



EMI - TEST REPORT

- FCC Part 15.519, RSS-220 -

Type / Model Name : BMW FBD5

Product Description : UWB+BLE CAN gateway for comfort access function in vehicles

Applicant : Continental Automotive GmbH

Address : Siemensstraße 12
93055 REGENSBURG, GERMANY

Manufacturer : Continental Automotive GmbH

Address : Siemensstraße 12
93055 REGENSBURG, GERMANY

| | |
|--|-----------------|
| Test Result according to the standards listed in clause 1 test standards: | POSITIVE |
|--|-----------------|

| | |
|--|--------------------------------|
| Test Report No. : T46614-00-06FX | 14. June 2021 Date of issue |
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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FCC ID: KR5FBD5 IC: 7812D-FBD5

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ATTACHMENT A1 and A2 as separate supplements

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2019)

| | |
|-----------------------------------|--|
| Part 15, Subpart A, Section 15.31 | Measurement standards |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements |

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2019)

| | |
|------------------------------------|---|
| 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 |

FCC Rules and Regulations Part 15, Subpart F – Ultra Wideband Operation (October 2019)

| | |
|------------------------------------|--|
| Part 15, Subpart F, Section 15.503 | Definitions |
| Part 15, Subpart F, Section 15.505 | Cross reference |
| Part 15, Subpart F, Section 15.519 | Technical requirements for hand held UWB systems |
| Part 15, Subpart F, Section 15.521 | Technical requirements applicable to all UWB devices |

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

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

| | |
|---------------------------------------|---|
| KDB 393764 D01 v02 (January 29, 2018) | Ultra-Wideband (UWB) Devices – Frequently Asked Questions |
|---------------------------------------|---|

| | |
|---------------------------------------|--------------------------|
| KDB 178919 D01 v06 (October 16, 2015) | Permissive Change Policy |
|---------------------------------------|--------------------------|

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 his/her instructions.

2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A1 and A2

2.4 Equipment type

Portable UWB Device

2.5 Short description of the equipment under test (EUT)

The FBD5 is a wireless UWB and BLE transceiver with CAN gateway for comfort access function in vehicles. 2 FBD5 anchors are mounted under the headliner of a vehicle. UWB is used for ranging, BLE for data transfer and security features. 4 further anchors (FBD5s) are mounted at the outer body of a vehicle and provide UWB functionality for ranging purposes. The anchors are connected to a central control unit and paired with a smartphone or wearable ID tag. The FBD5 can also communicate among each other for an initialization procedure. After initialization and training procedure the distance between FBD5 and smartphone or ID tag is measured and the position in relation to the vehicle is determined. The vehicle is unlocked, locked or started in case the smartphone or ID tag is in a permitted area around or inside the vehicle.

| | |
|---------------------------|--|
| Number of tested samples: | 9 |
| Serial number: | LM771 (continuous transmitting, channel 5, antenna 1), LM772 (continuous transmitting, channel 5, antenna 2), LM773 (continuous transmitting, channel 6, antenna 1), LM774 (continuous transmitting, channel 6, antenna 2), LM775 (continuous transmitting, channel 8, antenna 1), LM776 (continuous transmitting, channel 8, antenna 2), LM777 (continuous transmitting, channel 9, antenna 1), LM778 (continuous transmitting, channel 9, antenna 2), LM901 (UWB transceiver), |
| Firmware version: | A3C04887505 |
| UWB driver version: | 50D2C100_ATIC234 |

EUT configuration:
(The CDF filled by the applicant can be viewed at the test laboratory.)

2.6 Variants of the EUT

There are no variants.

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2.7 Operation frequency and channel plan

The operating frequency band is 3100 MHz to 10600 MHz.

Channel plan:

| Channel number | f _c (MHz) |
|----------------|----------------------|
| Channel 5 | 6489.6 |
| Channel 6 | 6988.8 |
| Channel 8 | 7488.8 |
| Channel 9 | 7987.2 |

2.8 Transmit operating modes

Modulation: variable pulse position modulation (PPM) in combination with binary phase shift keying (BPSK).

Data rate: 6.8 Mbit/s

2.9 Antenna

The following antennas shall be used with the EUT:

| Number | Characteristic | Type | Plug | f-range (GHz) | Max. Gain (dBi) |
|--------|----------------|-------------|------|---------------|-----------------|
| 1 | Omni | PCB antenna | none | 3.1 – 10.6 | 5.9 |
| 2 | Omni | PCB antenna | none | 3.1 – 10.6 | 5.4 |

The both antennas are identical in construction.

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 12 VDC (battery powered)

2.11 Peripheral devices and interface cables

For all tests except signal deactivation no peripheral devices or interface cables were used.

For the signal deactivation tests, the following peripheral devices and interface cables are connected during the measurements:

- LIN Interface Model : Uniport LIN

2.12 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes with horizontal and vertical antenna positions to determine the worst case condition.

FCC ID: KR5FBD5 IC: 7812D-FBD5**2.12.1 Test jig**

No test jig is used.

2.12.2 Test software

For all tests except signal deactivation, no test software is used. The EUT starts continuous transmitting on a pre-defined power level as soon as the power supply is attached.

For the signal deactivation tests, special test software provided by the customer was used.

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.

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3 TEST RESULT SUMMARY

UWB device using digital modulation:

Operating in the 3100 MHz – 10600 MHz:

| FCC Rule Part | RSS Rule Part | Description | Result |
|------------------------|--|--|--------|
| 15.207(a) | RSS-Gen, 8.8 | AC power line conducted emissions | passed |
| 15.519(b) | RSS-220, 2, 5.1(a) | UWB Bandwidth | passed |
| 15.209(a) 15.519(c) | RSS-Gen, 8.9 RSS-220, 3.4, 5.3.1(c), 5.3.1(d) | Radiated Emissions 9 kHz to 40 GHz | passed |
| 15.519(d) | RSS-220, 5.3.1(e) | Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz | passed |
| 15.519(e) | RSS-220, 5.3.1(g) | Peak Power radiated | passed |
| 15.519(a) | RSS-220, 5.3.1(b) | Signal deactivation | passed |

The mentioned RSS Rule Parts in the above table are related to:
 RSS-Gen, Issue 5, March 2019
 RSS-220, Issue 1, July 2018

3.1 Final assessment

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

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

Testing commenced on : 04 August 2020

Testing concluded on : 25 September 2020

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 acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. 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 Conducted Spurious Emissions | 0.15 MHz to 30 MHz | 95% | ± 3.29 dB |
| 20 dB Bandwidth | Center frequency of EUT | 95% | $\pm 2.5 \times 10^{-7}$ |
| 99% Occupied Bandwidth | Center frequency of EUT | 95% | $\pm 2.5 \times 10^{-7}$ |
| Radiated Spurious Emissions | 9 kHz to 30 MHz | 95% | ± 3.53 dB |
| Radiated Spurious Emissions | 30 MHz to 1000 MHz | 95% | ± 3.71 dB |
| Radiated Spurious Emissions | 1000 MHz to 10000 MHz | 95% | ± 2.34 dB |
| Peak conducted output power | 902 MHz to 928 MHz | 95% | ± 0.35 dB |
| Conducted Spurious Emissions | 9 kHz to 10000 MHz | 95% | ± 2.15 dB |

4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

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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. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.5.2.2 Radiated emission (electrical field 30 MHz - 1 GHz)

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. The setup of the equipment under test is established in accordance with ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from 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 in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR 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 | Level | + | Factor | = | Level | - | CISPR Limit | = |
| Delta | | | | | | | | |
| (MHz) | (dBµV) | | (dB) | | (dBµV/m) | | (dBµV/m) | (dB) |
| 719.0 | 75.0 | + | 32.6 | = | 107.6 | - | 110.0 | = -2.4 |

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FCC ID: KR5FBD5 IC: 7812D-FBD5**4.5.2.3 Radiated emission (electrical field 1 GHz - 40 GHz)**

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency 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 1.0 X 1.5 metre non-conducting table, 1.5 metre above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from 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. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyzer set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

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 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

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.

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5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz
 Min. limit margin -27.9 dB at 25.293 MHz

Limit according to FCC Part 15, Section 15.207(a):

| Frequency of Emission (MHz) | Conducted Limit (dBµV) | |
|-----------------------------|------------------------|------------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency

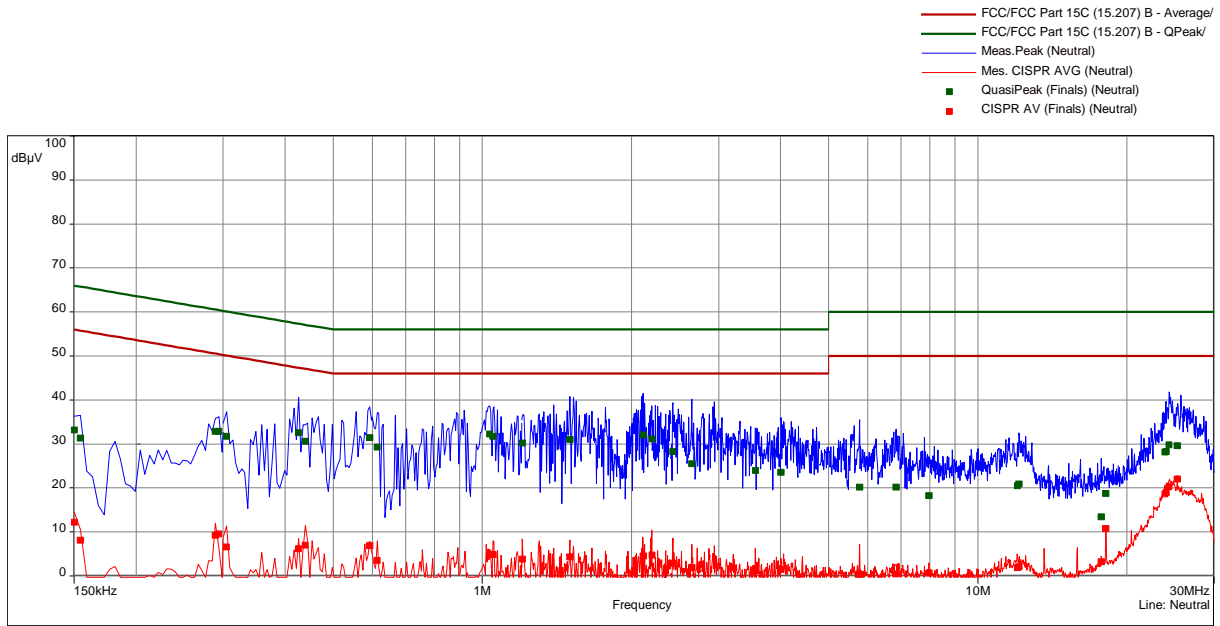
The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols.

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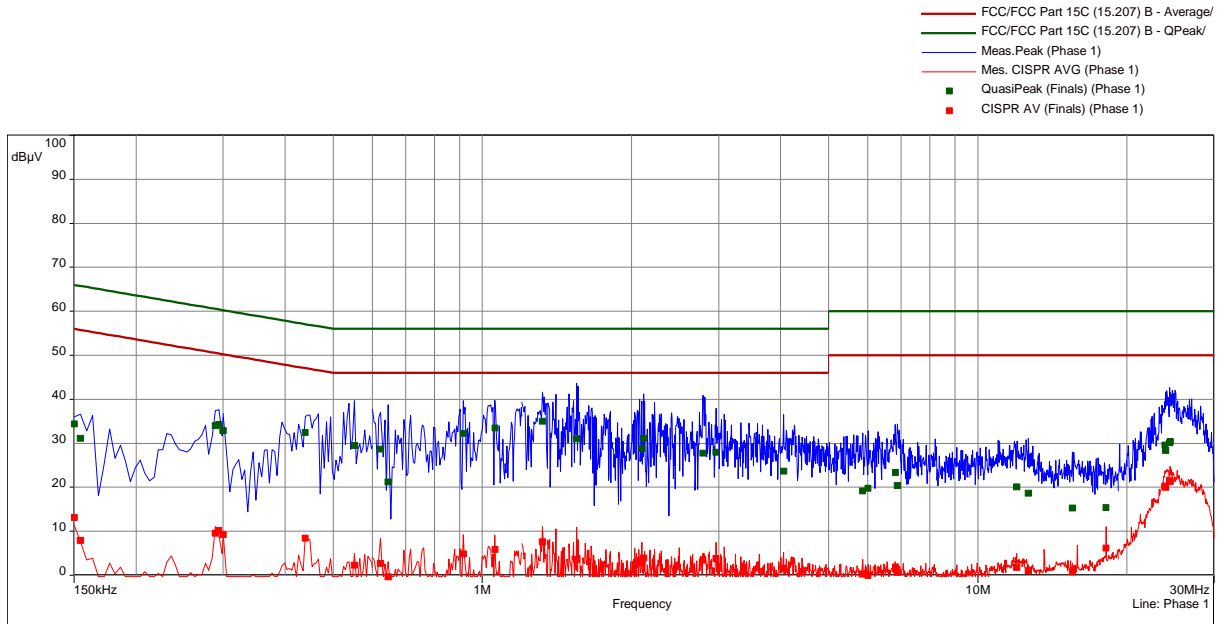
5.1.6 Test protocol



FCC/FCC Part 15C (15.207)B

| freq | QP | margin | limit | AV | margin | limit | corr |
|--------|--------|--------|-------|--------|--------|-------|------|
| MHz | dB(µV) | dB | dB | dB(µV) | dB | dB | dB |
| 0.150 | 34.5 | -31.6 | 66.0 | 13.2 | -42.8 | 56.0 | 10.1 |
| 0.155 | 31.2 | -34.5 | 65.8 | 8.0 | -47.7 | 55.8 | 10.1 |
| 0.290 | 34.0 | -26.5 | 60.5 | 9.6 | -40.9 | 50.5 | 10.1 |
| 0.294 | 34.3 | -26.1 | 60.4 | 10.2 | -40.2 | 50.4 | 10.1 |
| 0.300 | 32.9 | -27.3 | 60.2 | 9.3 | -41.0 | 50.2 | 10.1 |
| 0.440 | 32.6 | -24.5 | 57.1 | 8.5 | -38.6 | 47.1 | 10.2 |
| 0.552 | 29.5 | -26.5 | 56.0 | 2.3 | -43.7 | 46.0 | 10.2 |
| 0.623 | 28.8 | -27.2 | 56.0 | 2.8 | -43.2 | 46.0 | 10.2 |
| 0.645 | 21.2 | -34.8 | 56.0 | -0.5 | -46.5 | 46.0 | 10.2 |
| 0.915 | 32.4 | -23.7 | 56.0 | 4.9 | -41.1 | 46.0 | 10.2 |
| 1.059 | 33.6 | -22.4 | 56.0 | 5.9 | -40.1 | 46.0 | 10.2 |
| 1.322 | 35.1 | -20.9 | 56.0 | 7.7 | -38.3 | 46.0 | 10.3 |
| 1.551 | 31.1 | -24.9 | 56.0 | 3.7 | -42.3 | 46.0 | 10.3 |
| 2.100 | 28.8 | -27.2 | 56.0 | 2.9 | -43.1 | 46.0 | 10.3 |
| 2.118 | 31.2 | -24.8 | 56.0 | 4.0 | -42.0 | 46.0 | 10.3 |
| 2.792 | 27.9 | -28.2 | 56.0 | 3.5 | -42.5 | 46.0 | 10.3 |
| 2.967 | 28.0 | -28.0 | 56.0 | 3.9 | -42.1 | 46.0 | 10.4 |
| 4.061 | 23.7 | -32.3 | 56.0 | 1.6 | -44.4 | 46.0 | 10.4 |
| 5.867 | 19.2 | -40.8 | 60.0 | 0.3 | -49.7 | 50.0 | 10.5 |
| 6.011 | 19.8 | -40.2 | 60.0 | 0.1 | -50.0 | 50.0 | 10.5 |
| 6.812 | 23.5 | -36.5 | 60.0 | 1.9 | -48.1 | 50.0 | 10.6 |
| 6.888 | 20.4 | -39.6 | 60.0 | 0.8 | -49.2 | 50.0 | 10.6 |
| 11.994 | 20.2 | -39.9 | 60.0 | 1.8 | -48.2 | 50.0 | 10.9 |
| 12.642 | 18.7 | -41.3 | 60.0 | 1.1 | -48.9 | 50.0 | 11.0 |
| 15.536 | 15.3 | -44.7 | 60.0 | 0.8 | -49.2 | 50.0 | 11.2 |
| 18.155 | 15.5 | -44.6 | 60.0 | 6.2 | -43.8 | 50.0 | 11.4 |
| 23.912 | 29.7 | -30.4 | 60.0 | 20.4 | -29.6 | 50.0 | 11.6 |
| 23.930 | 28.4 | -31.6 | 60.0 | 20.0 | -30.0 | 50.0 | 11.6 |
| 24.398 | 30.1 | -29.9 | 60.0 | 21.7 | -28.3 | 50.0 | 11.7 |
| 24.447 | 30.4 | -29.6 | 60.0 | 21.3 | -28.7 | 50.0 | 11.7 |

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FCC/FCC Part 15C (15.207)B

| freq | QP | margin | limit | AV | margin | limit | corr |
|--------|--------|--------|-------|--------|--------|-------|------|
| MHz | dB(µV) | dB | dB | dB(µV) | dB | dB | dB |
| 0.150 | 33.3 | -32.8 | 66.0 | 12.3 | -43.8 | 56.0 | 10.1 |
| 0.155 | 31.4 | -34.4 | 65.8 | 8.2 | -47.5 | 55.8 | 10.1 |
| 0.290 | 32.9 | -27.6 | 60.5 | 9.3 | -41.3 | 50.5 | 10.1 |
| 0.294 | 33.0 | -27.5 | 60.4 | 9.6 | -40.8 | 50.4 | 10.1 |
| 0.305 | 31.8 | -28.3 | 60.1 | 6.7 | -43.5 | 50.1 | 10.1 |
| 0.426 | 32.7 | -24.7 | 57.3 | 6.3 | -41.1 | 47.3 | 10.2 |
| 0.440 | 30.6 | -26.4 | 57.1 | 7.0 | -40.1 | 47.1 | 10.2 |
| 0.593 | 31.5 | -24.5 | 56.0 | 6.9 | -39.1 | 46.0 | 10.2 |
| 0.614 | 29.4 | -26.6 | 56.0 | 3.6 | -42.4 | 46.0 | 10.2 |
| 1.037 | 32.3 | -23.7 | 56.0 | 5.0 | -41.0 | 46.0 | 10.2 |
| 1.050 | 31.8 | -24.2 | 56.0 | 4.9 | -41.1 | 46.0 | 10.2 |
| 1.205 | 30.2 | -25.8 | 56.0 | 3.9 | -42.1 | 46.0 | 10.2 |
| 1.502 | 31.1 | -24.9 | 56.0 | 4.4 | -41.6 | 46.0 | 10.3 |
| 2.114 | 32.1 | -23.9 | 56.0 | 4.6 | -41.4 | 46.0 | 10.3 |
| 2.199 | 31.2 | -24.8 | 56.0 | 4.8 | -41.2 | 46.0 | 10.3 |
| 2.427 | 28.3 | -27.7 | 56.0 | 2.9 | -43.1 | 46.0 | 10.3 |
| 2.648 | 25.6 | -30.4 | 56.0 | 2.0 | -44.0 | 46.0 | 10.3 |
| 3.552 | 24.0 | -32.0 | 56.0 | 1.8 | -44.3 | 46.0 | 10.4 |
| 4.002 | 23.6 | -32.4 | 56.0 | 1.6 | -44.4 | 46.0 | 10.4 |
| 5.777 | 20.3 | -39.7 | 60.0 | 0.4 | -49.6 | 50.0 | 10.5 |
| 6.848 | 20.2 | -39.8 | 60.0 | 0.5 | -49.5 | 50.0 | 10.6 |
| 7.977 | 18.3 | -41.7 | 60.0 | 0.7 | -49.3 | 50.0 | 10.6 |
| 12.012 | 20.6 | -39.5 | 60.0 | 2.0 | -48.0 | 50.0 | 10.8 |
| 12.116 | 21.0 | -39.0 | 60.0 | 2.1 | -47.9 | 50.0 | 10.8 |
| 17.741 | 13.5 | -46.5 | 60.0 | 3.3 | -46.8 | 50.0 | 11.2 |
| 18.141 | 18.8 | -41.2 | 60.0 | 10.9 | -39.1 | 50.0 | 11.2 |
| 23.822 | 28.3 | -31.8 | 60.0 | 18.8 | -31.3 | 50.0 | 11.3 |
| 23.966 | 28.3 | -31.7 | 60.0 | 19.0 | -31.0 | 50.0 | 11.3 |
| 24.348 | 29.8 | -30.2 | 60.0 | 20.3 | -29.7 | 50.0 | 11.3 |
| 25.293 | 29.6 | -30.4 | 60.0 | 22.1 | -27.9 | 50.0 | 11.2 |

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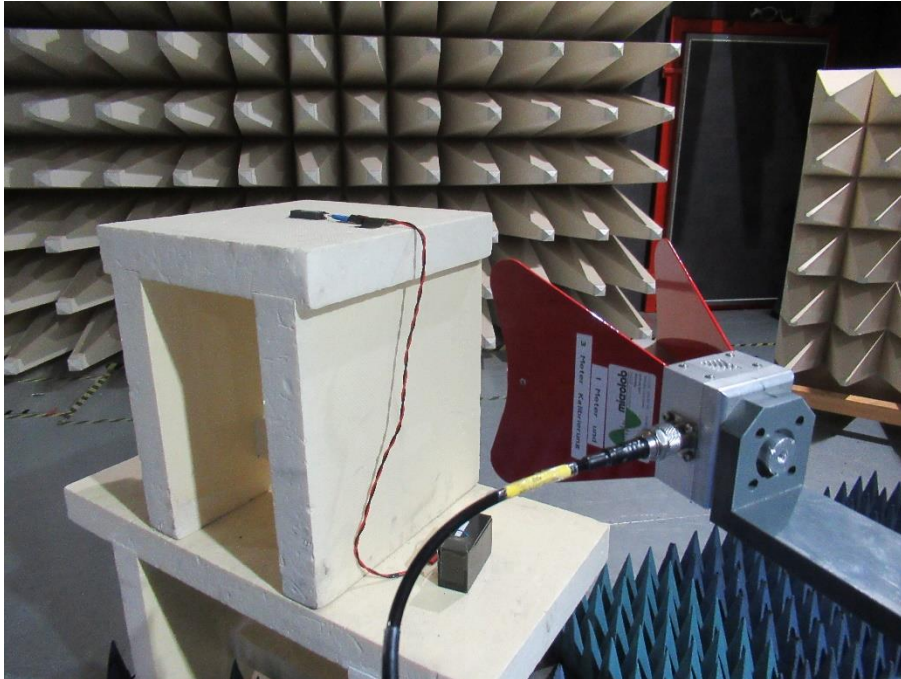
5.2 UWB Bandwidth

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

5.2.1 Description of the test location

Test location: Anechoic chamber 1

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15, Section 15.519(b):

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

According to FCC Part 15, Section 15.503(d):

Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

5.2.4 Description of Measurement

The measurement was performed radiated at a distance of 3 m. The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -10 dB.

Spectrum analyser settings:

RBW: 1 MHz, VBW: 3 MHz, Detector: Peak

FCC ID: KR5FBD5 IC: 7812D-FBD5

5.2.5 Test result

| channel | antenna | lowest frequency f_L (MHz) | highest frequency f_H (MHz) | Permitted frequency range (GHz) | UWB bandwidth (MHz) | Required UWB bandwidth (MHz) | result |
|---------|---------|------------------------------|-------------------------------|---------------------------------|---------------------|------------------------------|--------|
| 5 | 1 | 6229.58 | 6758.35 | 3.1 – 10.6 | 528.77 | > 500 | passed |
| 5 | 2 | 6229.47 | 6757.36 | 3.1 – 10.6 | 527.89 | > 500 | passed |
| 6 | 1 | 6713.57 | 7272.08 | 3.1 – 10.6 | 558.51 | > 500 | passed |
| 6 | 2 | 6689.93 | 7270.05 | 3.1 – 10.6 | 580.12 | > 500 | passed |
| 8 | 1 | 7199.31 | 7757.69 | 3.1 – 10.6 | 558.38 | > 500 | passed |
| 8 | 2 | 7211.31 | 7760.69 | 3.1 – 10.6 | 549.38 | > 500 | passed |
| 9 | 1 | 7700.86 | 8258.95 | 3.1 – 10.6 | 558.09 | > 500 | passed |
| 9 | 2 | 7701.36 | 8255.95 | 3.1 – 10.6 | 554.59 | > 500 | passed |

The requirements are **FULFILLED**.

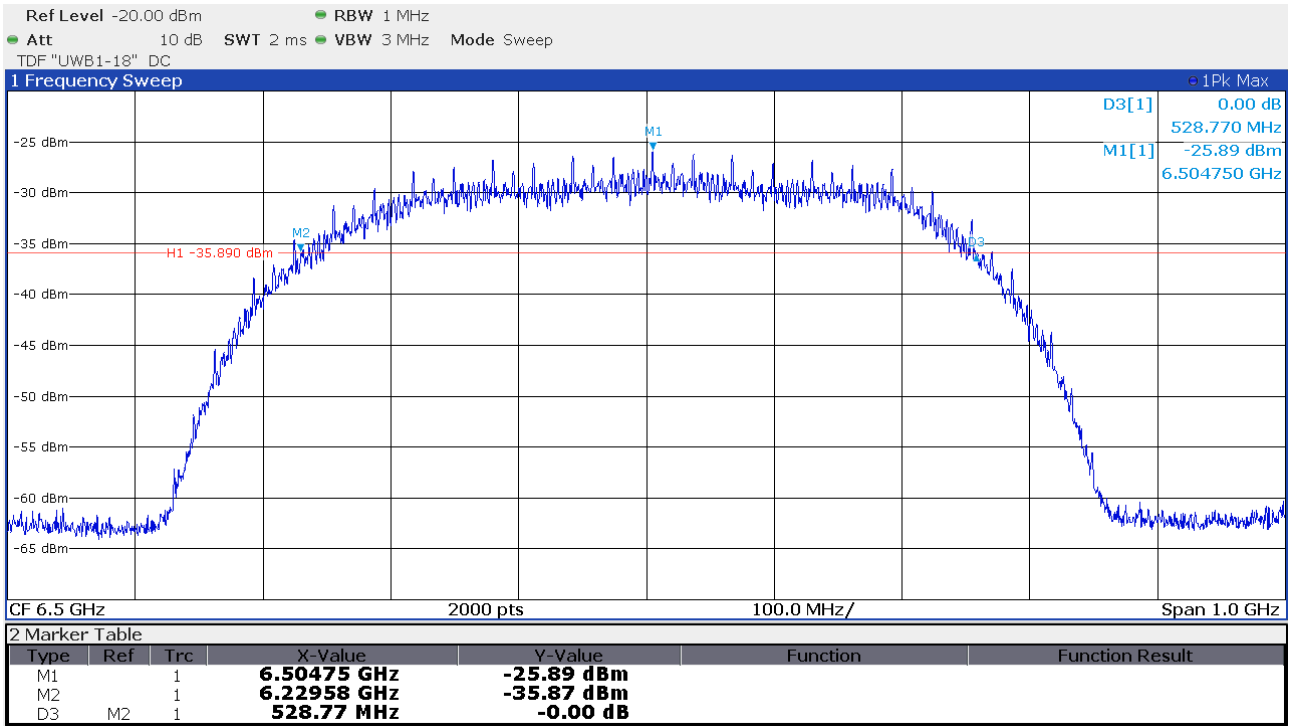
Remarks: For detailed test results please refer to following test protocols.

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.

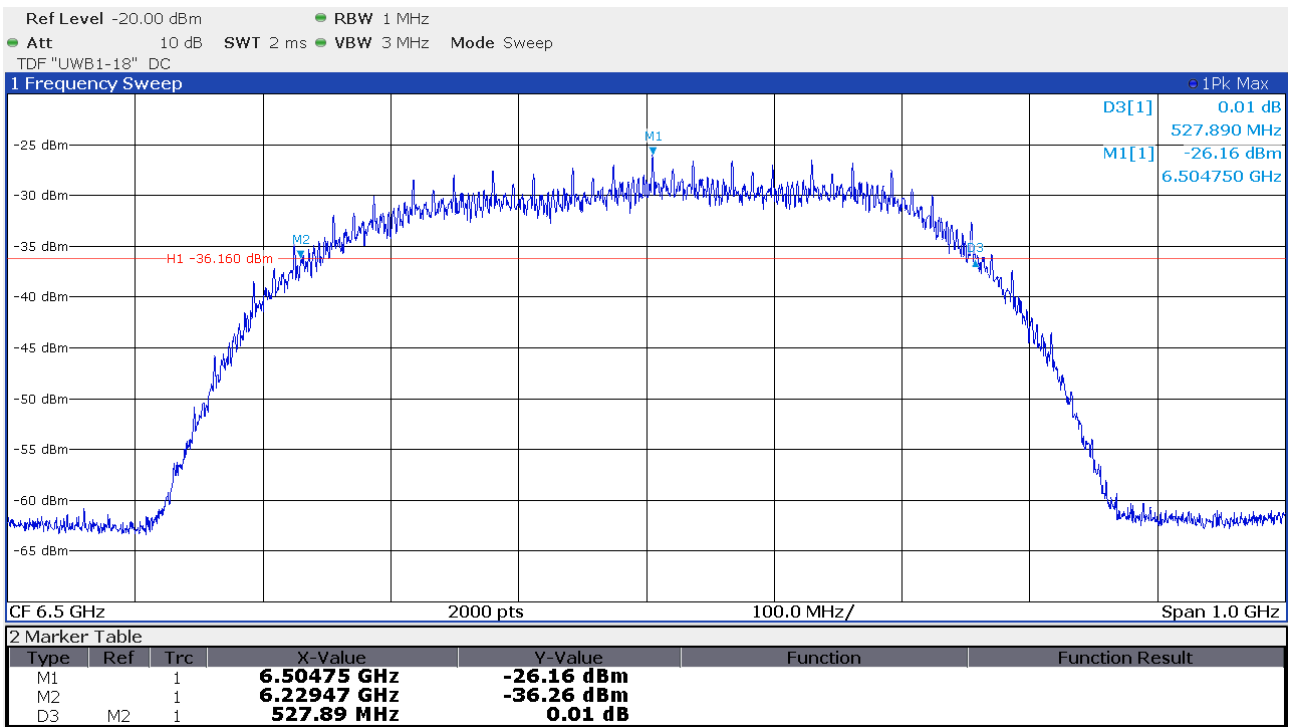
FCC ID: KR5FBD5 IC: 7812D-FBD5

5.2.6 Test protocols EBW

Channel 5 antenna 1

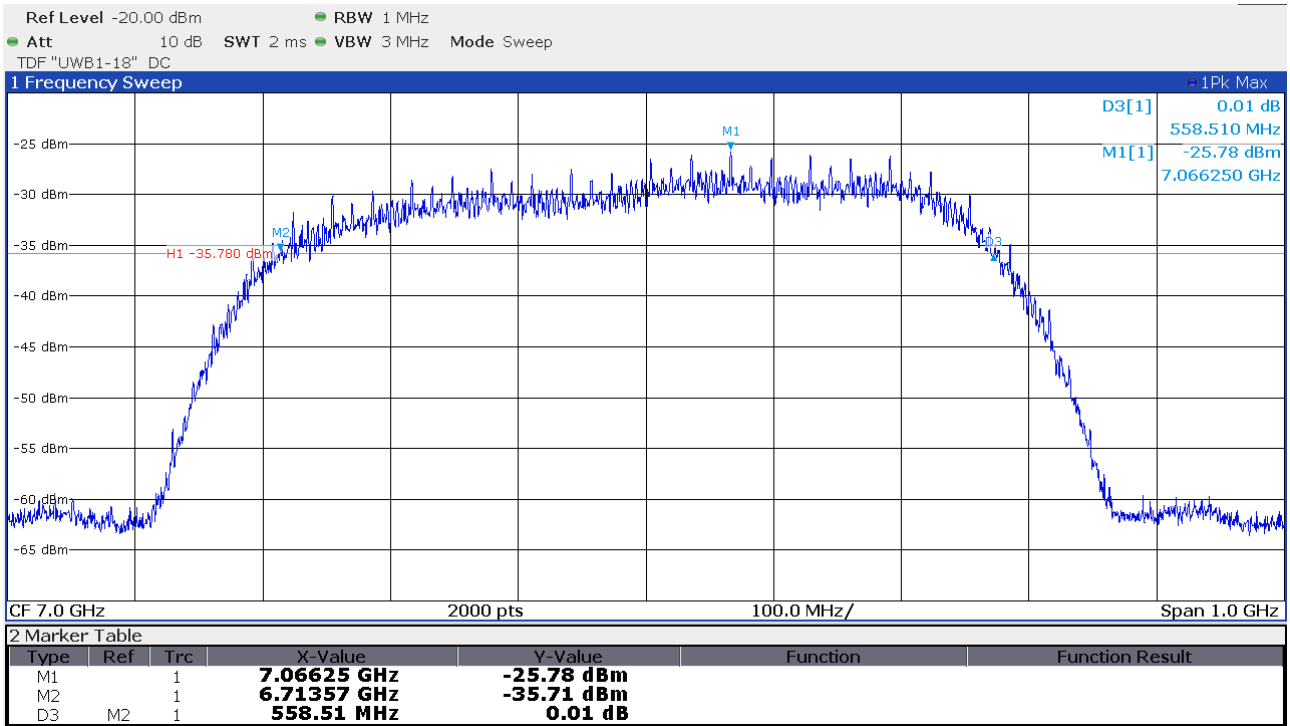


Channel 5 antenna 2

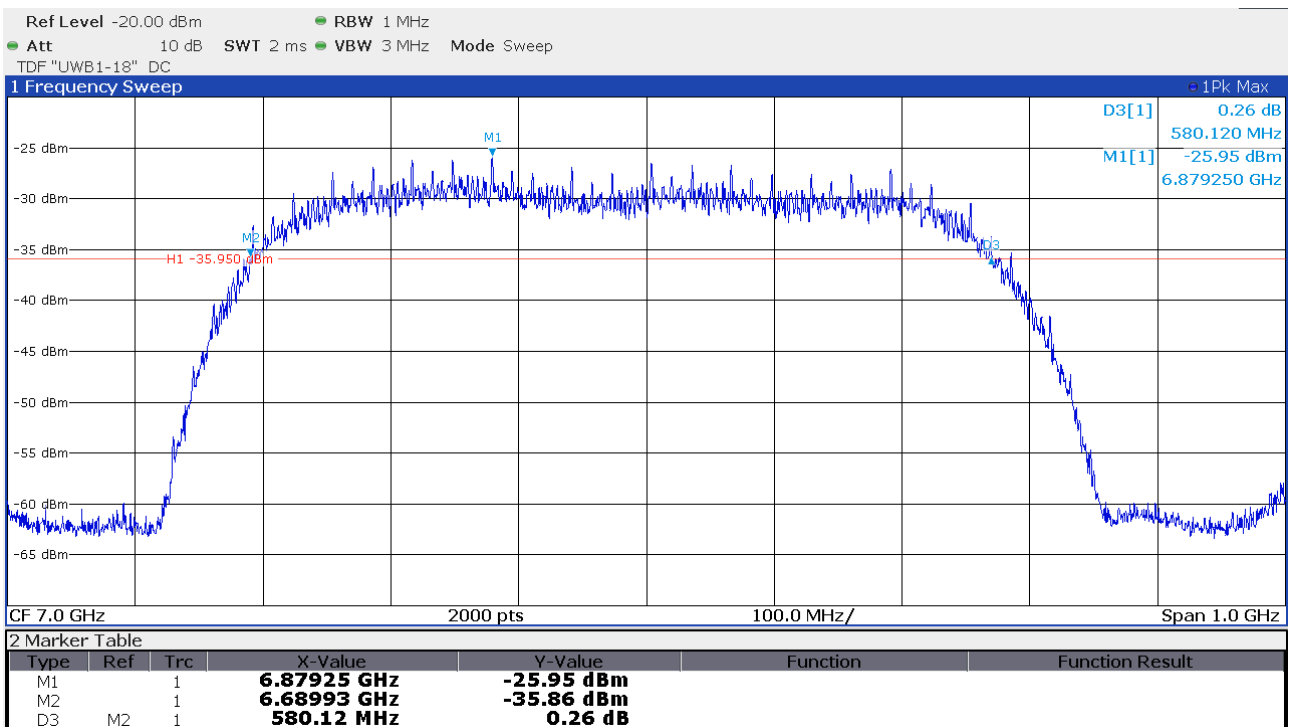


FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 6 antenna 1



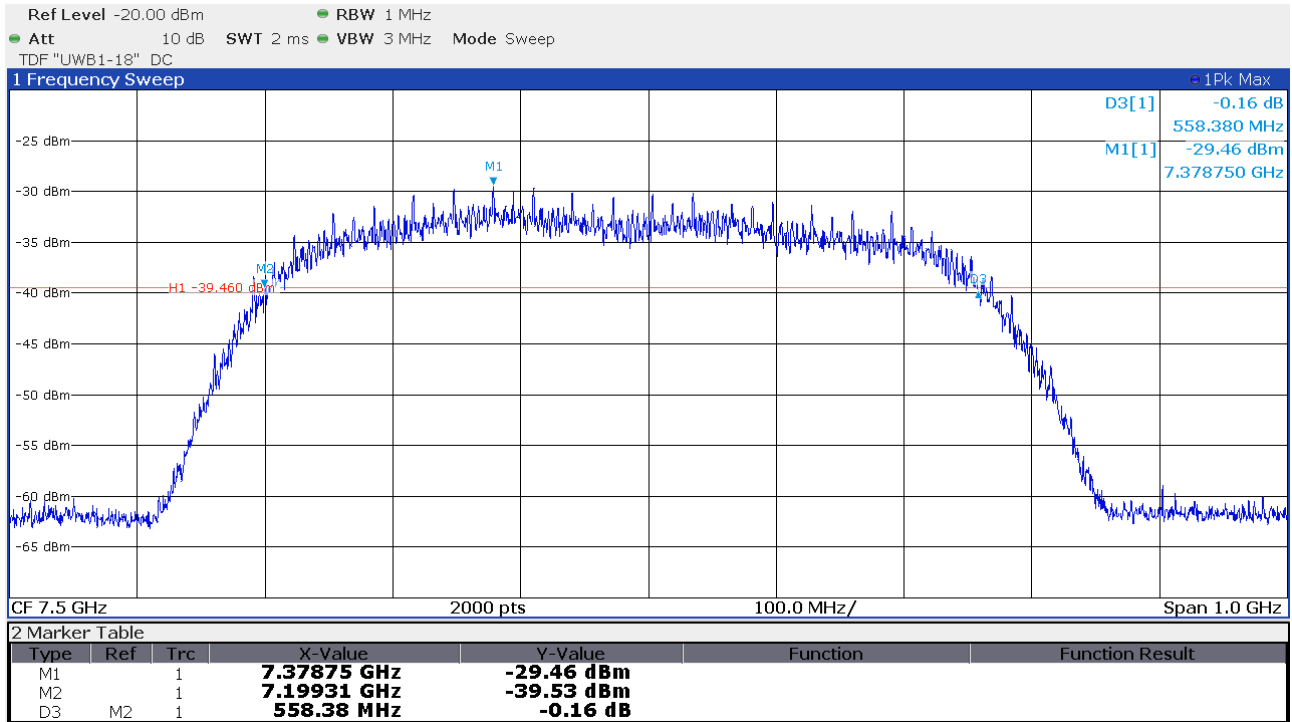
Channel 6 antenna 2



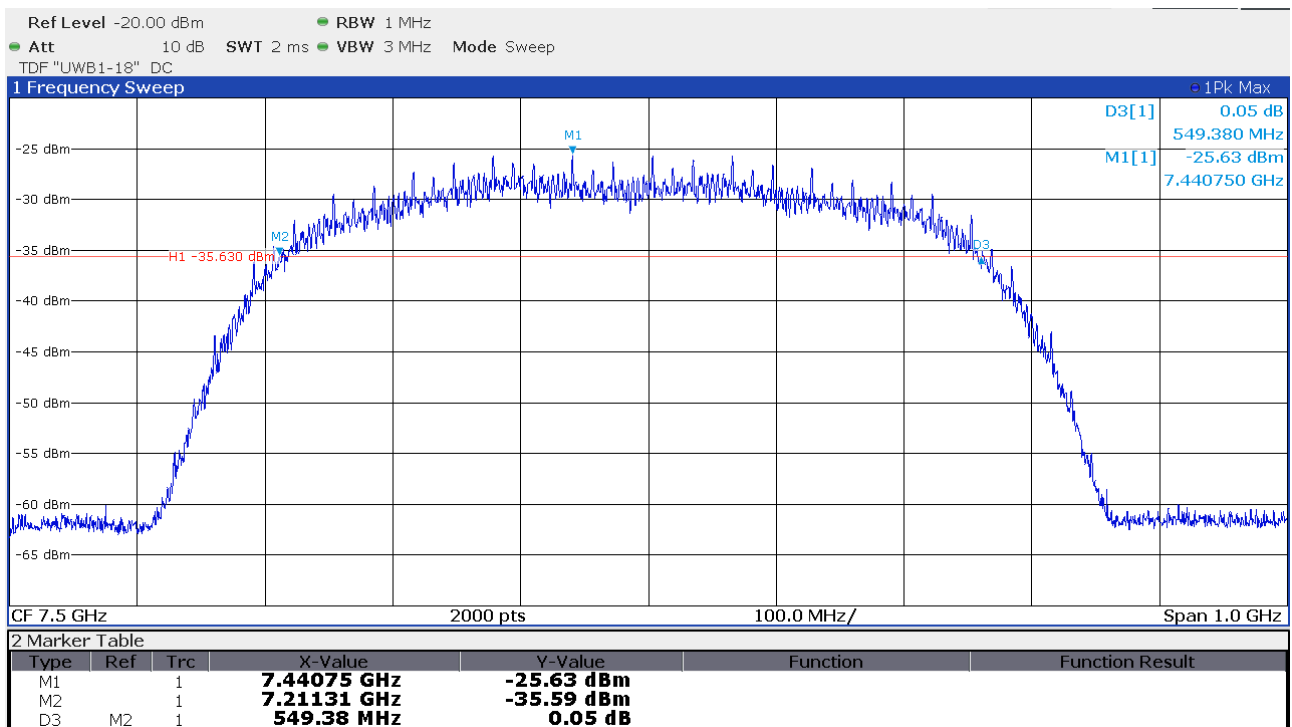
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 1



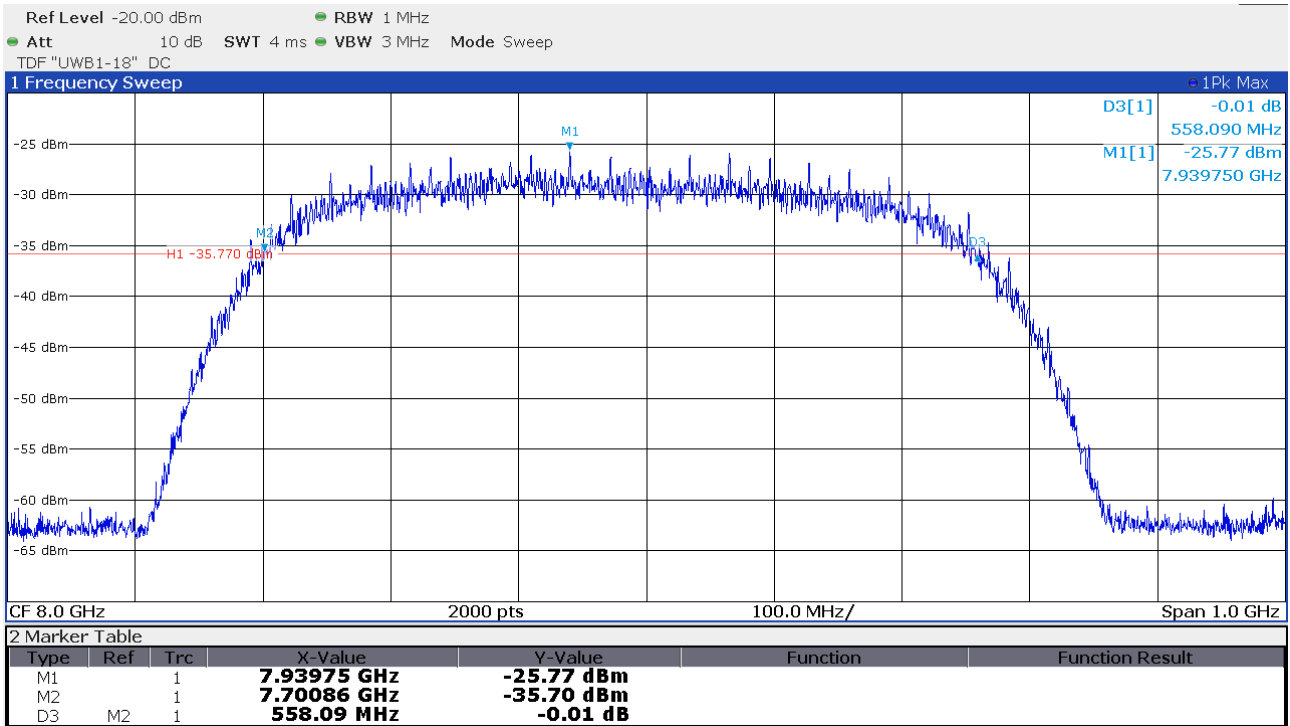
Channel 8 antenna 2



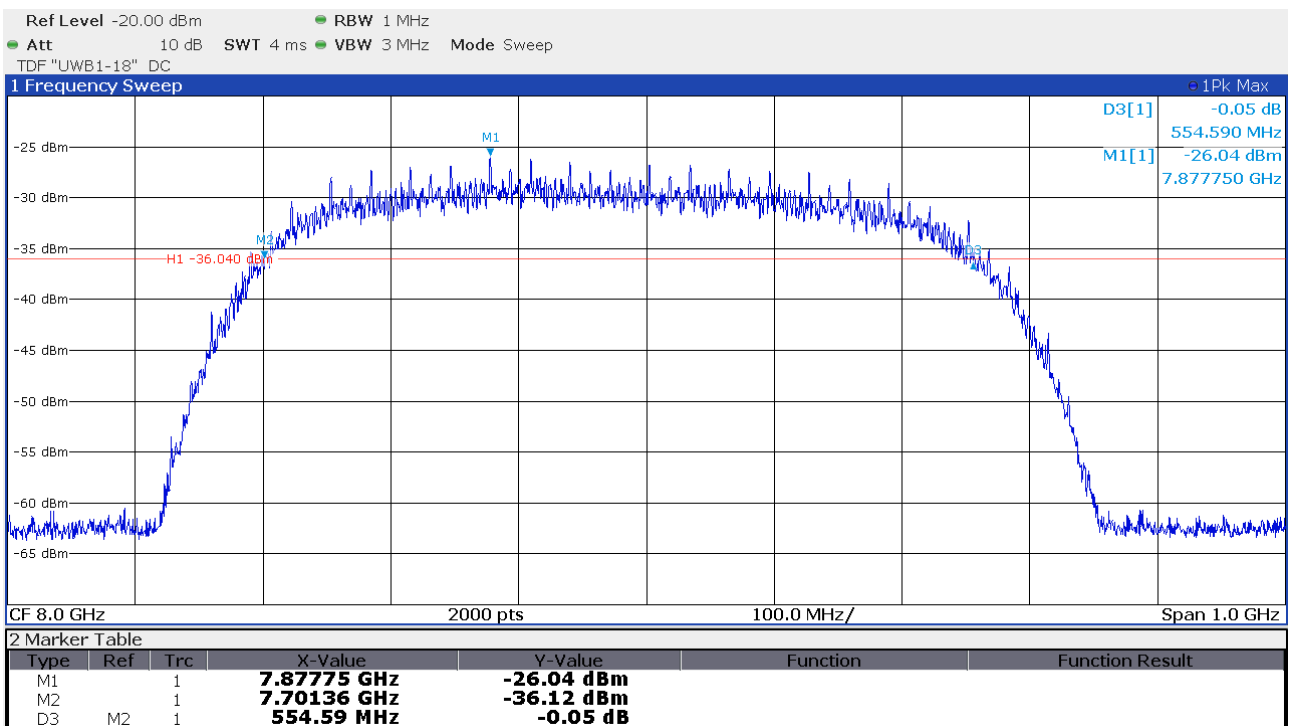
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 1



Channel 9 antenna 2

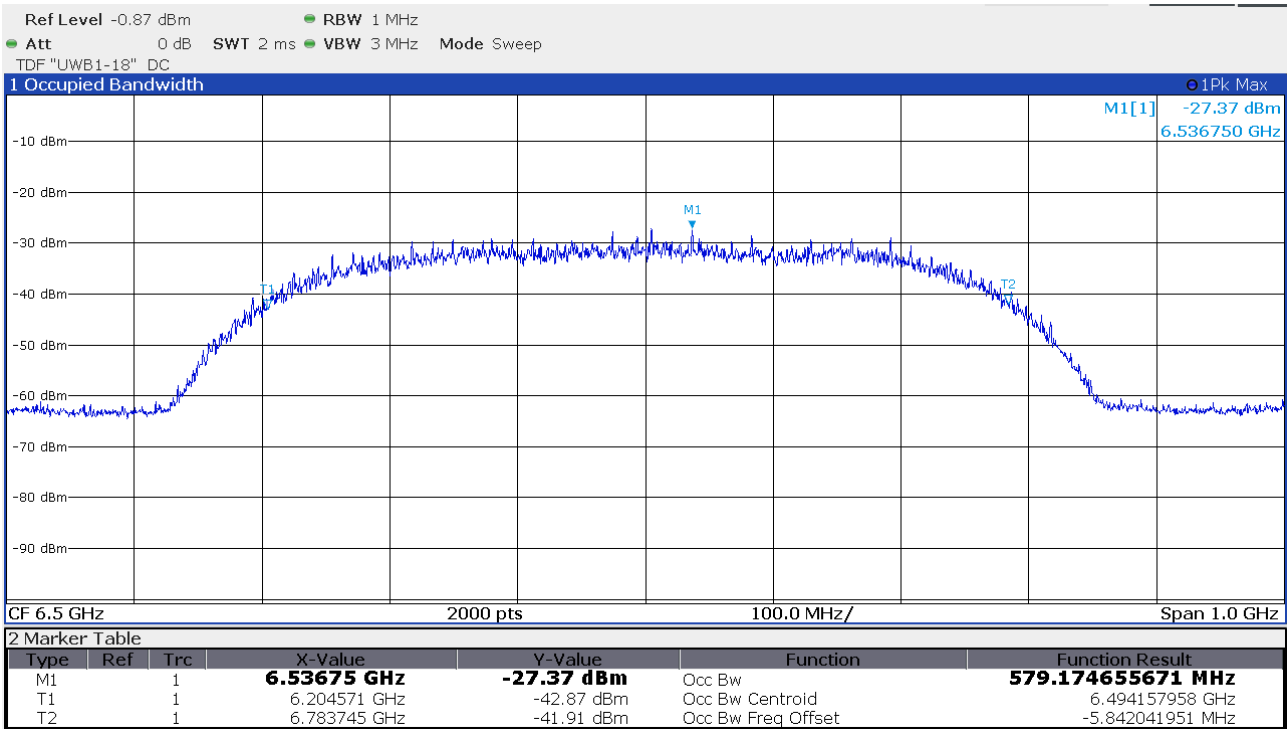


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

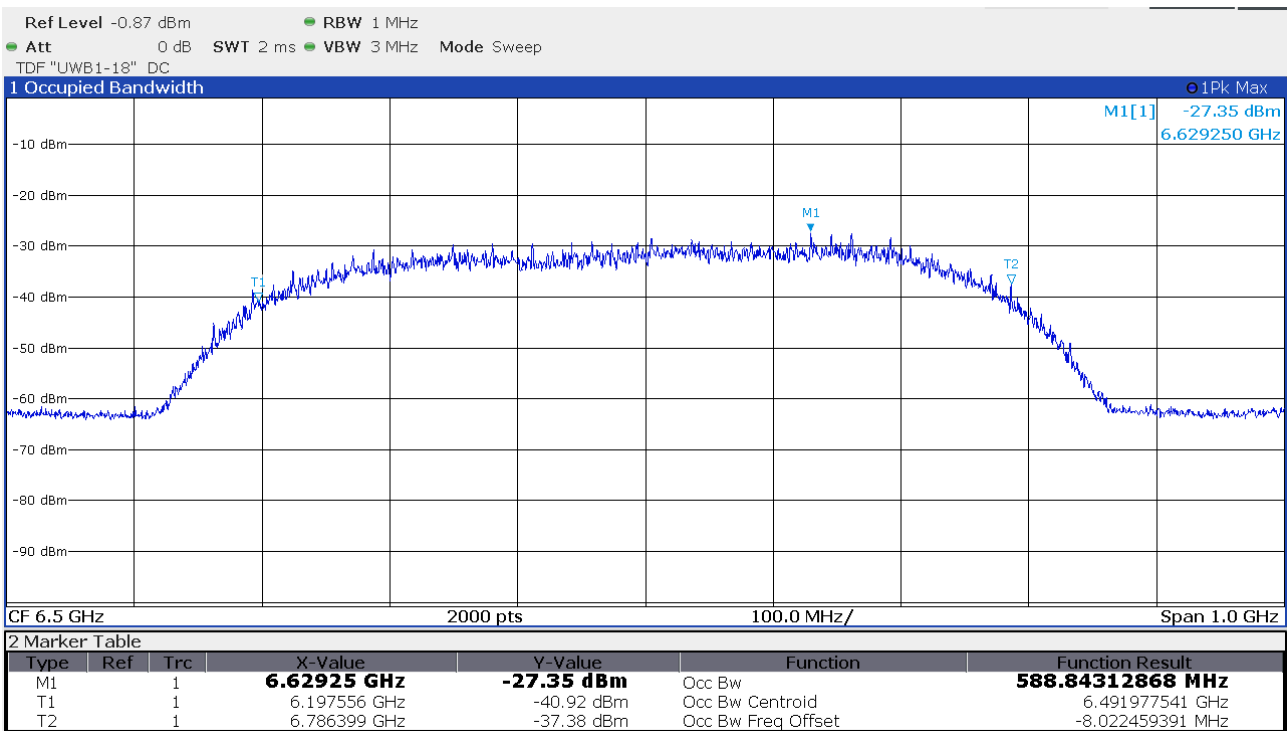
FCC ID: KR5FBD5 IC: 7812D-FBD5

5.2.7 Test protocols OBW

Channel 5 antenna 1

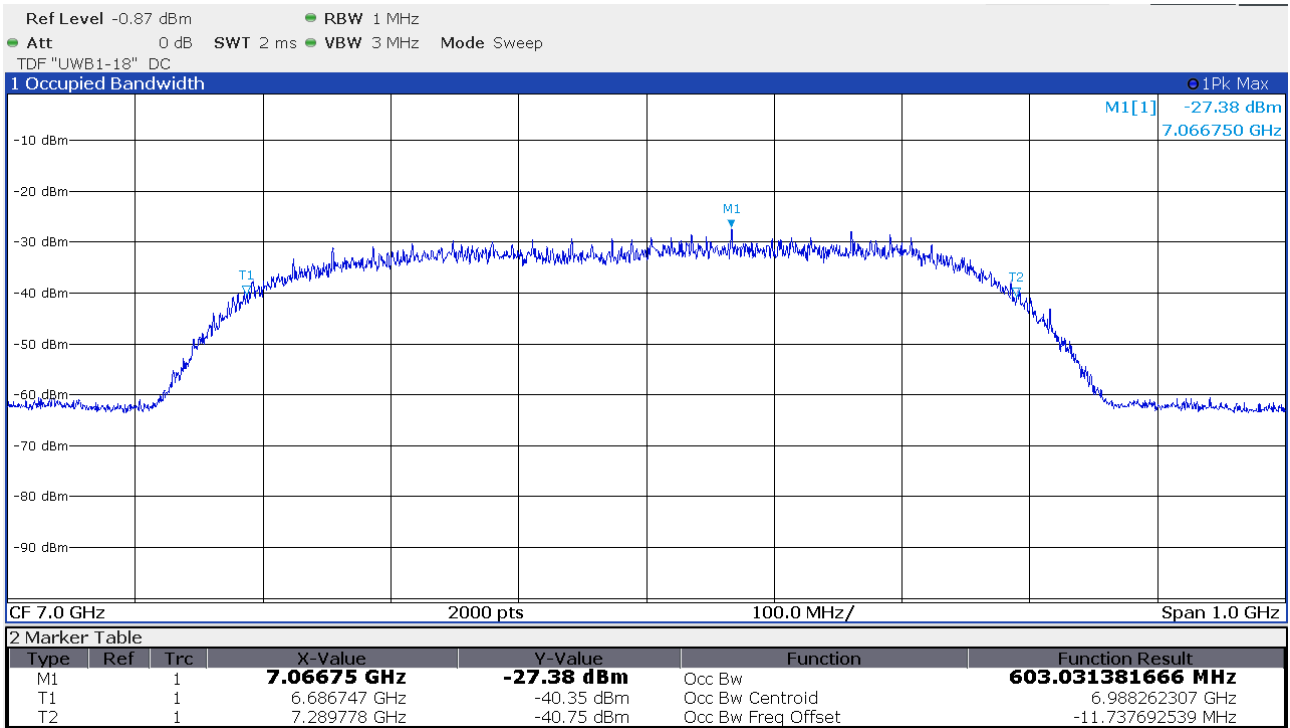


Channel 5 antenna 2

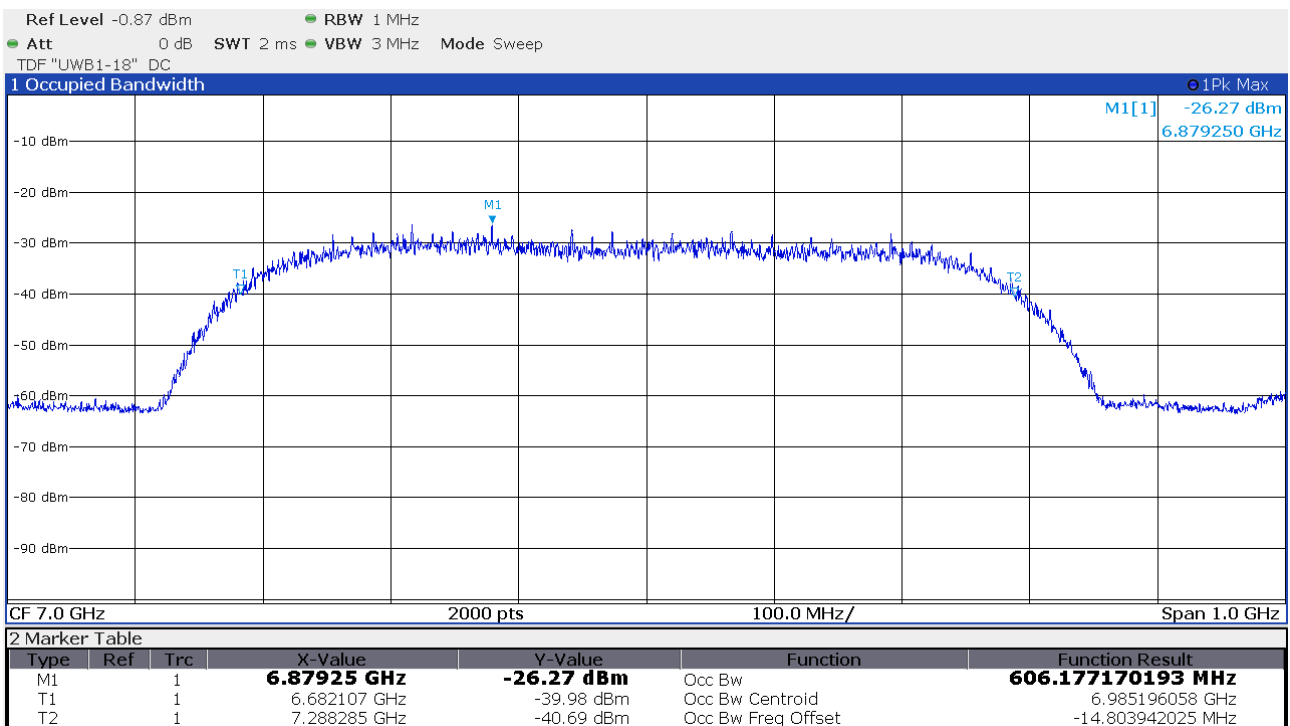


FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 6 antenna 1



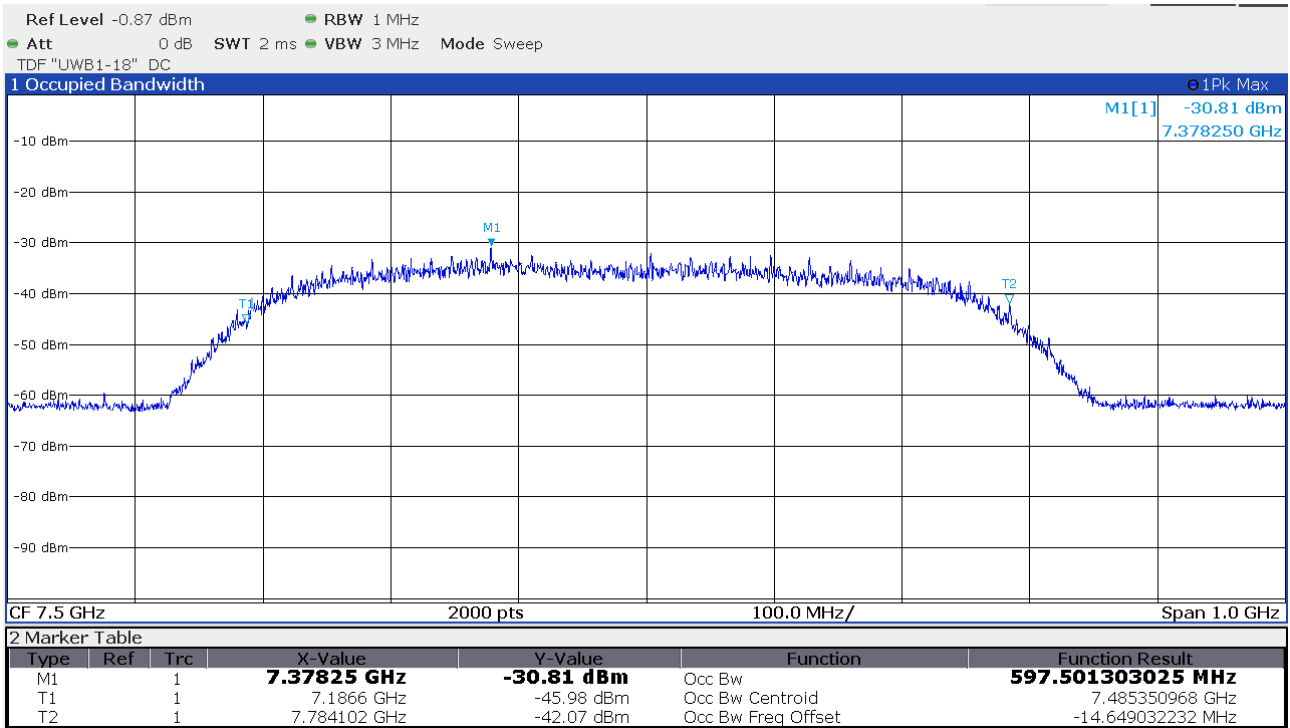
Channel 6 antenna 2



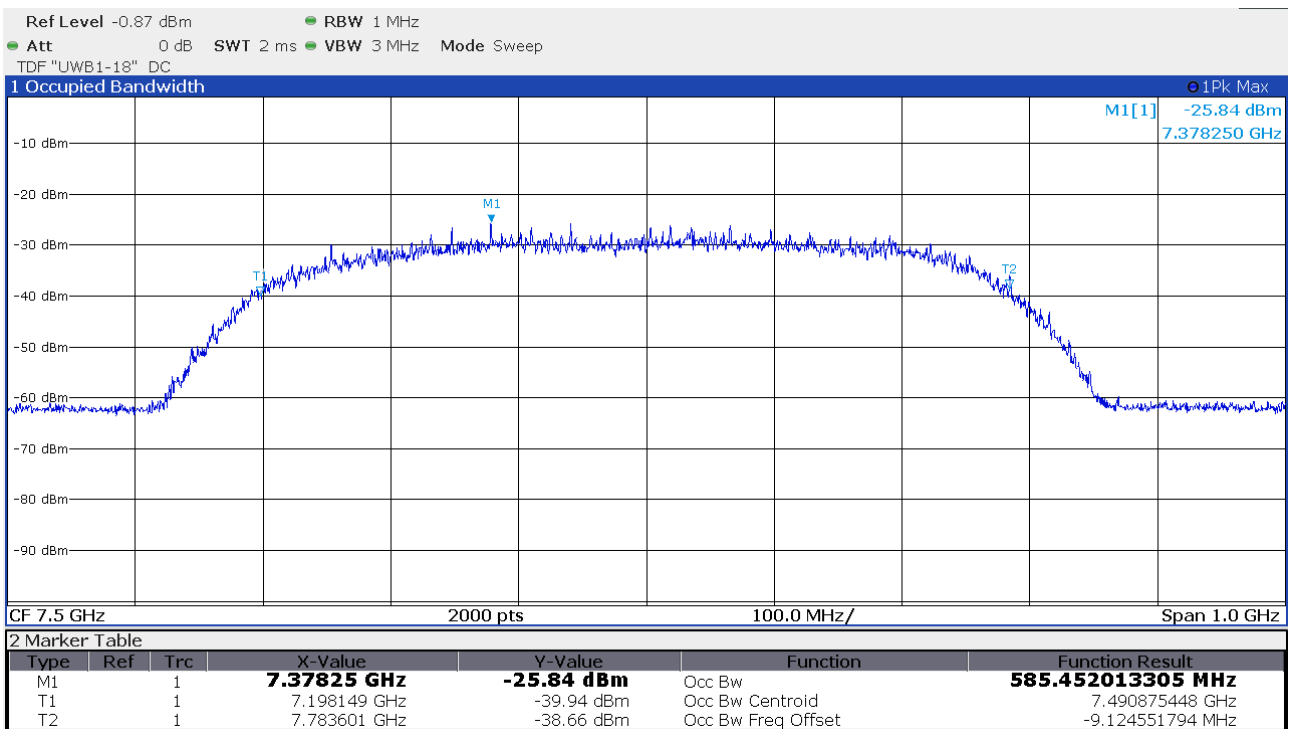
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FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 1



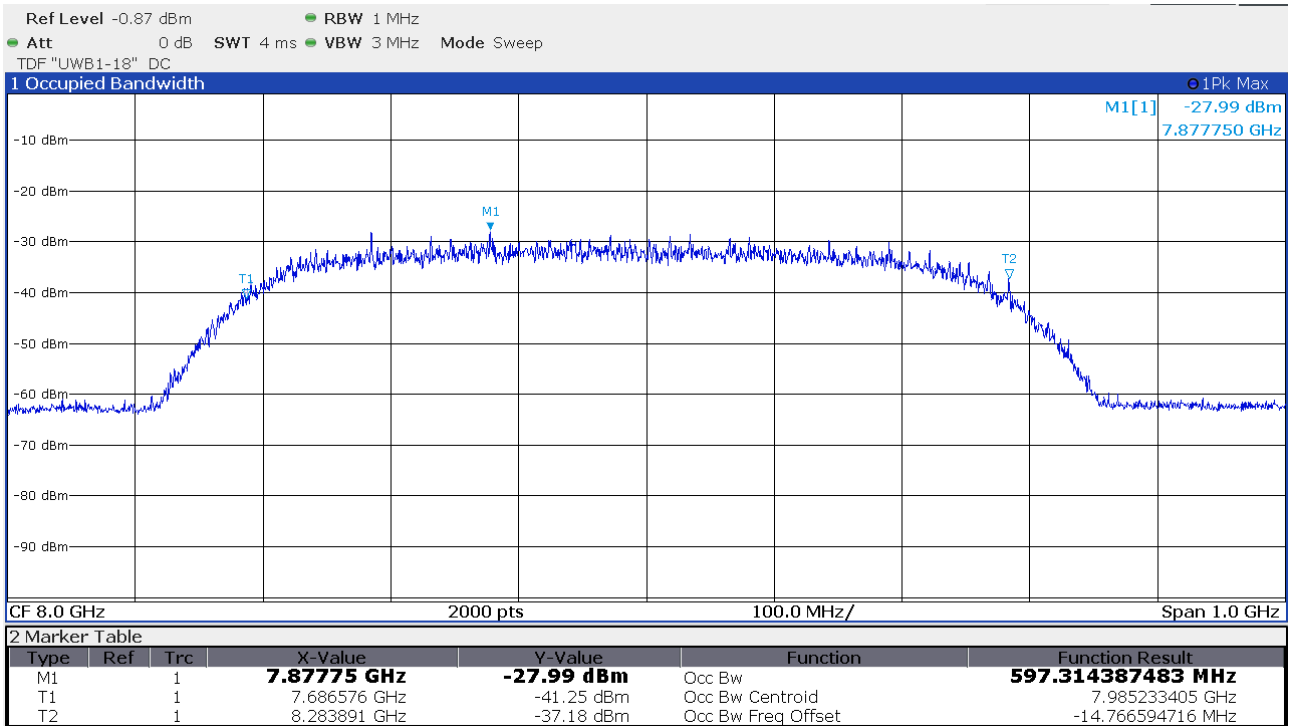
Channel 8 antenna 2



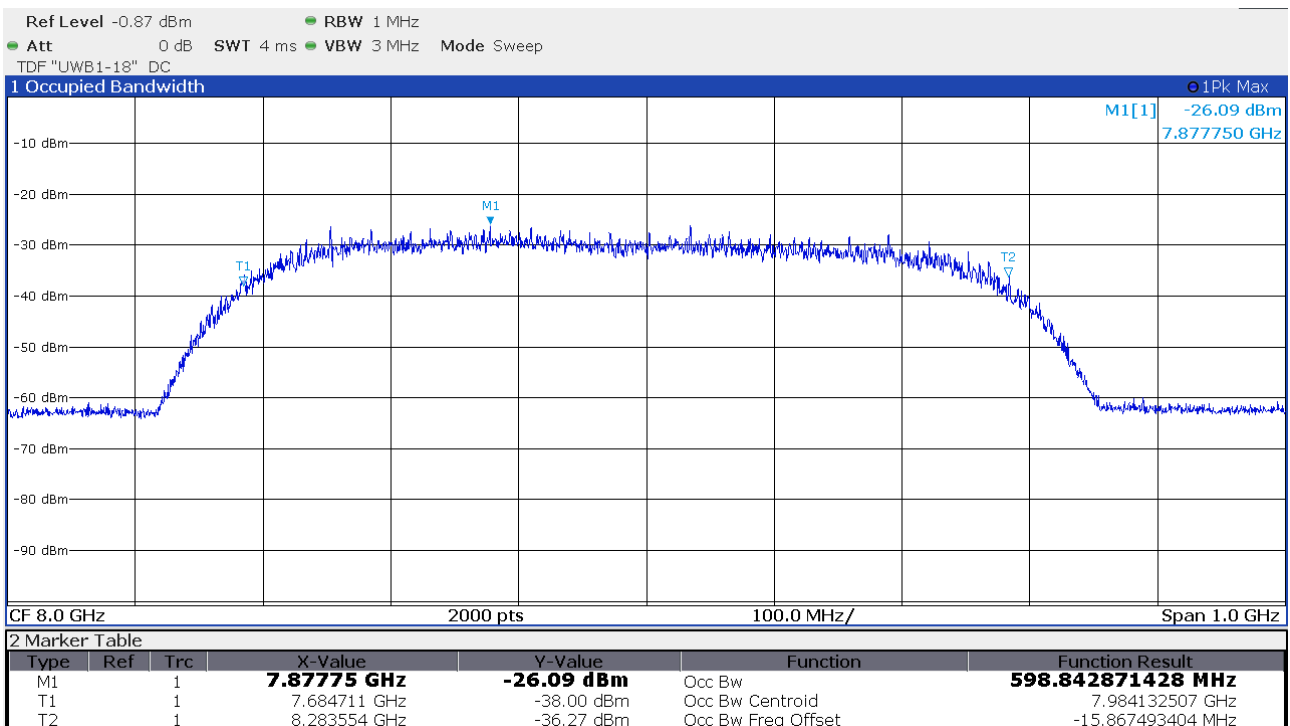
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 1



Channel 9 antenna 2



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

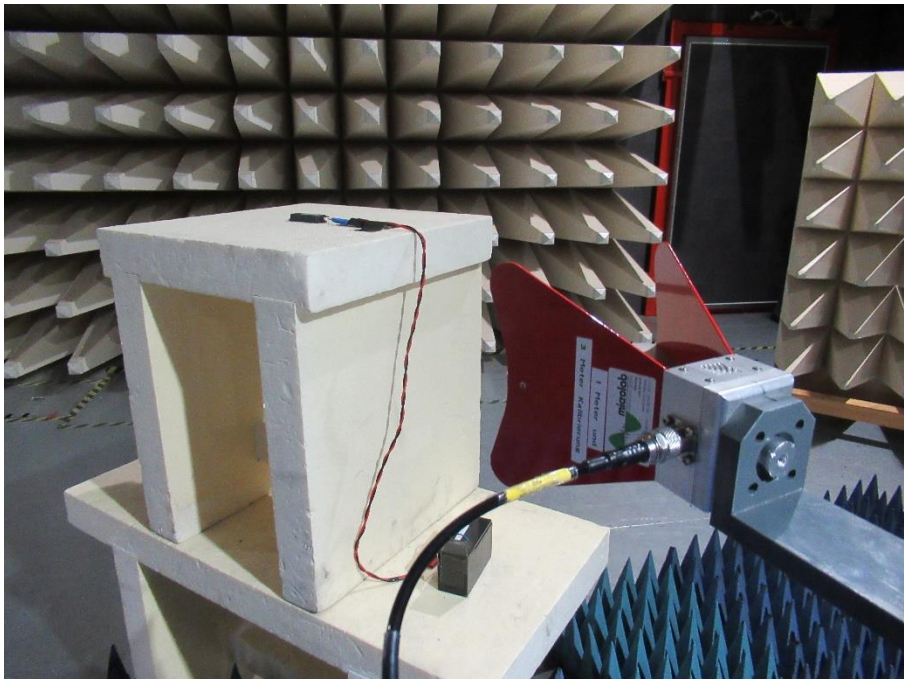
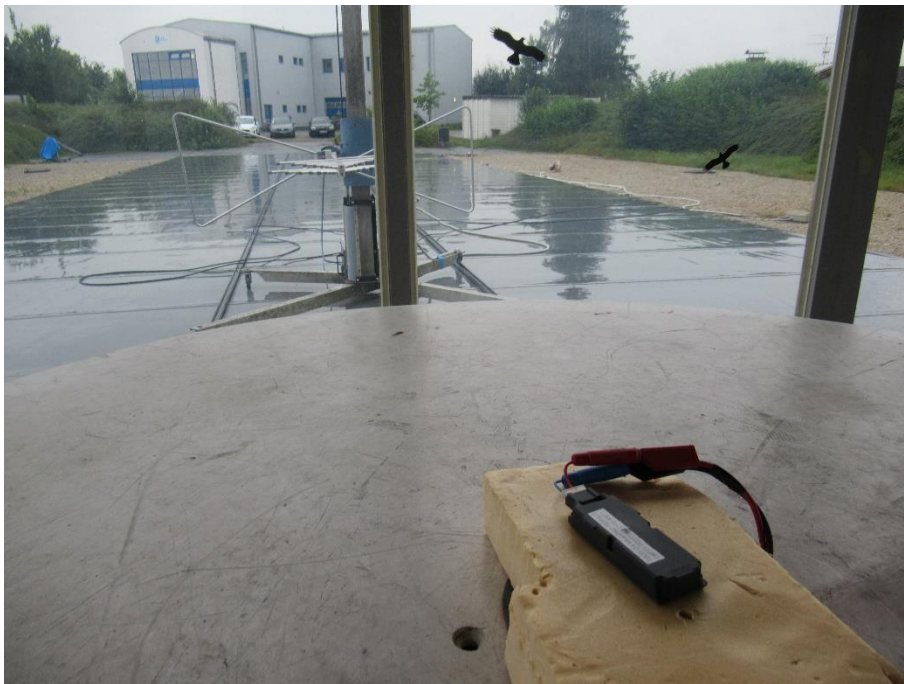
5.3 Radiated Emissions 9 kHz to 40 GHz

For test instruments and accessories used see section 6 Part **SER 2** and **SER 3**.

5.3.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up



FCC ID: KR5FBD5 IC: 7812D-FBD5



5.3.3 Applicable standard

According to FCC Part 15, Section 15.519(c):

The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz.

5.3.4 Analyser settings

| | | | | |
|------------------|--------------|--------------|---------------|------------------------|
| 9 kHz – 150 kHz | RBW: 200 Hz | | | |
| 150 kHz - 30 MHz | RBW: 9 kHz | | | |
| 30 MHz – 960 MHz | RBW: 120 kHz | Detector: QP | | |
| 960 MHz – 40 GHz | RBW: 1 MHz | VBW: 3 MHz | Detector: RMS | Sweeptime: 1ms per MHz |

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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

5.3.5 Test result

5.3.5.1 Measurement 9 kHz to 30 MHz

Note: Pre-measurements have shown, there are no detectable emissions in this frequency range.

5.3.5.2 Measurement 30 MHz to 960 MHz

| Frequency (MHz) | Reading Vert. (dBµV) | Reading Hor. (dBµV) | Correct. Vert. (dB) | Correct. Hor. (dB) | Level Vert. (dBµV/m) | Level Hor. (dBµV/m) | Limit (dBµV/m) | Dlimit (dB) |
|-----------------|----------------------|---------------------|---------------------|--------------------|----------------------|---------------------|----------------|-------------|
| 47,56 | 4,4 | 5,0 | 15,2 | 14,1 | 19,6 | 19,1 | 40,0 | -20,4 |
| 172,03 | 6,5 | 5,9 | 13,8 | 14,6 | 20,3 | 20,5 | 43,5 | -23,0 |
| 247,50 | 1,3 | -0,6 | 13,7 | 13,9 | 15,0 | 13,3 | 46,0 | -31,0 |
| 500,00 | -2,6 | -0,9 | 22,5 | 22,3 | 19,9 | 21,4 | 46,0 | -24,6 |
| 903,87 | -1,9 | -1,9 | 31,2 | 30,7 | 29,3 | 28,8 | 46,0 | -16,7 |

Note: Measurements were performed in the whole frequency range from 30 MHz to 1000 MHz. No significant emissions above the noise level could be detected. All emissions at not listed frequencies are 30 dB under the limit.

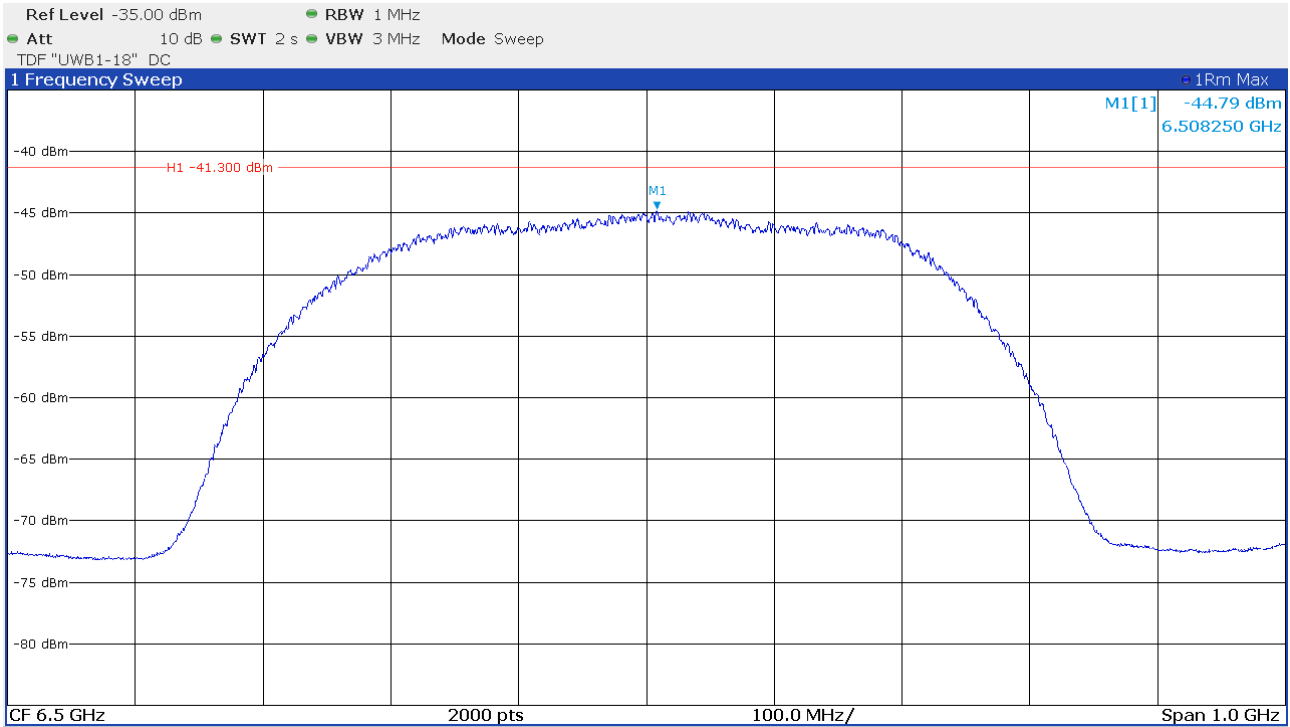
The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

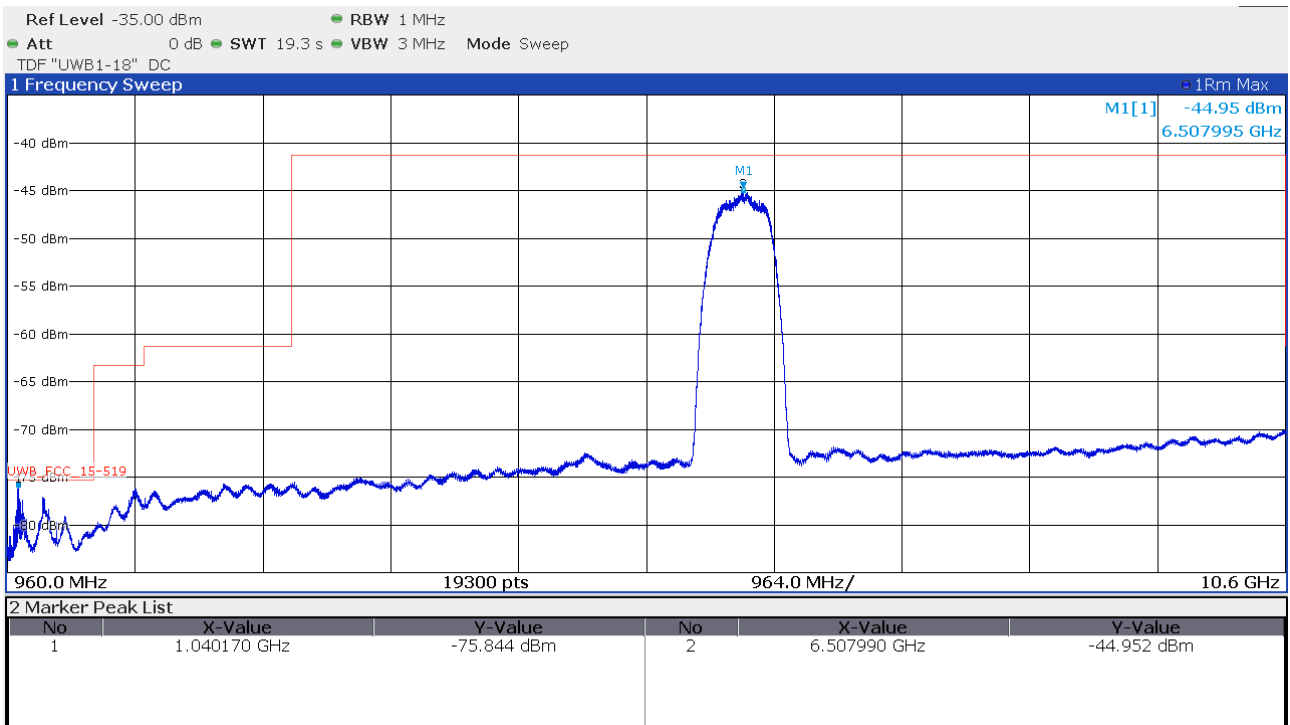
5.3.5.3 Measurement 960 MHz to 40 GHz

Channel 5 antenna 1

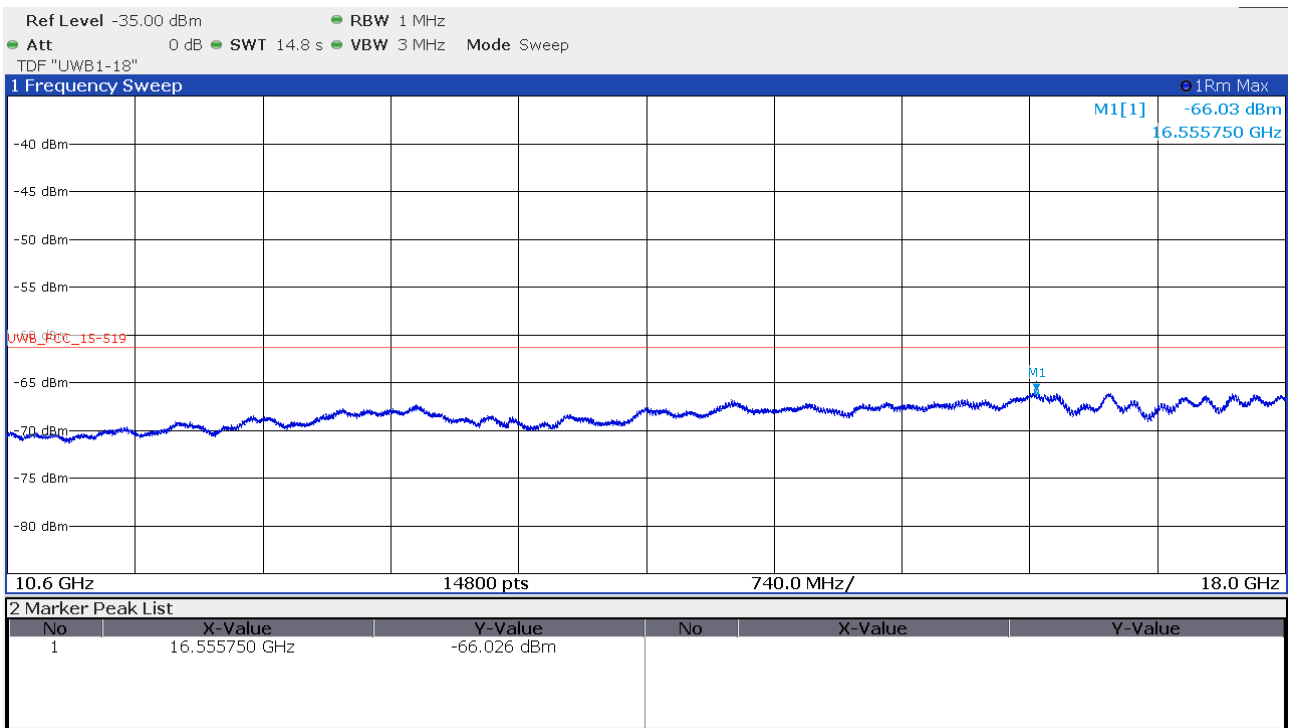
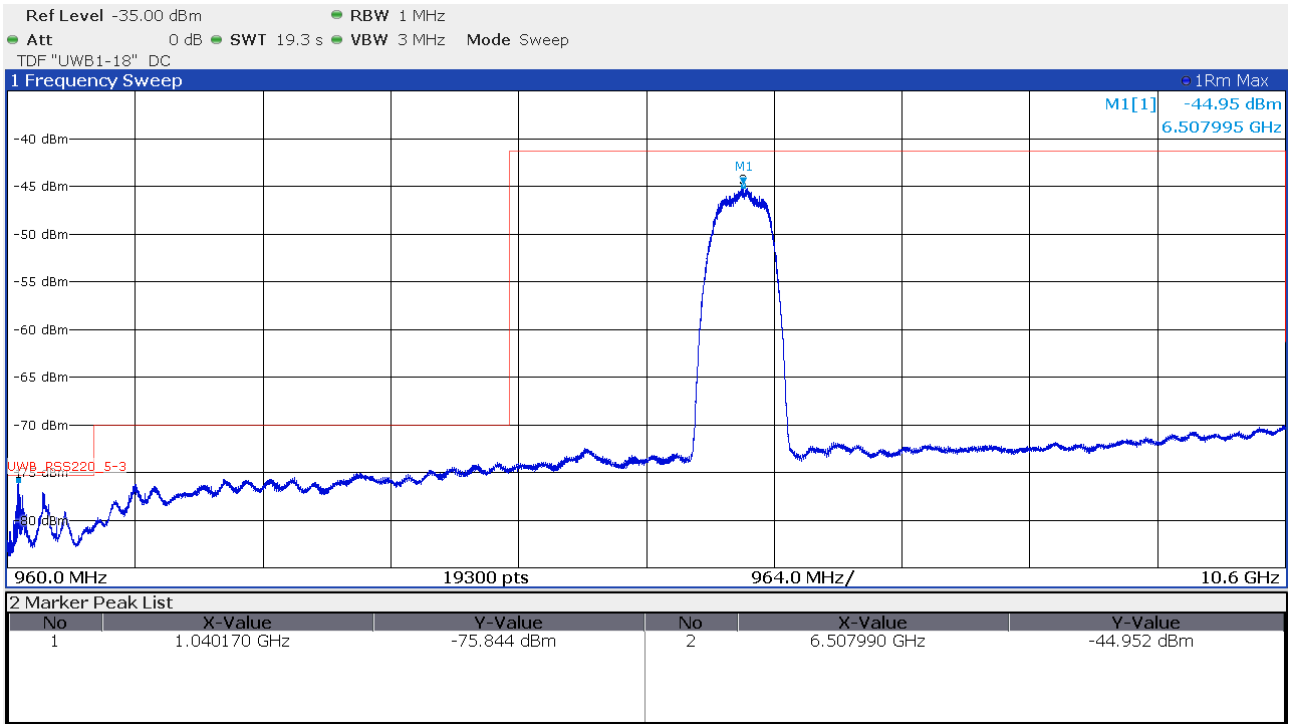
Mean Power



960 MHz to 18 GHz



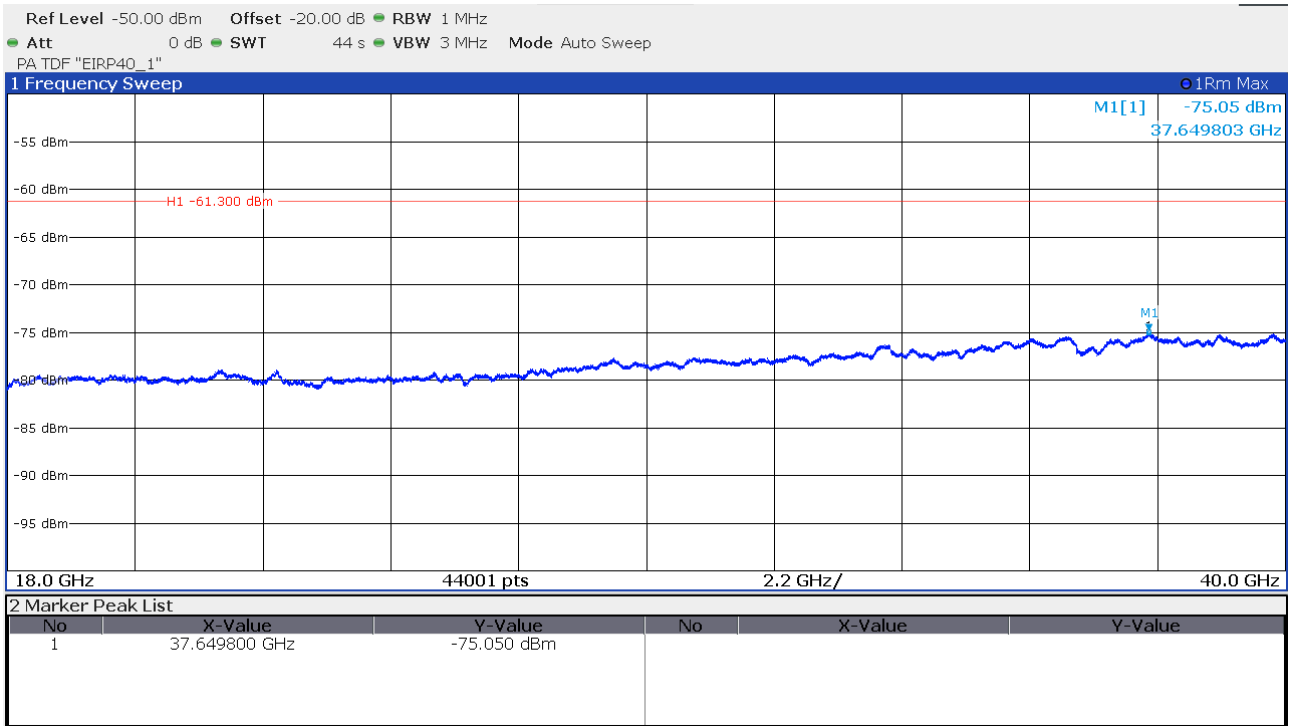
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

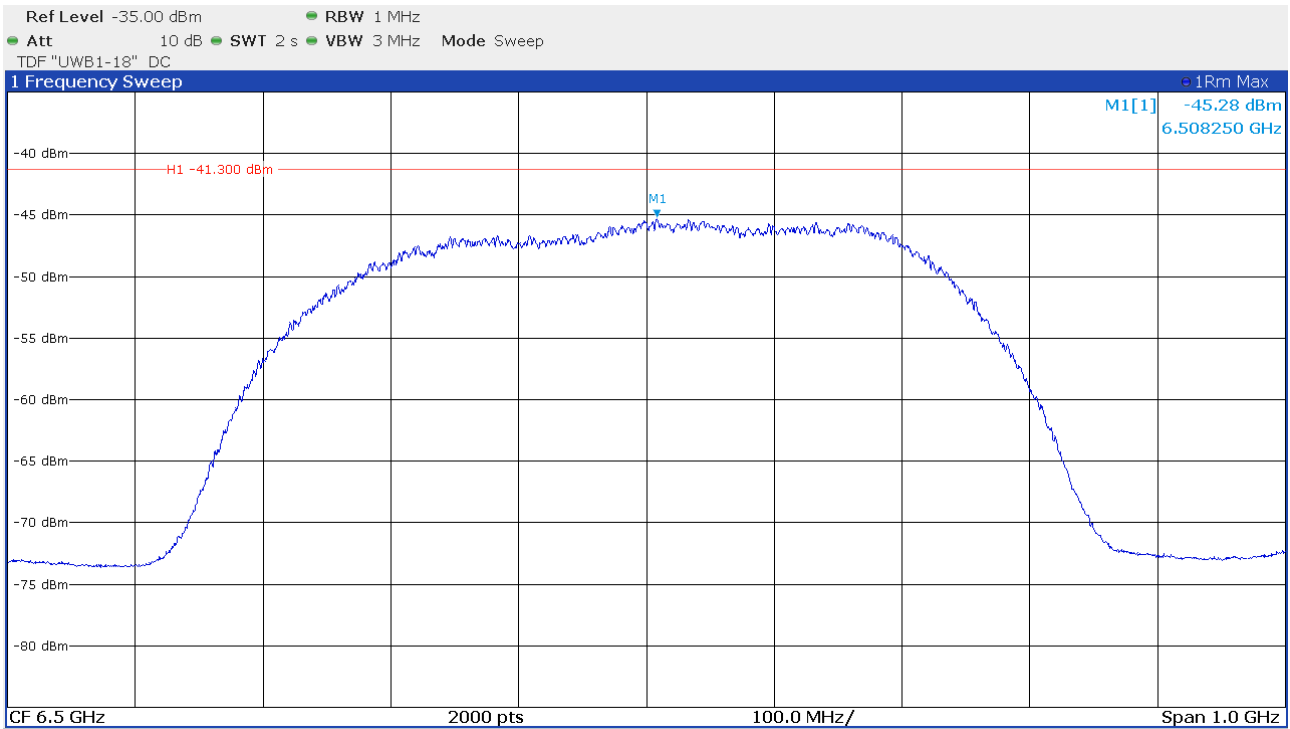


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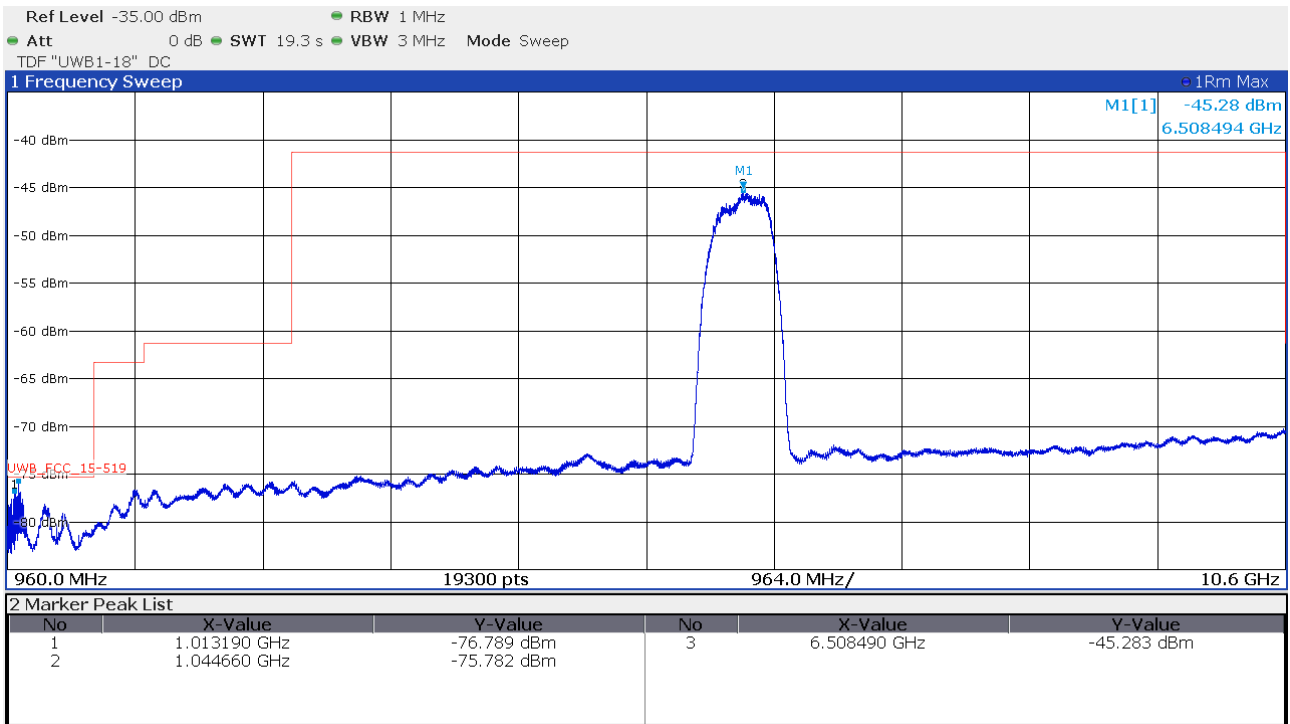
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 5 antenna 2

Mean Power

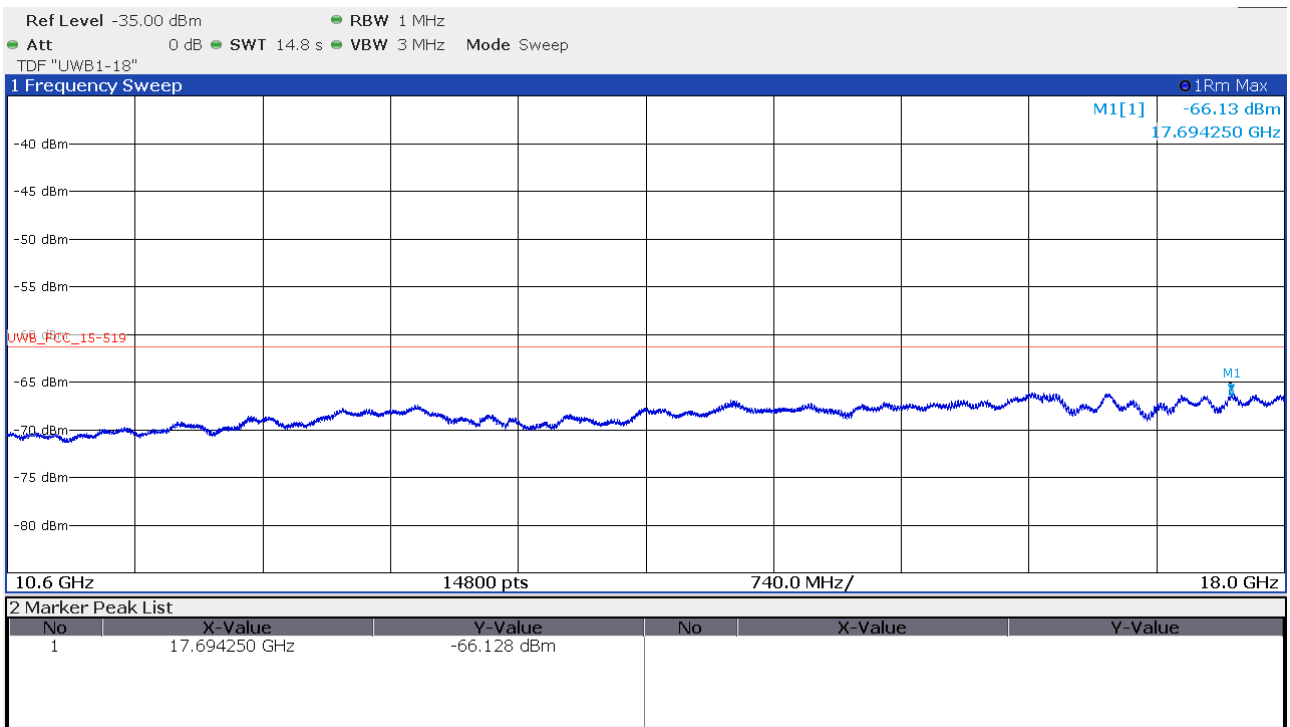
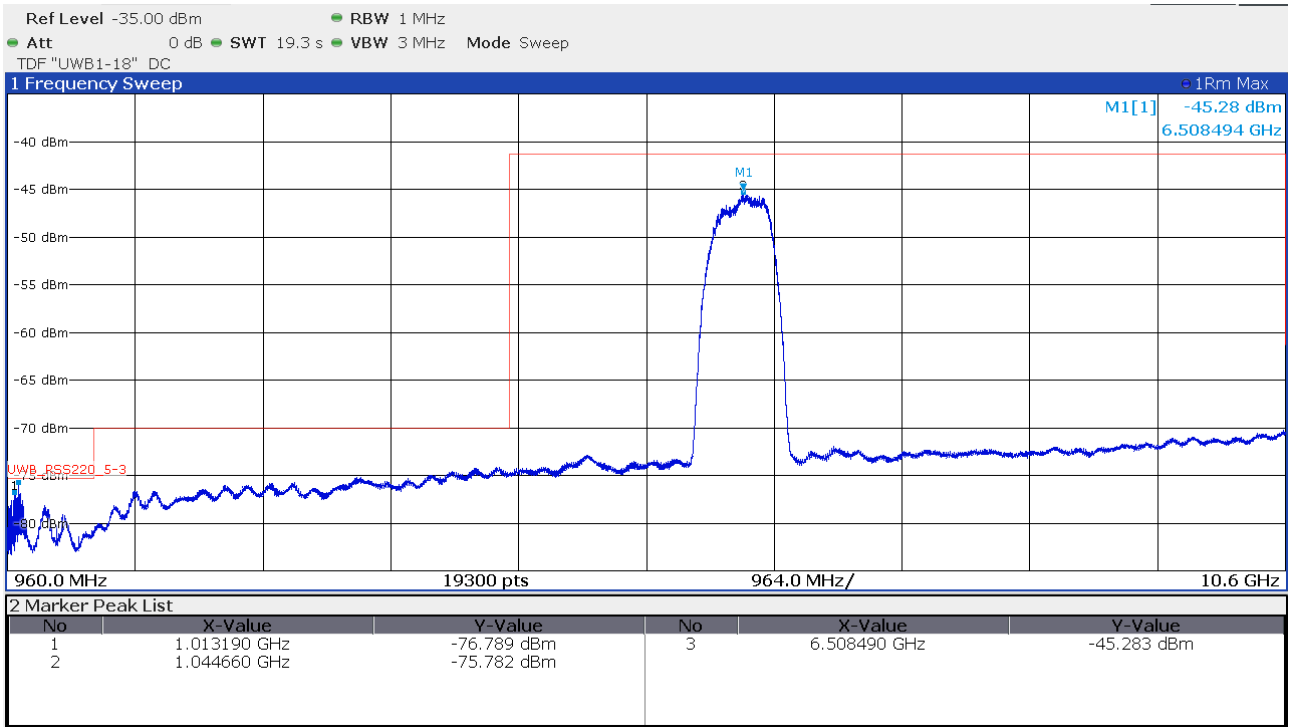


960 MHz to 18 GHz



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.

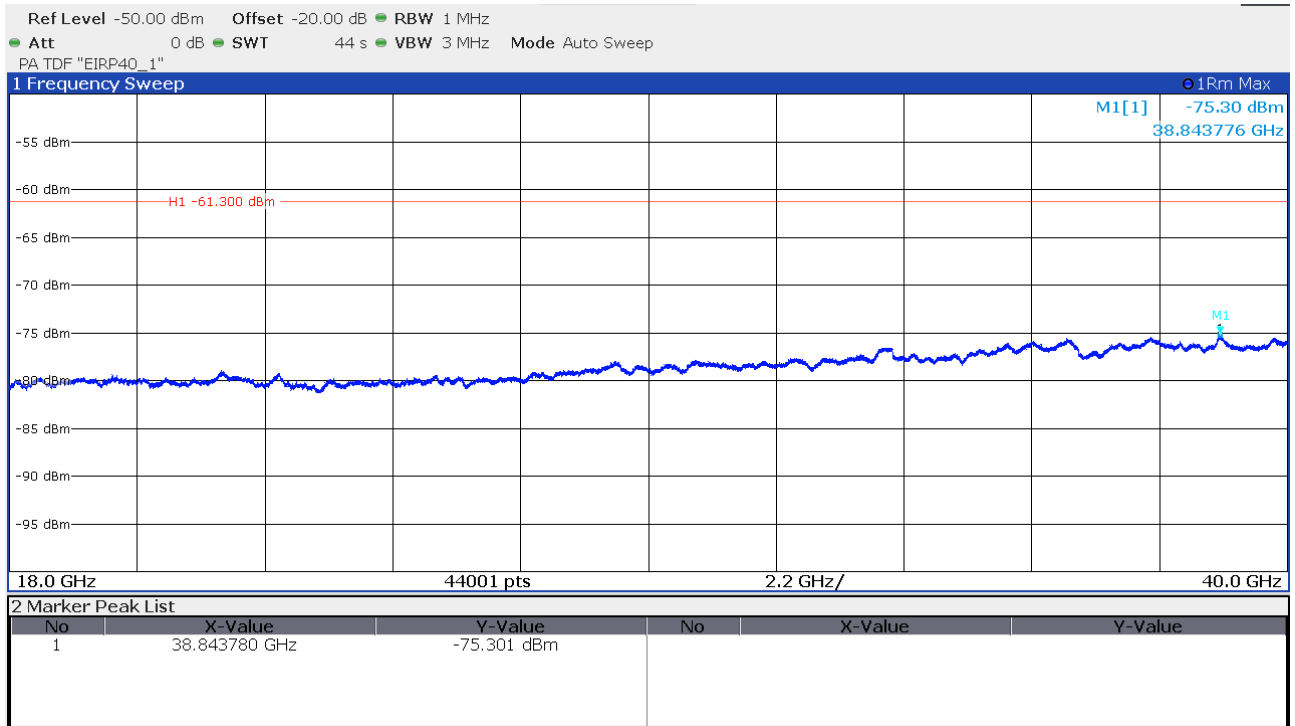
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

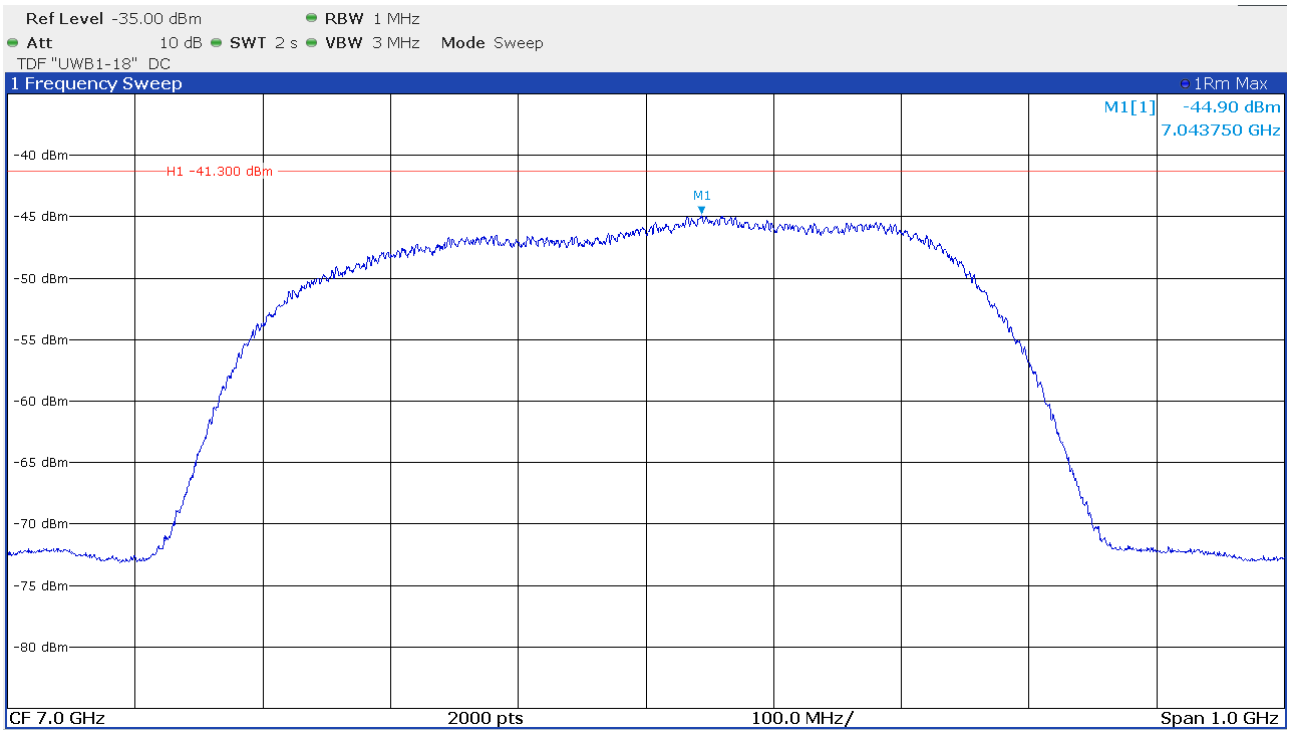


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

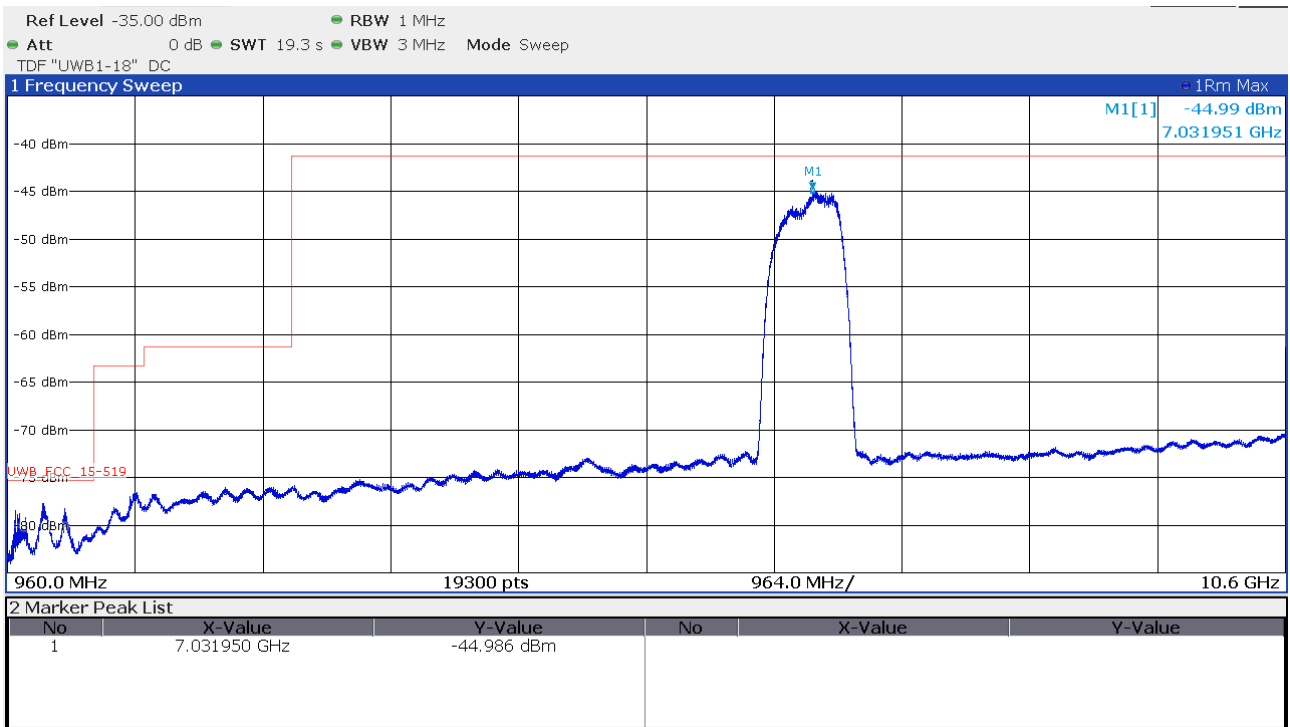
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Channel 6 antenna 1

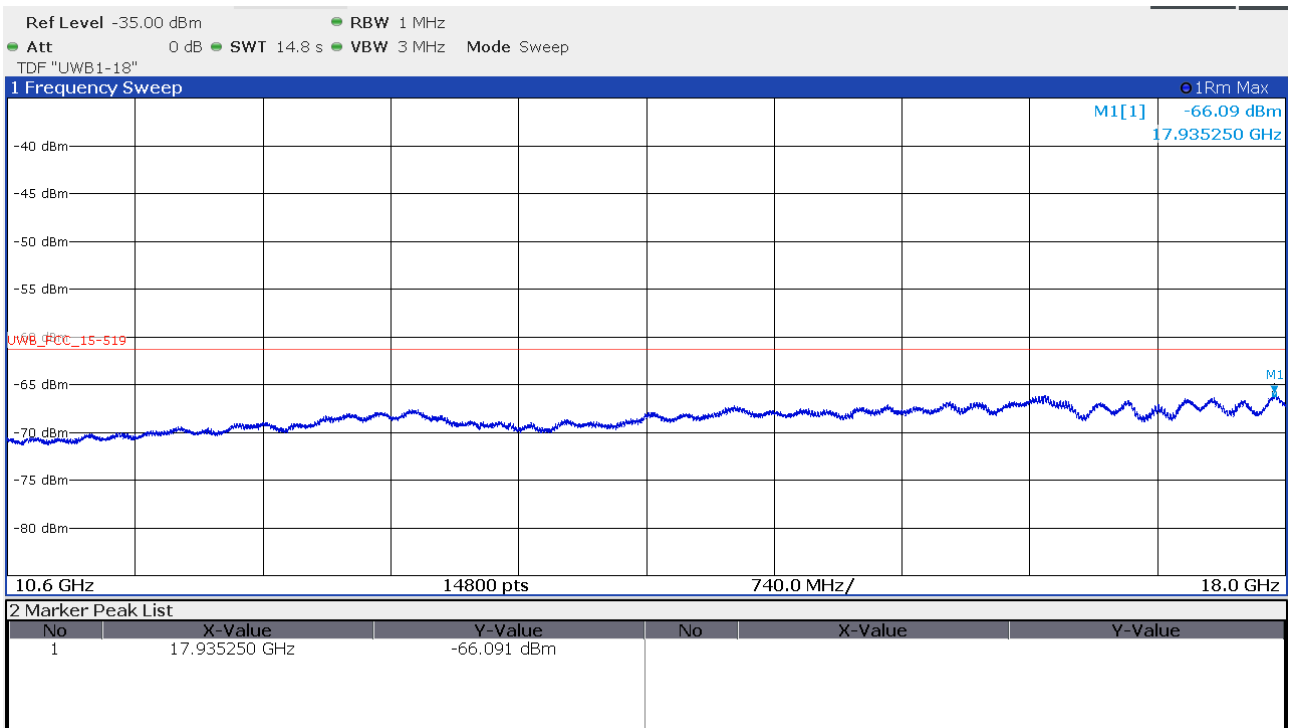
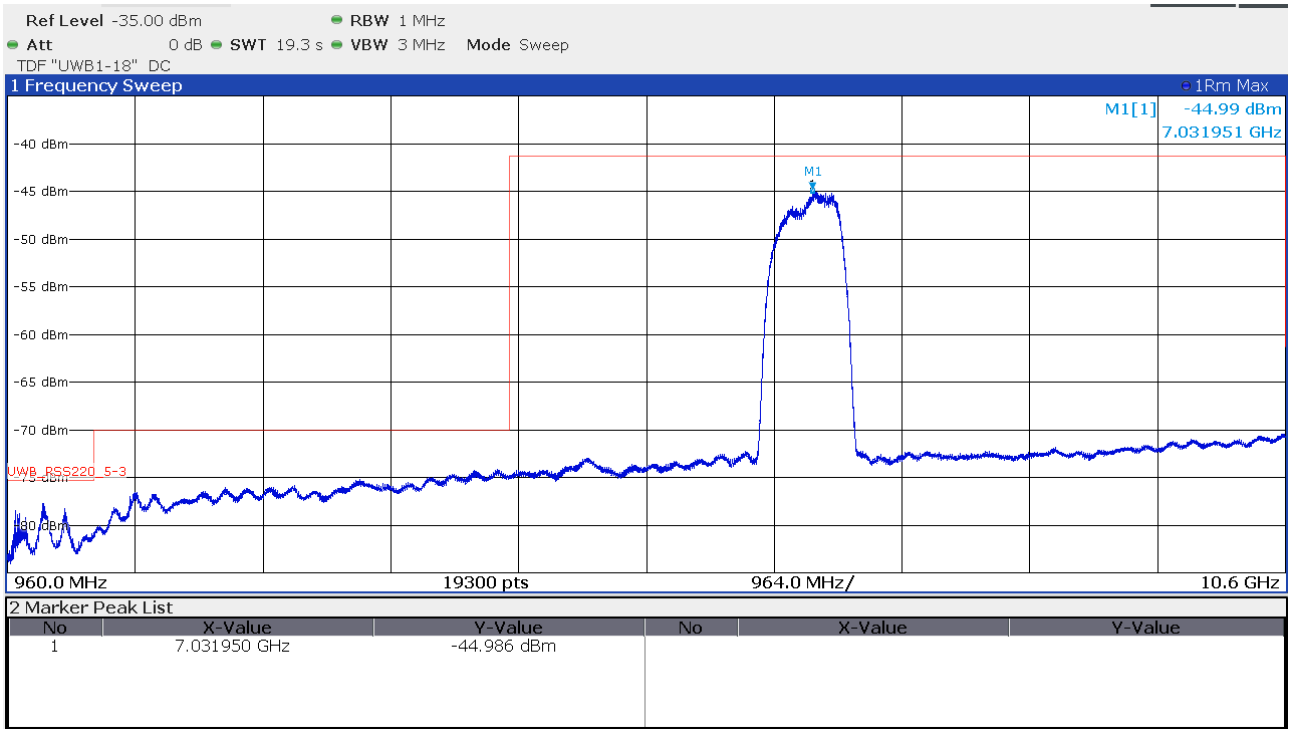
Mean Power



960 MHz to 18 GHz



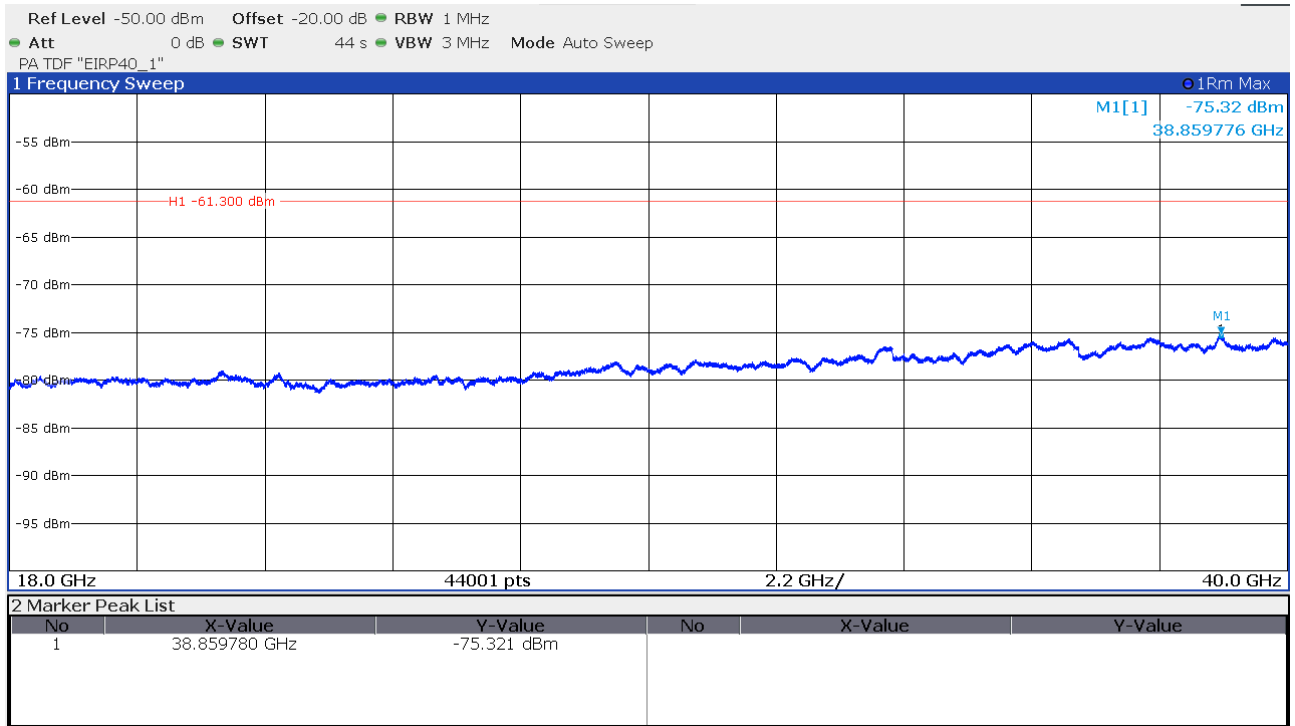
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

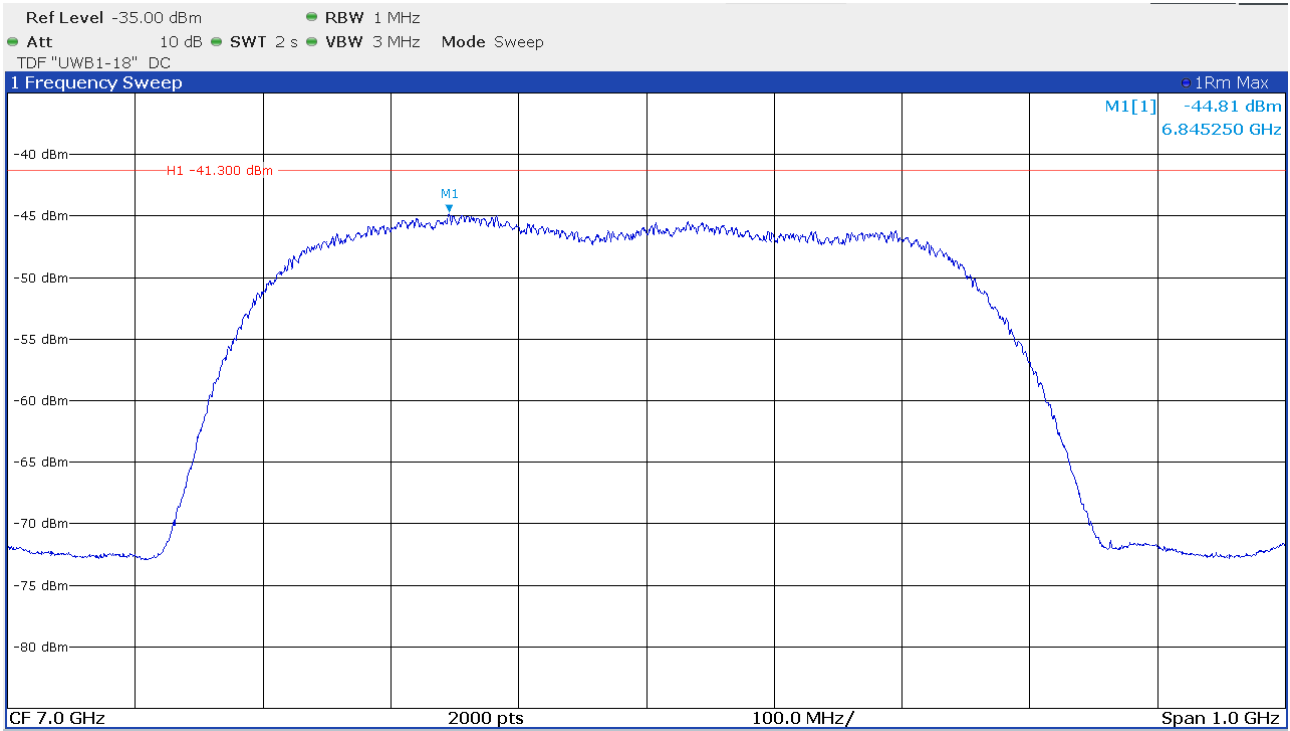


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

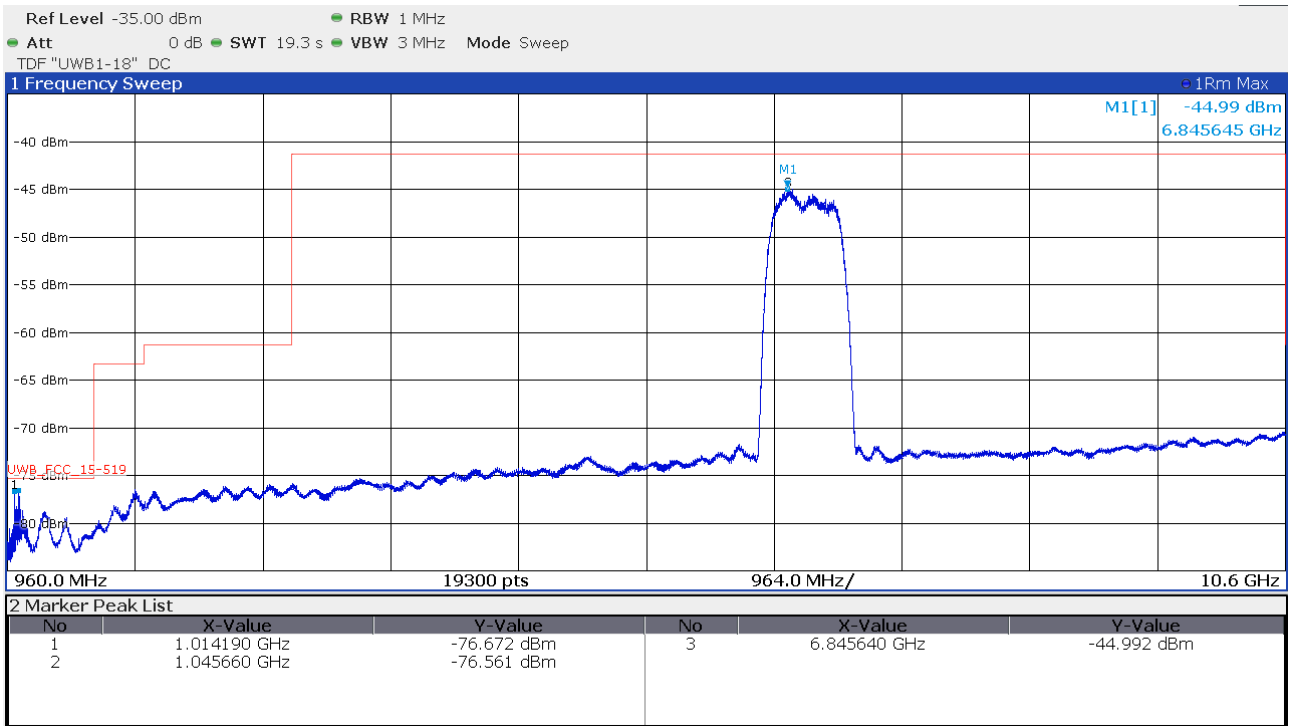
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Channel 6 antenna 2

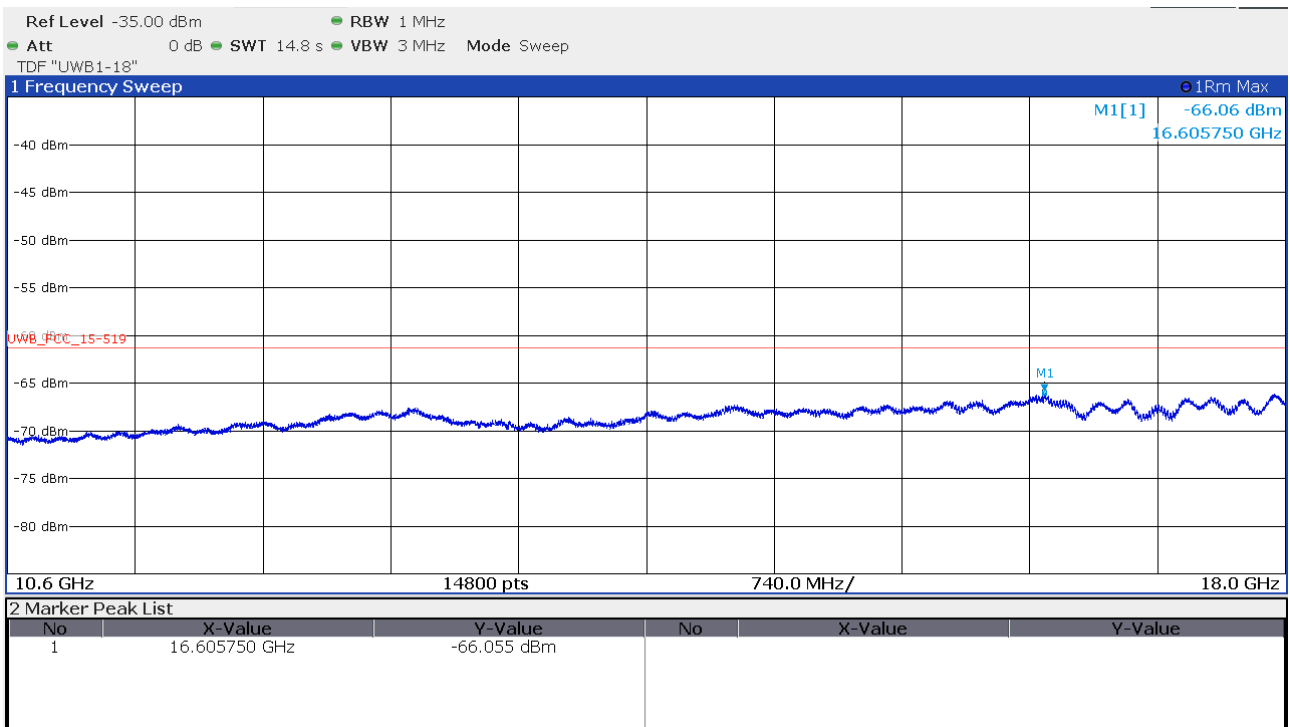
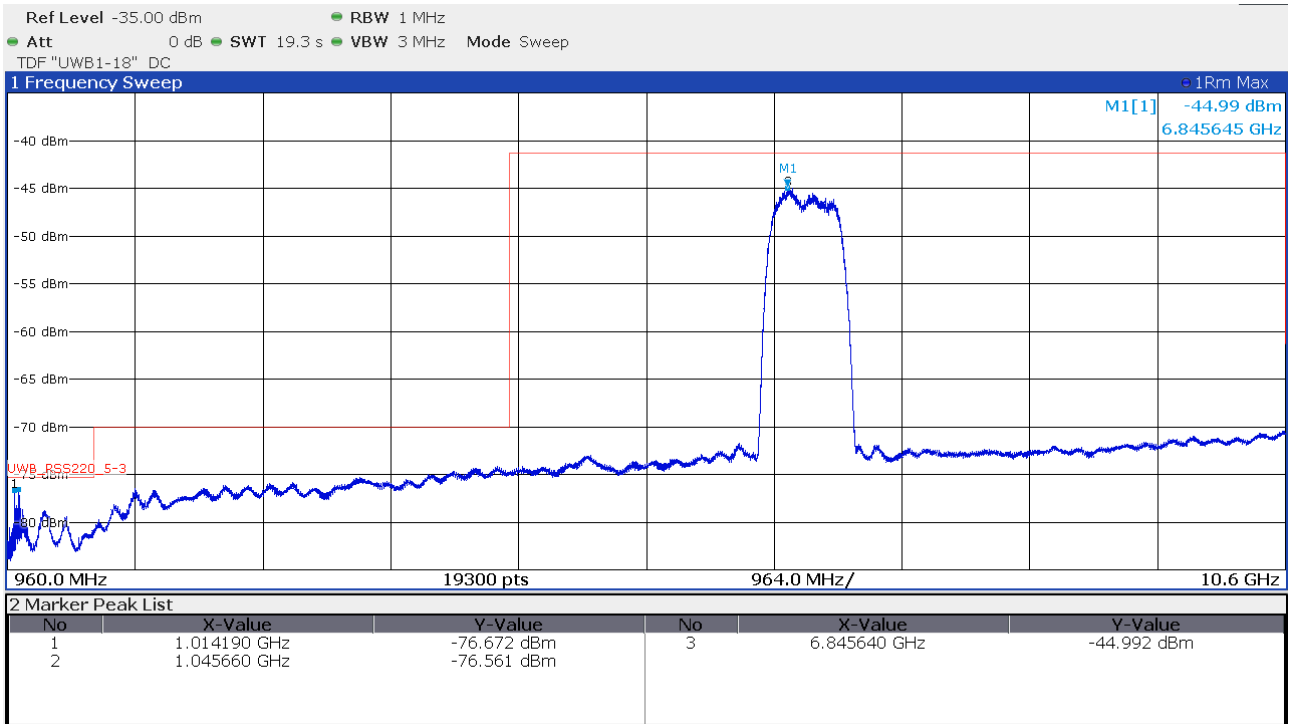
Mean Power



960 MHz to 18 GHz



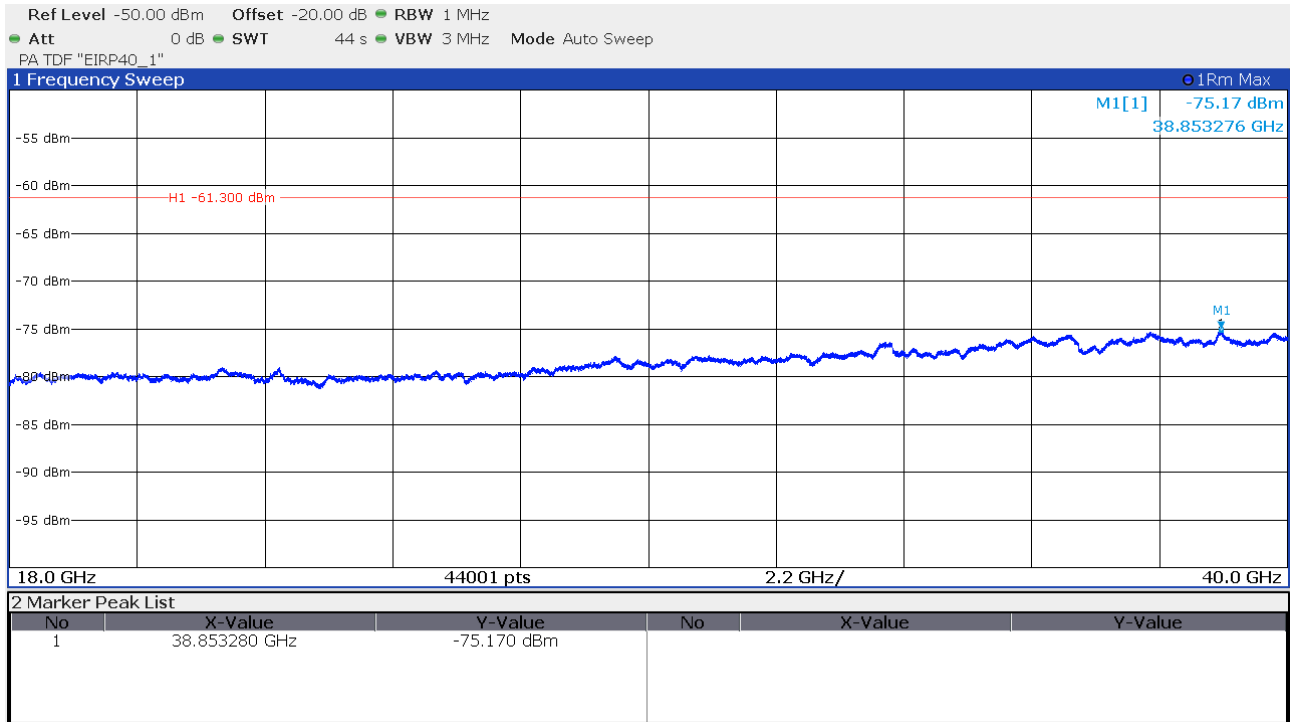
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

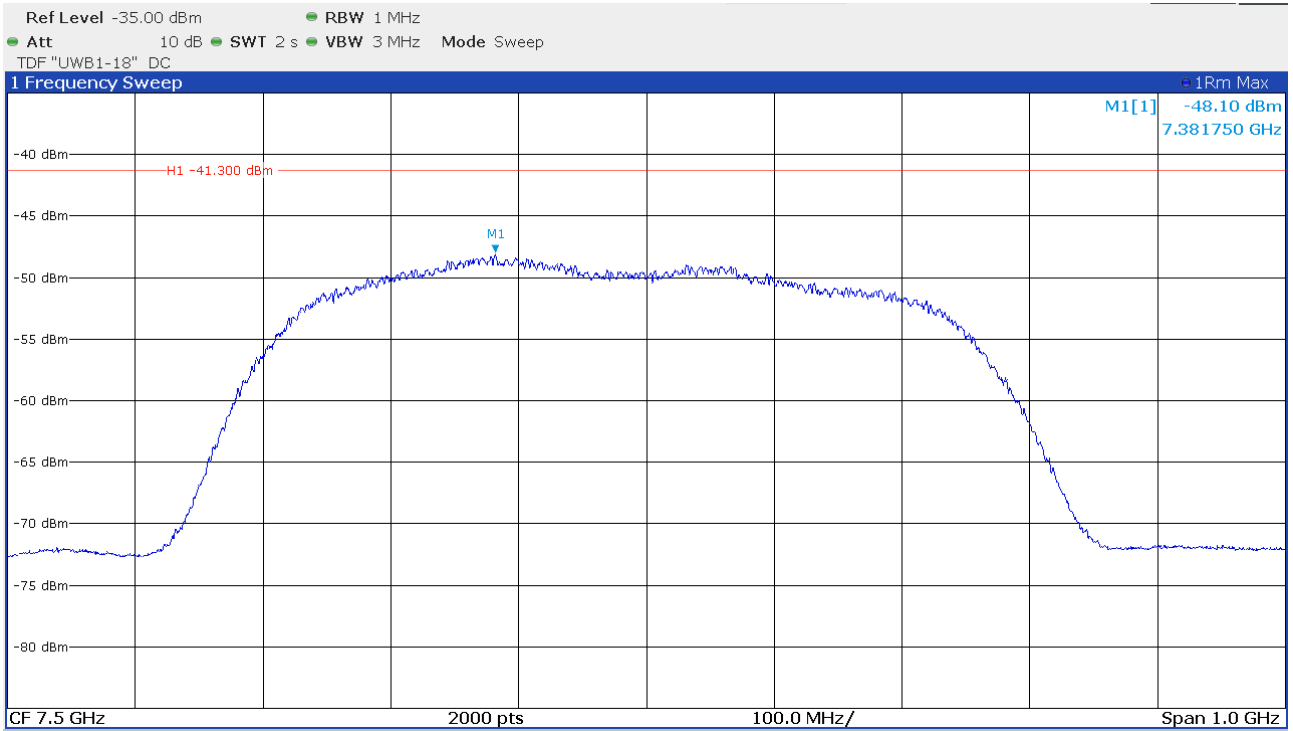


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

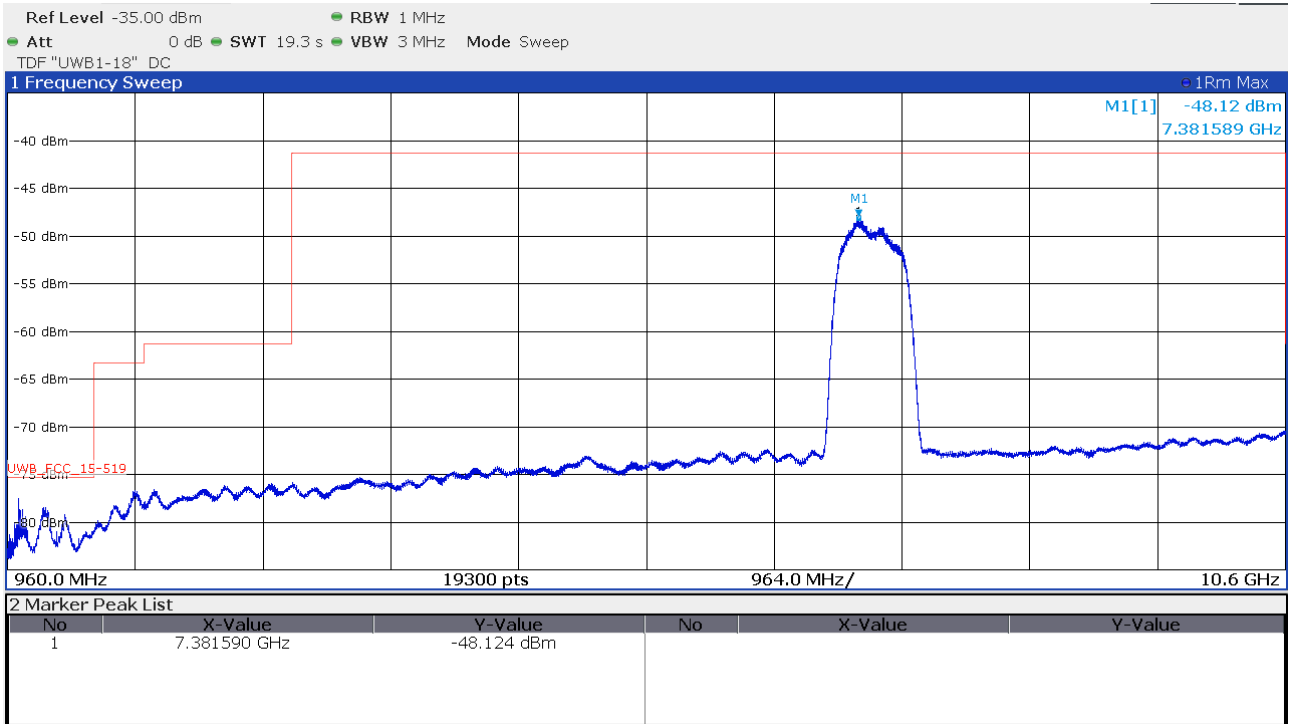
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Channel 8 antenna 1

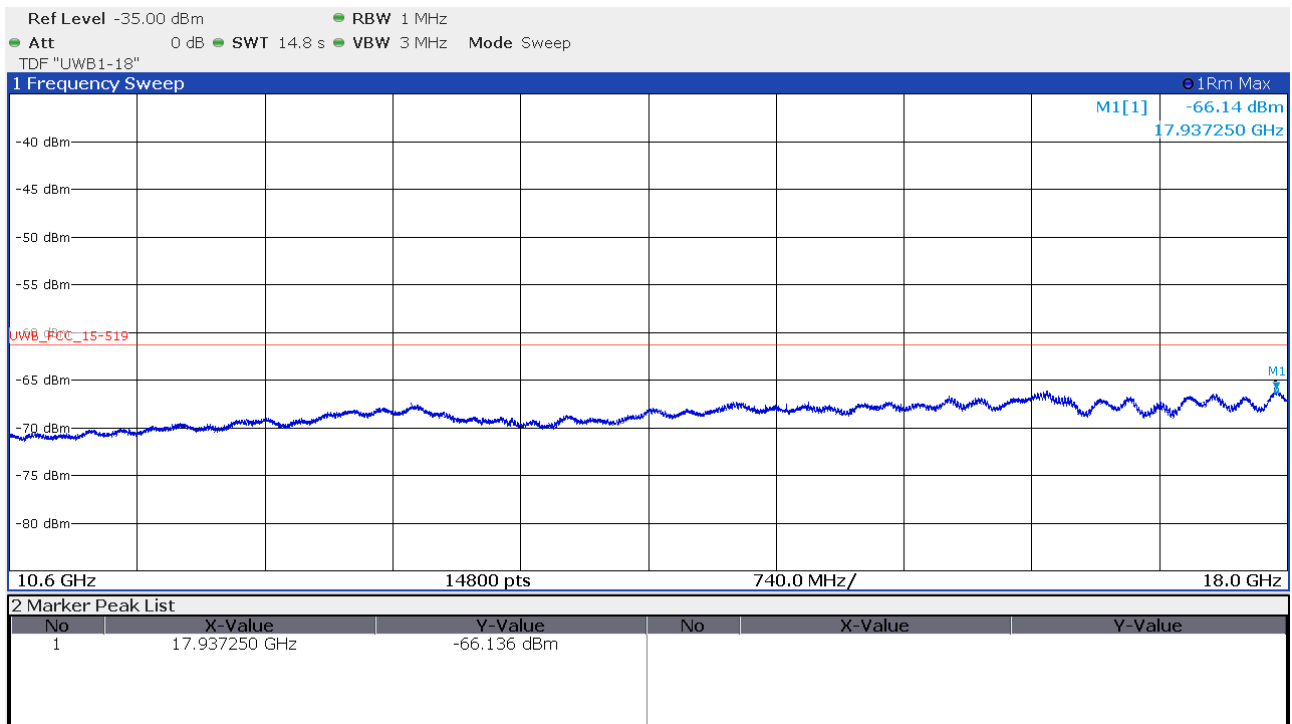
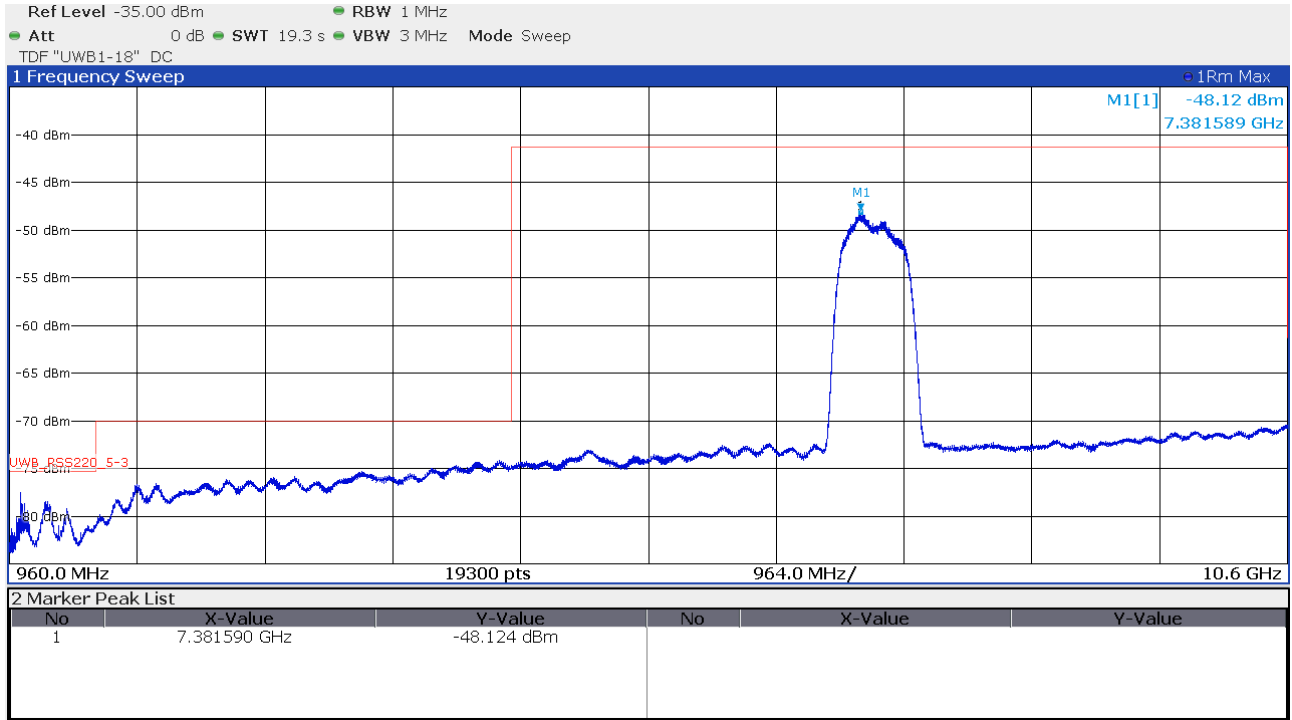
Mean Power



960 MHz to 18 GHz



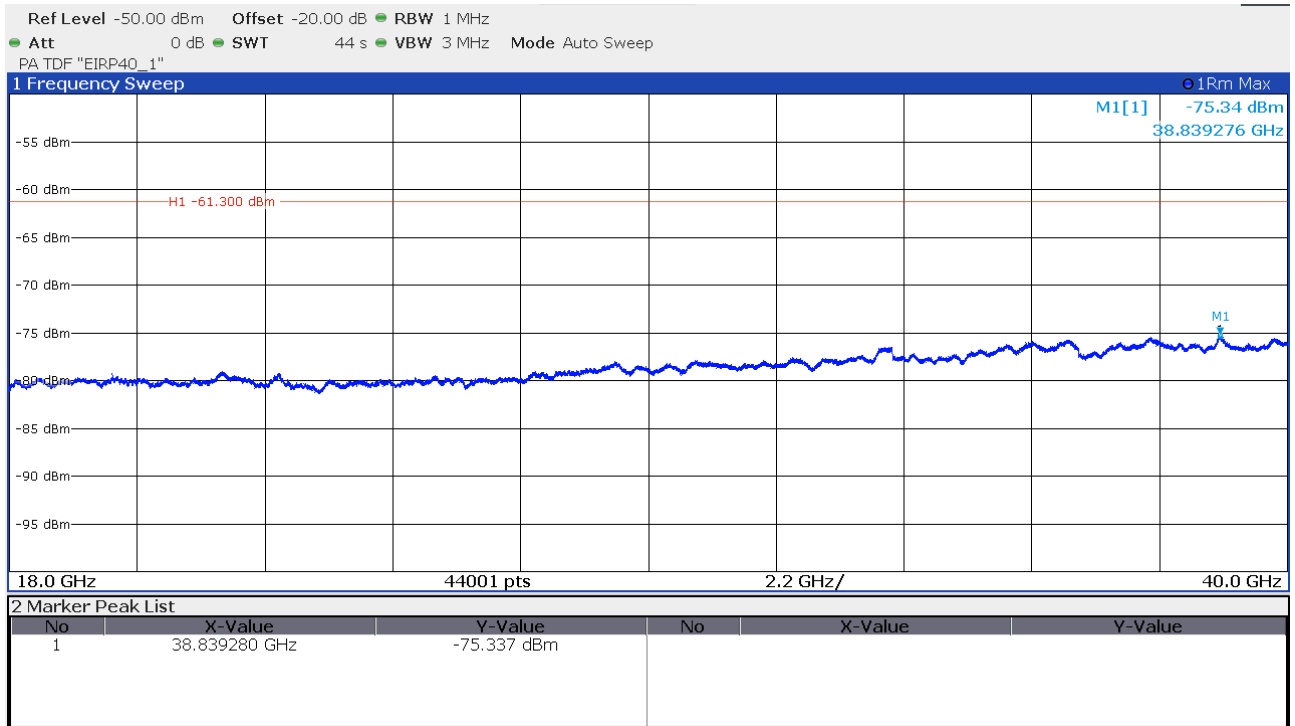
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The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

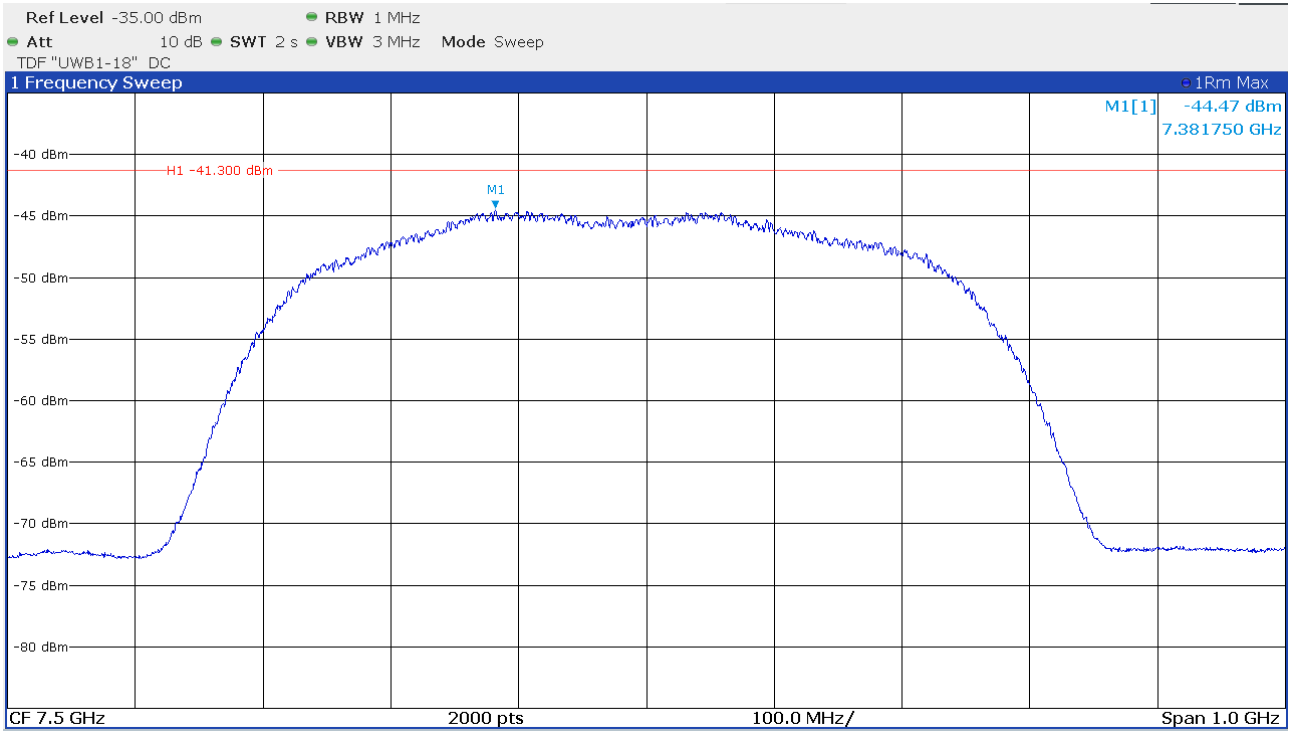


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

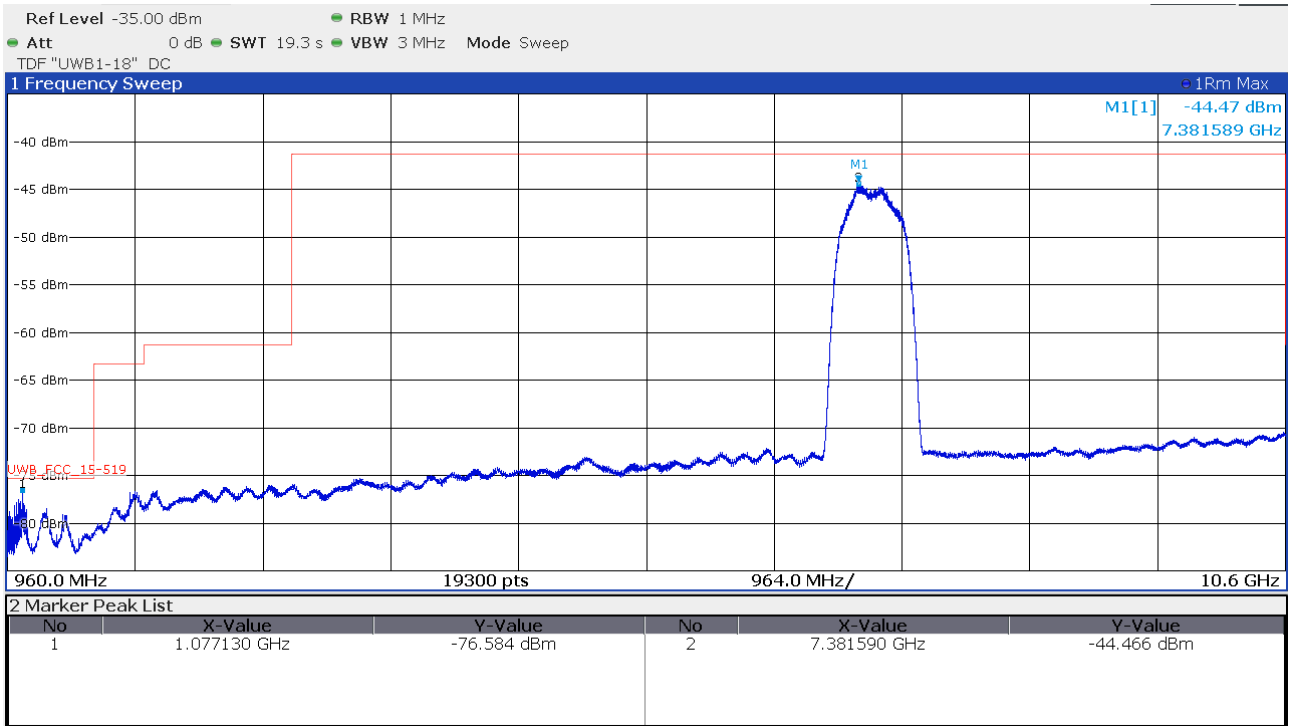
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 2

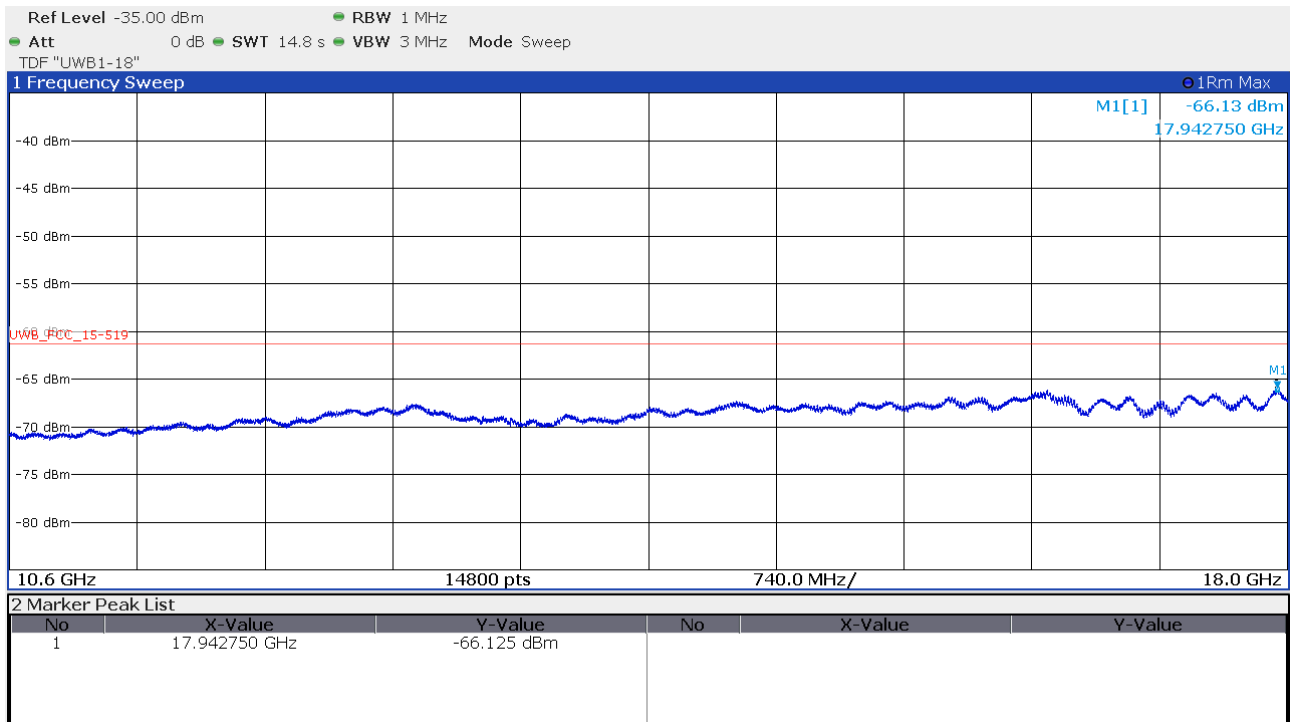
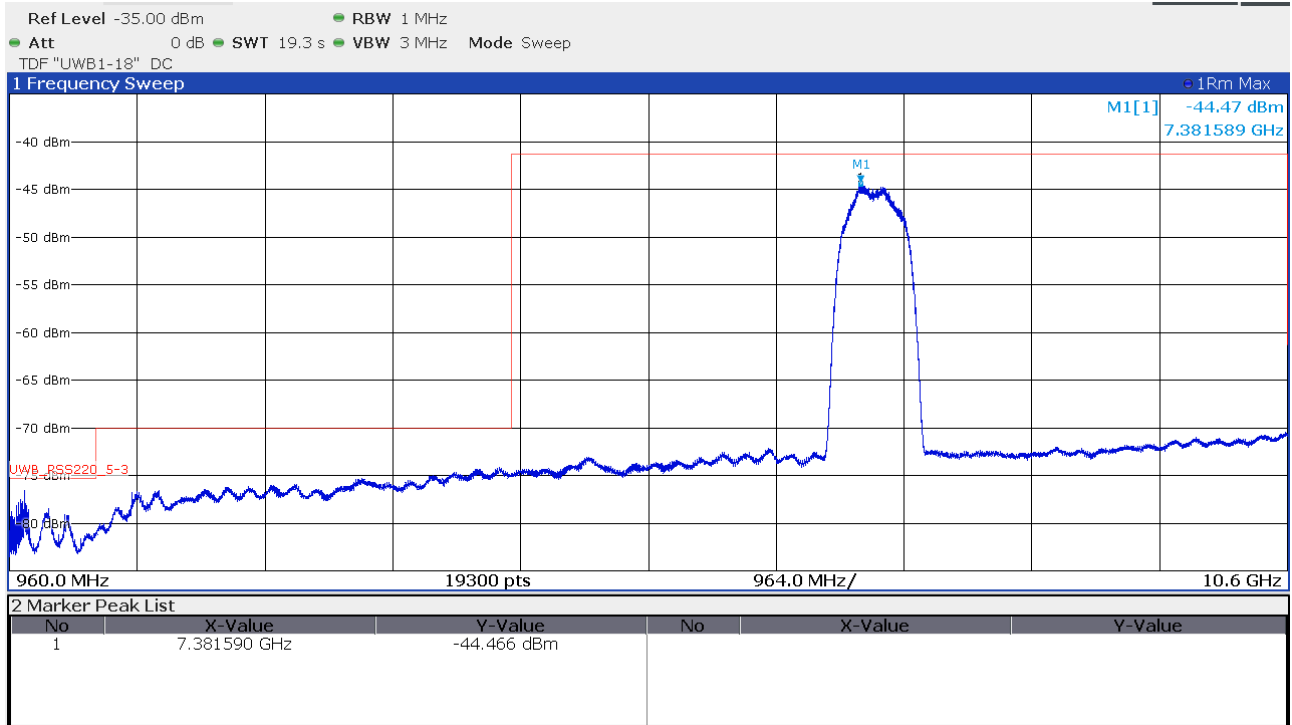
Mean Power



960 MHz to 18 GHz



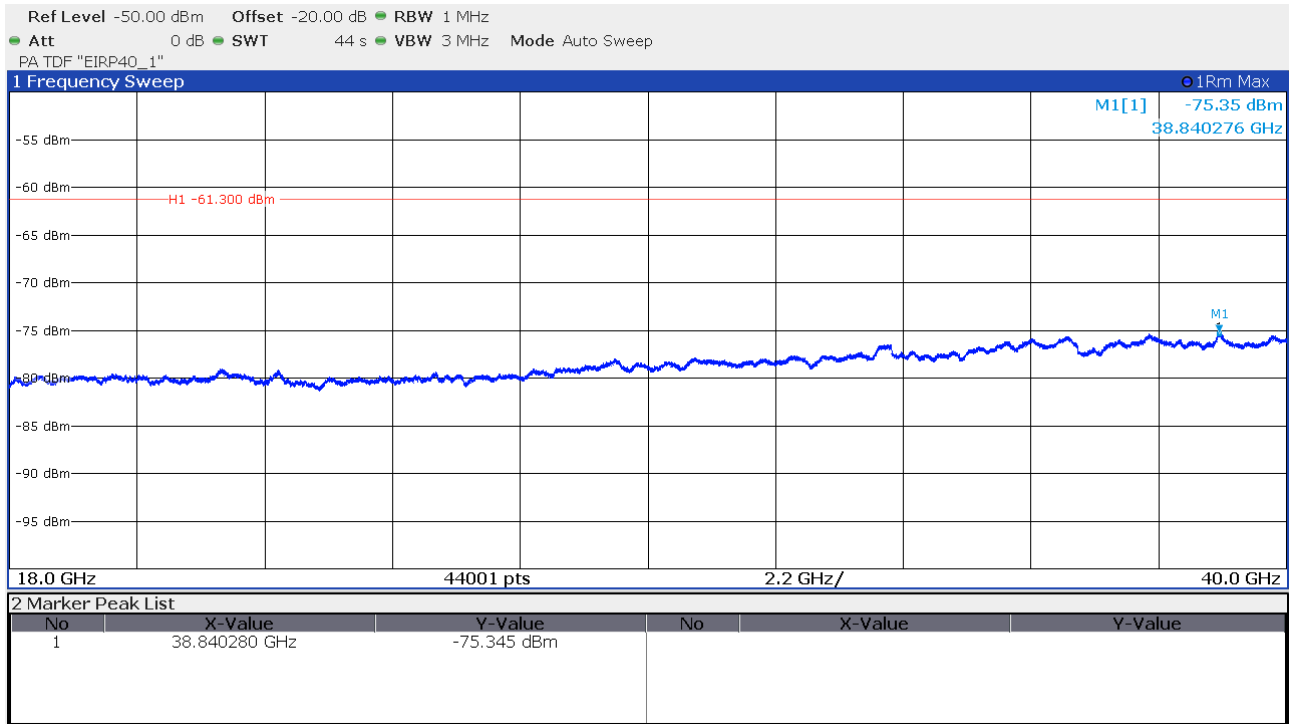
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The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

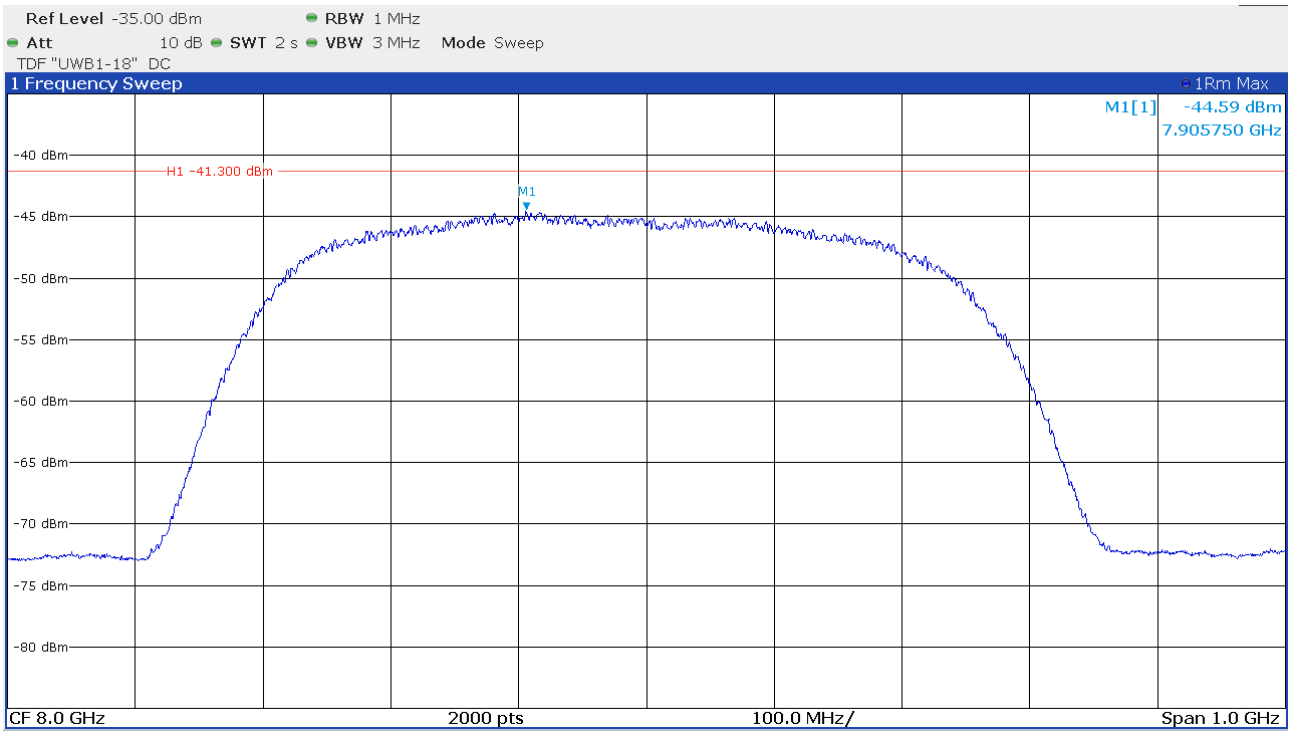


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

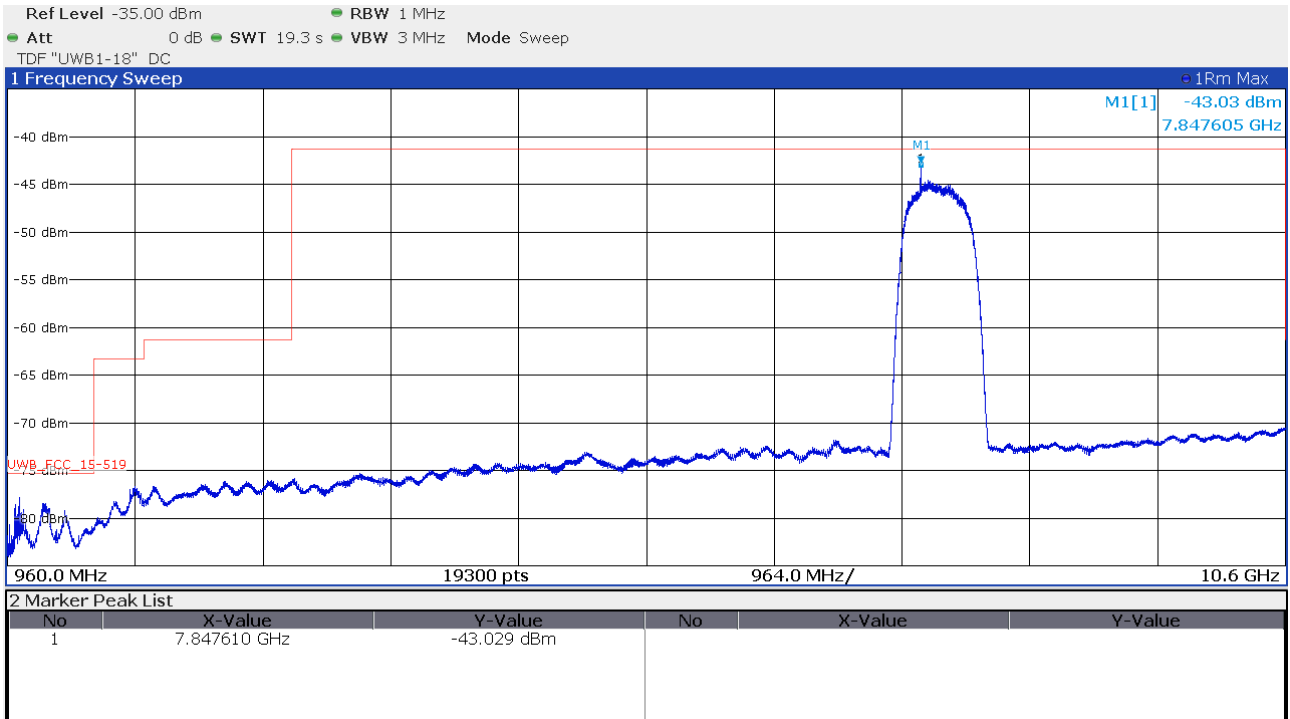
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Channel 9 antenna 1

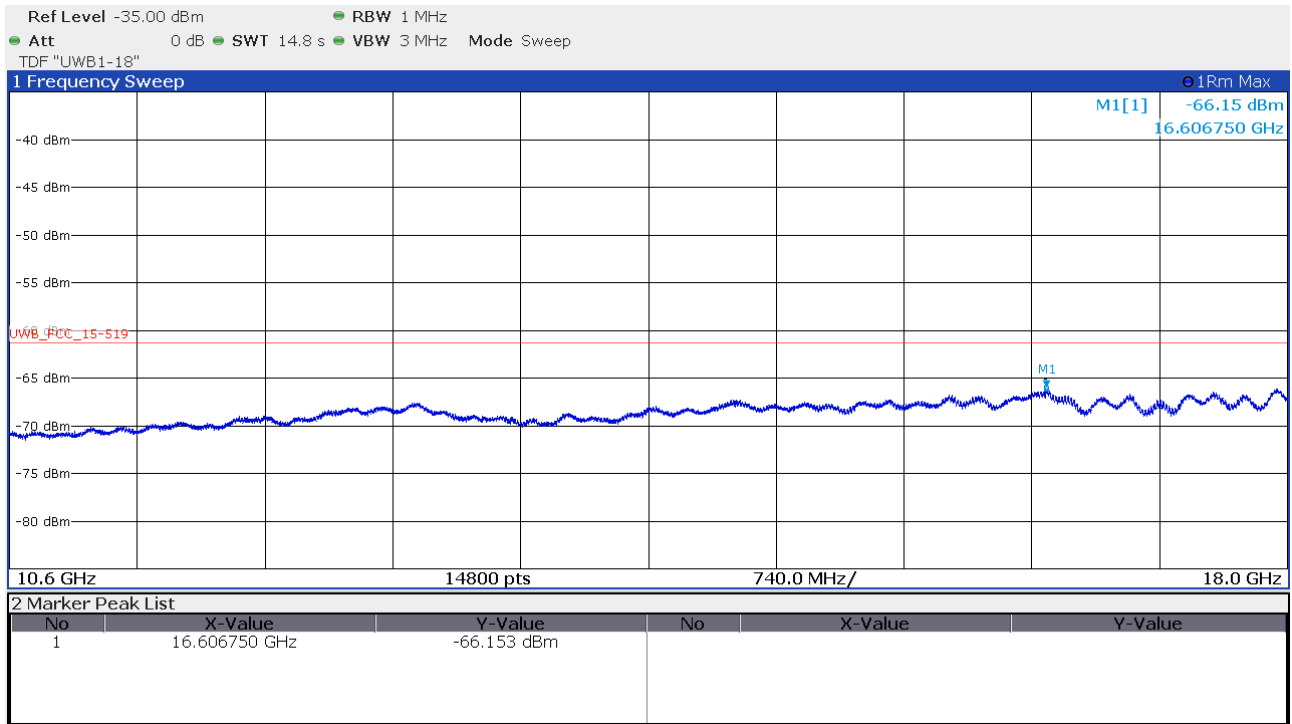
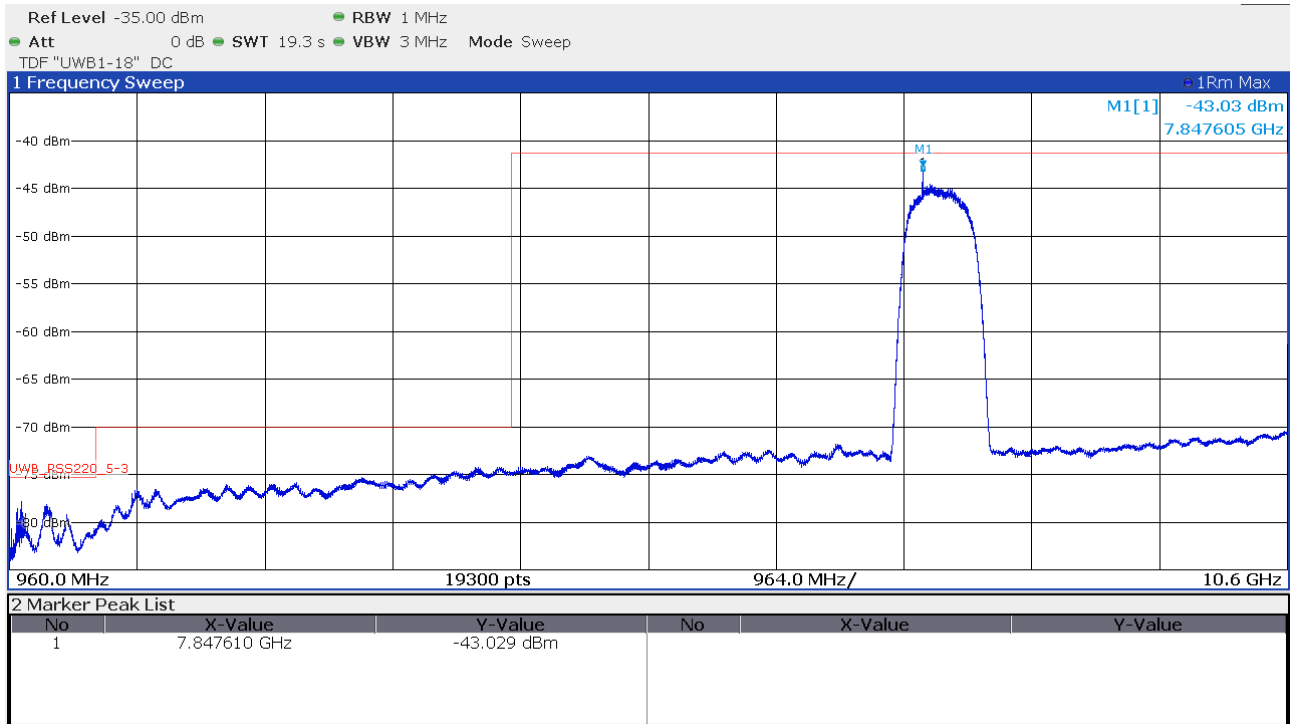
Mean Power



960 MHz to 18 GHz



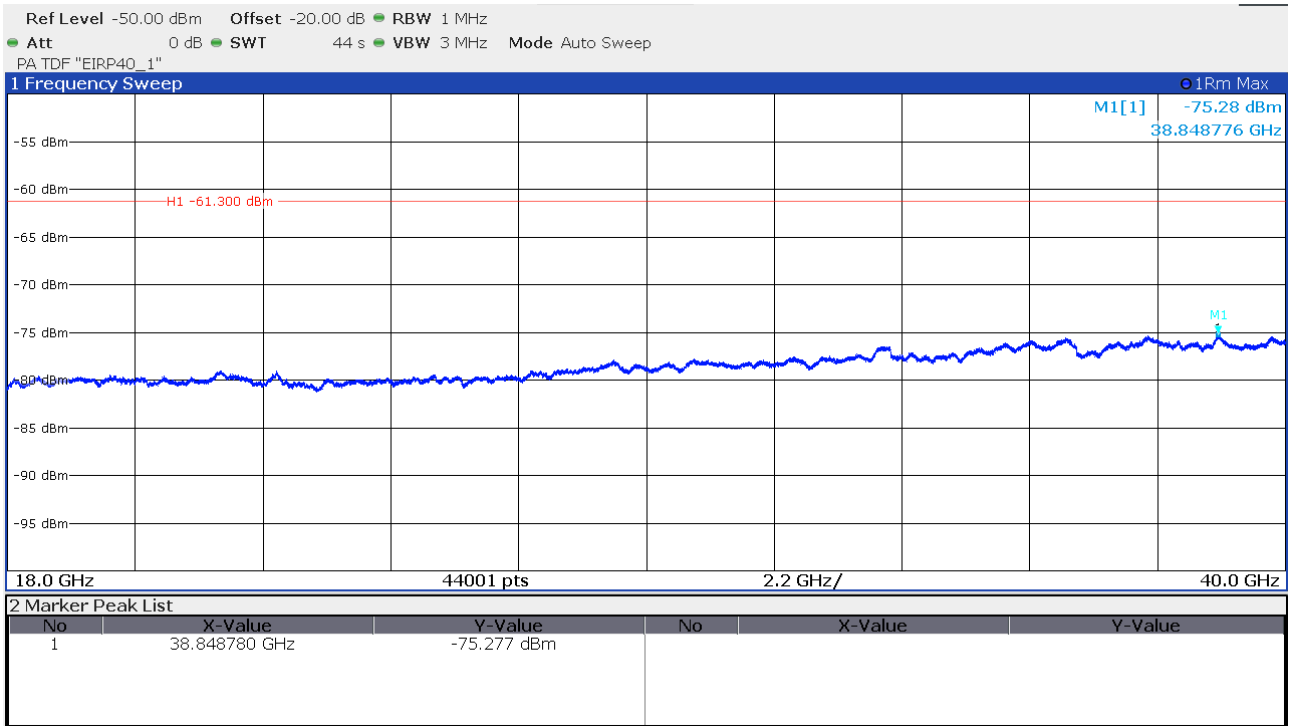
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance

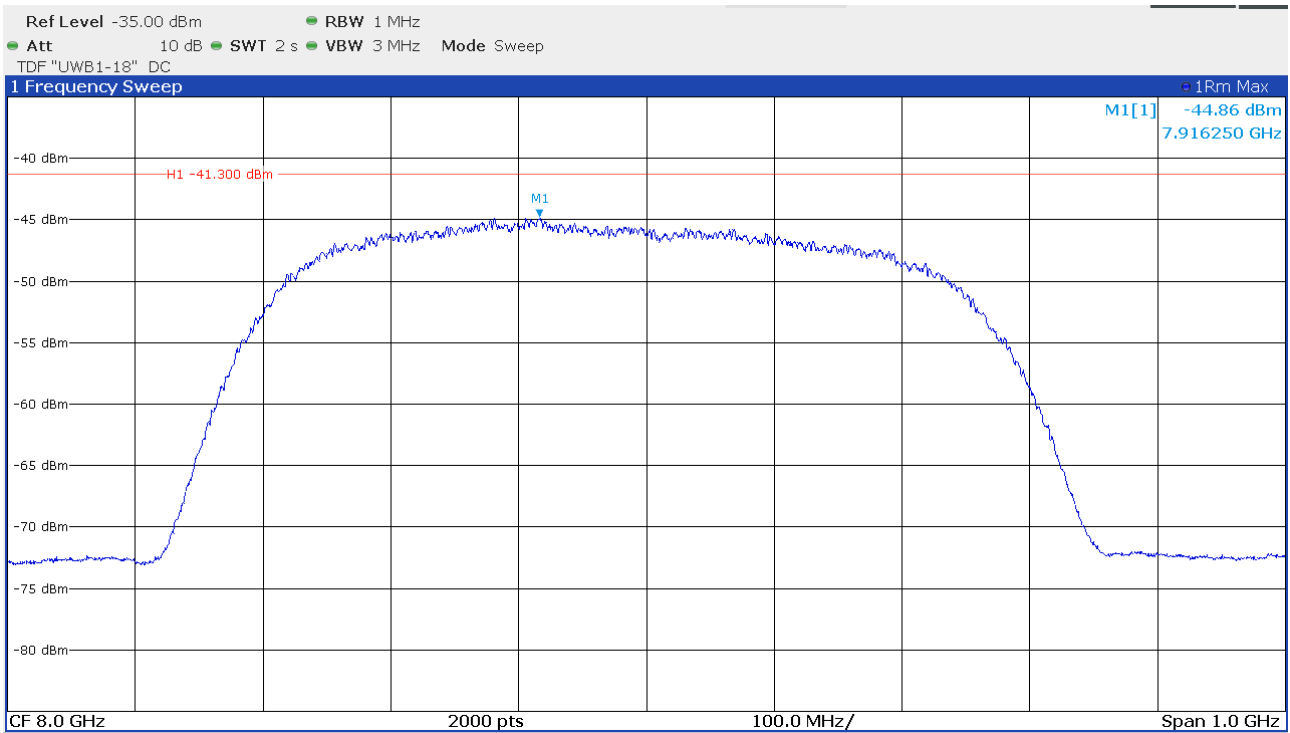


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

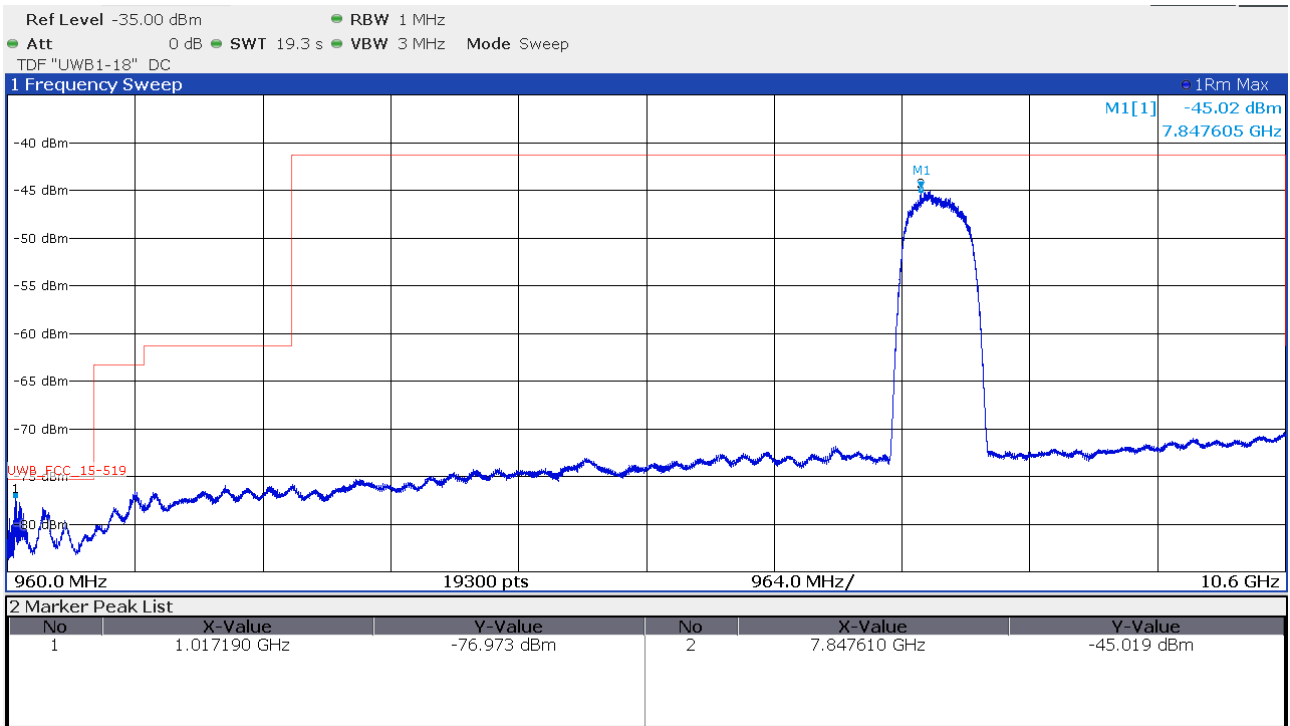
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 2

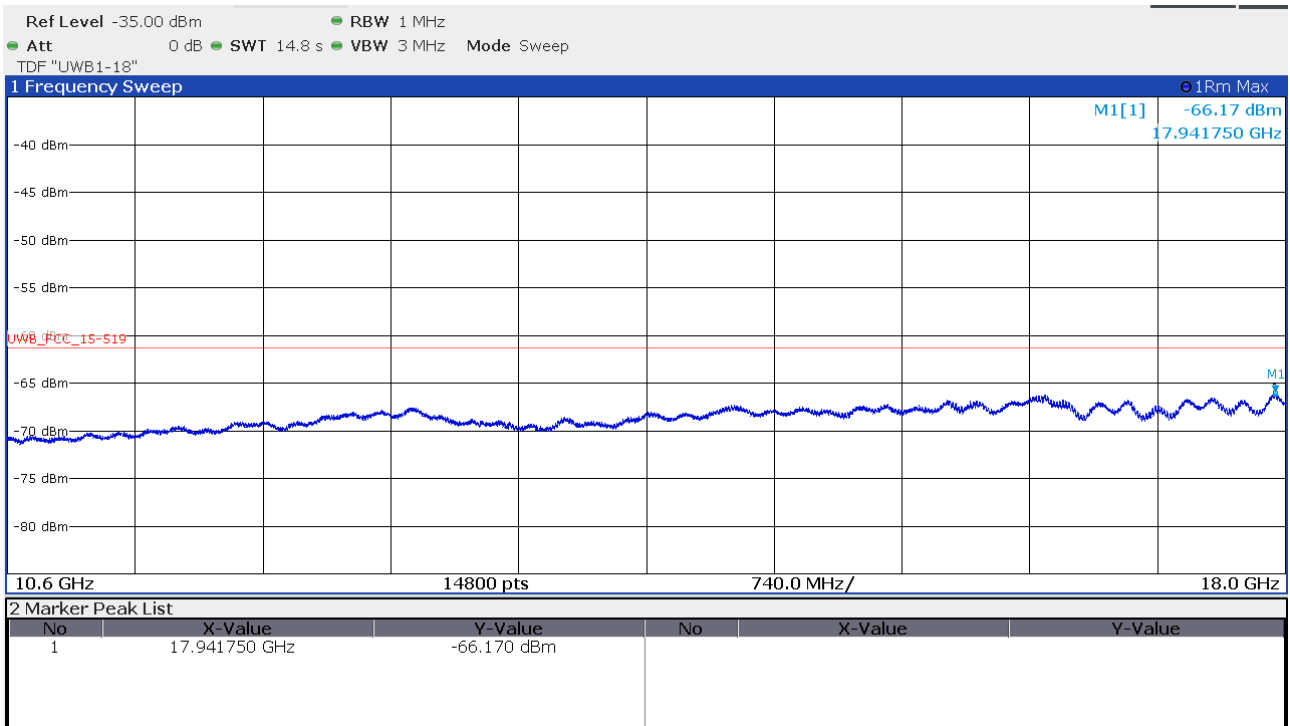
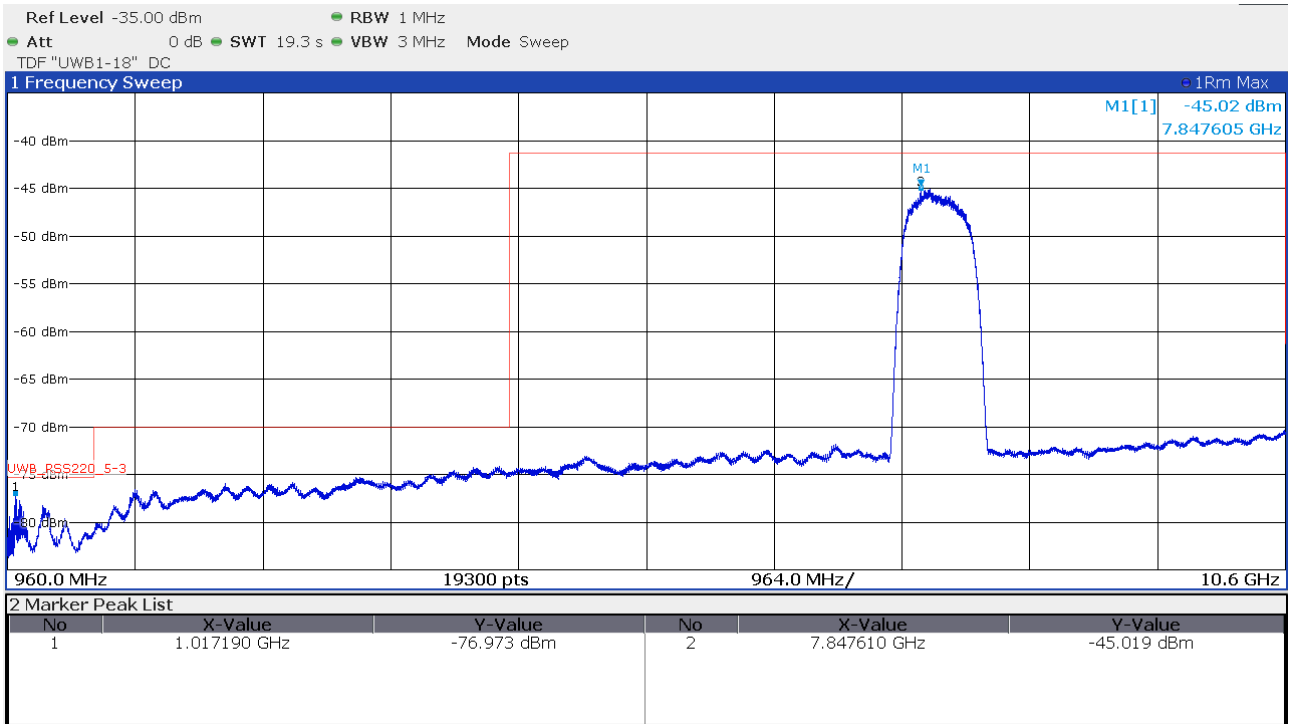
Mean Power



960 MHz to 18 GHz



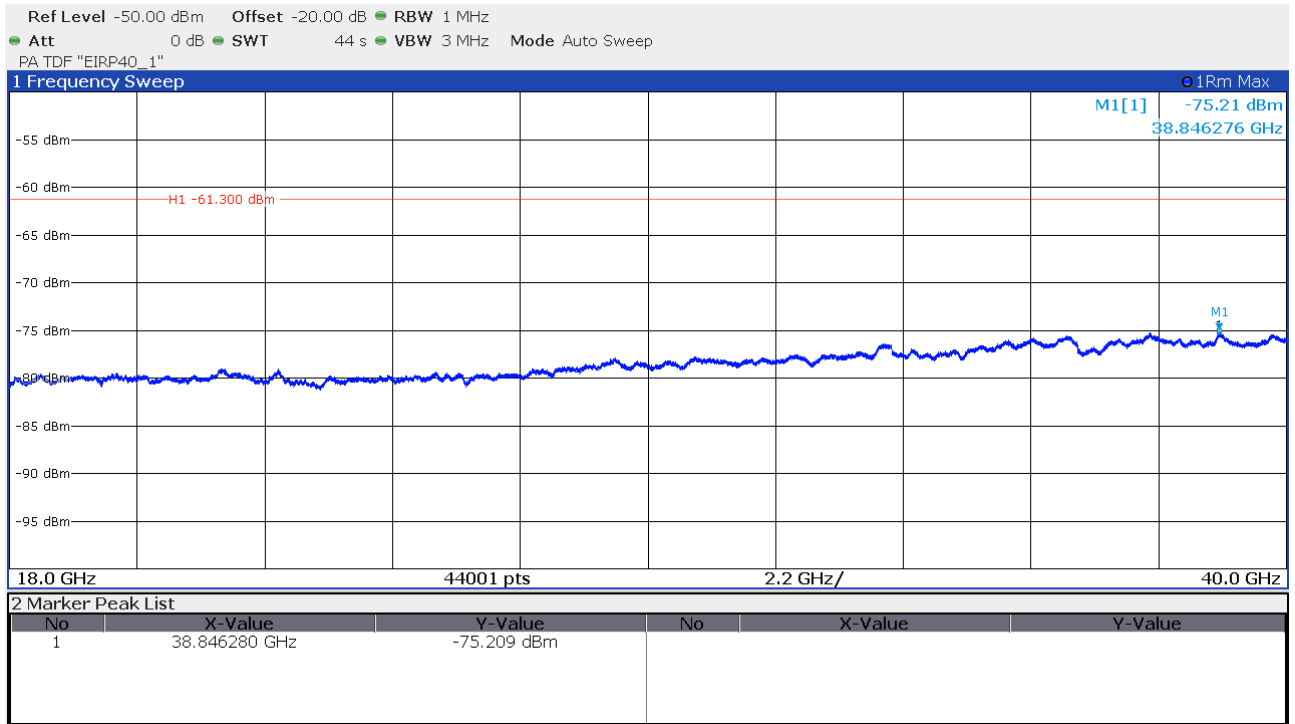
FCC ID: KR5FBD5 IC: 7812D-FBD5



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

18 GHz to 40 GHz at 10 cm distance



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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

Limits:

Limit according §15.209(a) in the frequency range 9 kHz 960 MHz:

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100** | 3 |
| 88-216 | 150** | 3 |
| 216-960 | 200** | 3 |
| Above 960 | 500 | 3 |

Limit according §15.519(c) in the frequency range 960 MHz to 40 GHz:

| Frequency in MHz | EIRP in dBm |
|------------------|-------------|
| 960-1610 | -75.3 |
| 1610-1990 | -63.3 |
| 1990-3100 | -61.3 |
| 3100-10600 | -41.3 |
| Above 10600 | -61.3 |

Limit according RSS-220 5.3.1 (d) in the frequency range 960 MHz to 40 GHz:

| Frequency in MHz | EIRP in dBm |
|------------------|-------------|
| 960-1610 | -75.3 |
| 1610-4750 | -70.0 |
| 4750-10600 | -41.3 |
| Above 10600 | -61.3 |

The requirements are **FULFILLED**.

Remarks: None.

FCC ID: KR5FBD5 IC: 7812D-FBD5

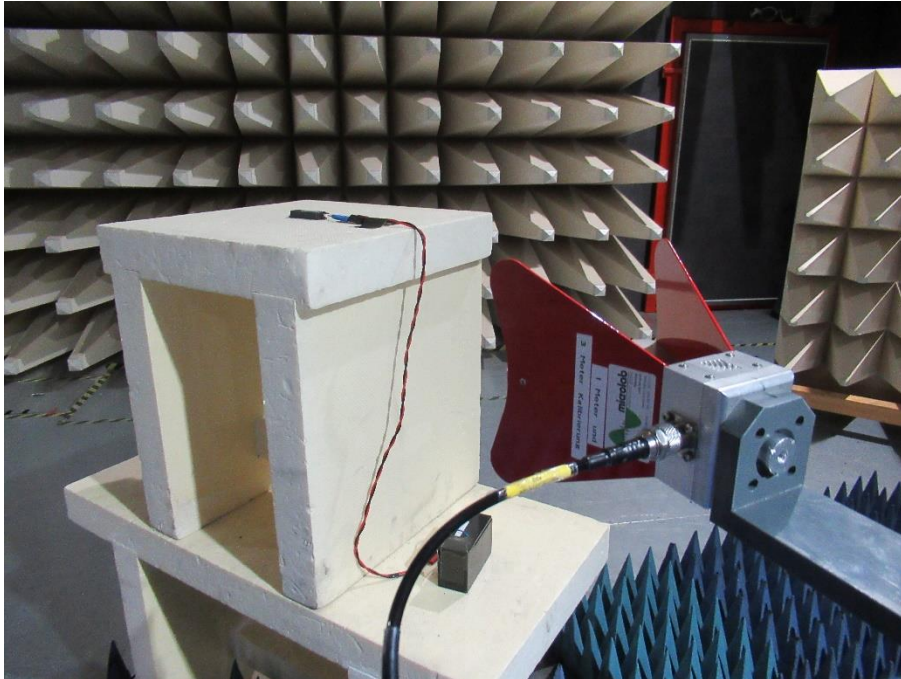
5.4 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz

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

5.4.1 Description of the test location

Test location: Anechoic chamber 1

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15, Section 15.519(d):

In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz.

5.4.4 Analyser settings

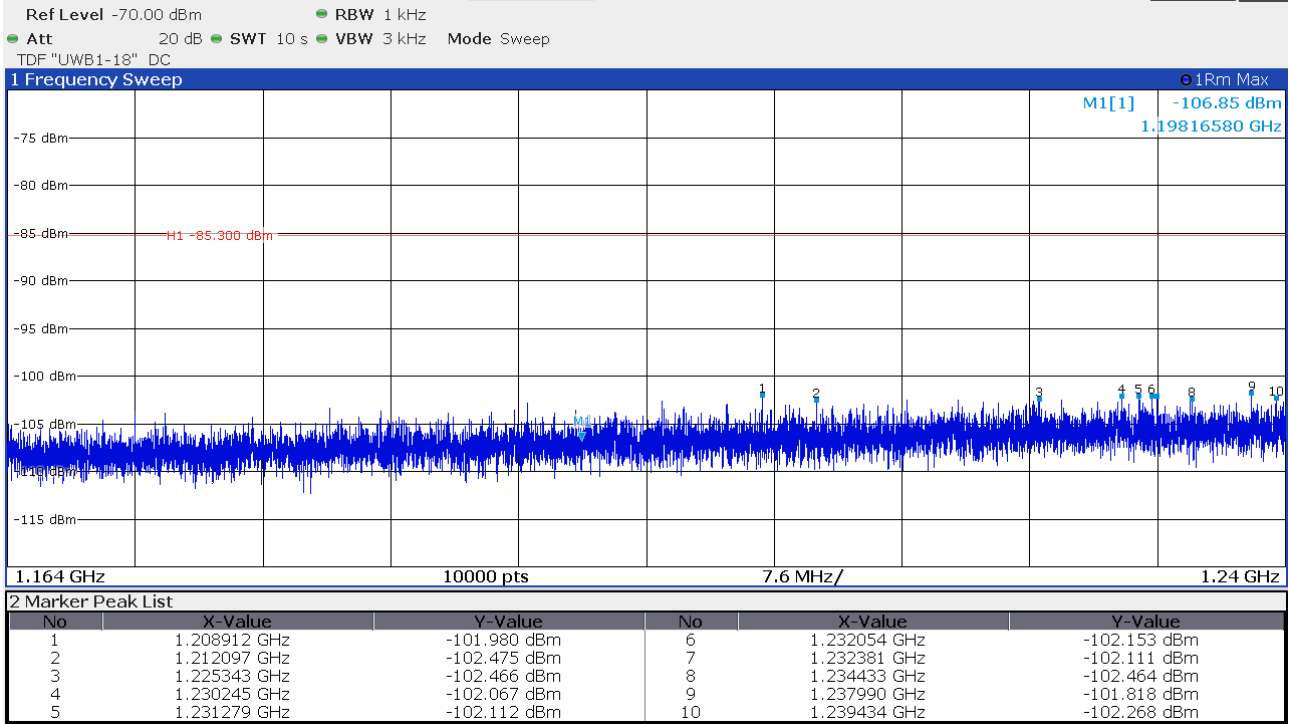
RBW: 1 kHz, VBW: 3 kHz, Detector: RMS, Sweep time: 1 ms/1kHz,

FCC ID: KR5FBD5 IC: 7812D-FBD5

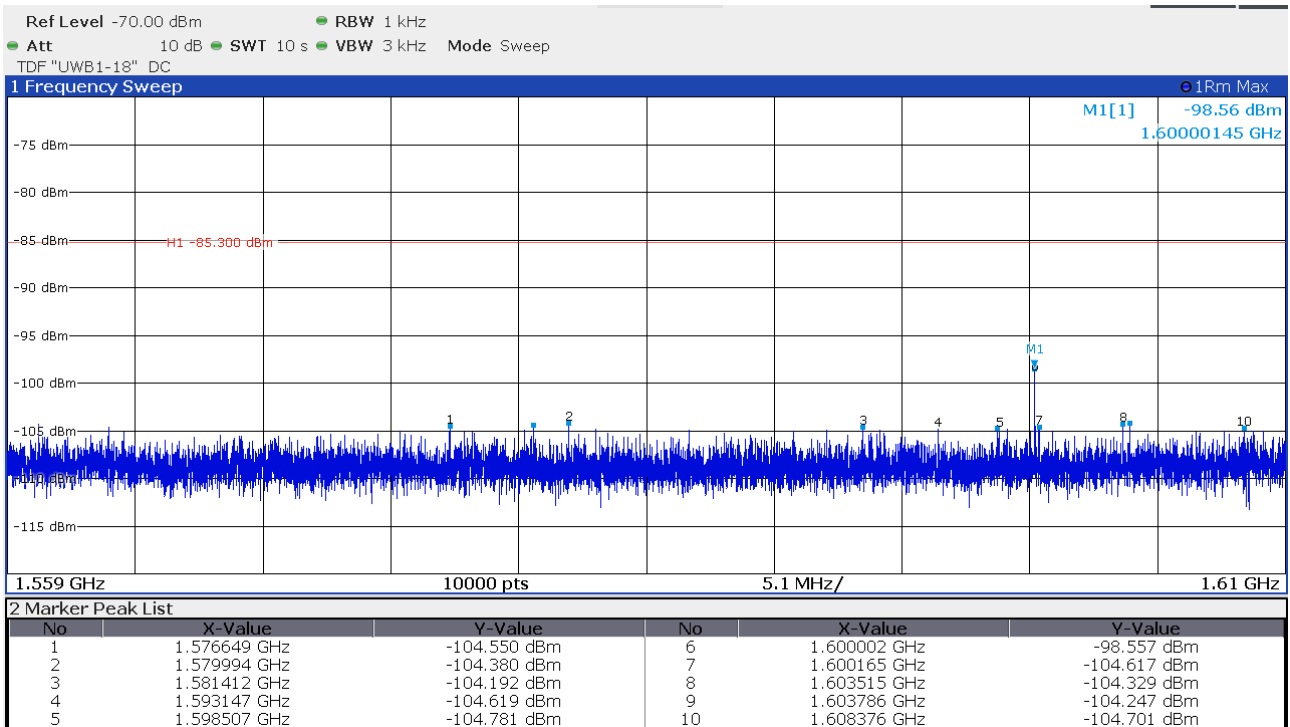
5.4.5 Test result

Channel 5 antenna 1

1164 MHz to 1240 MHz



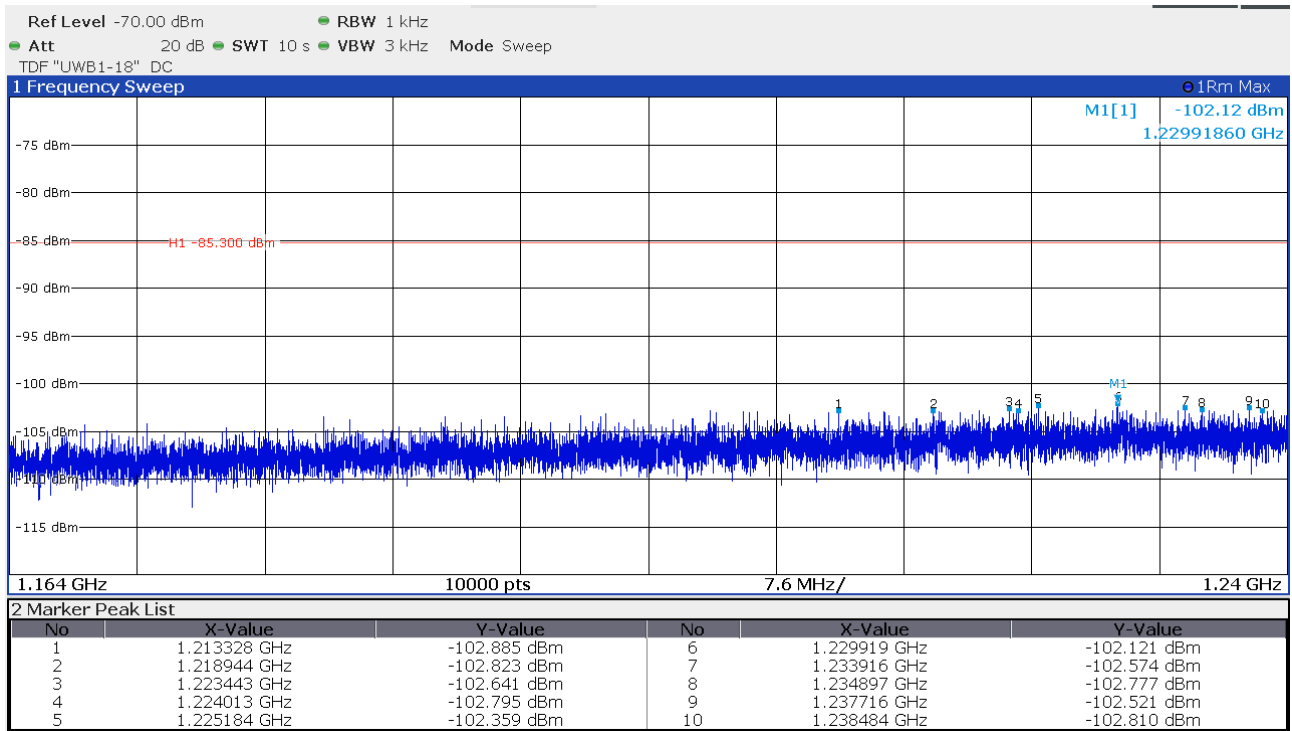
1559 MHz to 1610 MHz



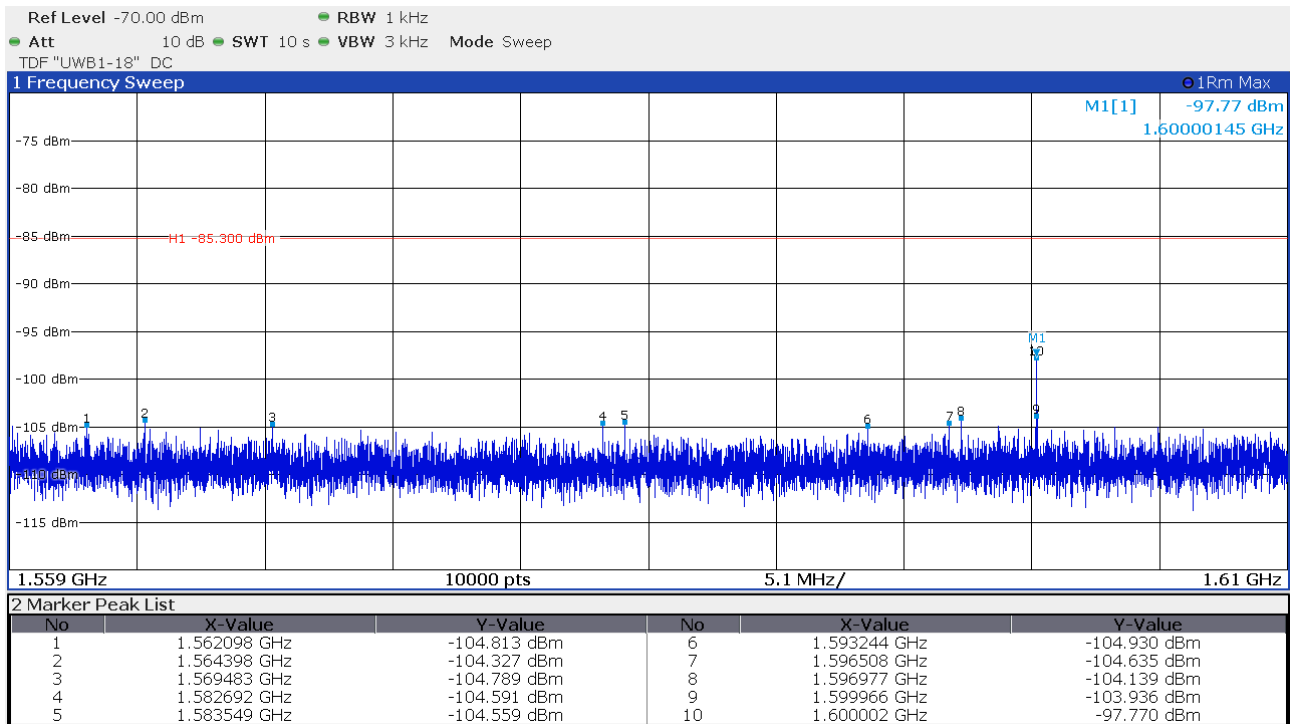
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 5 antenna 2

1164 MHz to 1240 MHz



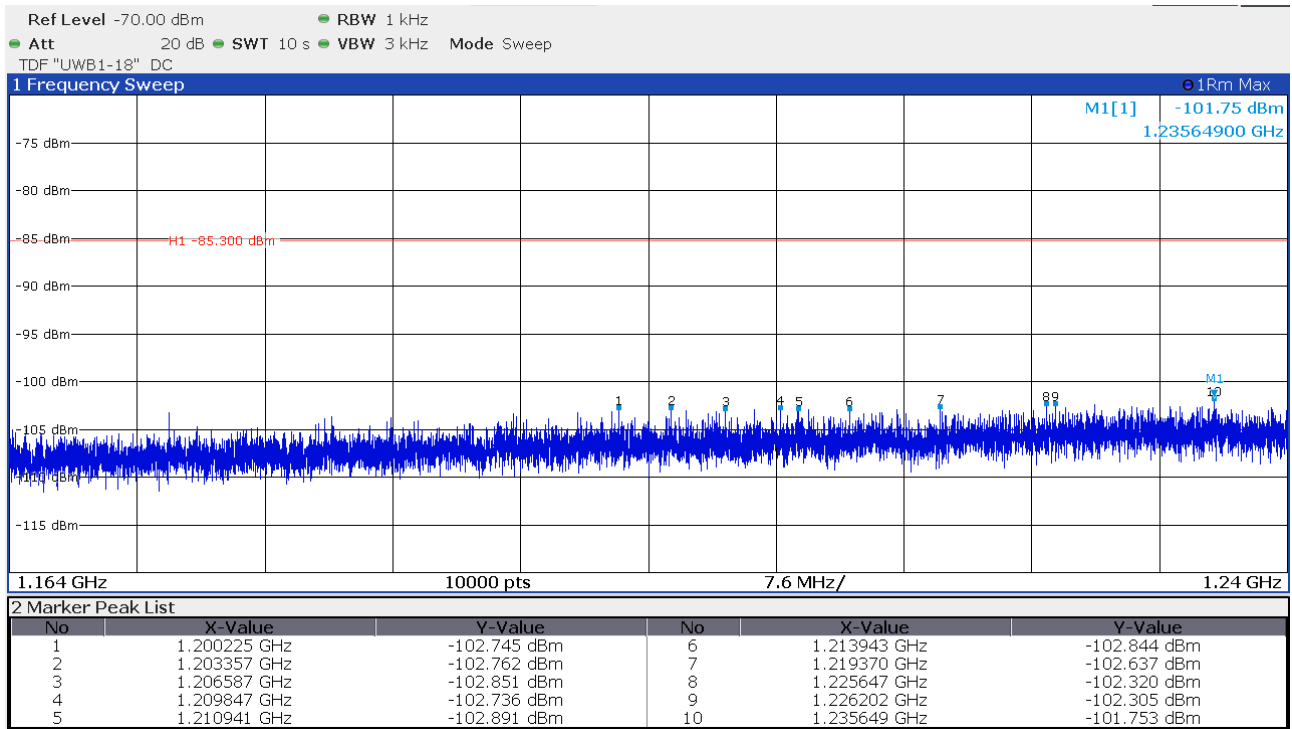
1559 MHz to 1610 MHz



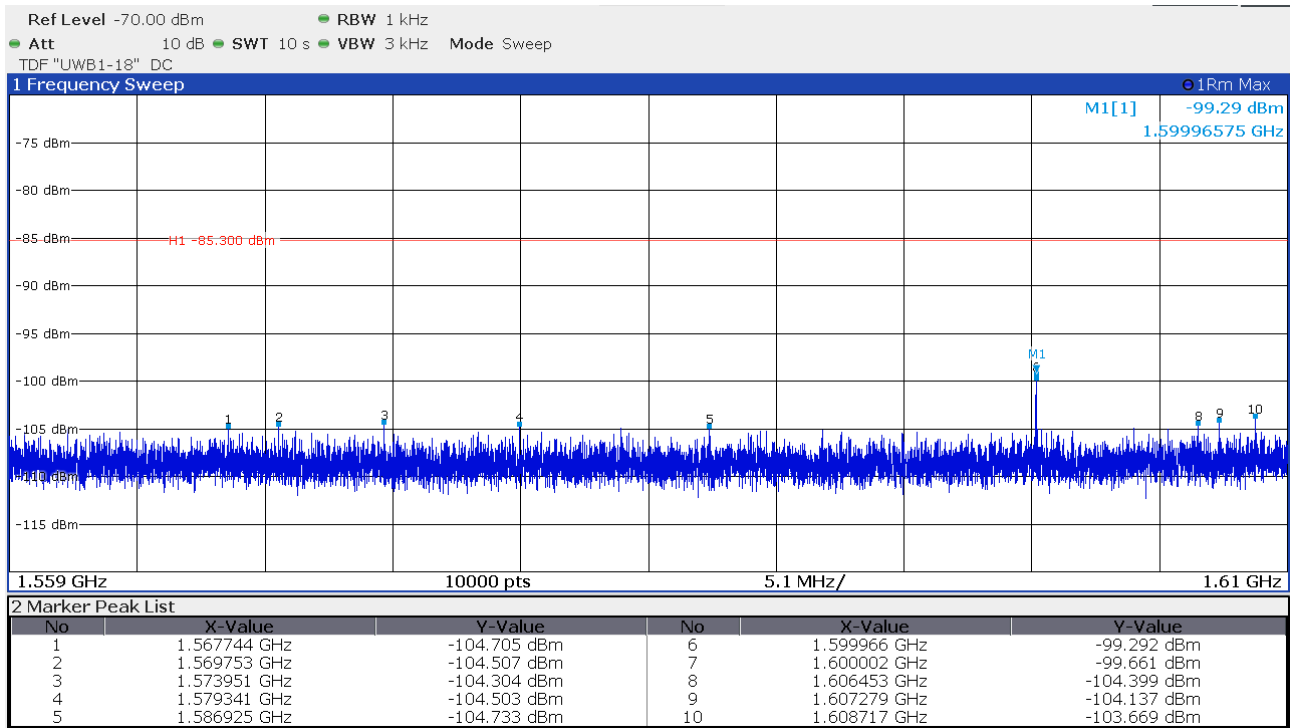
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 6 antenna 1

1164 MHz to 1240 MHz



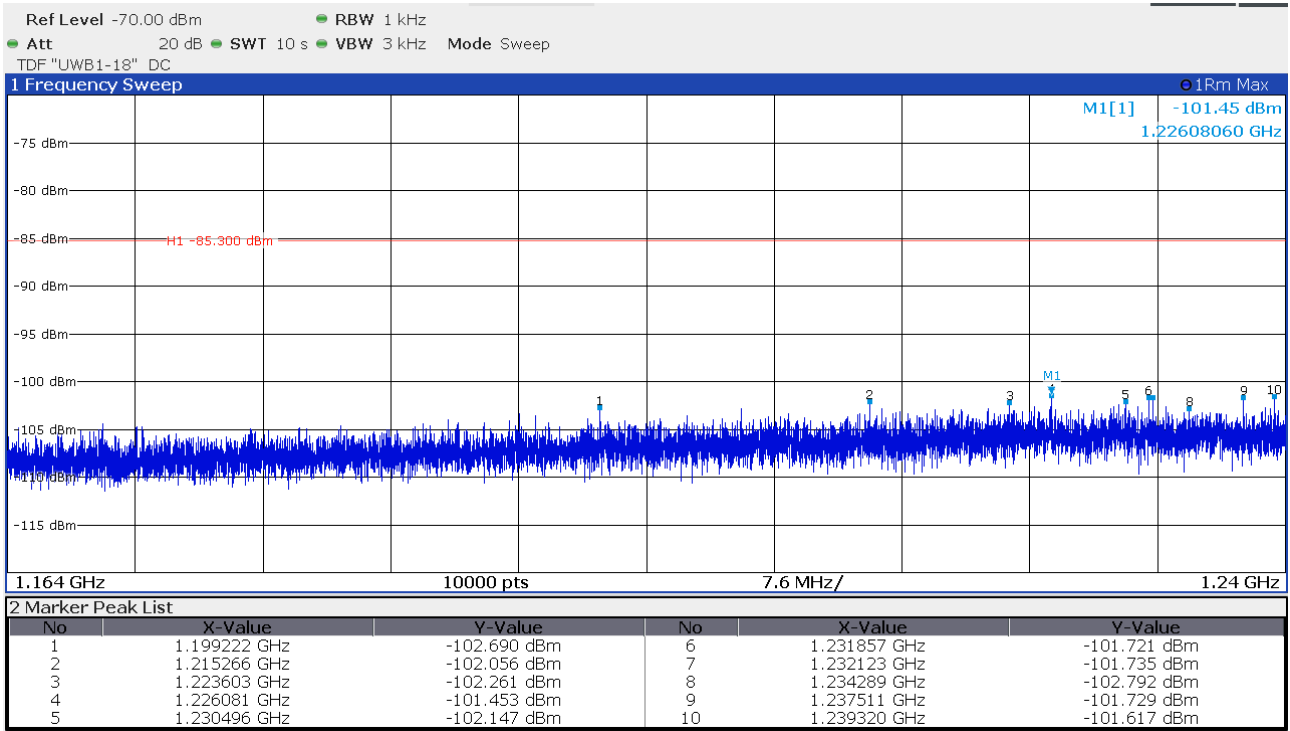
1559 MHz to 1610 MHz



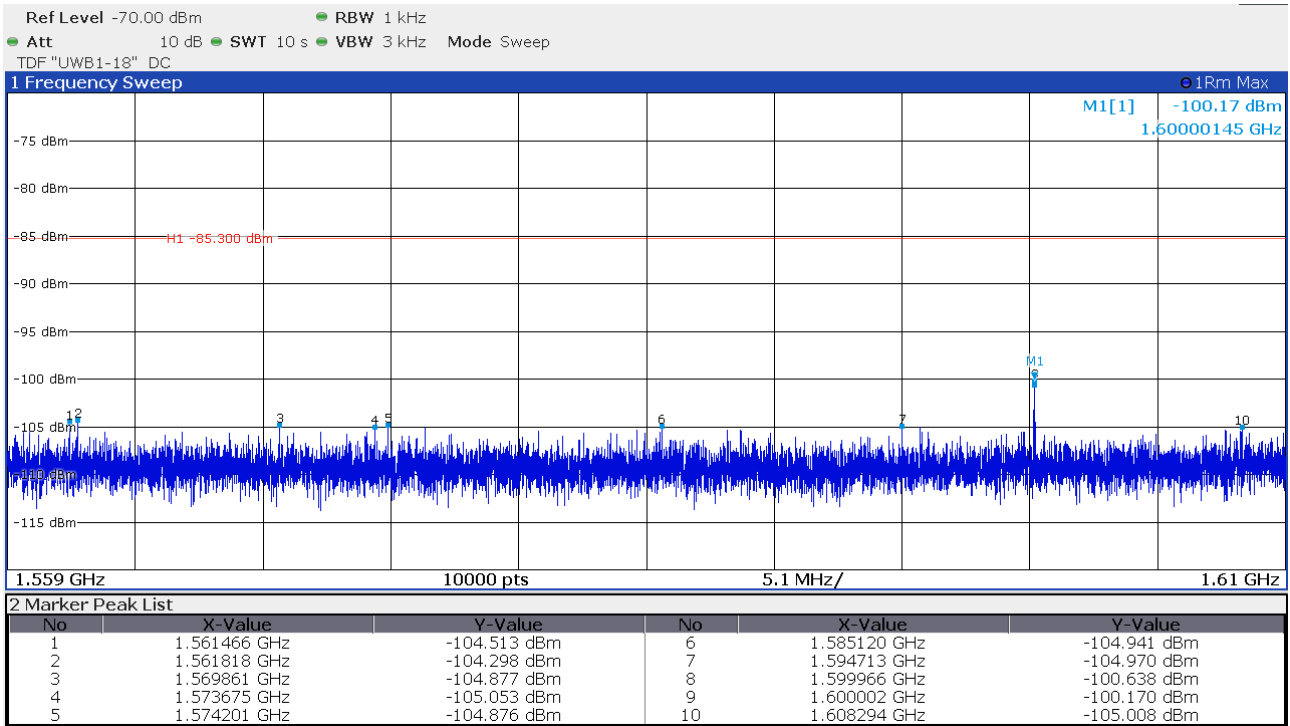
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 6 antenna 2

1164 MHz to 1240 MHz



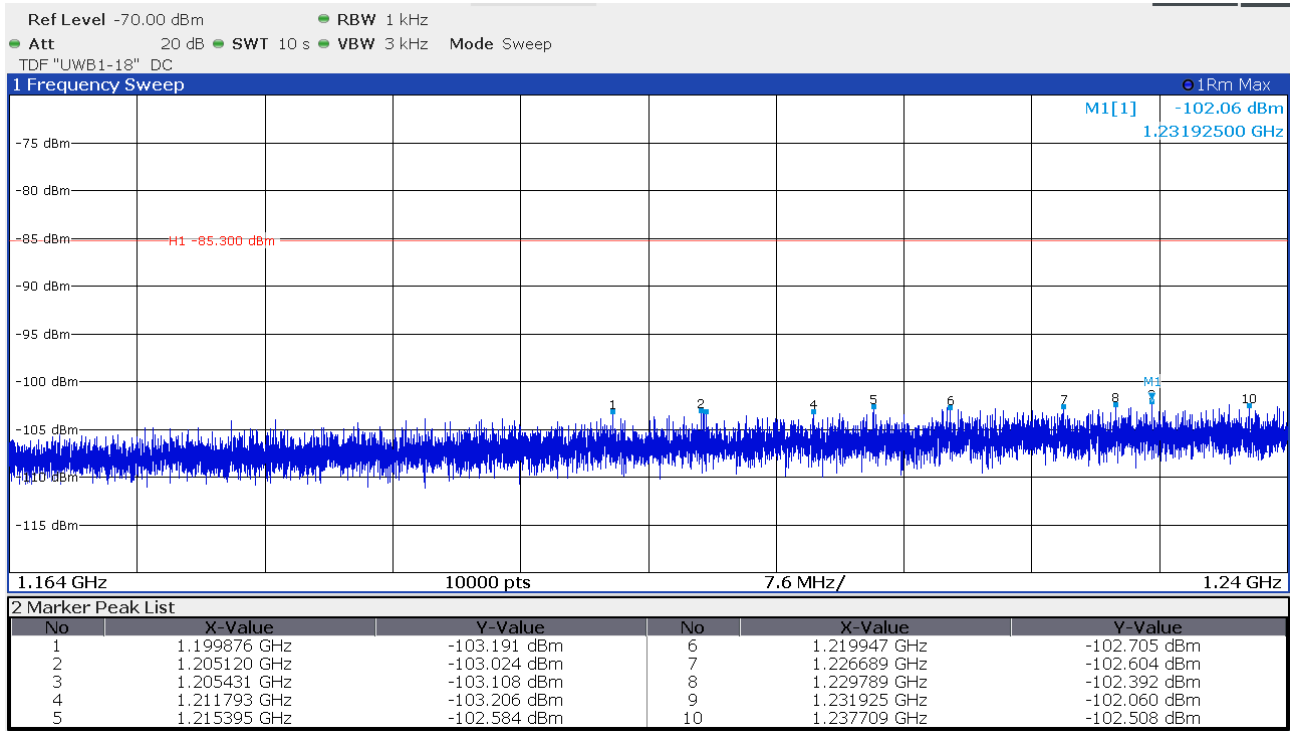
1559 MHz to 1610 MHz



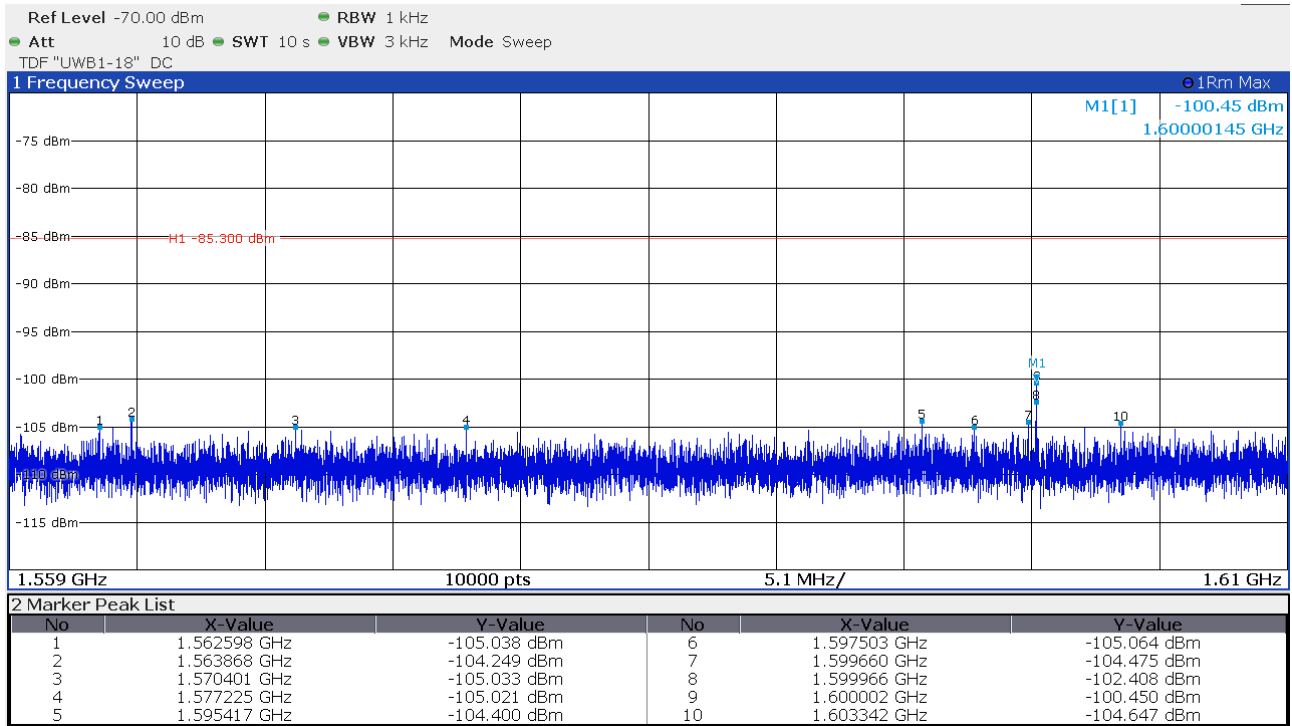
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 1

1164 MHz to 1240 MHz



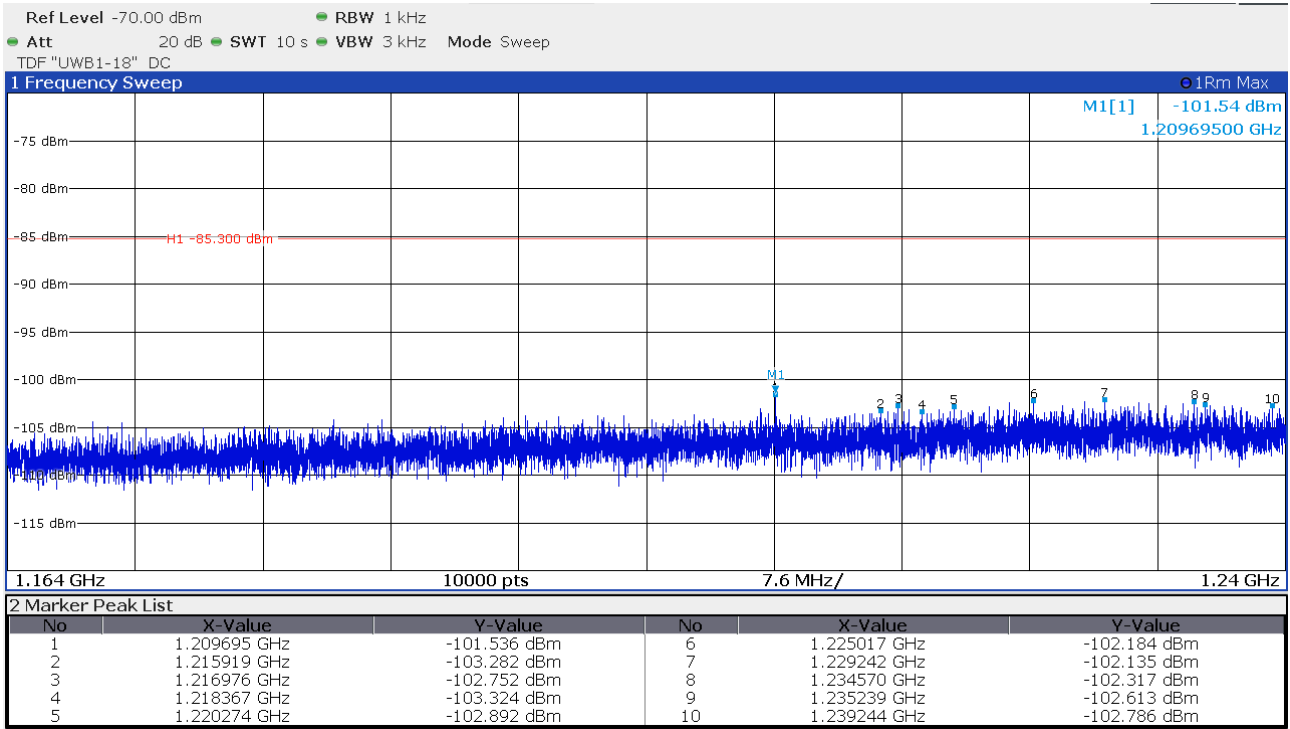
1559 MHz to 1610 MHz



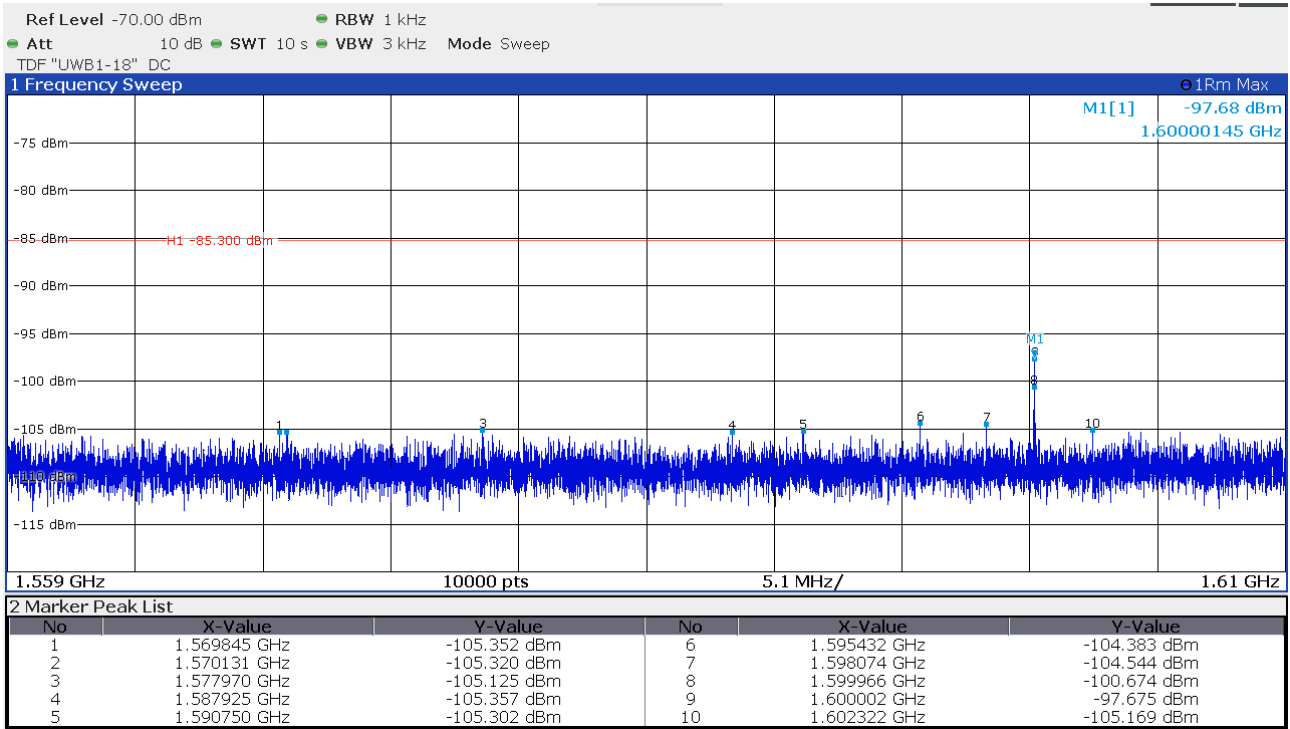
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 2

1164 MHz to 1240 MHz



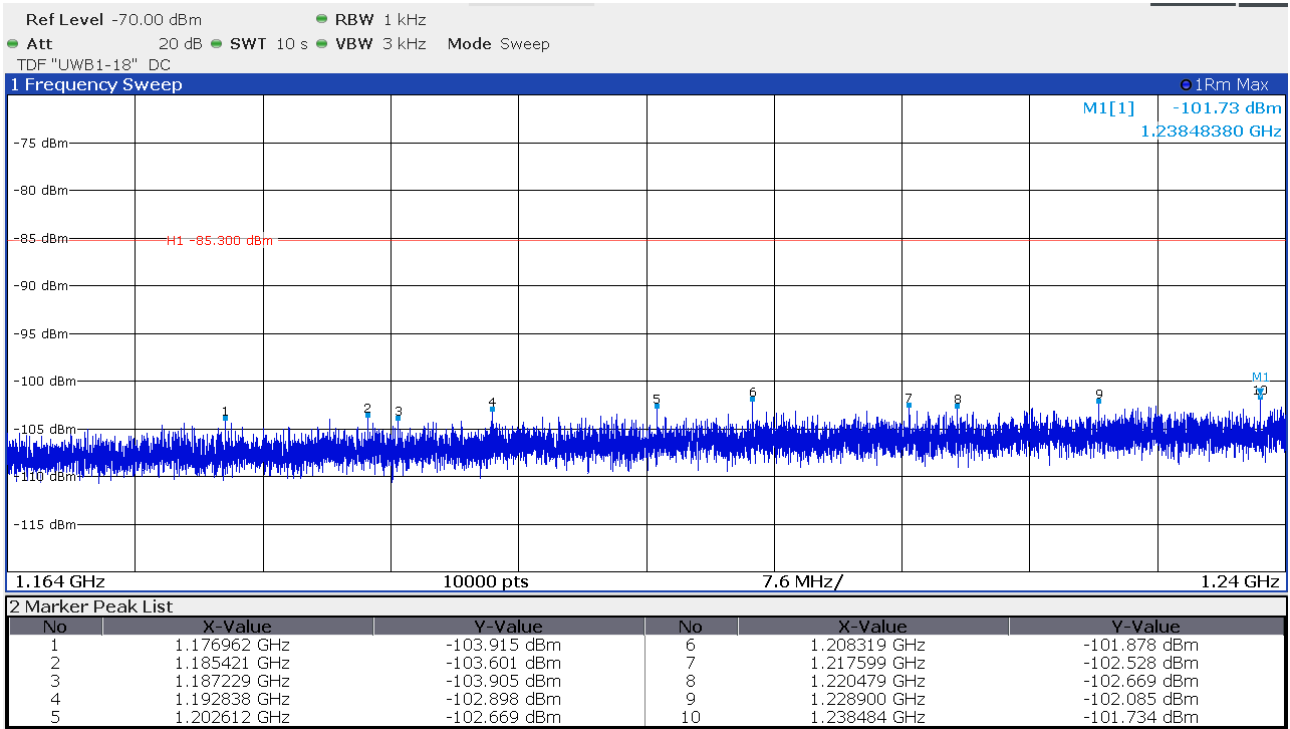
1559 MHz to 1610 MHz



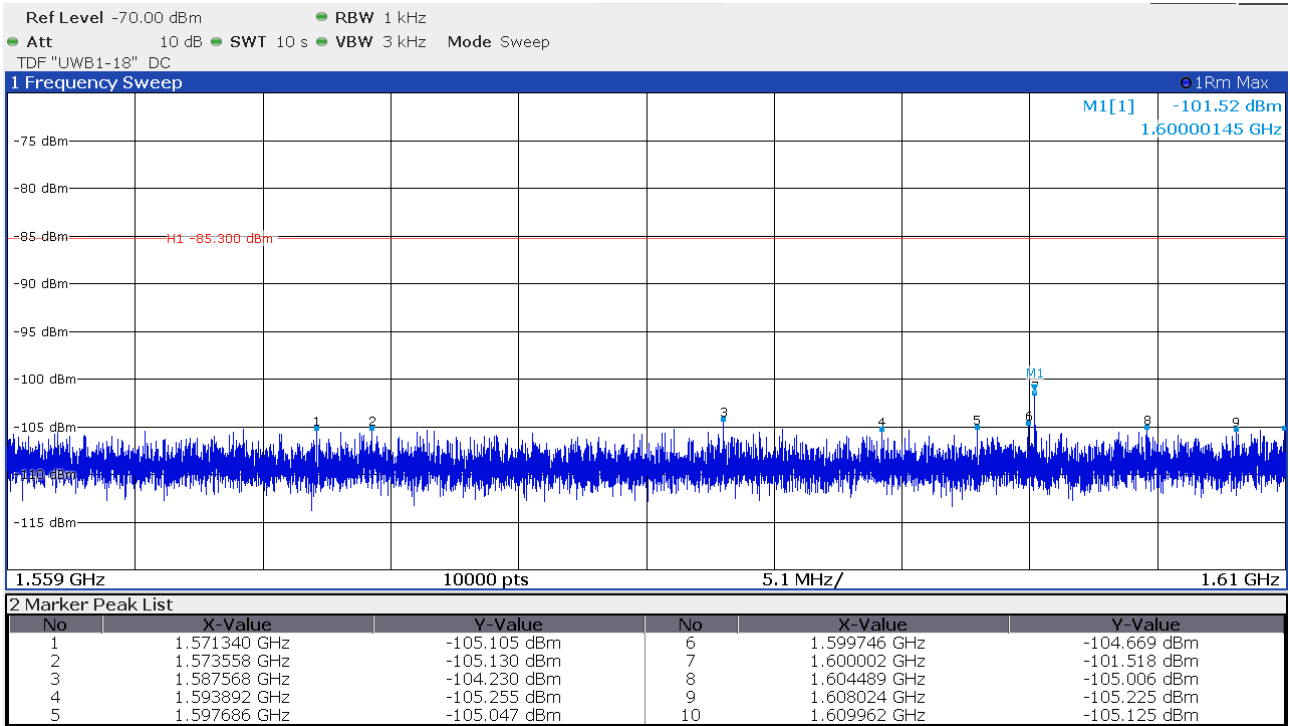
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 1

1164 MHz to 1240 MHz



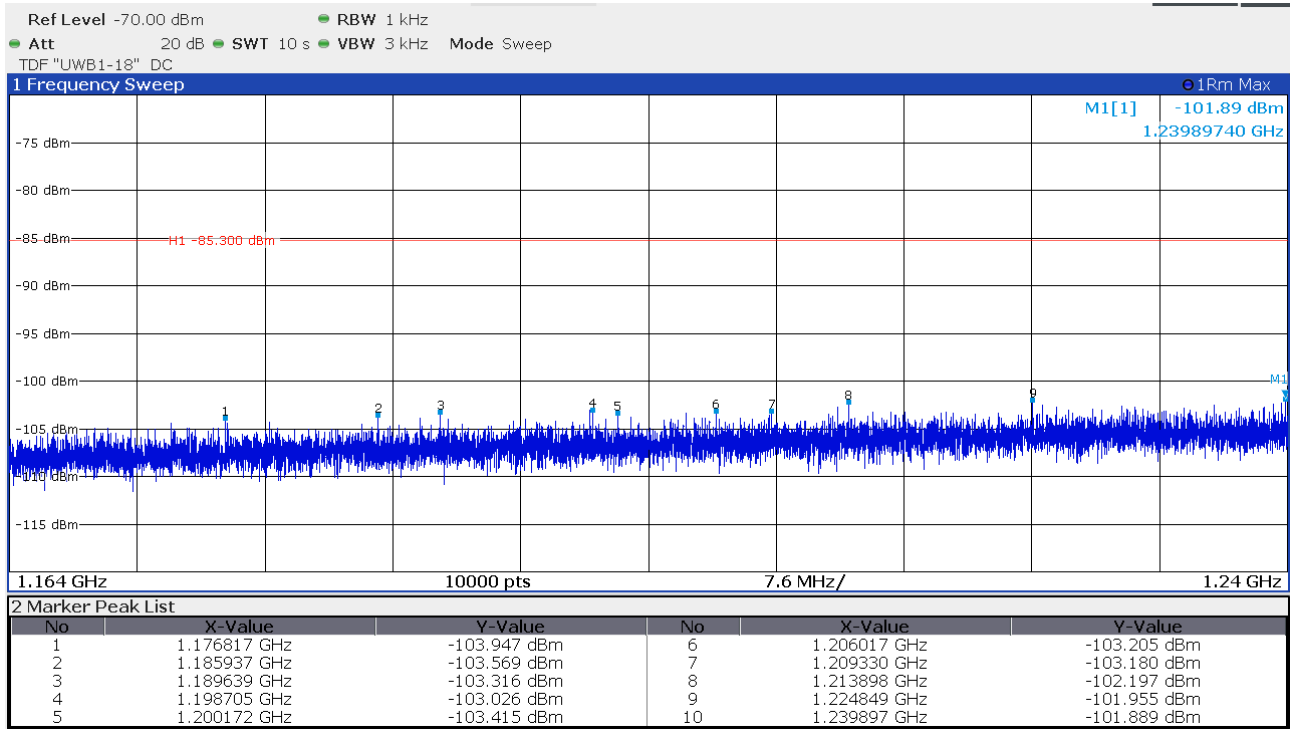
1559 MHz to 1610 MHz



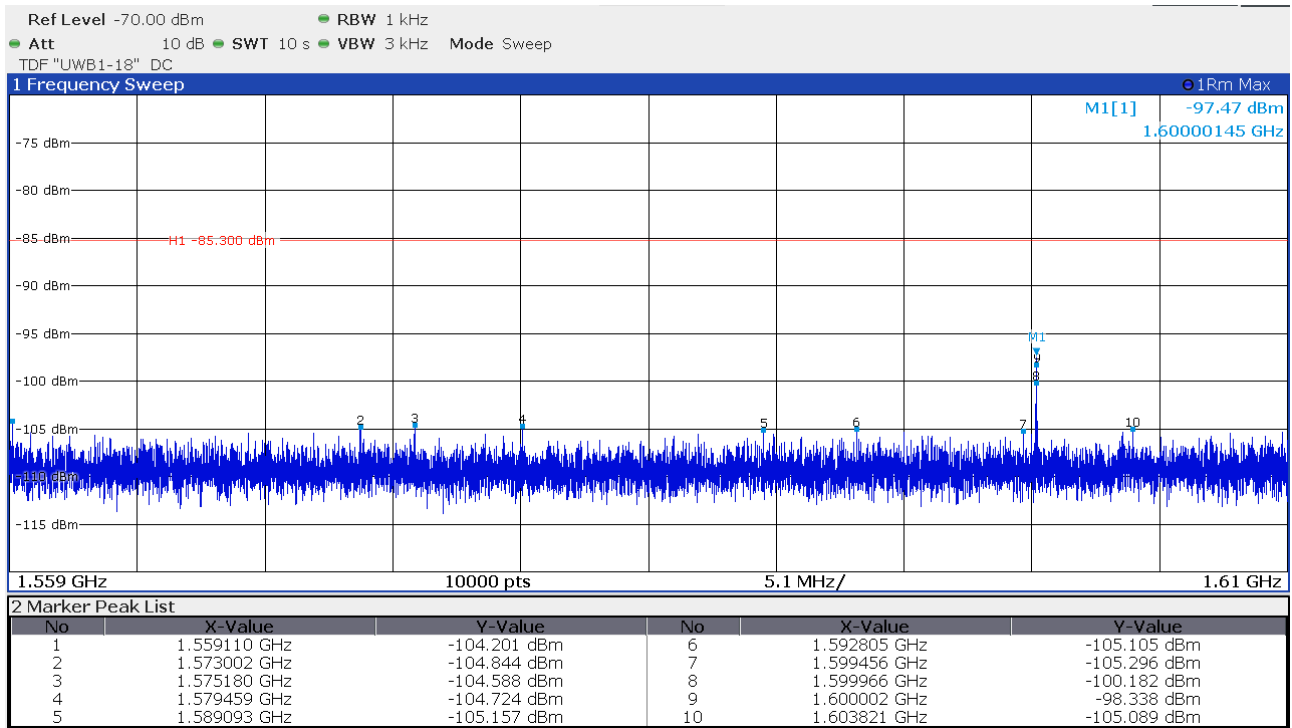
FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 2

1164 MHz to 1240 MHz



1559 MHz to 1610 MHz



FCC ID: KR5FBD5 IC: 7812D-FBD5

Limit according §15.519(c) in the frequency

| Frequency in MHz | EIRP in dBm |
|------------------|-------------|
| 1164-1240 | -85.3 |
| 1559-1610 | -85.3 |

The requirements are **FULFILLED**.

Remarks: The test graphs show the polarisation with the lowest margin to the limit (horizontal polarisation).

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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

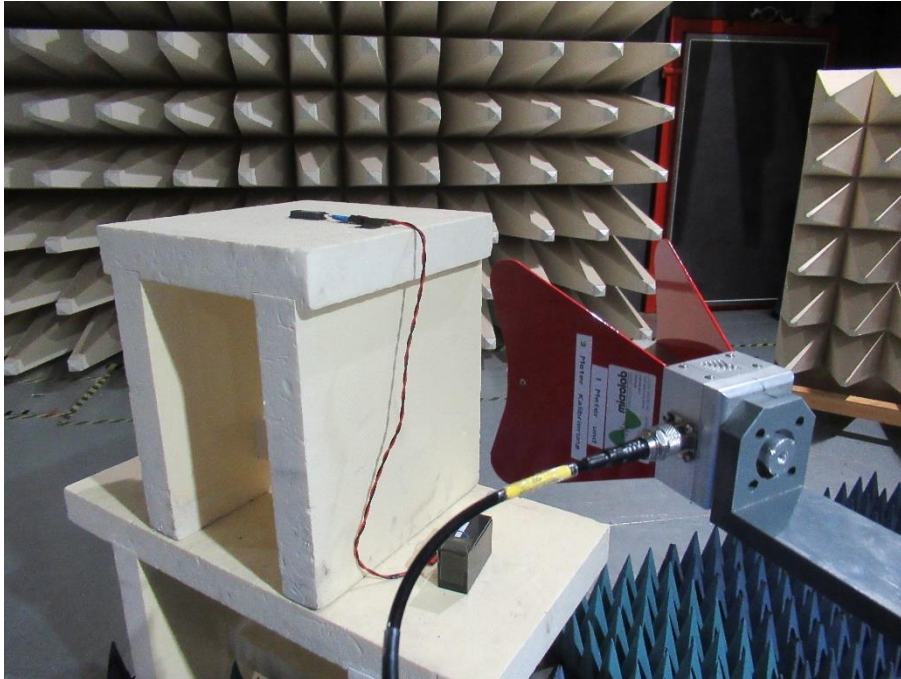
5.5 Peak Power radiated

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

5.5.1 Description of the test location

Test location: Anechoic chamber 1

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15, Section 15.519(e):

There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_m . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

5.5.4 Analyser settings

RBW: 50 MHz, VBW: 80 MHz, Detector: Peak, Trace Mode: Max hold

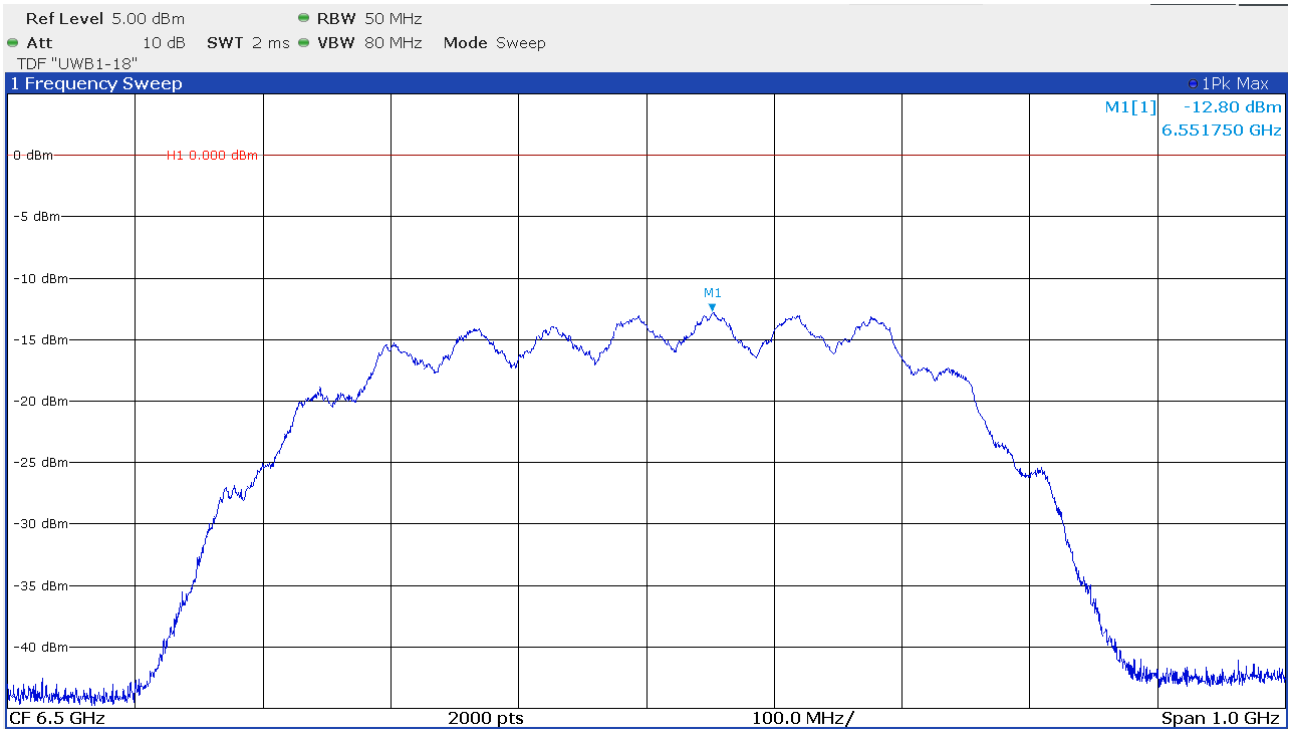
FCC ID: KR5FBD5 IC: 7812D-FBD5

5.5.5 Test result

Channel 5 antenna 1

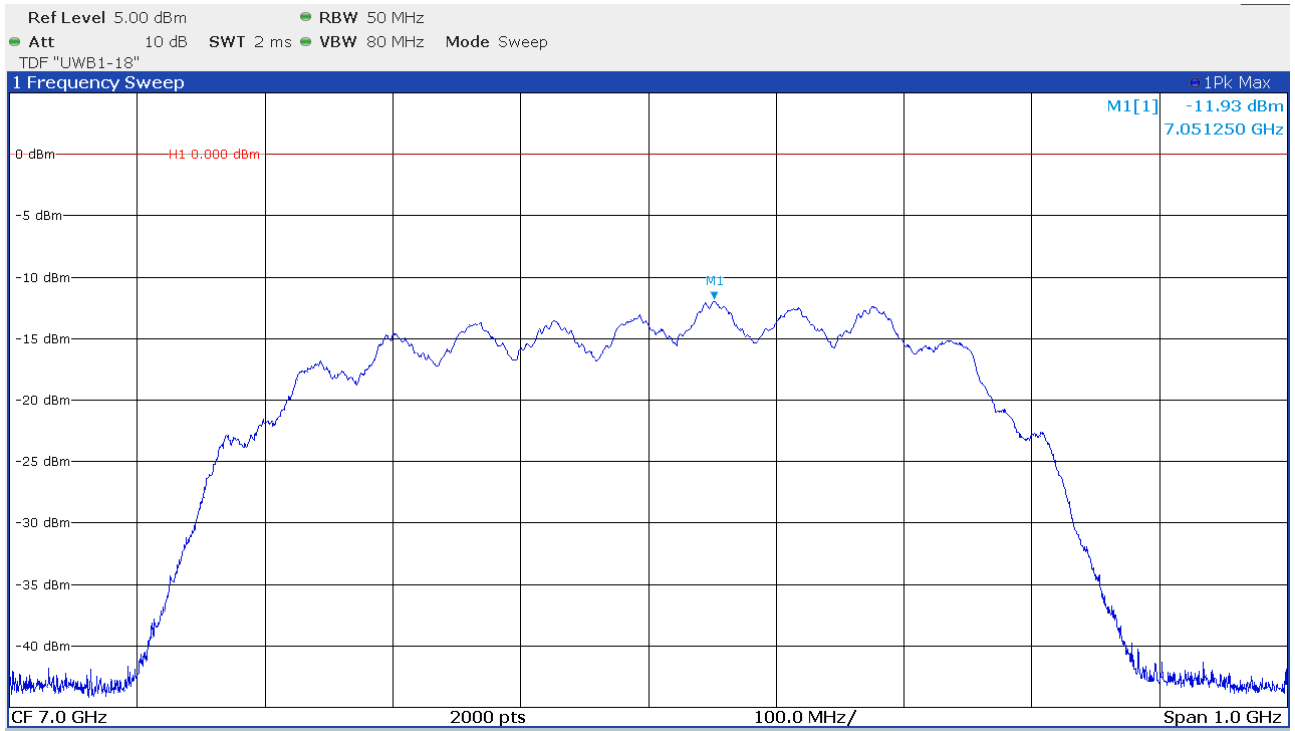


Channel 5 antenna 2

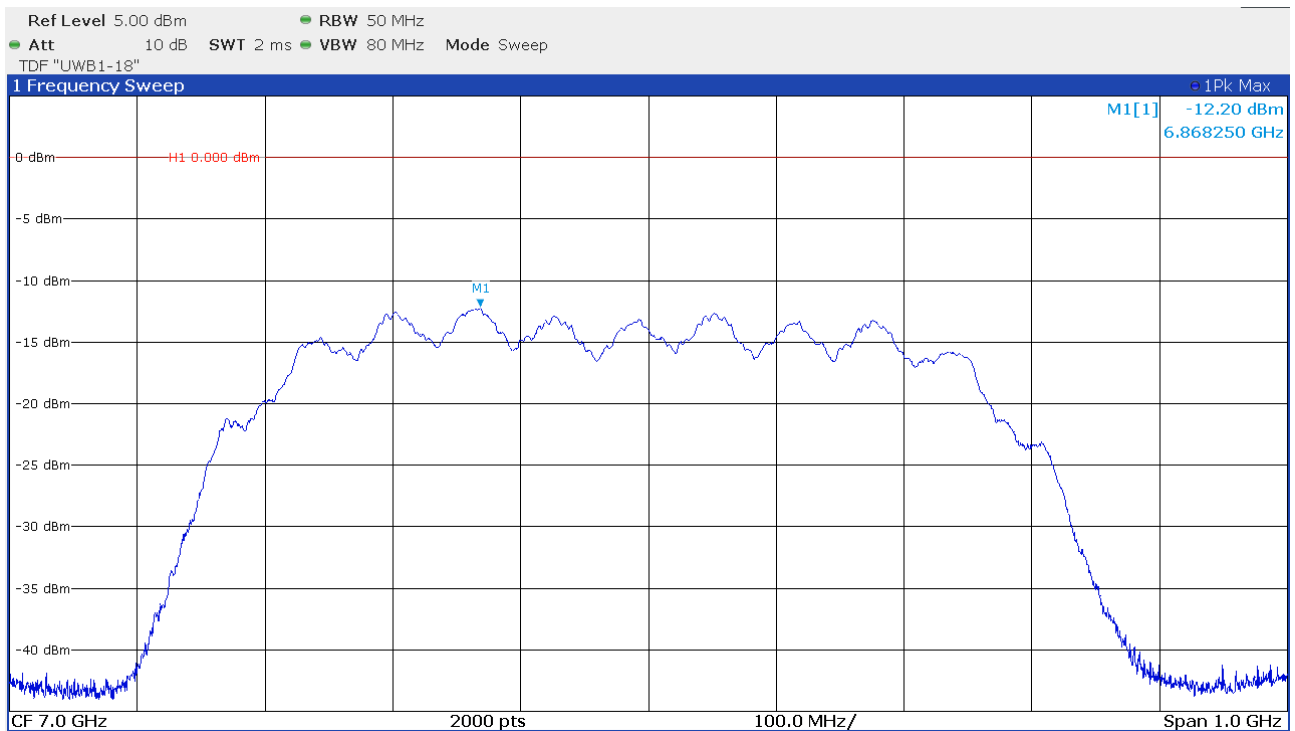


FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 6 antenna 1

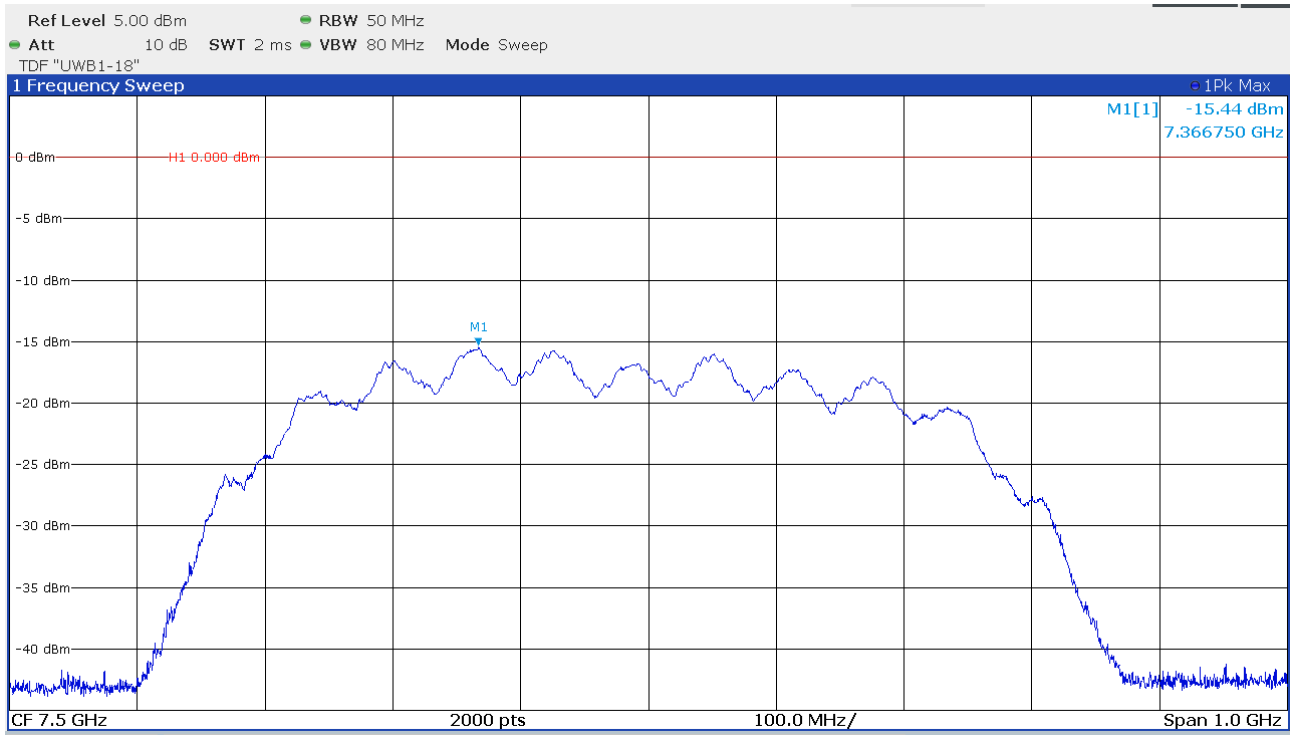


Channel 6 antenna 2

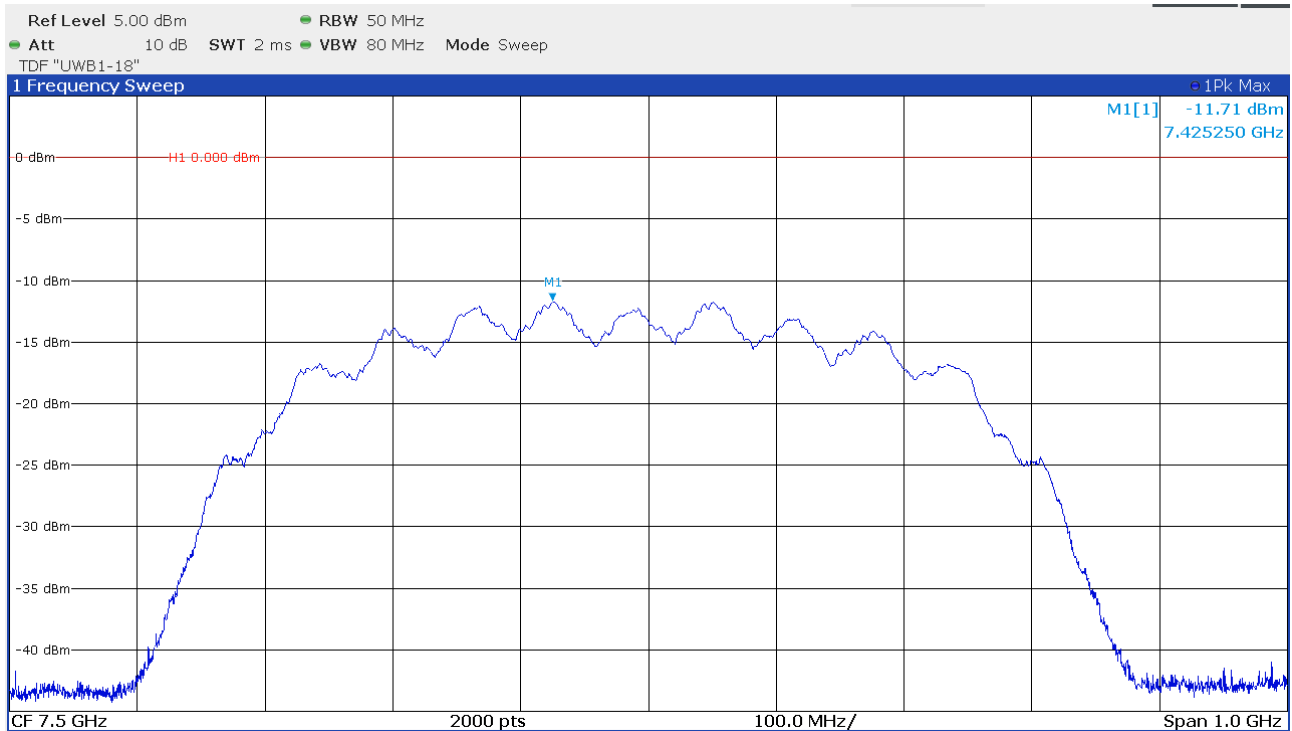


FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 8 antenna 1

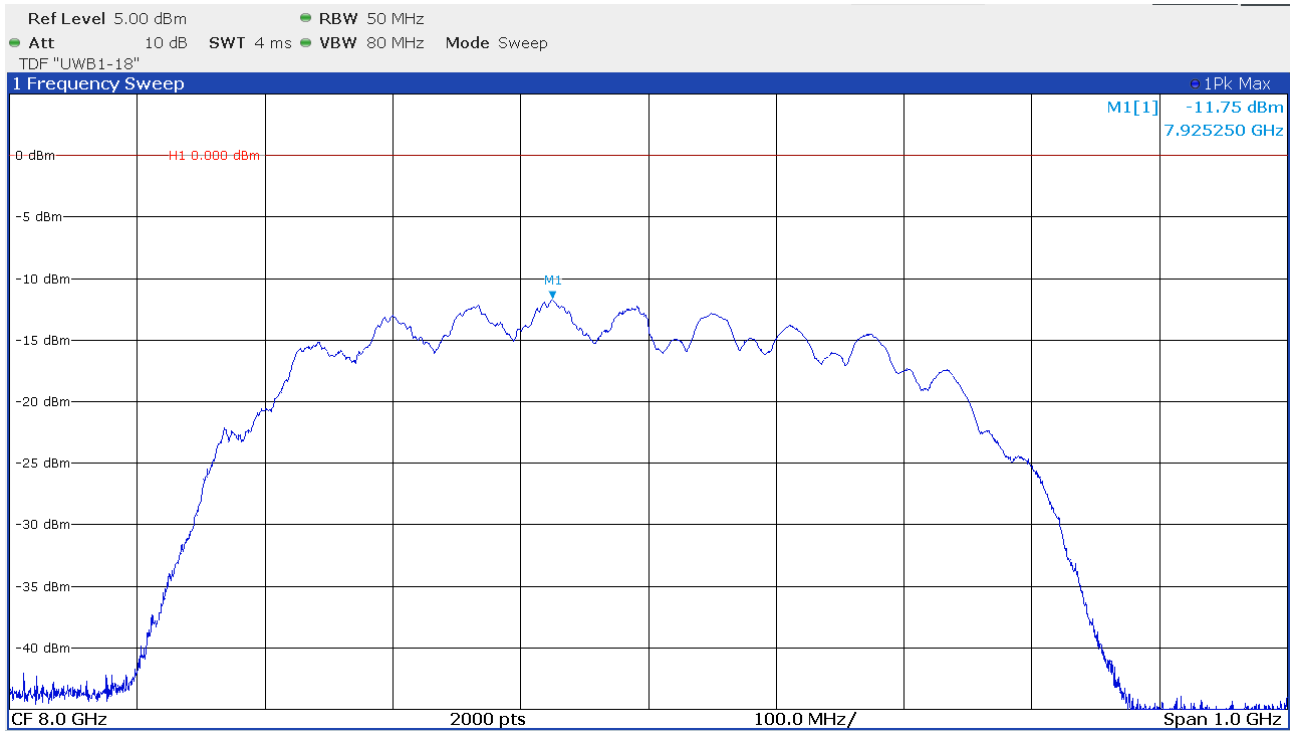


Channel 8 antenna 2

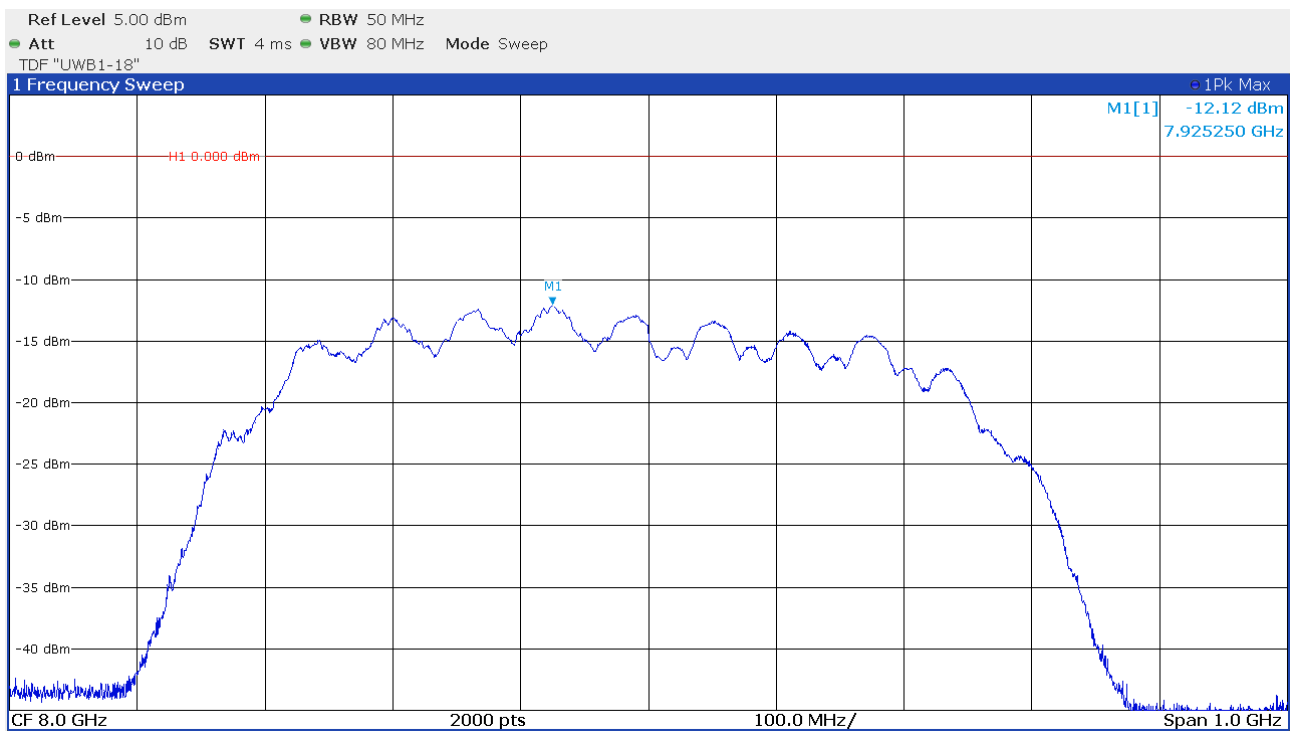


FCC ID: KR5FBD5 IC: 7812D-FBD5

Channel 9 antenna 1



Channel 9 antenna 2



FCC ID: KR5FBD5 IC: 7812D-FBD5

Min. limit margin: -11.7 dB at 7425.25 MHz

The requirements are **FULFILLED**.

Remarks: None.

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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

5.6 Signal deactivation

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

5.6.1 Description of the test location

Test location: Anechoic chamber 2

5.6.2 Photo documentation of the test set-up



5.6.3 Applicable standard

According to FCC Part 15, Section 15.519(a)(1):

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

According to KDB 393764 D01 UWB FAQ v02 section 4:

An acknowledgement of reception must continue to be received by the UWB device at least once every 10 seconds, or else the device shall cease transmission of any information other than periodic signals for use in the establishment or re-establishment of a communications link with an associated receiver.

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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

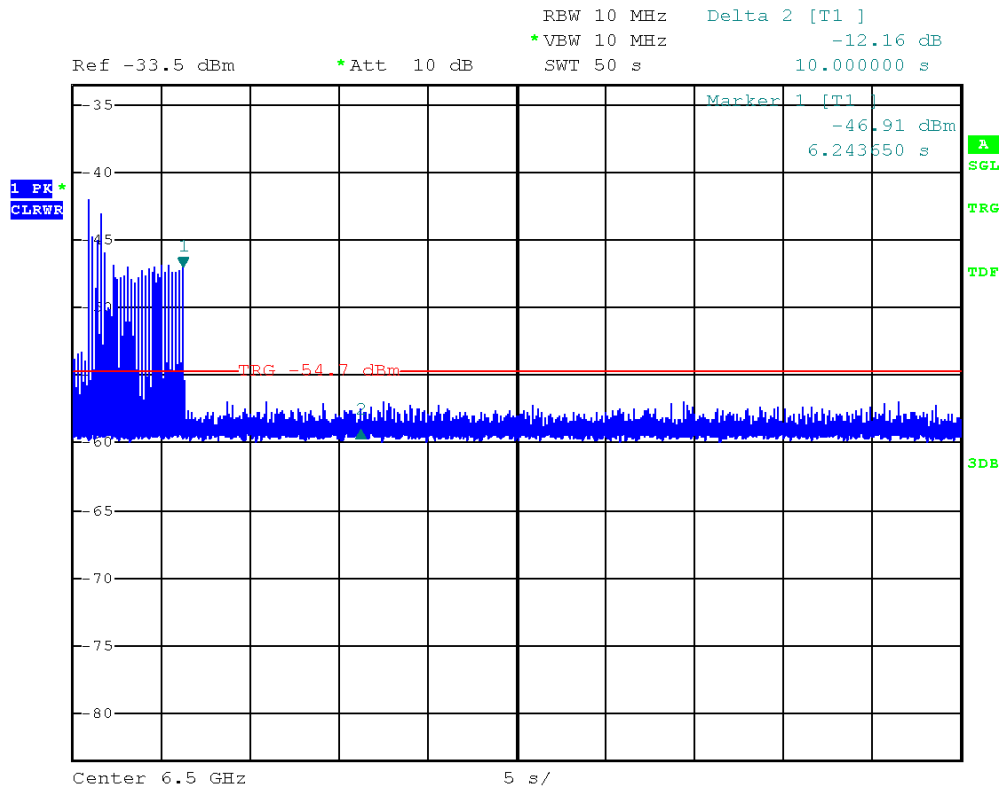
5.6.4 Description of Measurement

The measurement was performed radiated.

Spectrum analyser settings:

RBW: 10 MHz, VBW: 10 MHz, Detector: peak, zero span

5.6.5 Test result



Explanation:

The tests were performed with an EUT, which supports channel 5. The signal deactivation is independent of the chosen channel and shown here for a signal with channel 5 only.

At the time 6.243550 s (Marker M1) the companion device was powered off. The EUT stops its transmissions immediately.

This behaviour is in accordance with the applicable standards.

The requirements are **FULFILLED**.

Remarks: None.

FCC ID: KR5FBD5 IC: 7812D-FBD5

5.7 Antenna application

5.7.1 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 integrated antennas. No other antenna can be used with the device.

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

Remarks: None.

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.

FCC ID: KR5FBD5 IC: 7812D-FBD5

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. |
|---------|------------------------|-----------------|-------------|-------------|-------------|-------------|
| A 4 | BAT-EMC 3.19.1.24 | 01-02/68-13-001 | | | | |
| | ESCI | 02-02/03-15-001 | 24/06/2021 | 24/06/2020 | | |
| | ESH 2 - Z 5 | 02-02/20-05-004 | 31/10/2021 | 31/10/2019 | 04/11/2020 | 04/05/2020 |
| | N-4000-BNC | 02-02/50-05-138 | | | | |
| | N-1500-N | 02-02/50-05-140 | | | | |
| | ESH 3 - Z 2 | 02-02/50-05-155 | 13/11/2022 | 13/11/2019 | 12/11/2020 | 12/05/2020 |
| CPR 3 | FSW43 | 02-02/11-15-001 | 02/04/2021 | 02/04/2020 | | |
| | AFS5-12001800-18-10P-6 | 02-02/17-06-002 | | | | |
| | AFS4-01000400-10-10P-4 | 02-02/17-13-002 | | | | |
| | AMF-4F-04001200-15-10P | 02-02/17-13-003 | | | | |
| | 311702-02/24-05-009 | 18/06/2021 | 18/06/2020 | | | |
| | Sucoflex N-2000-SMA | 02-02/50-05-075 | | | | |
| MB | FSP 30 | 02-02/11-05-001 | 30/09/2020 | 30/09/2019 | | |
| | KK-SF104-11SMA-11N-2M | 02-02/50-14-003 | | | | |
| SER 2 | ESVS 30 | 02-02/03-05-006 | 15/07/2021 | 15/07/2020 | | |
| | VULB 9168 | 02-02/24-05-005 | 19/09/2020 | 19/07/2019 | | |
| | 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 | | | | |
| SER 3 | FSW43 | 02-02/11-15-001 | 02/04/2021 | 02/04/2020 | | |
| | AMF-6D-01002000-22-10P | 02-02/17-15-004 | | | | |
| | LNA-40-18004000-33-5P | 02-02/17-20-002 | | | | |
| | 311702-02/24-05-009 | 18/06/2021 | 18/06/2020 | | | |
| | BBHA 9170 | 02-02/24-05-013 | 19/05/2023 | 19/05/2020 | 14/01/2021 | 14/01/2020 |
| | WHKX 7.5/18G-8SS | 02-02/50-07-010 | | | | |
| | 18N-20 | 02-02/50-17-003 | | | | |
| | 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 | | | | |
| | BAT-EMC 3.19.1.24 | 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.