Report No. **376453-04-R00**

Test Report

Product	Wireless Sensor with Bluetooth Low Energy Processor Module
Name and address of the applicant	ABB AS Ole Deviks vei 10 NO-0666 Oslo, NORWAY
Name and address of the manufacturer	ABB AS Ole Deviks vei 10 NO-0666 Oslo, NORWAY
Model	PM001
Rating	3.7V_{DC} (Primary Battery, Lithium)
Trademark	ABB Ability Smart Sensor
Serial number	4JN0 23R3 G424
Additional information	Bluetooth LE 5.0
Tested according to	**FCC Part 15.247** 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	376453
Tested in period	2019-11-22 to 2019-11-26
Issue date	2020-01-16
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]

Template version: C

CONTENTS

1 INFORMATION

1.1 Test Item

Name	ABB Ability Smart Sensor
FCC ID	2ANYT-SSPM001AA
ISED ID	23238-SSPM001AA
Model/version	PM001
Serial number	4JN0 23R3 G424
Hardware identity and/or version	A
Software identity and/or version	5.0-4 (Version used during testing)
Frequency Range	2402 – 2480 MHz
Number of Channels	40
Operating Modes	BT Low Energy 5.0
Type of Modulation	GFSK
Rated Output Power	0.0023 W
Type of Power Supply	Primary Battery (3.7V Lithium)
Antenna Connector	None (Internal U-FL connector on PCB)
Number of Antennas	1

Description of Test Item

The EUT is a Bluetooth Low Energy 5.0 Processor Module in a Wireless Sensor.

1.2 Normal test condition

Temperature:	20 - 23 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3.7 V DC (Nominal Battery Voltage)

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen

1.4 Description of modification for Modification Filing

Not applicable.

1.5 Family List Rational

Not Applicable.

1.6 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

1.7 Worst-Case Configuration and Mode

All tests were performed with BT LE Long Range and 2Mb Mode.

1.8 Comments

All measurements were performed with the EUT powered by a new battery.

2 TEST REPORT SUMMARY

2.1 General

All measurements are tracable 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 and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m and 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”.

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

Revision history

Revision	Date	Comment	Sign
00	2020-01-16	First edition	FS

3 TEST RESULTS

3.1 Occupied Bandwidth (99% BW)

FCC Part 15.247 (a)(1)(iii)

ISED Canada RSS-247 Issue 2, Clause 5.1

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:

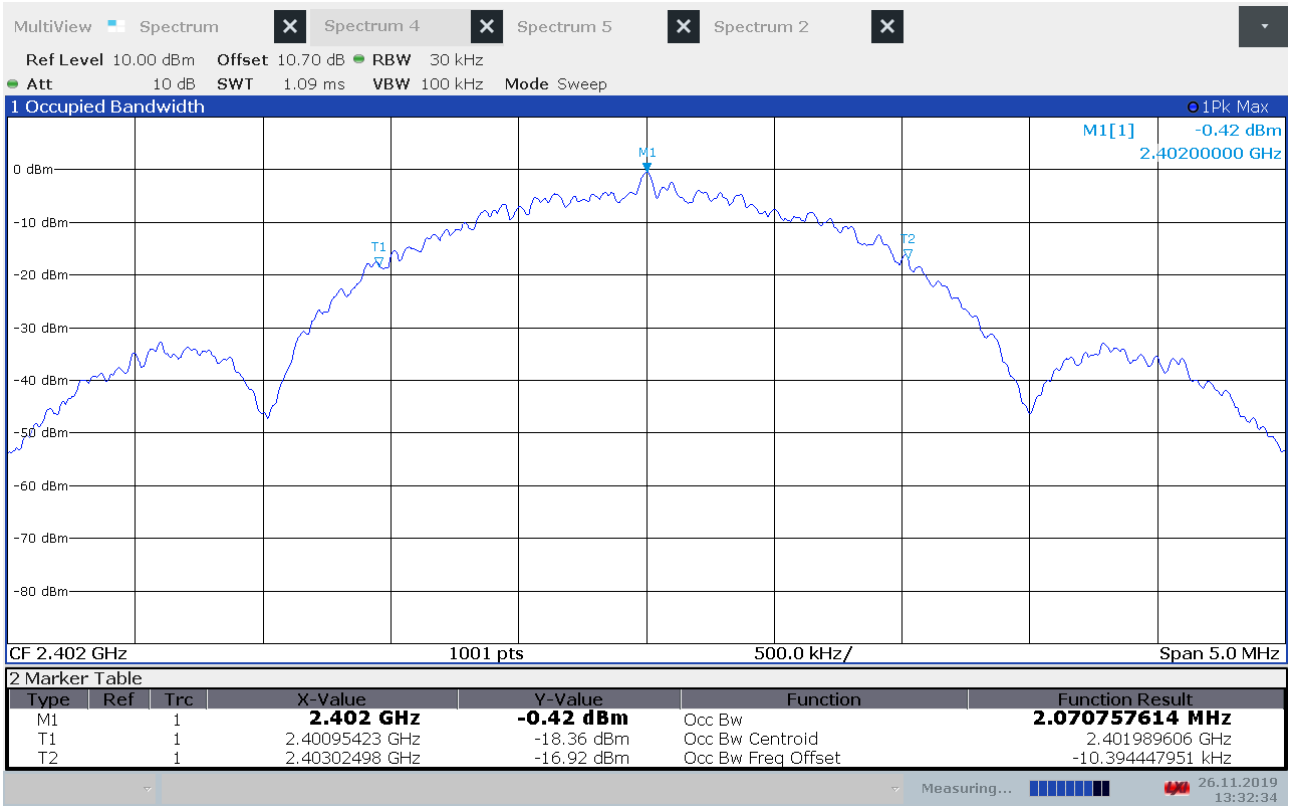
Carrier Frequency	Occupied Bandwidth (99% BW)	
	BT LE Long Range	BT LE 2Mbit
2402 MHz	1.07 MHz	2.07 MHz
2440 MHz	1.08 MHz	2.05 MHz
2480 MHz	1.08 MHz	2.06 MHz

See attached plots.

Requirements:

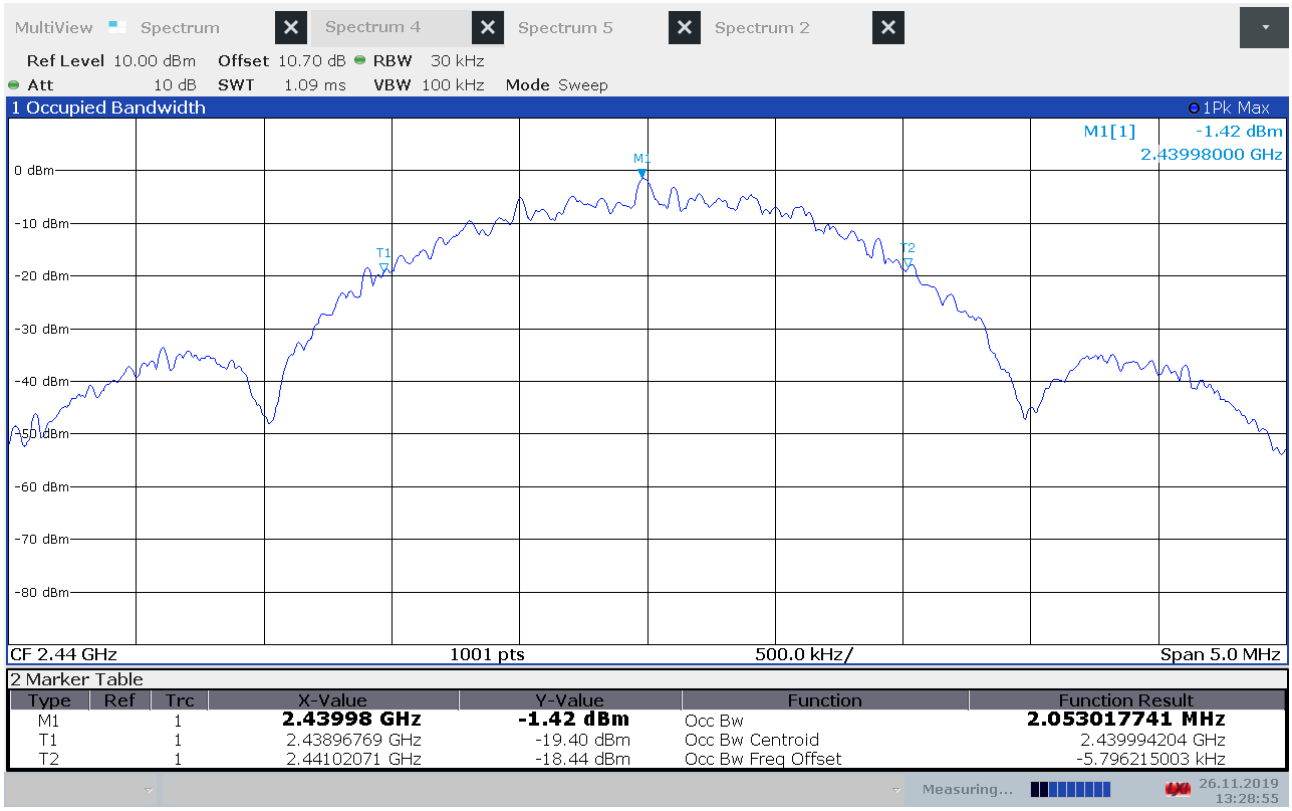
No requirement for 99% BW, reported for information only.

99% Bandwidth, 2402 MHz, BT LE Long Range



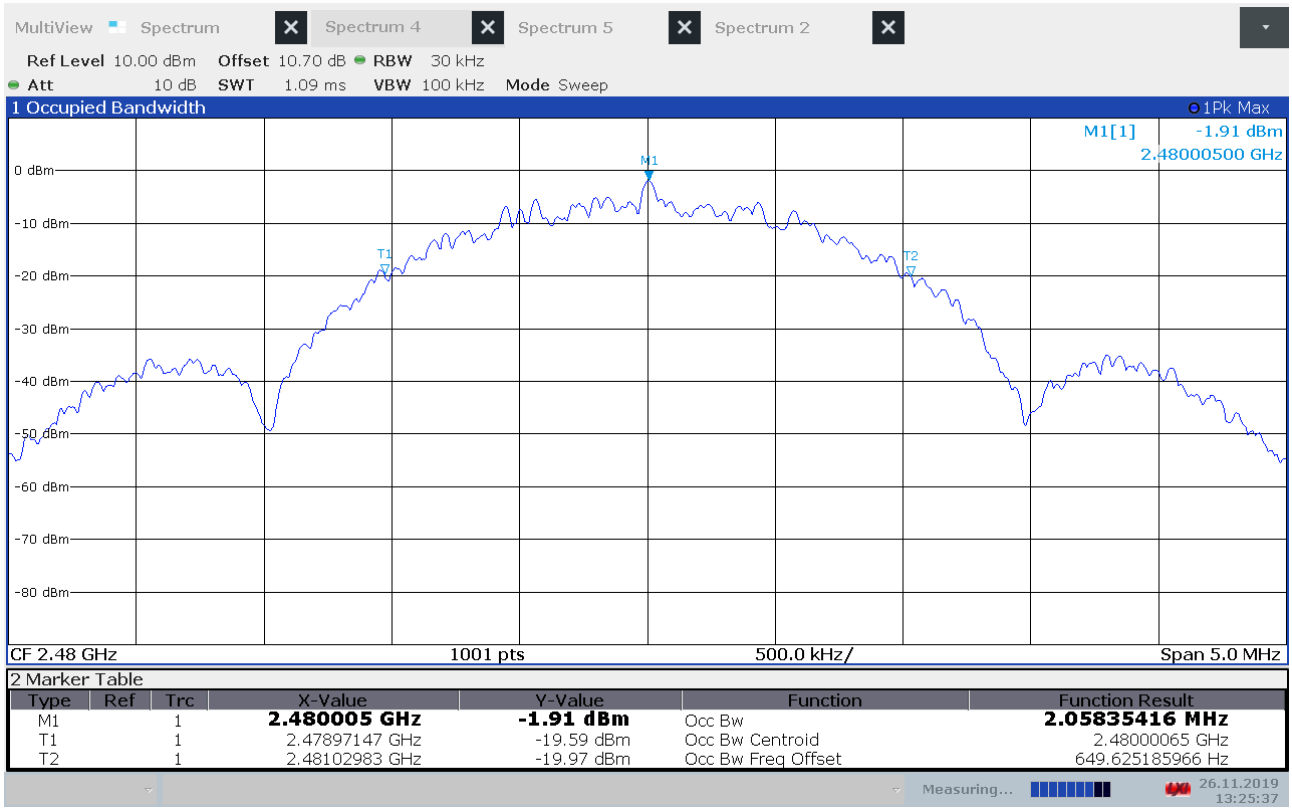
99% Bandwidth, 2402 MHz, BT LE 2Mbit

99% Bandwidth, 2440 MHz, BT LE Long Range



99% Bandwidth, 2440 MHz, BT LE 2Mbit

99% Bandwidth, 2480 MHz, BT LE Long Range



99% Bandwidth, 2480 MHz, BT LE 2Mbit

3.2 DTS Bandwidth (6dB BW)

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**

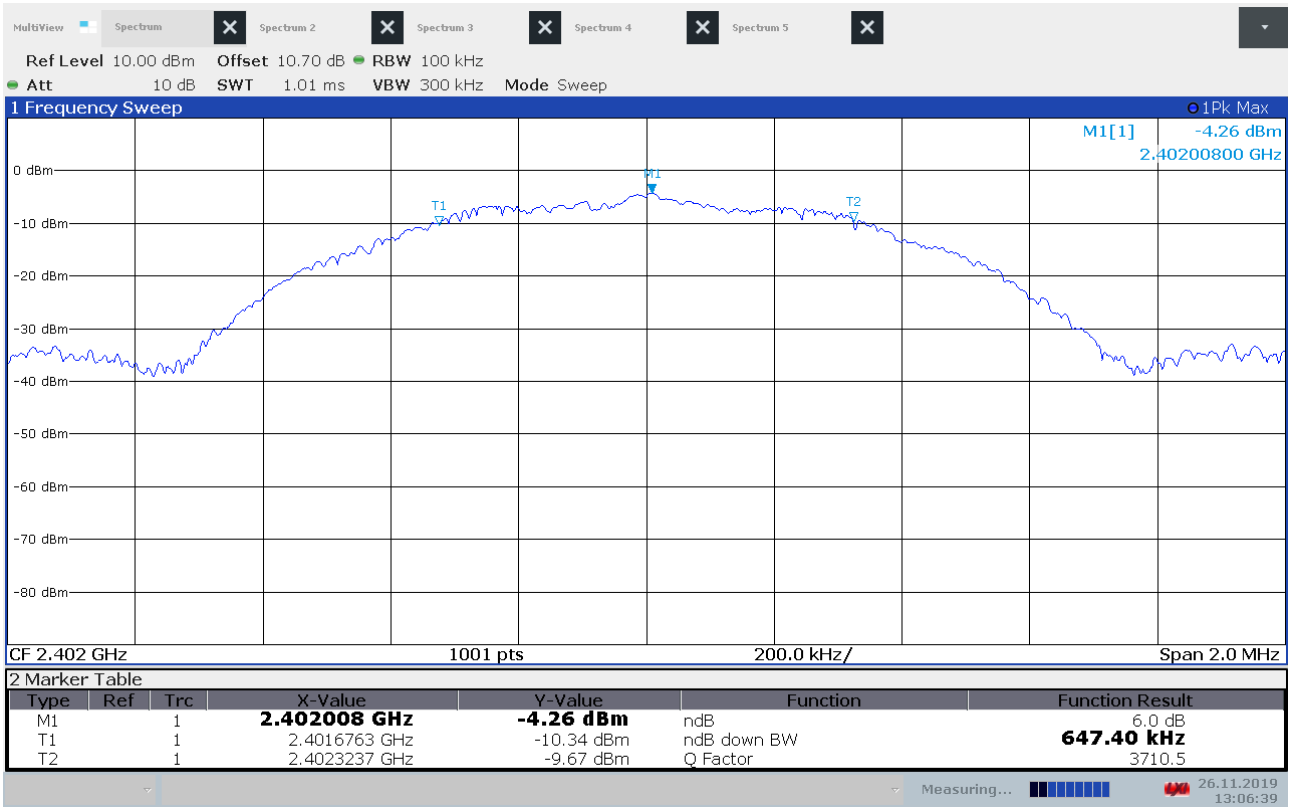
Measurement Data:

Carrier Frequency	DTS Bandwidth (6dB BW)	
	BT LE Long Range	BT LE 2Mbit
2402 MHz	647 kHz	1.12 MHz
2440 MHz	619 kHz	1.14 MHz
2480 MHz	619 kHz	1.21 MHz

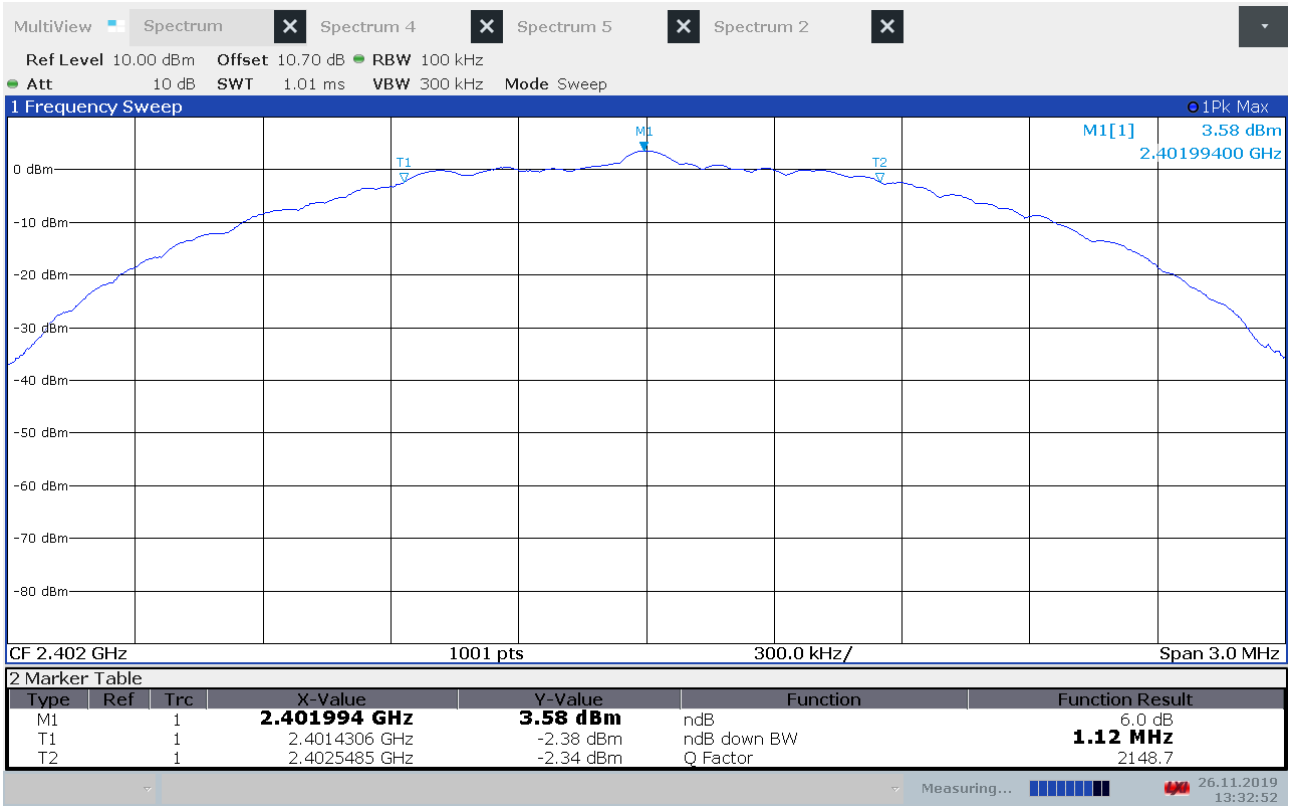
Requirements:

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

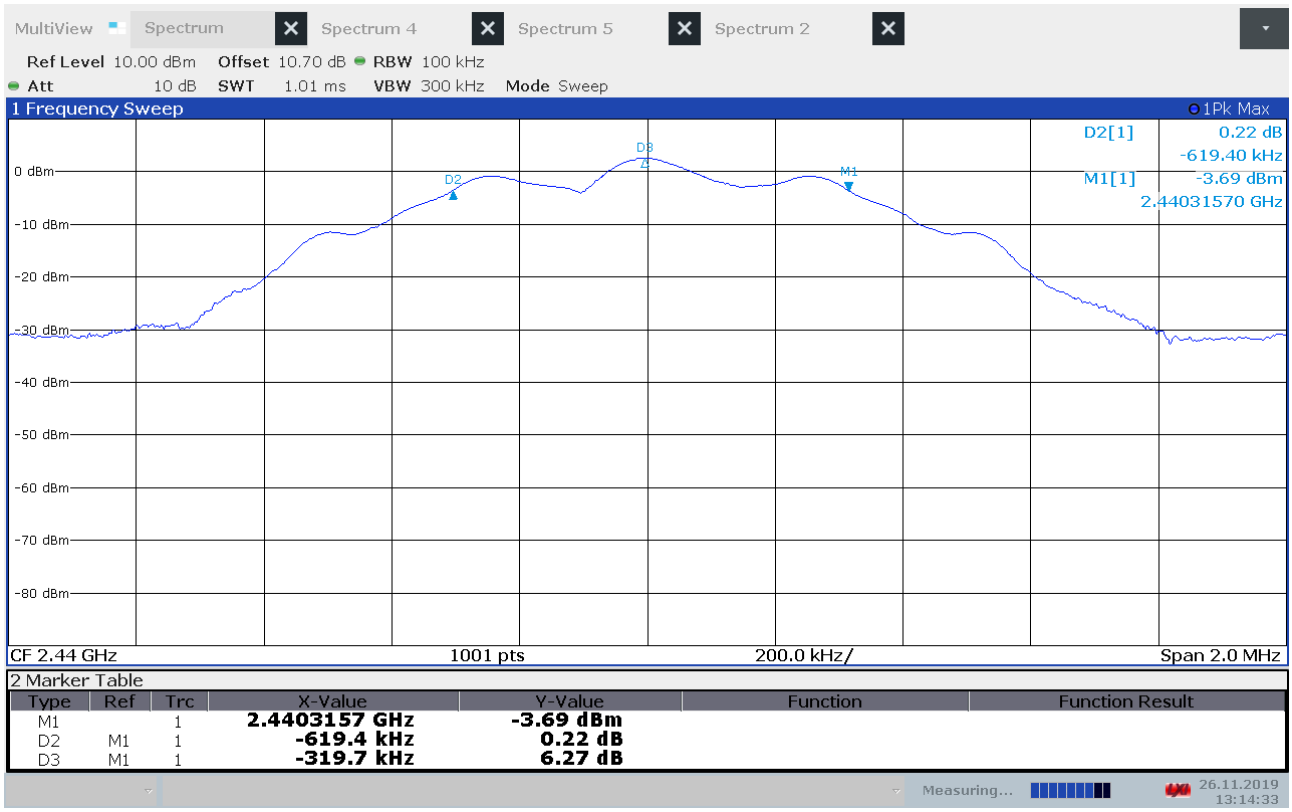
No requirements for Frequency Hopping Systems.



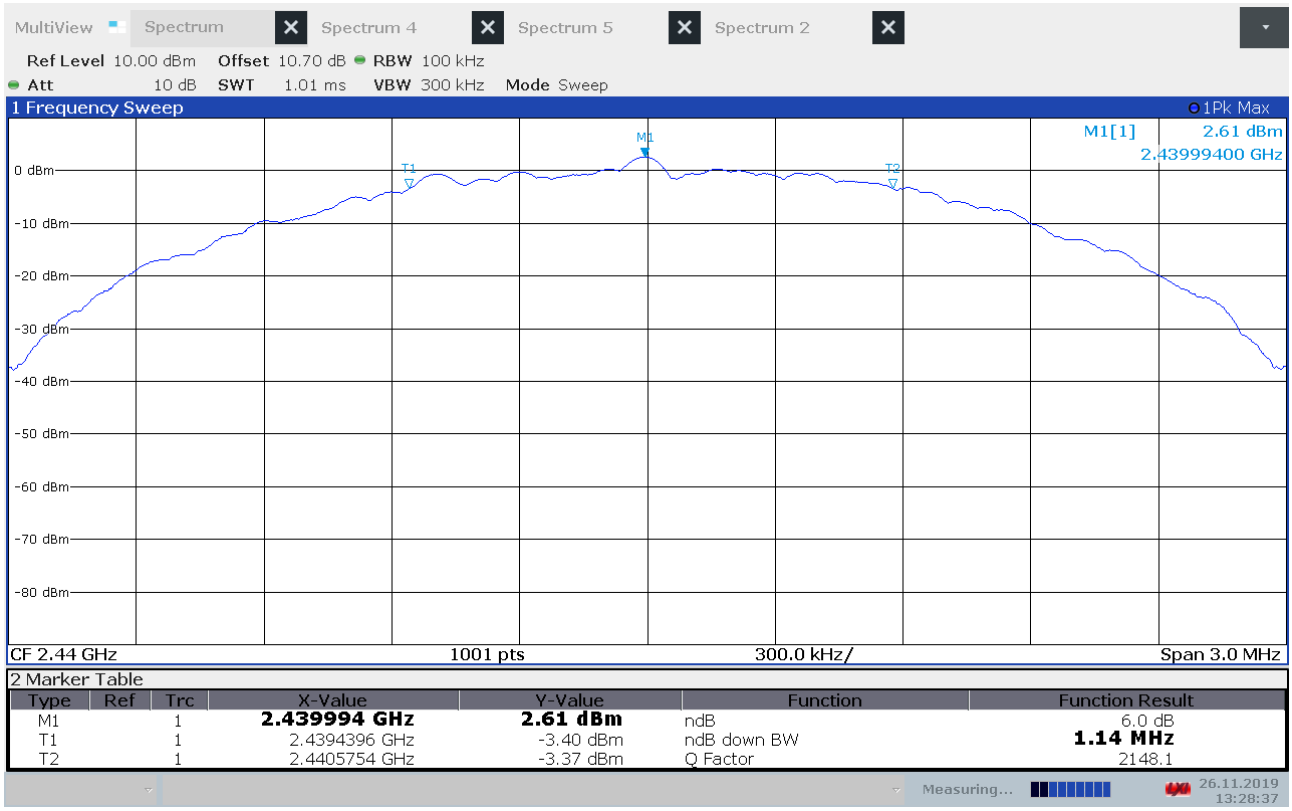
DTS Bandwidth, 2402 MHz, BT LE Long Range



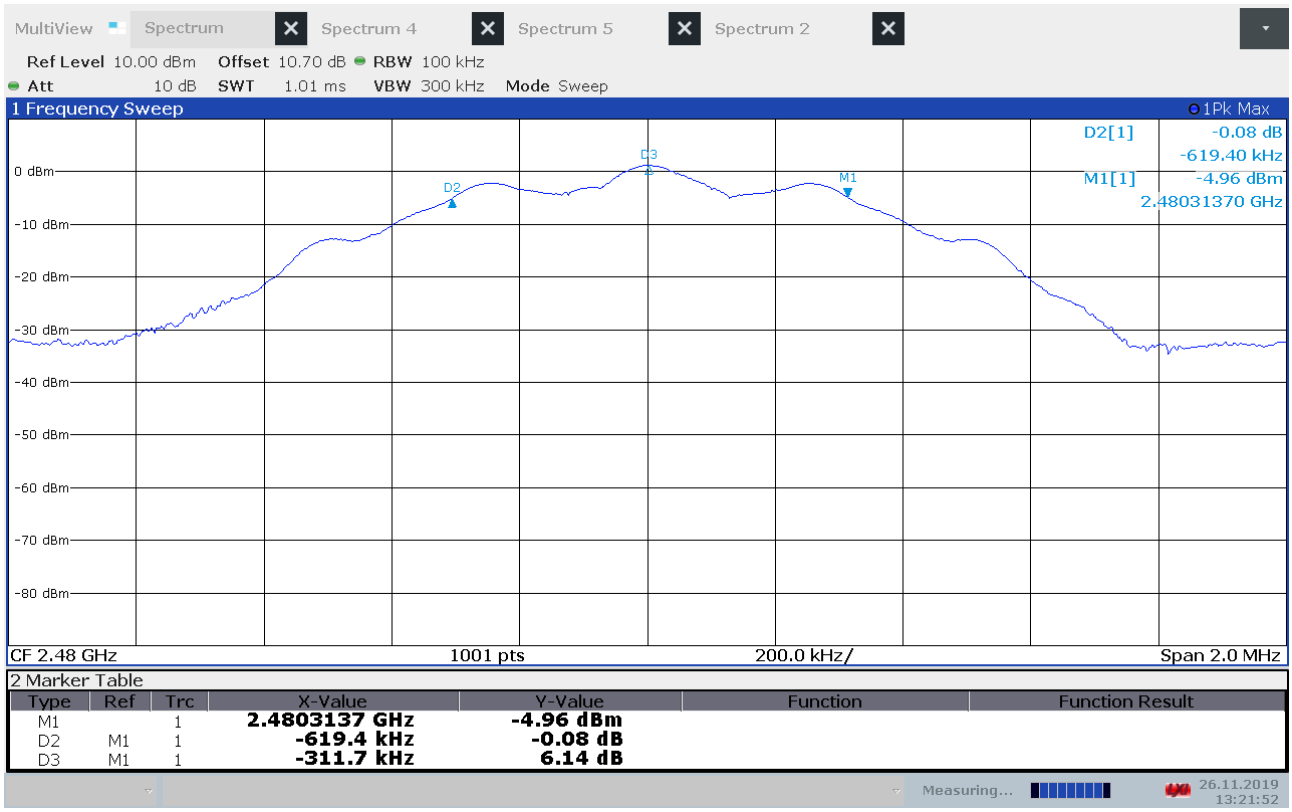
DTS Bandwidth, 2402 MHz, BT LE 2Mbit



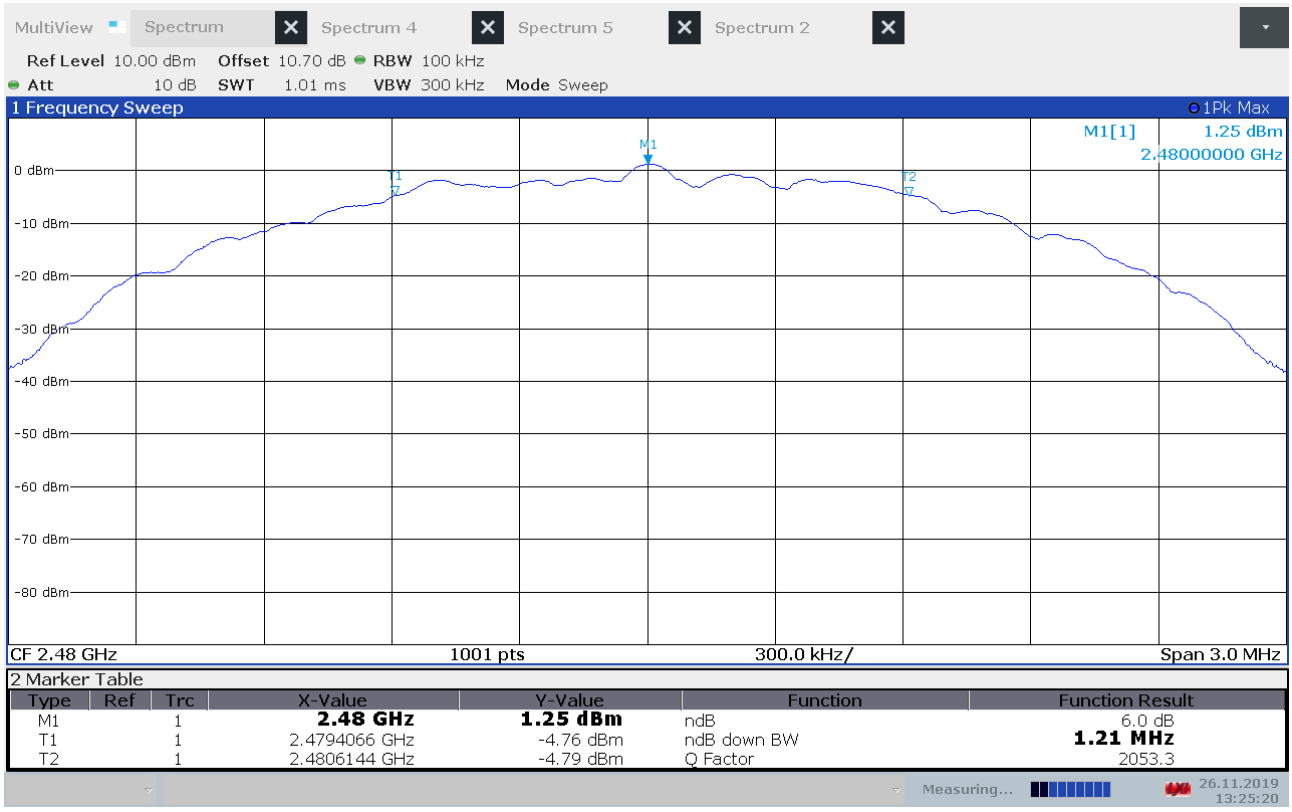
DTS Bandwidth, 2440 MHz, BT LE Long Range



DTS Bandwidth, 2440 MHz, BT LE 2Mbit



DTS Bandwidth, 2480 MHz, BT LE Long Range



DTS Bandwidth, 2480 MHz, BT LE 2Mbit

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:

Operating Mode	Carrier Freq	Conducted Peak Power (dBm)	Conducted Peak Power (mW)	Field Strength (dBµV/m)	Calculated EIRP (dBm)	Calculated Antenna Gain (dBi)
BT LE LR	2402 MHz	3.69	2.34	99.7	4.46	0.8
	2440 MHz	2.74	1.88	101.0	5.75	3.0
	2480 MHz	1.33	1.36	99.4	4.20	2.9
BT LE 2Mb	2402 MHz	3.70	2.34	99.8	4.54	0.8
	2440 MHz	2.72	1.87	98.5	3.25	0.5
	2480 MHz	1.36	1.37	99.5	4.30	2.9

Output Power reported is Maximum Peak Power.

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

Antenna Gain is less than 6 dBi.

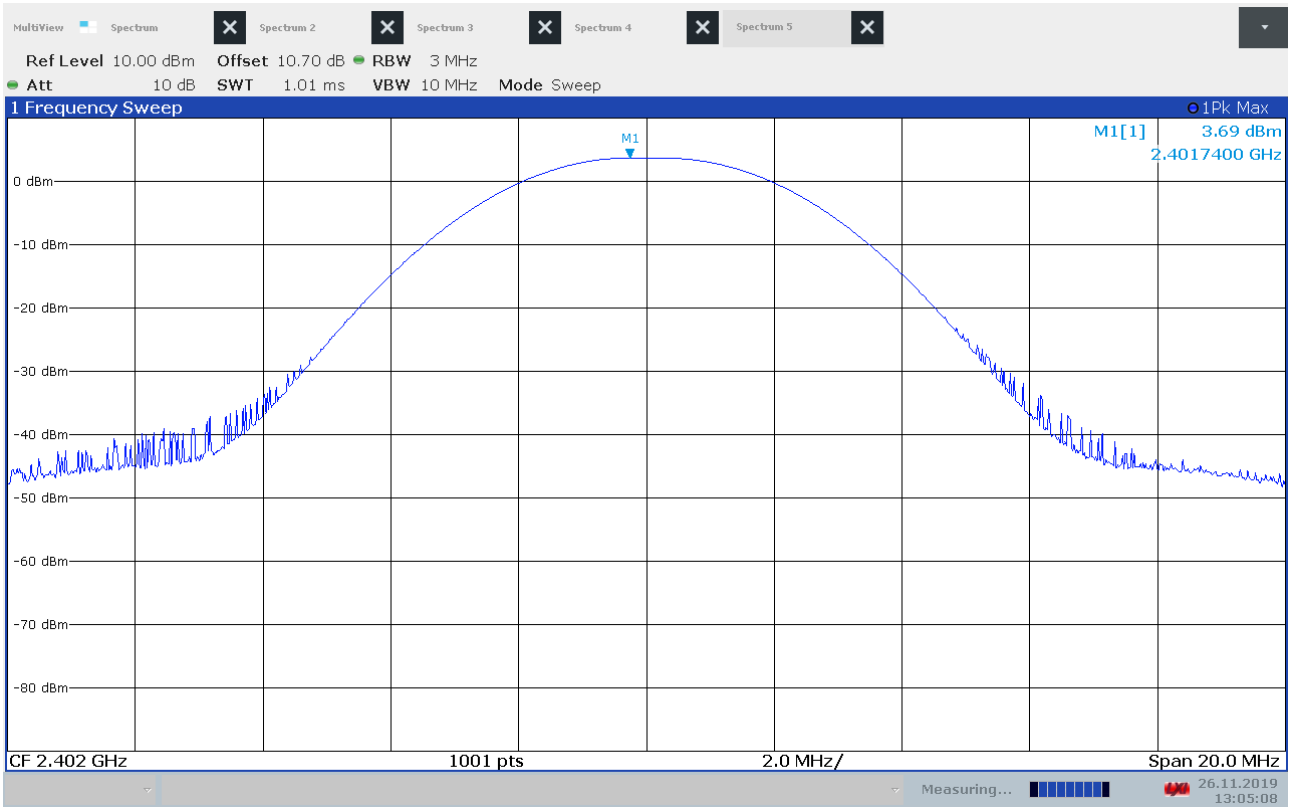
See attached plots.

Requirements:

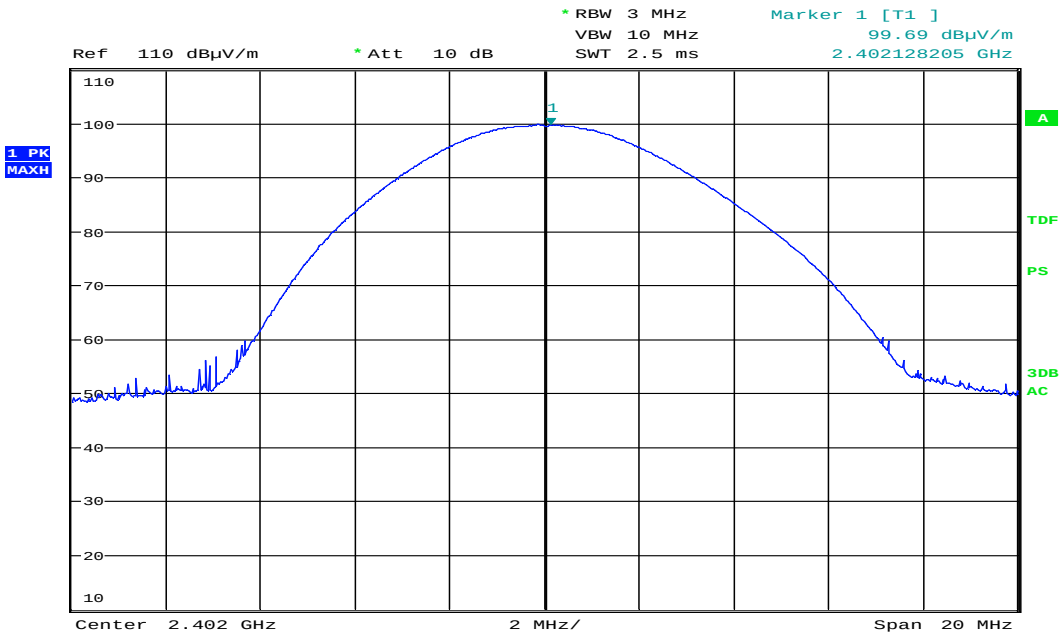
The maximum peak output power shall not exceed the following limits:

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.

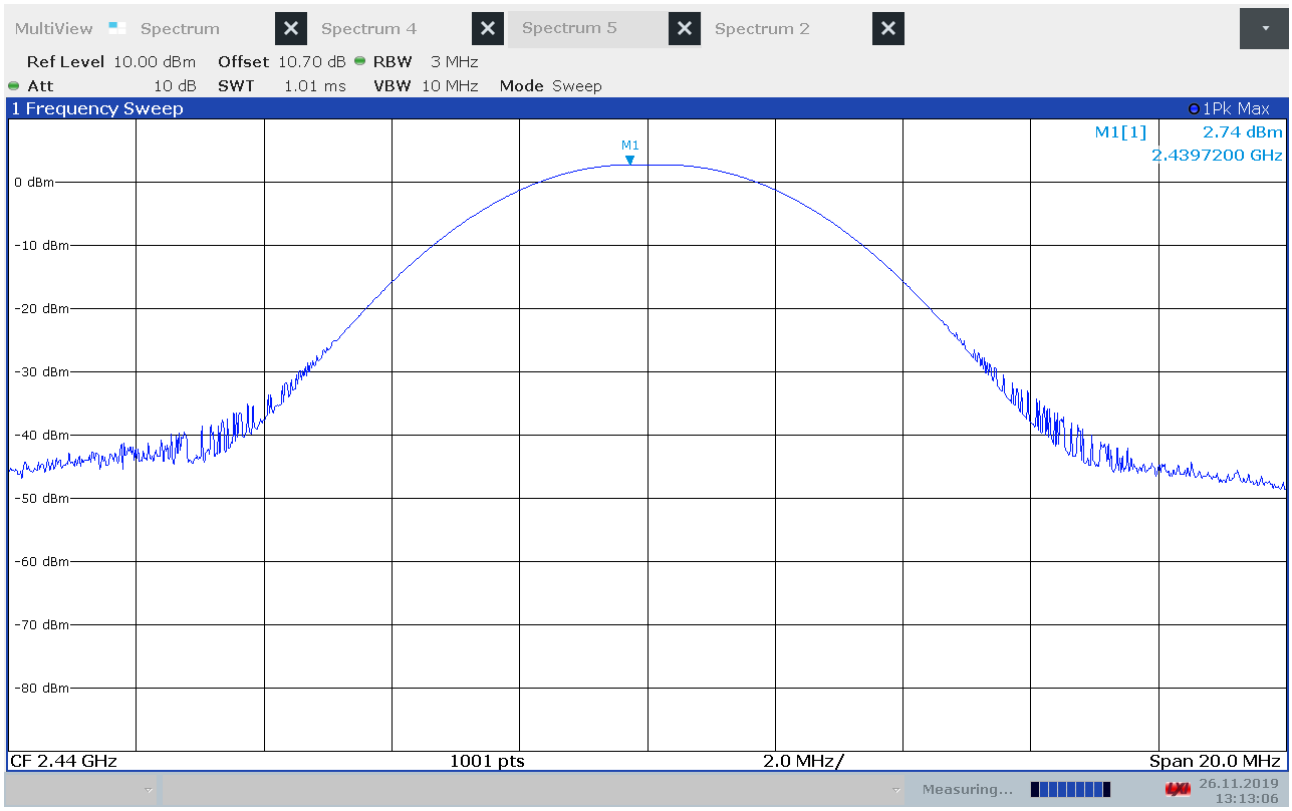


Conducted Power, 2402 MHz, BT LR

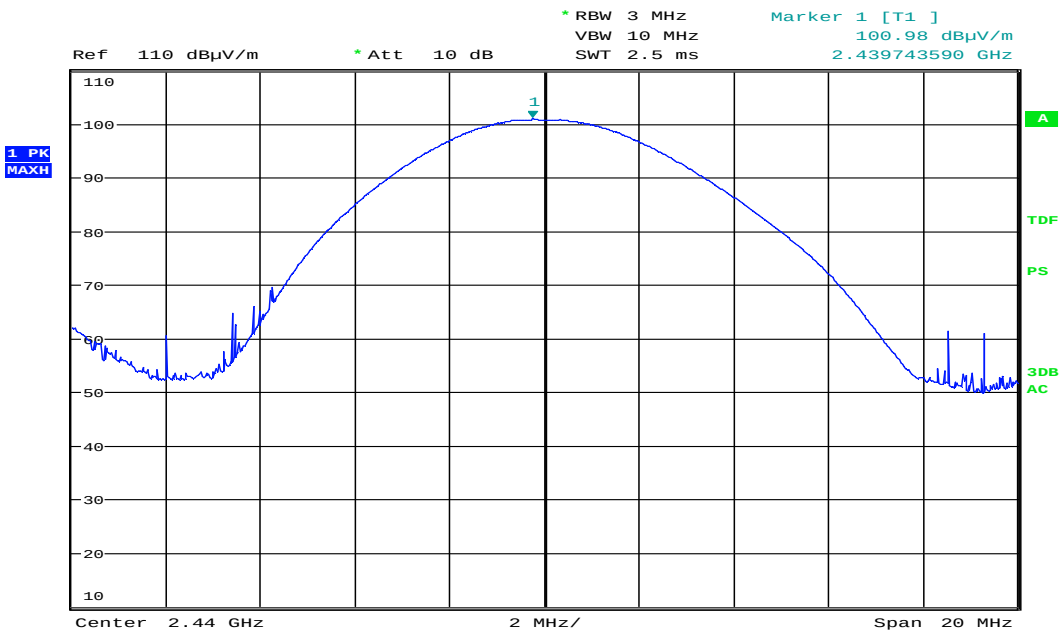


Date: 22.NOV.2019 13:09:55

Maximum Field Strength, 2402 MHz, BT LR

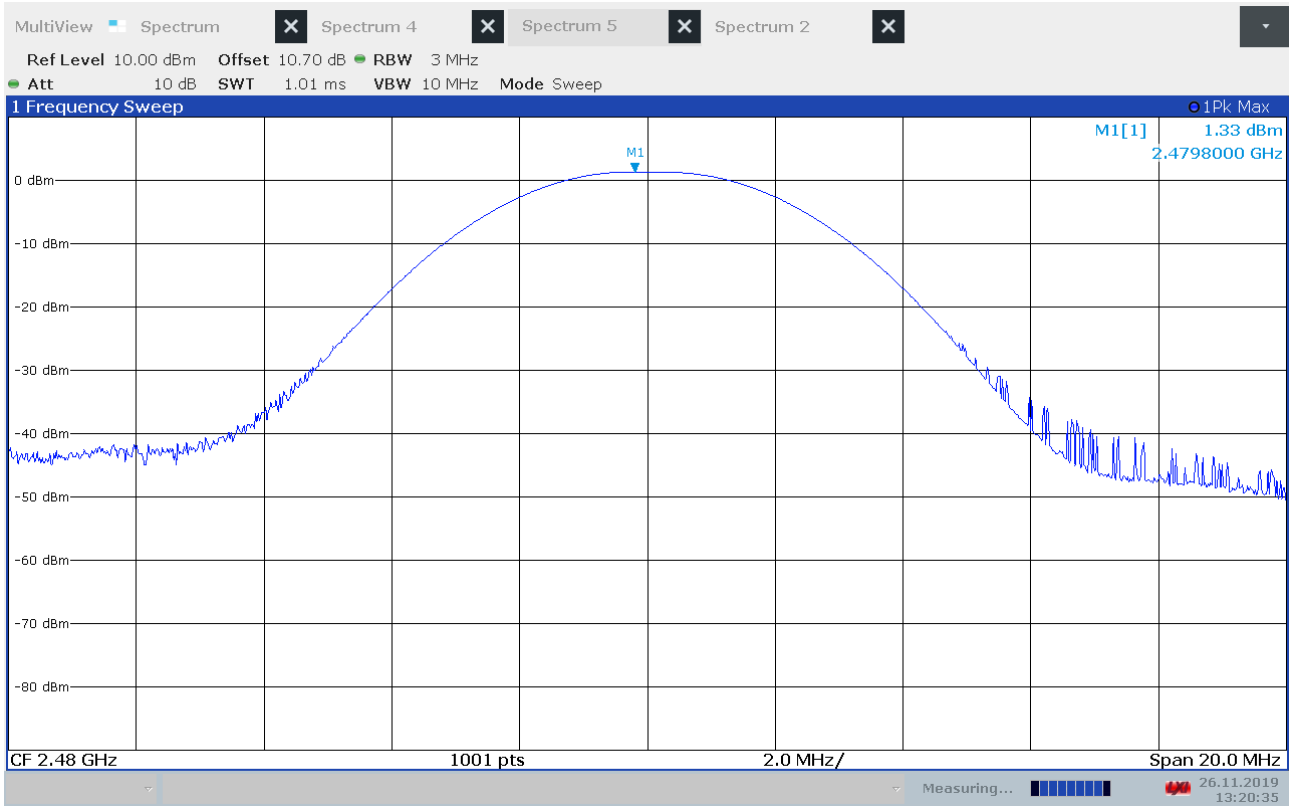


Conducted Power, 2440 MHz, BT LR

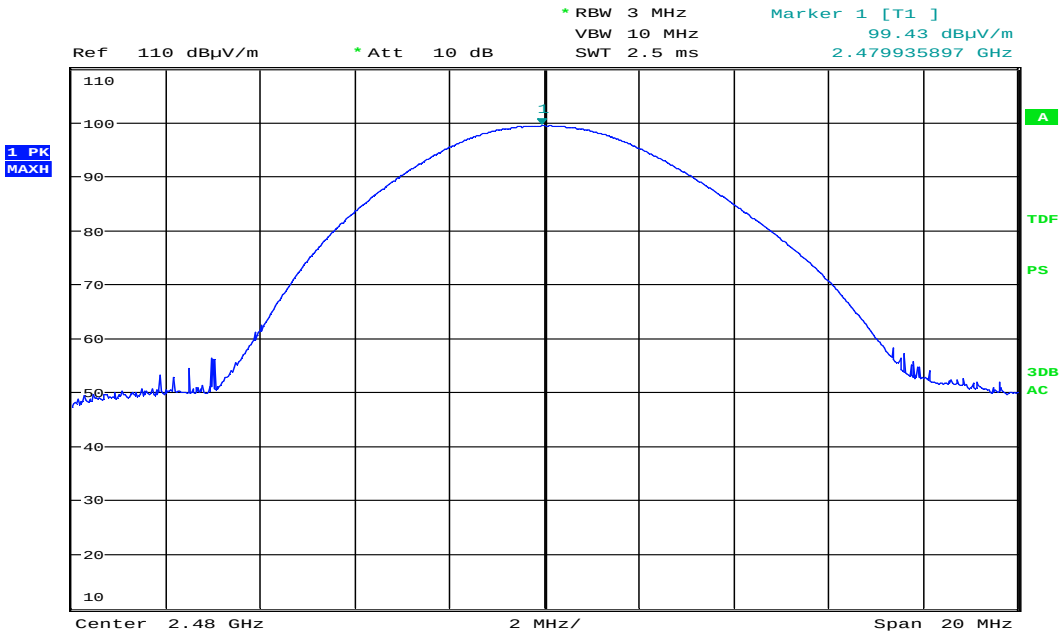


Date: 22.NOV.2019 10:07:00

Maximum Field Strength, 2440 MHz, BT LR

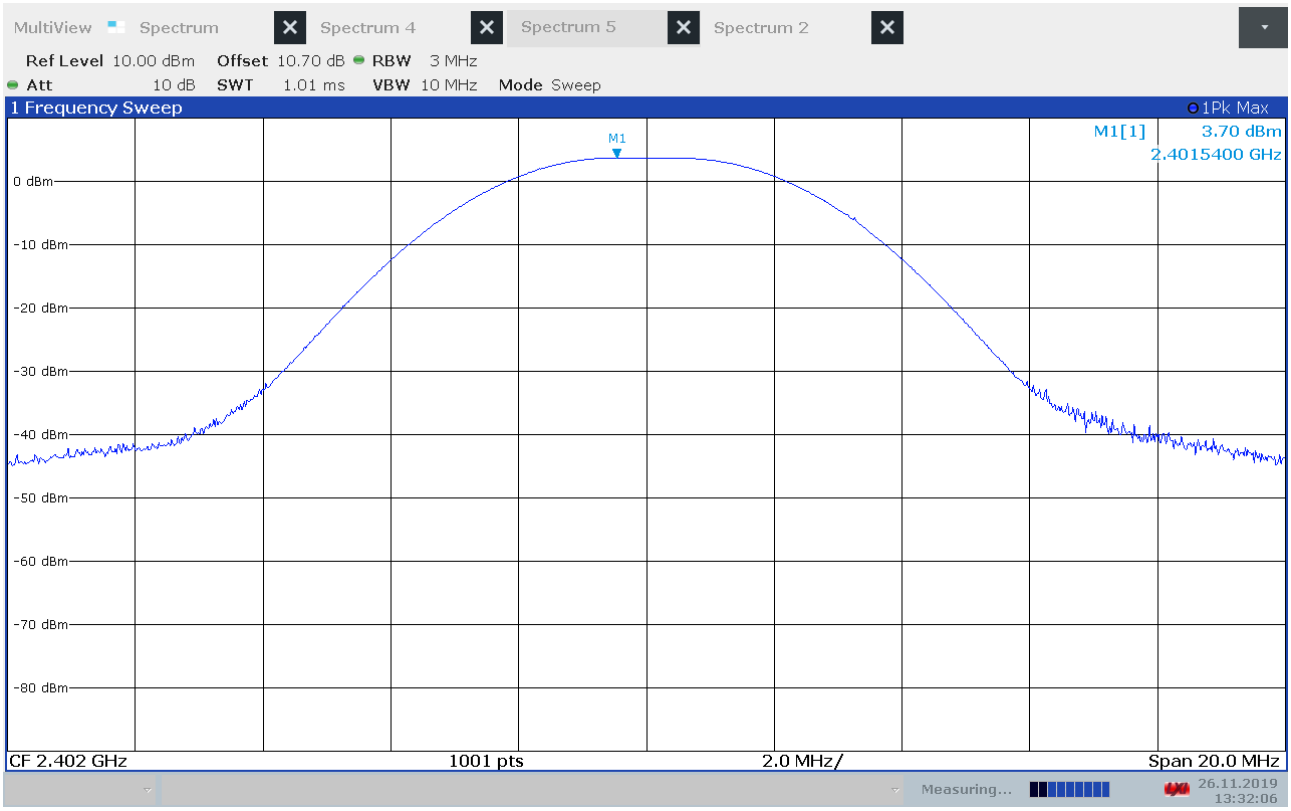


Conducted Power, 2480 MHz, BT LR

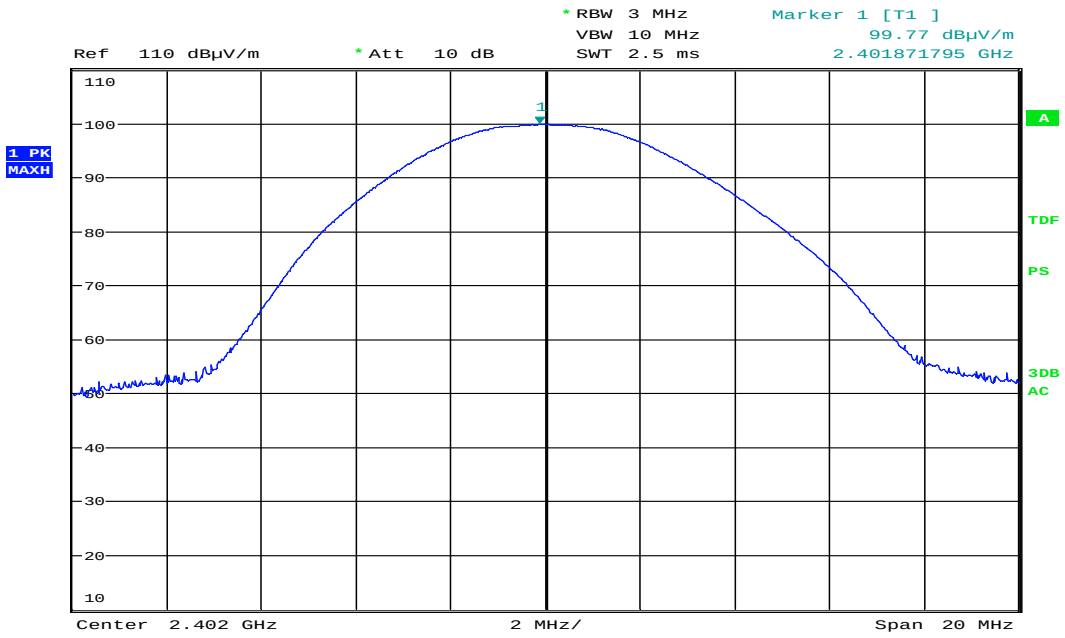


Date: 22.NOV.2019 13:13:07

Maximum Field Strength, 2480 MHz, BT LR

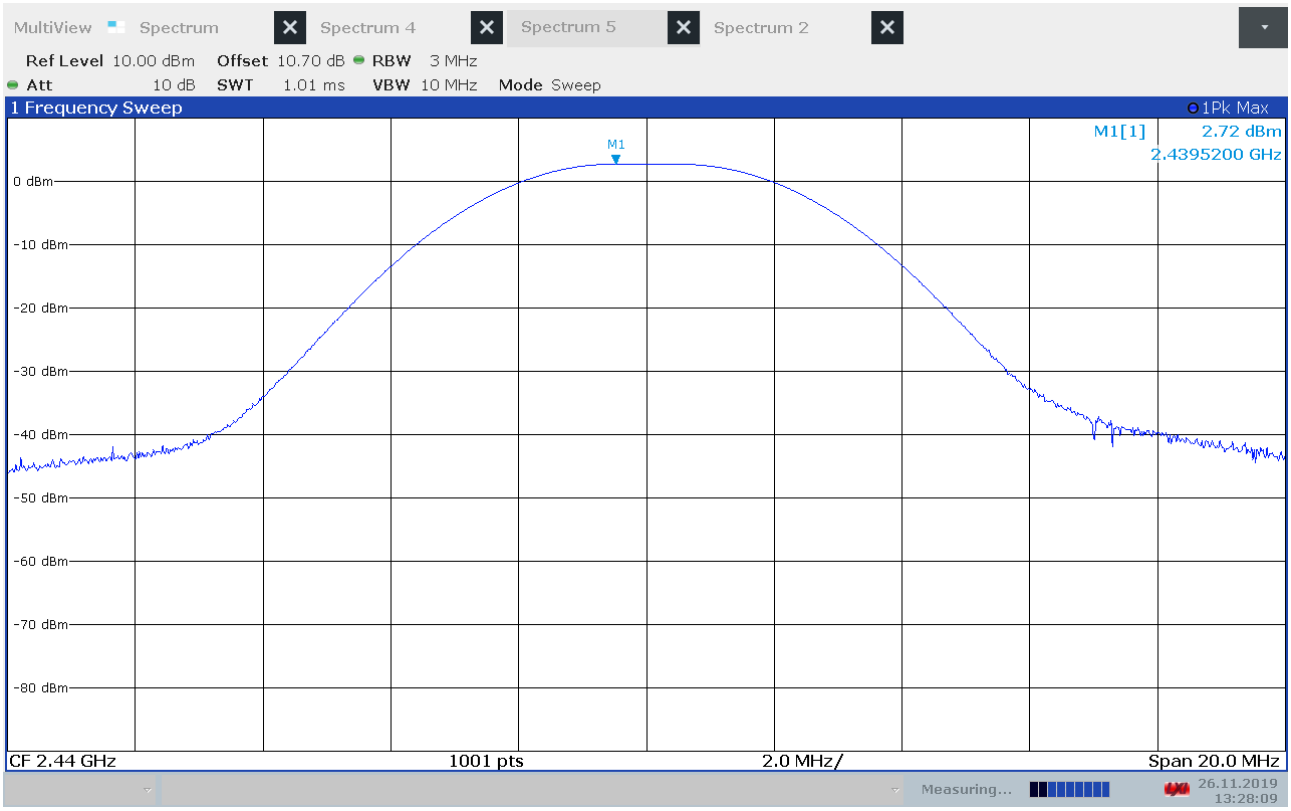


Conducted Power, 2402 MHz, BT LE 2Mb

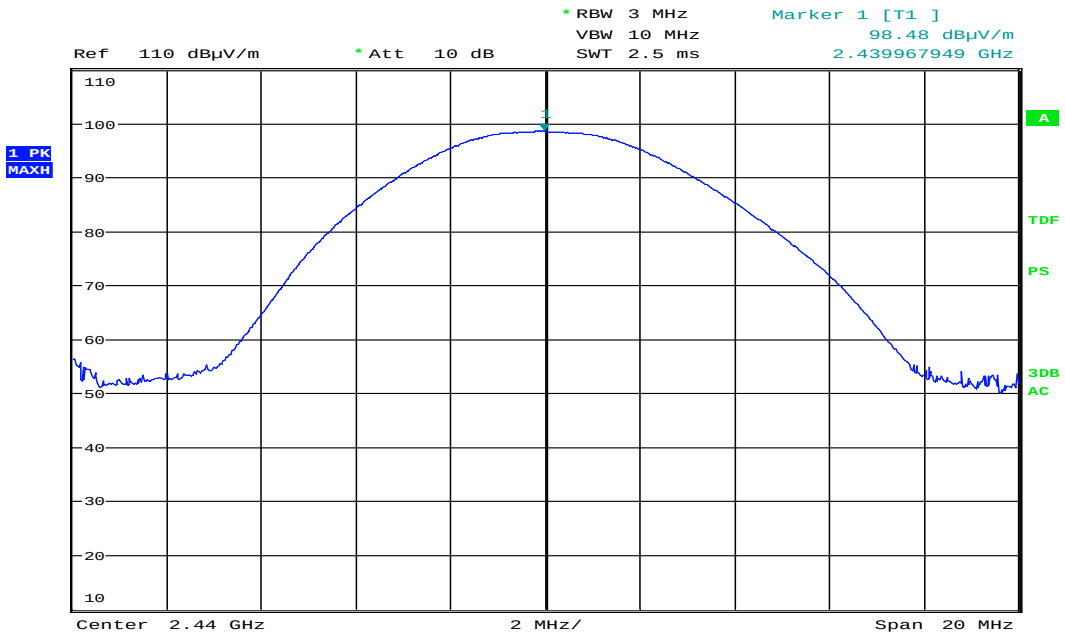


Date: 22.NOV.2019 12:52:41

Maximum Field Strength, 2402 MHz, BT LE 2Mb

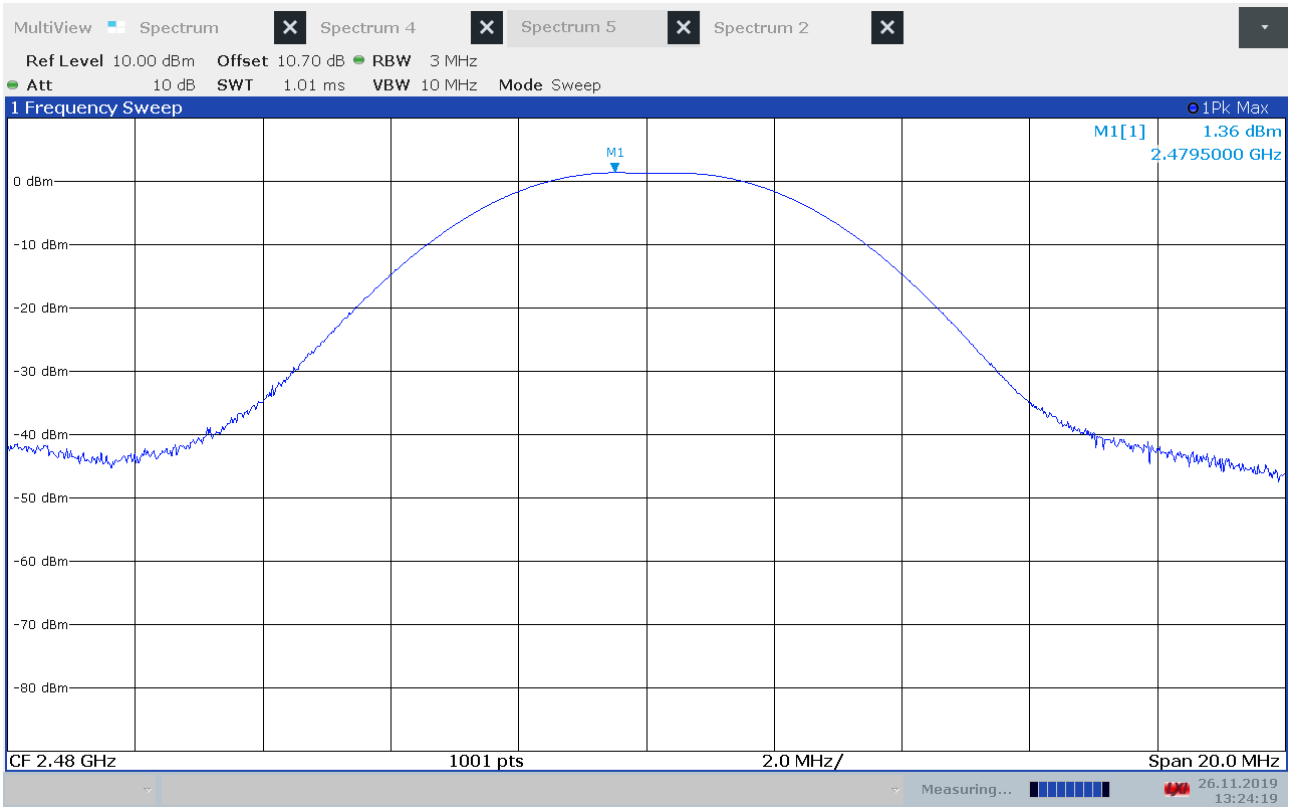


Conducted Power, 2440 MHz, BT LE 2Mb

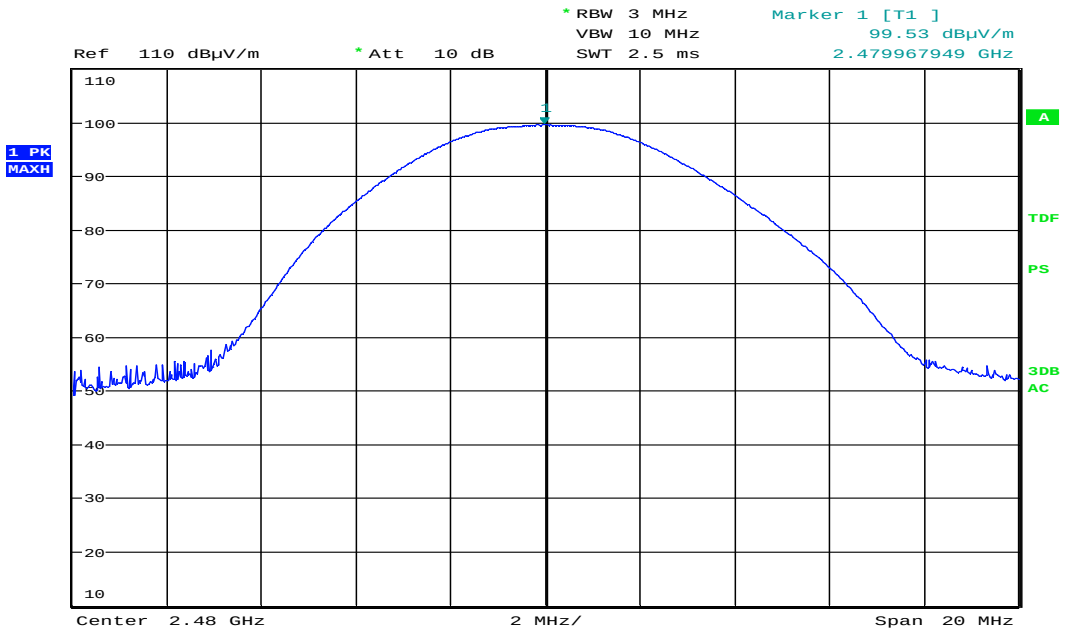


Date: 22.NOV.2019 12:07:36

Maximum Field Strength, 2440 MHz, BT LE 2Mb



Conducted Power, 2480 MHz, BT LE 2Mb



Date: 22.NOV.2019 12:56:25

Maximum Field Strength, 2480 MHz, BT LE 2Mb

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:

Operating Mode	Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
BT LR	2402 MHz	>40	>20	Pass
	2440 MHz	>40	>20	Pass
	2480 MHz	>40	>20	Pass
BT 2Mb	2402 MHz	>40	>20	Pass
	2440 MHz	>40	>20	Pass
	2480 MHz	>40	>20	Pass

Measured with Peak Detector

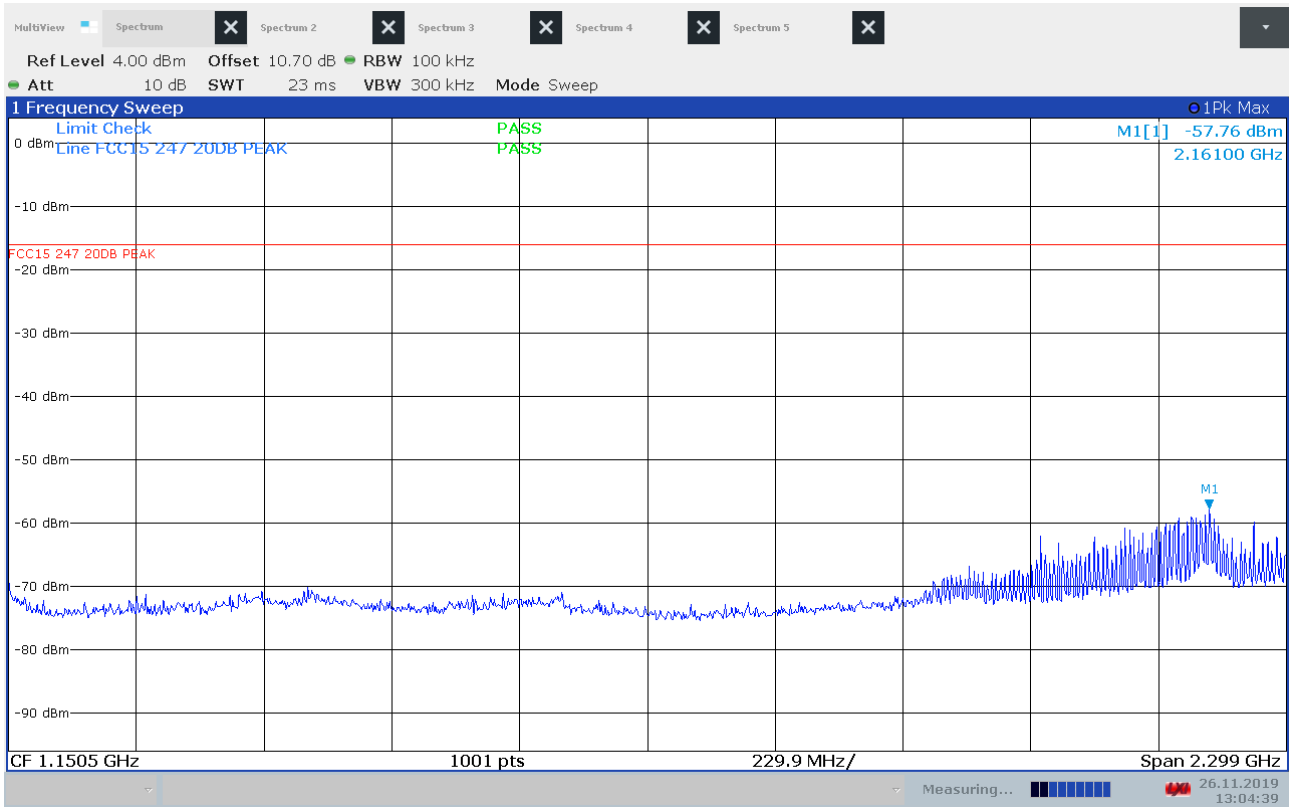
RF conducted power to 25 GHz: see attached plots.

Limit

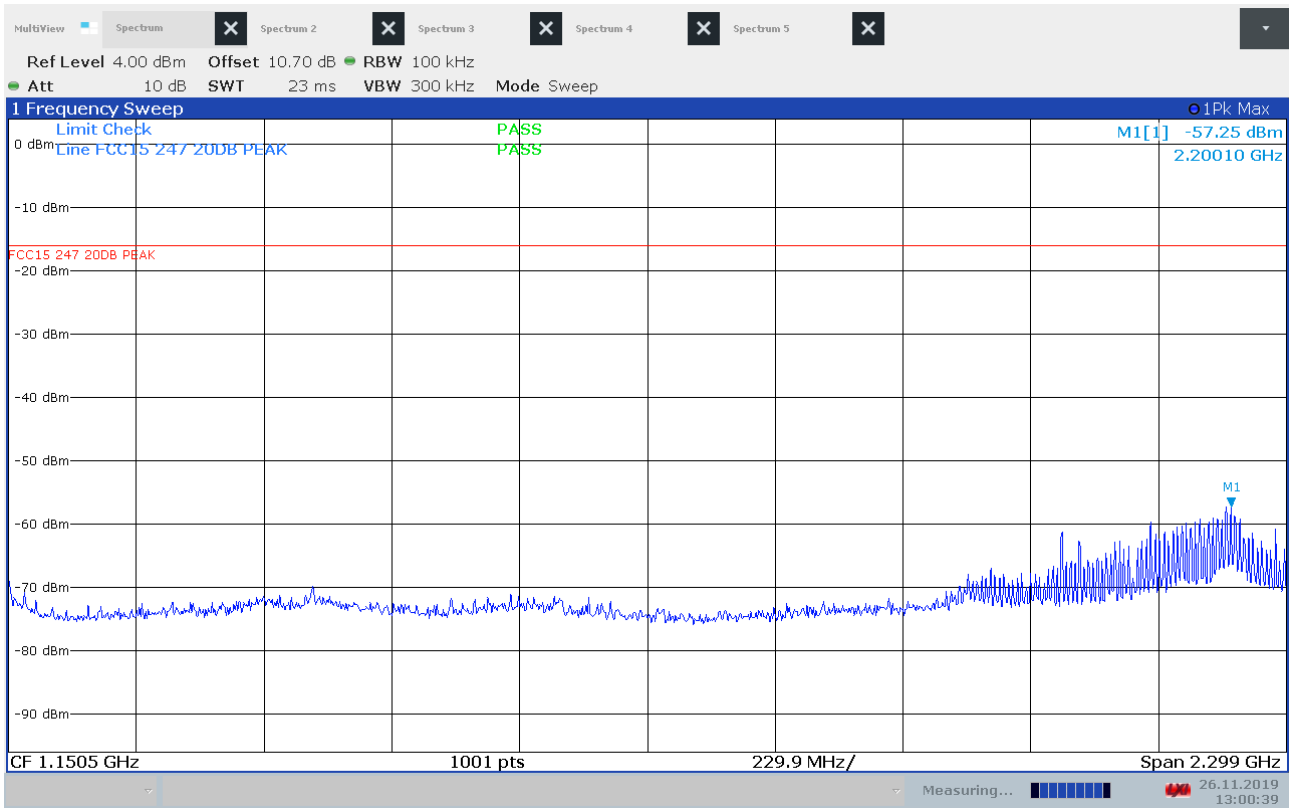
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

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

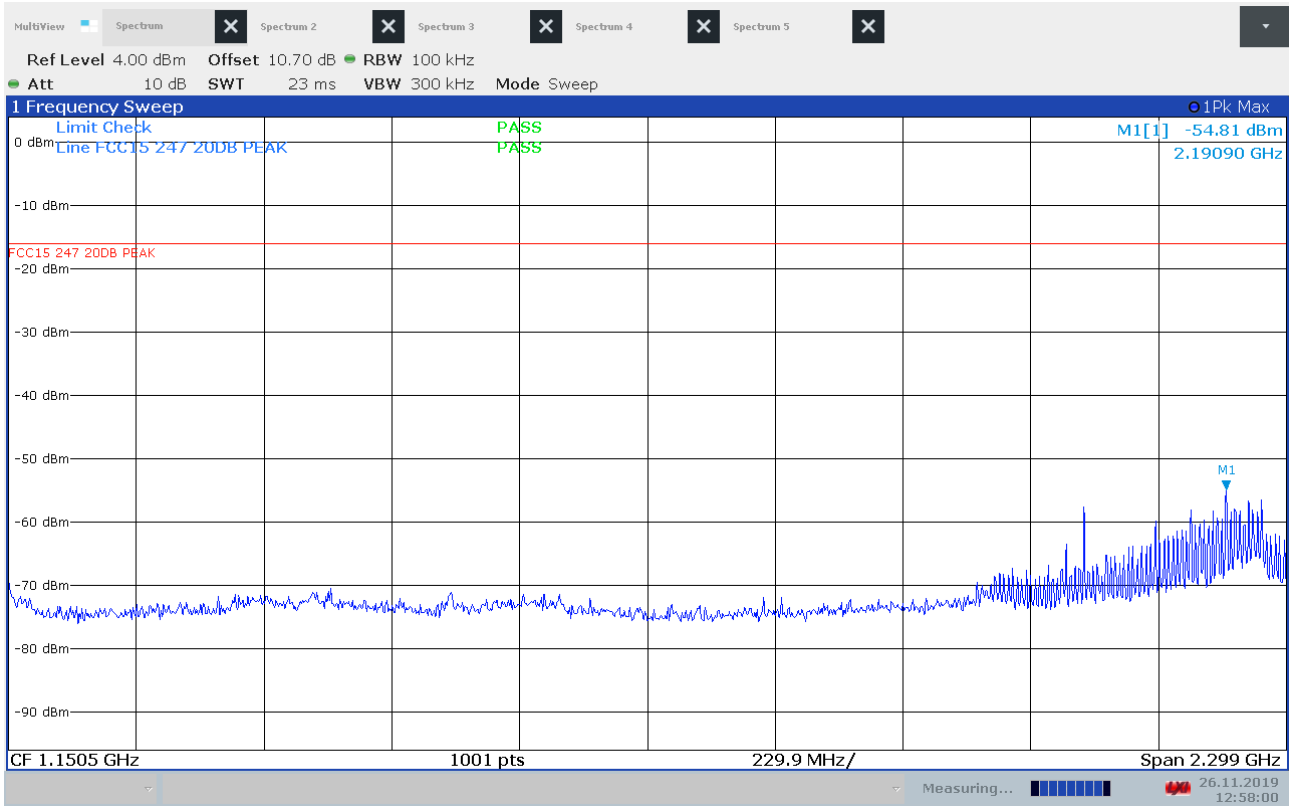
Attenuation below the general limits specified in part 15.209(a) is not required.



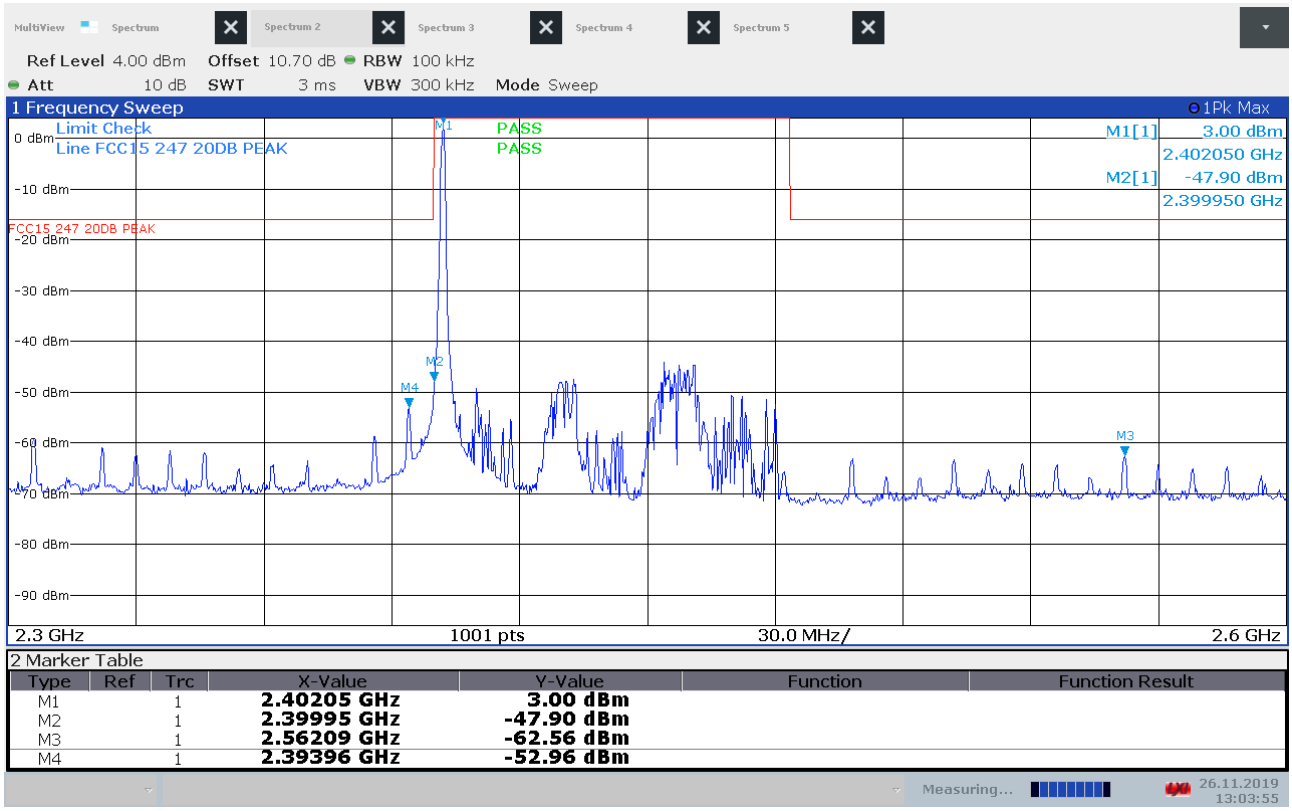
Conducted Emissions, 1 – 2300 MHz, 2402 MHz, BT LE



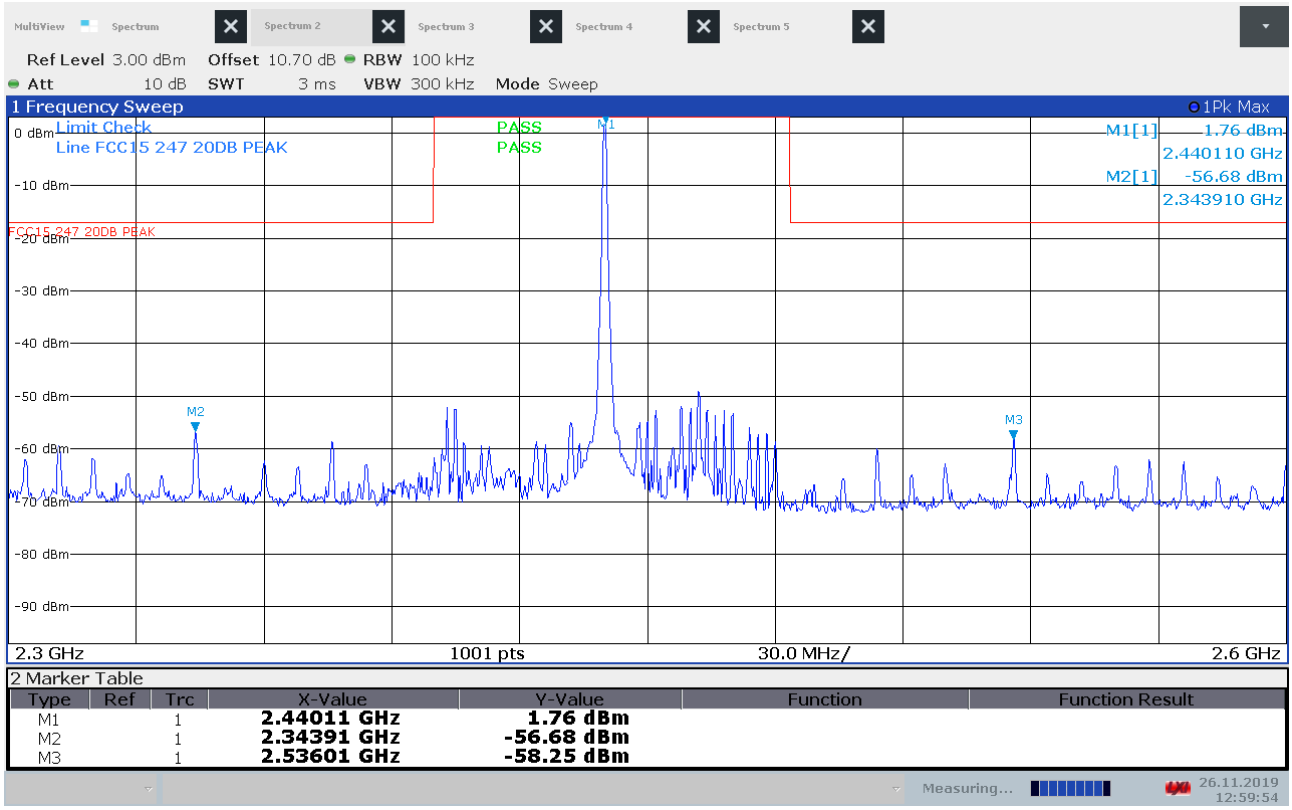
Conducted Emissions, 1 – 2300 MHz, 2440 MHz, BT LE



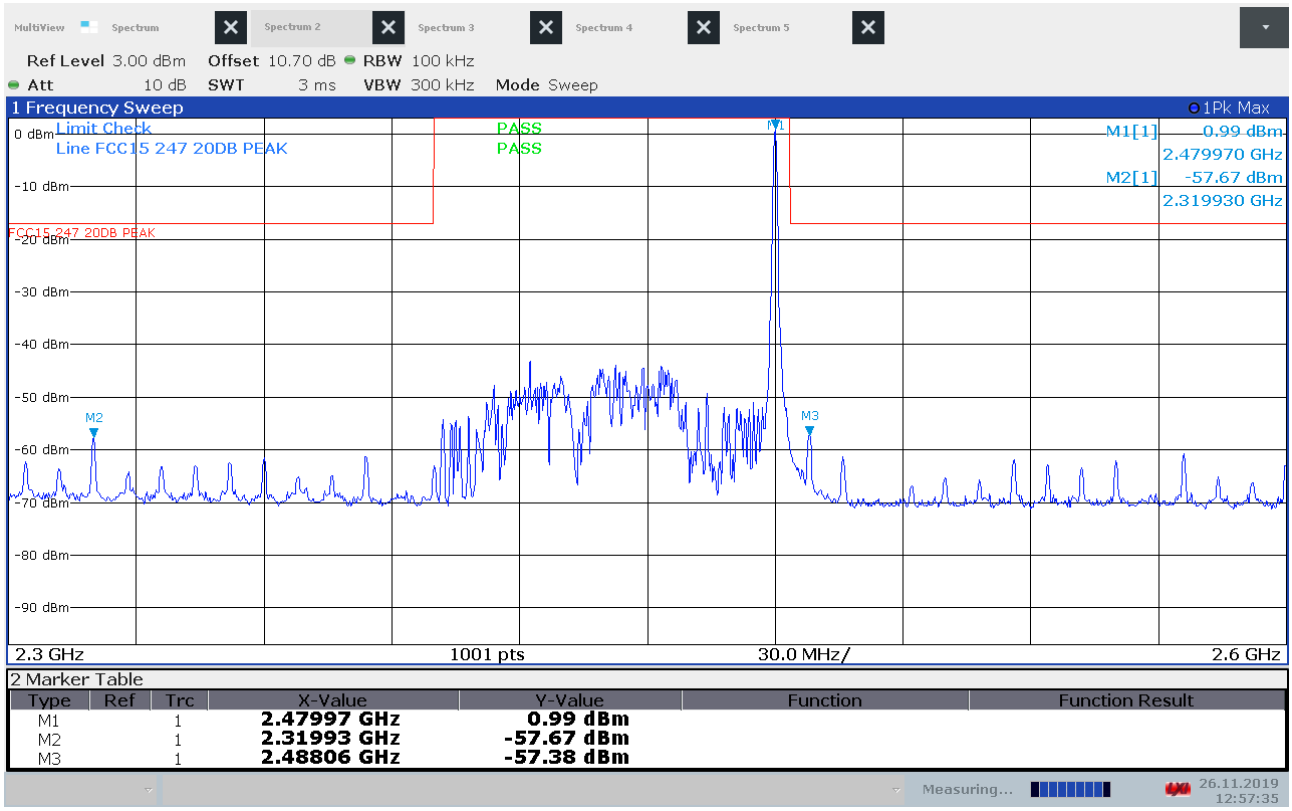
Conducted Emissions, 1 – 2300 MHz, 2480 MHz, BT LE



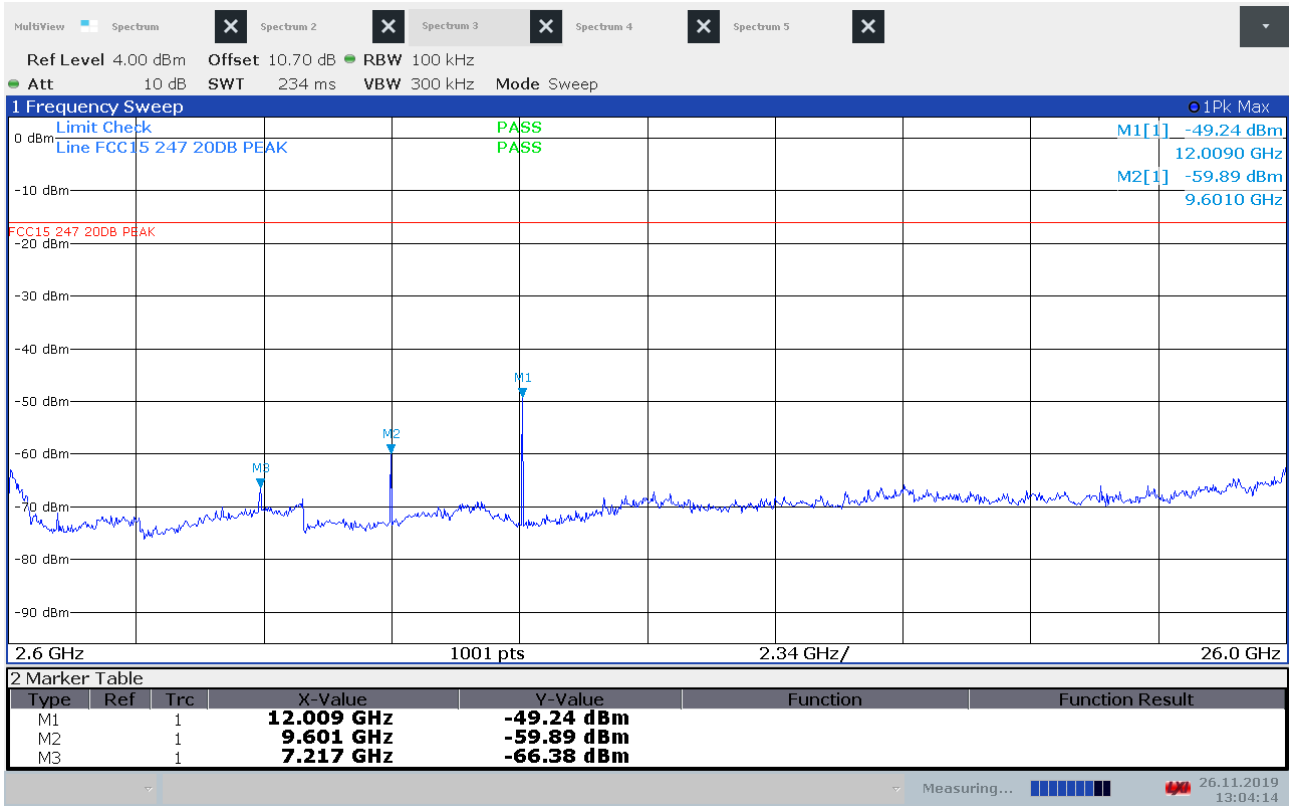
Conducted Emissions, 2300 - 2600 MHz, 2402 MHz, BT LE



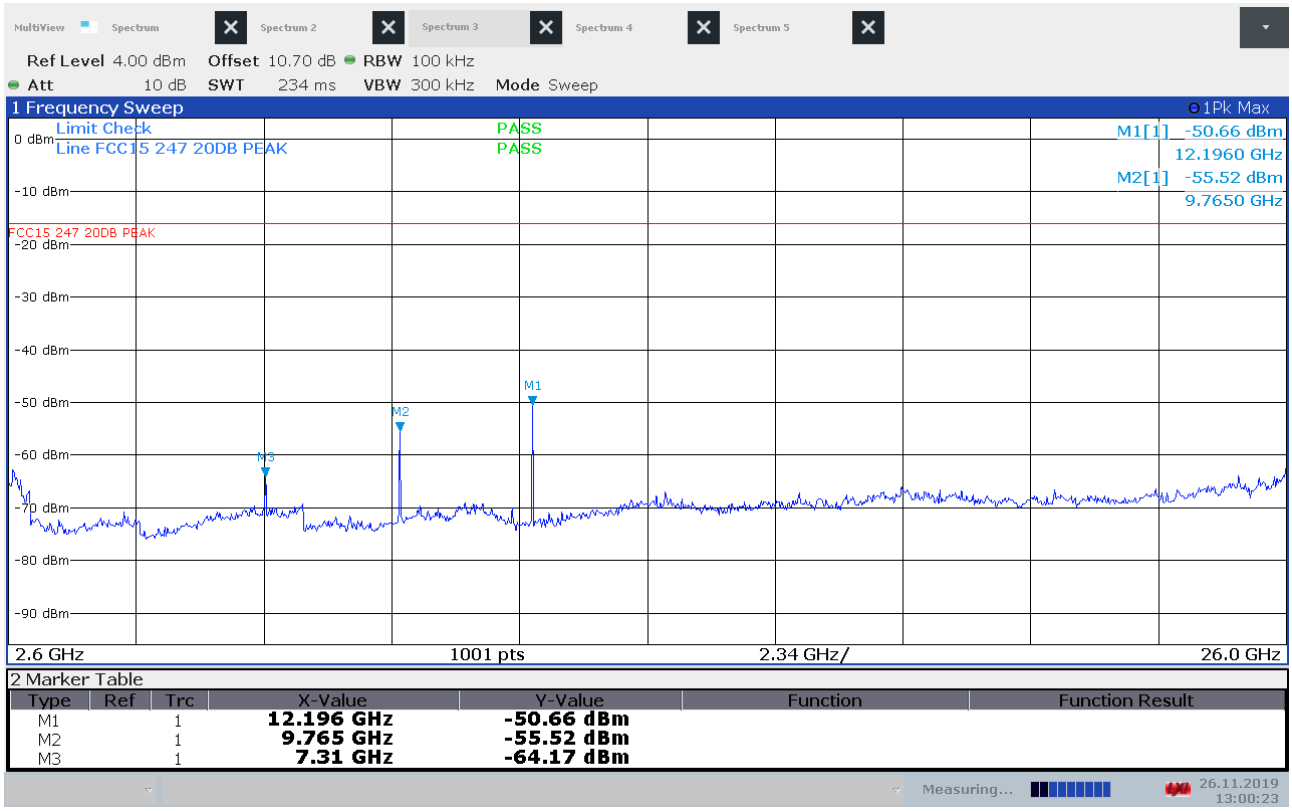
Conducted Emissions, 2300 - 2600 MHz, 2440 MHz, BT LE



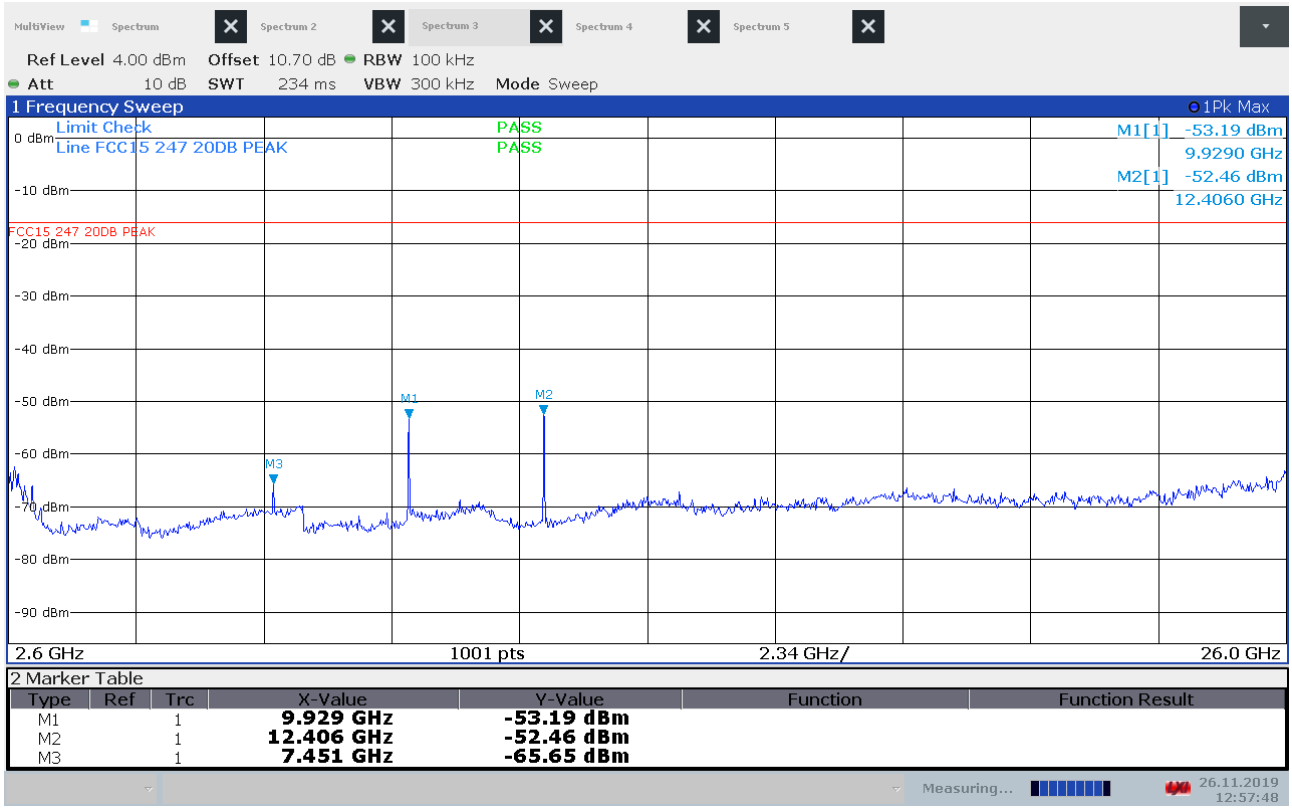
Conducted Emissions, 2300 - 2600 MHz, 2480 MHz, BT LE



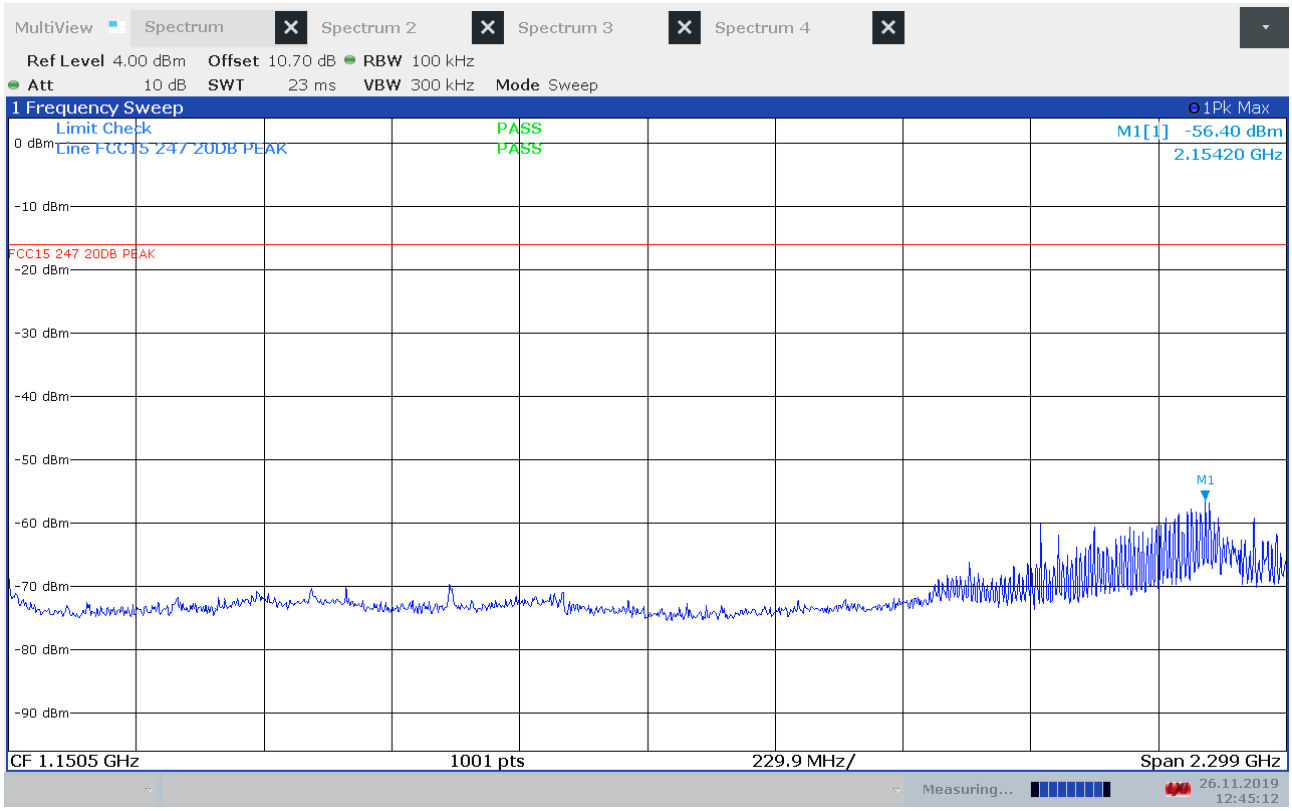
Conducted Emissions, 2600 – 26000 MHz, 2402 MHz, BT LE



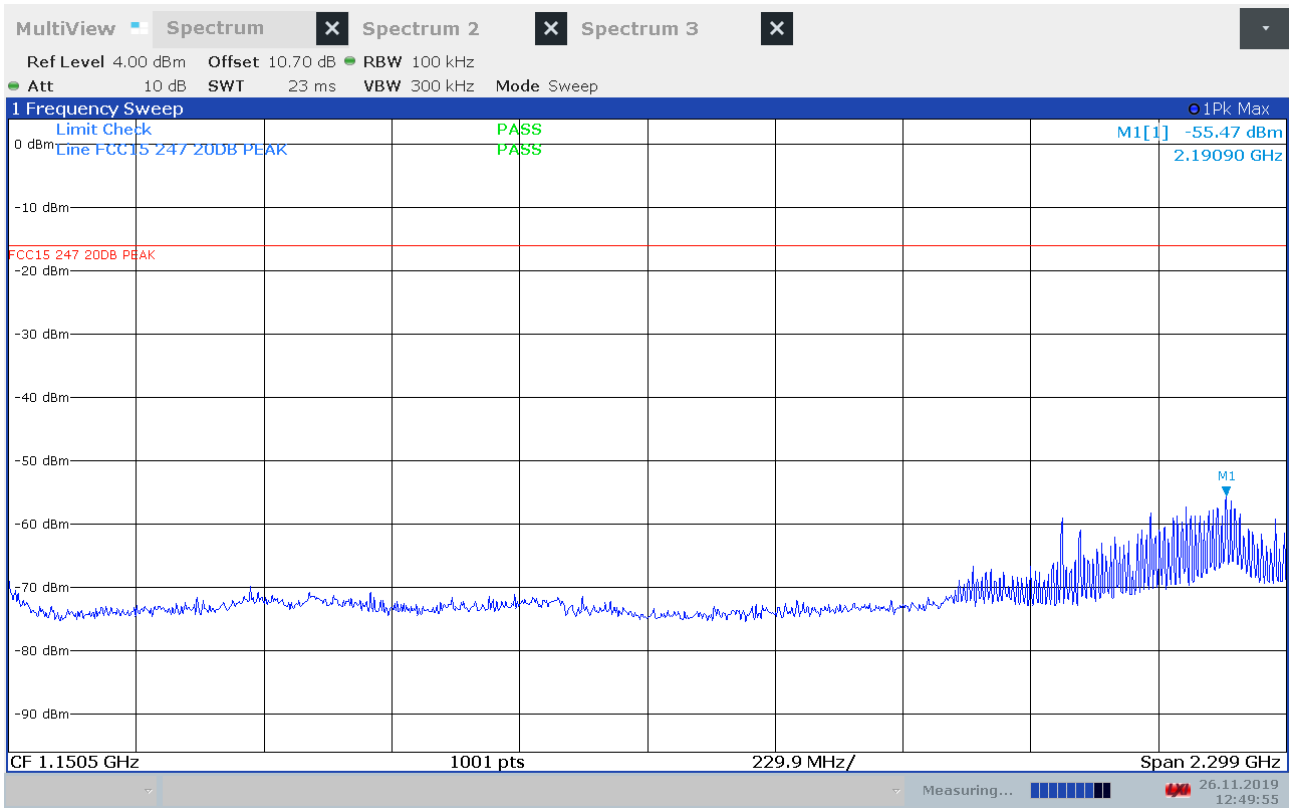
Conducted Emissions, 2600 – 26000 MHz, 2440 MHz, BT LE



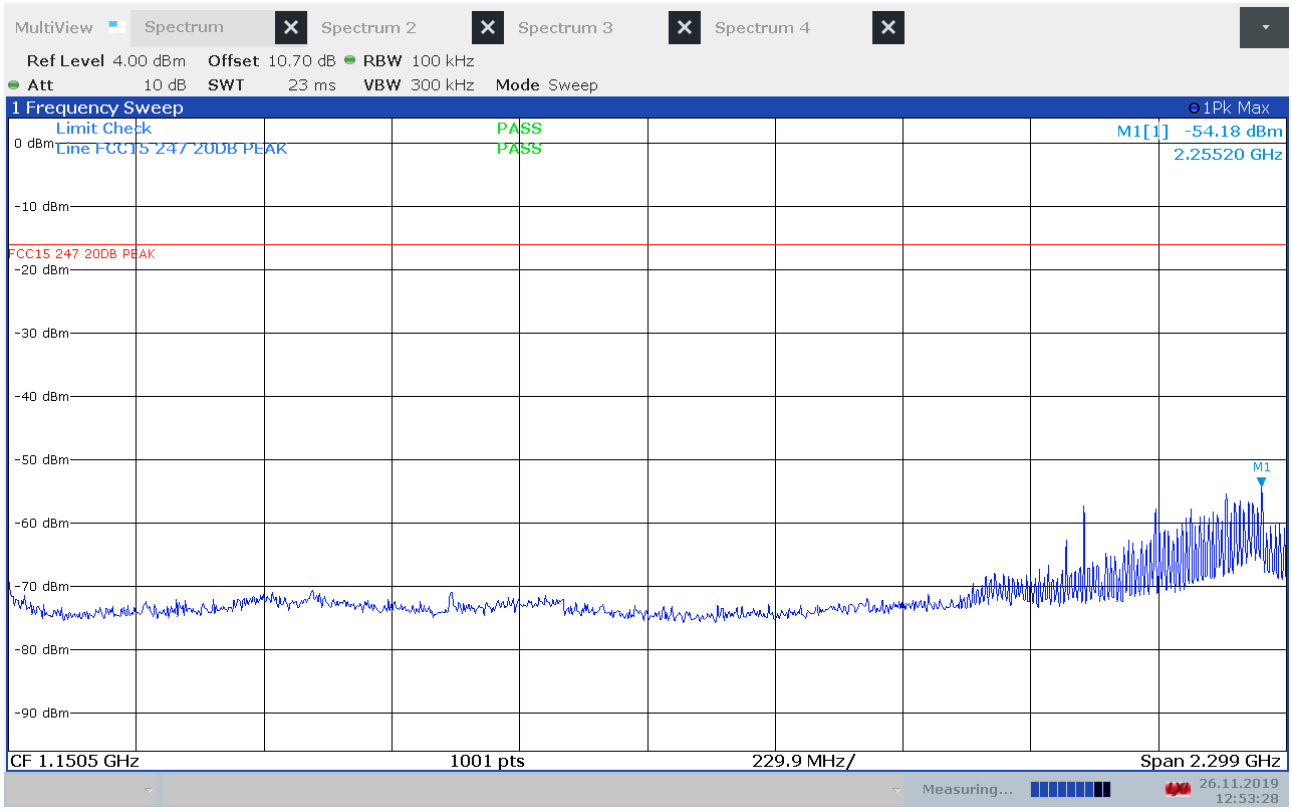
Conducted Emissions, 2600 – 26000 MHz, 2480 MHz, BT LE



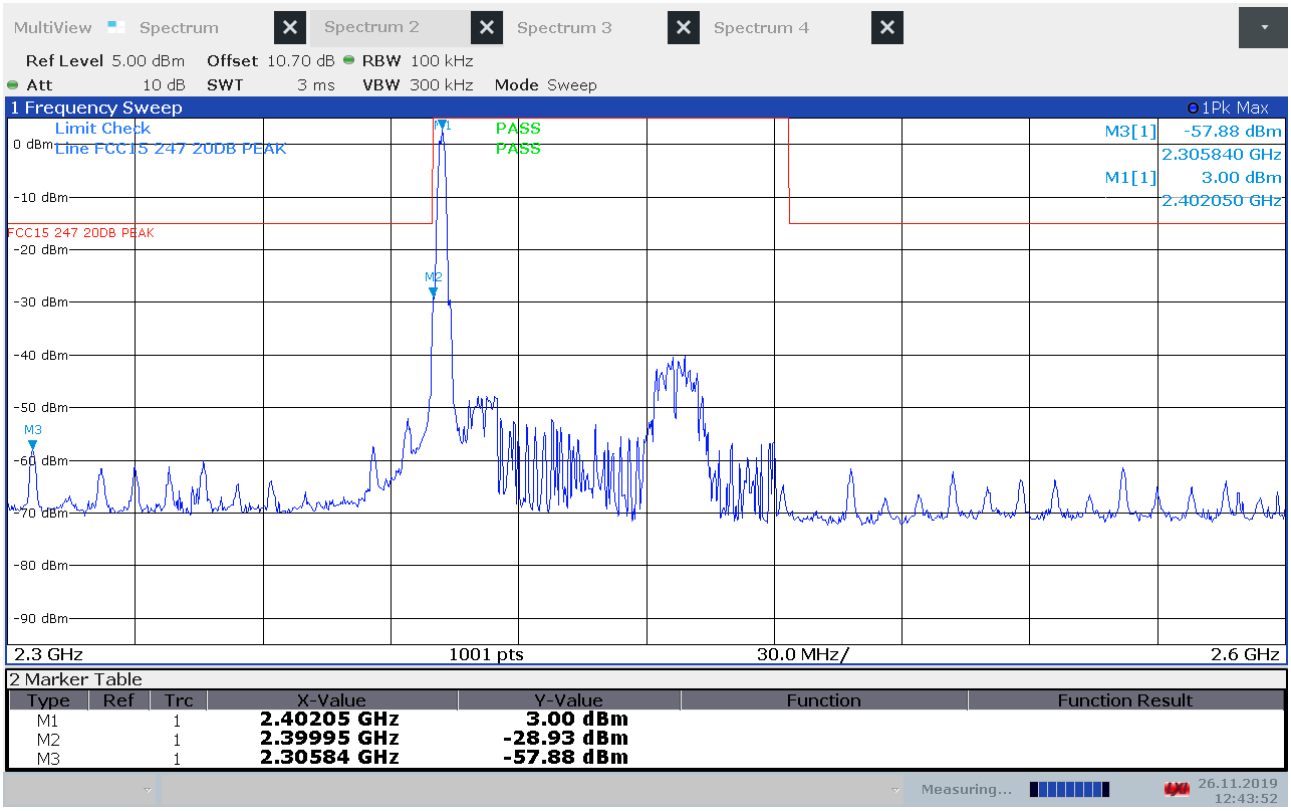
Conducted Emissions, 1 – 2300 MHz, 2402 MHz, BT LE 2Mb



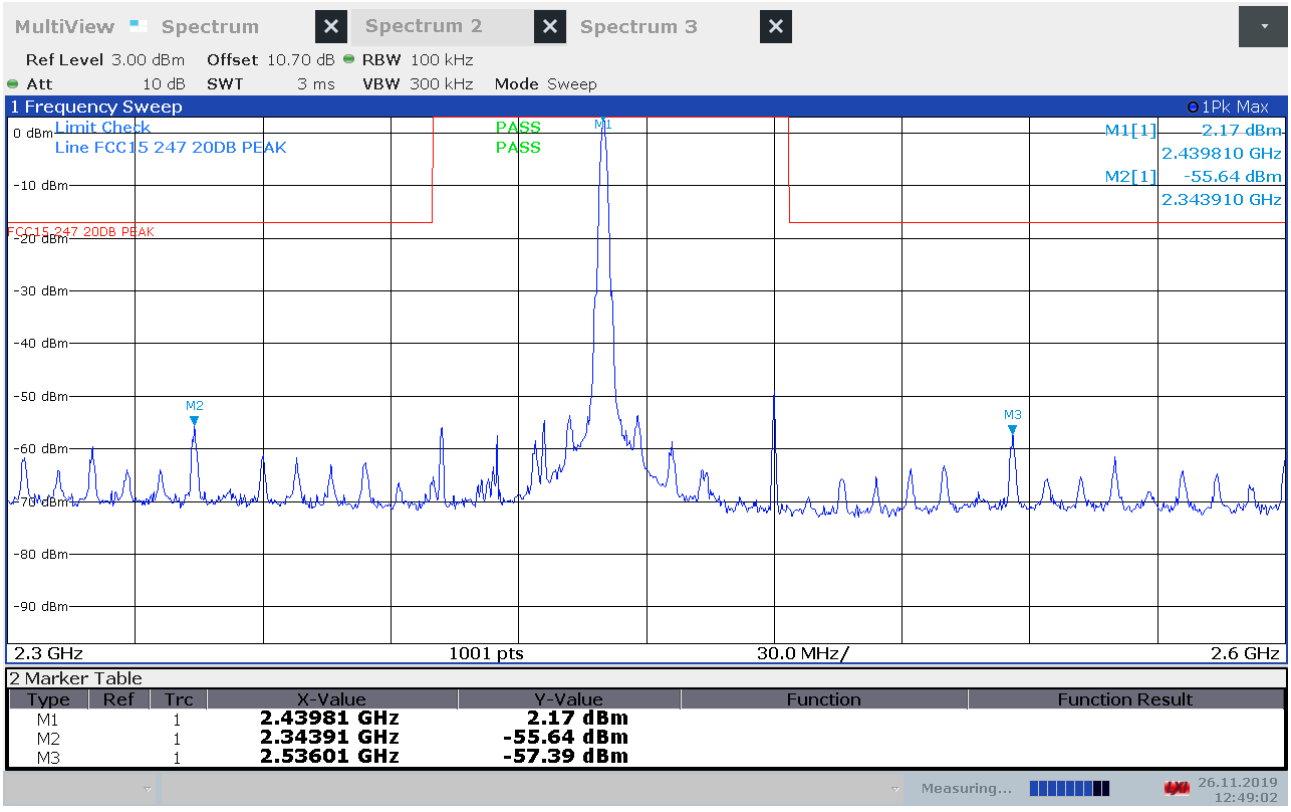
Conducted Emissions, 1 – 2300 MHz, 2440 MHz, BT LE 2Mb



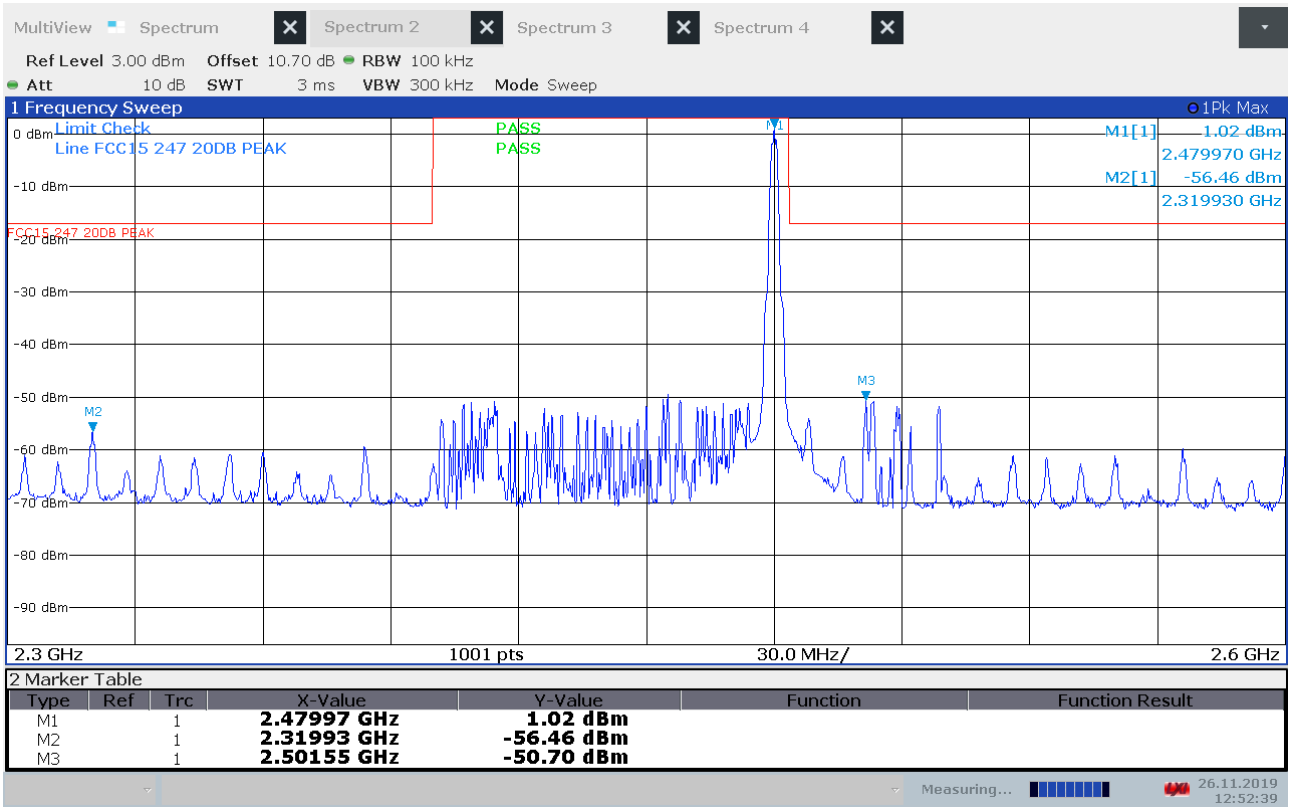
Conducted Emissions, 1 – 2300 MHz, 2480 MHz, BT LE 2Mb



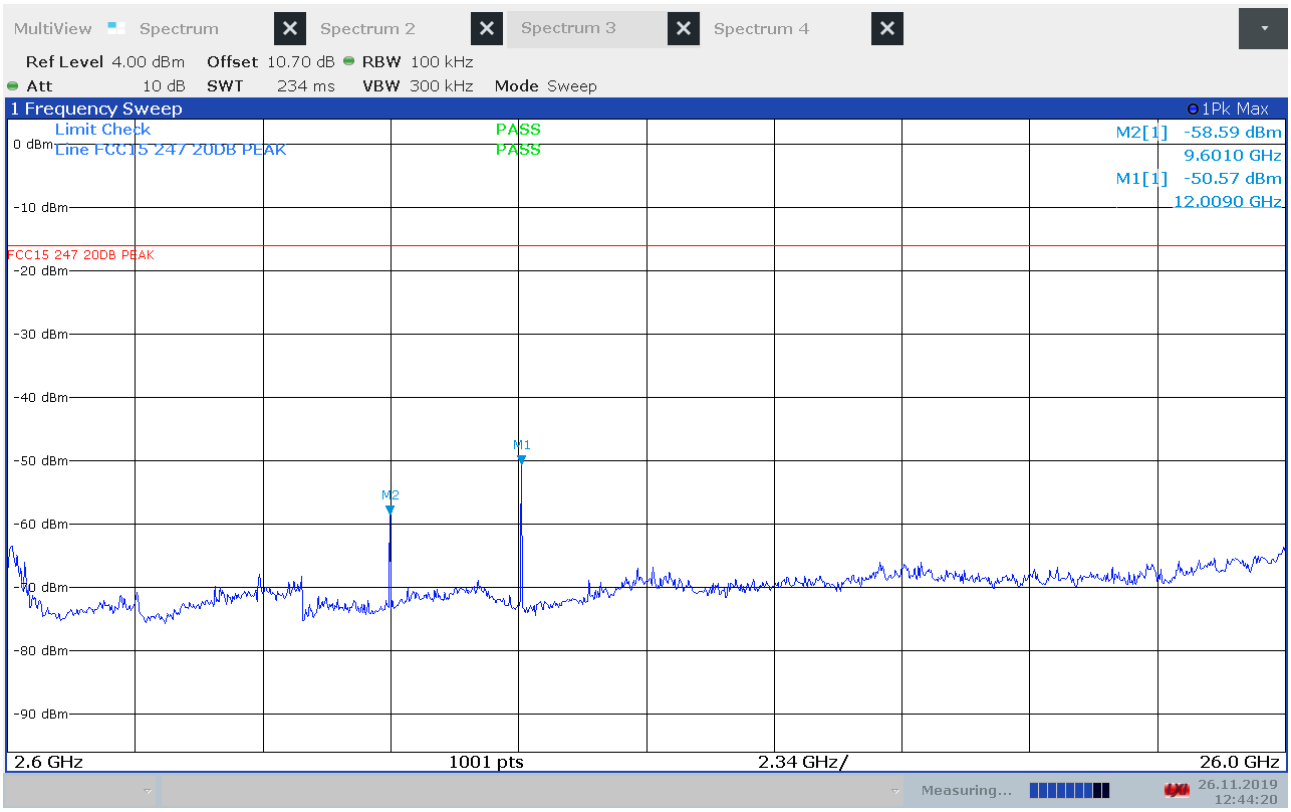
Conducted Emissions, 2300 - 2600 MHz, 2402 MHz, BT LE 2Mb



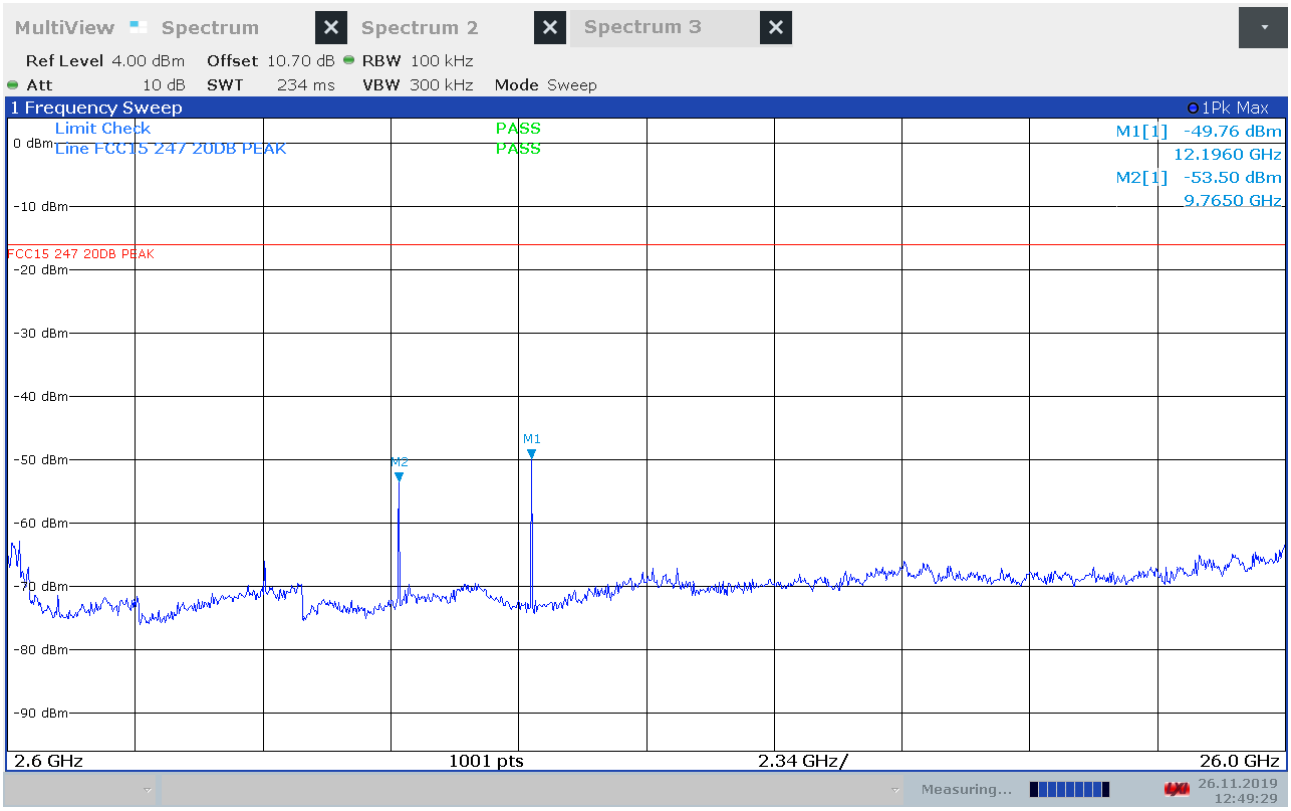
Conducted Emissions, 2300 - 2600 MHz, 2440 MHz, BT LE 2Mb



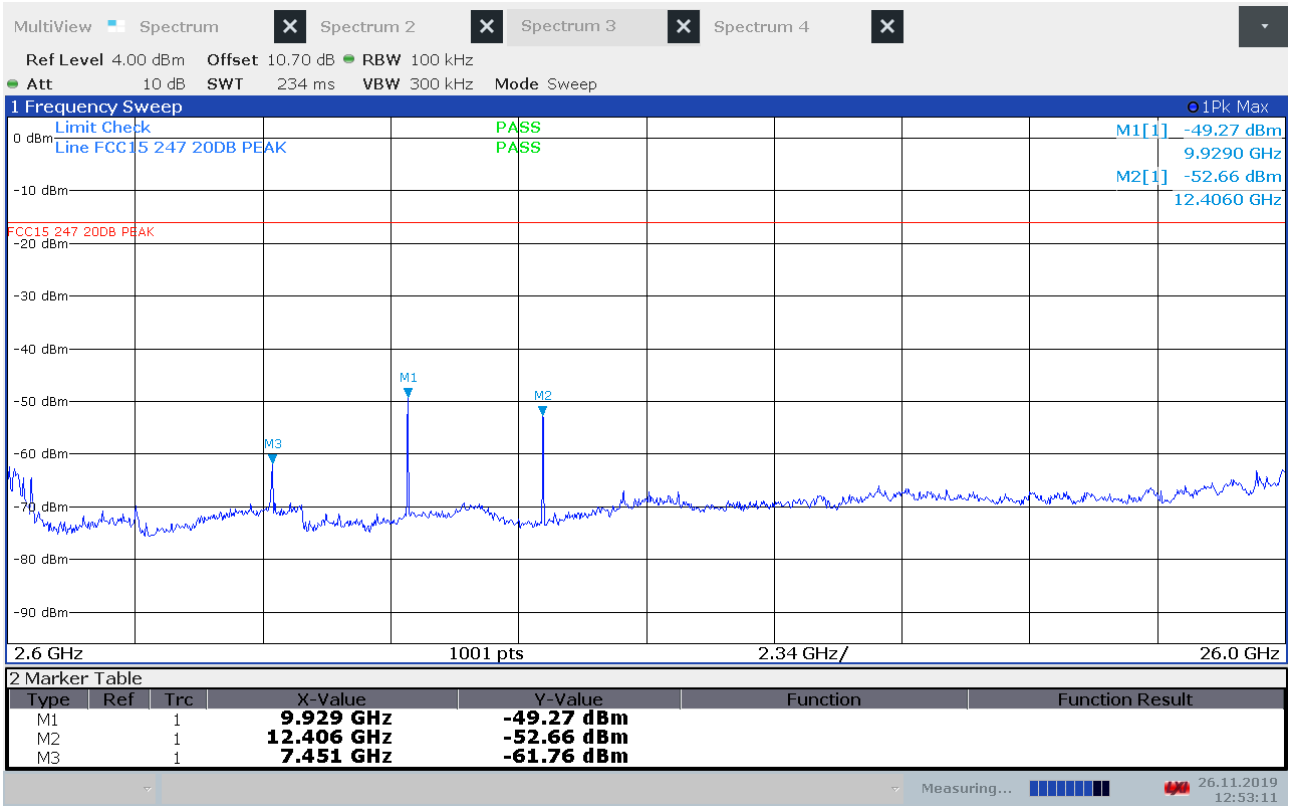
Conducted Emissions, 2300 - 2600 MHz, 2480 MHz, BT LE 2Mb



Conducted Emissions, 2600 – 26000 MHz, 2402 MHz, BT LE 2Mb



Conducted Emissions, 2600 – 26000 MHz, 2440 MHz, BT LE 2Mb



Conducted Emissions, 2600 – 26000 MHz, 2480 MHz, BT LE 2Mb

3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED 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)	ISED (MHz)	FCC (GHz)	ISED (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 ISED, 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**

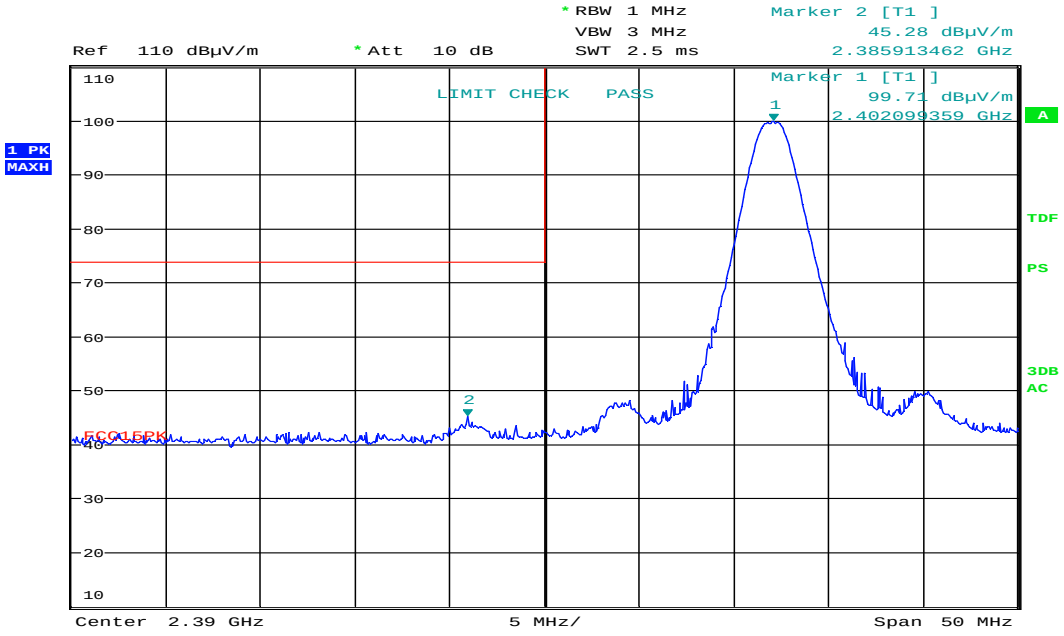
Test Results: Complies

Measurement Data:

Operating Mode	Detector	Measured field strength (dBµV/m)		Limit	Margin	
		2390 MHz	2483.5 MHz	dBµV/m	dB	
BT LE LR	Peak	45.3	58.8	74	28.7	15.2
BT LE 2Mb		45.0	63.7	74	29.0	10.3
BT LE LR	Average	25.3	38.8	54	28.7	15.2
BT LE 2Mb		25.0	43.7	54	29.0	10.3

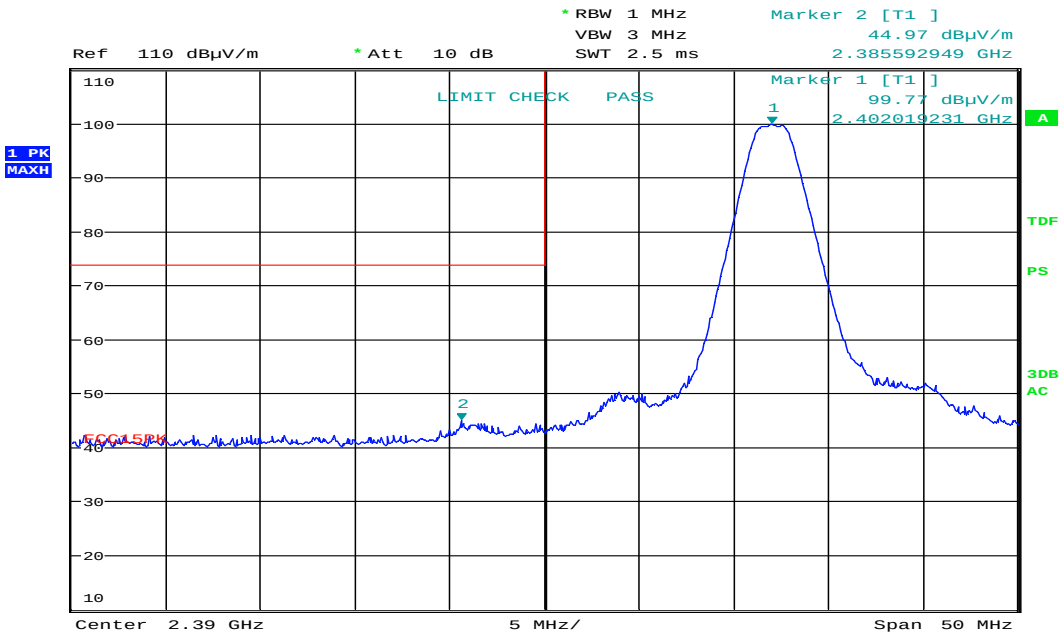
Average Detector values are measured with Peak Detector and corrected for Duty Cycle.

See attached plots.



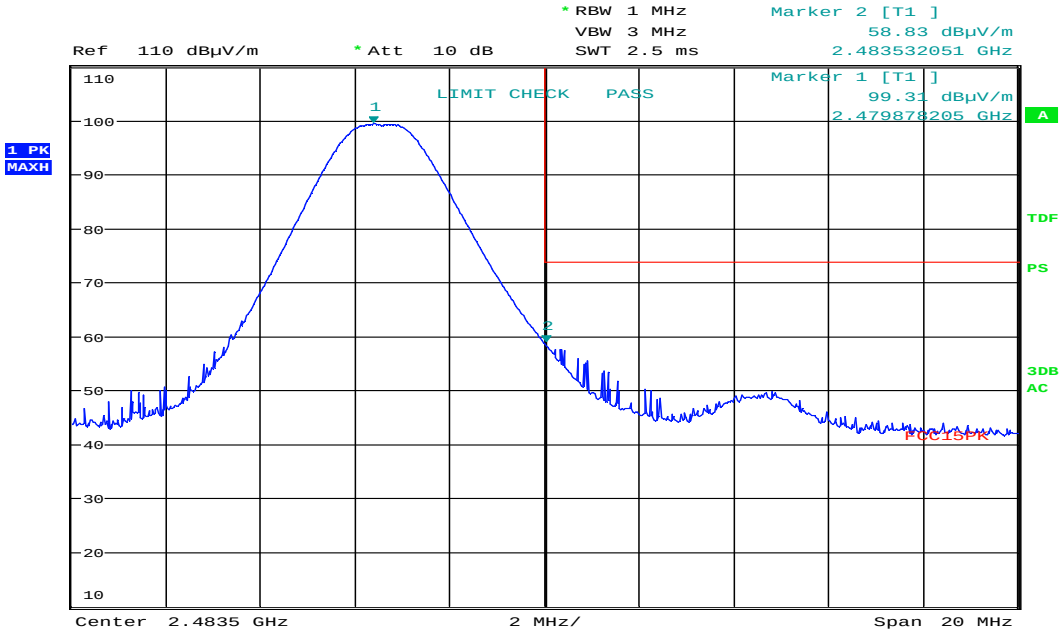
Date: 22.NOV.2019 13:11:11

Lower Band Edge, 2402 MHz, BT LE



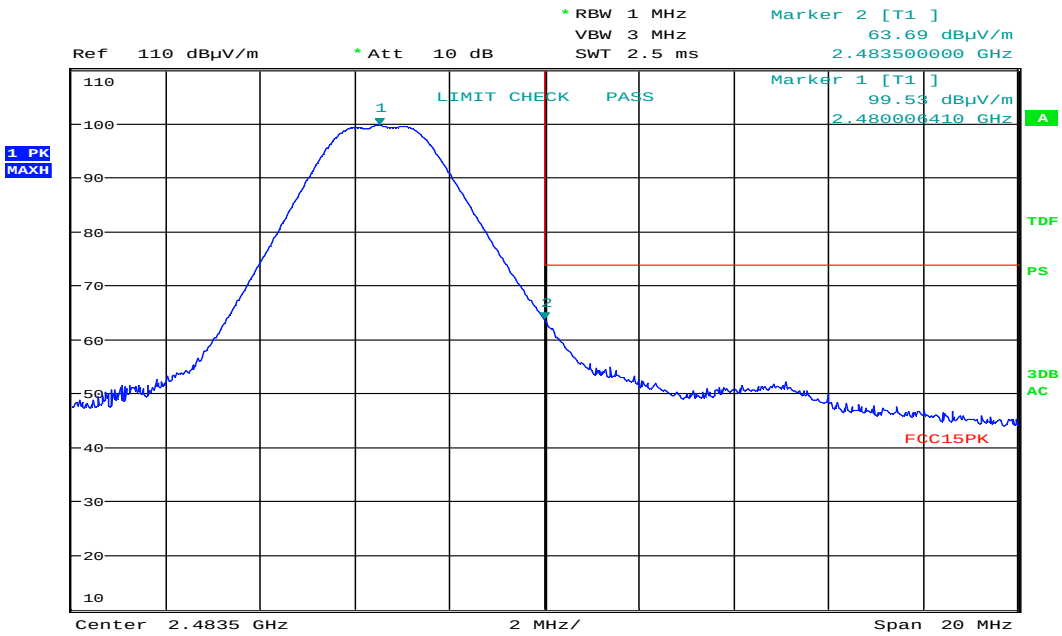
Date: 22.NOV.2019 12:53:23

Lower Band Edge, 2402 MHz, BT LE 2Mb



Date: 22.NOV.2019 13:12:41

Upper Band Edge, 2480 MHz, BT LE



Date: 22.NOV.2019 12:57:20

Upper Band Edge, 2480 MHz, BT LE 2Mb

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

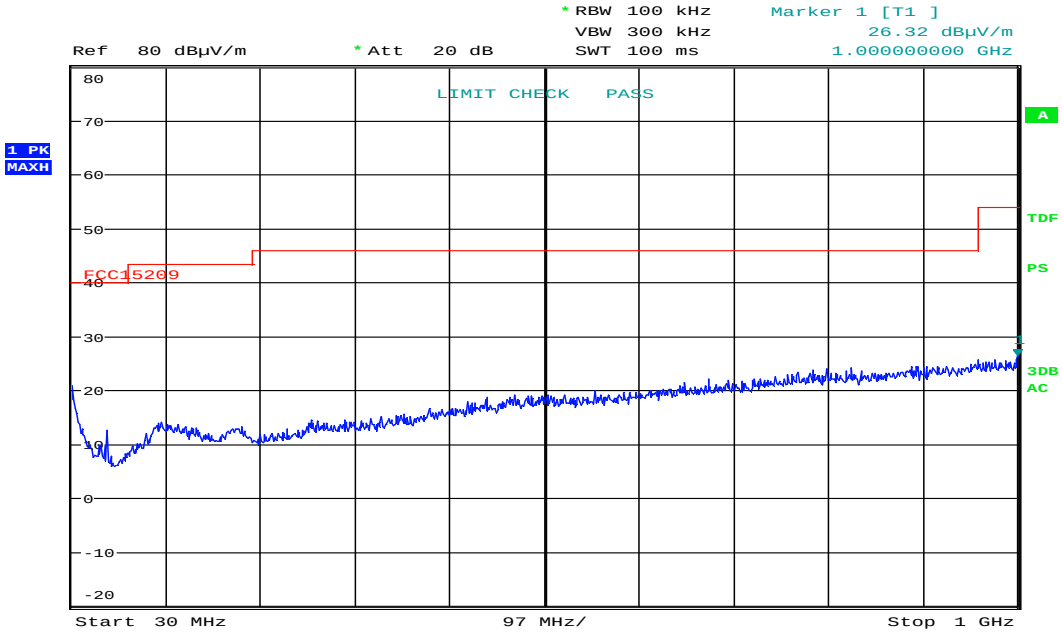
Measuring distance 3m

All frequencies are more than 20 dB below the limit even when measured with Peak Detector.

See attached plots

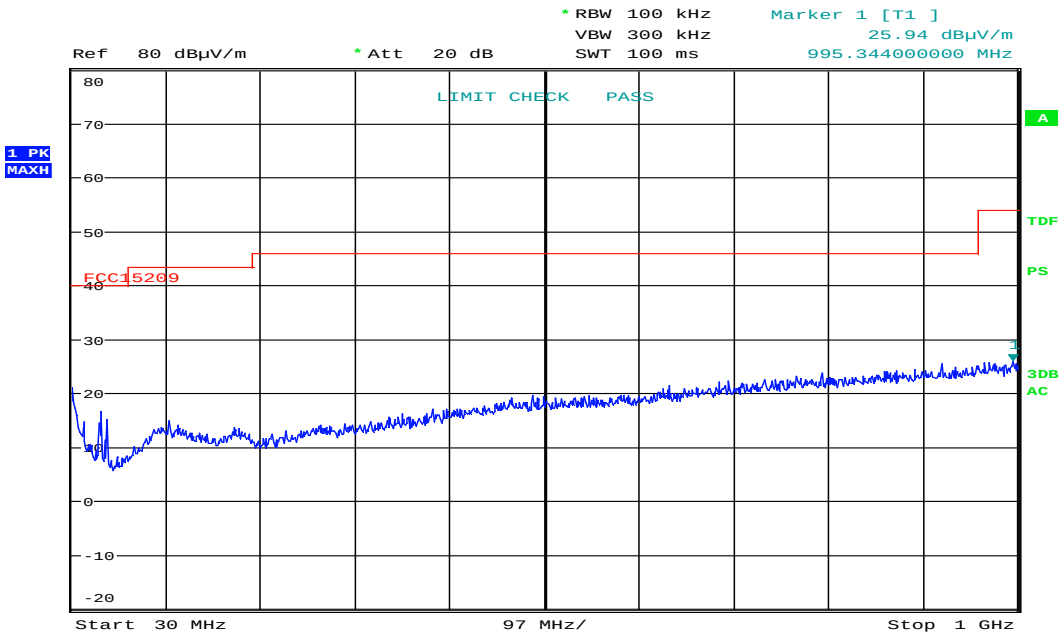
Requirements/Limit

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	



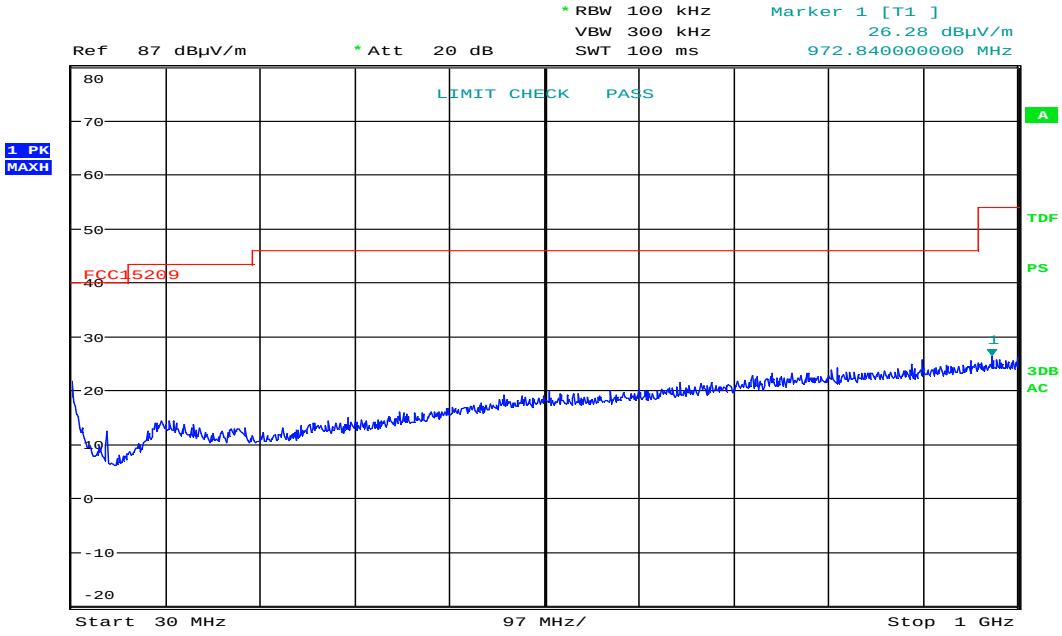
Date: 25.NOV.2019 09:27:57

Radiated Emissions, 30 – 1000 MHz, HP, BT LE



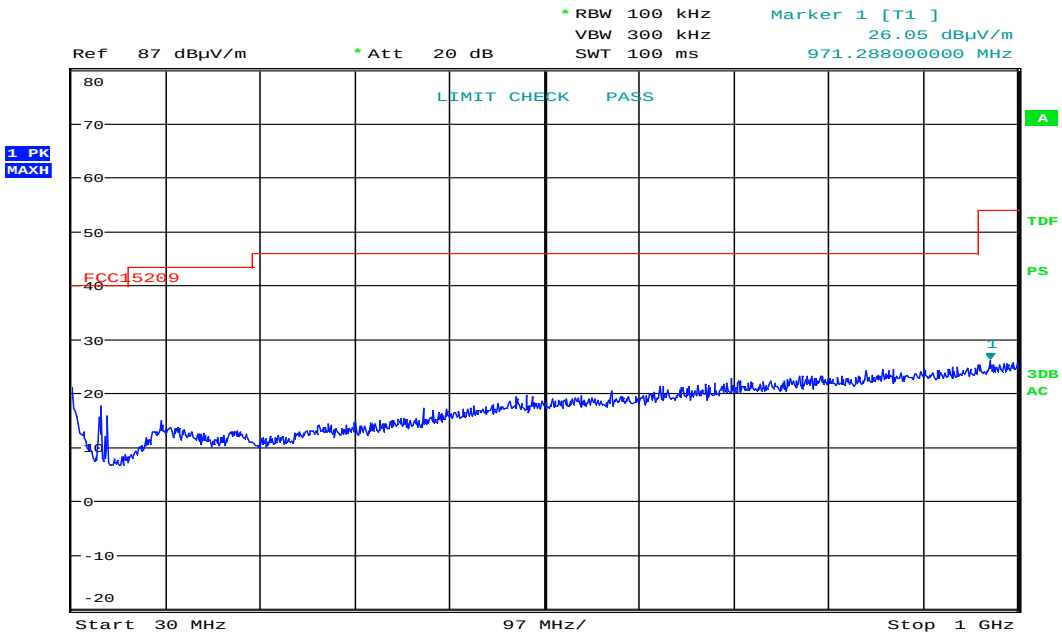
Date: 25.NOV.2019 09:25:53

Radiated Emissions, 30 – 1000 MHz, VP, BT LE



Date: 25.NOV.2019 09:39:18

Radiated Emissions, 30 – 1000 MHz, HP, BT 2Mb



Date: 25.NOV.2019 09:37:13

Radiated Emissions, 30 – 1000 MHz, VP, BT 2Mb

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)
1m (18 – 26 GHz)

Peak Detector:

Frequency	RF channel	Field strength, Peak Detector, 3m (dBµV/m)		Limit	Margin (dB)	
(MHz)		Long Range	2Mb	(dBµV/m)	LR	2Mb
7320	19	51.6	52.2	74	22.4	21.8
7440	39	56.9	57.0	74	17.1	17.0
12400	39	49.2	/	74	24.8	/
Other freqs	0 / 19 / 39	< 54	< 54	74	< 20	< 20

Average Detector:

Frequency	RF channel	Field strength, Average Detector, 3m (dBµV/m)		Limit	Margin (dB)	
(MHz)		Long Range	2Mb	(dBµV/m)	LR	2Mb
7320	19	31.6	32.2	54	22.4	21.8
7440	39	36.9	37.0	54	17.1	17.0
12400	39	29.2	/	54	24.8	/

Average Detector values are calculated from Peak values by Duty Cycle Correction Factor.

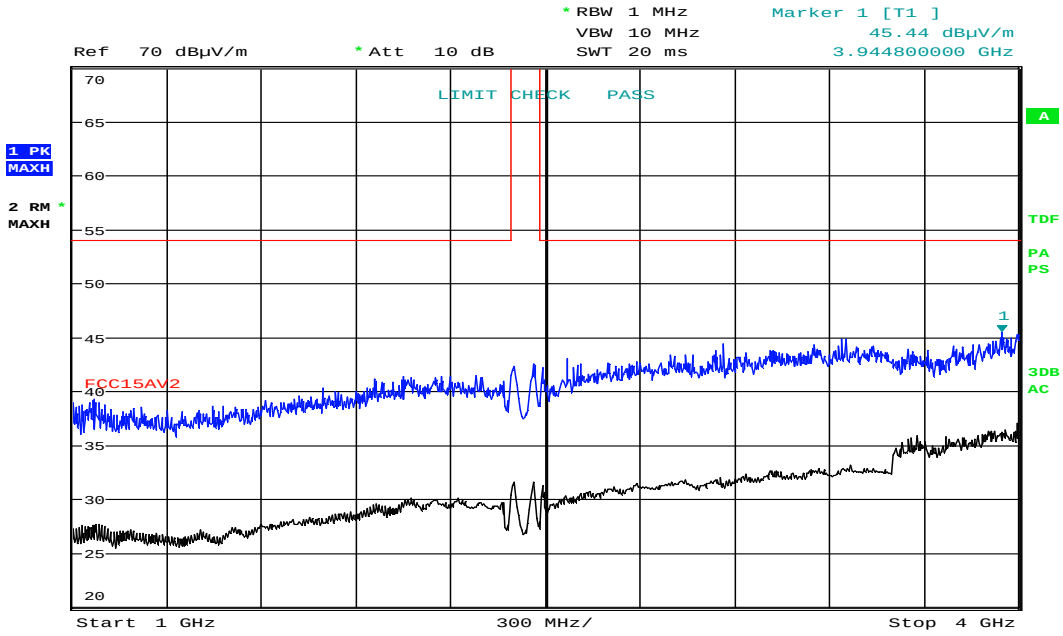
A Band Reject Filter was used for measurements from 1 GHz to 4 GHz and a High Pass Filter was used from 3 GHz to 18 GHz.

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

See plots.

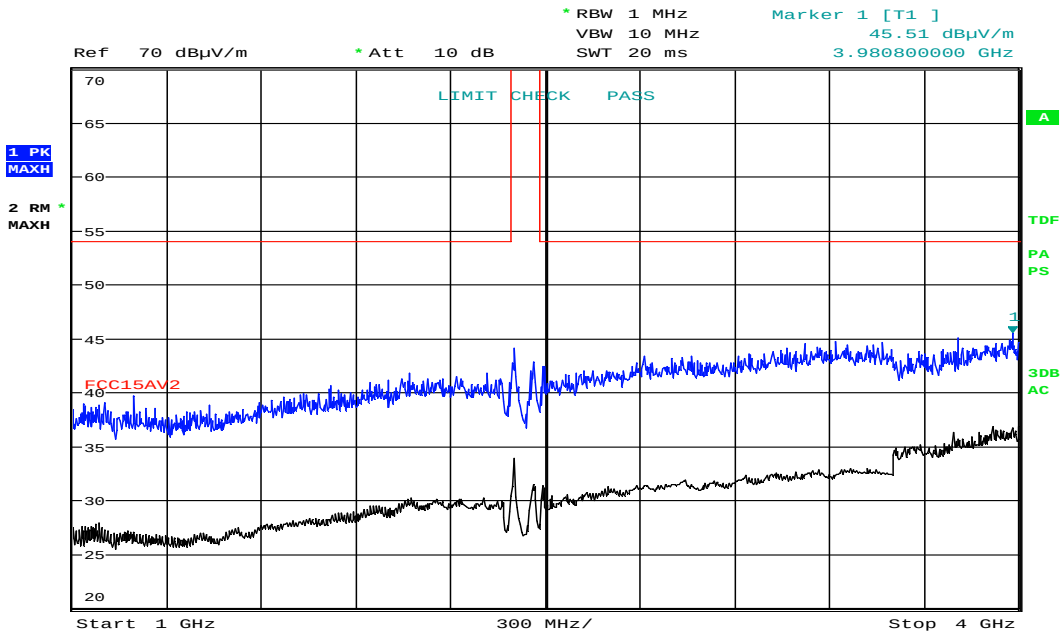
Requirements/Limit

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 dBµV/m	74.0 dBµV/m



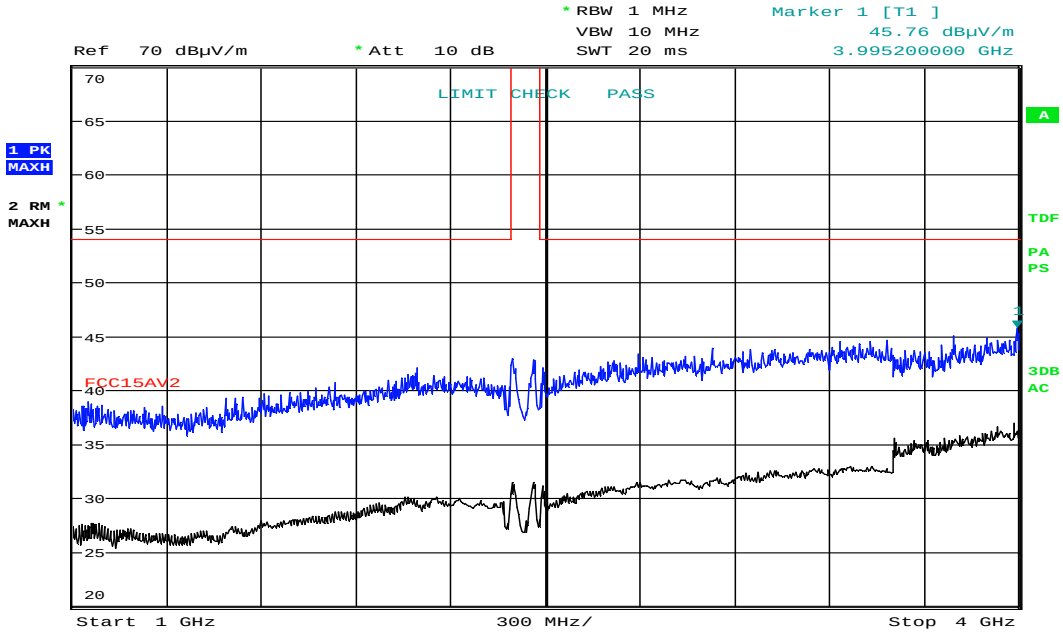
Date: 22.NOV.2019 13:42:01

Radiated Emissions, 1 – 4 GHz, 2402MHz, HP, BT LE LR



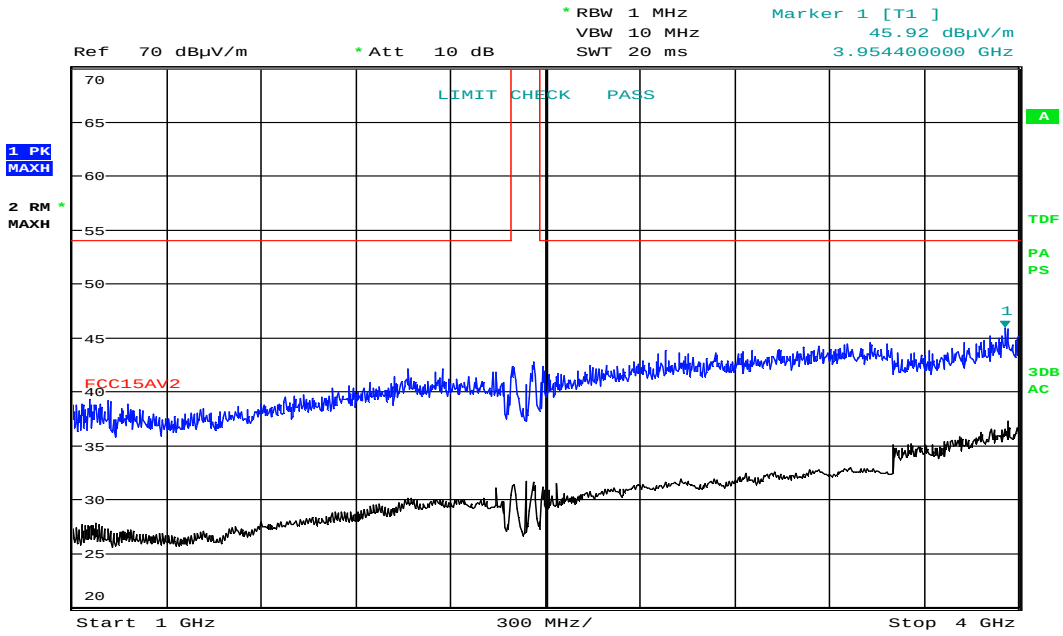
Date: 22.NOV.2019 13:40:04

Radiated Emissions, 1 – 4 GHz, 2402MHz, VP, BT LE LR



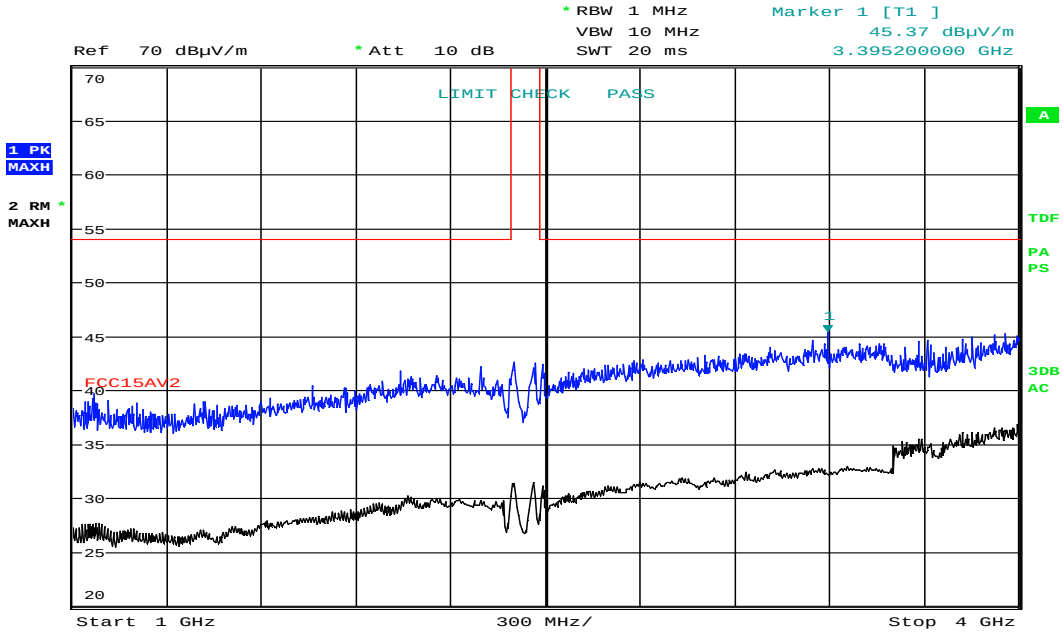
Date: 22.NOV.2019 13:48:42

Radiated Emissions, 1 – 4 GHz, 2440MHz, HP, BT LE LR



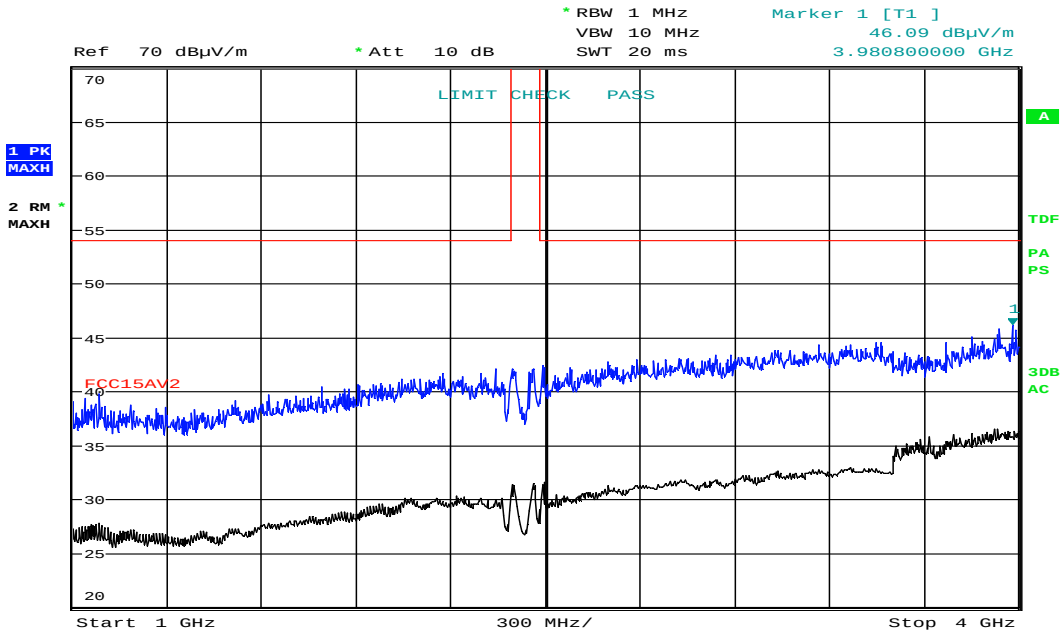
Date: 22.NOV.2019 13:46:46

Radiated Emissions, 1 – 4 GHz, 2440MHz, VP, BT LE LR



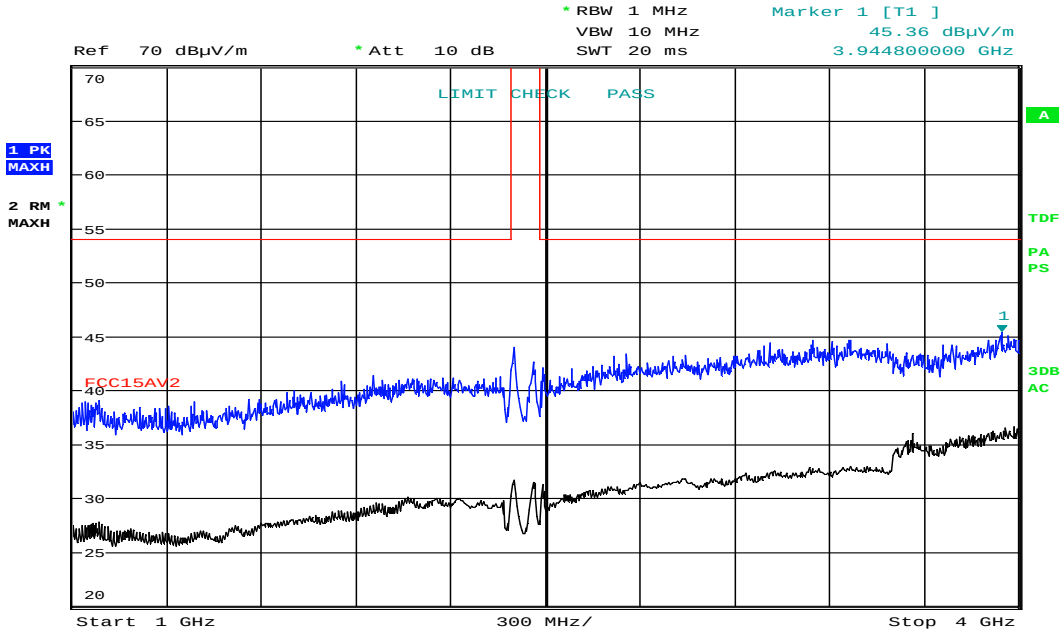
Date: 22.NOV.2019 13:54:23

Radiated Emissions, 1 – 4 GHz, 2480MHz, HP, BT LE LR



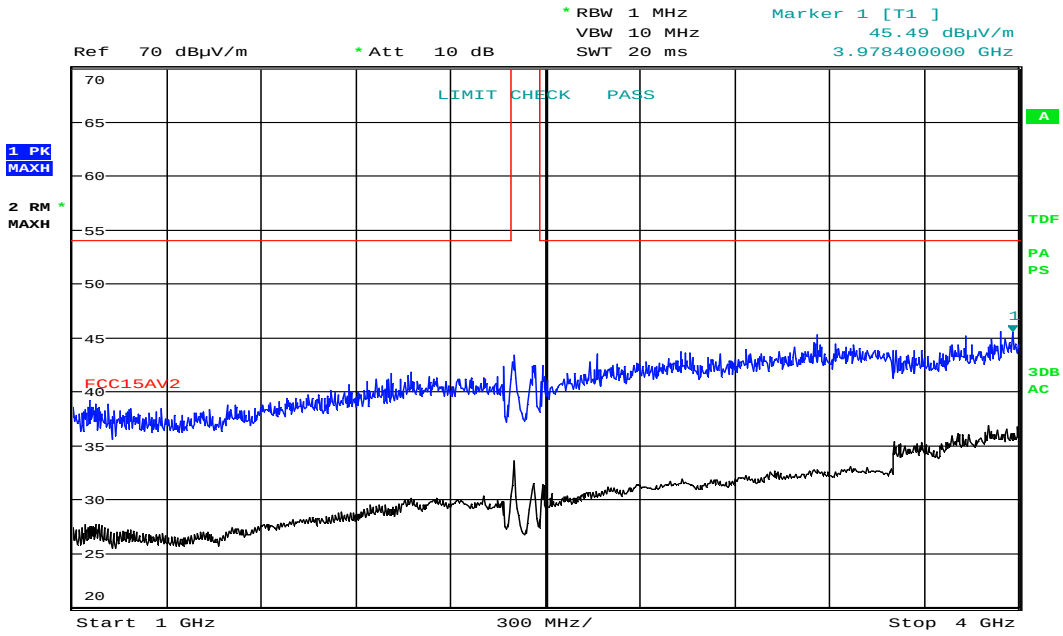
Date: 22.NOV.2019 13:52:27

Radiated Emissions, 1 – 4 GHz, 2480MHz, VP, BT LE LR



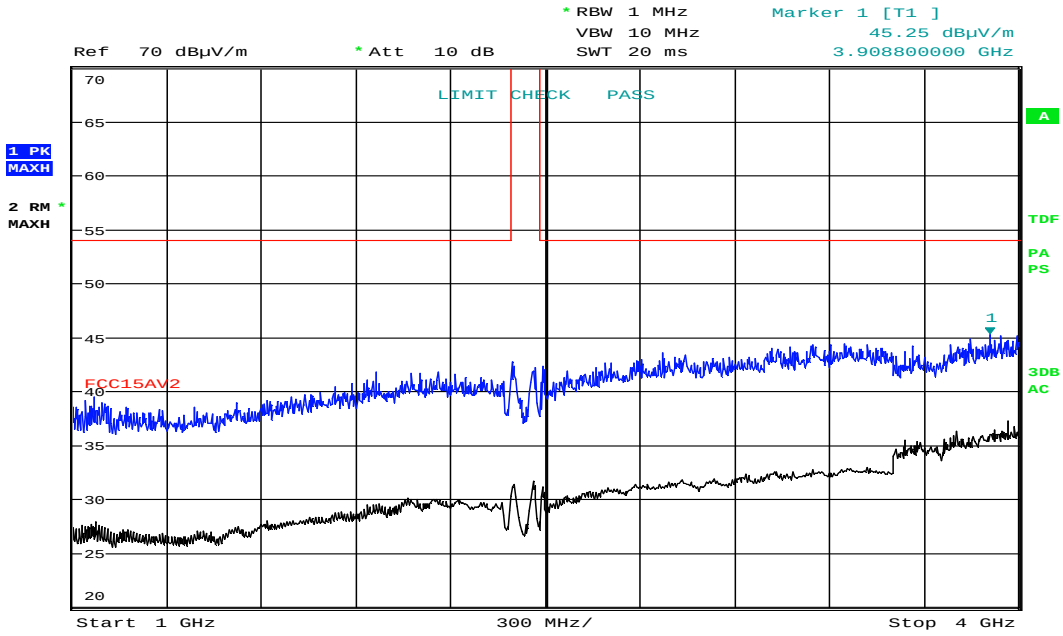
Date: 22.NOV.2019 13:30:58

Radiated Emissions, 1 – 4 GHz, 2402MHz, HP, BT LE 2Mb



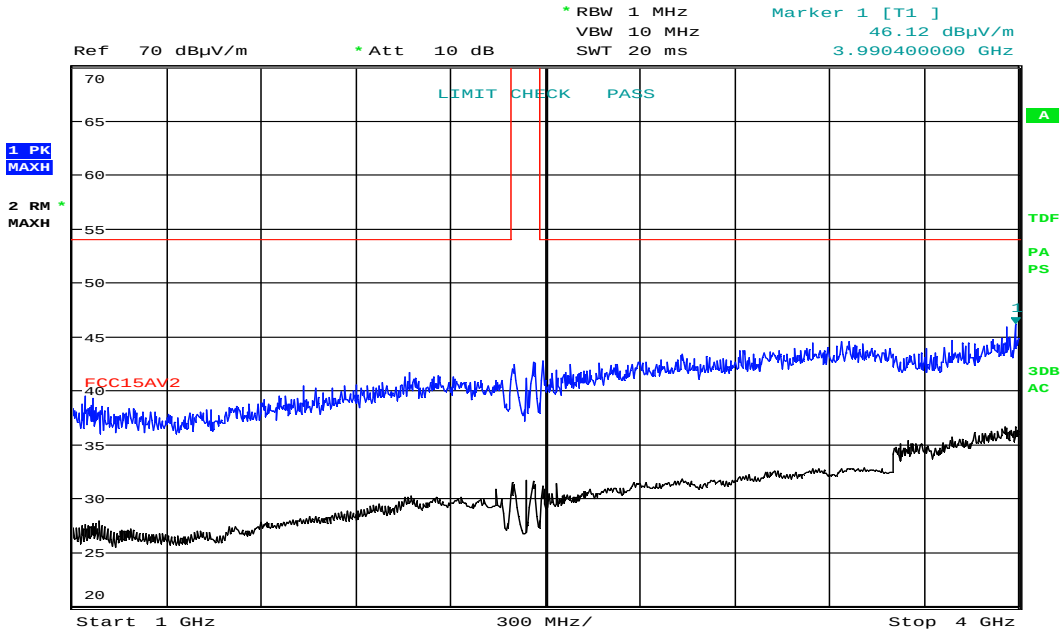
Date: 22.NOV.2019 13:29:01

Radiated Emissions, 1 – 4 GHz, 2402MHz, VP, BT LE 2Mb



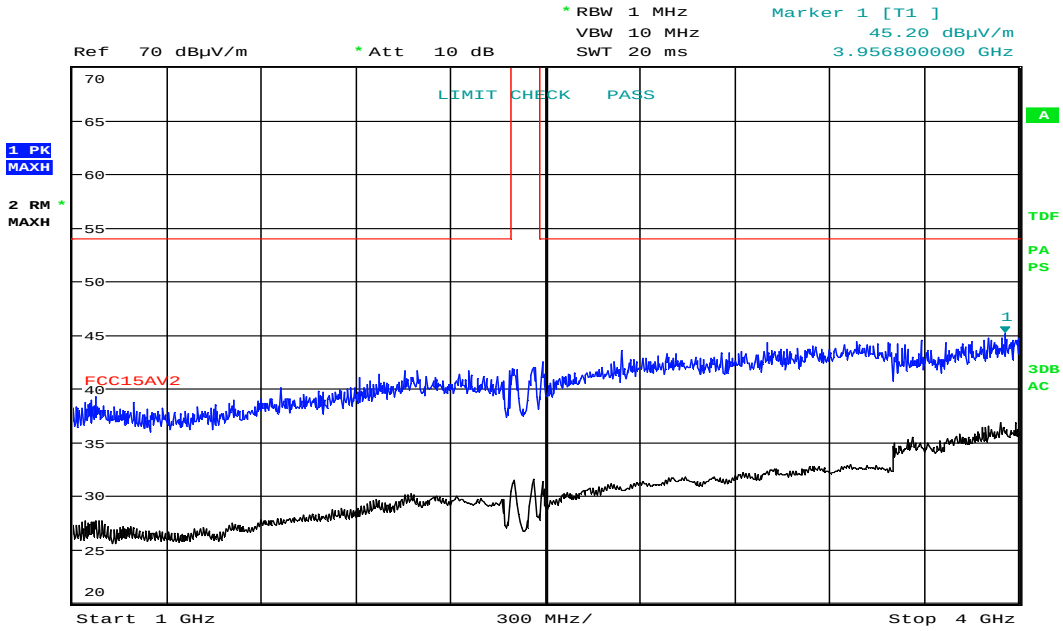
Date: 22.NOV.2019 13:20:27

Radiated Emissions, 1 – 4 GHz, 2440MHz, HP, BT LE 2Mb



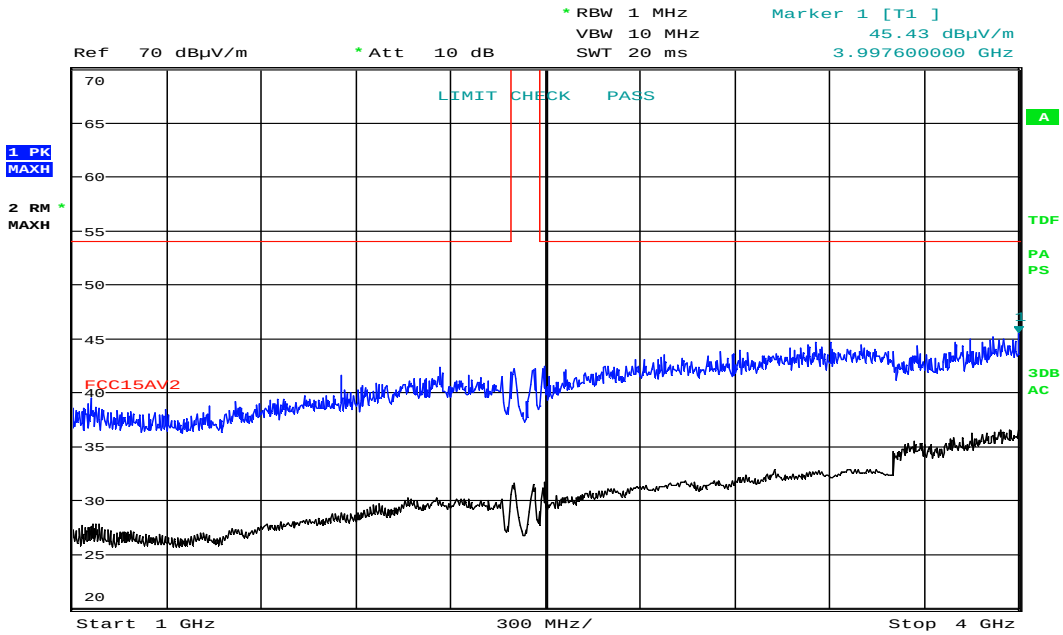
Date: 22.NOV.2019 13:18:30

Radiated Emissions, 1 – 4 GHz, 2440MHz, VP, BT LE 2Mb



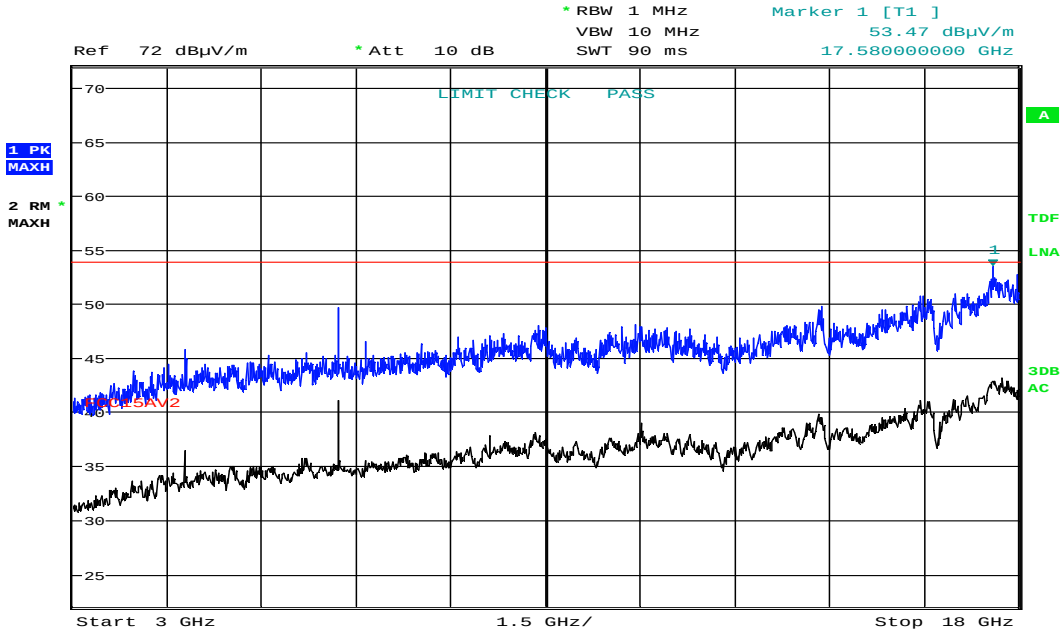
Date: 22.NOV.2019 13:36:28

Radiated Emissions, 1 – 4 GHz, 2480MHz, HP, BT LE 2Mb



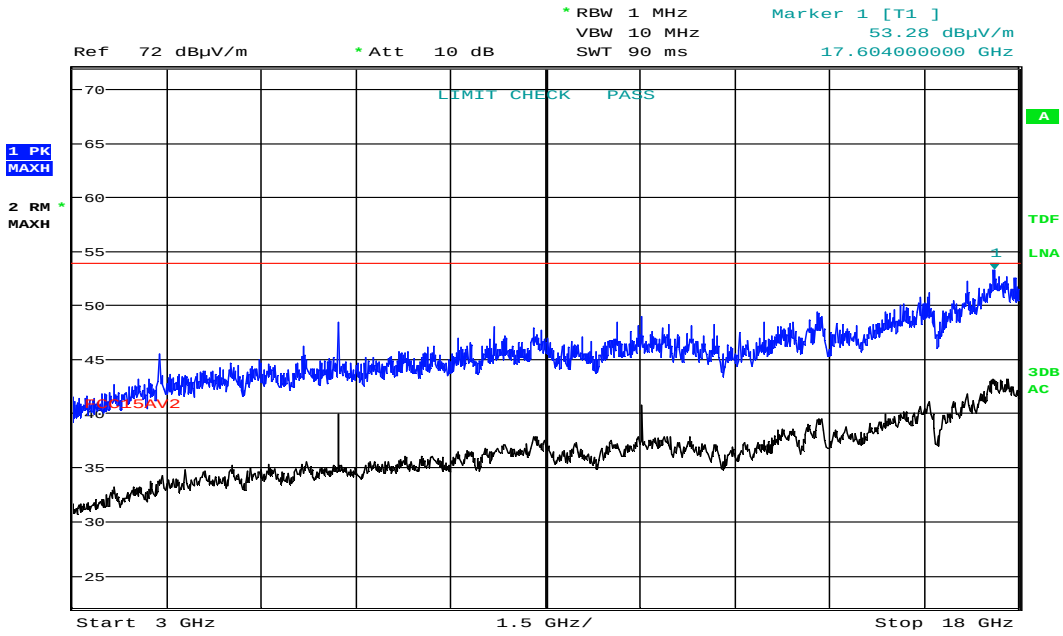
Date: 22.NOV.2019 13:34:32

Radiated Emissions, 1 – 4 GHz, 2480MHz, VP, BT LE 2Mb



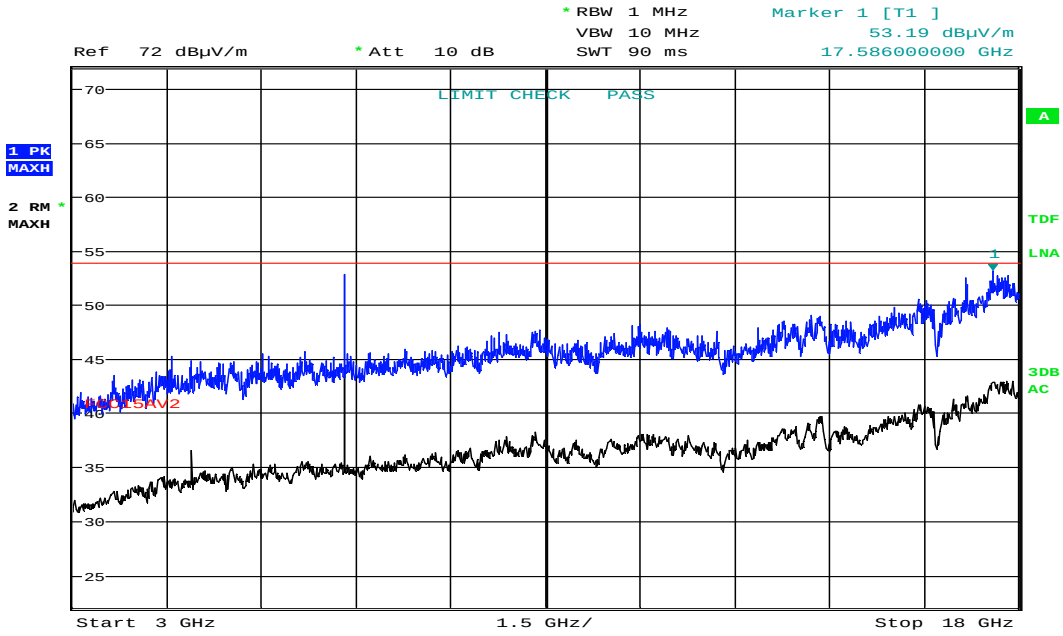
Date: 22.NOV.2019 14:07:34

Radiated Emissions, 3 – 18 GHz, 2402MHz, HP, BT LE LR



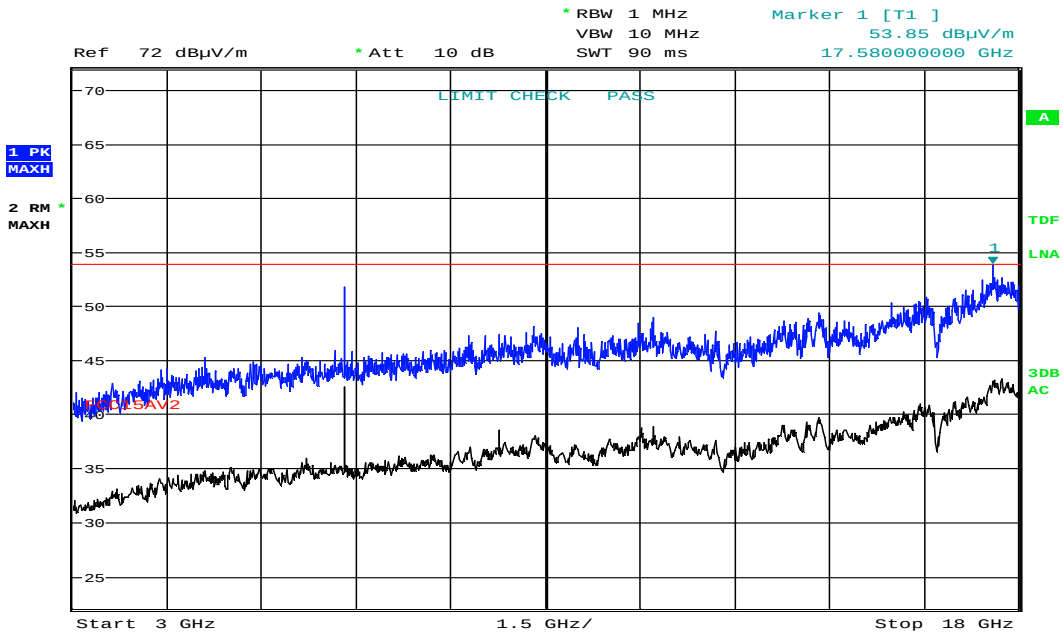
Date: 22.NOV.2019 14:05:37

Radiated Emissions, 3 – 18 GHz, 2402MHz, VP, BT LE LR



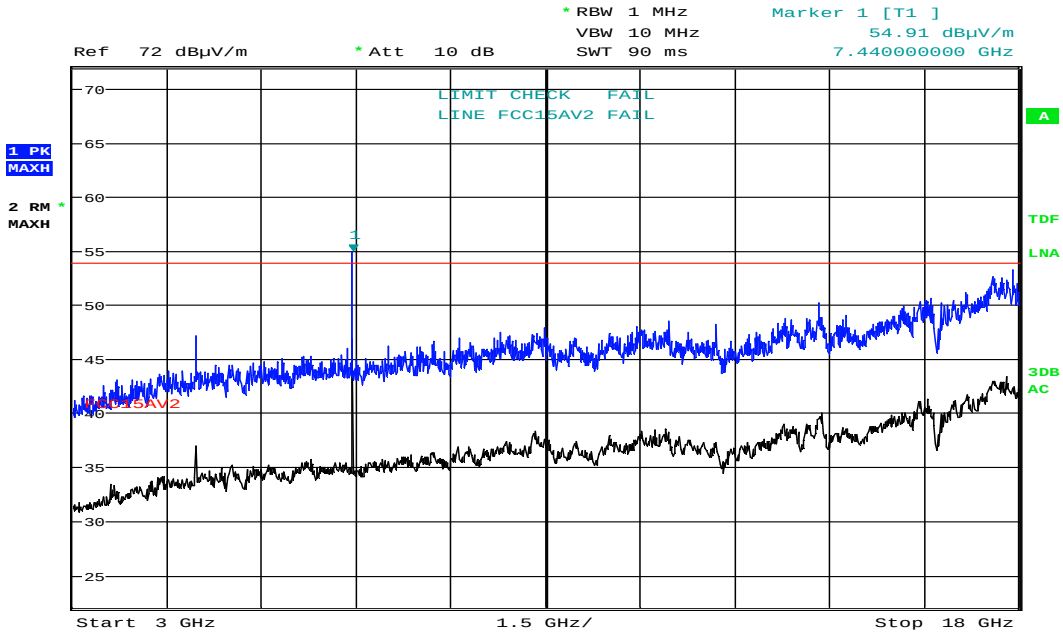
Date: 22.NOV.2019 14:12:57

Radiated Emissions, 3 – 18 GHz, 2440MHz, HP, BT LE LR



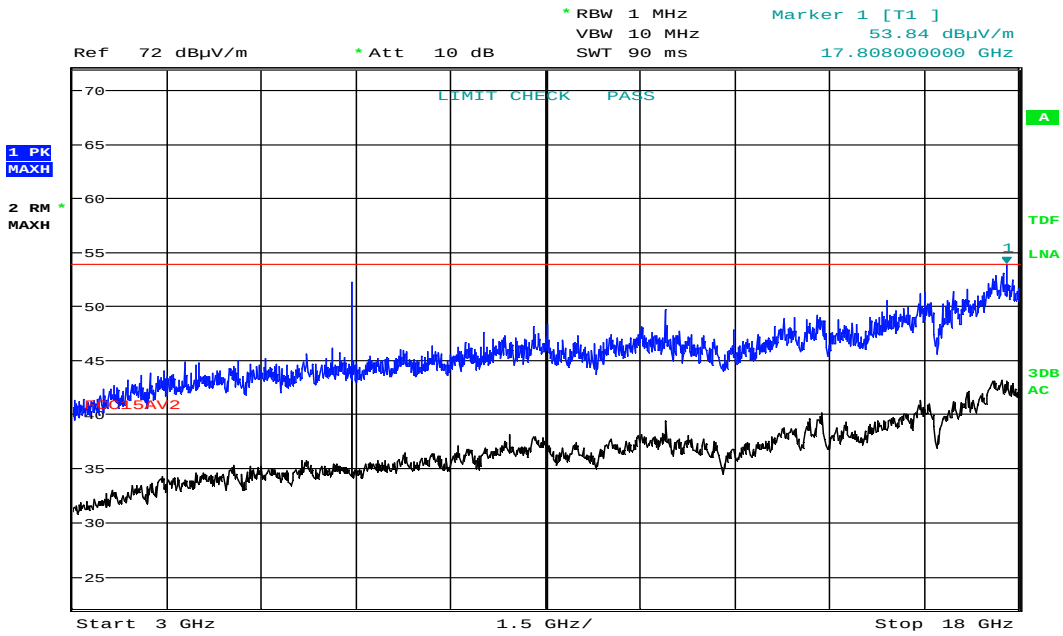
Date: 22.NOV.2019 14:11:00

Radiated Emissions, 3 – 18 GHz, 2440MHz, VP, BT LE LR



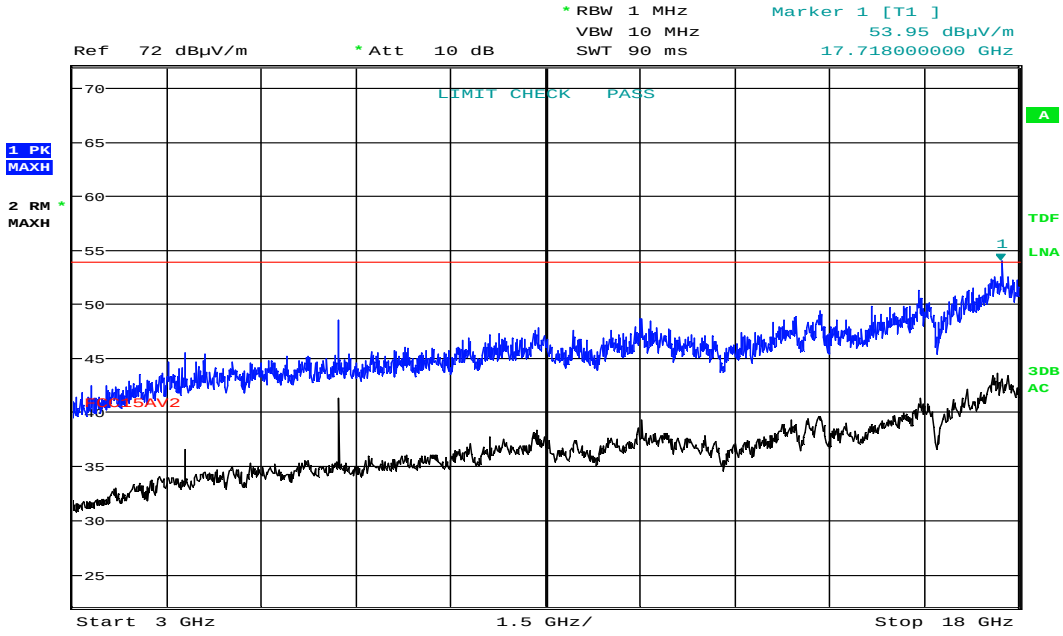
Date: 22.NOV.2019 14:18:49

Radiated Emissions, 3 – 18 GHz, 2480MHz, HP, BT LE LR



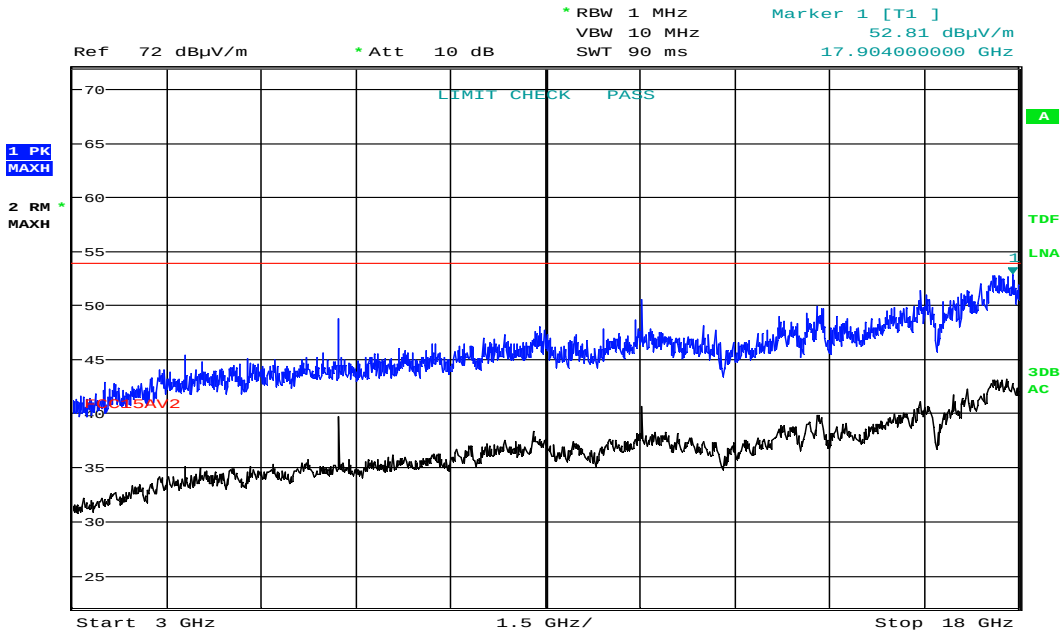
Date: 22.NOV.2019 14:16:52

Radiated Emissions, 3 – 18 GHz, 2480MHz, VP, BT LE LR



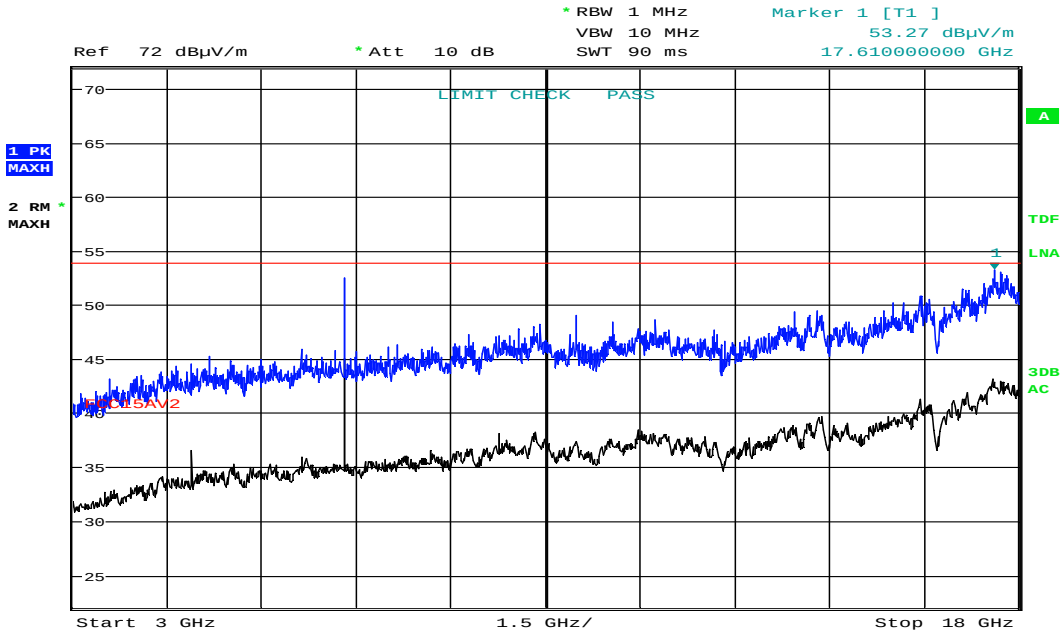
Date: 22.NOV.2019 14:37:09

Radiated Emissions, 3 – 18 GHz, 2402MHz, HP, BT LE 2Mb



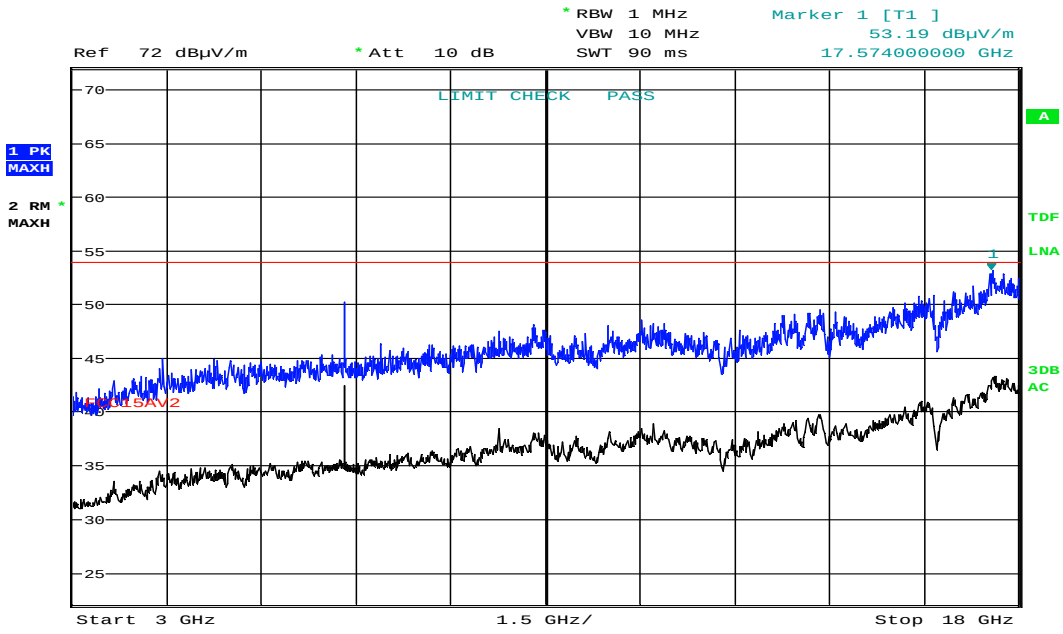
Date: 22.NOV.2019 14:35:13

Radiated Emissions, 3 – 18 GHz, 2402MHz, VP, BT LE 2Mb



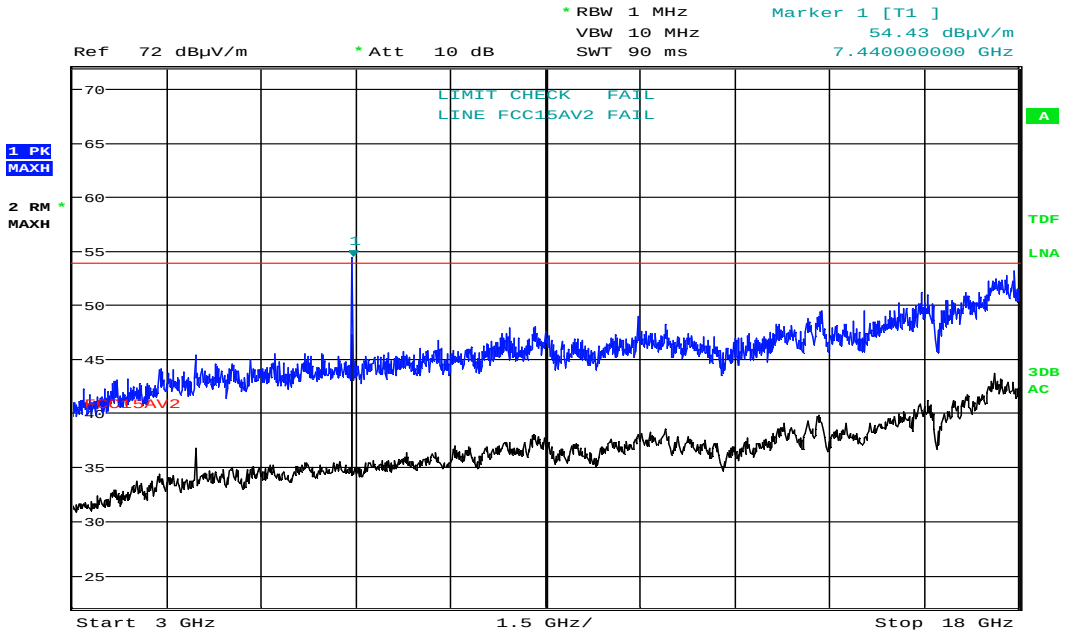
Date: 22.NOV.2019 14:29:27

Radiated Emissions, 3 – 18 GHz, 2440MHz, HP, BT LE 2Mb



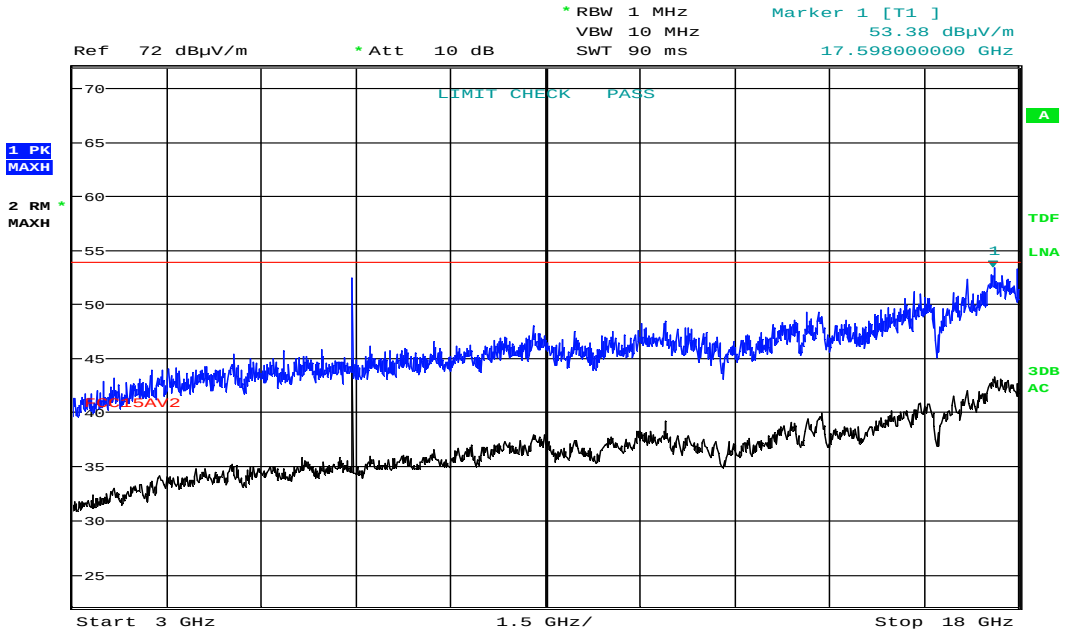
Date: 22.NOV.2019 14:27:30

Radiated Emissions, 3 – 18 GHz, 2440MHz, VP, BT LE 2Mb



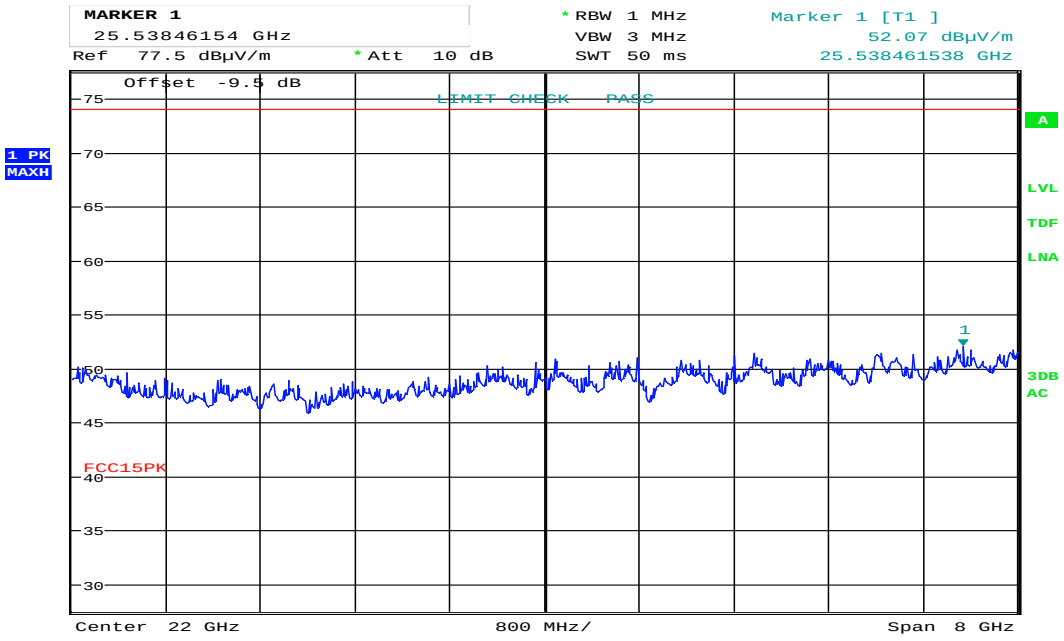
Date: 22.NOV.2019 14:24:28

Radiated Emissions, 3 – 18 GHz, 2480MHz, HP, BT LE 2Mb



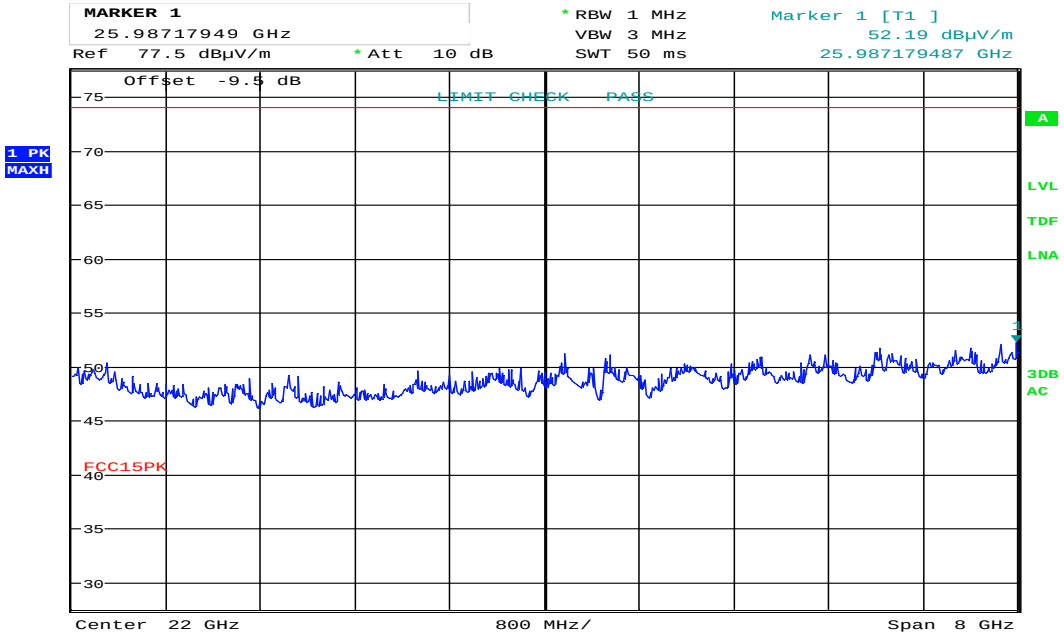
Date: 22.NOV.2019 14:22:31

Radiated Emissions, 3 – 18 GHz, 2480MHz, VP, BT LE 2Mb



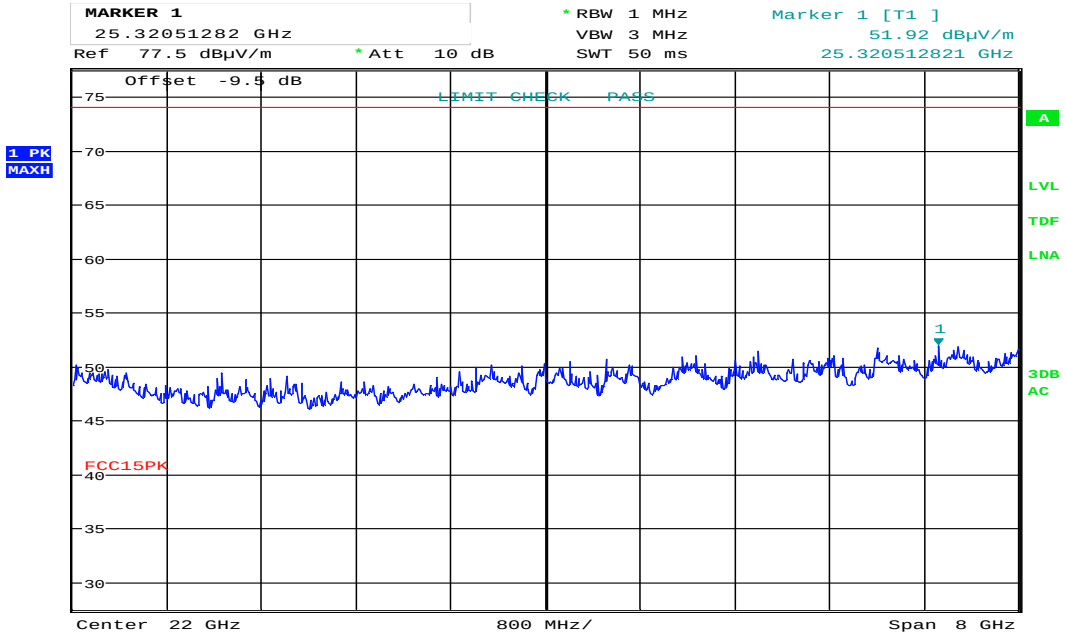
Date: 25.NOV.2019 12:49:42

Radiated Emissions, 18 – 26 GHz, 2402MHz, HP, BT LE LR, @1m



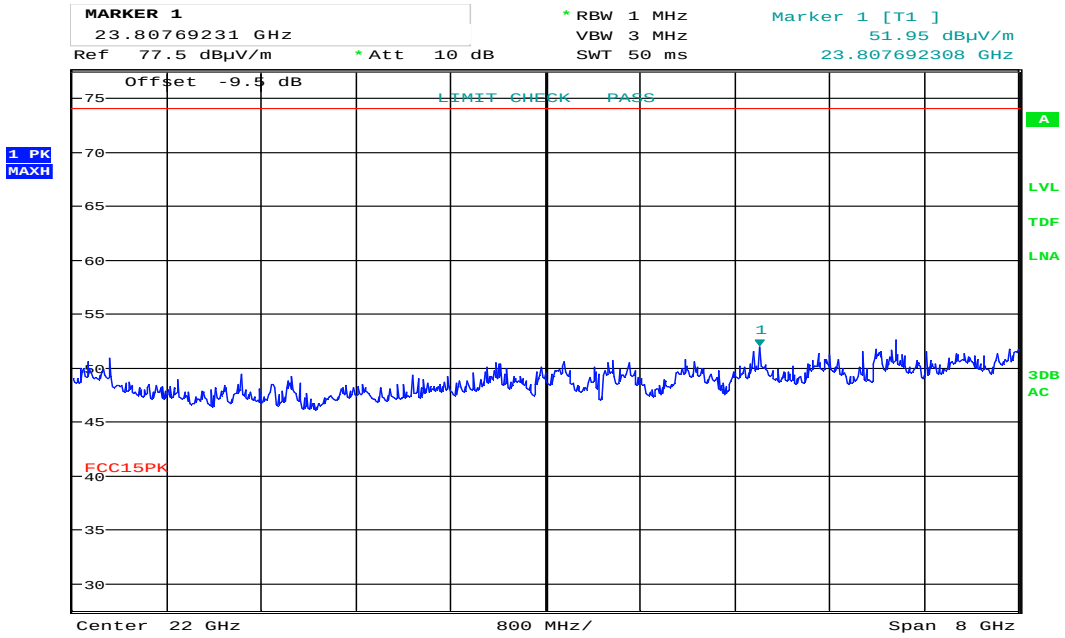
Date: 25.NOV.2019 12:48:39

Radiated Emissions, 18 – 26 GHz, 2402MHz, VP, BT LE LR, @1m



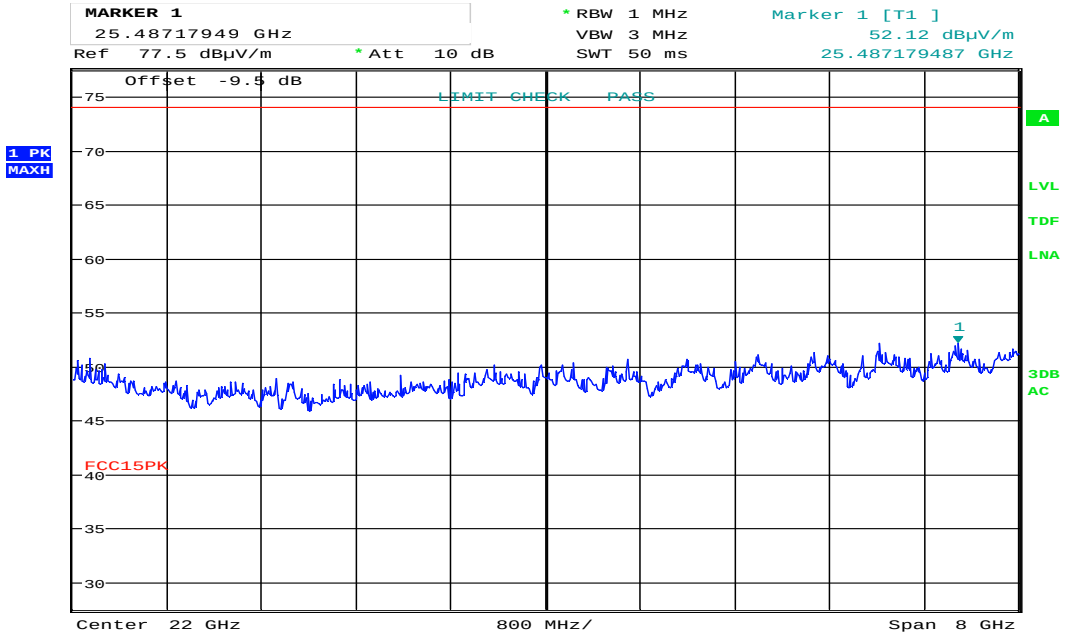
Date: 25.NOV.2019 12:43:47

Radiated Emissions, 18 – 26 GHz, 2440MHz, HP, BT LE LR, @1m



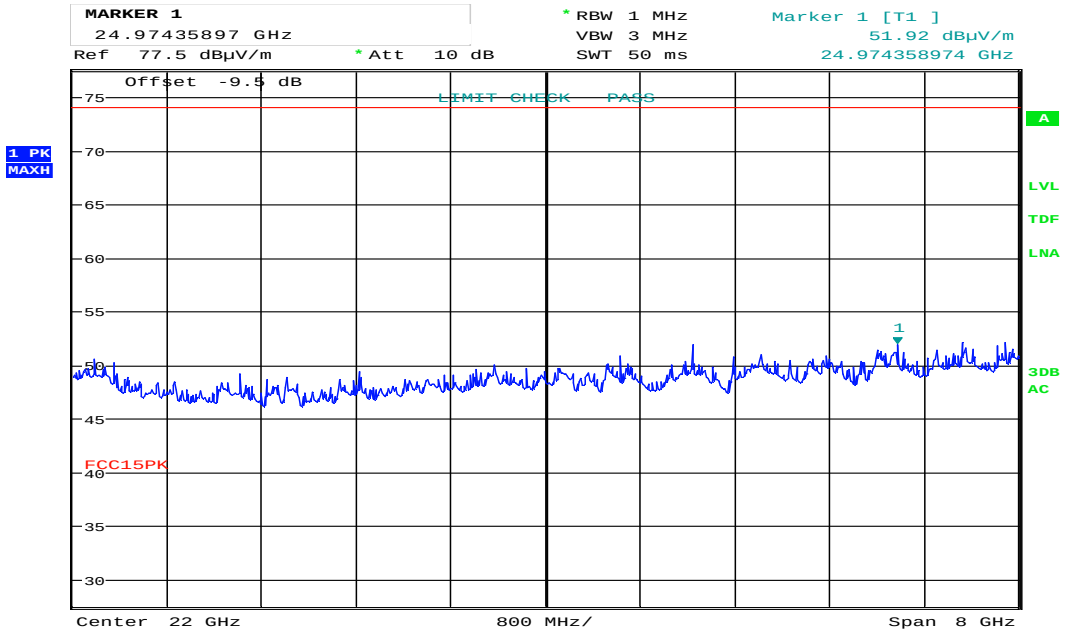
Date: 25.NOV.2019 12:44:41

Radiated Emissions, 18 – 26 GHz, 2440MHz, VP, BT LE LR, @1m



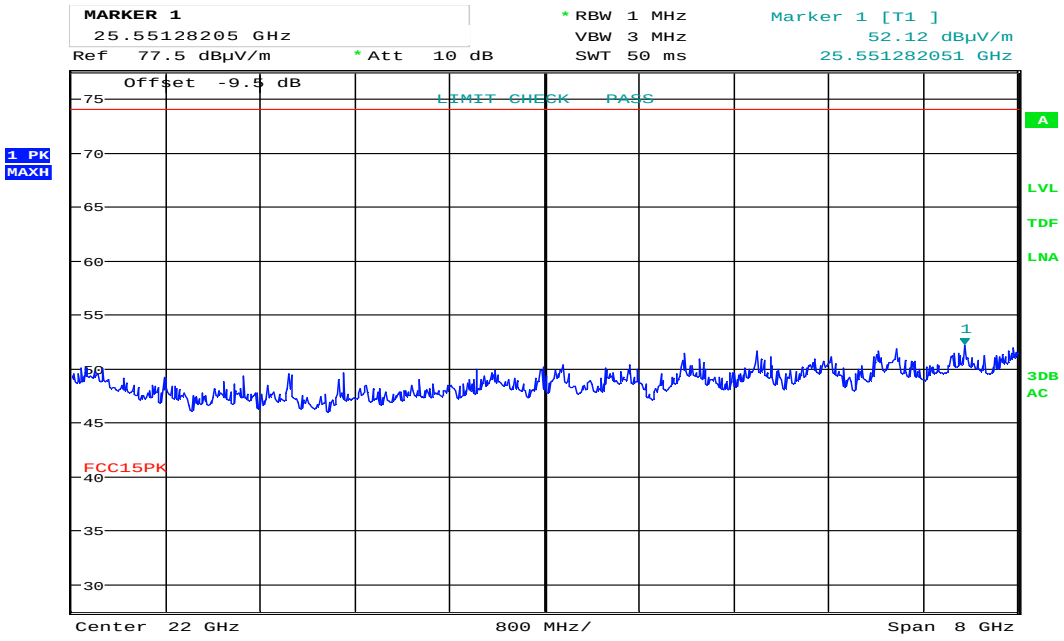
Date: 25.NOV.2019 12:07:56

Radiated Emissions, 18 – 26 GHz, 2480MHz, HP, BT LE LR, @1m



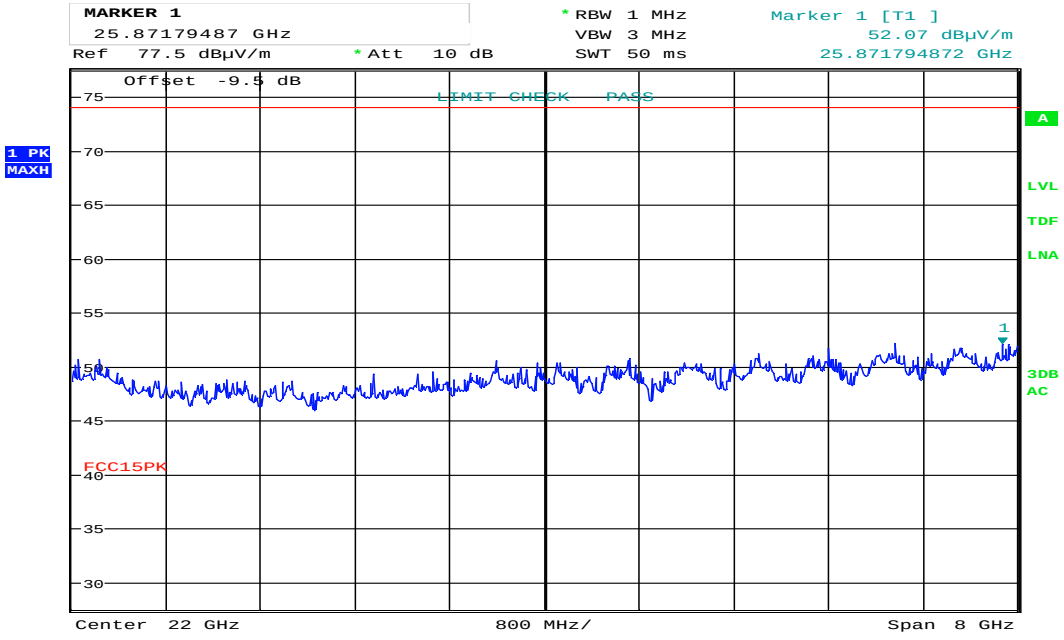
Date: 25.NOV.2019 12:07:04

Radiated Emissions, 18 – 26 GHz, 2480MHz, VP, BT LE LR, @1m



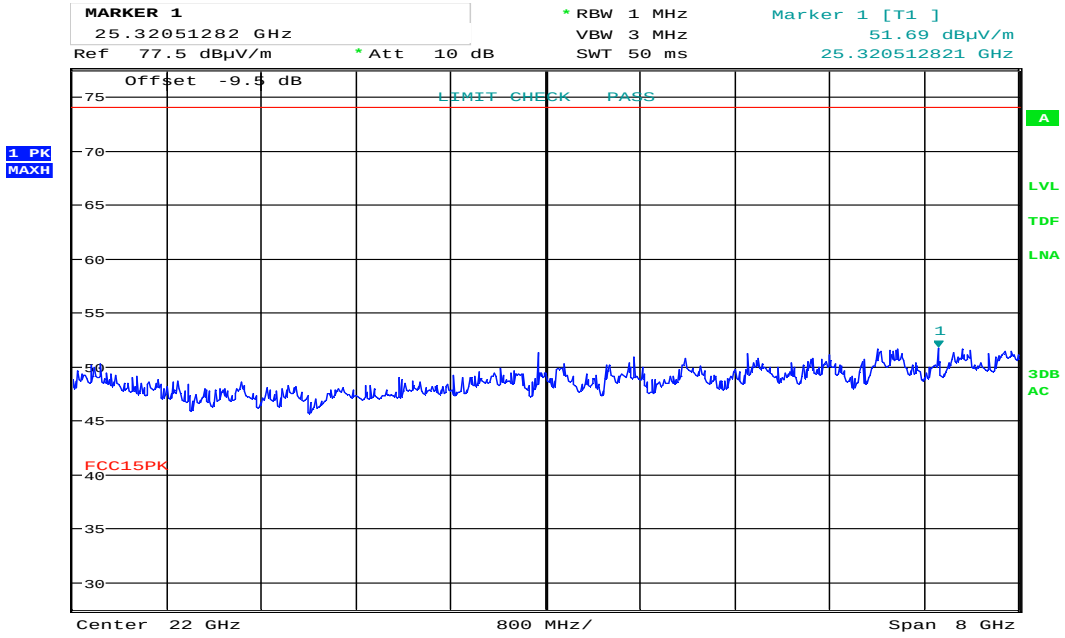
Date: 25.NOV.2019 12:57:28

Radiated Emissions, 18 – 26 GHz, 2402MHz, HP, BT LE 2Mb, @1m



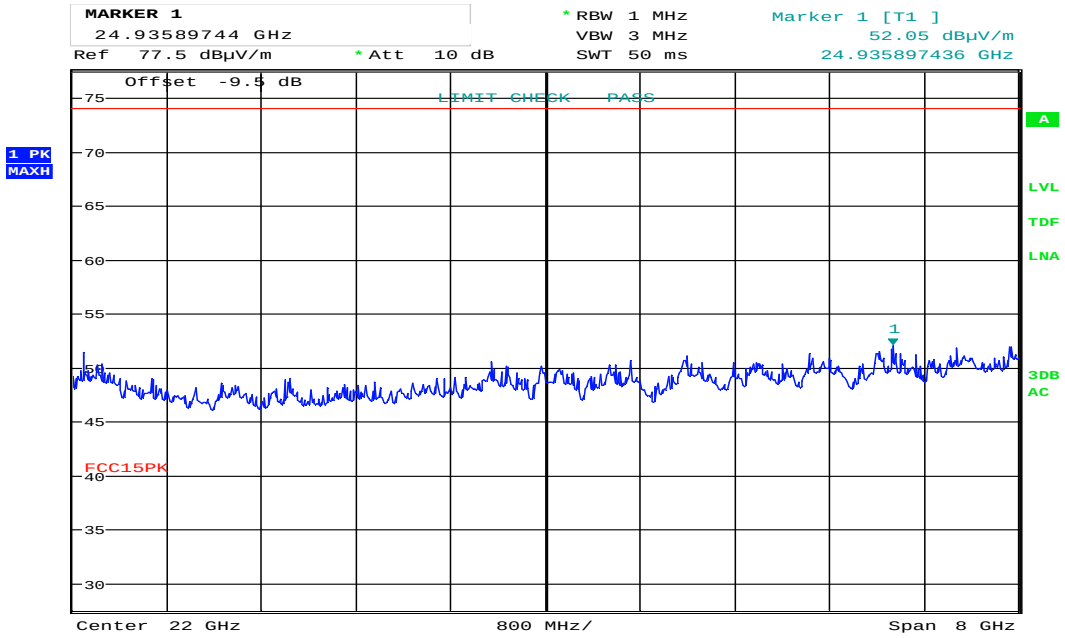
Date: 25.NOV.2019 12:58:29

Radiated Emissions, 18 – 26 GHz, 2402MHz, VP, BT LE 2Mb, @1m



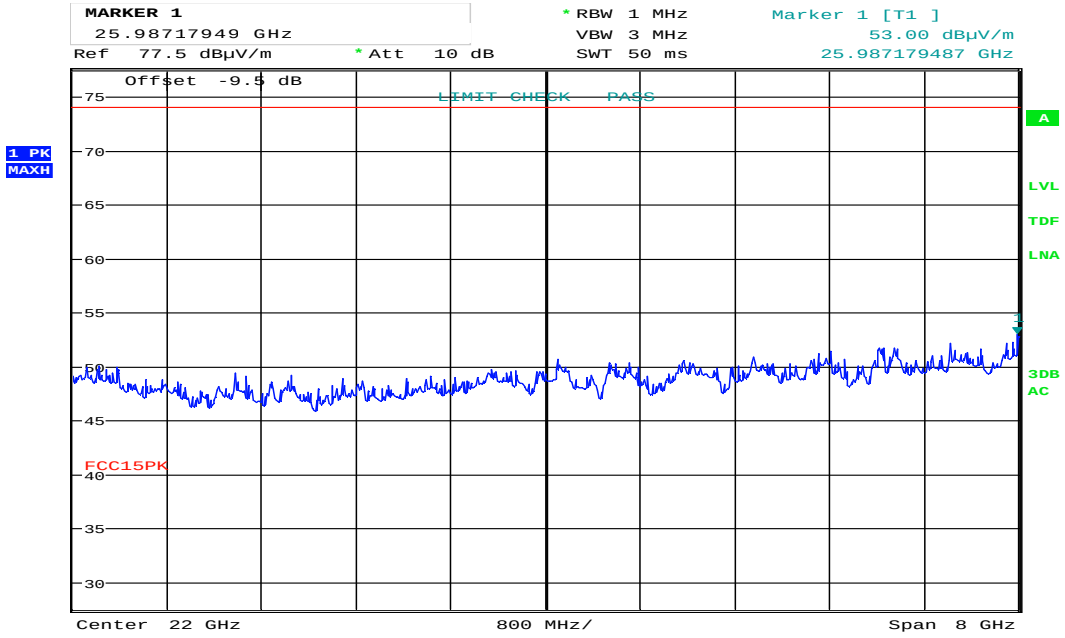
Date: 25.NOV.2019 12:36:39

Radiated Emissions, 18 – 26 GHz, 2440MHz, HP, BT LE 2Mb, @1m



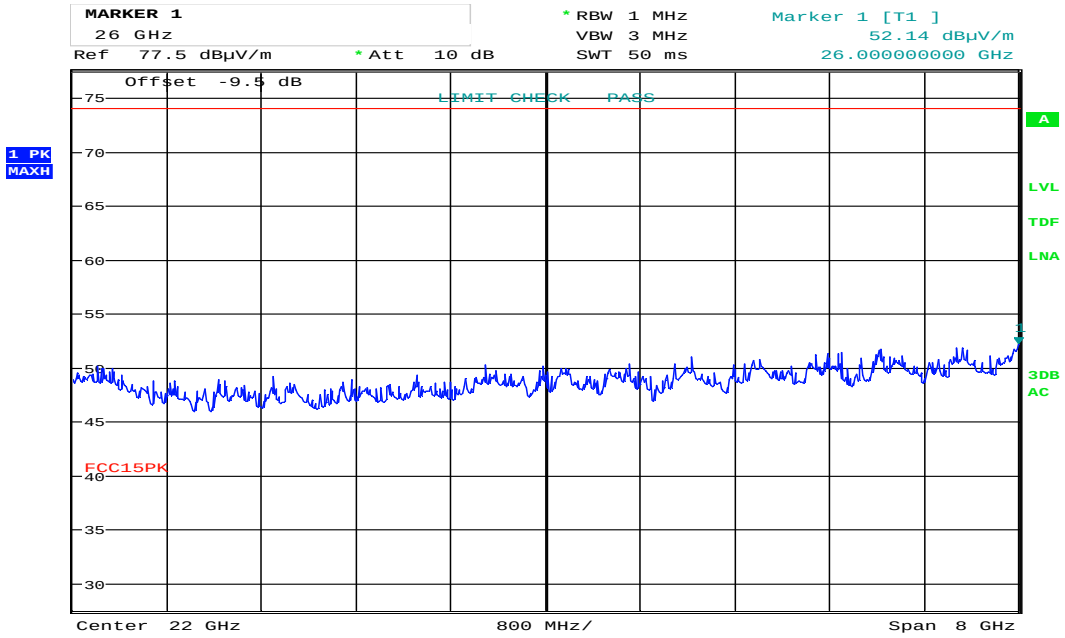
Date: 25.NOV.2019 12:35:51

Radiated Emissions, 18 – 26 GHz, 2440MHz, VP, BT LE 2Mb, @1m



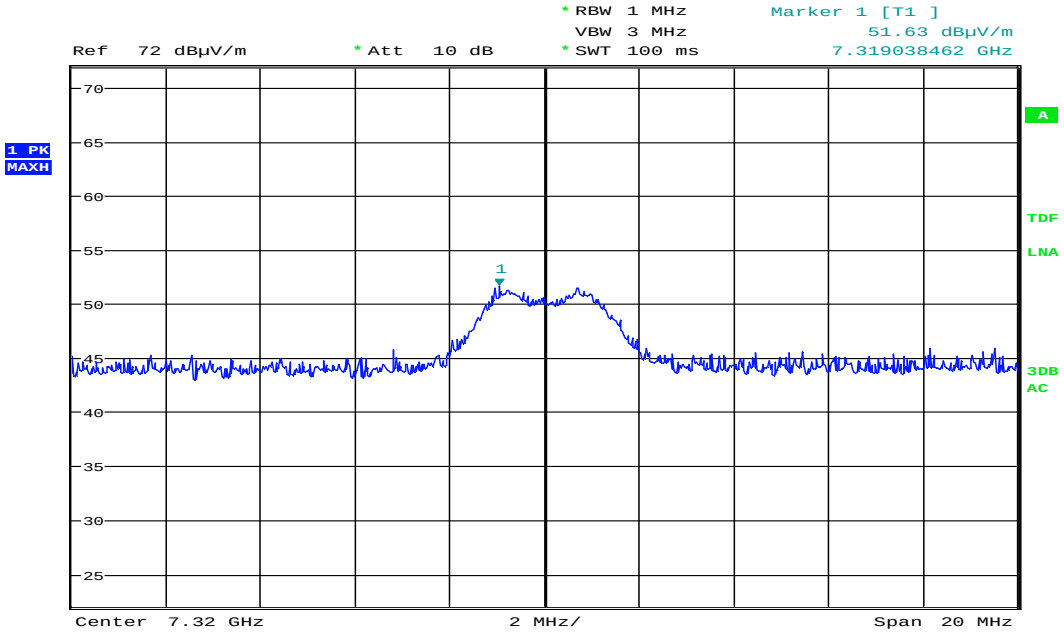
Date: 25.NOV.2019 12:15:26

Radiated Emissions, 18 – 26 GHz, 2480MHz, HP, BT LE 2Mb, @1m



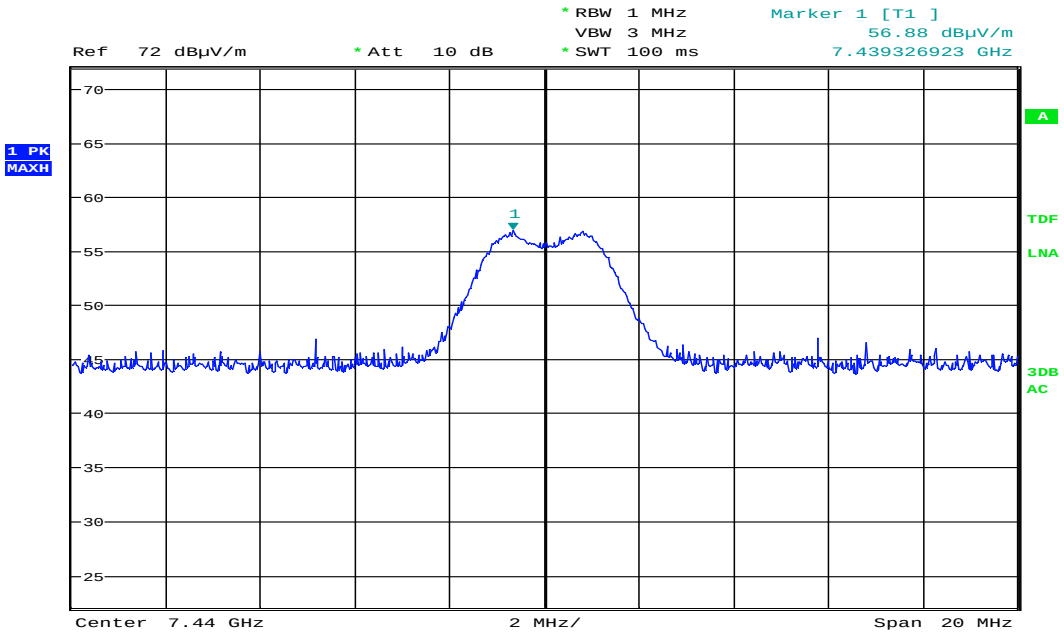
Date: 25.NOV.2019 12:16:09

Radiated Emissions, 18 – 26 GHz, 2480MHz, VP, BT LE 2Mb, @1m



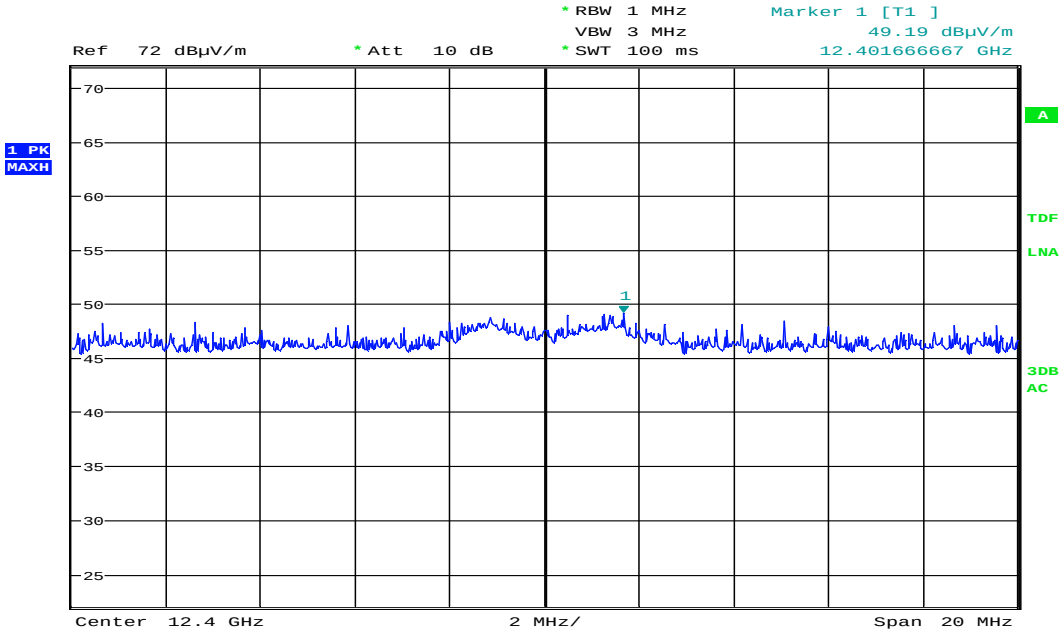
Date: 22.NOV.2019 15:37:38

Radiated Emissions, 7320 GHz, 2440MHz, VP, BT LE LR



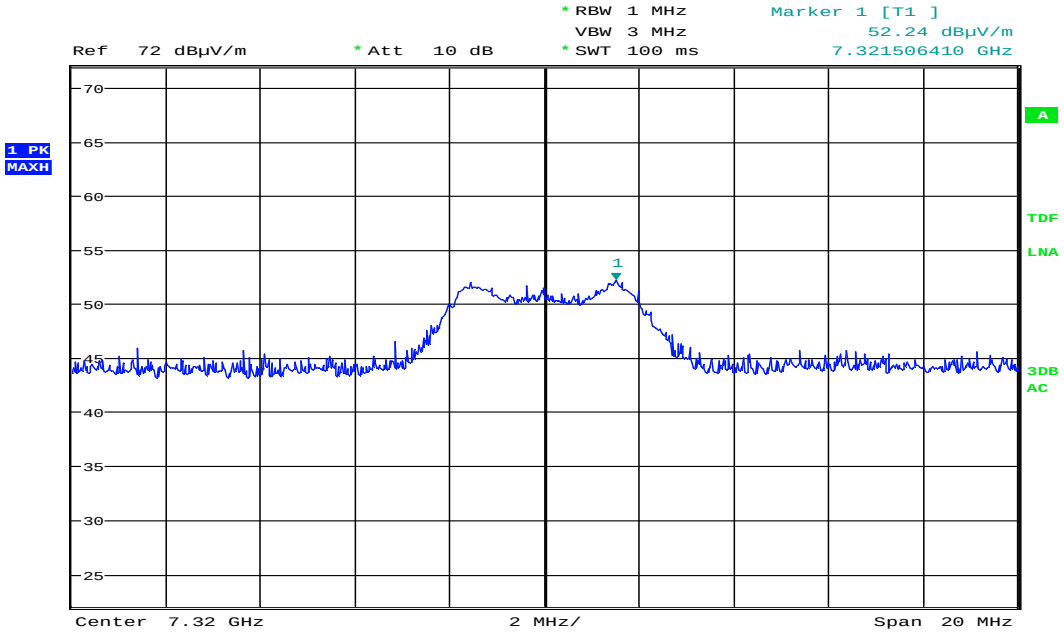
Date: 22.NOV.2019 15:02:27

Radiated Emissions, 7440 GHz, 2480MHz, HP, BT LE LR

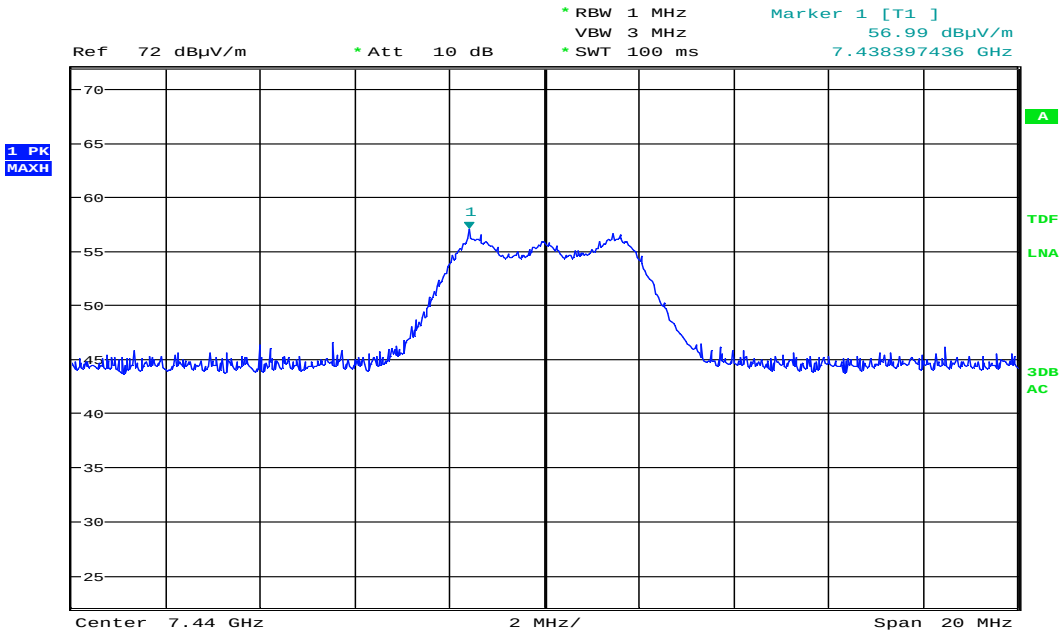


Date: 22.NOV.2019 14:50:58

Radiated Emissions, 12400 GHz, 2480MHz, VP, BT LE LR



Radiated Emissions, 7320 GHz, 2440MHz, VP, BT LE 2Mb



Radiated Emissions, 7440 GHz, 2480MHz, HP, BT LE 2Mb

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:

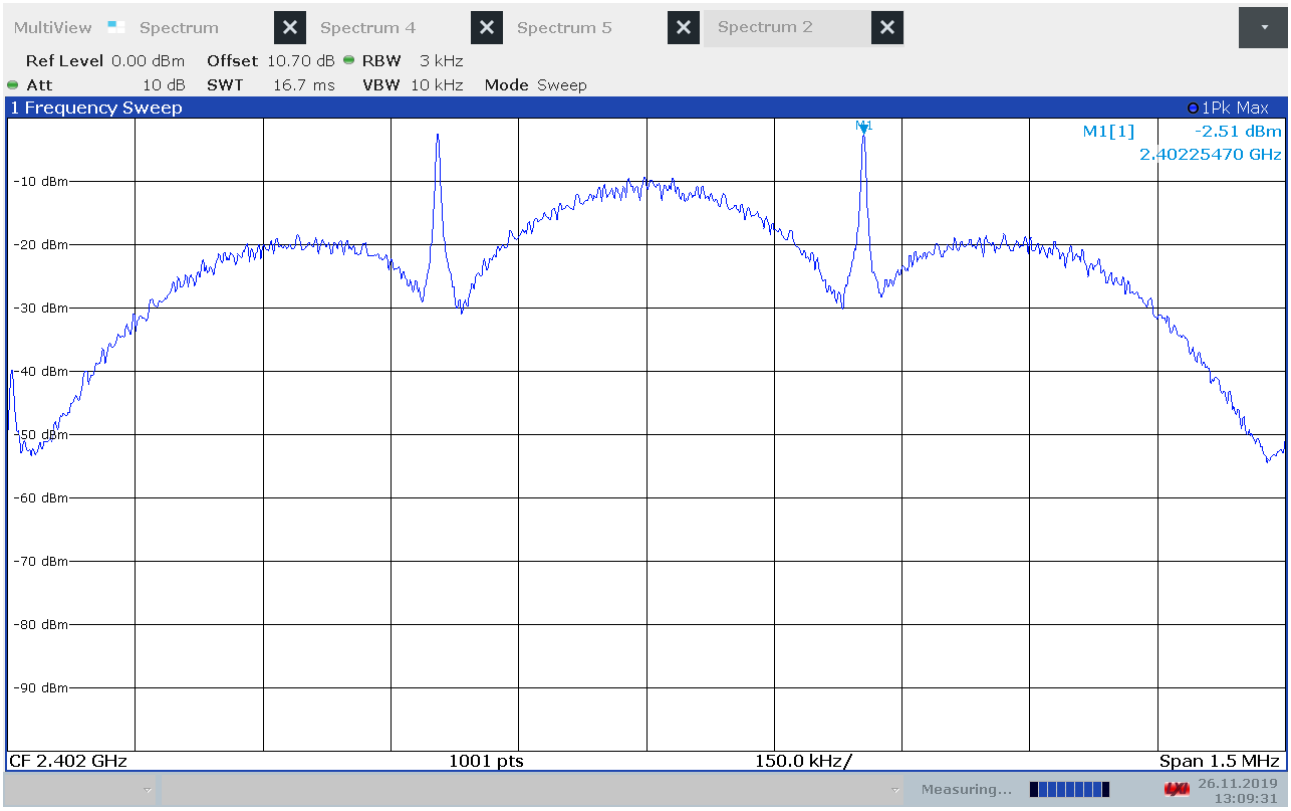
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

Operating Mode	Carrier Frequency	Measured Power Spectral Density (dBm/3kHz)
BT LE LR	2402 MHz	-2.5
	2440 MHz	-3.5
	2480 MHz	-4.8
BT LE 2Mb	2402 MHz	-12.8
	2440 MHz	-13.0
	2480 MHz	-14.4

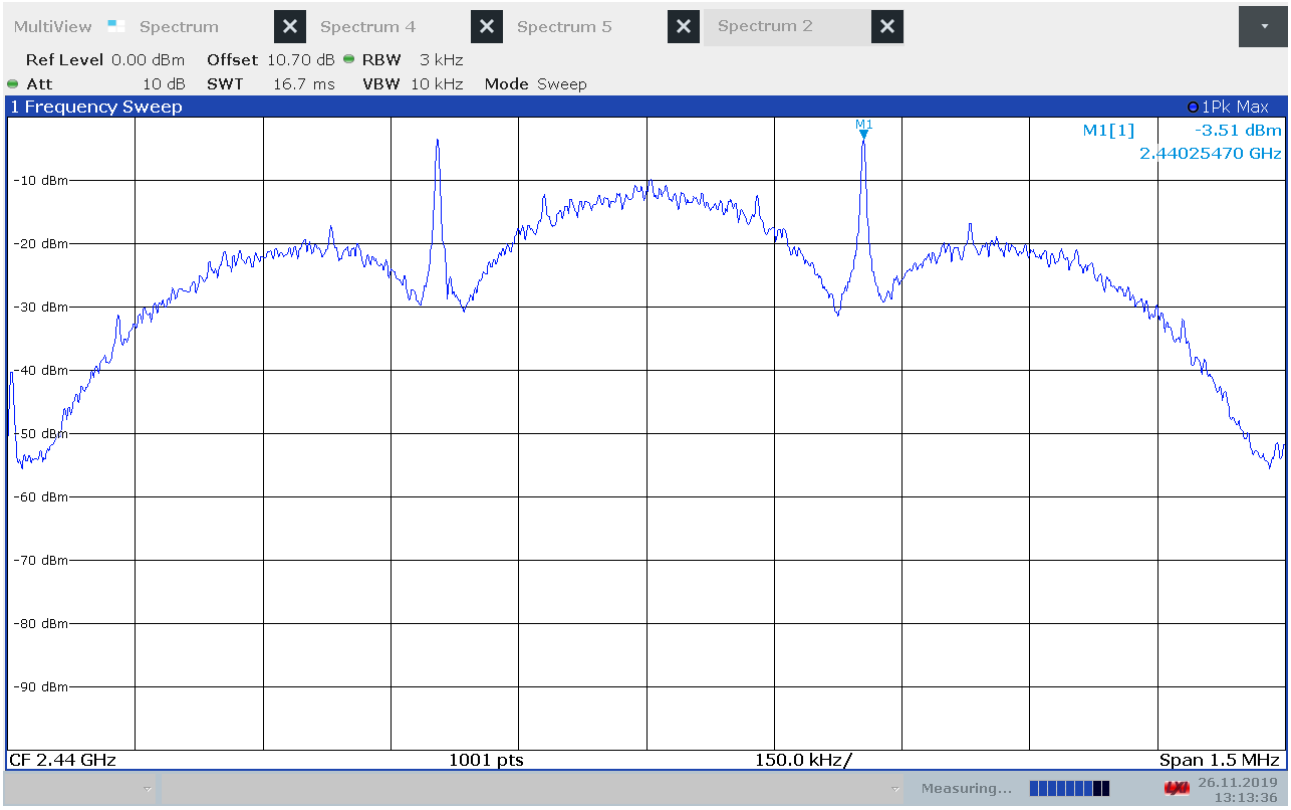
Requirements:

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

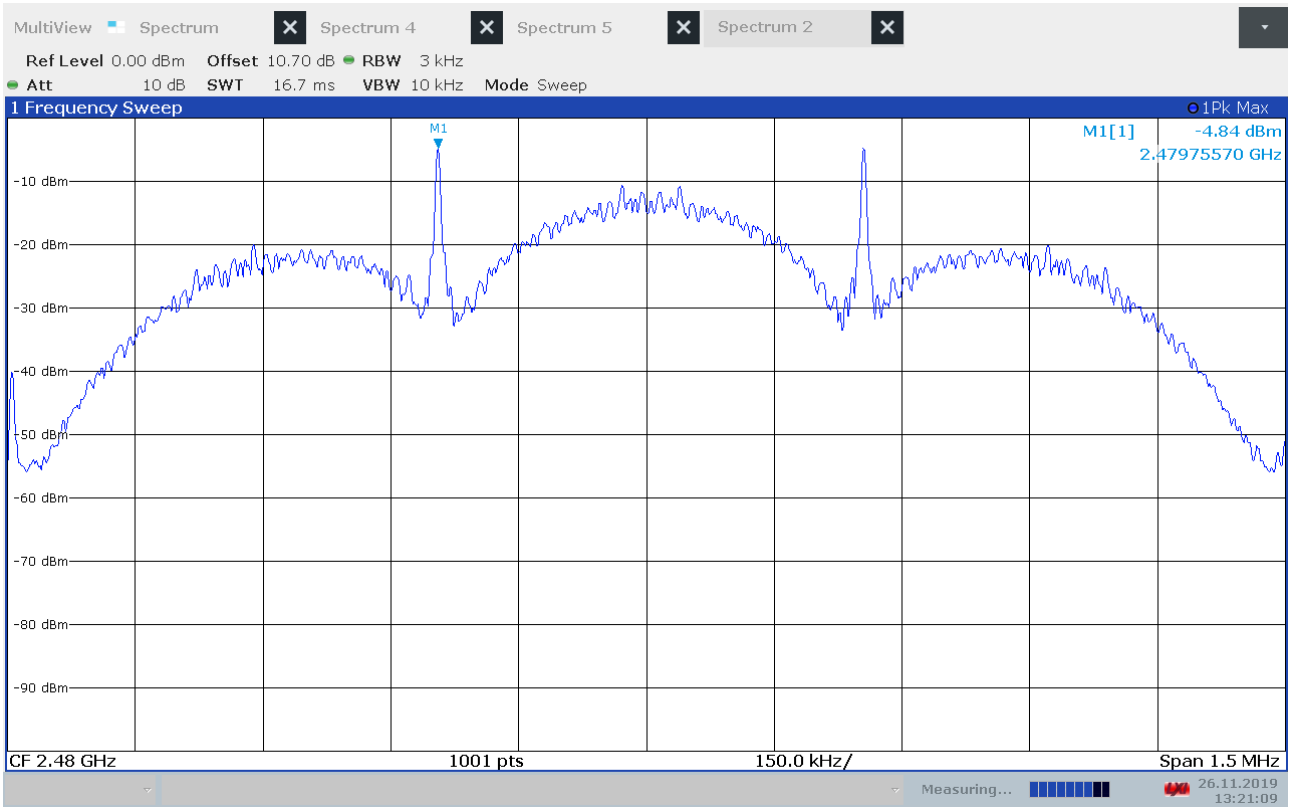
No requirements for Frequency Hopping Systems.



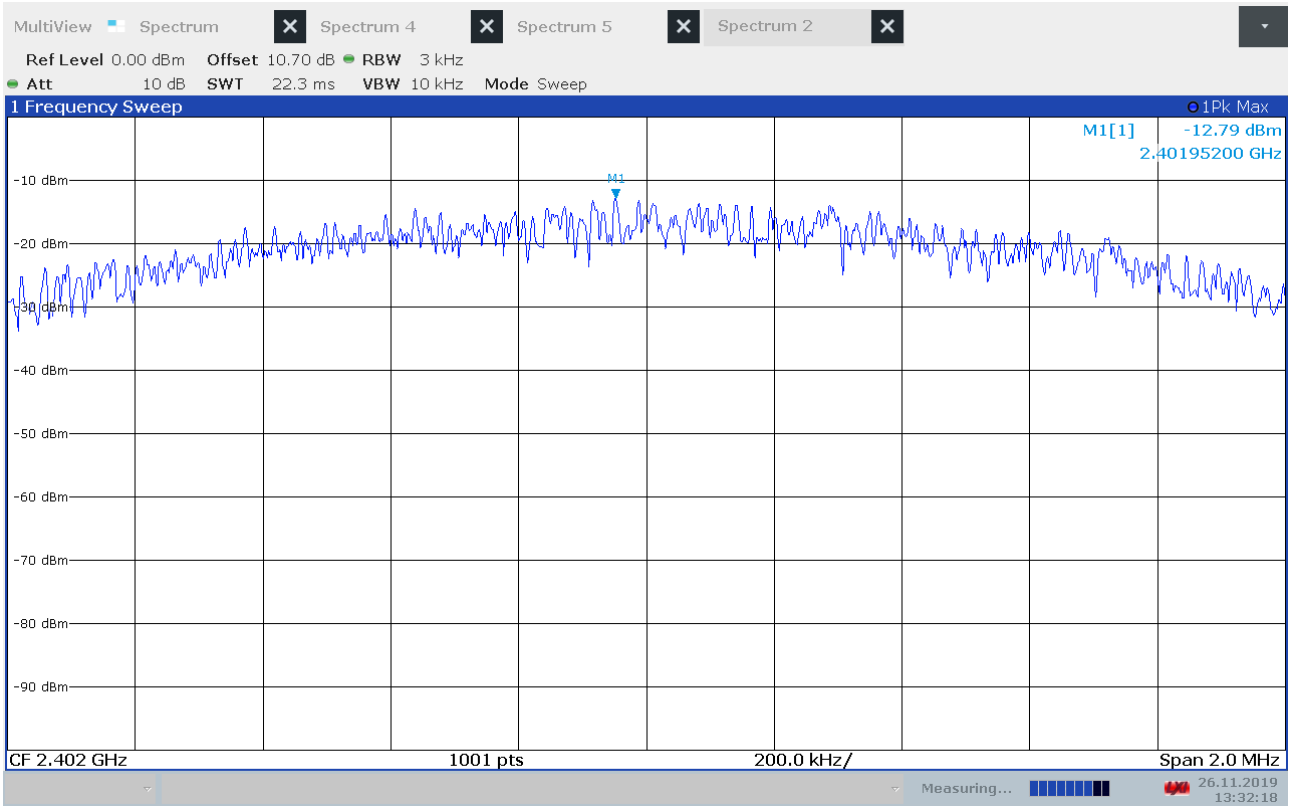
Power Spectral Density, 2402 MHz, BT LE LR



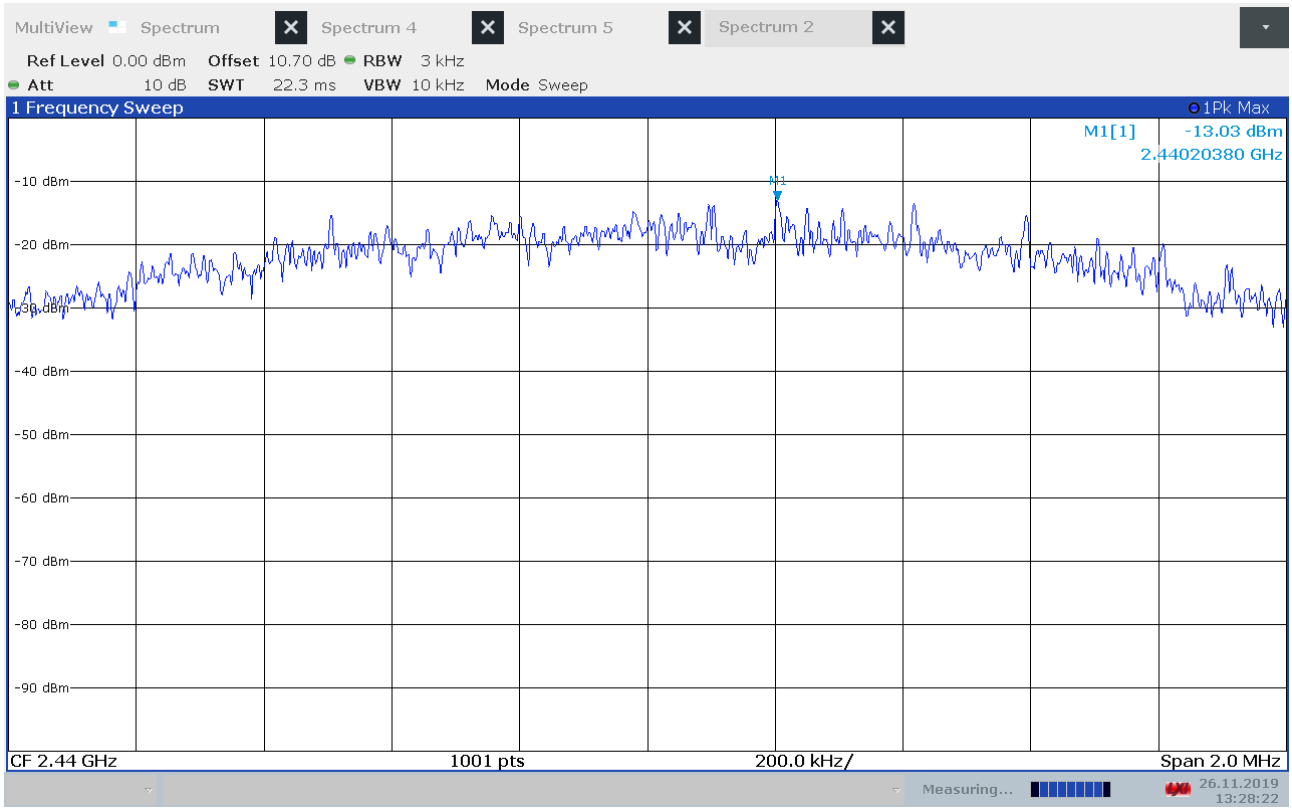
Power Spectral Density, 2440 MHz, BT LE LR



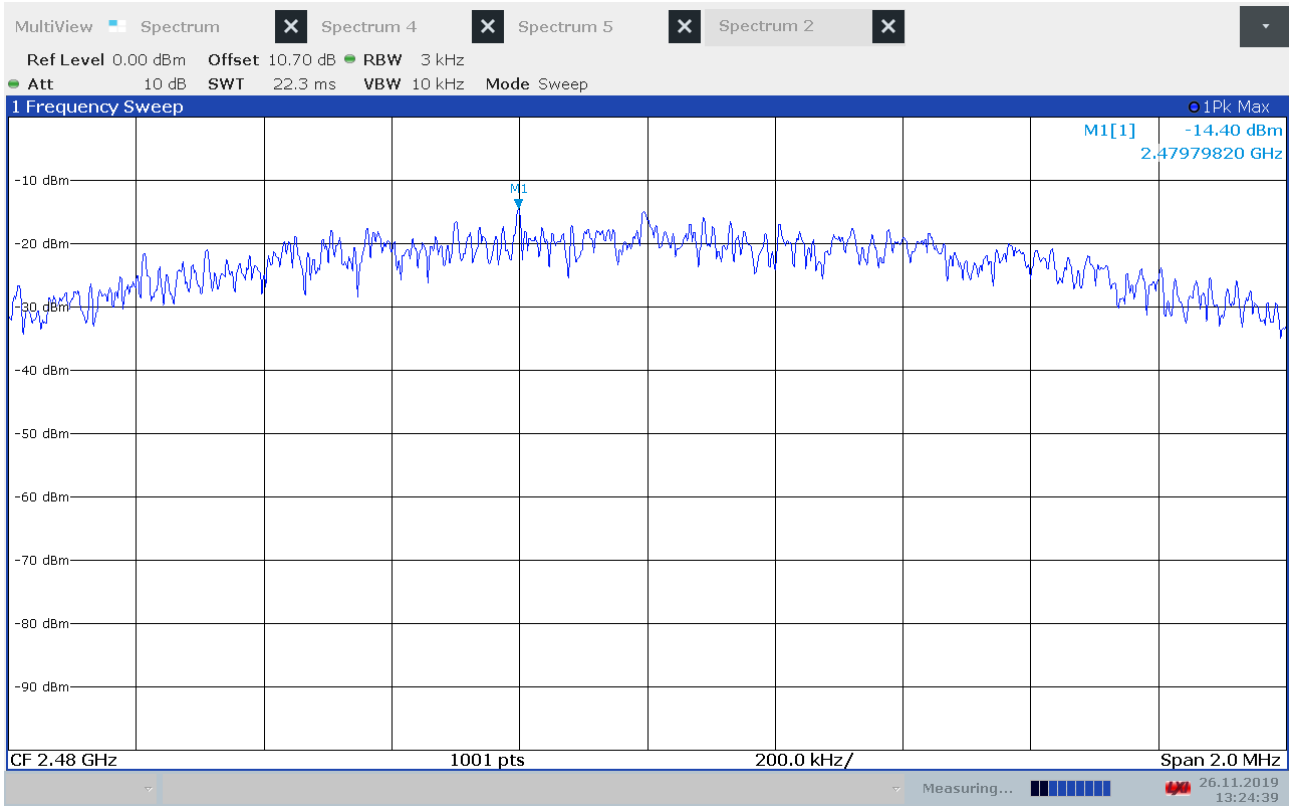
Power Spectral Density, 2480 MHz, BT LE LR



Power Spectral Density, 2402 MHz, BT LE 2Mb



Power Spectral Density, 2440 MHz, BT LE 2Mb



Power Spectral Density, 2480 MHz, BT LE 2Mb

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.

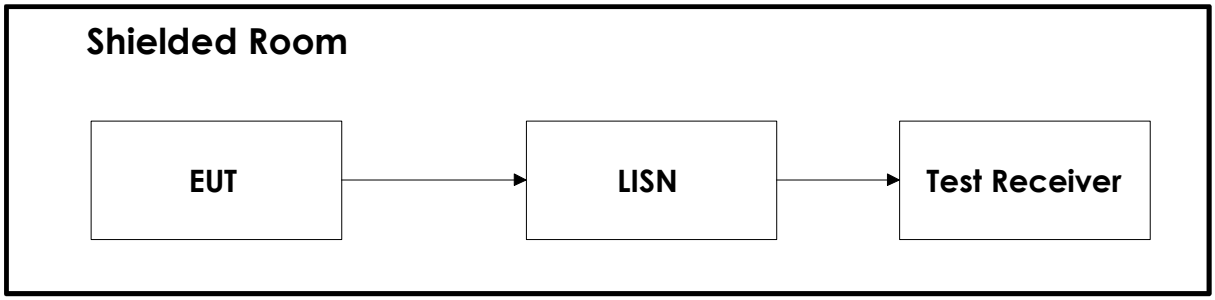
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW43	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2019.01	2020.01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2019.01	2020.01
3	6810.17B	Attenuator	Suhner	LR 1669	2019.07	2020.07
4	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	2019.07	2020.07
5	JB3	BiLog Antenna	Sunol Sciences	N-4525	2017.11	2020.11
6	Model 317	Preamplifier	Sonoma Inst.	LR 1687	2019.07	2020.07
7	3115	Horn Antenna	EMCO	LR 1330	2016.10	2021.10
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2019.07	2020.07
9	3117-PA	Horn Antenna with PreAmp	EMCO	LR 1717	2017.12	2019.12
10	638	Antenna Horn	Narda	LR 1480	2010.06	2020.06

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

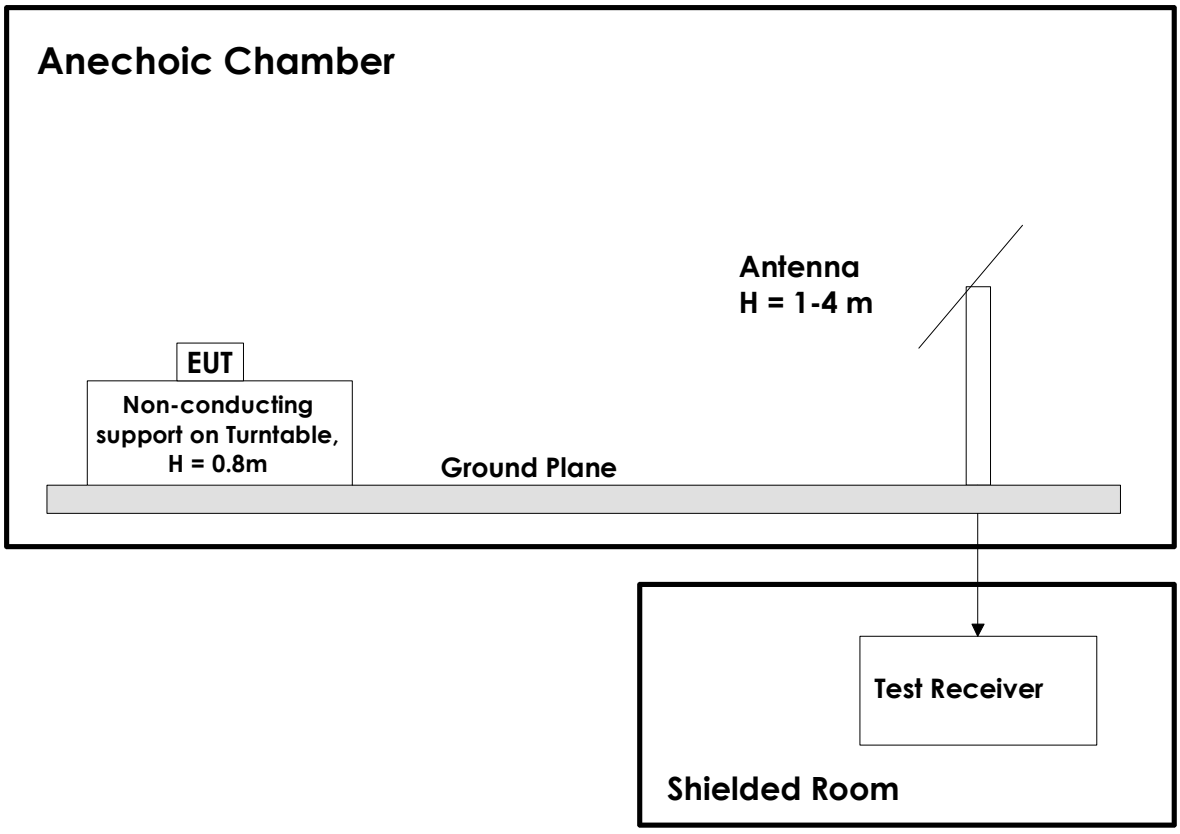
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	Power Line Conducted test software
2	Rohde & Schwarz	EMC32	10.50.10	Radiated Emission test software
3	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers

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.