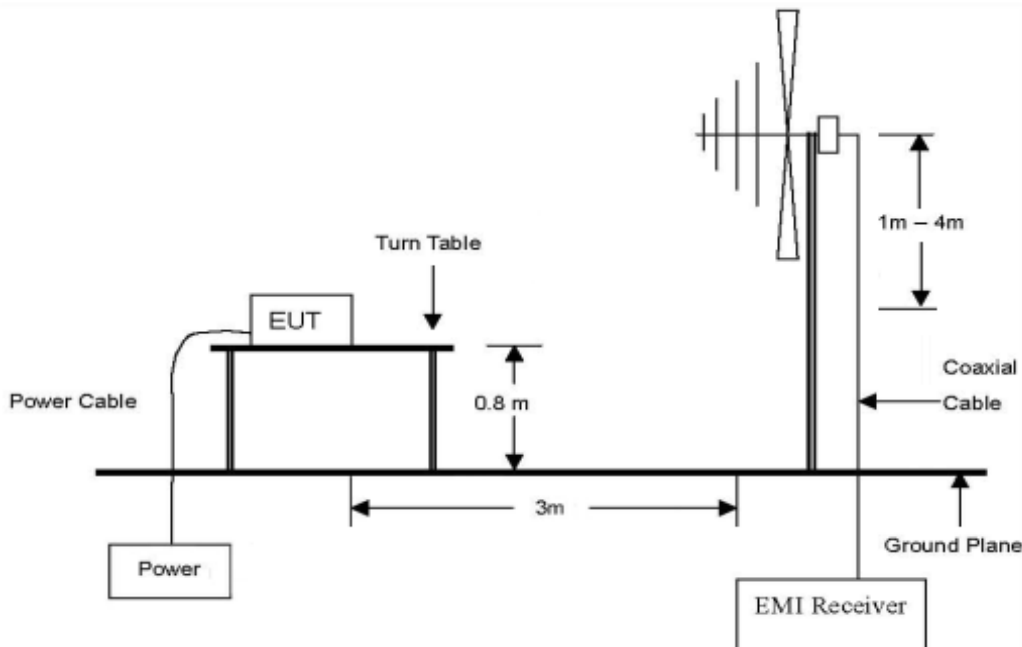
## 2. Radiated Emissions

### 2.1. Test Setup

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 1 000 MHz Emissions.



## 2.2. Limit

### FCC

According to §15.225,

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15 848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

According to §15.209,

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>(microvolts/meter) | Measurement Distance<br>(meter) |
|--------------------|--------------------------------------|---------------------------------|
| 0.009-0.490        | 2400/F(kHz)                          | 300                             |
| 0.490-1.705        | 24000/F(kHz)                         | 30                              |
| 1.705-30.0         | 30                                   | 30                              |
| 30-88              | 100**                                | 3                               |
| 88-216             | 150**                                | 3                               |
| 216-960            | 200**                                | 3                               |
| Above 960          | 500                                  | 3                               |

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



**IC**

According to RSS-210 Issue 10, B.6

The field strength of any emission shall not exceed the following limits:

- (a) 15.848 millivolts/m (84 dB $\mu$ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB $\mu$ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB $\mu$ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

According to RSS-Gen Issue 5, 8.9

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

**Table 5 - General field strength limits at frequencies above 30 MHz**

| Frequency (MHz) | Field Strength ( $\mu$ V/m at 3 m) |
|-----------------|------------------------------------|
| 30-88           | 100                                |
| 88-216          | 150                                |
| 216-960         | 200                                |
| Above 960       | 500                                |

**Table 6 - General field strength limits at frequencies below 30 MHz**

| Frequency              | Magnetic Field Strength (H-Field) ( $\mu$ A/m) | Measurement Distance (m) |
|------------------------|--|--------------------------|
| 9-490 kHz <sup>1</sup> | 6.37/F (F in kHz)                              | 300                      |
| 490-1 705 kHz          | 63.7/F (F in kHz)                              | 30                       |
| 1.705-30 MHz           | 0.08   | 30                       |

**Note 1:** The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

## 2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

### 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 Quasi peak Detect Function with Maximum Hold Mode.

### 2.3.2. Test Procedures for emission 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. 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.
3. The antenna is a bi-log 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.

#### Note;

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z, and the worst case data is reported.

## 2.4. Test Result

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

The following table shows the highest levels of radiated emissions.

### - Fundamental within the band 13.553 MHz - 13.567 MHz

| Radiated Emissions |                      |             | Ant. | Correction Factors |                 | Total                        |                               | Limit                        |             |
|--------------------|----------------------|-------------|------|--------------------|-----------------|------------------------------|-------------------------------|------------------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | Ant. Factor (dB/m) | Cable loss (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 m | Limit (dB $\mu$ V/m) at 30 m | Margin (dB) |
| 13.559             | 41.12                | Peak        | H    | 18.93              | 0.31            | 60.36                        | 20.36                         | 84.00                        | 63.64       |

### - Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz

| Radiated Emissions |                      |             | Ant. | Correction Factors |                 | Total                        |                               | Limit                        |             |
|--------------------|----------------------|-------------|------|--------------------|-----------------|------------------------------|-------------------------------|------------------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | Ant. Factor (dB/m) | Cable loss (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 m | Limit (dB $\mu$ V/m) at 30 m | Margin (dB) |
| 13.553             | 39.22                | Peak        | H    | 18.93              | 0.31            | 58.46                        | 18.46                         | 50.47                        | 32.01       |
| 13.567             | 39.07                | Peak        | H    | 18.93              | 0.31            | 58.31                        | 18.31                         | 50.47                        | 32.16       |

### - Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz

| Radiated Emissions |                      |             | Ant. | Correction Factors |                 | Total                        |                               | Limit                        |             |
|--------------------|----------------------|-------------|------|--------------------|-----------------|------------------------------|-------------------------------|------------------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | Ant. Factor (dB/m) | Cable loss (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 m | Limit (dB $\mu$ V/m) at 30 m | Margin (dB) |
| *13.387            | 10.08                | Peak        | H    | 18.93              | 0.32            | 29.33                        | -10.67                        | 29.54                        | 40.21       |
| *13.395            | 10.30                | Peak        | H    | 18.93              | 0.32            | 29.55                        | -10.45                        | 29.54                        | 39.99       |
| 13.710             | 10.97                | Peak        | H    | 18.93              | 0.30            | 30.20                        | -9.80                         | 40.51                        | 50.31       |

**- Spurious emission within the bands 9 kHz - 13.110 MHz**

| Radiated Emissions |                      |             | Ant. | Correction Factors |                 | Total                        |                                      | Limit                               |             |
|--------------------|----------------------|-------------|------|--------------------|-----------------|------------------------------|--------------------------------------|-------------------------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | Ant. Factor (dB/m) | Cable loss (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 or 300 m | Limit (dB $\mu$ V/m) at 30 or 300 m | Margin (dB) |
| 0.019              | 41.63                | Peak        | H    | 18.73              | 0.06            | 60.42                        | -19.58                               | 42.03                               | 61.61       |
| 0.067              | 28.09                | Peak        | H    | 18.29              | 0.04            | 46.42                        | -33.58                               | 31.08                               | 64.66       |
| 0.176              | 28.57                | Peak        | H    | 18.20              | 0.13            | 46.90                        | -33.10                               | 22.69                               | 55.79       |
| 1.692              | 30.26                | Peak        | H    | 18.54              | 0.51            | 49.31                        | 9.31                                 | 23.04                               | 13.73       |
| *12.292            | 8.24                 | Peak        | H    | 18.95              | 0.33            | 27.52                        | -12.48                               | 29.54                               | 42.02       |

**- Spurious emission within the bands 14.010 MHz - 30 MHz**

| Radiated Emissions |                      |             | Ant. | Correction Factors |                 | Total                        |                               | Limit                        |             |
|--------------------|----------------------|-------------|------|--------------------|-----------------|------------------------------|-------------------------------|------------------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | Ant. Factor (dB/m) | Cable loss (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 m | Limit (dB $\mu$ V/m) at 30 m | Margin (dB) |
| 14.410             | 8.58                 | Peak        | H    | 18.91              | 0.28            | 27.77                        | -12.23                        | 29.54                        | 41.77       |
| *16.422            | 7.25                 | Peak        | H    | 19.07              | 0.30            | 26.62                        | -13.38                        | 29.54                        | 42.92       |
| *25.622            | 7.61                 | Peak        | H    | 19.29              | 0.30            | 27.20                        | -12.80                        | 29.54                        | 42.34       |
| Above 26.000       | Not detected         | -           | -    | -                  | -               | -                            | -                             | -                            | -           |

**Remark;**

1. Fundamental limit ( $\mu$ V/m) =  $20 \log(15\ 848) = 84.00$  dB $\mu$ V/m.
2. 30 m distance compensation =  $40 \log(3/30) = -40$  dB $\mu$ V/m.
3. 300 m distance compensation =  $40 \log(3/300) = -80$  dB $\mu$ V/m.
4. "\*" means the restricted band.
5. If the spurious emissions are in the restricted band, the limit complied with §15.209.
6. All data were recorded using a spectrum analyzer employing a peak detector.  
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.
7. Radiated spurious emission measurement as below 30 MHz.  
(Actual (dB $\mu$ A/m) at 3m = Reading (dB $\mu$ V) + AF (dB/m) + CL (dB))

**- Spurious emission above 30 MHz**

| Radiated Emissions |                         |                | Ant  | Correction<br>(dB/m) | Total                    | Limit                   |                |
|--------------------|-------------------------|----------------|------|----------------------|--------------------------|-------------------------|----------------|
| Frequency<br>(MHz) | Reading<br>(dB $\mu$ V) | Detect<br>Mode | Pol. |                      | Actual<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB) |
| 40.640             | 32.40                   | Quasi<br>Peak  | H    | -8.81                | 23.59                    | 40.00                   | 16.41          |
| 298.27             | 34.87                   | Quasi<br>Peak  | V    | -7.18                | 27.69                    | 46.00                   | 18.31          |
| 325.40             | 35.70                   | Quasi<br>Peak  | V    | -6.31                | 29.39                    | 46.00                   | 16.61          |
| 352.53             | 35.11                   | Quasi<br>Peak  | V    | -5.53                | 29.58                    | 46.00                   | 16.42          |

**Remark;**

1. Radiated spurious emission measurement as below.  
 (Actual (dB $\mu$ A/m) = Reading (dB $\mu$ V) + Correction)  
 (Correction = Antenna Factor (dB/m) + AMP Factor (dB) + Cable Loss (dB))
2. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.
3. Test from 30 MHz to 1 000 MHz was performed using the software of ELEKTRA(V5.02) from Rohde & Schwarz GmbH & Co. KG.

### Test plots

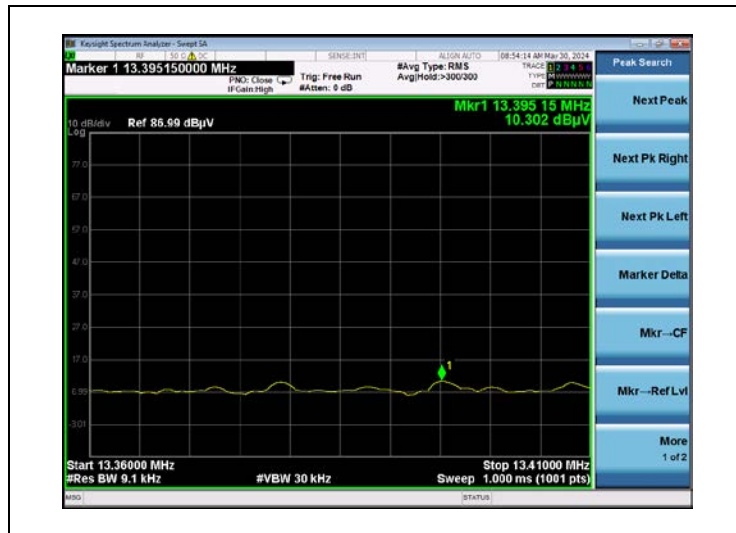
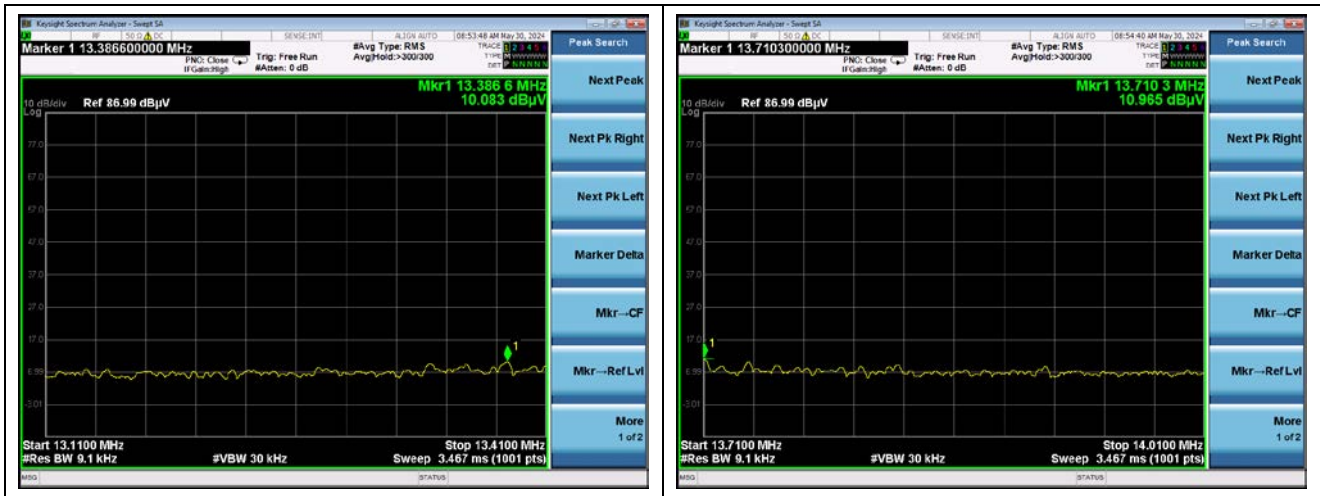
- Fundamental within the band 13.553 MHz - 13.567 MHz



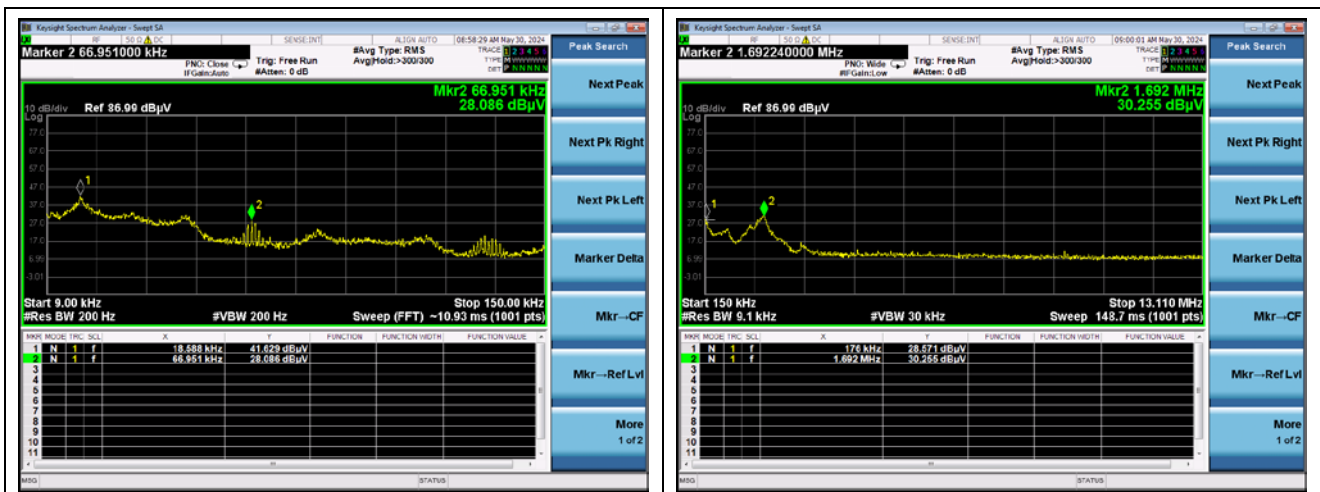
- Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz



**- Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz**



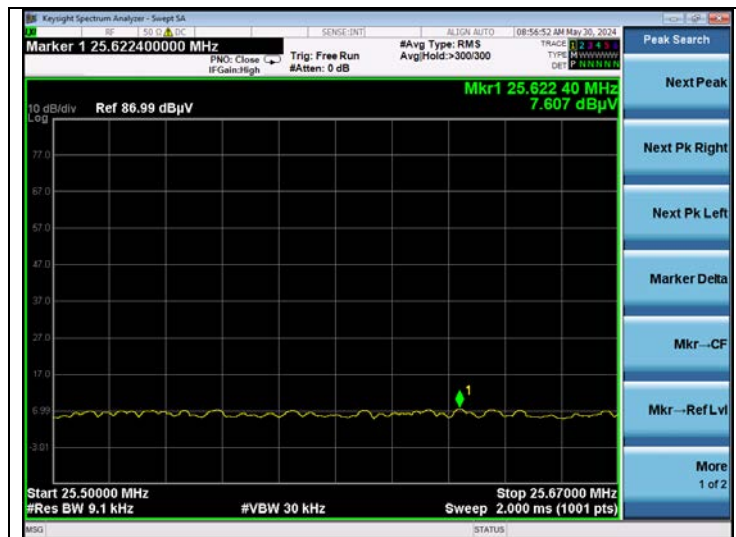
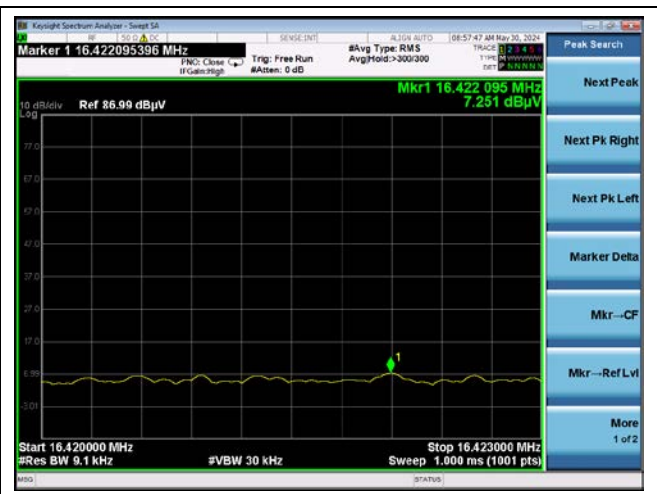
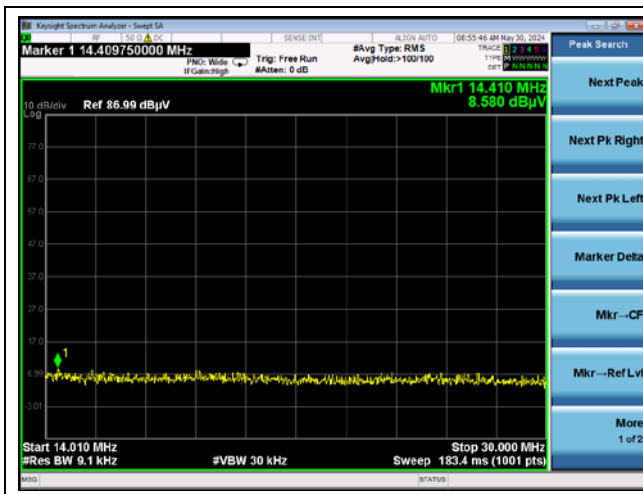
**- Spurious emission within the bands 9 kHz - 13.110 MHz**



**- Spurious emission within the bands 12.290 MHz – 12.293 MHz**

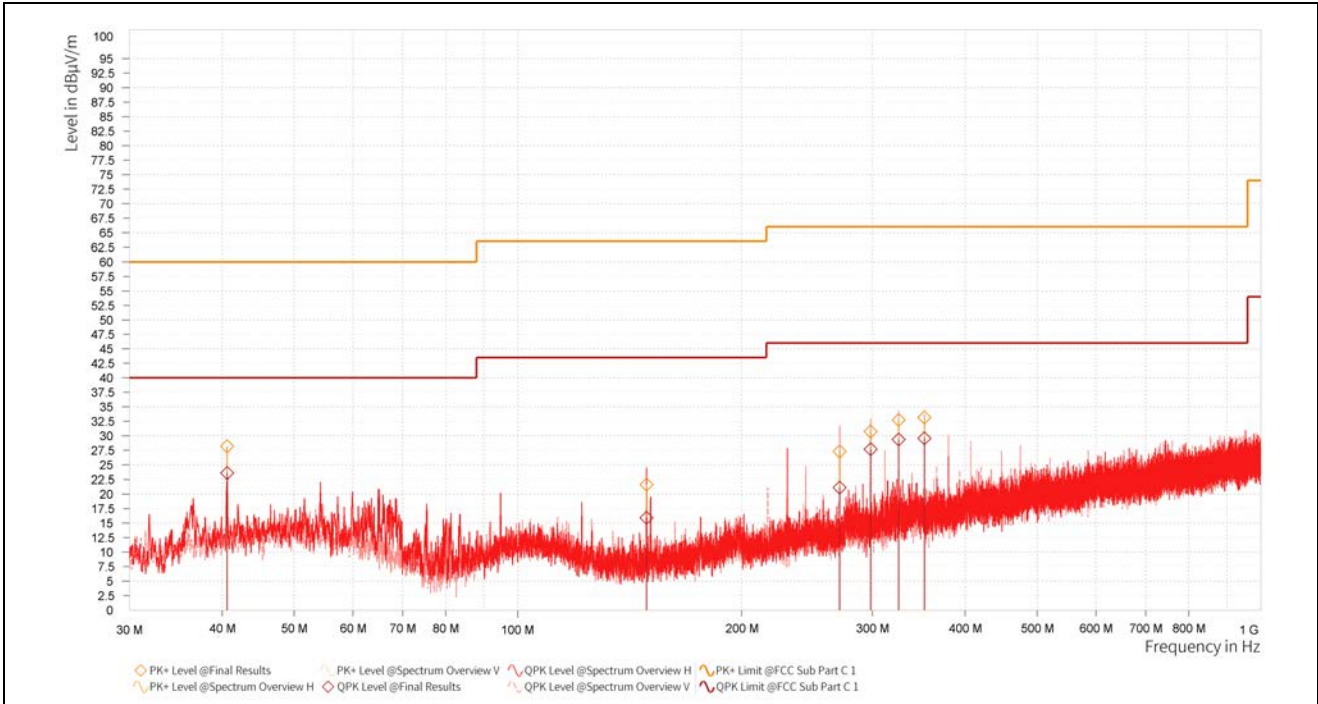


**- Spurious emission within the bands 14.010 MHz – 30 MHz**



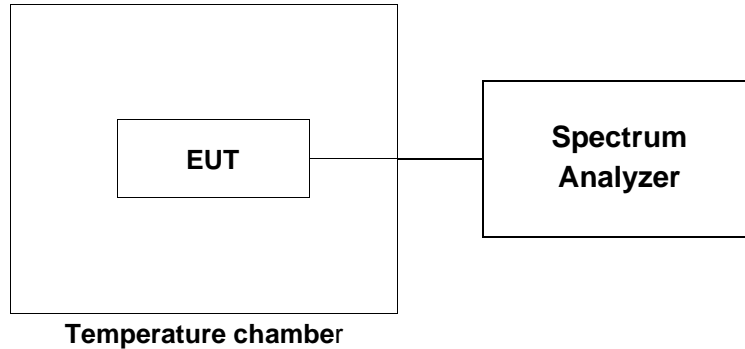


**- Spurious emission above 30 MHz**



### 3. Frequency Stability

#### 3.1. Test Setup



#### 3.2. Limit

##### FCC

According to §15.225(e), the frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from  $85\%$  to  $115\%$  of the rated supply voltage at a temperature of  $20$  degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

##### IC

According to RSS-210, Annex B, Section B.6

Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

#### 3.3. Test Procedures

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the environment into appropriate environment.
4. Set the spectrum analyzer as RBW = 100 Hz, VBW = 100 Hz, Span = 10 kHz, Sweep time = auto.
5. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
6. Repeat until all the results are investigated.

### 3.4. Test Result

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

#### Startup

##### Temperature Variations

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 12                        | -20              | 13 559 770     | -190            | -0.001 401    |
|                           | -10              | 13 559 740     | -220            | -0.001 622    |
|                           | 0                | 13 559 710     | -250            | -0.001 844    |
|                           | +10              | 13 559 740     | -220            | -0.001 622    |
|                           | +20(Ref.)        | 13 559 960     | -               | -             |
|                           | +30              | 13 559 910     | -50             | -0.000 369    |
|                           | +40              | 13 560 290     | 330             | 0.002 434     |
|                           | +50              | 13 560 150     | 190             | 0.001 401     |

##### Voltage Variations

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 115 % (13.80)             | +20              | 13 560 030     | 70              | 0.000 516     |
| 85 % (10.20)              | +20              | 13 560 140     | 180             | 0.001 327     |

2 minutes

**Temperature Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 12                        | -20              | 13 559 770     | -420            | -0.003 097    |
|                           | -10              | 13 559 740     | -450            | -0.003 319    |
|                           | 0                | 13 559 710     | -480            | -0.003 540    |
|                           | +10              | 13 559 740     | -450            | -0.003 319    |
|                           | +20(Ref.)        | 13 560 190     | -               | -             |
|                           | +30              | 13 559 860     | -330            | -0.002 434    |
|                           | +40              | 13 560 000     | -190            | -0.001 401    |
|                           | +50              | 13 560 203     | 13              | 0.000 096     |

**Voltage Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 115 % (13.80)             | +20              | 13 560 640     | 450             | 0.003 319     |
| 85 % (10.20)              | +20              | 13 560 140     | -50             | -0.000 369    |

**5 minutes**

**Temperature Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 12                        | -20              | 13 559 770     | -420            | -0.003 097    |
|                           | -10              | 13 559 740     | -450            | -0.003 319    |
|                           | 0                | 13 559 710     | -480            | -0.003 540    |
|                           | +10              | 13 559 740     | -450            | -0.003 319    |
|                           | +20(Ref.)        | 13 560 190     | -               | -             |
|                           | +30              | 13 559 860     | -330            | -0.002 434    |
|                           | +40              | 13 560 000     | -190            | -0.001 401    |
|                           | +50              | 13 560 200     | 10              | 0.000 074     |

**Voltage Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 115 % (13.80)             | +20              | 13 560 930     | 740             | 0.005 457     |
| 85 % (10.20)              | +20              | 13 560 150     | -40             | -0.000 295    |

10 minutes

**Temperature Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 12                        | -20              | 13 559 770     | -460            | -0.003 392    |
|                           | -10              | 13 559 740     | -490            | -0.003 614    |
|                           | 0                | 13 559 710     | -520            | -0.003 835    |
|                           | +10              | 13 559 740     | -490            | -0.003 614    |
|                           | +20(Ref.)        | 13 560 230     | -               | -             |
|                           | +30              | 13 559 860     | -370            | -0.002 729    |
|                           | +40              | 13 560 000     | -230            | -0.001 696    |
|                           | +50              | 13 560 200     | -30             | -0.000 221    |

**Voltage Variations**

| Power (V <sub>d.c</sub> ) | Temperature (°C) | Frequency (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---------------------------|------------------|----------------|-----------------|---------------|
| 115 % (13.80)             | +20              | 13 561 030     | 800             | 0.005 900     |
| 85 % (10.20)              | +20              | 13 560 120     | -110            | -0.000 811    |

## 4. 20 dB Bandwidth & 99 % Bandwidth

### 4.1. Test Setup



### 4.2. Limit

None; for reporting purposes only.

### 4.3. Test Procedures

#### 20 dB Bandwidth

1. Span = set to capture all products of the modulation process, including the emission skirts. RBW = 10 kHz, VBW = 10 kHz, Sweep = auto, Detector = peak, Trace = max hold.
2. The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

#### 99 % Bandwidth

1. Set the spectrum analyzer as Span = set to capture all products of the modulation process, including the emission skirts, RBW = 10 kHz, VBW = 10 kHz, Detector = Peak, Trace mode = max hold.
2. Measure lowest and highest frequencies are placed in a running sum until 0.5 % and 99.5 % of the total is reached.
3. The difference between the two recorded frequencies is the occupied bandwidth.

### 4.3. Test Result

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

| Frequency (MHz) | 20 dB Bandwidth (kHz) | 99 % Bandwidth (kHz) |
|-----------------|-----------------------|----------------------|
| 13.560          | 66.33                 | 114.91               |

#### -Test plots

20 dB Bandwidth



99 % Bandwidth



**-End of the Test report-**