



RF – TEST REPORT

- FCC Part 15.247, RSS-247, partly -

Type / Model Name : SPB209A

Product Description : WLAN module

Applicant : Avnet Embedded GmbH

Address : Ludwig-Erhard-Str. 10c

85375 NEUFABRN, GERMANY

Manufacturer : H&D Wireless AB

Address : Färögatan 33

164 51 KISTA, SWEDEN

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

POSITIVE

Test Report No. : **80205072-00 Rev_1**

02. April 2025

Date of issue



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

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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.

FCC Rules and Regulations Part 15, Subpart A - General (May 2024)

Measurement standards

Frequency range of radiated measurements

Measurement detector functions and bandwidths

Part 15, Subpart C, Section 15.203

Antenna requirement

External radio frequency power amplifiers and antenna modifications

Restricted bands of operation

Conducted limits

Radiated emission limits, general requirements

Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

Testing Unlicensed Wireless Devices

Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, April 2, 2019.

MODULAR TRANSMITTER INTEGRATION GUIDE— GUIDANCE FOR HOST PRODUCT MANUFACTURERS



2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

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

2.2 Sampling

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

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

2.4 General remarks

The EUT is a communication module and consists of a fully tested and approved WLAN-Module according to FCC part 15.247 with a manufacturer designed host and PCB antennas. This test report shows the further compliance to the FCC part 15.247 with a new antenna (C2PC) after integration. Therefore, the re-test is partly done to the following requirements, only.

- RF output power
- Transmitter unwanted emissions, radiated

2.5 Equipment type

WLAN - Client, mobile device

2.6 Short description of the equipment under test (EUT)

The EUT is a part 15C certificated WLAN module with an external antenna.

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

2.7 Variants of the EUT

There are no variants.

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.

2.8 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan WLAN Standard 802.11b, g, n HT 20:

Channel	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

Channel plan WLAN Standard 802.11n HT 40:

Channel up	Channel down	Frequency (MHz)
1 up	5 down	2422
2 up	6 down	2427
3 up	7 down	2432
4 up	8 down	2437
5 up	9 down	2442
6 up	10 down	2447
7 up	11 down	2452

2.9 Transmit operating modes

The EUT use DSSS or OFDM modulation and may operate under operating mode 2 and provide following data rates with auto-fall-back:

- 802.11b mode 11, 5.5, 2, 1 Mbps (Mbps = megabits per second)
- 802.11g mode 54, 48, 36, 24, 18, 12, 9, 6 Mbps (Mbps = megabits per second)
- 802.11n HT20, MCS 0 - 7
- 802.11n HT40, MCS 0 - 7

2.10 Antenna

The following antennas shall be used with the EUT:

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

2.11 Power supply system utilised

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

2.12 Peripheral devices and interface cables

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

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

2.13 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.



X



Y



Z

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

Preliminary tests are performed to find the worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate.

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

WLAN	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.11b	1 to 11	1, 6, 11	+ 11 dBm	DSSS	DBPSK	1 Mbps
802.11n HT20	1 to 11	1, 6, 11	+ 11 dBm	OFDM	BPSK	MCS7
802.11n HT40	1up to 7up	1up, 3up, 7up	+ 11 dBm	OFDM	BPSK	MCS7

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

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

3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	Not applicable
15.247(a)(2)	RSS-247, 5.2(a)	-6 dB EBW	Not tested
15.247(b)(3)	RSS-247, 5.4(d)	Maximum peak conducted output power	Passed
15.247(d)	RSS-247, 5.5	Unwanted emission, radiated	Passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	Passed
15.247(e)	RSS-247, 5.2(b)	PSD	Not tested
15.35(c)	RSS-Gen, 6.10	Pulsed operation	Not tested
15.203	-	Antenna requirement	Passed
	RSS-Gen, 6.11	Transmitter frequency stability	Not tested
	RSS-Gen, 6.6	99 % Bandwidth	Not tested

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

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80205072-00	0	27 May 2024	Initial test report
	1	02 April 2025	Clause 4.5.3.2.4: correction of table height Clause 5.1.4: correction of test method (ANSI reference) Clause 5.2.5.2: test result update, AV measurement CH11 hor. on p. 33 Clause 6: clarification of testing period regarding calibration date

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

3.2 Final assessment

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

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

Testing commenced on : 29 April 2024

Testing concluded on : 22 May 2024

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Franz-Xaver Schrettenbrunner
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

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

4.2 Environmental conditions

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

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.3 Statement of the measurement uncertainty

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

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	$\pm 3.29 \text{ dB}$
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	$\pm 2.71 \text{ dB}$
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	$\pm 2.71 \text{ dB}$
Power spectral density	2400 MHz to 3000 MHz	95%	$\pm 0.62 \text{ dB}$
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	$\pm 2.15 \text{ dB}$
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	$\pm 3.47 \text{ dB}$
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	$\pm 3.53 \text{ dB}$
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	$\pm 4.44 \text{ dB}$
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	$\pm 2.34 \text{ dB}$
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	$\pm 5.13 \text{ dB}$

4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule ($w = 0$).

Details can be found in the procedure CSA_B_V50_29.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

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

FCC: DE 0011

ISED: DE0009

4.5.2 General Standard information

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

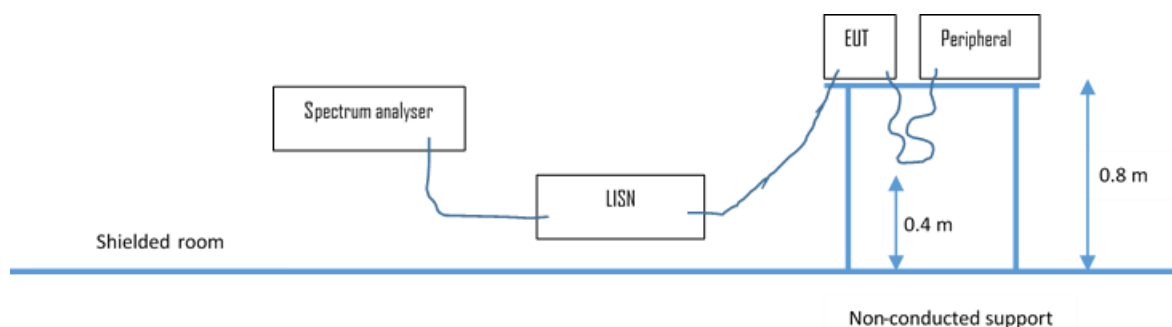
4.5.2.1 Justification

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

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



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

To convert between dB μ V and μ V, the following conversions apply:

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

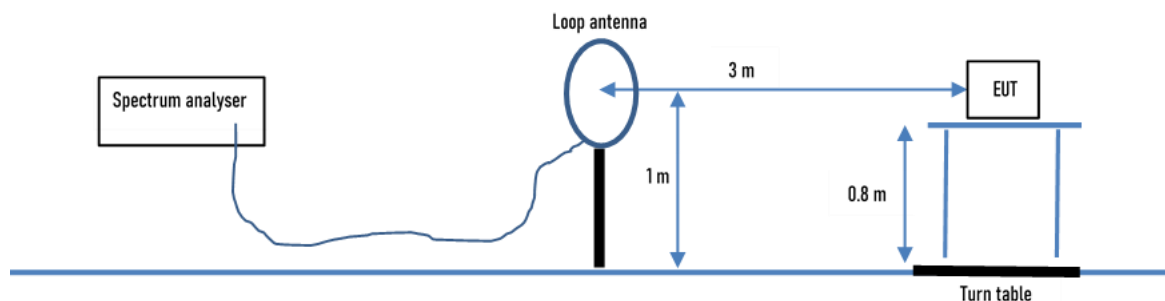
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

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

4.5.3.2 Radiated emission

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

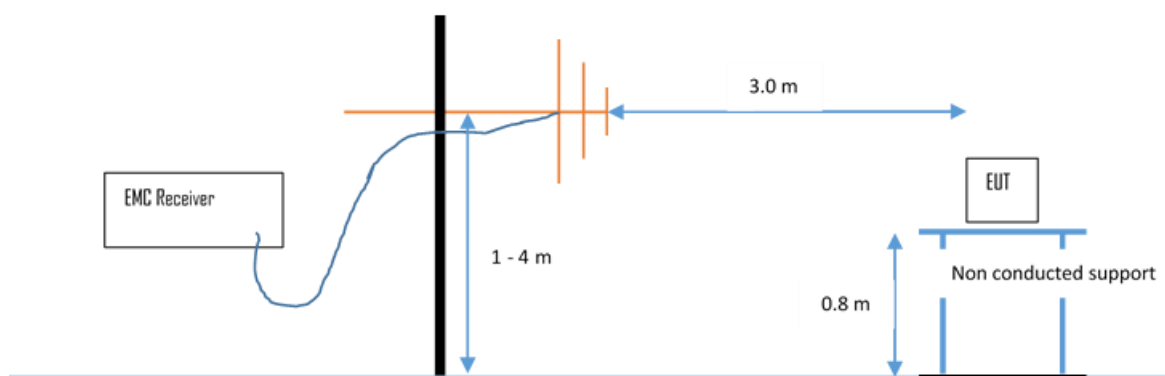
Test setup according ANSI C63.10



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

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

Test setup according ANSI C63.10.



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

The resolution bandwidth setting:

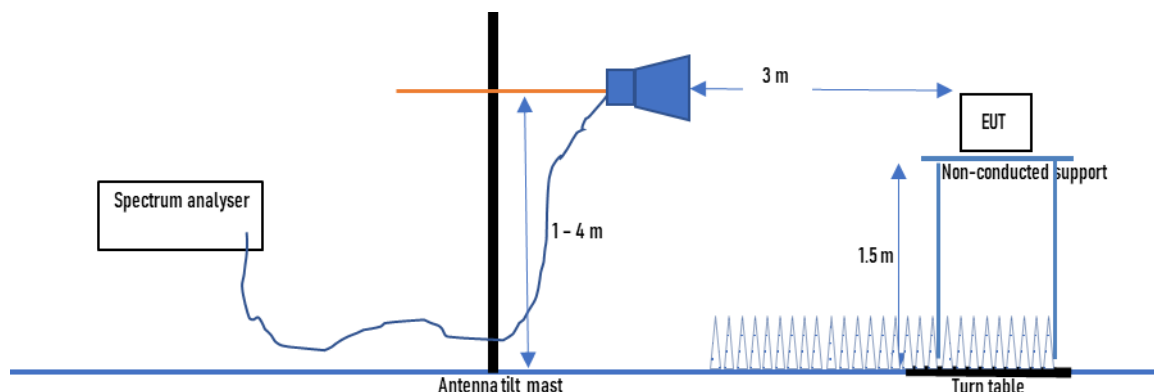
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor (dB)	=	Level (dB μ V/m)	-	Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

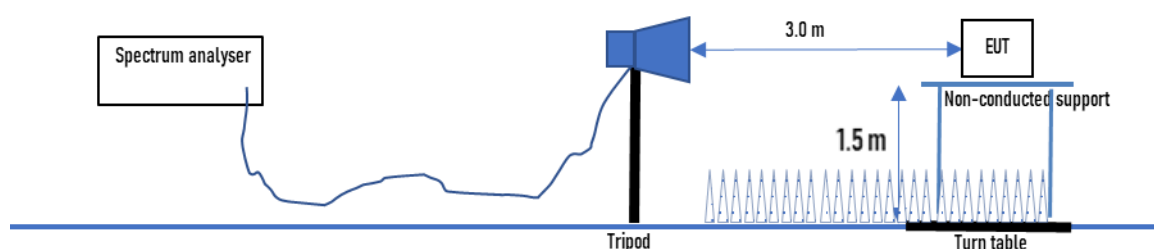
4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



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

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



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

5 TEST CONDITIONS AND RESULTS

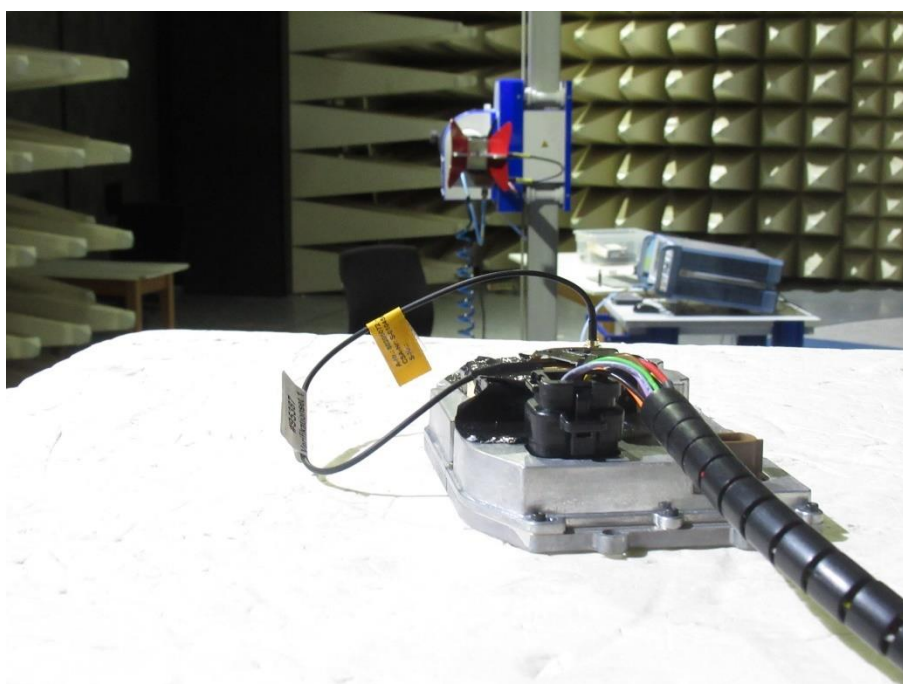
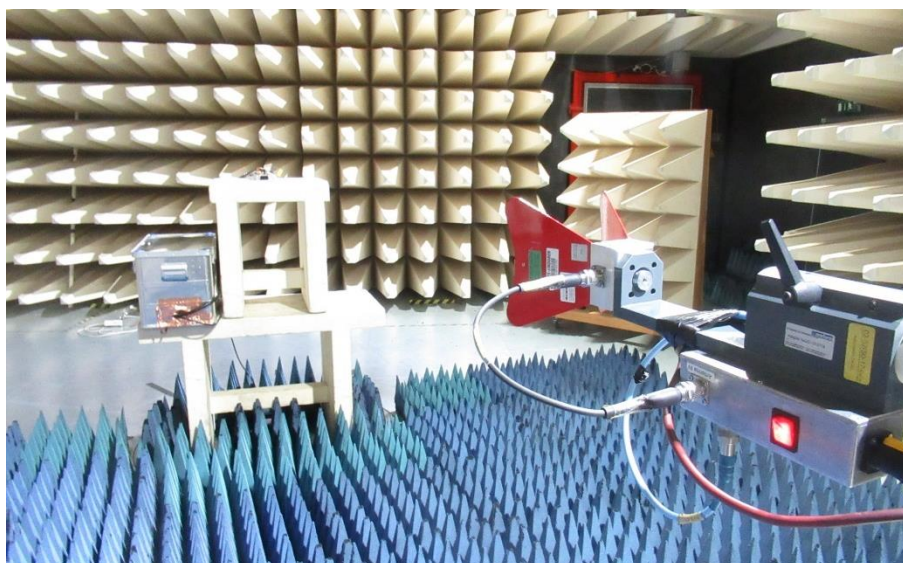
5.1 Maximum peak radiated output power

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

5.1.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.1.2 Photo documentation of the test set-up



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

5.1.3 Applicable standard

According to FCC Part 15, Section 15.247 (b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.1.4 Description of Measurement

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

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

5.1.5 Test result

Channel	WLAN standard	FS (dBμV/m)	P EIRP (dBm)	EIRP limit (dBm)	Margin (dB)	result
1	802.11b	108.7	13.5	36.0	-22.5	passed
6		110.1	14.9		-21.1	passed
11		112.2	17.0		-19.0	passed
1	802.11n HT20	115.0	19.8		-16.2	passed
6		117.9	22.7		-13.3	passed
11		118.4	23.2		-12.8	passed
1up	802.11n HT40	115.6	20.4		-15.6	passed
3up		116.4	21.2		-14.8	passed
7up		116.8	21.6		-14.4	passed

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(W)
902-928	36	4.0
2400-2483.5	36	4.0
5725-5850	36	4.0

The requirements are **FULFILLED**.

Remarks: None.

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5.2 Unwanted emissions in restricted bands, radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3.**

5.2.1 Description of the test location

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

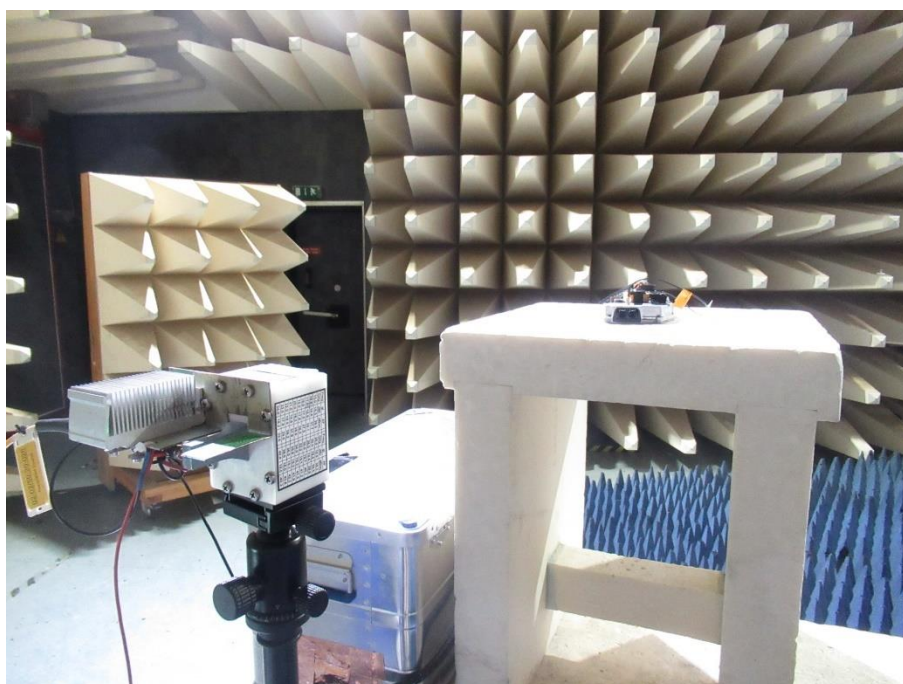
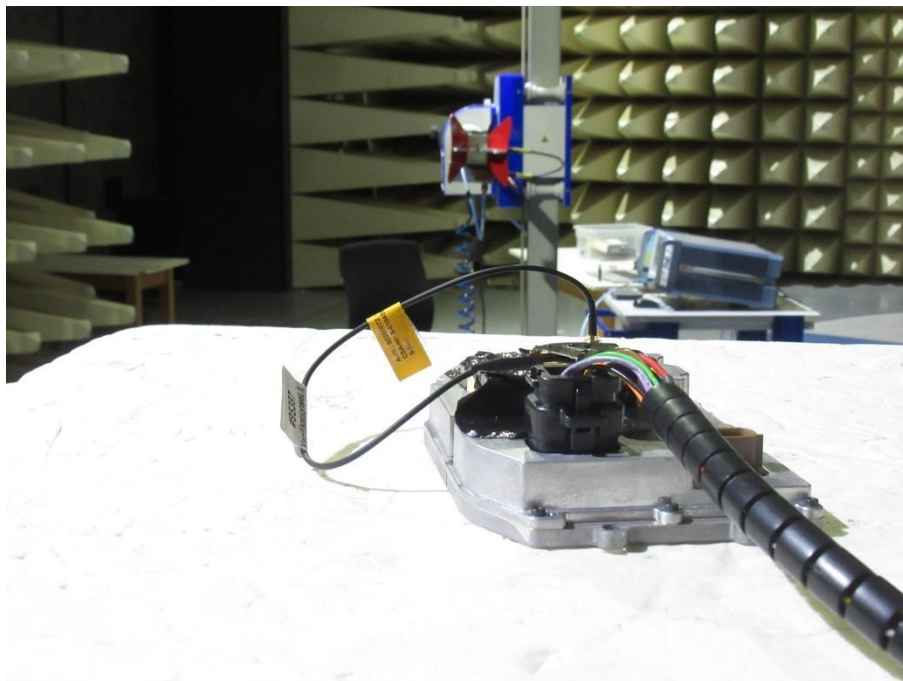
5.2.2 Photo documentation of the test set-up

Open area test site



FCC ID: XO2SPB209A

Anechoic chamber



5.2.3 Applicable standard

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

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

5.2.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Test receiver settings for SER2:

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

Spectrum analyser settings for SER3:

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

5.2.5 Test result

f < 1000 MHz:

FCC

f (MHz)	Level QP@3m (dBμV)	Ant. factor (dB/m)	Field strength QP@3m dB(μV/m)	Distance corr. 3m to 30/300m (dB)	Corrected level QP@30/300m dB(μV/m)	Limit QP dB(μV/m)
0.500	17.4	20.0	37.4	-40.0	-2.6	33.6
5.000	11.7	20.0	31.7	-40.0	-8.3	29.5
10.000	25.3	20.0	45.3	-40.0	5.3	29.5
15.000	12.7	20.0	32.7	-40.0	-7.3	29.5
20.000	5.5	20.0	25.5	-40.0	-14.5	29.5
25.000	3.1	20.0	23.1	-40.0	-16.9	29.5

ISED

f (MHz)	Level QP@3m (dBμA)	Ant. factor (dB/m)	Field strength QP@3m dB(μA/m)	Distance corr. 3m to 30/300m (dB)	Corrected level QP@30/300m dB(μA/m)	Limit QP dB(μA/m)
0.500	17.4	20.0	-14.1	-40.0	-54.4	-17.9
5.000	11.7	20.0	-19.8	-40.0	-59.8	-22.0
10.000	25.3	20.0	-6.2	-40.0	-46.2	-22.0
15.000	12.7	20.0	-18.8	-40.0	-58.8	-22.0
20.000	5.5	20.0	-26.0	-40.0	-66.0	-22.0
25.000	3.1	20.0	-28.4	-40.0	-68.4	-22.0

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)
161.00	14.2	11.1	19.6	19.2	33.8	30.3	43.5	-9.7
240.00	11.6	8.9	18.4	18.3	30.0	27.2	46.0	-16.0
264.00	2.4	1.0	19.2	19.3	21.6	20.3	46.0	-24.4
360.00	5.3	3.6	22.1	22.5	27.4	26.1	46.0	-18.6
580.00	2.3	-2.1	27.8	28.1	30.1	26.0	46.0	-15.9
705.00	-4.1	-6.3	29.9	30.4	25.8	24.1	46.0	-20.2

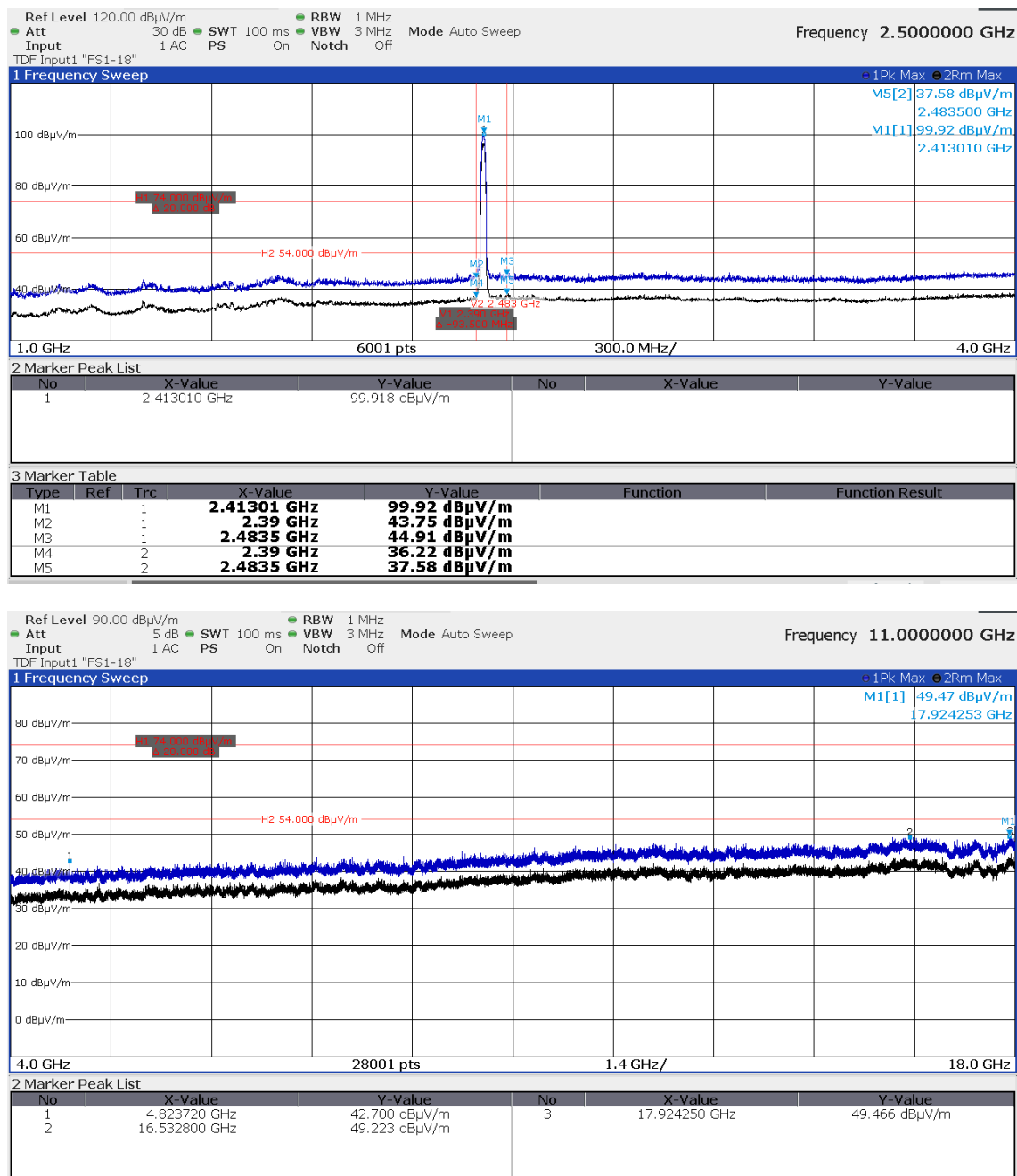


FCC ID: XO2SPB209A

f > 1000 MHz:

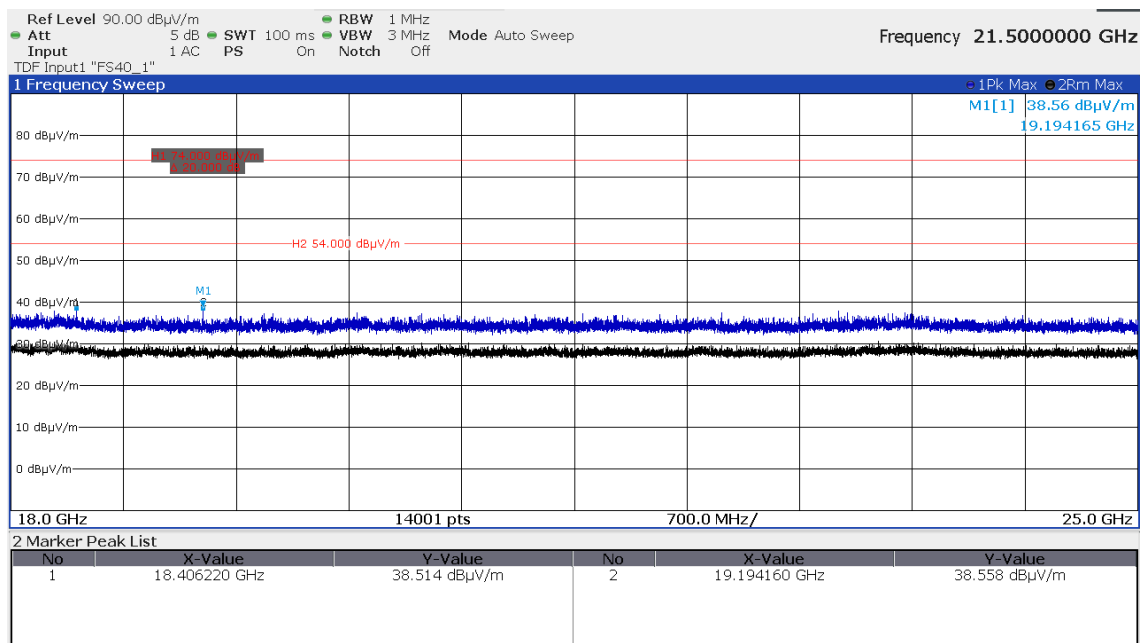
5.2.5.1 WLAN Standard 802.11b, 11 Mbps, P11

CH1 horizontal

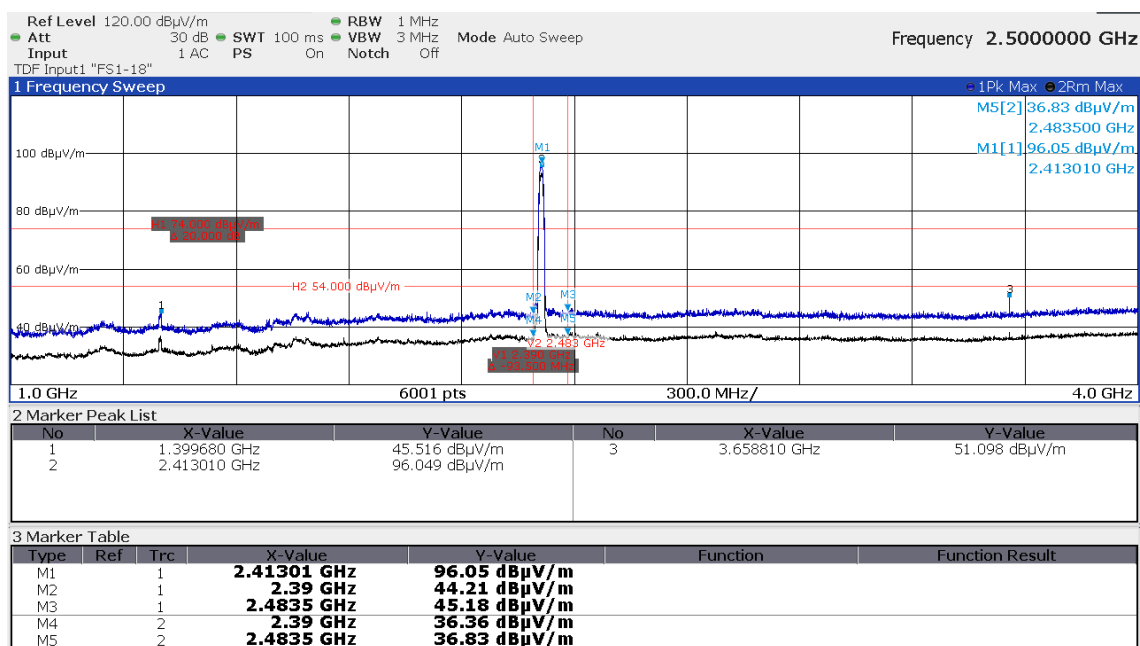


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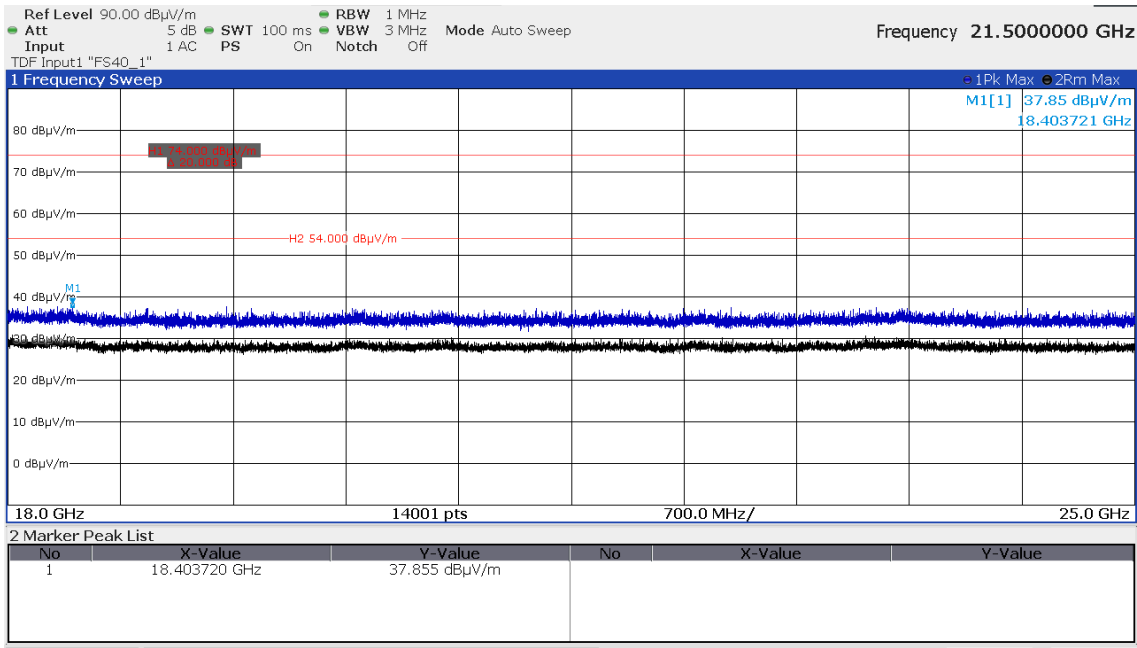
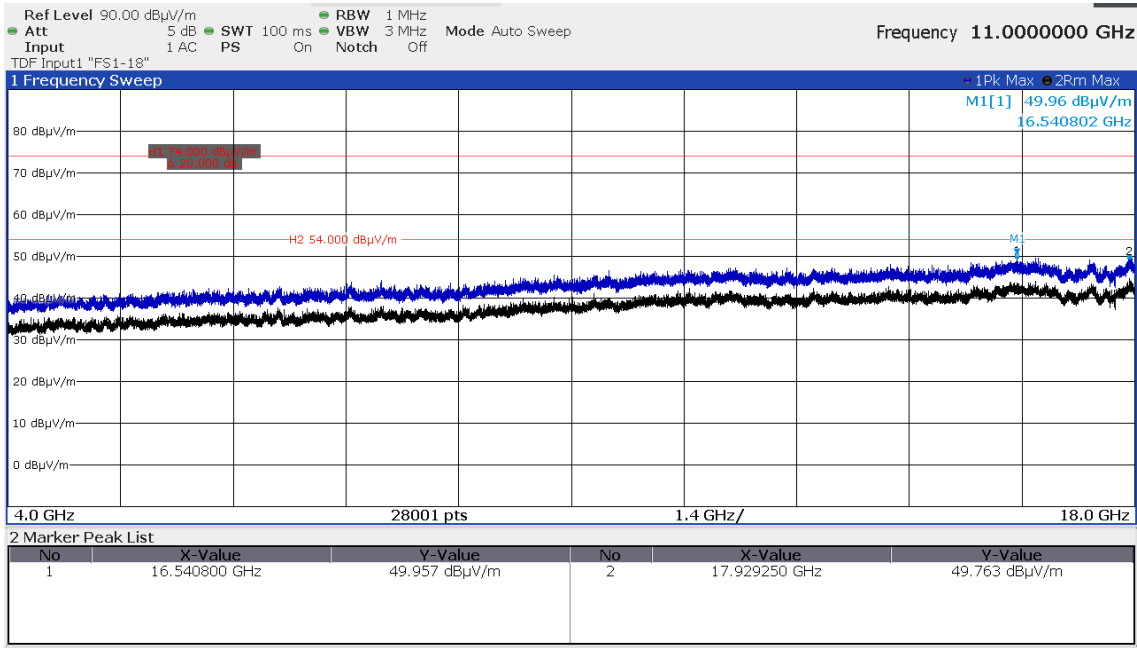


CH1 vertical





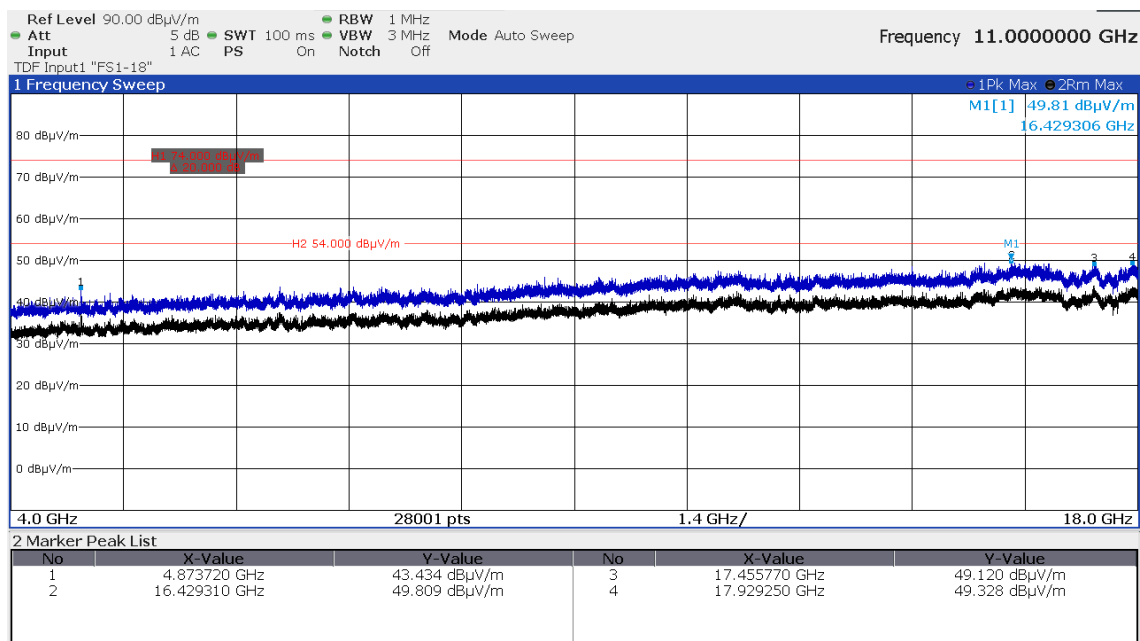
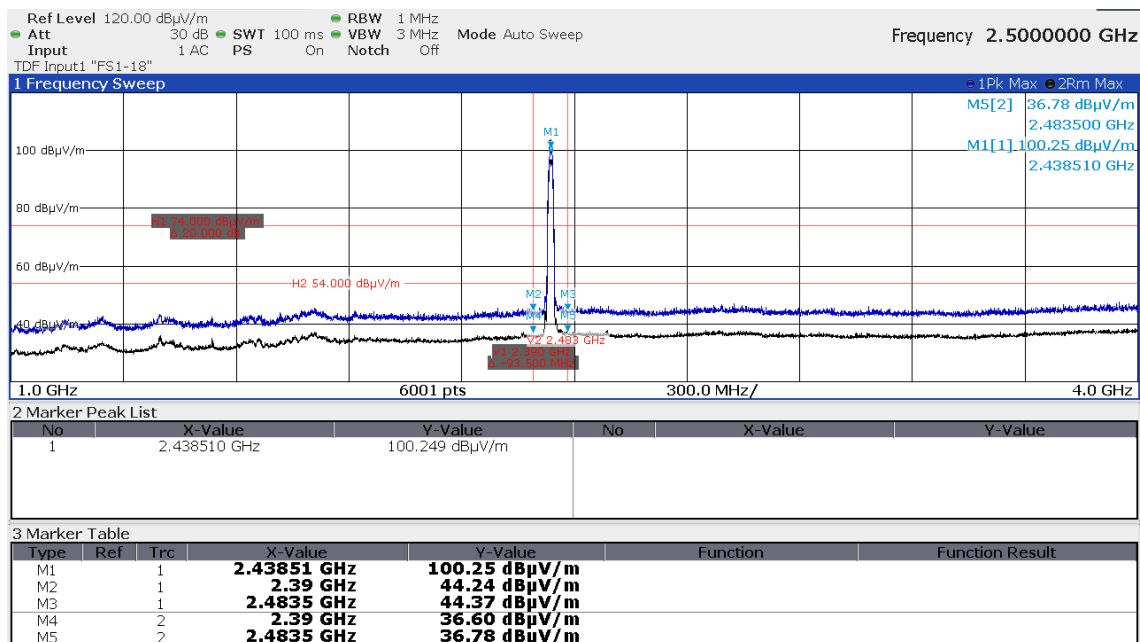
FCC ID: XO2SPB209A





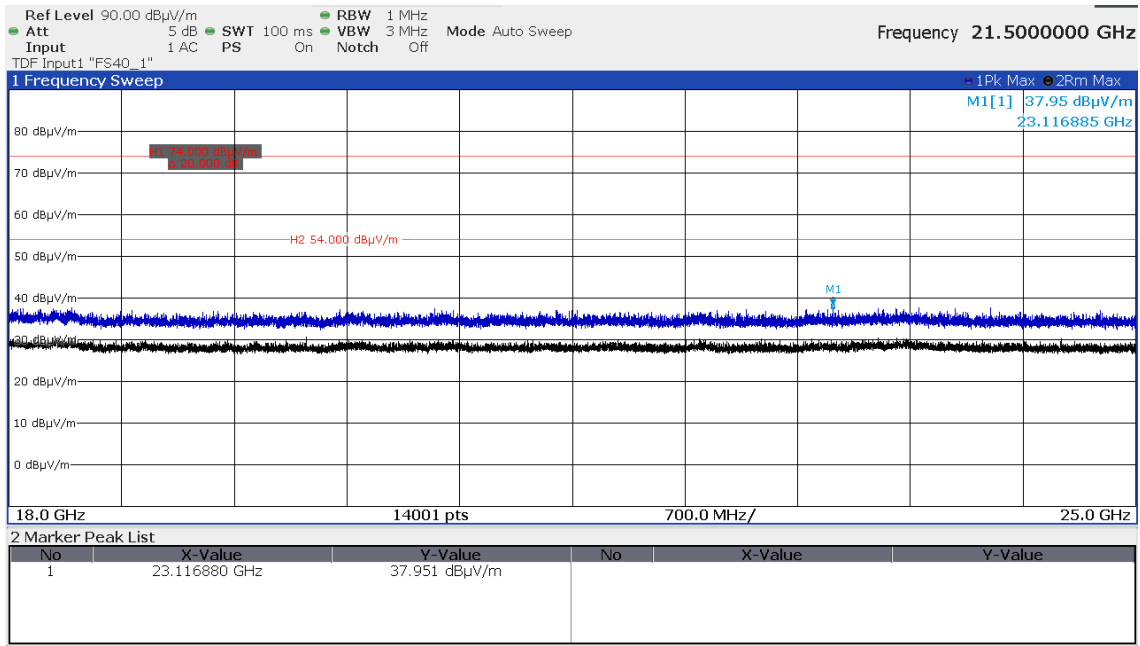
FCC ID: XO2SPB209A

CH6 horizontal

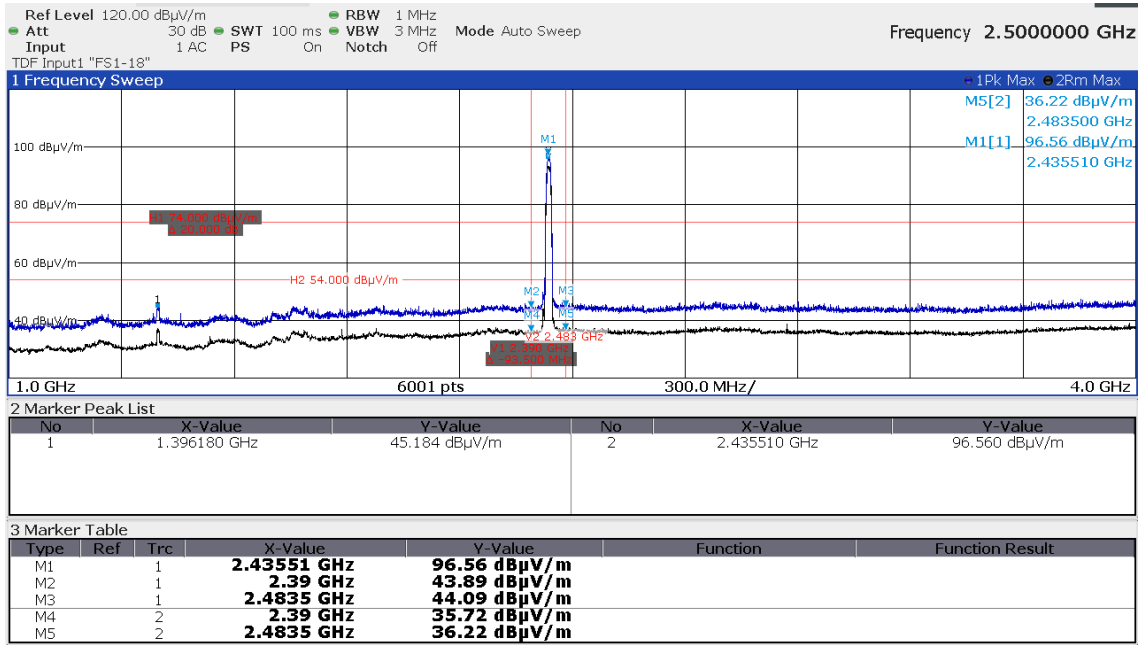




FCC ID: XO2SPB209A

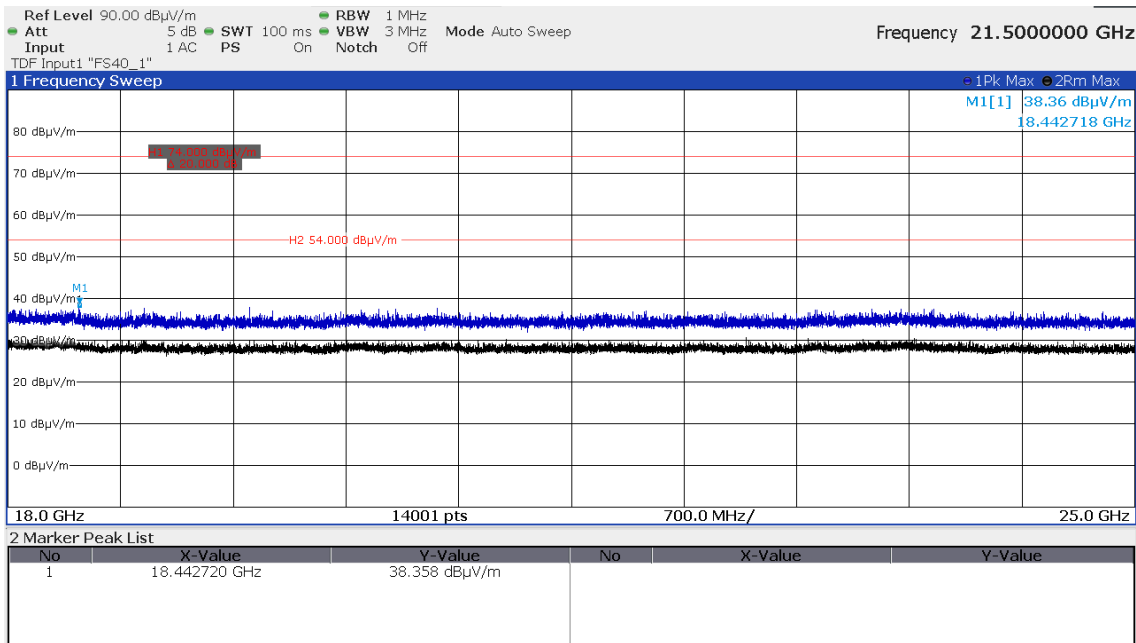
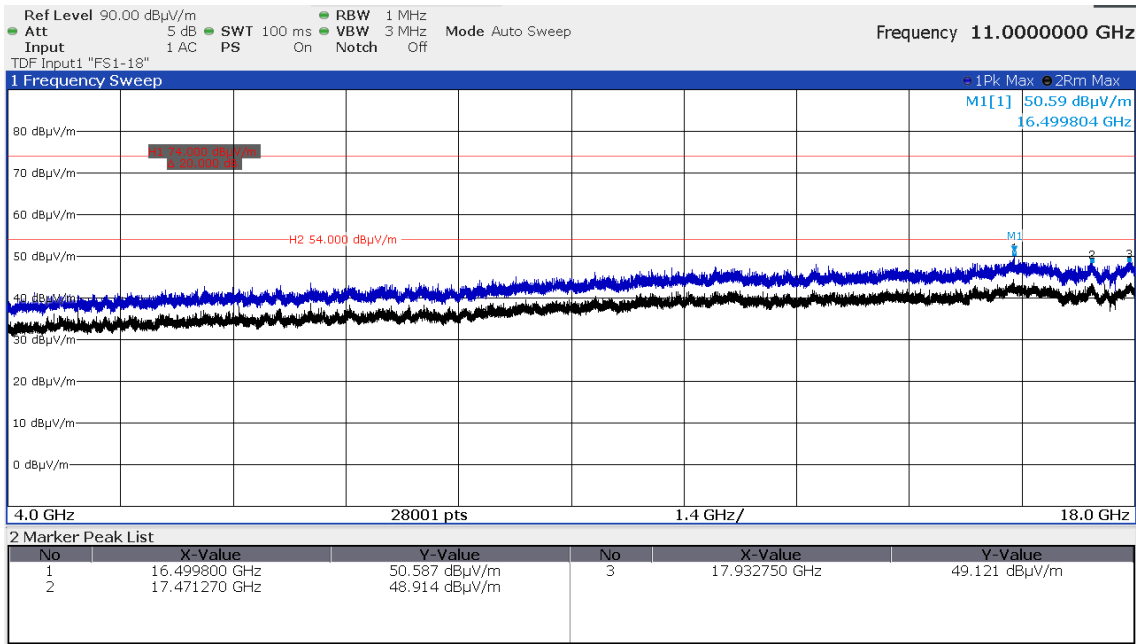


CH6 vertical

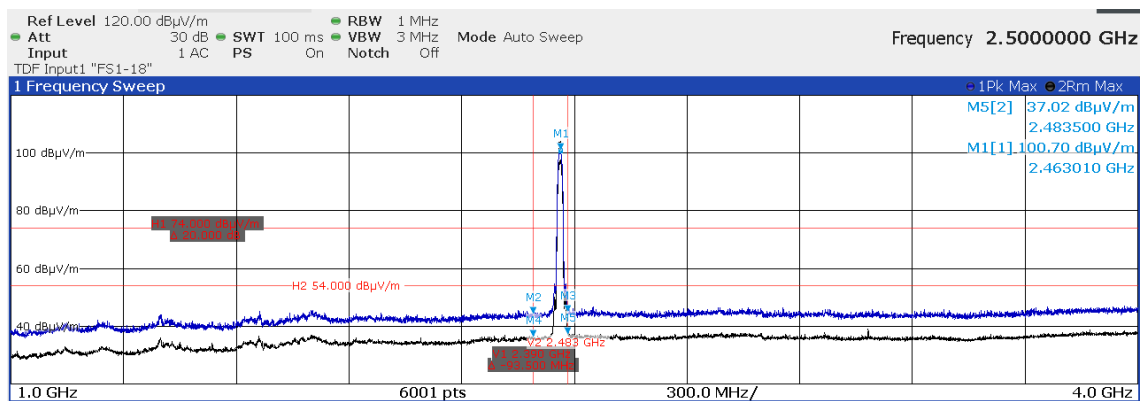




FCC ID: XO2SPB209A



CH11 horizontal

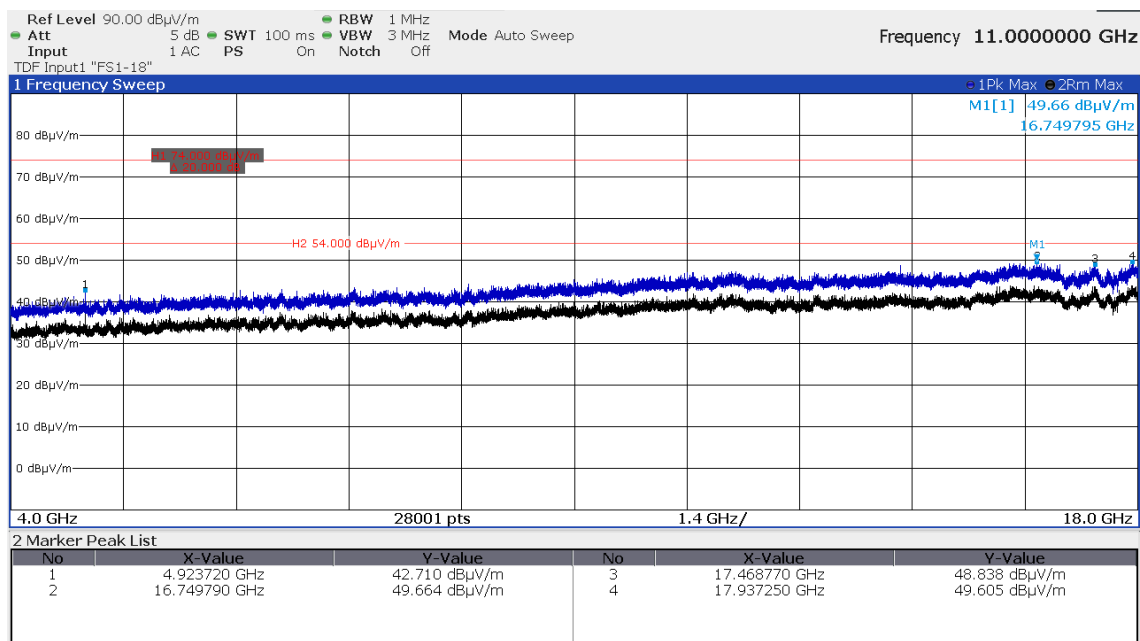


2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	2.463010 GHz	100.700 dBμV/m			

3 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		2.46301 GHz	100.70 dBμV/m		
M2	1		2.39 GHz	44.08 dBμV/m		
M3	1		2.4835 GHz	44.61 dBμV/m		
M4	2		2.39 GHz	35.82 dBμV/m		
M5	2		2.4835 GHz	37.02 dBμV/m		

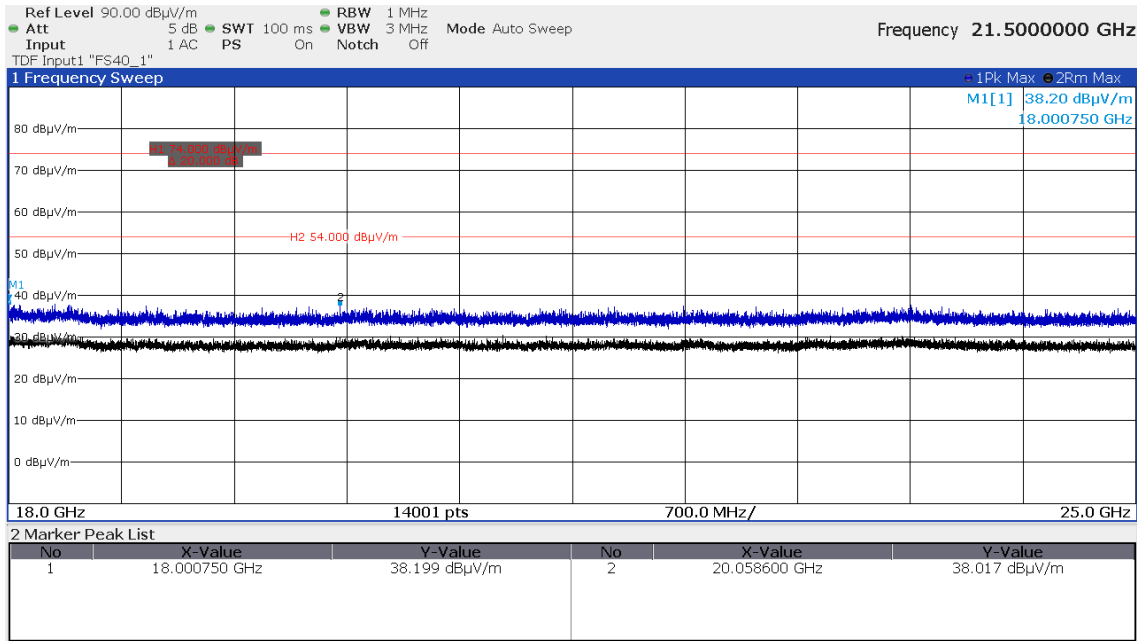


2 Marker Peak List

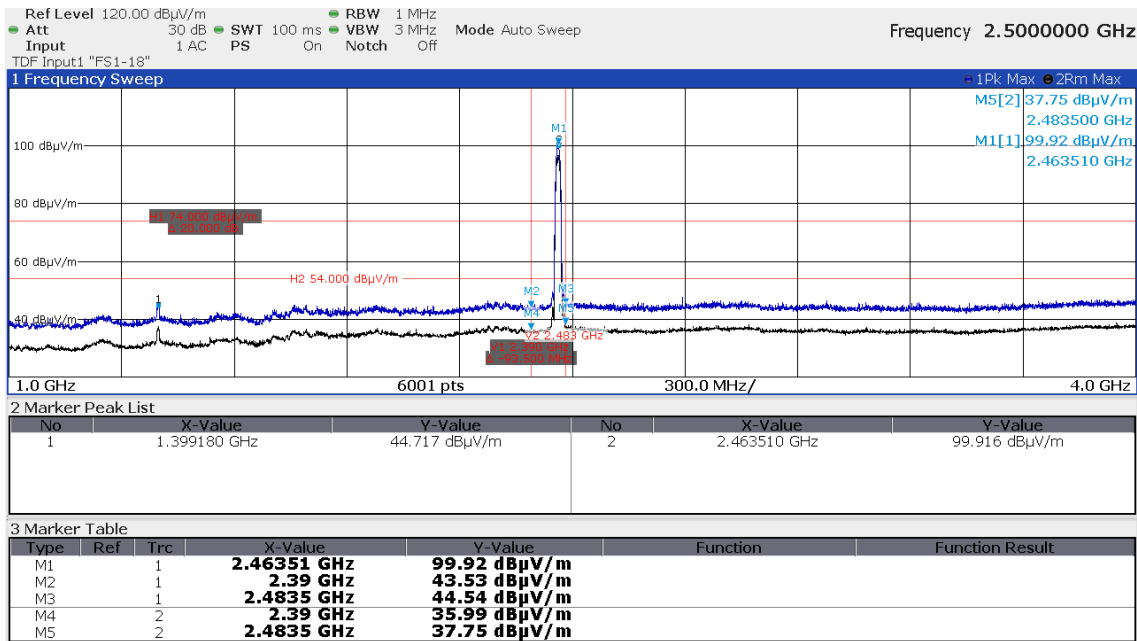
No	X-Value	Y-Value	No	X-Value	Y-Value
1	4.923720 GHz	42.710 dBμV/m	3	17.468770 GHz	48.838 dBμV/m
2	16.749790 GHz	49.664 dBμV/m	4	17.937250 GHz	49.605 dBμV/m



FCC ID: XO2SPB209A

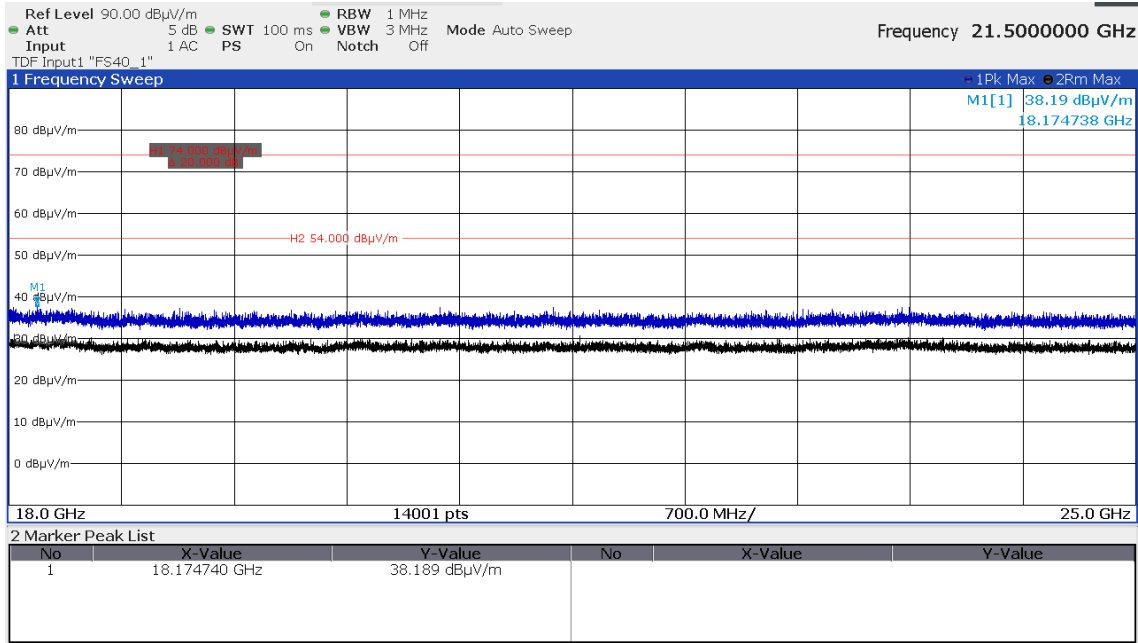
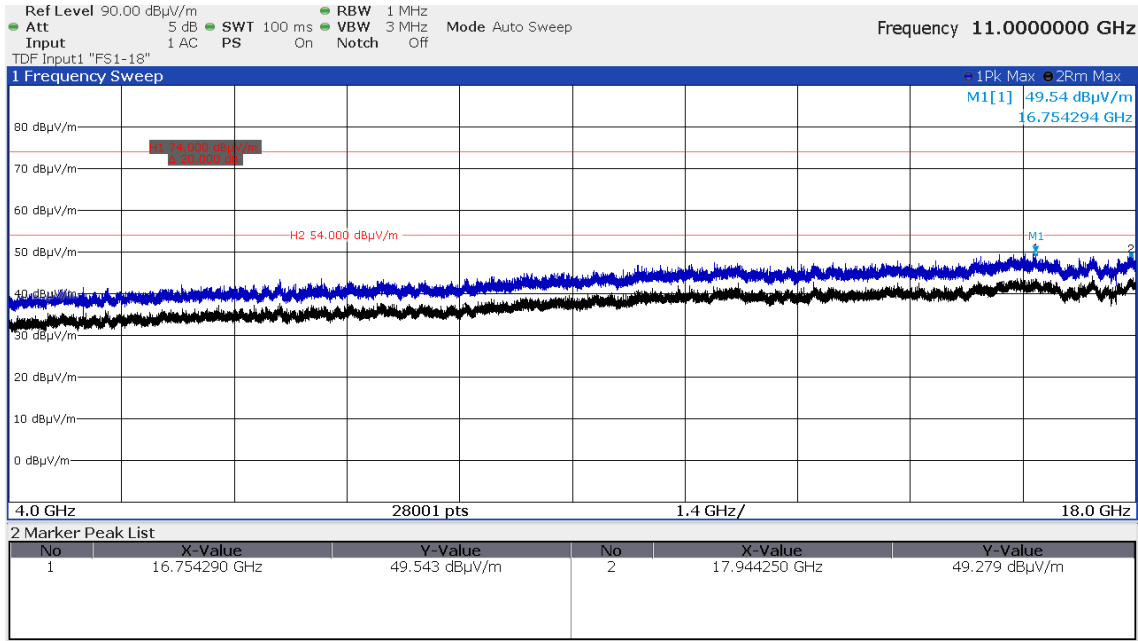


CH11 vertical





FCC ID: XO2SPB209A

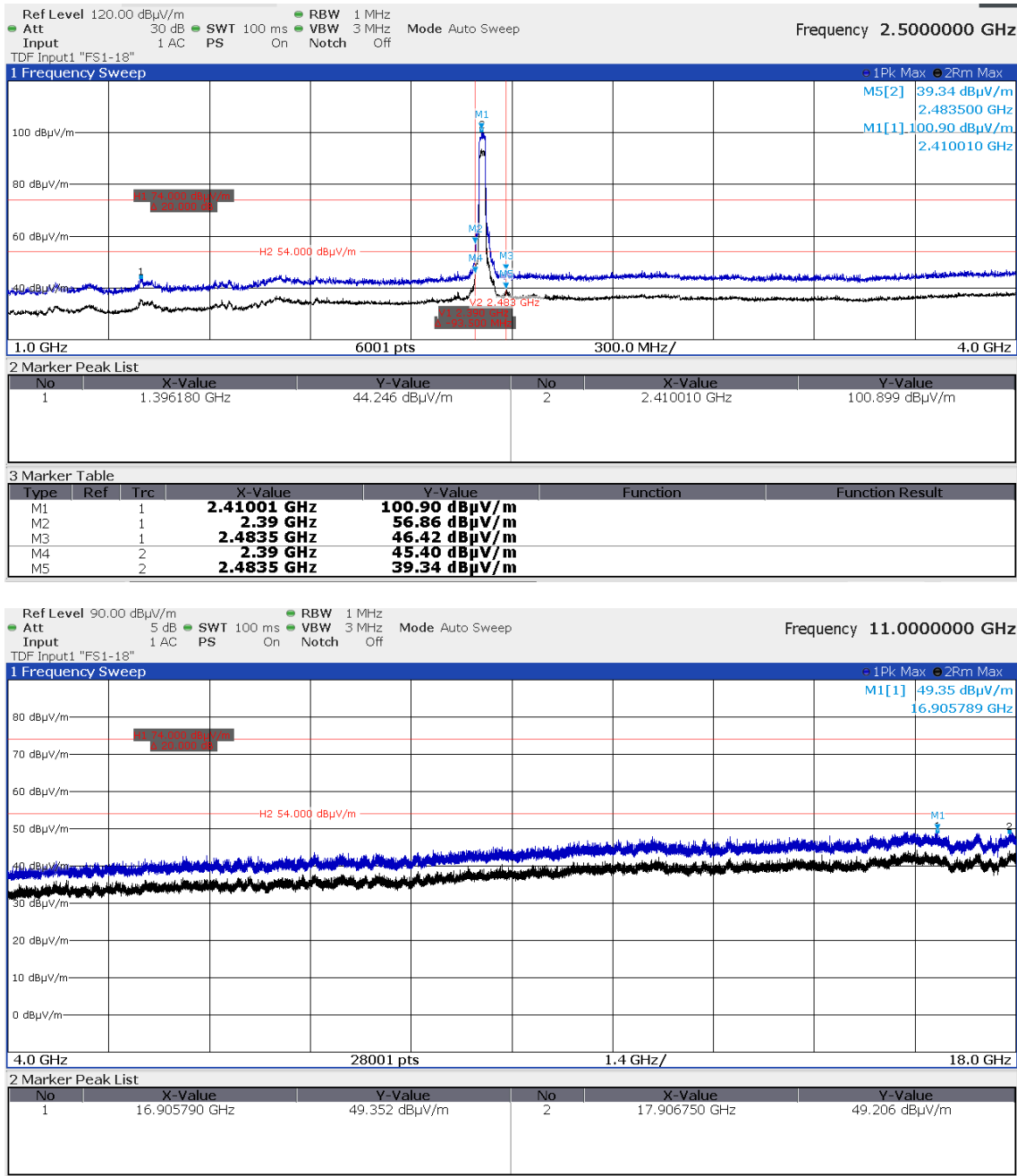




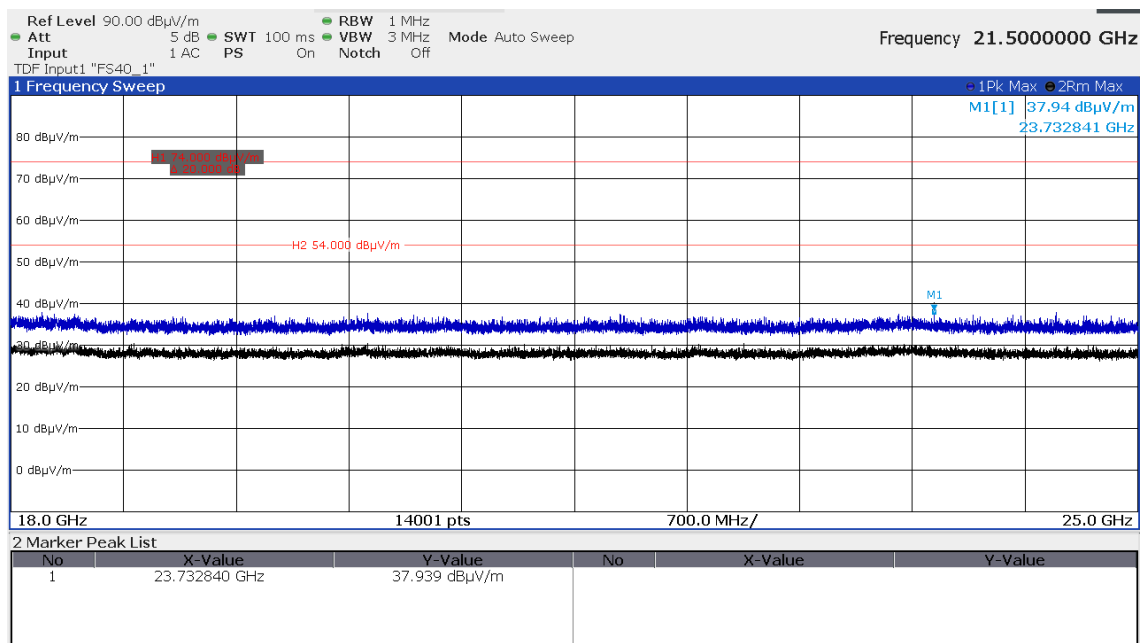
FCC ID: XO2SPB209A

5.2.5.2 WLAN Standard 802.11n HT20, MCS7, P11

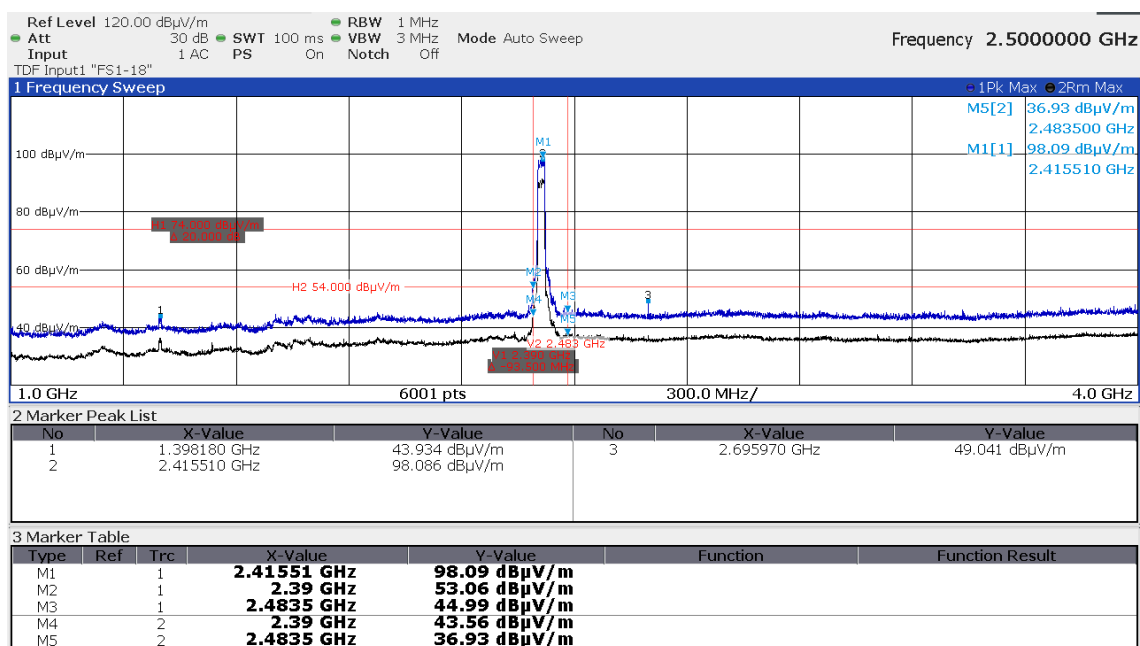
CH1 horizontal



FCC ID: XO2SPB209A

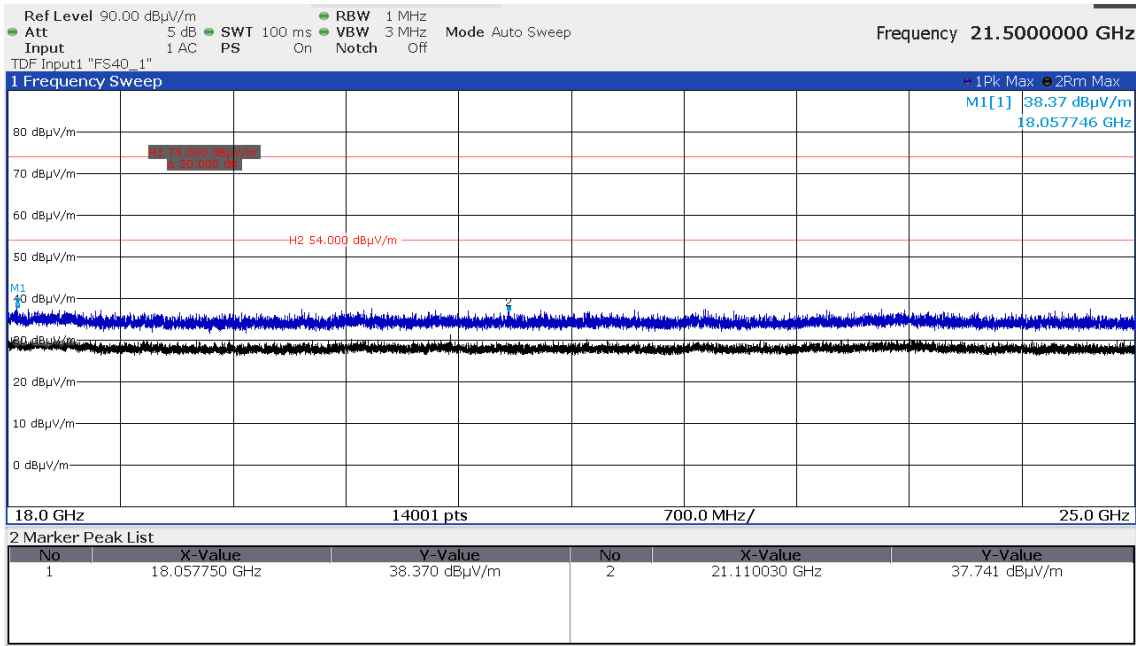
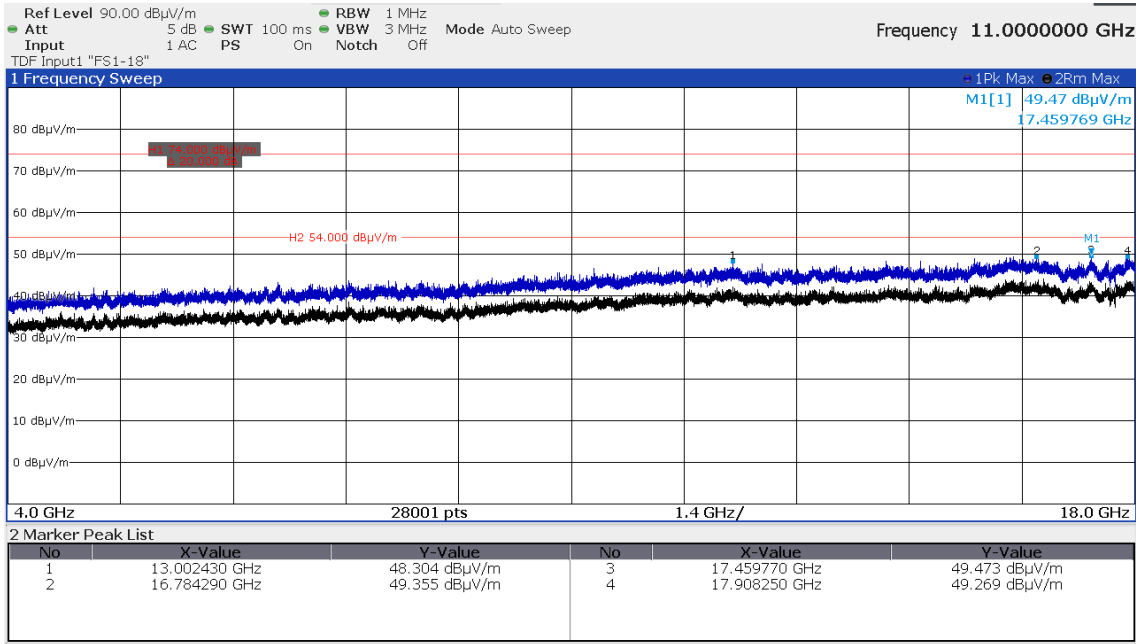


CH1 vertical

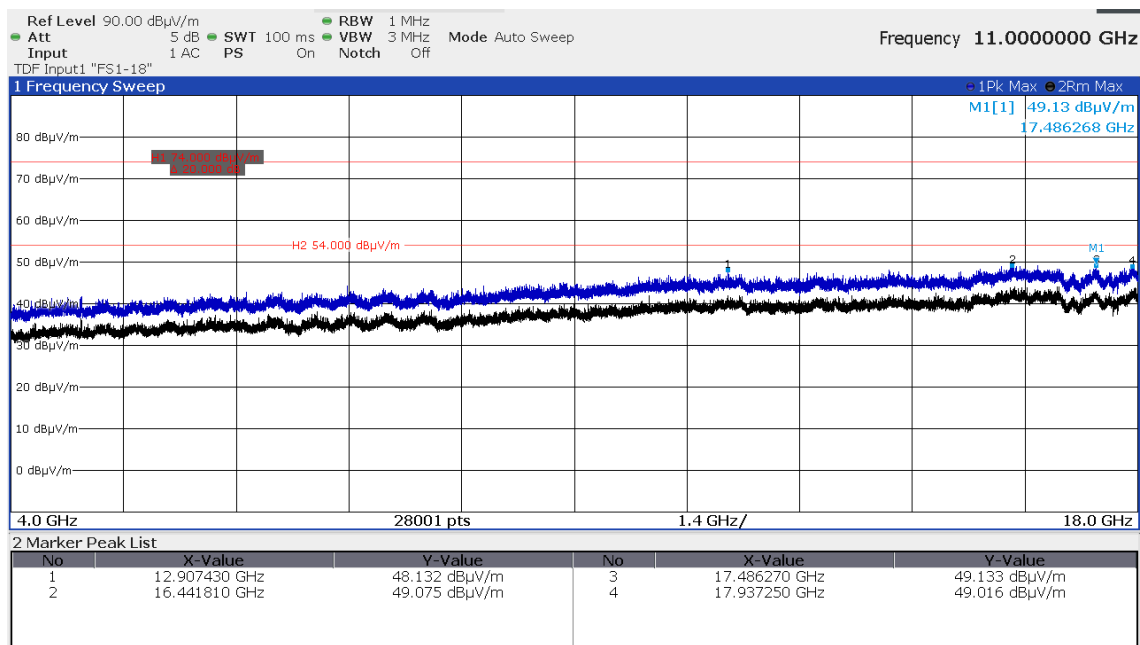
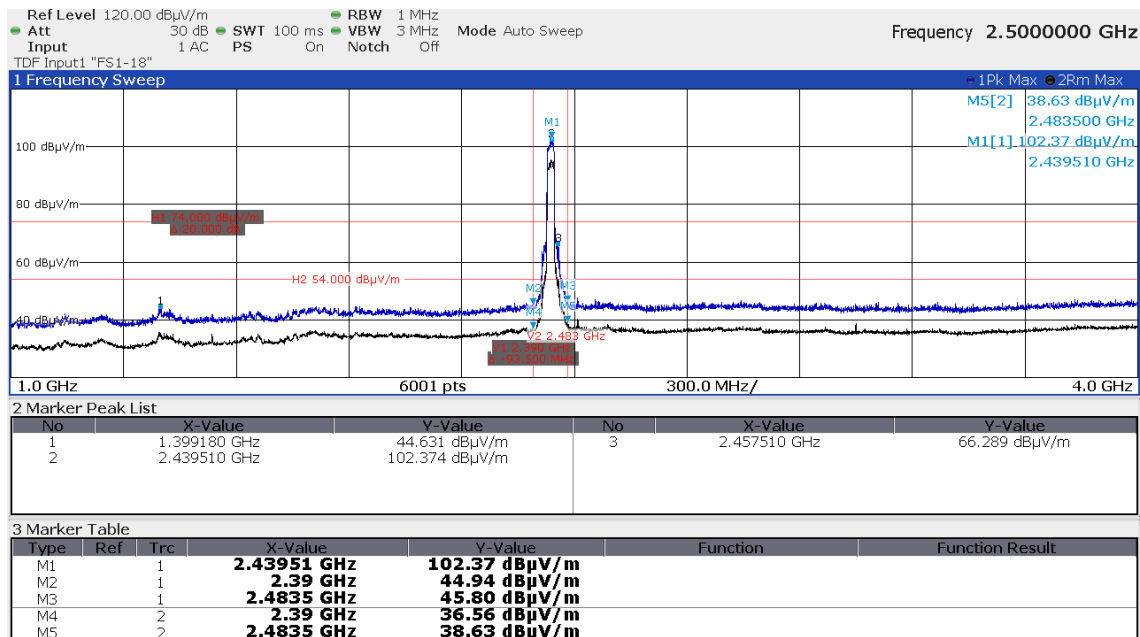




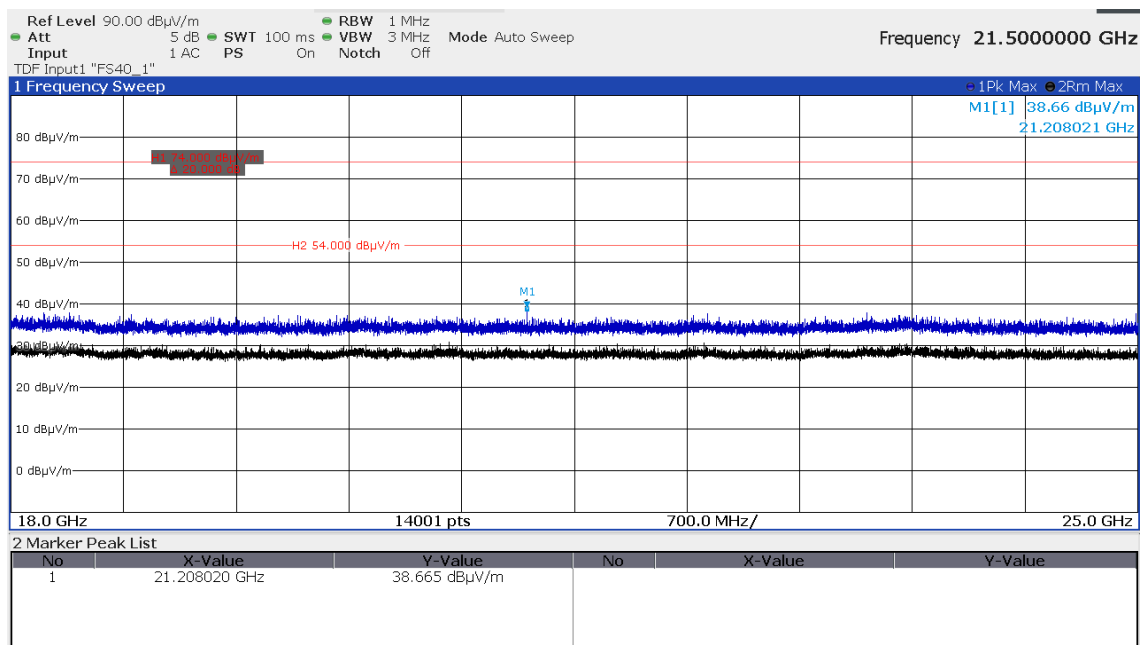
FCC ID: XO2SPB209A



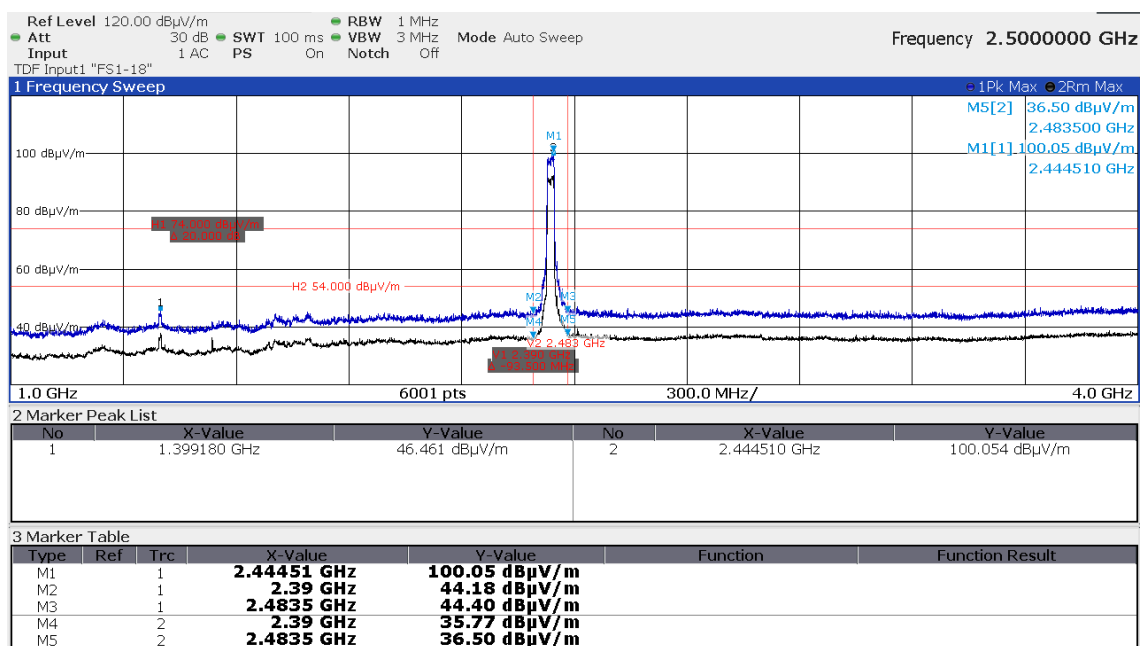
CH6 horizontal



FCC ID: XO2SPB209A

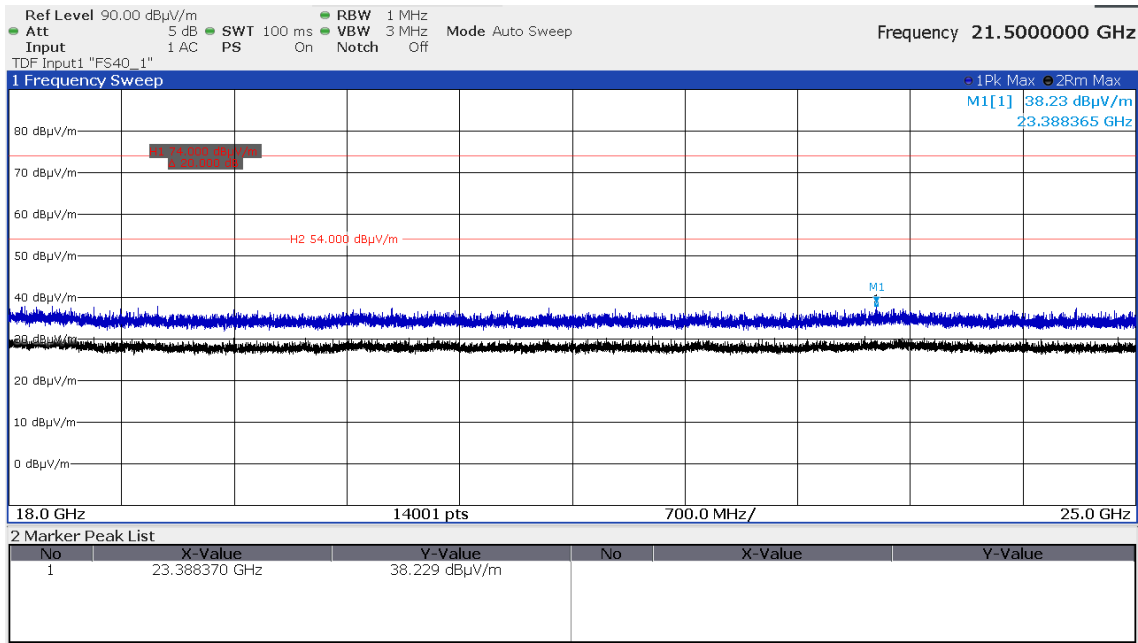
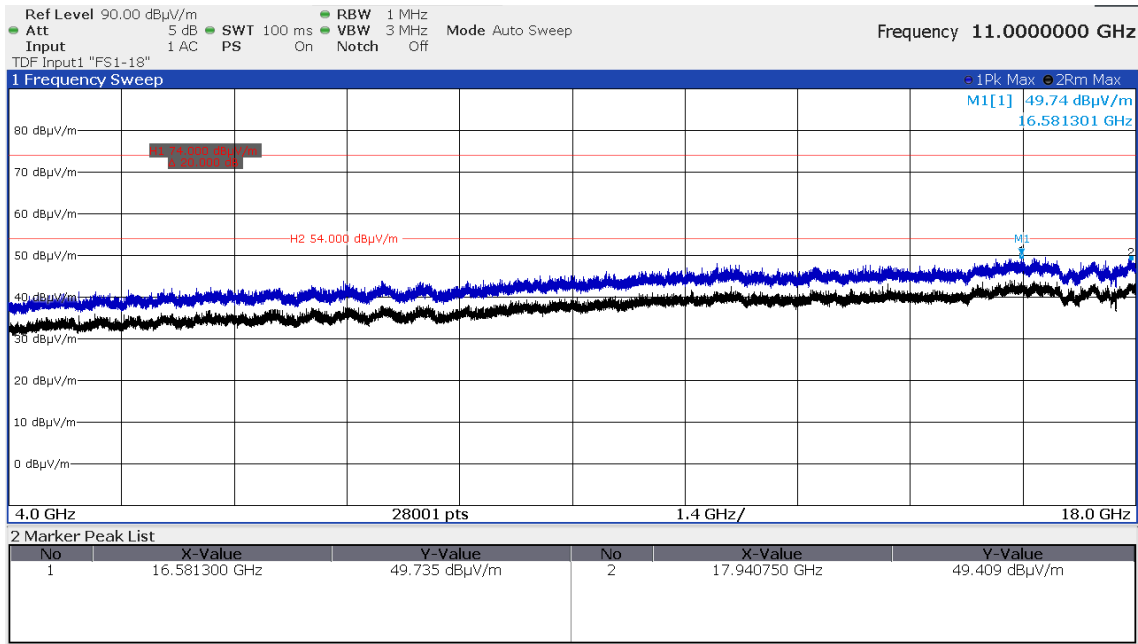


CH6 vertical





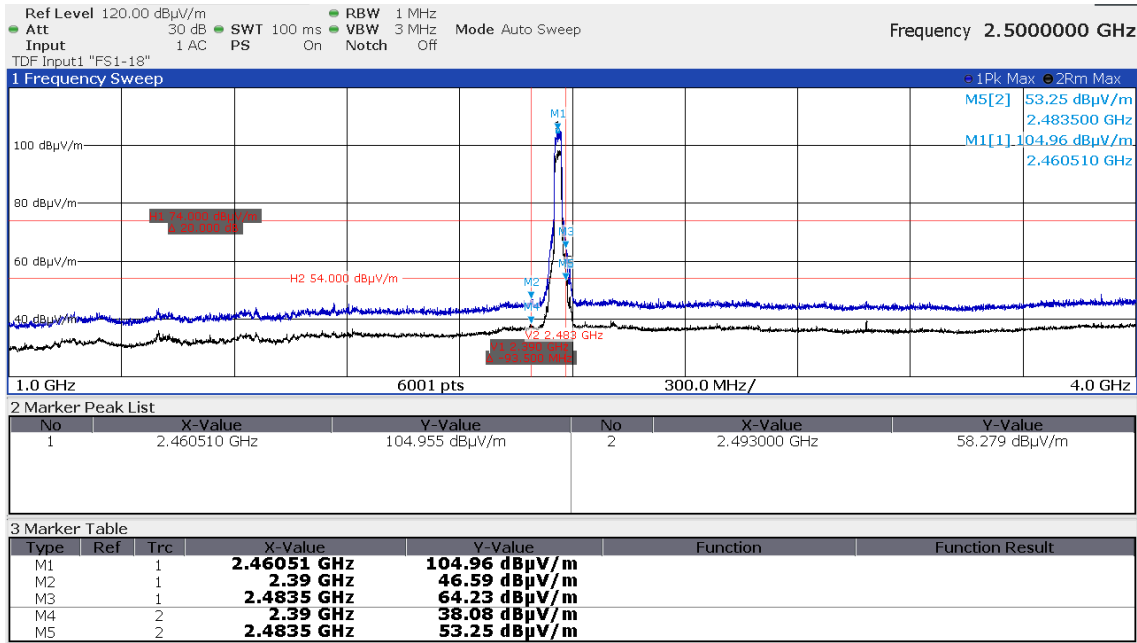
FCC ID: XO2SPB209A



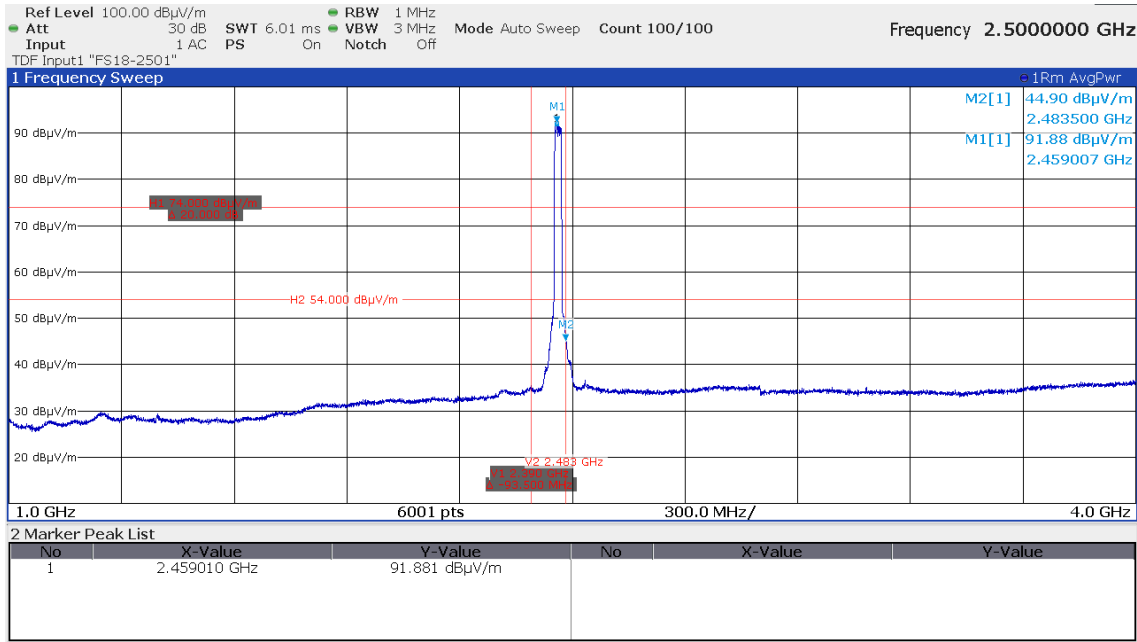


FCC ID: XO2SPB209A

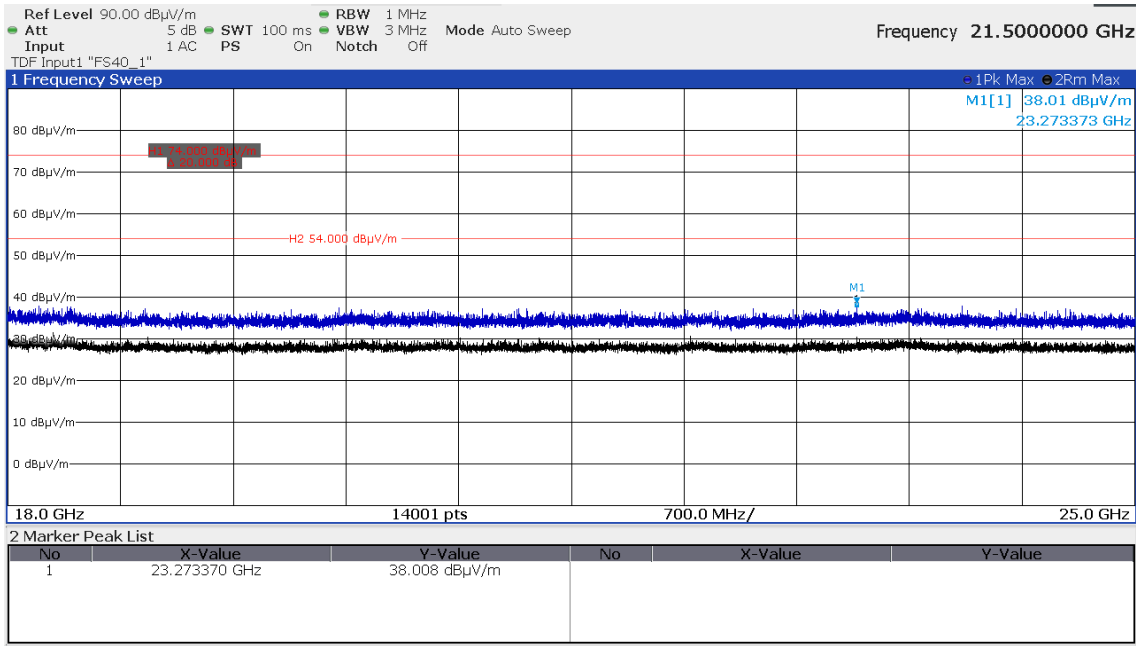
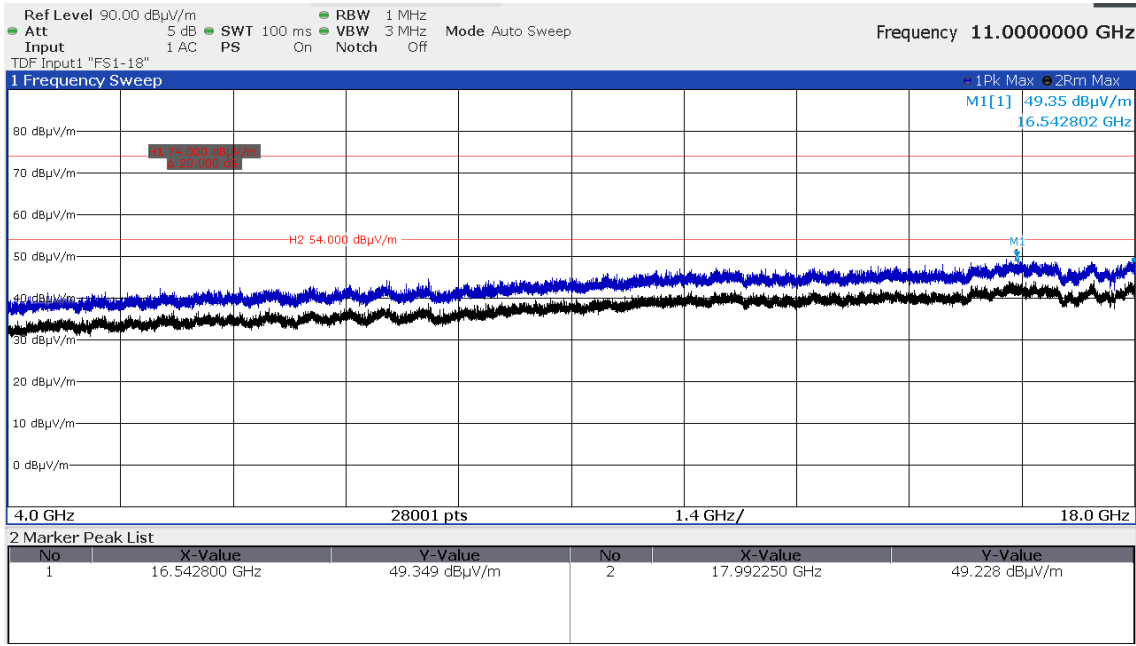
CH11 horizontal



Peak value at measurement point 2 (2.493 GHz, 58.279 dBµV/m) is over average limit. Compliance is shown with average measurement according to ANSI C63.10 clause 11.12.2.5.1:



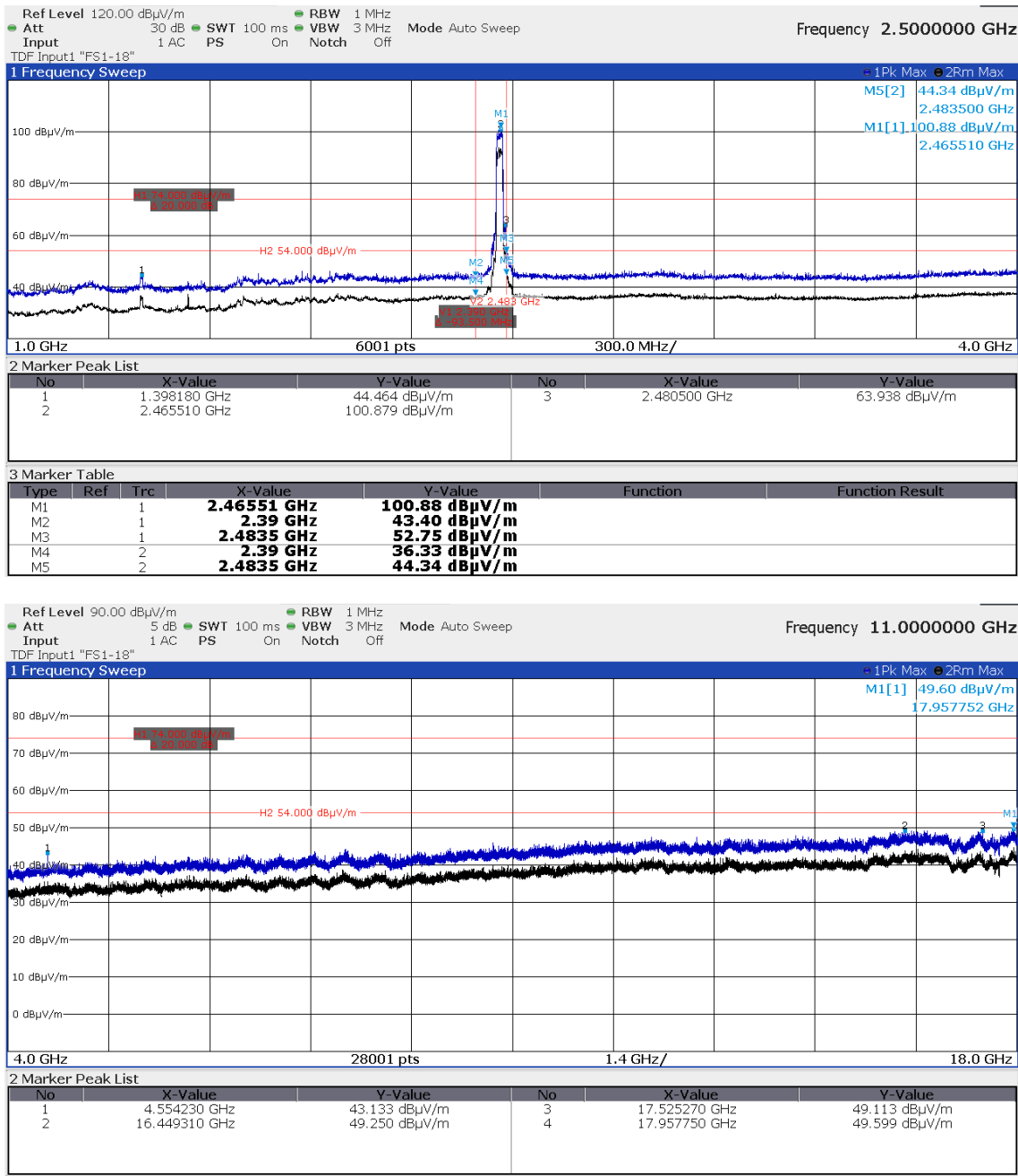
FCC ID: XO2SPB209A





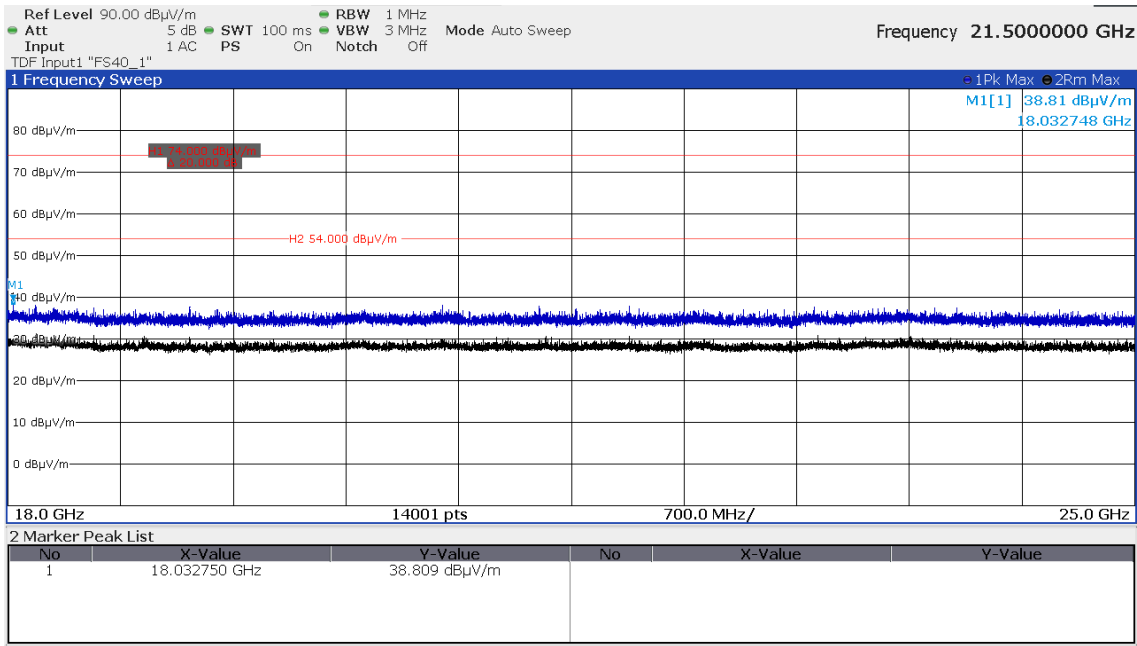
FCC ID: XO2SPB209A

CH11 vertical



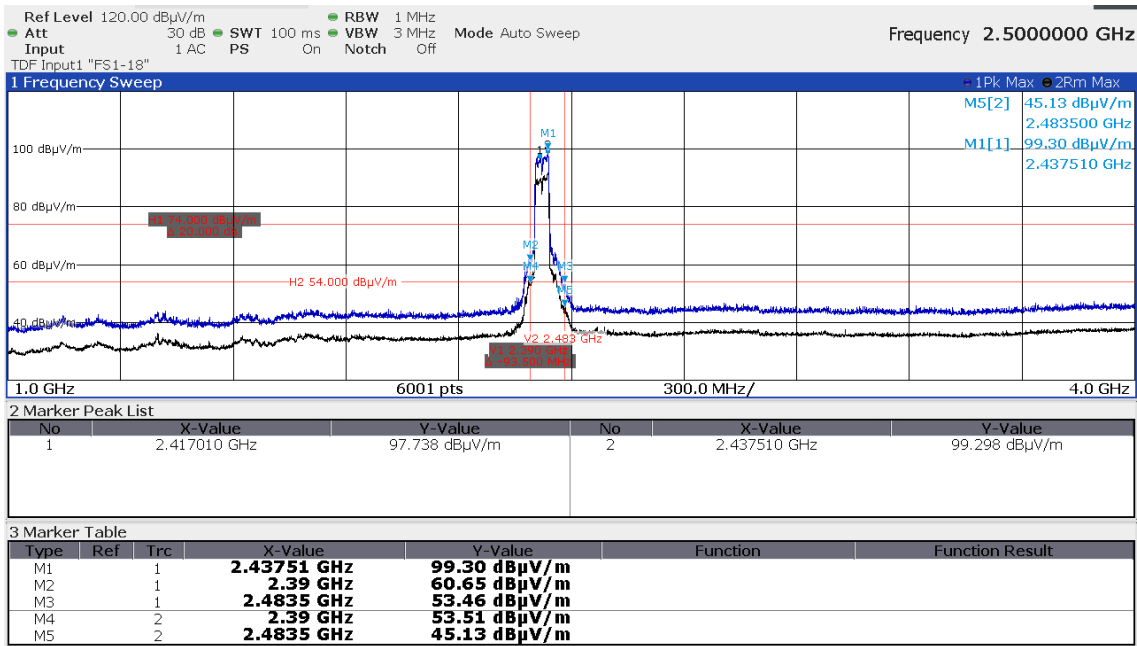


FCC ID: XO2SPB209A



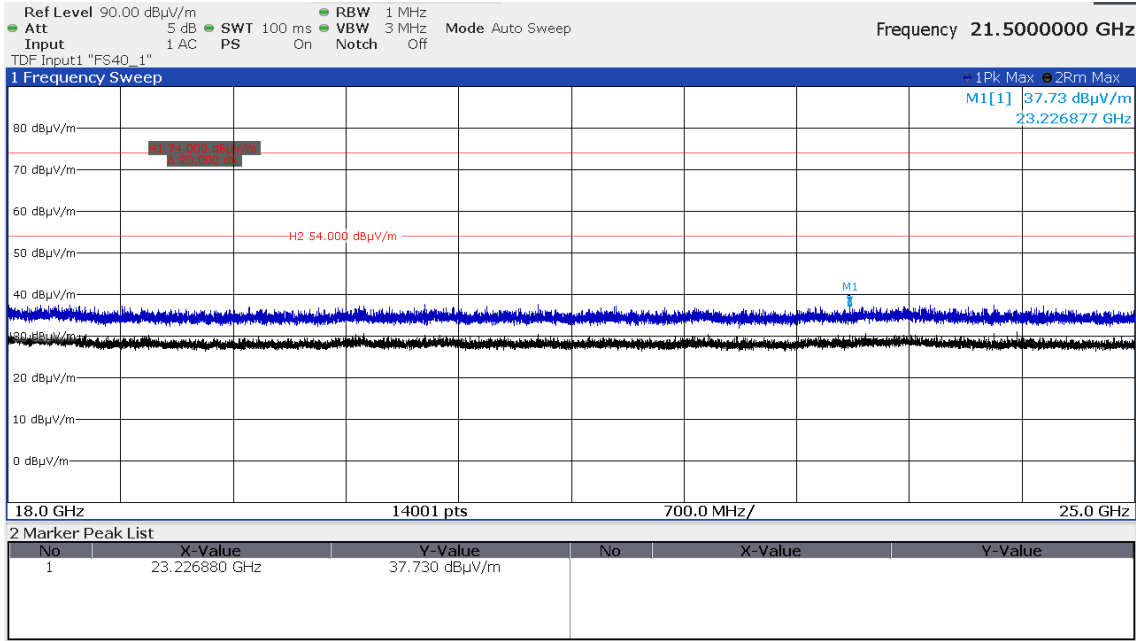
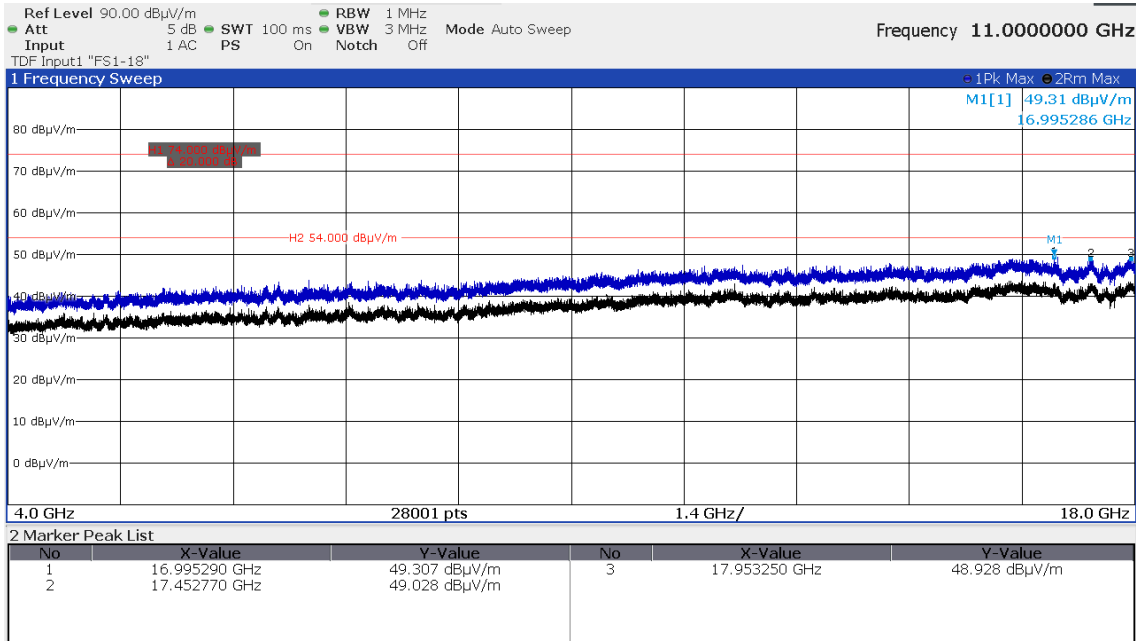
5.2.5.3 WLAN Standard 802.11n HT40, MCS7, P11

CH1up horizontal





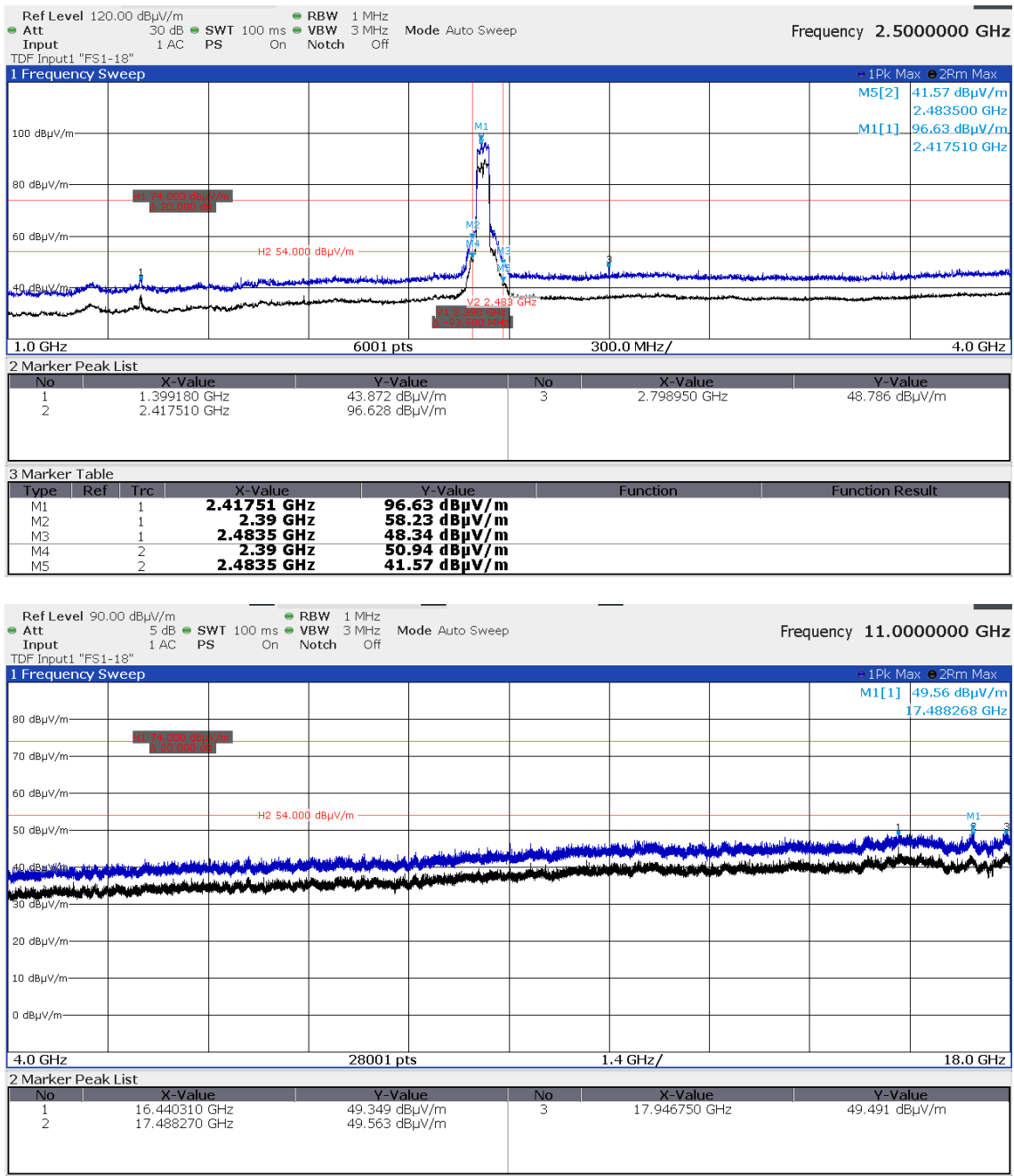
FCC ID: XO2SPB209A



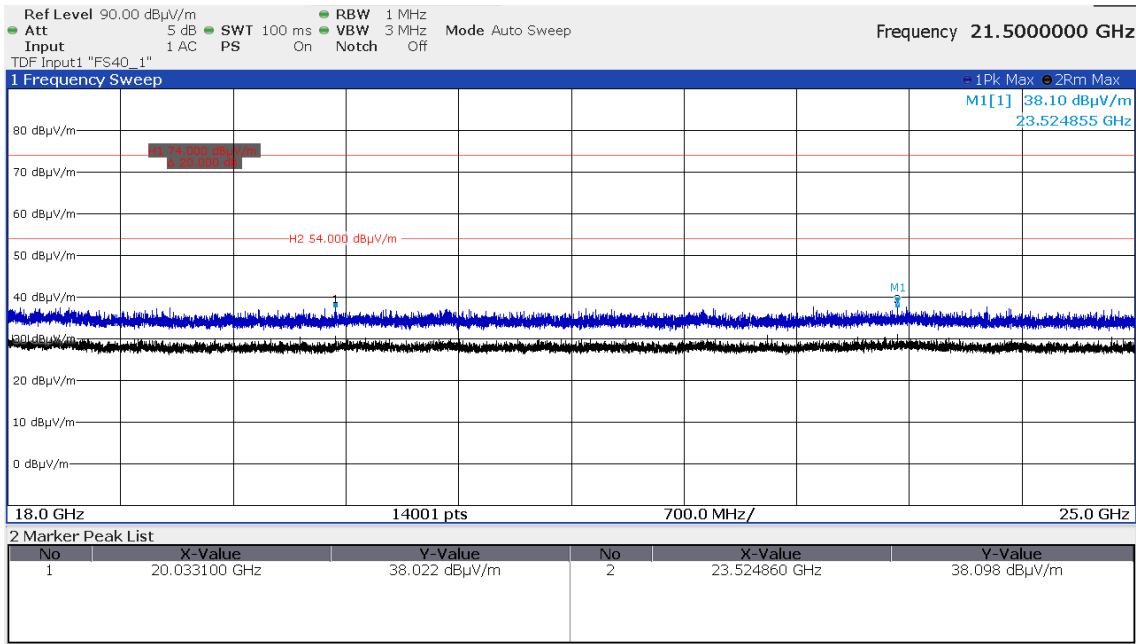


FCC ID: XO2SPB209A

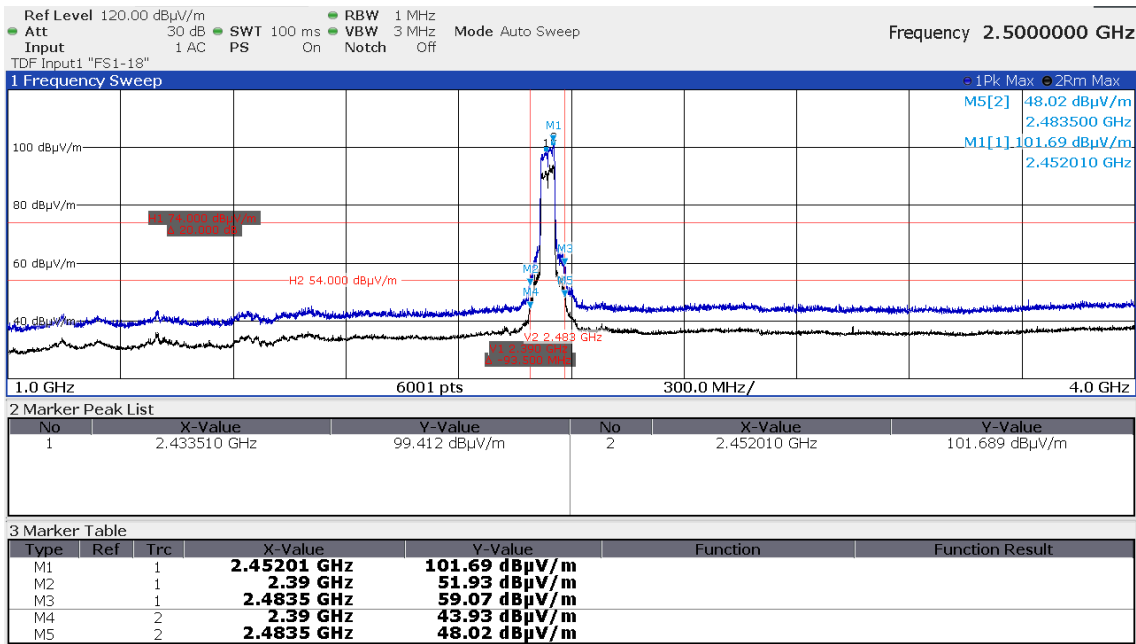
CH1up verticall



FCC ID: XO2SPB209A

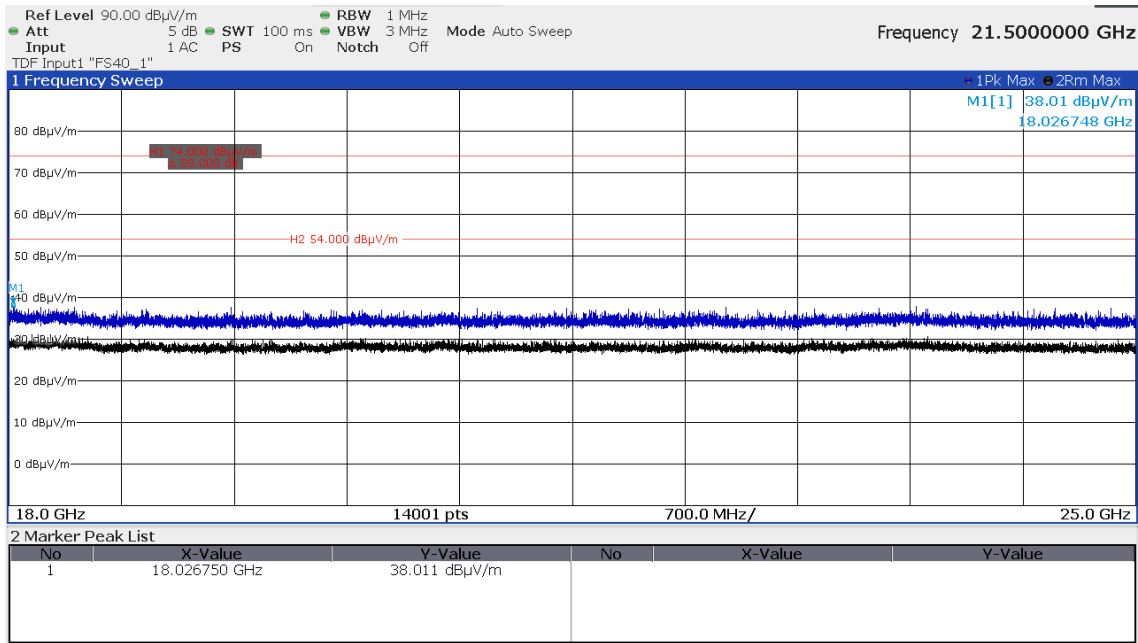
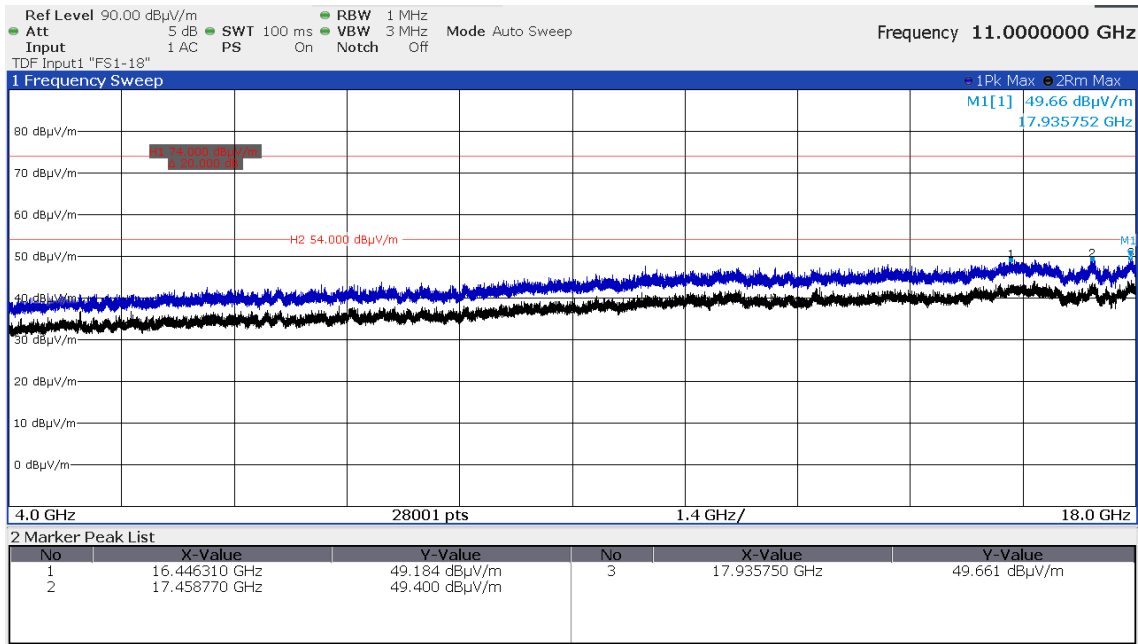


CH4up horizontal

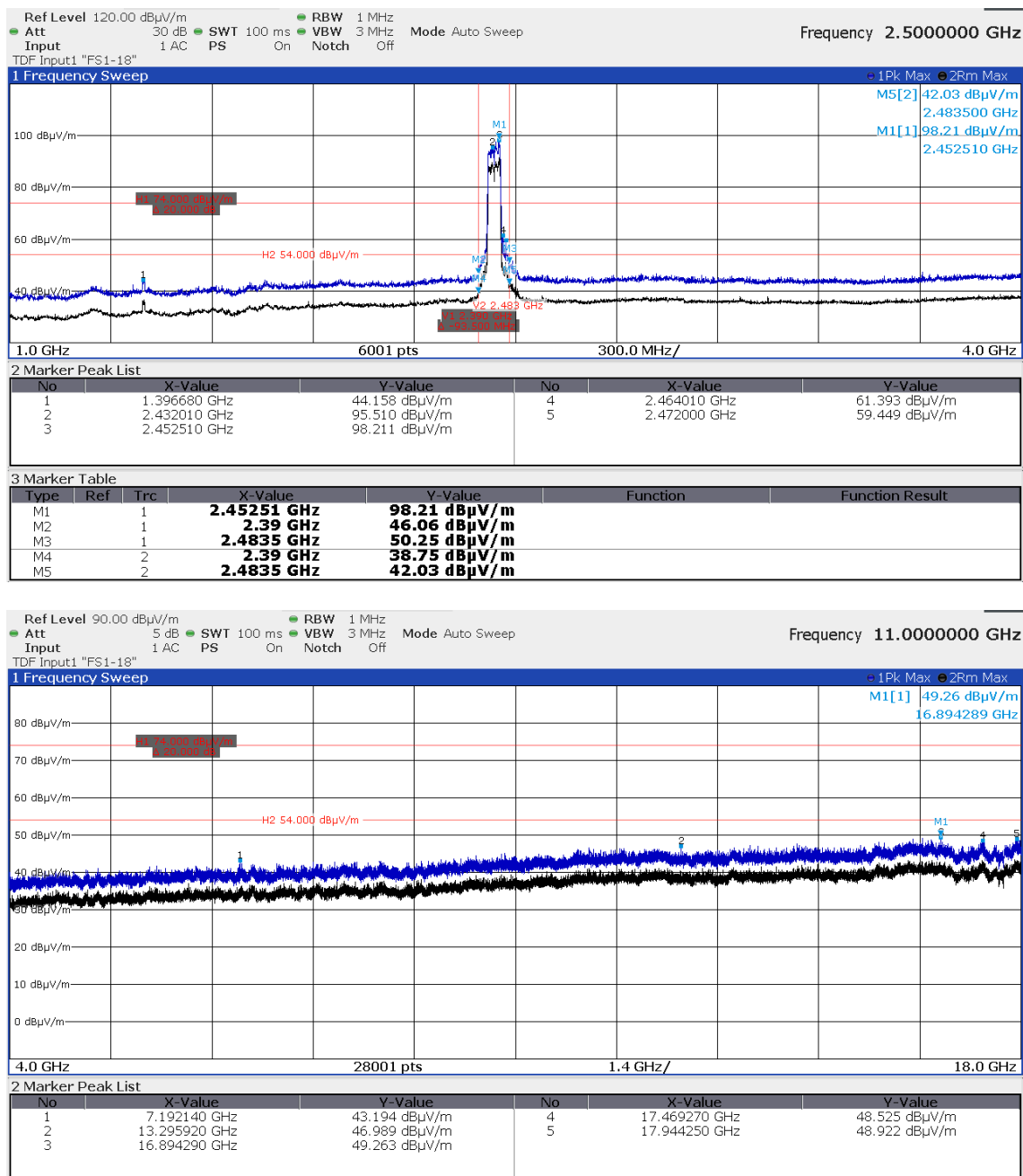




FCC ID: XO2SPB209A

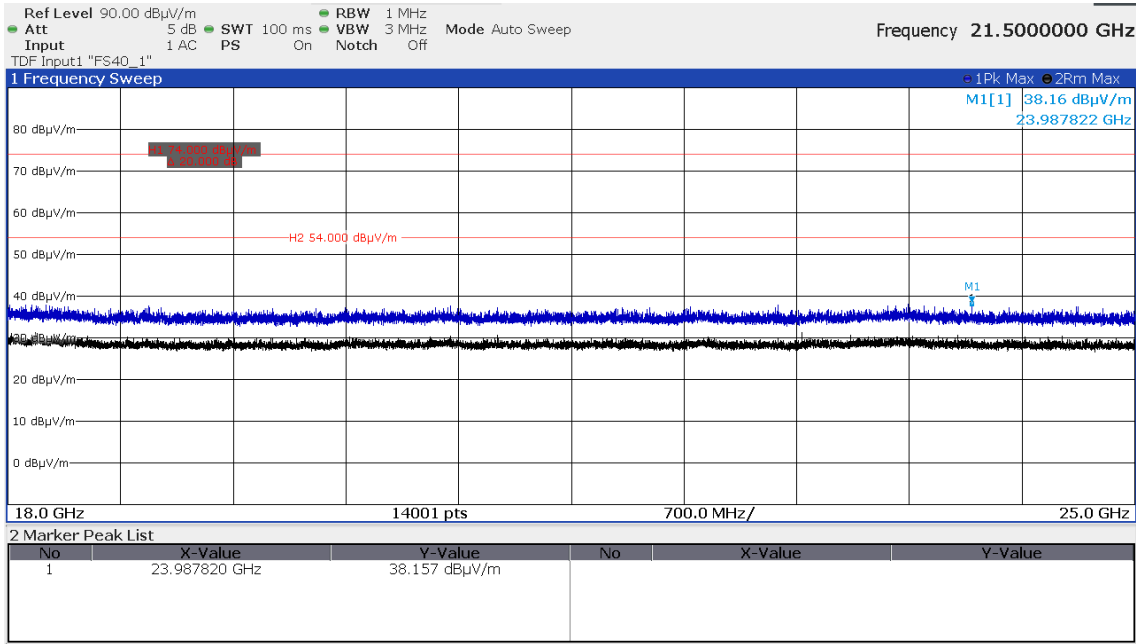


CH4up verticall

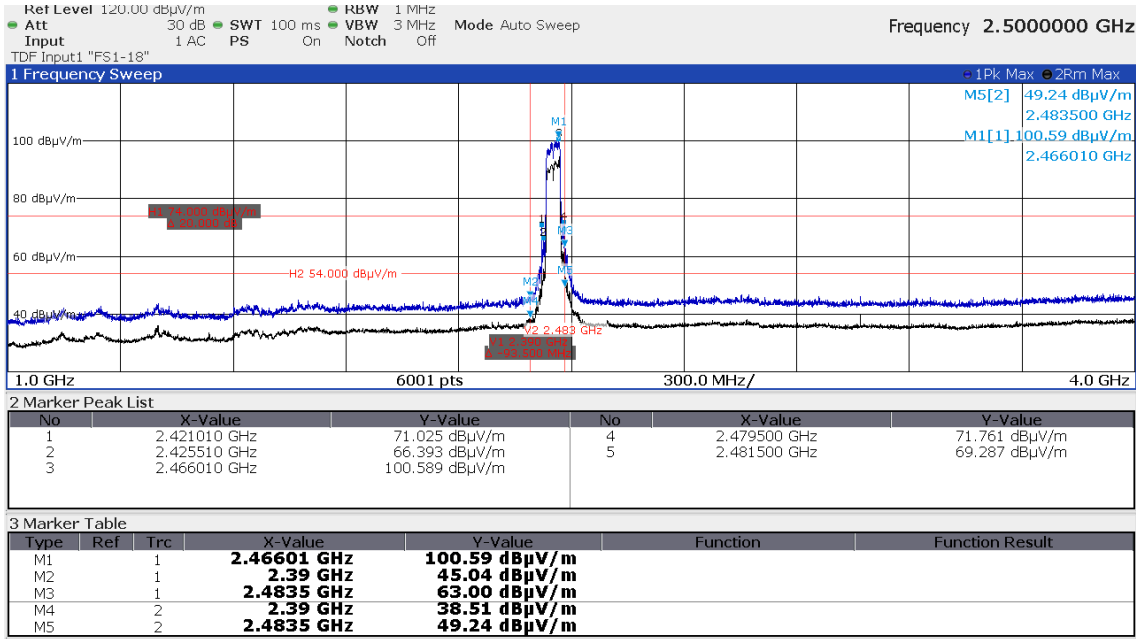




FCC ID: XO2SPB209A

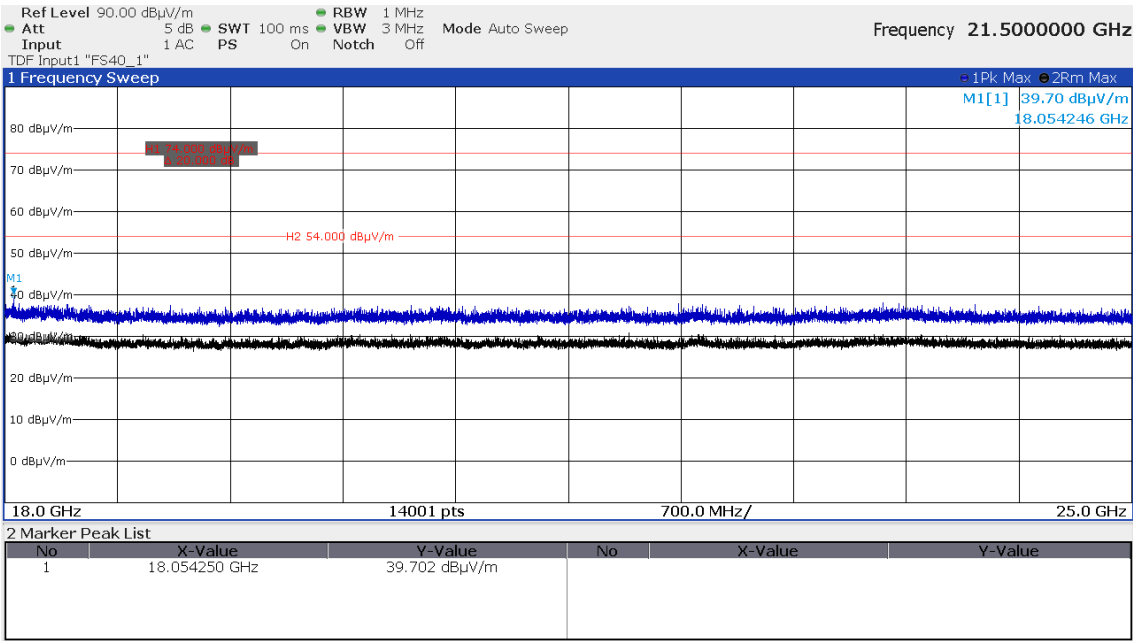
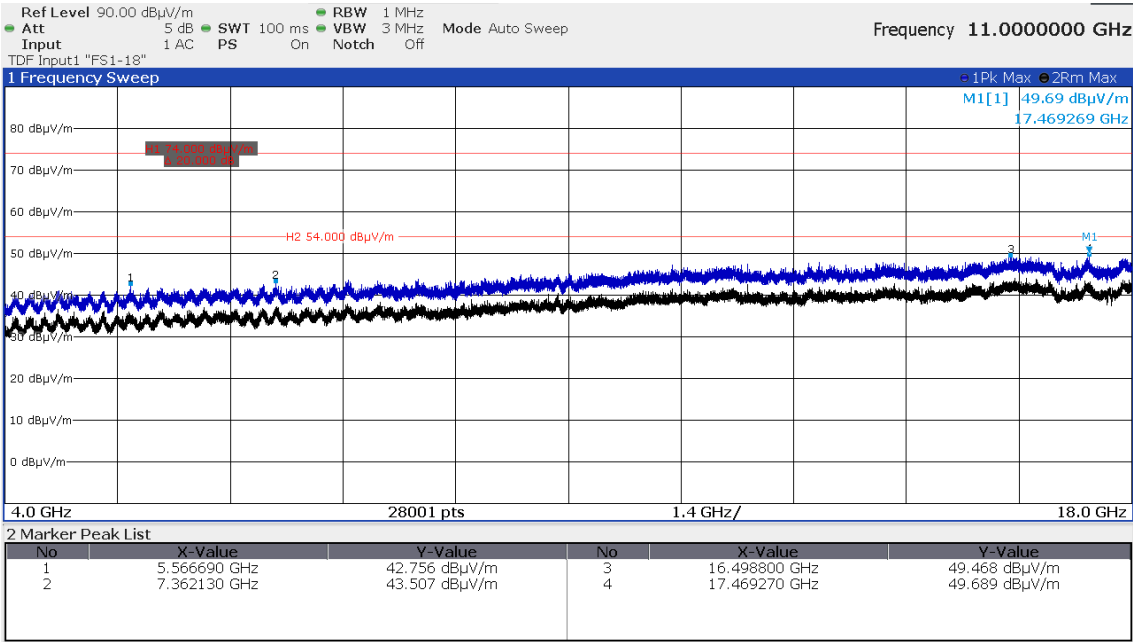


CH7up horizontal





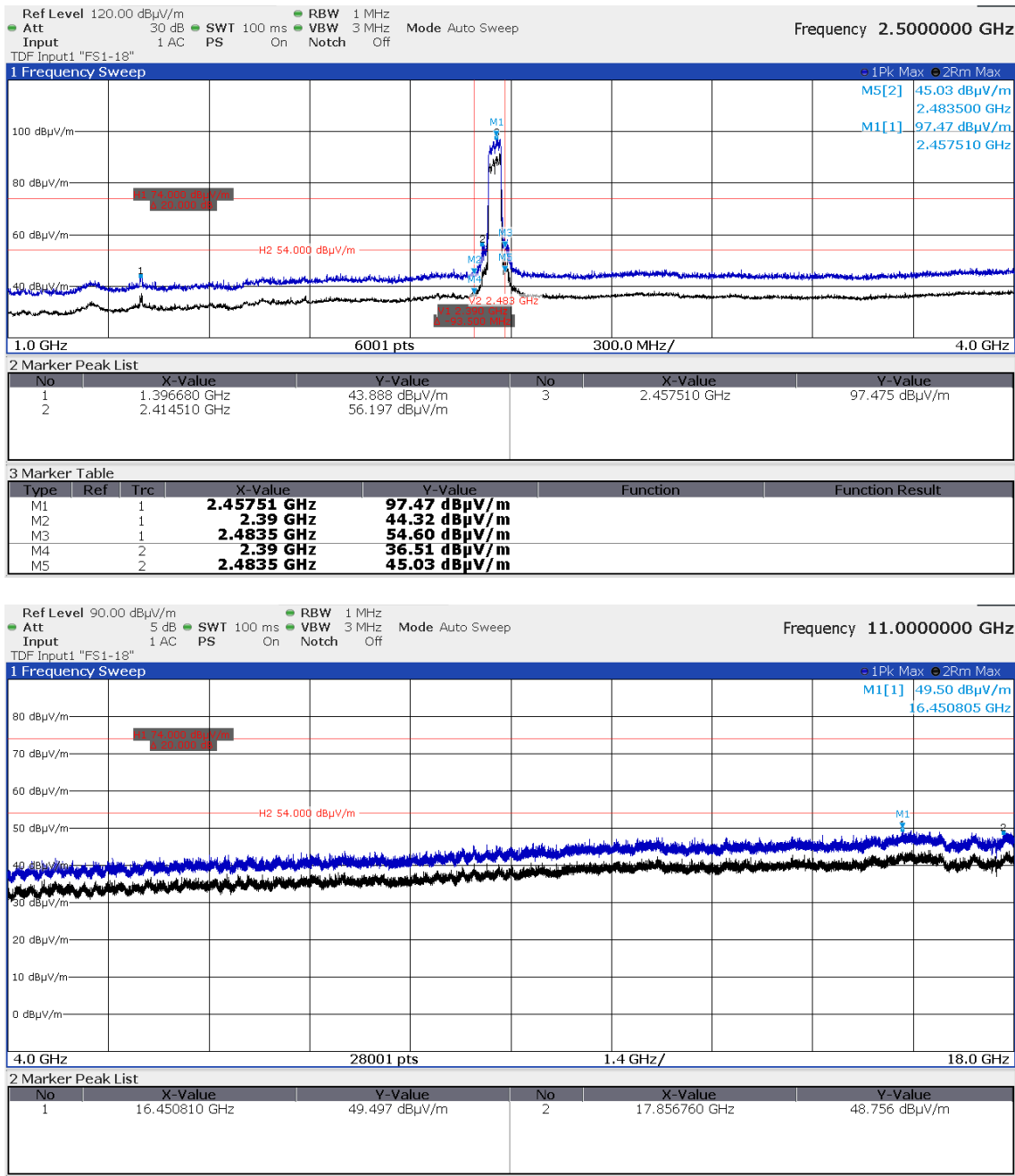
FCC ID: XO2SPB209A



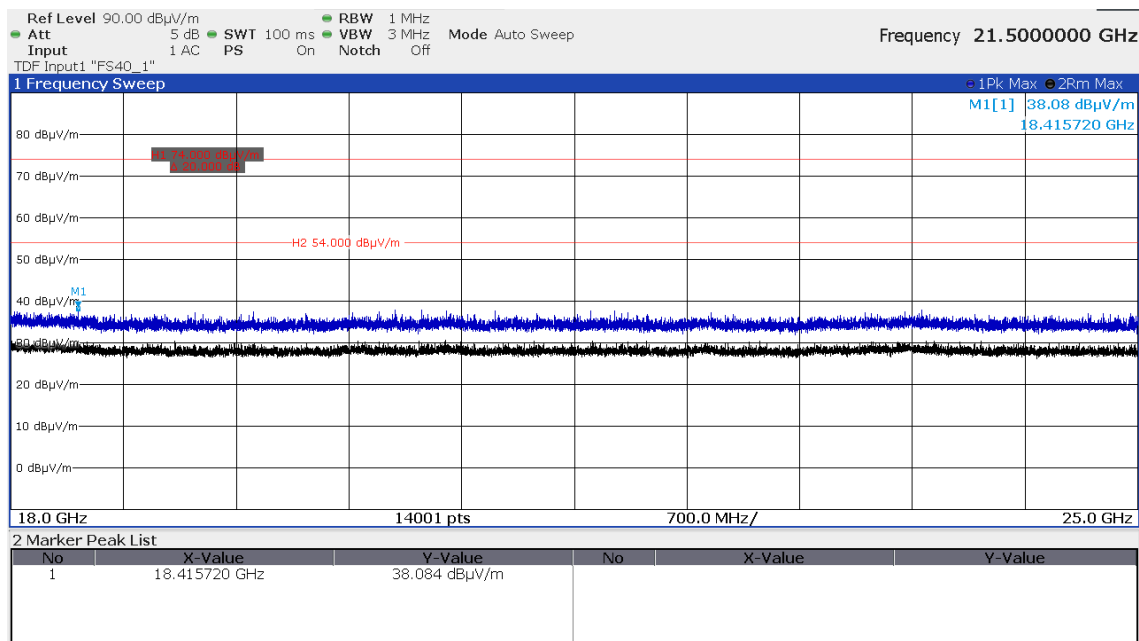


FCC ID: XO2SPB209A

CH7up verticall



FCC ID: XO2SPB209A



Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

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

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

FCC ID: XO2SPB209A

RSS-Gen, Table 6 – Restricted Frequency Bands

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

The requirements are **FULFILLED**.

Remarks: The measurement is performed up to the 10th harmonic.

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

5.3 Spurious emissions radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3.**

5.3.1 Description of the test location

Test location: NONE

Test distance: -

5.3.2 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

5.3.3 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.10. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

Test receiver settings for SER2:

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

Spectrum analyser settings for SER3:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

5.3.4 Test result

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency (MHz)	Spurious emission limit
Below 1000	20 dB below the highest level of the desired power
Above 1000	20 dB below the highest level of the desired power

The requirements are **FULFILLED**.

Remarks: None.

5.4 Antenna application

5.4.1 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.

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

5.4.2 Antenna requirements

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

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

Defacto EIRP-Limit:

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

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

Remarks: None.

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.

6 USED TEST EQUIPMENT AND ACCESSORIES

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

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 3	ESW26	02-02/03-17-002	16/04/2025	16/04/2024		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	12/07/2024	12/07/2023		
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	18N-20	02-02/50-21-009	17/10/2024	17/04/2024		
	BAT-EMC 2023.0.8.0	02-02/68-13-001				
SER 1	ESW26	02-02/03-17-002	16/04/2025	16/04/2024		
	HFH 2 - Z 2	02-02/24-15-001				
	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 2	ESW26	02-02/03-17-002	16/04/2025	16/04/2024		
	VULB 9168	02-02/24-05-005	20/04/2024	20/04/2023	03/05/2024	03/05/2023
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	ESW26	02-02/03-17-002	16/04/2025	16/04/2024		
	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	12/07/2024	12/07/2023		
	BBHA 9170	02-02/24-05-013	21/03/2026	21/03/2023	22/01/2025	22/01/2024
	WHK 3.0/18G-10EF	02-02/50-05-180				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				
	BAT-EMC 2023.0.8.0	02-02/68-13-001				

Note: SER2 measurements were performed on 22nd May 2024.

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.