



# RF – TEST REPORT

- FCC Part 15.247, RSS-247, partly -

**Type / Model Name** : NT - NG

**Product Description** : Display Control Unit (DCU)

**Applicant** : Avnet Embedded GmbH

**Address** : Ludwig-Erhard-Str. 10c

85375 NEUFABRN, GERMANY

**Manufacturer** : Avnet Embedded GmbH

**Address** : Ludwig-Erhard-Str. 10c

85375 NEUFABRN, GERMANY

**Test Result** according to the standards  
listed in clause 1 test standards:

**POSITIVE**

**Test Report No. :** **80164053-02 Rev\_1**

01. April 2025

Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-03  
D-PL-12030-01-04

# Contents

|          |                                                                   |                  |
|----------|-------------------------------------------------------------------|------------------|
| <b>1</b> | <b><u>TEST STANDARDS</u></b>                                      | <b><u>3</u></b>  |
| <b>2</b> | <b><u>EQUIPMENT UNDER TEST</u></b>                                | <b><u>4</u></b>  |
| 2.1      | Information provided by the Client                                | 4                |
| 2.2      | Sampling                                                          | 4                |
| 2.3      | Photo documentation of the EUT – Detailed photos see ATTACHMENT A | 4                |
| 2.4      | General remarks                                                   | 4                |
| 2.5      | Equipment type                                                    | 4                |
| 2.6      | Short description of the equipment under test (EUT)               | 4                |
| 2.7      | Variants of the EUT                                               | 4                |
| 2.8      | Operation frequency and channel plan                              | 5                |
| 2.9      | Transmit operating modes                                          | 5                |
| 2.10     | Antenna                                                           | 6                |
| 2.11     | Power supply system utilised                                      | 6                |
| 2.12     | Peripheral devices and interface cables                           | 6                |
| 2.13     | Determination of worst-case conditions for final measurement      | 7                |
| <b>3</b> | <b><u>TEST RESULT SUMMARY</u></b>                                 | <b><u>8</u></b>  |
| 3.1      | Revision history of test report                                   | 8                |
| 3.2      | Final assessment                                                  | 9                |
| <b>4</b> | <b><u>TEST ENVIRONMENT</u></b>                                    | <b><u>10</u></b> |
| 4.1      | Address of the test laboratory                                    | 10               |
| 4.2      | Environmental conditions                                          | 10               |
| 4.3      | Statement of the measurement uncertainty                          | 10               |
| 4.4      | Conformity Decision Rule                                          | 11               |
| 4.5      | Measurement protocol for FCC and ISED                             | 11               |
| <b>5</b> | <b><u>TEST CONDITIONS AND RESULTS</u></b>                         | <b><u>14</u></b> |
| 5.1      | Maximum peak radiated output power                                | 14               |
| 5.2      | Radiated emissions in restricted bands                            | 16               |
| 5.3      | Antenna application                                               | 48               |
| <b>6</b> | <b><u>USED TEST EQUIPMENT AND ACCESSORIES</u></b>                 | <b><u>49</u></b> |

ATTACHMENT A as separate supplement

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

# **1 TEST STANDARDS**

The tests were performed according to following standards:

## **FCC Rules and Regulations Part 15, Subpart A - General (September 2021)**

|                                   |                                               |
|-----------------------------------|-----------------------------------------------|
| Part 15, Subpart A, Section 15.31 | Measurement standards                         |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements      |
| Part 15, Subpart A, Section 15.35 | Measurement detector functions and bandwidths |

## **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2021)**

|                                    |                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------|
| Part 15, Subpart C, Section 15.203 | Antenna requirement                                                             |
| Part 15, Subpart C, Section 15.204 | External radio frequency power amplifiers and antenna modifications             |
| Part 15, Subpart C, Section 15.205 | Restricted bands of operation                                                   |
| Part 15, Subpart C, Section 15.207 | Conducted limits                                                                |
| Part 15, Subpart C, Section 15.209 | Radiated emission limits, general requirements                                  |
| Part 15, Subpart C, Section 15.247 | Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz |

|                   |                                     |
|-------------------|-------------------------------------|
| ANSI C63.10: 2013 | Testing Unlicensed Wireless Devices |
|-------------------|-------------------------------------|

|                                  |                                                                                                                                                                    |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ETSI TR 100 028 V1.3.1: 2001-03, | Electromagnetic Compatibility and Radio Spectrum Matters (ERM);<br>Uncertainties in the Measurement of Mobile Radio Equipment<br>Characteristics—Part 1 and Part 2 |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                       |                                                                                                                                                   |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| KDB 558074 D01 v05r02 | Guidance for compliance measurements on DTS; FHSS and hybrid<br>system devices operating under Section 15.247 of the FCC rules,<br>April 2, 2019. |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|

## 2 EQUIPMENT UNDER TEST

### 2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

### 2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

### 2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

### 2.4 General remarks

**This report covers the emissions of the Module “SPB209A” in combination with the host device “NT - NG”**

Performed tests:

- RF output power (radiated)
- Transmitter unwanted emissions, radiated

### 2.5 Equipment type

Bluetooth device

### 2.6 Short description of the equipment under test (EUT)

The EUT is a Display Control Unit (DCU). The function is to render the user interface and transfer it via a display port interface to one or two attached Display Modules (DM).

Number of tested samples: 1  
Serial number: 3063260476  
Firmware version: v1.40  
Firmware version (RF module): 15.2.7.69

### 2.7 Variants of the EUT

There are no variants.

## 2.8 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan IEEE-Standard 802.15.1:

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|---------|-----------|
| 1       | 2402      | 28      | 2429      | 55      | 2456      |
| 2       | 2403      | 29      | 2430      | 56      | 2457      |
| 3       | 2404      | 30      | 2431      | 57      | 2458      |
| 4       | 2405      | 31      | 2432      | 58      | 2459      |
| 5       | 2406      | 32      | 2433      | 59      | 2460      |
| 6       | 2407      | 33      | 2434      | 60      | 2461      |
| 7       | 2408      | 34      | 2435      | 61      | 2462      |
| 8       | 2409      | 35      | 2436      | 62      | 2463      |
| 9       | 2410      | 36      | 2437      | 63      | 2464      |
| 10      | 2411      | 37      | 2438      | 64      | 2465      |
| 11      | 2412      | 38      | 2439      | 65      | 2466      |
| 12      | 2413      | 39      | 2440      | 66      | 2467      |
| 13      | 2414      | 40      | 2441      | 67      | 2468      |
| 14      | 2415      | 41      | 2442      | 68      | 2469      |
| 15      | 2416      | 42      | 2443      | 69      | 2470      |
| 16      | 2417      | 43      | 2444      | 70      | 2471      |
| 17      | 2418      | 44      | 2445      | 71      | 2472      |
| 18      | 2419      | 45      | 2446      | 72      | 2473      |
| 19      | 2420      | 46      | 2447      | 73      | 2474      |
| 20      | 2421      | 47      | 2448      | 74      | 2475      |
| 21      | 2422      | 48      | 2449      | 75      | 2476      |
| 22      | 2423      | 49      | 2450      | 76      | 2477      |
| 23      | 2424      | 50      | 2451      | 77      | 2478      |
| 24      | 2425      | 51      | 2452      | 78      | 2479      |
| 25      | 2426      | 52      | 2453      | 79      | 2480      |
| 26      | 2427      | 53      | 2454      |         |           |
| 27      | 2428      | 54      | 2455      |         |           |

Note: the marked frequencies are determined for final testing.

## 2.9 Transmit operating modes

- synchronous mode (SCO or eSCO traffic, for HV, DV or DM packets) for transmitting voice or data,
- asynchronous mode (ACL traffic, for DM or DH packets) for transmitting data,
- mixed transfer mode (for voice and data,

The most important mode is the ACL mode at a data rate of 3 Mbps for the worst case.

### Packets:

A summary of the packets in ACL mode and their characteristics is shown in the following table:

### Modulation types:

For the DH5 packet the pay load modulation GFSK, for 2-DH5 the modulation  $\pi/4$ -DQPSK, for 3-DH5 the modulation 8DPSK is used. The packet 3-DH5 shows most of modulation side bands and means the worst case.

| Type  | Payload Header (bytes) | User Payload (bytes) | FEC | CRC | Symmetric Max. Rate (kb/s) | Asymmetric Max. Rate (kb/s) |         |
|-------|------------------------|----------------------|-----|-----|----------------------------|-----------------------------|---------|
|       |                        |                      |     |     |                            | Forward                     | Reverse |
| DM1   | 1                      | 0 - 17               | 2/3 | yes | 108.8                      | 108.8                       | 108.8   |
| DH1   | 1                      | 0 - 27               | no  | yes | 172.8                      | 172.8                       | 172.8   |
| DM3   | 2                      | 0 - 121              | 2/3 | yes | 258.1                      | 387.2                       | 54.4    |
| DH3   | 2                      | 0 - 183              | no  | yes | 390.4                      | 585.6                       | 86.4    |
| DM5   | 2                      | 0 - 224              | 2/3 | yes | 286.7                      | 477.8                       | 36.3    |
| DH5   | 2                      | 0 - 339              | no  | yes | 433.9                      | 723.2                       | 57.6    |
| AUX1  | 1                      | 0 - 29               | no  | no  | 185.6                      | 185.6                       | 185.6   |
| 2-DH1 | 2                      | 0 - 54               | no  | yes | 345.6                      | 345.6                       | 345.6   |
| 2-DH3 | 2                      | 0 - 367              | no  | yes | 782.9                      | 1174.4                      | 172.8   |
| 2-DH5 | 2                      | 0 - 679              | no  | yes | 869.1                      | 1448.5                      | 115.2   |
| 3-DH1 | 2                      | 0 - 83               | no  | yes | 531.2                      | 531.2                       | 531.2   |
| 3-DH3 | 2                      | 0 - 552              | no  | yes | 1177.6                     | 1766.4                      | 235.6   |
| 3-DH5 | 2                      | 0 - 1021             | no  | yes | 1306.9                     | 2178.1                      | 177.1   |

## 2.10 Antenna

The following antennas shall be used with the EUT:

| Number | Characteristic | Model number          | Plug | Frequency range (GHz) | Peak Gain (dBi) |
|--------|----------------|-----------------------|------|-----------------------|-----------------|
| 1      | Omni           | Taoglas PC14.03.3000D | None | 2.4 – 5.2             | 5.6             |

## 2.11 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 12 V DC

## 2.12 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- 12 V DC battery \_\_\_\_\_ Model : commercially available \_\_\_\_\_
- Null modem cable \_\_\_\_\_ Model : commercially available \_\_\_\_\_

## 2.13 Determination of worst-case conditions for final measurement

Preliminary tests are performed in all three orthogonal axes to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.



X



Y



Z

The tests are carried out in the following frequency band:

**2400 MHz – 2483.5 MHz**

For the final test the following channels and test modes are selected:

| Packet type | Available channel | Tested channels | Power setting | Modulation | Modulation type |
|-------------|-------------------|-----------------|---------------|------------|-----------------|
| DH5         | 1 to 79           | 1, 41, 79       | + 4 dBm       | DSSS       | GFSK            |
| 2-DH5       | 1 to 79           | 1, 41, 79       | + 4 dBm       | DSSS       | $\pi/4$ -DQPSK  |
| 3-DH5       | 1 to 79           | 1, 41, 79       | + 4 dBm       | DSSS       | 8DPSK           |

### 2.13.1 Test jig

No test jig is used.

### 2.13.2 Test software

The test software for the EUT provides free power setting, power control off, the special test mode RX and the TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator.

### 3 TEST RESULT SUMMARY

| FCC Rule Part | RSS Rule Part   | Description                       | Result         |
|---------------|-----------------|-----------------------------------|----------------|
| 15.207(a)     | RSS-Gen, 8.8    | AC power line conducted emissions | not applicable |
| 15.247(a)(1)  | RSS-247, 5.1(a) | 20 dB EBW                         | Not tested     |
| 15.247(a)(1)  | RSS-247, 5.1(b) | Channel separation                | Not tested     |
| 15.247(a)(1)  | RSS-247, 5.1(d) | Dwell time                        | Not tested     |
| 15.247(b)(1)  | RSS-247, 5.4(b) | Peak power                        | passed         |
| 15.247(d)     | RSS-247, 5.5    | Spurious emissions                | passed         |
| 15.247(d)     | RSS-247, 5.5    | Out-of-band emission, radiated    | passed         |
| 15.247(d)     | RSS-Gen, 8.10   | Emissions in restricted bands     | passed         |
| 15.247(e)     | RSS-247, 5.1(d) | Hopping sequence                  | Not tested     |
| 15.247(a)     | RSS-247, 5.1(a) | Receiver input bandwidth          | Not tested     |
| 15.247(a)     | RSS-247, 5.4(b) | Number of hopping channels        | Not tested     |
| 15.247(a)     | -               | Equal hopping frequency use       | Not tested     |
| 15.35(c)      | RSS-Gen, 6.10   | Pulsed operation                  | Not tested     |
| 15.203        | RSS-247, 5.4(b) | Antenna requirement               | passed         |
|               | RSS-Gen, 6.11   | Transmitter frequency stability   | Not tested     |

The mentioned RSS Rule Parts in the above table are related to:  
RSS-Gen, Issue 5 + Amendment 1 + Amendment 2, March 2019  
RSS-247, Issue 3, August 2023

#### 3.1 Revision history of test report

| Test report No | Rev. | Issue Date    | Changes                                                                                                                                                                                                                                                                                  |
|----------------|------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 80164053-02    | 0    | 15 May 2023   | Initial test report                                                                                                                                                                                                                                                                      |
|                | 1    | 01 April 2025 | Clause 3: update references RSS-247 from issue 2 to 3<br>Clause 4.5.3.2.4: correction of table height<br>Clause 5.1.4: correction of test method (ANSI reference)<br>Clause 5.2.5: correction of typo on page 35<br>Clause 6: clarification of testing period regarding calibration date |

The test report with the highest revision number replaces the previous test reports.

### 3.2 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 17 April 2023

Testing concluded on : 26 April 2023

Checked by:

Tested by:

---

Klaus Gegenfurtner  
Teamleader Radio

---

Franz-Xaver Schrettenbrunner  
Radio Team

## 4 TEST ENVIRONMENT

### 4.1 Address of the test laboratory

**CSA Group Bayern GmbH  
Ohmstrasse 1-4  
94342 STRASSKIRCHEN  
GERMANY**

### 4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 ° C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

### 4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report on basis of the ETSI Technical Report TR 100 028 Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1 and Part 2. The results are documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

| Measurement Type                    | Range                  | Confidence Level | Calculated Uncertainty   |
|-------------------------------------|------------------------|------------------|--------------------------|
| AC power line conducted emissions   | 0.15 MHz to 30 MHz     | 95%              | $\pm 3.29 \text{ dB}$    |
| EBW and OBW                         | 2400 MHz to 3000 MHz   | 95%              | $\pm 2.5 \times 10^{-7}$ |
| Maximum peak conducted output power | 2400 MHz to 3000 MHz   | 95%              | $\pm 0.62 \text{ dB}$    |
| Power spectral density              | 2400 MHz to 3000 MHz   | 95%              | $\pm 0.62 \text{ dB}$    |
| Conducted Spurious Emissions        | 9 kHz to 10000 MHz     | 95%              | $\pm 2.15 \text{ dB}$    |
| Conducted Spurious Emissions        | 10000 MHz to 40000 MHz | 95%              | $\pm 3.47 \text{ dB}$    |
| Radiated Spurious Emissions         | 9 kHz to 30 MHz        | 95%              | $\pm 3.53 \text{ dB}$    |
| Radiated Spurious Emissions         | 30 MHz to 1000 MHz     | 95%              | $\pm 3.71 \text{ dB}$    |
| Radiated Spurious Emissions         | 1000 MHz to 10000 MHz  | 95%              | $\pm 2.34 \text{ dB}$    |
| Field strength of the fundamental   | 100 kHz to 100 MHz     | 95%              | $\pm 3.53 \text{ dB}$    |

## 4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule ( $w = 0$ ).  
Details can be found in the procedure CSA\_B\_V50\_29.

## 4.5 Measurement protocol for FCC and ISED

### 4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

**FCC: DE 0011**  
**ISED: DE0009**

### 4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

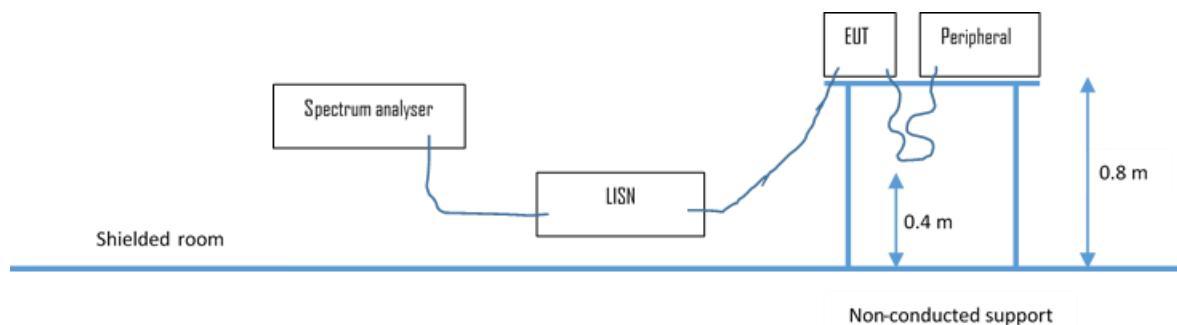
#### 4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

### 4.5.3 Details of test procedures

#### 4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

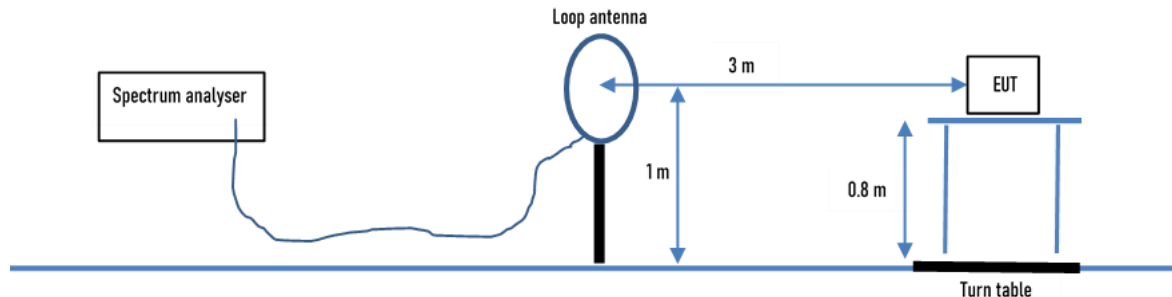
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50  $\Omega$  / 50  $\mu$ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

#### 4.5.3.2 Radiated emission

##### 4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):

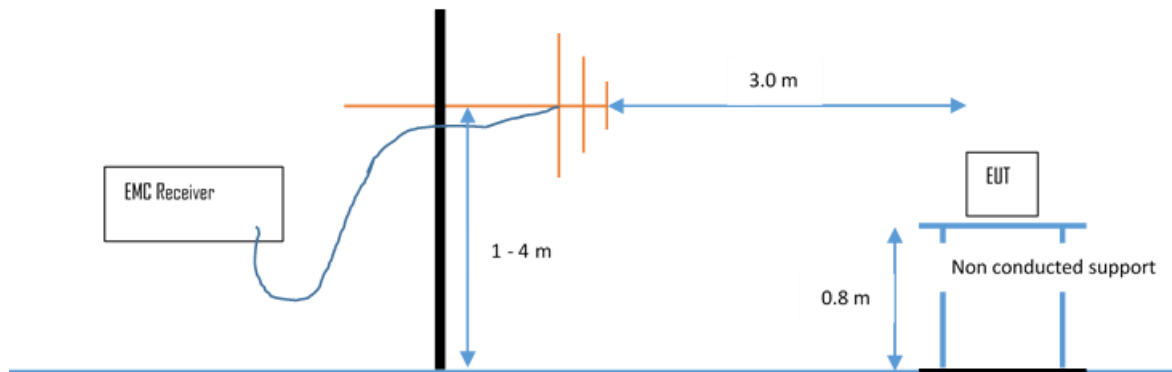
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

##### 4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dB $\mu$ V/m is calculated by taking the reading from the EMI receiver (Level dB $\mu$ V) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

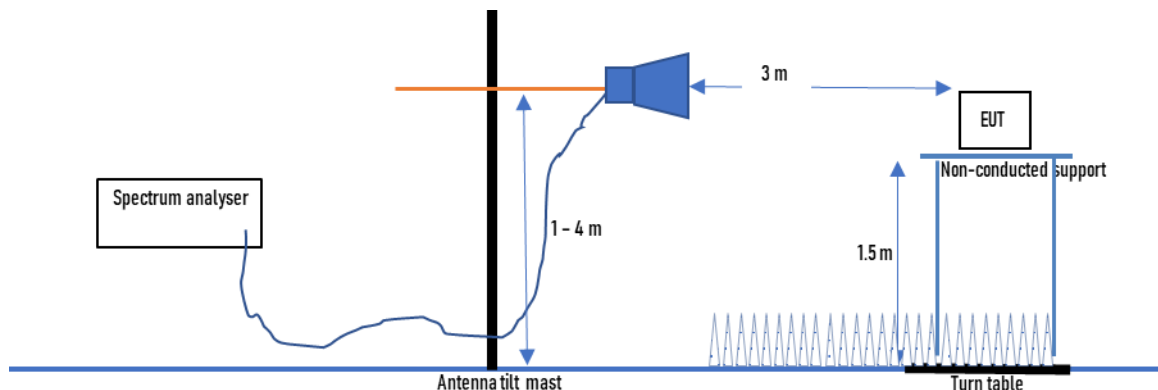
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

| Frequency<br>(MHz) | Level<br>(dB $\mu$ V) | + | Factor<br>(dB) | = | Level<br>(dB $\mu$ V/m) | - | Limit<br>(dB $\mu$ V/m) | = | Delta<br>(dB) |
|--------------------|-----------------------|---|----------------|---|-------------------------|---|-------------------------|---|---------------|
| 719.0              | 75.0                  | + | 32.6           | = | 107.6                   | - | 110.0                   | = | -2.4          |

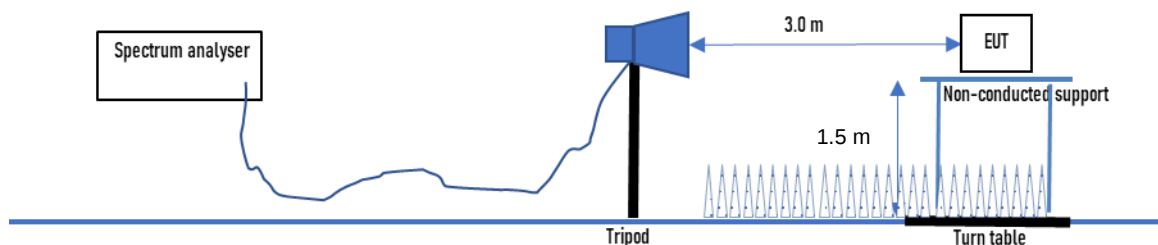
#### 4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

#### 4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limits are adopted.

## 5 TEST CONDITIONS AND RESULTS

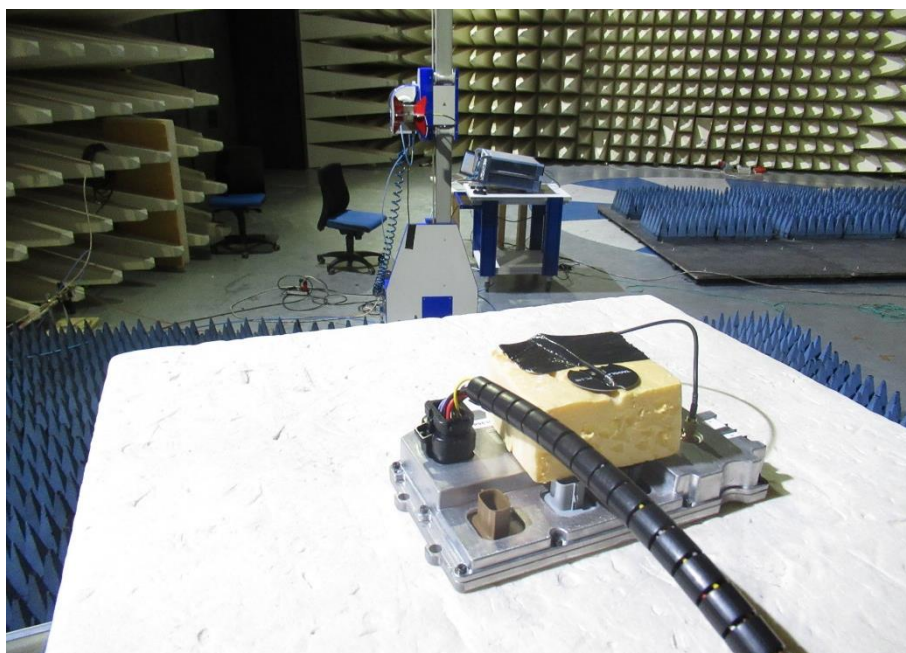
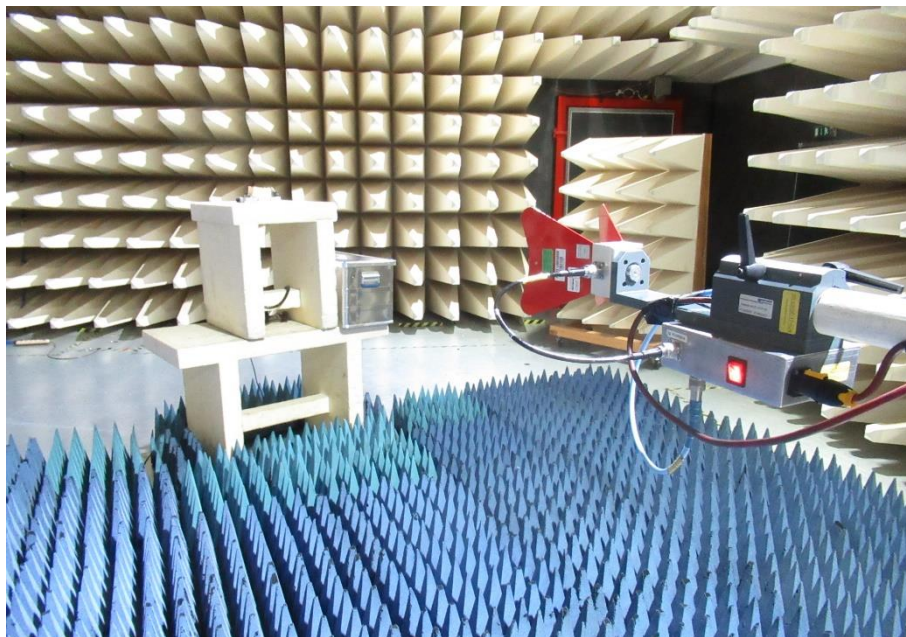
### 5.1 Maximum peak radiated output power

For test instruments and accessories used see section 6 Part **CPR 3**.

#### 5.1.1 Description of the test location

Test location: Anechoic chamber 1  
Test distance: 3 m

#### 5.1.2 Photo documentation of the test set-up



The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

### 5.1.3 Applicable standard

According to FCC Part 15C, Section 15.247(b)(1):

The maximum peak output power of an intentional radiator shall not exceed the limit defined in dependency of the channel separation and of the number of hopping channels.

### 5.1.4 Description of Measurement

The maximum peak radiated output power is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 11.9.1.1. The EUT is set in TX continuous mode while measuring. The radiated measurement was performed in terms of fieldstrength. Therefore, the formula set out in ANSI C63.10, item 9.5 (Equation 22) is changed into the following term:

$$E = \text{EIRP} - (20 \cdot \log_{10}(3)) + 104.7$$

### 5.1.5 Test result

| Channel | Mod. / packet type   | FS (dBμV/m) | P EIRP (dBm) | EIRP limit (dBm) | Margin (dB) | result |
|---------|----------------------|-------------|--------------|------------------|-------------|--------|
| 1       | GFSK /<br>DH5        | 92.2        | -3.0         | 36.0             | -39.0       | passed |
| 40      |                      | 91.4        | -3.8         |                  | -39.8       | passed |
| 79      |                      | 93.7        | -1.5         |                  | -37.5       | passed |
| 1       | π/4-DQPSK /<br>2-DH5 | 96.8        | 1.6          |                  | -34.4       | passed |
| 40      |                      | 98.9        | 3.7          |                  | -32.3       | passed |
| 79      |                      | 101.1       | 5.9          |                  | -30.1       | passed |
| 1       | 8DPSK<br>3-DH5       | 99.3        | 4.1          |                  | -31.9       | passed |
| 40      |                      | 99.0        | 3.8          |                  | -32.2       | passed |
| 79      |                      | 101.4       | 6.2          |                  | -29.8       | passed |

Peak Power Limit according to FCC Part 15C, Section 15.247(b)(1):

| Frequency<br>(MHz) | Channel separation | Hop<br>Channels | Peak power limit |        |
|--------------------|--------------------|-----------------|------------------|--------|
|                    |                    |                 | (dBm)            | (Watt) |
| 2400 - 2483.5      | -                  | ≥ 75            | 30               | 1      |

The requirements are **FULFILLED**.

Remarks: None.

## 5.2 Radiated emissions in restricted bands

For test instruments and accessories used see section 6 Part **SER3**.

### 5.2.1 Description of the test location

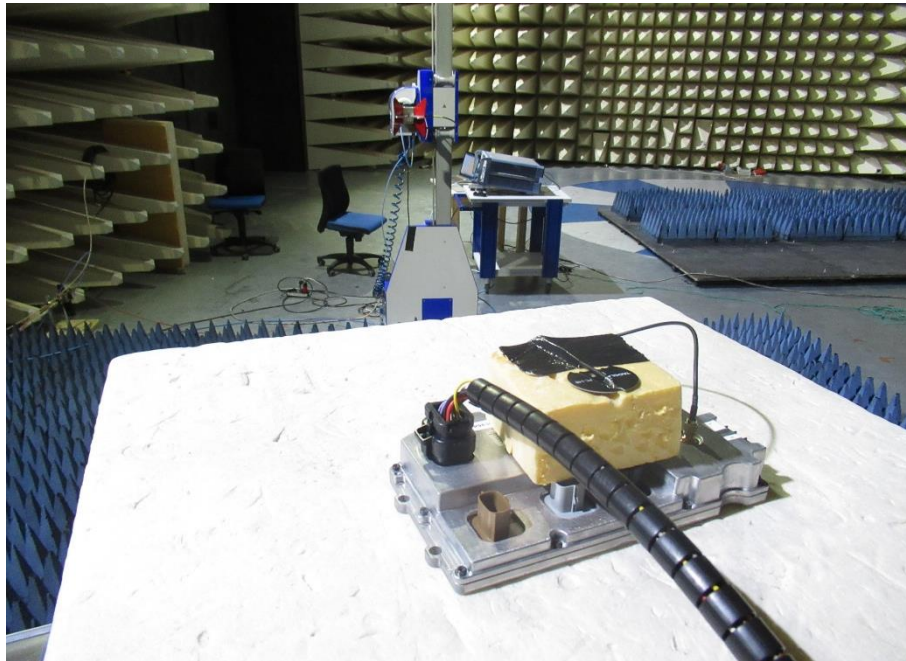
Test location: OATS 1  
 Test location: Anechoic chamber 1  
 Test distance: 3 m

### 5.2.2 Photo documentation of the test set-up

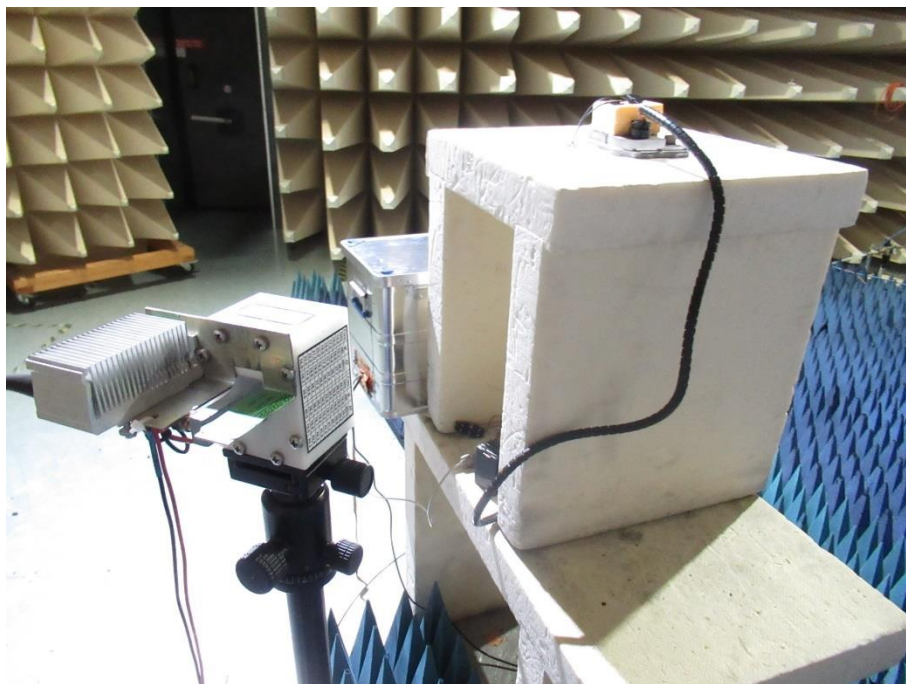
Open area test site



Anechoic chamber



Anechoic chamber



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

## 5.2.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser was set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

## 5.2.5 Test result

**f < 1000 MHz:**

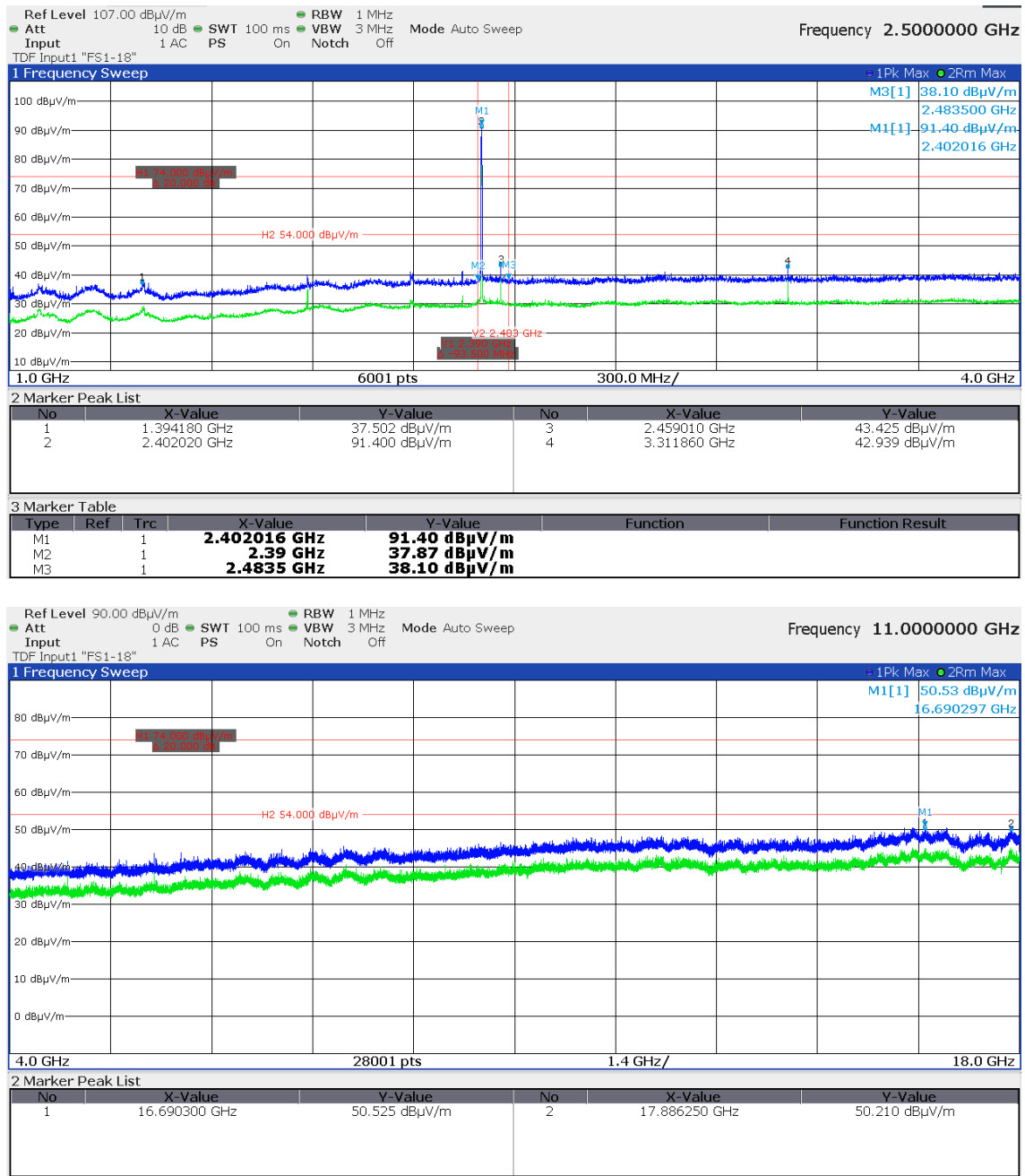
| Frequency<br>(MHz) | Reading<br>Vert.<br>(dBµV) | Reading<br>Hor.<br>(dBµV) | Correct.<br>Vert.<br>(dB) | Correct.<br>Hor.<br>(dB) | Level<br>Vert.<br>(dBµV/m) | Level<br>Hor.<br>(dBµV/m) | Limit<br>(dBµV/m) | Dlimit<br>(dB) |
|--------------------|----------------------------|---------------------------|---------------------------|--------------------------|----------------------------|---------------------------|-------------------|----------------|
| 82.37              | 0.4                        | -4.5                      | 10.5                      | 10.5                     | 10.9                       | 6.0                       | 40.0              | -29.1          |
| 134.62             | -2.9                       | -4.0                      | 13.1                      | 13.9                     | 10.2                       | 9.9                       | 43.5              | -33.3          |
| 235.00             | 0.8                        | -6.2                      | 13.0                      | 13.4                     | 13.8                       | 7.2                       | 46.0              | -32.2          |
| 430.00             | 1.9                        | -1.8                      | 20.6                      | 20.4                     | 22.5                       | 18.6                      | 46.0              | -23.5          |
| 600.00             | -3.8                       | -3.1                      | 25.5                      | 25.3                     | 21.7                       | 22.2                      | 46.0              | -23.8          |
| 750.00             | -3.1                       | -3.3                      | 28.3                      | 27.7                     | 25.2                       | 24.4                      | 46.0              | -20.8          |

Note: All values represent max. peak noise values of the OATS. No emission could be detected for the EUT, independent of the mode of the EUT (BLE, BT, WiFi).

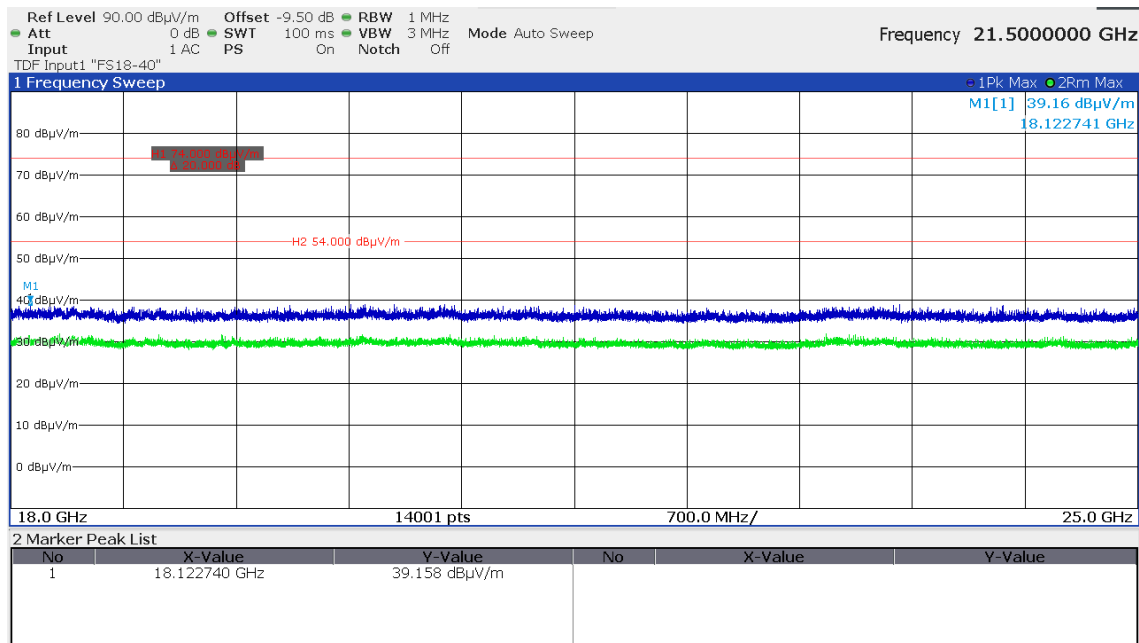
f > 1000 MHz:

### 5.2.5.1 GFSK

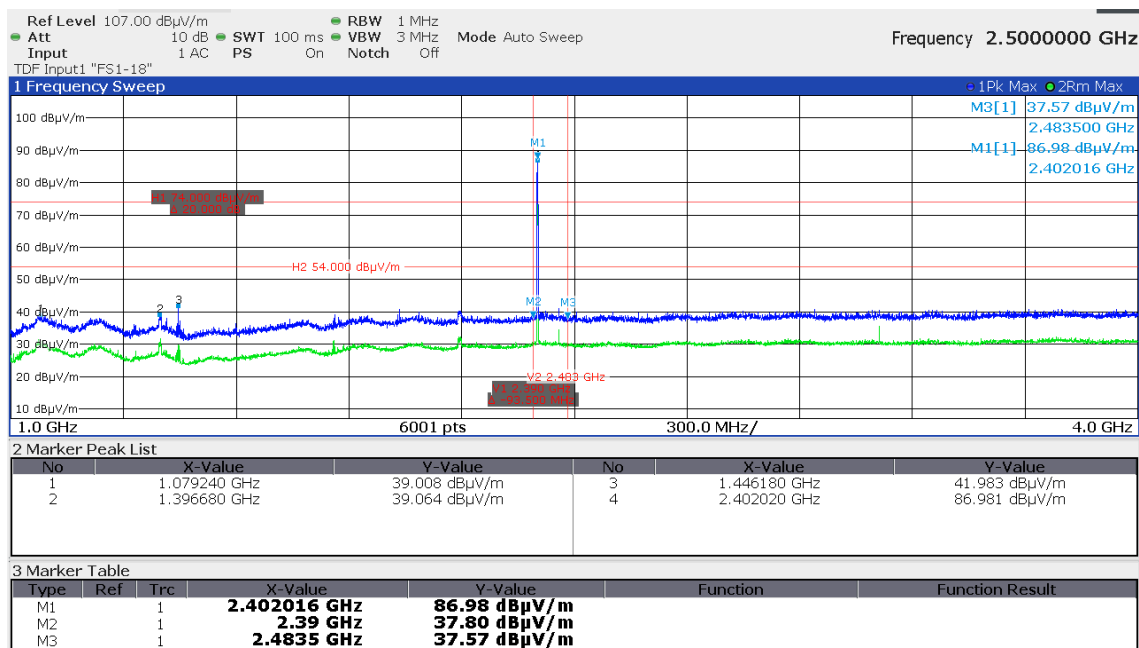
CH1 horizontal

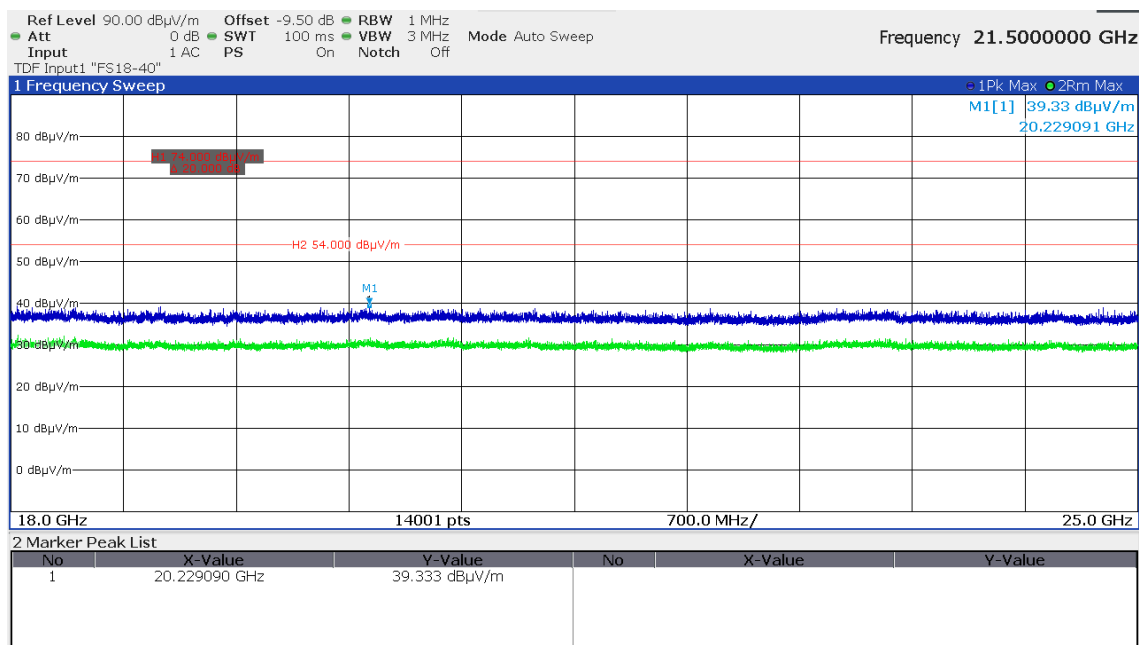
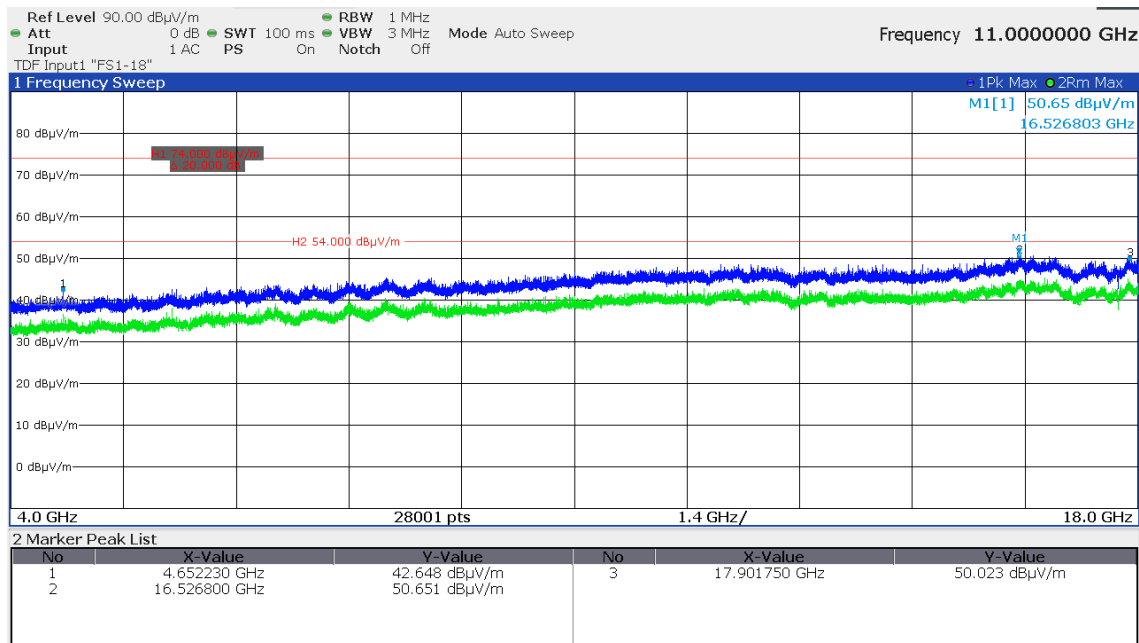


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

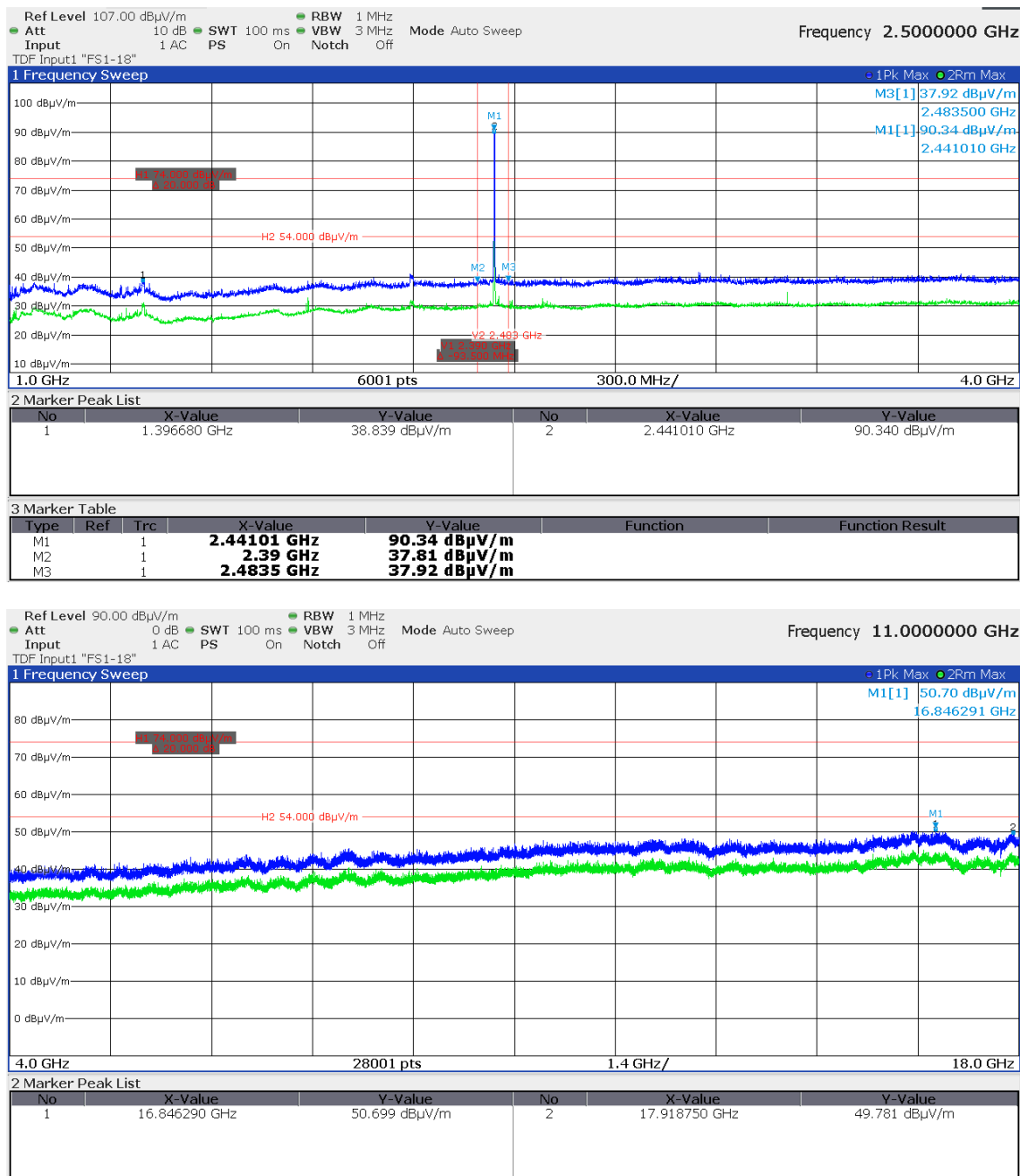


CH1 vertical

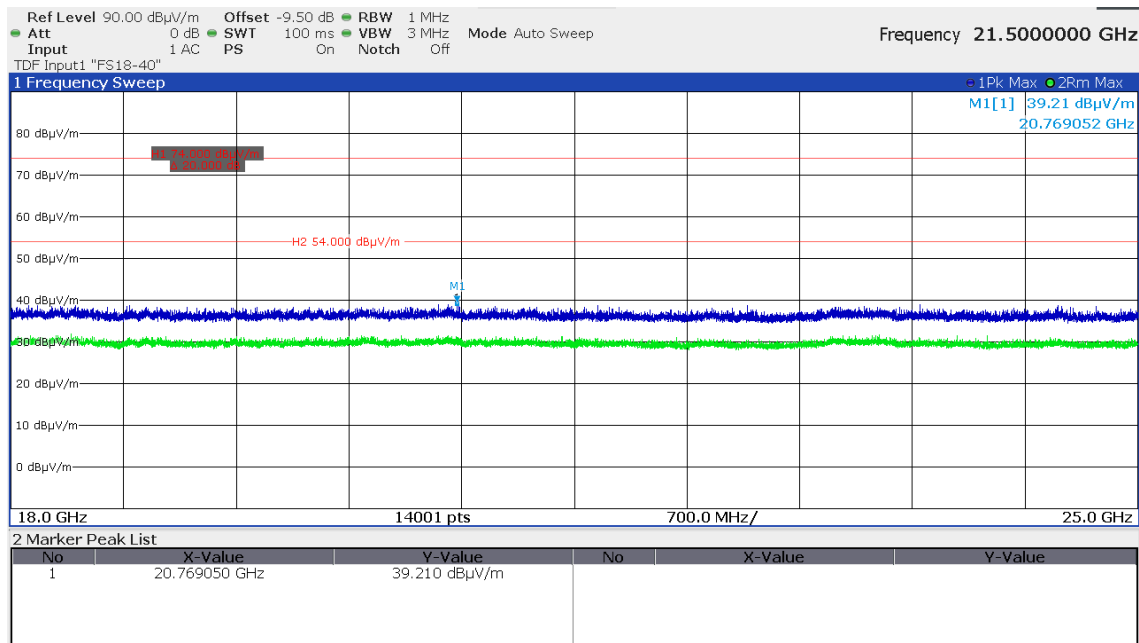




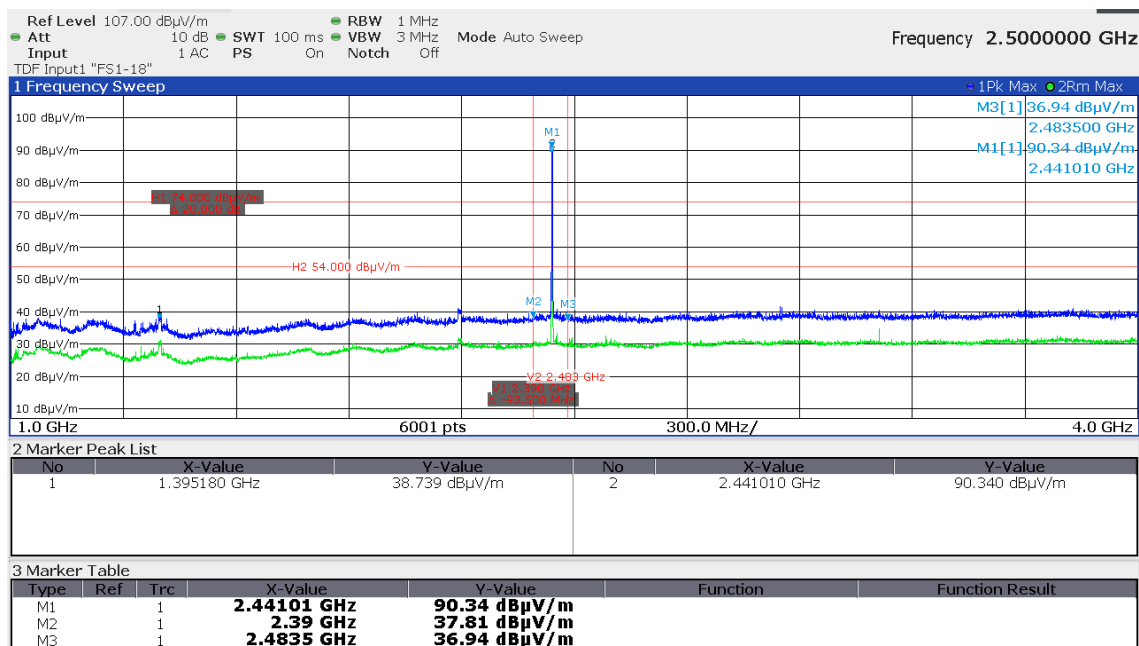
# CH40 horizontal

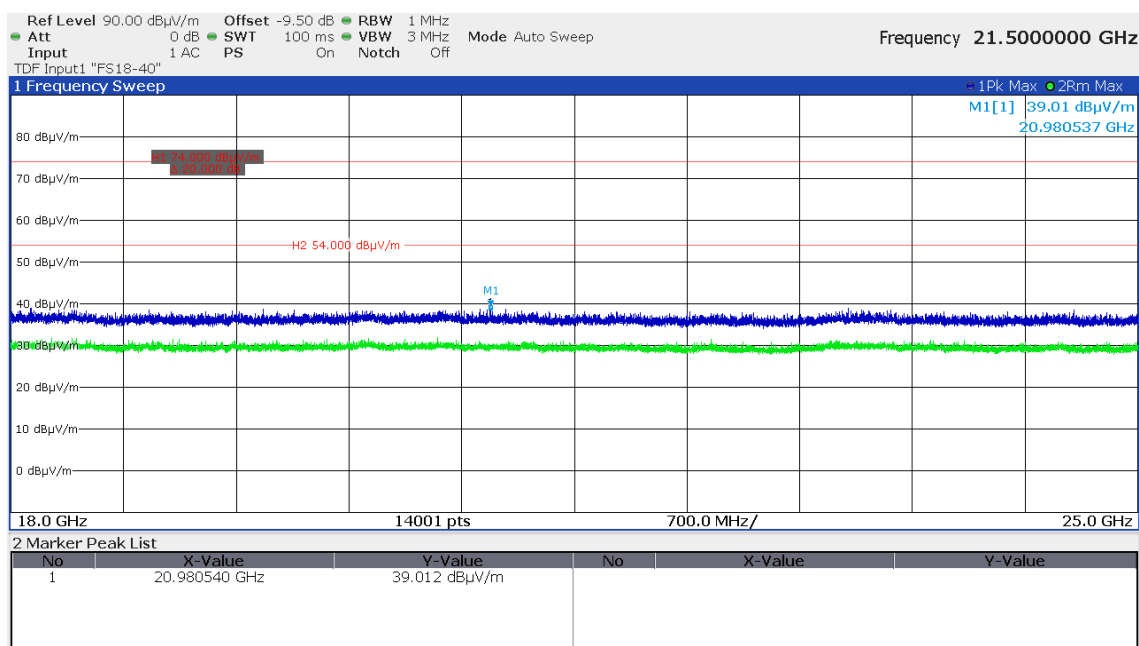
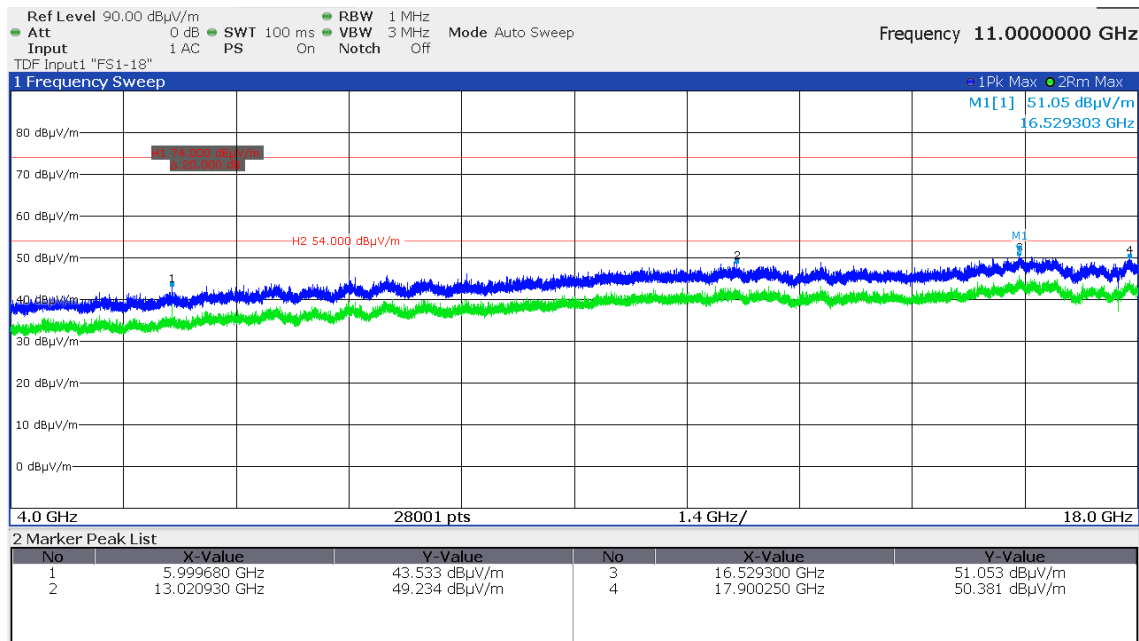


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

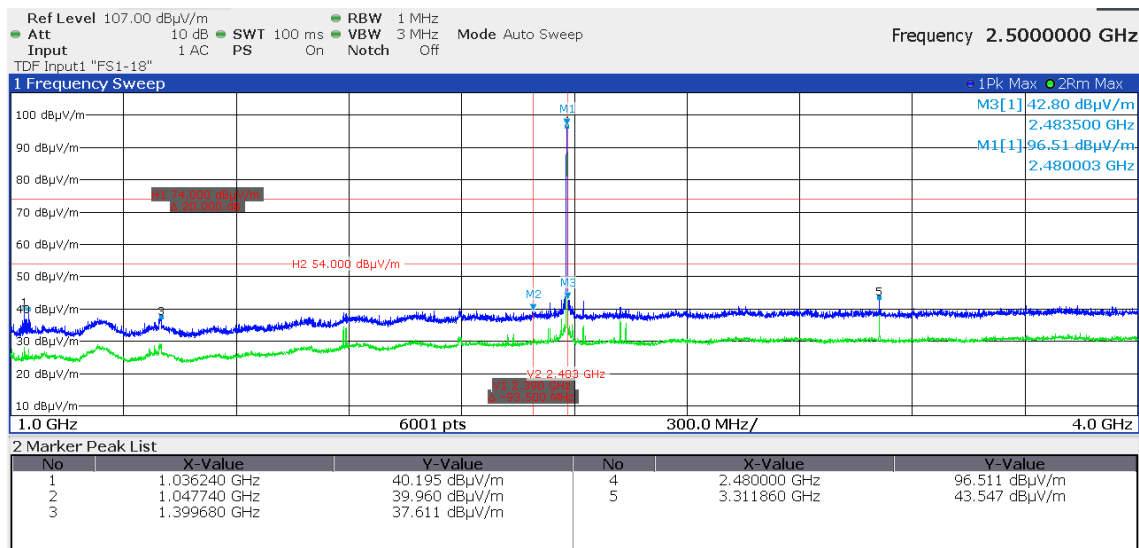


CH40 vertical

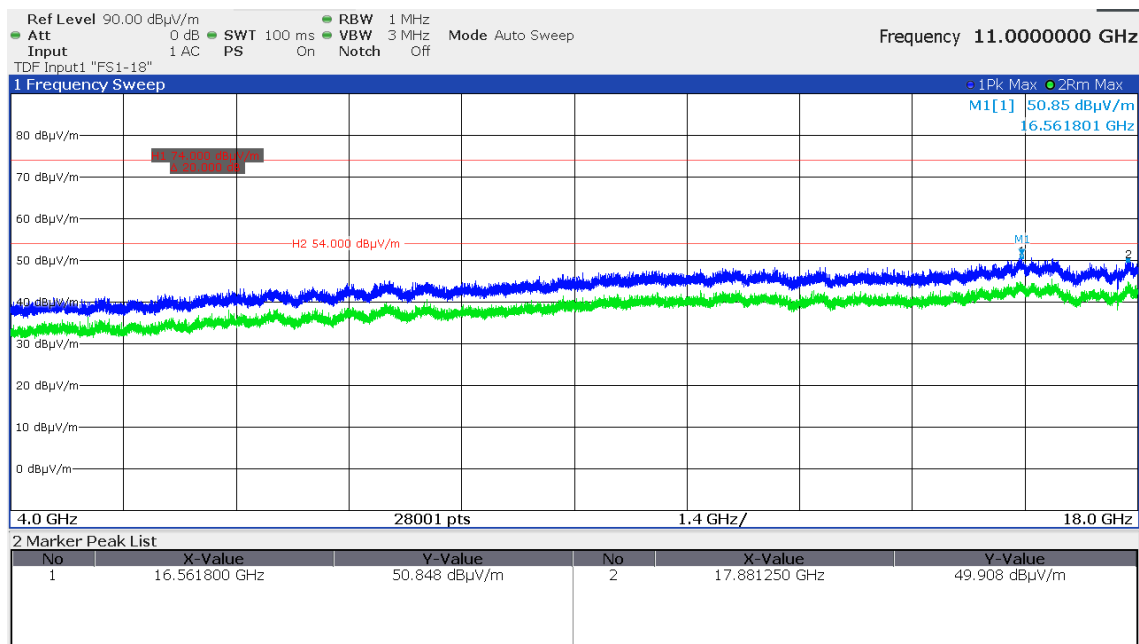


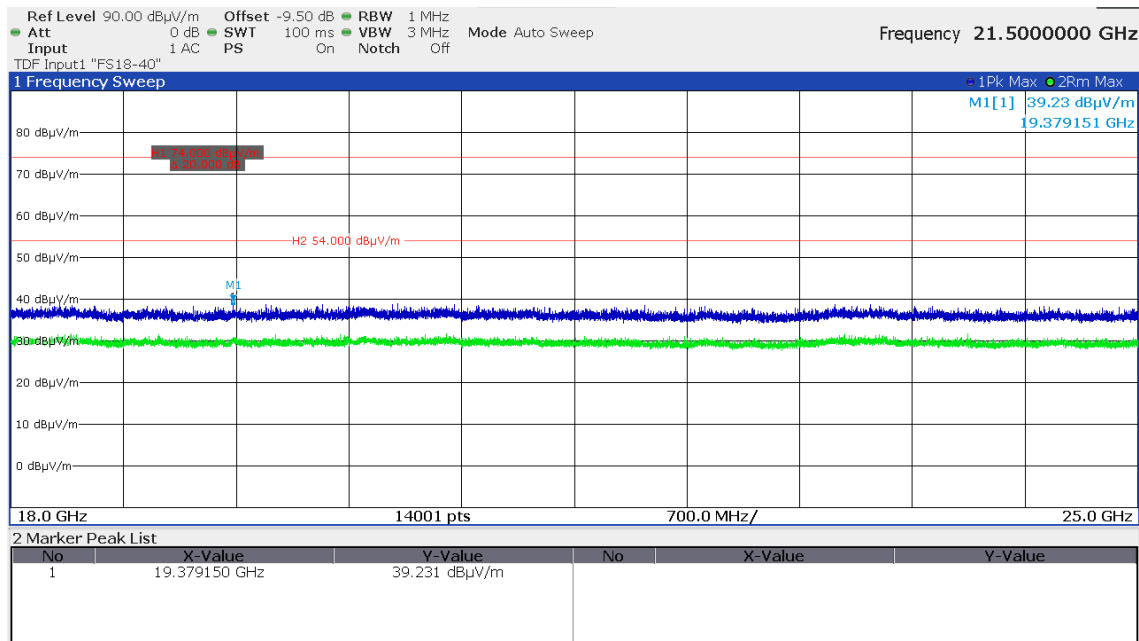


# CH79 horizontal

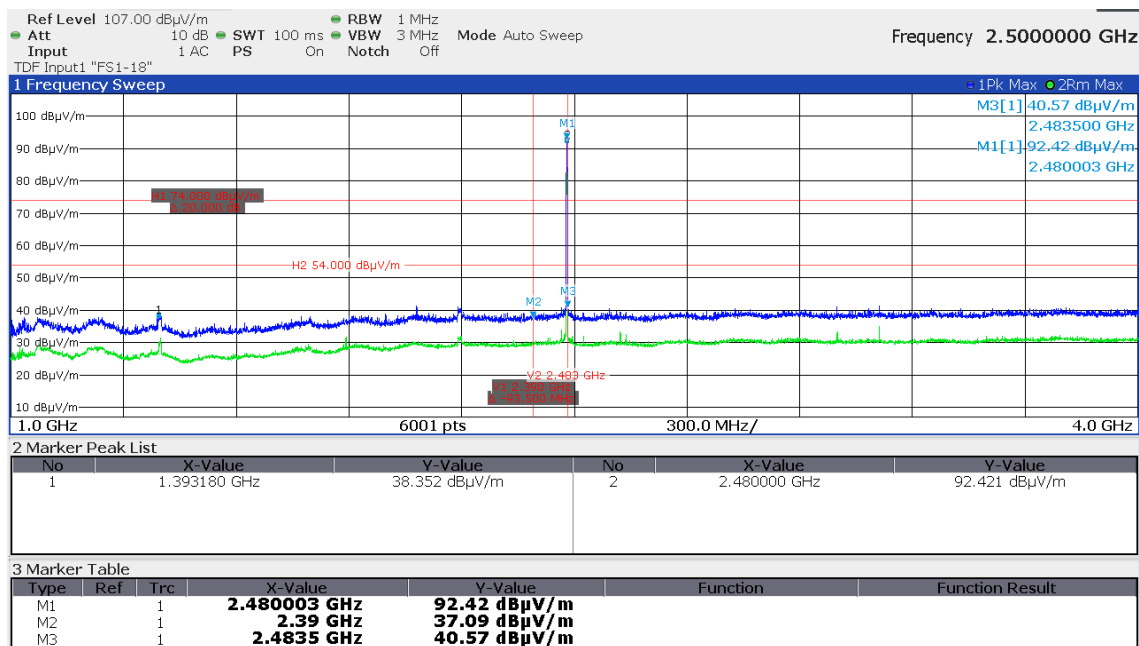


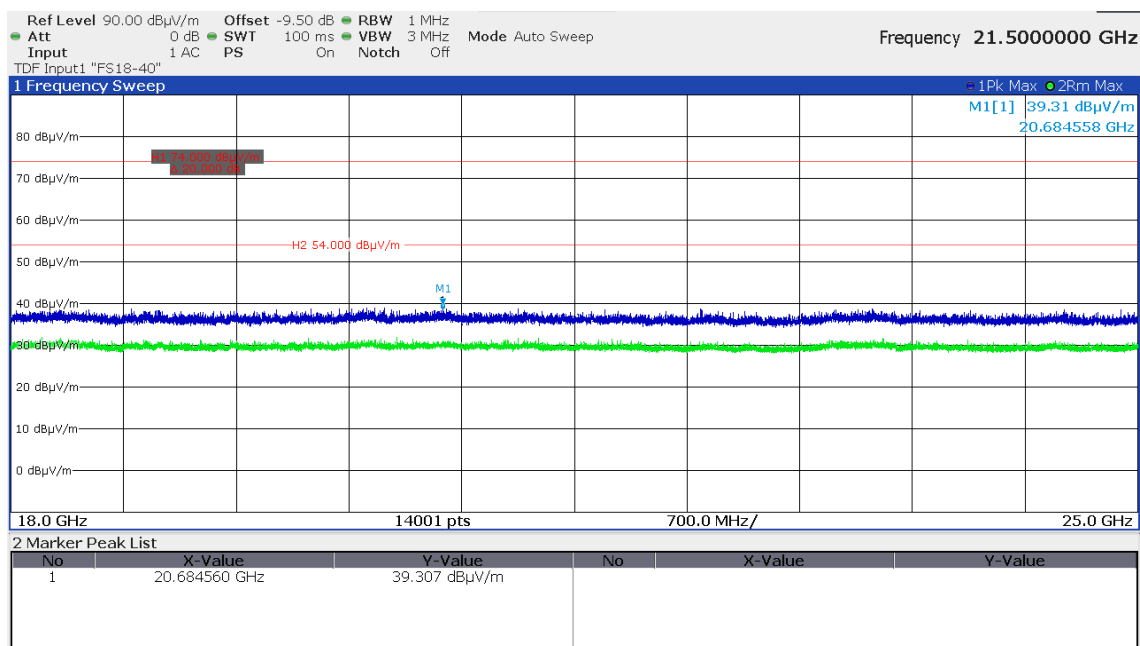
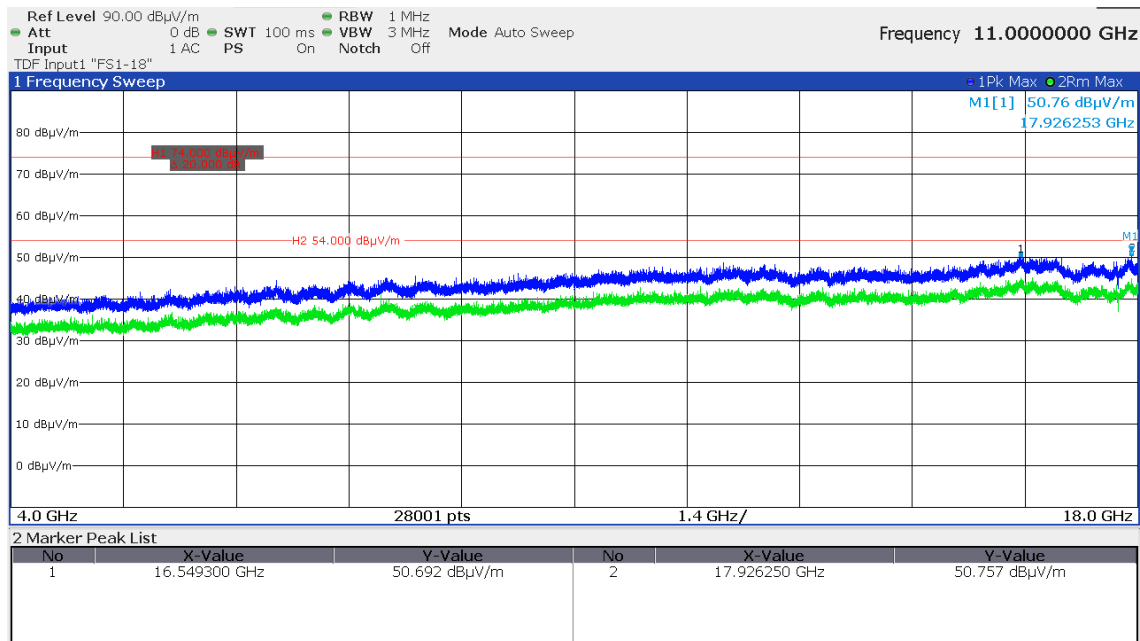
| Type | Ref | Trc | X-Value      | Y-Value      | Function | Function Result |
|------|-----|-----|--------------|--------------|----------|-----------------|
| M1   | 1   |     | 2.480003 GHz | 96.51 dBμV/m |          |                 |
| M2   | 1   |     | 2.39 GHz     | 39.10 dBμV/m |          |                 |
| M3   | 1   |     | 2.4835 GHz   | 42.80 dBμV/m |          |                 |





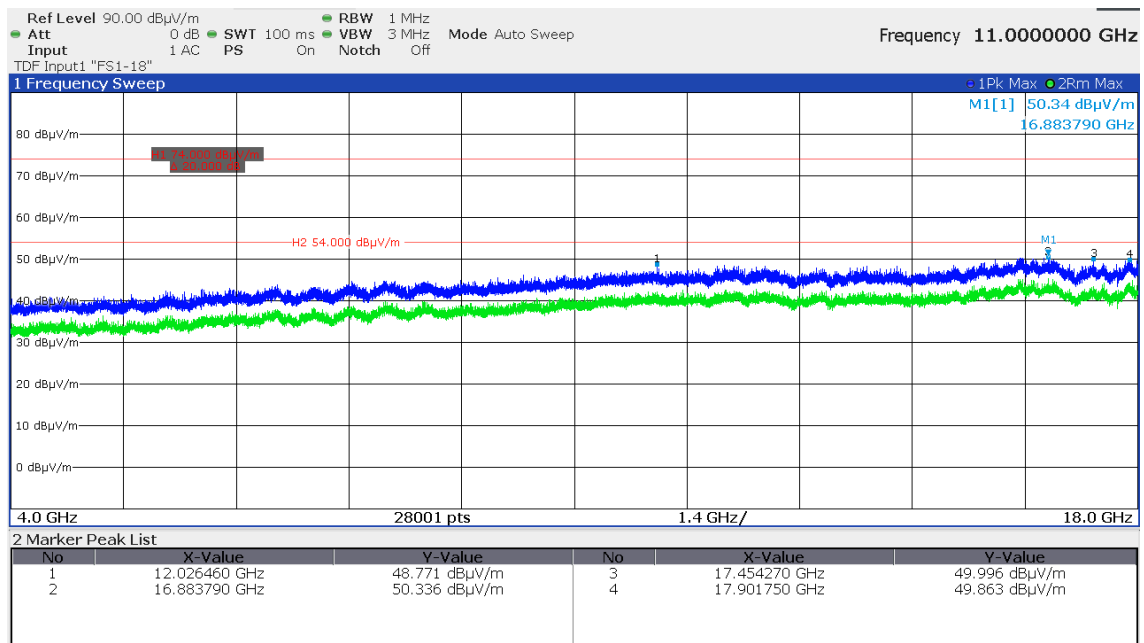
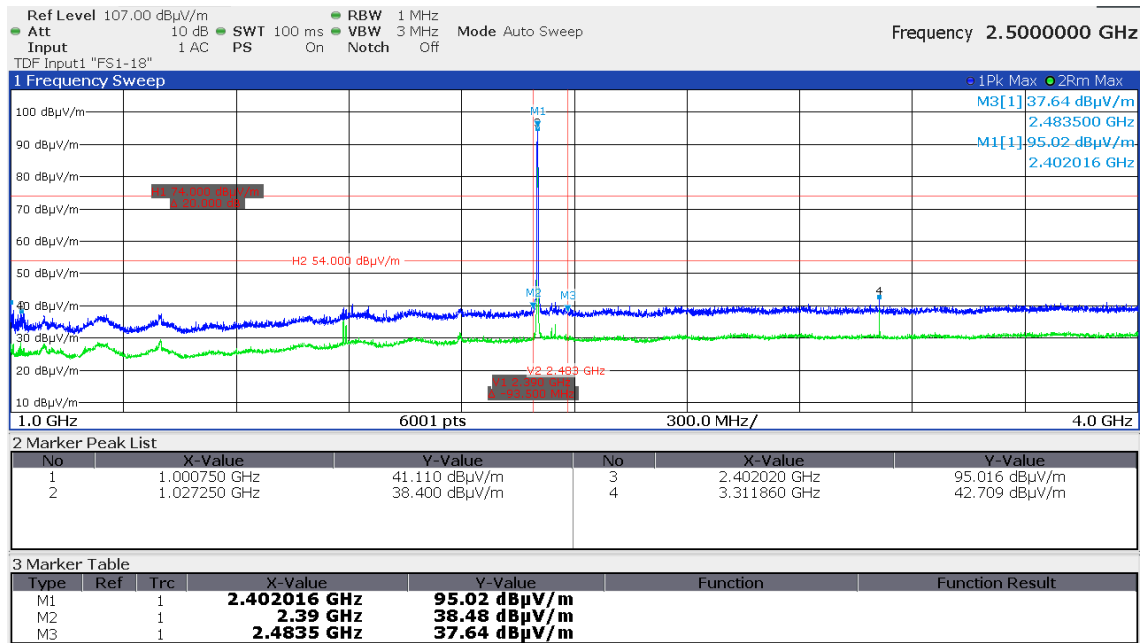
## CH79 vertical

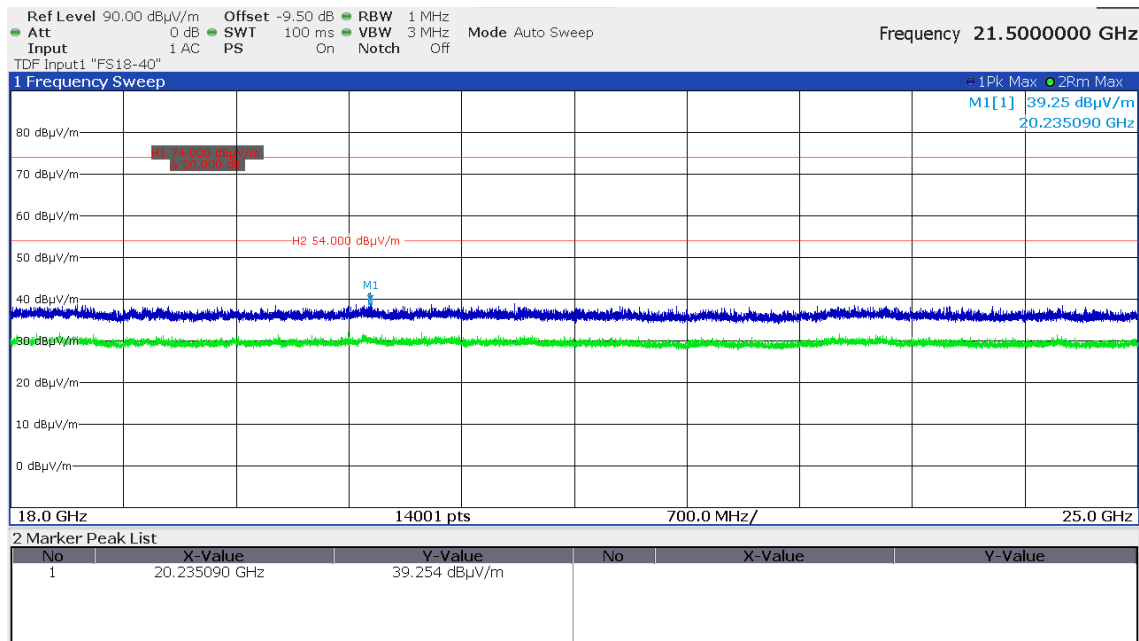




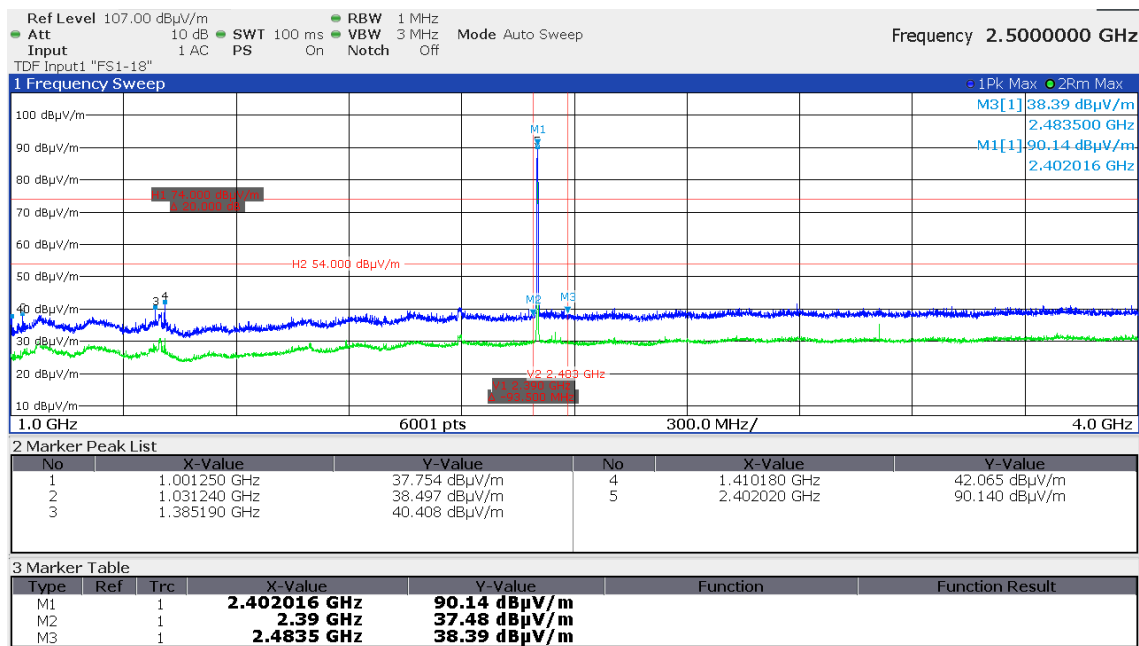
### 5.2.5.2 $\pi/4$ -DQPSK

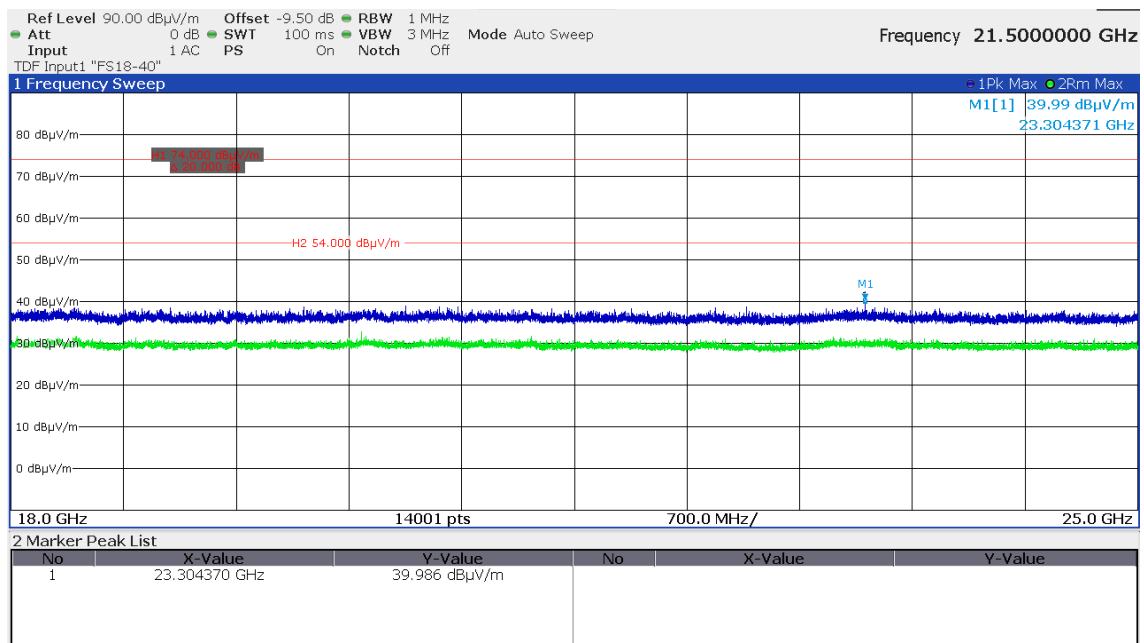
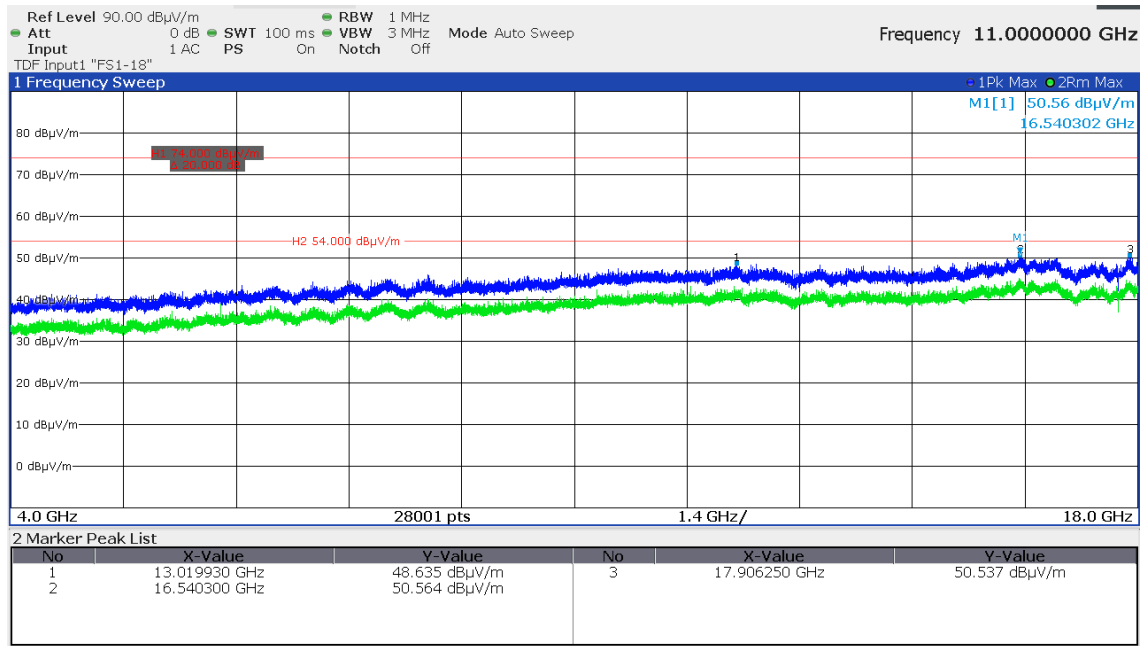
CH1 horizontal



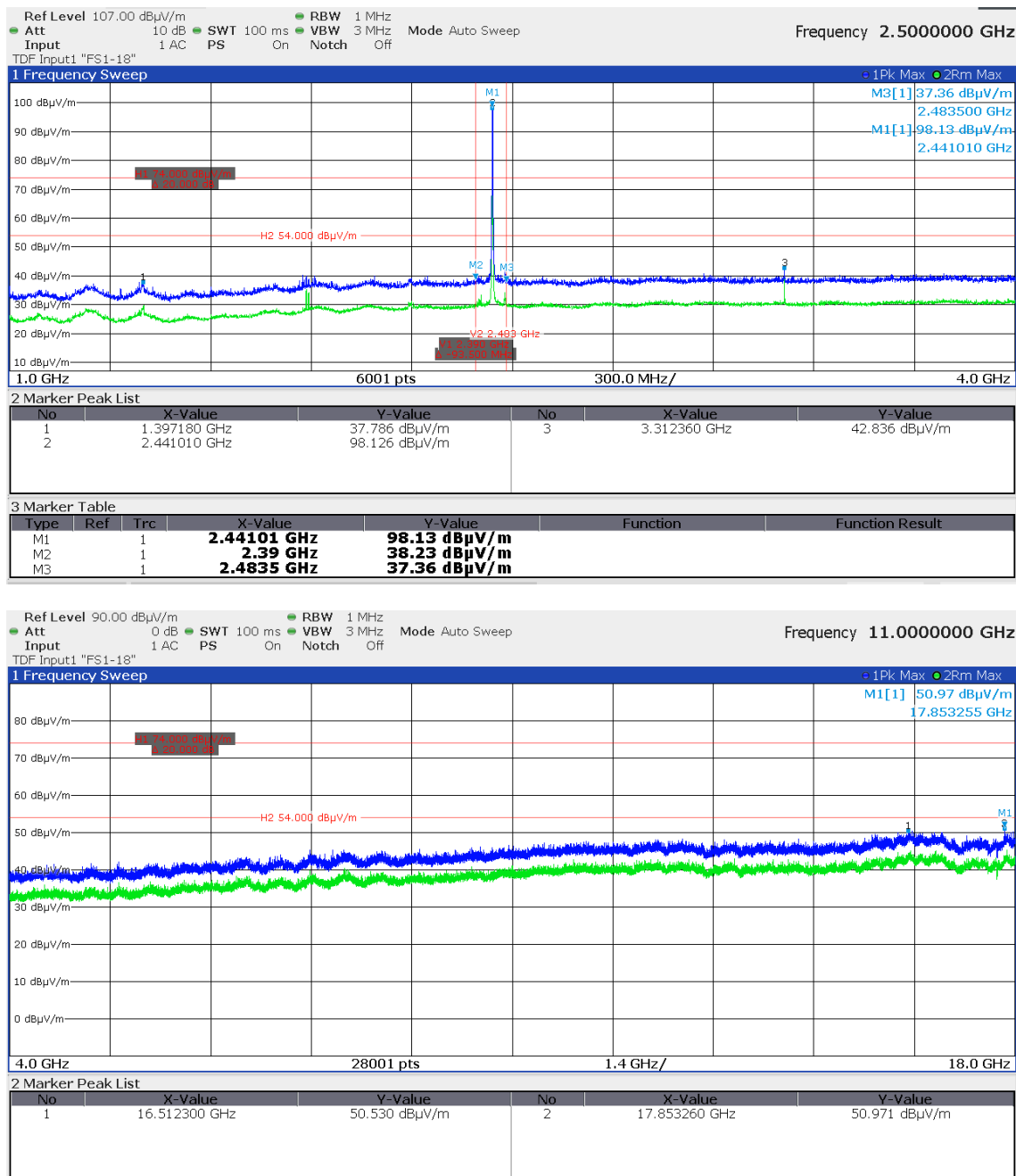


## CH1 vertical

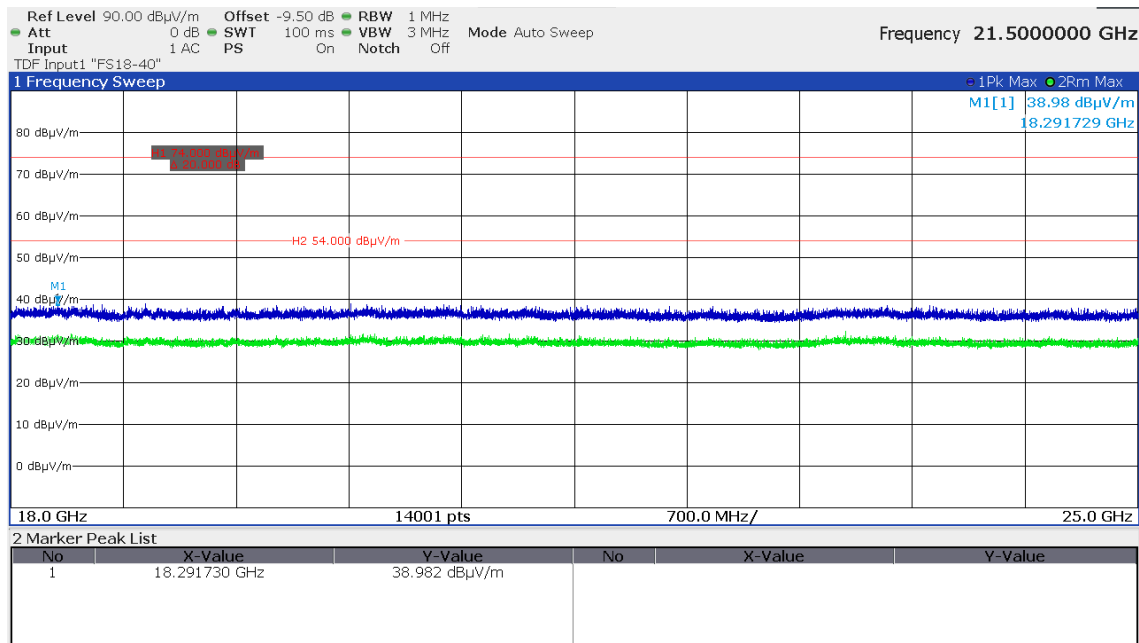




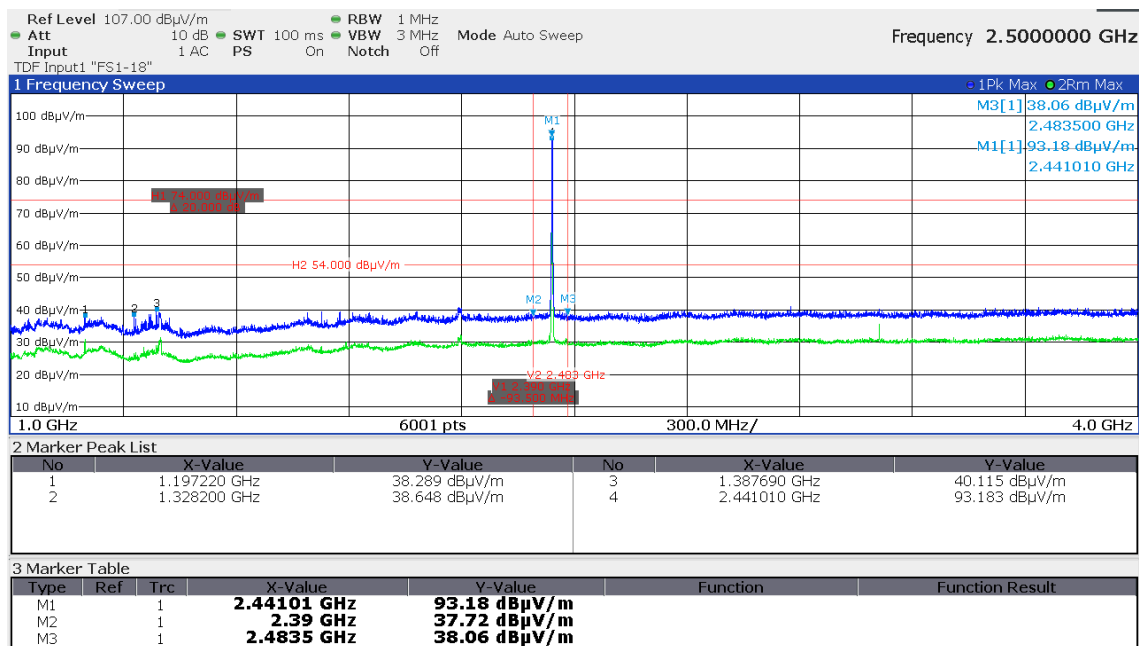
# CH40 horizontal

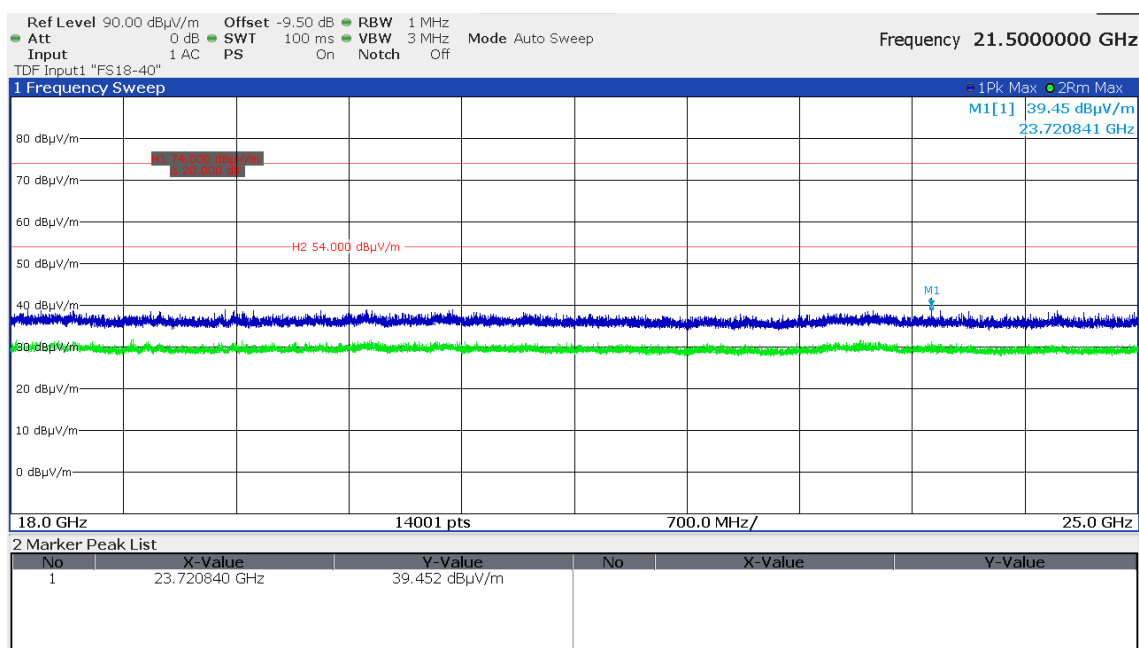
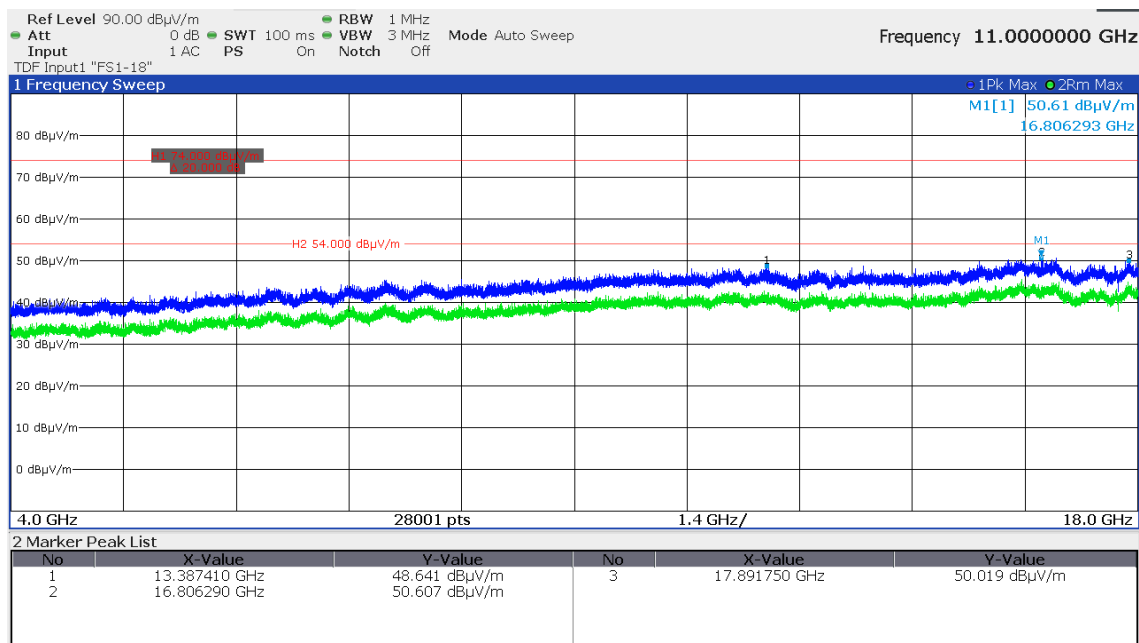


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

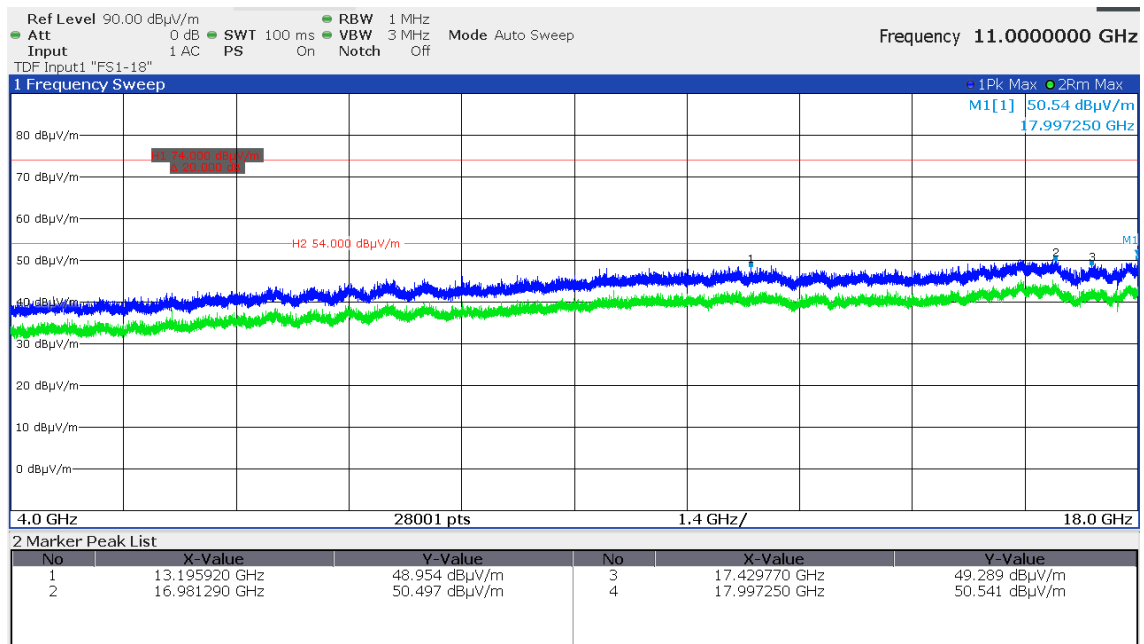
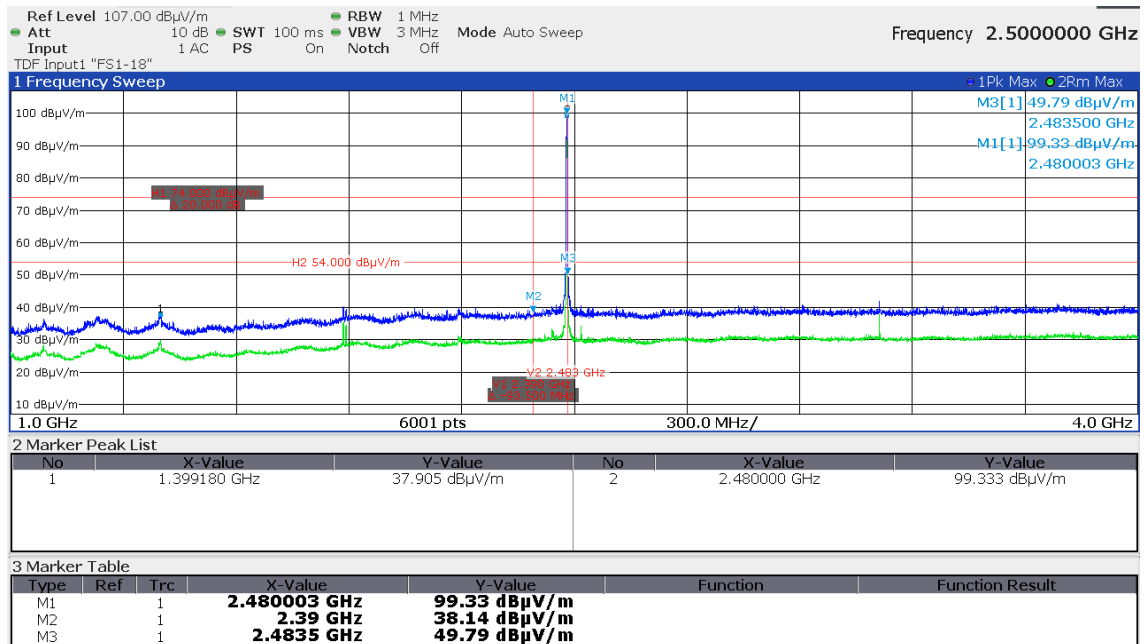


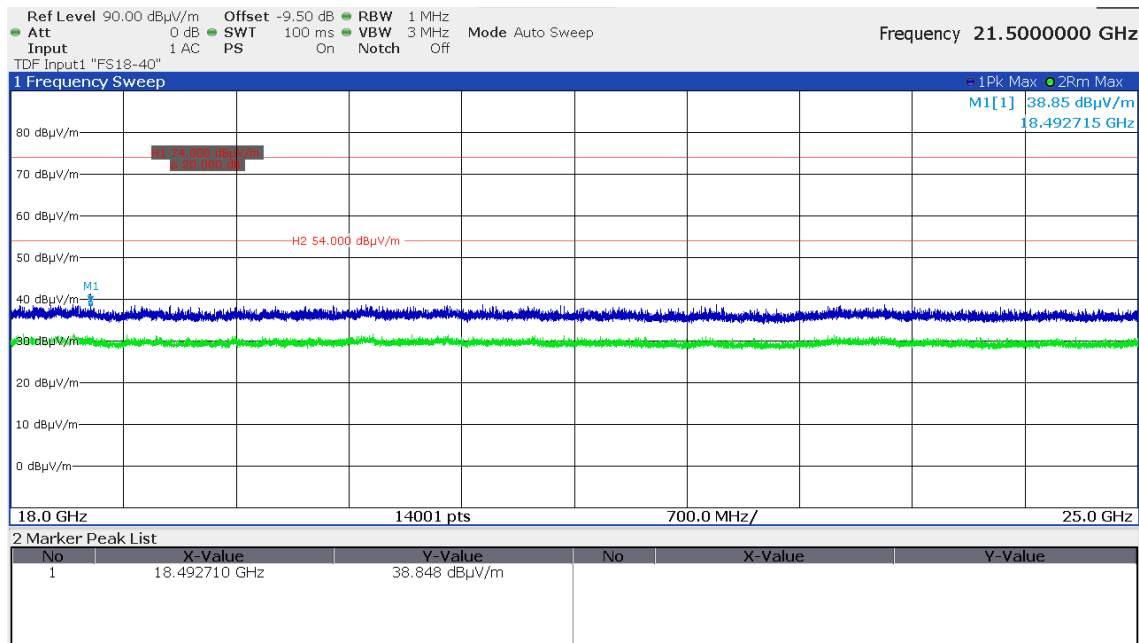
## CH40 vertical



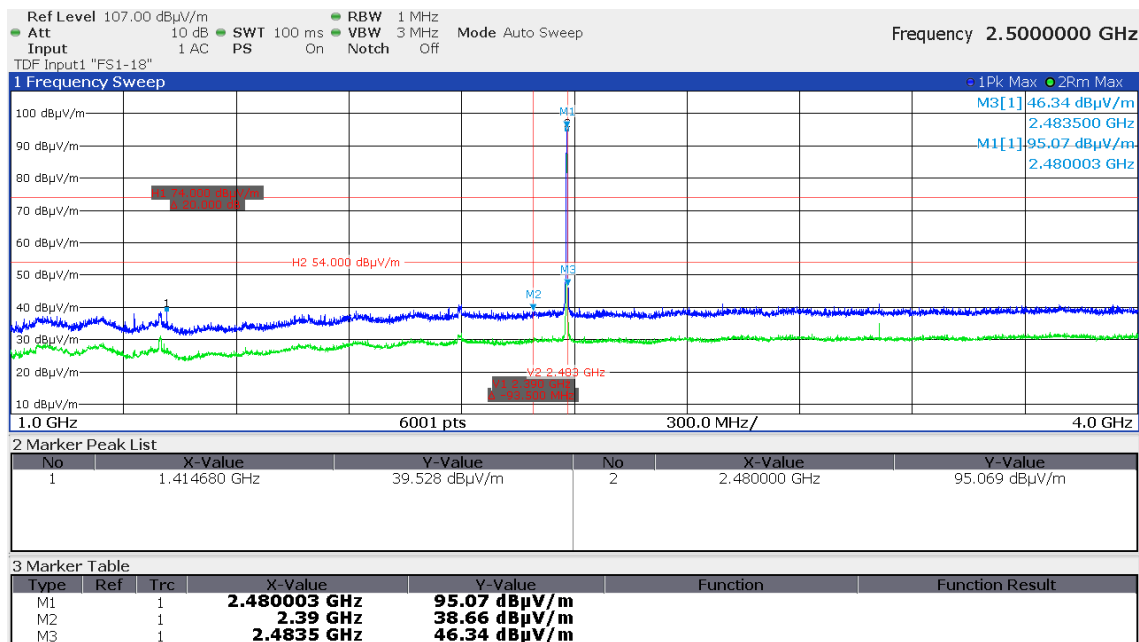


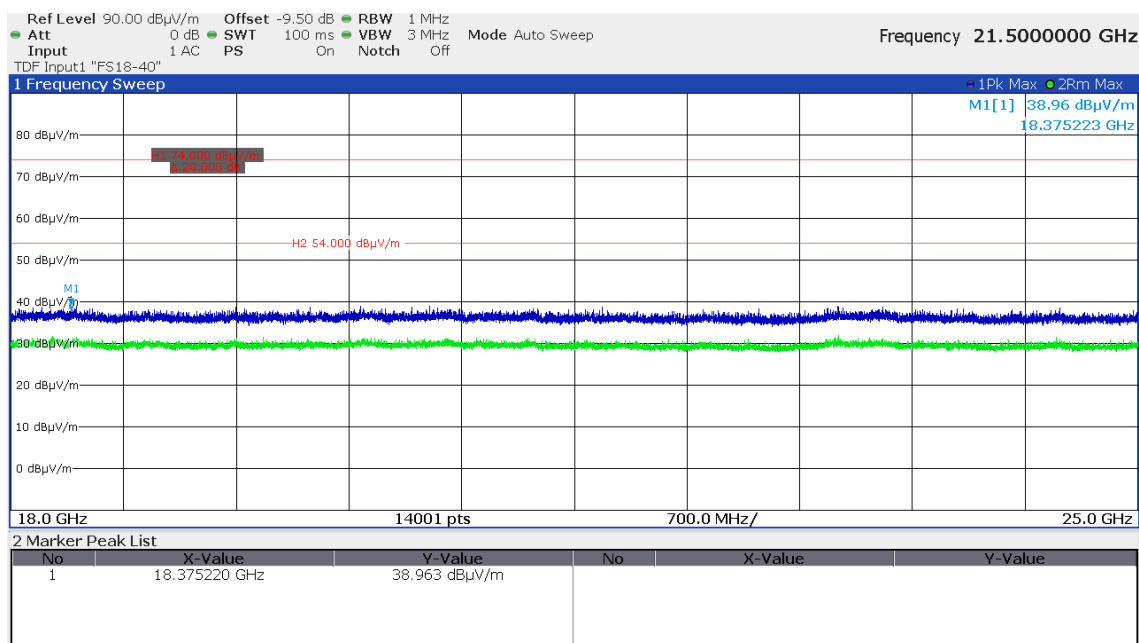
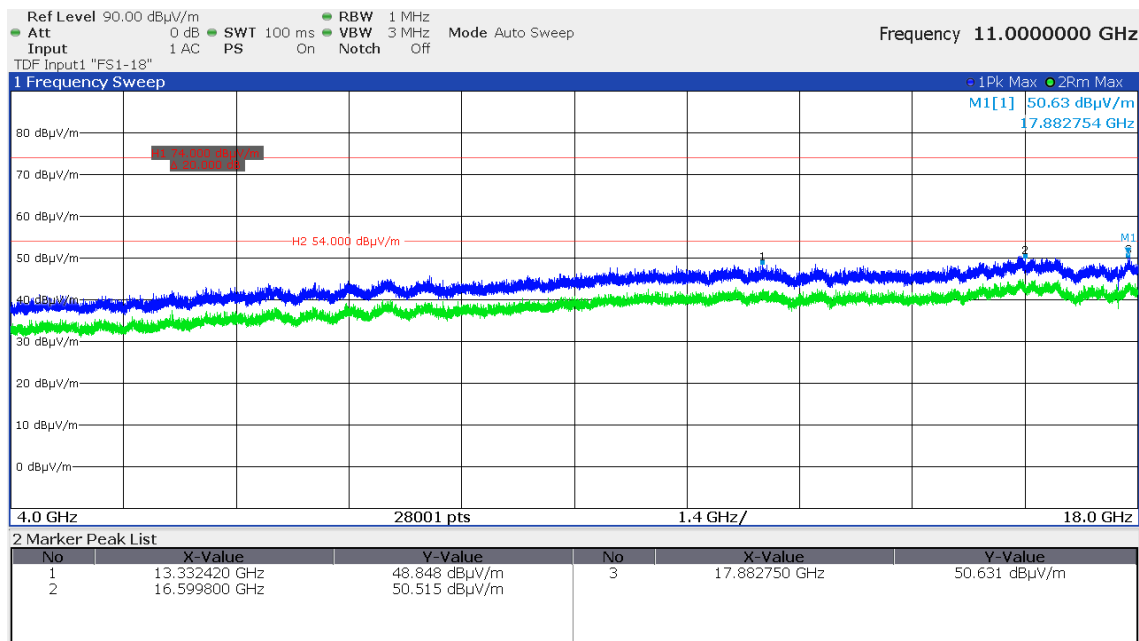
# CH79 horizontal





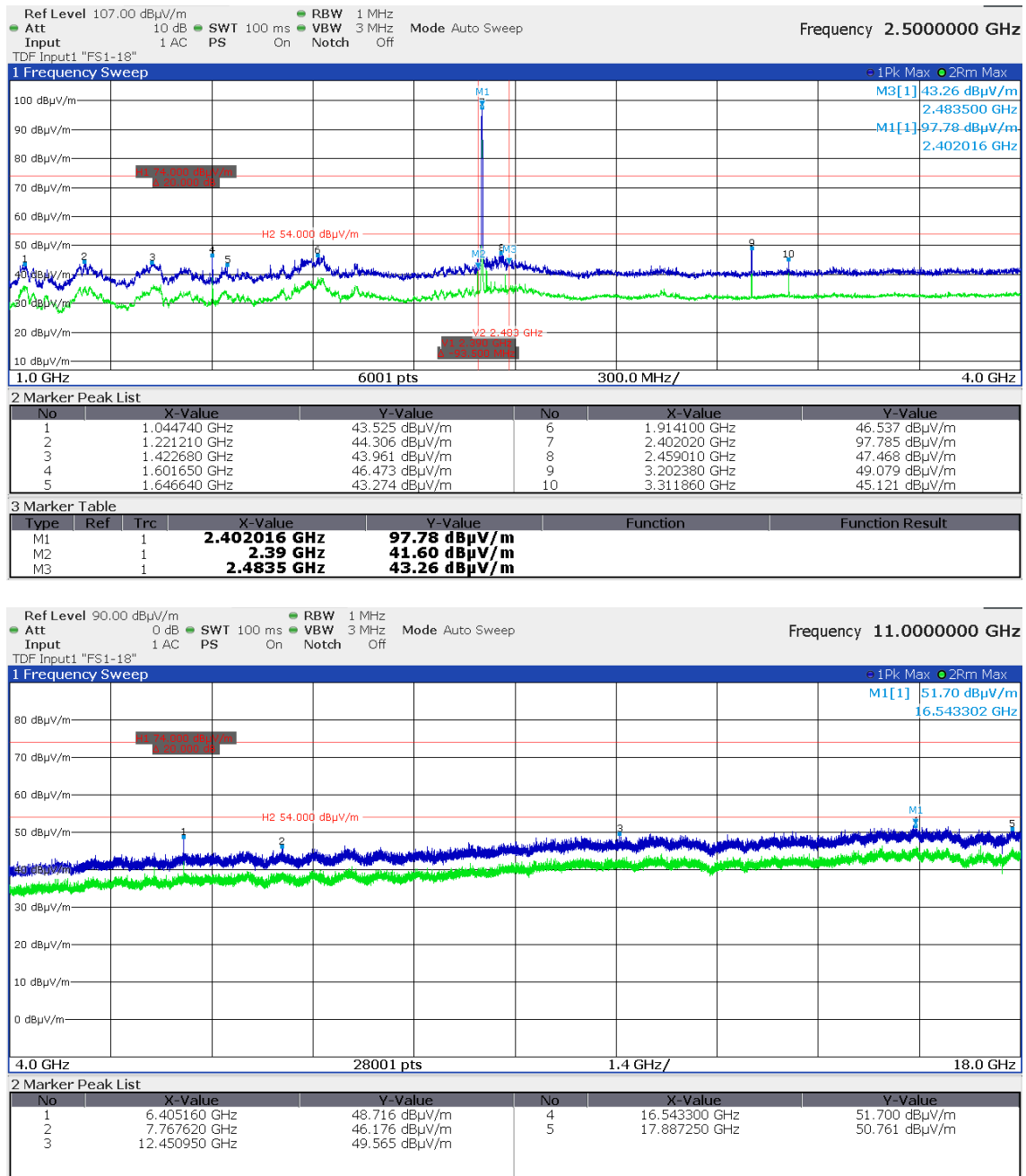
## CH79 vertical



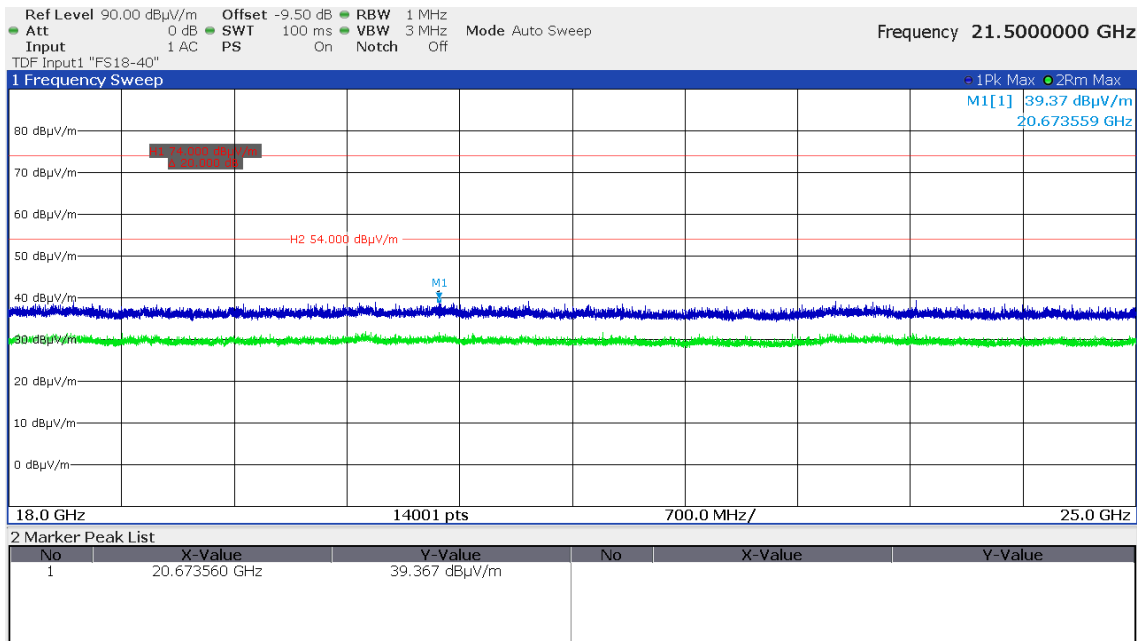


### 5.2.5.3 8DPSK

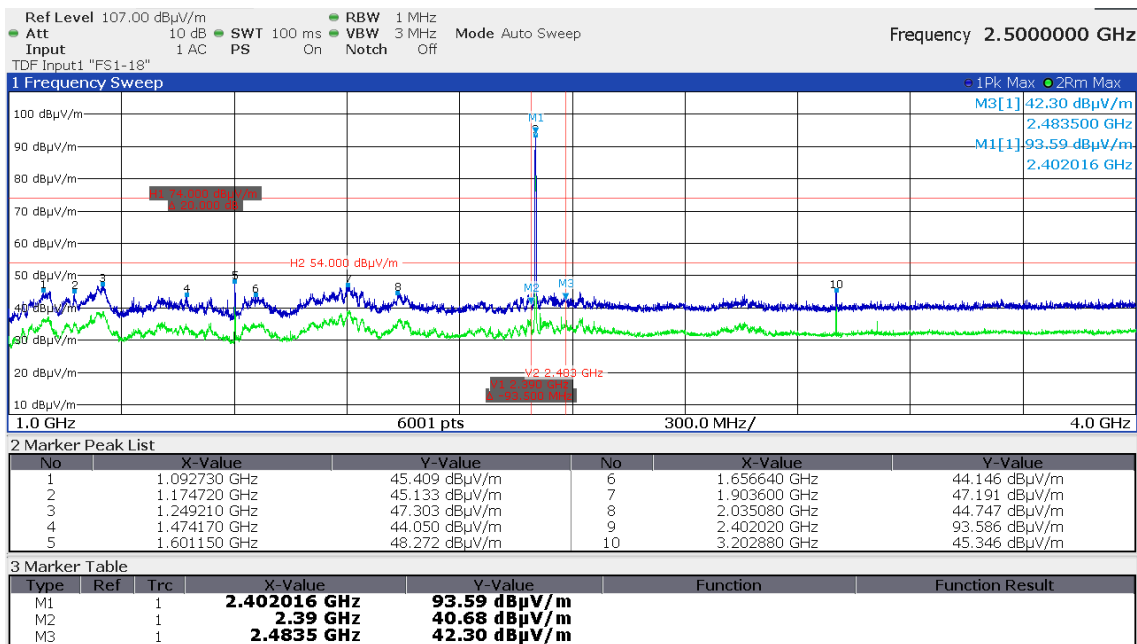
CH1 horizontal

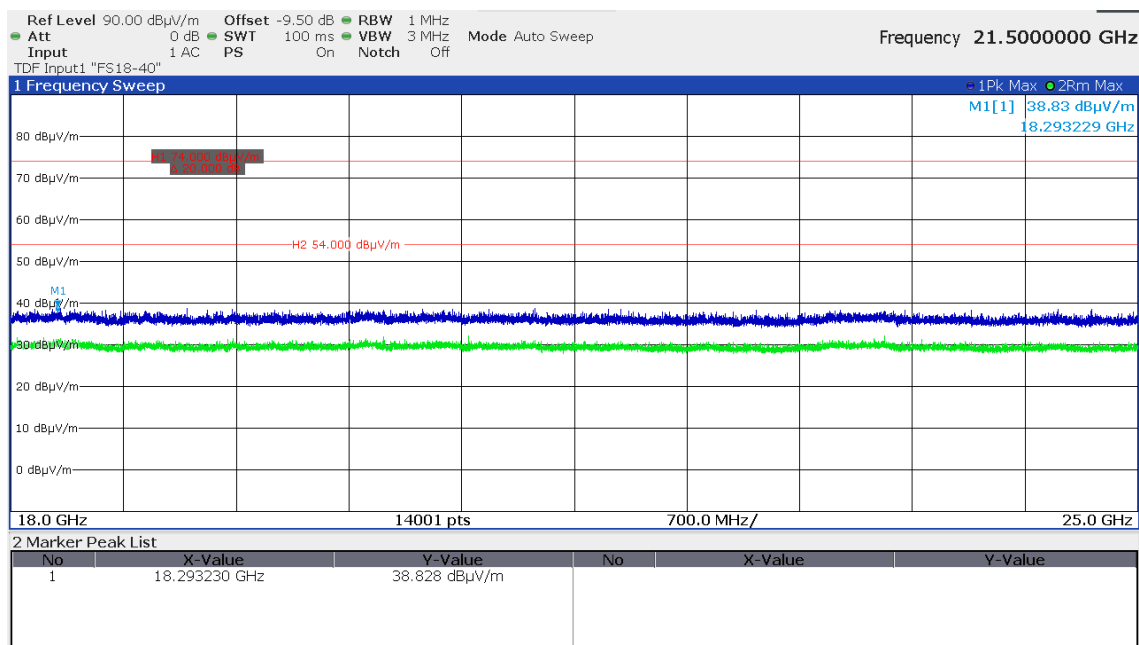
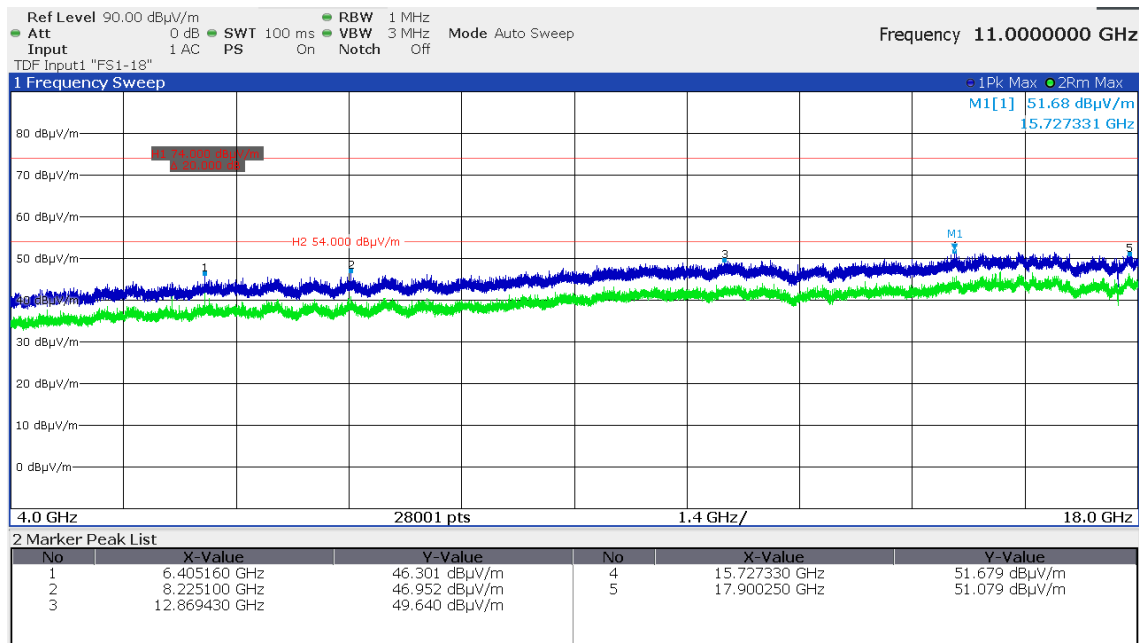


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

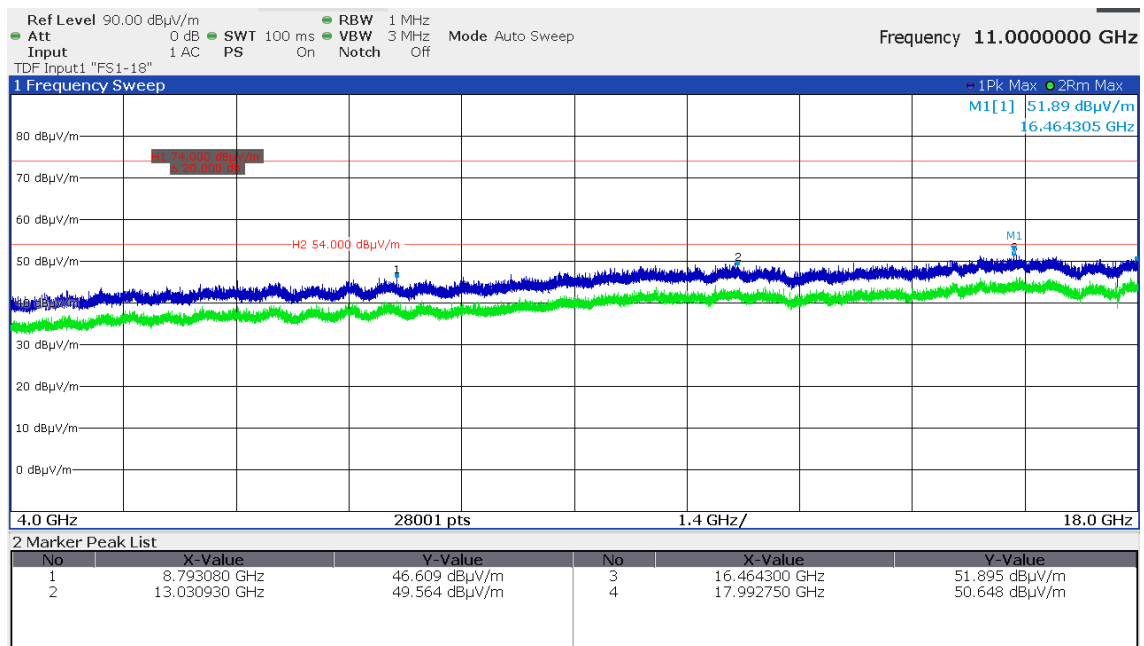
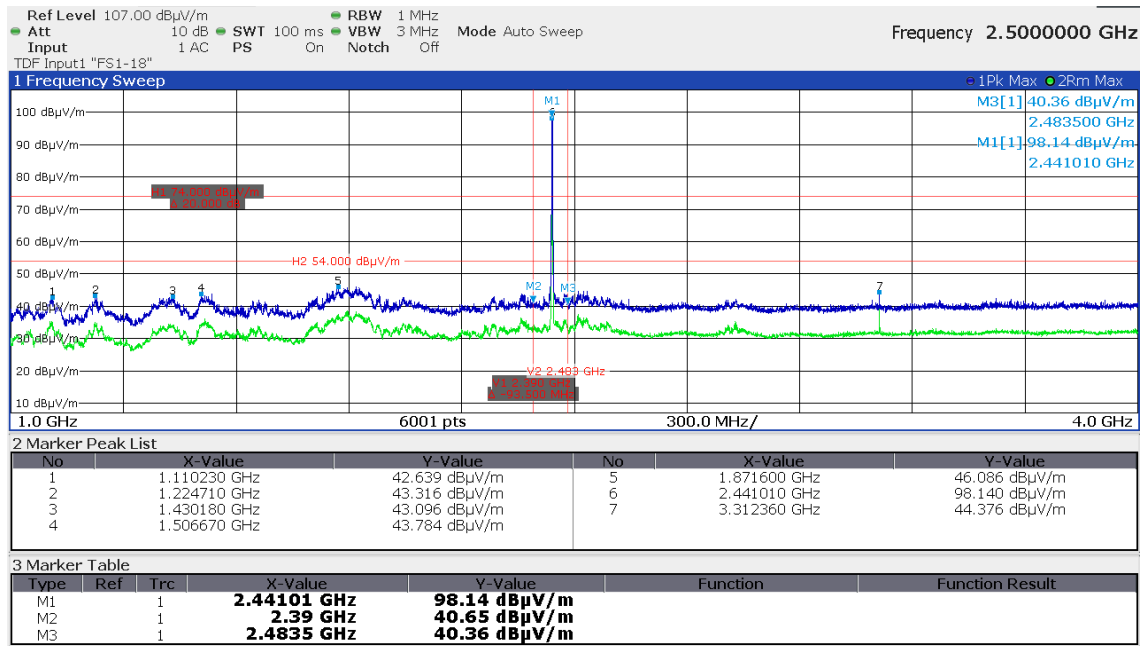


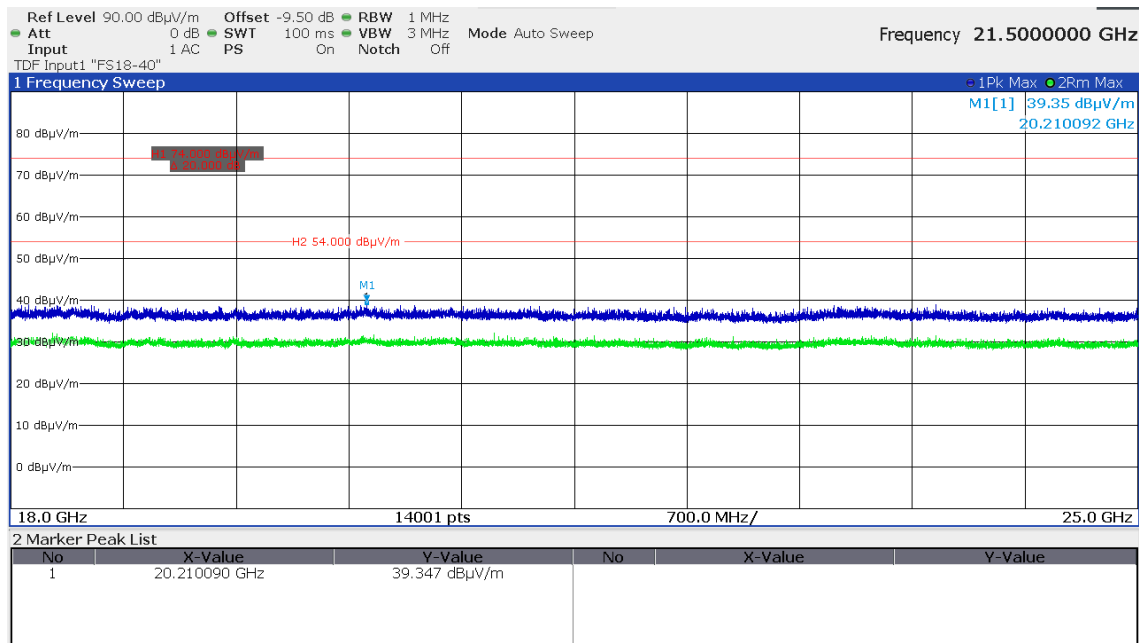
## CH1 vertical



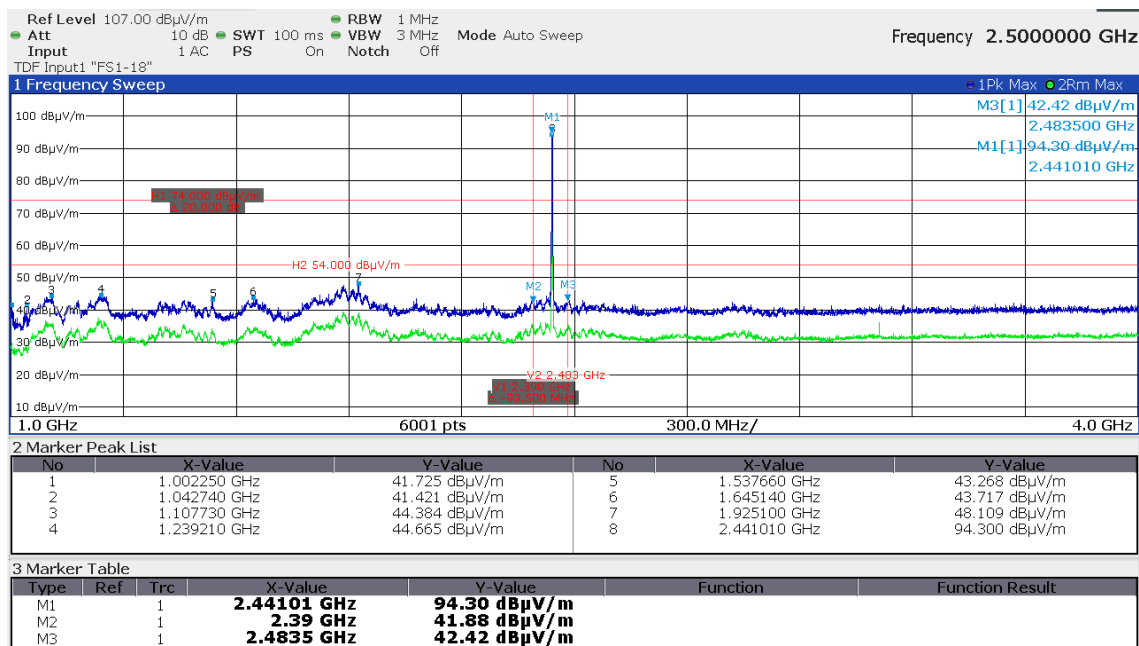


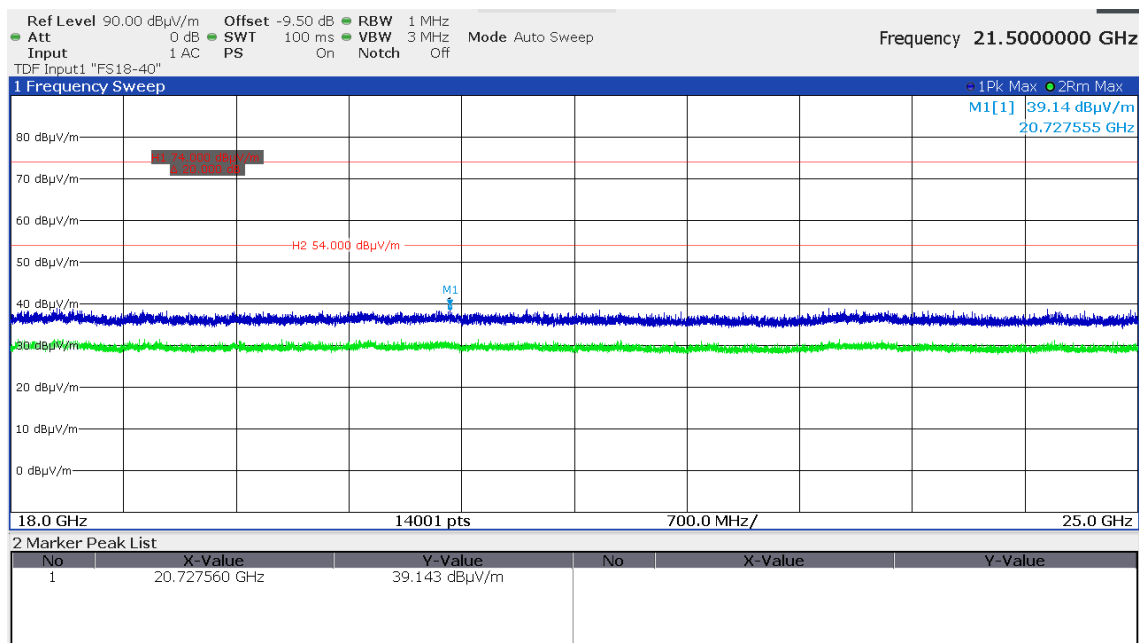
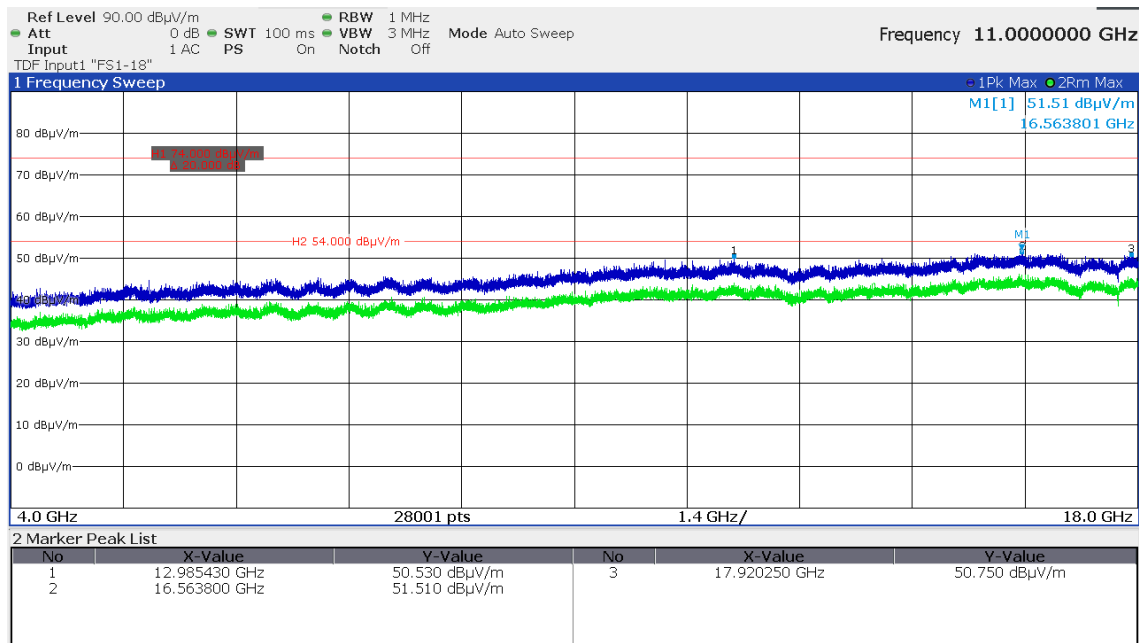
# CH40 horizontal



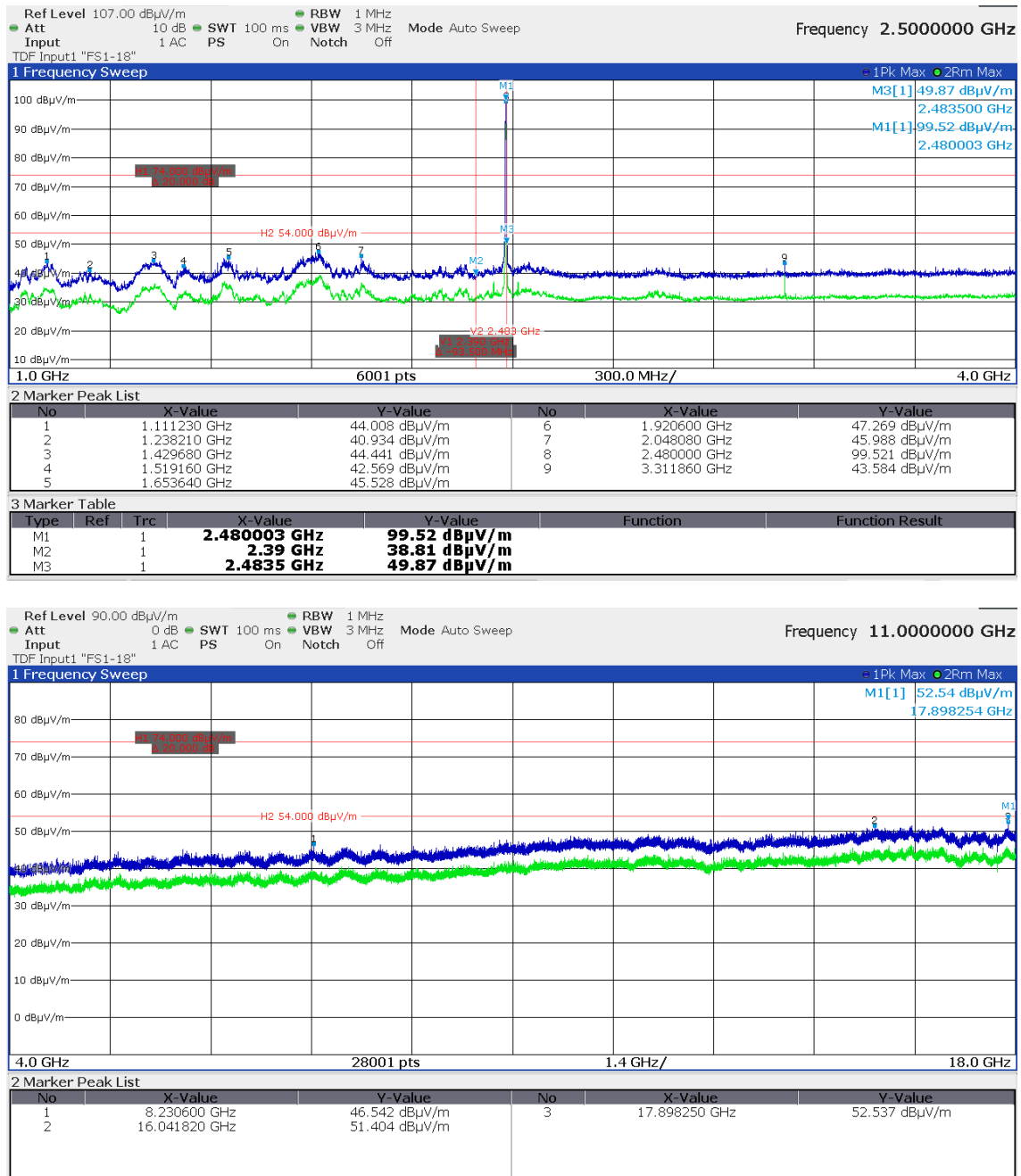


## CH40 vertical

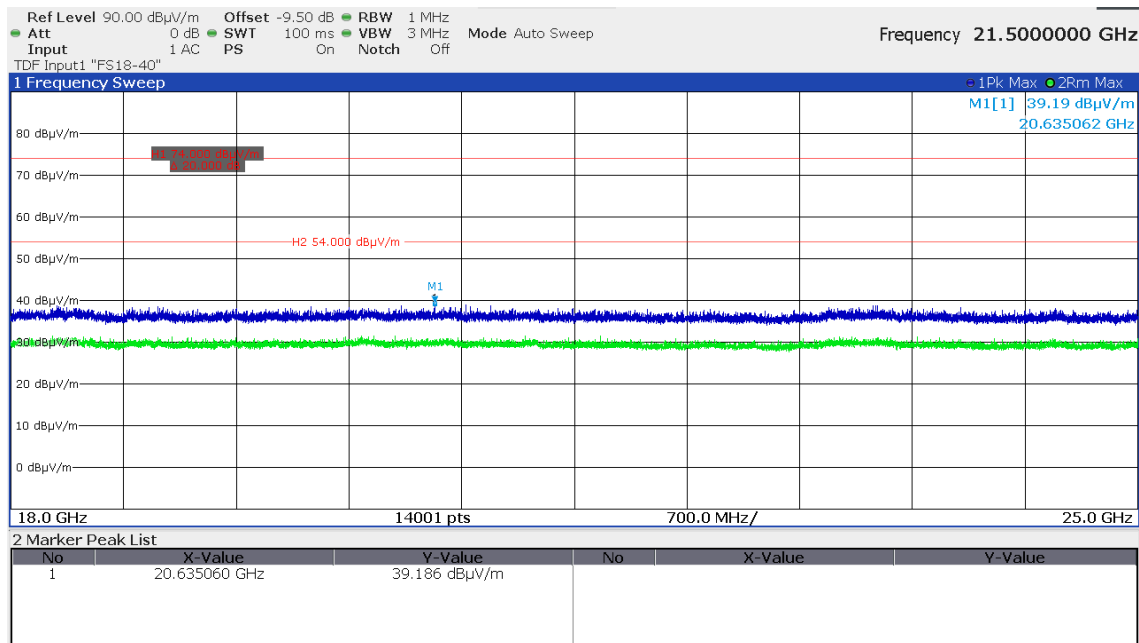




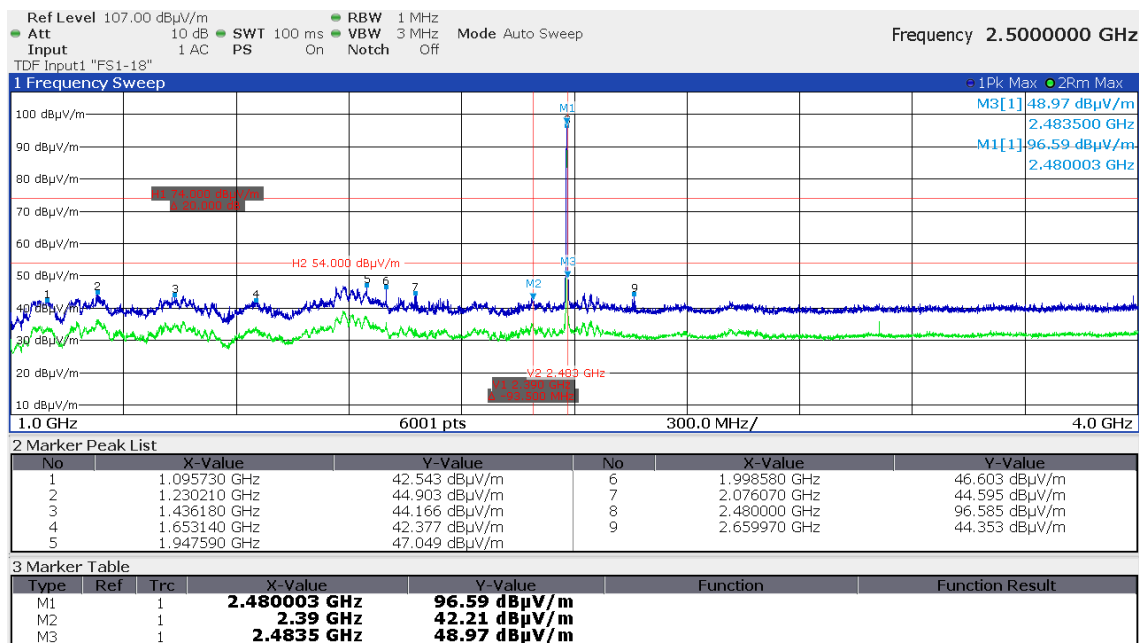
# CH79 horizontal

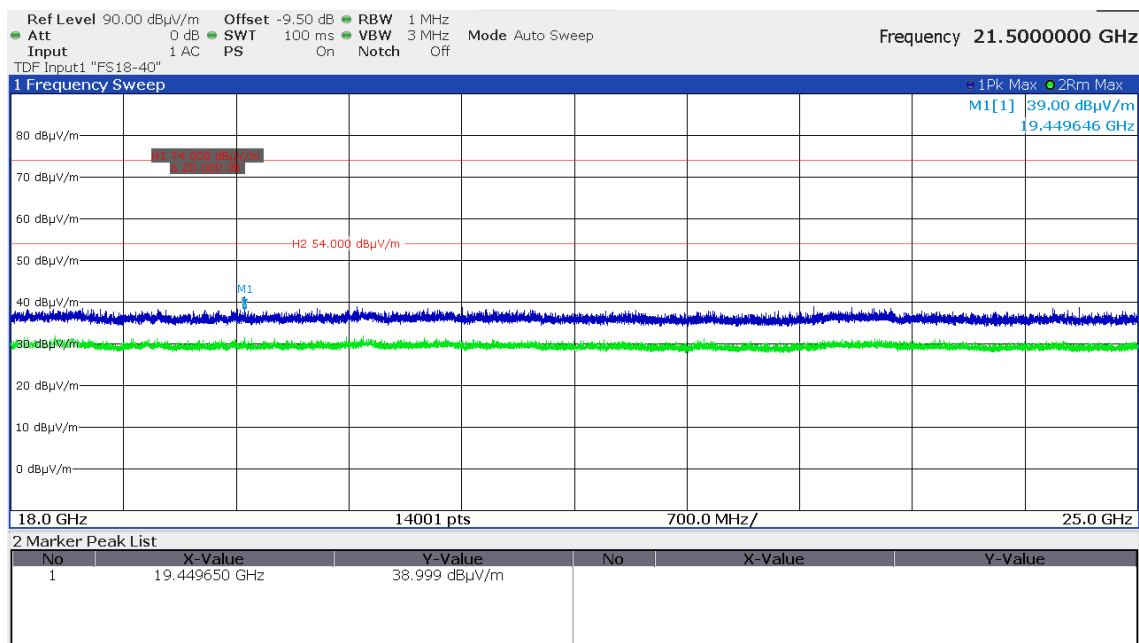
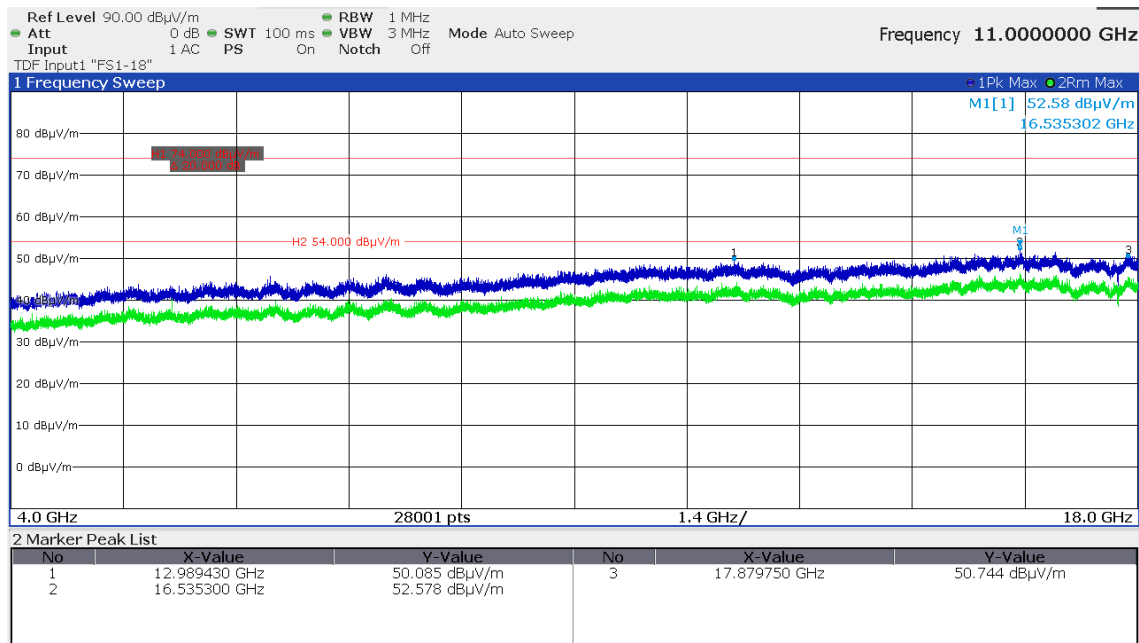


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



## CH79 verticall





The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

Peak-Limit according to FCC Part 15C, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

| Frequency<br>(MHz) | Limits acc. 15.209 |             | Measurement distance<br>(m) |
|--------------------|--------------------|-------------|-----------------------------|
|                    | PK dB(μV/m)        | AV dB(μV/m) |                             |
| Above 960          | 74                 | 54          | 3                           |

#### Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209:

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 – 0.110       | 16.42 – 16.423        | 399.9 – 410     | 4.5 – 5.15    |
| 0.495 – 0.505       | 16.69475 – 16.69525   | 608 – 614       | 5.35 – 5.46   |
| 2.1735 – 2.1905     | 16.80425 – 16.80475   | 960 – 1240      | 7.25 – 7.75   |
| 4.125 – 4.128       | 25.5 – 25.67          | 1300 – 1427     | 8.025 – 8.5   |
| 4.17725 – 4.17775   | 37.5 – 38.25          | 1435 – 1626.5   | 9.0 – 9.2     |
| 4.20725 – 4.20775   | 73 – 74.6             | 1645.5 – 1646.5 | 9.3 – 9.5     |
| 6.215 – 6.218       | 74.8 – 75.2           | 1660 – 1710     | 10.6 – 12.7   |
| 6.26775 – 6.26825   | 108 – 121.94          | 1718.8 – 1722.2 | 13.25 – 13.4  |
| 6.31175 – 6.31225   | 123 – 138             | 2200 – 2300     | 14.47 – 14.5  |
| 8.291 – 8.294       | 149.9 – 150.05        | 2310 – 2390     | 15.35 – 16.2  |
| 8.362 – 8.366       | 156.52475 – 156.52525 | 2483.5 – 2500   | 17.7 – 21.4   |
| 8.37625 – 8.38675   | 156.7 – 156.9         | 2690 – 2900     | 22.01 – 23.12 |
| 8.41425 – 8.41475   | 162.0125 – 167.17     | 3260 – 3267     | 23.6 – 24.0   |
| 12.29 – 12.293      | 167.72 – 173.2        | 3332 – 3339     | 31.2 – 31.8   |
| 12.51975 – 12.52025 | 240 – 285             | 3345.8 – 3358   | 36.43 – 36.5  |
| 12.57675 – 12.57725 | 322 – 335.4           | 3600 – 4400     | Above 38.6    |

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

RSS-Gen, Table 6 – Restricted Frequency Bands

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110       | 12.57675 - 12.57725   | 399.9 - 410     | 7.250 - 7.750 |
| 0.495 - 0.505       | 13.36 - 13.41         | 608 - 614       | 8.025 – 8.500 |
| 2.1735 - 2.1905     | 16.42 - 16.423        | 960 - 1427      | 9.0 - 9.2     |
| 3.020 - 3.026       | 16.69475 - 16.69525   | 1435 - 1626.5   | 9.3 - 9.5     |
| 4.125 - 4.128       | 16.80425 - 16.80475   | 1645.5 - 1646.5 | 10.6 - 12.7   |
| 4.17725 - 4.17775   | 25.5 - 25.67          | 1660 - 1710     | 13.25 - 13.4  |
| 4.20725 - 4.20775   | 37.5 - 38.25          | 1718.8 - 1722.2 | 14.47 - 14.5  |
| 5.677 - 5.683       | 73 - 74.6             | 2200 - 2300     | 15.35 - 16.2  |
| 6.215 - 6.218       | 74.8 - 75.2           | 2310 - 2390     | 17.7 - 21.4   |
| 6.26775 - 6.26825   | 108 – 138             | 2483.5 - 2500   | 22.01 - 23.12 |
| 6.31175 - 6.31225   | 149.9 - 150.05        | 2655 - 2900     | 23.6 - 24.0   |
| 8.291 - 8.294       | 156.52475 - 156.52525 | 3260 – 3267     | 31.2 - 31.8   |
| 8.362 - 8.366       | 156.7 - 156.9         | 3332 - 3339     | 36.43 - 36.5  |
| 8.37625 - 8.38675   | 162.0125 - 167.17     | 3345.8 - 3358   | Above 38.6    |
| 8.41425 - 8.41475   | 167.72 - 173.2        | 3500 - 4400     |               |
| 12.29 - 12.293      | 240 – 285             | 4500 - 5150     |               |
| 12.51975 - 12.52025 | 322 - 335.4           | 5350 - 5460     |               |

The requirements are **FULFILLED**.

**Remarks:**     For detailed test results please see the following test protocols.

\_\_\_\_\_

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

## 5.3 Antenna application

### 5.3.1 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated PCB antennas. No other antennas can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

### 5.3.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Defacto EIRP-Limit:**

$$P_{out} = 30 - (G_x - 6);$$

The EUT uses antennas smaller than 6 dBi. No defacto limit results.

**Remarks:** None.

---

## 6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

| Test ID | Model Type             | Equipment No.   | Next Calib. | Last Calib. | Next Verif. | Last Verif. |
|---------|------------------------|-----------------|-------------|-------------|-------------|-------------|
| CPR 3   | ESW26                  | 02-02/03-17-002 | 08/03/2024  | 08/03/2023  |             |             |
|         | AMF-6D-01002000-22-10P | 02-02/17-15-004 |             |             |             |             |
|         | 3117                   | 02-02/24-05-009 | 23/06/2023  | 23/06/2022  |             |             |
|         | BAM 4.5-P              | 02-02/50-17-024 |             |             |             |             |
|         | NCD                    | 02-02/50-17-025 |             |             |             |             |
|         | KK-SF106-2X11N-6,5M    | 02-02/50-18-016 |             |             |             |             |
|         | 18N-20                 | 02-02/50-21-009 |             |             |             |             |
|         | BAT-EMC 2022.0.23.0    | 02-02/68-13-001 |             |             |             |             |
| SER 2   | ESVS 30                | 02-02/03-05-006 | 27/07/2023  | 27/07/2022  |             |             |
|         | ESR 7                  | 02-02/03-17-001 | 05/08/2023  | 05/08/2022  |             |             |
|         | VULB 9168              | 02-02/24-05-005 | 20/03/2023  | 20/12/2021  | 03/07/2023  | 03/07/2022  |
|         | NW-2000-NB             | 02-02/50-05-113 |             |             |             |             |
|         | KK-EF393/U-16N-21N20 m | 02-02/50-12-018 |             |             |             |             |
|         | KK-SD_7/8-2X21N-33,0M  | 02-02/50-15-028 |             |             |             |             |
|         | 50F-003 N 3 dB         | 02-02/50-21-010 |             |             |             |             |
| SER 3   | ESW26                  | 02-02/03-17-002 | 08/03/2024  | 08/03/2023  |             |             |
|         | AMF-6D-01002000-22-10P | 02-02/17-15-004 |             |             |             |             |
|         | LNA-40-18004000-33-5P  | 02-02/17-20-002 |             |             |             |             |
|         | 3117                   | 02-02/24-05-009 | 23/06/2023  | 23/06/2022  |             |             |
|         | BBHA 9170              | 02-02/24-05-013 | 21/03/2026  | 21/03/2023  | 21/03/2024  | 21/03/2023  |
|         | WHK 3.0/18G-10EF       | 02-02/50-05-180 |             |             |             |             |
|         | BAM 4.5-P              | 02-02/50-17-024 |             |             |             |             |
|         | NCD                    | 02-02/50-17-025 |             |             |             |             |
|         | KK-SF106-2X11N-6,5M    | 02-02/50-18-016 |             |             |             |             |
|         | KMS116-GL140SE-KMS116- | 02-02/50-20-026 |             |             |             |             |
|         | BAT-EMC 2022.0.23.0    | 02-02/68-13-001 |             |             |             |             |

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.