



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. : 80131513-00 Rev0

29. June 2022

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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: KR5FBD5MY23 IC: 7812D-FBD5MY23

Contents

1	<u>TEST STANDARDS</u>	<u>3</u>
2	<u>EQUIPMENT UNDER TEST</u>	<u>4</u>
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	Equipment type	4
2.5	Short description of the equipment under test (EUT)	4
2.6	Variants of the EUT	4
2.7	Operation frequency and channel plan	4
2.8	Transmit operating modes	5
2.9	Antenna	5
2.10	Power supply system utilised	5
2.11	Peripheral devices and interface cables	5
2.12	Determination of worst case conditions for final measurement	5
3	<u>TEST RESULT SUMMARY</u>	<u>6</u>
3.1	Revision history of test report	6
3.2	Final assessment	7
4	<u>TEST ENVIRONMENT</u>	<u>8</u>
4.1	Address of the test laboratory	8
4.2	Environmental conditions	8
4.3	Statement of the measurement uncertainty	8
4.4	Conformity Decision Rule	8
5	<u>TEST CONDITIONS AND RESULTS</u>	<u>11</u>
5.1	AC power line conducted emissions	11
5.2	UWB Bandwidth	15
5.3	Radiated Emissions 9 kHz to 40 GHz	25
5.4	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	45
5.5	Peak Power radiated	63
5.6	Signal deactivation	69
5.7	Antenna application	71
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	<u>72</u>

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 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
---------------------------------------	--------------------------

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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 A

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: 1
Serial number: 00023
Firmware version: 51C23110

2.6 Variants of the EUT

There are no variants.

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

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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

The EUT provides the package types "FC1T1ND" and "FC1T2".

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

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

- PCAN-USB FD Model : Peak IPEH 004022027090
- Notebook Model : Fujitsu Lifebook

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.

2.12.1 Test jig

No test jig is used.

2.12.2 Test software

Special software is used for setting the EUT in a continuous Tx mode.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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) 15.521(j)	RSS-Gen, 8.8	AC power line conducted emissions	passed
15.519(b) 15.521(e)	RSS-220, 2, 5.1(a)	UWB Bandwidth	passed
15.209(a) 15.519(c) 15.521(c)(d)(h)	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) 15.521(g)	RSS-220, 5.3.1(g)	Peak Power radiated	passed
15.519(a)	RSS-220, 5.3.1(b)	Signal deactivation	passed
15.203 15.521(b)	---	Antenna requirement	passed *1
15.204(a)-(d) 15.521(b)	---	External radio frequency power amplifiers and antenna modifications	passed *1
15.521(a)(b)(f)(i)	---	Technical requirements applicable to all UWB devices	passed *2

*1: According to the applicant, the EUT has internal PCB antennas. No other antennas can be connected to the EUT. Therefore, the requirements are regarded as fulfilled.

*2: According to the applicant, the EUT will be used in road vehicles only. For details refer to the user manual. The EUT is no imaging system.

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 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80131513-00	0	29 June 2022	Initial test report

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

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

3.2 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 : 18 February 2022

Testing concluded on : 25 March 2022

Checked by:



Klaus Gegenfurtner
I confirm the correctness
and integrity of this
document
2022.06.30 09:11:54
+02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:



I am the author of
this document
2022.06.29 21:13:52
+02'00'

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.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23**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.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
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.

For the measurement, the following accessoires according §2.1033 were used:

- 12V 5A Universal Adapter Model : LEYF Adptr12V-5A

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -10.9 dB at 1.326 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**.

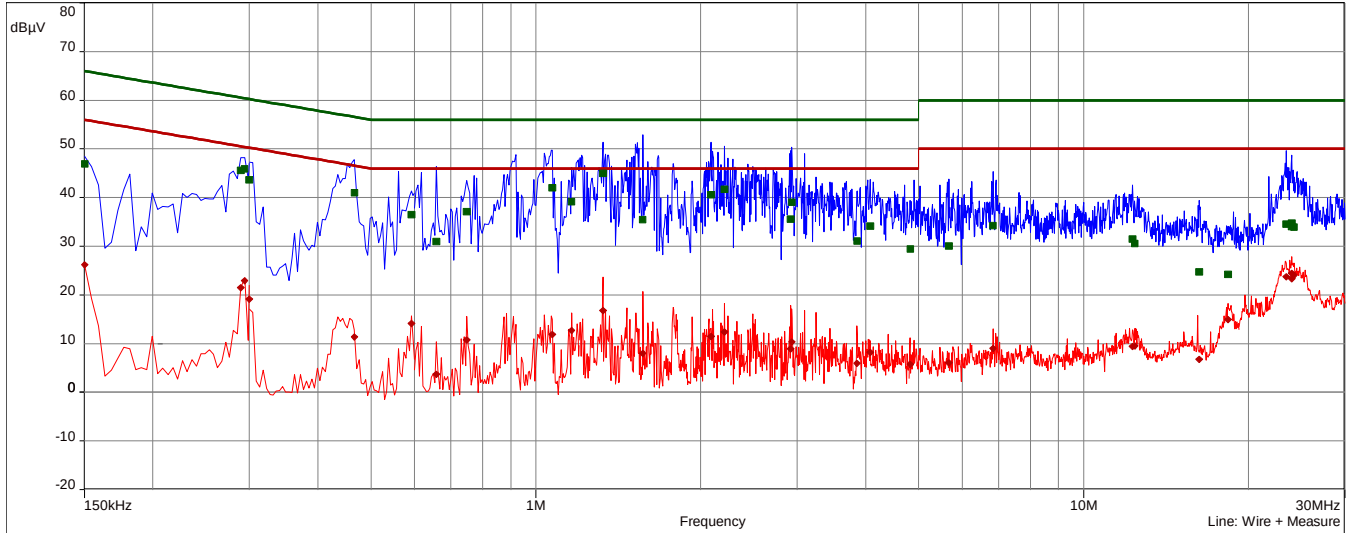
Remarks: For detailed test result please refer to following test protocols.

The results are independent of the used antenna path or channel. Tests carried out with ch 5.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

5.1.6 Test protocol

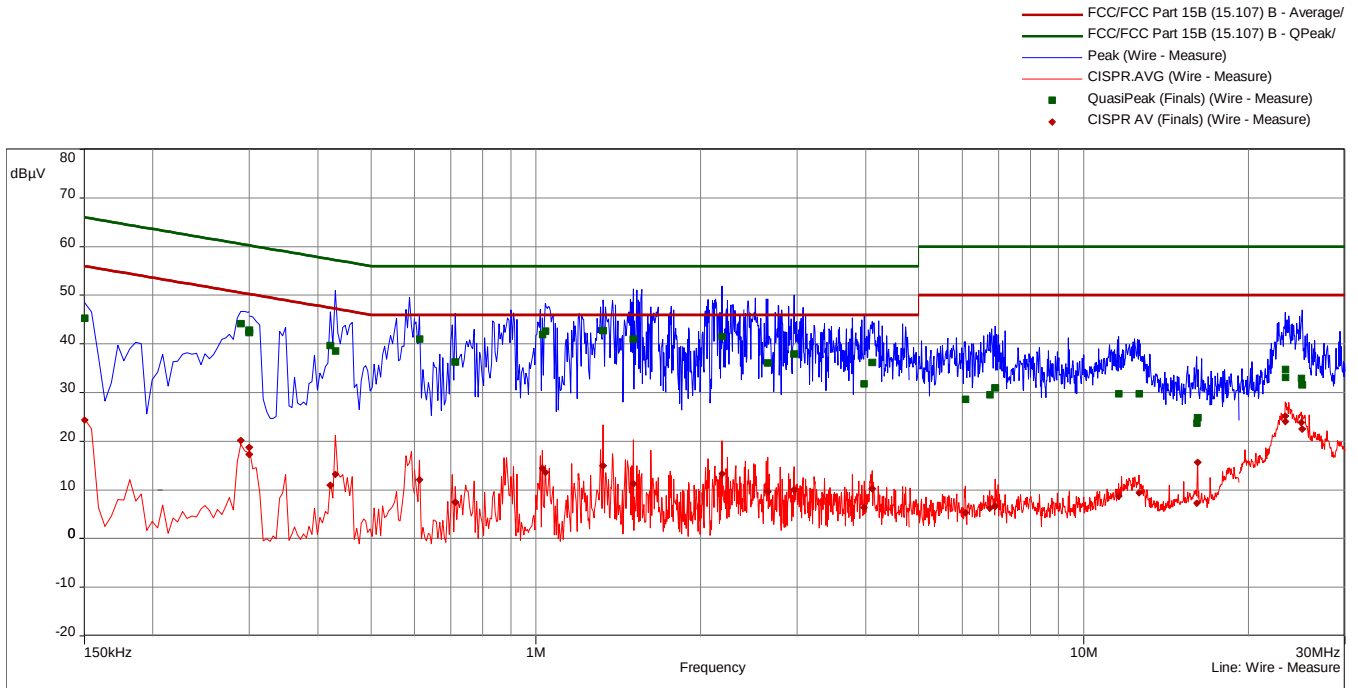
- FCC/FCC Part 15B (15.107) B - Average/
- FCC/FCC Part 15B (15.107) B - QPeak/
- Peak (Wire + Measure)
- CISPR.AVG (Wire + Measure)
- QuasiPeak (Finals) (Wire + Measure)
- ◆ CISPR AV (Finals) (Wire + Measure)



FCC/FCC Part 15B (15.107)B

freq	QP	margin	limit	AV	margin	limit
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150	46.9	-19.1	66.0	26.2	-29.8	56.0
0.290	45.6	-14.9	60.5	21.5	-29.0	50.5
0.294	46.0	-14.4	60.4	23.0	-27.5	50.4
0.300	43.8	-16.5	60.2	19.2	-31.0	50.2
0.467	41.1	-15.5	56.6	11.4	-35.2	46.6
0.593	36.5	-19.5	56.0	14.2	-31.9	46.0
0.659	31.0	-25.0	56.0	3.7	-42.3	46.0
0.749	37.1	-18.9	56.0	10.8	-35.2	46.0
1.073	42.1	-13.9	56.0	11.9	-34.1	46.0
1.163	39.2	-16.8	56.0	12.7	-33.3	46.0
1.326	45.1	-10.9	56.0	16.8	-29.2	46.0
1.569	35.6	-20.4	56.0	8.0	-38.0	46.0
2.087	40.7	-15.3	56.0	11.5	-34.5	46.0
2.208	41.8	-14.2	56.0	12.4	-33.6	46.0
2.918	35.7	-20.3	56.0	9.0	-37.0	46.0
2.931	39.1	-16.9	56.0	10.4	-35.6	46.0
3.858	31.1	-24.9	56.0	6.0	-40.0	46.0
4.079	34.2	-21.8	56.0	8.2	-37.8	46.0
4.823	29.5	-26.6	56.0	5.8	-40.2	46.0
5.673	30.1	-29.9	60.0	6.1	-43.9	50.0
6.839	34.3	-25.7	60.0	9.1	-40.9	50.0
12.278	31.6	-28.4	60.0	9.5	-40.6	50.0
12.417	30.6	-29.4	60.0	9.6	-40.4	50.0
16.251	24.8	-35.2	60.0	6.8	-43.2	50.0
18.371	24.3	-35.7	60.0	15.0	-35.0	50.0
23.448	34.6	-25.4	60.0	23.8	-26.2	50.0
23.993	34.1	-25.9	60.0	23.3	-26.7	50.0
24.006	34.8	-25.2	60.0	24.5	-25.5	50.0
24.231	34.0	-26.0	60.0	24.1	-25.9	50.0

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23



freq	QP	margin	limit	AV	margin	limit
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.150	45.4	-20.6	66.0	24.4	-31.6	56.0
0.290	44.3	-16.3	60.5	20.2	-30.3	50.5
0.300	42.4	-17.9	60.2	17.3	-32.9	50.2
0.300	42.9	-17.4	60.2	18.8	-31.5	50.2
0.422	39.7	-17.7	57.4	11.0	-36.5	47.4
0.431	38.6	-18.6	57.2	13.3	-34.0	47.2
0.614	41.1	-14.9	56.0	12.2	-33.9	46.0
0.713	36.3	-19.7	56.0	7.5	-38.5	46.0
1.028	41.9	-14.1	56.0	14.5	-31.5	46.0
1.041	42.7	-13.3	56.0	13.7	-32.3	46.0
1.326	42.8	-13.2	56.0	15.0	-31.0	46.0
1.506	41.1	-14.9	56.0	11.3	-34.7	46.0
2.186	41.6	-14.4	56.0	13.4	-32.7	46.0
2.652	36.2	-19.9	56.0	9.7	-36.3	46.0
2.963	37.9	-18.1	56.0	10.1	-35.9	46.0
3.975	31.8	-24.2	56.0	6.4	-39.6	46.0
4.115	36.3	-19.7	56.0	10.3	-35.7	46.0
6.078	28.7	-31.3	60.0	5.4	-44.6	50.0
6.744	29.6	-30.4	60.0	6.3	-43.8	50.0
6.897	31.0	-29.0	60.0	6.7	-43.3	50.0
11.571	29.8	-30.2	60.0	8.7	-41.3	50.0
12.615	29.8	-30.2	60.0	9.4	-40.6	50.0
16.071	23.8	-36.2	60.0	7.3	-42.7	50.0
16.139	24.9	-35.1	60.0	15.7	-34.3	50.0
23.358	33.1	-26.9	60.0	24.1	-25.9	50.0
23.363	34.8	-25.2	60.0	25.2	-24.8	50.0
24.951	33.0	-27.0	60.0	23.9	-26.1	50.0
25.050	31.7	-28.3	60.0	22.5	-27.5	50.0

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

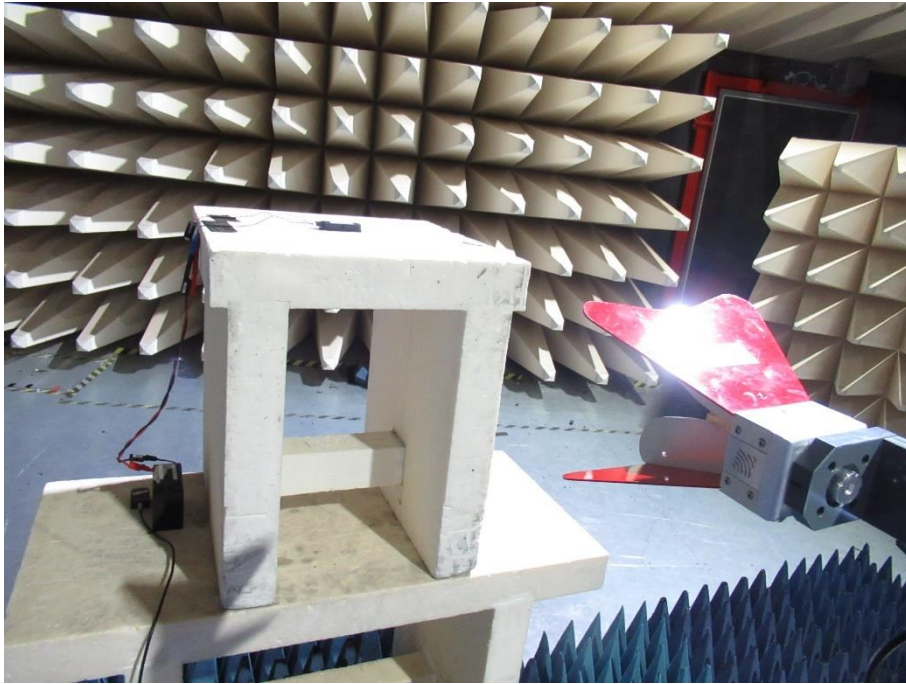
5.2 UWB Bandwidth

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: KR5FBD5MY23 IC: 7812D-FBD5MY23
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	6221.5	6770.5	3.1 – 10.6	549.0	> 500	passed
5	2	6207.9	6771.2	3.1 – 10.6	563.3	> 500	passed
6	1	6690.8	7270.5	3.1 – 10.6	579.7	> 500	passed
6	2	6691.1	7270.2	3.1 – 10.6	579.1	> 500	passed
8	1	7188.1	7769.2	3.1 – 10.6	581.1	> 500	passed
8	2	7190.1	7769.0	3.1 – 10.6	578.9	> 500	passed
9	1	7685.0	8283.9	3.1 – 10.6	598.9	> 500	passed
9	2	7685.6	8253.9	3.1 – 10.6	568.3	> 500	passed

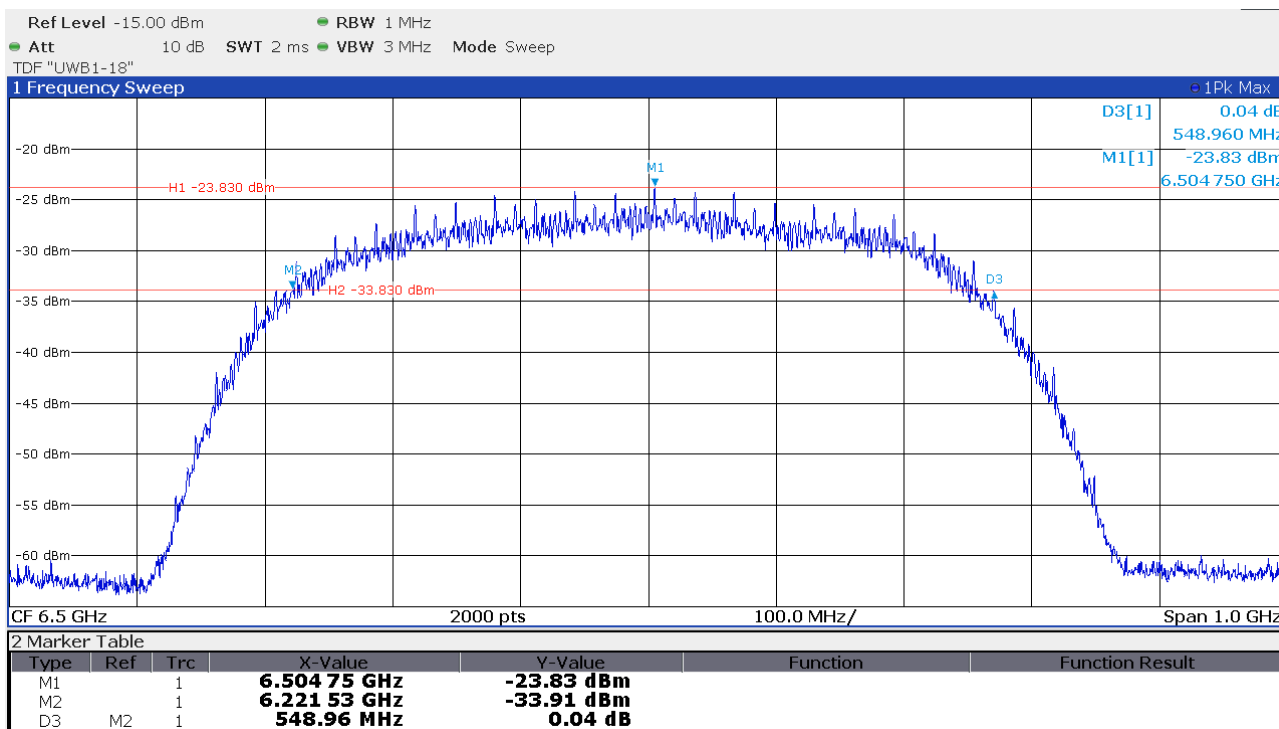
The requirements are **FULFILLED**.

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

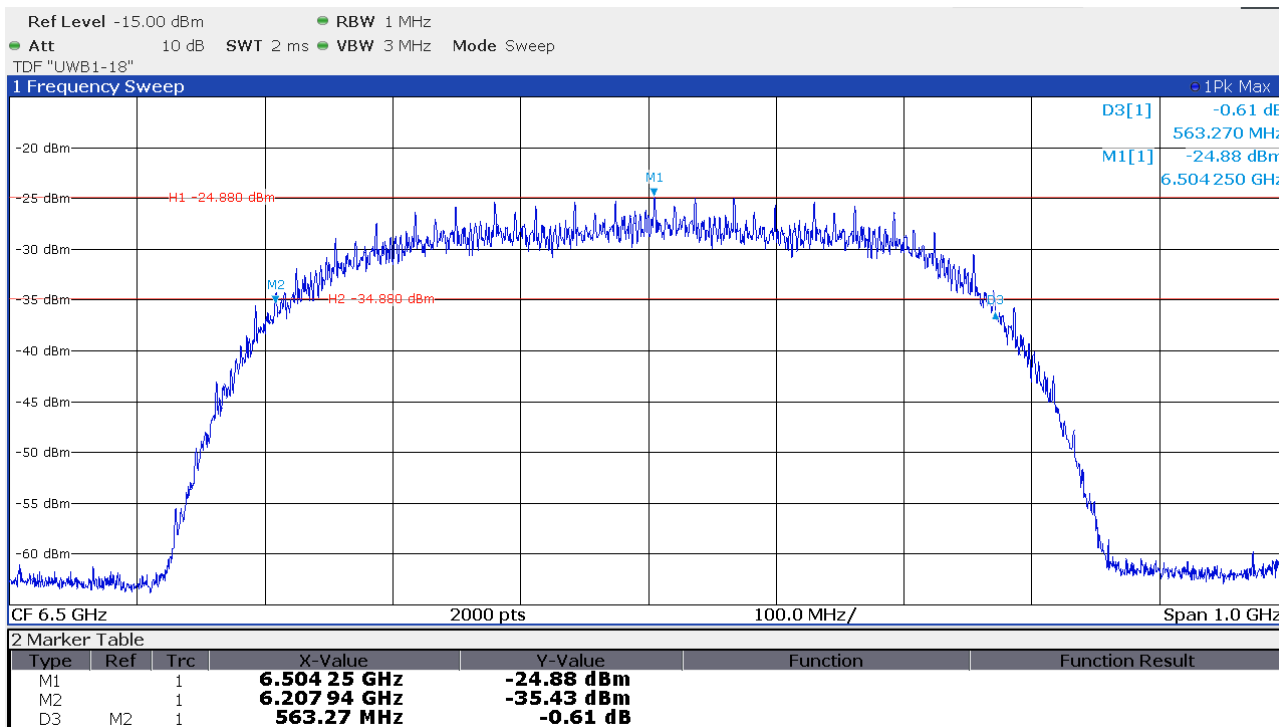
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

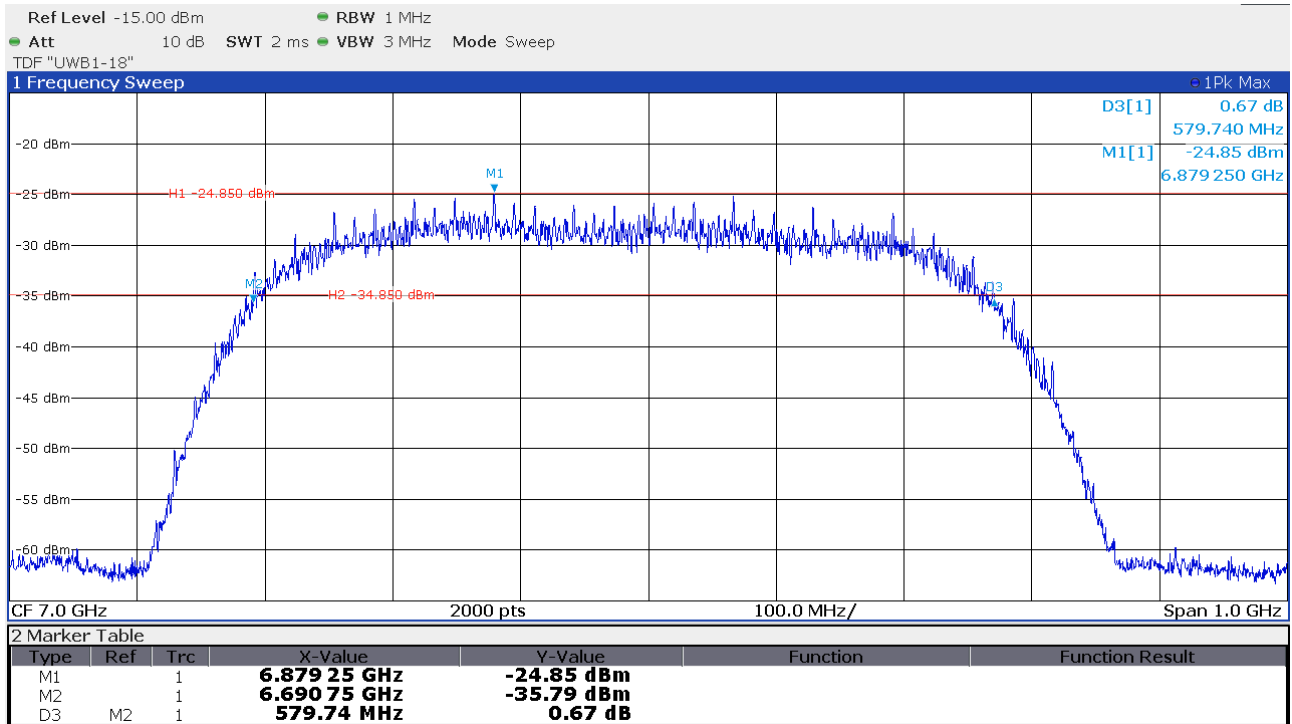
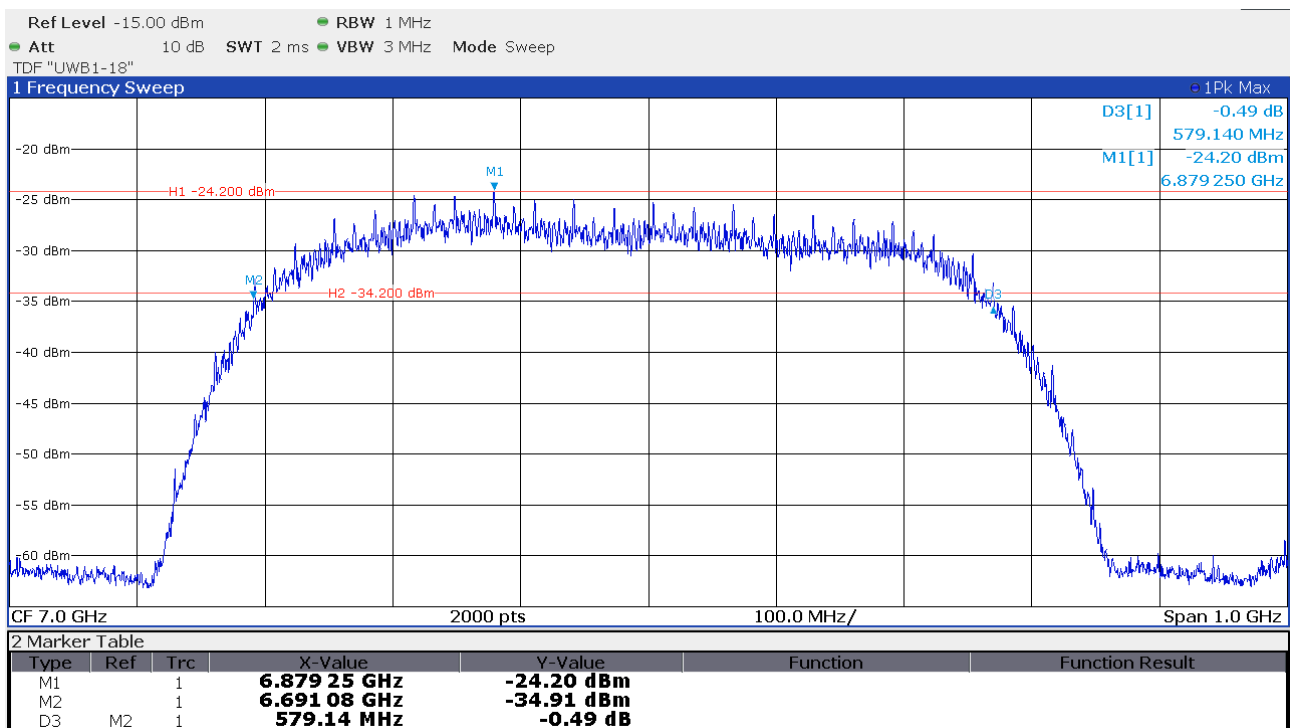
5.2.6 Test protocols EBW

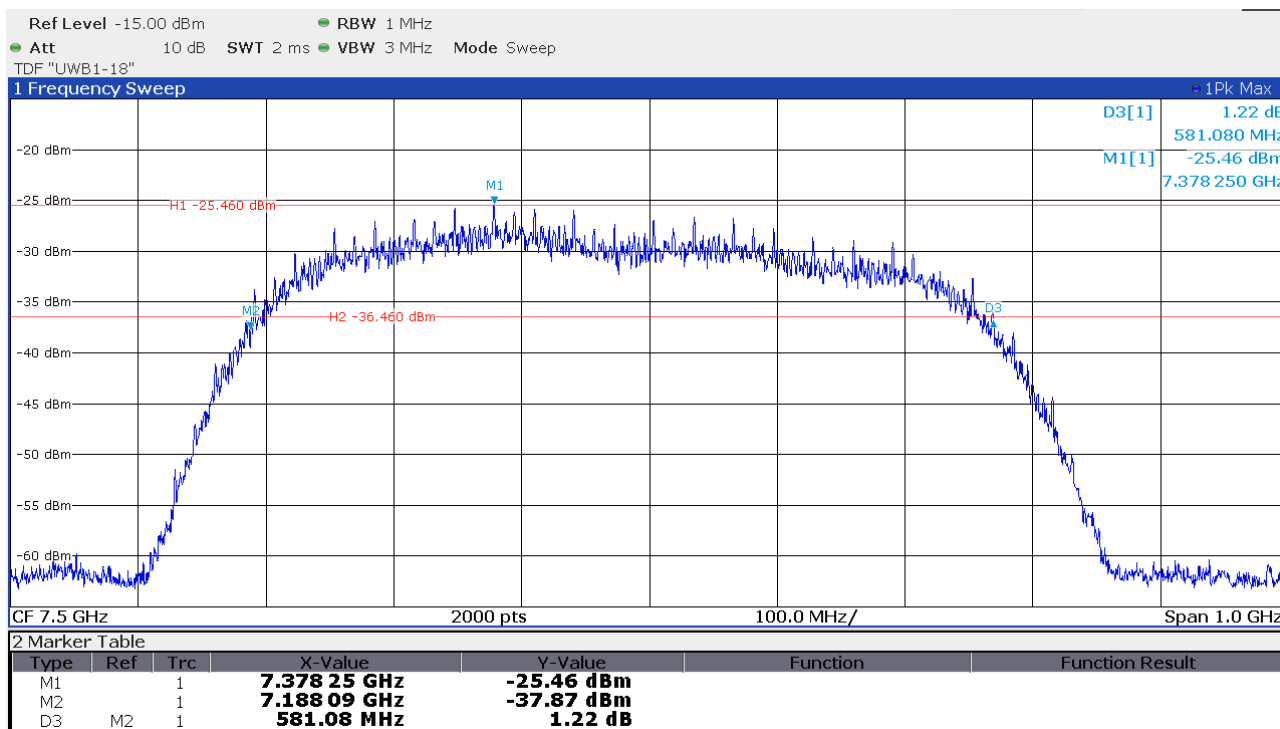
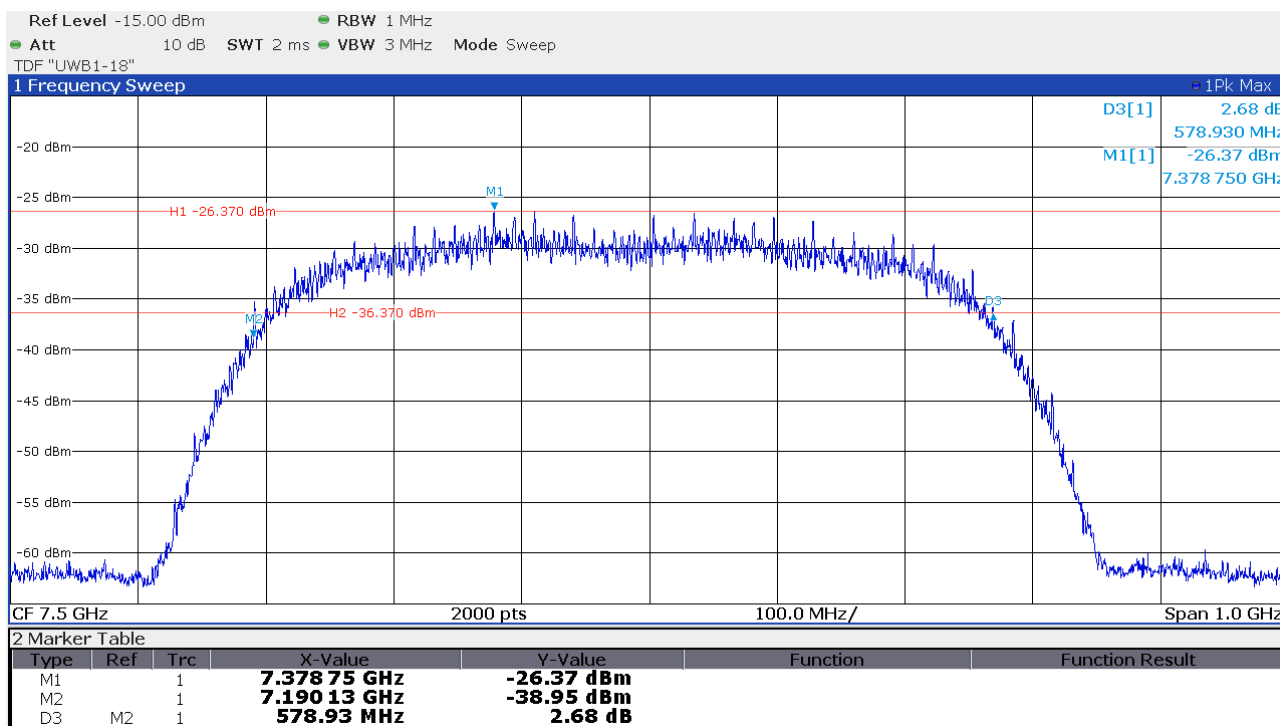
Channel 5 antenna 1

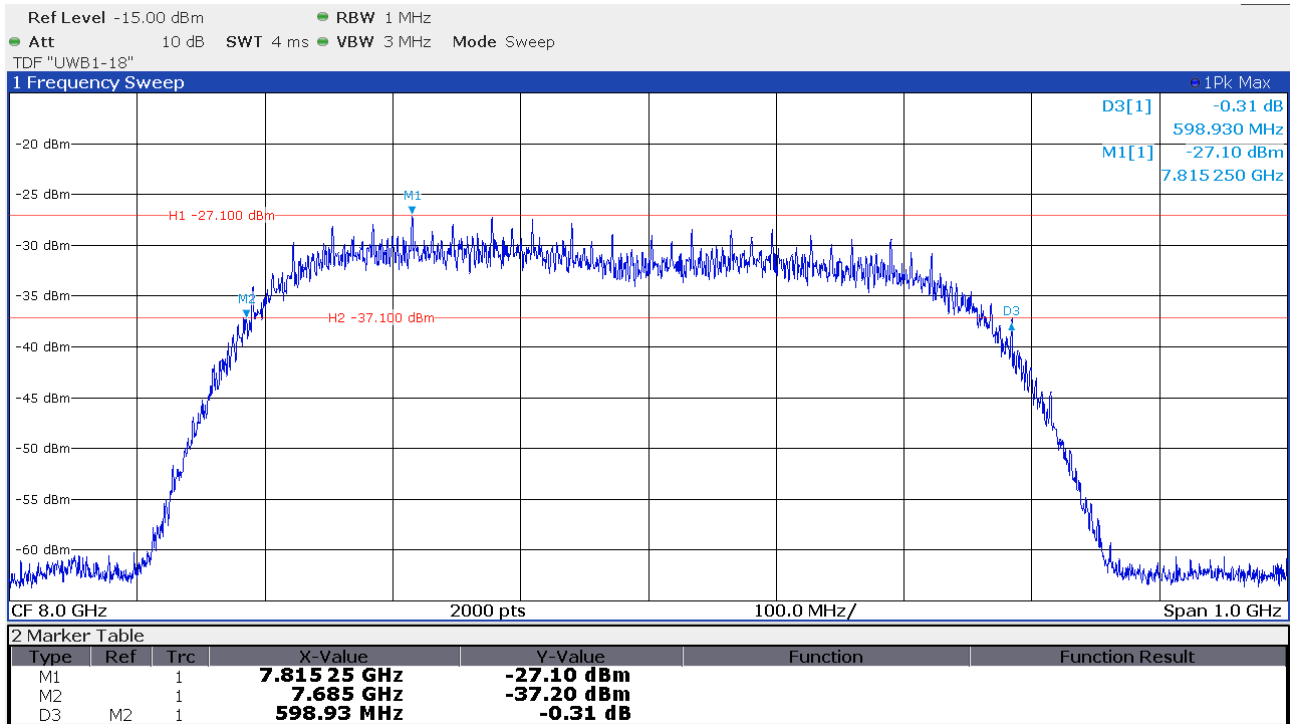
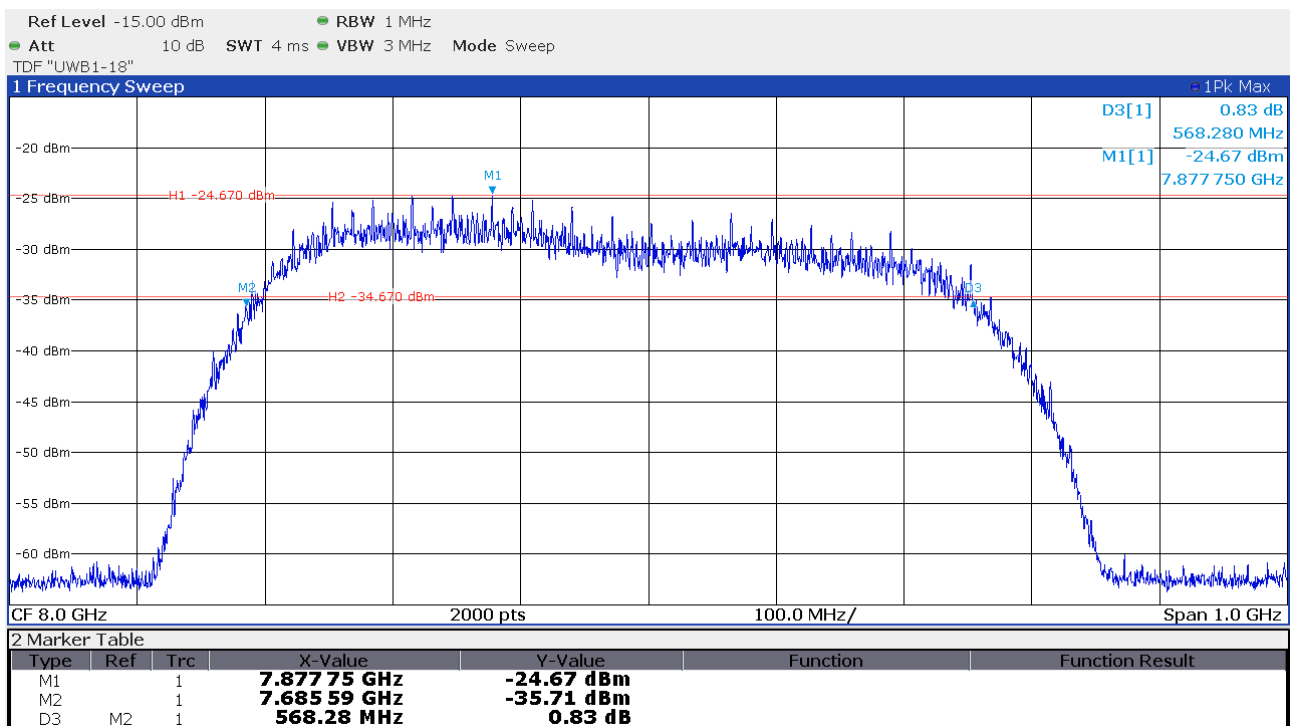


Channel 5 antenna 2



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1

Channel 6 antenna 2


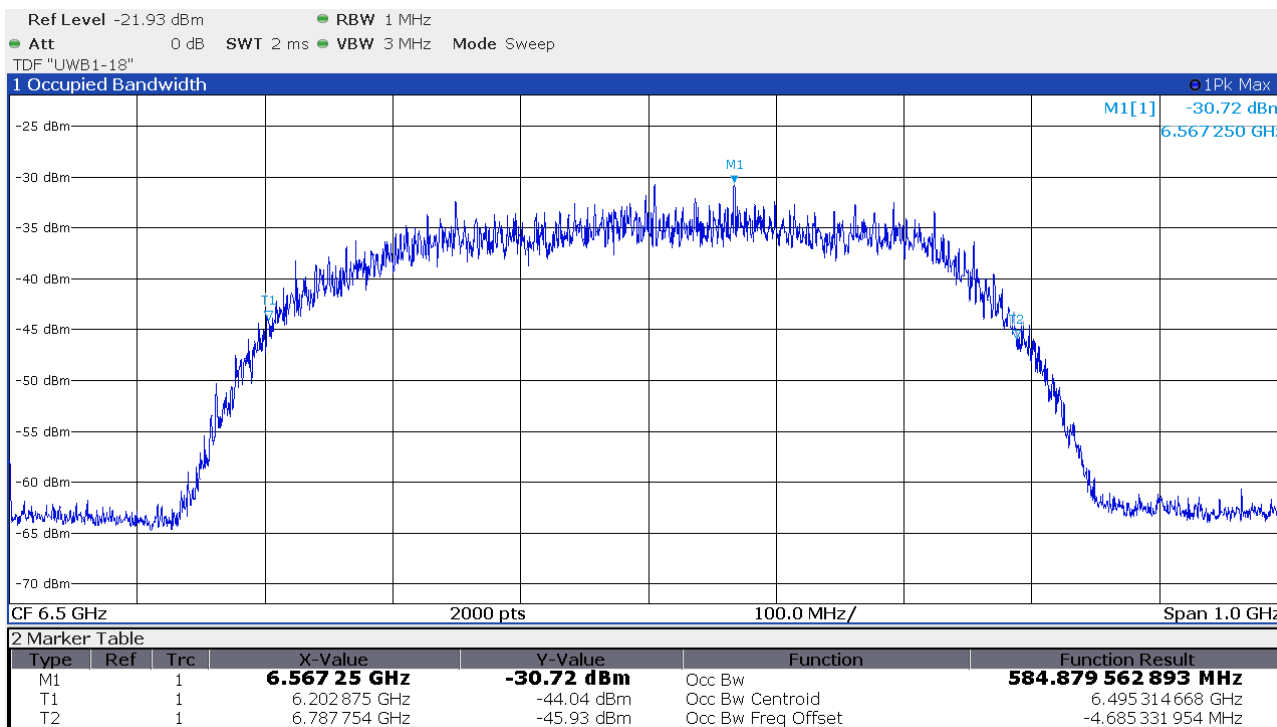
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 1

Channel 8 antenna 2


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 1

Channel 9 antenna 2


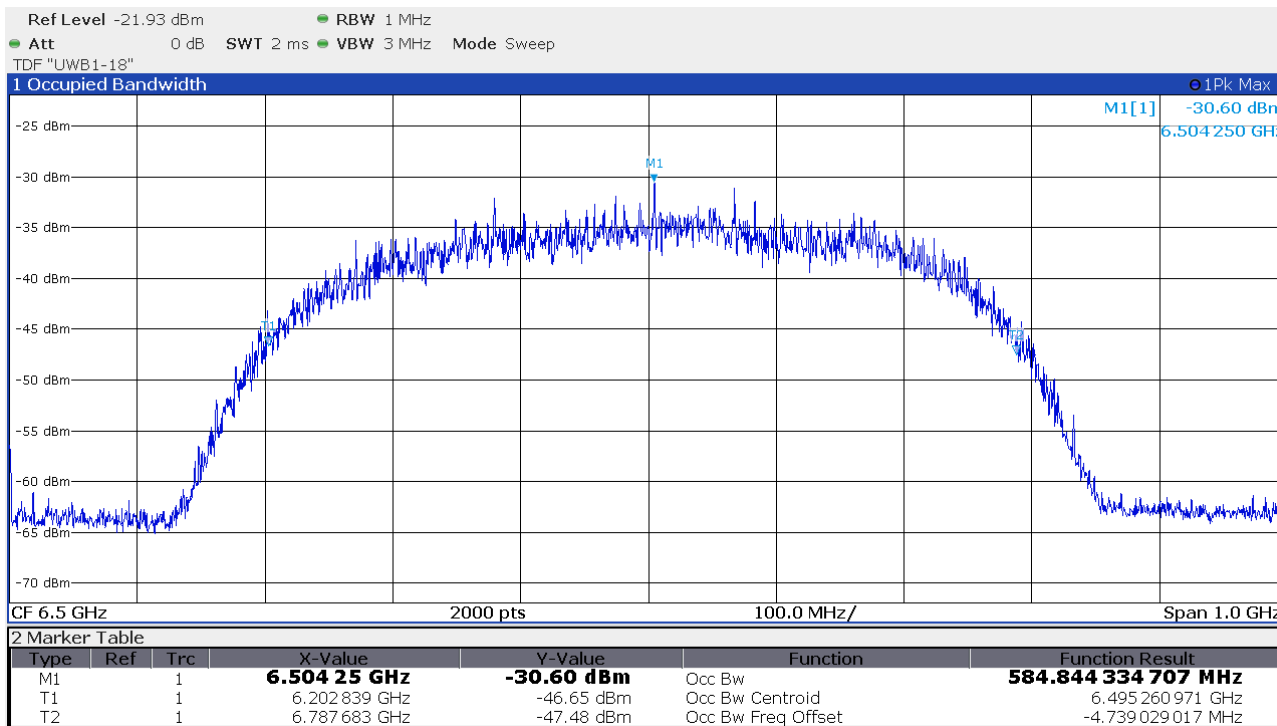
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

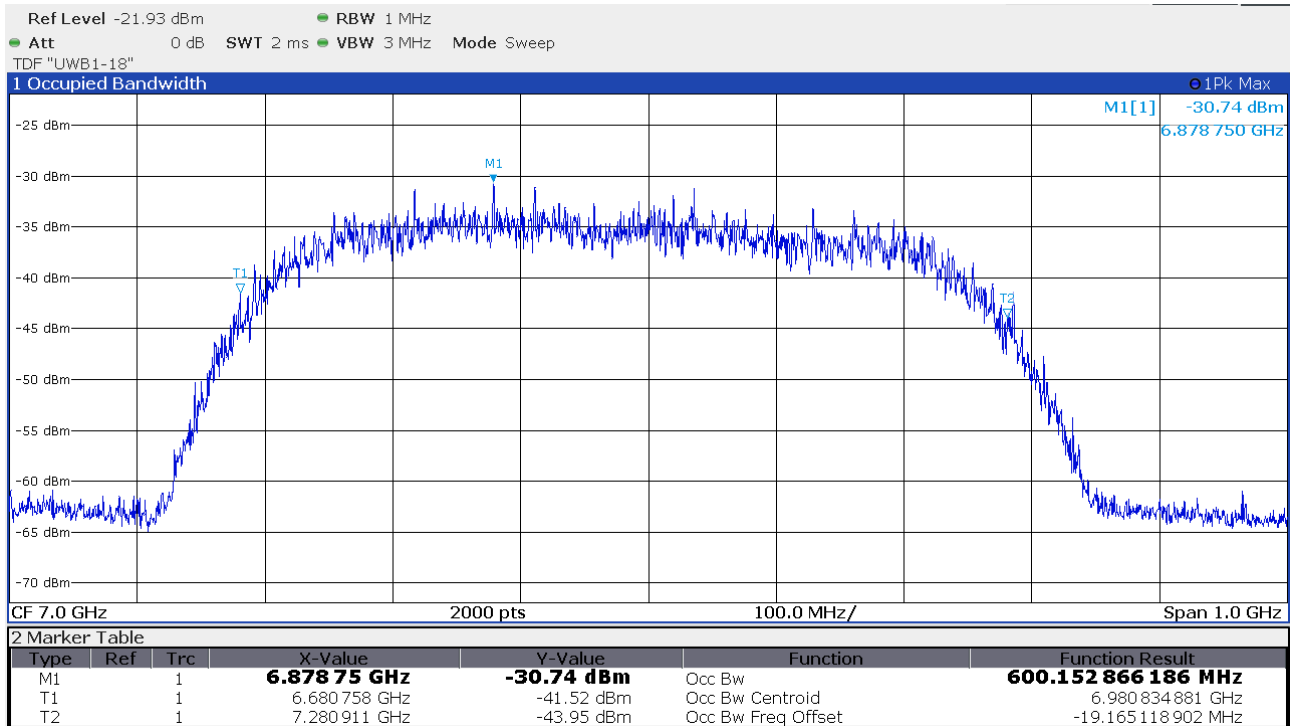
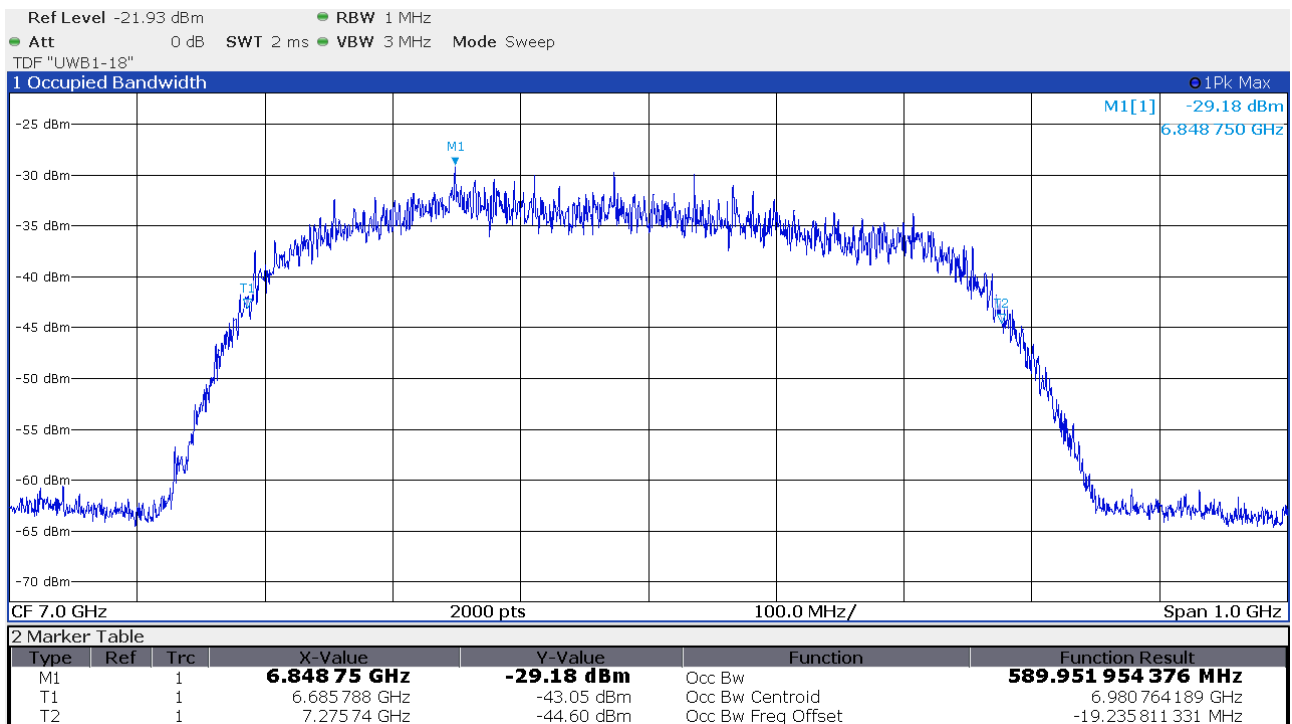
5.2.7 Test protocols OBW

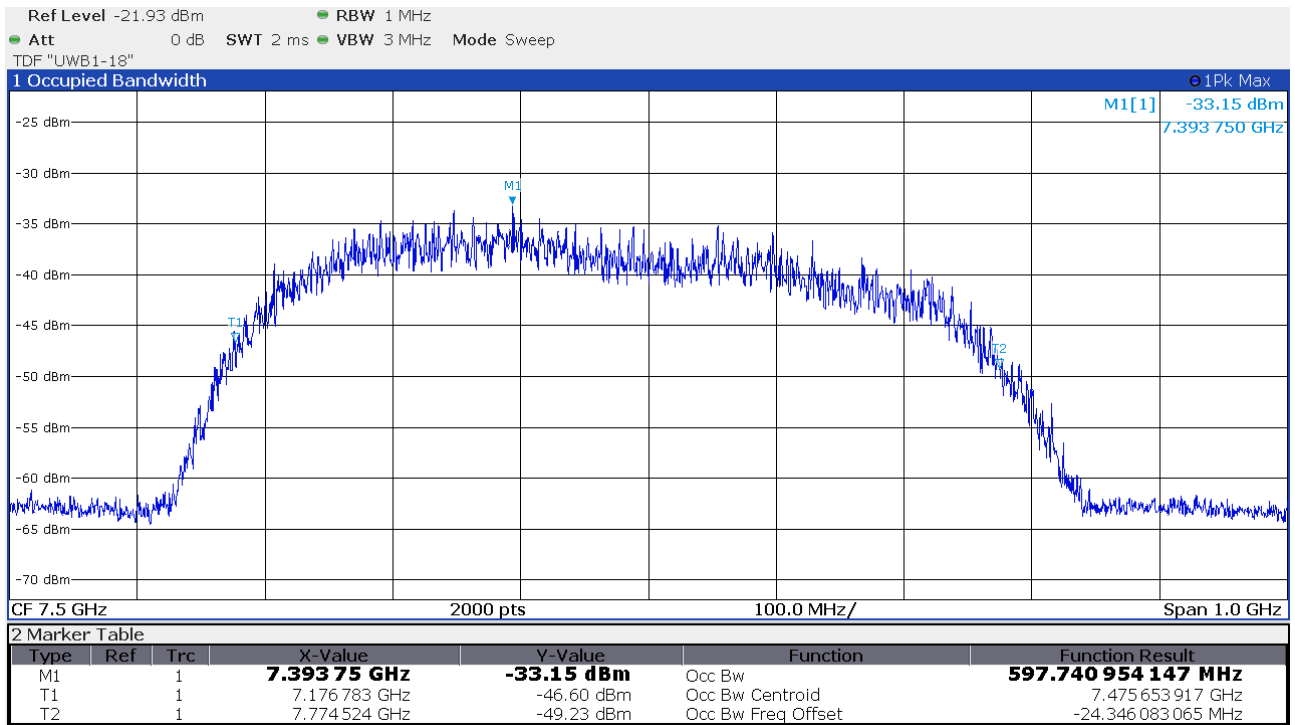
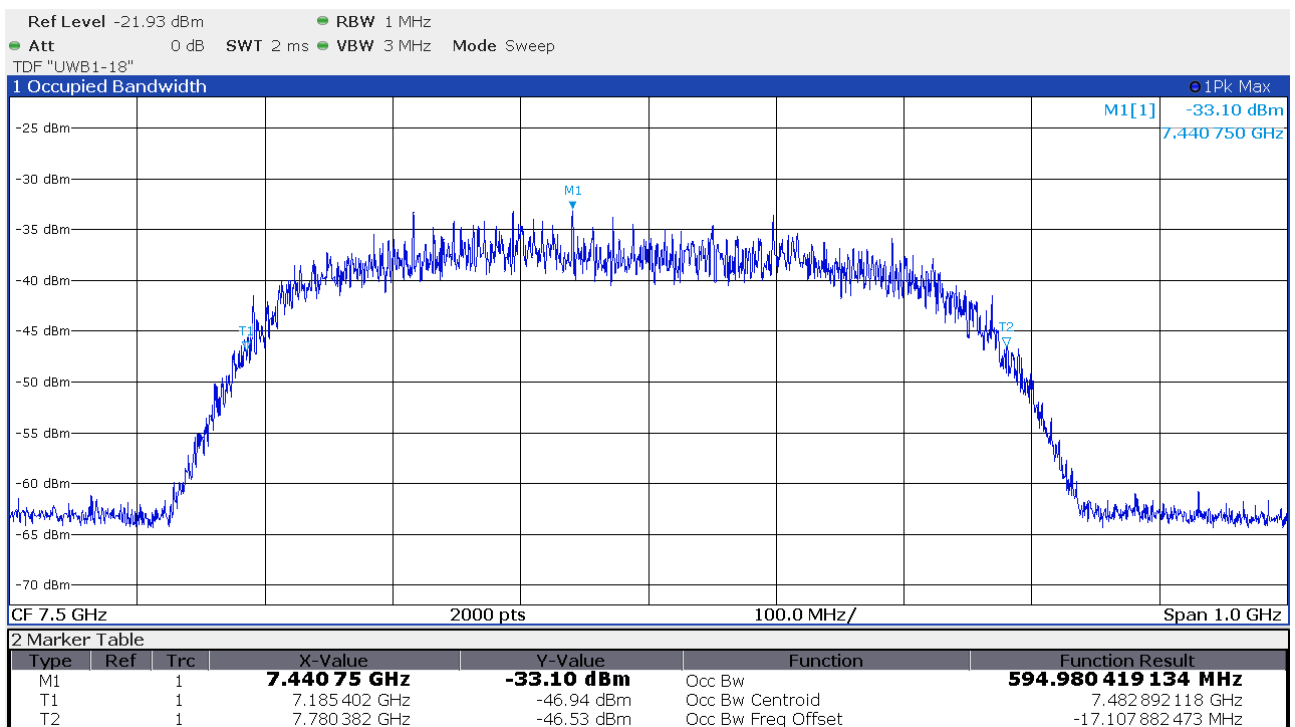
Channel 5 antenna 1



Channel 5 antenna 2

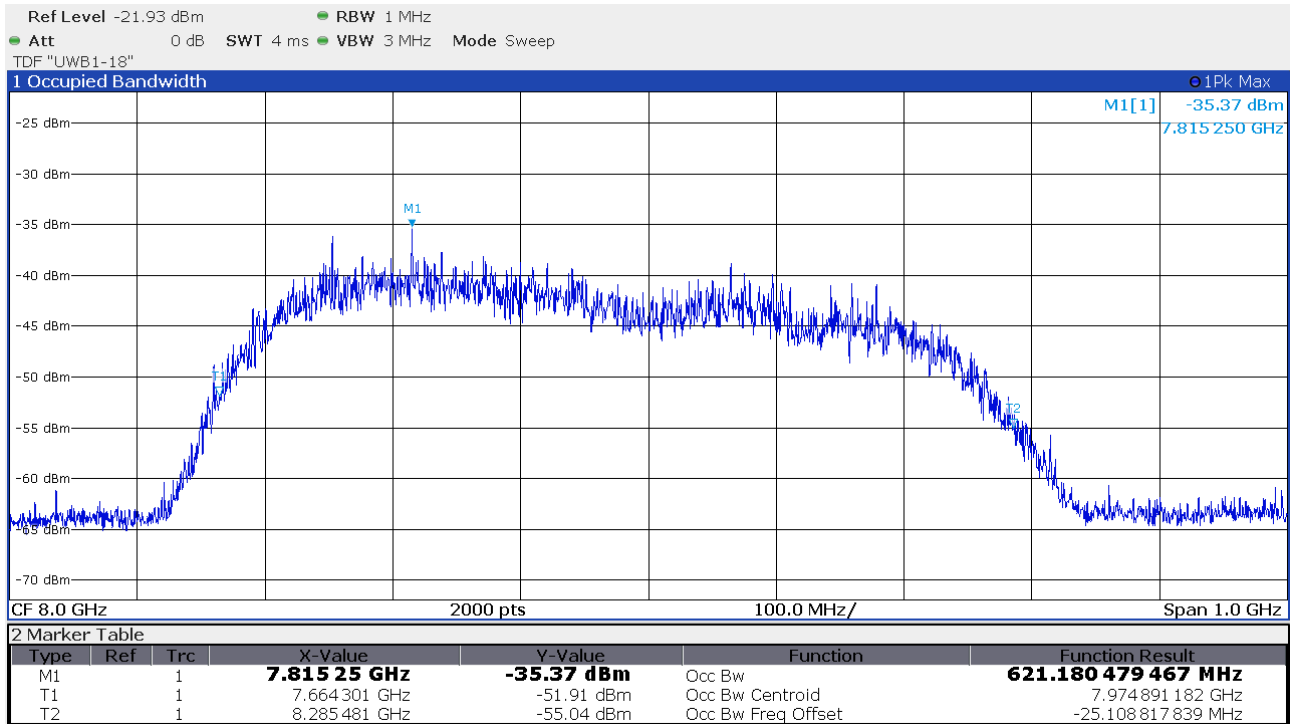


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1

Channel 6 antenna 2


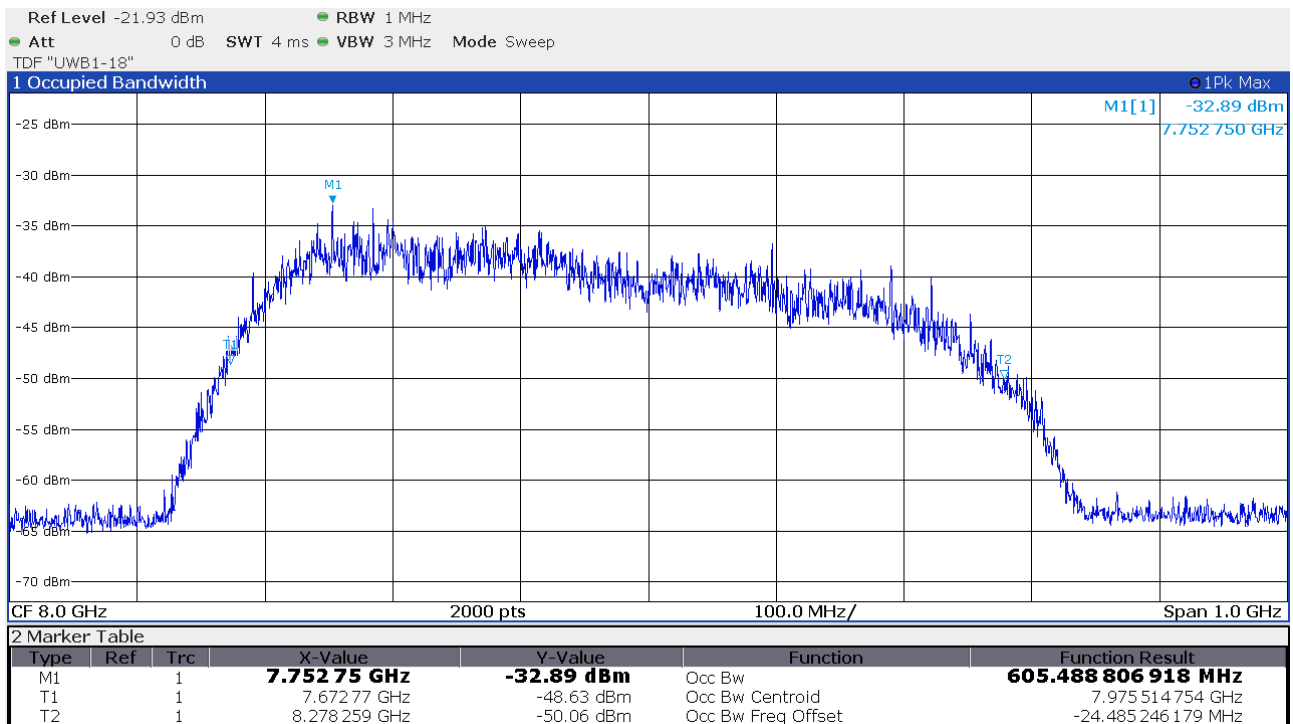
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 1

Channel 8 antenna 2


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Channel 9 antenna 1



Channel 9 antenna 2



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

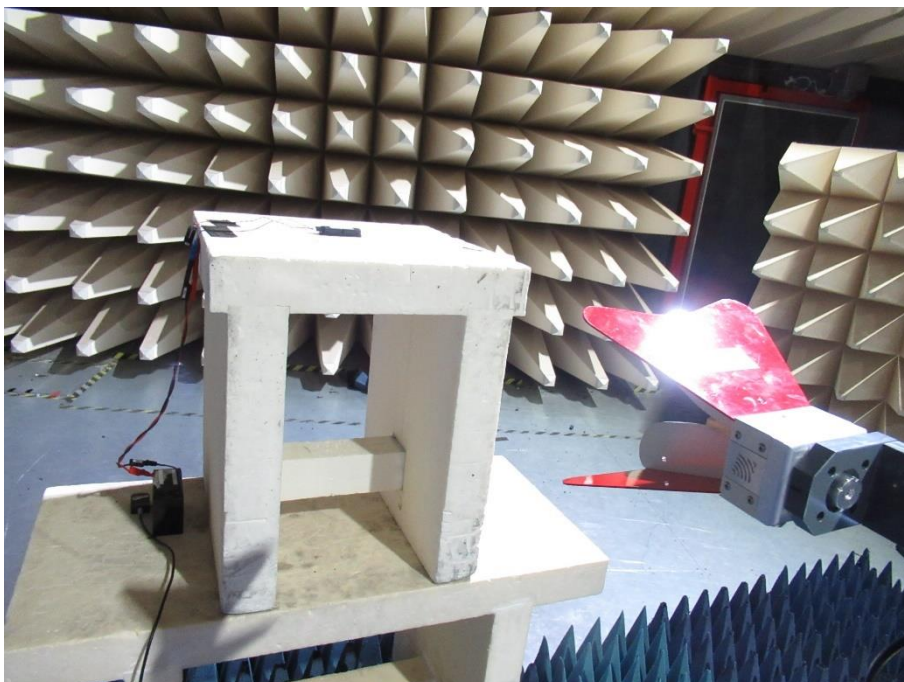
5.3 Radiated Emissions 9 kHz to 40 GHz

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

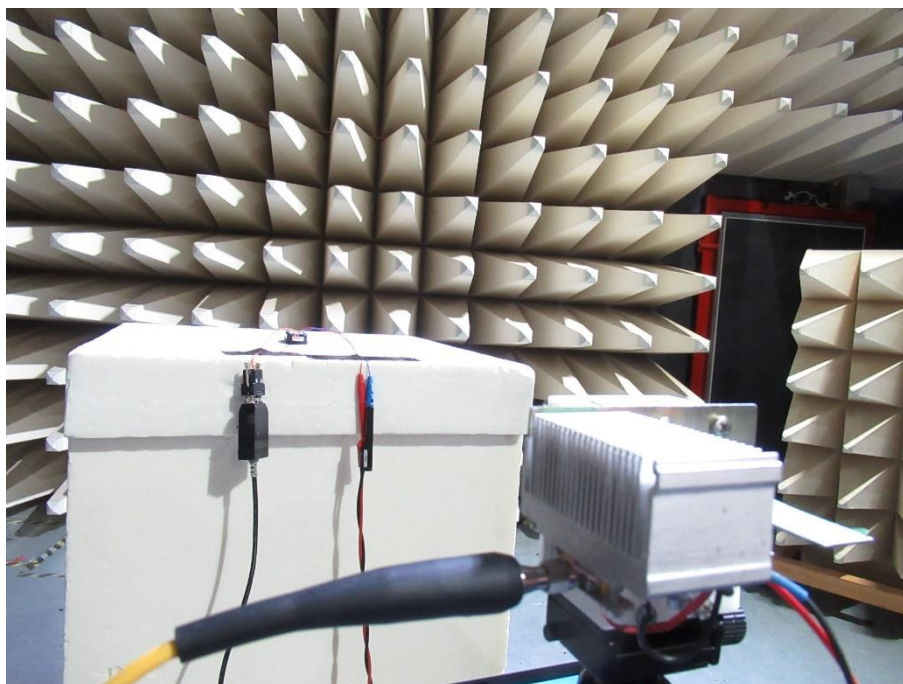
5.3.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23



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	Sweep time: 1ms per MHz

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
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)
49.25	-0.4	3.3	17.5	18.8	17.1	22.1	40.0	-17.9
96.00	10.0	21.1	14.4	13.4	24.4	34.5	43.5	-9.0
236.97	1.2	1.4	18.3	18.1	19.5	19.5	46.0	-26.5
341.00	-2.8	-3.5	21.4	21.8	18.6	18.3	46.0	-27.4
462.21	-1.2	-3.5	24.7	25.1	23.5	21.6	46.0	-22.5
573.65	-4.1	-4.3	27.4	27.8	23.3	23.5	46.0	-22.5
720.00	-3.3	-3.2	29.9	30.4	26.6	27.2	46.0	-18.8

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.

5.3.5.3 Measurement 960 MHz to 40 GHz

According to § 15.521(c), missions from digital circuitry used to enable the operation of the UWB transmitter shall comply with the limits in § 15.209. The average limit is given by 54dBμV/m at 3 meter distance, which corresponds to an EIRP of -41.3 dBm according to ANSI C63.10 2013 clause 10.3.9.

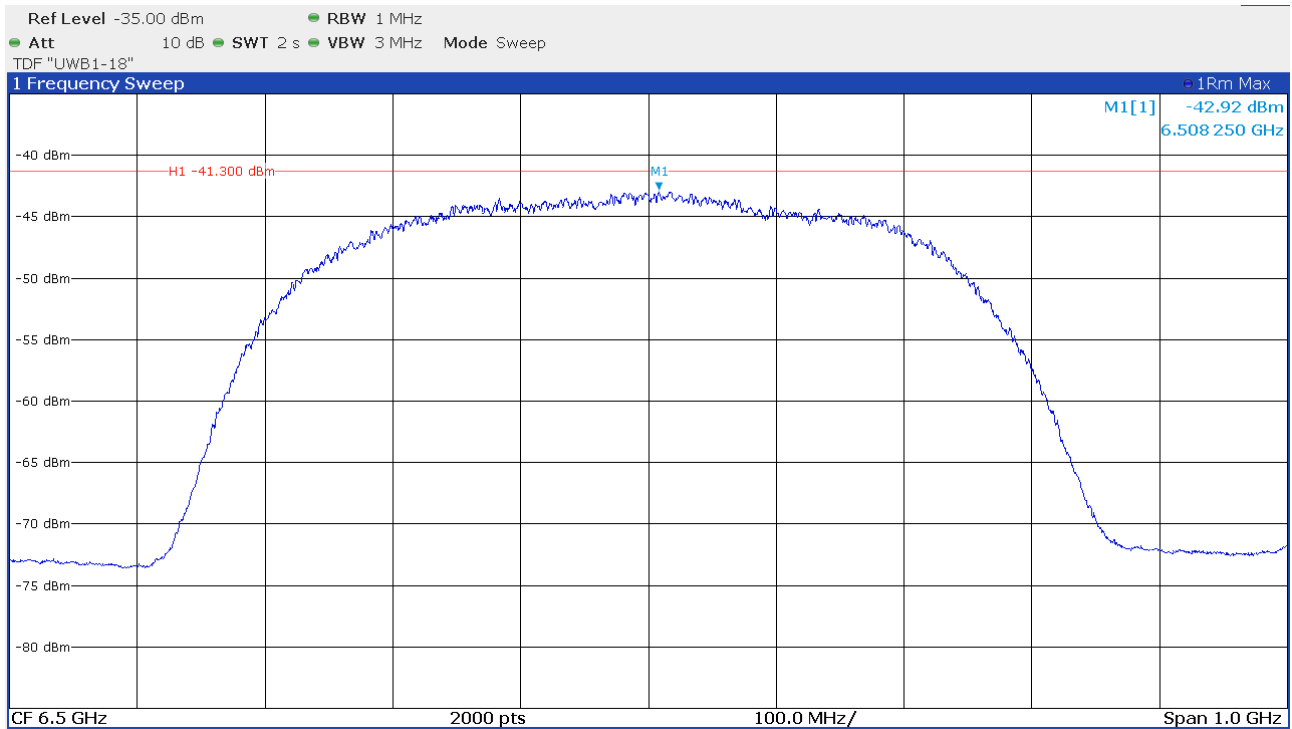
As proven in the following measurements, no emissions outside the UWB transmission can be detected in the frequency range 960 MHz and 40 GHz and the highest emissions occurs by the UWB emission itself, which lies under the UWB limit of -41.3 dBm. Therefore, the requirements according to § 15.209 can be regarded as fulfilled.

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.

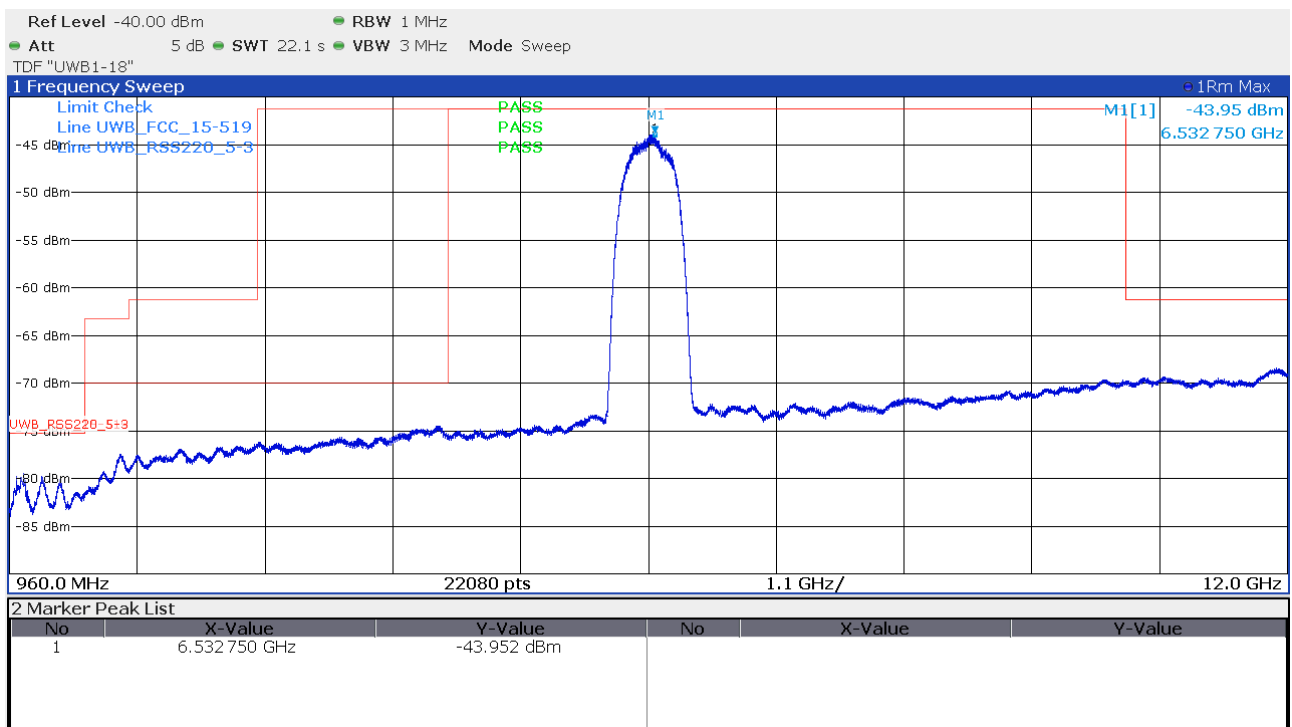
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

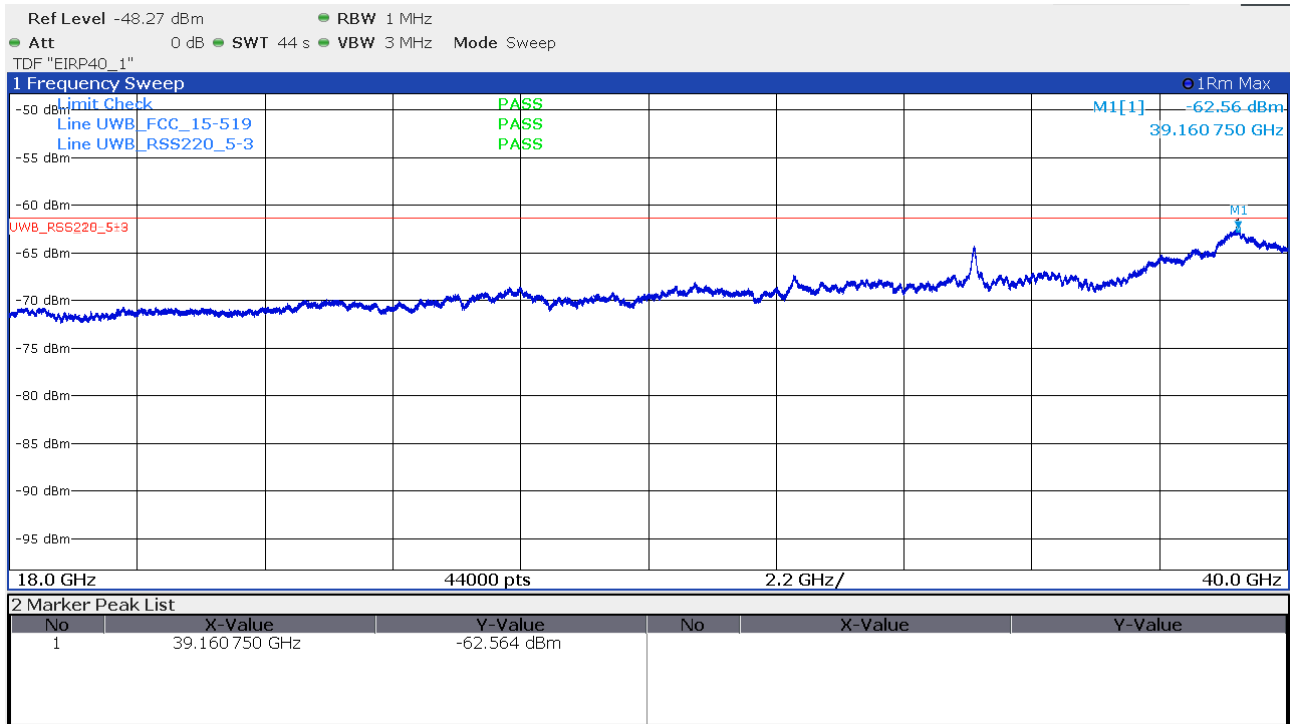
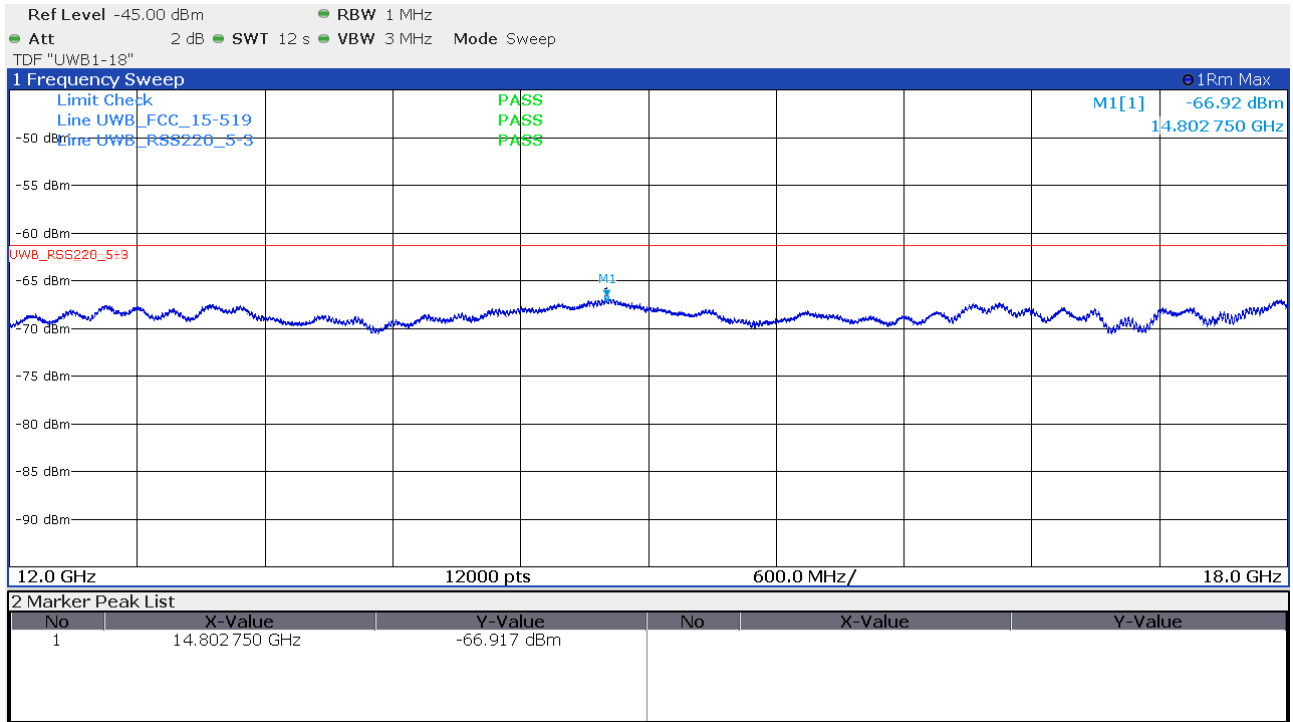
Channel 5 antenna 1

Mean Power



960 MHz to 40 GHz

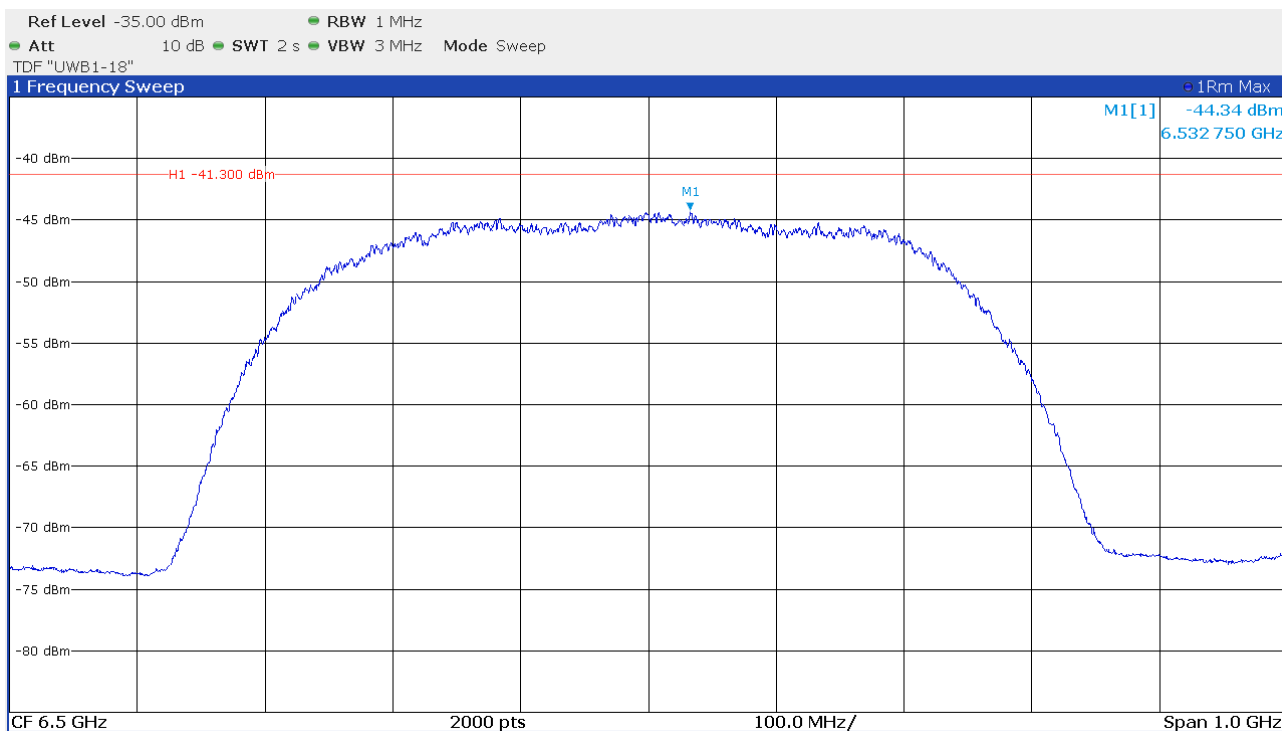


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


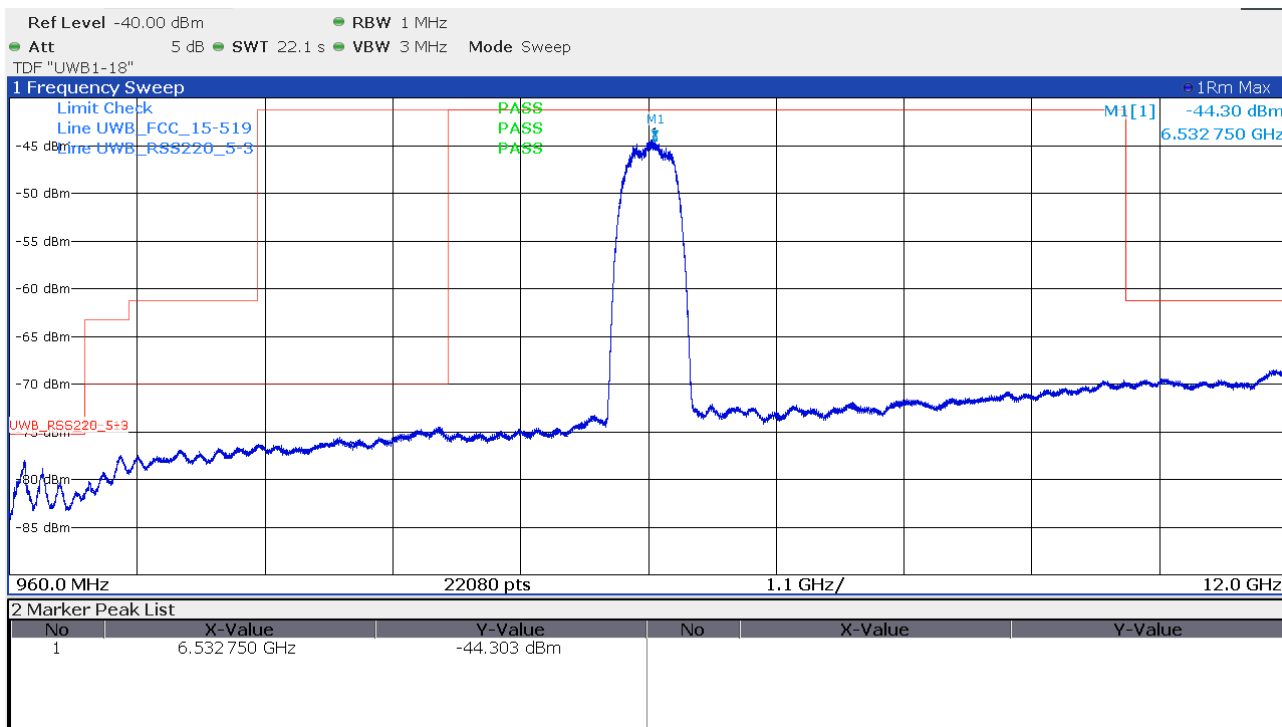
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

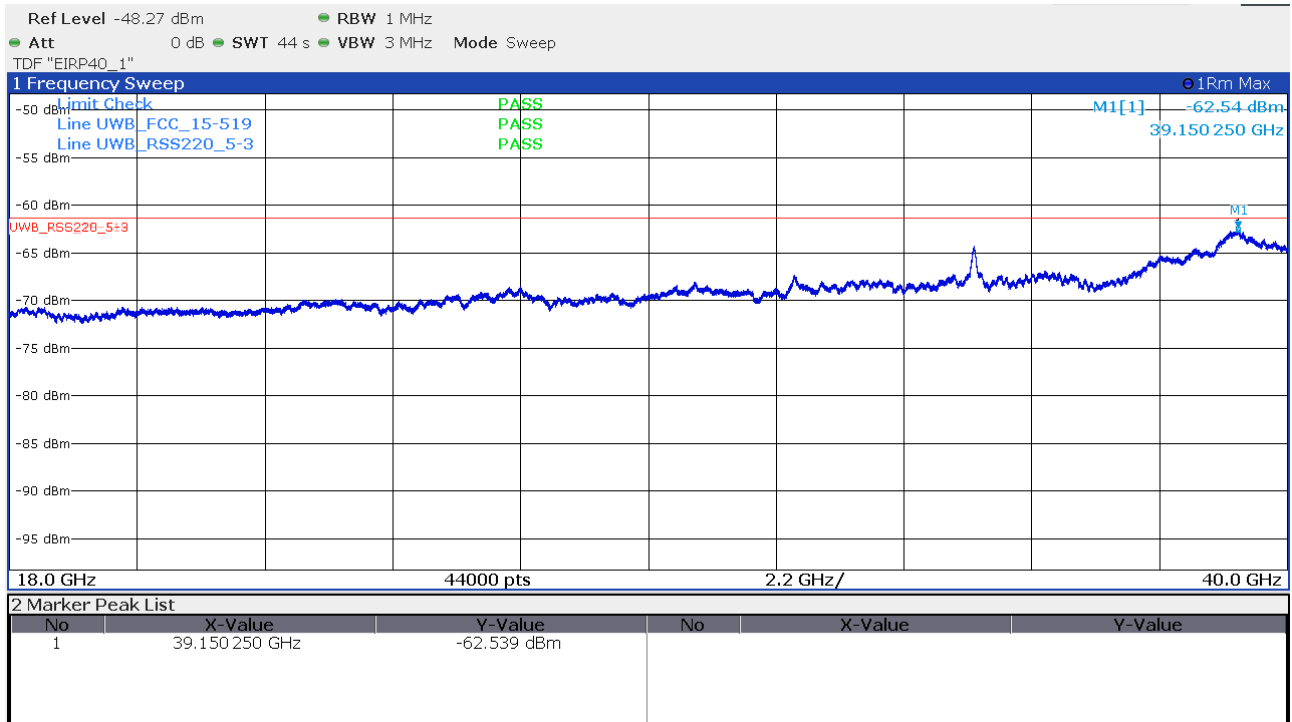
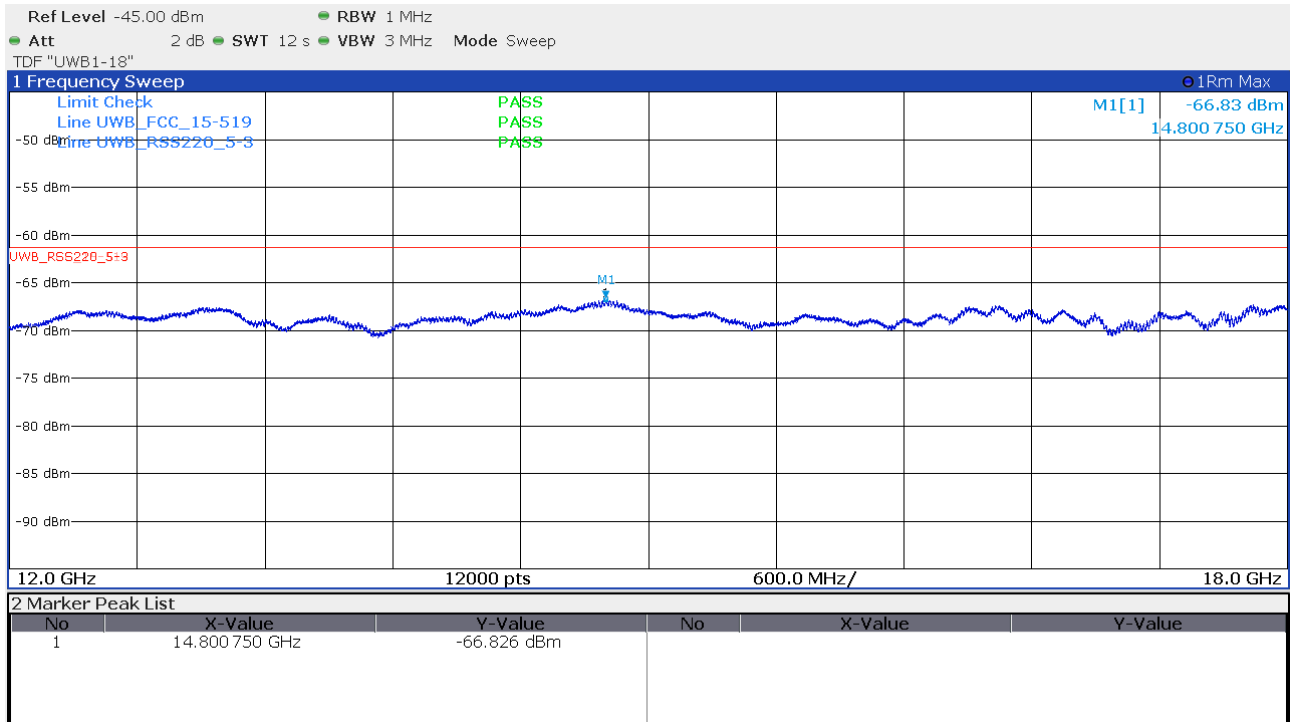
Channel 5 antenna 2

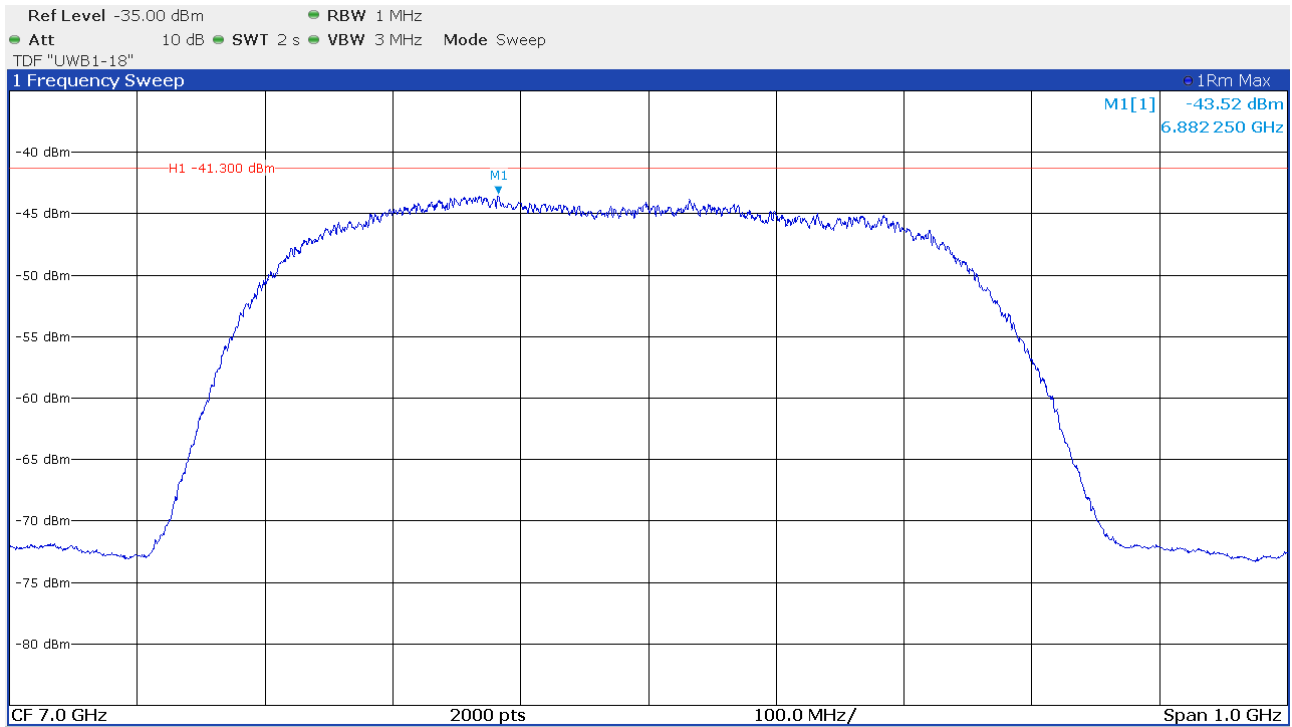
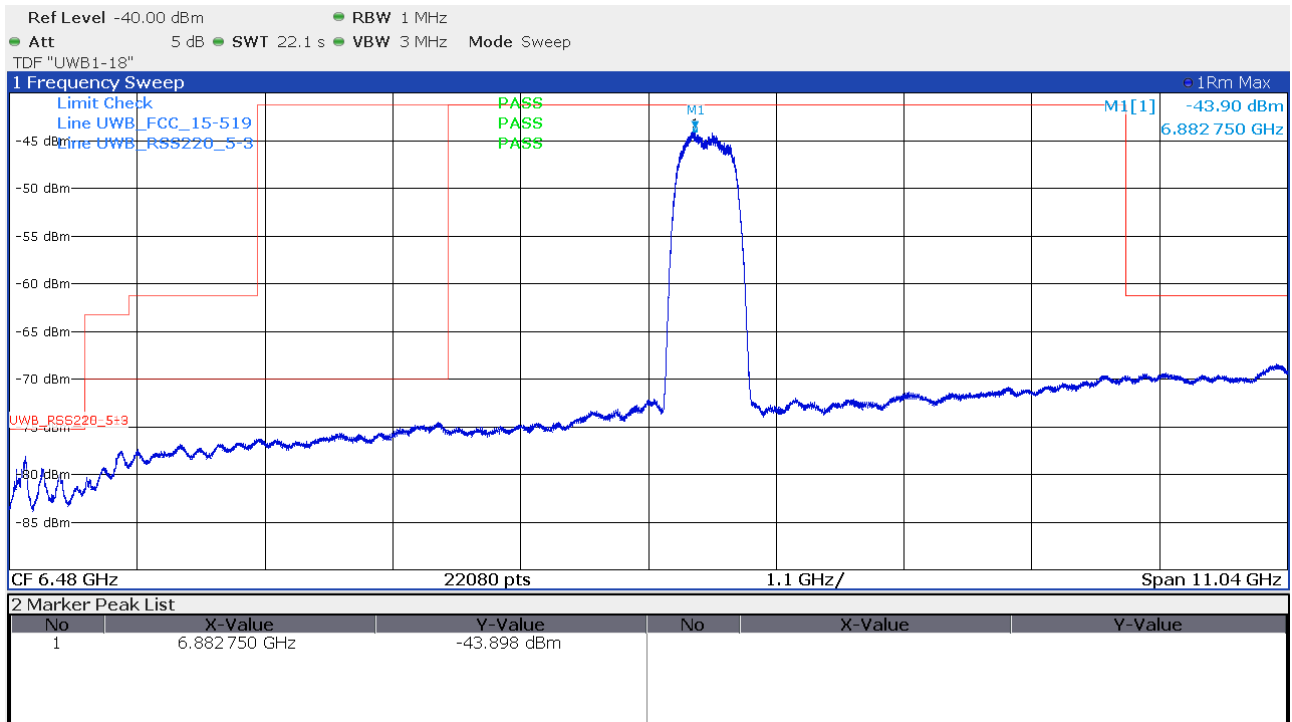
Mean Power



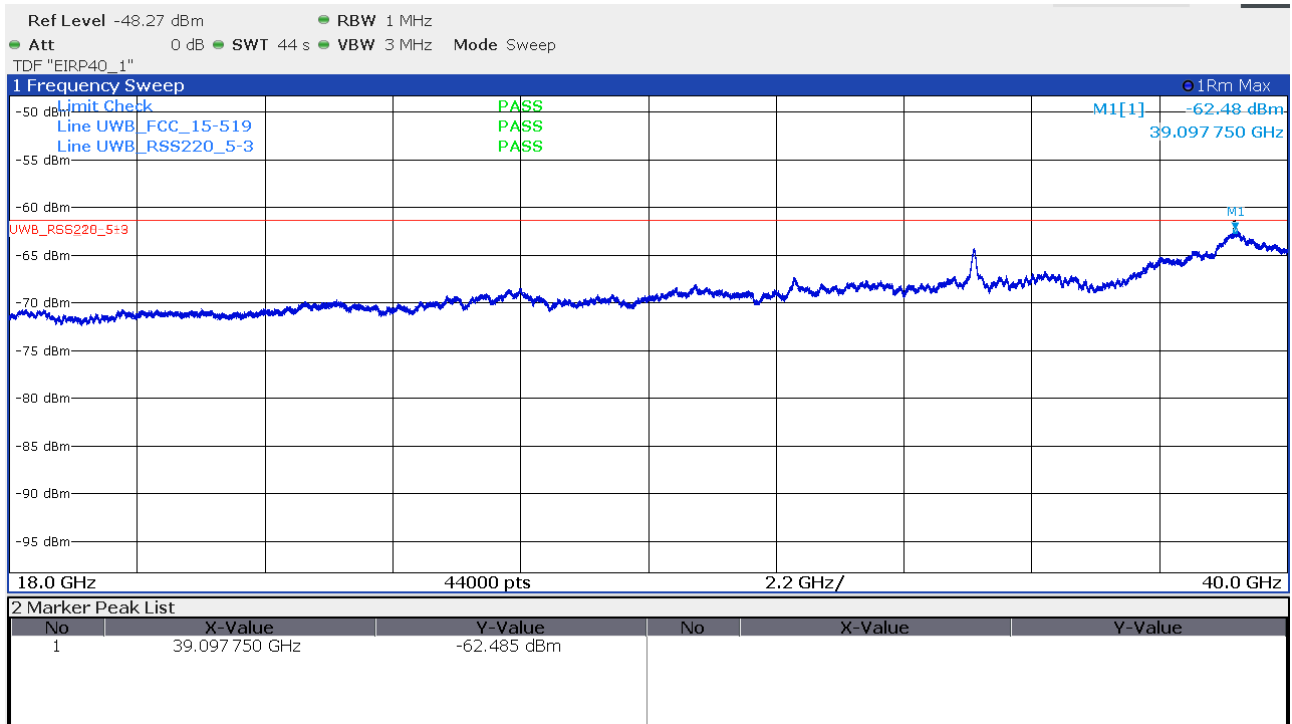
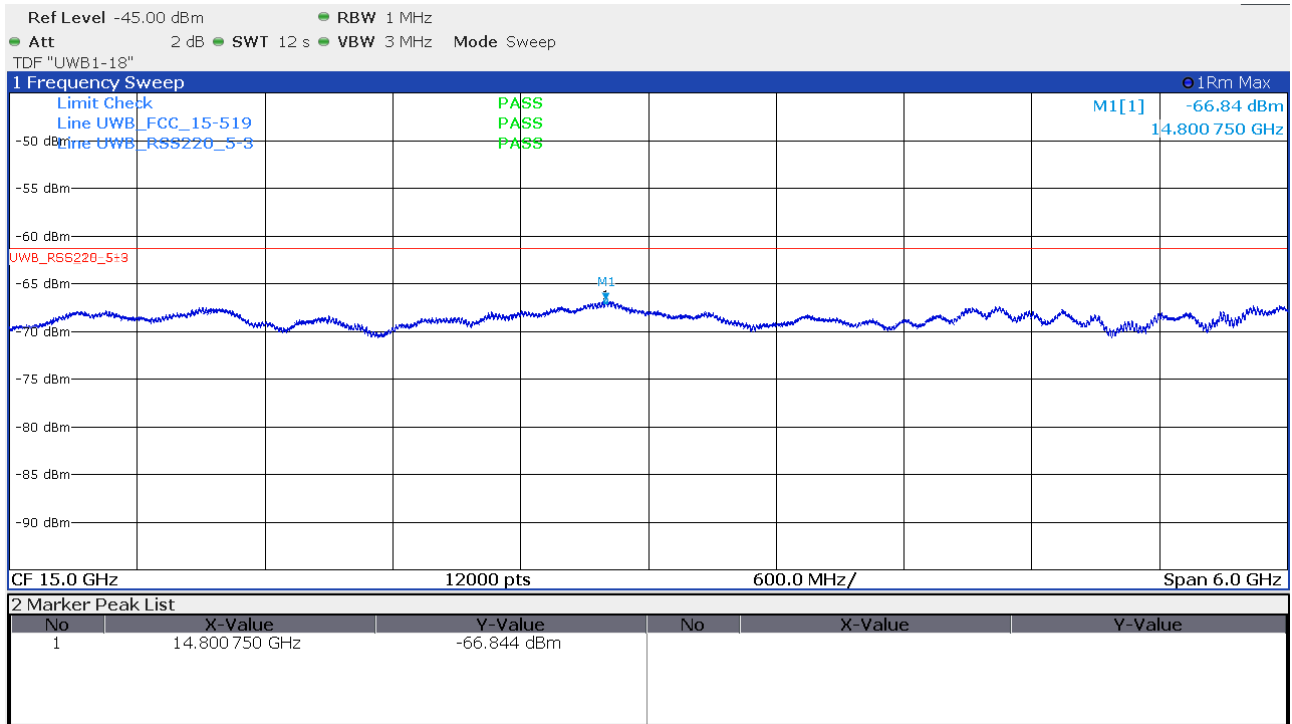
960 MHz to 40 GHz

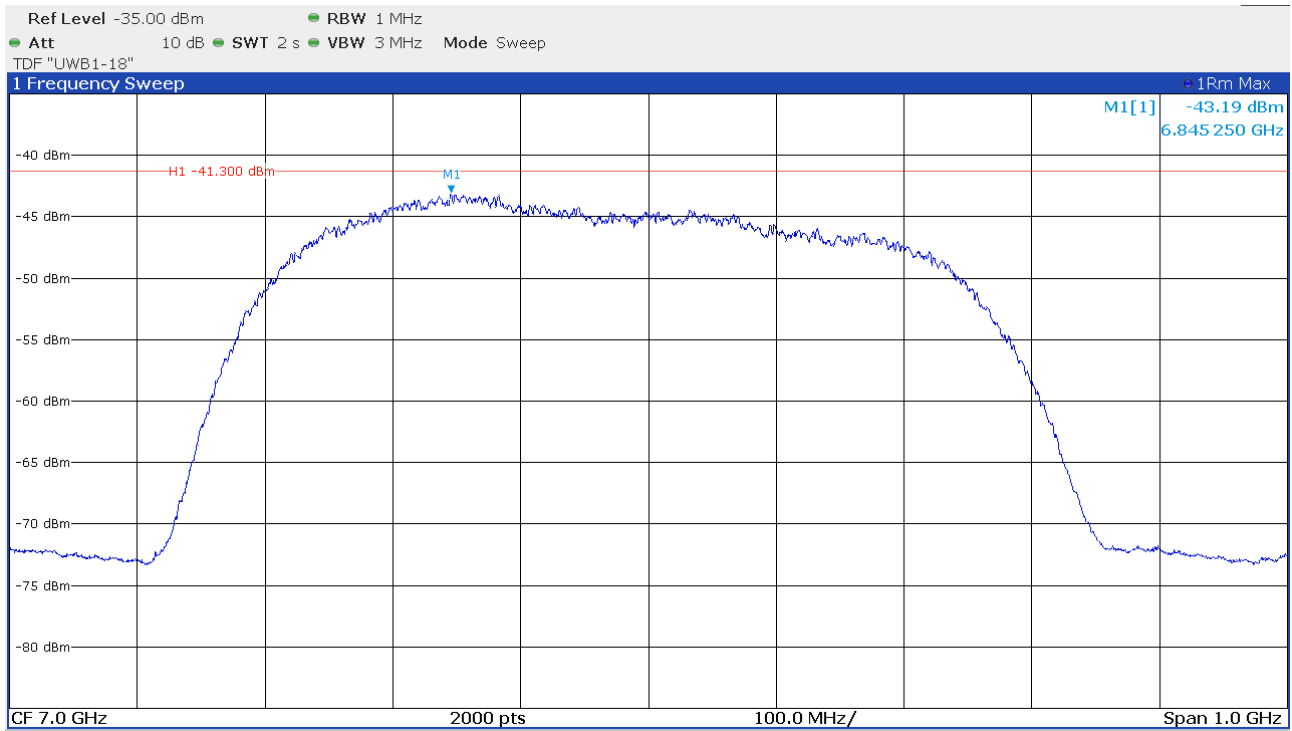
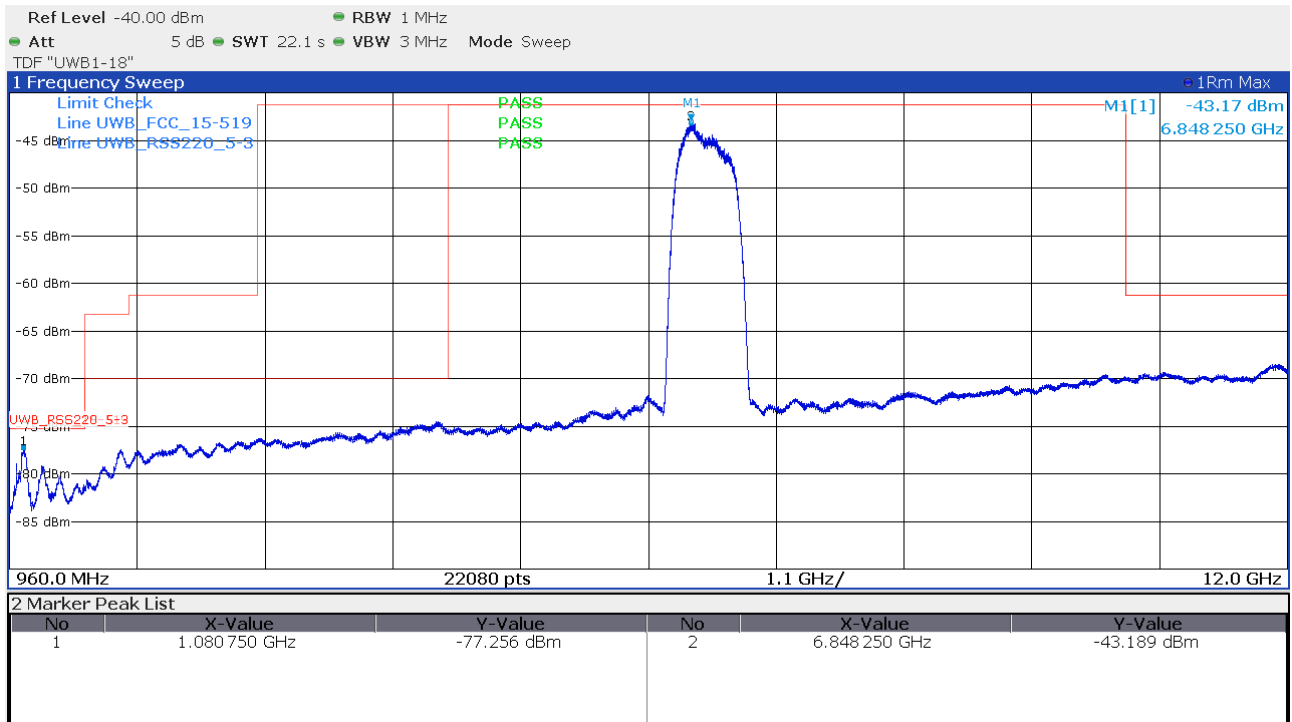


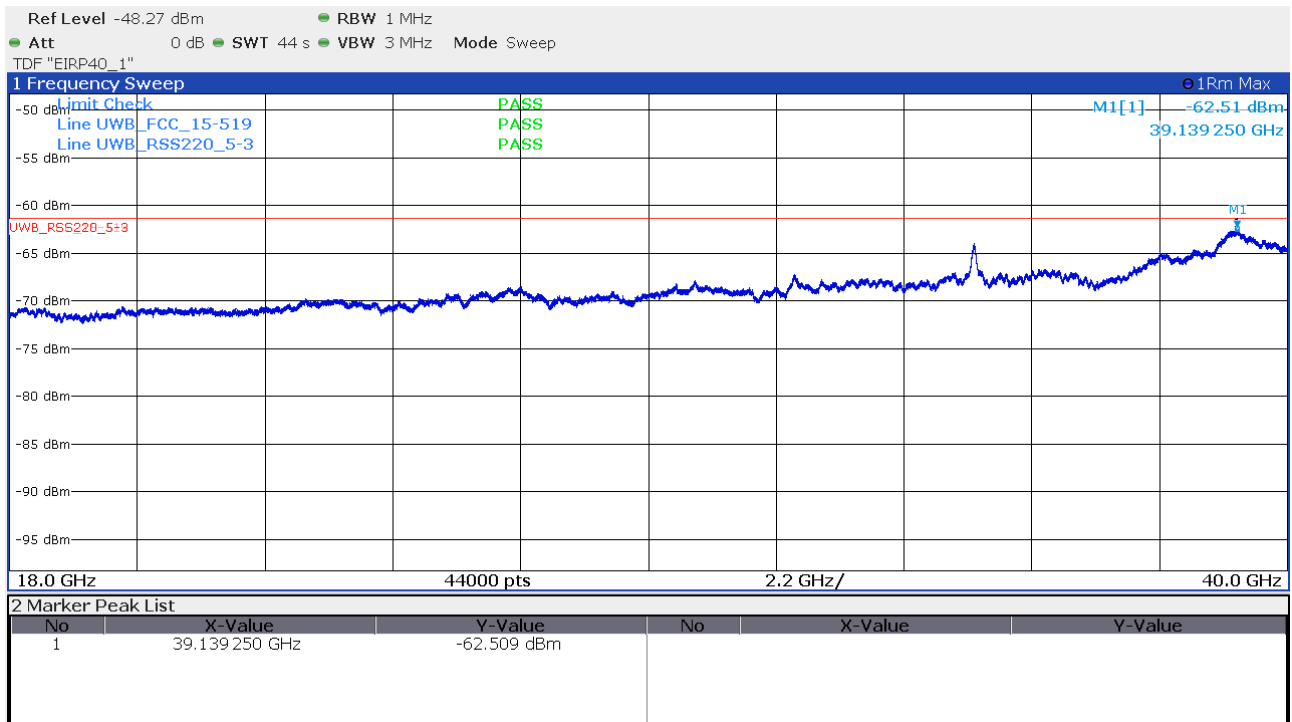
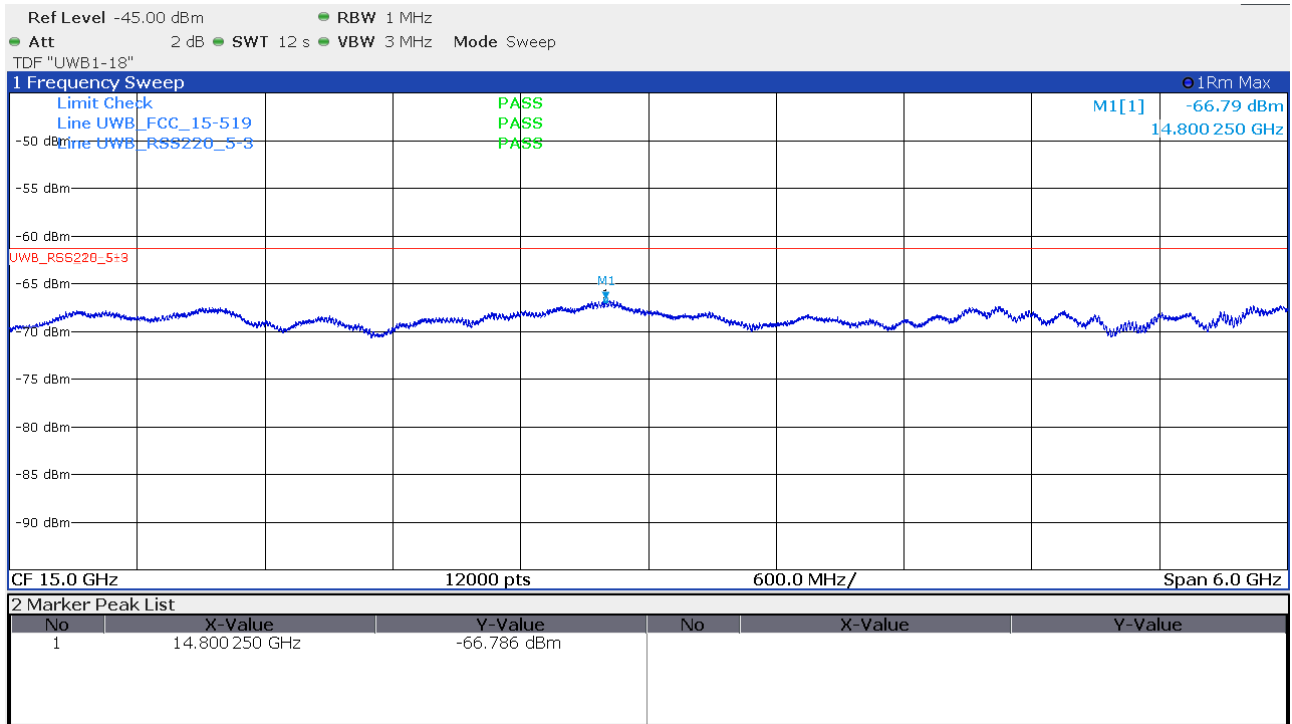
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


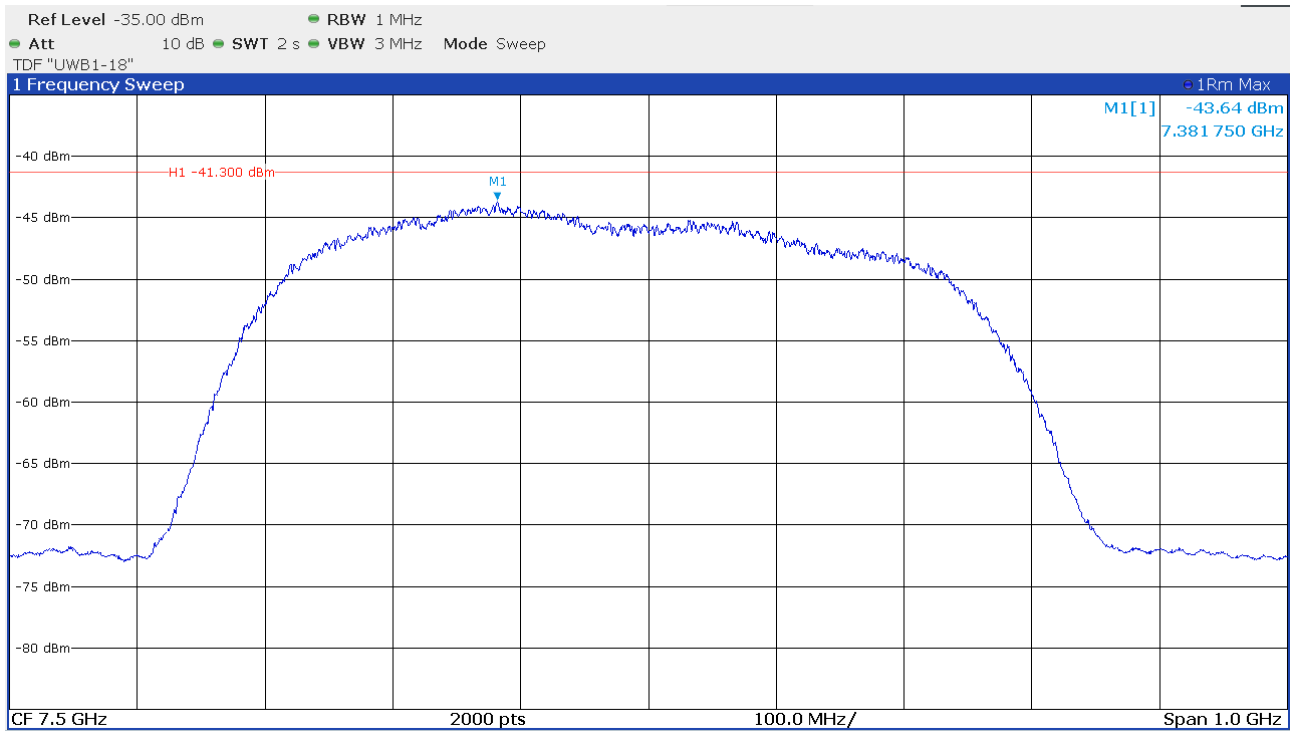
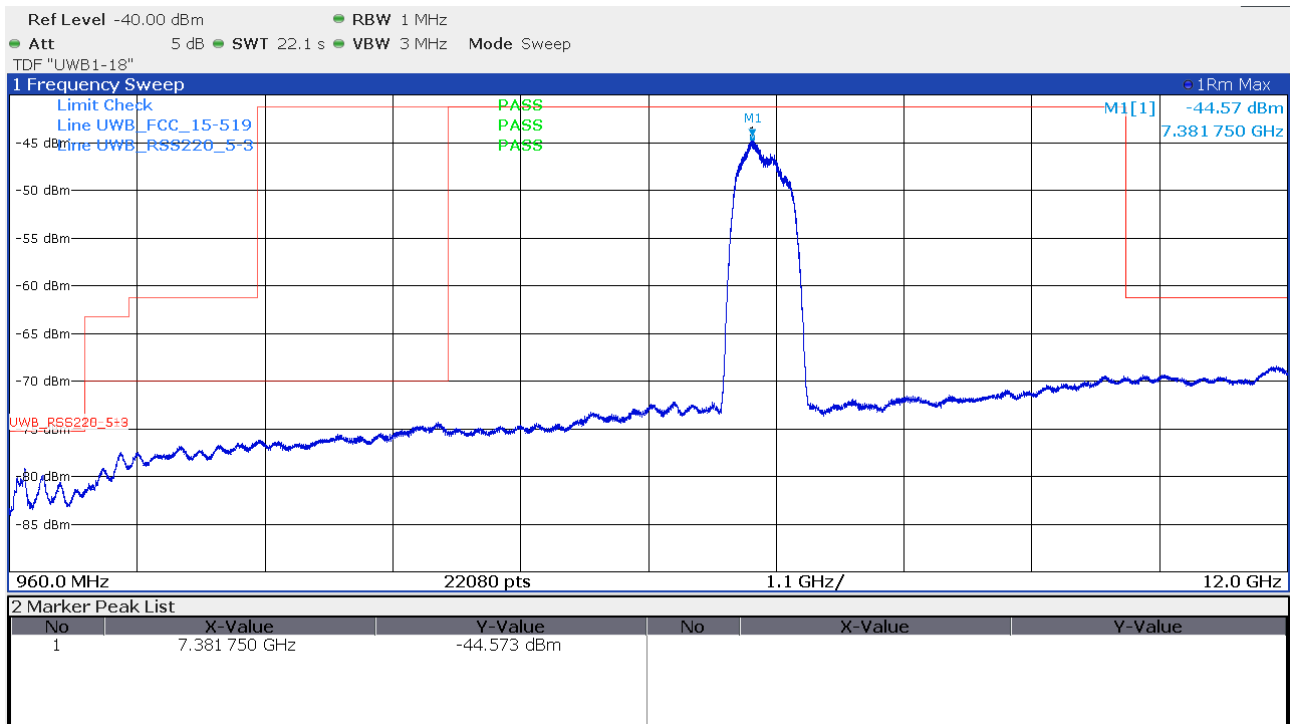
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1
Mean Power

960 MHz to 40 GHz


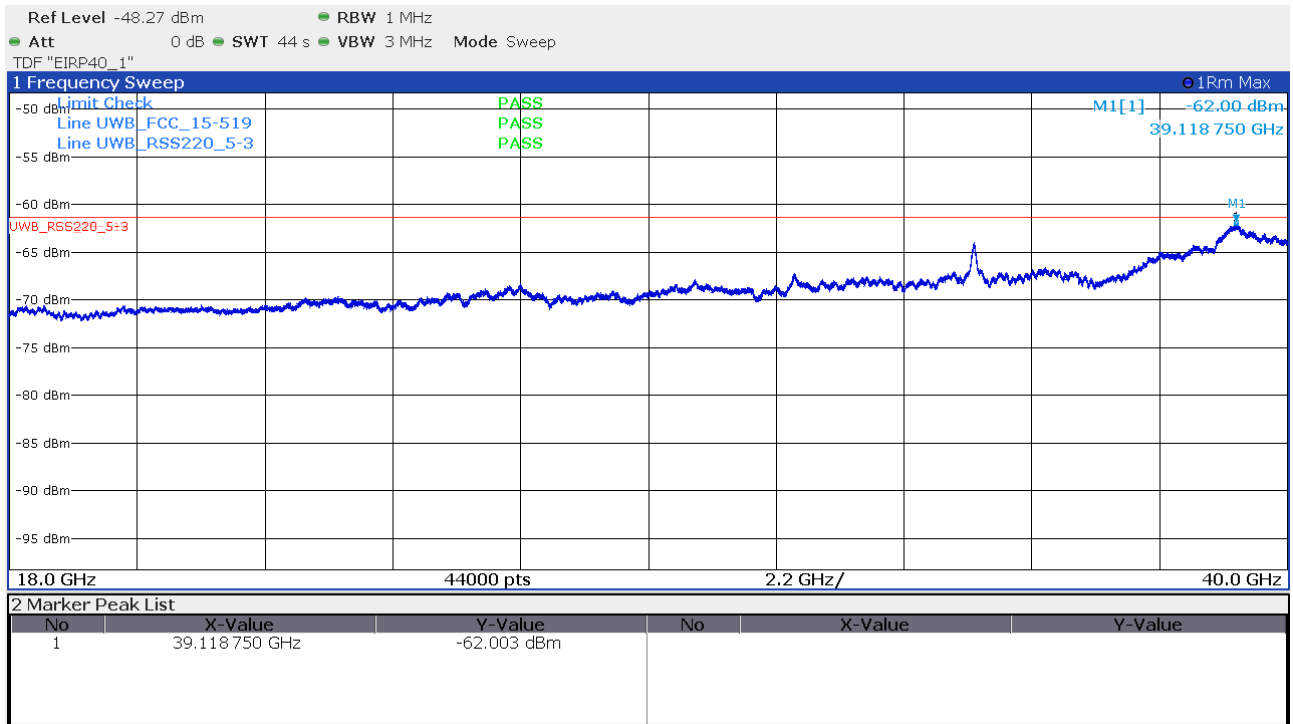
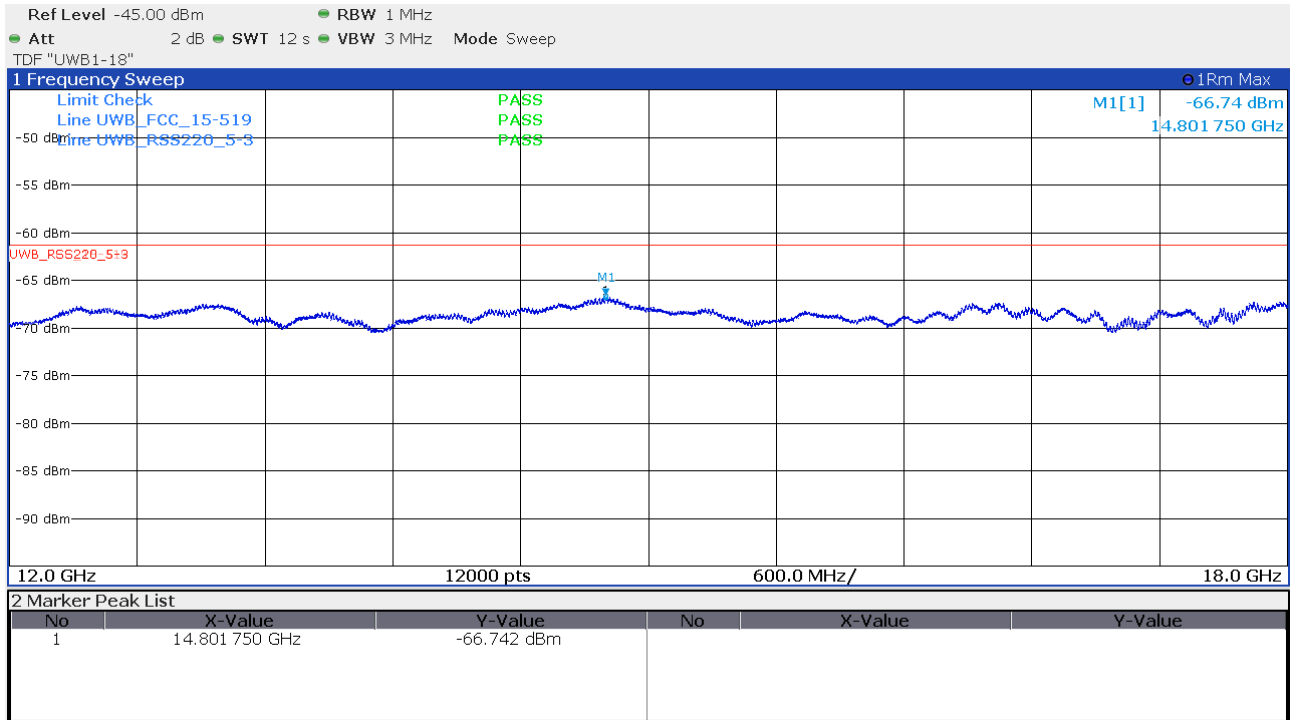
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 2
Mean Power

960 MHz to 40 GHz


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


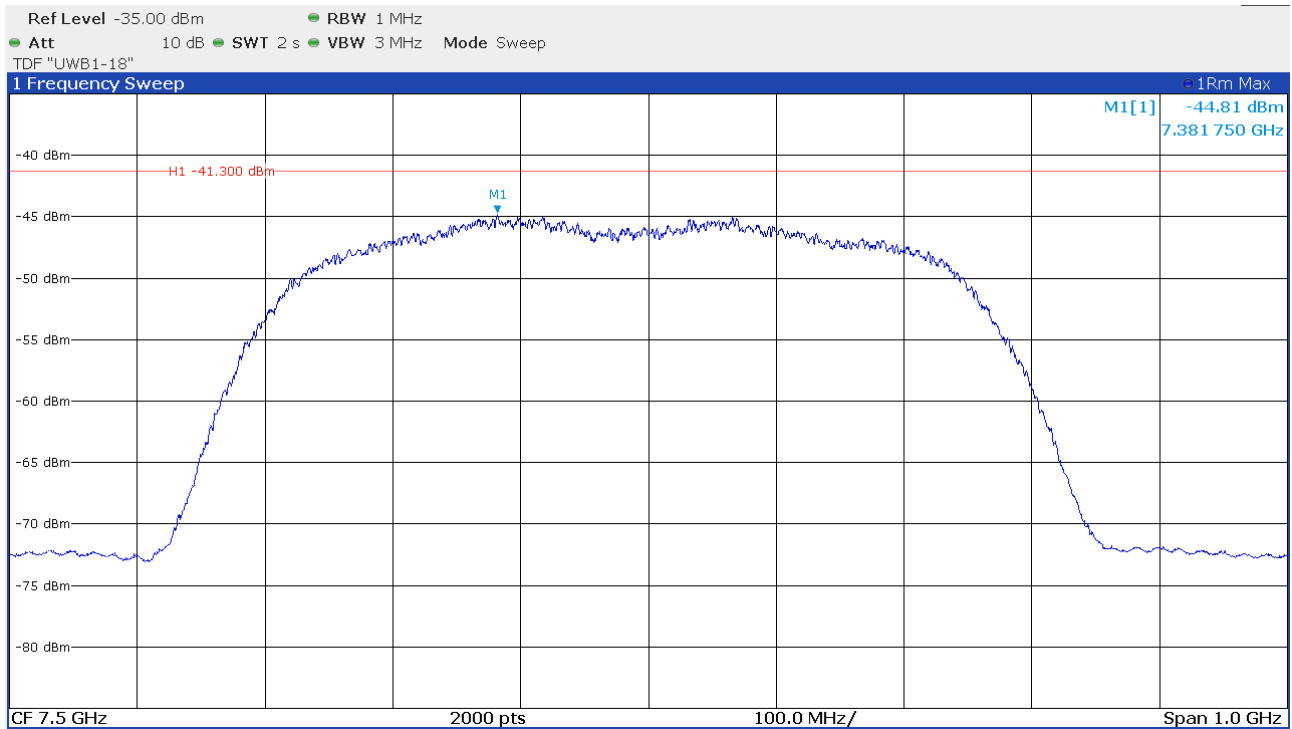
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 1
Mean Power

960 MHz to 40 GHz


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


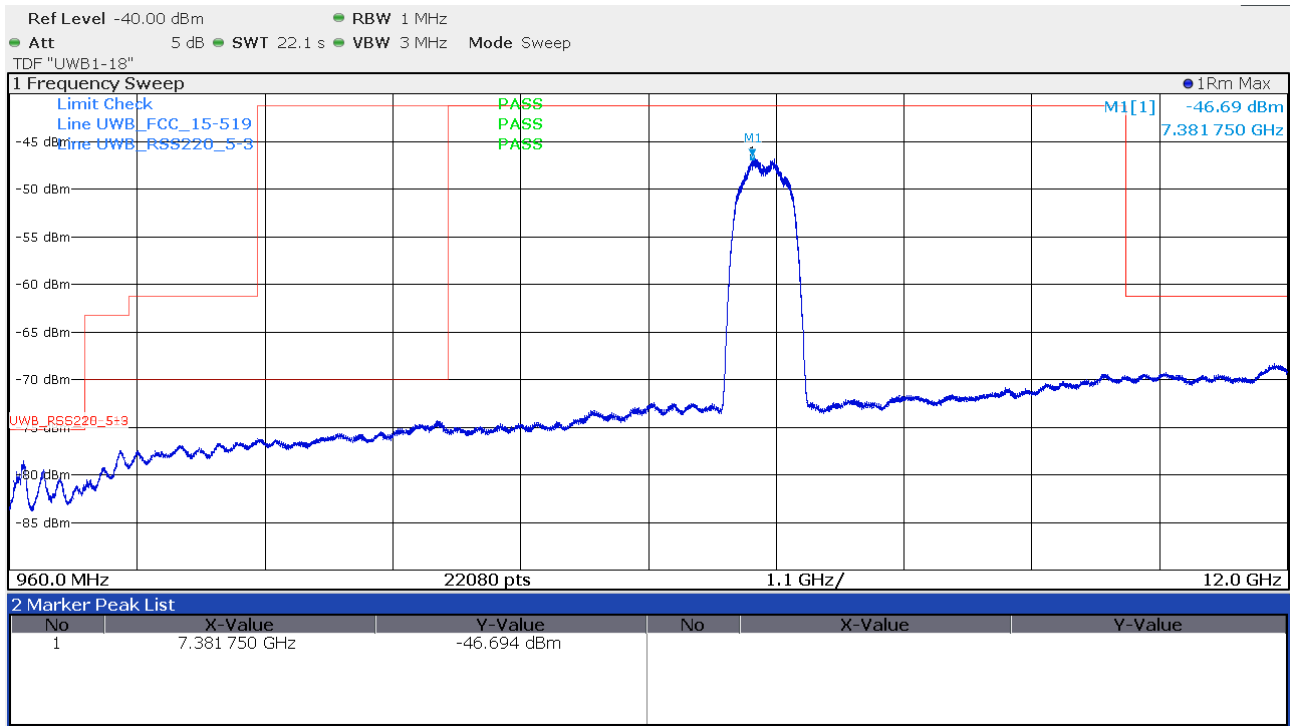
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

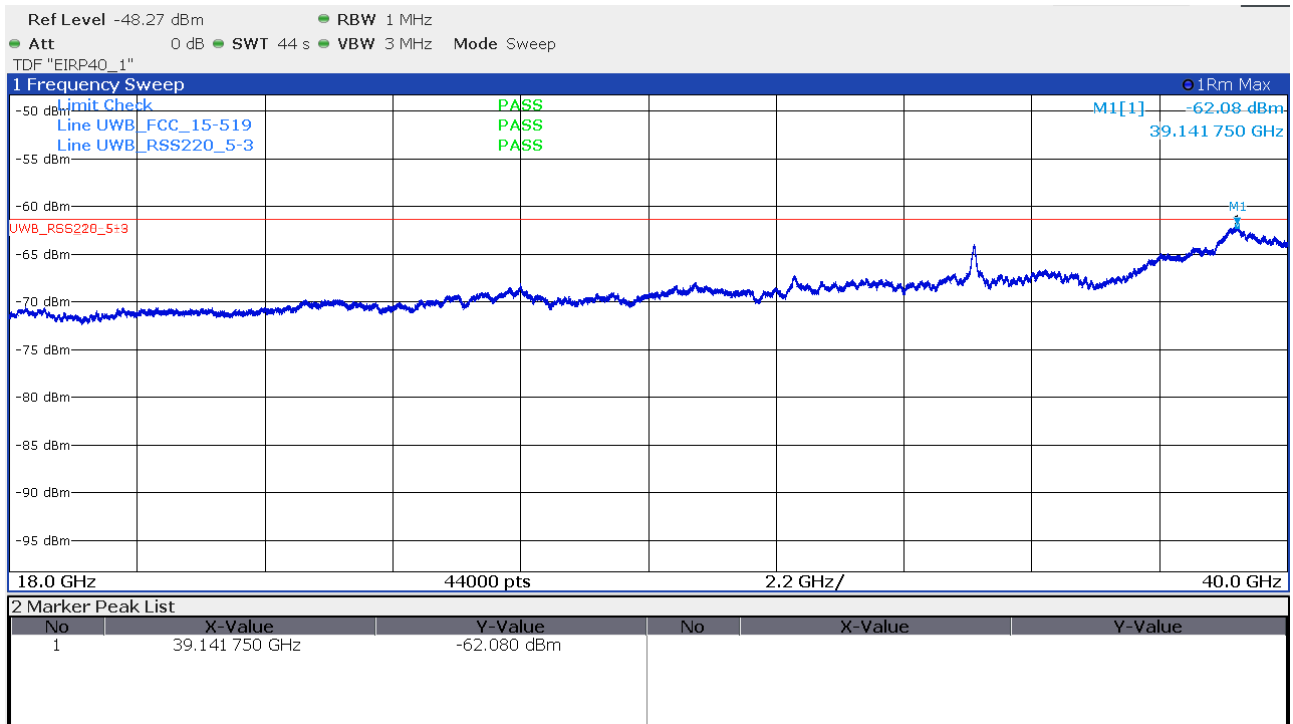
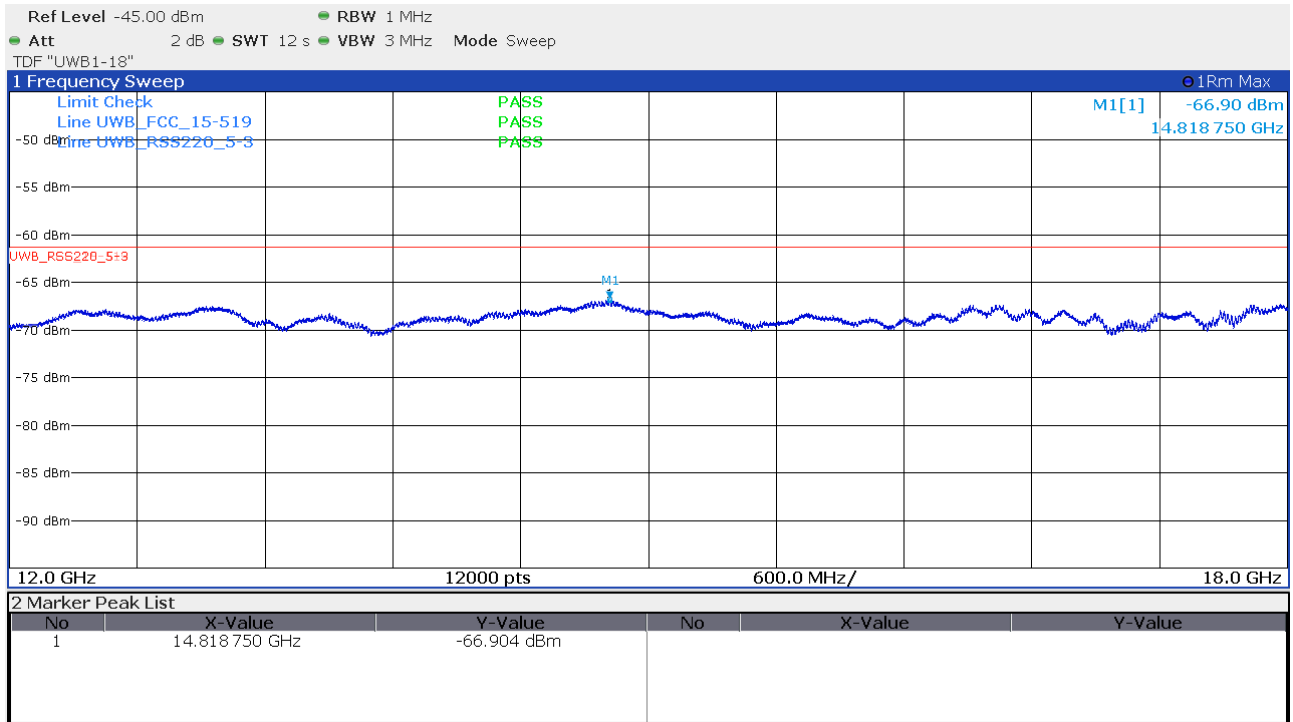
Channel 8 antenna 2

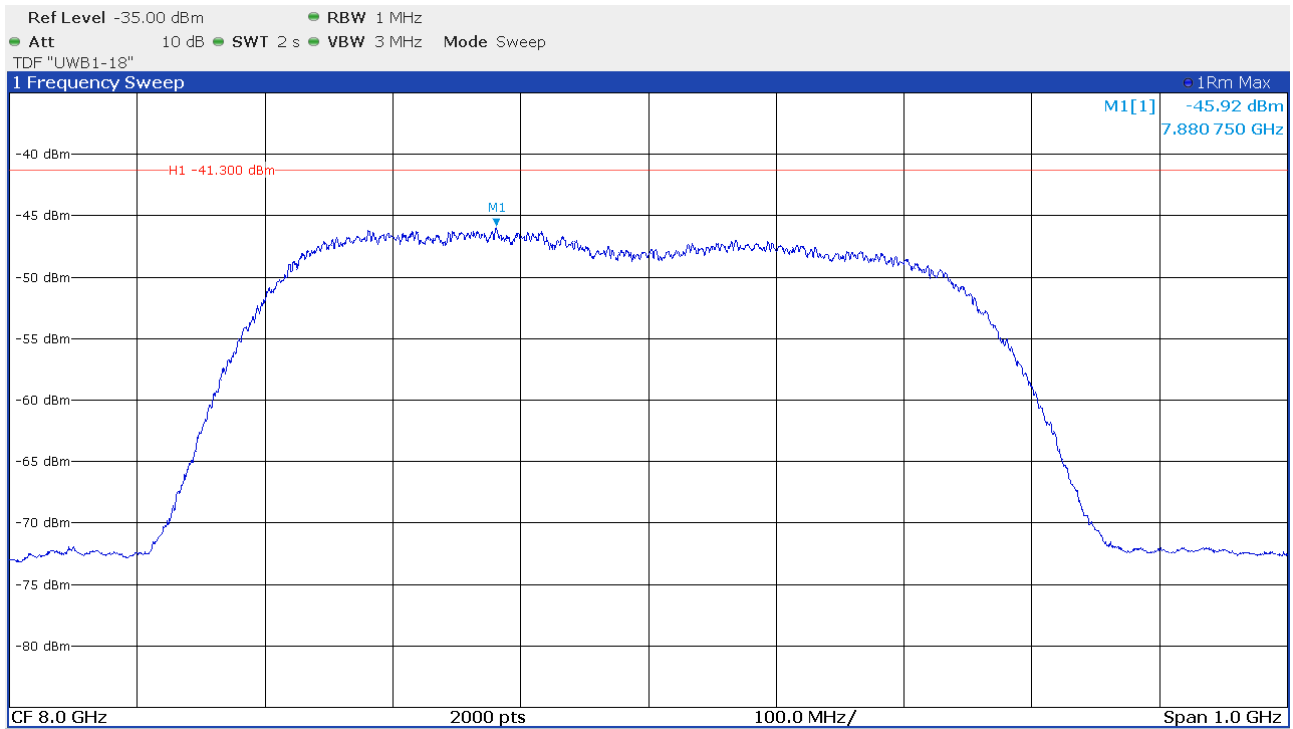
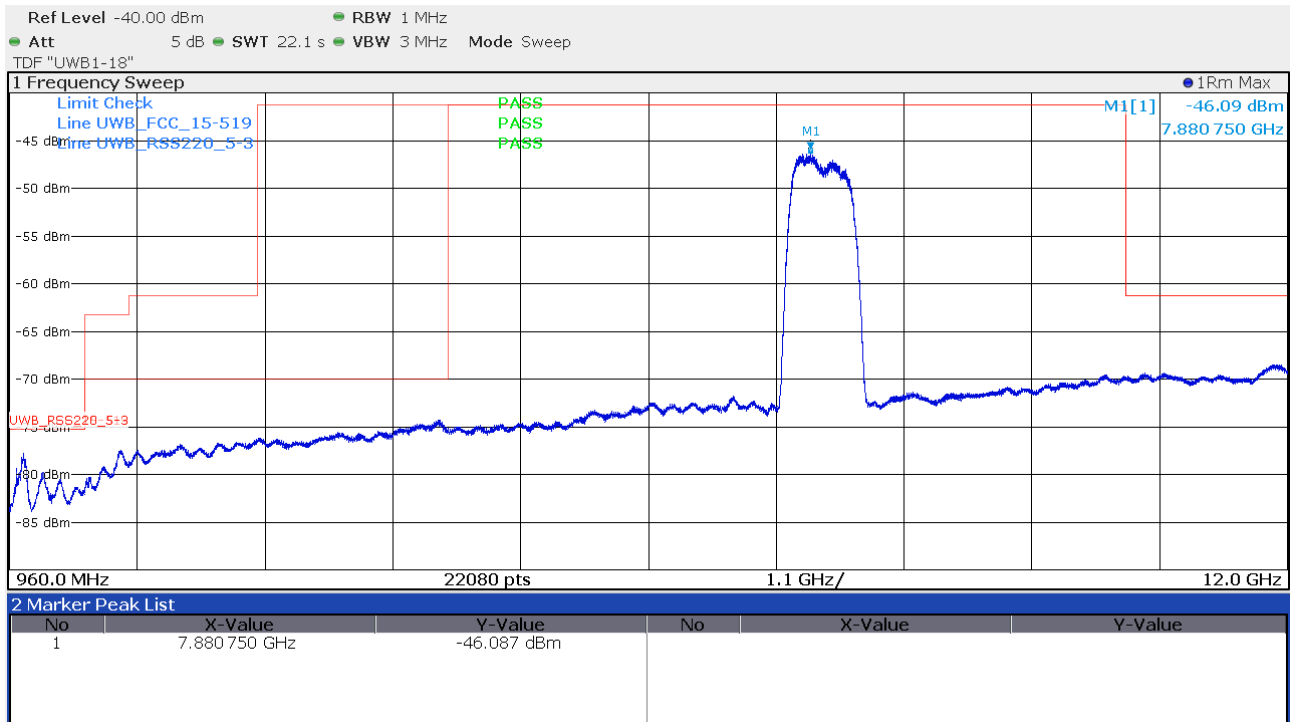
Mean Power

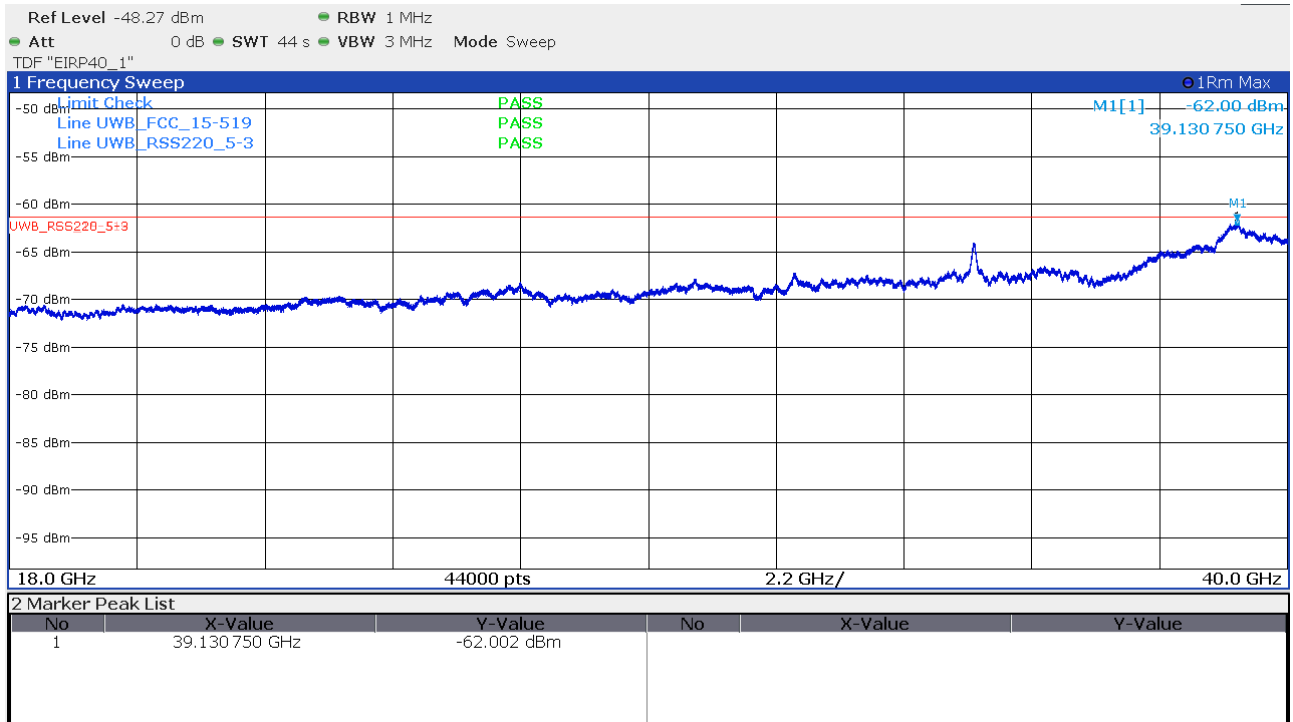
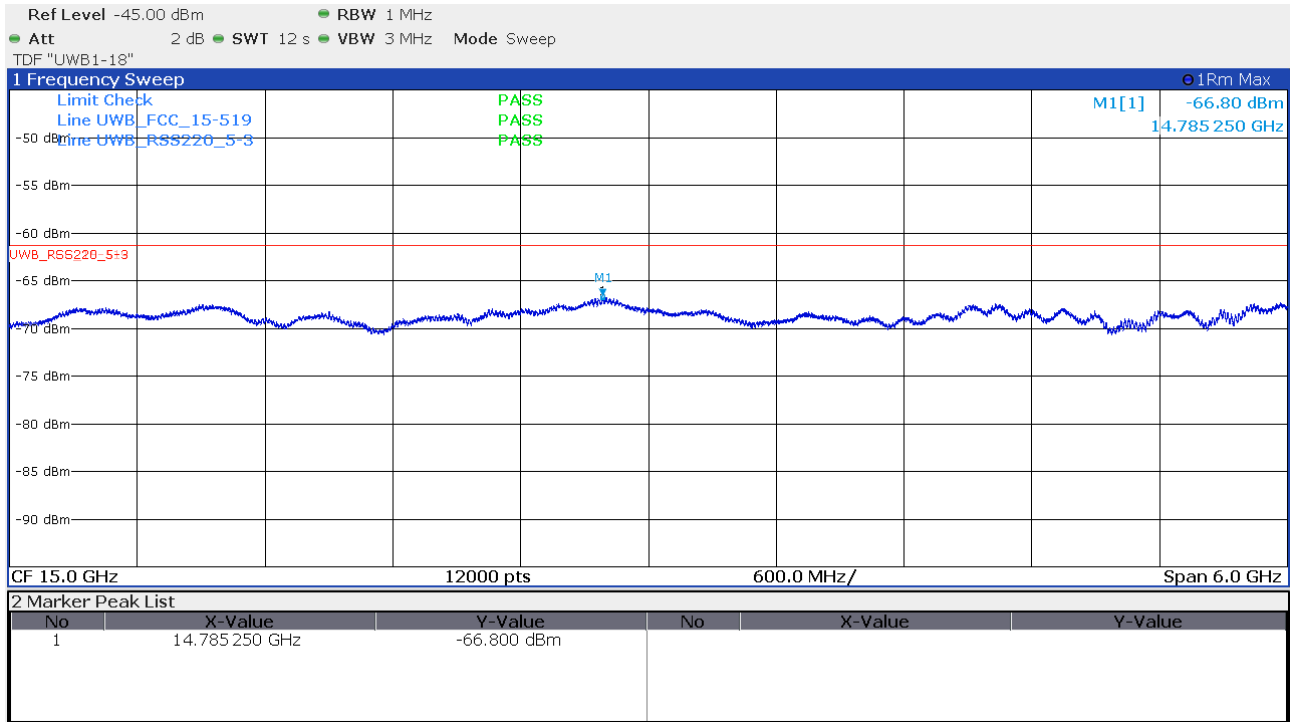


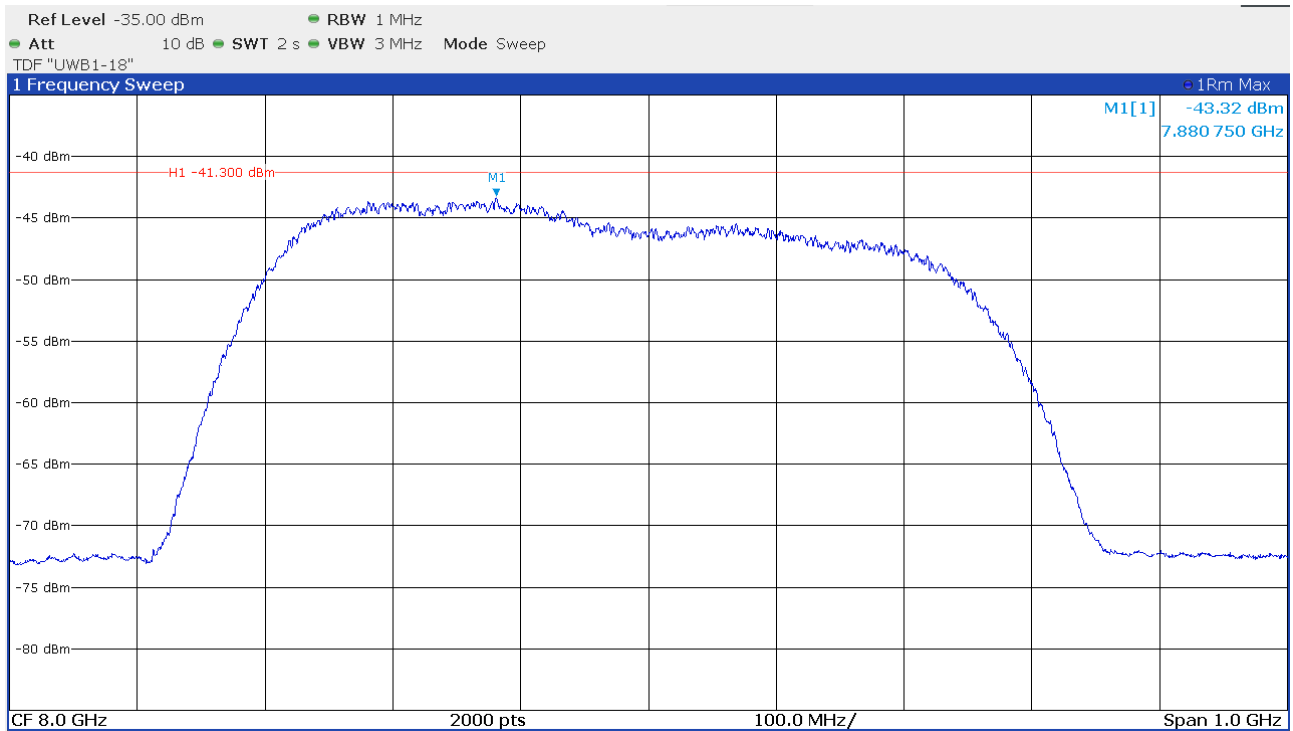
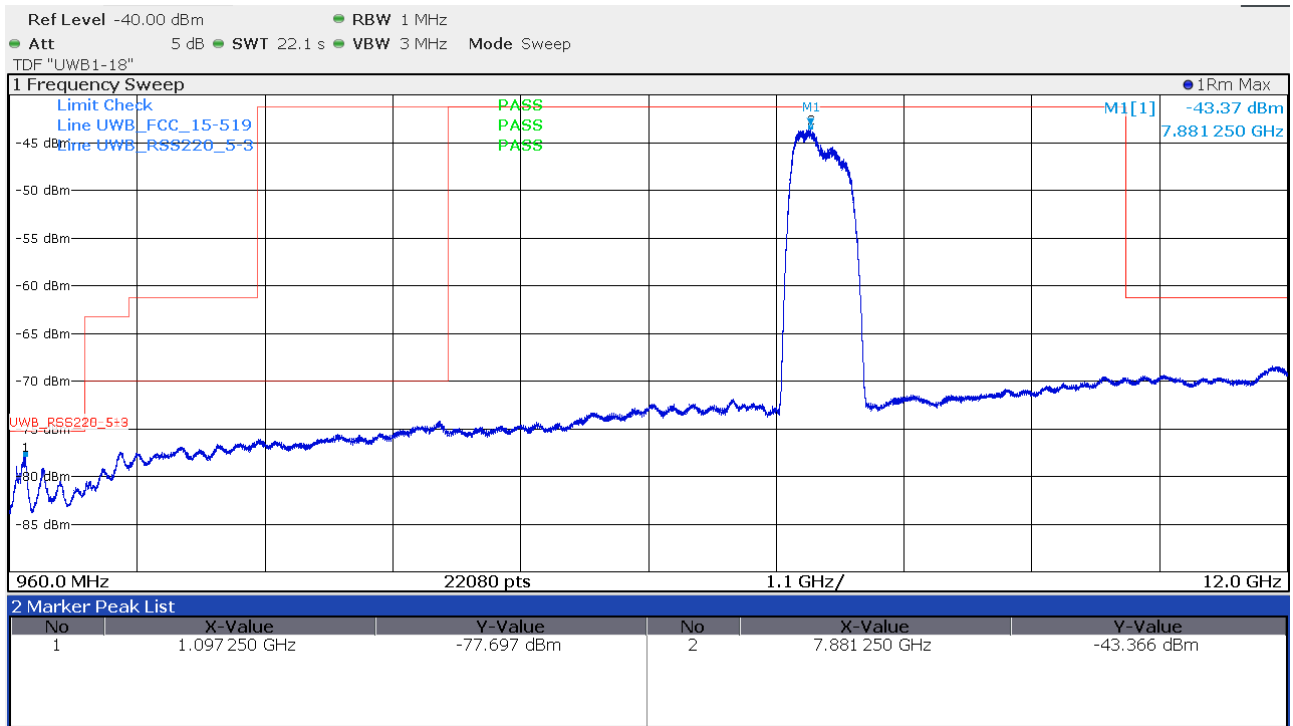
960 MHz to 40 GHz

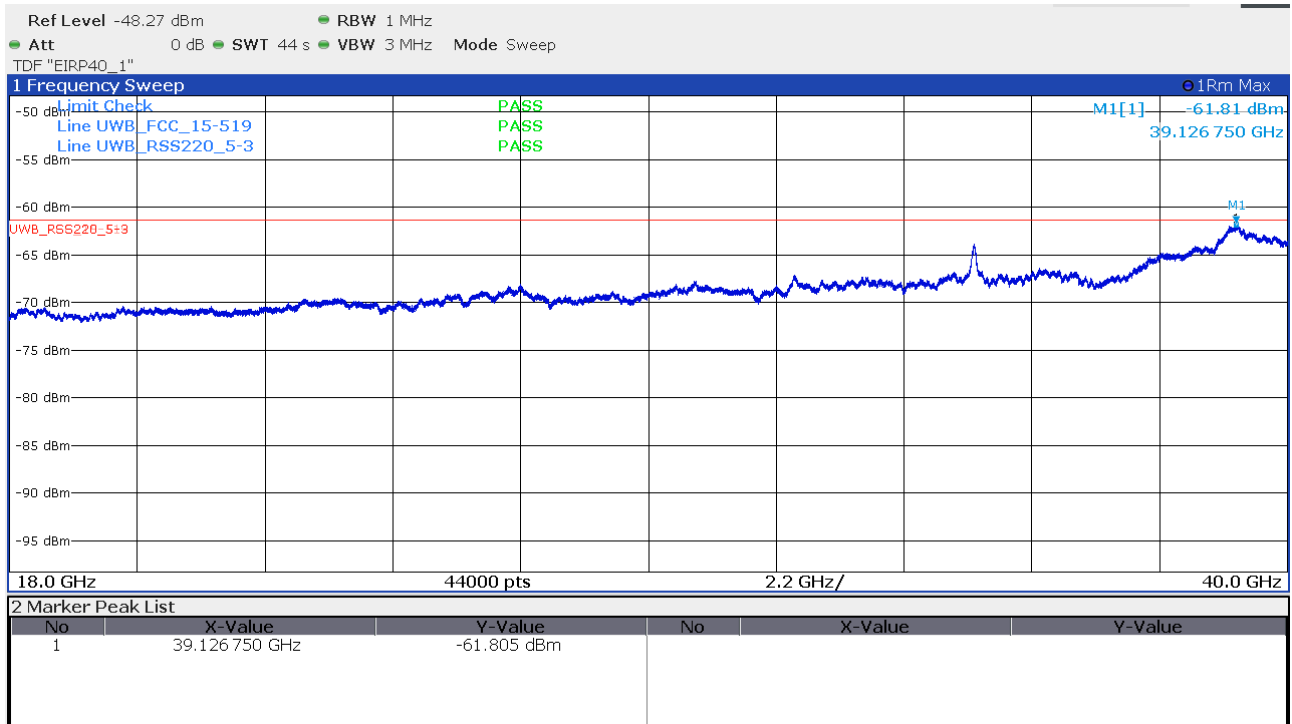
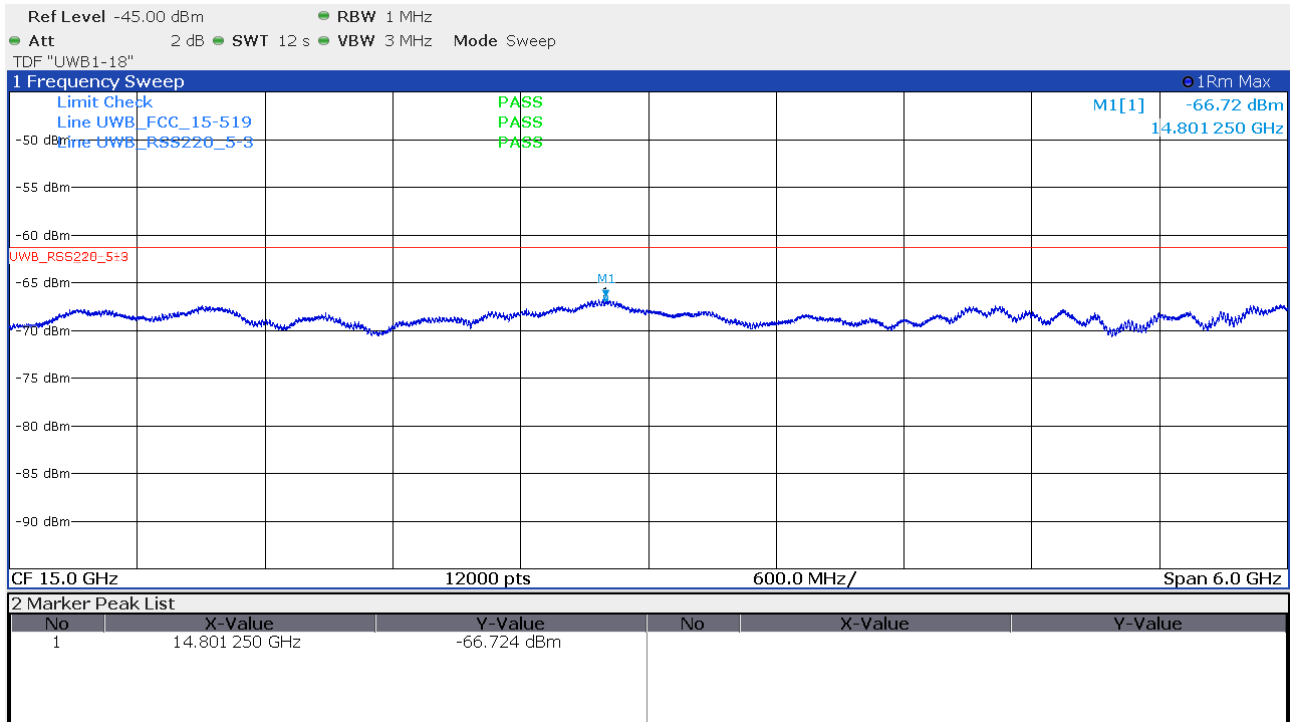


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 1
Mean Power

960 MHz to 40 GHz


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 2
Mean Power

960 MHz to 40 GHz


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
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: KR5FBD5MY23 IC: 7812D-FBD5MY23

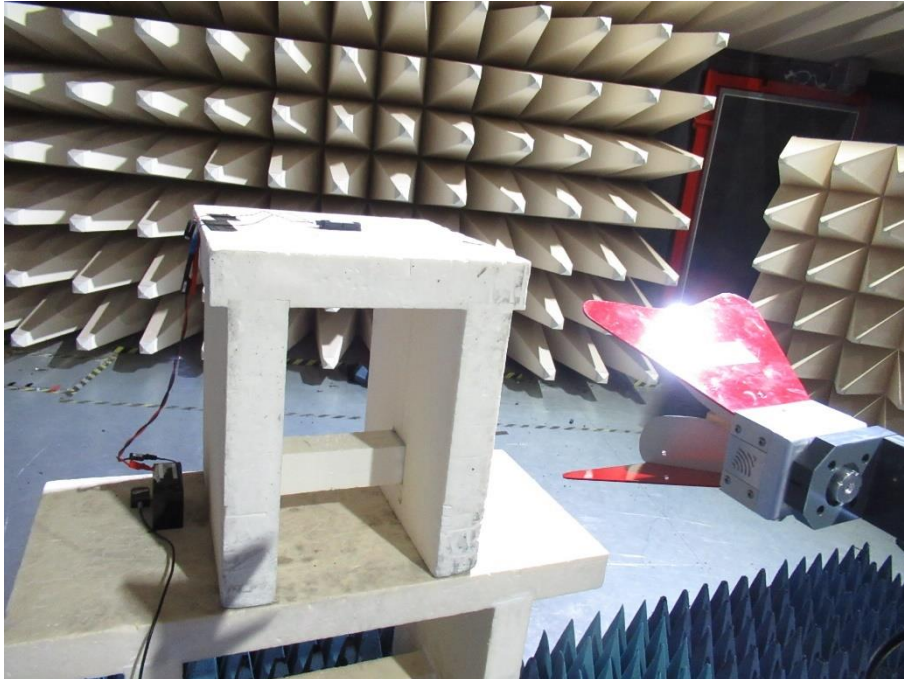
5.4 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz

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

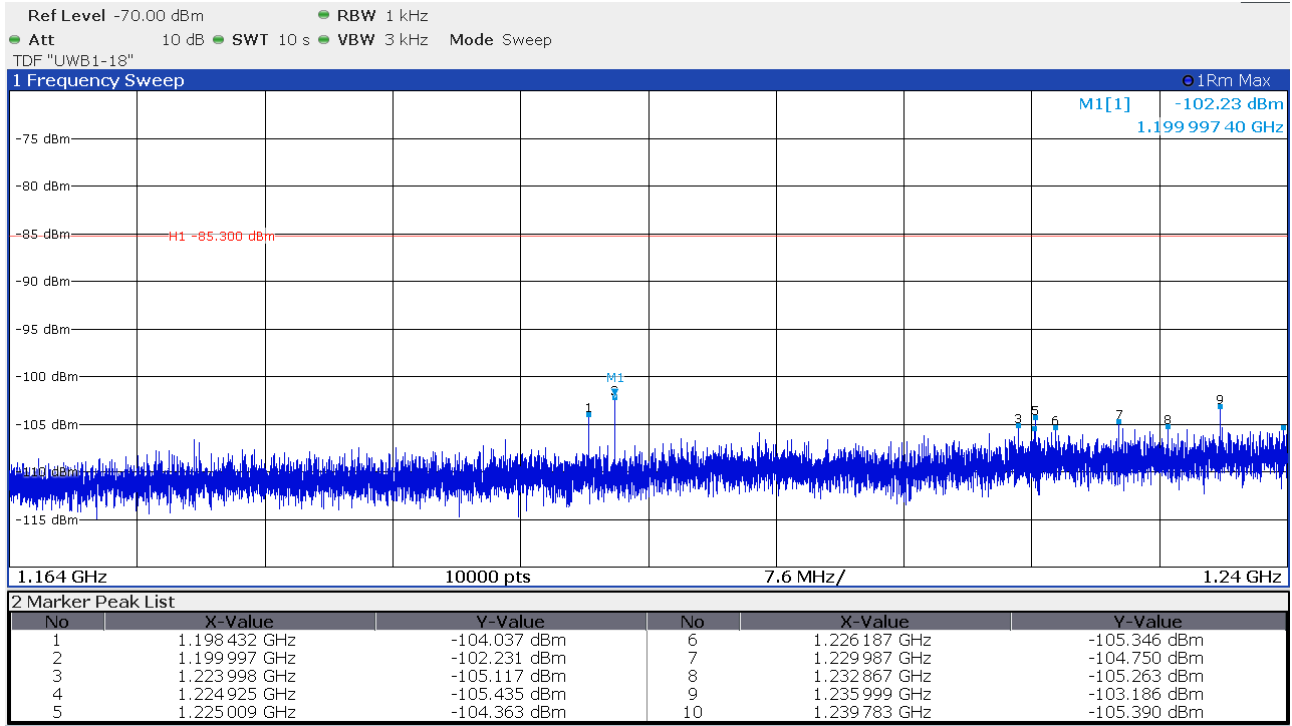
RBW: 1 kHz, VBW: 3 kHz, Detector: RMS, Sweep time: 1 ms/1kHz,

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

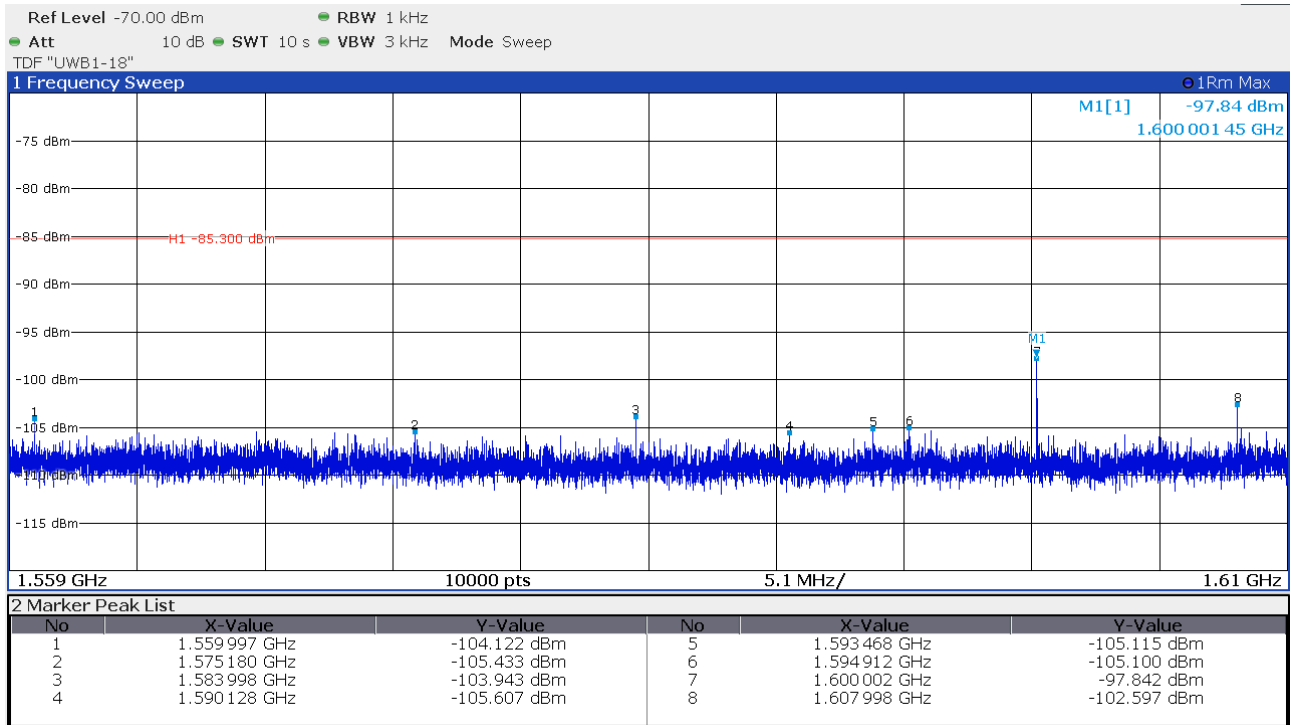
5.4.5 Test result

Channel 5 antenna 1 horizontal

1164 MHz to 1240 MHz

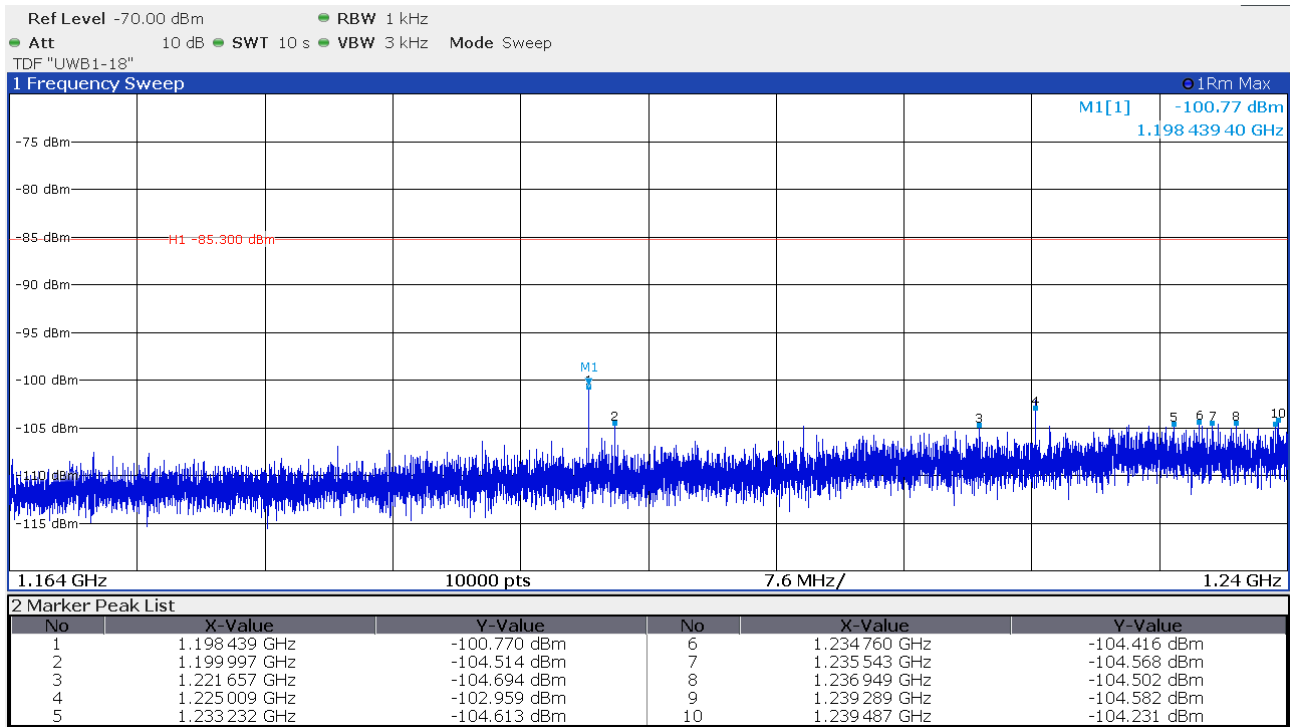


1559 MHz to 1610 MHz

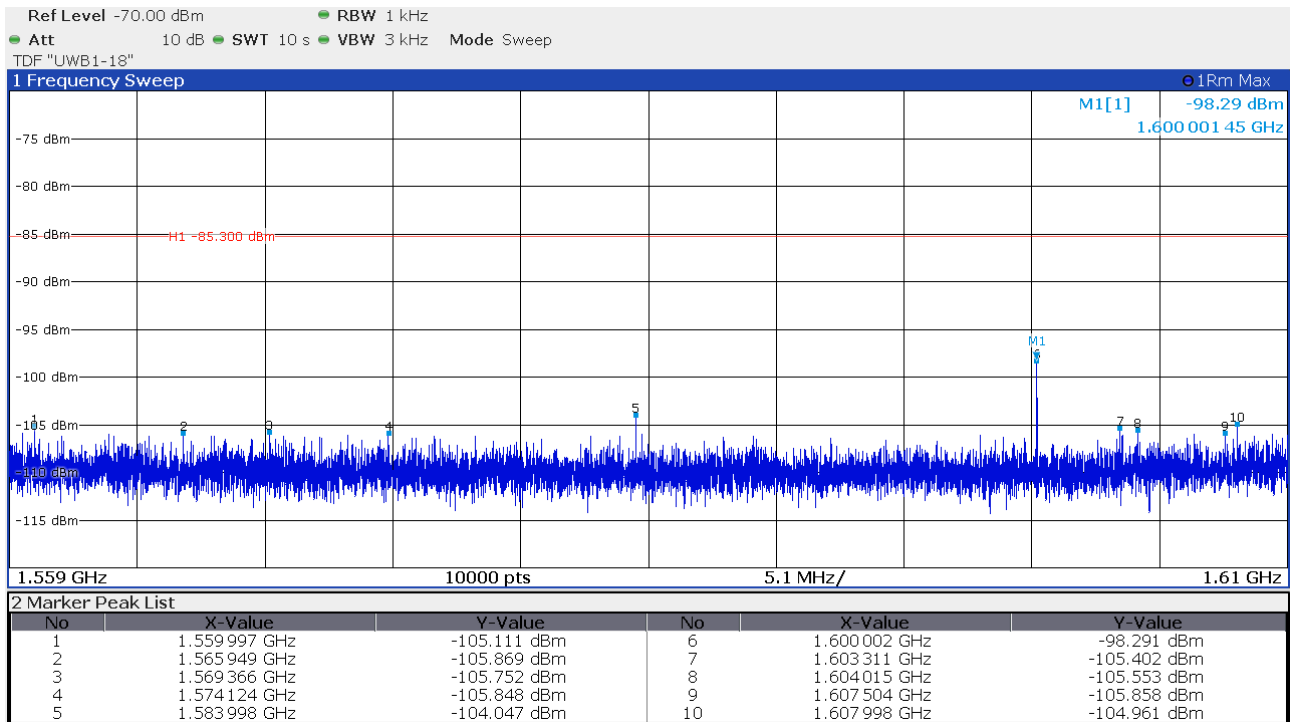


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 5 antenna 1 vertical

1164 MHz to 1240 MHz



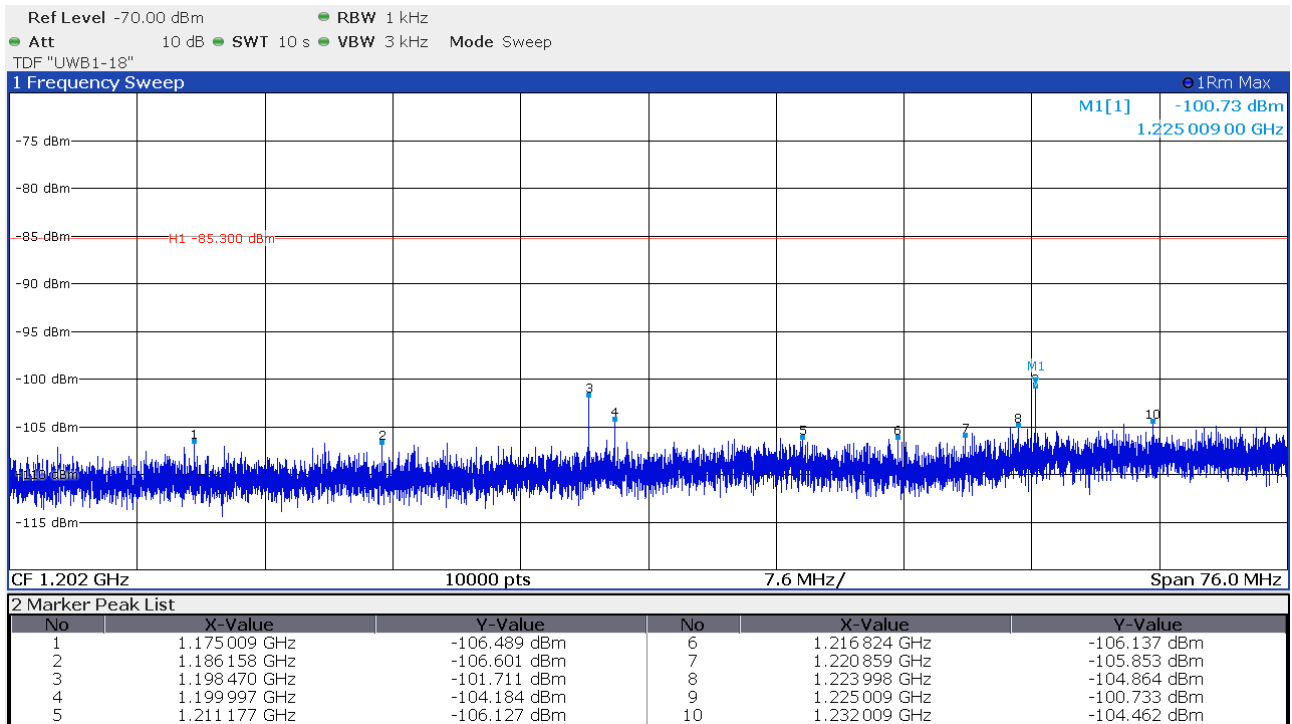
1559 MHz to 1610 MHz



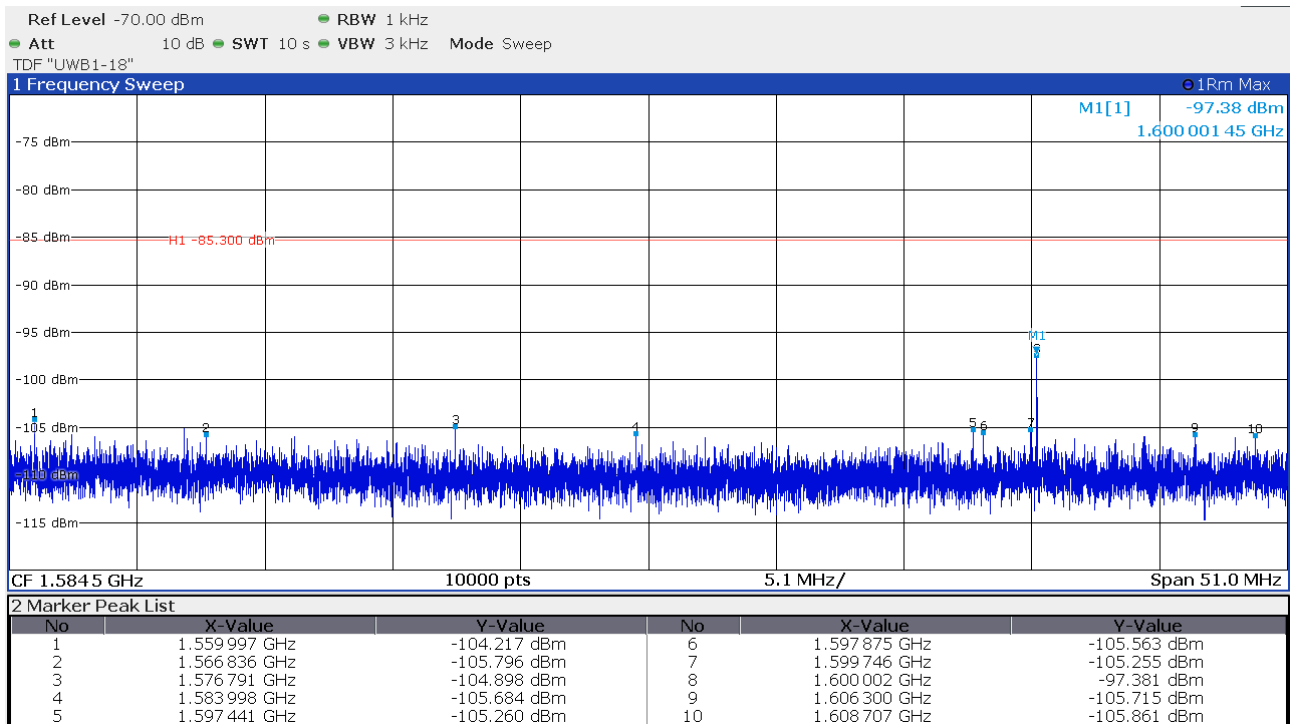
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Channel 5 antenna 2 horizontal

1164 MHz to 1240 MHz

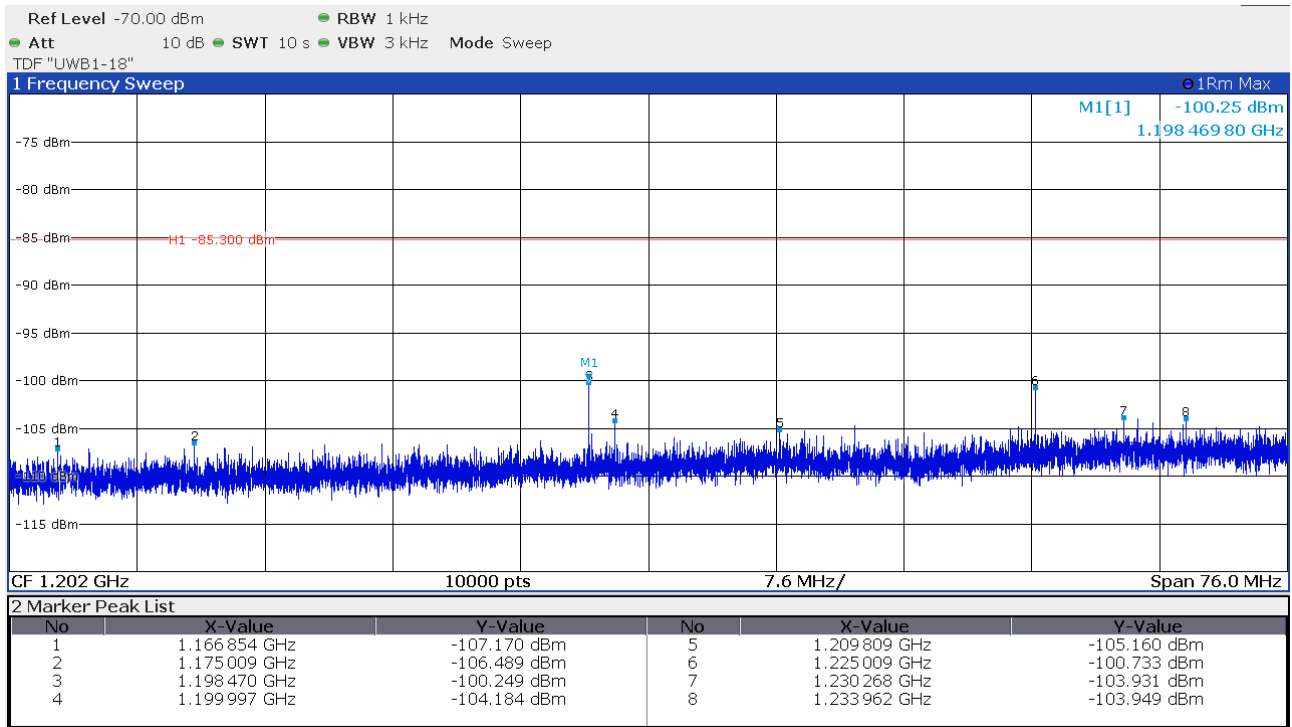


1559 MHz to 1610 MHz

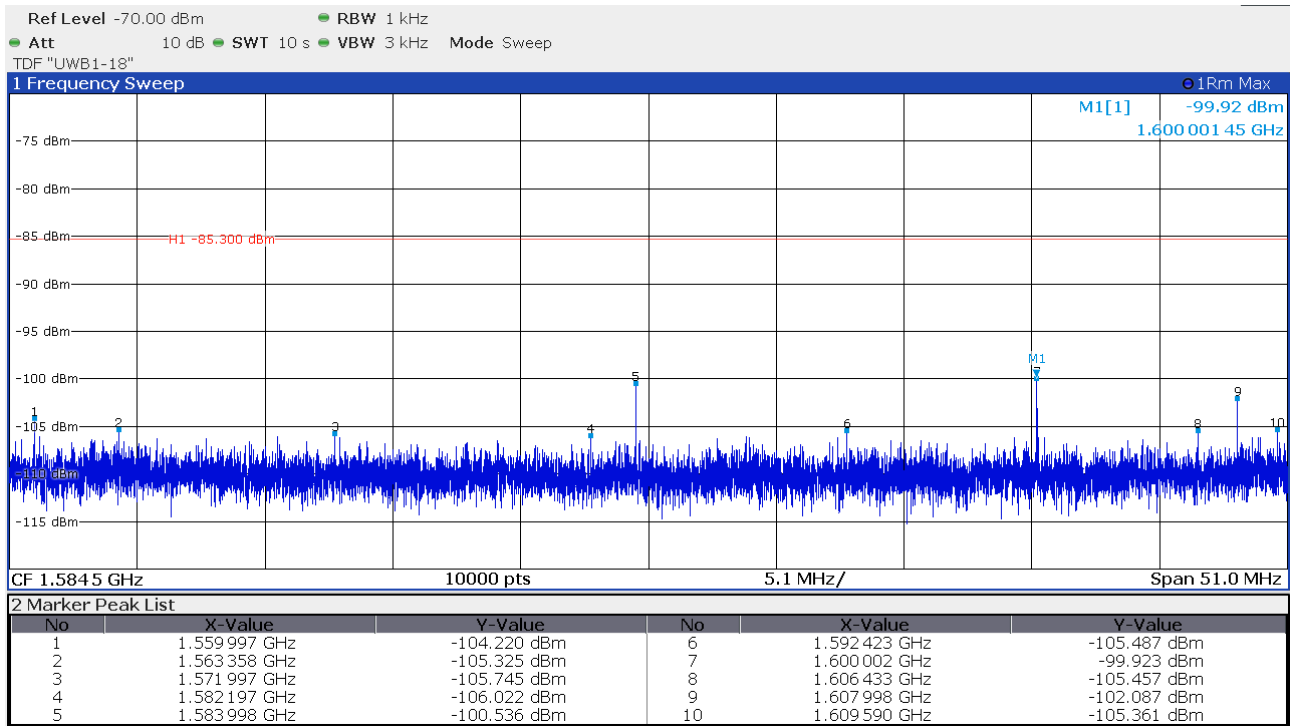


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 5 antenna 2 vertical

1164 MHz to 1240 MHz

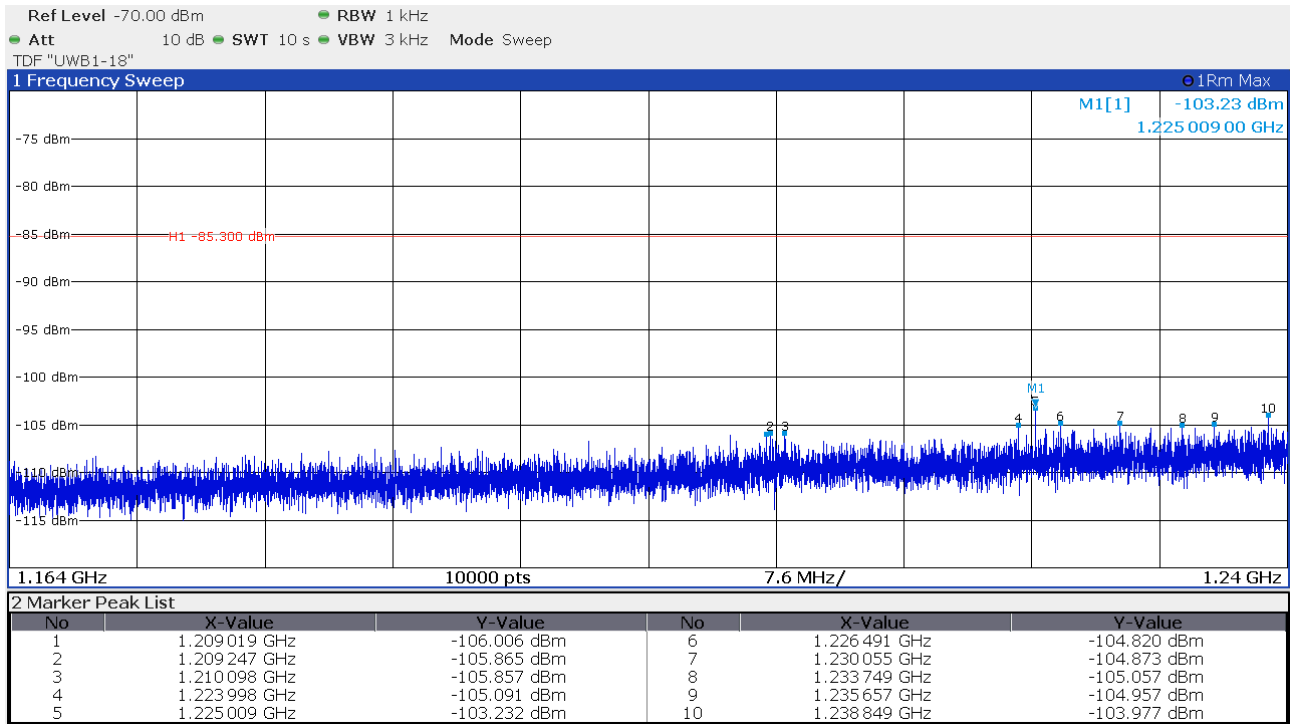


1559 MHz to 1610 MHz

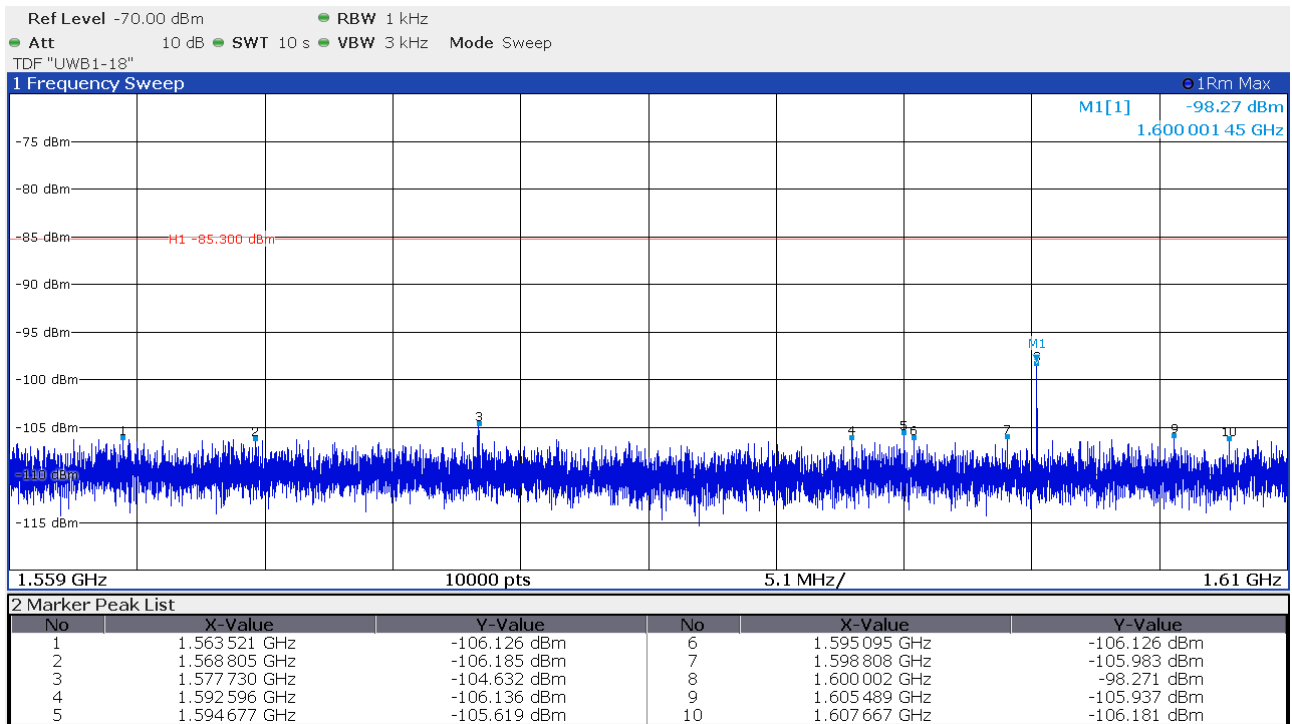


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1 horizontal

1164 MHz to 1240 MHz

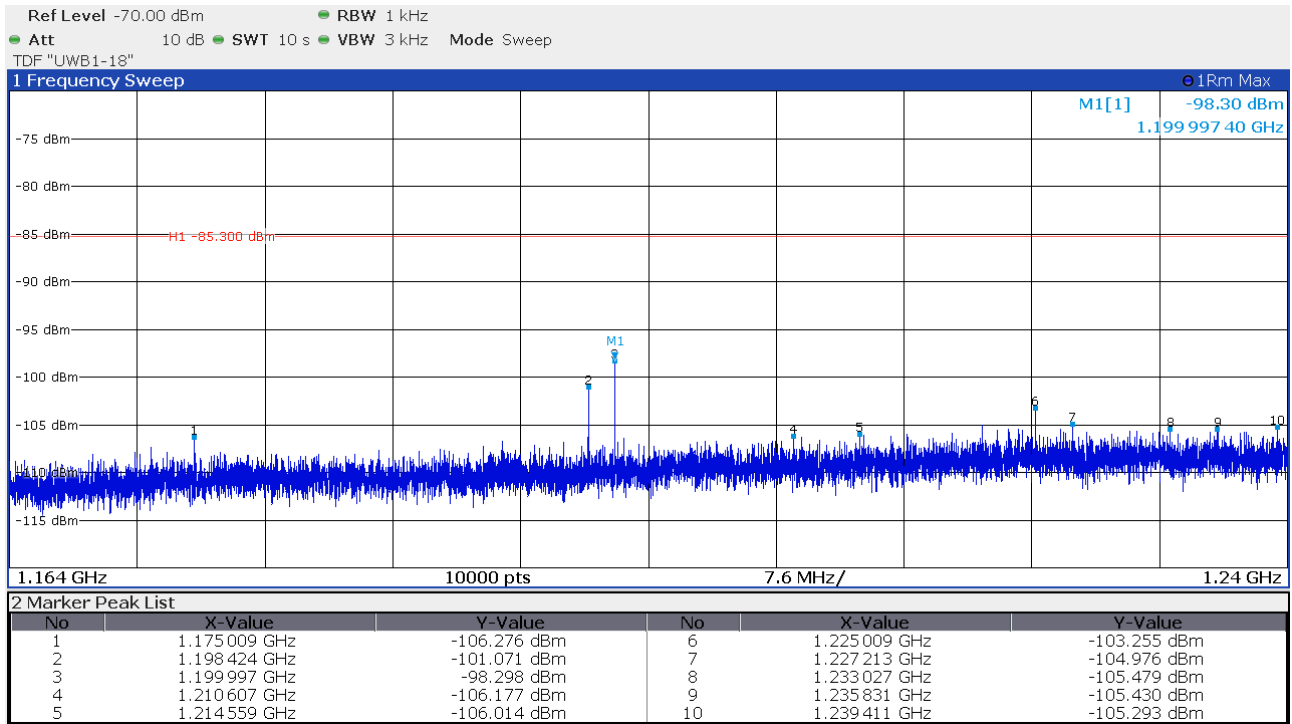


1559 MHz to 1610 MHz

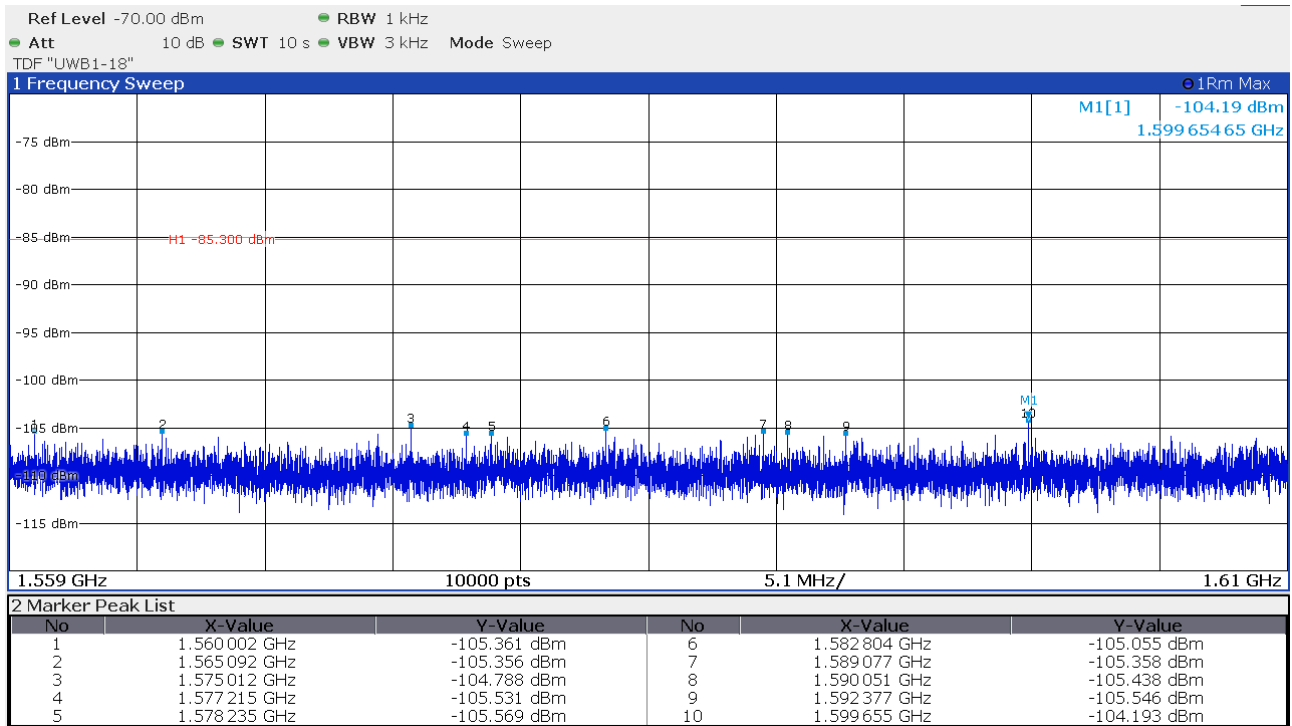


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1 vertical

1164 MHz to 1240 MHz

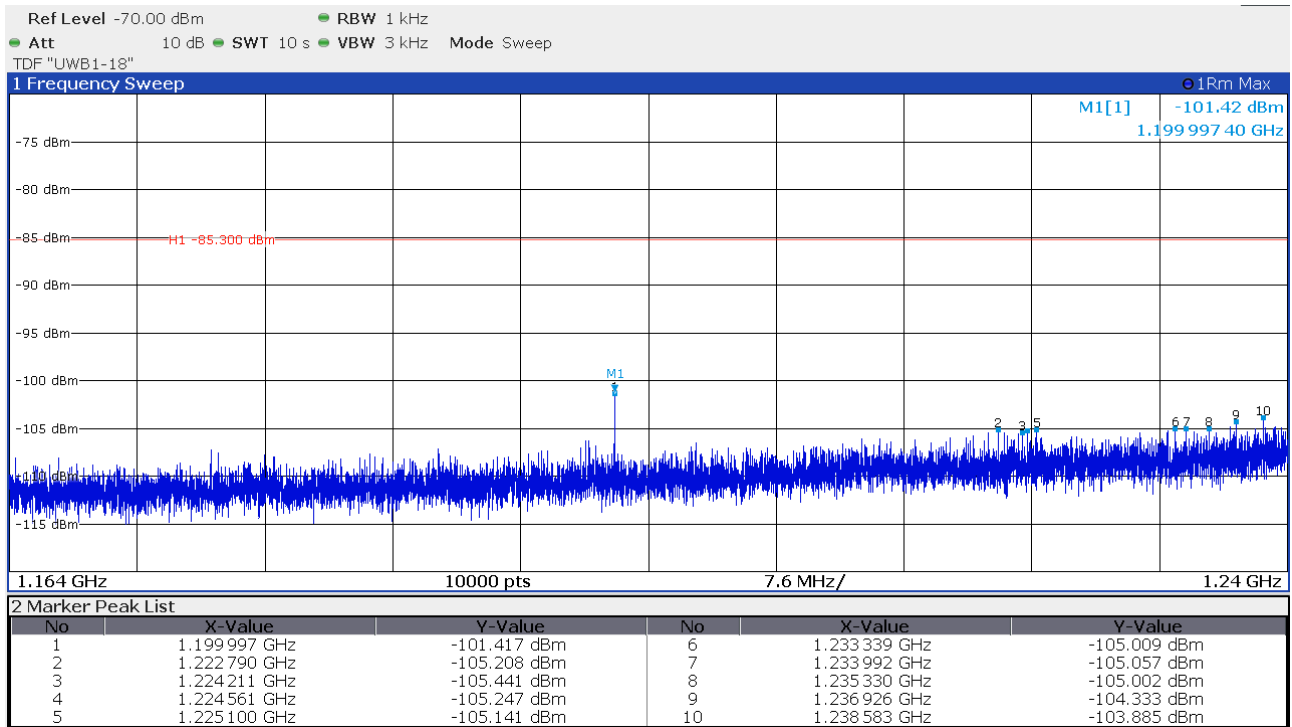


1559 MHz to 1610 MHz

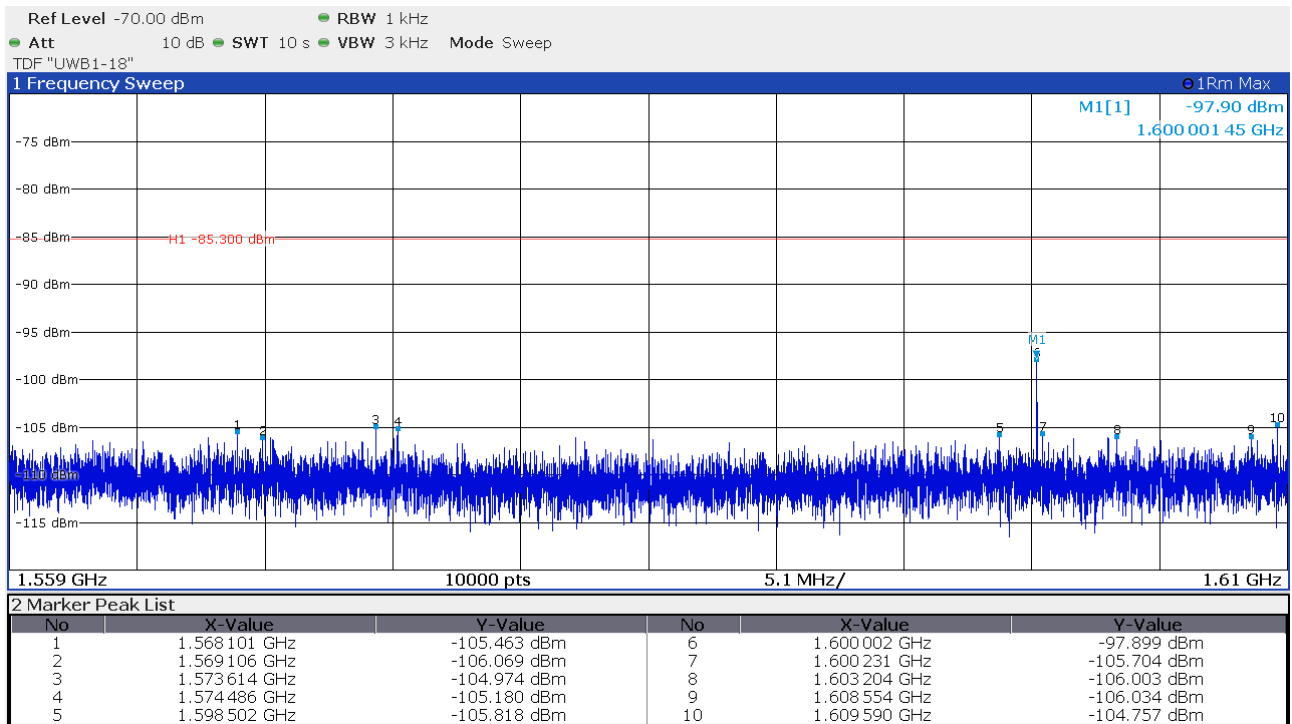


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 2 horizontal

1164 MHz to 1240 MHz

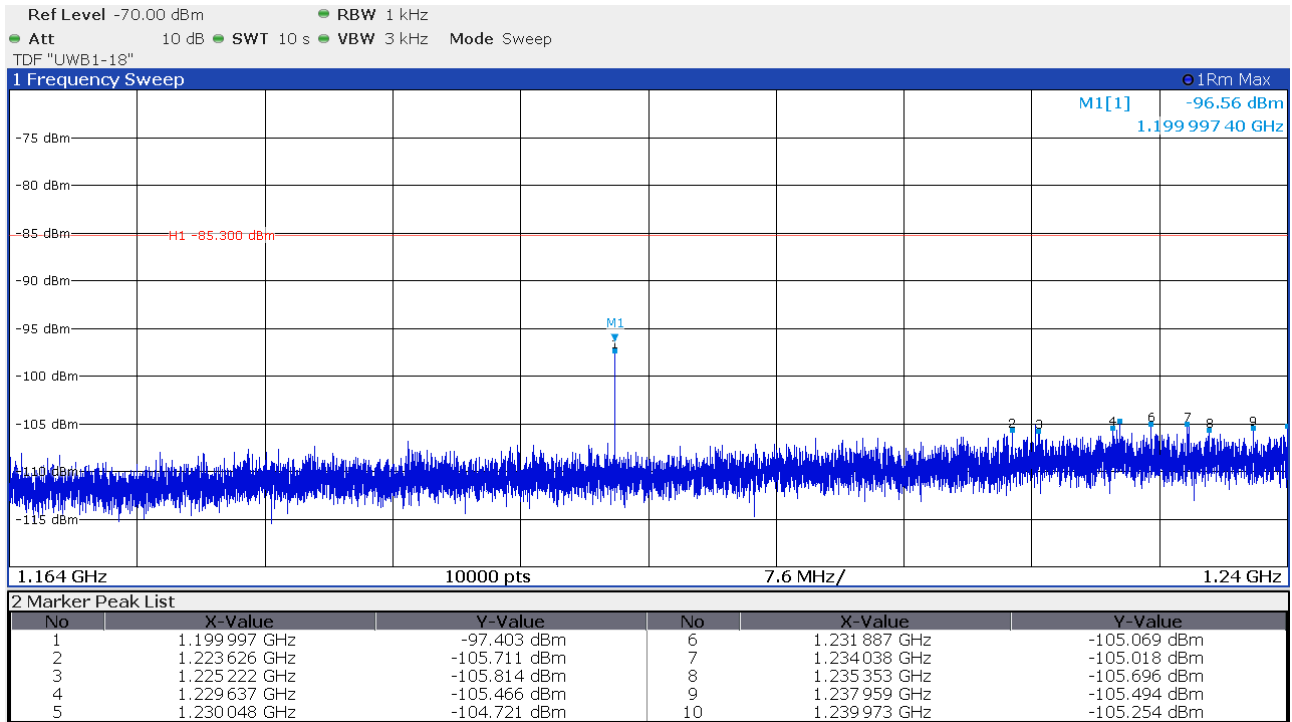


1559 MHz to 1610 MHz

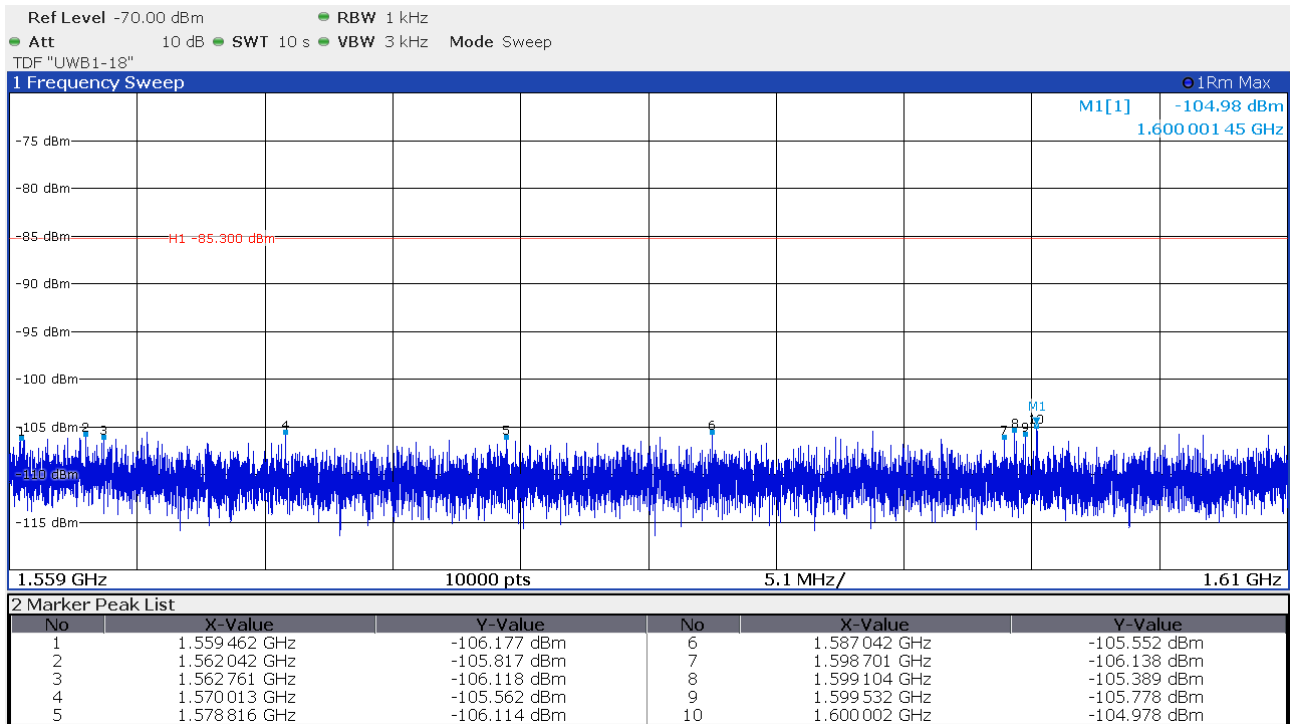


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 2 vertical

1164 MHz to 1240 MHz

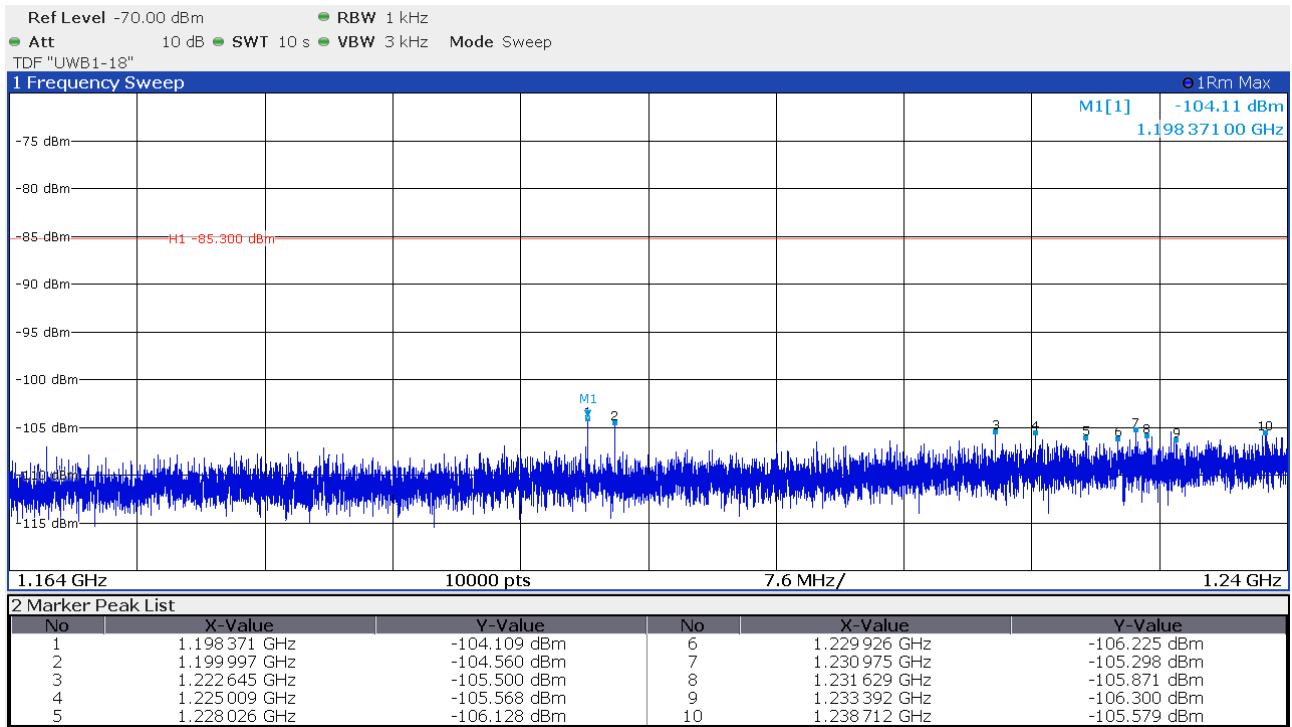


1559 MHz to 1610 MHz

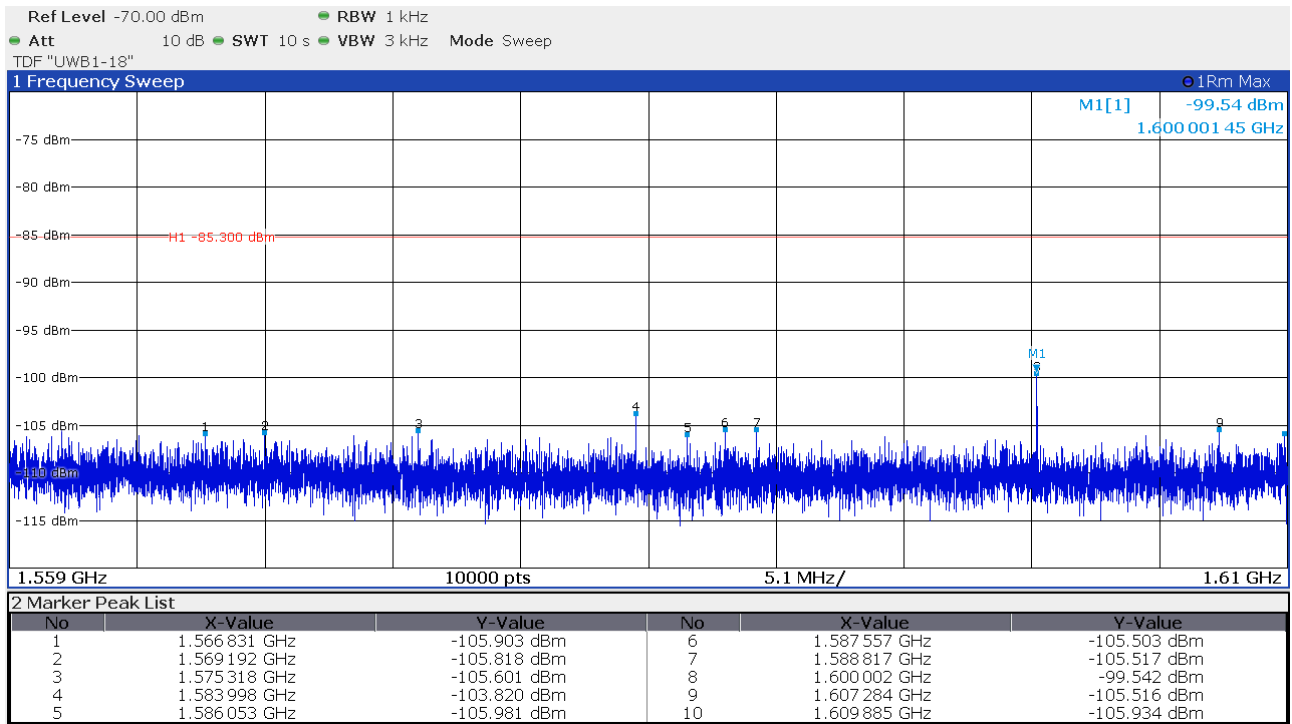


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 1 horizontal

1164 MHz to 1240 MHz

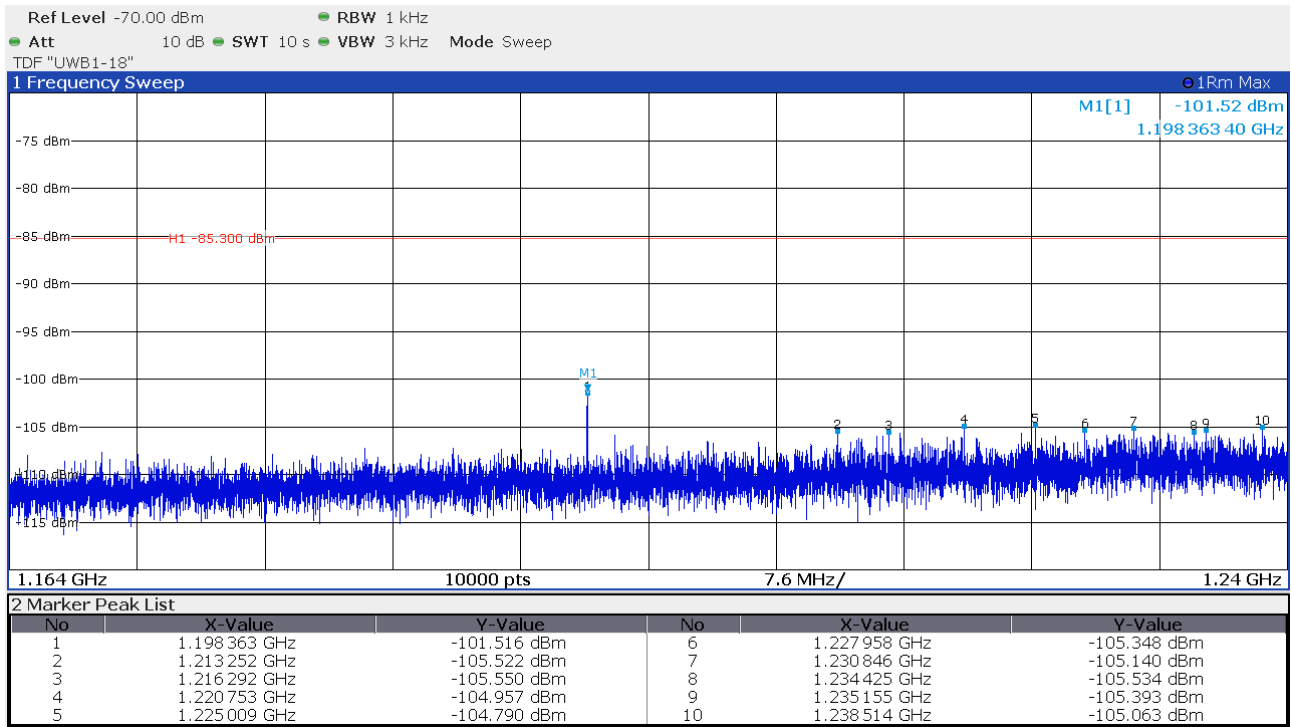


1559 MHz to 1610 MHz

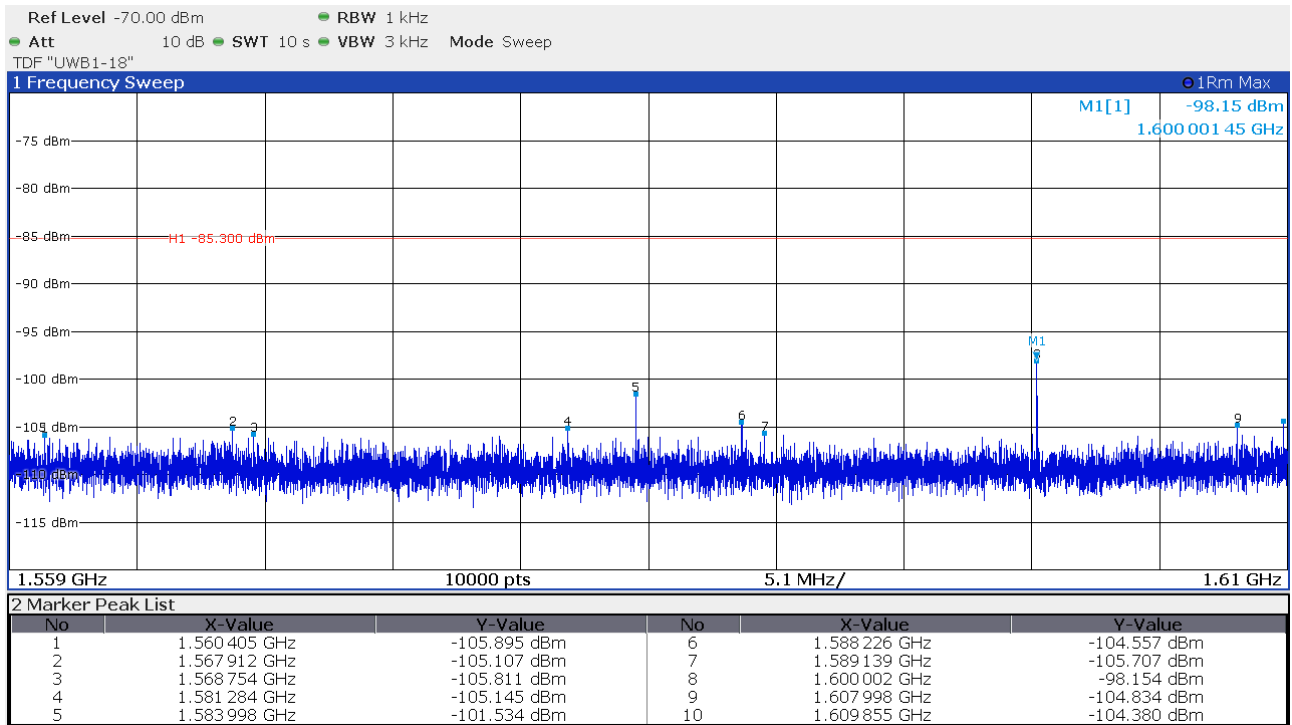


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 1 vertical

1164 MHz to 1240 MHz

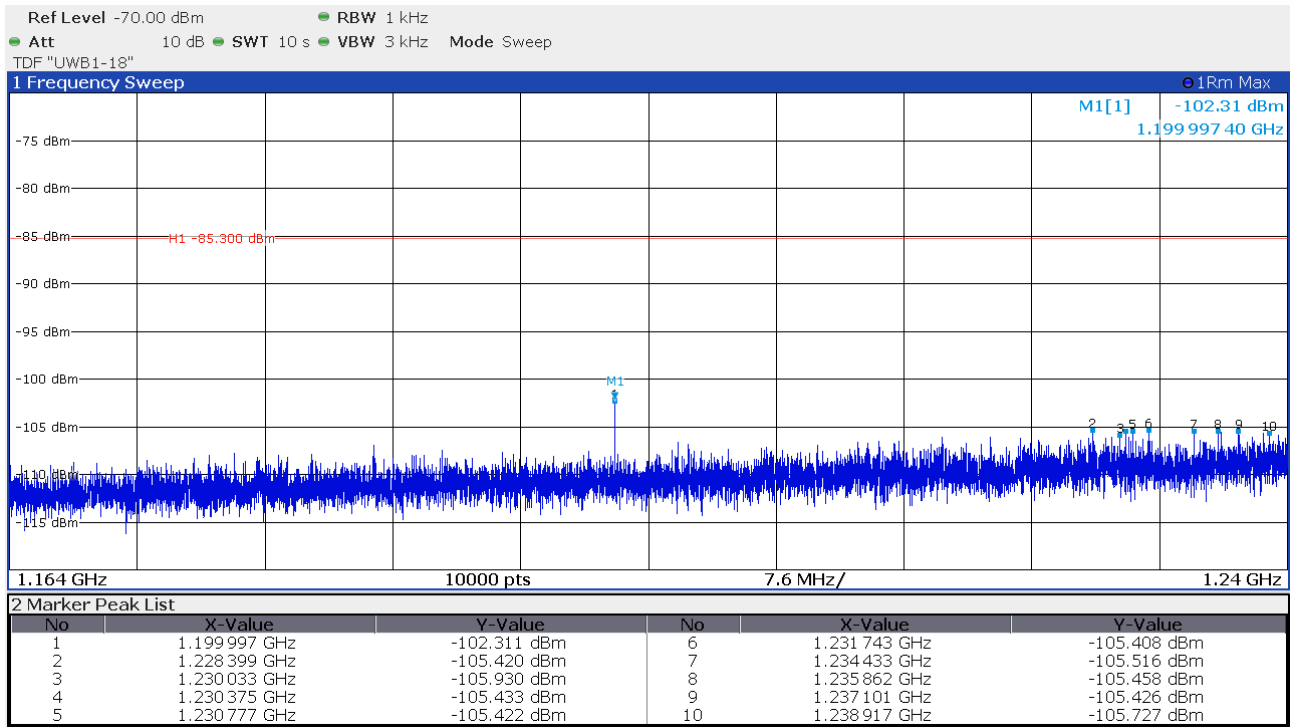


1559 MHz to 1610 MHz

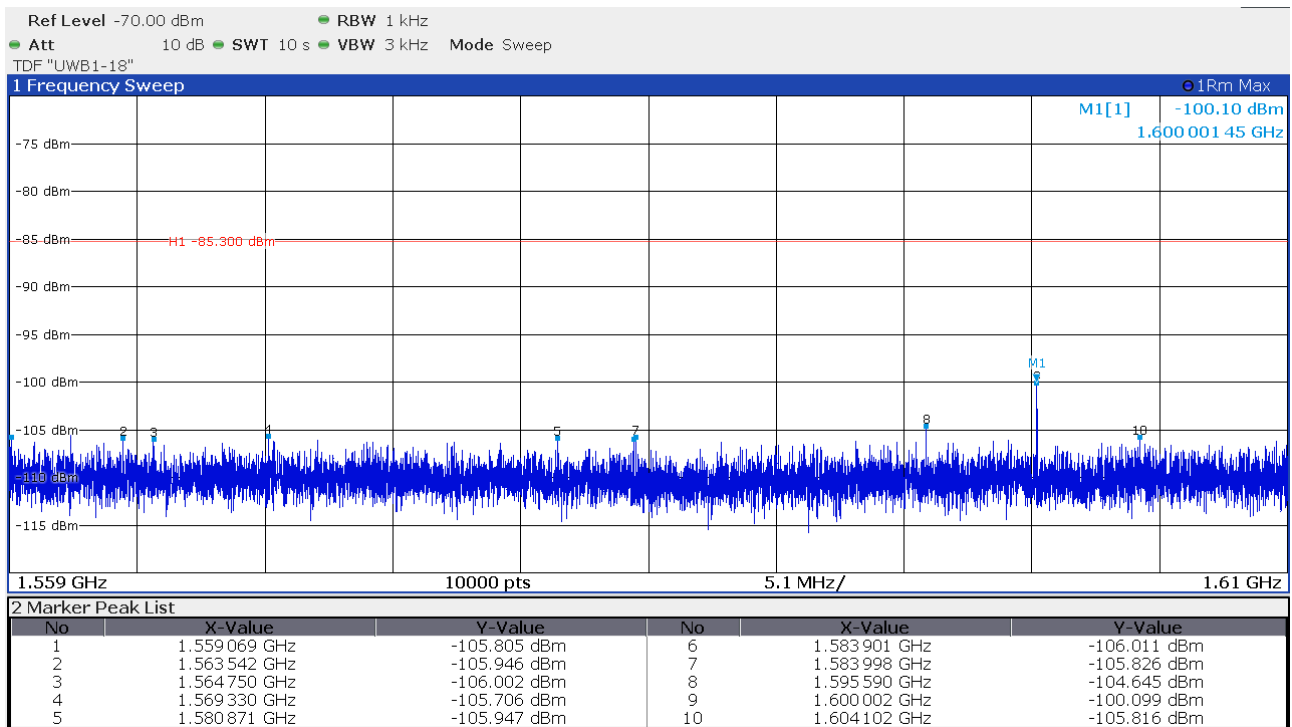


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 2 horizontal

1164 MHz to 1240 MHz

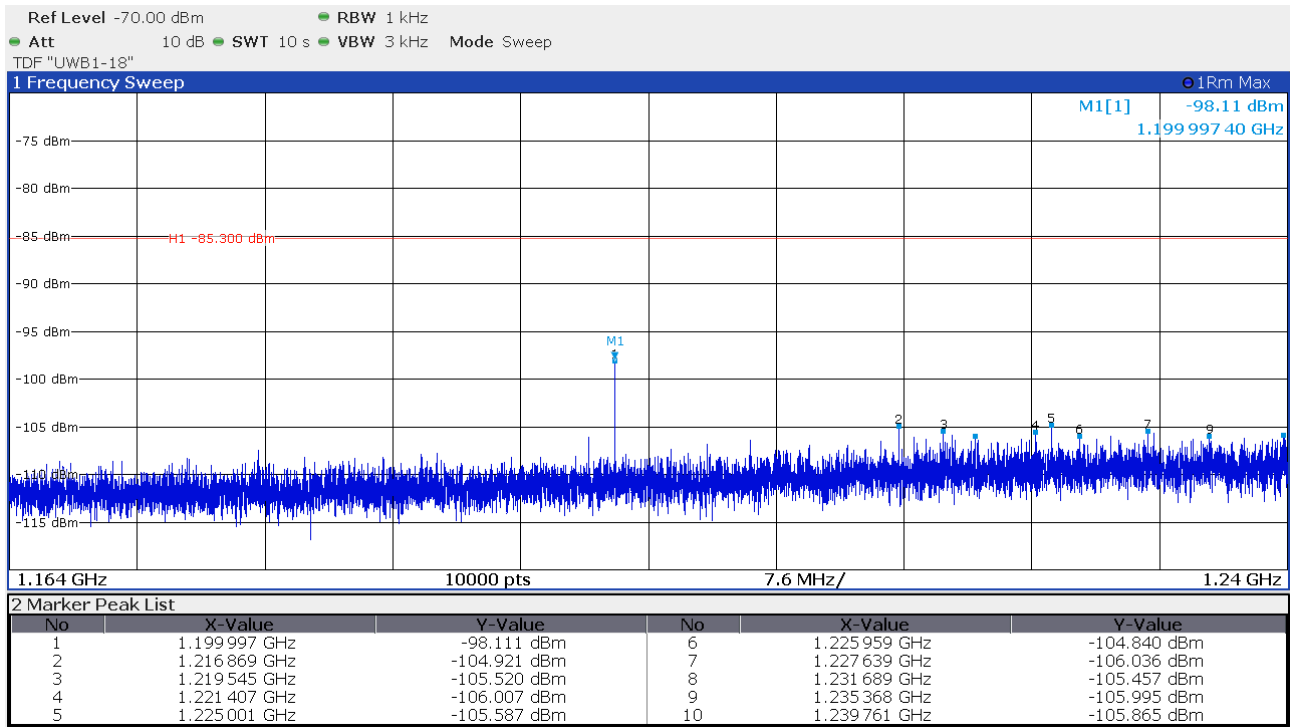


1559 MHz to 1610 MHz

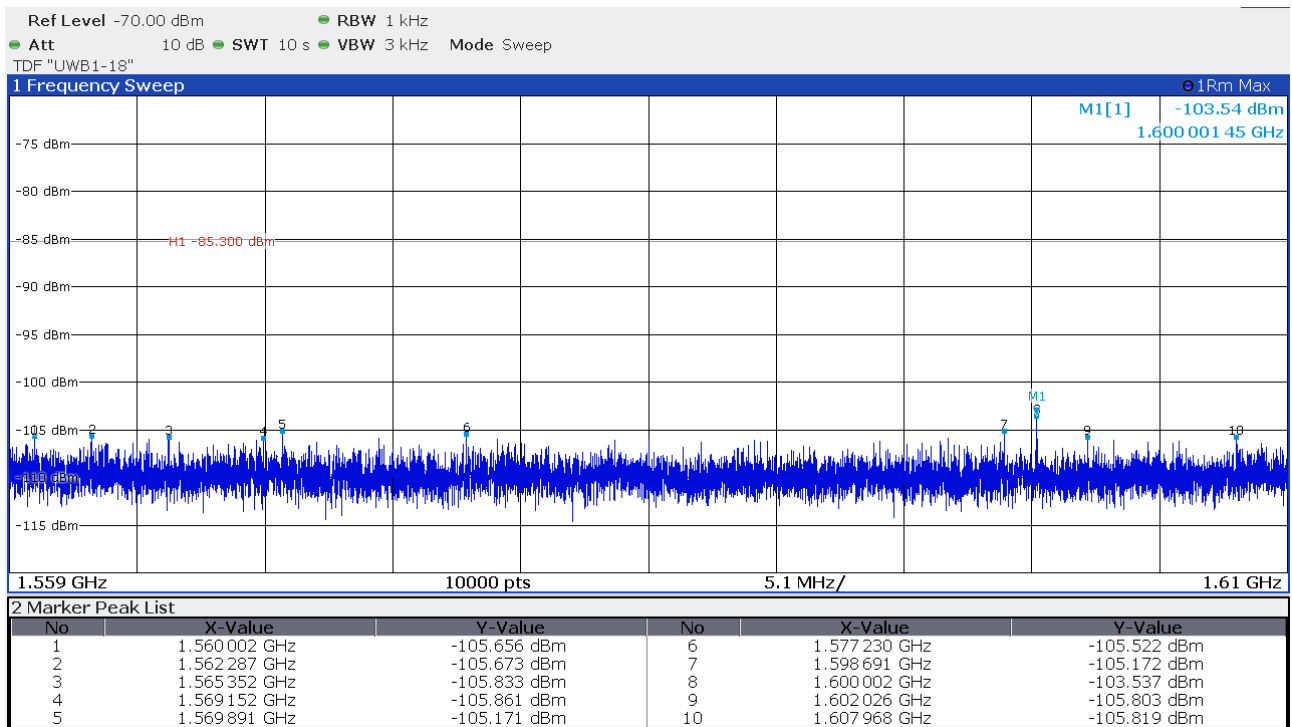


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 8 antenna 2 vertical

1164 MHz to 1240 MHz

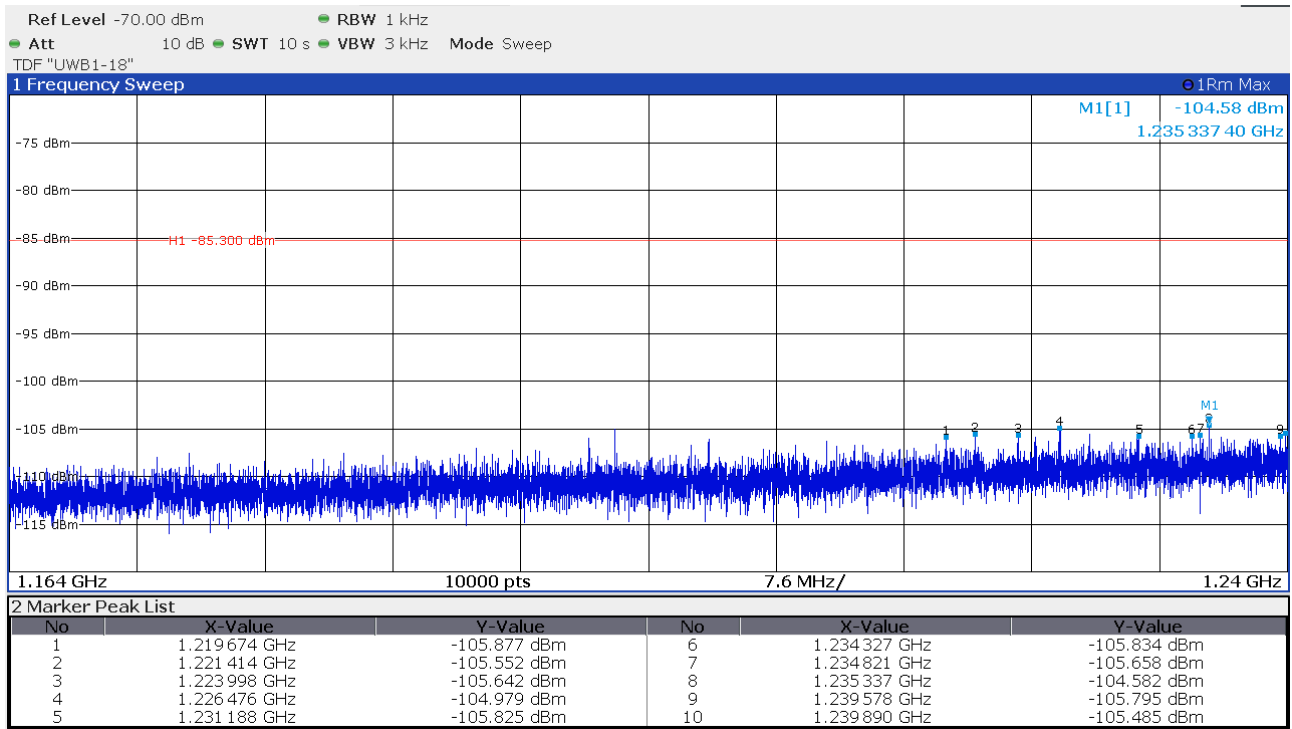


1559 MHz to 1610 MHz

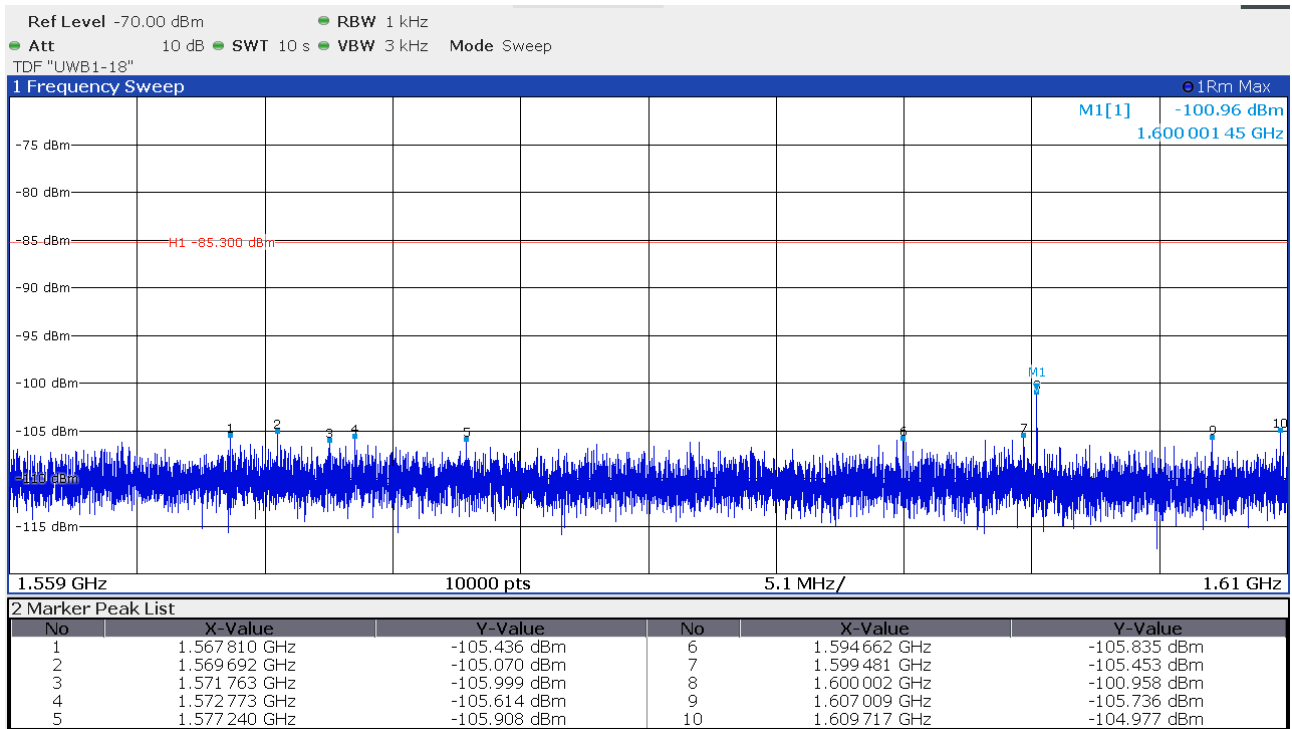


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 1 horizontal

1164 MHz to 1240 MHz



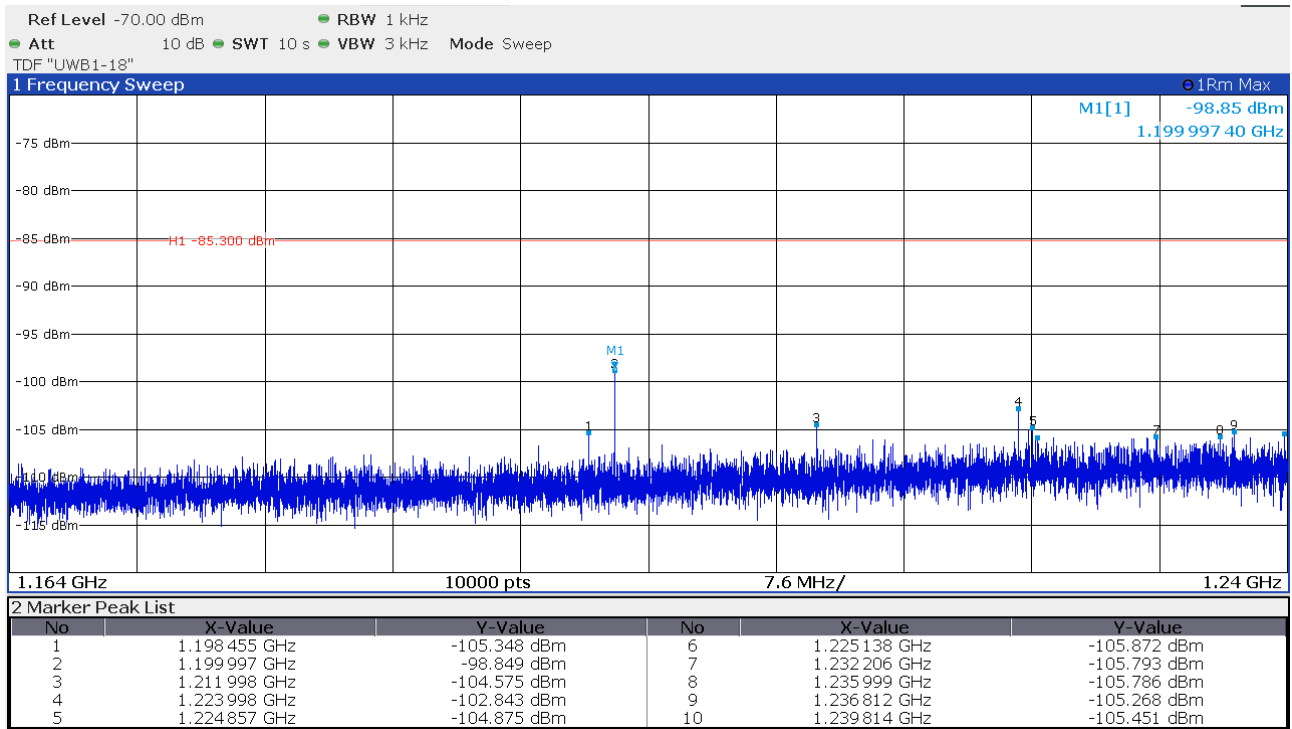
1559 MHz to 1610 MHz



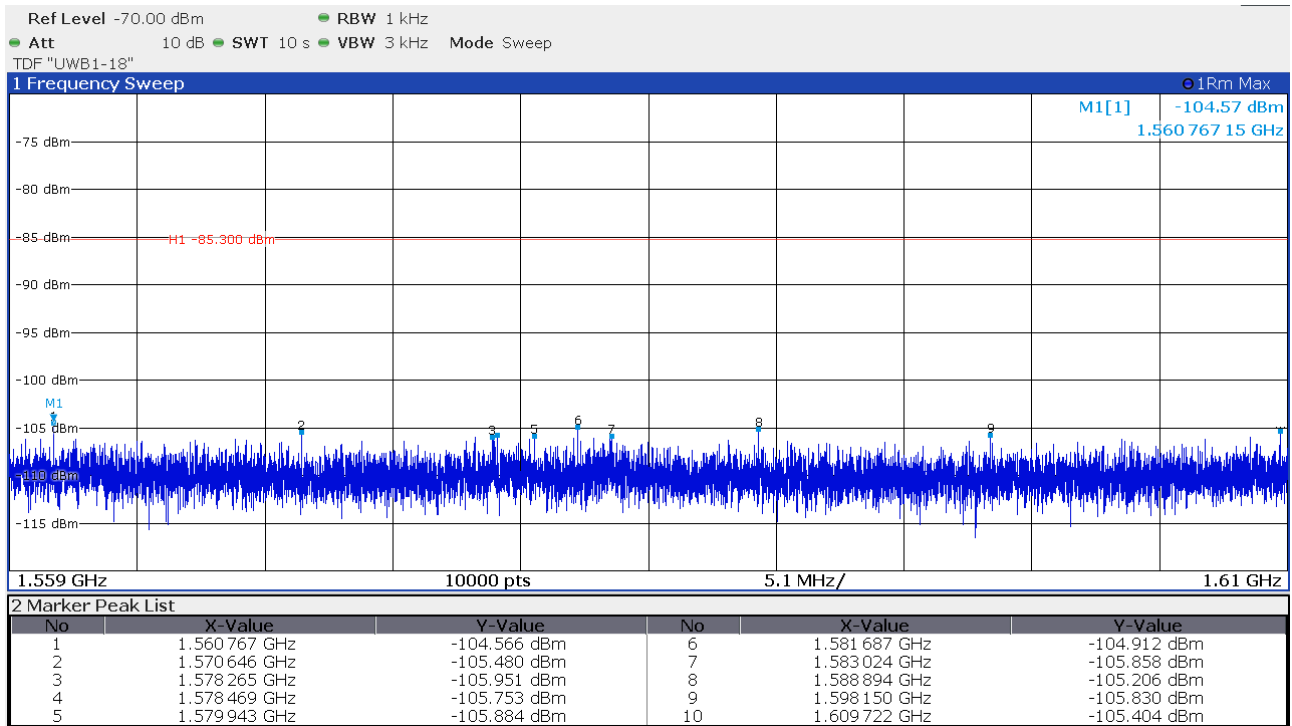
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Channel 9 antenna 1 vertical

1164 MHz to 1240 MHz

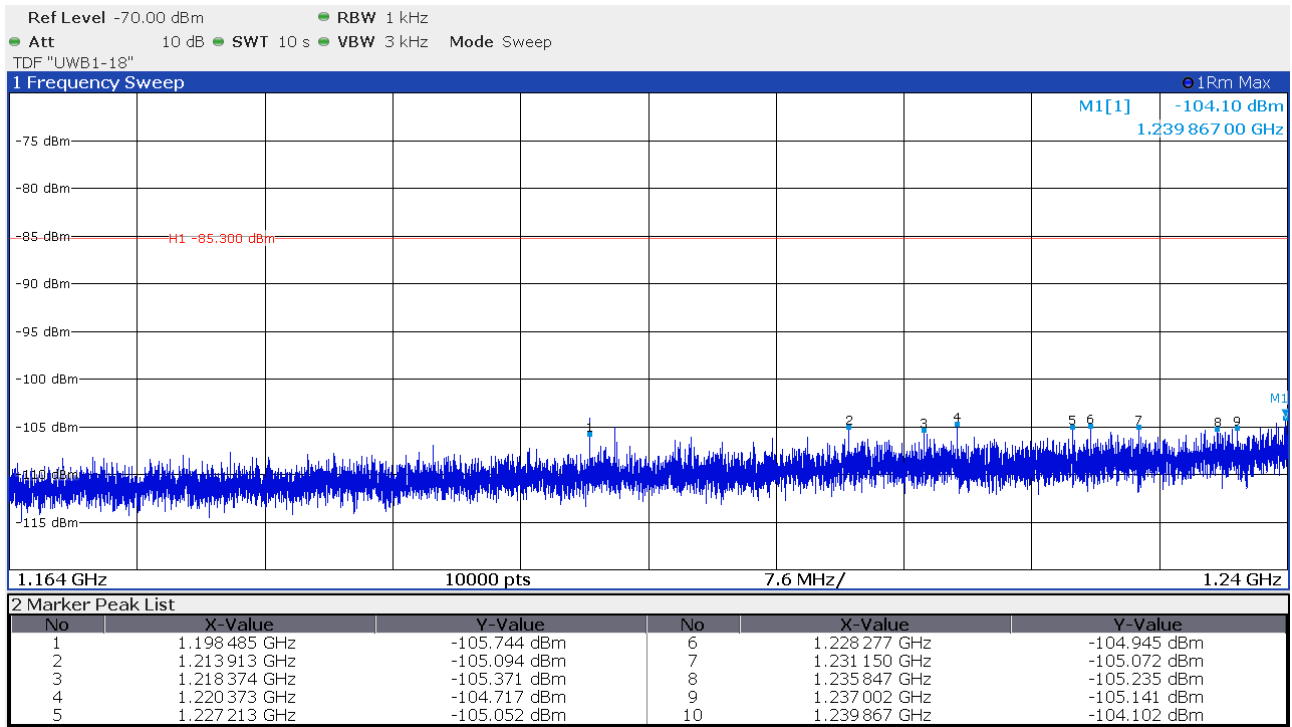


1559 MHz to 1610 MHz

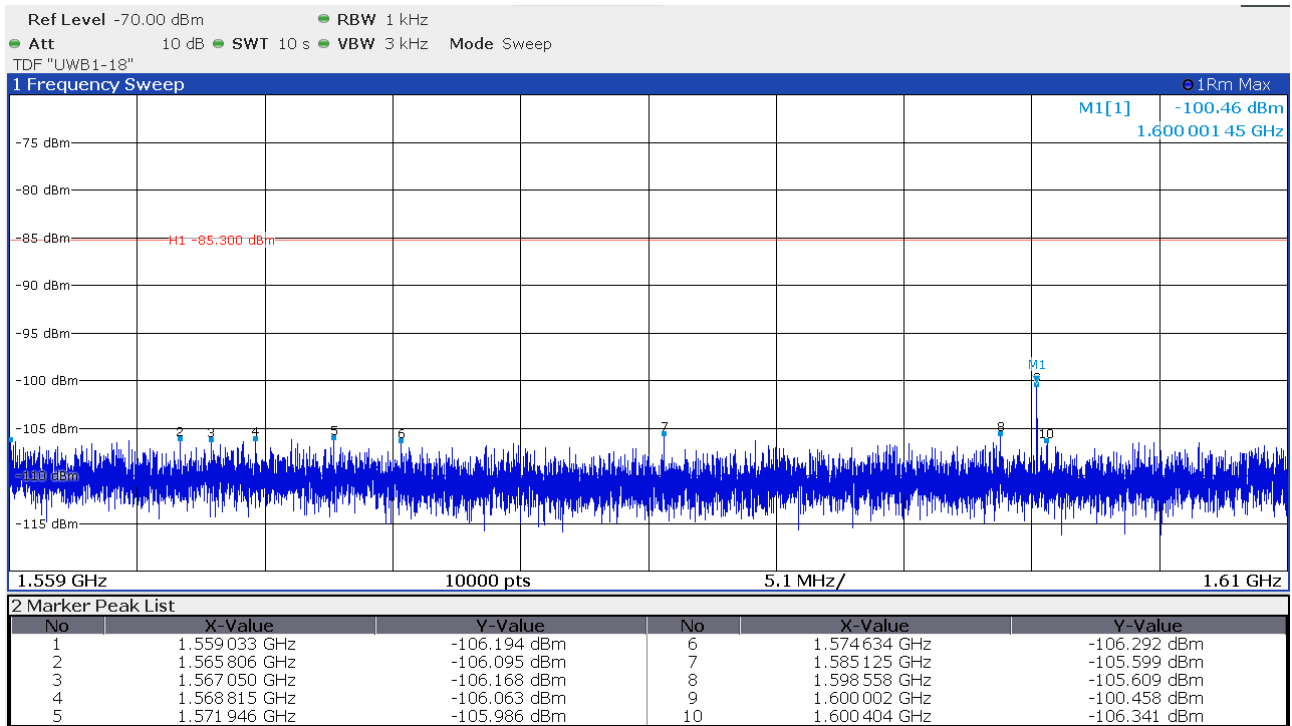


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 2 horizontal

1164 MHz to 1240 MHz

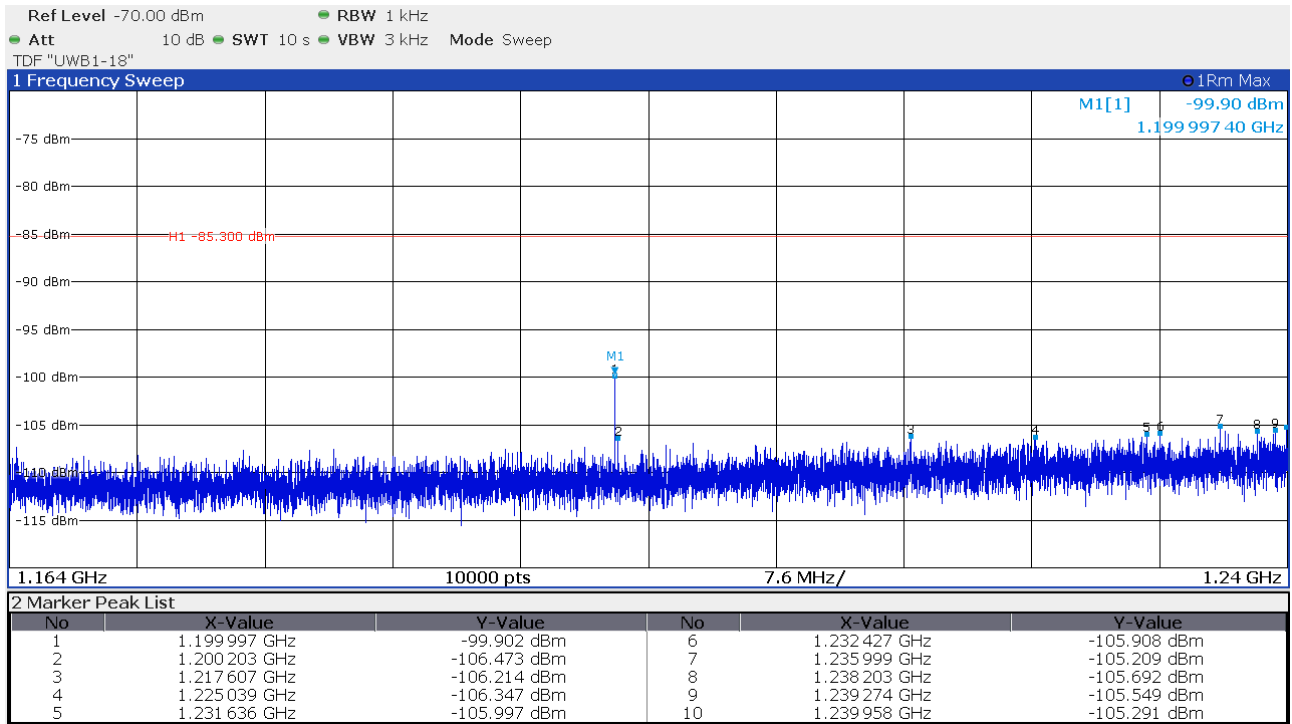


1559 MHz to 1610 MHz

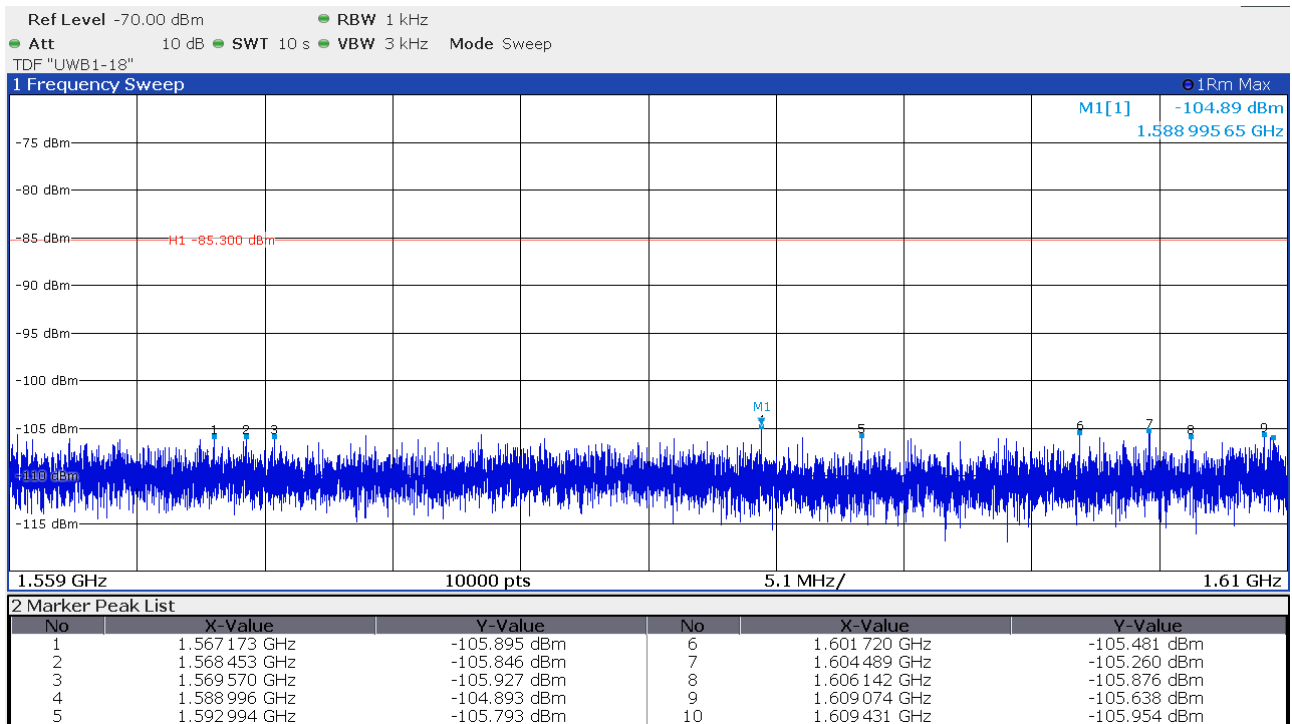


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 9 antenna 2 vertical

1164 MHz to 1240 MHz



1559 MHz to 1610 MHz



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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: 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: KR5FBD5MY23 IC: 7812D-FBD5MY23

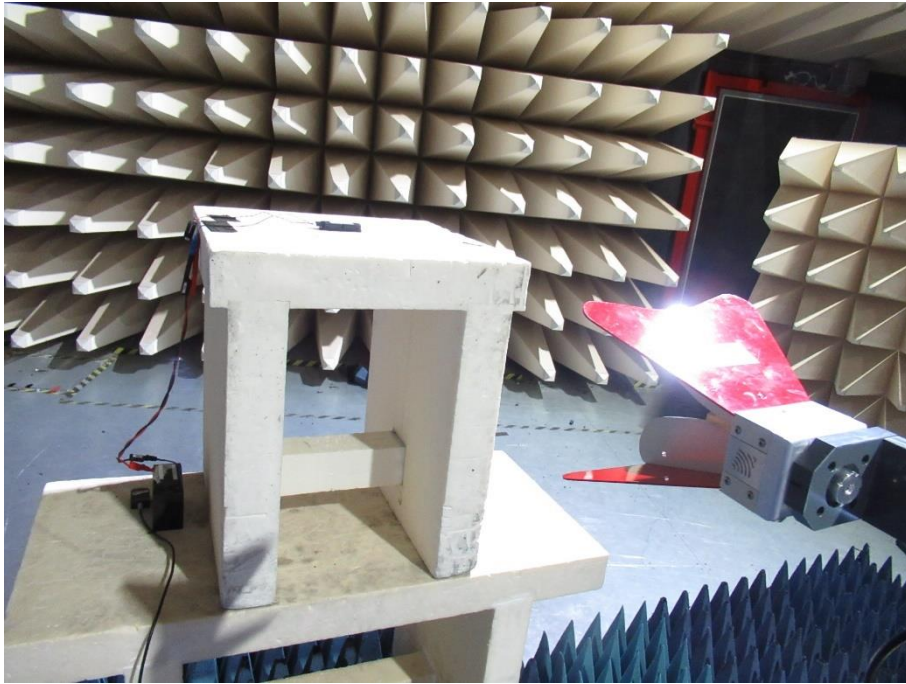
5.5 Peak Power radiated

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.

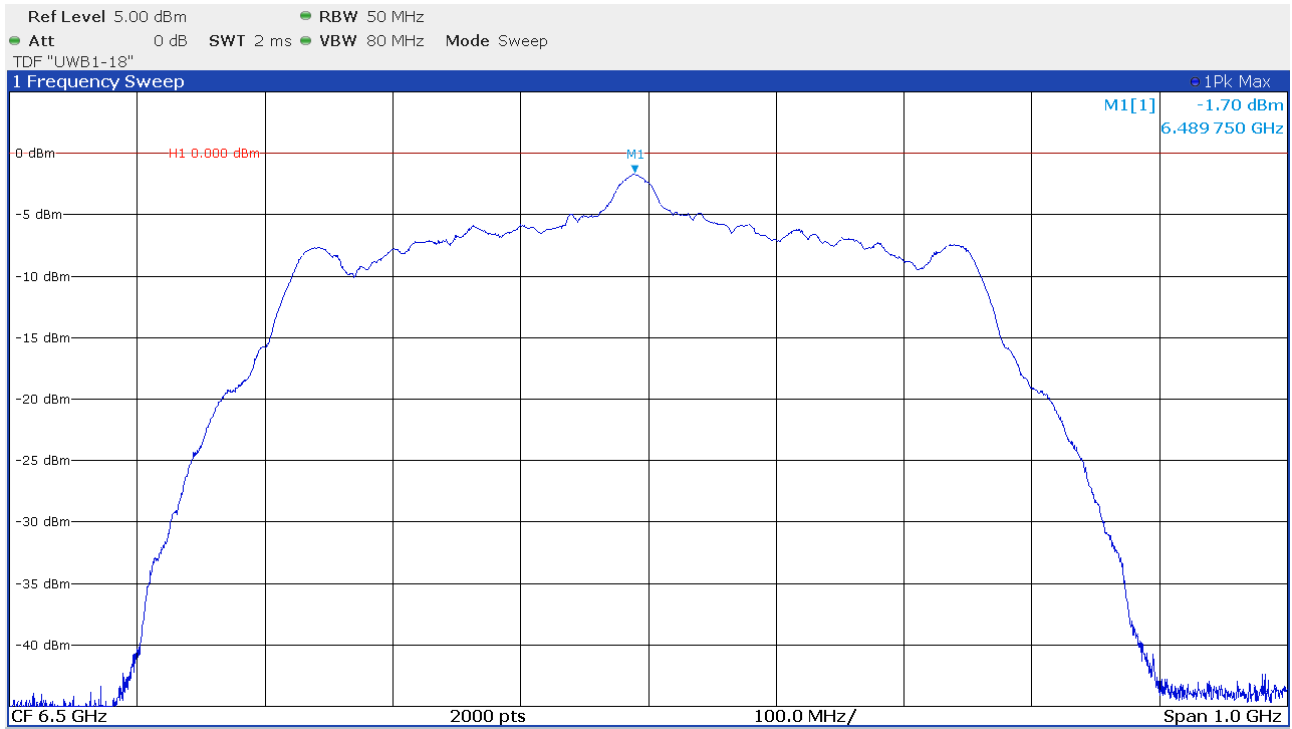
5.5.4 Analyser settings

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

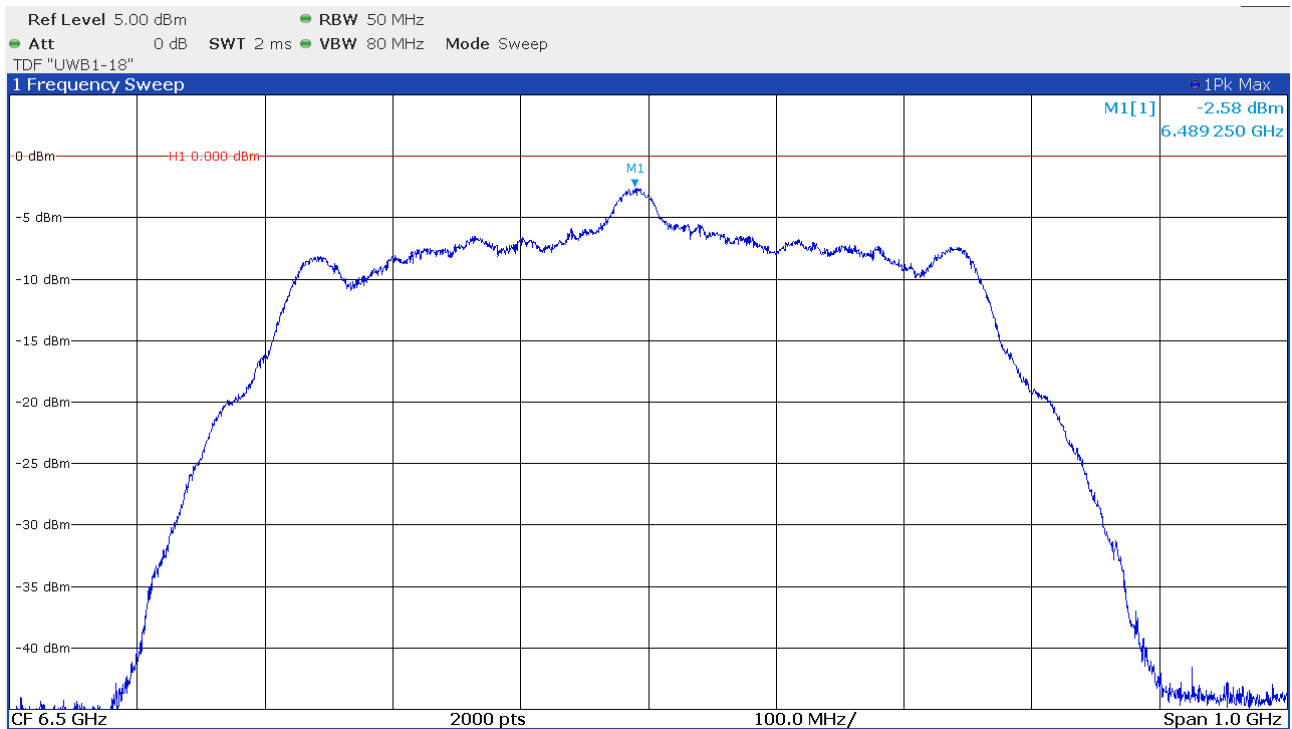
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

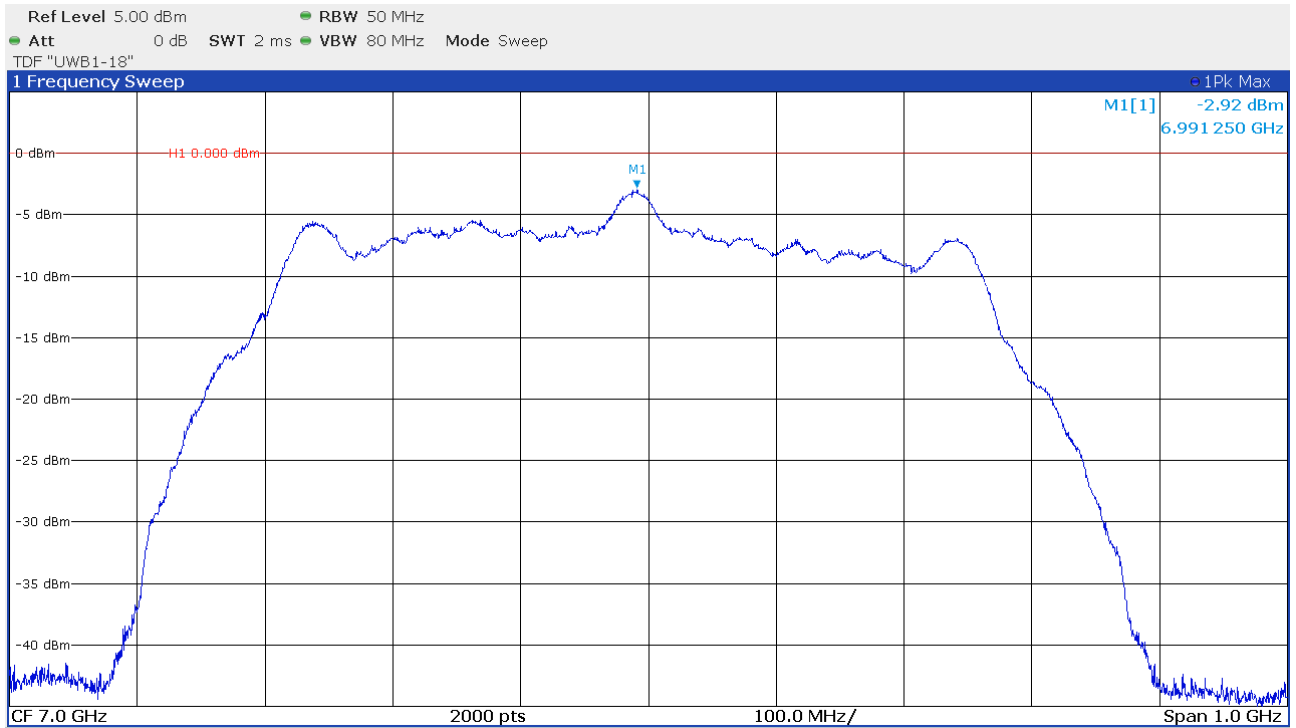
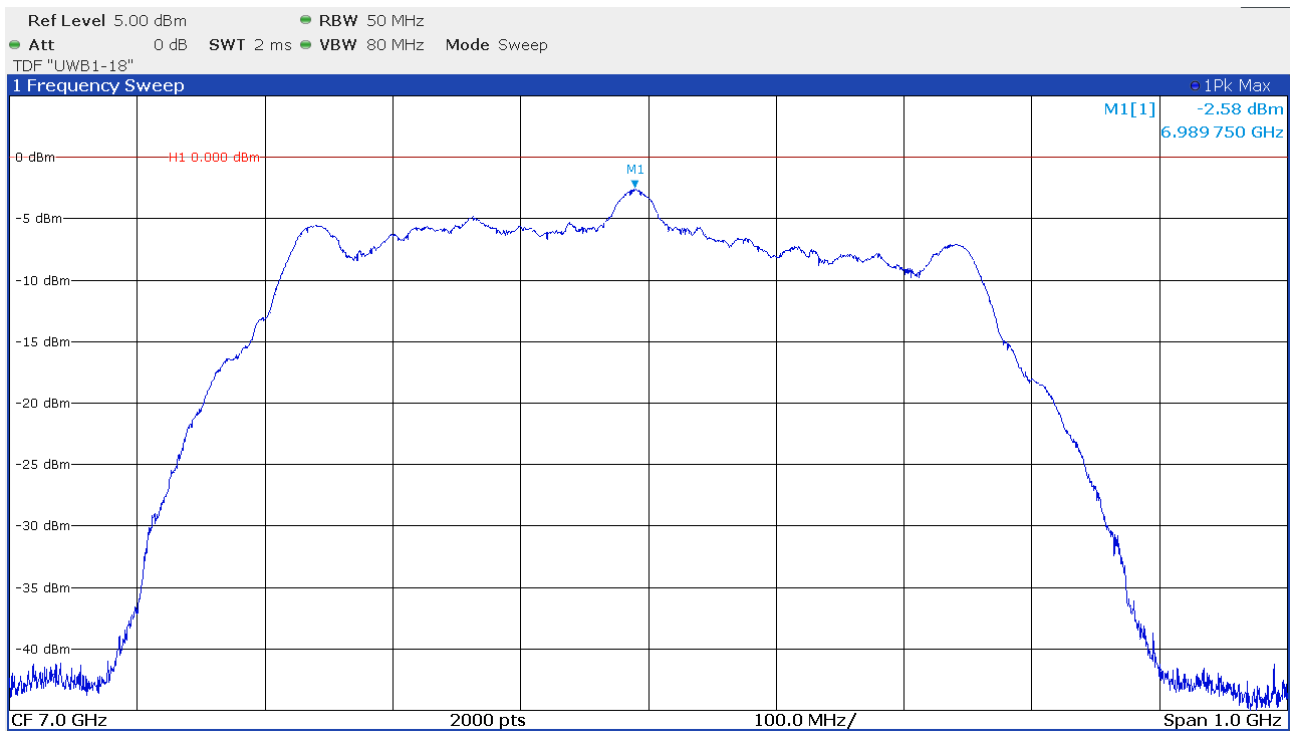
5.5.5 Test result

Channel 5 antenna 1



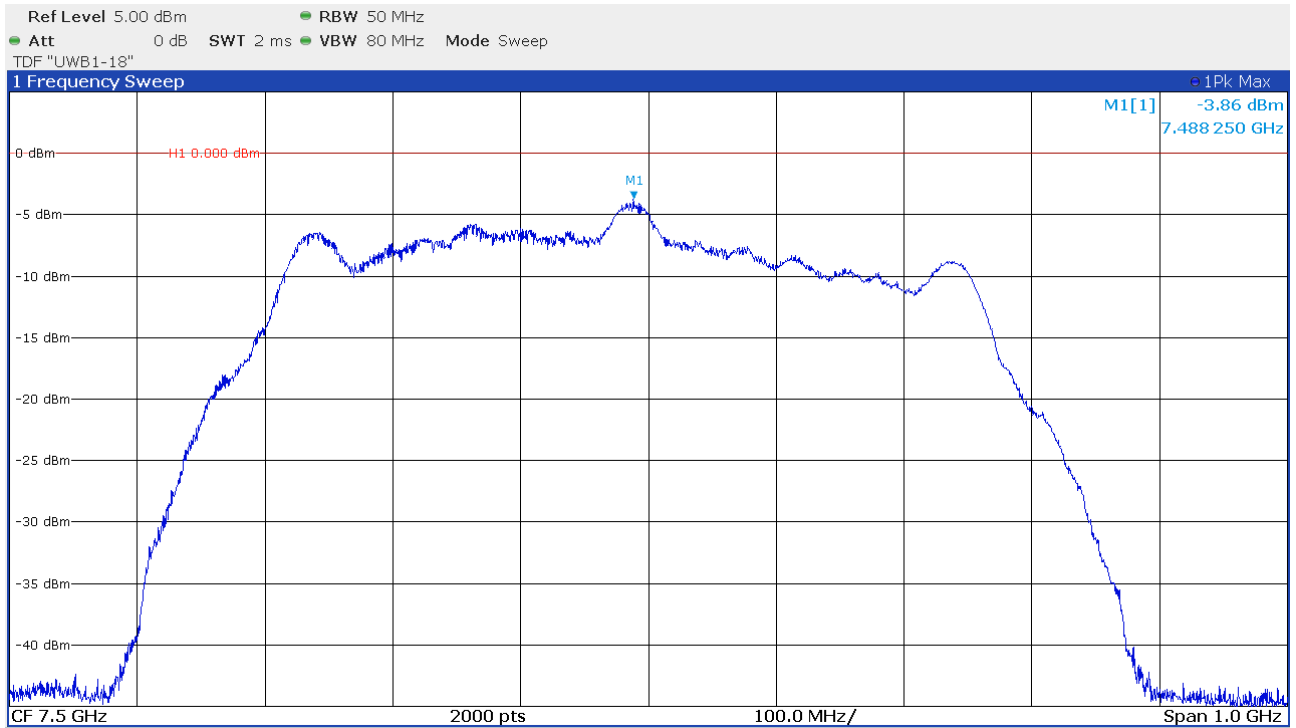
Channel 5 antenna 2



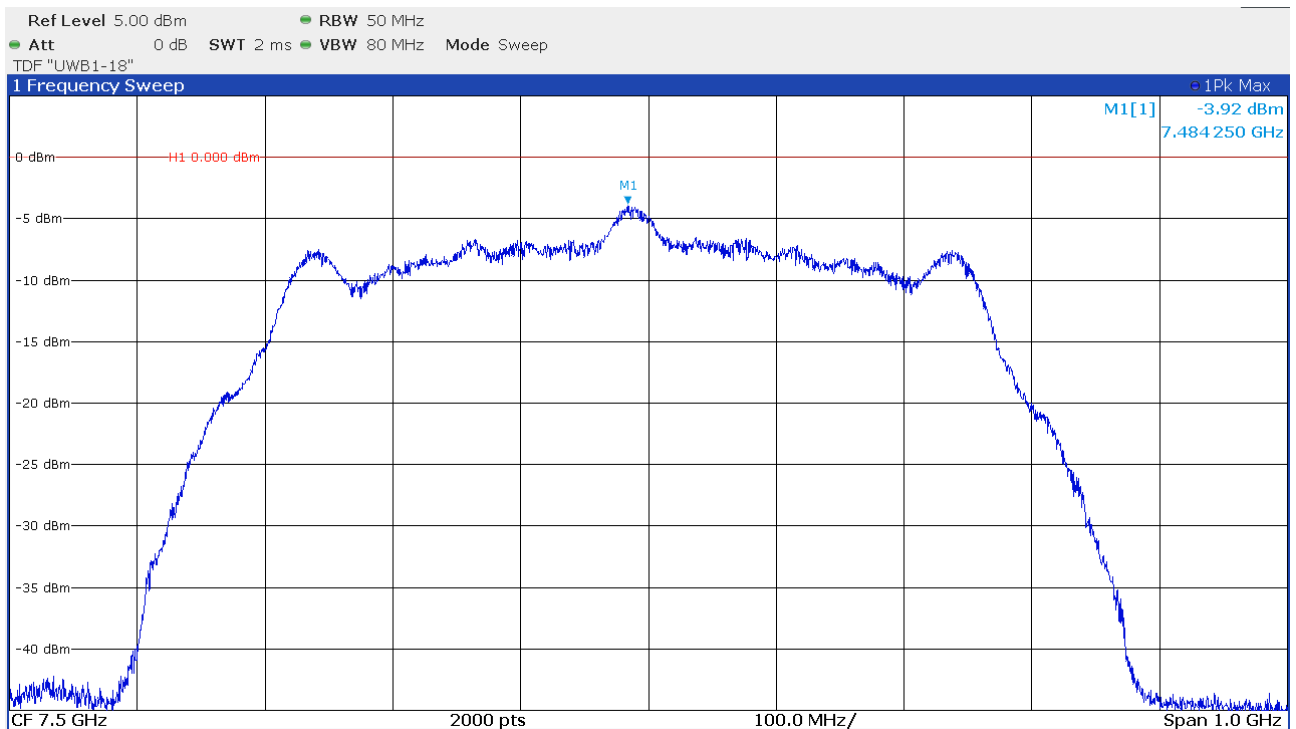
FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23
Channel 6 antenna 1

Channel 6 antenna 2


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Channel 8 antenna 1

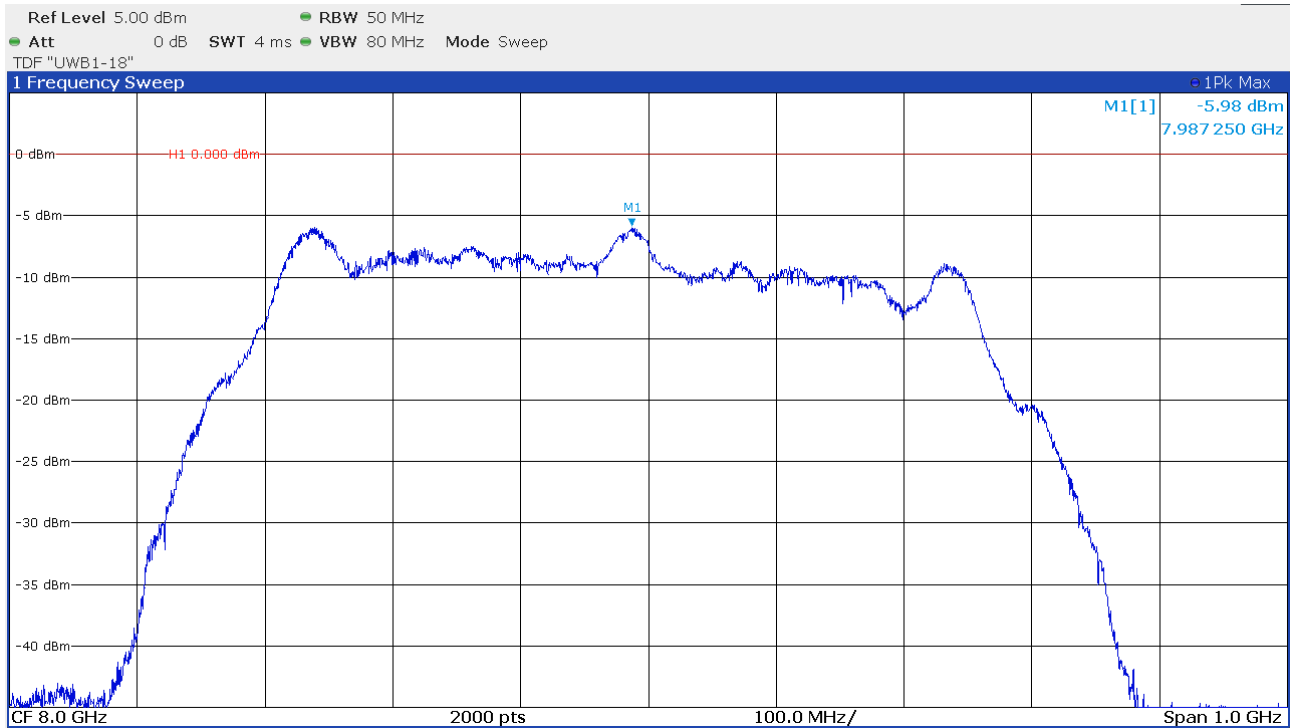


Channel 8 antenna 2

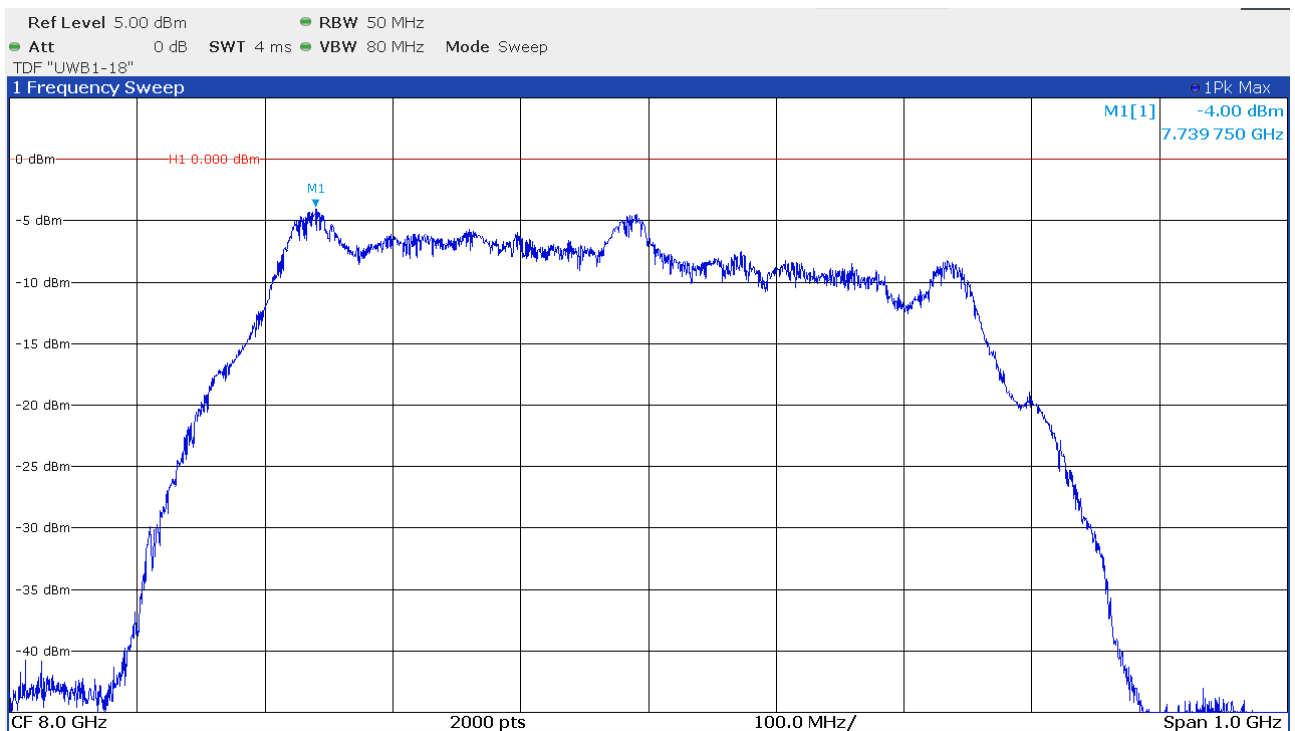


FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Channel 9 antenna 1



Channel 9 antenna 2



FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

Min. limit margin: -1.7 dB at 6489.8 MHz

The requirements are **FULFILLED**.

Remarks: Tests were carried out with worst-case peak power package type FC1T2.

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: KR5FBD5MY23 IC: 7812D-FBD5MY23

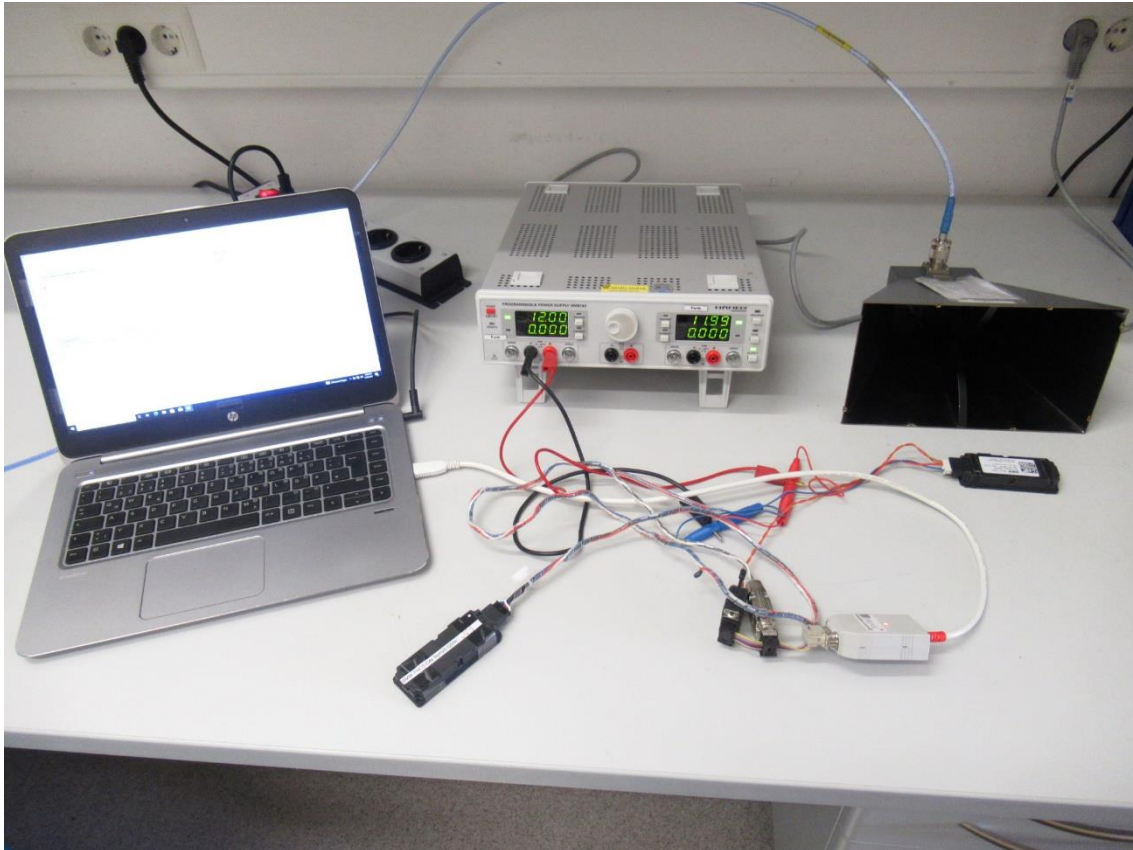
5.6 Signal deactivation

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

5.6.1 Description of the test location

Test location: Shielded room S6

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: KR5FBD5MY23 IC: 7812D-FBD5MY23

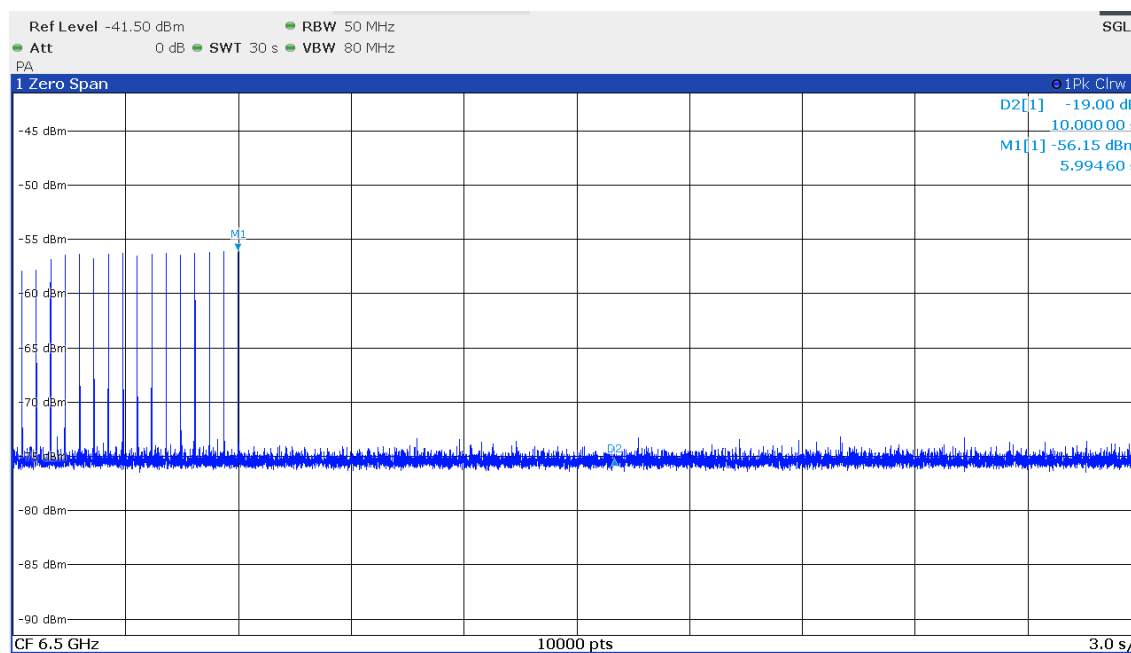
5.6.4 Description of Measurement

The measurement was performed radiated.

Spectrum analyser settings:

RBW: 50 MHz, VBW: 80 MHz, Detector: peak, zero span

5.6.5 Test result



Explanation:

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

At the time M1 (6 sec.) the companion device was powered off. The EUT immediately stops all transmissions. This behaviour is in accordance with the applicable standards.

The requirements are **FULFILLED**.

Remarks: None.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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.

FCC ID: KR5FBD5MY23 IC: 7812D-FBD5MY23

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 3.21.0.24	01-02/68-13-001				
	ESCI	02-02/03-15-001	17/06/2023	17/06/2022		
	ESH 2 - Z 5	02-02/20-05-004	31/10/2022	31/10/2019	22/09/2022	22/03/2022
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-155	13/11/2022	13/11/2019	08/09/2022	08/03/2022
CPR 3	FSW43	02-02/11-15-001	22/04/2023	22/04/2022		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	311702-02/24-05-009	28/06/2022	28/06/2021			
	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 3.21.0.24	02-02/68-13-001				
MB	FSW43	02-02/11-21-001	16/05/2023	16/05/2022		
	BBHA 9120	02-02/24-05-031				
	HM 8143	02-02/50-10-016				
SER 2	ESVS 30	02-02/03-05-006	09/07/2022	09/07/2021		
	VULB 9168	02-02/24-05-005	20/12/2022	20/12/2021	07/07/2022	07/07/2021
	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	FSW43	02-02/11-15-001	22/04/2023	22/04/2022		
	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	28/06/2022	28/06/2021		
	BBHA 9170	02-02/24-05-013	19/05/2023	19/05/2020	10/03/2023	10/03/2022
	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				
	ZHSS-11G-S+	02-02/50-20-025				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				
	BAT-EMC 3.21.0.24	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.