

Test Report

Product	System Control Unit with NFMI, Bluetooth Basic Rate and Low Energy
Name and address of the applicant	3M Svenska AB Box 2341, 331 02 Värnamo Sweden
Name and address of the manufacturer	3M Svenska AB Box 2341, 331 02 Värnamo Sweden
Model	SCU-300NA
Rating	3.0V _{DC} (2x AAA cells, Alkaline Batteries)
Trademark	Comtac VII
Serial number	Radiated Sample: 102 / Conducted Sample: 101
Additional information	Bluetooth Low Energy
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Industry Canada RSS-247, Issue 2 Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	383891
Tested in period	2020-01-22 to 2020-01-24 and 2020-03-12
Issue date	2020-04-28
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com CAB Number: FCC: NO0001 ISED: NO0470 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50   An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Frode Sveinsen]  Approved by [G.Suhanthakumar]	
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1 INFORMATION

1.1 Test Item

Name	Comtac VII
Model/version	SCU-300NA
FCC ID	Y9ZSCU300
ISED ID	4406A-SCU300
Serial number	Conducted Sample: Nr. 101 Radiated Sample: Nr. 103
Hardware identity and/or version	K399Ava05
Software identity and/or version	K399-st-application-0.9.0
Frequency Range	2402 – 2480 MHz
Number of Channels	40
Operating Modes	Bluetooth Low Energy 4.0
Type of Modulation	GFSK
Rated Output Power	0.55 mW
Type of Power Supply	Primary Batteries (2x AAA Alkaline Batteries)
Antenna Connector	None (Integral Antenna)
Number of Antennas	1
Interfaces	Proprietary Connector

Description of Test Item

The EUT is a System Control Unit (SCU) with integrated NFMI radio and Bluetooth (Basic, EDR and BLE) communications. The NFMI is audio based for using with the headset Comtac VII.

The headset can also be connected to the SCU using cable. The Bluetooth is a dual radio chip with one antenna path that allows the user to connect the Comtac VII to a cellular phone or an external radio. The SCU can also be connected to external radio by wires. The SCU is powered by 2 x 1.5V by AAA/LR03 alkaline batteries or rechargeable NiMH batteries. The batteries can not be charged while in the SCU.

1.2 Normal test condition

Temperature: 20 - 24 °C
Relative humidity: 20 - 50 %
Normal test voltage: 3.0 V_{DC} (Nominal battery voltage)

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 Antenna Requirement

Is the antenna detachable? ☐ Yes ☒ No

If detachable, is the antenna connector non-standard? ☐ Yes ☐ No

Type of antenna connector: N/A

Ref. FCC §15.203

1.5 Worst-Case Configuration and Mode

The EUT have only one output power, one modulation and one bit-rate in Low Energy mode.
Tests were performed at highest, lowest and on a channel in the middle of the band.

1.6 Comments

All measurements were done with the EUT powered by new batteries.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distance of 3m.

A description of the test facility is on file with FCC and ISED.

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DTS Equipment Code

☐ Family Listing



THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2, RSS-GEN Issue 5 reference	ANSI C63.10-2013 Reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	5.13	N/A
Antenna Requirement	15.203	6.8 (RSS-GEN)	5.8	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	6.2	N/A
Occupied Bandwidth (99% BW)	N/A	6.7 (RSS-GEN)	6.9.3	Complies
DTS Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	11.8 Option 2	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	11.9.1.1	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	11.10.2 PKPSD (DTS)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	6.7 11.11 (DTS)	Complies
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 7.3 (RSS-GEN) 8.9 (RSS-GEN)	6.3, 6.5, 6.6, 6.10 11.12, 11.13 (DTS)	Complies

EUT is battery operated only

3 TEST RESULTS

3.1 Occupied Bandwidth (99% BW)

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3 / 7.8.3

Test Results: Complies

Measurement Data:

Measured Occupied Bandwidth (99% BW) (MHz)		
2402 MHz	2440 MHz	2480 MHz
1.02	1.02	1.02

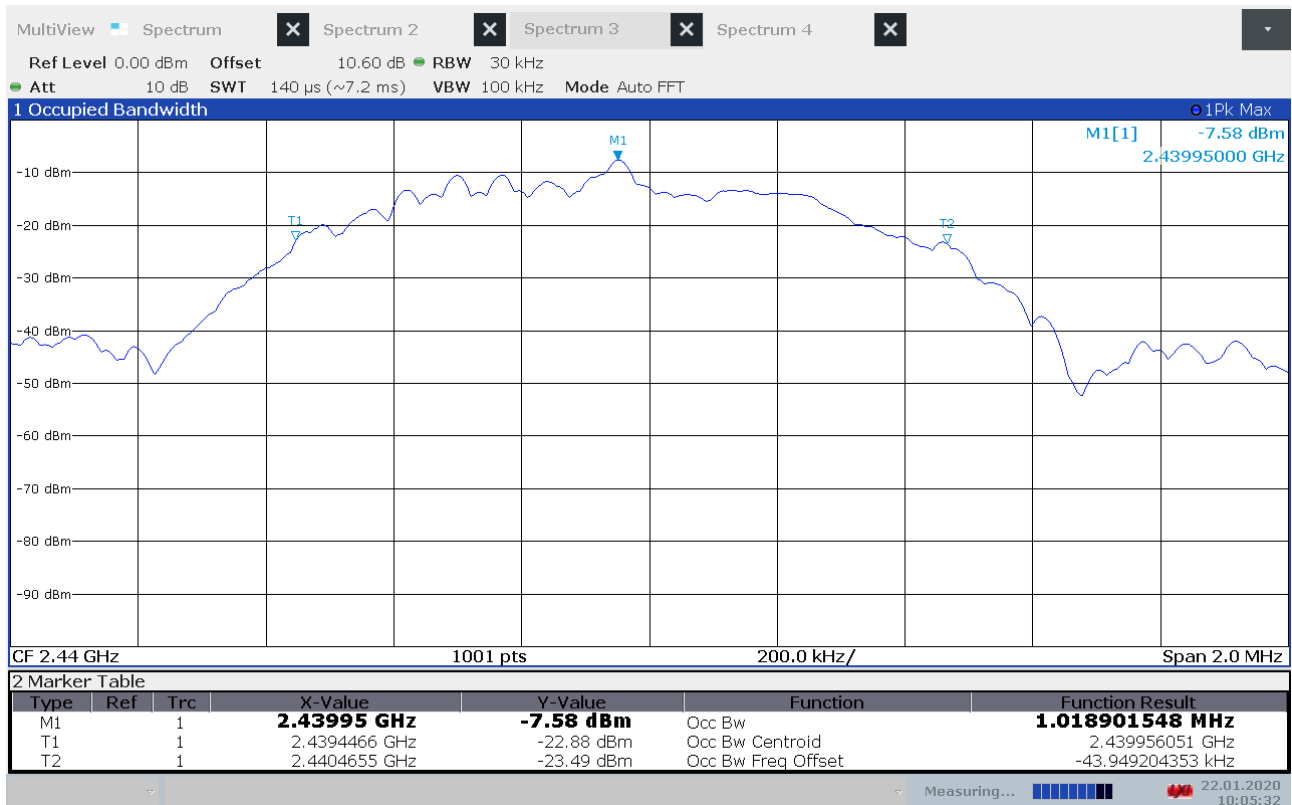
See attached plots.

Requirements:

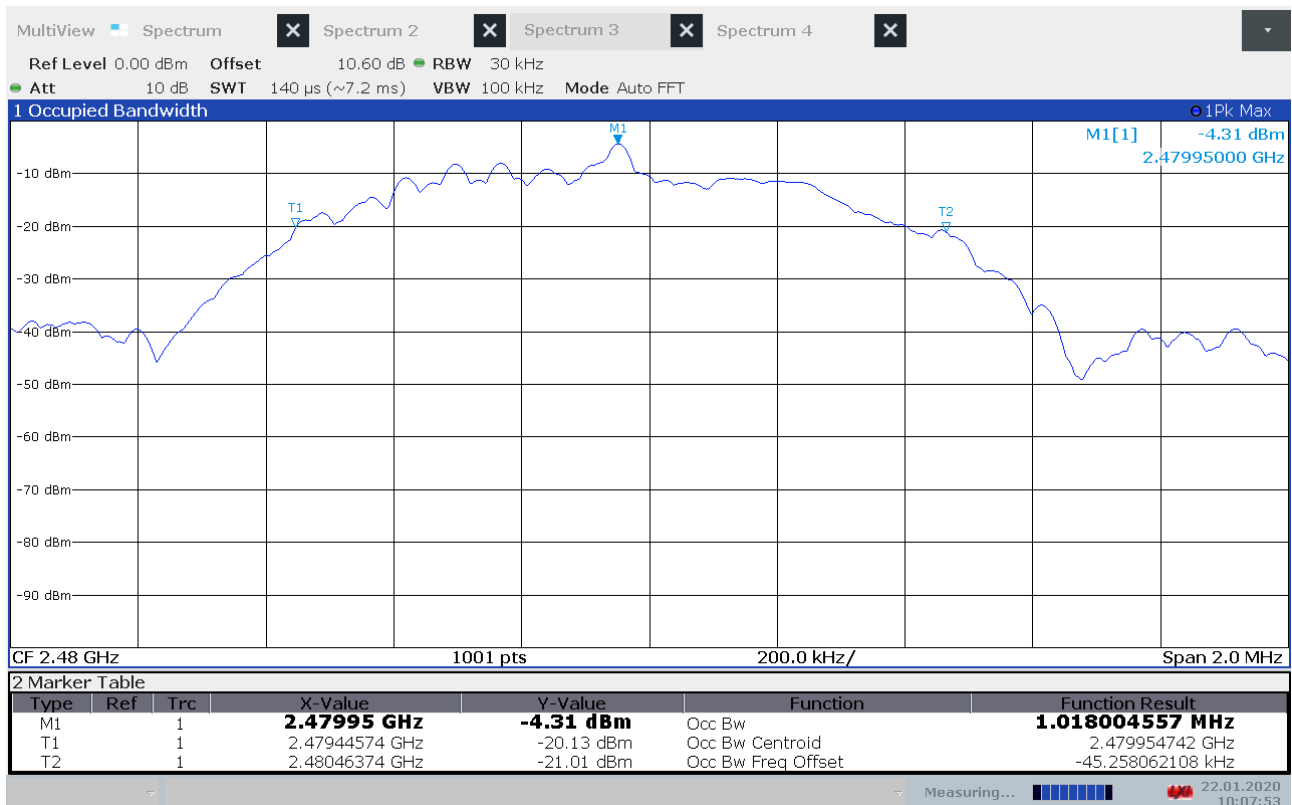
No requirement.



99% Bandwidth, 2402 MHz



99% Bandwidth, 2440 MHz



99% Bandwidth, 2480 MHz

3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 2, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

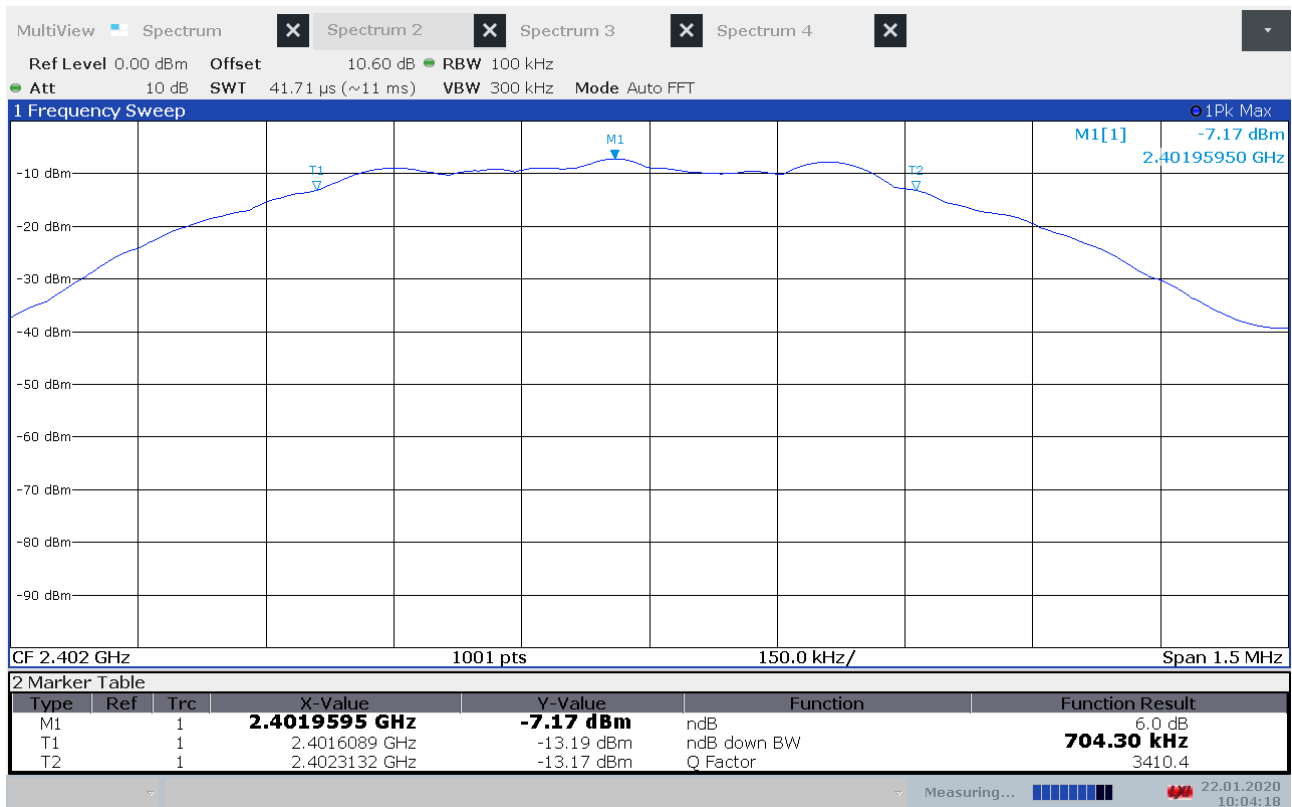
Measurement Data:

Measured DTS Bandwidth (kHz)		
2402 MHz	2440 MHz	2480 MHz
704	689	719

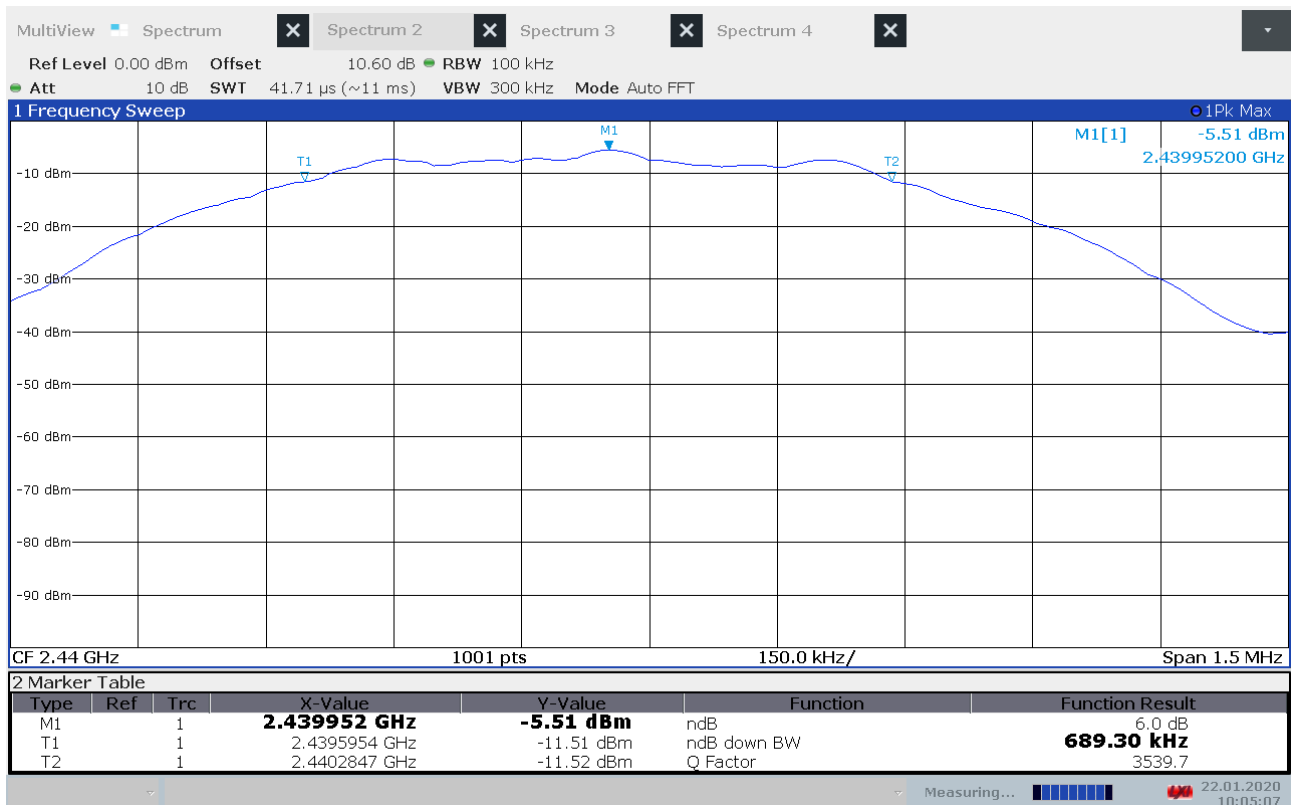
Requirements:

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

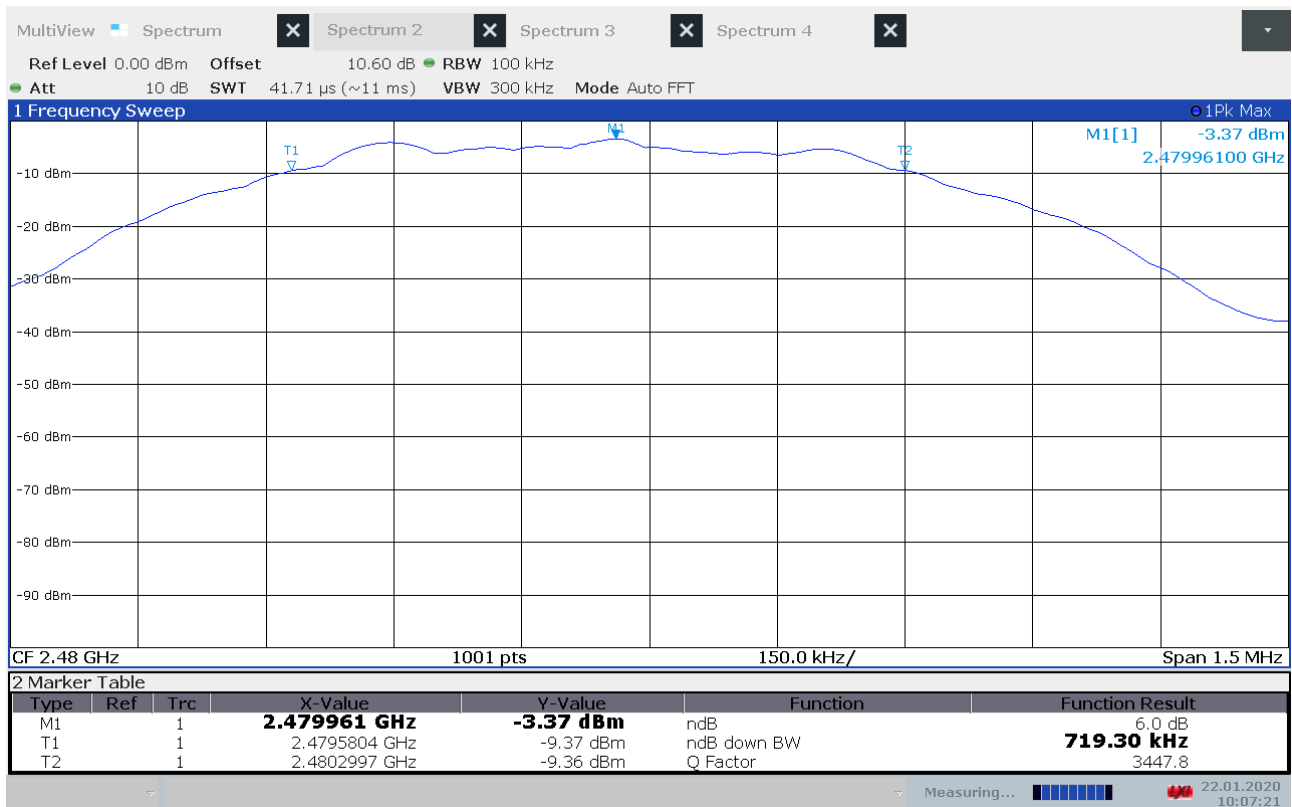
No requirements for Frequency Hopping Systems.



DTS Bandwidth, 2402 MHz



DTS Bandwidth, 2440 MHz



DTS Bandwidth, 2480 MHz

3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

	2402 MHz	2440 MHz	2480 MHz
Conducted Power (dBm)	-6.6	-5.1	-2.6
Conducted Power (Watts)	0.00022	0.00031	0.00055

Output Power reported is Maximum Peak Power.

The Integrated Band Power Method was used to measure Output Power

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

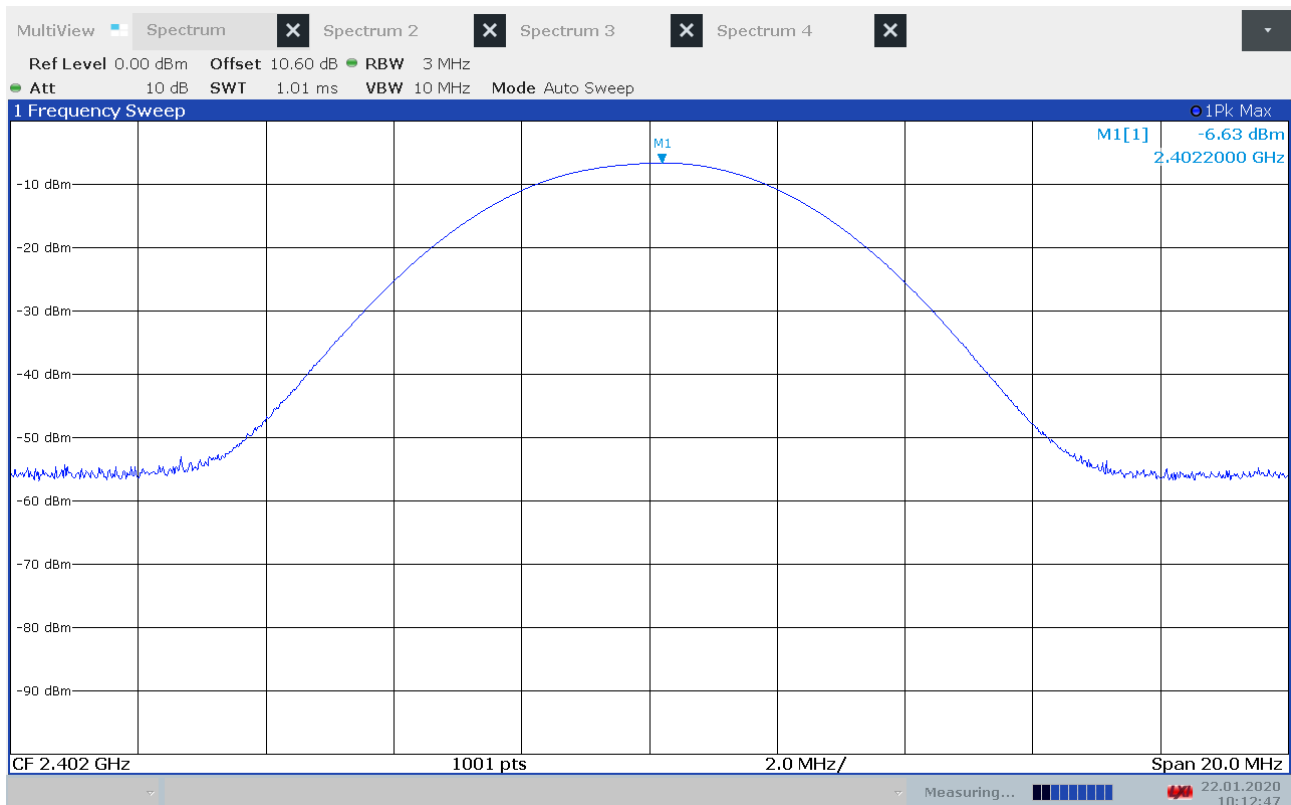
See attached plots.

Requirements:

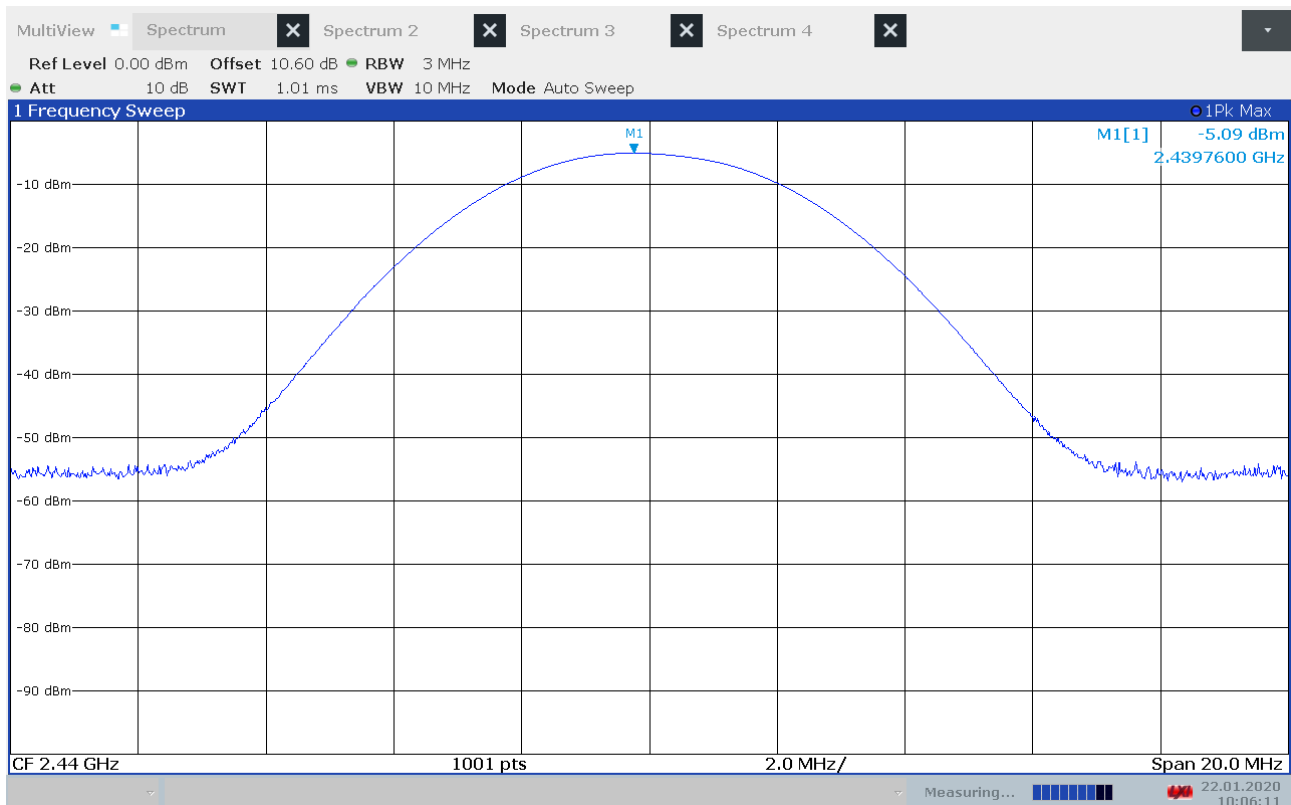
The maximum peak output power shall not exceed the following limits:

For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

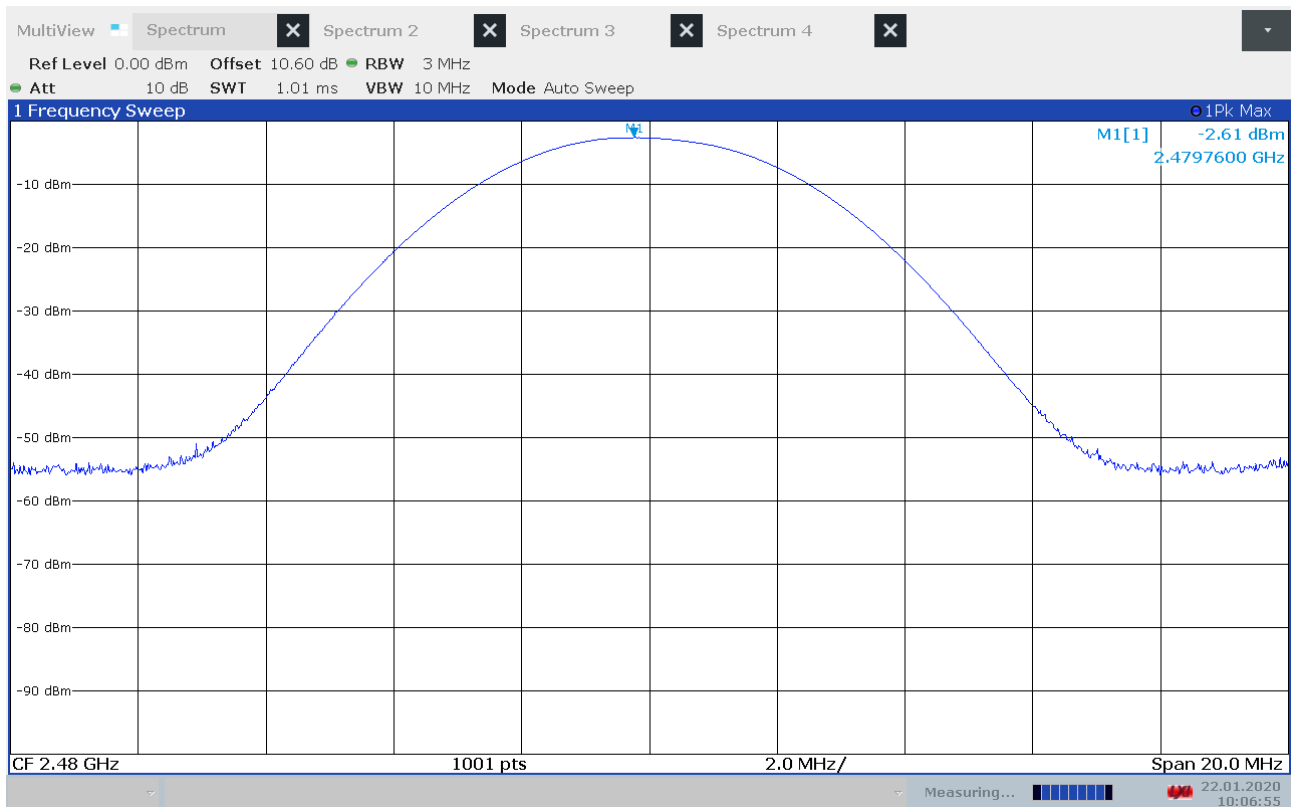
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



Output Power, 2402 MHz



Output Power, 2440 MHz



Output Power, 2480 MHz

3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

Measurement Data:

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	> 40	> 20	Pass
2440 MHz	> 40	> 20	Pass
2480 MHz	> 40	> 20	Pass

Measured with Peak Detector

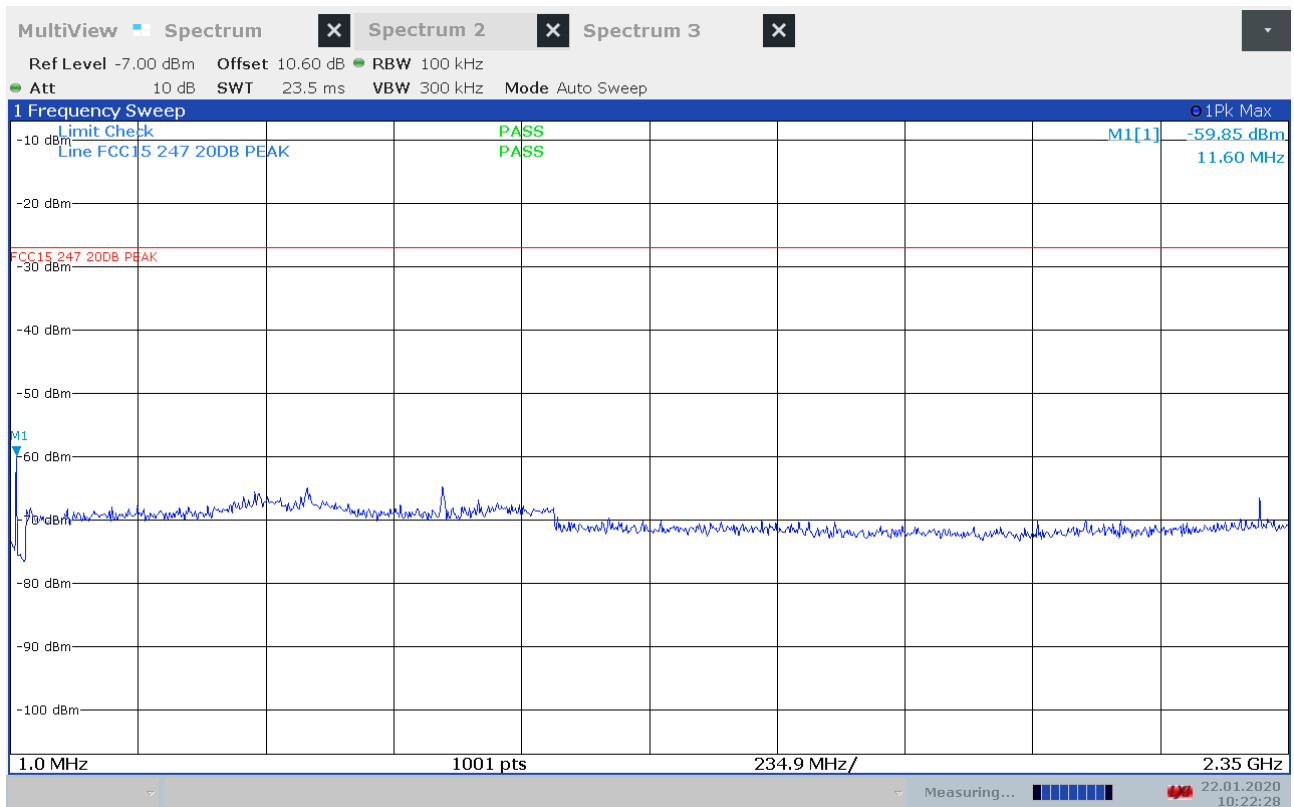
RF conducted power to 25 GHz: see attached plots.

Limit

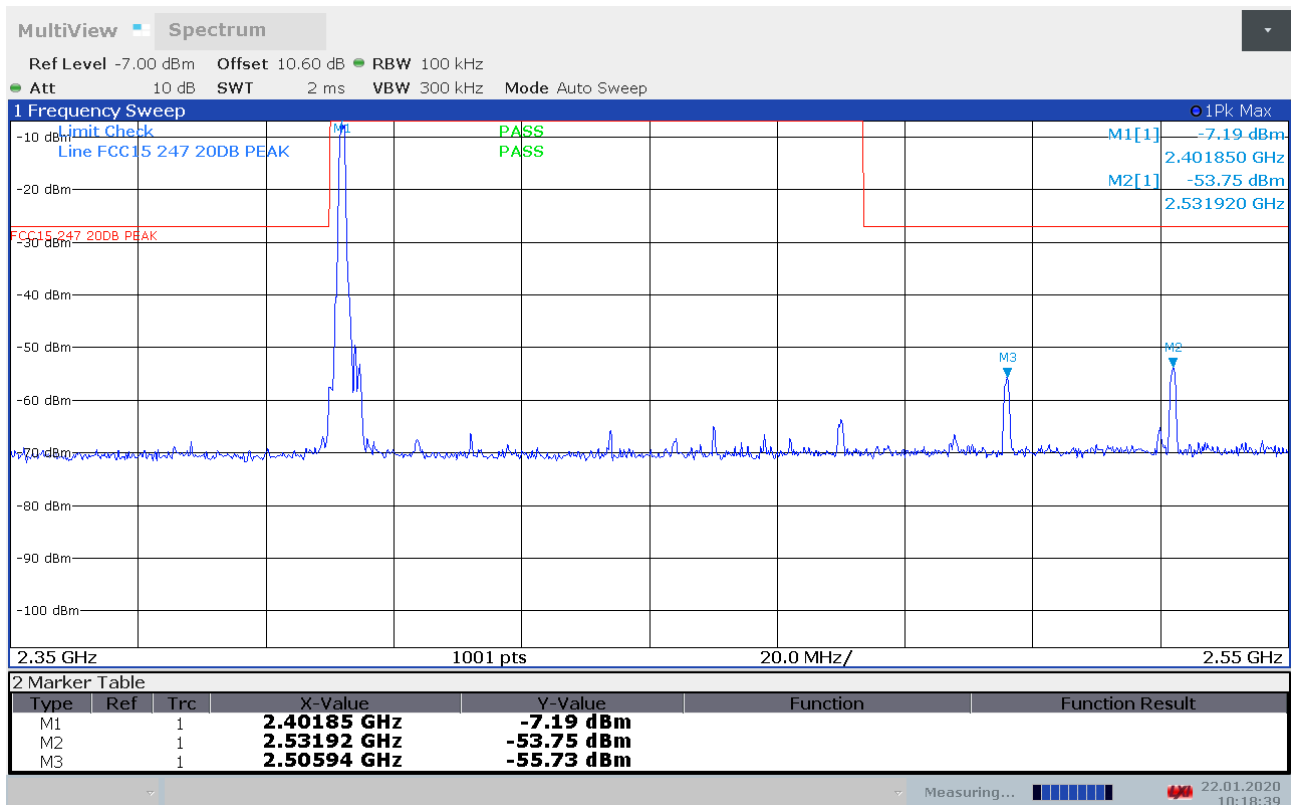
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

Detector type shall be the same as used for measuring Output Power.

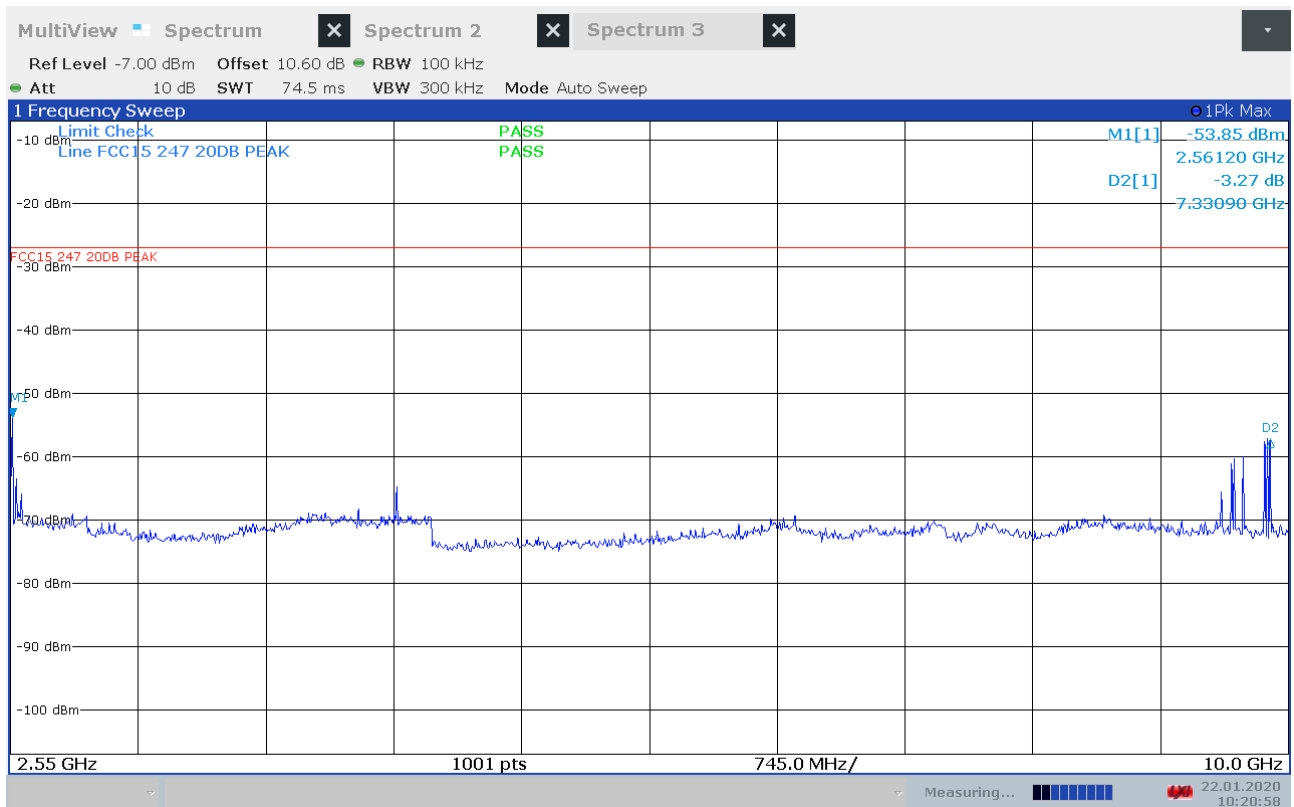
Attenuation below the general limits specified in part 15.209(a) is not required.



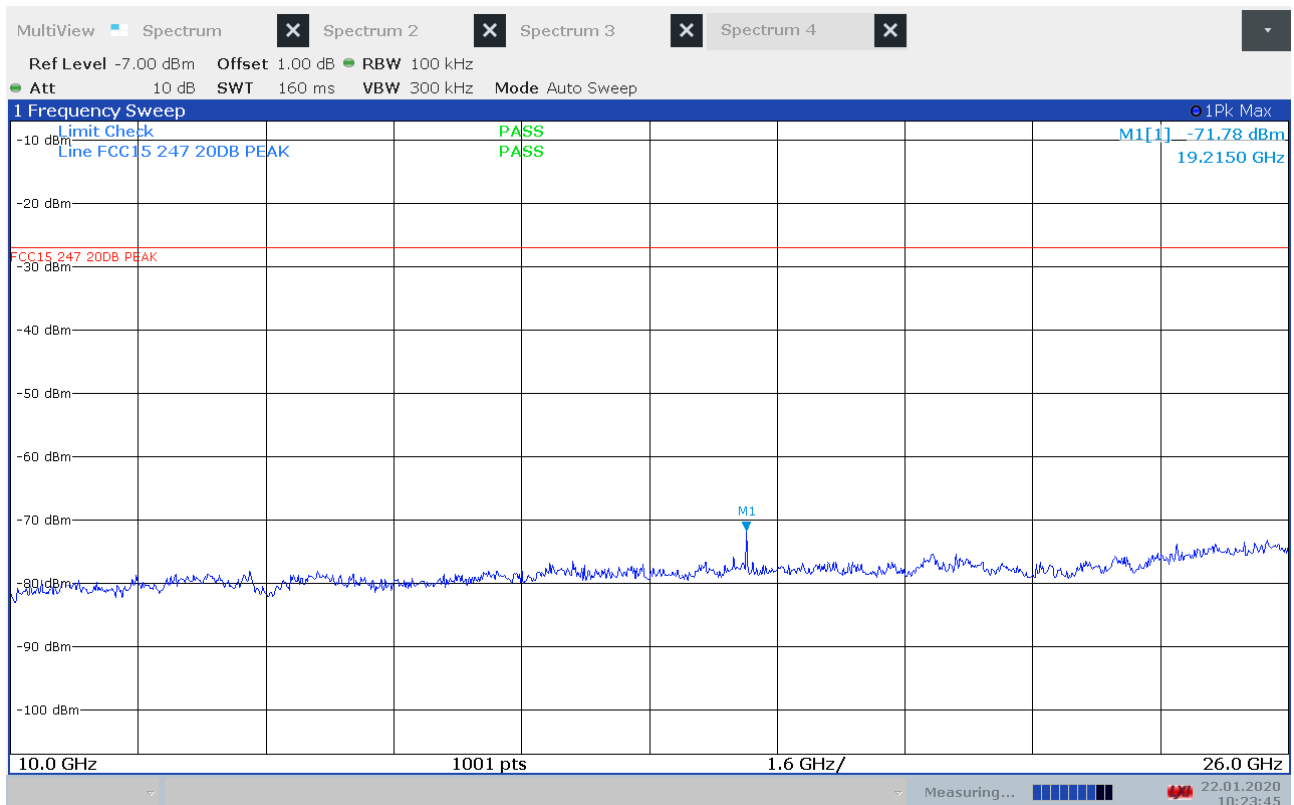
Spurious Emissions, Conducted 1 -2350MHz, 2402MHz



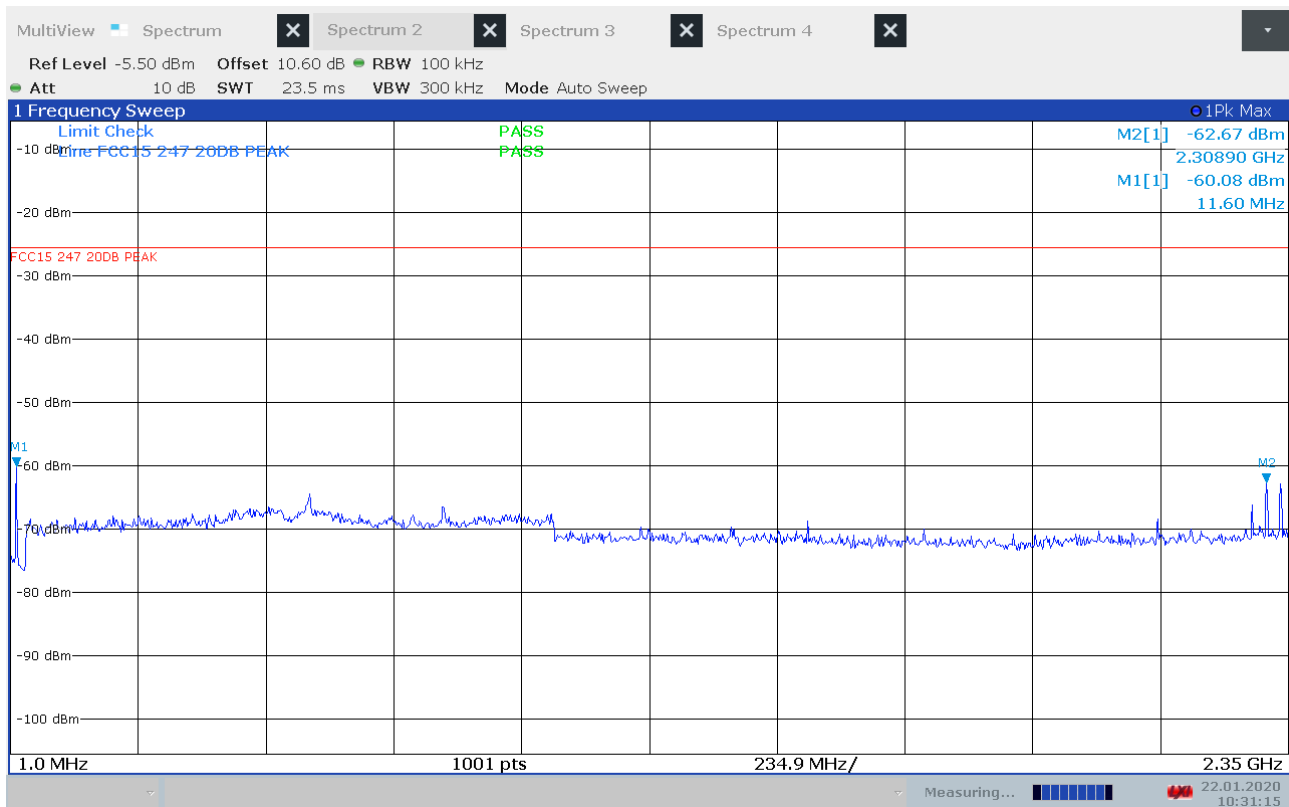
Spurious Emissions, Conducted 2350 -2550MHz, 2402MHz



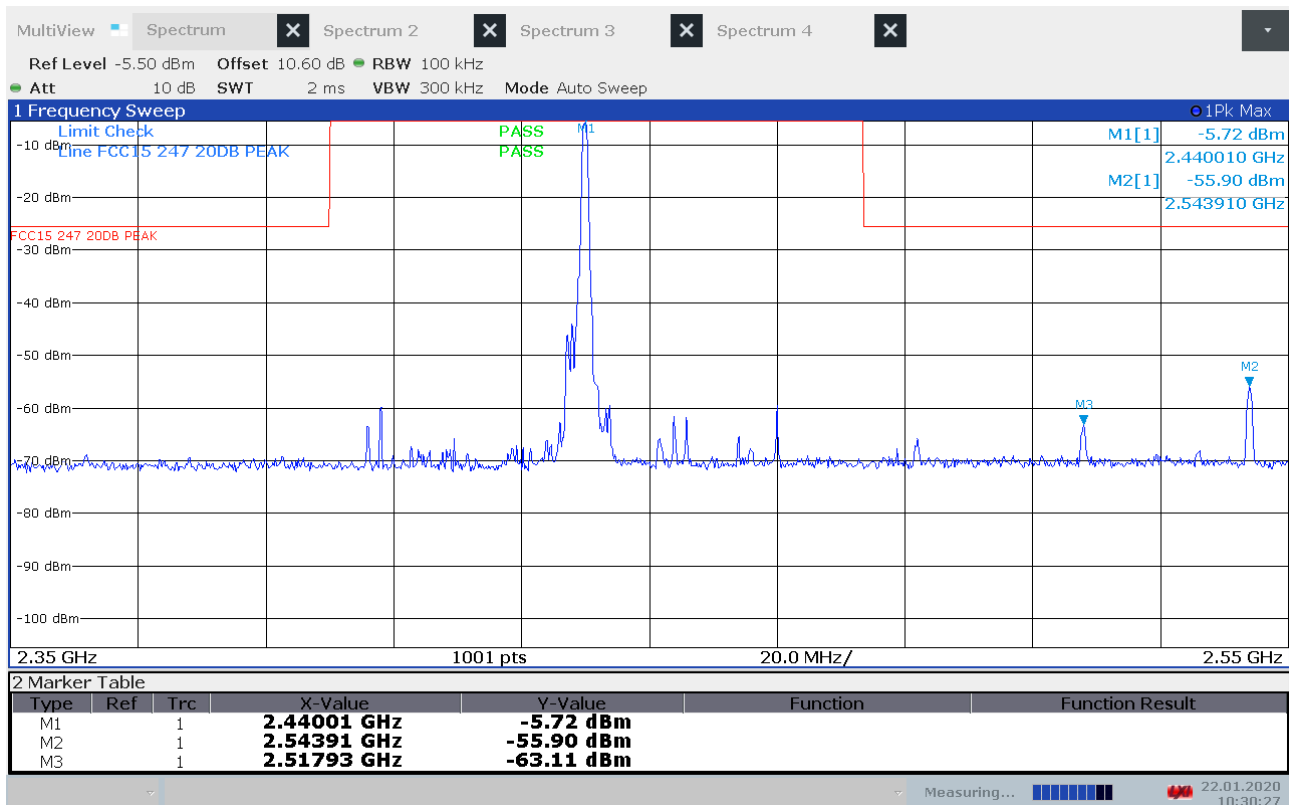
Spurious Emissions, Conducted 2550 -10000MHz, 2402MHz



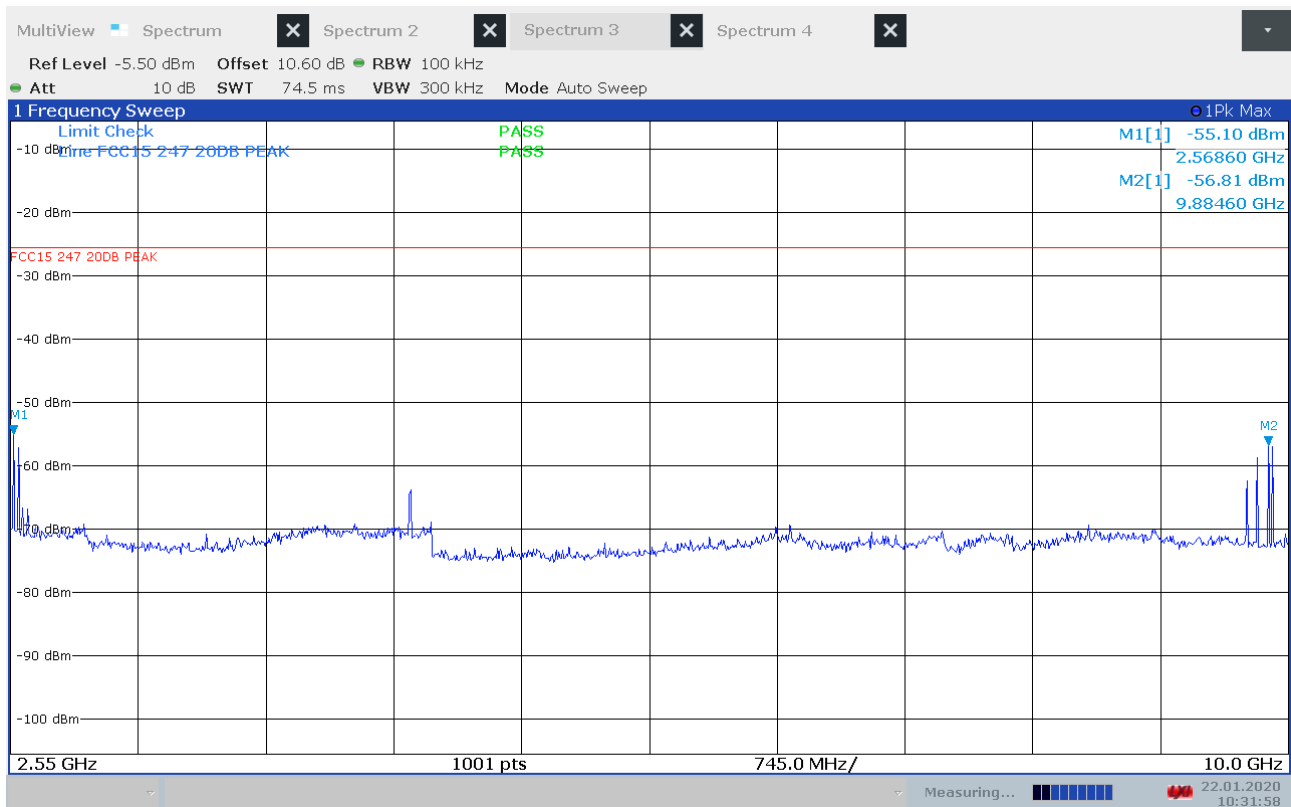
Spurious Emissions, Conducted 10000 -26000MHz, 2402MHz



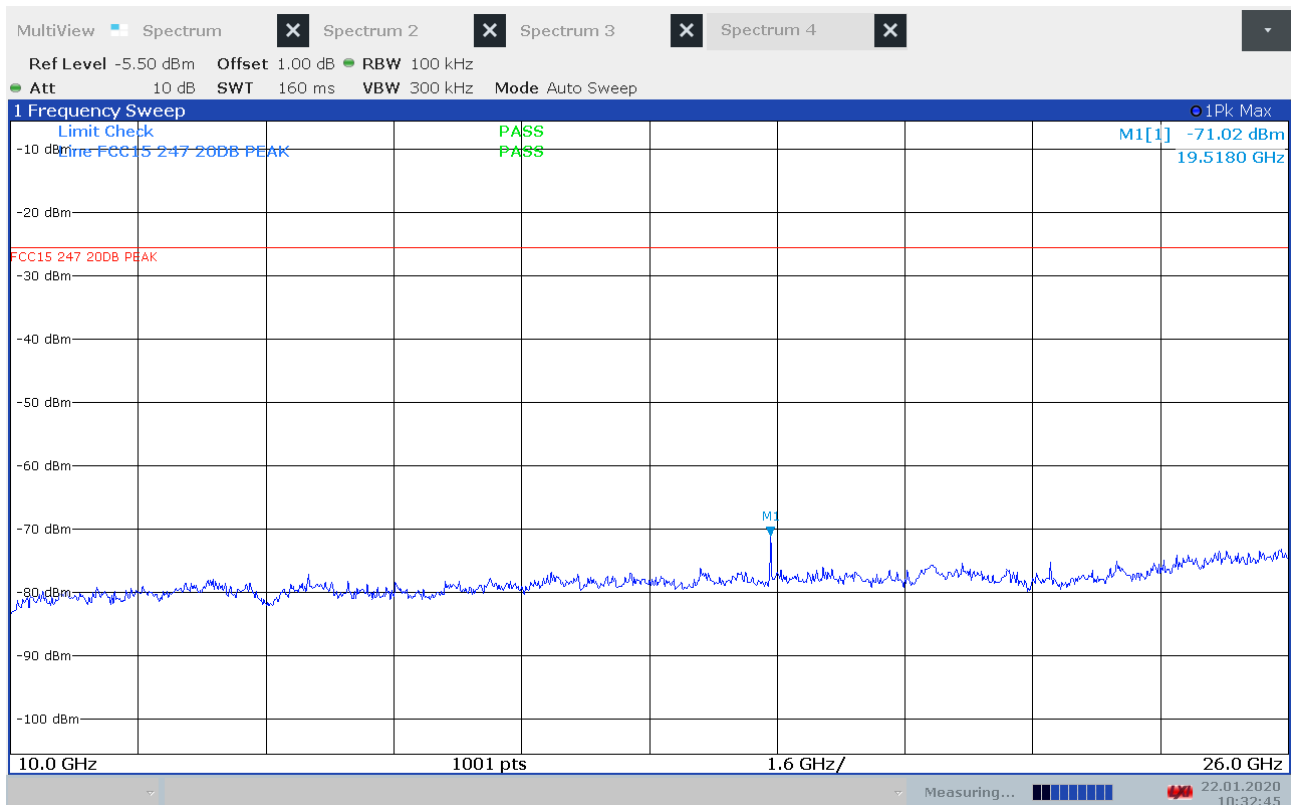
Spurious Emissions, Conducted 1 -2350MHz, 2440MHz



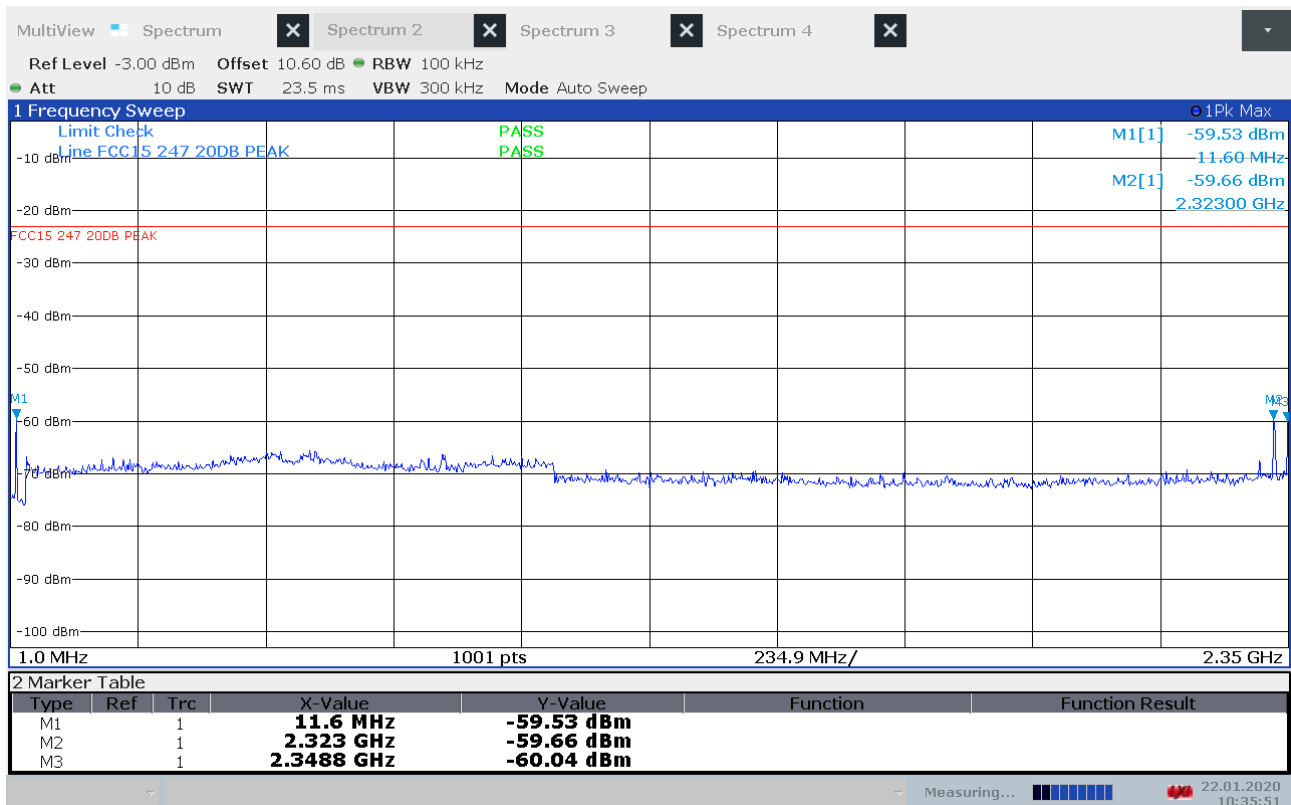
Spurious Emissions, Conducted 2350 -2550MHz, 2440MHz



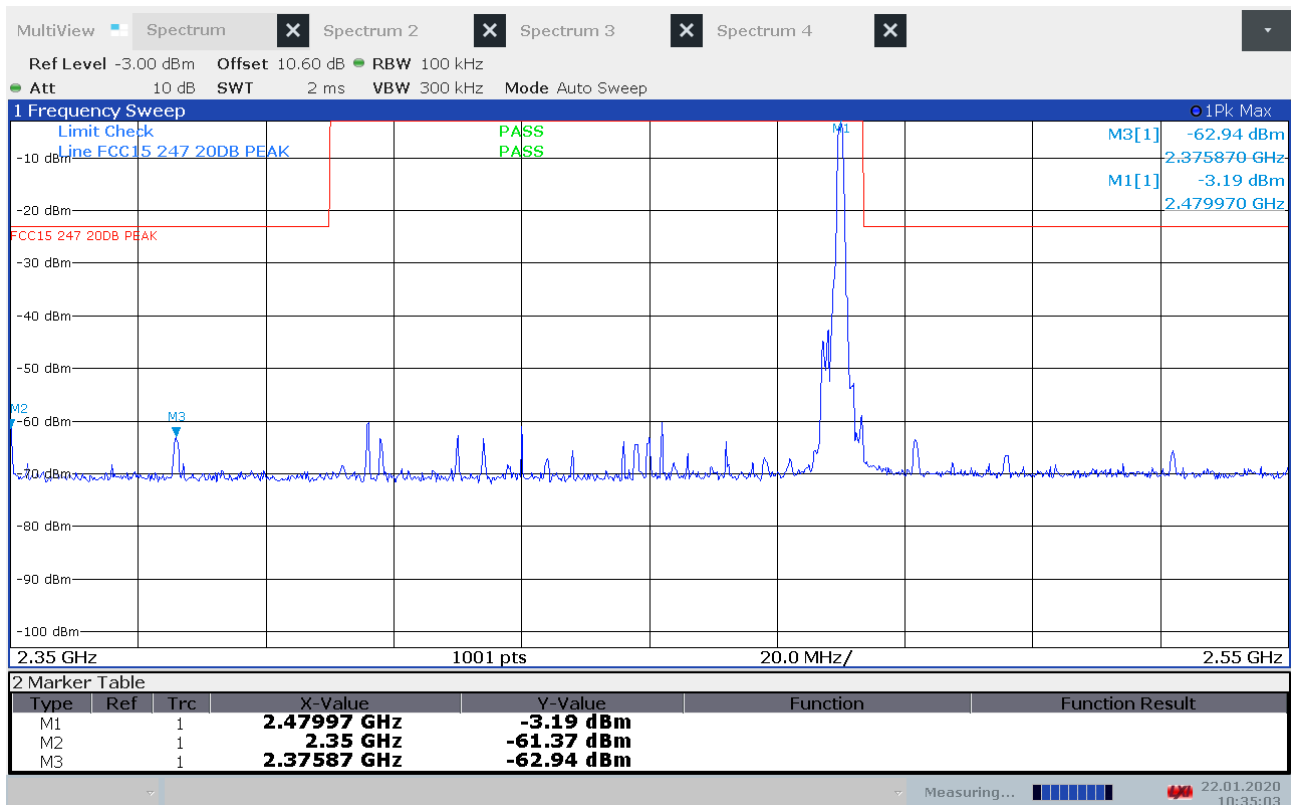
Spurious Emissions, Conducted 2550 -10000MHz, 2440MHz



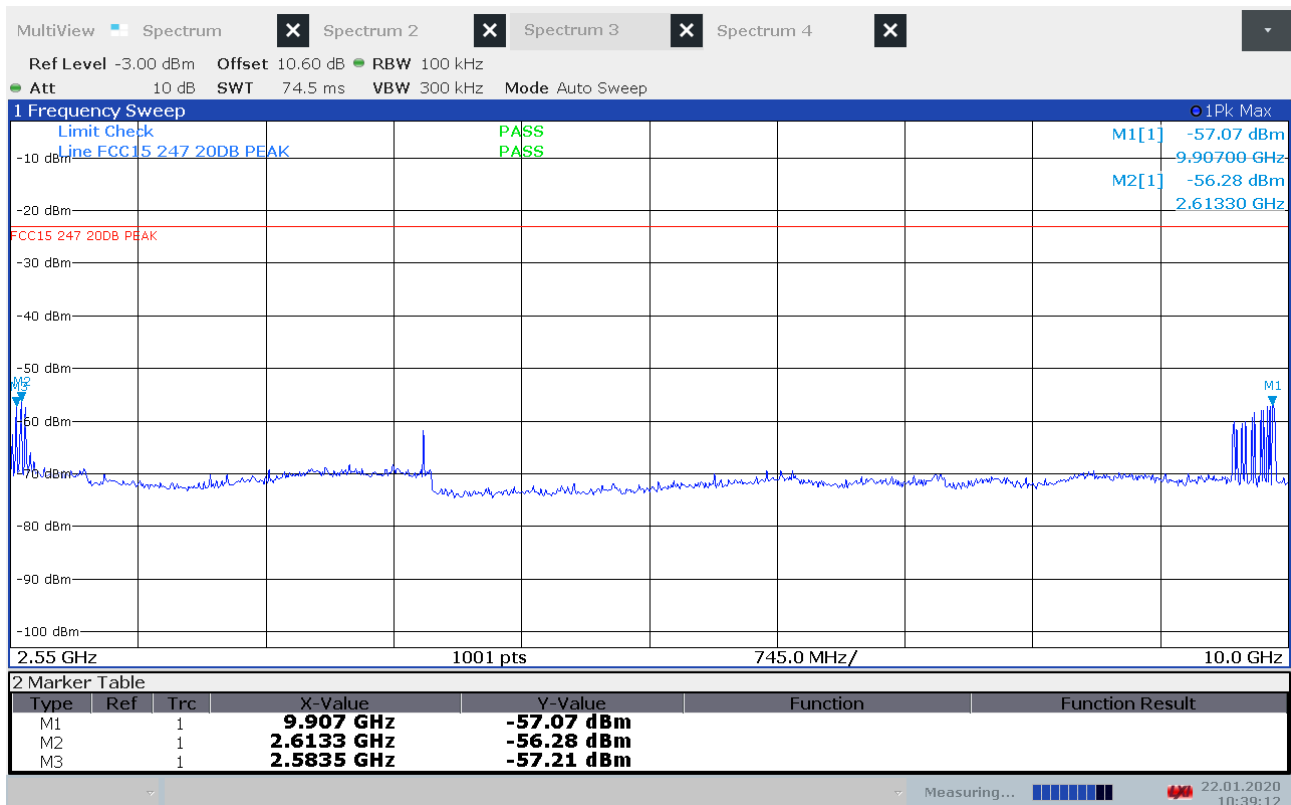
Spurious Emissions, Conducted 10000 -26000MHz, 2440MHz



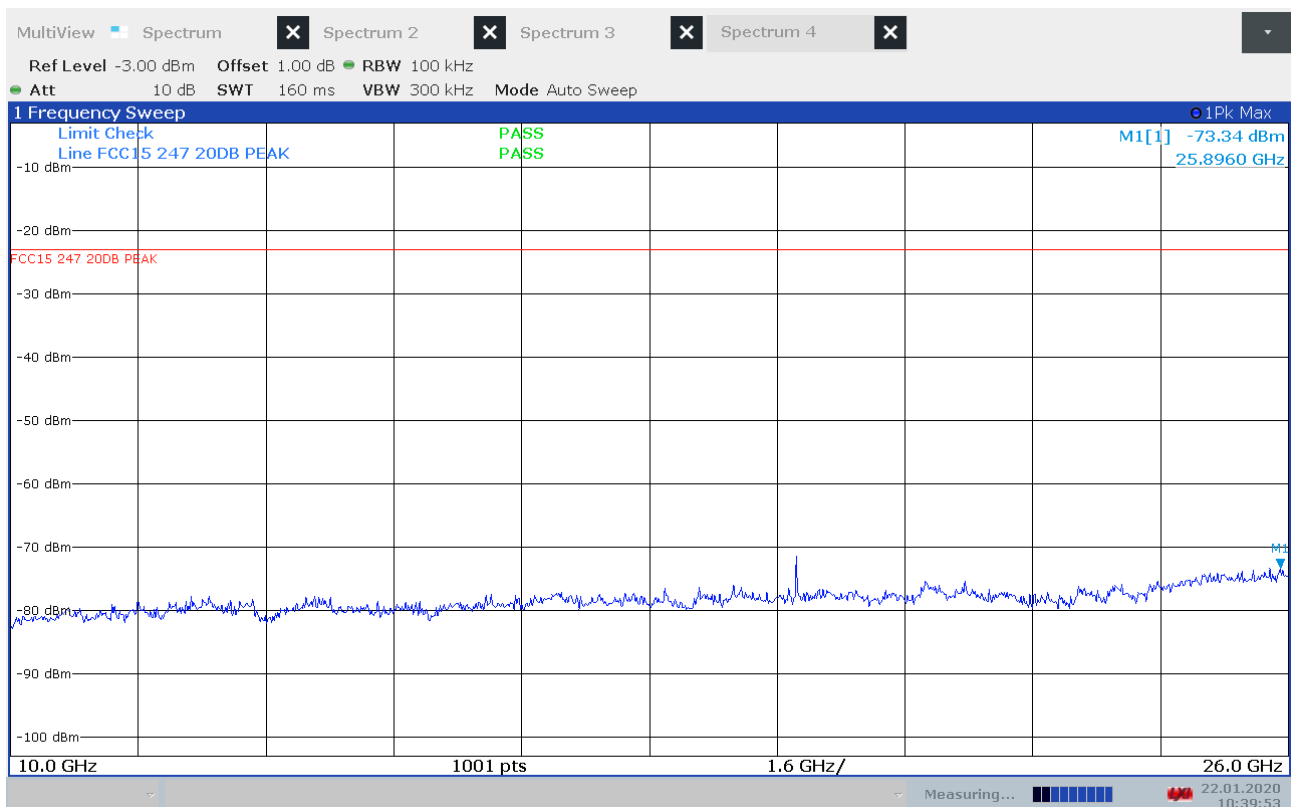
Spurious Emissions, Conducted 1 -2350MHz, 2480MHz



Spurious Emissions, Conducted 2350 -2550MHz, 2480MHz



Spurious Emissions, Conducted 2550 -10000MHz, 2480MHz



Spurious Emissions, Conducted 10000 -26000MHz, 2480MHz

3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISSED are defined in FCC Part 15.205 and ISSED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISSED (MHz)	FCC (GHz)	ISSED (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		3.6-4.4	3.5-4.4
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 123-138	108-138	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISSED, all other frequencies are common.

3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

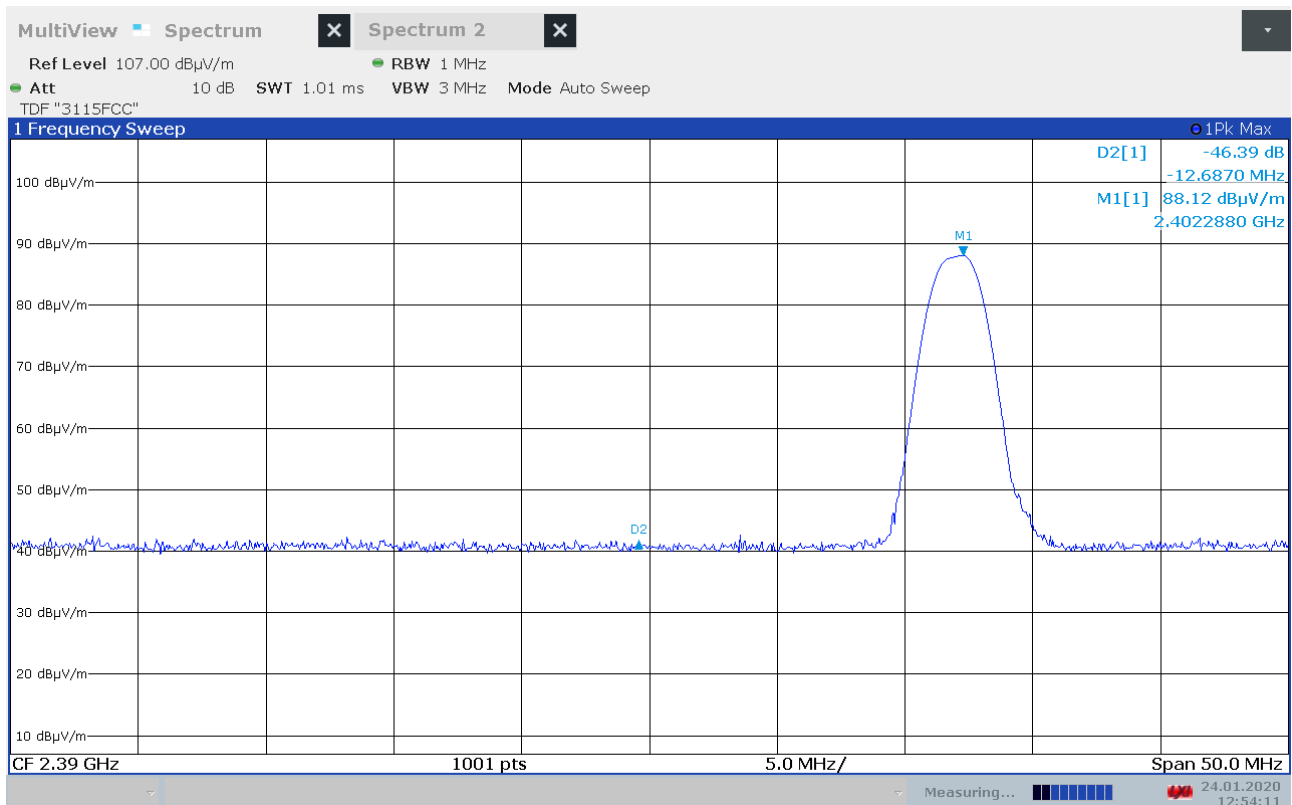
Test Results: Complies

Measurement Data:

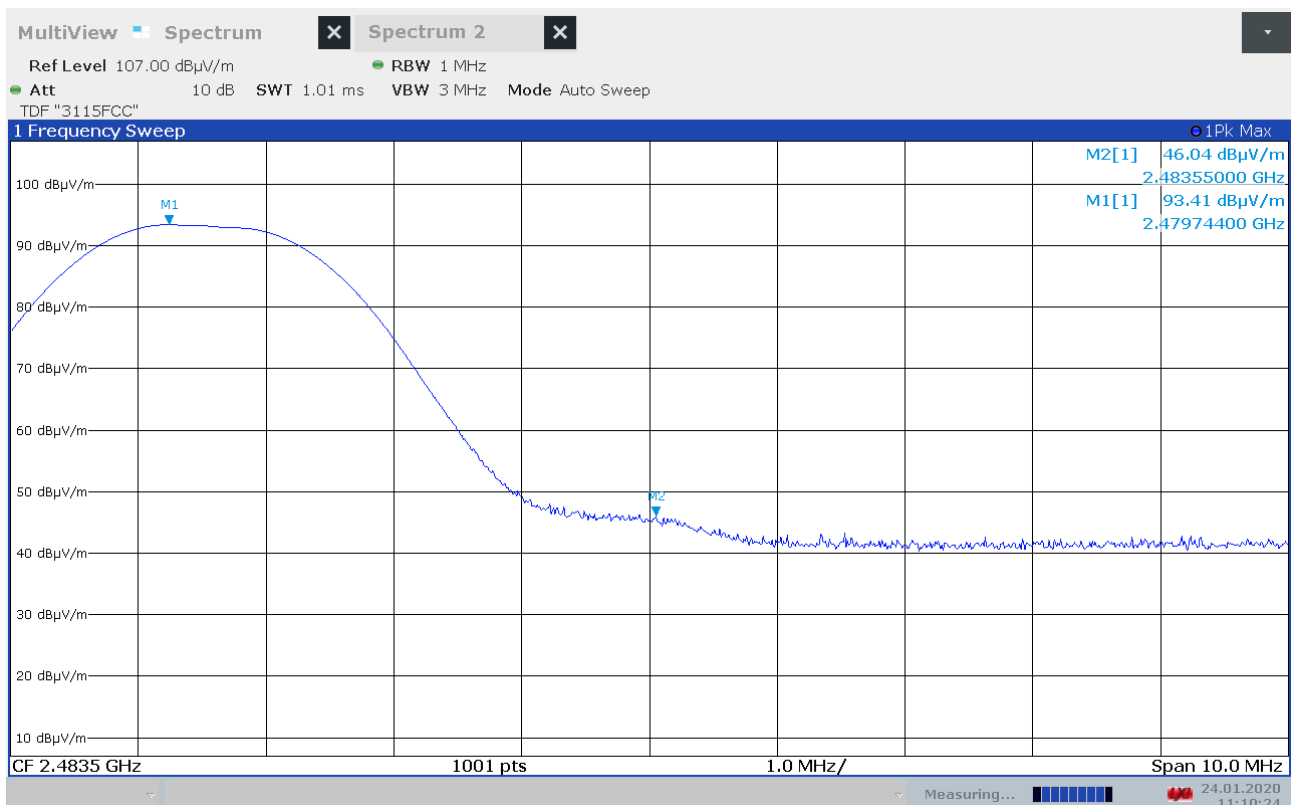
	Measured field strength (dB μ V/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB μ V/m	dB	
Peak Detector	41.7	46.0	74	32.3	28.0

Peak values are below the Average Limit.

See attached plots.



Band Edge, 2402 MHz, Peak



Band Edge, 2480 MHz, Peak

3.7 Radiated Emission, 30 – 1000 MHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Detector: Peak

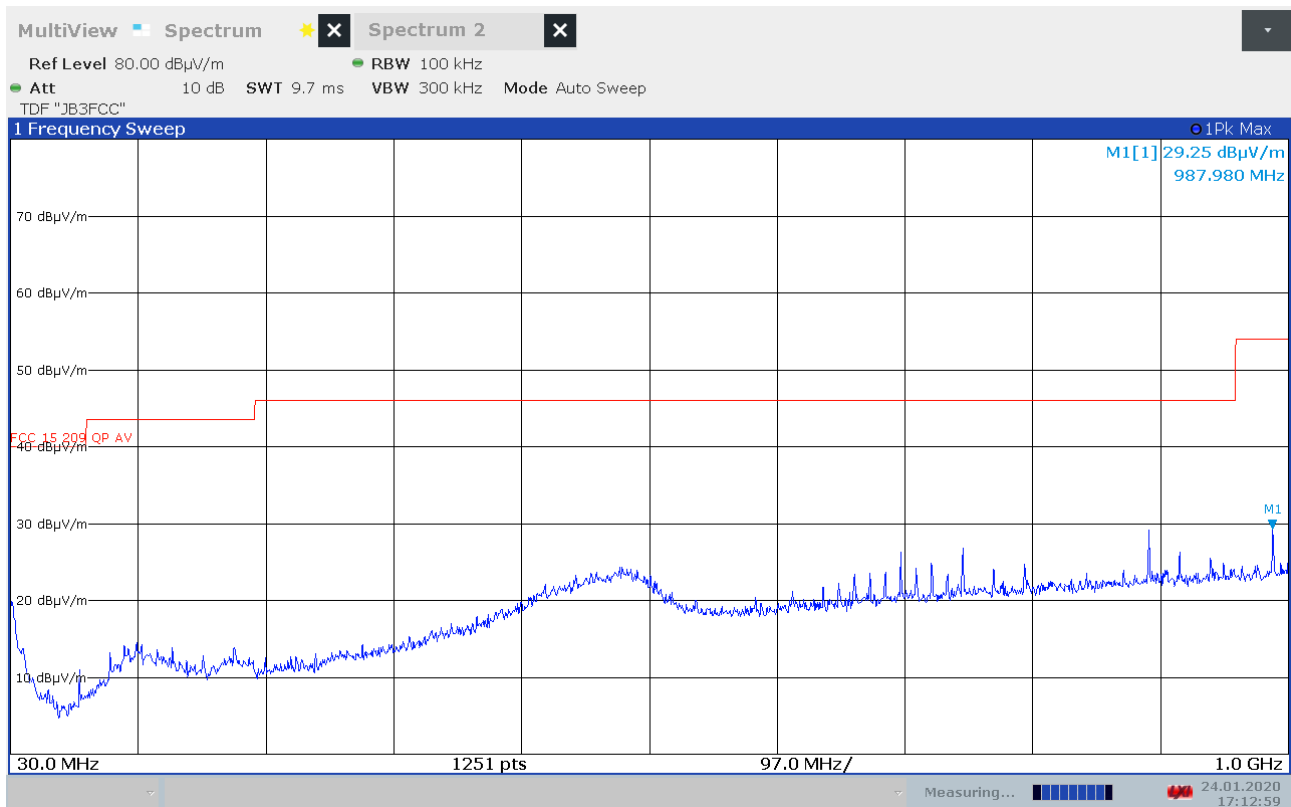
Measuring distance 3m

Frequency MHz	Dist. corr. Factor dB	Field strength @3m QP Det., dBμV/m	Limit dBμV/m	Margin dB
30 – 88	0	< 20	40	> 20
88 – 216	0	< 20	43.5	> 23.5
216 – 960	0	< 30	46	> 16
960 - 1000	0	< 36	54	> 18

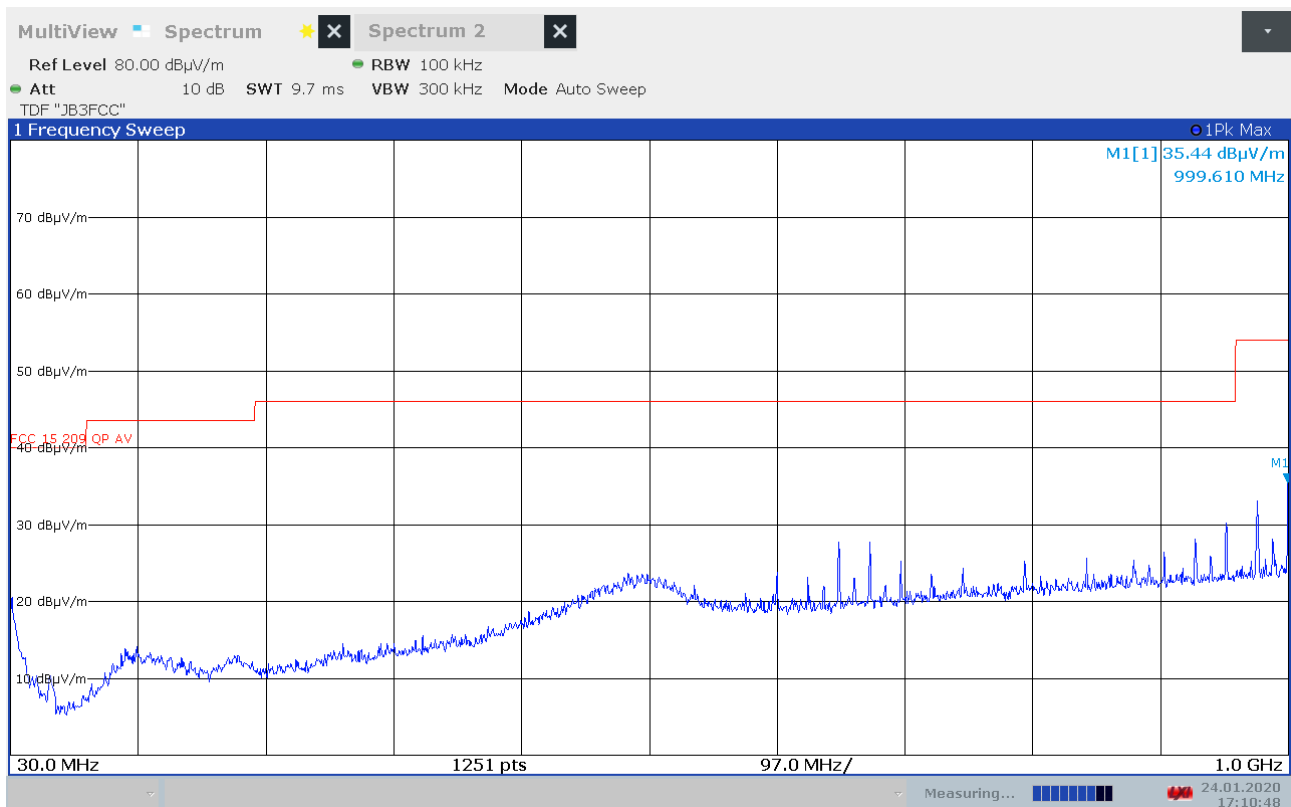
See attached plots

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 μV/m	40.0 dBμV/m
88 – 216 MHz	150 μV/m	43.5 dBμV/m
216 – 960 MHz	200 μV/m	46.0 dBμV/m
960 – 1000 MHz	500 μV/m	54.0 dBμV/m
Limits above are with Quasi Peak Detector		



Radiated Emissions, 30 -1000 MHz, EUT V, HP



Radiated Emissions, 30 -1000 MHz, EUT V, VP

3.8 Radiated Emissions, 1 – 26 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
MHz		dB	dB μ V/m	dB	dB μ V/m	dB
4804	00	0	50.0	20	74	24.0
4880	19	0	51.7	20	74	22.3
4960	39	0	49.5	20	74	24.5
Other freqs	all	0	None detected	20	74	>20

Peak values are below the Average Limit.

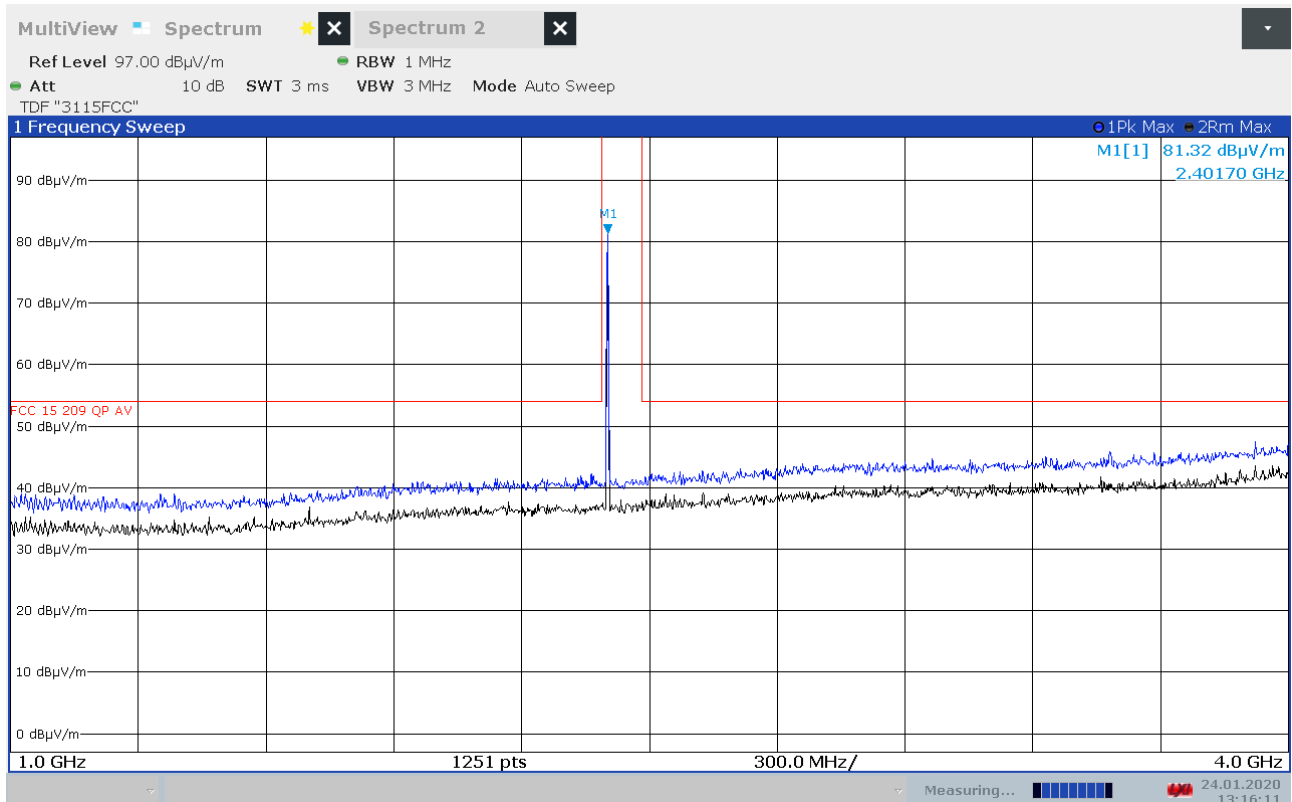
A High Pass Filter was used from 3 GHz to 18 GHz.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

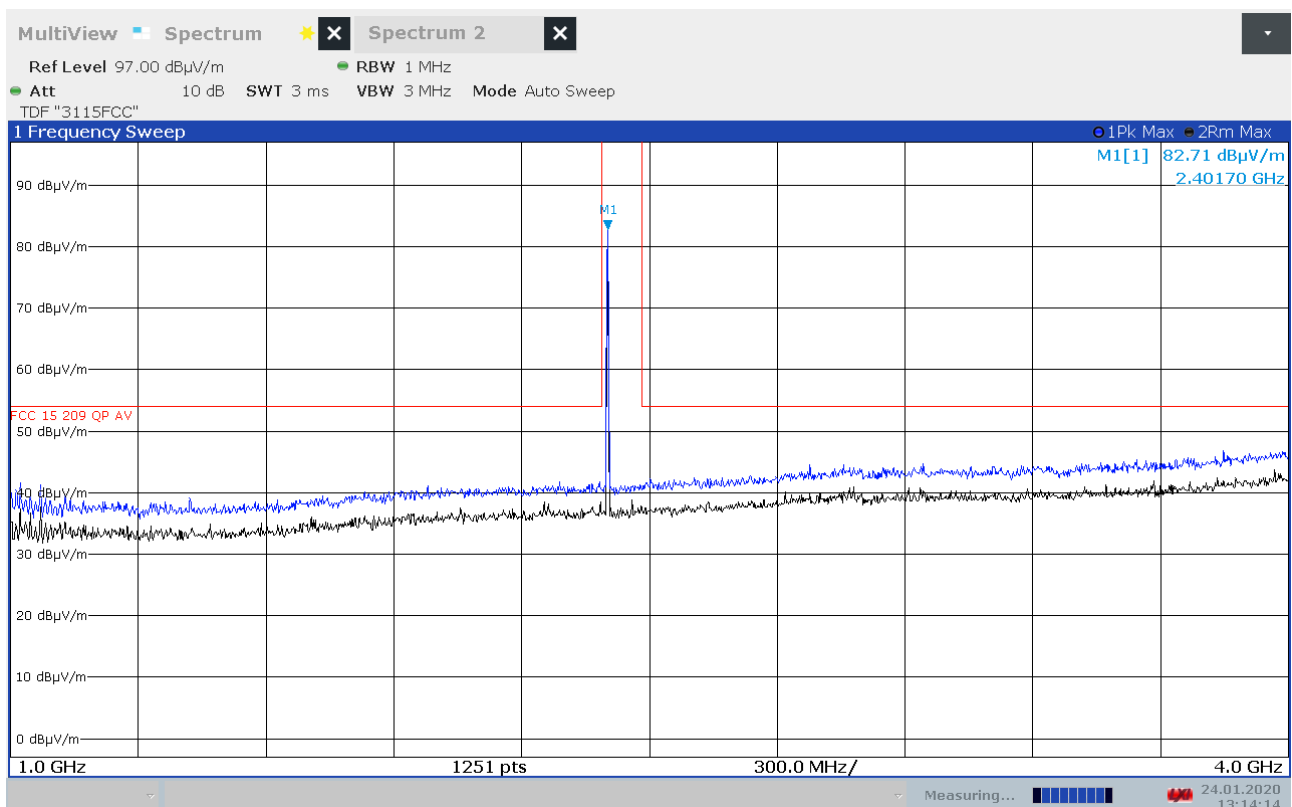
See plots.

Requirements/Limit

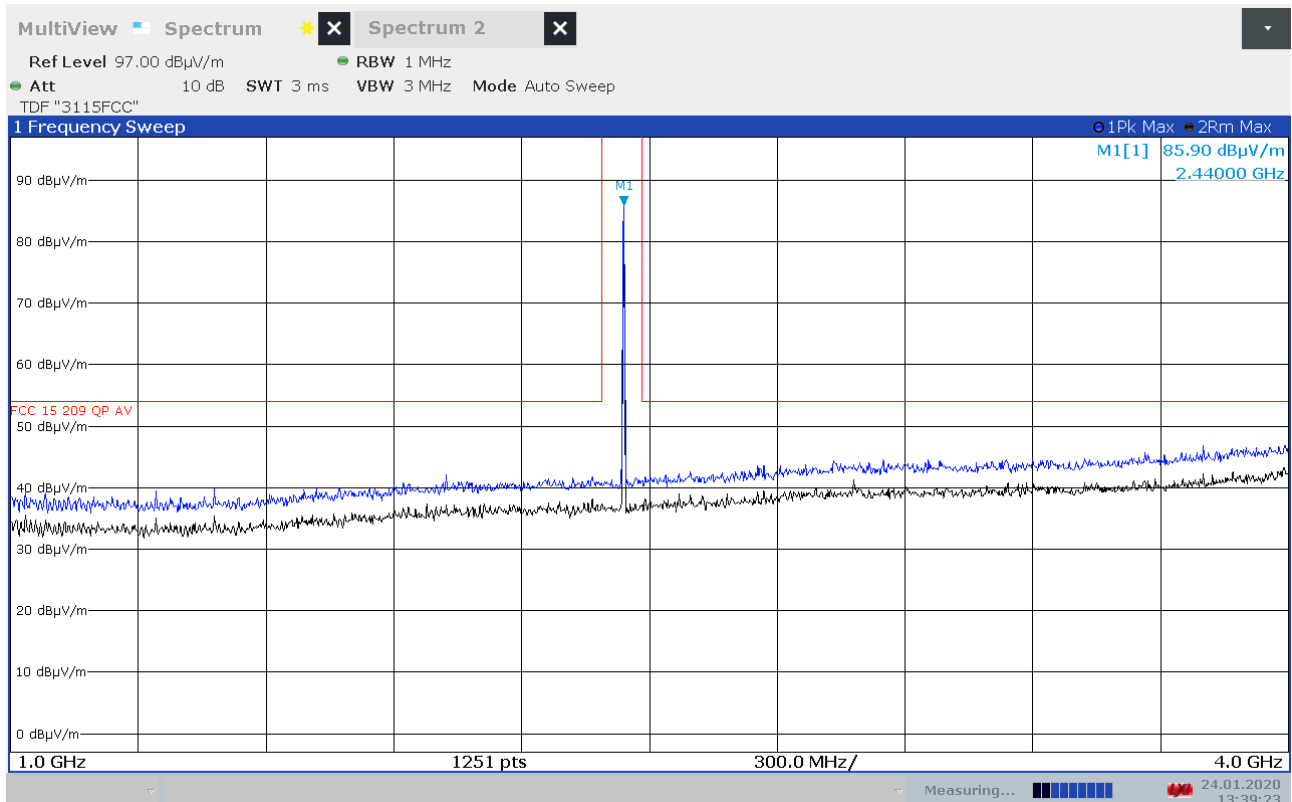
FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector	Peak Detector
1 – 26 GHz	54.0 dB μ V/m	74.0 dB μ V/m



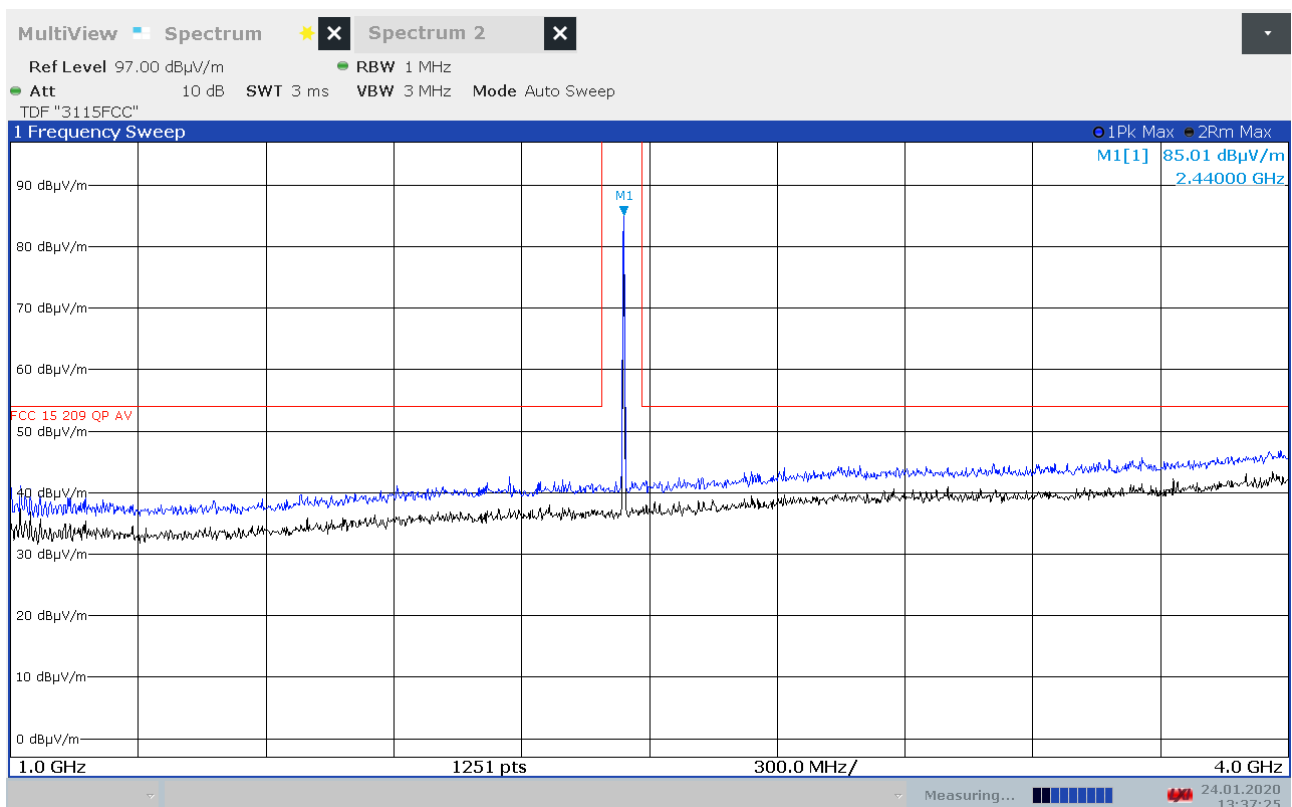
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT V, HP



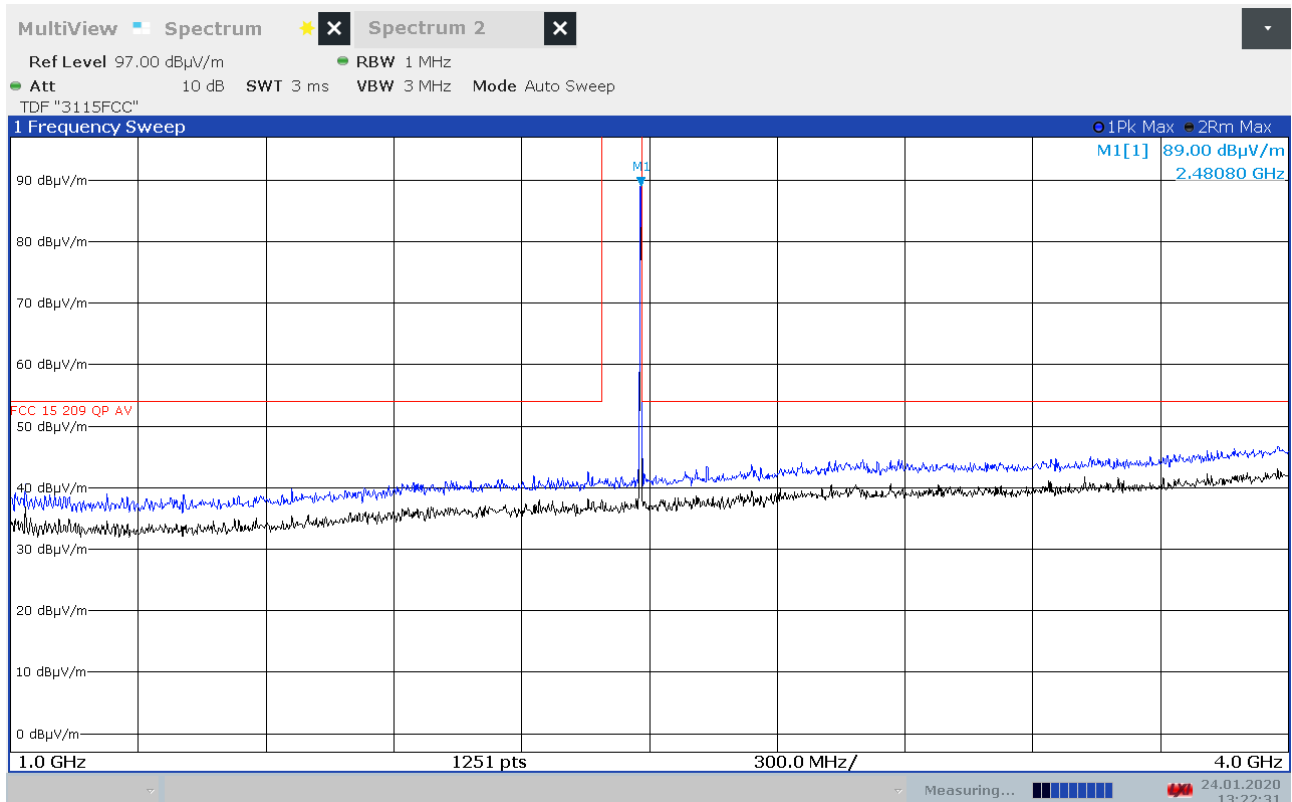
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT V, VP



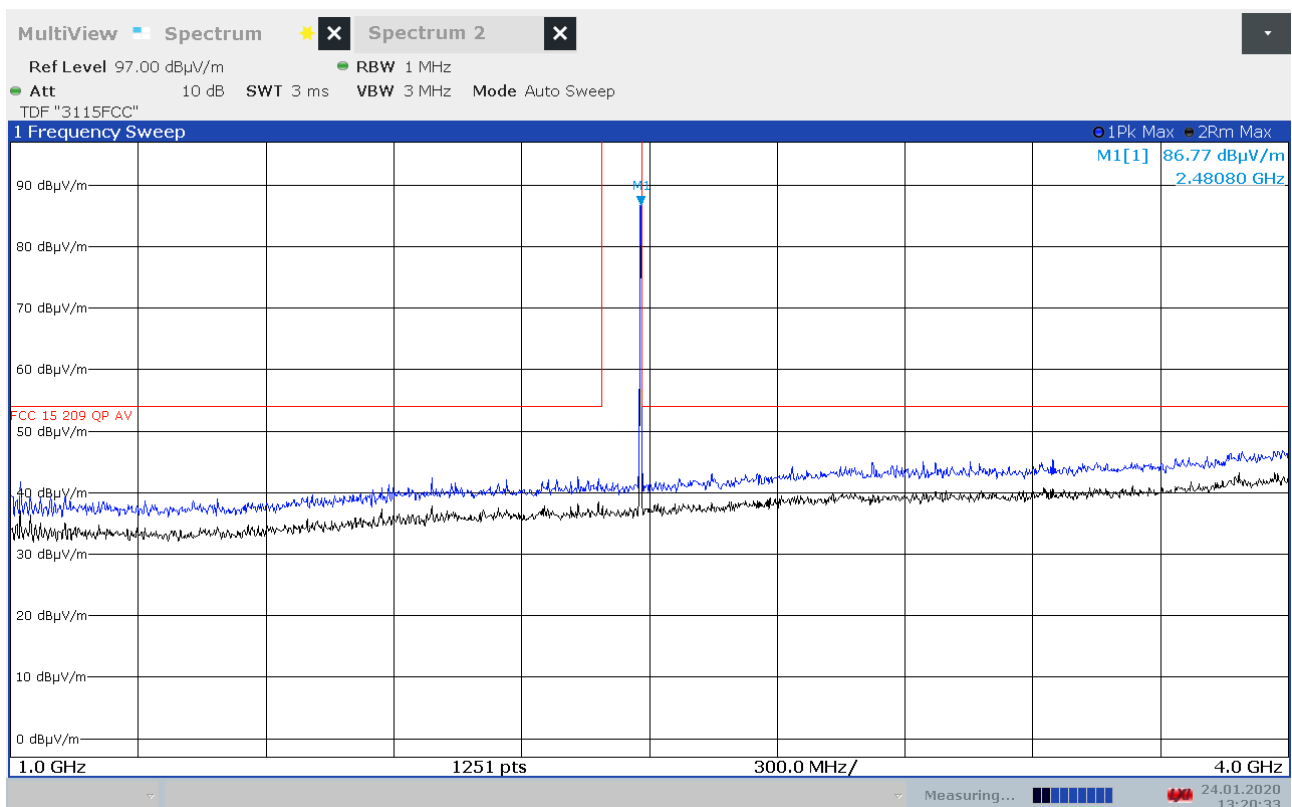
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT V, HP



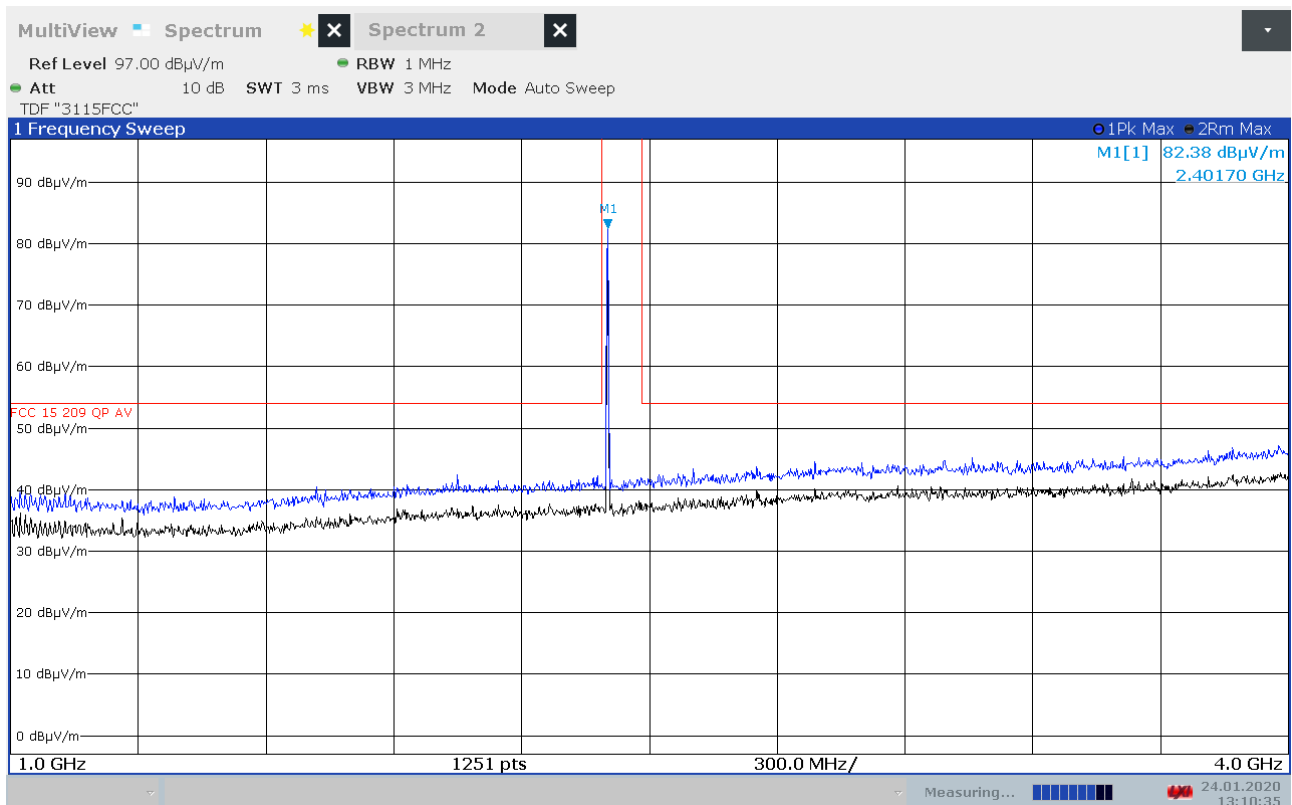
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT V, VP



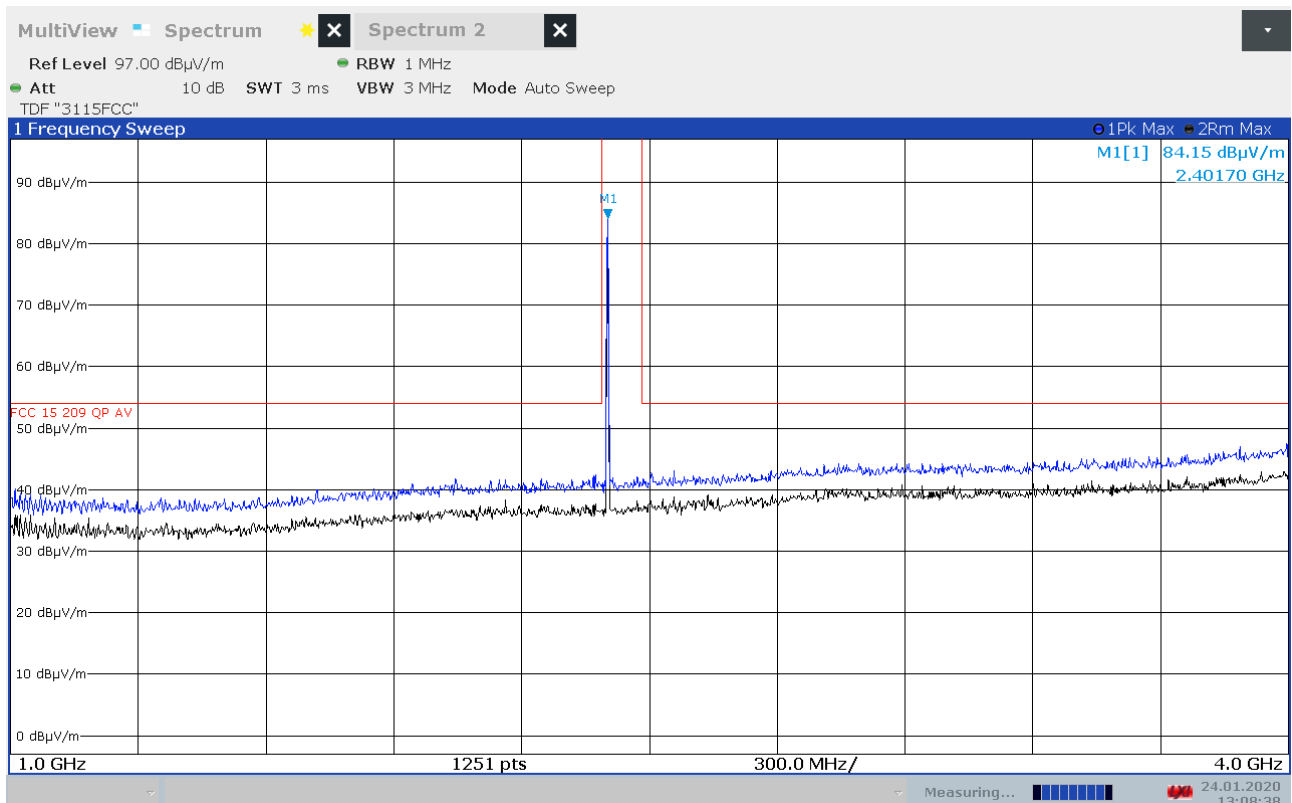
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT V, HP



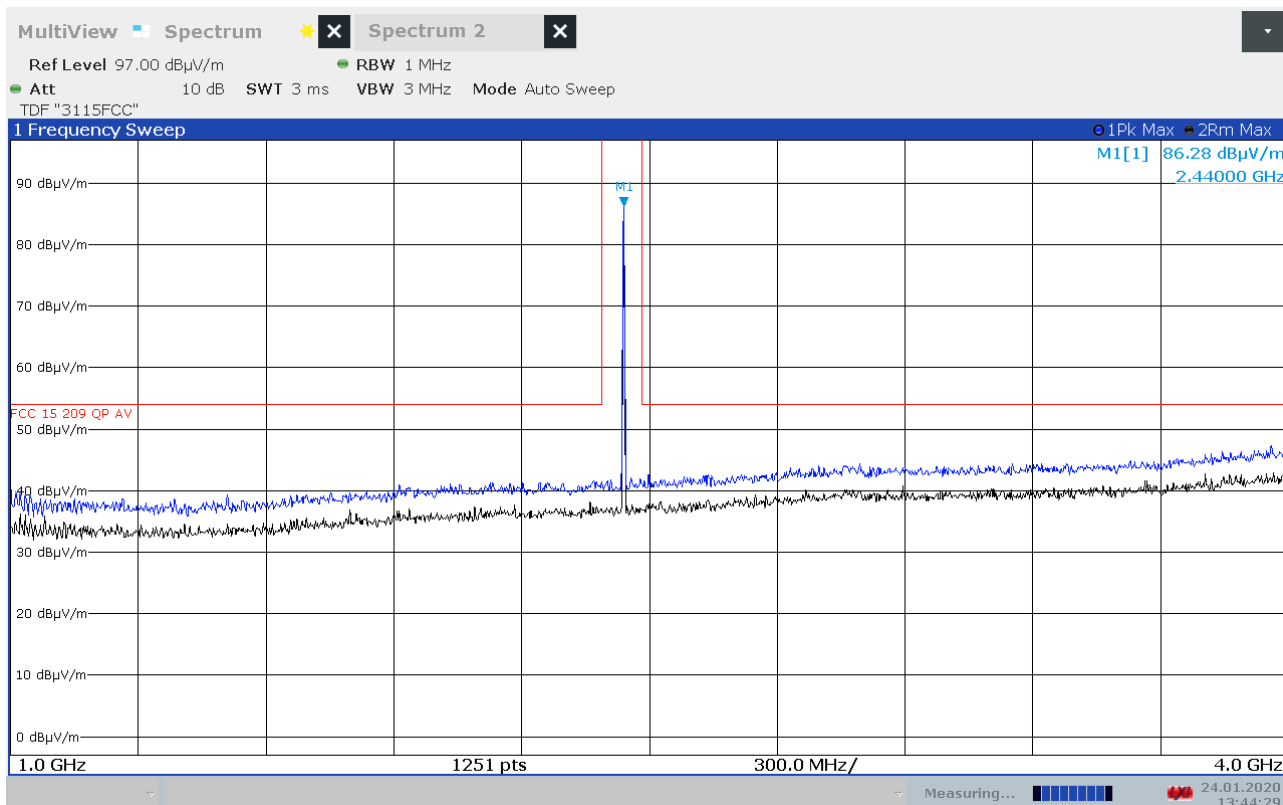
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT V, VP



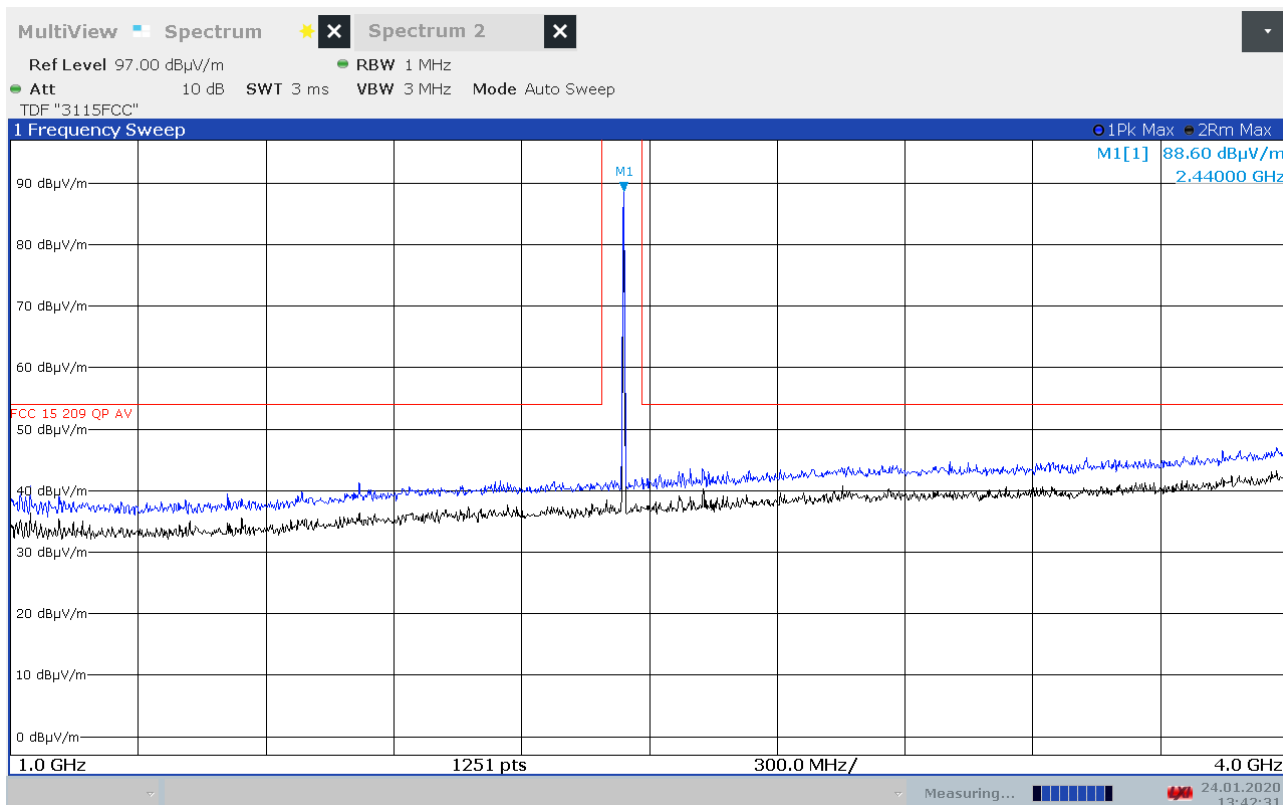
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT H1, HP



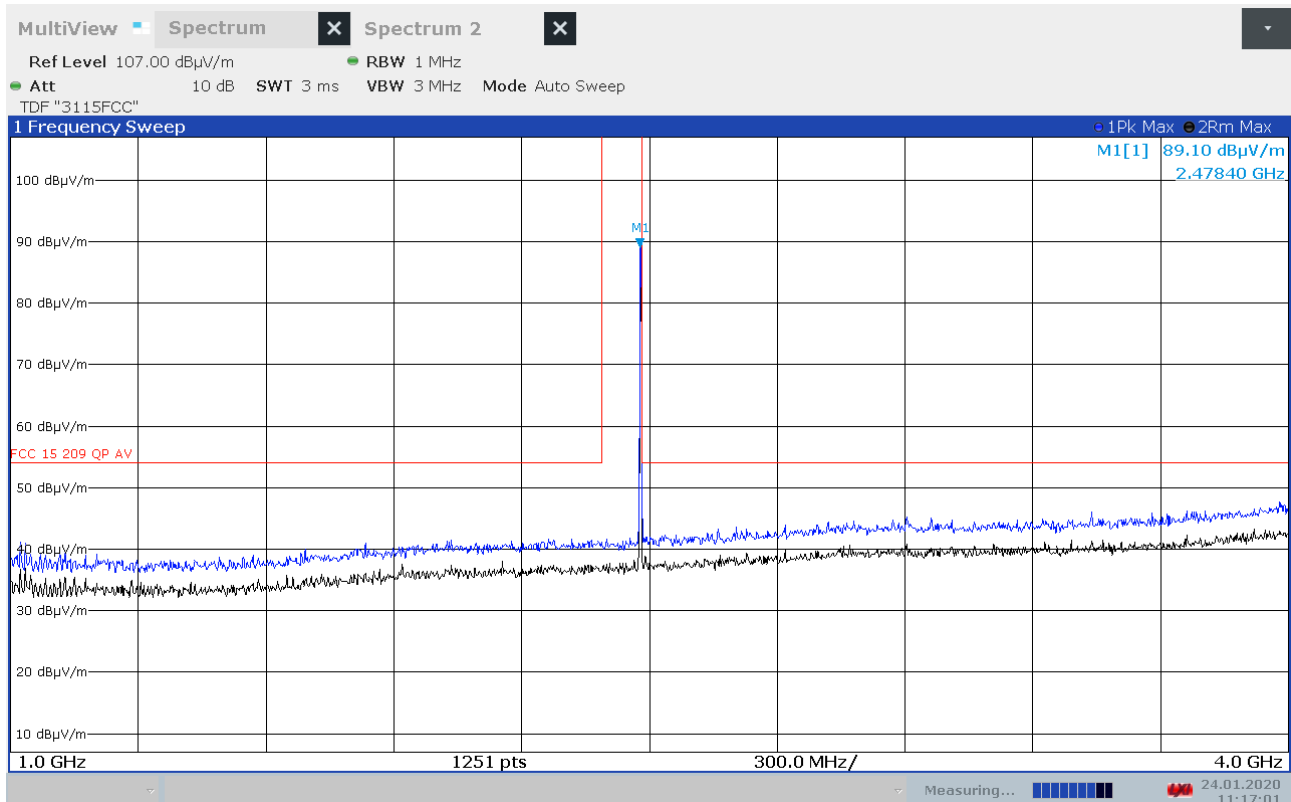
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT H1, VP



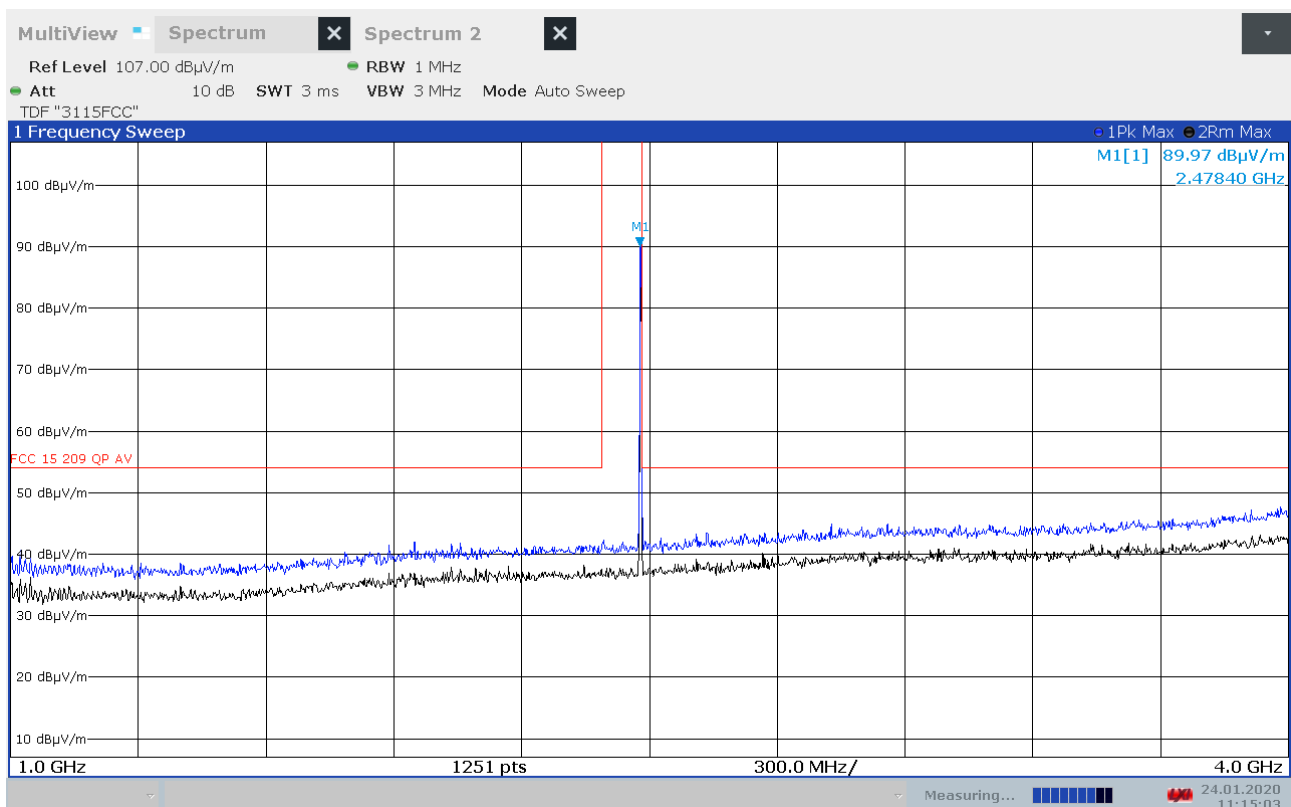
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT H1, HP



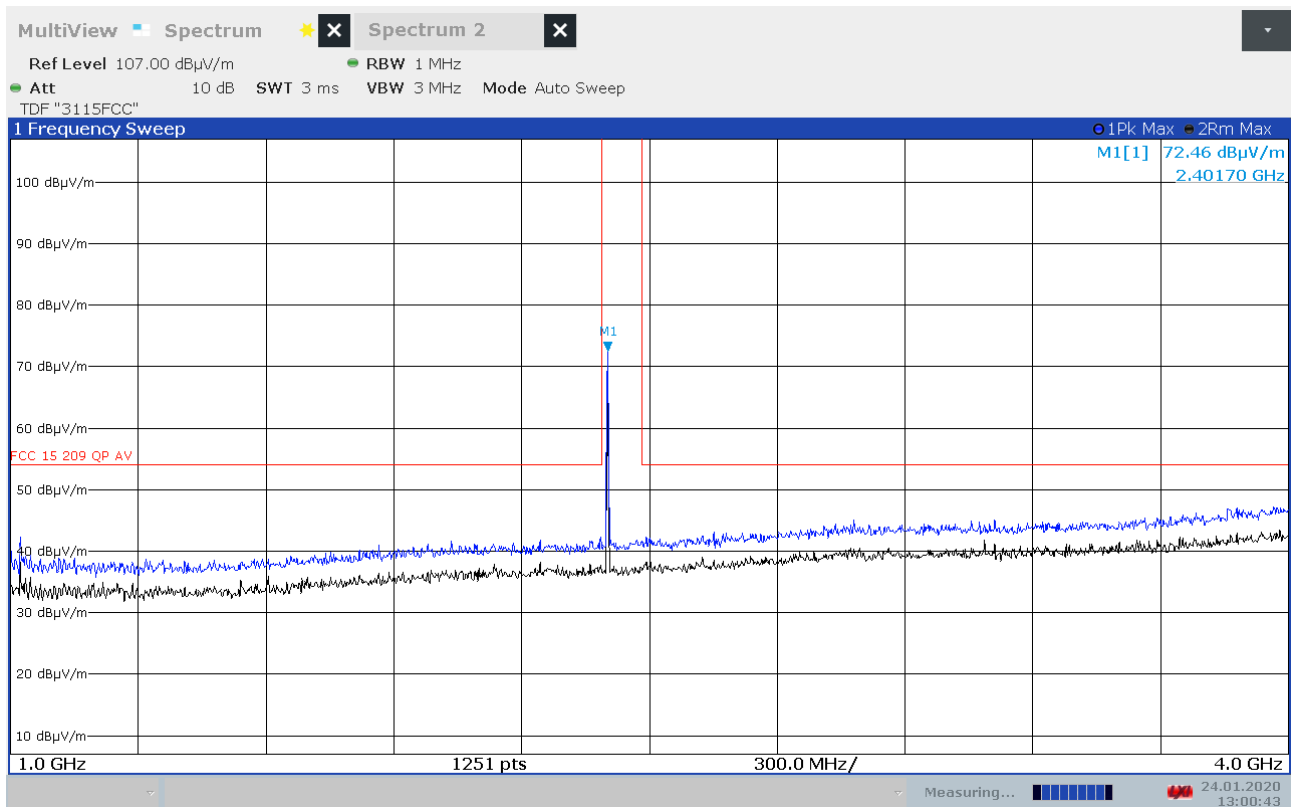
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT H1, VP



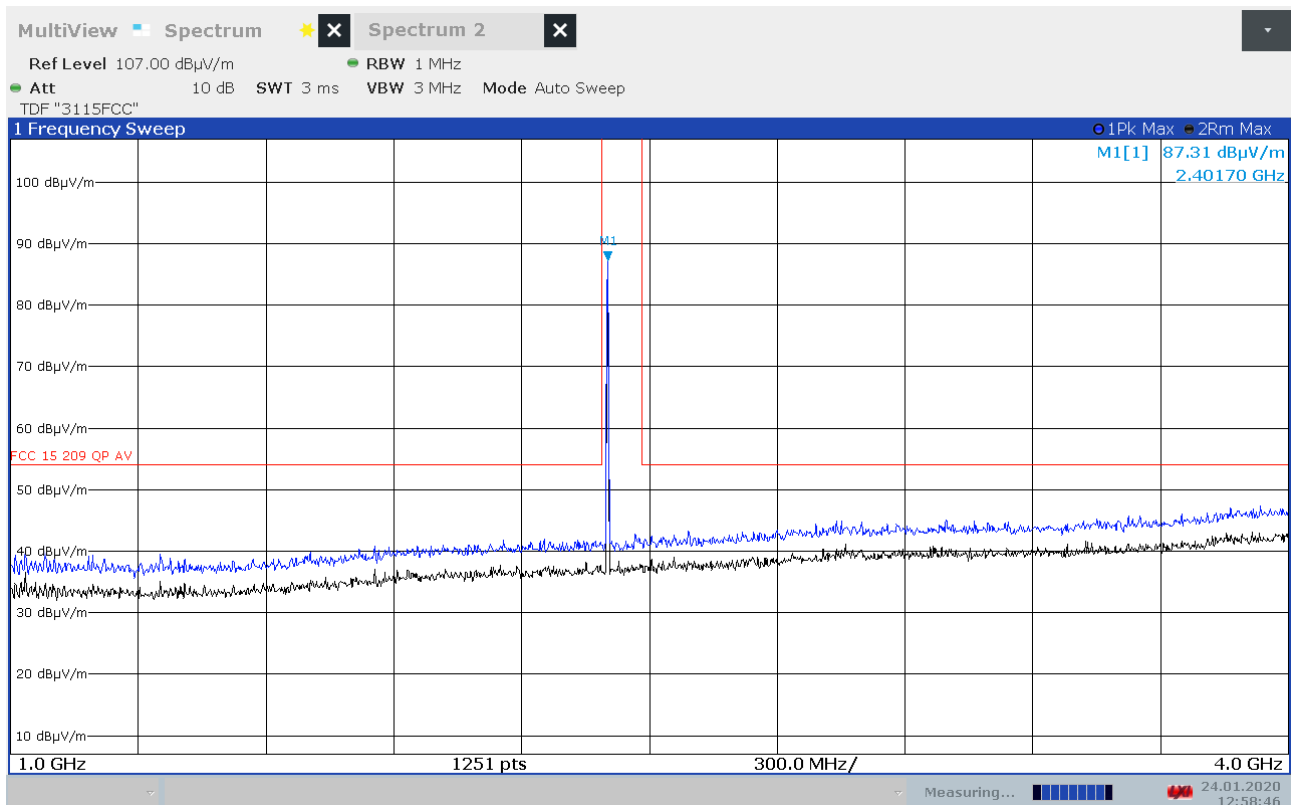
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT H1, HP



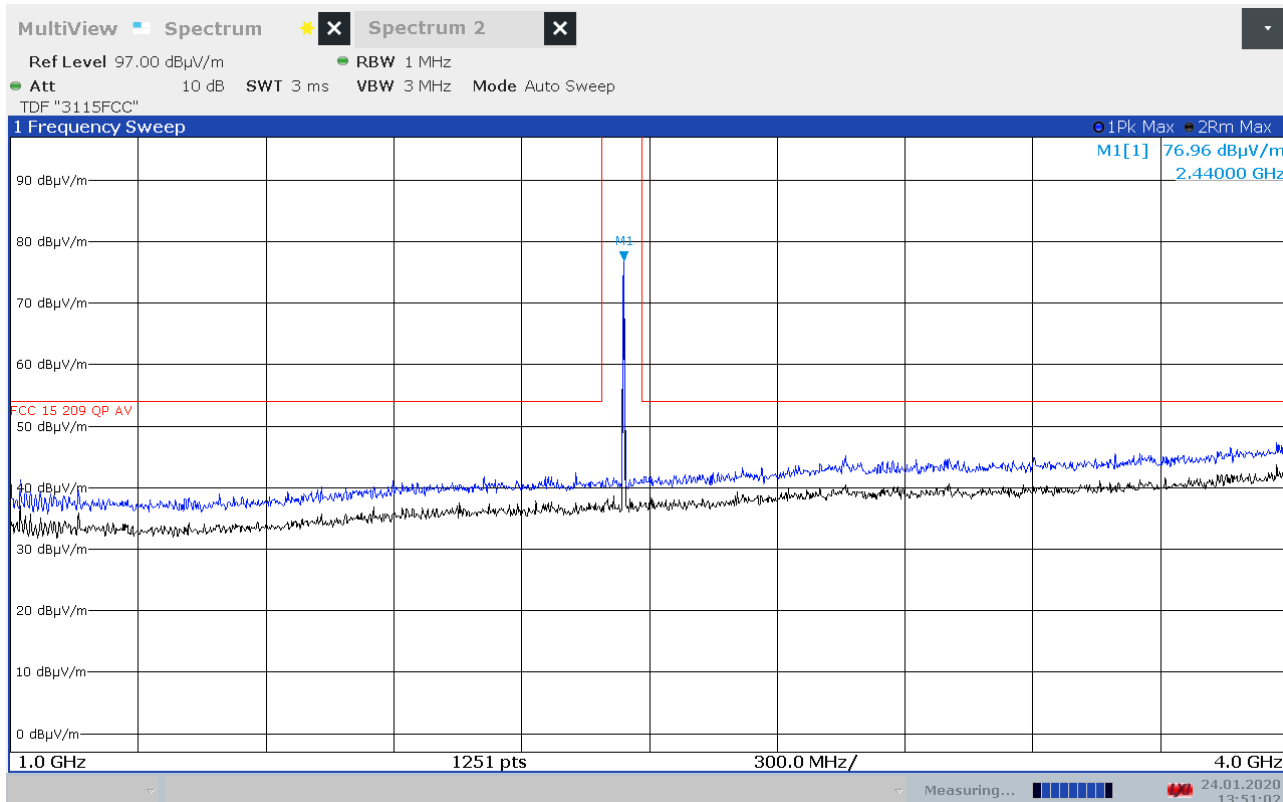
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT H1, VP



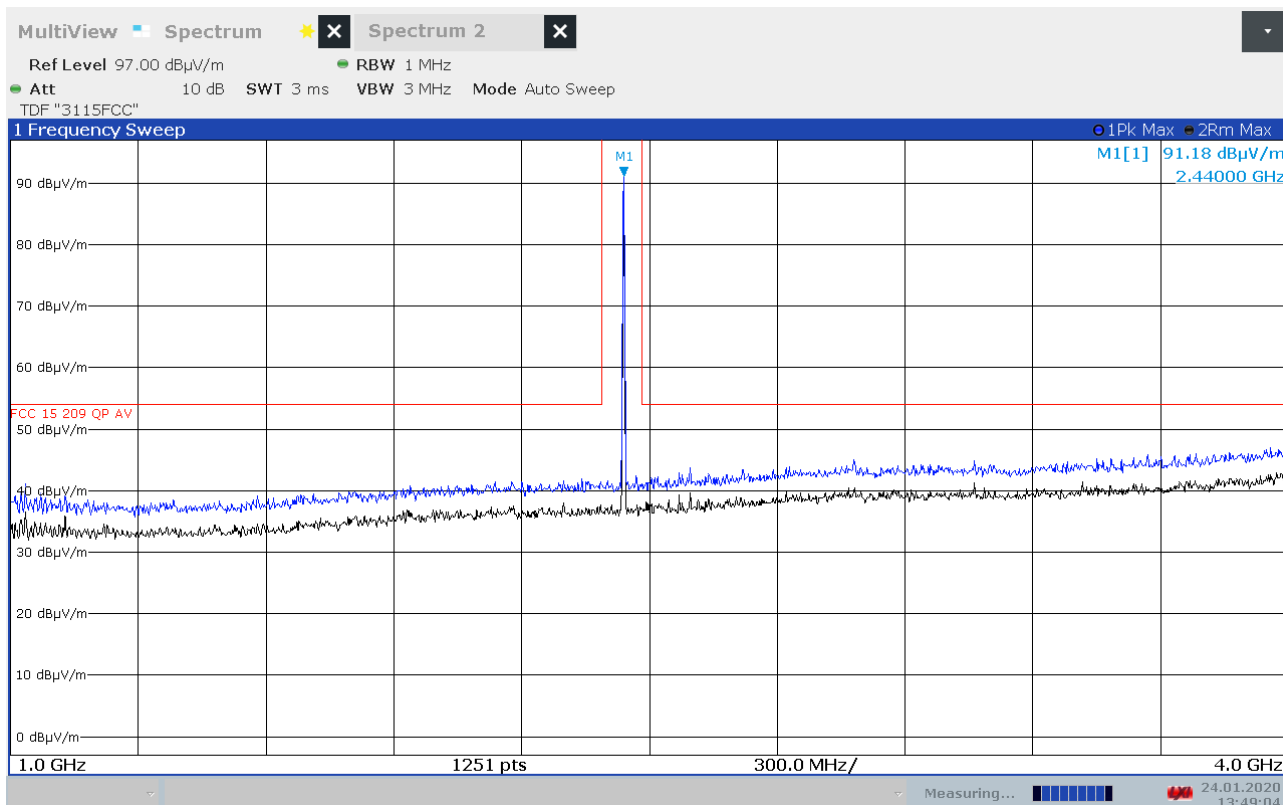
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT H2, HP



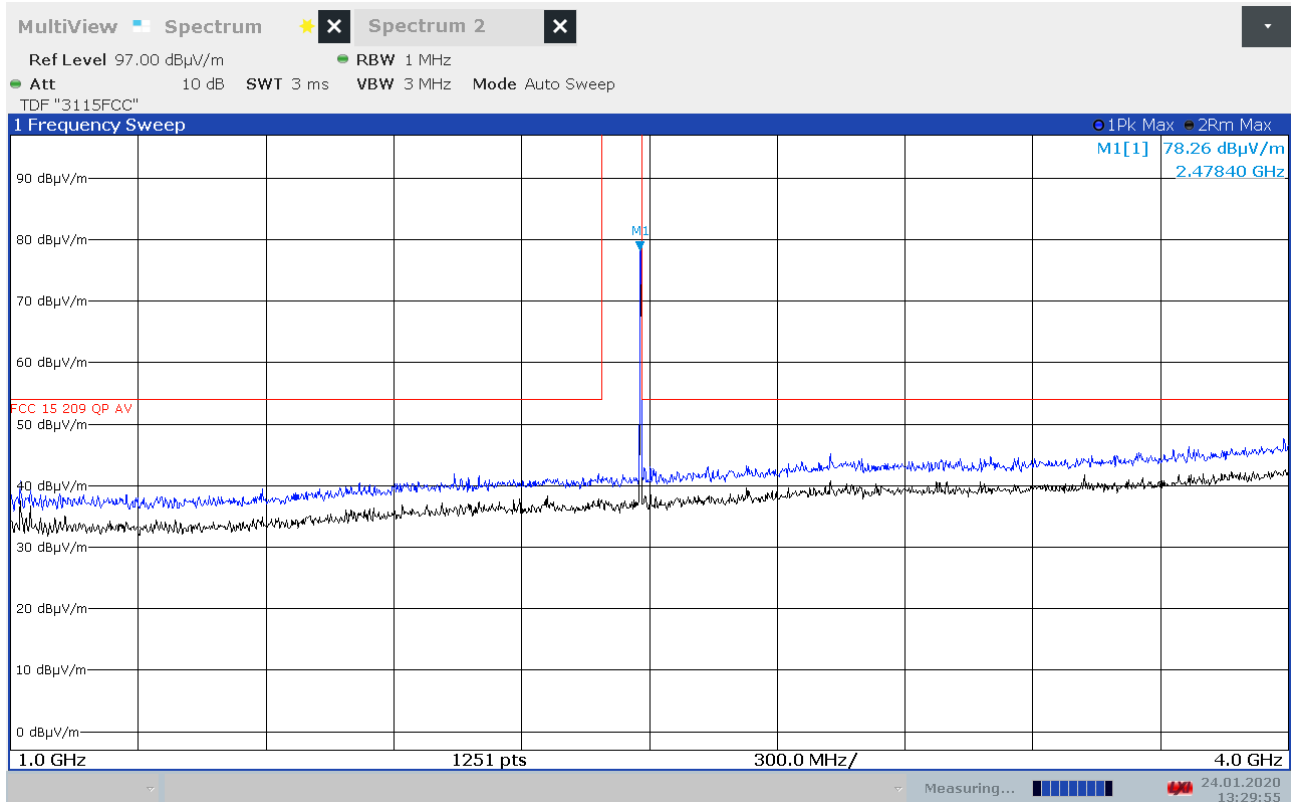
Radiated Emissions, 1000 -4000 MHz, 2402MHz, EUT H2, VP



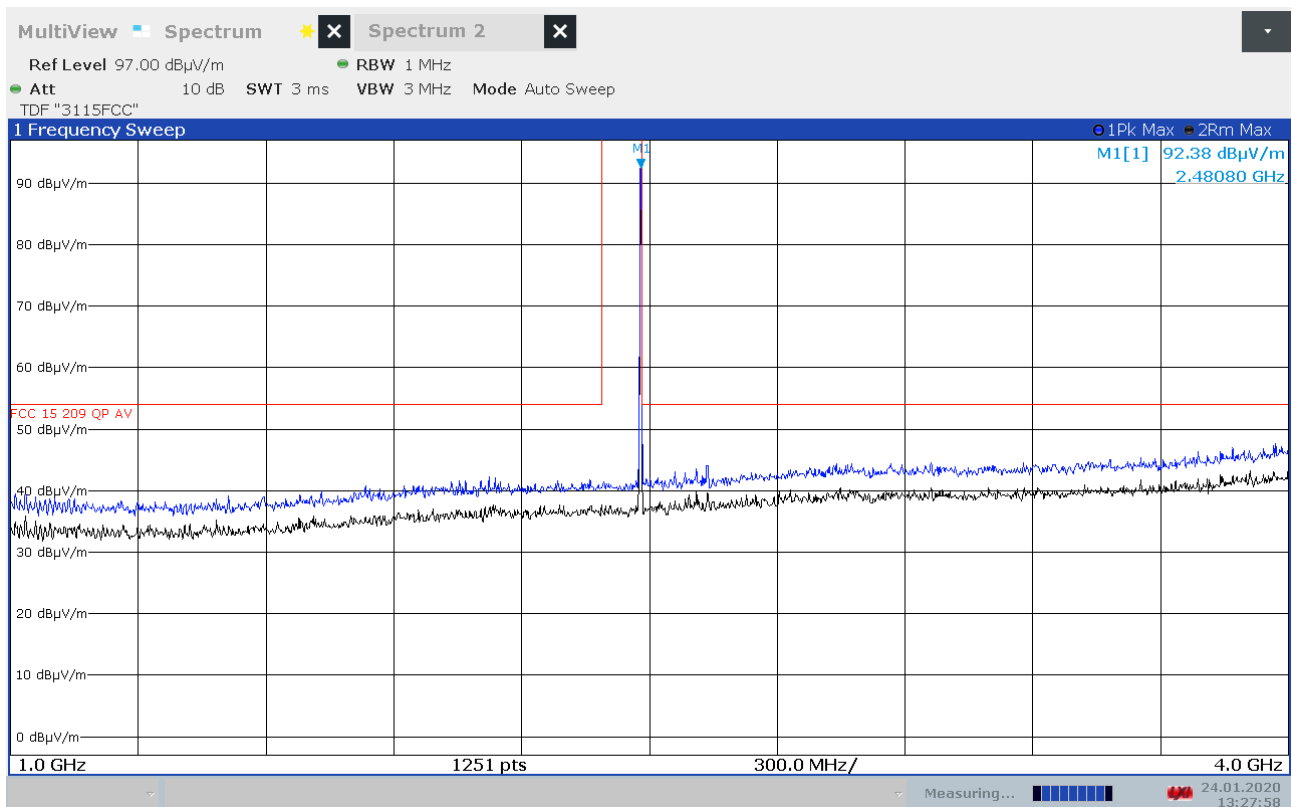
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT H2, HP



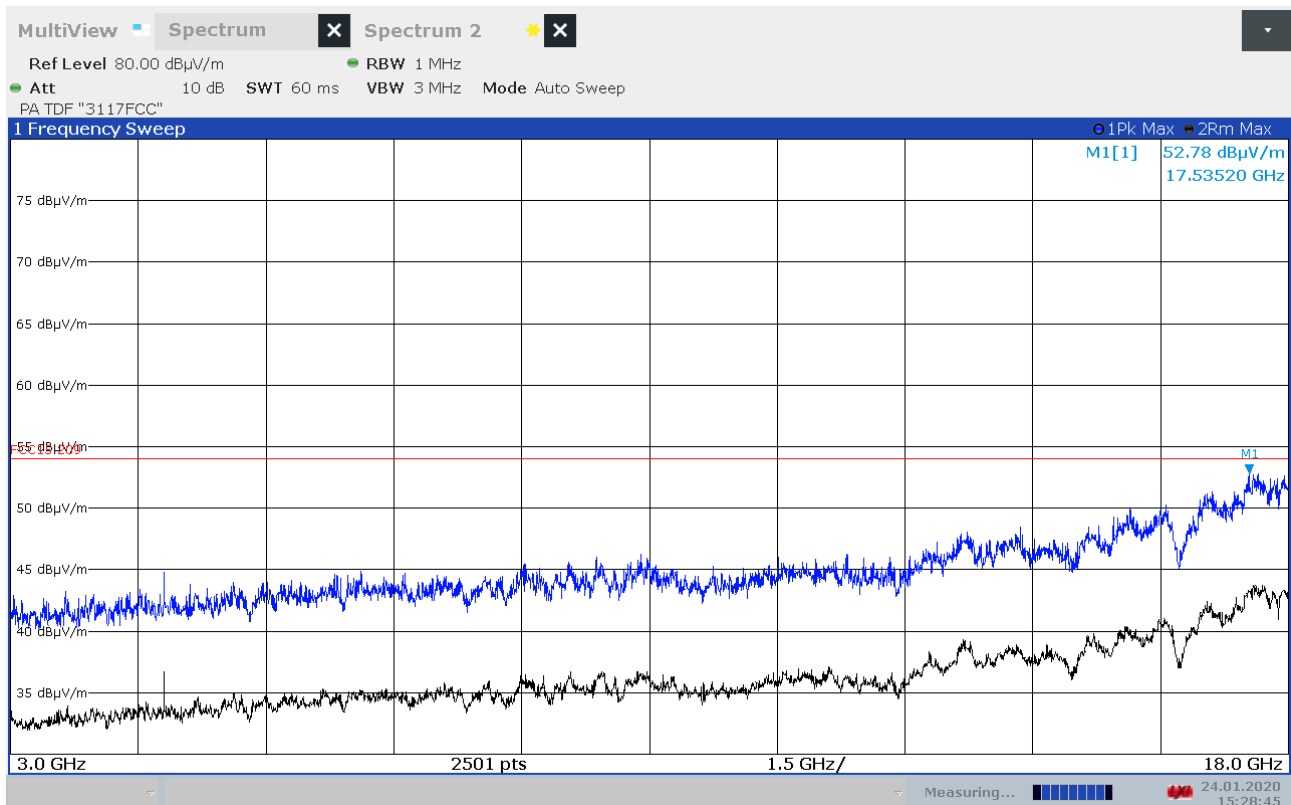
Radiated Emissions, 1000 -4000 MHz, 2440MHz, EUT H2, VP



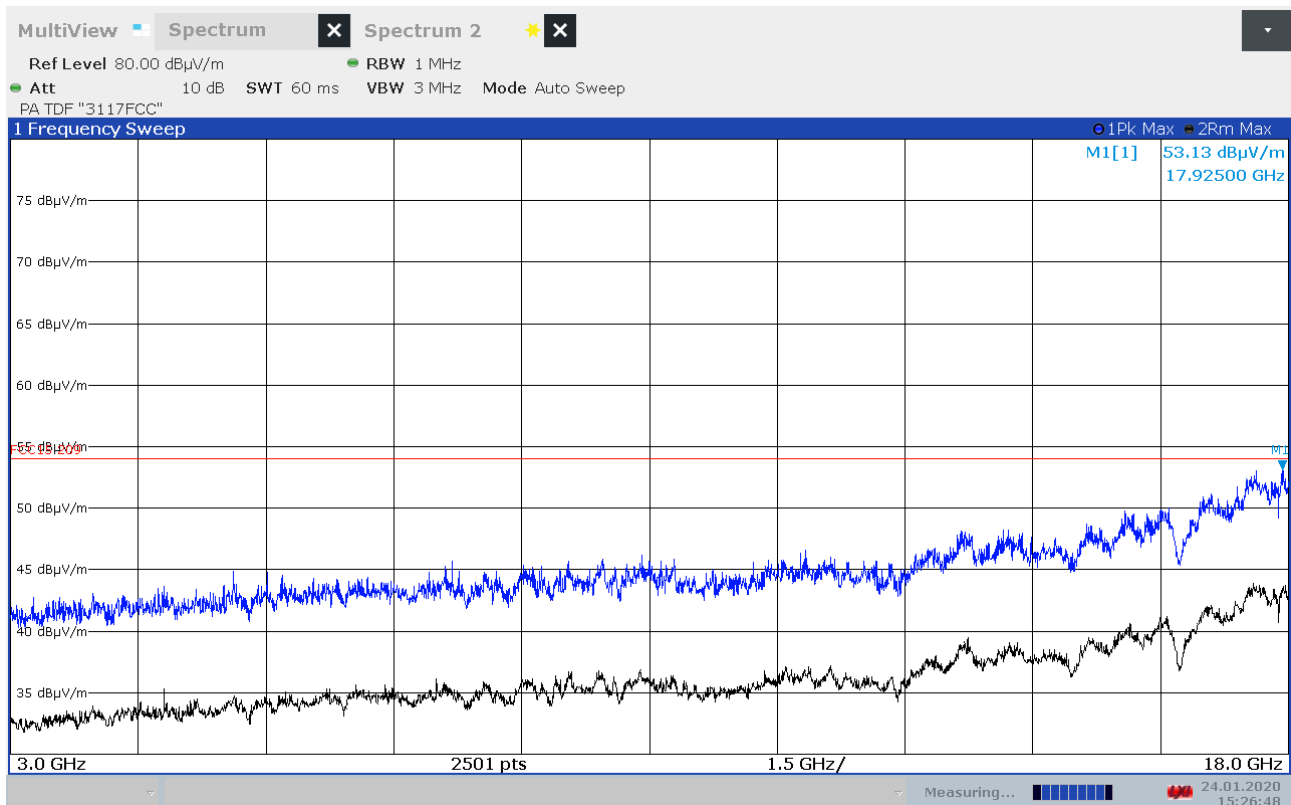
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT H2, HP



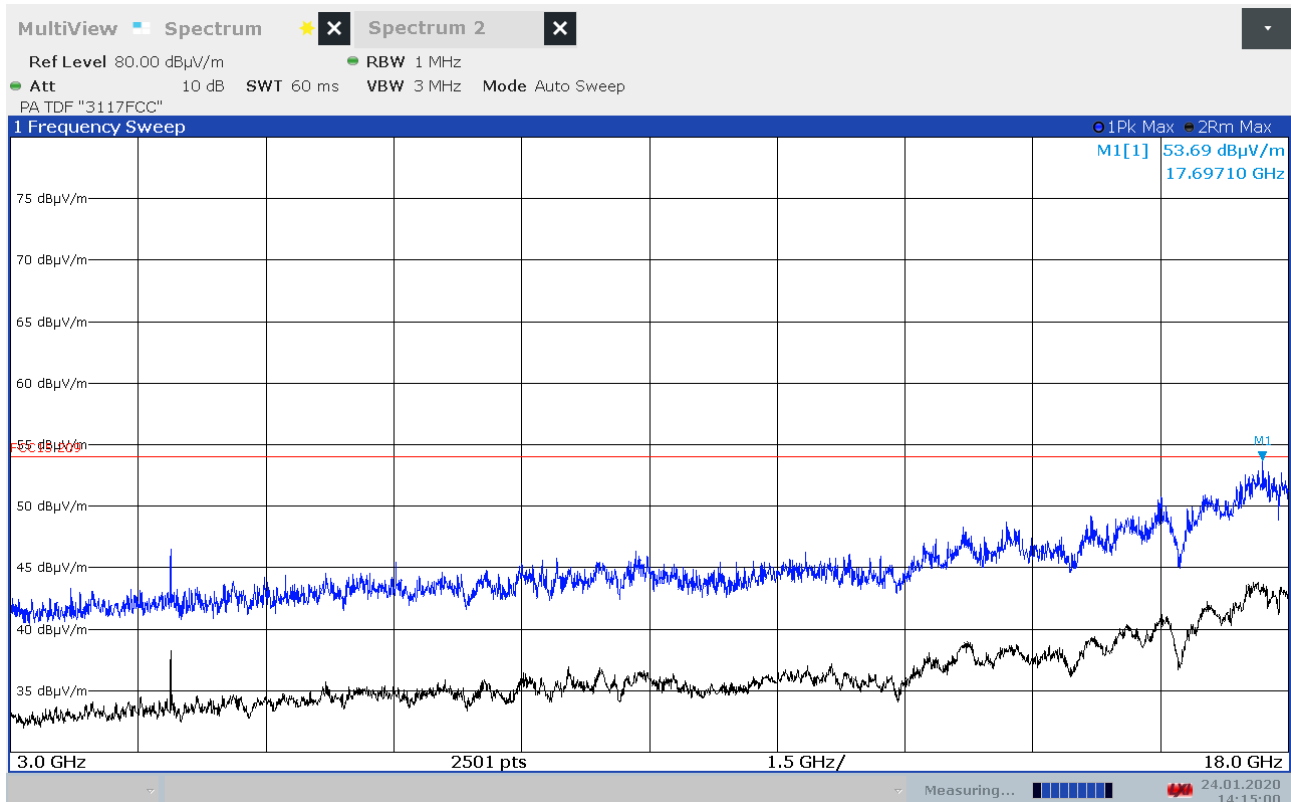
Radiated Emissions, 1000 -4000 MHz, 2480MHz, EUT H2, VP



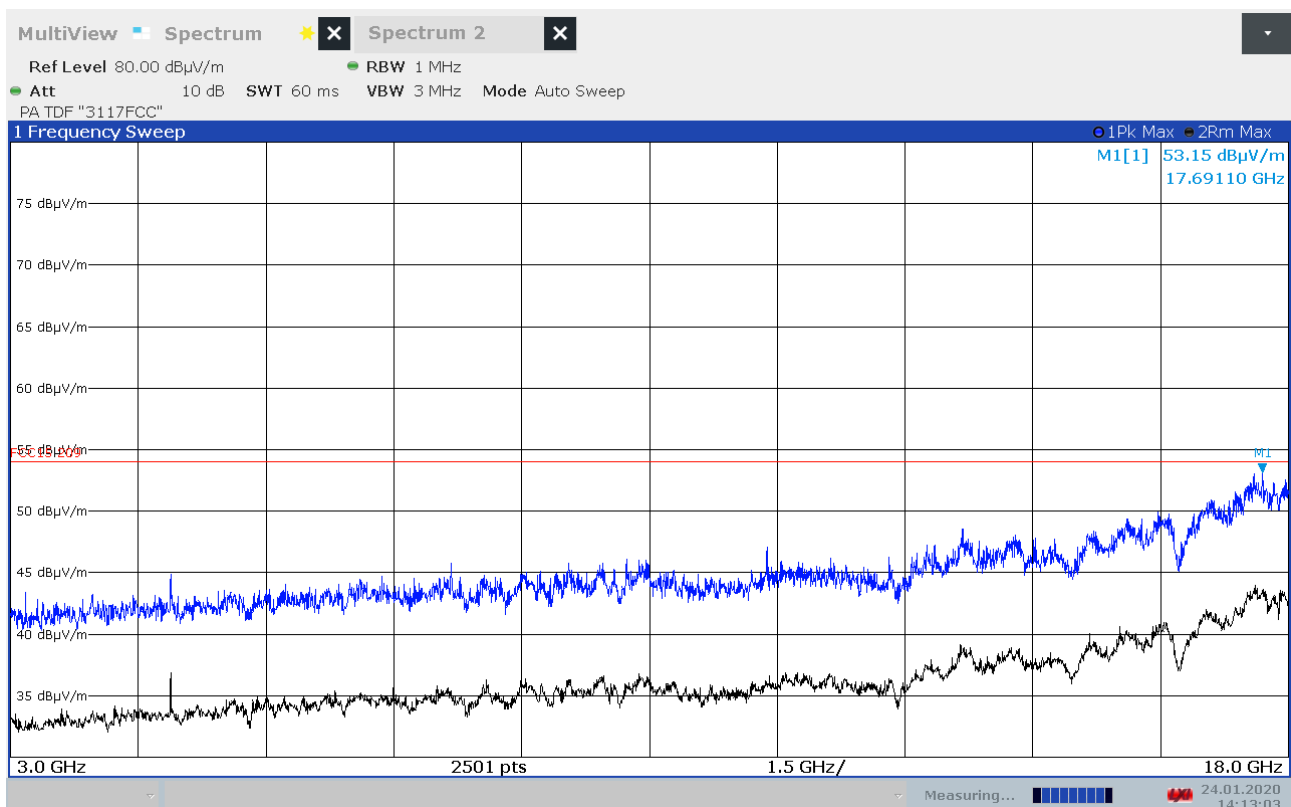
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT V, HP



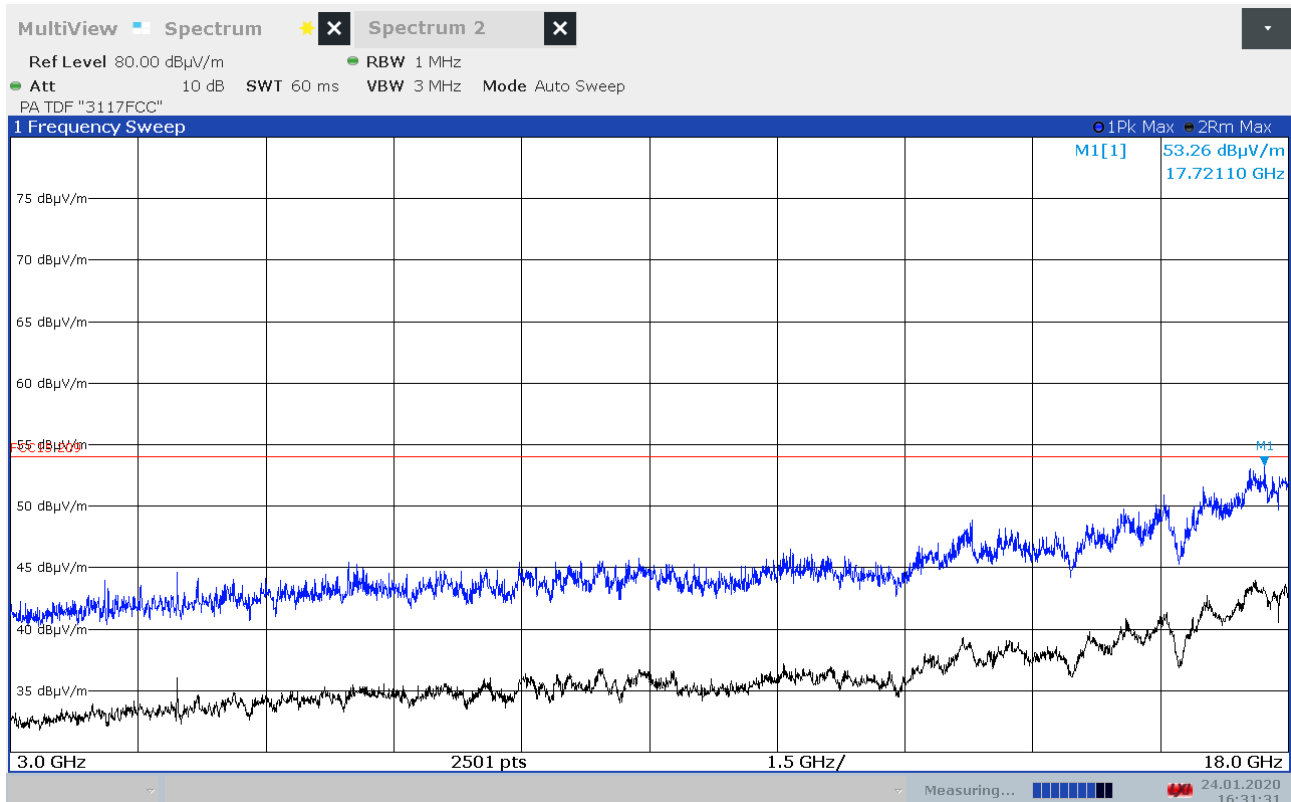
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT V, VP



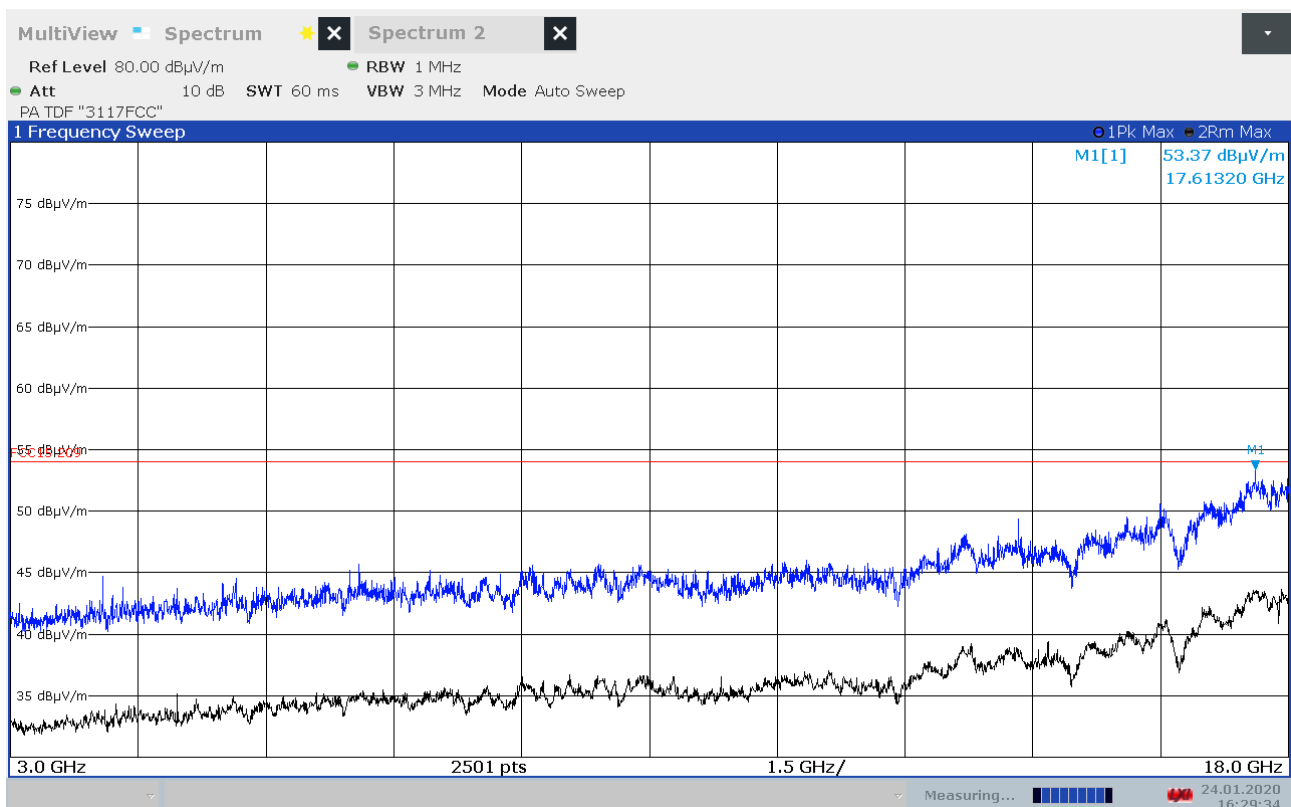
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT V, HP



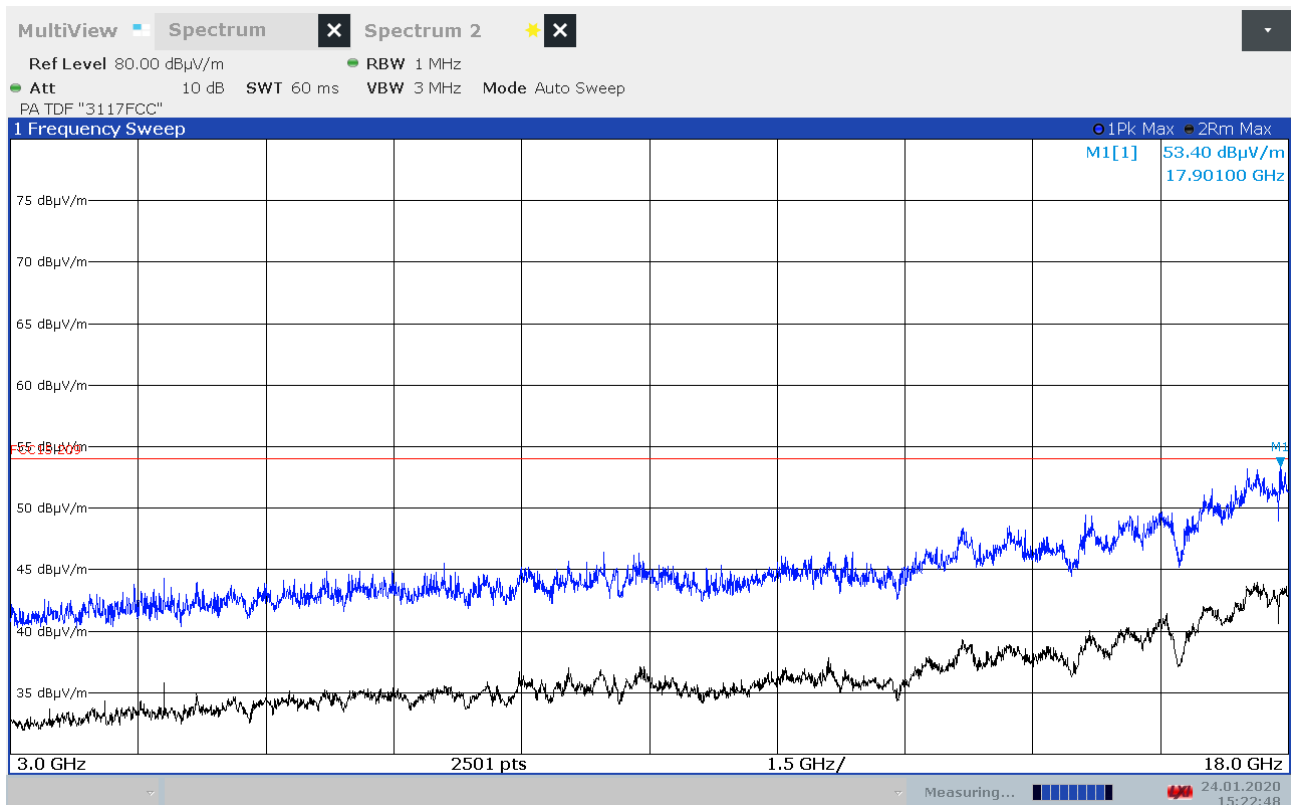
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT V, VP



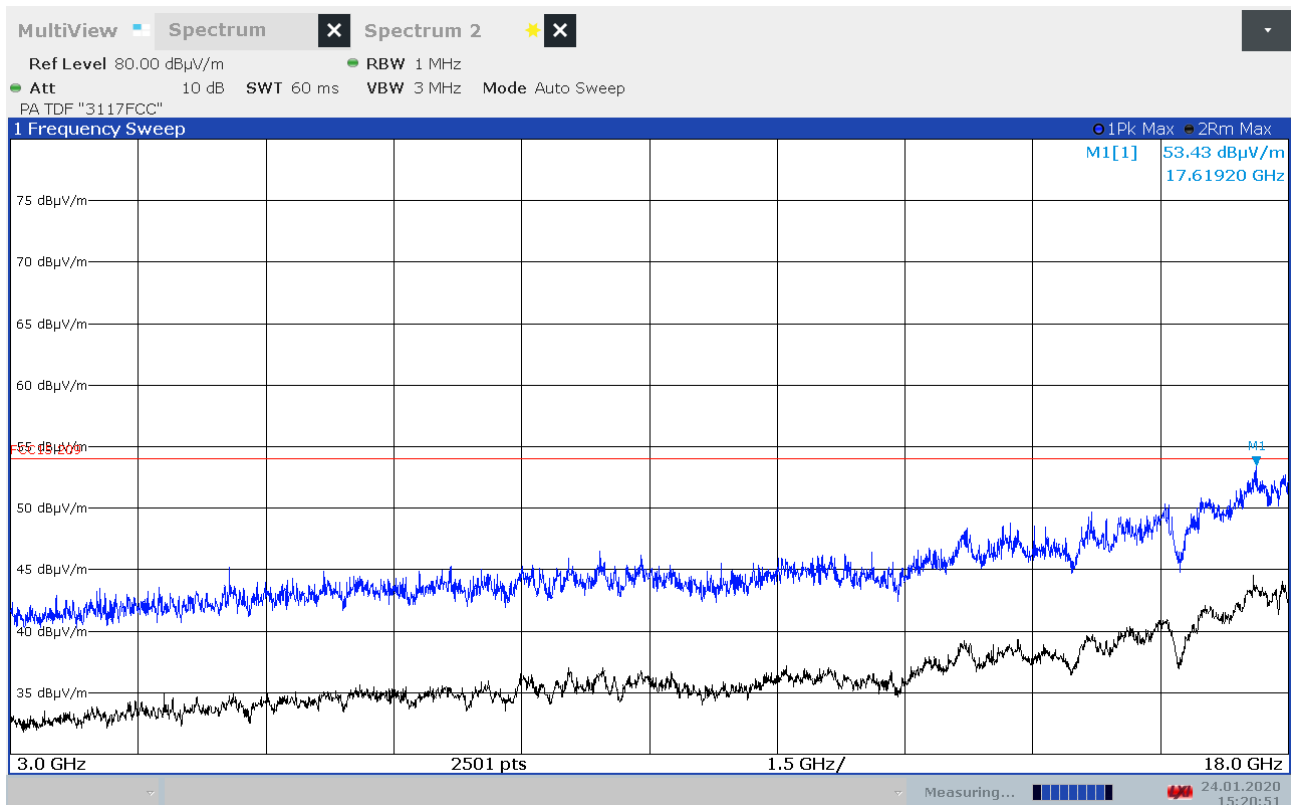
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT V, HP



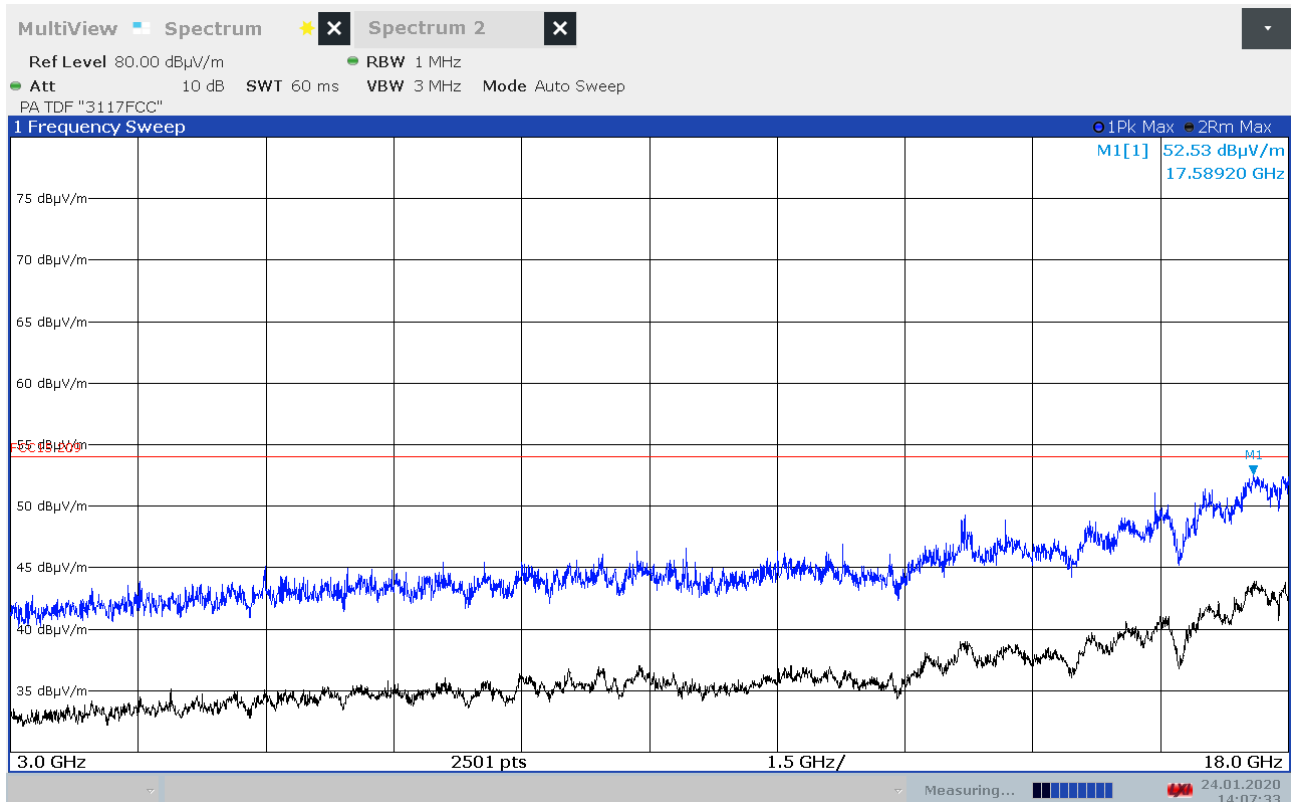
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT V, VP



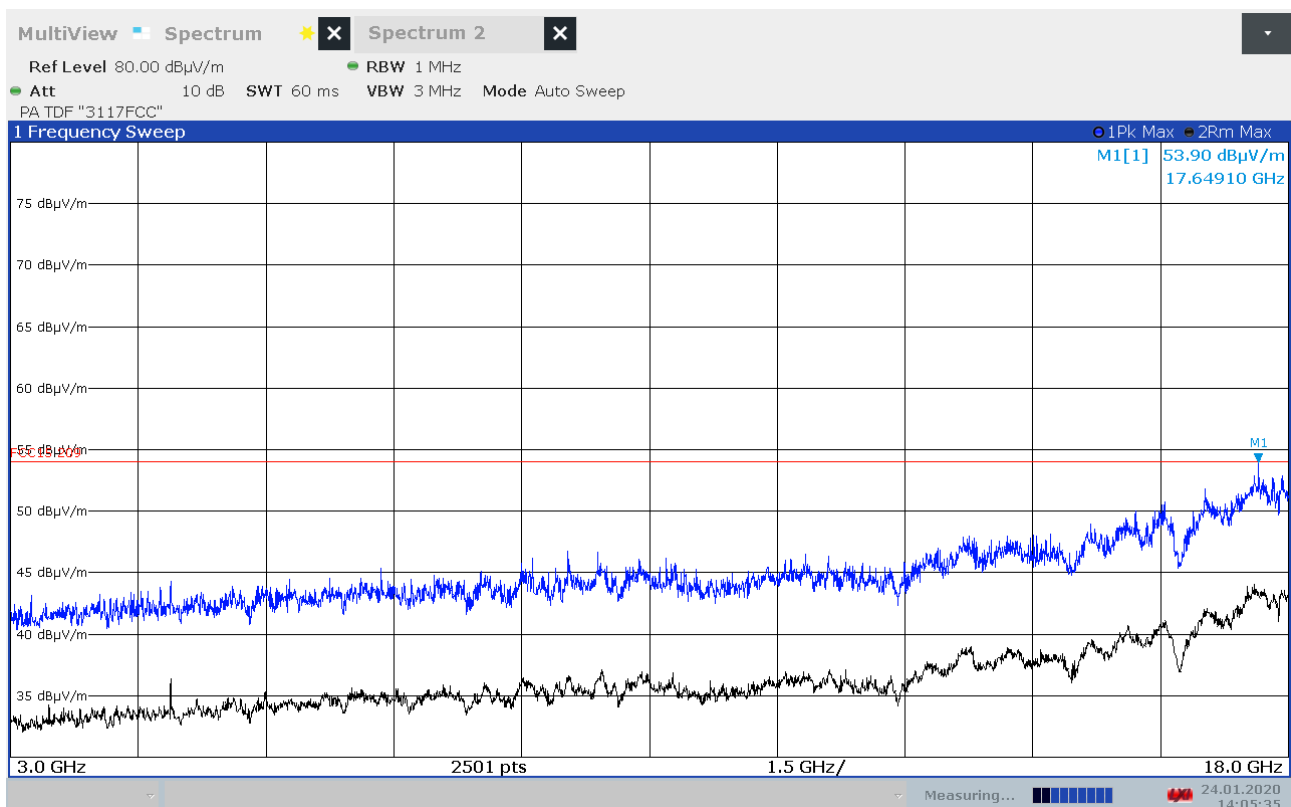
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT H1, HP



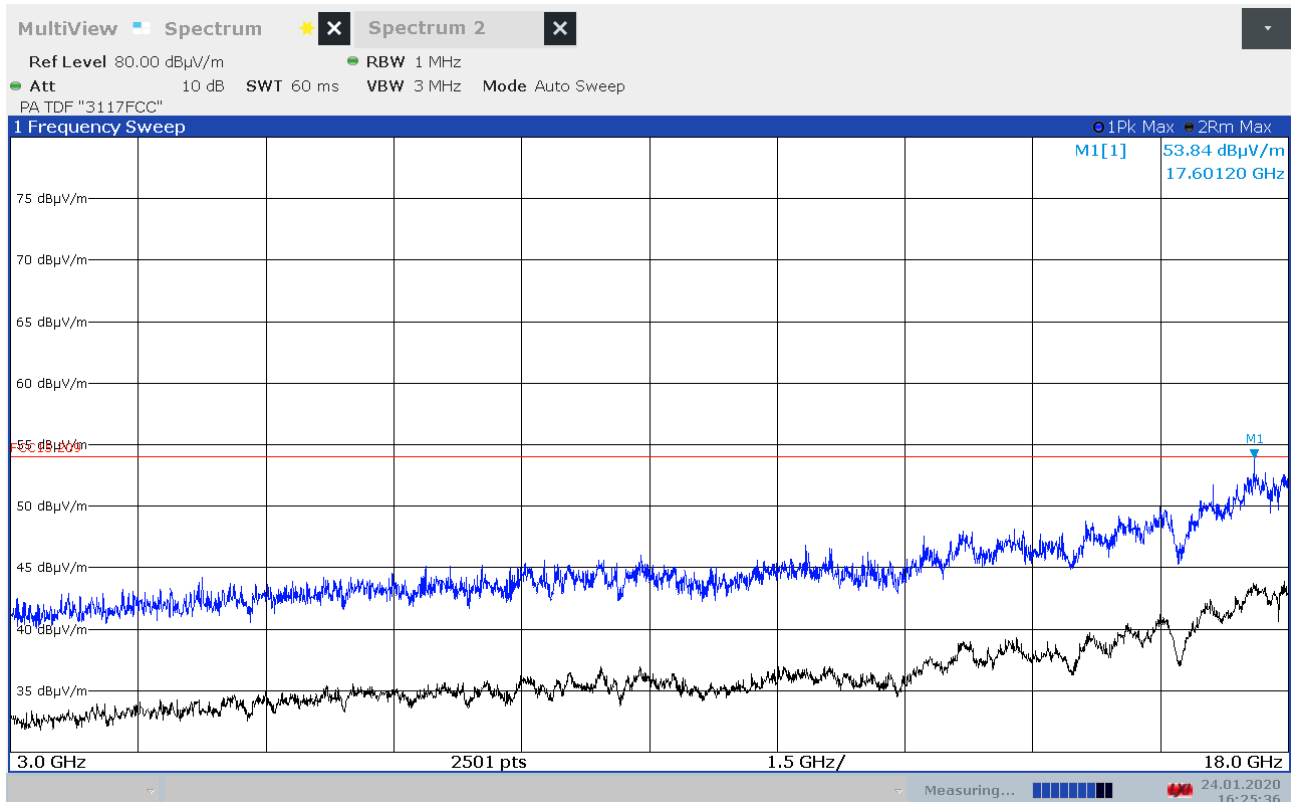
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT H1, VP



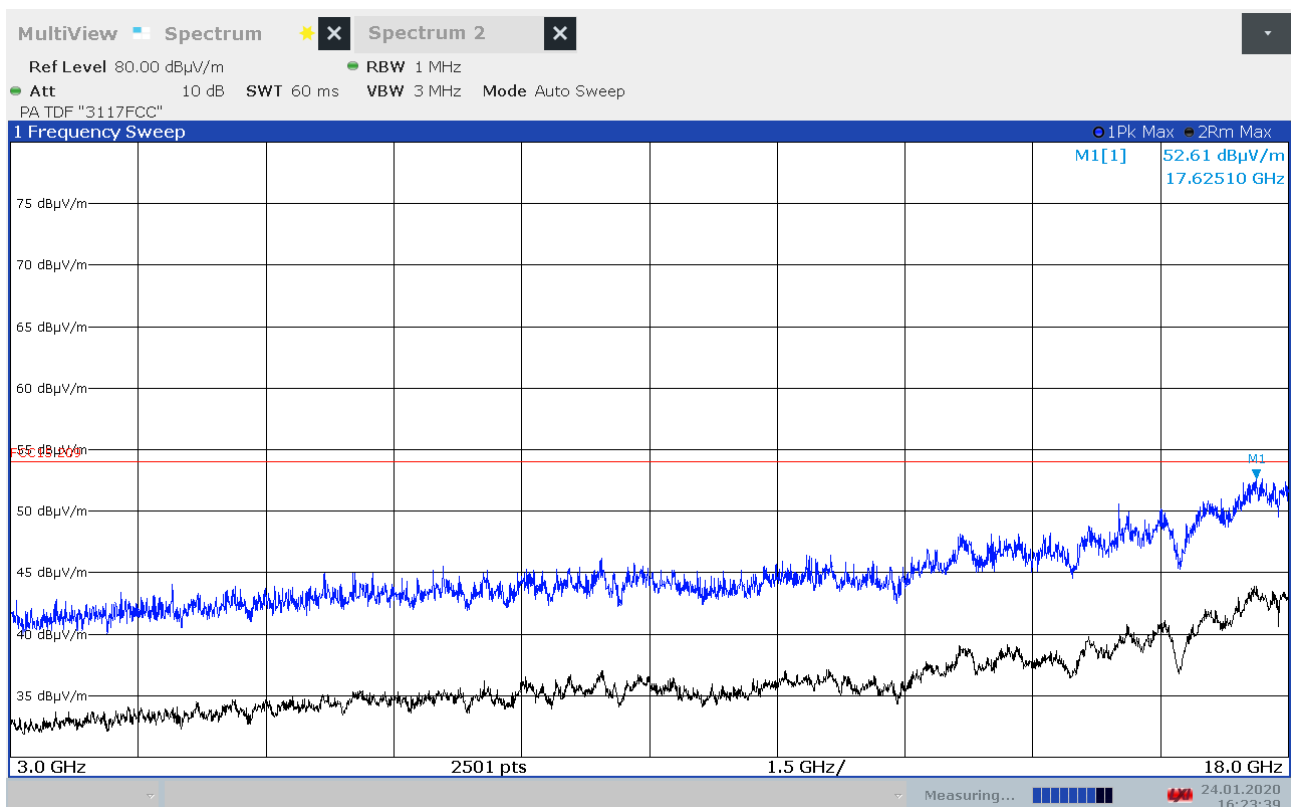
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT H1, HP



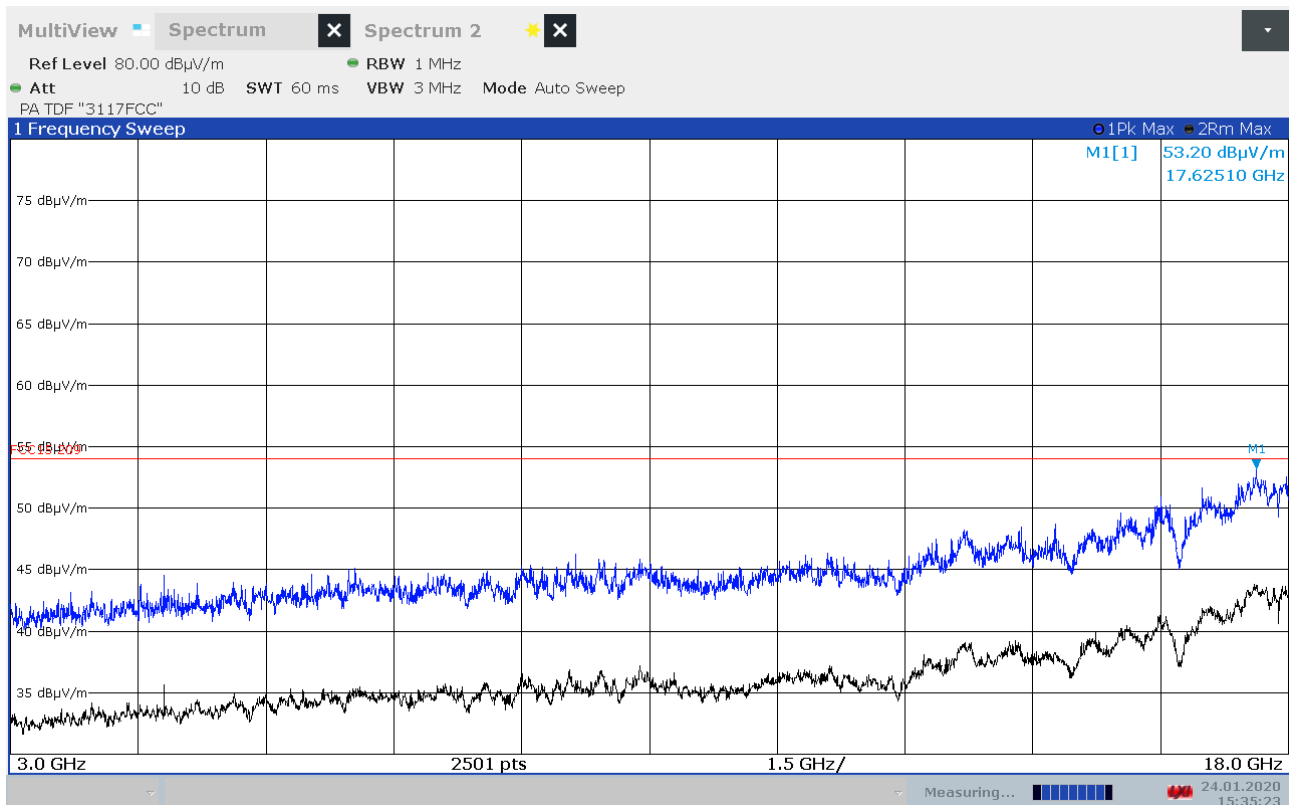
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT H1, VP



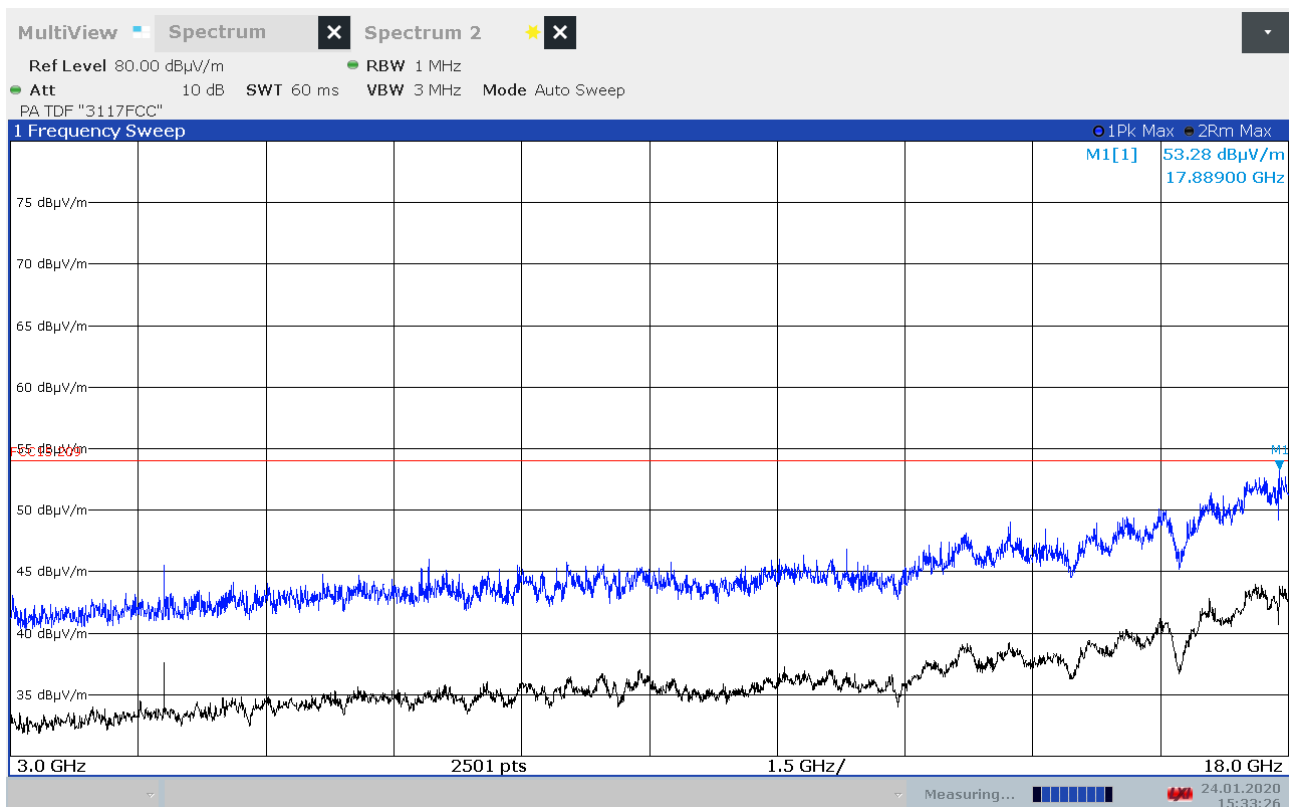
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT H1, HP



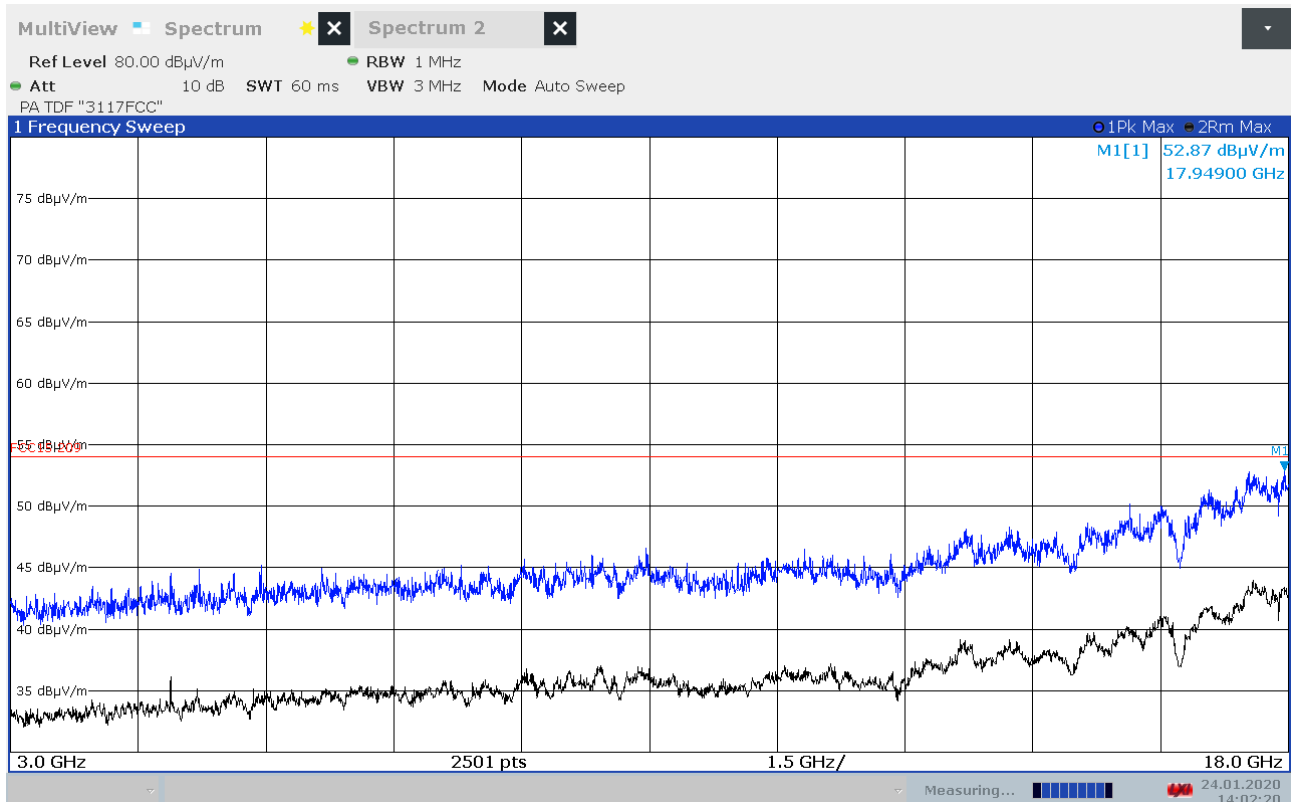
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT H1, VP



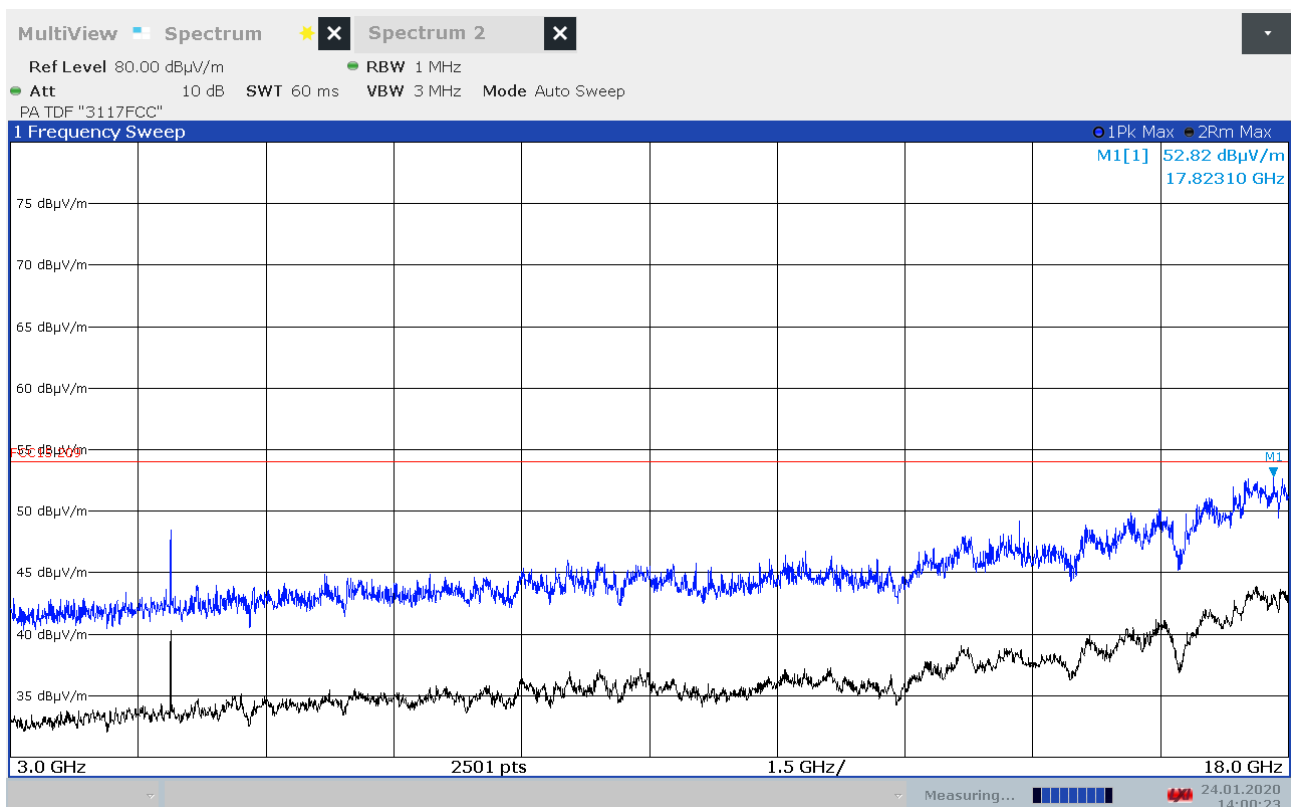
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT H2, HP



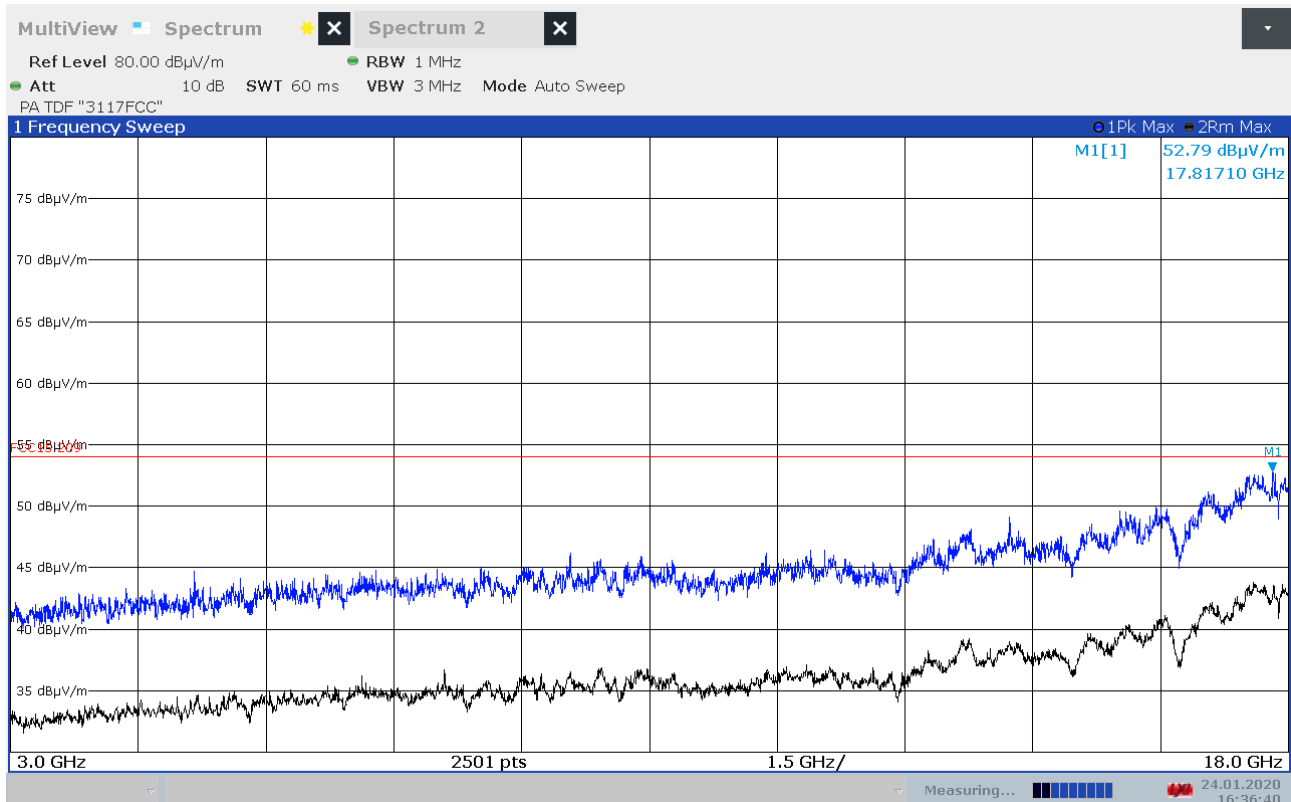
Radiated Emissions, 3000 -18000 MHz, 2402MHz, EUT H2, VP



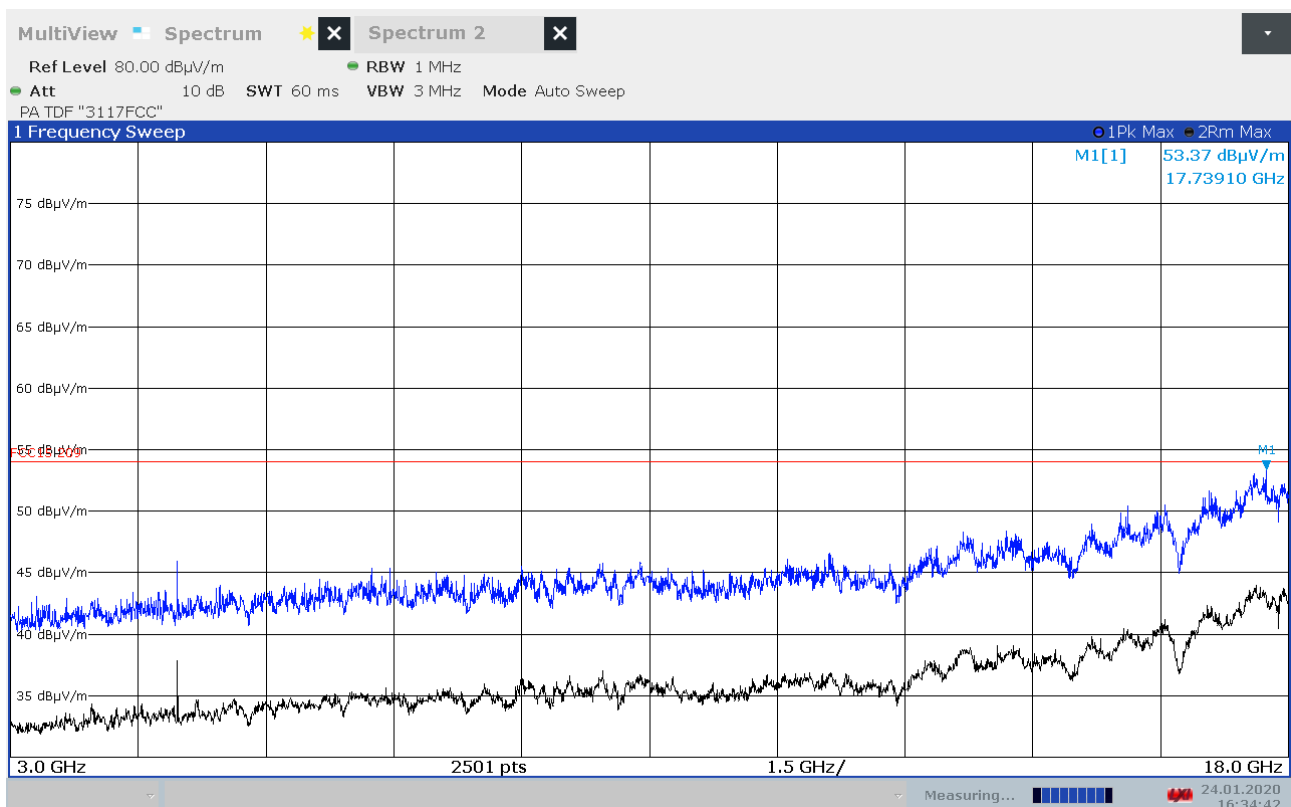
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT H2, HP



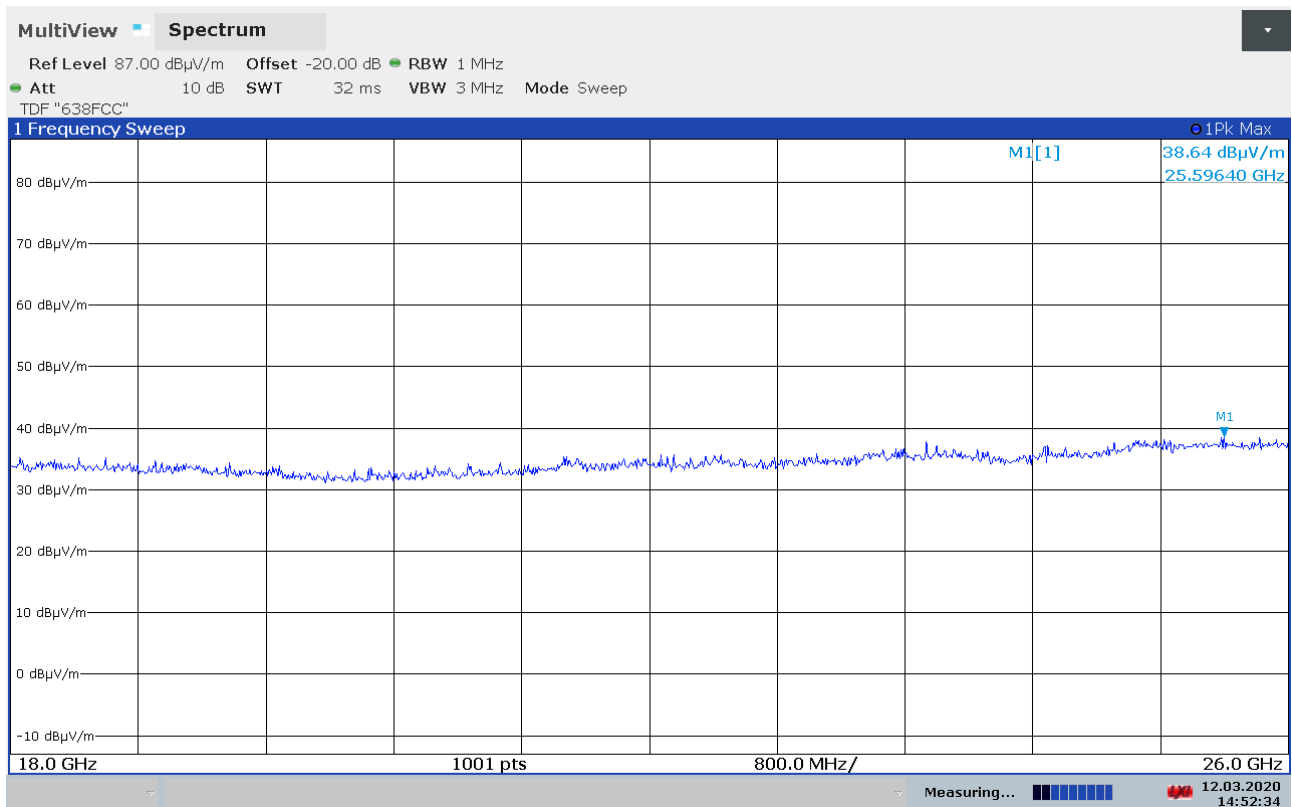
Radiated Emissions, 3000 -18000 MHz, 2440MHz, EUT H2, VP



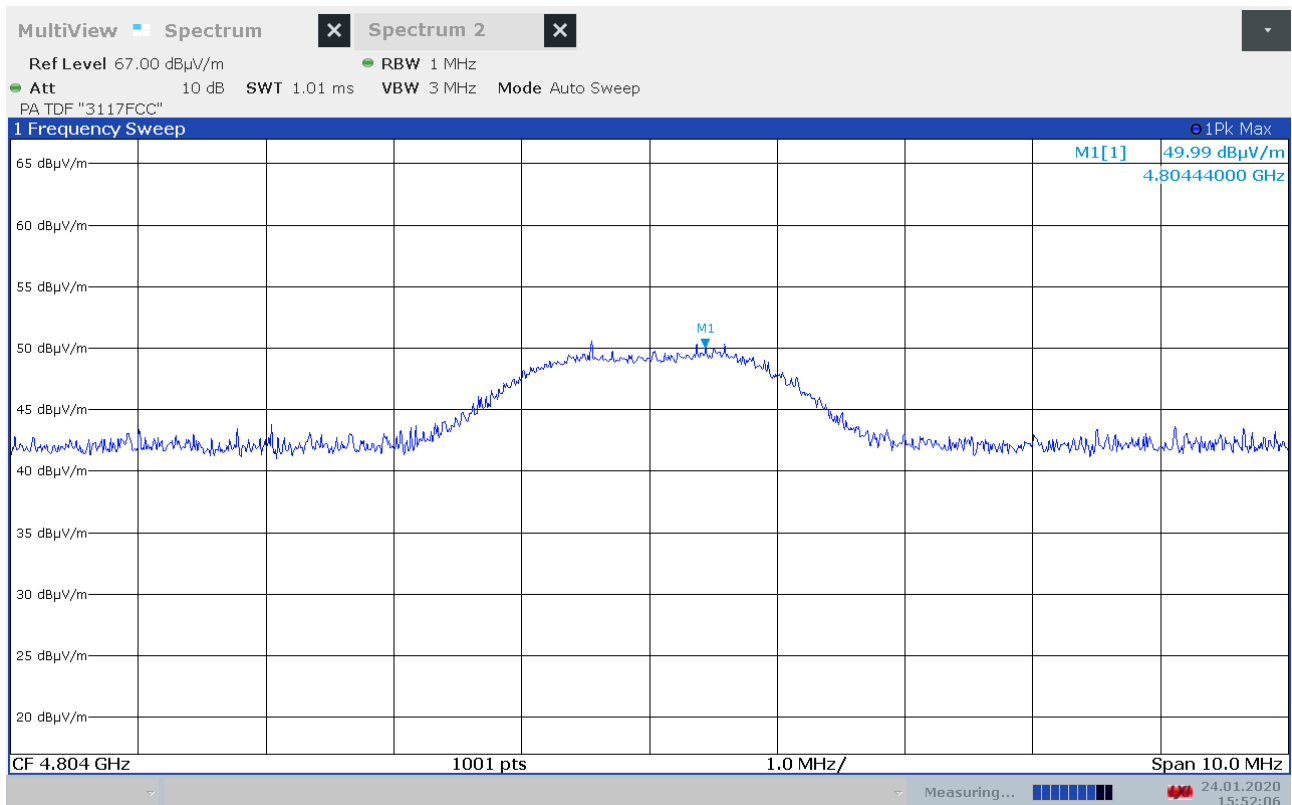
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT H2, HP



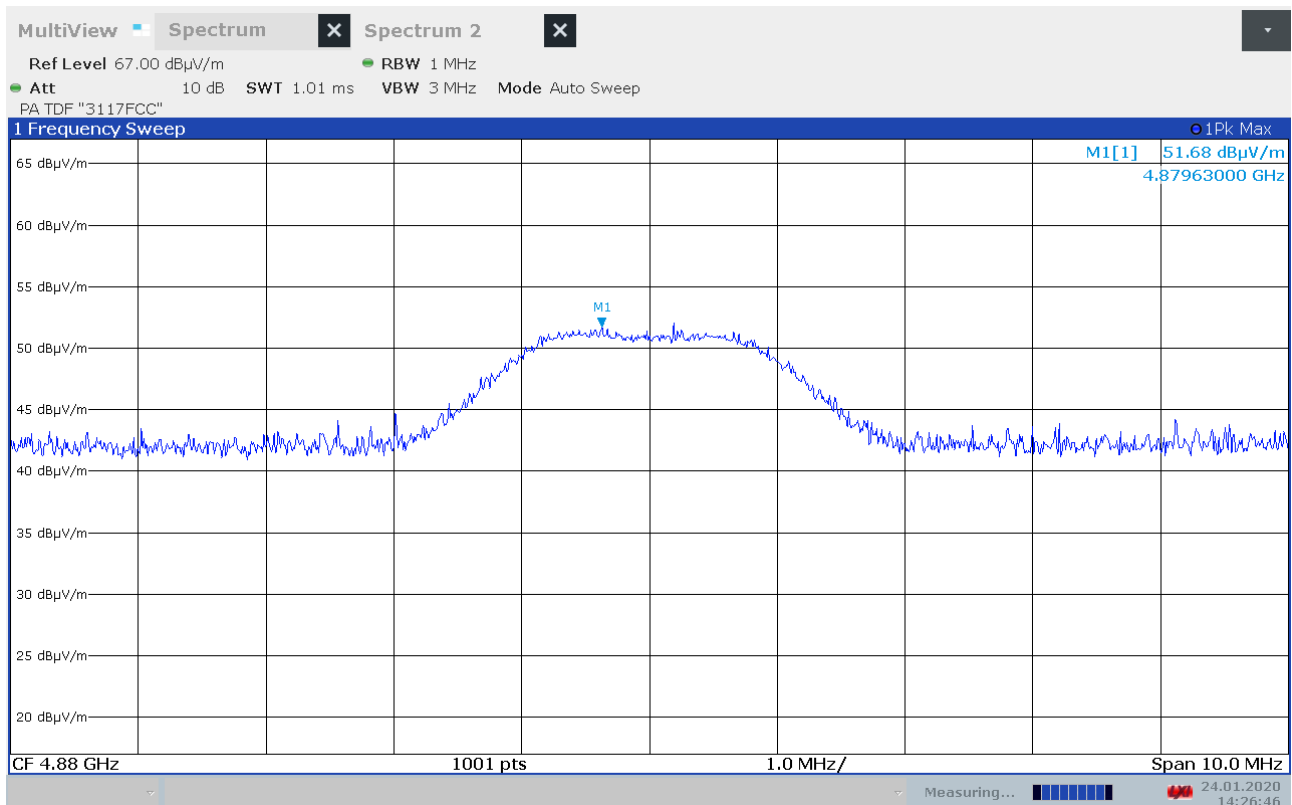
Radiated Emissions, 3000 -18000 MHz, 2480MHz, EUT H2, VP



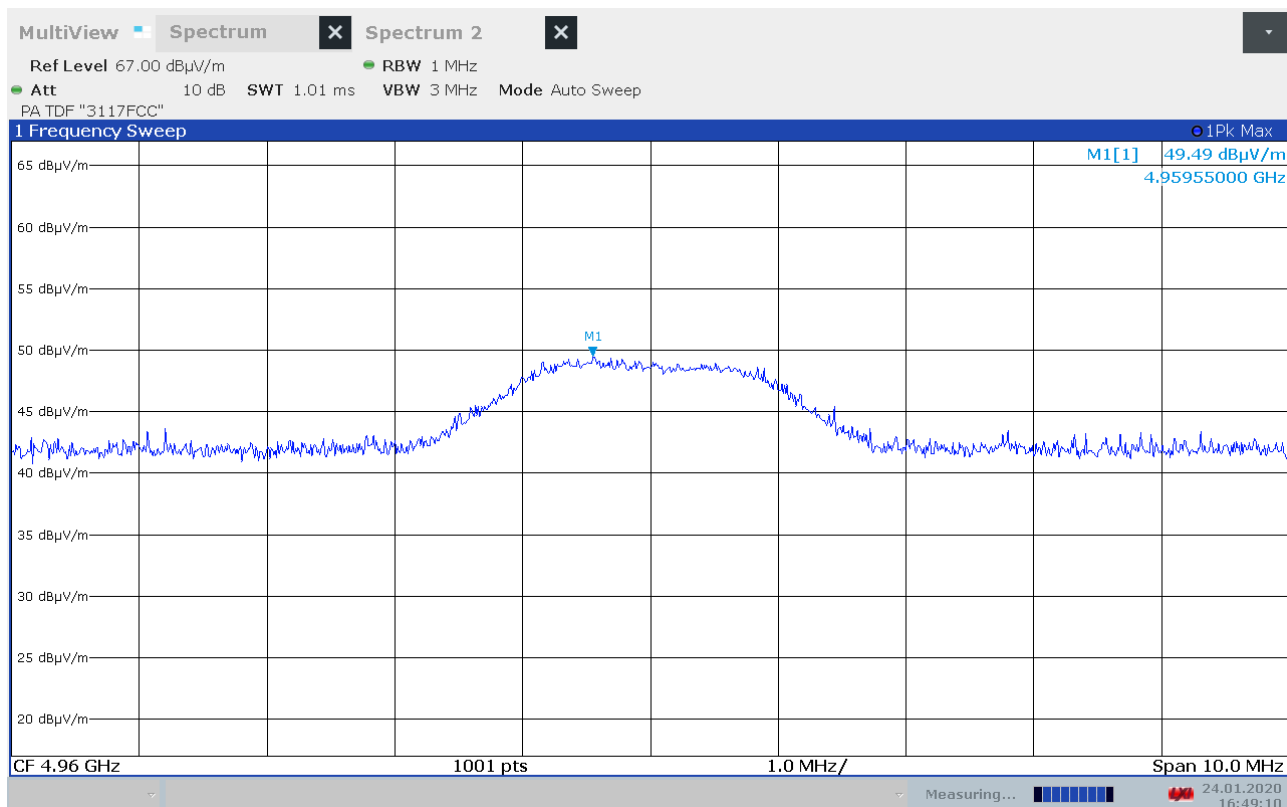
Pre-scan, 18 -26 GHz, 2440MHz @30cm



Radiated Emissions, 4804 MHz, 2402MHz, HP



Radiated Emissions, 4880 MHz, 2440MHz, HP



Radiated Emissions, 4960 MHz, 2480MHz, VP

3.9 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 2, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

Measurement Data:

The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

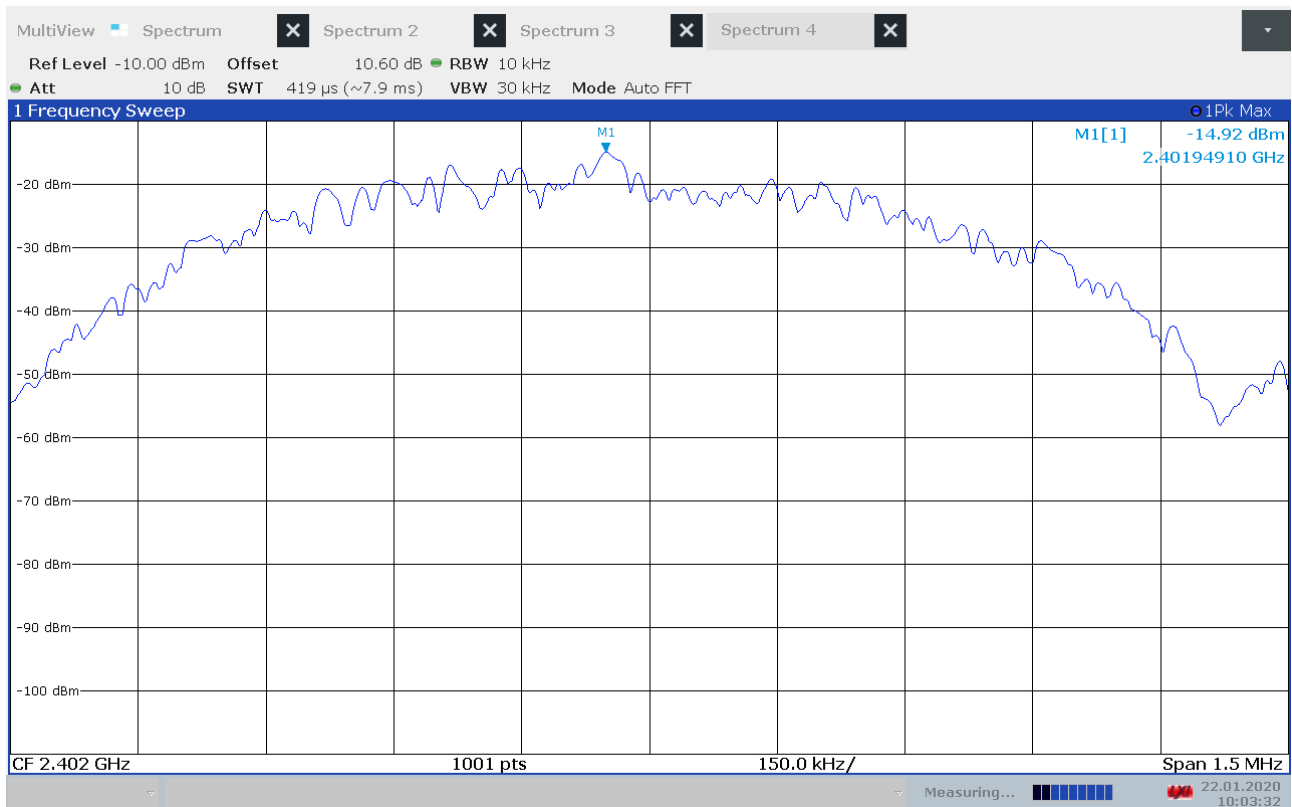
Carrier Frequency	Measured Power Spectral Density (dBm/3kHz)
2402 MHz	-20.1
2440 MHz	-18.6
2480 MHz	-16.2

The measured values with 10kHz RBW are corrected by a Bandwidth Correction Factor of -5.2 dB.

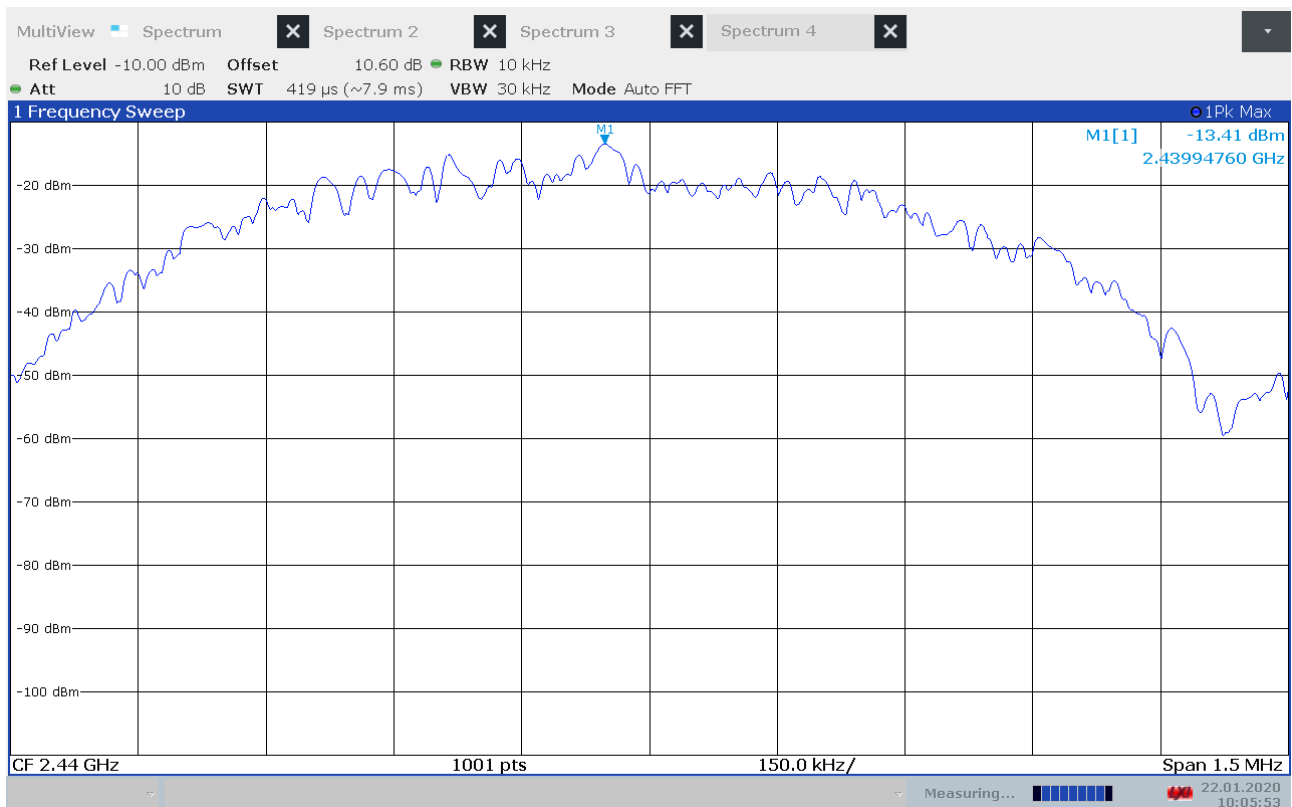
Requirements:

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

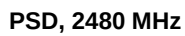
No requirements for Frequency Hopping Systems.



PSD, 2402 MHz



PSD, 2440 MHz



4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2020-01	2021-01
2	6810.17B	Attenuator	Suhner	LR 1669	2019-07	2020-07
3	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	2019-07	2020-07
4	VULB9163	BiLog Antenna	Schwarzbech	LR 1616	2020-01	2023-01
5	Model 317	PreAmplifier	Sonoma	LR 1687	2019-07	2020-07
6	3117-PA	Horn Antenna with PreAmp	EMCO	LR 1717	2017-12	2020-12
7	3115	Horn Antenna	EMCO	LR 1330	2016-10	2021-10
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2019-07	2020-07
9	638	Antenna Horn	Narda	LR 1480	2010-06	2020-06
10	ST 8/SMAm/Nm/36	RF Cable	Suhner	LR 1630	COU	

The software listed below has been used for one or more tests.

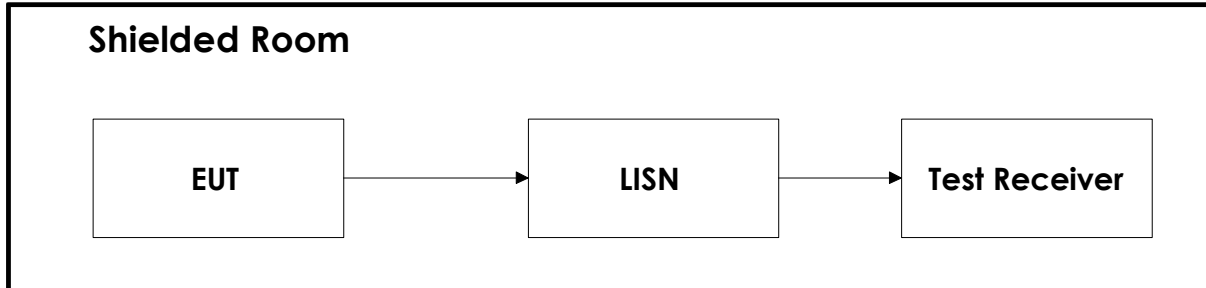
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	Radiated Emissions test software
2	Rohde & Schwarz	GPBShot	2.7	Screenshots from R&S Spectrum Analyzers

Revision history

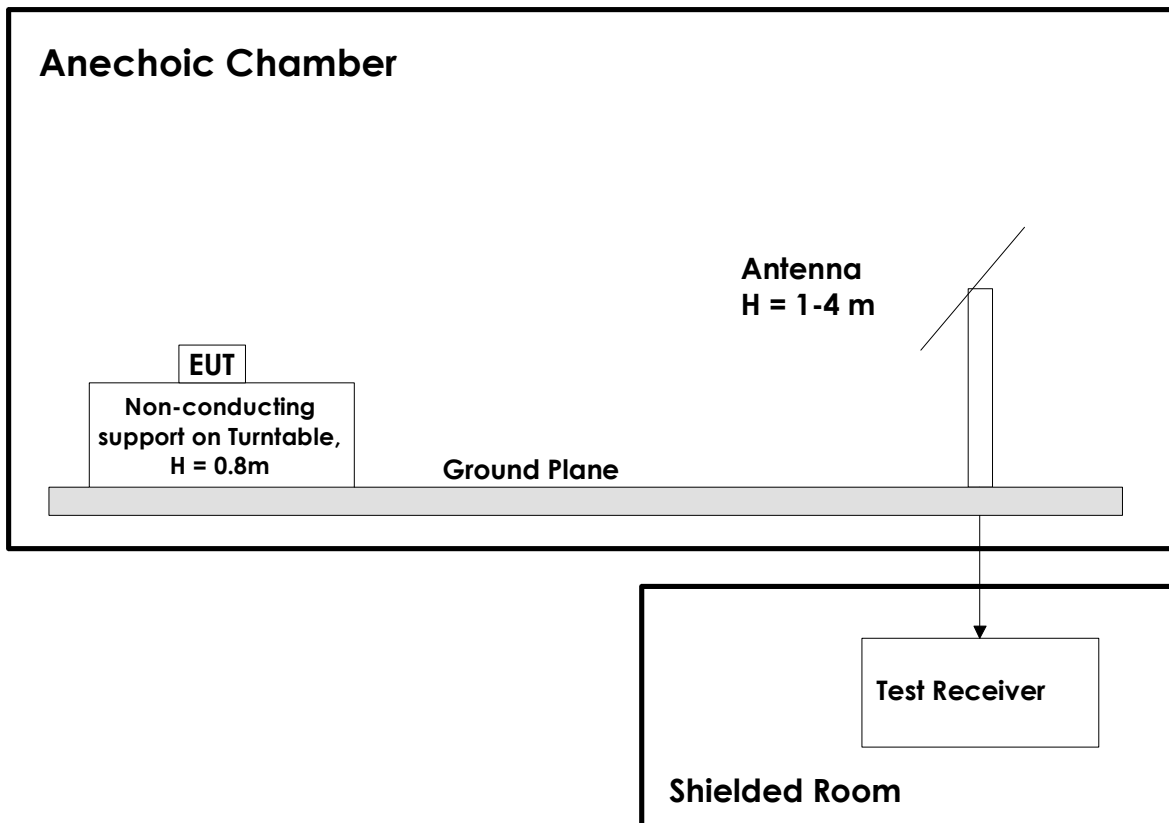
Revision	Date	Comment	Sign
00	2020-04-28	First edition	FS

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.