
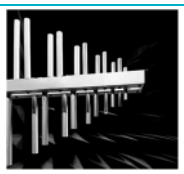
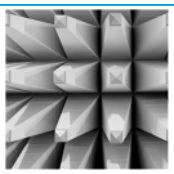

# TEST REPORT

**Test report no.: 23-1-0144001T007_TR1-R02**

DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-00

## Testing laboratory


**cetecom advanced GmbH**
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.cetecomadvanced.com
e-mail: mail@cetecomadvanced.com


**Accredited Testing Laboratory:**
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS).
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

## Applicant


**Brose Fahrzeugteile SE & Co. KG, Bamberg**
Berliner Ring 1
96052 Bamberg, GERMANY
Phone: +49 9517474-0
Contact: Bertram Bopp
e-mail: Bertram.Bopp@brose.com


## Manufacturer

**Brose Fahrzeugteile SE & Co. KG, Bamberg**
Berliner Ring 1
96052 Bamberg, GERMANY

## Test standard/s

| | |
|---|---|
| FCC - Title 47 CFR Part 95 | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal Radio Services |

For further applied test standards please refer to section 3 of this test report.

## Test Item

| | |
|---|---|
| **Kind of test item:** | **Kick Sensor** (HfA) |
| **Model name:** | **R-HFA GEN2** |
| **FCC ID:** | **2AHV8-G69634** |
| **IC:** | **29958-G69634** |
| Frequency: | 77 – 79 GHz |
| Technology tested: | RADAR |
| Antenna: | Integrated antenna |
| Power supply: | 8 V to 16 V DC |
| Temperature range: | -40°C to 105°C |

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## Test report authorized:

Christian Lorenz
CN = Christian Lorenz email = christian.lorenz@cetecomadvanced.com C = DE O = cetecom advanced GmbH OU = RC8G
2025.02.14 09:09:51 +01'00'

Christian Lorenz
Lab Manager
Radio Communications

## Test performed:

Al-Amin Hossain
CN = Al-Amin Hossain email = al-amin.hossain@cetecomadvanced.com C = DE O = cetecom advanced GmbH OU = Radio Labs
2025.02.14 10:13:40 +01'00'

Al-Amin Hossain
Testing Manager
Radio Communications

# 1 Table of contents

# 2 General information

## 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2024-02-27 |
| Date of receipt of test item: | 2024-08-15 |
| Start of test:* | 2024-08-20 |
| End of test:* | 2024-09-11 |
| Person(s) present during the test: | -/- |

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

## 2.3 Involved test locations

| | Saarbruecken lab | | Essen lab |
|---|---|---|---|
| ☐ | Untertuerkheimer Str. 6-10<br>66117 Saarbruecken<br>Germany | ☒ | Im Teelbruch 116<br>45219 Essen<br>Germany |

## 2.4 Test laboratories sub-contracted

None

## 2.5 Laboratory listings and recognitions

| | Saarbruecken | Essen |
|---|---|---|
| **FCC** | DE0002 | DE0003 |
| **ISED** | DE0001 3462C | DE0001 3462D |

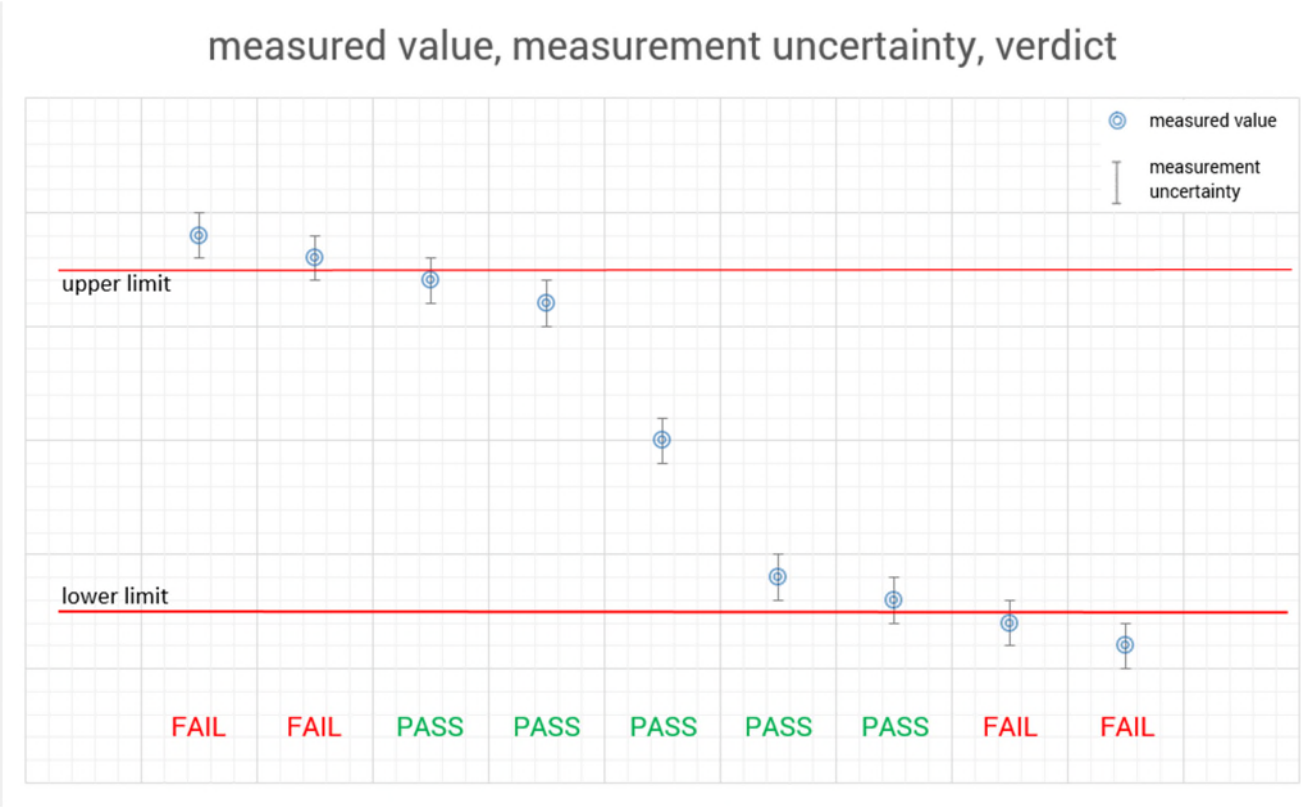
## 3 Test standard/s, references and accreditations

| Test standard | Date | Description |
|---|---|---|
| FCC - Title 47 CFR Part 95 | 2017-09-20 | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal Radio Services |

| Guidance | Version | Description |
|---|---|---|
| ANSI C63.4-2014 | -/- | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10-2020 | -/- | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| ANSI C63.26-2015 | -/- | American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services |
| 76-81 GHz Radars KDB | v01r02 | 653005 D01 76-81 GHz Radars v01r02: EQUIPMENT AUTHORIZATION GUIDANCE FOR 76-81 GHz RADAR DEVICES |

## 4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong.



# 5 Test environment

| | | | |
|---|---|---|---|
| Temperature | : | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | 20 °C during room temperature tests<br>50 °C during high temperature tests<br>-20 °C during low temperature tests |
| Relative humidity content | : | | 55 % - 65 % |
| Barometric pressure | : | | 985 hPa |
| Power supply | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 12 V DC<br>13.8 V DC (115% $V_{nom}$)<br>10.2 V DC (85% $V_{nom}$) |

# 6 Test item

## 6.1 General description

| | | |
|---|---|---|
| Kind of test item | : | Kick Sensor (HfA) |
| Model name | : | AWRL 1422 |
| PMN | : | *R-HFA GEN2* |
| HVIN | : | *R-HFA GEN2* |
| FVIN | : | *G8C574-000* |
| S/N serial number | : | Engineering Sample / 23-1-01440S11_C01 (PMT Sample No.) |
| Hardware status | : | G69634-100 |
| Software status | : | B013 |
| Firmware status | : | G8C574-000 |
| Frequency band | : | 77 – 79 GHz |
| Type of modulation | : | FMCW |
| Number of modes | : | 1 |
| Antenna | : | Integrated antenna |
| Power supply | : | 8.0 V to 16.0 V DC (Powered by Vehicular Battery) |
| Temperature range | : | -40°C to 105°C |

## 6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:

- 23-1-0144001T007_TR1-A101-R01 (External photographs of EUT)
- 23-1-0144001T007_TR1-A102-R01 (Internal photographs of EUT)
- 23-1-0144001T007_TR1-A103-R01 (Test set-up photographs)
- Note: The referenced photos show EUT delivered by the customer in this project, not necessarily the exact one used for the specific tests. EUT identification shown in the photos may differ.

Additional measurement reports:

- 23-1-0144001T007_TR1-A201-R01

Additional declarations (manufacturer's declarations, declarations of conformity, etc.):

# 7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**Agenda:** Kind of Calibration

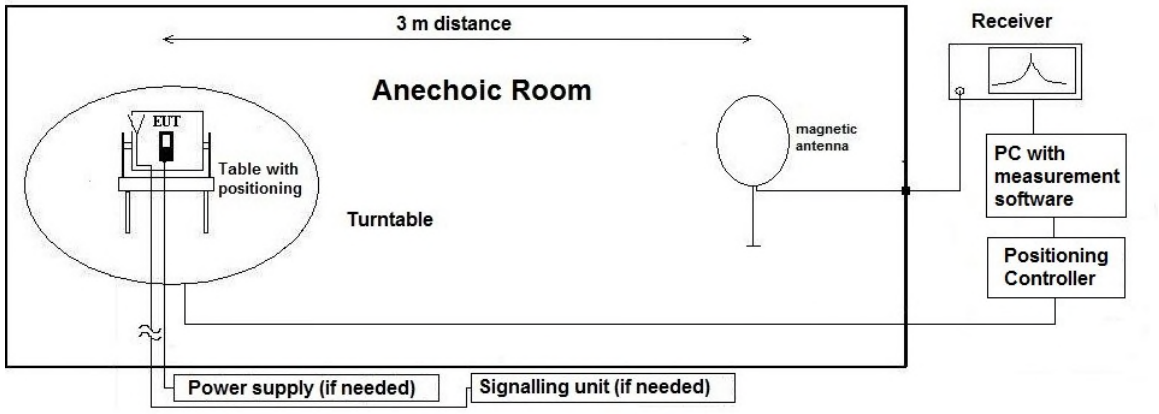
| | | | |
|---|---|---|---|
| K (cal) | calibration / calibrated | EK | limited calibration |
| Ne (cnn) | not required (k, ev, izw, zw not required) | zw | cyclical maintenance (external cyclical maintenance) |
| Ev (chk) | periodic self verification | izw | internal cyclical maintenance |
| Ve | long-term stability recognized | g | blocked for accredited testing |
| vlkl! | Attention: extended calibration interval | cpu | Verification before usage |
| NK! | Attention: not calibrated | *) | next calibration ordered / currently in progress |

## 7.1 Shielded semi anechoic chamber

Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter 9.2.1. The tests are performed in the semi anechoic room recognized by the regulatory commission.

### Schematic:




### Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
The EUT and it's associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded.

The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

**Formula:**

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF = Antenna factor
$C_L$ = Cable loss
$D_F$ = Distance correction factor (if used)
$E_C$ = Electrical field – corrected value
$E_R$ = Receiver reading
$G_A$ = Gain of pre-amplifier (if used)
$L_T$ = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

### 7.1.1 Sample calculation

| Raw-Value [dBuV/m] | Antenna factor | Distance Correction [dB] | Cable Loss | Preamplifier | Resulting correction value [dB] | Final result [dBuV/m] | Remarks |
|---|---|---|---|---|---|---|---|
| 19.83 | 18.9 | -70.75 | 0.18 | -- | -51.67 | -31.83 | 30 to 3 m correction used according ANSI C63.10-2020 |

Remark: This calculation is based on an example value at 458 kHz

### 7.1.2 Correction factors due to reduced meas. distance (f < 30 MHz):

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors

| Frequency Range | f [kHz/MHz] | Lambda [m] | Far-Field Point [m] | Distance Limit accord. 15.209 [m] | 1st Condition (dmeas < Dnear-field) | 2nd Condition (Limit distance bigger dnear-field) | Distance Correction accord. Formula |
|---|---|---|---|---|---|---|---|
| kHz | 9 | 33333.33 | 5305.17 | 300 | fullfilled | not fullfilled | -80.00 |
| | 10 | 30000.00 | 4774.65 | | fullfilled | not fullfilled | -80.00 |
| | 20 | 15000.00 | 2387.33 | | fullfilled | not fullfilled | -80.00 |
| | 30 | 10000.00 | 1591.55 | | fullfilled | not fullfilled | -80.00 |
| | 40 | 7500.00 | 1193.66 | | fullfilled | not fullfilled | -80.00 |
| | 50 | 6000.00 | 954.93 | | fullfilled | not fullfilled | -80.00 |
| | 60 | 5000.00 | 795.78 | | fullfilled | not fullfilled | -80.00 |
| | 70 | 4285.71 | 682.09 | | fullfilled | not fullfilled | -80.00 |
| | 80 | 3750.00 | 596.83 | | fullfilled | not fullfilled | -80.00 |
| | 90 | 3333.33 | 530.52 | | fullfilled | not fullfilled | -80.00 |
| | 100 | 3000.00 | 477.47 | | fullfilled | not fullfilled | -80.00 |
| | **125** | 2400.00 | 381.97 | | fullfilled | not fullfilled | -80.00 |
| | 200 | 1500.00 | 238.73 | | fullfilled | fullfilled | -78.02 |
| | 300 | 1000.00 | 159.16 | | fullfilled | fullfilled | -74.49 |
| | 400 | 750.00 | 119.37 | | fullfilled | fullfilled | -72.00 |
| | **490** | 612.24 | 97.44 | | fullfilled | fullfilled | -70.23 |
| | 500 | 600.00 | 95.49 | 30 | fullfilled | not fullfilled | -40.00 |
| | 600 | 500.00 | 79.58 | | fullfilled | not fullfilled | -40.00 |
| | 700 | 428.57 | 68.21 | | fullfilled | not fullfilled | -40.00 |
| | 800 | 375.00 | 59.68 | | fullfilled | not fullfilled | -40.00 |
| | 900 | 333.33 | 53.05 | | fullfilled | not fullfilled | -40.00 |
| MHz | 1.00 | 300.00 | 47.75 | | fullfilled | not fullfilled | -40.00 |
| | **1.59** | 188.50 | **30.00** | | fullfilled | not fullfilled | -40.00 |
| | 2.00 | 150.00 | 23.87 | | fullfilled | fullfilled | -38.02 |
| | 3.00 | 100.00 | 15.92 | | fullfilled | fullfilled | -34.49 |
| | 4.00 | 75.00 | 11.94 | | fullfilled | fullfilled | -32.00 |
| | 5.00 | 60.00 | 9.55 | | fullfilled | fullfilled | -30.06 |
| | 6.00 | 50.00 | 7.96 | | fullfilled | fullfilled | -28.47 |
| | 7.00 | 42.86 | 6.82 | | fullfilled | fullfilled | -27.13 |
| | 8.00 | 37.50 | 5.97 | | fullfilled | fullfilled | -25.97 |
| | 9.00 | 33.33 | 5.31 | | fullfilled | fullfilled | -24.95 |
| | 10.00 | 30.00 | 4.77 | | fullfilled | fullfilled | -24.04 |
| | 10.60 | 28.30 | 4.50 | | fullfilled | fullfilled | -23.53 |
| | 11.00 | 27.27 | 4.34 | | fullfilled | fullfilled | -23.21 |
| | 12.00 | 25.00 | 3.98 | | fullfilled | fullfilled | -22.45 |
| | **13.56** | 22.12 | 3.52 | | fullfilled | fullfilled | -21.39 |
| | 15.00 | 20.00 | 3.18 | | fullfilled | fullfilled | -20.51 |
| | 15.92 | 18.85 | **3.00** | | fullfilled | fullfilled | -20.00 |
| | 17.00 | 17.65 | 2.81 | | not fullfilled | fullfilled | -20.00 |
| | 18.00 | 16.67 | 2.65 | | not fullfilled | fullfilled | -20.00 |
| | 20.00 | 15.00 | 2.39 | | not fullfilled | fullfilled | -20.00 |
| | 21.00 | 14.29 | 2.27 | | not fullfilled | fullfilled | -20.00 |
| | 23.00 | 13.04 | 2.08 | | not fullfilled | fullfilled | -20.00 |
| | 25.00 | 12.00 | 1.91 | | not fullfilled | fullfilled | -20.00 |
| | 27.00 | 11.11 | 1.77 | | not fullfilled | fullfilled | -20.00 |
| | 29.00 | 10.34 | 1.65 | | not fullfilled | fullfilled | -20.00 |
| | 30.00 | 10.00 | 1.59 | | not fullfilled | fullfilled | -20.00 |

### 7.1.3 Measurement Location

| Test site | SAC 3 |
|---|---|

### 7.1.4 Limit

| Radiated emissions limits (3 meters) | | | | | |
|---|---|---|---|---|---|
| **Frequency Range [MHz]** | **Limit [µV/m]** | **Limit [dBµV/m]** | **Distance [m]** | **Detector** | **RBW [kHz]** |
| 0.009 – 0.09 | 2400 / f [kHz] | 67.6 – 20Log(f) (kHz) | 300 | Pk & Avg | 0.2 |
| 0.09 – 0.11 | 2400 / f [kHz] | 67.6 – 20Log(f) (kHz) | 300 | Quasi peak | 0.2 |
| 0.11 – 0.15 | 2400 / f [kHz] | 67.6 – 20Log(f) (kHz) | 300 | Pk & Avg | 0.2 |
| 0.15 – 0.49 | 2400 / f [kHz] | 67.6 – 20Log(f) (kHz) | 300 | Pk & Avg | 9 |
| 0.49 – 1.705 | 24000 / f [kHz] | 87.6 – 20Log(f) (kHz) | 30 | Quasi peak | 9 |
| 1.705 - 30 | 30 | 29.5 | 30 | Quasi peak | 9 |

*Remark: In Canada same limits apply, just unit reference is different

### 7.1.5 Result

Note: For more information Check Chapter 12.5

**Equipment table:**

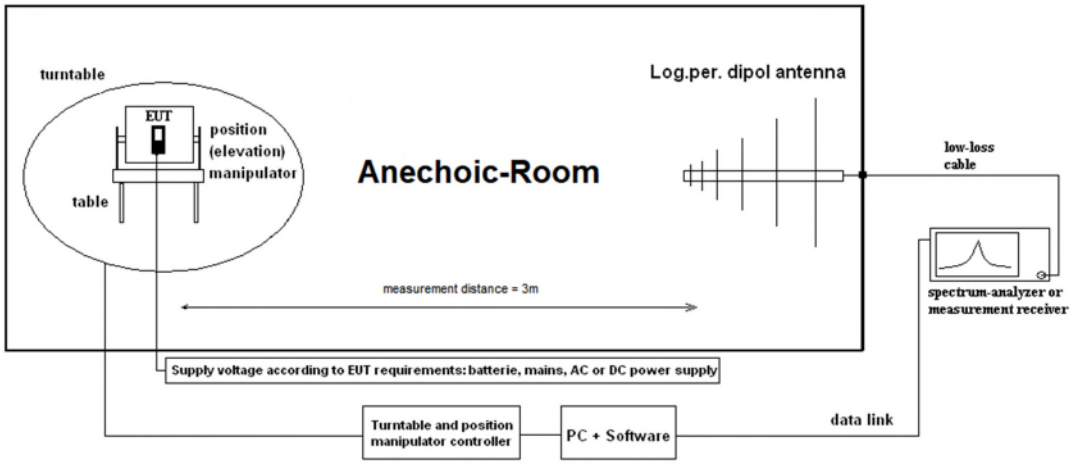
| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 20341 | Digital Multimeter | Digital Multimeter Fluke 112 | Fluke Deutschland GmbH / Glottertal | 81650455 | – | cal | 13.05.2024 | 13.05.2026 |
| 2 | 20442 | Semi Anechoic Chamber | Semi Anechoic Chamber SAC3 | ETS-Lindgren Gmbh / Taufkirchen | without | – | cnn | 02.08.2013 | -/- |
| 3 | 20482 | Filter Matrix | Filter Matrix SAC3 | cetecom advanced GmbH / Essen | without | – | cnn | -/- | -/- |
| 4 | 20574 | Biconilog Hybrid Antenna | Biconilog Hybrid Antenna BTA-L | Frankonia GmbH / Heideck | 980026L | – | cal | 15.06.2022 | 15.06.2025 |
| 5 | 20620 | EMI Test Receiver | EMI Test Receiver ESU26 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 100362 | – | cal | 15.05.2024 | 15.05.2025 |
| 6 | 20885 | Power Supply EA3632A | Power Supply EA3632A | Agilent Technologies Deutschland GmbH | 75305850 | – | cnn | -/- | -/- |
| 7 | 25038 | Loop Antenna | Loop Antenna HFH2-Z2 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 879824/13 | – | cal | 04.07.2022 | 04.07.2025 |

## 7.2 Radiated field strength emissions 30 MHz – 1000 MHz (Chamber: SAC 3)

### 7.2.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant Semi anechoic Chamber (SAC) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 1 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz.

#### Schematic:




#### Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

**Formula:**

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

AF = Antenna factor
$C_L$ = Cable loss
$D_F$ = Distance correction factor (if used)
$E_C$ = Electrical field – corrected value
$E_R$ = Receiver reading
$G_A$ = Gain of pre-amplifier (if used)
$L_T$ = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

### 7.2.2 Sample calculation

| Raw-Value [dBuV/m] | Antenna factor | Distance Correction [dB] | Cable Loss | Preamplifier | Resulting correction value [dB] | Final result [dBuV/m] | Remarks |
|---|---|---|---|---|---|---|---|
| 32.7 | 22.25 | -- | 3.1 | -- | 25.35 | 58.05 | -- |

Remark: This calculation is based on an example value at 800.4 MHz

### 7.2.3 Measurement Location

| | |
|---|---|
| **Test site** | SAC 3 |

### 7.2.4 Limit

| Radiated emissions limits (3 meters) | | | | |
|---|---|---|---|---|
| **Frequency Range [MHz]** | **Limit [µV/m]** | **Limit [dBµV/m]** | **Detector** | **RBW / VBW [kHz]** |
| 30 - 88 | 100 | 40.0 | Quasi peak | 100 / 300 |
| 88 - 216 | 150 | 43.5 | Quasi peak | 100 / 300 |
| 216 - 960 | 200 | 46.0 | Quasi peak | 100 / 300 |
| 960 - 1000 | 500 | 54.0 | Quasi peak | 100 / 300 |

### 7.2.5 Result

Note: For more information Check Chapter 12.5

## Equipment table:

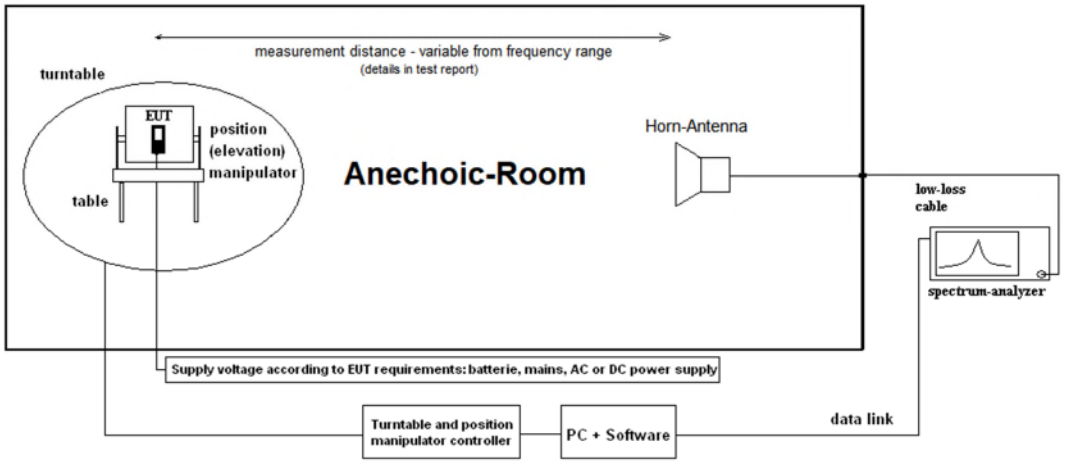
| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|
| 1 | 20341 | Digital Multimeter | Digital Multimeter Fluke 112 | Fluke Deutschland GmbH / Glottertal | 81650455 | cal | 13.05.2024 | 13.05.2026 |
| 2 | 20442 | Semi Anechoic Chamber | Semi Anechoic Chamber SAC3 | ETS-Lindgren Gmbh / Taufkirchen | without | cnn | 24.10.2024 | 24.10.2025 |
| 3 | 20482 | Filter Matrix | Filter Matrix SAC3 | cetecom advanced GmbH / Essen | without | cnn | -/- | -/- |
| 4 | 20574 | Biconilog Hybrid Antenna | Biconilog Hybrid Antenna BTA-L | Frankonia GmbH / Heideck | 980026L | cal | 15.06.2022 | 15.06.2025 |
| 5 | 20620 | EMI Test Receiver | EMI Test Receiver ESU26 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 100362 | cal | 15.05.2024 | 15.05.2025 |
| 6 | 20885 | Power Supply EA3632A | Power Supply EA3632A | Agilent Technologies Deutschland GmbH | 75305850 | cnn | -/- | -/- |

## 7.3 Shielded fully anechoic chamber (1 GHz – 18 GHz / Chamber: FAC 2)

### 7.3.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 12.4 GHz and 2 meter up to 18 GHz. Horn antennas are used for frequency range 1 GHz to 65 GHz.

**Schematic:**




**Testing method:**

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

**Formula:**

$P_{EIRP} = P_{MEAS} + C_L + FSL - G_A$ (1)

$P_{MEAS}$ = measured power at instrument
M = Margin
$L_T$ = Limit

FSL = Free Space loss = Function(frequency, measurement distance)

$M = L_T - P_{EIRP}$

$C_L$= cable loss
$G_A$ = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

### 7.3.2 Sample calculation

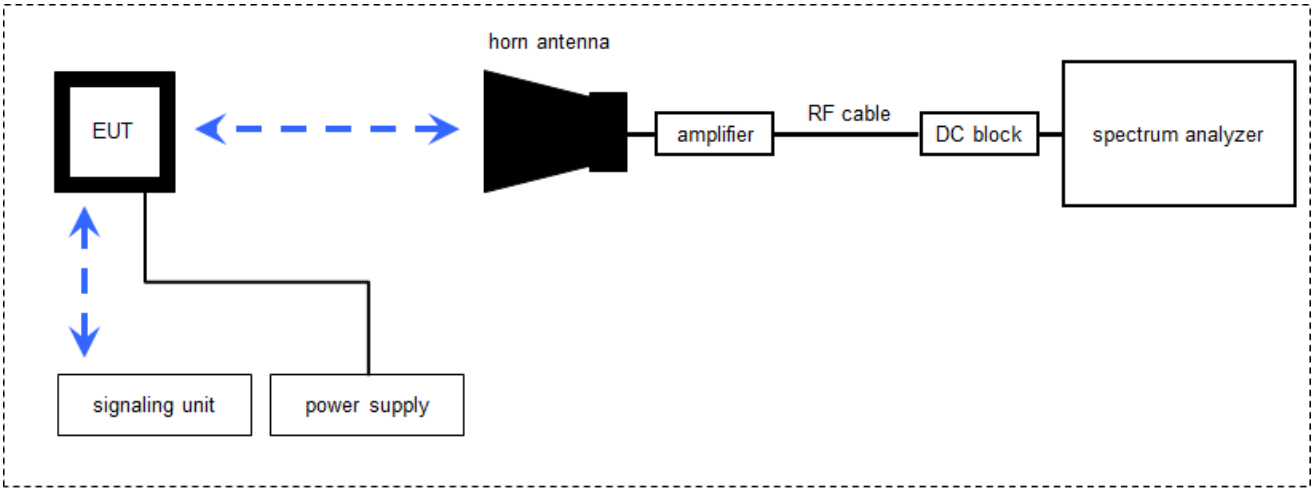
| Raw-Value [dBuV/m] | Antenna factor | Distance Correction [dB] | Cable Loss + Preamplifier | Resulting correction value [dB] | Final result [dBuV/m] | Remarks |
|---|---|---|---|---|---|---|
| 29.37 | 41.20 | -- | 24.28 | 16.92 | 46.3 | CableLoss and PreAmp data in one data correction file |

Remark: This calculation is based on an example value at 10 GHz

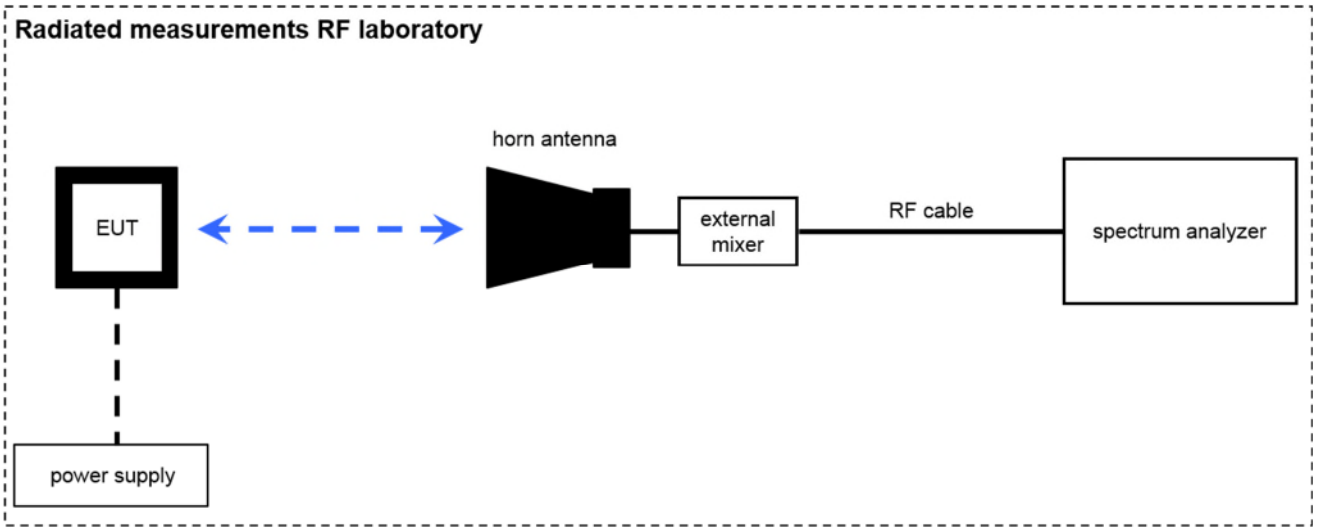
### 7.3.3 Equipment table

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|
| 1 | 20133 | Double-Ridged Waveguide Horn Antenna | Double-Ridged Waveguide Horn Antenna 3115 (Meas 1) | EMCO Elektronik GmbH / Gilching | 9012-3629 | cal | 22.05.2023 | 22.05.2026 |
| 2 | 20354 | DC - Power Supply 40A | DC - Power Supply 40A NGPE 40/40 | | 448 | cpu | 05.03.2008 | -/- |
| 3 | 20412 | Fully Anechoic Chamber | Fully Anechoic Chamber 2 | ETS-Lindgren Gmbh / Taufkirchen | without | chk | 15.03.2024 | 15.03.2025 |
| 4 | 20972 | Signal- and Spectrum Analyzer | Signal- and Spectrum Analyzer FSW50 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101929 | cal | 05.01.2024 | 05.01.2025 |
| 5 | 20811 | Horn Antenna | Horn Antenna ASY-SGH-124-SMA | Antenna Systems Solutions S.L / Santander | 29F14182337 | chk | 20.10.2021 | 07.10.2025 |
| 6 | 20816 | SGH Antenna | SGH Antenna SGH-26-WR10 | Anteral S.L. | 1144 | cnn | -/- | -/- |
| 7 | 20817 | Waveguide Rectangular Horn Antenna | Waveguide Rectangular Horn Antenna SAR-2309-22-S2 | ERAVANT / Torrance | 13254-01 | chk | 16.10.2024 | 20.10.2026 |
| 8 | 20836 | Amplifier | 1-18 GHz Amplifier | Wright Technologies, Inc., Inc. / Roseville | 0001 | chk | 18.10.2024 | 18.10.2026 |
| 9 | 20912 | Low noise Amplifier Module 0.5-4GHz | Low noise Amplifier Module 0.5-4GHz | RF-Lambda Europe GmbH / Rüsselsheim | 19041200083 | cpu | 18.10.2024 | 18.10.2025 |
| 10 | 20913 | Phase Amplitude Stable Cable Assembly | Phase Amplitude Stable Cable Assembly DC-40GHz | RF-Lambda Europe GmbH | AC19040001 | cnn | -/- | -/- |
| 11 | 25457 | DRG Horn Antenna | DRG Horn Antenna SAS-574 | A.H. Systems, Inc. / Chatsworth | 383 | cal | 28.03.2022 | 28.03.2025 |

## 7.4 Radiated measurements > 18 GHz




## 7.5 Radiated measurements > 50/85 GHz




Measurement distance: horn antenna e.g. 75 cm

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

*Example calculation:*
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance;
G-antenna gain+amplifier gain; CA-loss signal path)

*Example calculation:*
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

Note: conversion loss of mixer is already included in analyzer value.

## 7.5.1 Equipment table

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|
| 1 | 20133 | Double-Ridged Waveguide Horn Antenna | Double-Ridged Waveguide Horn Antenna 3115 (Meas 1) | EMCO Elektronik GmbH / Gilching | 9012-3629 | cal | 22.05.2023 | 22.05.2026 |
| 2 | 20354 | DC - Power Supply 40A | DC - Power Supply 40A NGPE 40/40 | | 448 | cpu | 05.03.2008 | -/- |
| 3 | 20412 | Fully Anechoic Chamber | Fully Anechoic Chamber 2 | ETS-Lindgren Gmbh / Taufkirchen | without | chk | 15.03.2024 | 15.03.2025 |
| 4 | 20729 | Harmonic Mixer | FS-Z140 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101004 | cal | 16.06.2023 | 16.06.2026 |
| 5 | 20730 | Harmonic Mixer | FS-Z110 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101468 | cal | 02.06.2023 | 02.06.2026 |
| 6 | 20731 | Harmonic Mixer | FS-Z75 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101022 | cal | 18.05.2022 | 18.05.2025 |
| 7 | 20732 | Signal- and Spectrum Analyzer | Signal- and Spectrum Analyzer FSW67 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 104023 | cal | 30.07.2024 | 30.07.2025 |
| 8 | 20733 | Harmonic Mixer | Harmonic Mixer FS-Z220 | RPG-Radiometer Physics GmbH / Meckenheim | 101009 | cal | 24.05.2024 | 24.05.2027 |
| 9 | 20734 | Harmonic Mixer | Harmonic Mixer FS-Z325 | RPG-Radiometer Physics GmbH / Meckenheim | 101005 | cal | 24.05.2024 | 24.05.2027 |
| 10 | 20765 | Pickett-Potter Horn Antenna | Pickett-Potter Horn Antenna FH-PP 40-60 | RPG-Radiometer Physics GmbH / Meckenheim | 010001 | chk | 16.10.2024 | 16.10.2026 |
| 11 | 20767 | Pickett-Potter Horn Antenna | Pickett-Potter Horn Antenna FH-PP 140-220 | RPG-Radiometer Physics GmbH / Meckenheim | 010011 | chk | 09.10.2024 | 09.10.2026 |
| 12 | 20811 | Horn Antenna | Horn Antenna ASY-SGH-124-SMA | Antenna Systems Solutions S.L / Santander | 29F14182337 | cal | 08.10.2024 | 08.10.2027 |
| 13 | 20813 | Pickett-Potter Horn Antenna | Pickett-Potter Horn Antenna FH-PP 075 | RPG-Radiometer Physics GmbH / Meckenheim | 10006 | chk | 16.10.2024 | 16.10.2026 |
| 14 | 20814 | Pickett-Potter Horn Antenna | Pickett-Potter Horn Antenna FH-PP 140 | RPG-Radiometer Physics GmbH / Meckenheim | 10008 | chk | 09.10.2024 | 09.10.2026 |
| 15 | 20815 | Pickett-Potter Horn Antenna | Pickett-Potter Horn Antenna FH-PP 110 | RPG-Radiometer Physics GmbH / Meckenheim | 10014 | chk | 22.03.2024 | 22.03.2026 |
| 16 | 20817 | Waveguide Rectangular Horn Antenna | Waveguide Rectangular Horn Antenna SAR-2309-22-S2 | ERAVANT / Torrance | 13254-01 | chk | 16.10.2024 | 16.10.2026 |
| 17 | 20836 | Amplifier | 1-18 GHz Amplifier | Wright Technologies, Inc., Inc. / Roseville | 0001 | chk | 18.10.2024 | 18.10.2026 |
| 18 | 20912 | Low noise Amplifier Module 0.5-4GHz | Low noise Amplifier Module 0.5-4GHz | RF-Lambda Europe GmbH / Rüsselsheim | 19041200083 | cpu | 18.10.2024 | 18.10.2025 |
| 19 | 20913 | Phase Amplitude Stable Cable Assembly | Phase Amplitude Stable Cable Assembly DC-40GHz | RF-Lambda Europe GmbH | AC19040001 | cnn | -/- | -/- |
| 20 | 25457 | DRG Horn Antenna | DRG Horn Antenna SAS-574 | A.H. Systems, Inc. / Chatsworth | 383 | cal | 28.03.2022 | 28.03.2025 |

# 8 Sequence of testing

## 8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

**Setup**
Note: Check Chapter 7.1

**Premeasurement***
Note: Check Chapter 7.1

**Final measurement**
Note: Check Chapter 7.1

*)Note: The sequence will be repeated two times with different EUT orientations.

## 8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

**Setup**
Note: Check Chapter 7.2

**Premeasurement**
Note: Check Chapter 7.2

**Final measurement**
Note: Check Chapter 7.2

## 8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

**Setup**
Note: Check Chapter 7.3

**Premeasurement**
Note: Check Chapter 7.3

**Final measurement**
Note: Check Chapter 7.3

## 8.4 Sequence of testing radiated spurious above 18 GHz up to 50 GHz

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The DC power port of the EUT is connected to a power outlet.
- The measurement distance is specified in chapter 10.
- The EUT is set into operation.

**Premeasurement**

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

**Final measurement**

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 8.5 Sequence of testing radiated spurious above 50 GHz with external mixers

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The DC power port of the EUT is connected to a power outlet.
- The measurement distance is specified in chapter 10.
- The EUT is set into operation.

**Premeasurement**

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

**Final measurement**

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

# 9 Measurement uncertainty

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor k, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it contribution to the overall uncertainty according its statistical distribution calculated.

| Issue No. | Measurement type | Reference | Frequency range of measurement | | Calculated Uncertainty based on confidence level of 95.54% | Remarks |
|---|---|---|---|---|---|---|
| | | | Start [MHz] | Stop [MHz] | | |
| 1 | Magnetic Field Strength | EN ,FCC, JP, IC | 0.009 | 30 | 4.86 | Magnetic loop antenna, Pre-Amp on |
| 2 | RF-Output Power (EIRP)<br>Unwanted emissions (EIRP)<br>[dB] | EN, FCC, JP, IC | 30 | 100 | 4.57 | without Pre-Amp |
| | | | 30 | 100 | 4.91 | with Pre-Amp |
| | | | 100 | 1000 | 4.02 | without Pre-Amp |
| | | | 100 | 1000 | 4.26 | with Pre-Amp |
| | | | 1000 | 18000 | 4.36 | without Pre-Amp |
| | | | 1000 | 18000 | 5.23 | with Pre-Amp |
| | | | 18000 | 33000 | 4.92 | Schwarzbeck BBHA9170 (#20302) Antenna set-up non-waveguide antenna) |
| | | | 33000 | 50000 | 4.17 | Set-up for Q-Band (WR-22), non-wave guide antenna |
| | | | 40000 | 60000 | 4.69 | Set-up U-Band (WR-19), non-waveguide antenna |
| | | | 50000 | 75000 | 4.06 | External Mixer set-up V-Band (WR-15) |
| | | | 75000 | 110000 | 4.17 | External Mixer set-up W-Band (WR-6) |
| | | | 90000 | 140000 | 5.49 | External Mixer set-up F-Band (WR-8) |
| | | | 140000 | 225000 | 6.22 | External Mixer set-up G-Band (WR-5) |
| | | | 225000 | 325000 | 7.04 | External Mixer set-up (WR-3) |
| | | | 325000 | 500000 | 8.84 | External Mixer set-up (WR-2.2) |
| 3 | Radiated Blocking<br>[dB] | EN | 1000 | 18000 | 2.85 | Typical set-up with microwave generator and antenna, value for 7 GHz calculated |
| | | | 18000 | 33000 | 4.66 | Typical set-up with microwave generator and antenna |
| | | | 33000 | 50000 | 3.48 | WR-22 set-up |
| | | | 50000 | 75000 | 3.73 | WR-15 set-up |
| | | | 75000 | 110000 | 4.26 | WR-6 set-up |
| 4 | Frequency Error / UWB+FMCW<br>[kHz] | EN, FCC, JP, ISED | 40000 | 77000 | 276.19 | calculated for 77 GHz (FMCW) carrier |
| | | | 6000 | 7000 | 33.92 | calculated for 6.5 GHz UWB Ch.5 |
| | Frequency Error / NFC<br>[Hz] | EN, FCC, JP, ISED | 11.00 | 14.00 | 20.76 | calculated for 13.56 MHz NFC carrier |
| 5 | TS 8997<br>Conducted Parameters | FCC15/18 / ISED | 30 | 6000 | 1.11 | 1. Power measurement with Fast-sampling-detector |
| | | | 30 | 6000 | 1.20 | 2. Power measurement with Spectrum-Analyzer |
| | | | 30 | 6000 | 1.20 | 3. Power Spectrum-Density measurement |
| | | | 30 | 7500 | 1.20 | 4. Conducted Spurious emissions |
| | | | 0.009 | 30 | 2.56 | 5. Conducted Spurious emissions |
| | | | 2.4 | 2.48 | 1.95 ppm | 6a. Bandwidth / 2-Marker Method for 2.4 GHz ISM |
| | | | 5.18 | 5.825 | 7.180 ppm | 6b. Bandwidth / 2-Marker Method for 5 GHz WLAN |
| | | | 5.18 | 5.825 | 1.099 ppm | 7. Frequency (Marker method) for 5 GHz WLAN |
| | | | 30 | 6000 | 0.11561 µs | 8. Medium-Utilization factor / Timing |
| | | | 30 | 6000 | 1.85 | 9a. Blocking-Level of companion device |
| | | | 30 | 6000 | 1.62 | 9b. Blocking Generator level |
| 6 | Conducted Emissions | EN, FCC | 0.009 | 30 | 3.57 | general EMI-measurements on AC/DC ports |

## 10 Far field consideration for measurements above 18 GHz

**Far field distance calculation:**

$D_{ff} = 2 \times D^2/\lambda$

with
$D_{ff}$ Far field distance
D Antenna dimension
λ wavelength

**Spurious emission measurements:**

| Antenna frequency range in GHz | Highest measured frequency in GHz | D in m | λ in m | $D_{ff}$ in m |
|---|---|---|---|---|
| 18 – 40 | 40 | 0.0450 | 0.00749481 | 0.54 |
| 40-55 | 55 | 0.0384 | 0.005450772 | 0.54 |
| 55-75 | 73.5 | 0.03072 | 0.004078810 | 0.46 |
| 55-75 | 74.5 | 0.03072 | 0.004024060 | 0.47 |
| 55-75 | 75 | 0.03072 | 0.003997233 | 0.47 |
| 75-110 | 76 | 0.020757 | 0.003944640 | 0.22 |
| 75-110 | 78.5 | 0.020757 | 0.003819010 | 0.23 |
| 75-110 | 79.5 | 0.020757 | 0.003770974 | 0.23 |
| 75-110 | 81 | 0.020757 | 0.003701141 | 0.23 |
| 75-110 | 90 | 0.020757 | 0.003331027 | 0.26 |
| 75-110 | 98 | 0.020757 | 0.003059107 | 0.28 |
| 75-110 | 110 | 0.020757 | 0.002725386 | 0.32 |
| 90-140 | 122 | 0.016696 | 0.002457315 | 0.23 |
| 90-140 | 130 | 0.016696 | 0.002306100 | 0.24 |
| 140-220 | 220 | 0.010700 | 0.001362693 | 0.17 |
| 220-325 | 250 | 0.007050 | 0.001199170 | 0.08 |

Measurement distance used during measurements:

| Measurement frequency range, [GHz]: | Measurement distance, [m] | Boundary for near/far field, [m] |
|---|---|---|
| 18 - 40 | 1 | 0.54 |
| 40 – 50 | 1.5 | 0.49 |
| 50 – 55 | 1 | 0.54 |
| 55 – 65 | 0.5 | 0.41 |
| 65 – 75 | 0.5 | 0.47 |
| 75 – 95 | 0.5 | 0.27 |
| 95 – 110 | 0.5 | 0.32 |
| 110 – 120 | 0.5 | 0.22 |
| 120 – 140 | 0.5 | 0.26 |
| 140 – 150 | 0.5 | 0.11 |
| 150 – 160 | 0.5 | 0.12 |
| 160 – 170 | 0.5 | 0.13 |
| 170 – 180 | 0.5 | 0.14 |
| 180 – 190 | 0.17 | 0.15 |
| 190 – 200 | 0.17 | 0.15 |
| 200 – 220 | 0.17 | 0.17 |
| 220 – 243 | 0.17 | 0.08 |

# 11 Summary of measurement results

## 11.1 Summary

| | |
|---|---|
| ☒ | **No deviations from the technical specifications were ascertained** |
| ☐ | There were deviations from the technical specifications ascertained |
| ☐ | This test report is only a partial test report.<br>The content and verdict of the performed test cases are listed below. |

| TC Identifier | Description | Verdict | Date | Remark |
|---|---|---|---|---|
| RF-Testing | 47 CFR Part 95 Subpart M | see below | 2025-02-14 | -/- |

| Test specification clause | Test case | Temperature conditions | Power source voltages | Pass | Fail | NA | NP | Remark |
|---|---|---|---|---|---|---|---|---|
| §2.1046<br>§95.3367 (a) / (b) | Radiated power | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| §2.1047 | Modulation characteristics | -/- | -/- | ☐ | ☐ | ☐ | ☒ | Provided by customer, see chapter 12.2 |
| §2.1049 | Occupied bandwidth (99% bandwidth) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| §2.1051 | Spurious emissions at antenna terminals | Nominal | Nominal | ☐ | ☐ | ☒ | ☐ | see note 2, DUT has integral antenna |
| §2.1053<br>§95.3379 (a)(1)<br>§95.3379 (a)(2)<br>§95.3379 (a)(3) | Unwanted emissions (radiated spurious) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| §2.1055<br>§95.3379 (b) | Frequency stability | Nominal and Extreme | Nominal and Extreme | ☒ | ☐ | ☐ | ☐ | complies |

**Note:**

1) C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

2) ANSI C63.26-2015, chapter 5.5.1:
"…many contemporary portable transmitters utilize integral antennas, precluding access to an antenna output port from which to perform conducted compliance measurements. For these types of transmitters, all of the data necessary to demonstrate compliance must be measured in a radiated test configuration…"

## 11.2 Additional comments

Reference documents: None

Special test descriptions: AWRl1422_ Manual Switch-Cable Certification.docx

Configuration descriptions: None

# 12 Measurement results

## 12.1 Radiated power

**Description:**

§95.3367:
The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as shown below.

**Limits:** **FCC §95.3367 (a) (b)**

| Frequency | Limit (eirp) |
|---|---|
| 76.0 - 81.0 GHz | 50 dBm/MHz (Average) |
| 76.0 - 81.0 GHz | 55 dBm/MHz (PEAK) |

**Measurement: Average Power**

| Measurement parameter | |
|---|---|
| Detector: | RMS |
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Trace-Mode: | Max Hold |

**Measurement:** **Peak Power**

| Measurement parameter | |
|---|---|
| Detector: | Pos-Peak |
| Resolution bandwidth: | 50 MHz |
| Video bandwidth: | 80 MHz |
| Trace-Mode: | Max Hold |

**Note:** **KDB 653005 4.(c)(1)**
Peak power measurements of swept frequency radar implementations (e.g., high sweep rate FMCW) may require a desensitization correction factor to be applied to the measurement results.

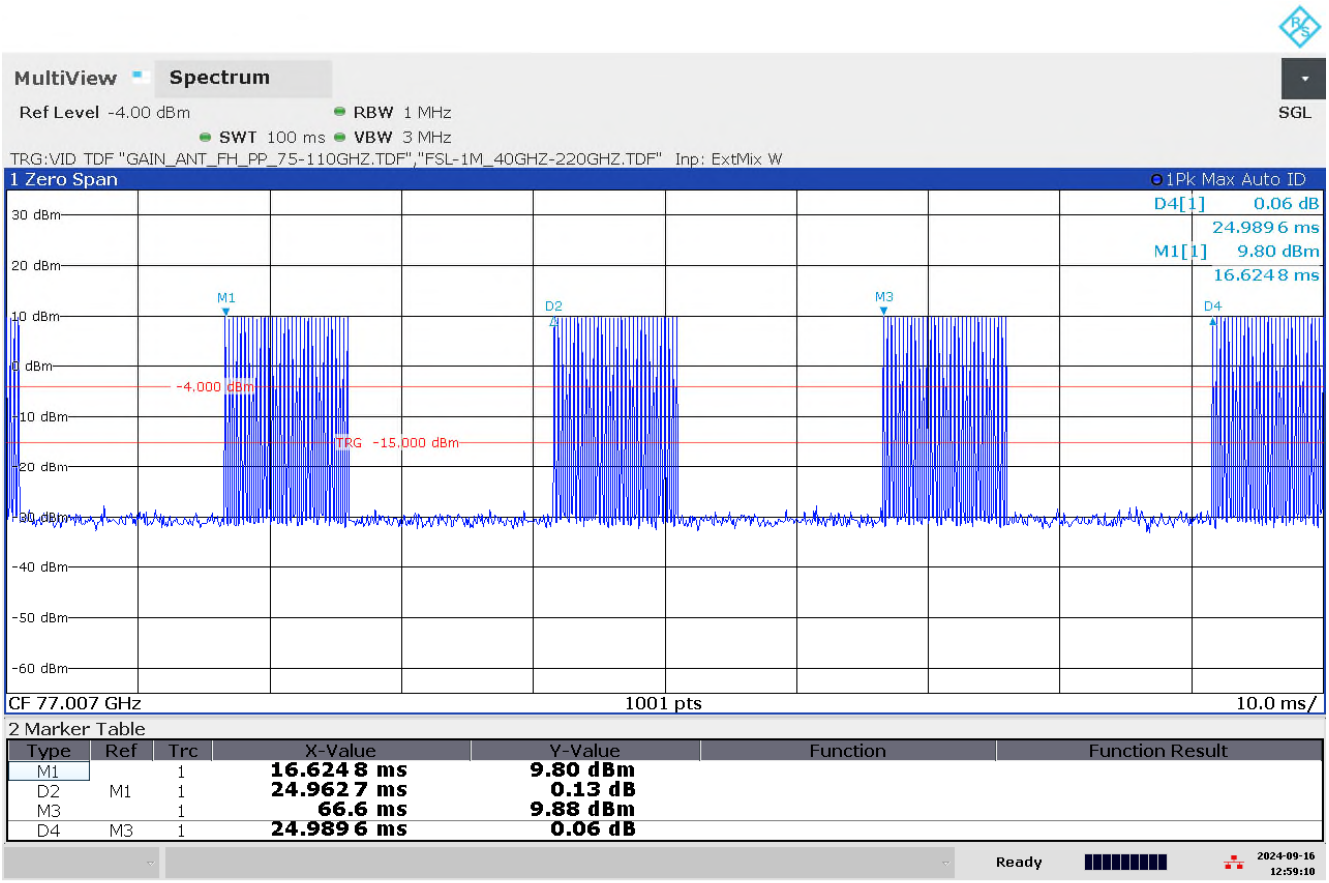
**Consequence:**
Worst case measurement, the peak power measurement is performed with a greater resolution bandwidth to solve the problem with the desensitization.

**Measurement results:**

| EUT | Mode | Test condition | Radiated peak power (eirp) | Radiated Mean Power (eirp) |
|---|---|---|---|---|
| **1** | **1** | $T_{nom}$ / $V_{nom}$ | **13.86** | **4.07** |

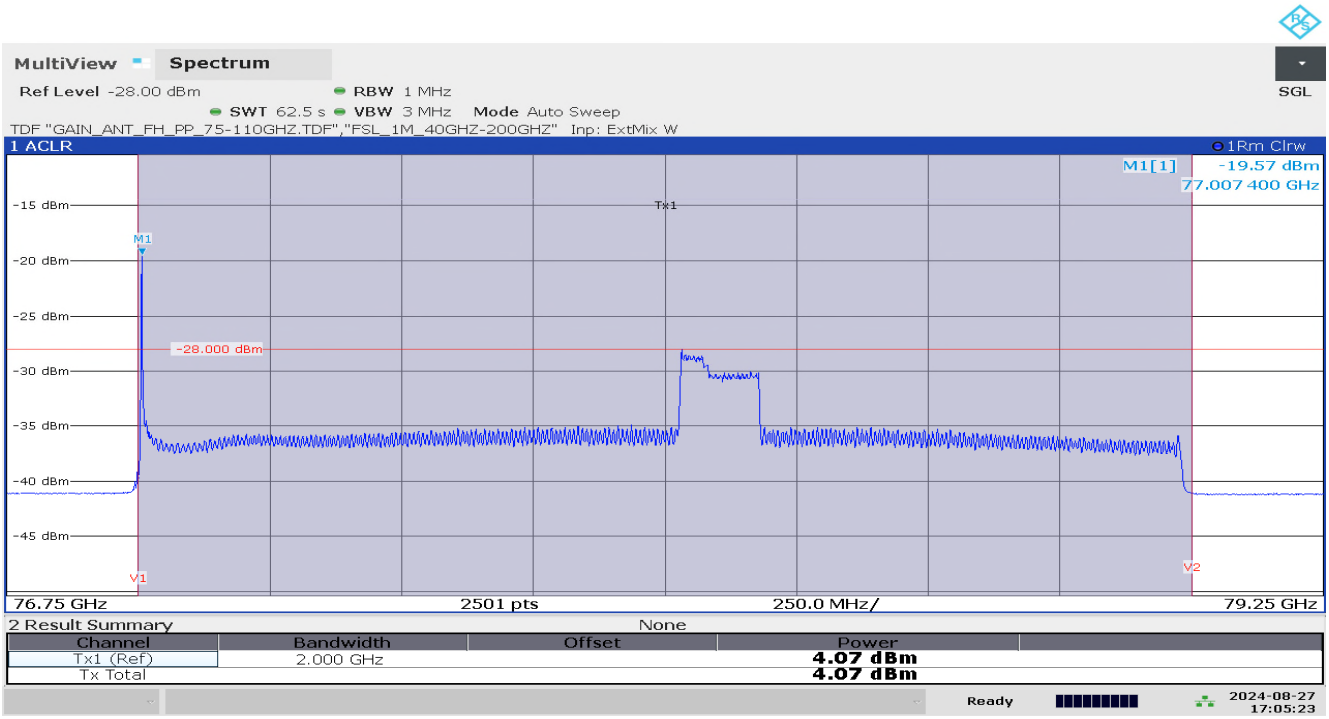
**Verdict:** **Complies**

TID100_23-1-0144001T007_EUT_Cycle_Time_AntH_25ms



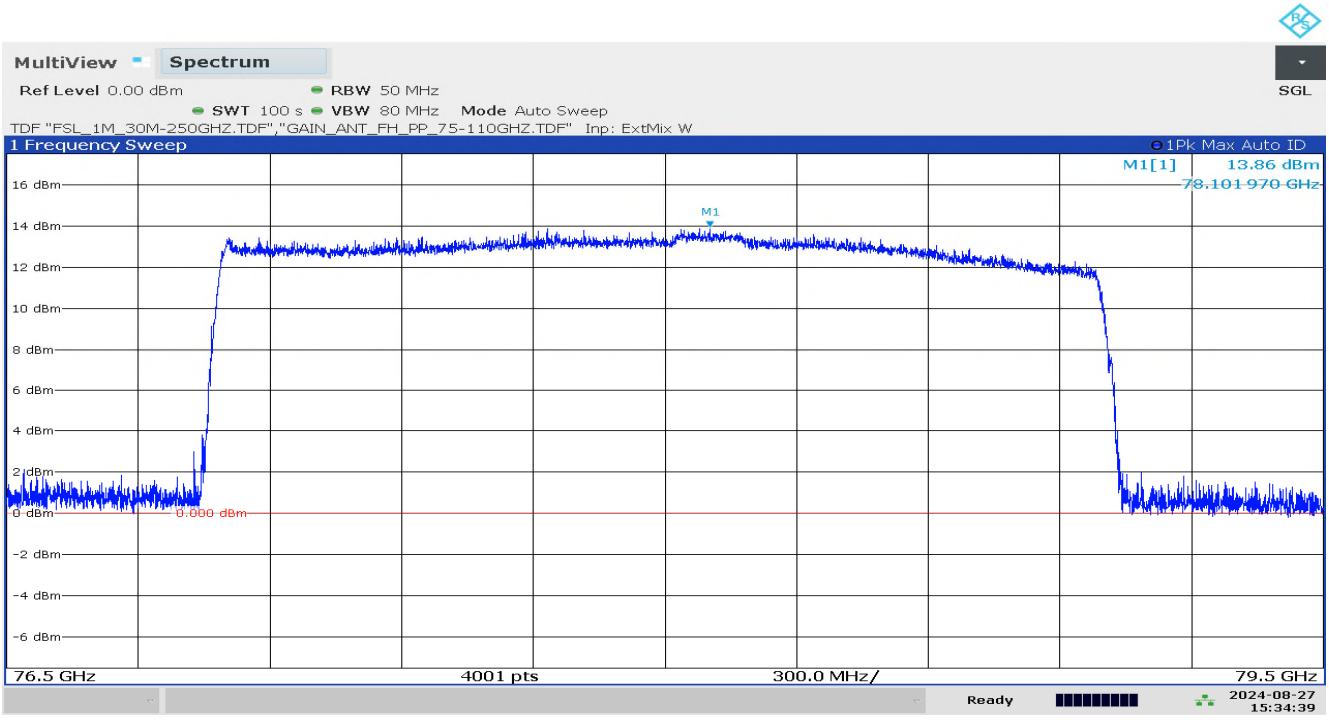

Note: EUT Cycle time has been verified according to customer declaration, EUT cycle Time = 25 ms.

TID113_02_23-1-0144001T007_Mean_Power_AntH_single_sweep




Note:

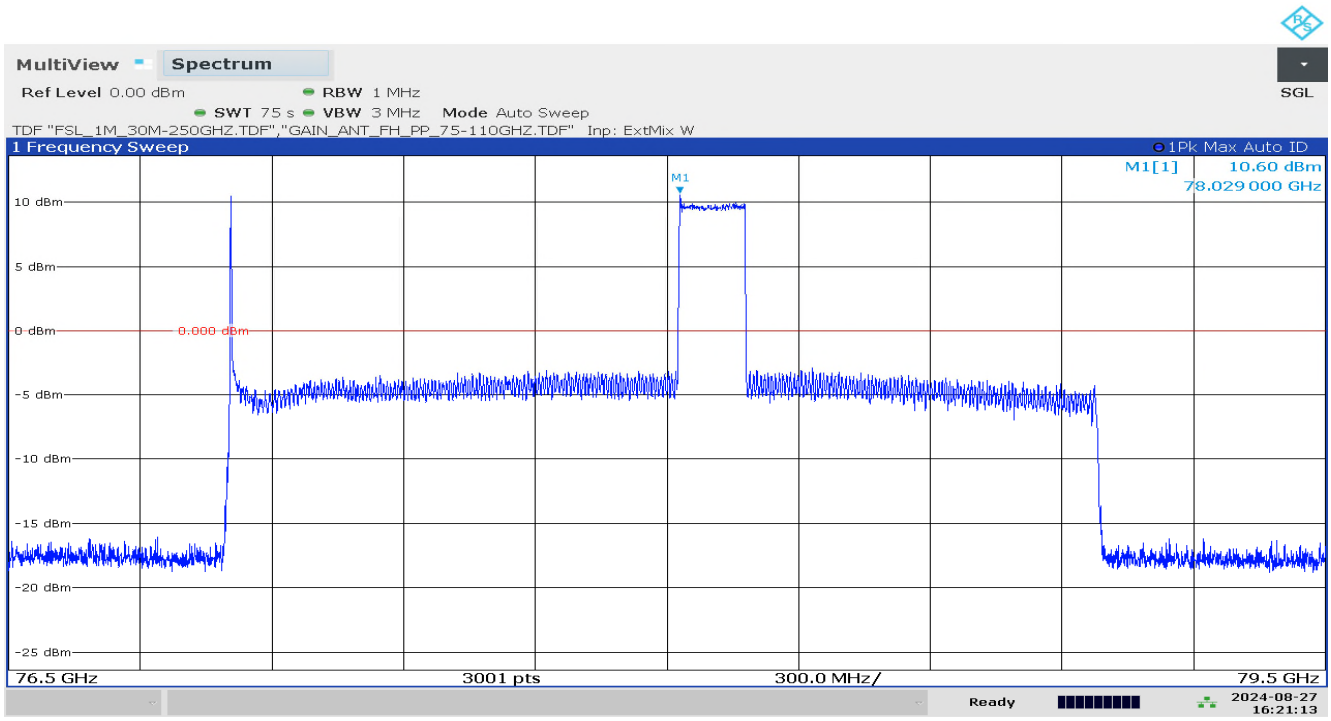
TID106_23-1-0144001T007_Peak_Power_AntH_RBW_50MHz_auto_id




Note: Antenna Polarization Horizontal,
RBW 50 MHz has been used to avoid desensitization factor.Maximum Peak EIRP = 13.86 dBm

Note: Different RBW are used to avoid desensitization factor and to get a stable Peak EIRP, TID106 is the Final test result but the below TIDs are only for information,

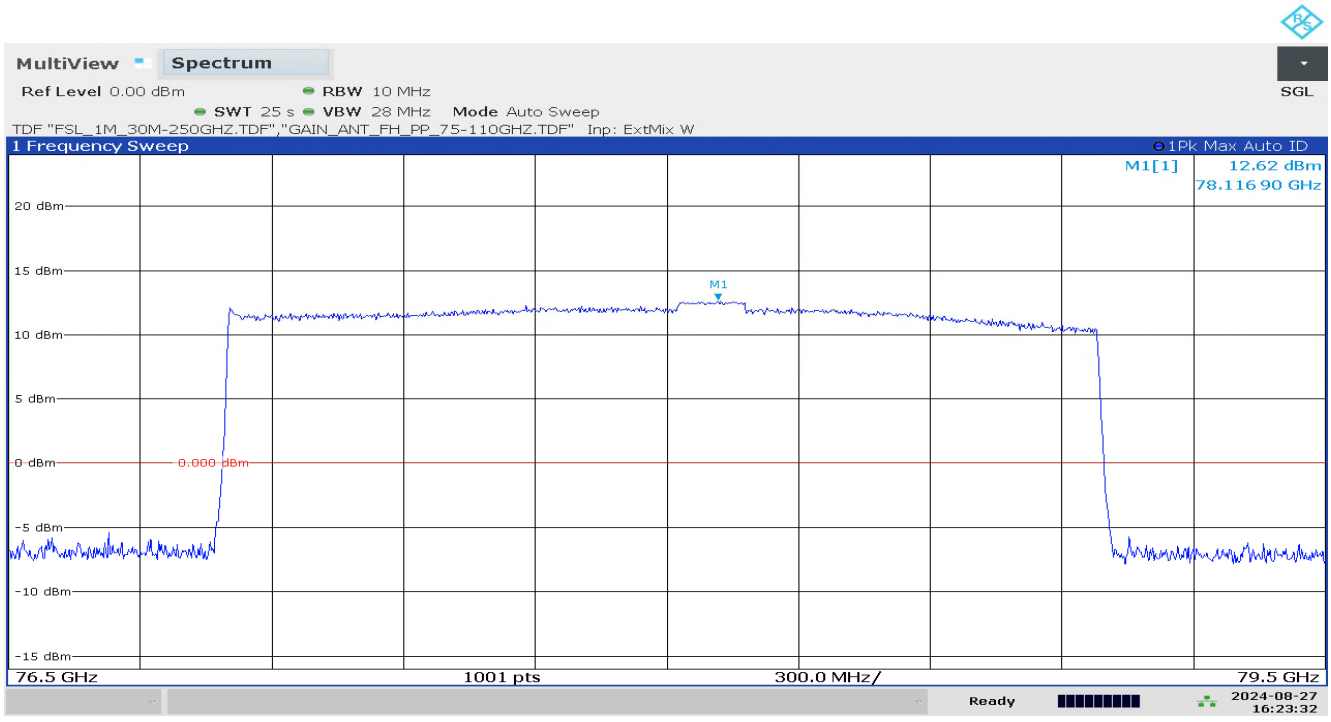
TID101_23-1-0144001T007_Peak_Power_AntH_RBW_1MHz




04:21:13 08/27/2024

Note: Only for information, for final result check TID106.

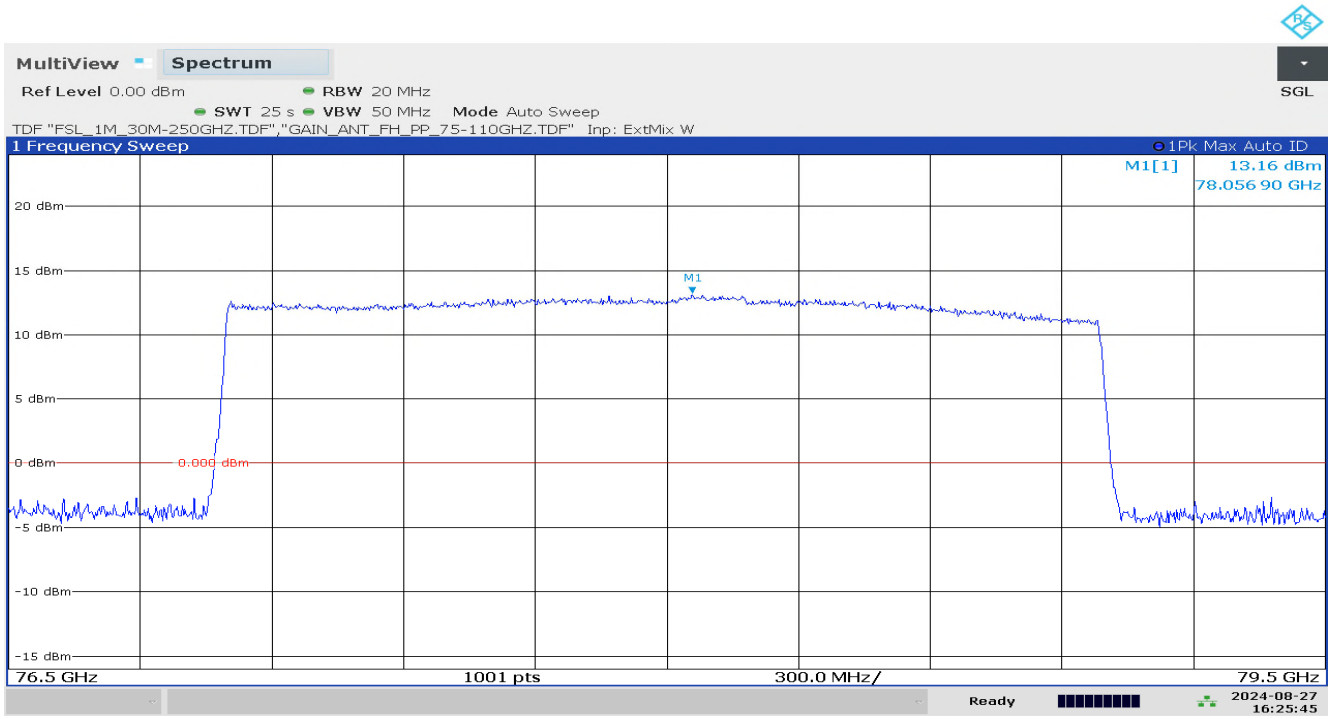
TID102_23-1-0144001T007_Peak_Power_AntH_RBW_10MHz




04:23:32 08/27/2024

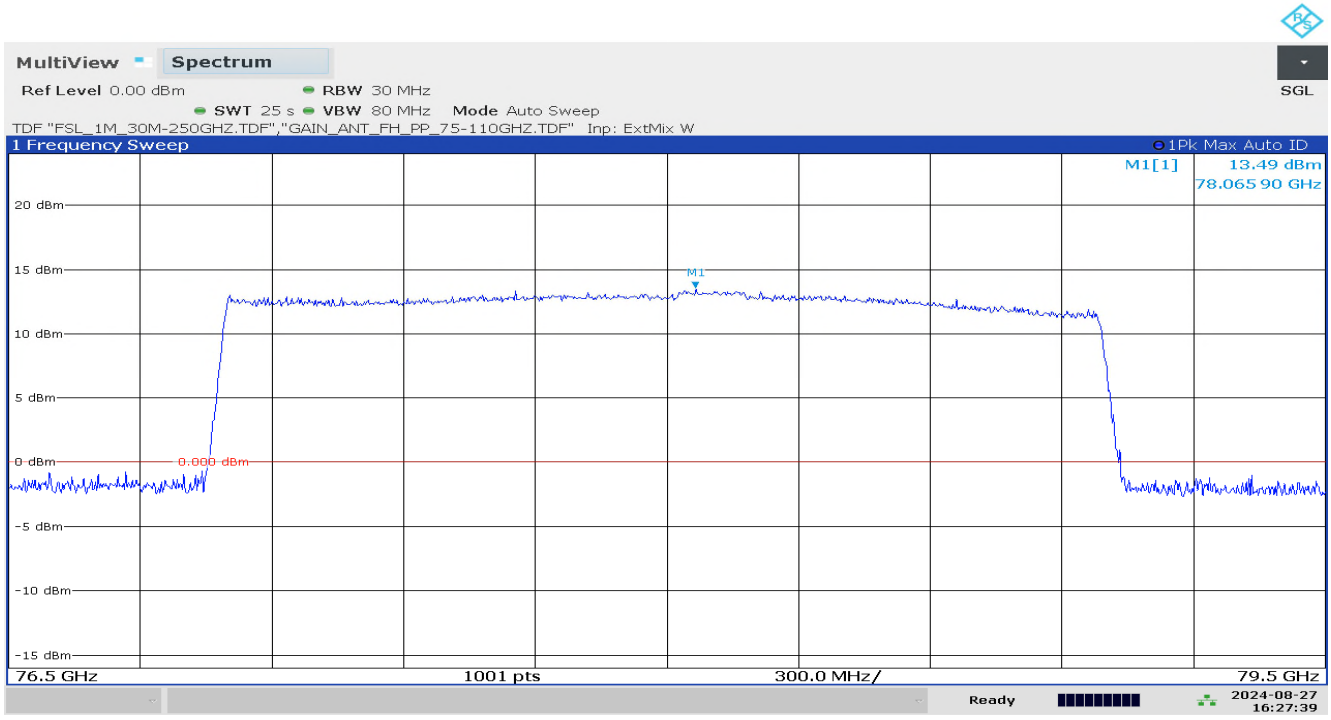
Note: Only for information, for final result check TID106.

TID103_23-1-0144001T007_Peak_Power_AntH_RBW_20MHz



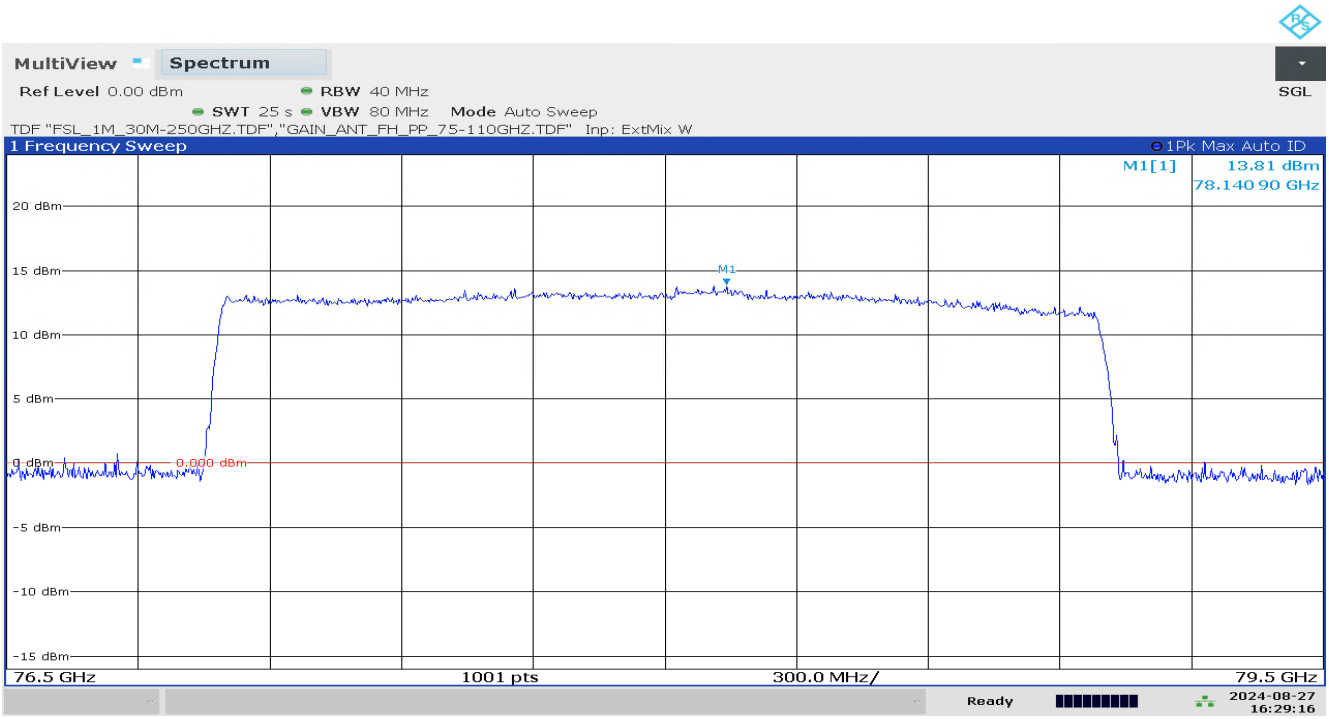

Note: Only for information, for final result check TID106.

TID104_23-1-0144001T007_Peak_Power_AntH_RBW_30MHz



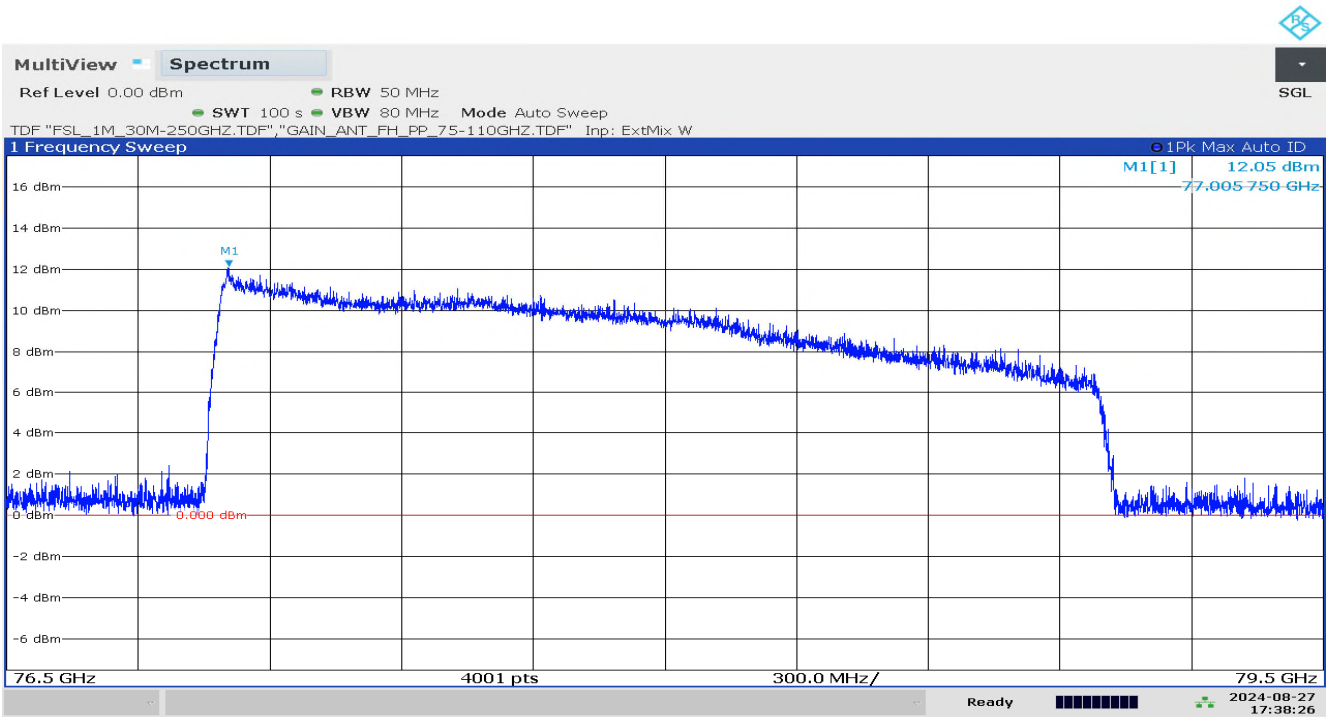

Note: Only for information, for final result check TID106.

TID105_23-1-0144001T007_Peak_Power_AntH_RBW_40MHz




Note: Only for information, for final result check TID106.

TID108_03_23-1-0144001T007_Peak_Power_AntV_RBW_50MHz_auto_id




Note: Antenna polarization Vertical.
Only for information, for final result check TID106.

## 12.2 Modulation characteristics

**Description:**

§2.1047 (d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

KDB 653005 D01 76-81 GHz Radars v01r02, section 3 (g)
Concerning the Section 2.1047 modulation characteristics requirement, the following information should be provided:
1) Pulsed radar: pulse width and pulse repetition frequency (if PRF is variable, then report maximum and minimum values).
2) Non-pulsed radar (e.g., FMCW): modulation type (i.e., sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).

**Information from manufacturer on modulation characteristics:**

| **Modulation Type** | FMCW |
|---|---|
| **Modulation characteristics:** | |
| Sweep bandwidth | ➢ Sweep bandwidth = 1989.9MHz<br>➢ Sweep rate = 111.79 MHz/us<br>➢ Sweep time = 17.8us |
| Sweep rate | |
| Sweep time | |

## 12.3 Occupied bandwidth

**Description:**

§2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

**Limits:**

| FCC | IC |
|---|---|
| FCC §95.3379 (b) | RSS-251 chapter 7.2: |
| The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following: | |
| Frequency range | |
| 76 GHz – 81 GHz | |

**Measurement:**

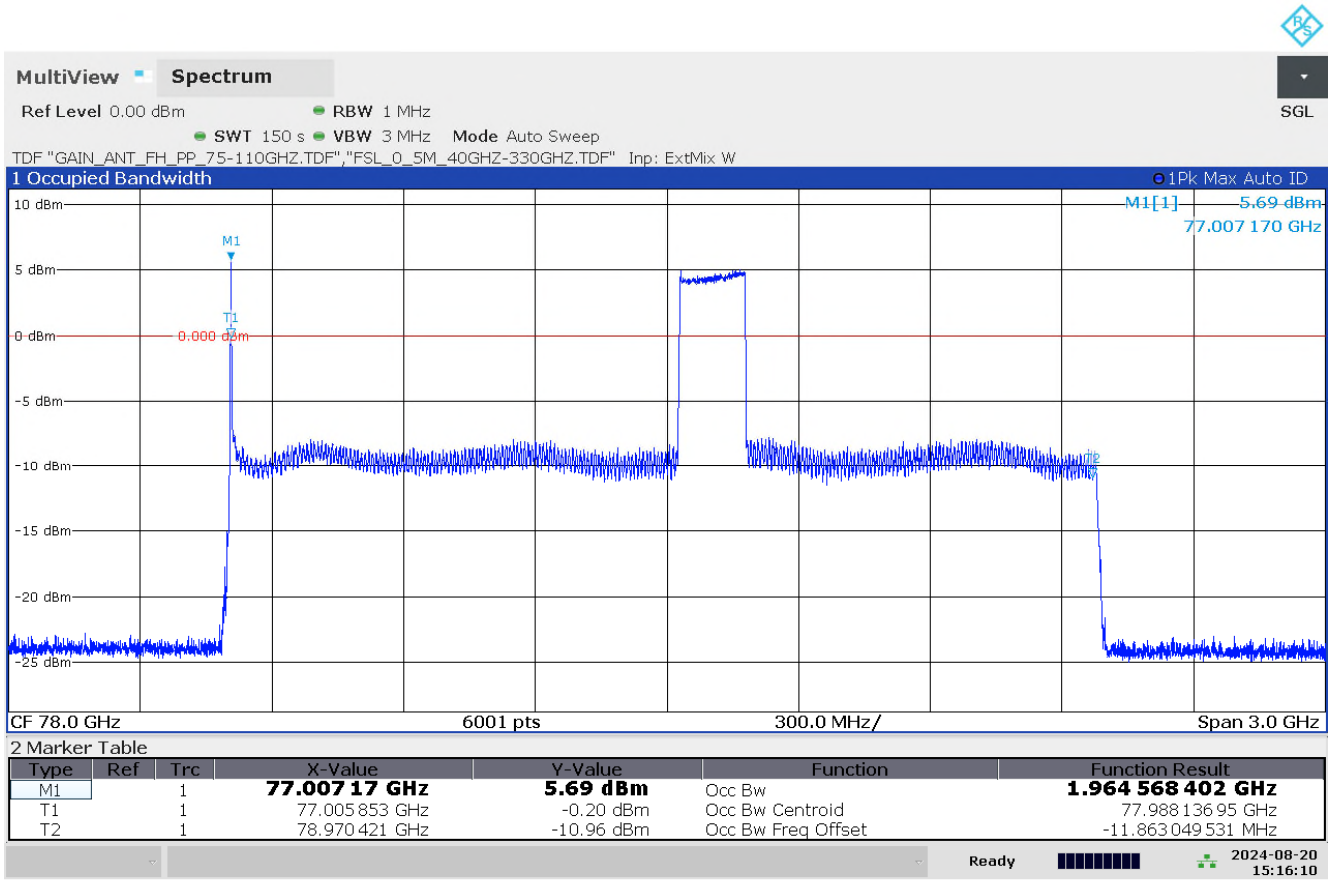
| Parameters | |
|---|---|
| Detector: | Pos-Peak |
| Resolution bandwidth: | 50 MHz |
| Video bandwidth: | 80 MHz |
| Trace-Mode: | Max Hold |

**Results:**

| EUT | TEST CONDITIONS | $f_L$ in GHz | $f_H$ in GHz | Occupied Bandwidth (99%) in GHz | Plot |
|---|---|---|---|---|---|
| **EUT 1** | $T_{nom}$ / $V_{nom}$ | 77.005853 | 78.970421 | 1.964568 | TID111 |

**Verdict:** **Complies**

Plot:
TID111_23-1-0144001T007_99%OBW_AntH_Peak_RBW_1MHz




03:16:10 08/20/2024

## 12.4 Band edge compliance

**Description:**

Investigation of the emission limits at the band edge.

**Limits:** **FCC §95.3379 (a) (2) (i) + (ii) / ANSI C63.10-2020 / 6.10**

| Frequency Range [GHz] | Measurement distance | Power Density |
|---|---|---|
| 40 – 76 and 81 – 200 | 3.0 m | 600 pW/cm$^2$ → -1.7 dBm |

**FCC §95.3367 (a) (b)**

| Frequency Range [GHz] | Power Density |
|---|---|
| 76 - 81 | 50 dBm/MHz (e.i.r.p) |

**Measurement:**

| Parameters | |
|---|---|
| Detector: | RMS |
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Trace-Mode: | Max Hold |

**Measurement results:**

- Results are part of chapter 12.5

**Verdict:** **Complies**

## 12.5 Unwanted emissions

**Description:**

Measurement of the radiated unwanted emissions.

**Limits:**

**FCC §95.3379**

(a) The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

| FCC | | |
|---|---|---|
| CFR Part 95.3379 (a) (1) / CFR Part 95.3379 (a) (3) | | |
| Radiated unwanted emissions | | |
| Frequency (MHz) | Field Strength (µV/m) | Measurement distance (m) |
| 0.009 – 0.490 | 2400/F[kHz] | 300 |
| 0.490 – 1.705 | 24000/F[kHz] | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30  88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 – 960 | 200 | 3 |
| 960 – 40 000 | 500 | 3 |

(i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

| Frequency Range (GHz) | Power Density | EIRP |
|---|---|---|
| 40 – 200 | 600 pW/cm$^2$ @ 3m | -1.7 dBm |
| 200 – 231 | 1000 pW/cm$^2$ @ 3m | +0.5 dBm |

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

**Limit conversion (ANSI C63.10-2020 9.2.3):**

$EIRP[dBm] = 10 \times \log(4 \times \pi \times d^2 \times PD[W/m^2])$

- Power density at the distance specified by the limit: PD [W/m²]
- Equivalent isotropically radiated power: EIRP [dBm]
- Distance at which the power density limit is specified: d [m]

According to this formula, an emission limit of PD = 600 pW/cm² at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -1.7 dBm.

**Measurement:**

| **Measurement parameter** | |
|---|---|
| Detector: | Quasi Peak / Pos-Peak / LinAV / RMS |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 1 MHz |
| Video bandwidth: | F < 1 GHz: 300 kHz<br>F > 1 GHz: 3 MHz |
| Trace-Mode: | Max Hold |

**Measurement results:**

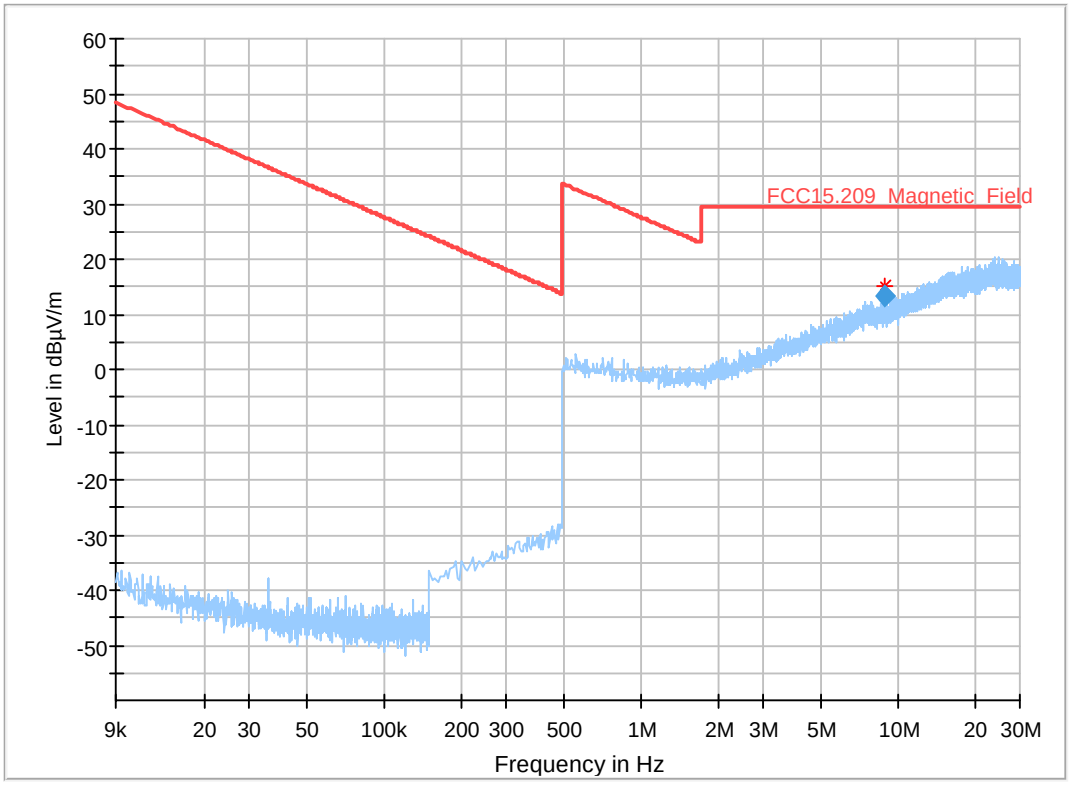
| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| 0.000009 - 0.03 | Max Peak | 0.009 | 13.32 dBµV | 29.54 dBµV | 16.22 |
| 0.03 - 1 | Quasi Peak | 0.12 | 41.31 dBµV | 46 dBµV | 4.69 |
| 1 – 12.4 | Max Peak<br>LinAV | 1 | 61.87 dBµV<br>46.98 dBµV | 74 dBµV<br>54 dBµV | 12.13<br>7.02 |
| 12.4 - 18 | Max Peak<br>LinAV | 1 | 57.65 dBµV<br>51.60 dBµV | 74 dBµV<br>54 dBµV | 16.35<br>2.40 |
| 18 - 40 | Max Peak<br>LinAV | 1 | 63.41 dBµV<br>48.10 dBµV | 74 dBµV<br>54 dBµV | 10.59<br>5.90 |
| 40 - 50 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 50 - 55 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 55 - 65 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 65 - 75 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 75 - 95 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 95 - 110 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 110 - 120 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 120 - 140 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 140 - 150 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 150 - 160 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 160 - 170 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 170 - 180 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 180 - 190 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 190 - 200 | RMS | 1 | *No critical Emission found | -1.7 dBm | Only noise level |
| 200 - 220 | RMS | 1 | *No critical Emission found | 0.5 dBm | Only noise level |
| 220 - 243 | RMS | 1 | *No critical Emission found | 0.5 dBm | Only noise level |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

Note: *No critical Emission found = more than 20 dB from Limit line has considered as no critical emission. Only worst-case result stated in this Table.

**Verdict: Complies**

TID117_RSE_MgField_S12_9kHz-30MHz

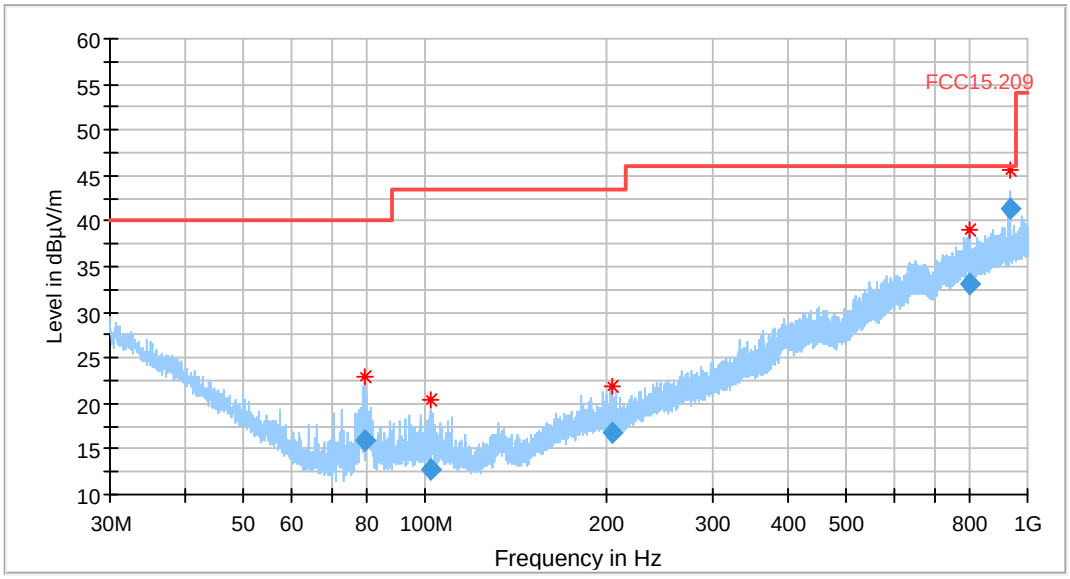
Full Spectrum




# Final_Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|---|---|---|---|---|---|---|---|---|
| **8.870000** | **13.32** | **29.54** | **16.22** | **9.000** | **H** | **216.0** | **-5.7** | **18:19:05 - 23.08.2024** |

TID118_RSE_E-Field_S12_30-1GHz



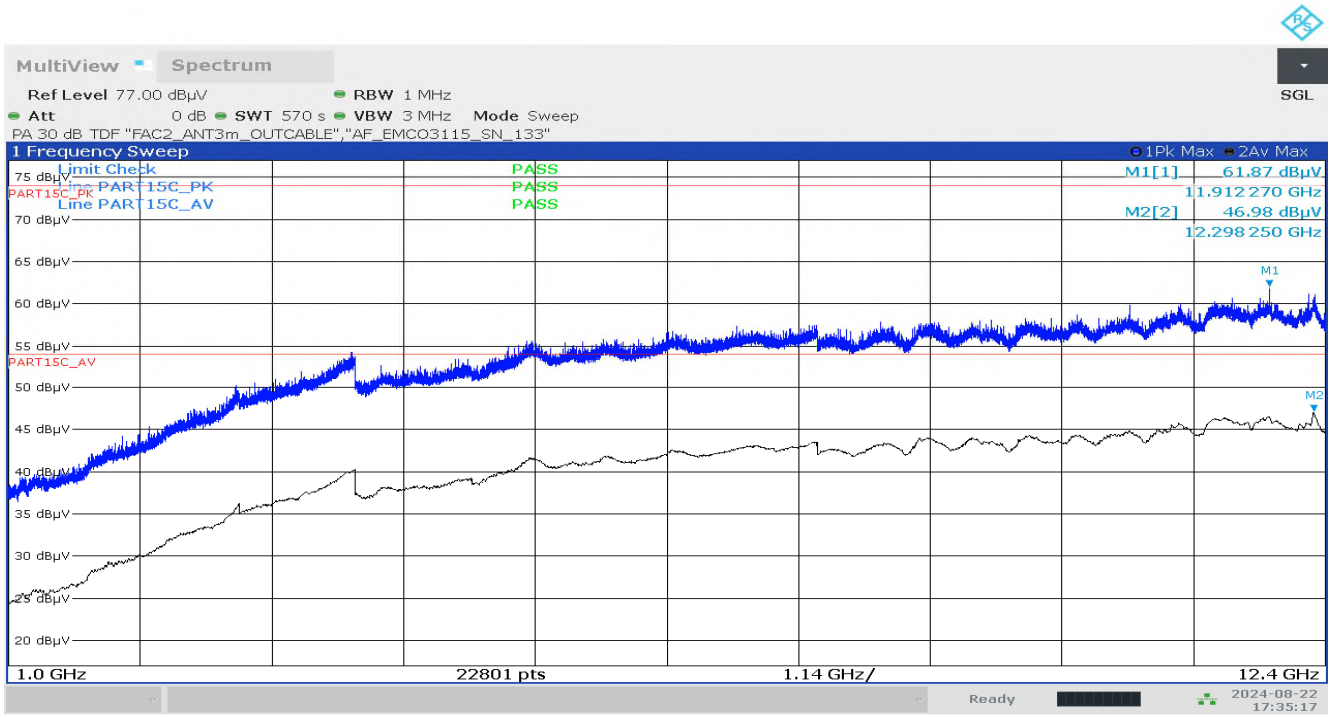

# Final_Result

| Frequency (MHz) | Quasi Peak (dBµV /m) | Limit (dBµV /m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Sig Path (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 79.723000 | 15.99 | 40.00 | 24.01 | 120.000 | 137.0 | V | 60.0 | 6.9 | 0.0 |
| 101.843000 | 12.66 | 43.50 | 30.84 | 120.000 | 121.0 | V | 252.0 | 7.7 | 0.0 |
| 204.315000 | 16.78 | 43.50 | 26.72 | 120.000 | 109.0 | V | 70.0 | 11.1 | 0.0 |
| 798.635000 | 33.08 | 46.00 | 12.92 | 120.000 | 163.0 | H | 92.0 | 25.5 | 0.0 |
| 934.805000 | 41.31 | 46.00 | 4.69 | 120.000 | 264.0 | V | 0.0 | 27.1 | 0.0 |

**(continuation of the "Final_Result" table from column 17 ...)**

| Frequency (MHz) | Preamp (dB) | Trd Corr. (dB/m) | Raw Rec (dBµV) | Comment |
|---|---|---|---|---|
| 79.723000 | 0.9 | 6.0 | 9.1 | 19:17:17 - 23.08.2024 |
| 101.843000 | 0.9 | 6.8 | 4.9 | 19:22:16 - 23.08.2024 |
| 204.315000 | 1.4 | 9.7 | 5.7 | 19:12:41 - 23.08.2024 |
| 798.635000 | 3.1 | 22.4 | 7.6 | 19:07:47 - 23.08.2024 |
| 934.805000 | 3.4 | 23.7 | 14.2 | 19:27:26 - 23.08.2024 |

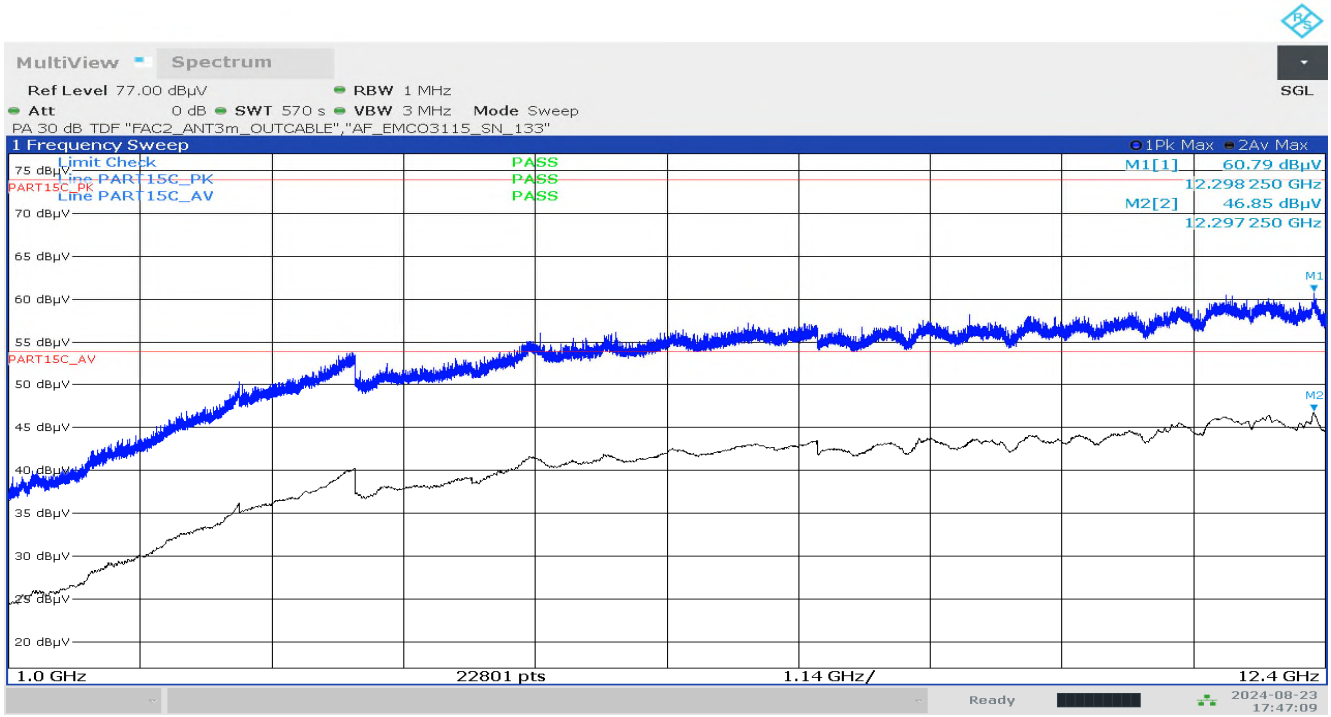
TID119a__RSE_TX_S12_1-12.4GHz__AntH




05:35:17 08/22/2024

Note:
Limit Line: Peak: 74 dBµV, Average: 54 dBµV,
Result: Peak: Pass, Average: Pass.

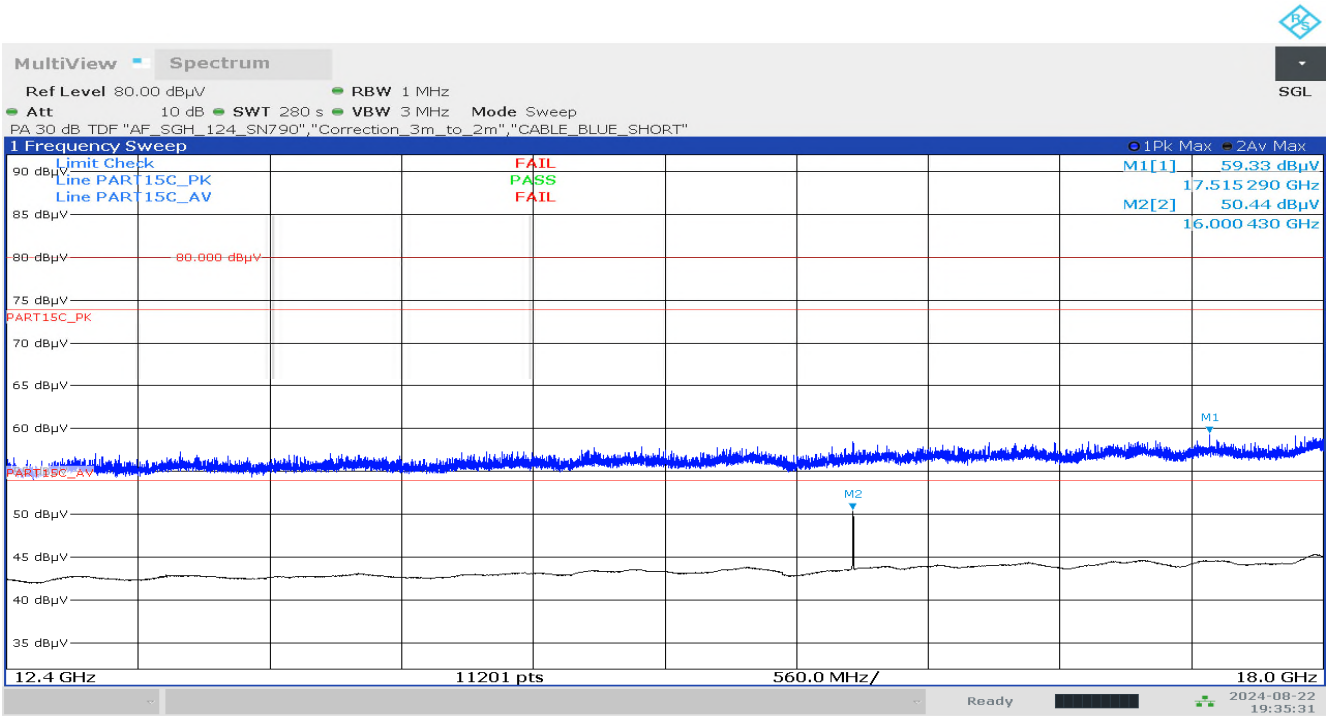
TID119b__RSE_TX_S12_1-12.4GHz__AntV




05:47:09 08/23/2024

Note:
Limit Line: Peak: 74 dBµV, Average: 54 dBµV,
Result: Peak: Pass, Average: Pass.

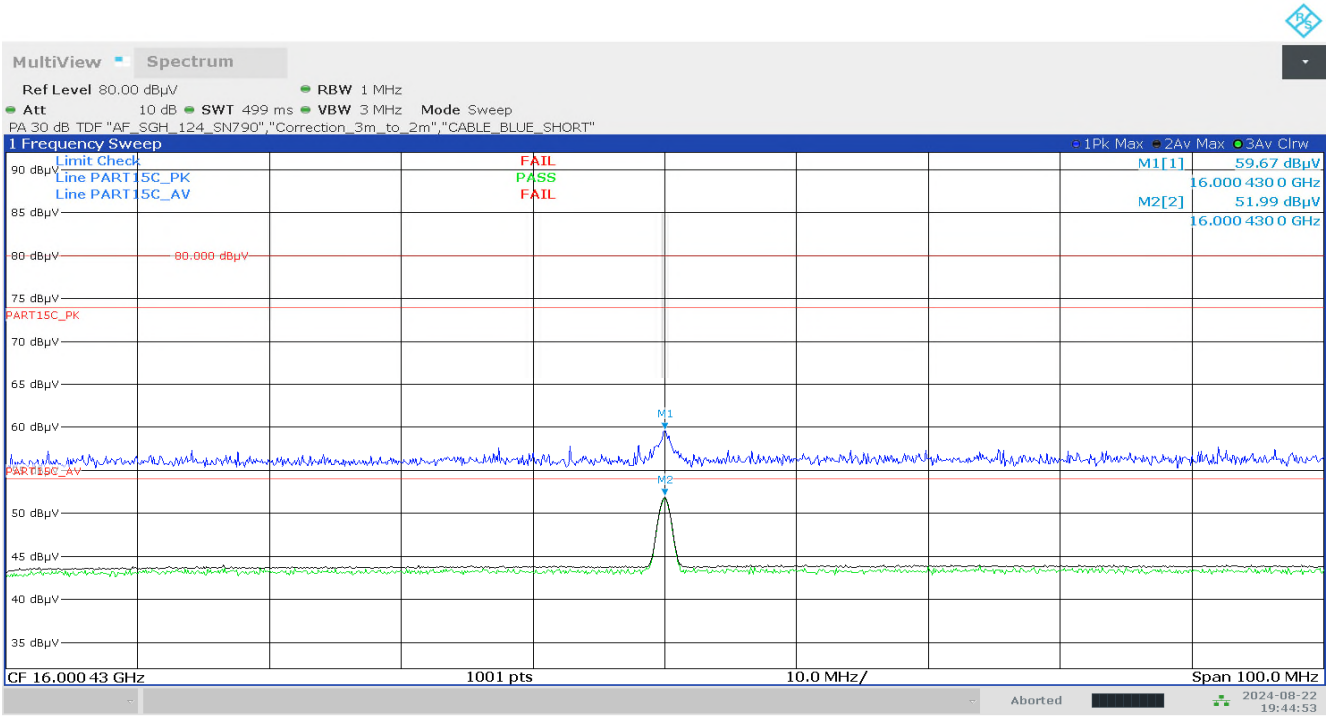
TID120a__RSE_TX_S12_12.4-18GHz__AntH




07:35:32 08/22/2024

Note: Maximum Emission found at 16.000430 GHz (M2) with average detector, for Final test check below test TID120a_02 with Zero span, Limit line: Peak: 74 dBµV, Average: 54 dBµV.

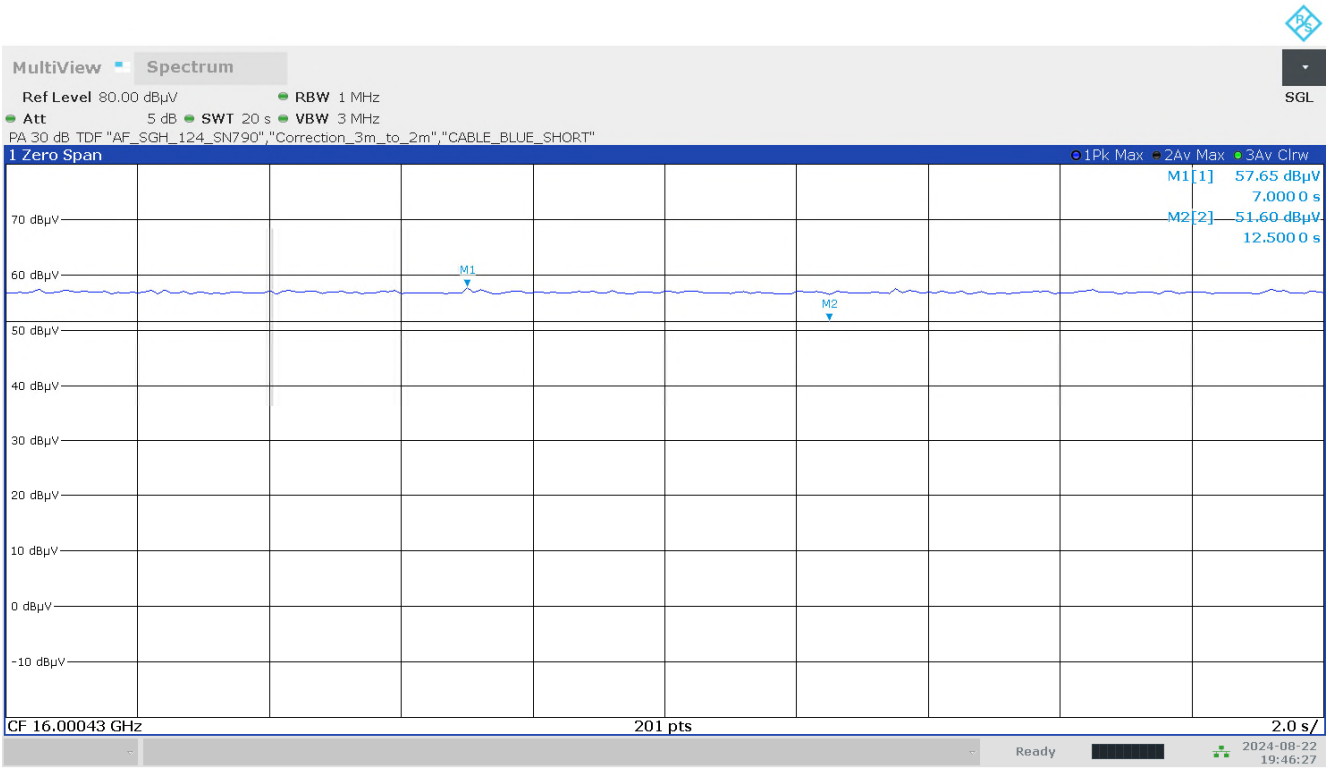
TID120a_01_S12_f1_16GHz_A138deg_E95deg__AntH




07:44:53 08/22/2024

Note: Maximum Emission search and found at TT138°, TD95°

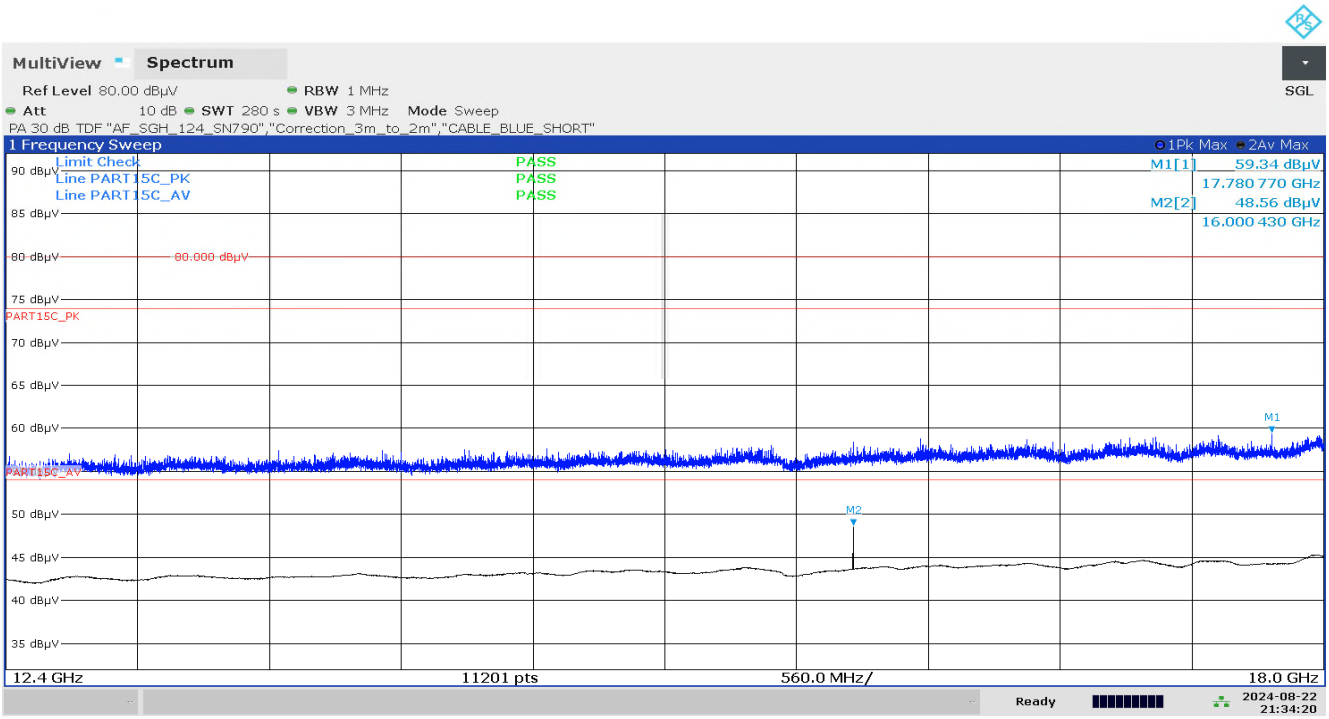
TID120a_02_S12_f1_16GHz_ZeroSpan_100ms_A138deg_E95deg__AntH




Note:
Maximum Emission found with Average Detector: 51.60 dBµV, Limit Line: 54 dBµV, Result: Pass.

Maximum Emission found with Peak Detector: 57.65 dBµV, Limit Line: 74 dBµV, Result: Pass.

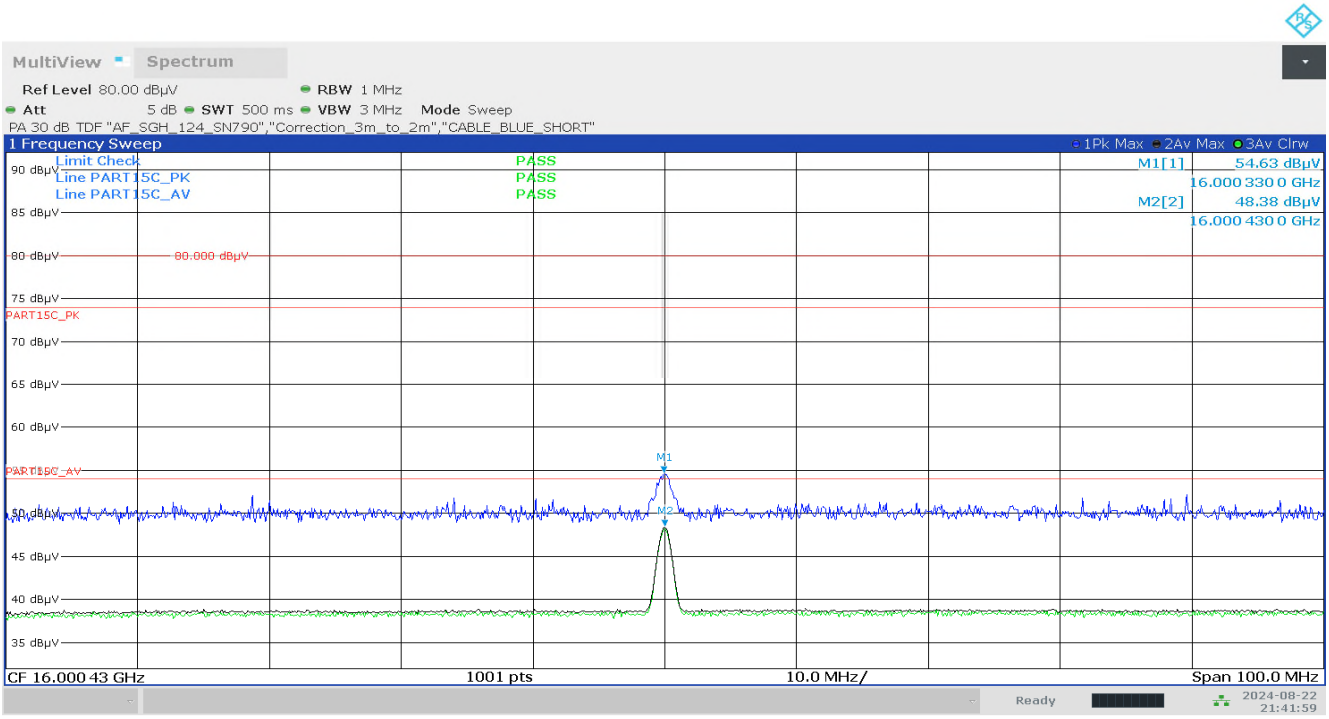
TID120b__RSE_TX_S12_12.4-18GHz__AntV




09:34:20 08/22/2024

Note: Maximum Emission found at 16.000430 GHz (M2) with average detector, for Final test check below test TID120a_02 with Zero span, Limit line: Peak: 74 dBµV, Average: 54 dBµV.

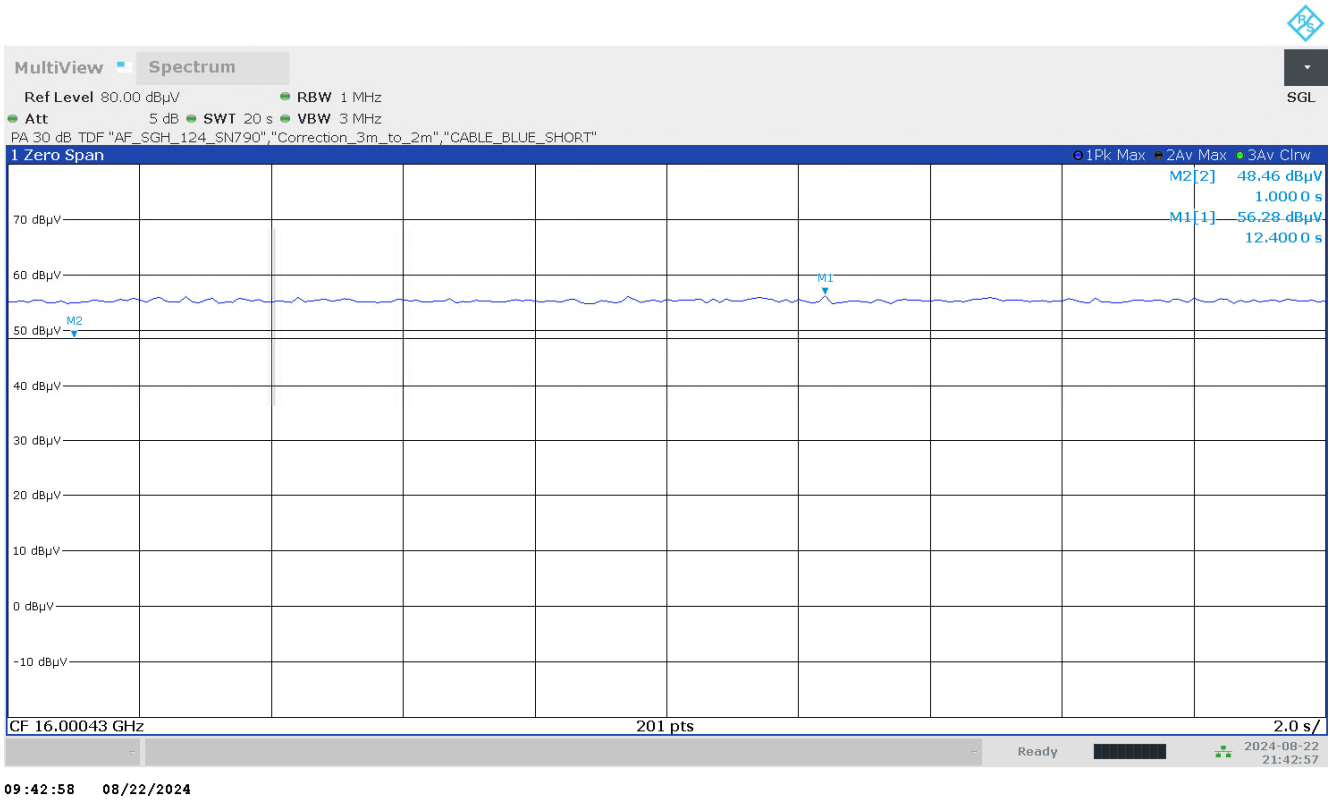
TID120b_01_S12_f1_16GHz_A329deg_E11deg__AntV




09:41:59 08/22/2024

Note: Maximum Emission search and found at TT329°, TD11°

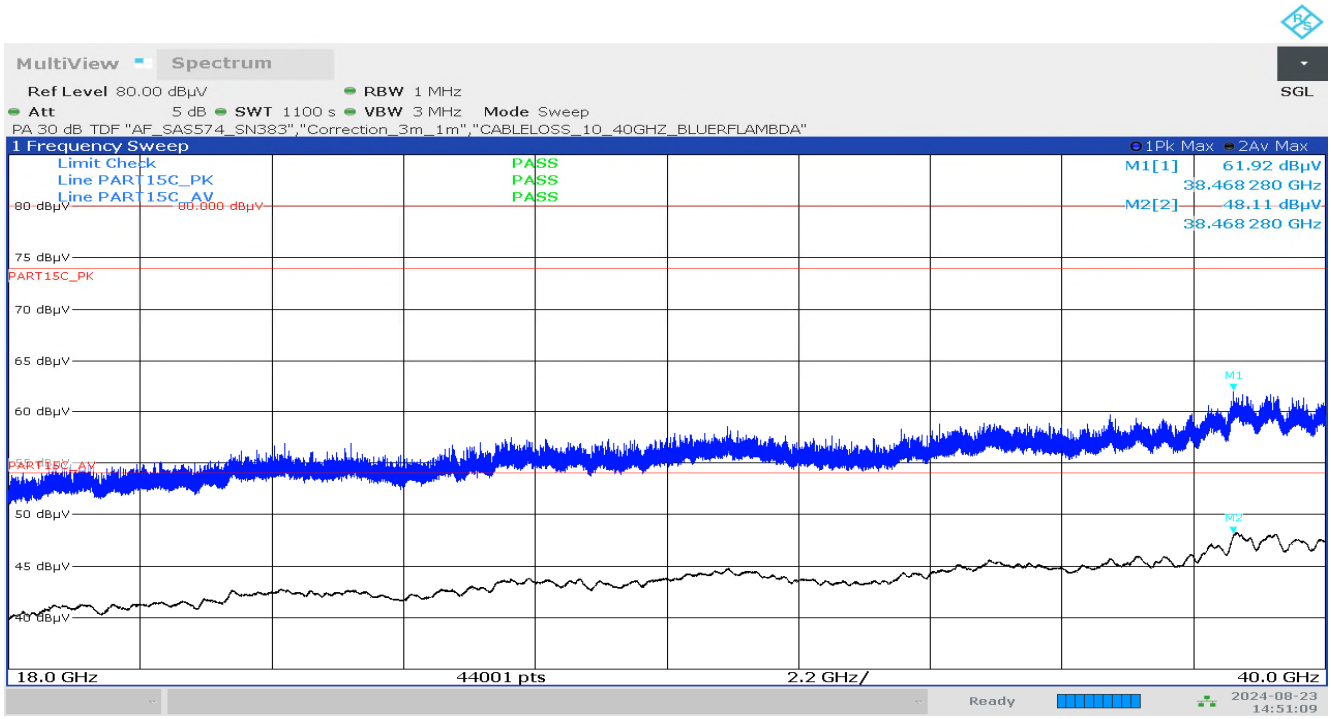
TID120b_02_S12_f1_16GHz_ZeroSpan_100ms_A329deg_E11deg__AntV




Note:
Maximum Emission found with Average Detector: 48.46 dBµV, Limit Line: 54 dBµV, Result: Pass.

Maximum Emission found with Peak Detector: 56.28 dBµV, Limit Line: 74 dBµV, Result: Pass.

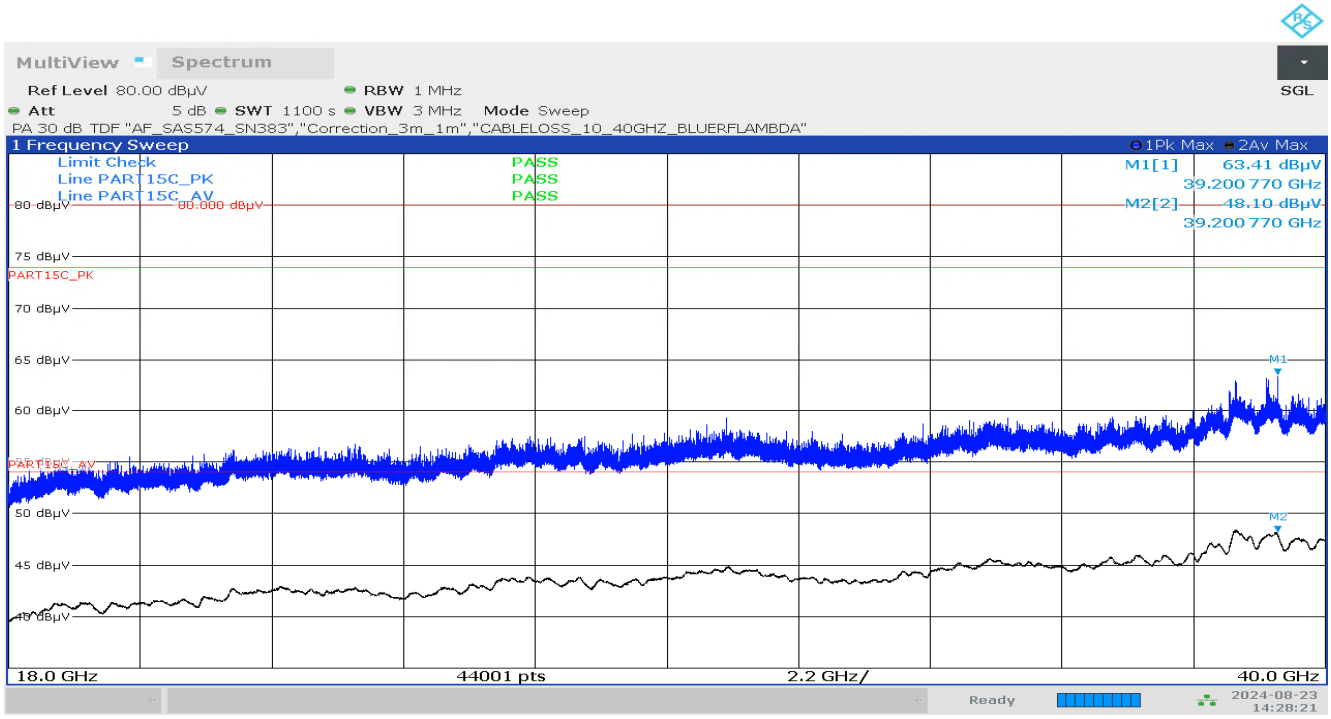
TID121a__RSE_TX_S12_18-40GHz__AntH




02:51:10 08/23/2024

Note:
Limit Line: Peak: 74 dBµV, Average: 54 dBµV,
Result: Peak: Pass, Average: Pass.

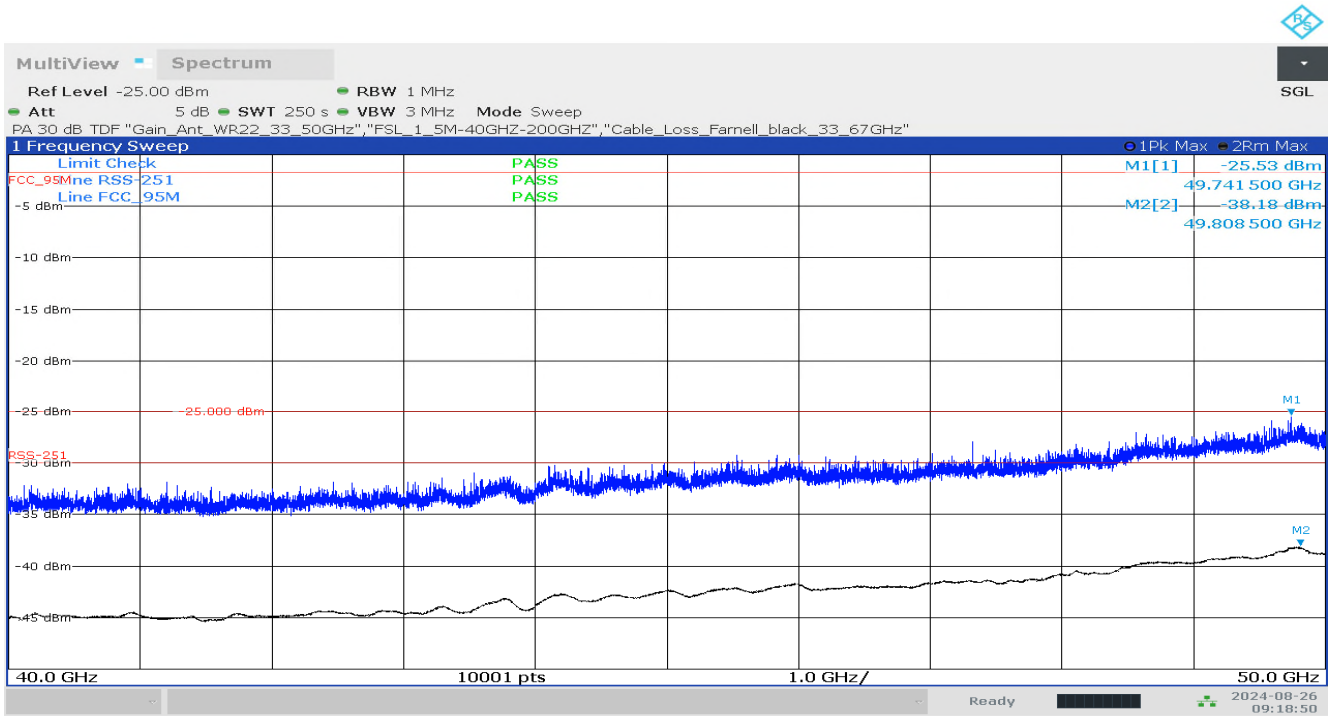
TID121b__RSE_TX_S12_18-40GHz__AntV




02:28:22 08/23/2024

Note:
Limit Line: Peak: 74 dBµV, Average: 54 dBµV,
Result: Peak: Pass, Average: Pass.

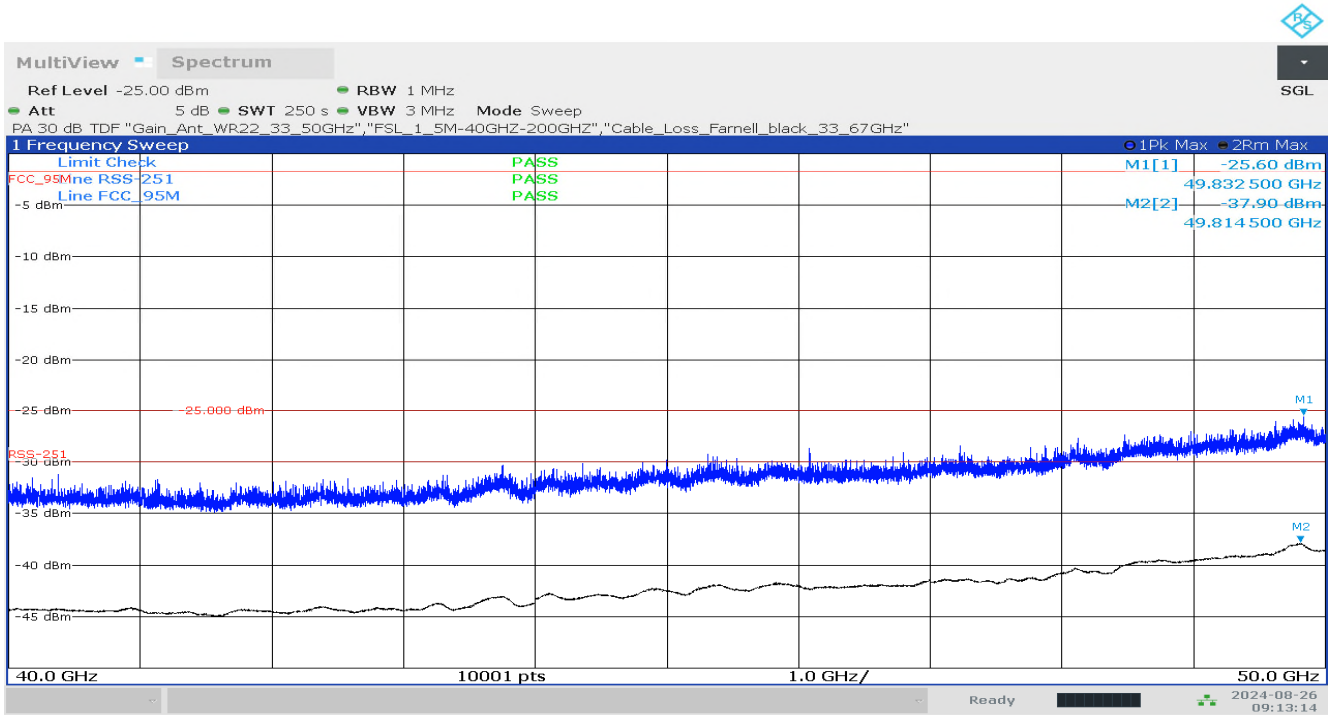
TID122a__RSE_TX_S12_40G-50GHz__AntH




09:18:51 08/26/2024

Note: No Critical Emission found, Only Noise Level from Spectrum Analyzer.

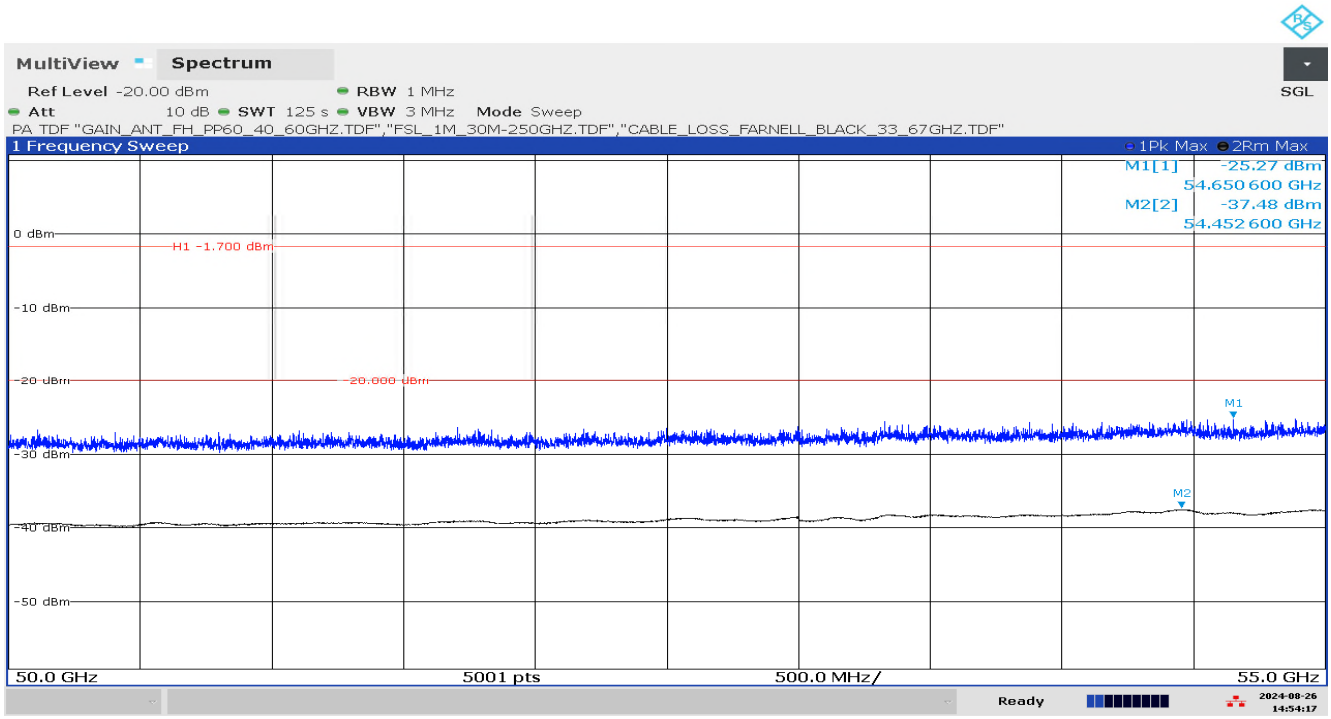
TID122b__RSE_TX_S12_40G-50GHz__AntV




09:13:14 08/26/2024

Note: No Critical Emission found, Only Noise Level from Spectrum Analyzer.

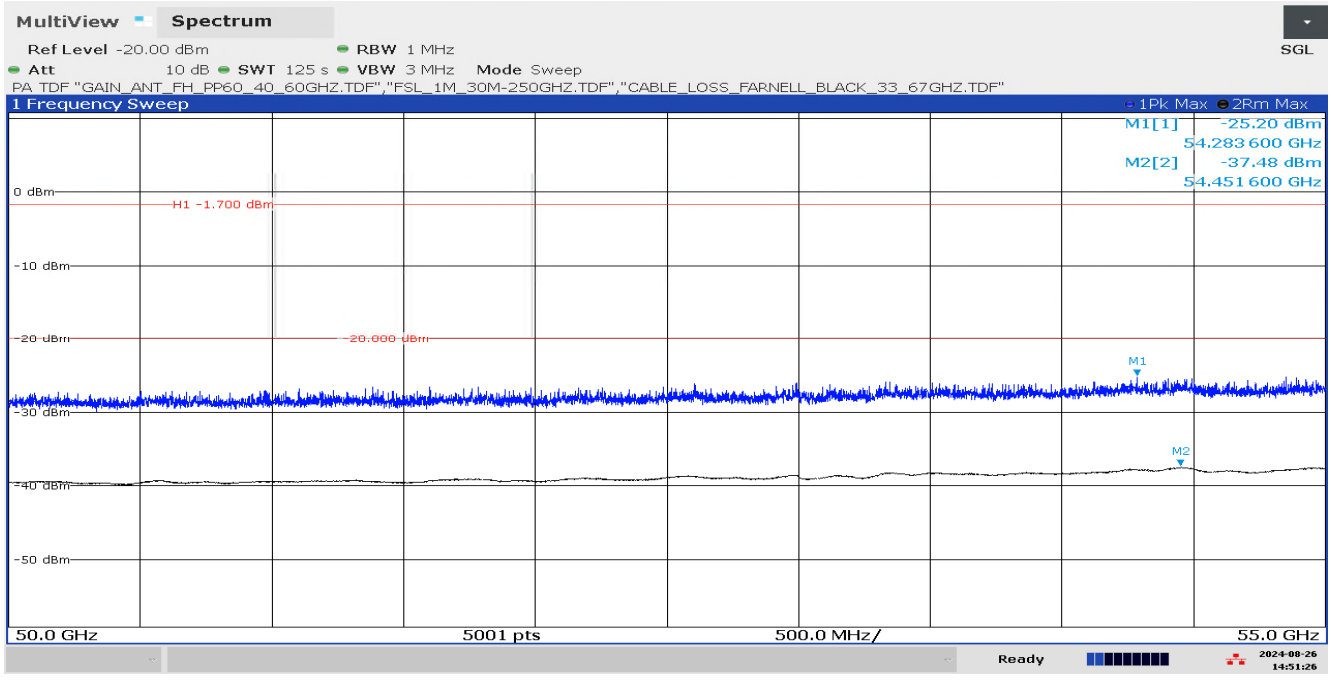
TID223a_23-1-0144001T007_RSE_50 G - 55 GHz_FCC_AntH




02:54:17 PM 08/26/2024

Note: No Critical Emission found, Only Noise Level from Spectrum Analyzer.

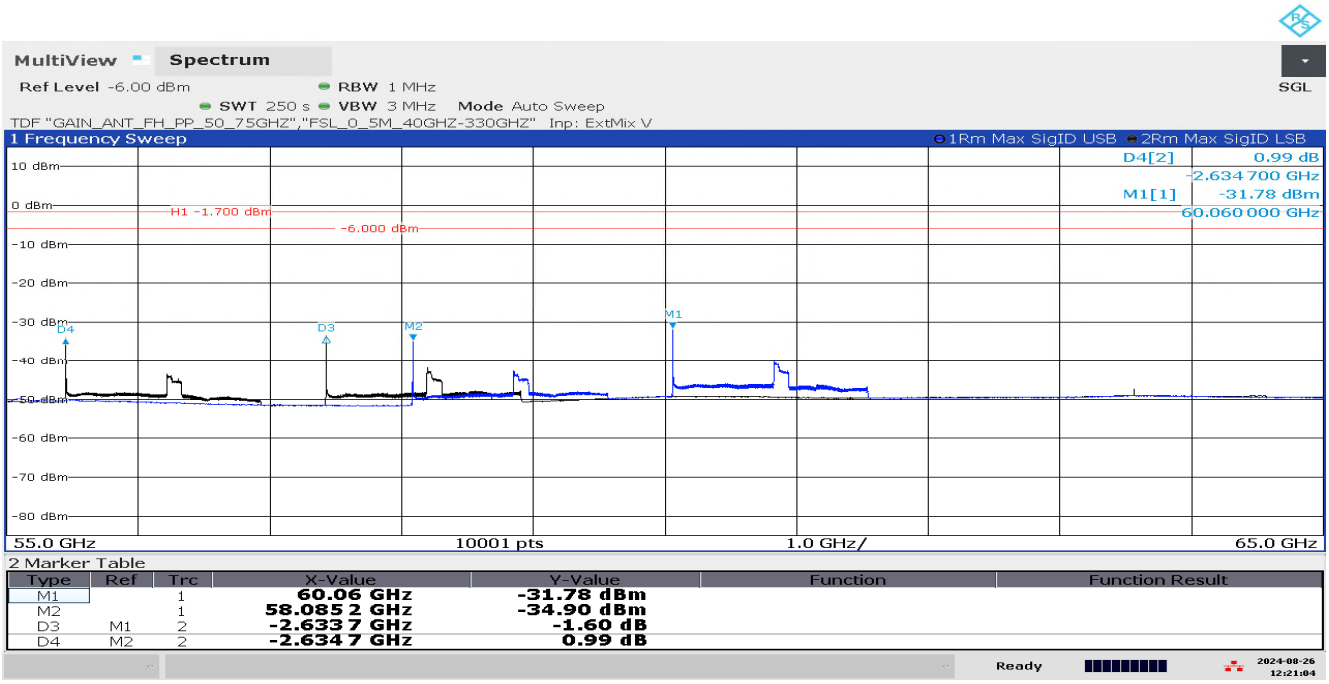
TID223b_23-1-0144001T007_RSE_50 G - 55 GHz_FCC_AntV




02:51:26 PM 08/26/2024

Note: No Critical Emission found, Only Noise Level from Spectrum Analyzer.

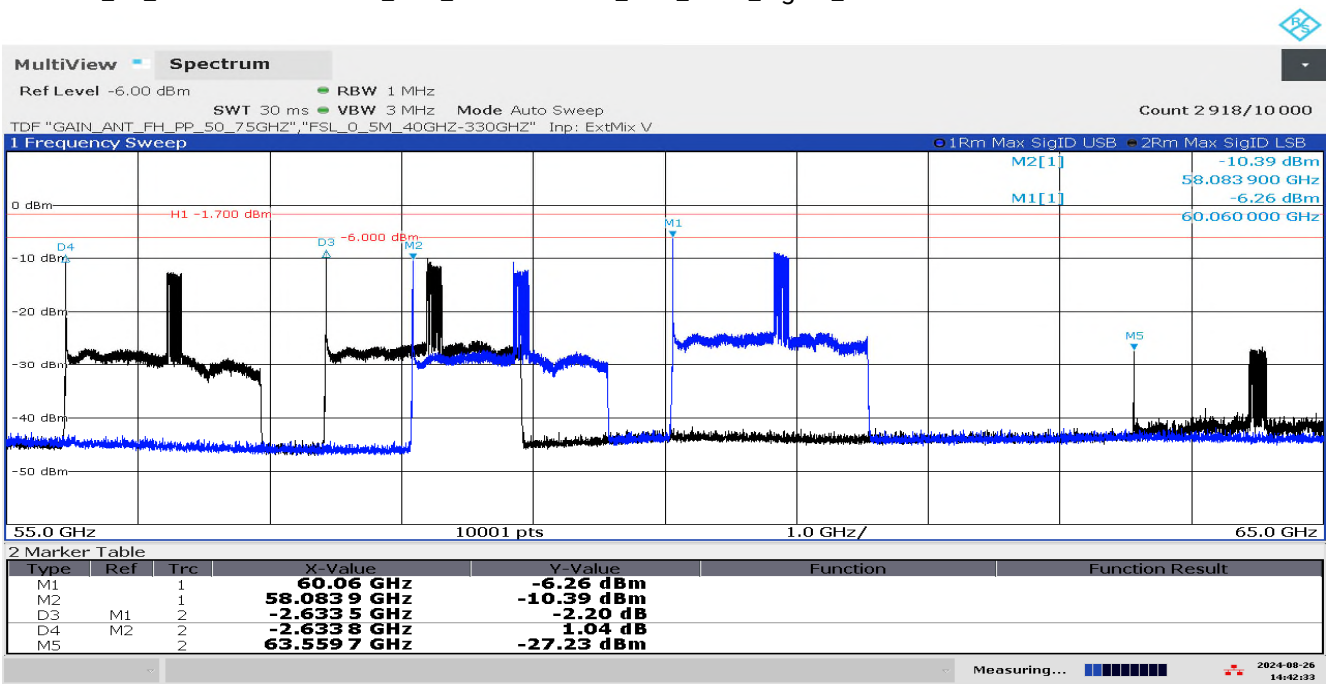
TID224a_23-1-0144001T007_RSE_55 G - 65 GHz_FCC_AntH




12:21:04 PM 08/26/2024

Note: No Critical emission found, only image signal, check below TID224a_01 for more information.

TID224a_01_23-1-0144001T007_RSE_55 G - 65 GHz_FCC_AntH_signal_id



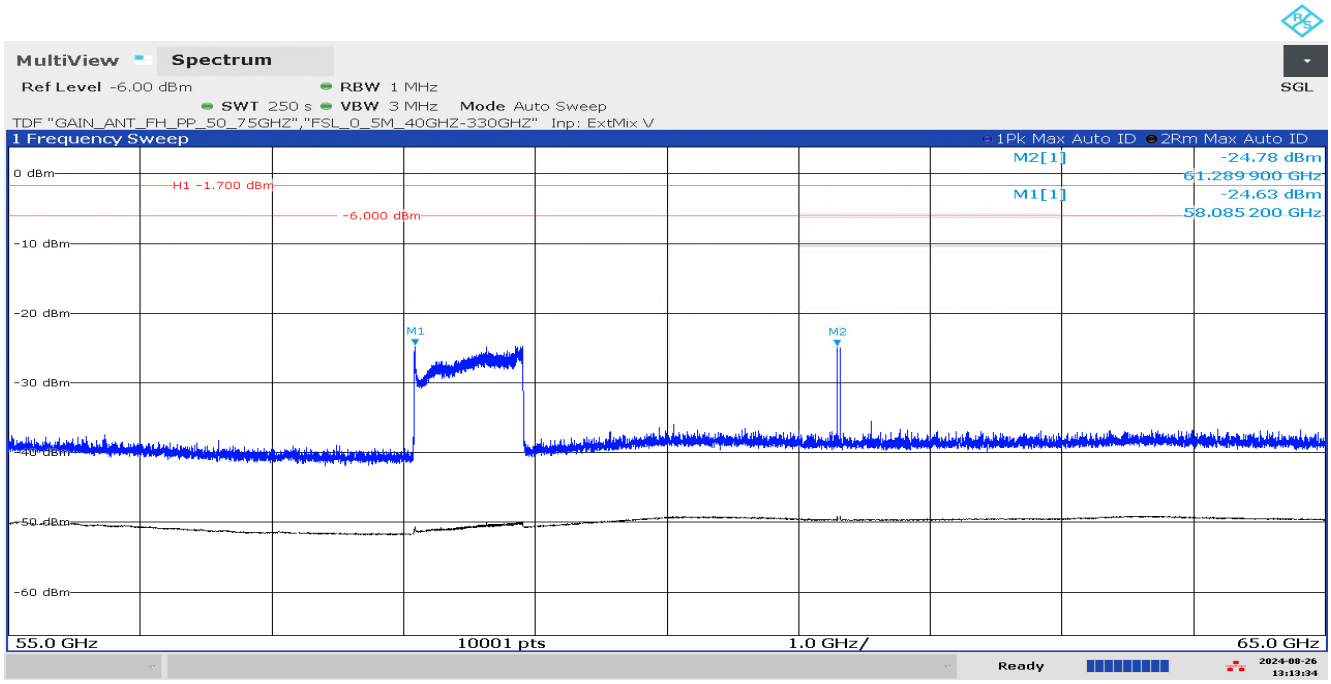

02:42:33 PM 08/26/2024

Note: Continuous Sweep with auto sweep time to verify image/ghost signals, only for information.

All are Image/Ghost Signals, since Mixer products are used.

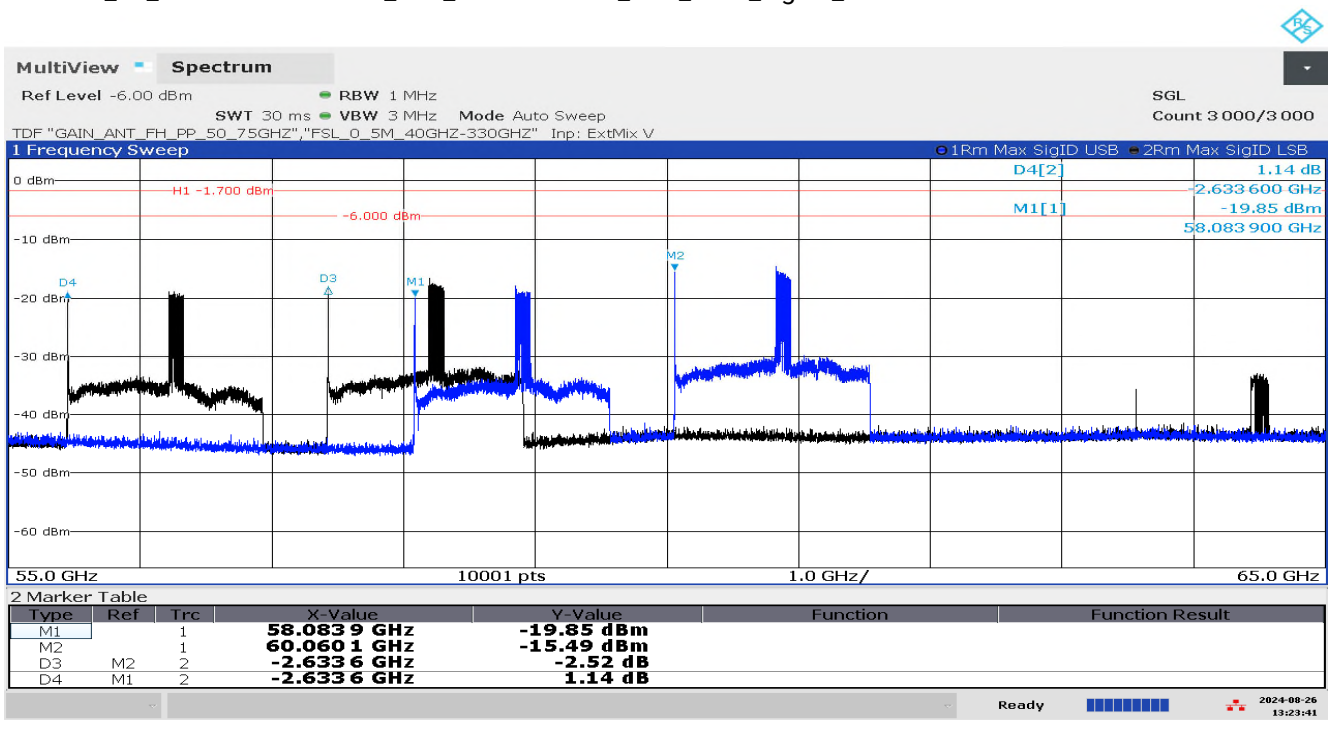
Image/Ghost Signal: Signals, which are not overlapping(USB+LSB), Real Signal: Signals, which are overlapping(USB+LSB).

TID224b_23-1-0144001T007_RSE_55 G - 65 GHz_FCC_AntV_auto_id




Note: No critical Emission found, only image/ghost signals, for more information check below TID224b_01

TID224b_01_23-1-0144001T007_RSE_55 G - 65 GHz_FCC_AntV_signal_id

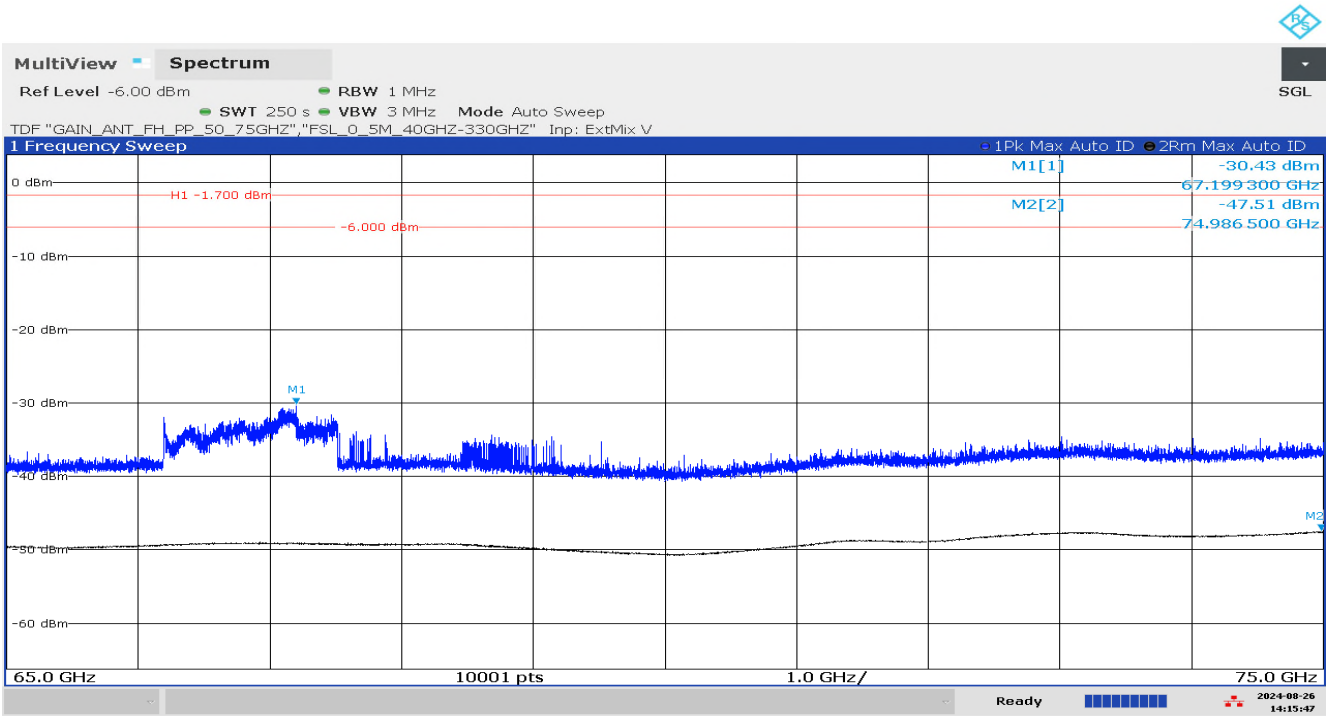



Note: Continuous Sweep with auto sweep time to verify image/ghost signals, only for information.

All are Image/Ghost Signals, since Mixer products are used.

Image/Ghost Signal: Signals, which are not overlapping(USB+LSB), Real Signal: Signals, which are overlapping(USB+LSB).

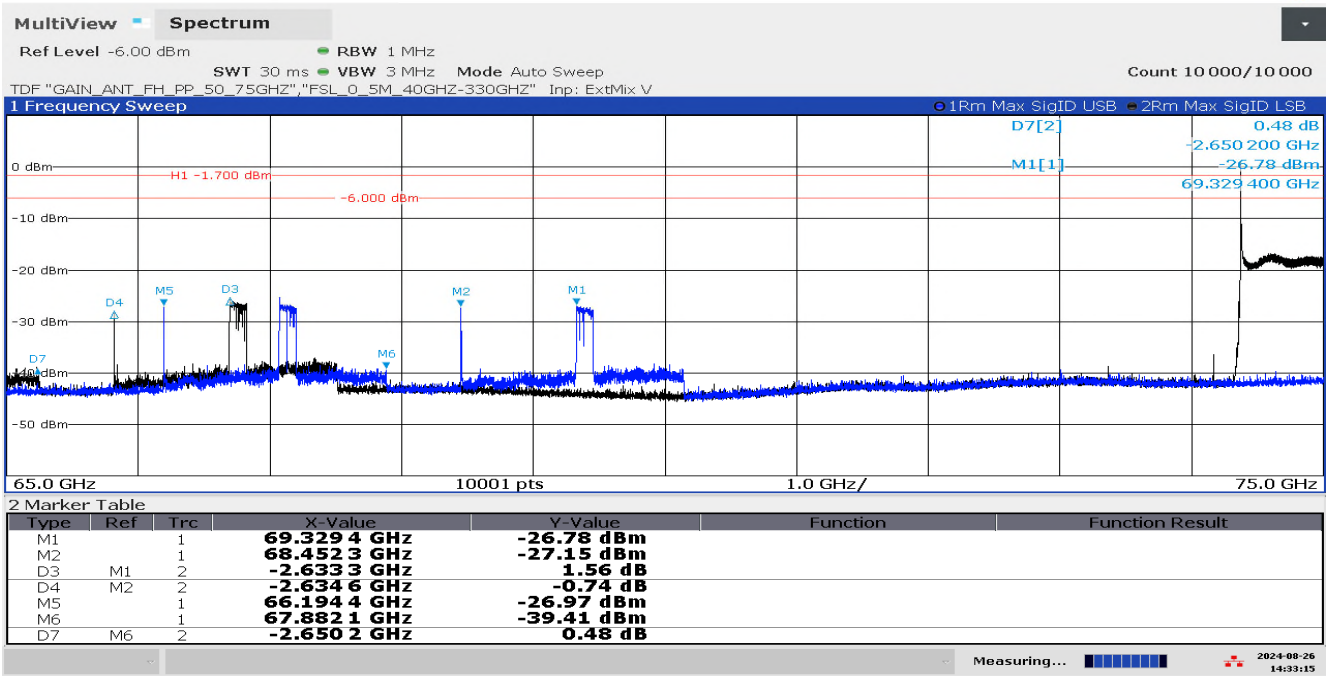
TID225a_23-1-0144001T007_RSE_65 G - 75 GHz_FCC_AntH




02:15:47 PM 08/26/2024

Note: No Critical Emission found, only image signal, check TID225a_02 below for more information.

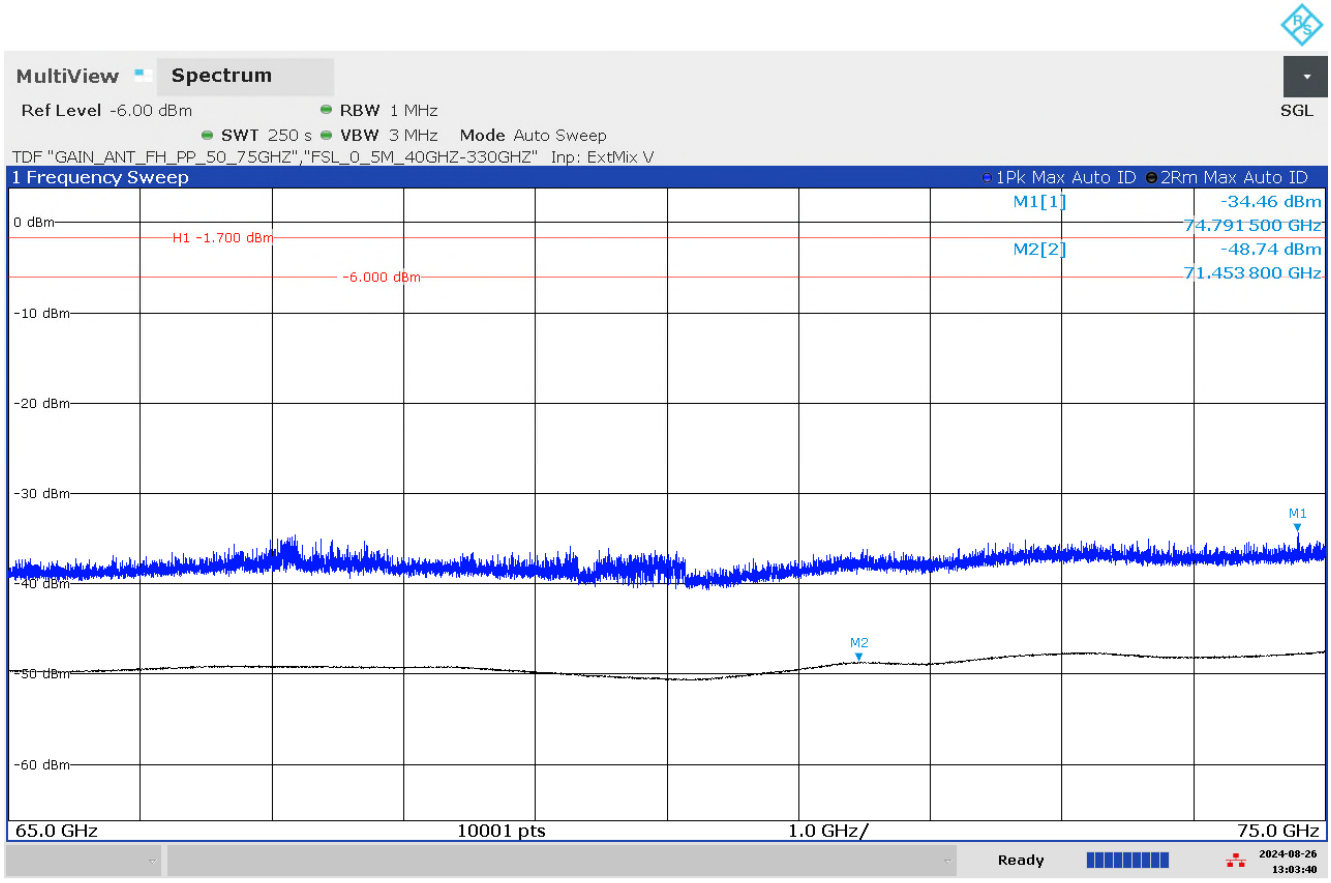
TID225a_02_23-1-0144001T007_RSE_65 G - 75 GHz_FCC_AntH_signal_id




02:33:15 PM 08/26/2024

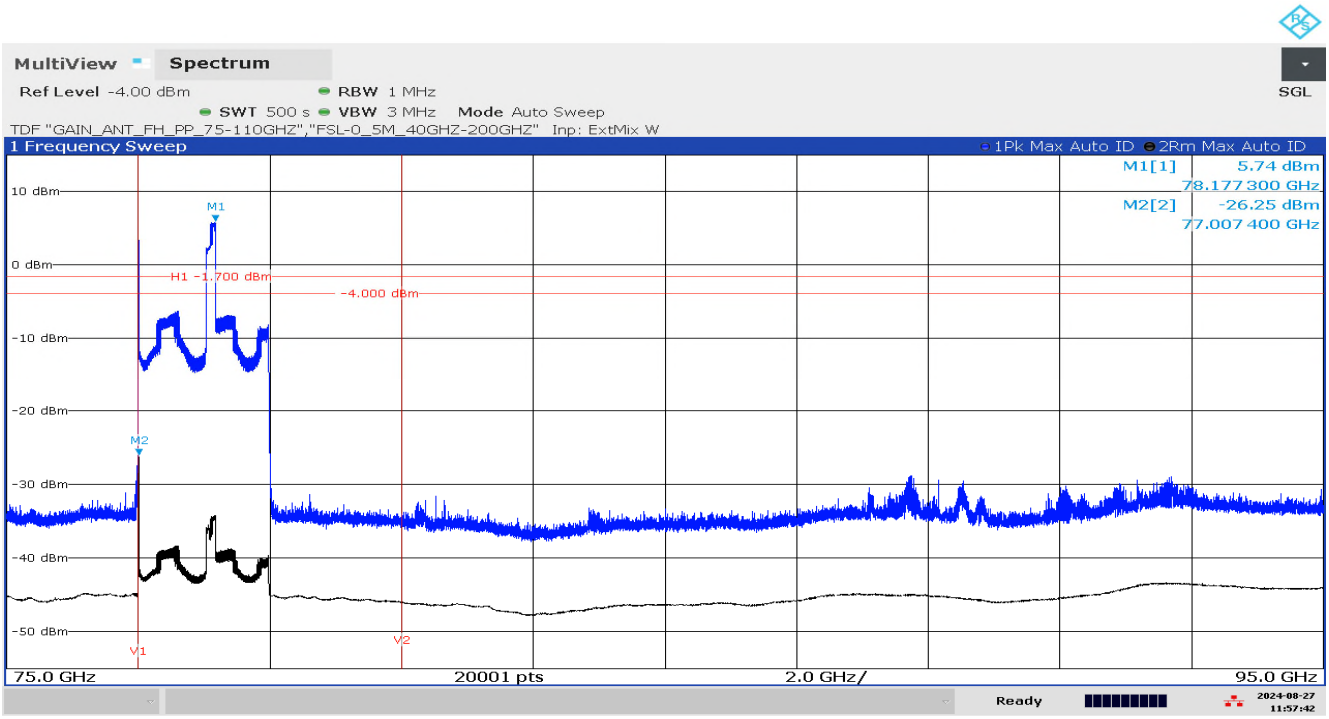
Note: Signal ID functions are activated to verify image / ghost signals. No critical Emission found, only image signal.

TID225b_23-1-0144001T007_RSE_65 G - 75 GHz_FCC_AntV



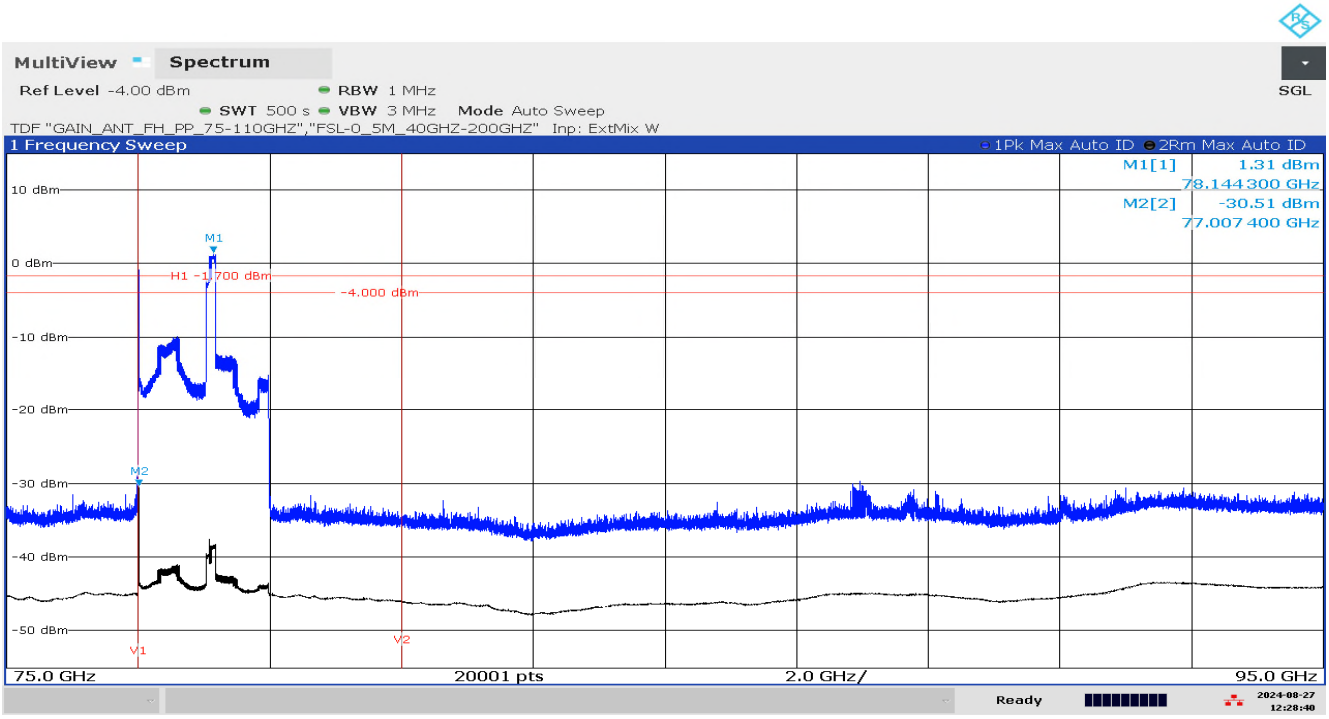

01:03:40 PM 08/26/2024

TID226a_23-1-0144001T007_RSE_75 G - 95 GHz_FCC_AntH



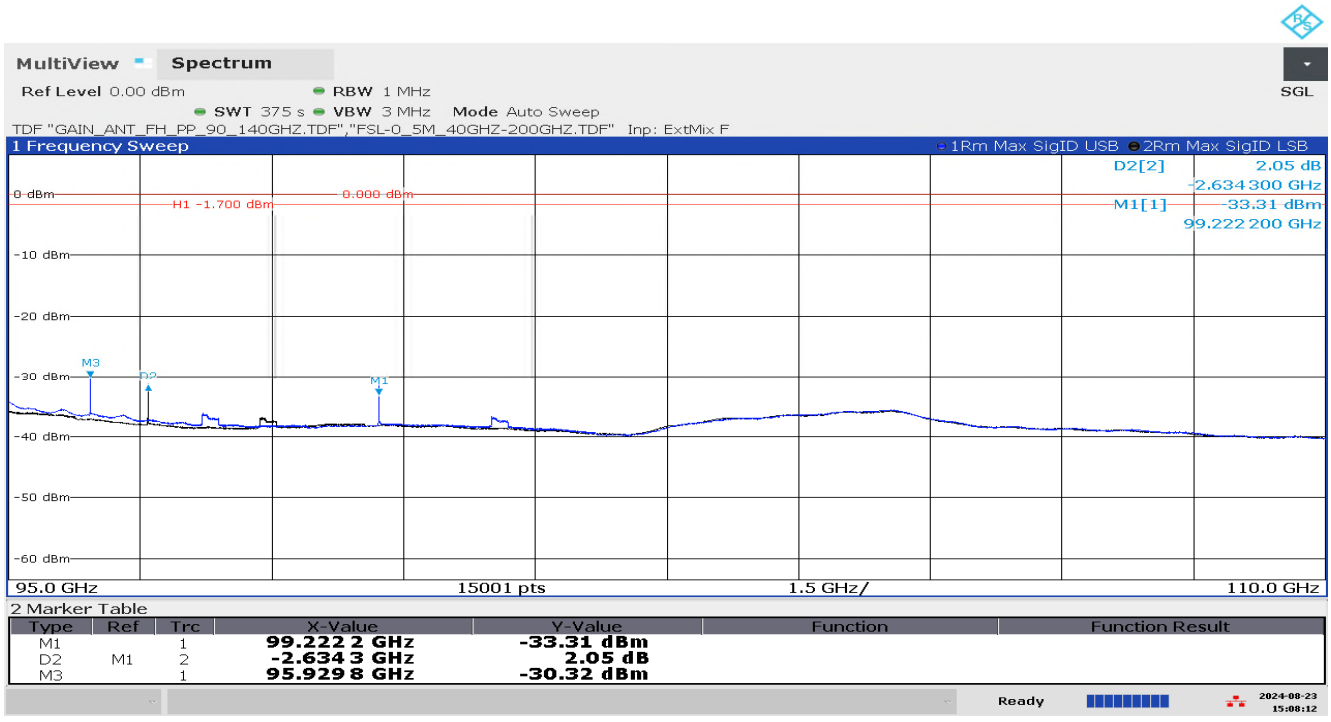

Note: In this Plot, V1 = 77 GHz, V2 = 81 GHz, RADAR active from 77 – 79 GHz. No critical Emission found.

TID226b_23-1-0144001T007_RSE_75 G - 95 GHz_FCC_AntV




Note: In this Plot, V1 = 77 GHz, V2 = 81 GHz, RADAR active from 77 – 79 GHz. No critical Emission found.

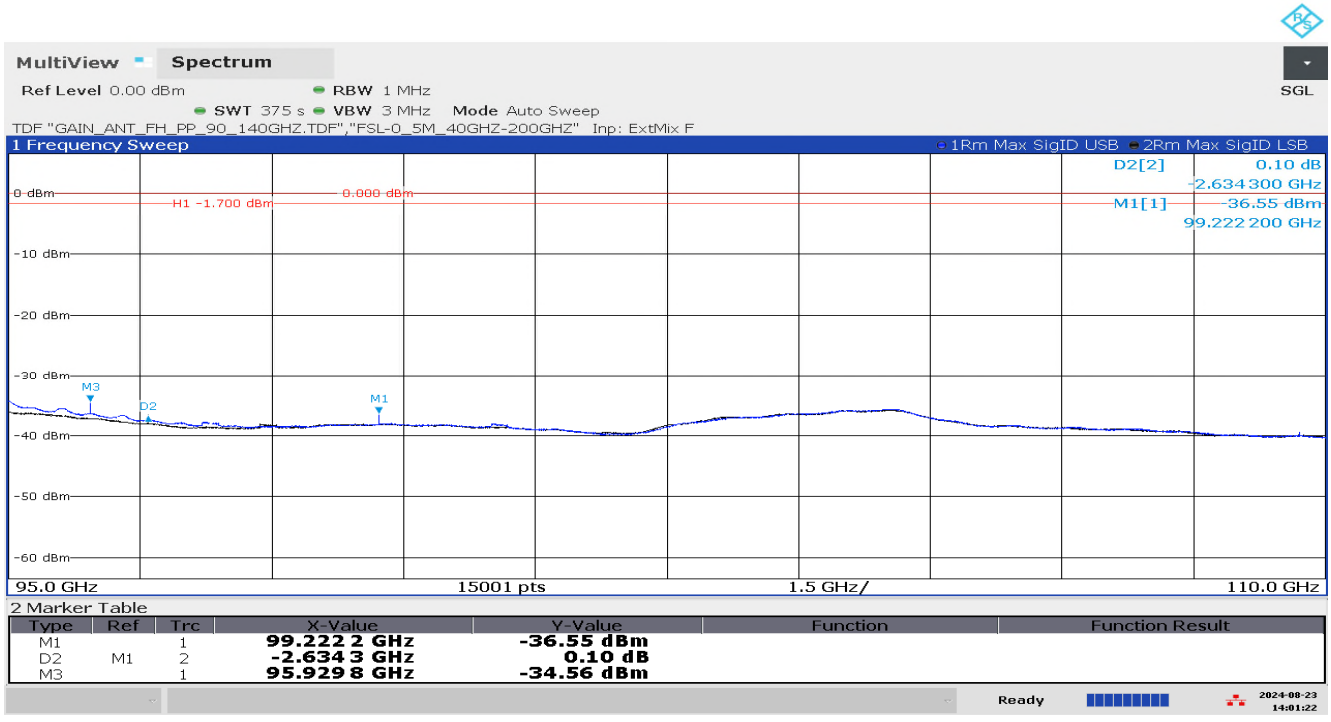
TID227_01a_23-1-0144001T007_RSE_95 G - 110 GHz_FCC_AntH




03:08:12 PM 08/23/2024

Note: Signal ID functions are activated to verify image / ghost signals. No critical Emission found, only image signal.

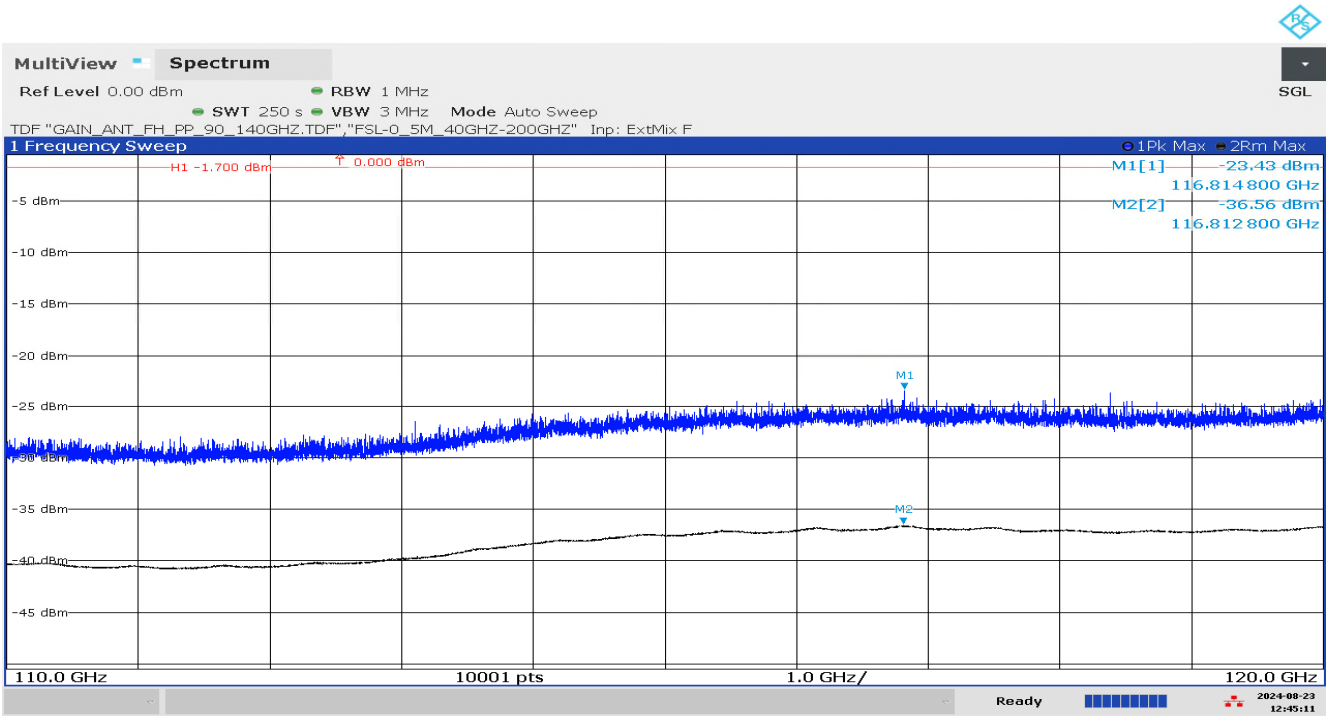
TID227_01b_23-1-0144001T007_RSE_95 G - 110 GHz_FCC_AntV




02:01:23 PM 08/23/2024

Note: Signal ID functions are activated to verify image / ghost signals. No critical Emission found, only image signal.

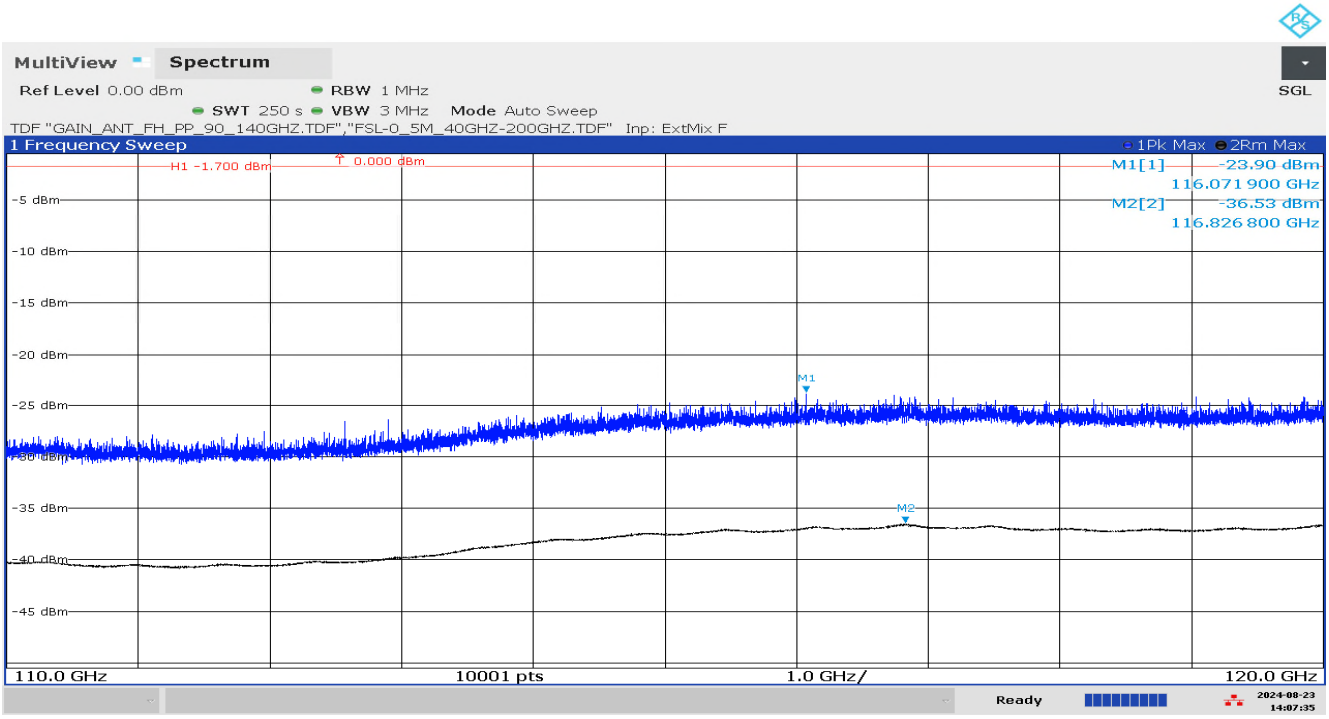
TID227_02a_23-1-0144001T007_RSE_110 G - 120 GHz_FCC_AntH




12:45:11 PM 08/23/2024

Note: No critical Emission found, only noise level from Spectrum Analyzer.

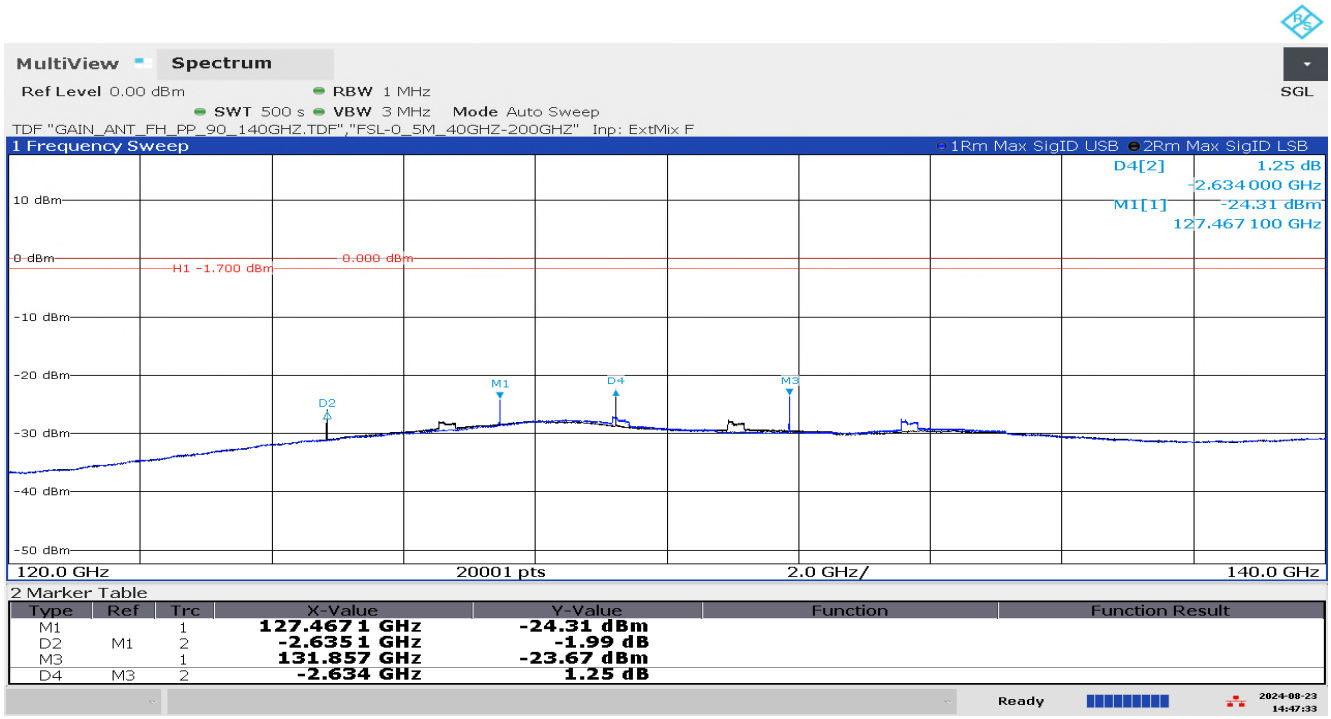
TID227_02b_23-1-0144001T007_RSE_110 G - 120 GHz_FCC_AntV




02:07:36 PM 08/23/2024

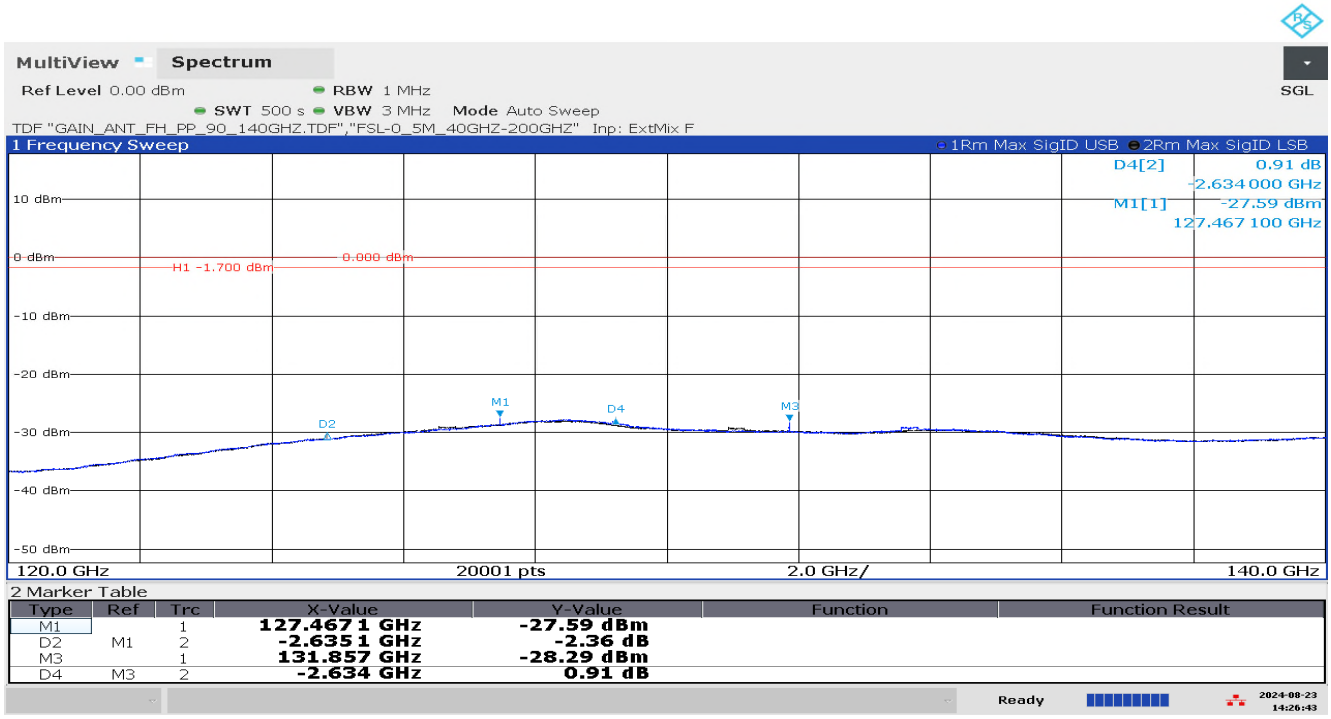
Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID227_03a_23-1-0144001T007_RSE_120 G - 140 GHz_FCC_AntH



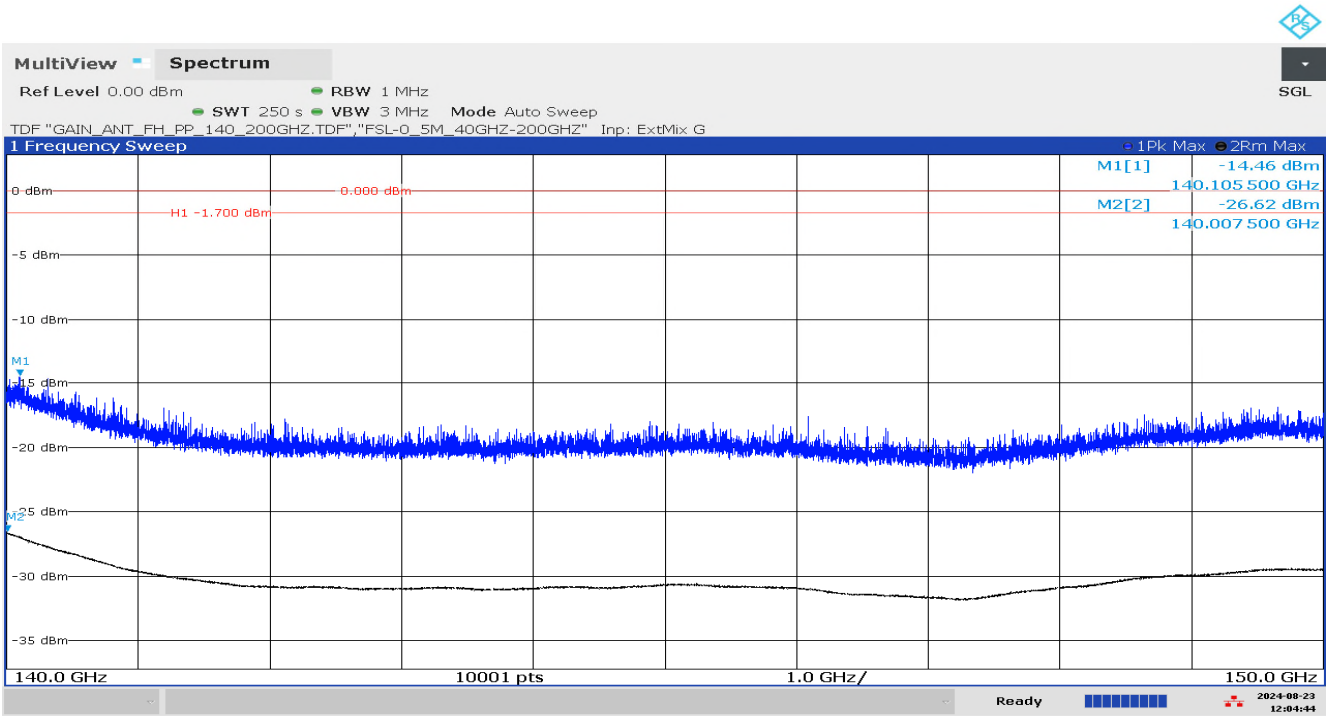

Note: Signal ID functions are activated to verify image / ghost signals. No critical Emission found, only image signal

TID227_03b_23-1-0144001T007_RSE_120 G - 140 GHz_FCC_AntV



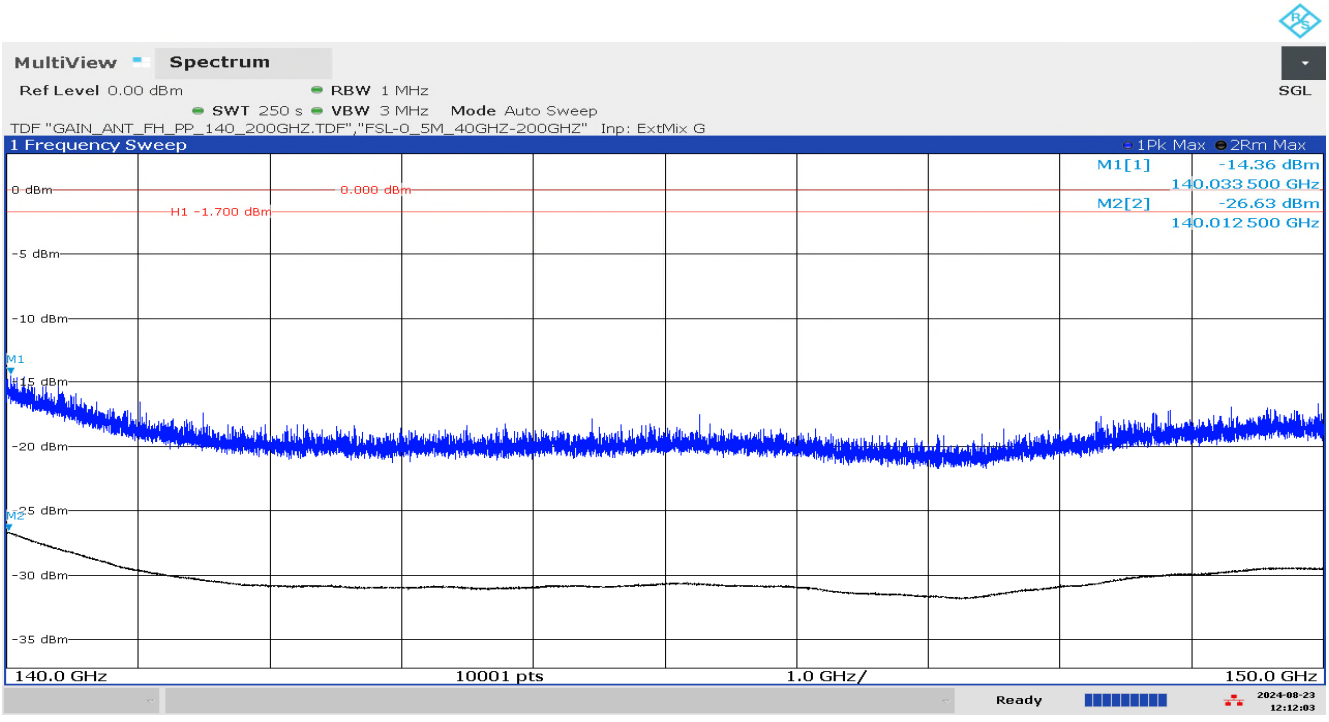

Note: Signal ID functions are activated to verify image / ghost signals. No critical Emission found, only image signal

TID227_04a_23-1-0144001T007_RSE_140 G - 150 GHz_FCC_AntH



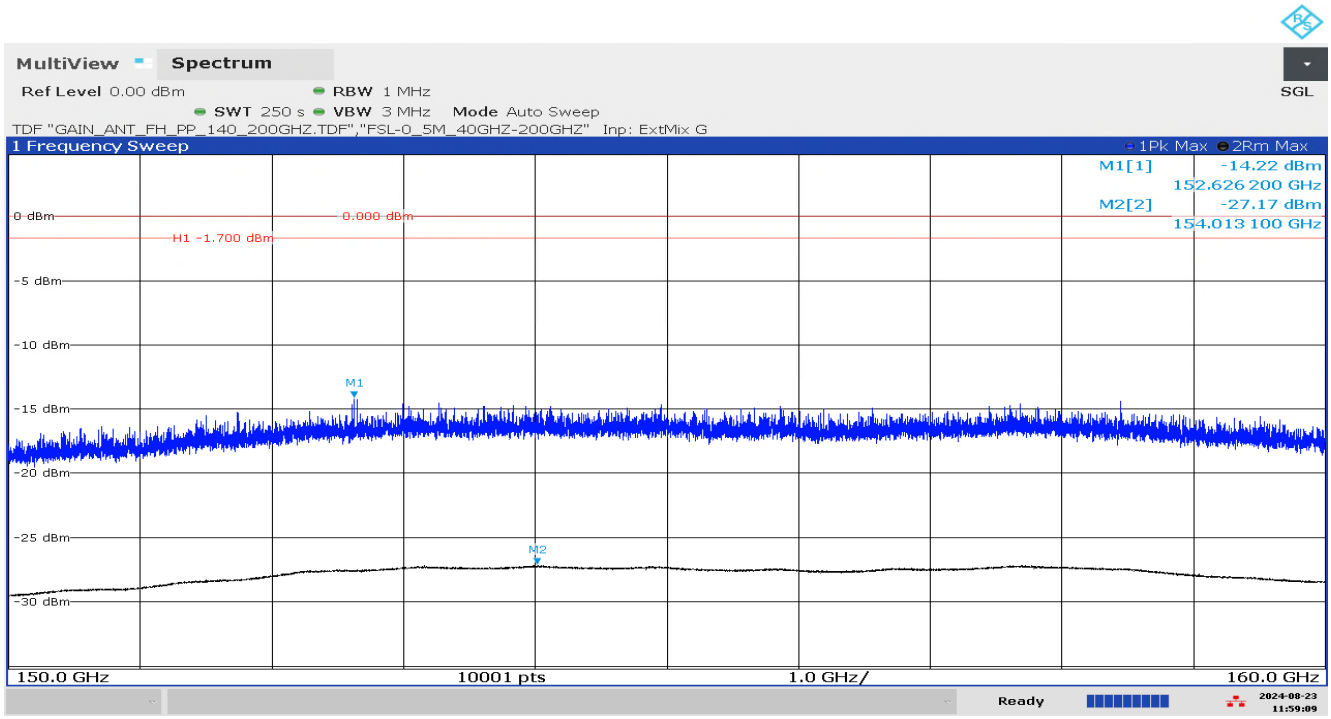

Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID227_04b_23-1-0144001T007_RSE_140 G - 150 GHz_FCC_AntV



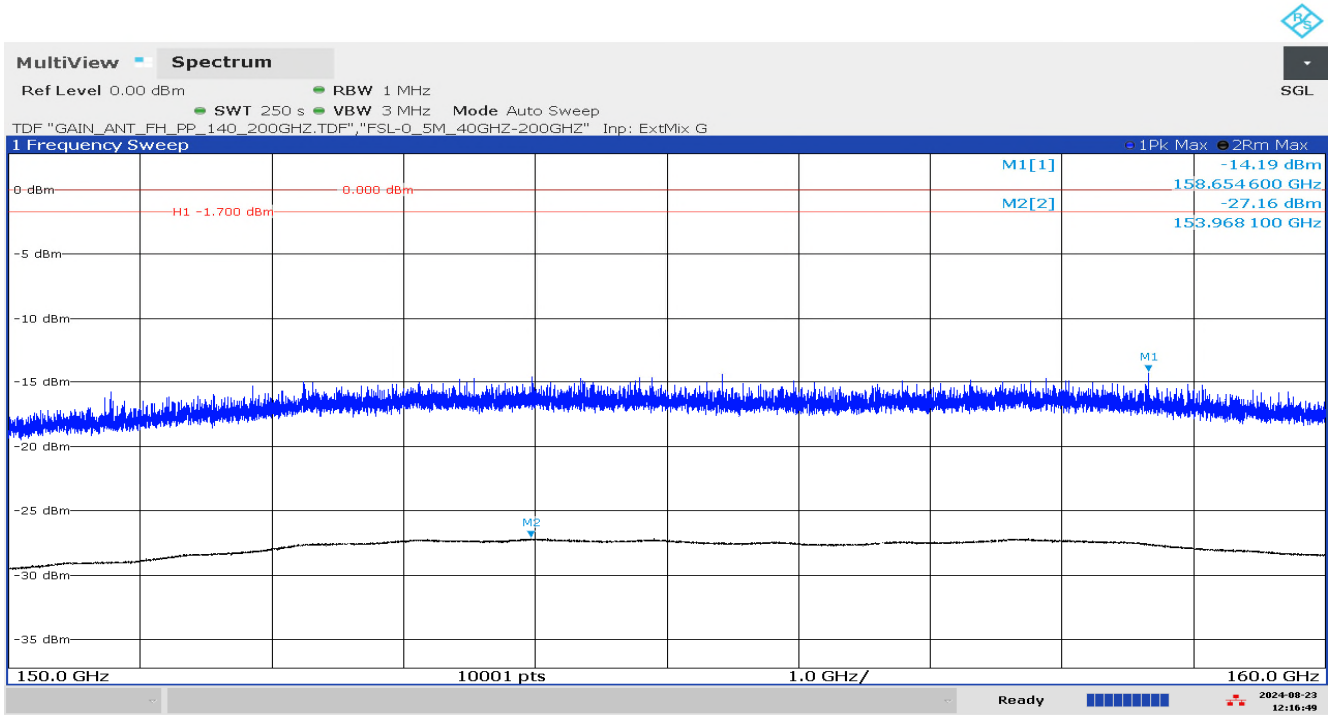

Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID227_05a_23-1-0144001T007_RSE_150 G - 160 GHz_FCC_AntH



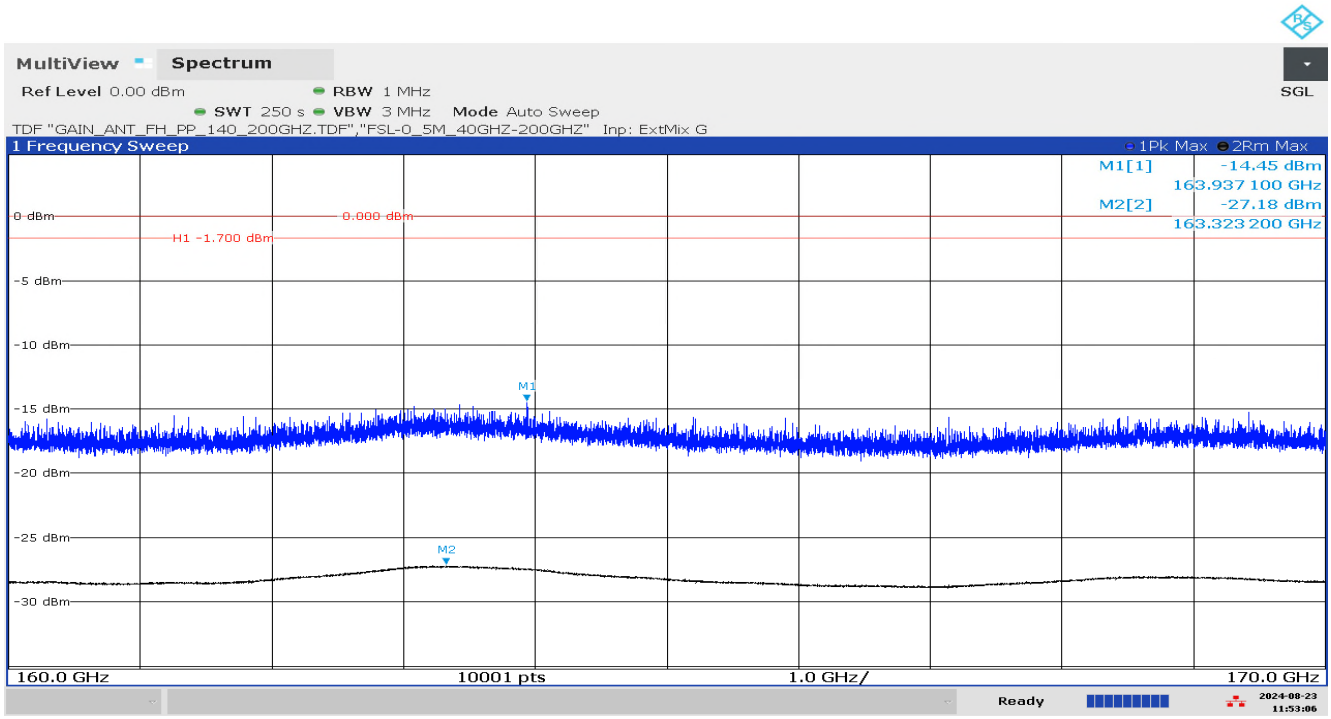

Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID227_05b_23-1-0144001T007_RSE_150 G - 160 GHz_FCC_AntV




Note: No critical Emission found, only noise level from Spectrum Analyzer.

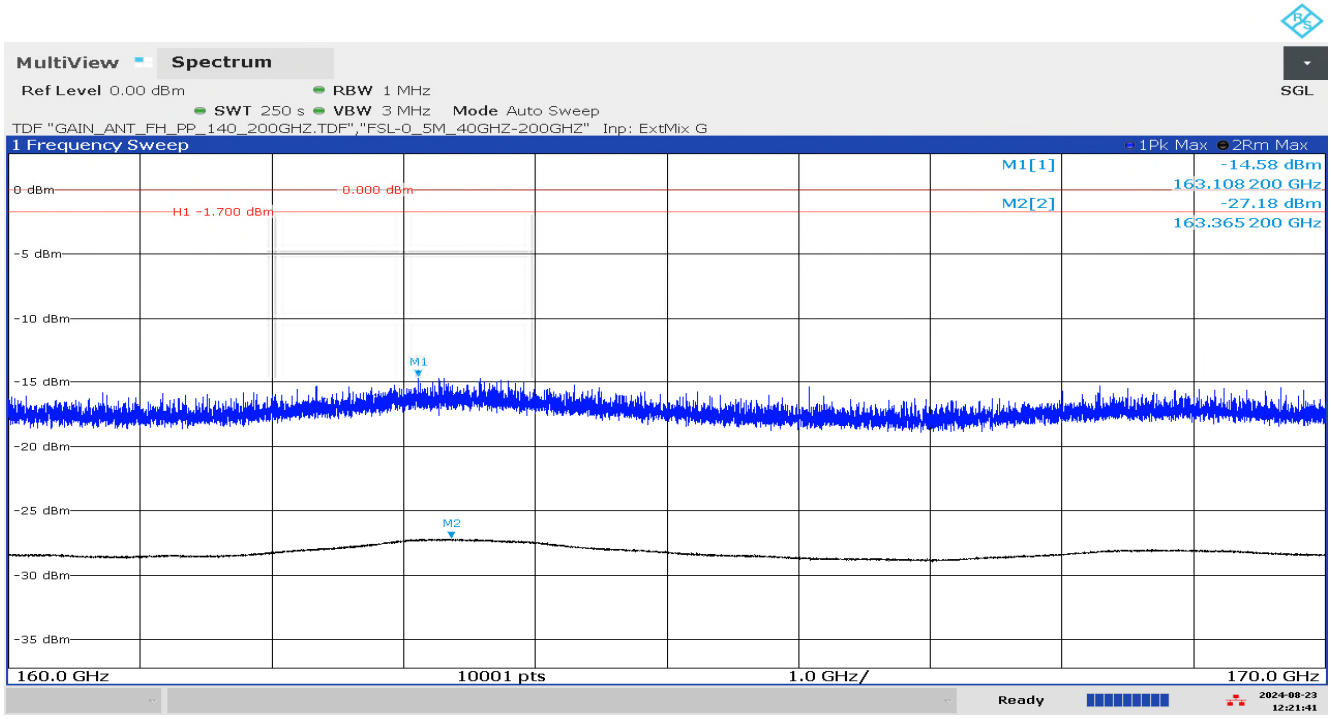
TID227_06a_23-1-0144001T007_RSE_160 G - 170 GHz_FCC_AntH




11:53:07 AM 08/23/2024

Note: No critical Emission found, only noise level from Spectrum Analyzer.

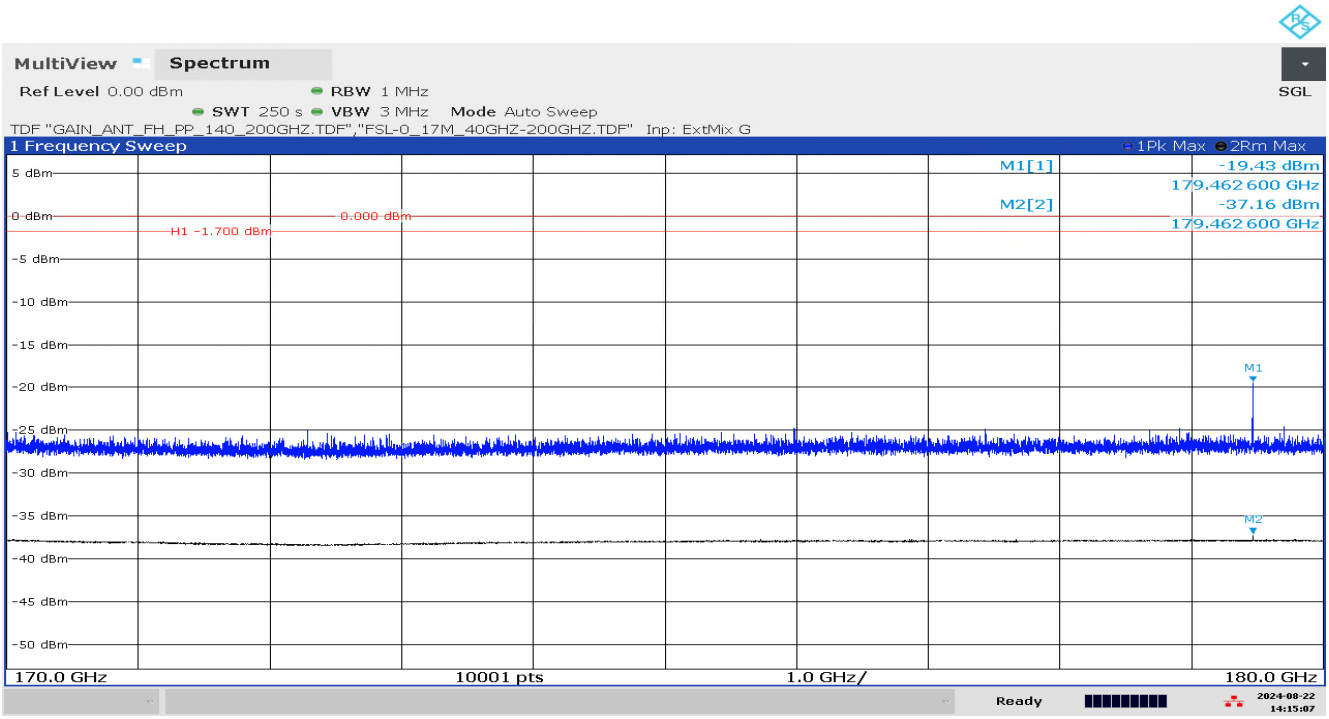
TID227_06b_23-1-0144001T007_RSE_160 G - 170 GHz_FCC_AntV




12:21:41 PM 08/23/2024

Note: No critical Emission found, only noise level from Spectrum Analyzer.

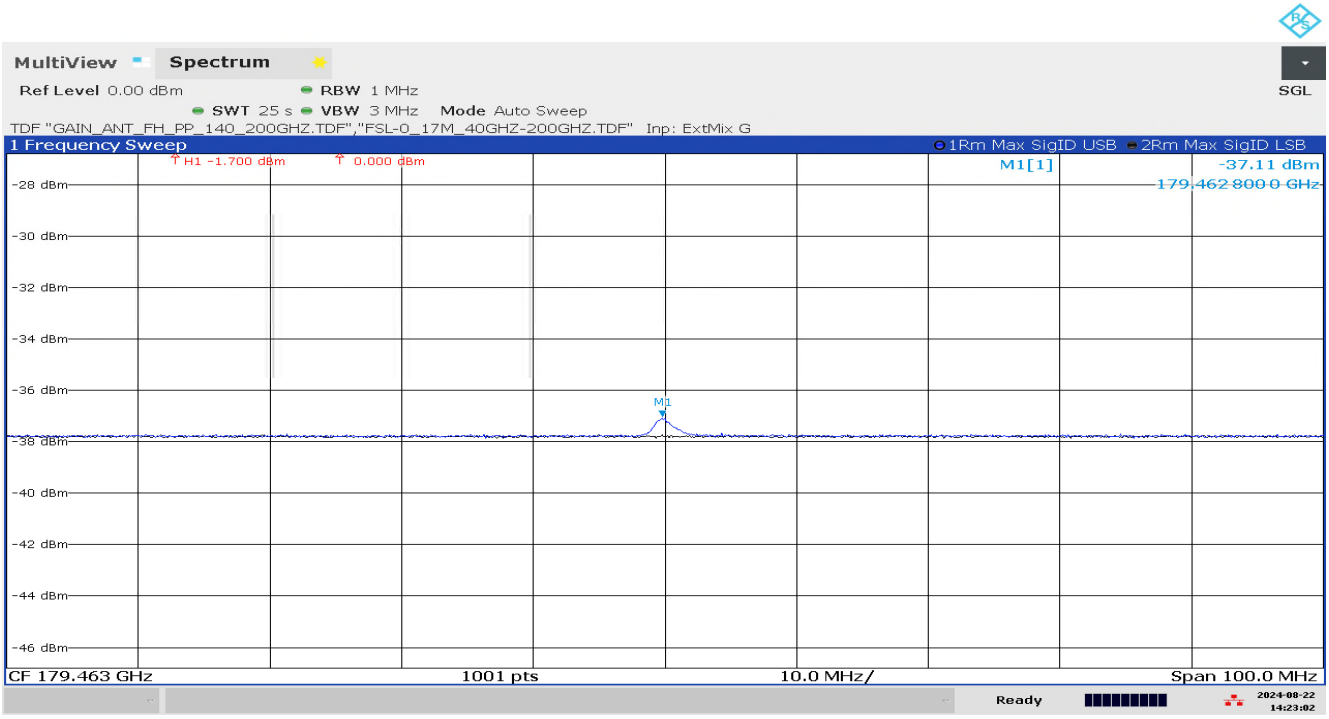
TID228_23-1-0144001T007_RSE_170 G - 180 GHz_AntH_FCC




02:15:07 PM 08/22/2024

Note: Emission at 179.4626 GHz is image signal, no critical emission, for more information, check below TID228_01

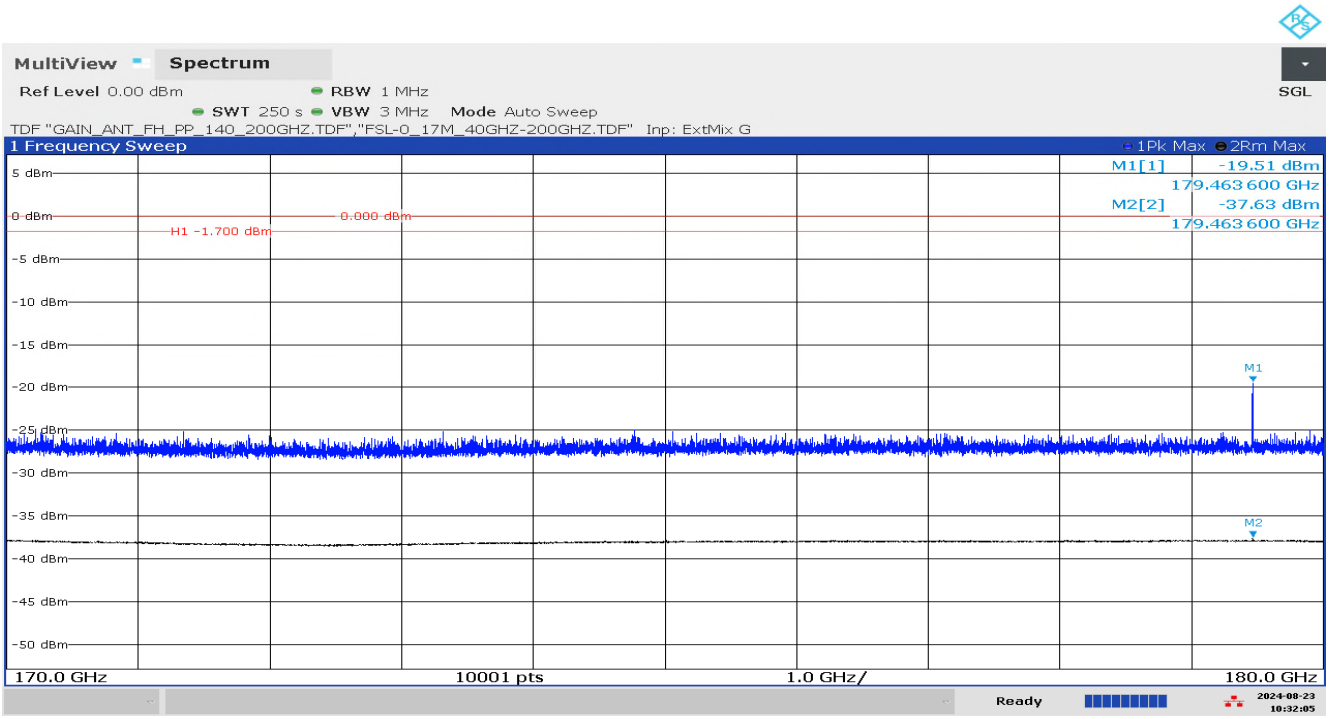
TID228_01_23-1-0144001T007_RSE_179.46 GHz_AntH_FCC_image_signal




02:23:02 PM 08/22/2024

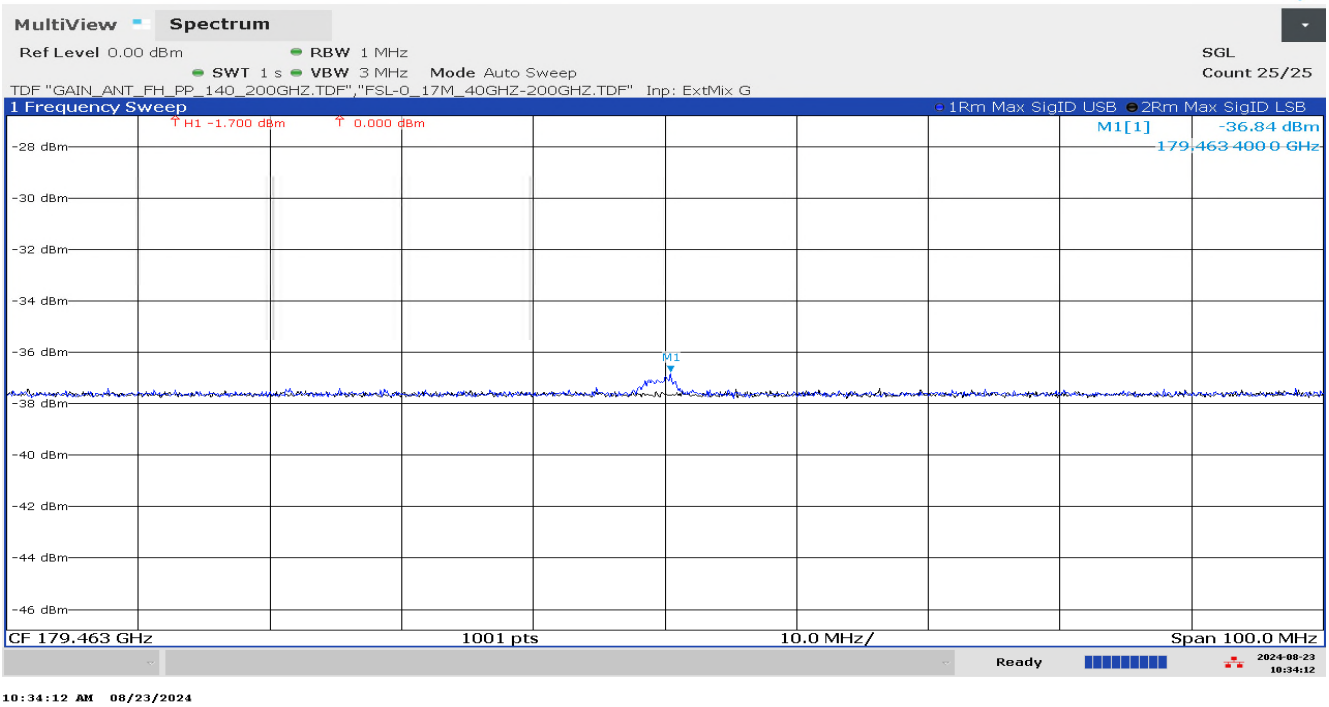
Note: Signal ID function are activated to verify image / ghost signal, Emission at 179.46 GHz is image signal. No critical emission. Signal which are not overlapping(USB+LSB)(USB+LSB) is image / ghost signal.

TID229_23-1-0144001T007_RSE_170 G - 180 GHz_AntV_FCC



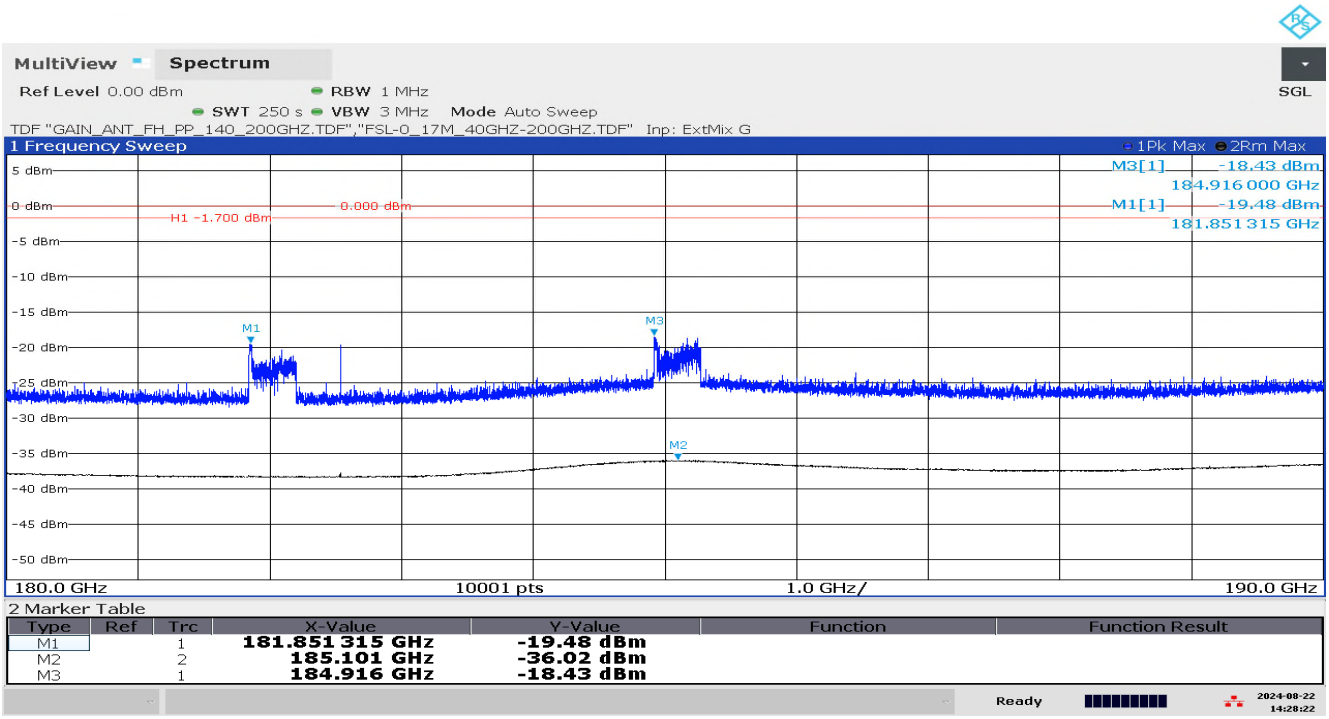

Note: Emission at 179.4626 GHz is image signal, no critical emission, for more information, check below TID229_01

TID229_01_23-1-0144001T007_RSE_179.46 GHz_AntH_FCC_image_signal



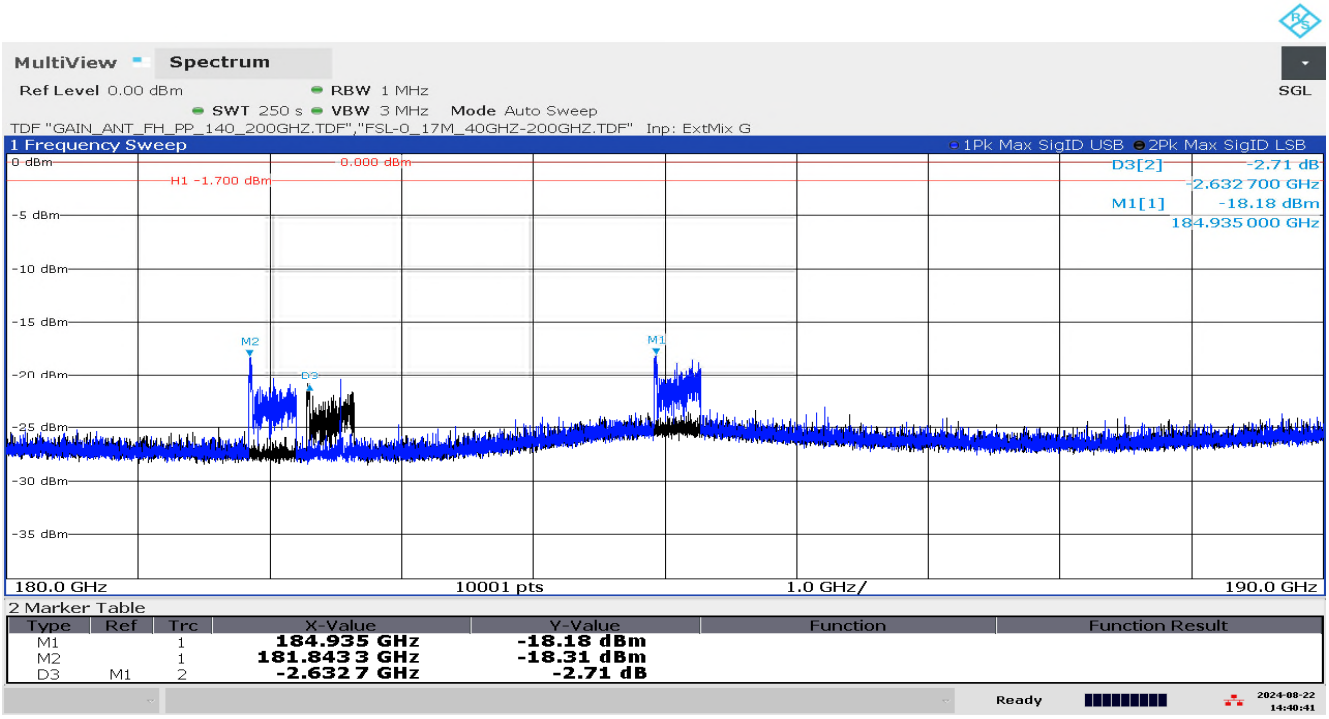

Note: Signal ID function are activated to verify image / ghost signal, Emission at 179.46 GHz is image signal. No critical emission. Signal which are not overlapping(USB+LSB)(USB+LSB) is image / ghost signal.

TID230_23-1-0144001T007_RSE_180 G - 190 GHz_AntH_FCC



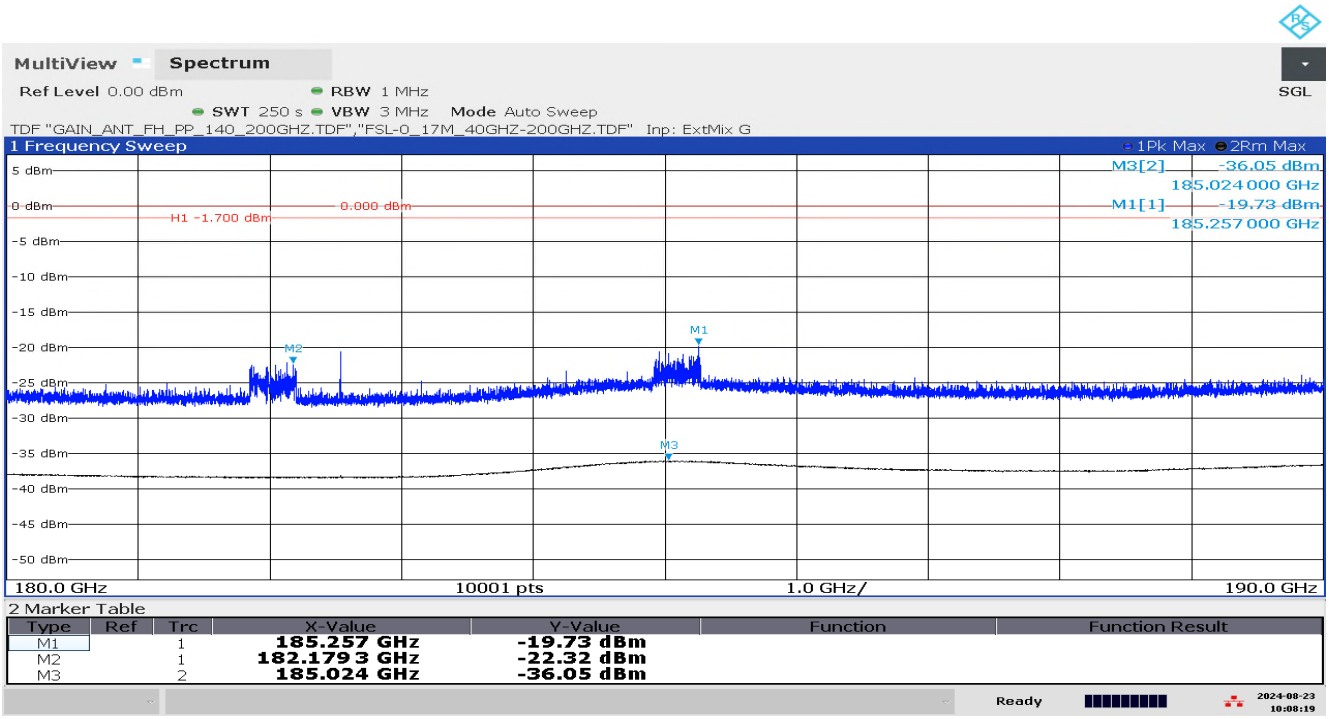

Note: Emission at Marker-1 and Marker-2 are image signals, check below TID230_01 for more information.

TID230_01_23-1-0144001T007_RSE_180 G - 190 GHz_AntH_FCC_signal_id




Note: Signal ID function are activated to verify image / ghost signal, in this plot all are image signal.
No critical emission. Signal which are not overlapping(USB+LSB)(USB+LSB) is image / ghost signal.

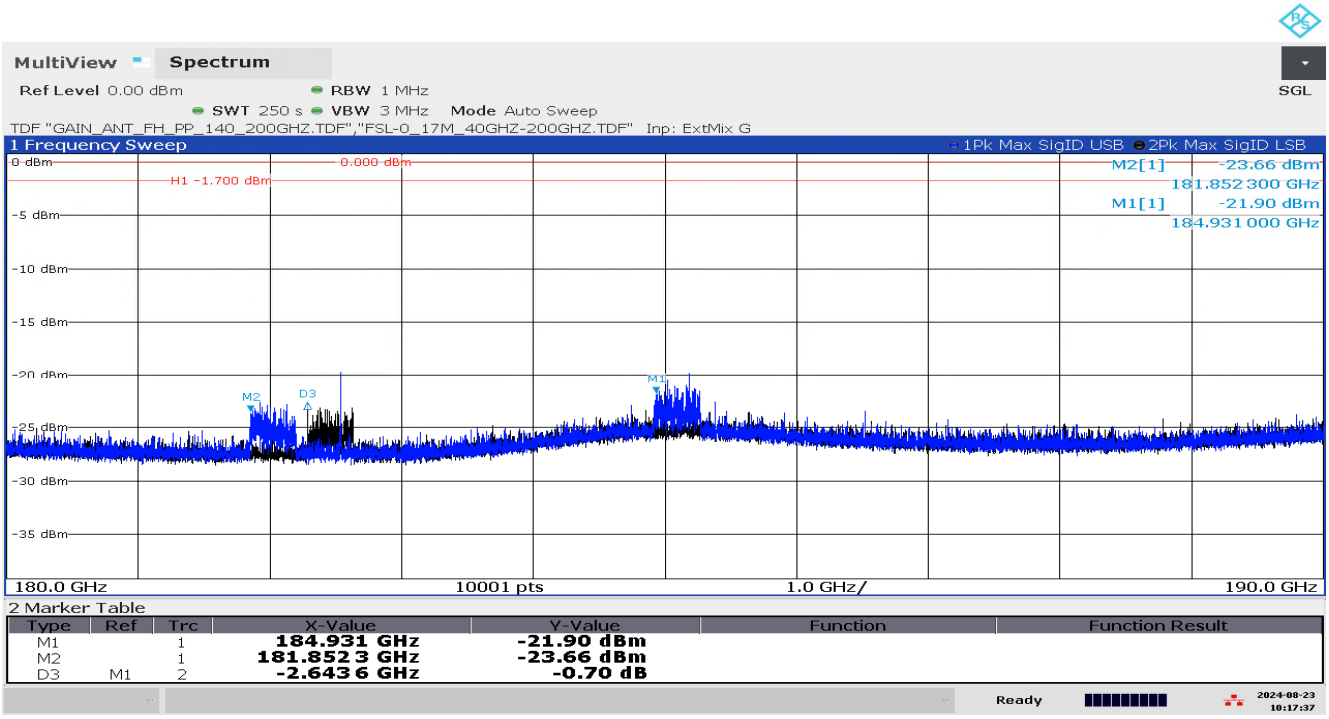
TID231_23-1-0144001T007_RSE_180 G - 190 GHz_AntV_FCC




10:08:19 AM 08/23/2024

Note: Emission at Marker-1 and Marker-2 are image signals, check below TID231_01 for more information.

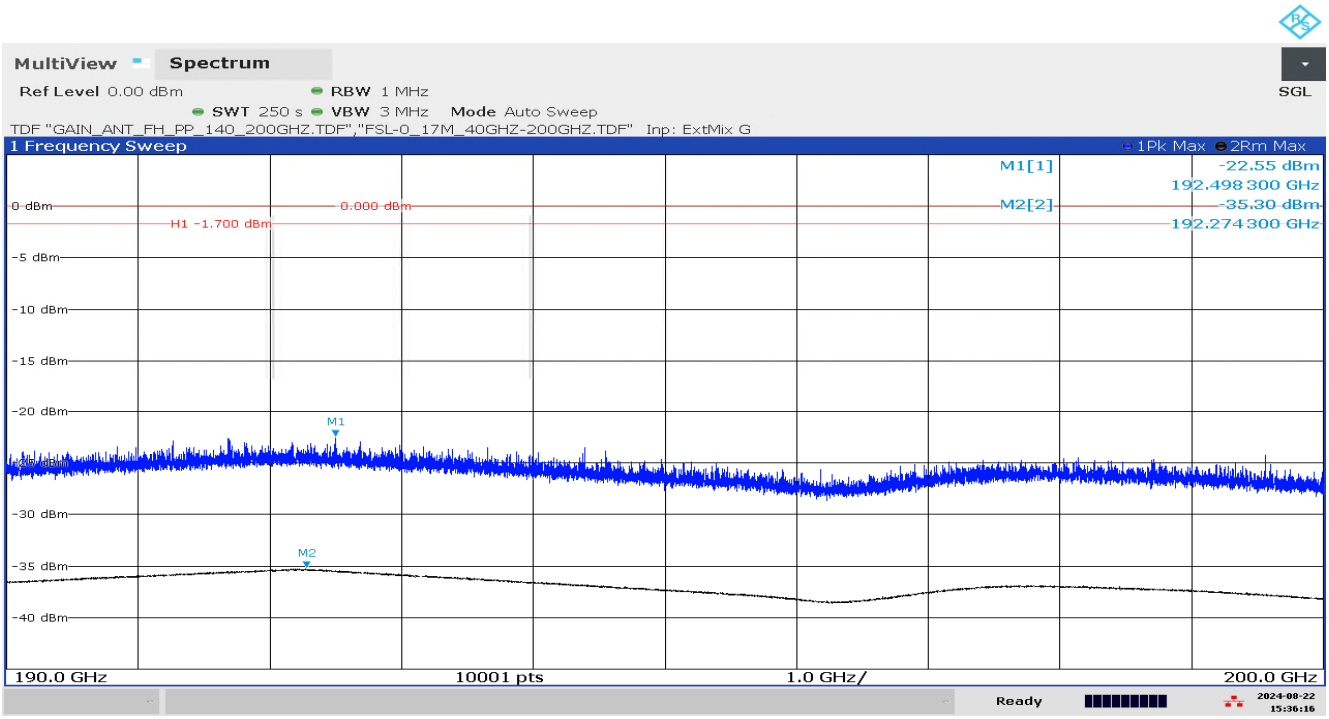
TID231_01_23-1-0144001T007_RSE_180 G - 190 GHz_AntV_FCC_signal_id




10:17:37 AM 08/23/2024

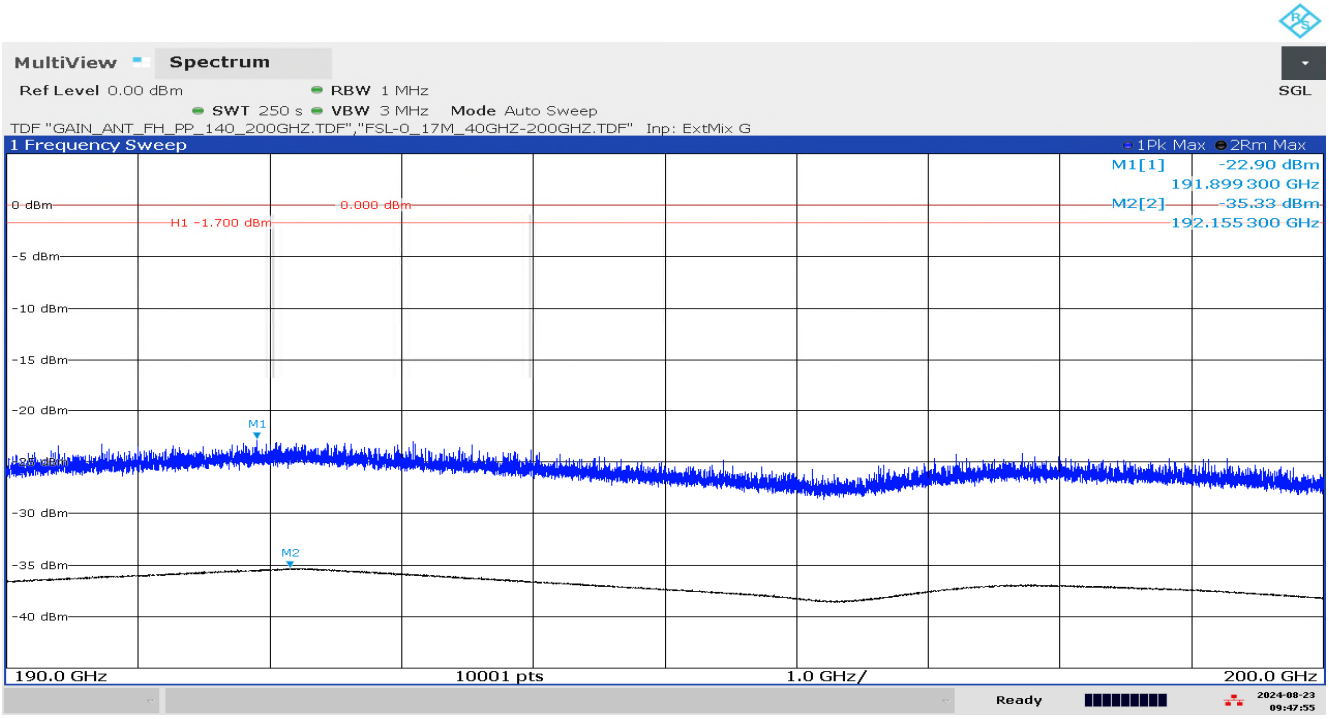
Note: Signal ID function are activated to verify image / ghost signal, in this plot all are image signal.
No critical emission. Signal which are not overlapping(USB+LSB) (USB+LSB) is image / ghost signal.

TID232_23-1-0144001T007_RSE_190 G - 200 GHz_AntH_FCC



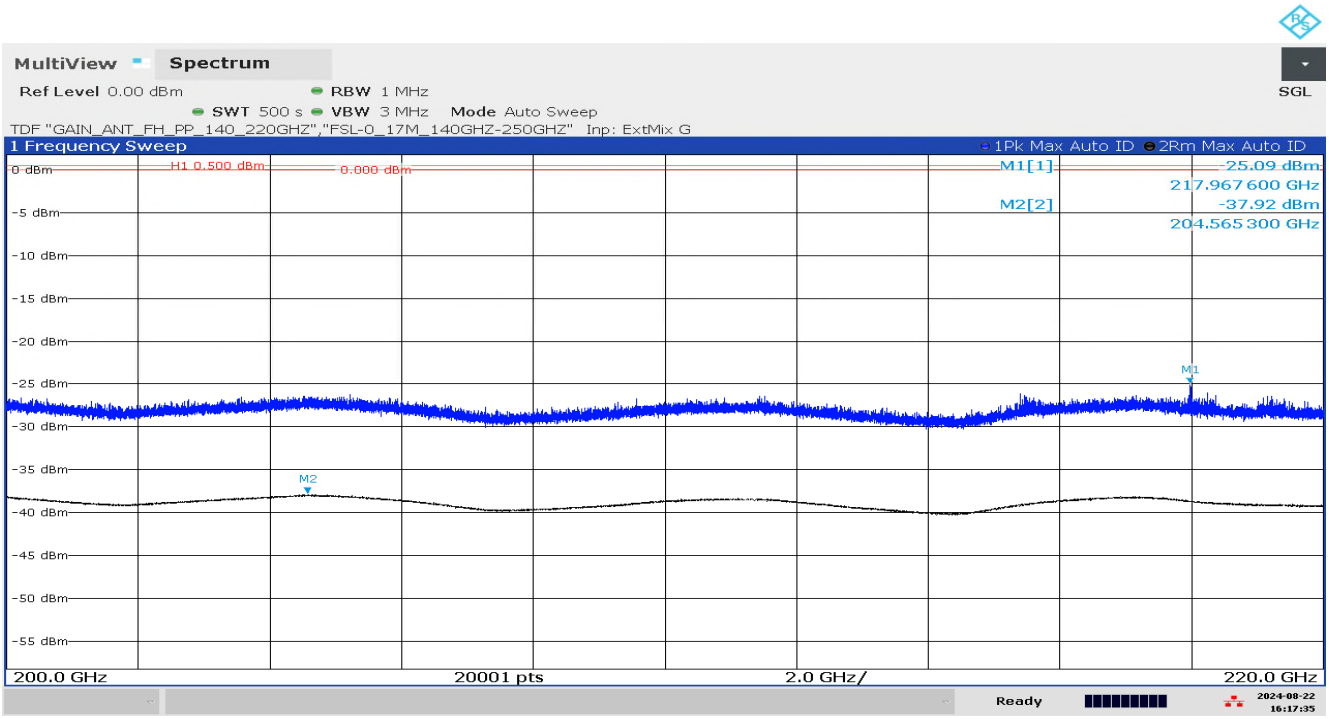

Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID233_23-1-0144001T007_RSE_190 G - 200 GHz_AntV_FCC



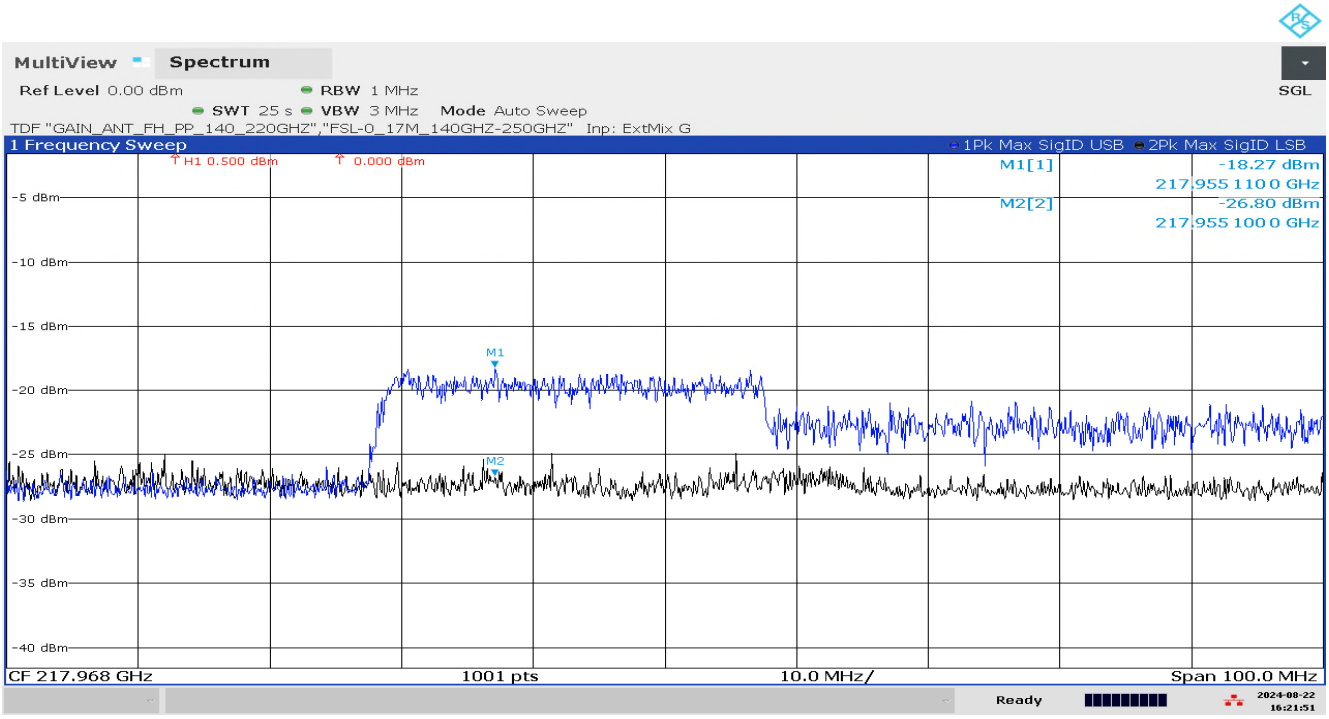

Note: No critical Emission found, only noise level from Spectrum Analyzer.

TID234_23-1-0144001T007_RSE_200 G - 220 GHz_AntH_FCC



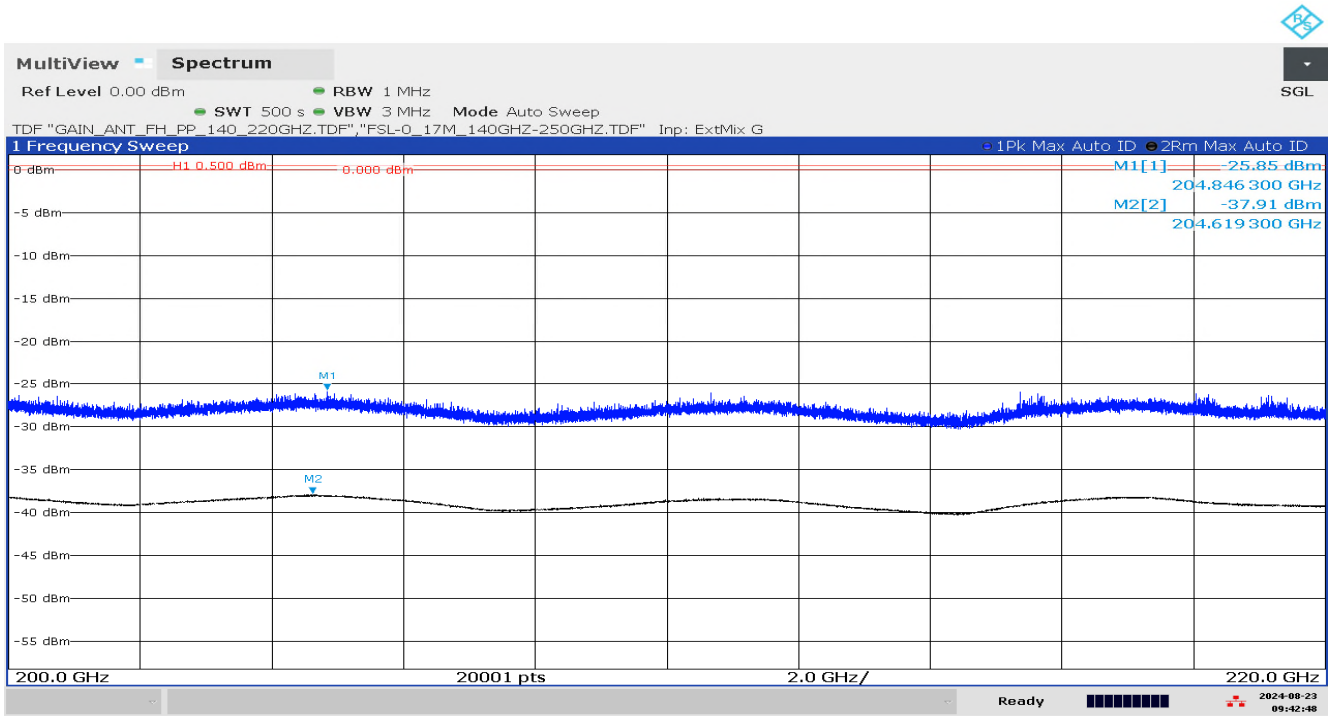

Note: Peak Detector is only for information, No Critical frequency found.Emission at M1 (217.9676 GHz is image signal)
Limit Line: 0.5 dBm, Result: Pass

TID234_01_23-1-0144001T007_RSE_200 G - 220 GHz_AntH_FCC_signal_id




Note: Since Mixer Products are used, there are some image/ghost signal.
Signals, which are overlapping (USB+LSB), are real signal, in this plot there is only image signal not related to assessment.

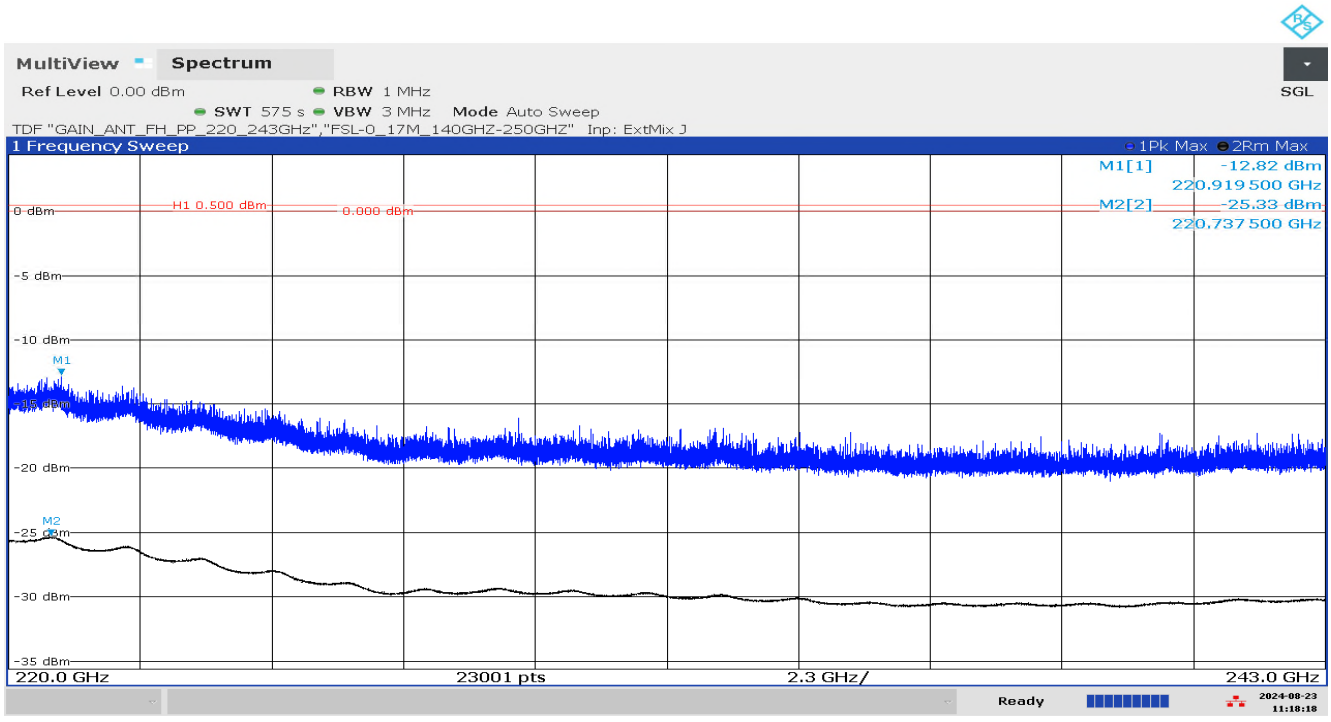
TID235_23-1-0144001T007_RSE_200 G - 220 GHz_AntV_FCC




09:42:48 AM 08/23/2024

Note: Peak Detector is only for information, No Critical frequency found.
Limit Line: 0.5 dBm, Result: Pass

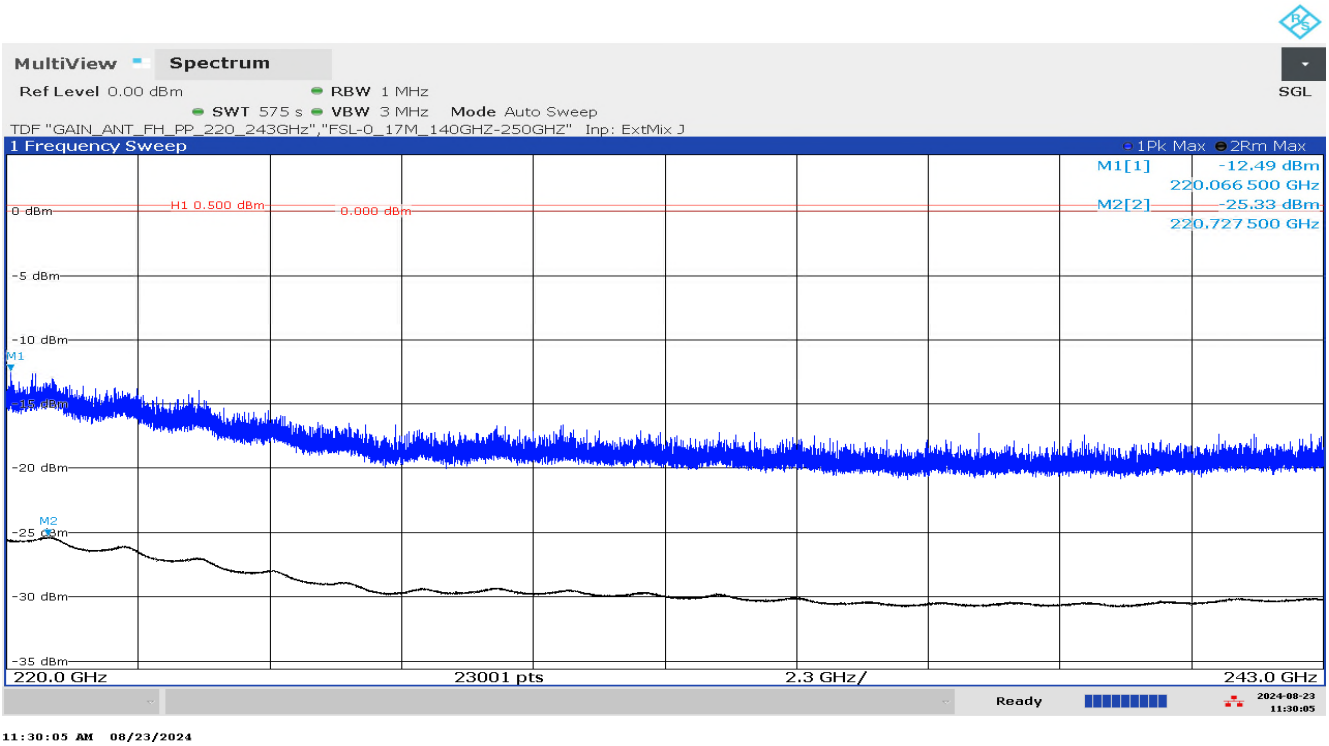
TID236_23-1-0144001T007_RSE_220 G - 243 GHz_AntH_FCC




11:18:18 AM 08/23/2024

Note: Peak Detector is only for information, No Critical frequency found.
Limit Line: 0.5 dBm, Result: Pass

TID237_23-1-0144001T007_RSE_220 G - 243 GHz_AntV_FCC




Note: Peak Detector is only for information, No Critical frequency found.
Limit Line: 0.5 dBm, Result: Pass

## 12.6 Frequency stability

**Description:**
§95.3379 (b) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

**Limits:**

| FCC |
|---|
| FCC §95.3379 (b) |
| The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following: |
| Frequency range |
| 76 GHz – 81 GHz |

**Measurement:**

| Parameters | |
|---|---|
| Detector: | Pos-Peak |
| Resolution bandwidth: | 50 MHz |
| Video bandwidth: | 80 MHz |
| Trace-Mode: | Max Hold |

**Measurement results:**

| Test condition | Frequency $f_L$ [GHz] | Frequency $f_H$ [GHz] | Bandwidth [GHz] |
|---|---|---|---|
| -20 °C / $V_{nom}$ | 77.008053 | 78.942130 | 1.934077 |
| -10 °C / $V_{nom}$ | 77.007406 | 78.945789 | 1.938378 |
| 0 °C / $V_{nom}$ | 77.006951 | 78.956179 | 1.949228 |
| 10 °C / $V_{nom}$ | 77.006337 | 78.962884 | 1.956547 |
| 20 °C / $V_{nom}$ | 77.005933 | 78.966823 | 1.960890 |
| 20 °C / $V_{min}$ | 77.005837 | 78.965884 | 1.960051 |
| 20 °C / $V_{max}$ | 77.005801 | 78.965736 | 1.959934 |
| 30 °C / $V_{nom}$ | 77.005328 | 78.968232 | 1.962904 |
| 40 °C / $V_{nom}$ | 77.005369 | 78.971956 | 1.966587 |
| 50 °C / $V_{nom}$ | 77.004802 | 78.972297 | 1.967495 |

**Note:**

- The EUT is measured in the temperature range from -20°C to 50°C specified by §95.3379 (b) and RSS Gen 6.11.
- If the operating temperature range of the device specified by the manufacturer exceeds the test temperature range (-20°C to +50°C), the customer is responsible for ensuring the frequency stability and proper functioning of the device within the extended operating temperature range.

**Verdict:** **Complies**

**Note: For measurement diagrams, check another document "23-1-0144001T007_TR1-A201-R1.pdf"**

## 13 Glossary

| | |
|---|---|
| **EUT** | Equipment under test |
| **DUT** | Device under test |
| **UUT** | Unit under test |
| **GUE** | GNSS User Equipment |
| **ETSI** | European Telecommunications Standards Institute |
| **EN** | European Standard |
| **FCC** | Federal Communications Commission |
| **FCC ID** | Company Identifier at FCC |
| **IC** | Industry Canada |
| **PMN** | Product marketing name |
| **HMN** | Host marketing name |
| **HVIN** | Hardware version identification number |
| **FVIN** | Firmware version identification number |
| **EMC** | Electromagnetic Compatibility |
| **HW** | Hardware |
| **SW** | Software |
| **Inv. No.** | Inventory number |
| **S/N or SN** | Serial number |
| **C** | Compliant |
| **NC** | Not compliant |
| **NA** | Not applicable |
| **NP** | Not performed |
| **PP** | Positive peak |
| **QP** | Quasi peak |
| **AVG** | Average |
| **OC** | Operating channel |
| **OCW** | Operating channel bandwidth |
| **OBW** | Occupied bandwidth |
| **OOB** | Out of band |
| **DFS** | Dynamic frequency selection |
| **CAC** | Channel availability check |
| **OP** | Occupancy period |
| **NOP** | Non occupancy period |
| **DC** | Duty cycle |
| **PER** | Packet error rate |
| **CW** | Clean wave |
| **MC** | Modulated carrier |
| **WLAN** | Wireless local area network |
| **RLAN** | Radio local area network |
| **DSSS** | Dynamic sequence spread spectrum |
| **OFDM** | Orthogonal frequency division multiplexing |
| **FHSS** | Frequency hopping spread spectrum |
| **GNSS** | Global Navigation Satellite System |
| **$C/N_0$** | Carrier to noise-density ratio, expressed in dB-Hz |

## 14 Document history

| Version | Applied changes | Date of release |
|---|---|---|
| R01 | Initial release | 2024-11-20 |
| R02 | Frequency band corrected. R01 of the report is replaced and not valid anymore. | 2025-02-14 |

################################## END OF TEST REPORT ##################################