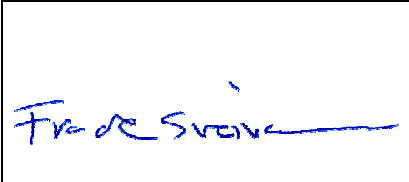


Test Report

Product	Bluetooth Transceiver in DECT Base Station		
Name and address of the applicant	Panasonic Corporation of North America Two Riverfront Plaza, 9 th Floor Newark, 07102-5490, NJ, USA		
Name and address of the manufacturer	Panasonic Corporation 1-62, 4-chome, Minoshima, Hakata-ku Fukuoka, 812-8531, Japan		
Model	KX-TGF770, KX-TGF780		
Rating	Mains (120V, 60Hz)		
Trademark	Panasonic		
Serial number	/		
Additional information	DECT 6.0, Bluetooth		
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	363985		
Tested in period	2018.10.12 to 2018.11.08		
Issue date	2018.11.19		
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway SITE NUMBER: FCC: NO0001 IC: 2040D-1   An accredited technical test executed under the Norwegian accreditation scheme		
 Prepared by [Frode Sveisen]  Approved by [Jan G Eriksen]			
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1 INFORMATION

1.1 Test Item

Name	Panasonic
FCC ID	ACJ96NKX-TGF780
ISED ID	216A-KXTGF780
Model/version	KX-TGF770, KX-TGF780
Serial number	/
Hardware identity and/or version	PNLB2793xx
Software identity and/or version	SW200
Frequency Range	2402 – 2480 MHz
Number of Channels	79
Operating Modes	Classic Bluetooth
Type of Modulation	Digital (GFSK)
User Frequency Adjustment	None
Rated Output Power	22.5 mW (Conducted)
Type of Power Supply	AC Adaptor PNLV226
Antenna Connector	None
Number of Antennas	1
Diversity or Smart Antennas	No

Description of Test Item

The EUT is a DECT Base Station with Bluetooth transceiver for connection to a cellular phone or Bluetooth headset. If the Base station is connected to a cellular phone it is possible to make outgoing calls through the cellular phone from DECT handsets connected to the Base Station.

The models KX-TGF770 and KX-TGF780 are identical.

1.2 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	120 V AC

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

Radiated Emissions and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario.

1.8 Comments

The measurements were done with the EUT powered by 120 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during spurious emission measurements.

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 distances of 1m, 3m and 10m.

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

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DSS 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	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Number of Operating Frequencies	15.31(m)	5.1 (6) (RSS-247)	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	>
Channel Separation	15.247(a)(1)	5.1 (4) (RSS-247)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3) (RSS-247)	Complies
Time of Occupancy	15.247(a)(1)(iii)	5.1 (5) (RSS-247)	Complies
Occupied Bandwidth	N/A	6.7 (RSS-GEN)	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	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)	Complies

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.107 (a)

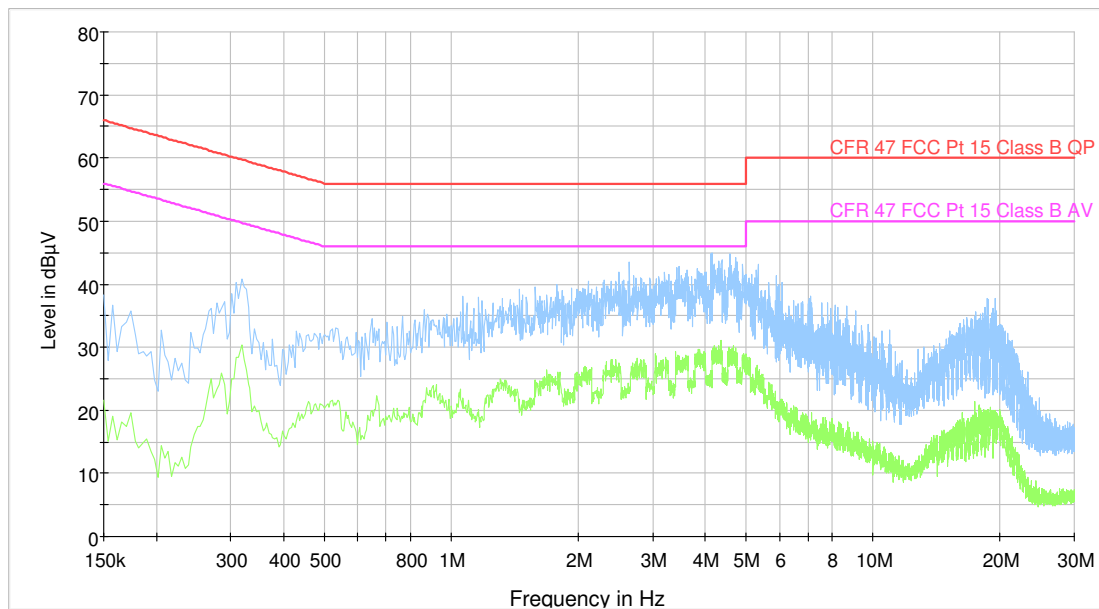
ISED ICES-003 Issue 6, Clause 6.1

Measurement procedure: ANSI C63.4-2014 using 50 μ H/50 ohms LISN.

Test Results: Complies

Measurement Data: See attached plots.

120V 60Hz



3.2 Channel Separation

FCC Part 15.247(a)(1)

Test Results: **Complies**

Measurement Data:

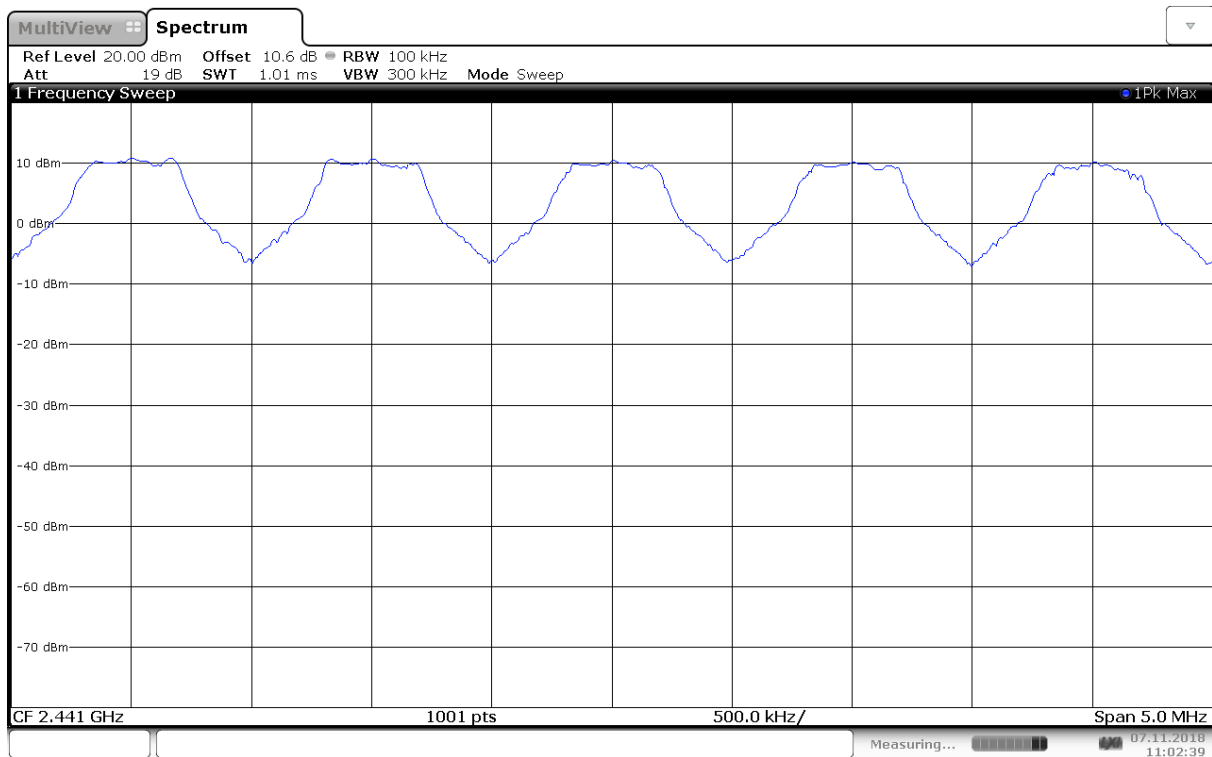
Channel Separation:	1.0 MHz
Nominal value for Channel Separation	1.0 MHz

Carrier Frequency	20 dB Bandwidth
2402 MHz	963 kHz
2441 MHz	977 kHz
2480 MHz	911 kHz

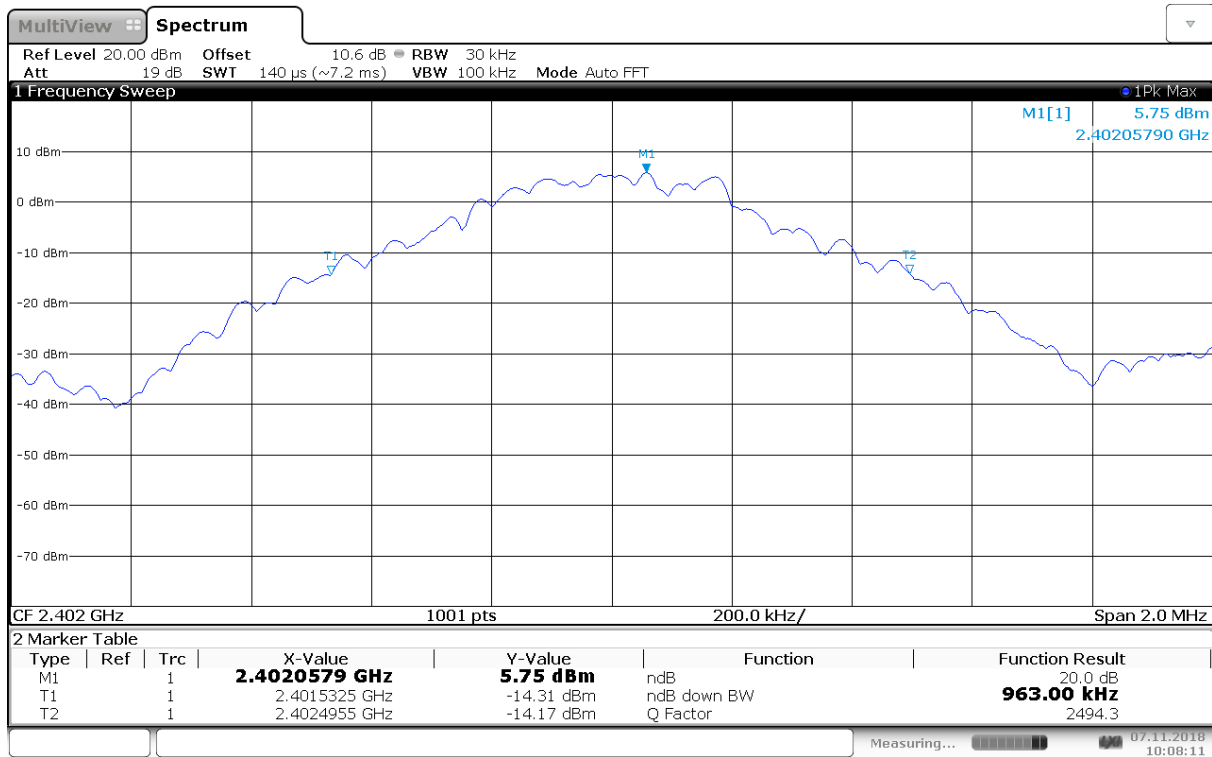
See attached plots

Requirement:

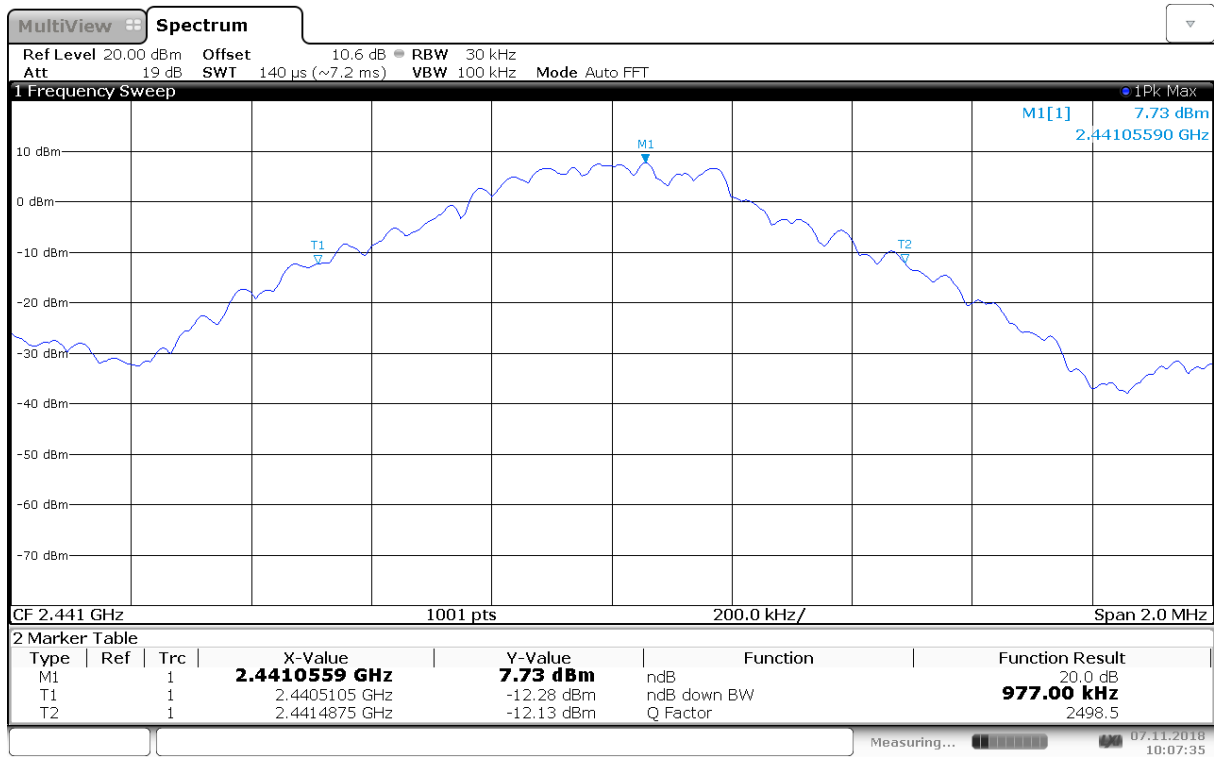
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.



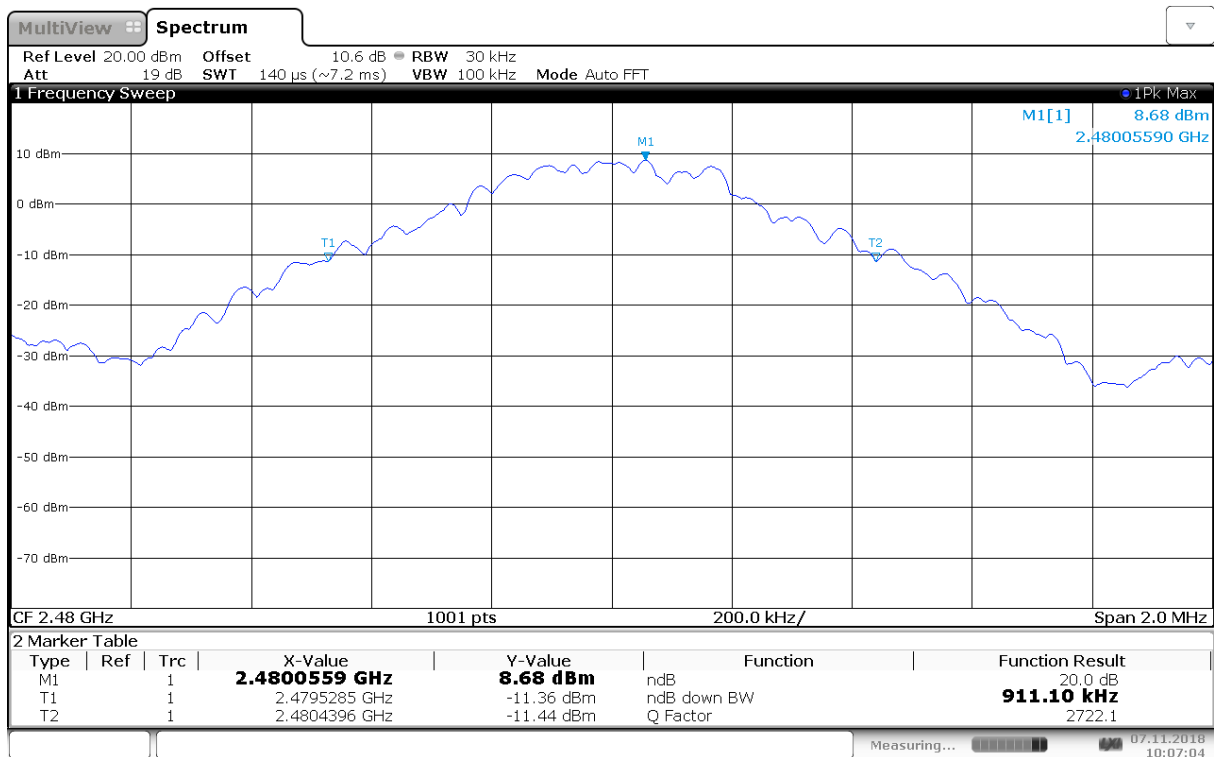
Channel Separation



20dB Bandwidth, 2402 MHz



20dB Bandwidth, 2441 MHz



20dB Bandwidth, 2480 MHz

3.3 Pseudorandom Hopping Algorithm

FCC Part 15.247 (a)(1)

Test Results: Complies

Measurement Data: /

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

Base Table Hopping Sequence

The hopping sequence is described in the document >.

3.4 Occupancy Time

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

Test Results: Complies

Measurement Data:

Number of RF Channels:	79
Maximum Length of RF Burst pr. channel	2.915 ms
Time between RF Burst on same RF Channel	296.25 ms
Time of Occupancy	311 ms

BT, 79 Ch Mode:

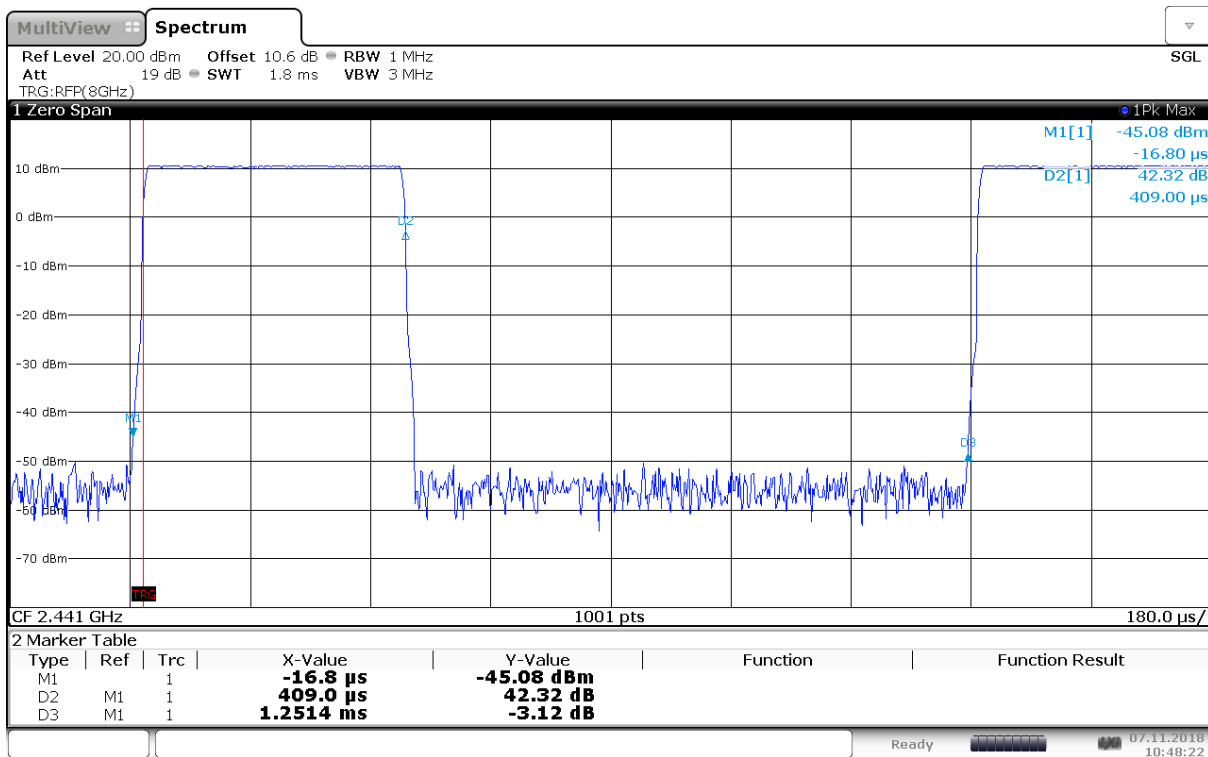
Time between RF burst on same channel: $3.75 \times 79 \text{ ms} = 296.25 \text{ ms}$

Time of occupancy: $(2.915 \times 400 \times 79) / 296.25 = 311 \text{ ms}$

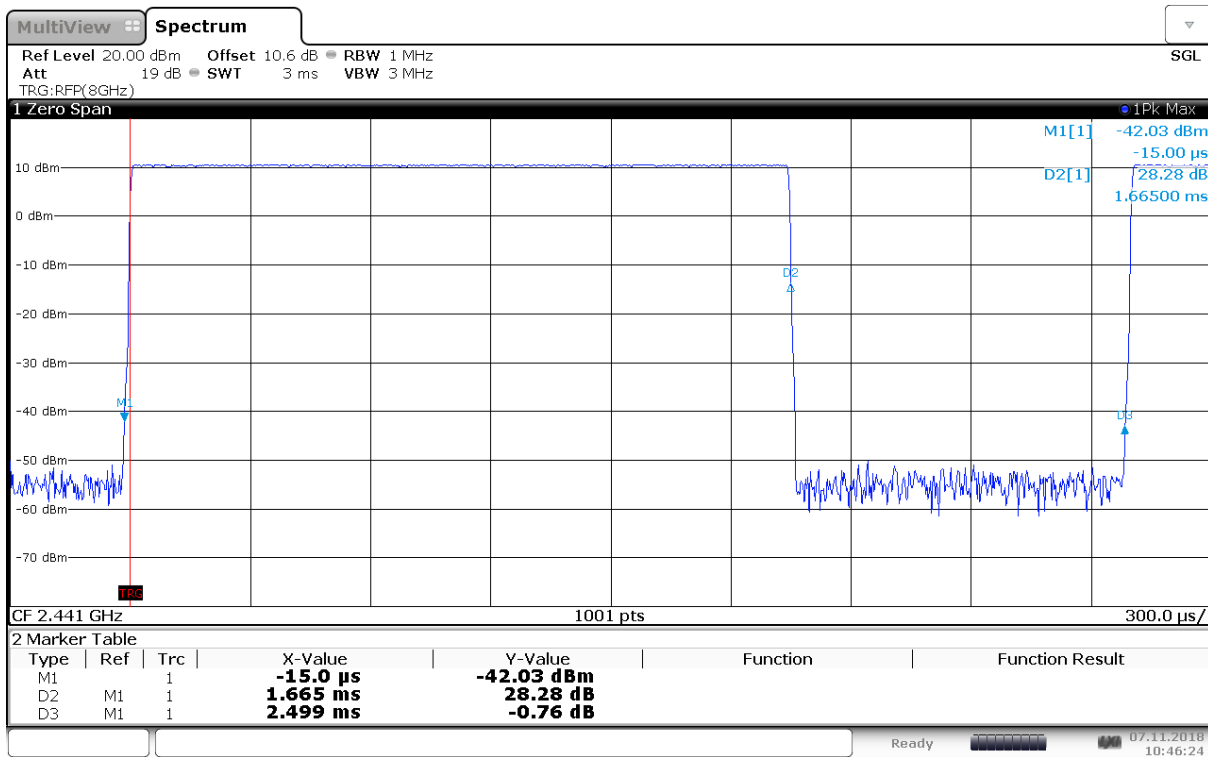
See attached plots

Requirements:

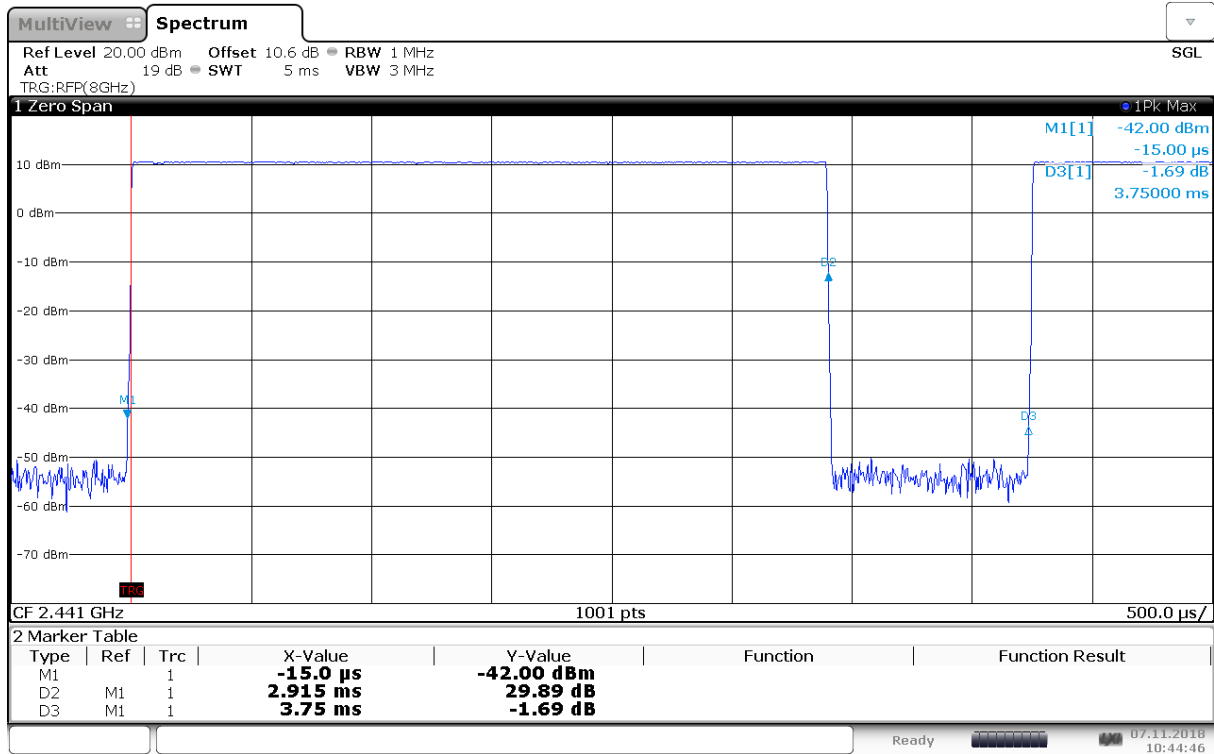
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



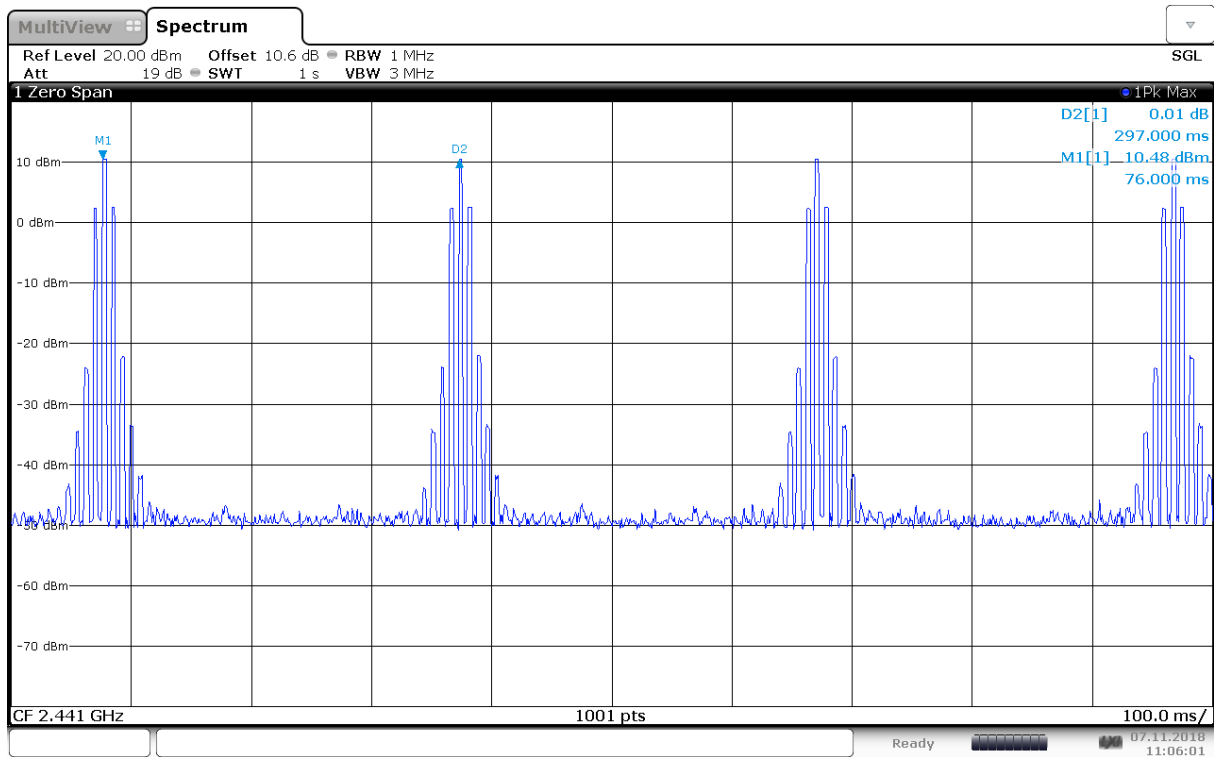
Burst Length, DH1



Burst Length, DH3



Burst Length, DH5



Occupancy Time

3.5 Occupied Bandwidth

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

Test Results: Complies

Measurement Data:

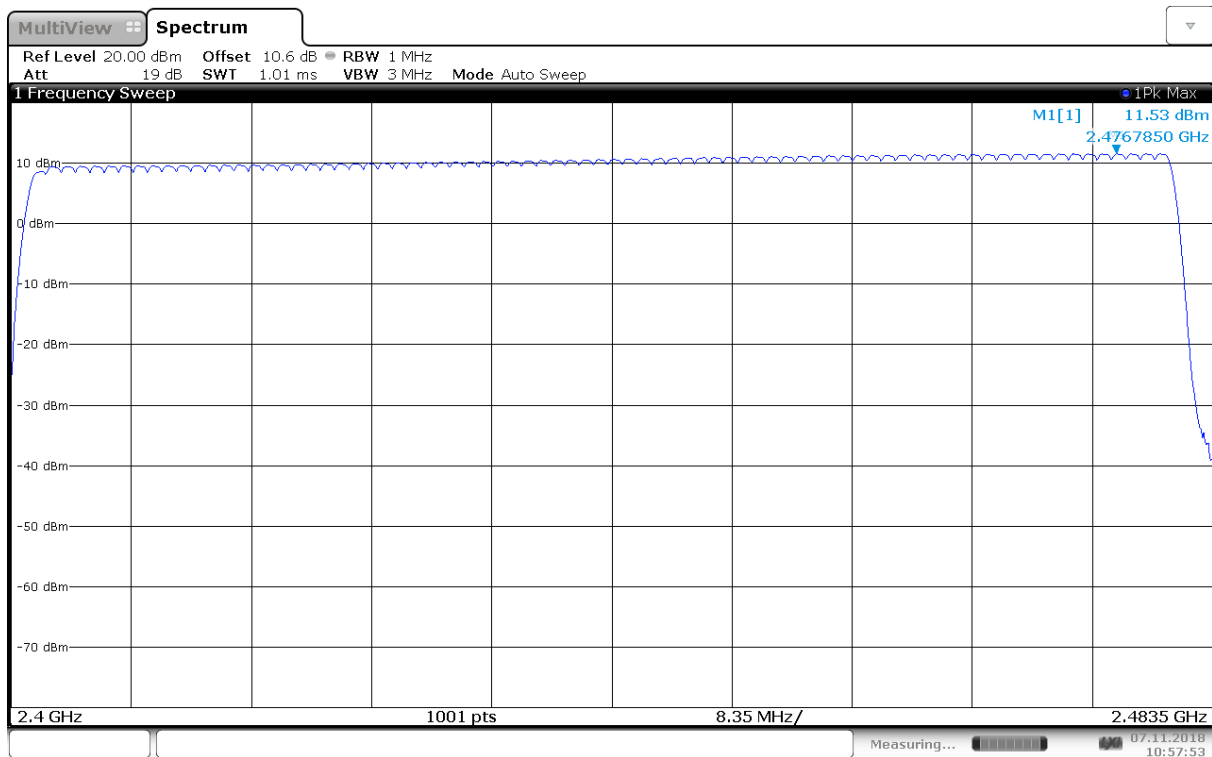
Number of RF Channels in use:	79
Channel Centre Frequencies:	Every full MHz from 2402 to 2480 MHz
99% BW Measured on Centre Channel (2441 MHz)	878.75 kHz

See attached plots.

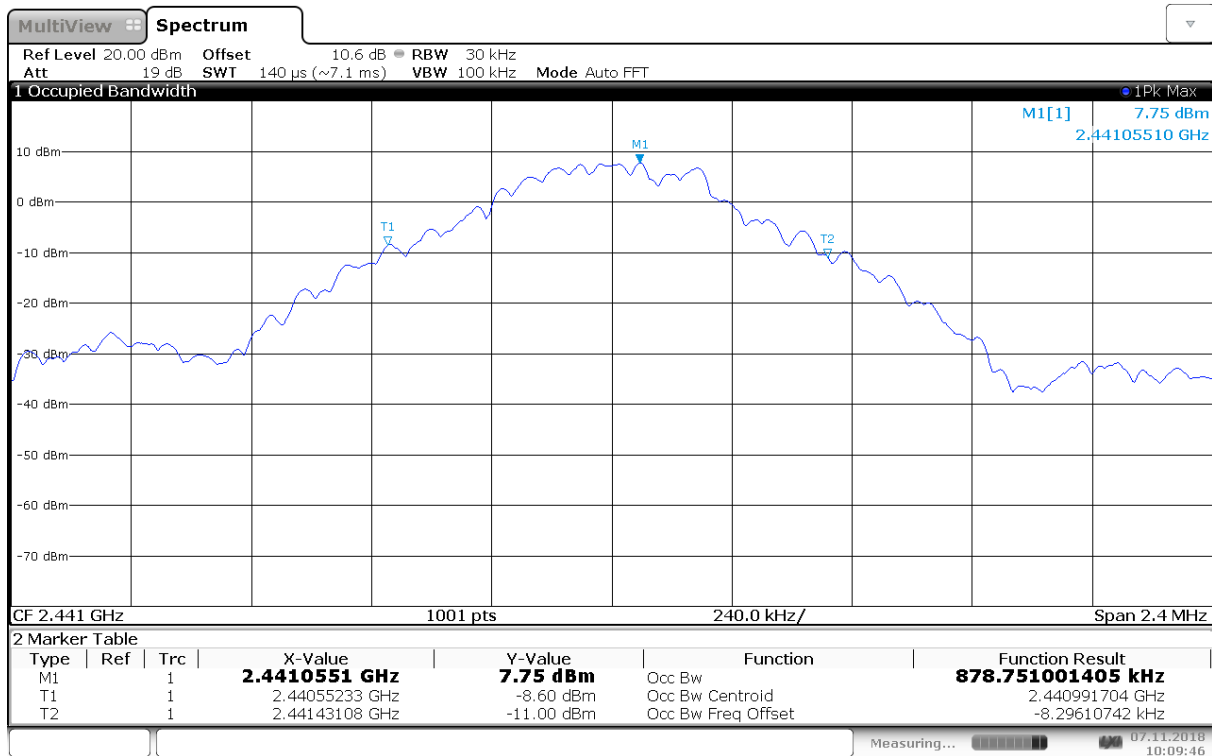
Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

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



RF Channels in Use



99% Bandwidth

3.6 Peak Power Output

FCC part 15.247 (b)

Test Results: Complies

Measurement Data:

	2402 MHz	2441 MHz	2480 MHz
Conducted Power (dBm)	10.89	12.36	13.52
Conducted Power (mW)	12.3	17.2	22.5
Field Strength (dBμV/m)	98.3	97.5	96.5
EIRP, Calculated (mW)	2.03	1.69	1.27
Antenna gain (dBi)	-7.8	-10.1	-12.2

Antenna gain = $10 \cdot \log(\text{EIRP} / \text{Conducted power})$ dBi

EIRP is calculated from measured field strength by the formulas in KDB 412172 D01 Determining ERP and EIRP v01.

See attached plots.

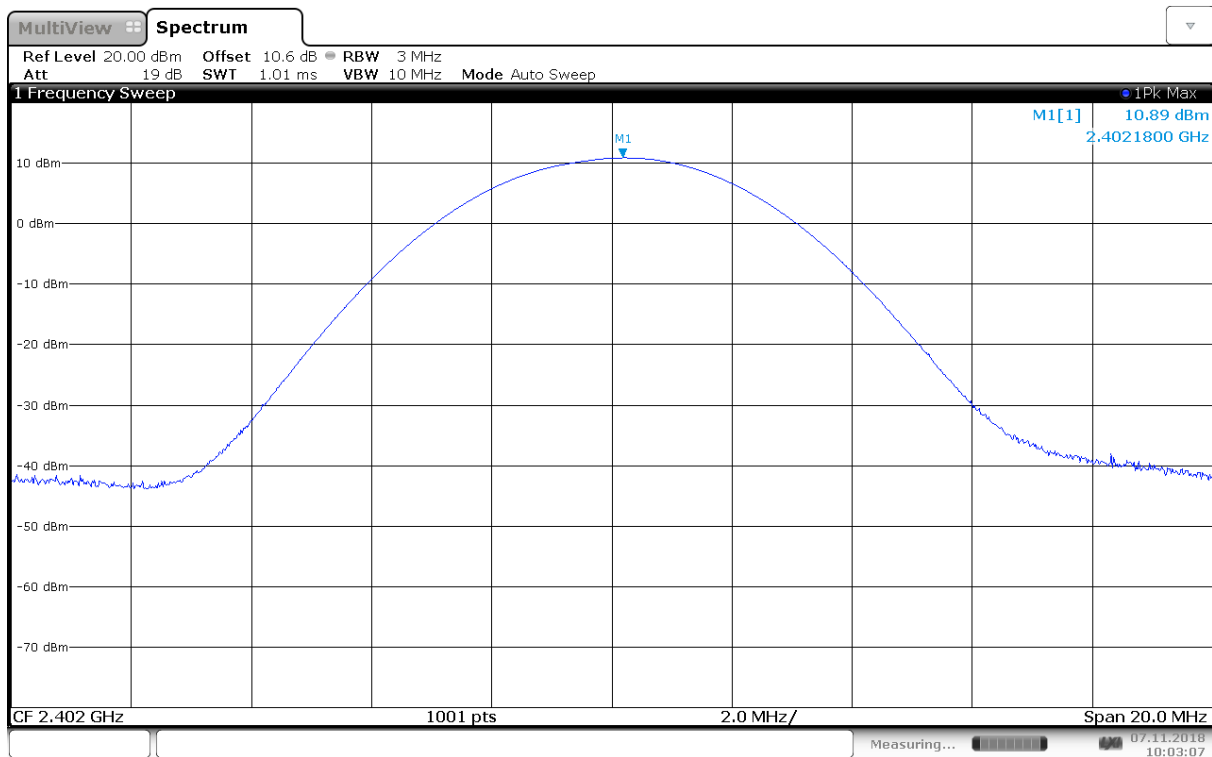
Requirements:

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

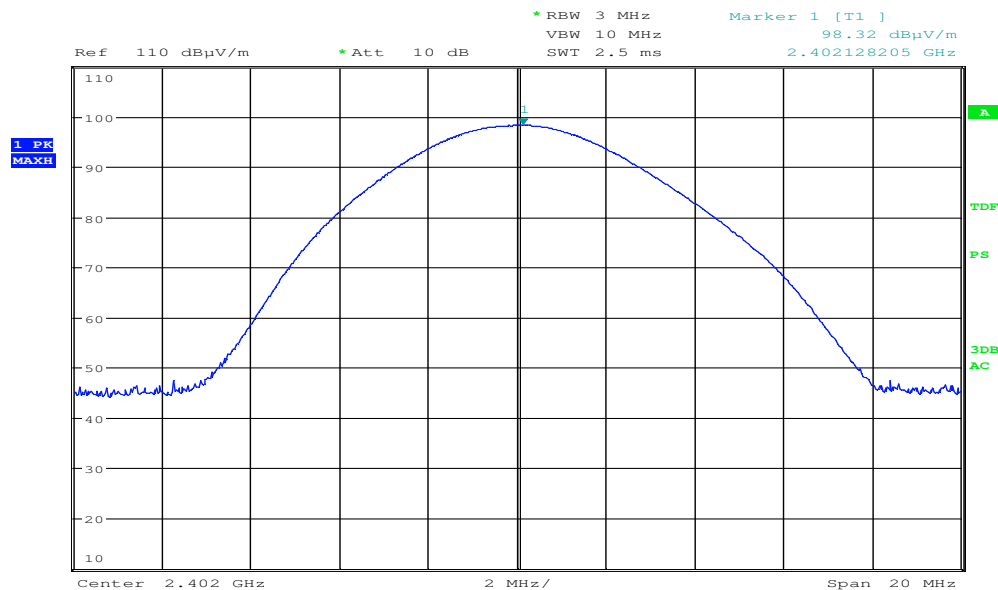
For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

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.

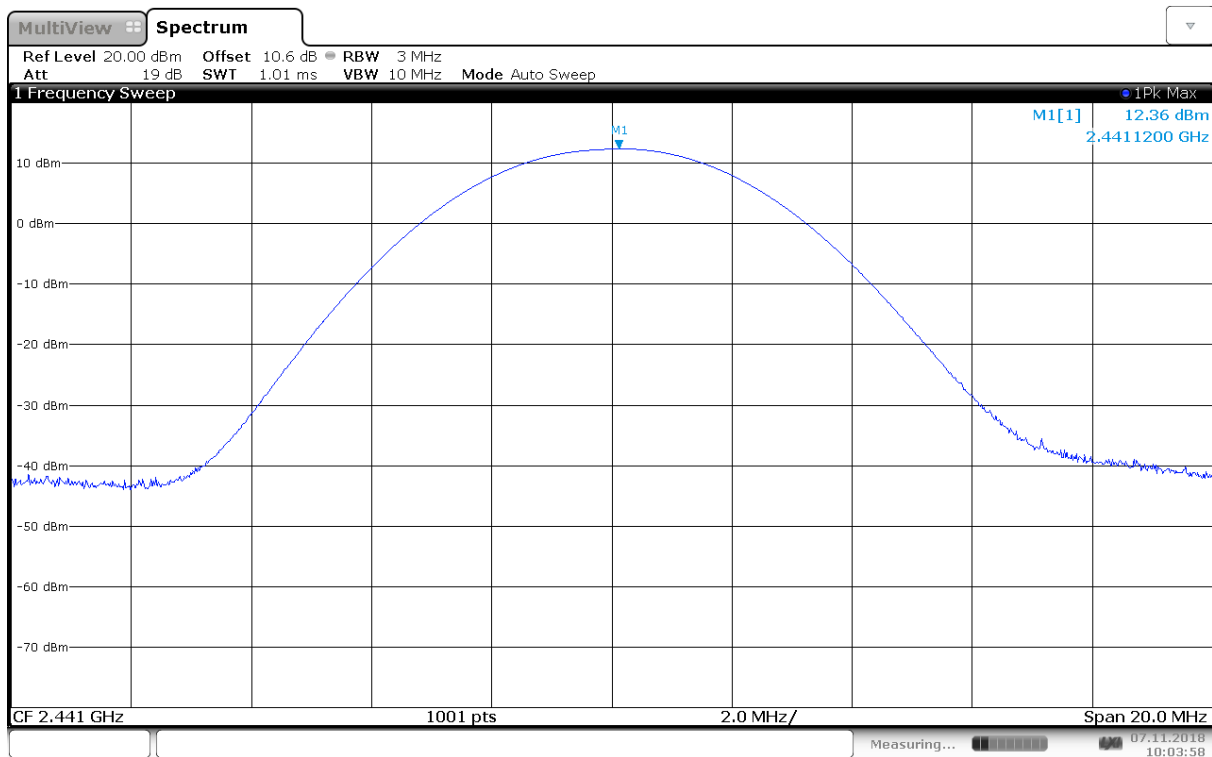


Conducted Output Power, 2402 MHz

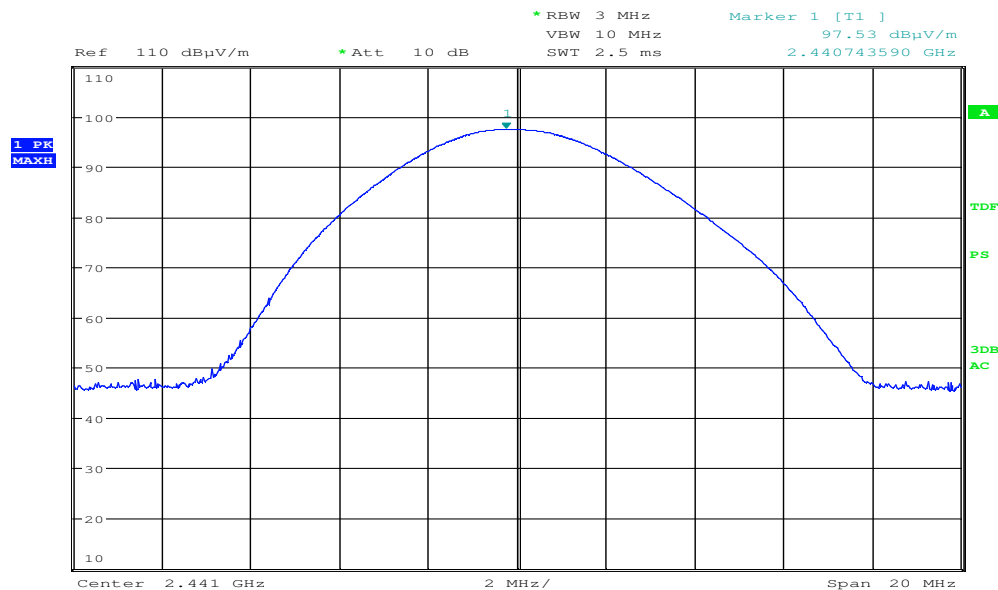


Date: 12.OCT.2018 16:32:00

Field Strength, 2402 MHz (Max: VP)

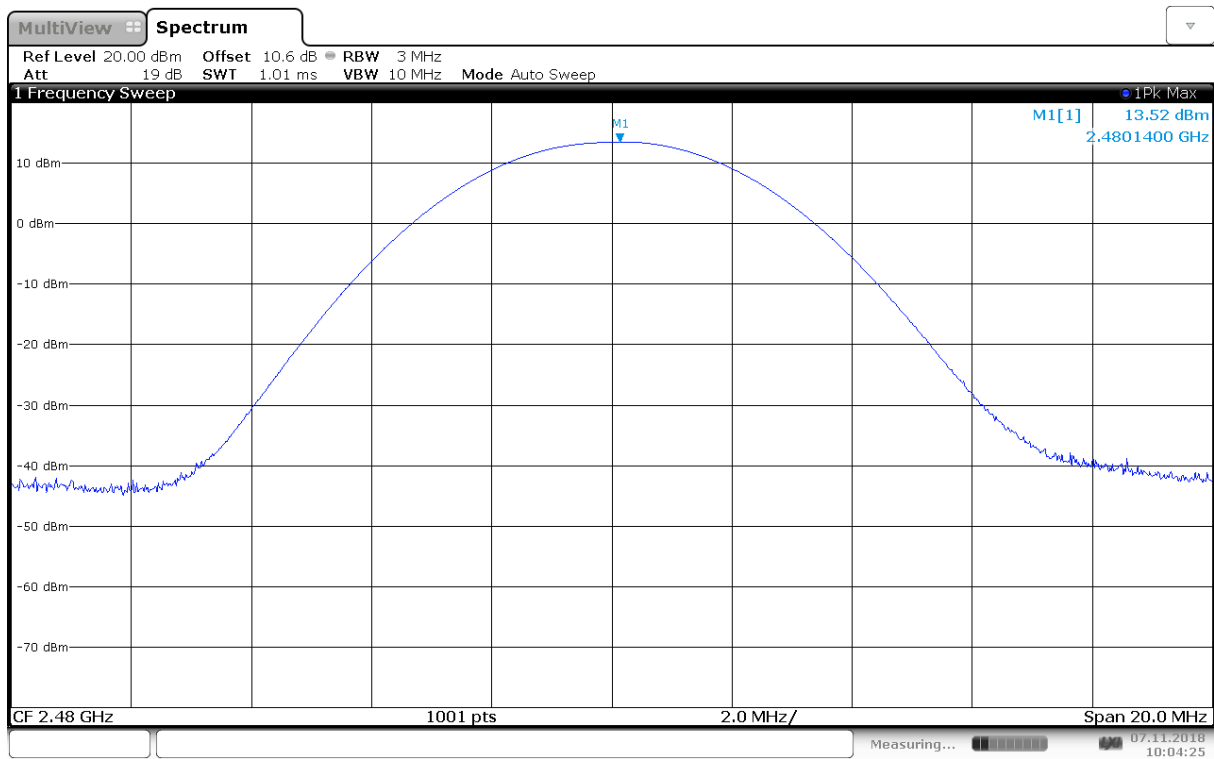


Conducted Output Power, 2441 MHz

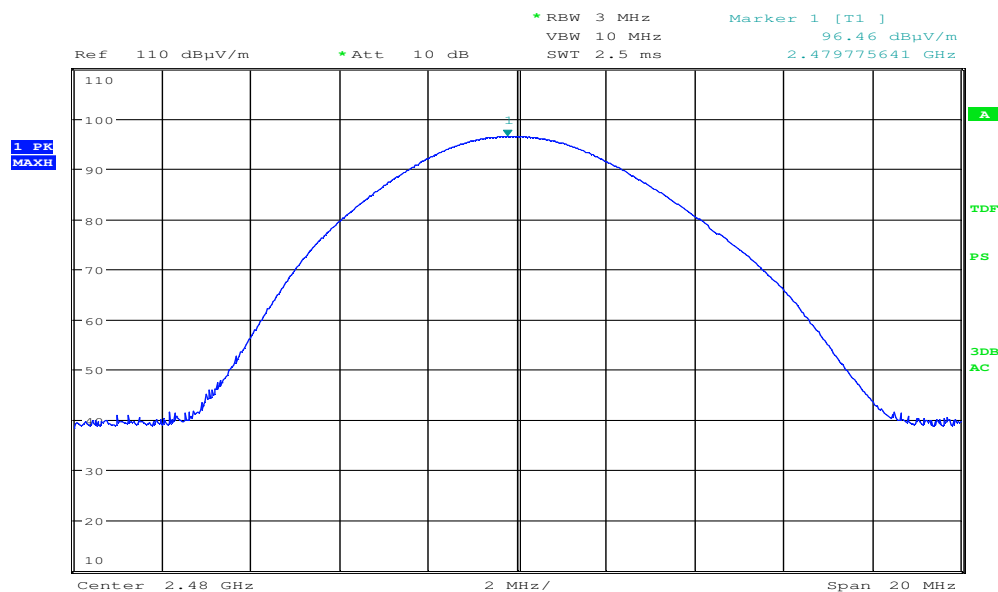


Date: 12.OCT.2018 16:38:56

Field Strength, 2441 MHz (Max: VP)



Conducted Output Power, 2480 MHz



Date: 12.OCT.2018 15:47:59

Field Strength, 2480 MHz (Max: VP)

3.7 Conducted Emissions at Antenna Connector

Para. No.: 15.247 (d)

Carrier Frequency	Highest Value (dBc)	Margin (dB)	Verdict
2402 MHz	> 50	> 30	Pass
2441 MHz	> 50	> 30	Pass
2480 MHz	> 50	> 30	Pass

Measured with Peak Detector

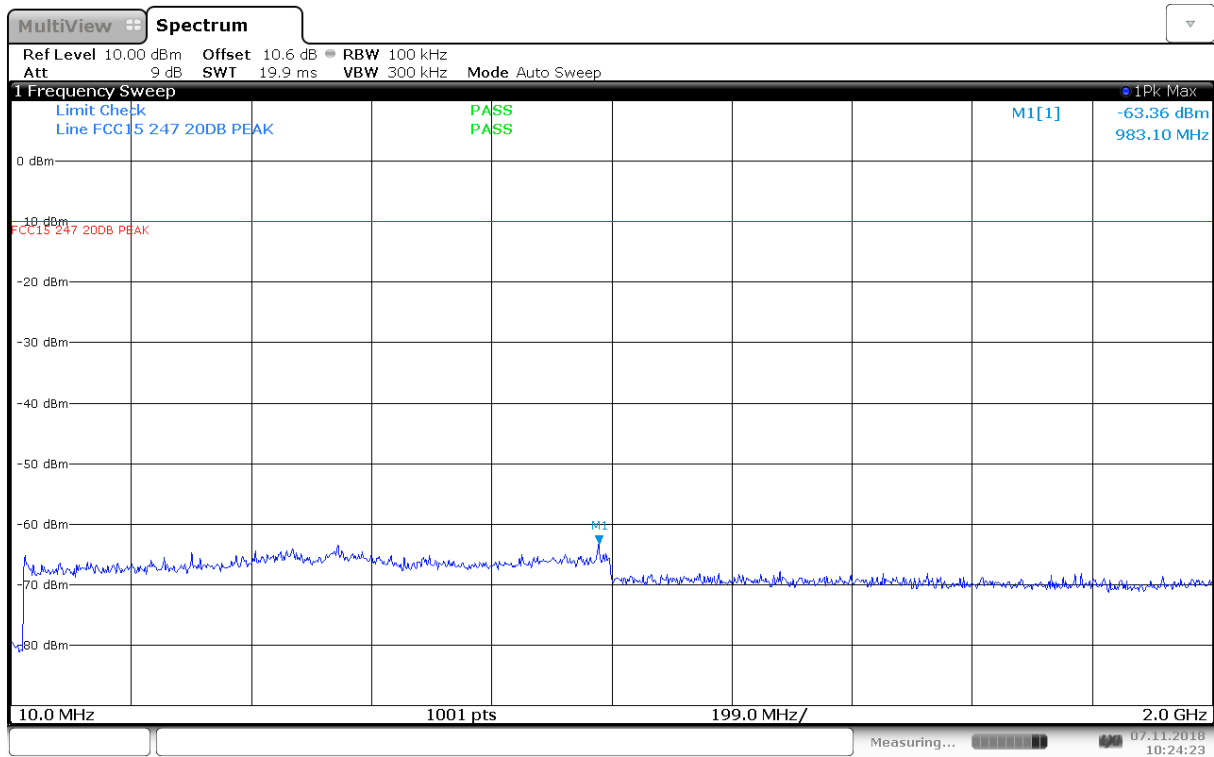
RF conducted power to 25 GHz: see attached plots.

Limit

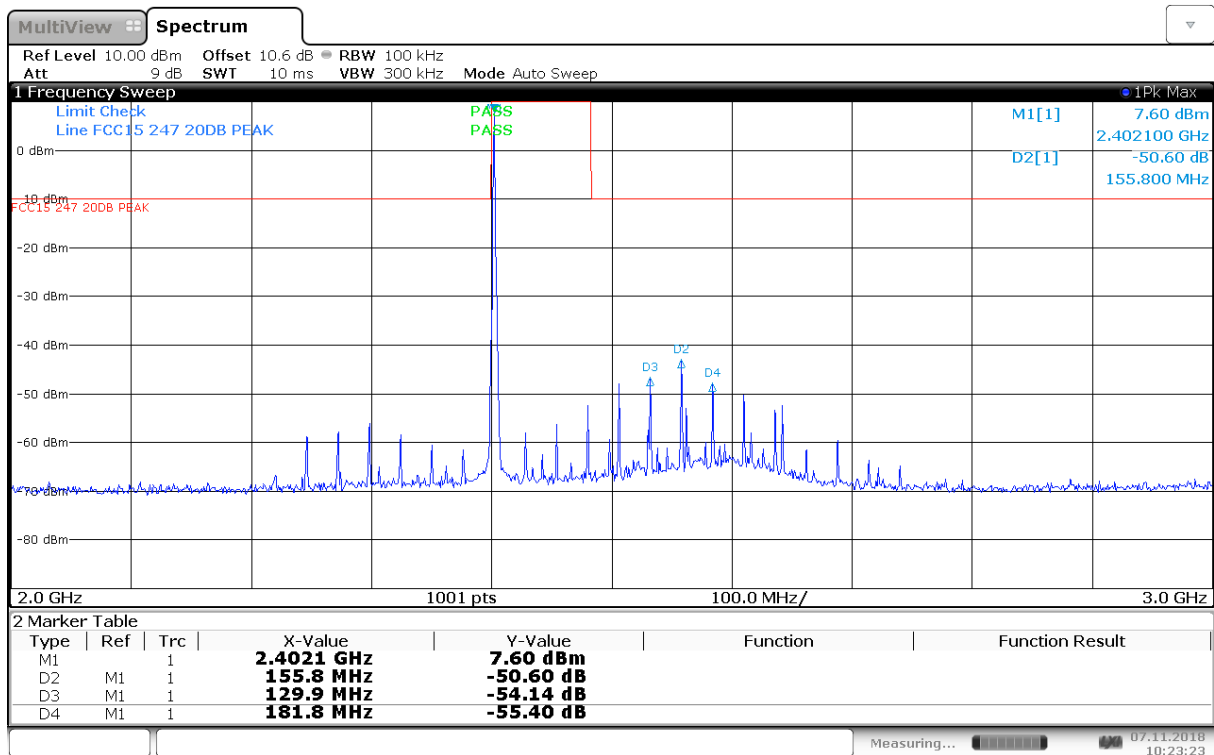
Peak measurement	RMS averaging
20 dBc or more in 100 kHz bandwidth	30 dBc or more in 100 kHz bandwidth

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

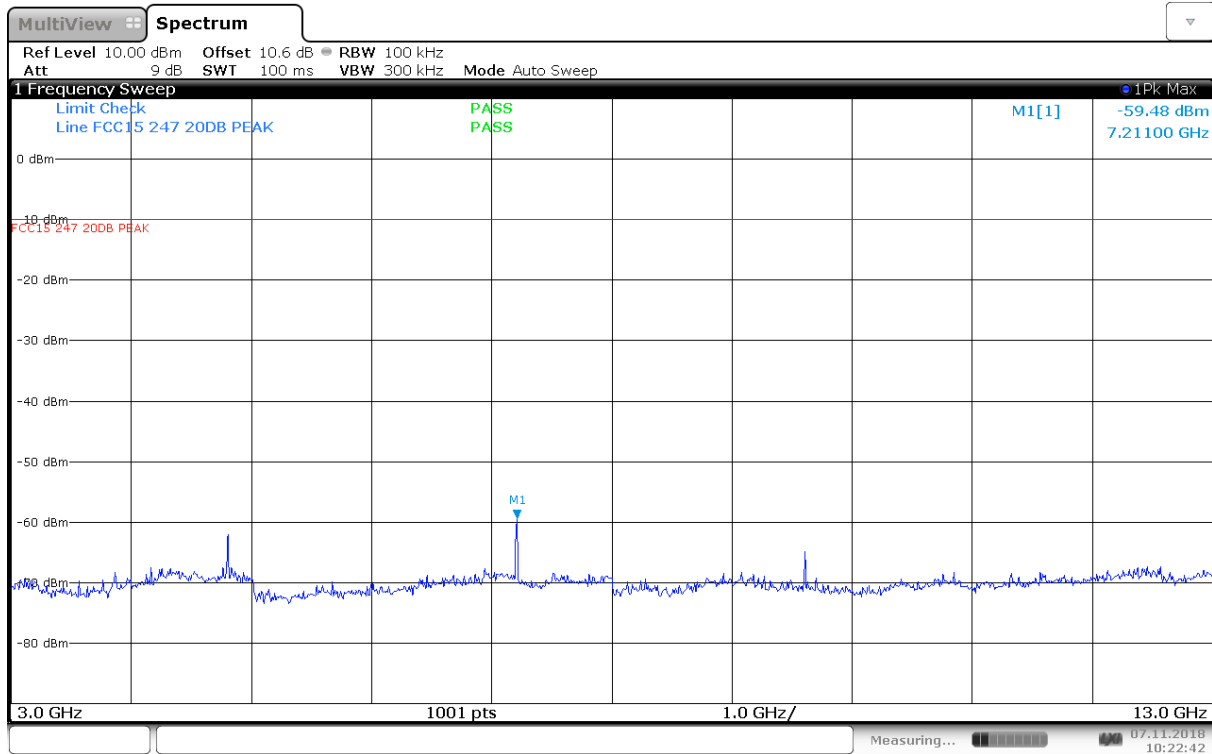
Attenuation below the general limits specified in part 15.209(a) is not required.



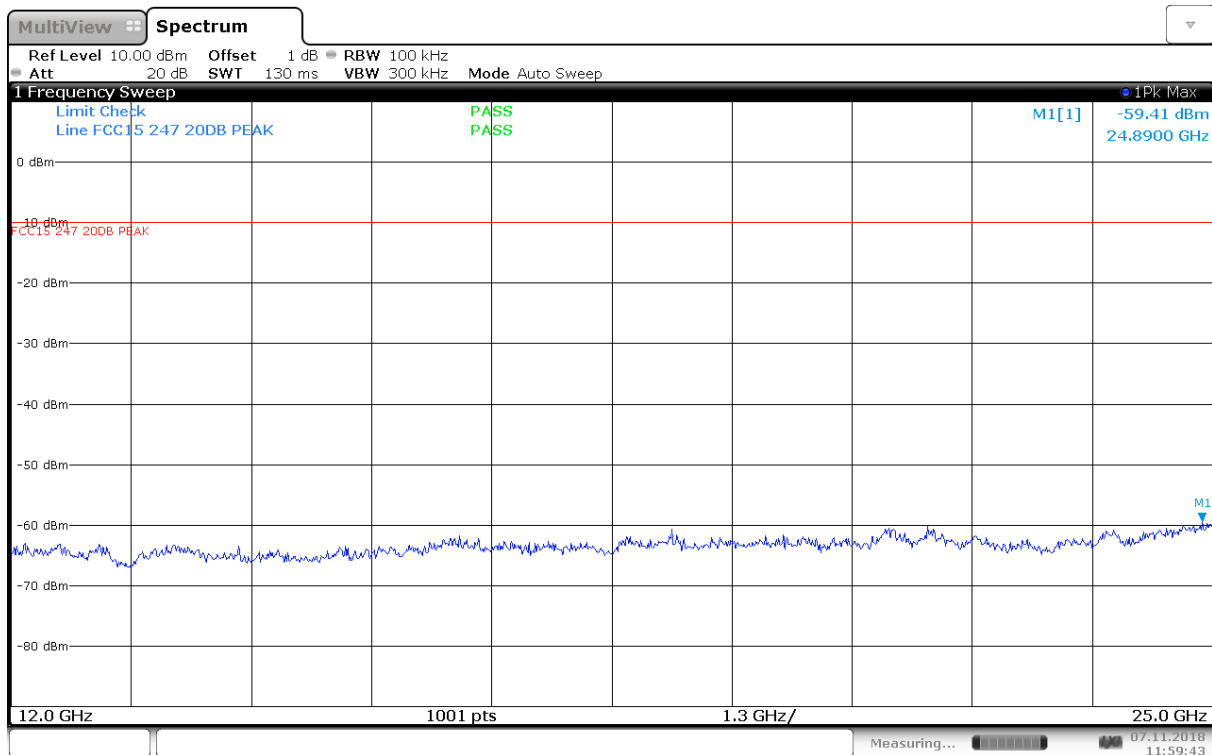
Conducted Emissions, 10 – 2000 MHz, Carrier 2402 MHz



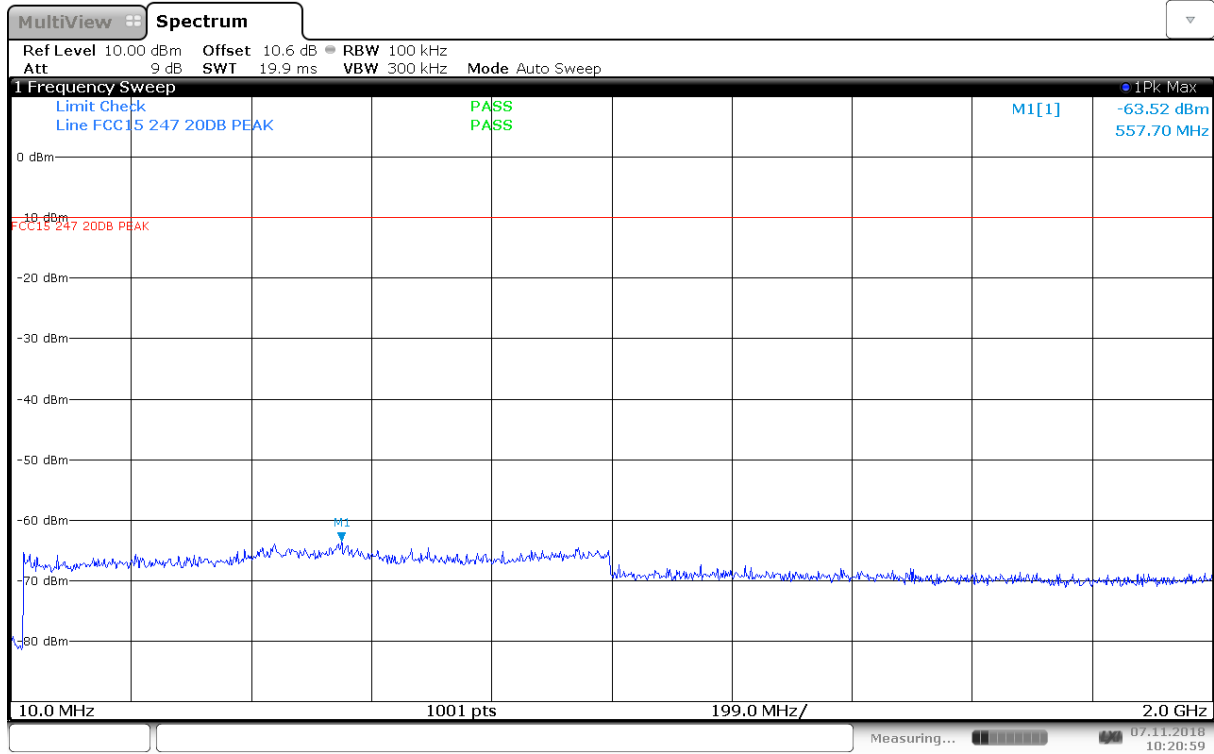
Conducted Emissions, 2000 – 3000 MHz, Carrier 2402 MHz



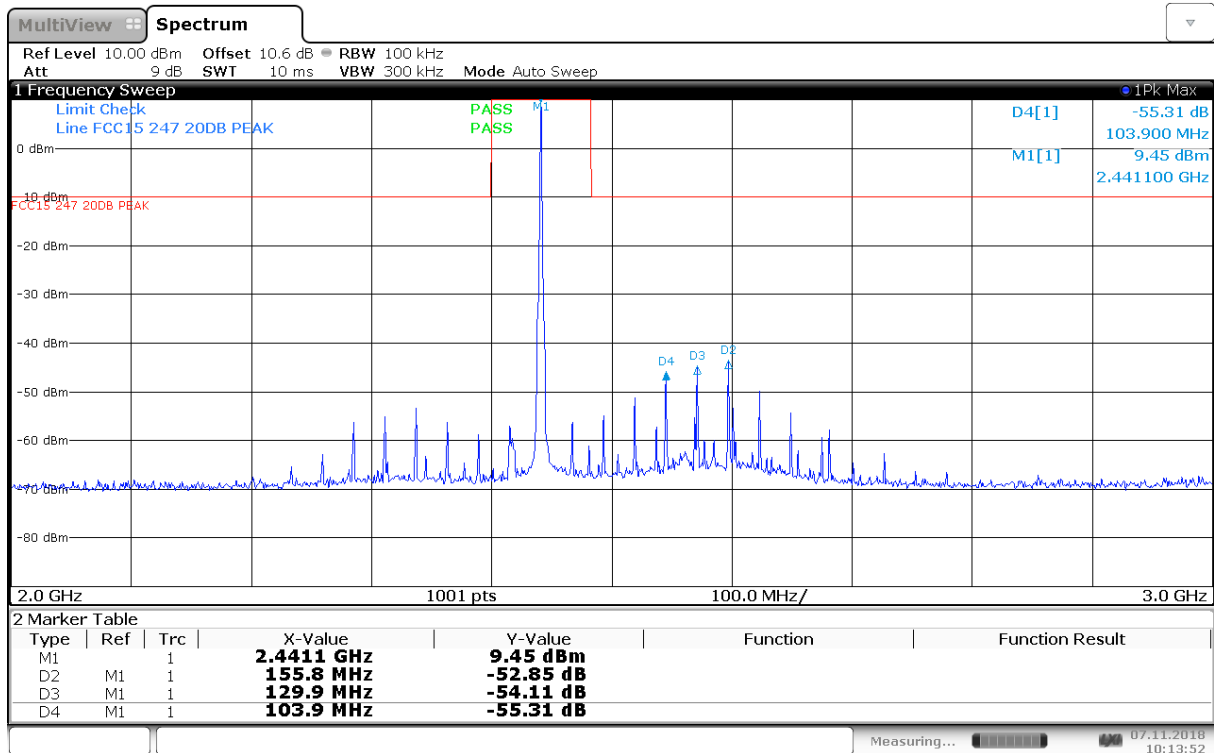
Conducted Emissions, 3000 – 13000 MHz, Carrier 2402 MHz



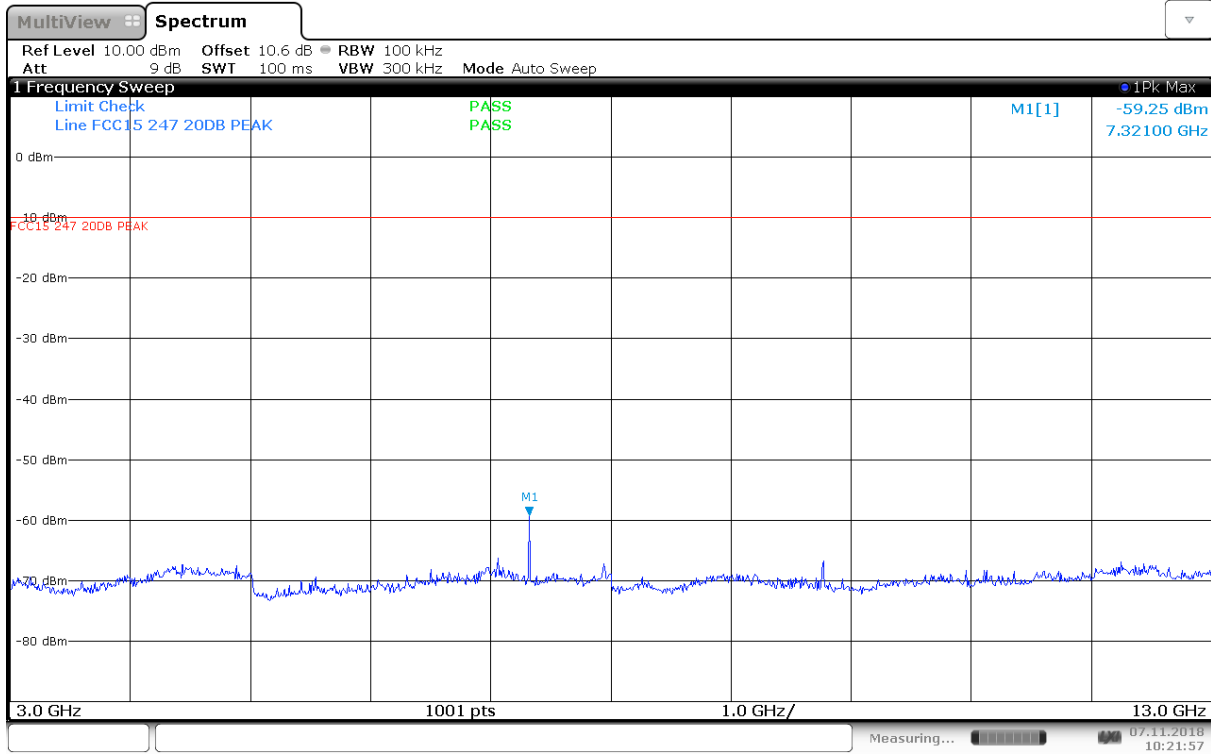
Conducted Emissions, 12000 – 25000 MHz, Carrier 2402 MHz



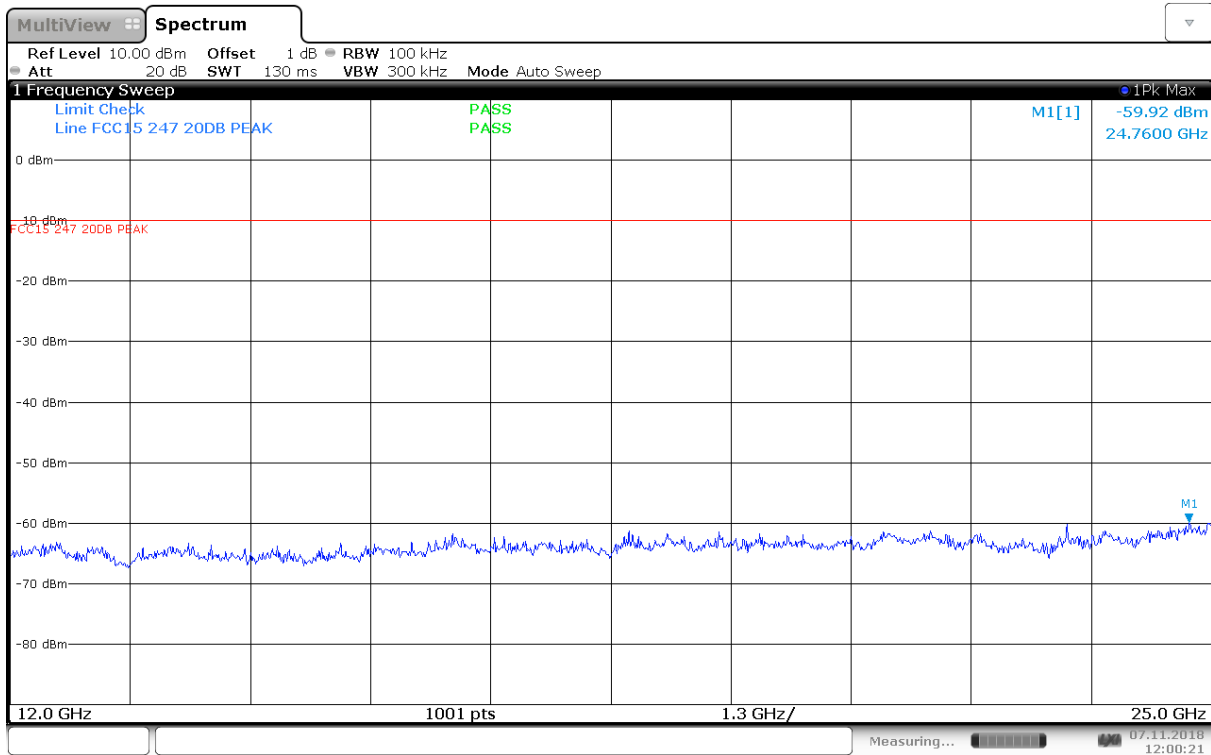
Conducted Emissions, 10 – 2000 MHz, Carrier 2441 MHz



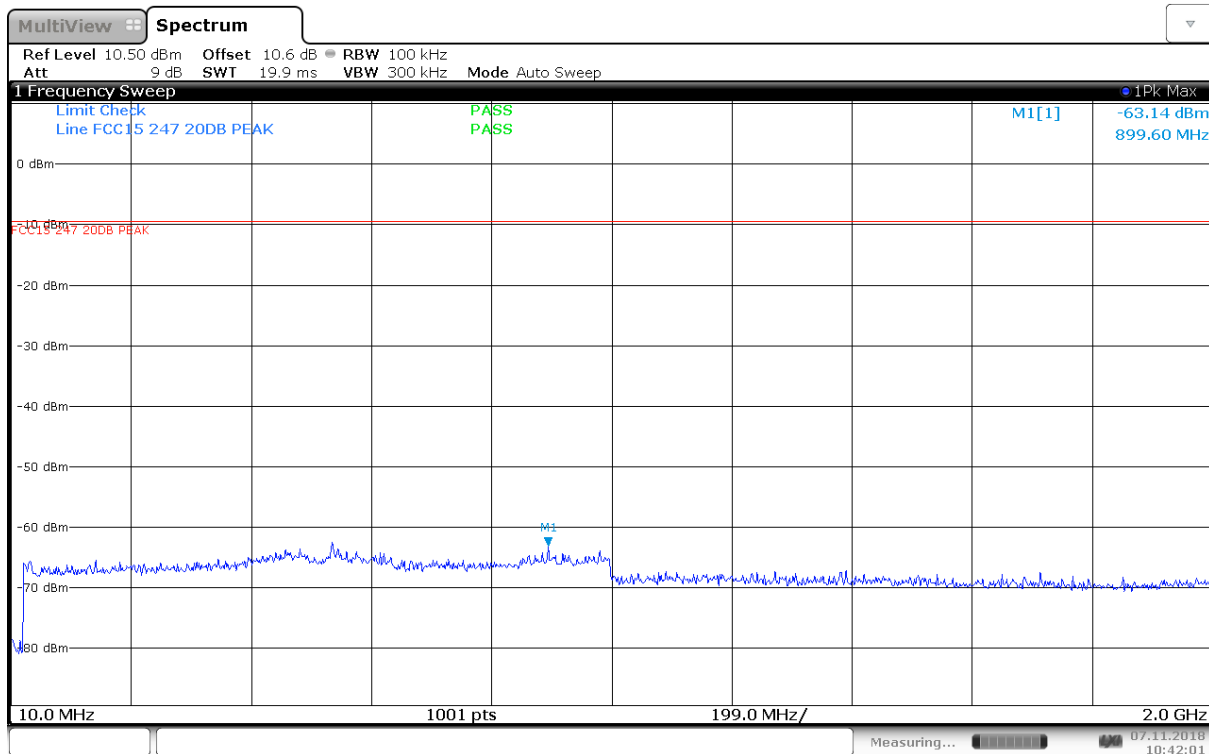
Conducted Emissions, 2000 – 3000 MHz, Carrier 2441 MHz



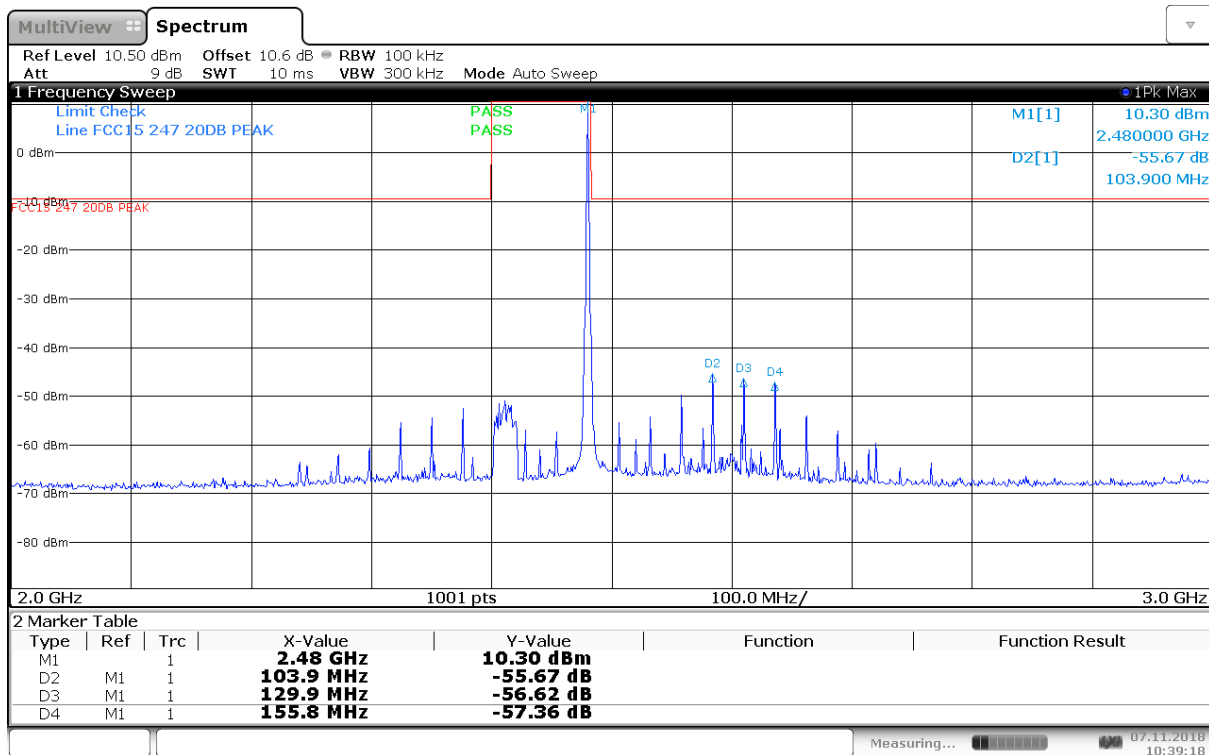
Conducted Emissions, 3000 – 13000 MHz, Carrier 2441 MHz



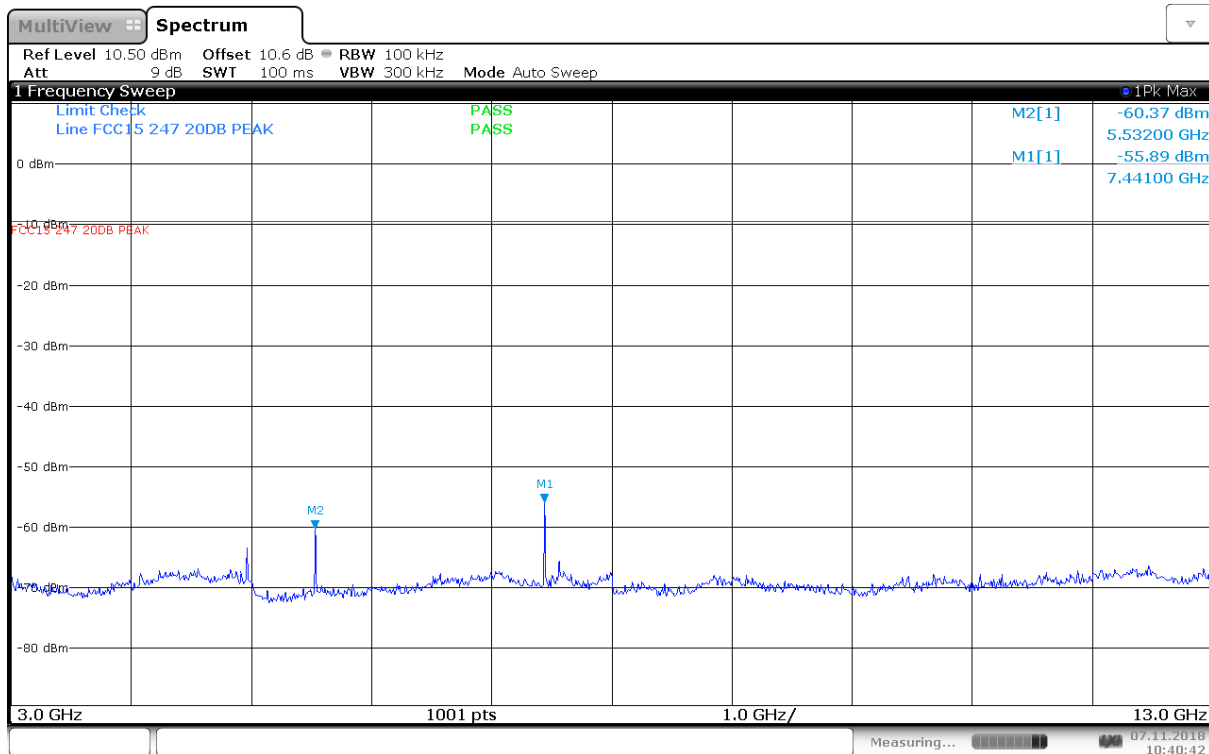
Conducted Emissions, 12000 – 25000 MHz, Carrier 2441 MHz



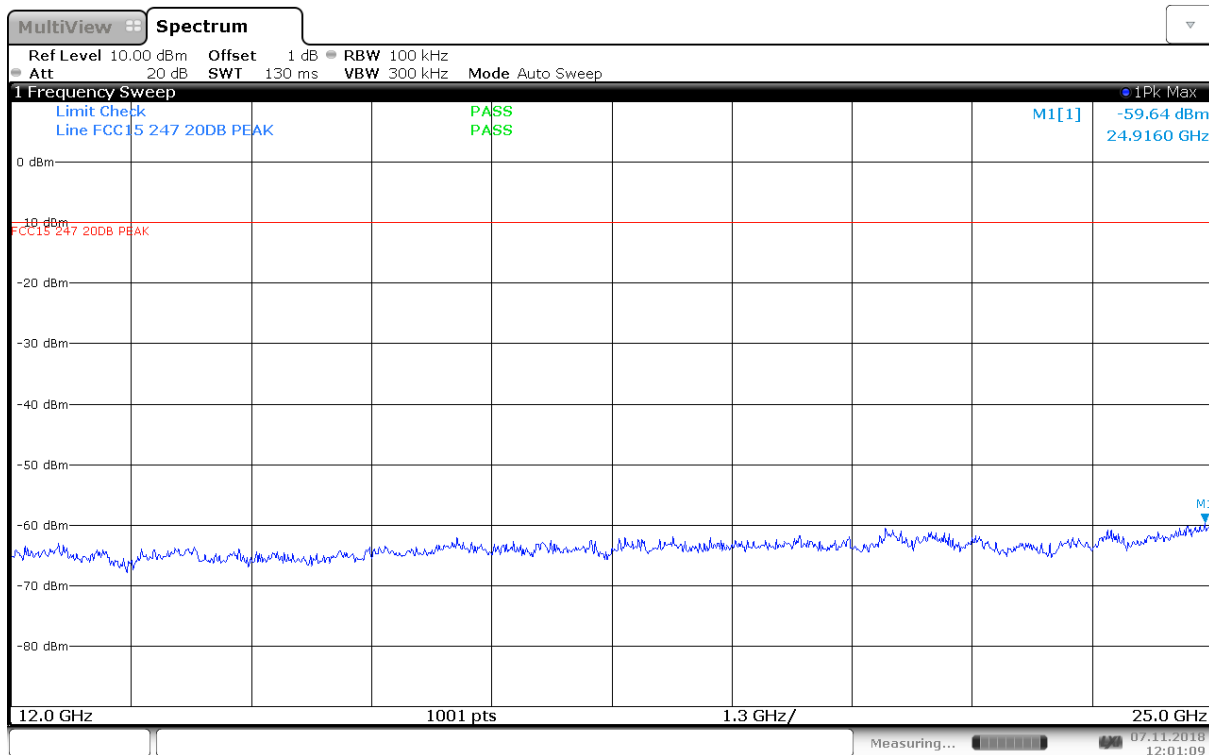
Conducted Emissions, 10 – 2000 MHz, Carrier 2480 MHz



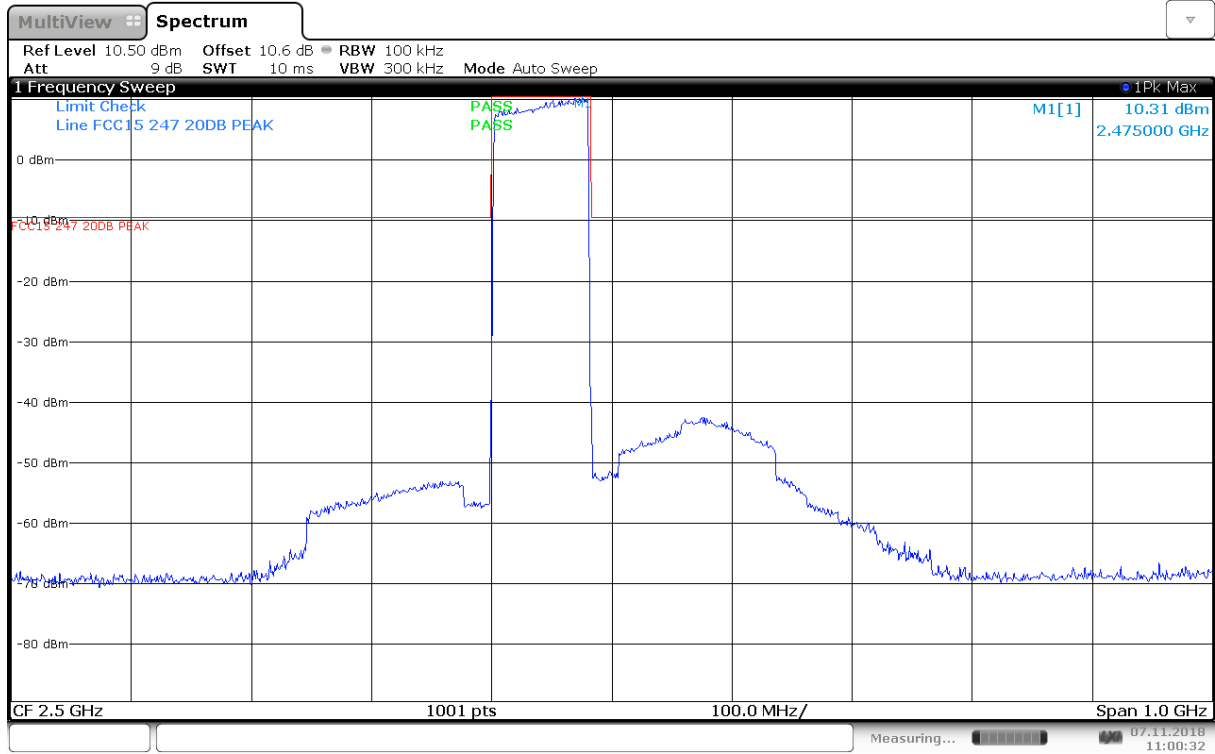
Conducted Emissions, 2000 – 3000 MHz, Carrier 2480 MHz



Conducted Emissions, 3000 – 13000 MHz, Carrier 2480 MHz



Conducted Emissions, 12000 – 25000 MHz, Carrier 2480 MHz



Conducted Emissions, 2000 – 3000 MHz, Hopping

3.8 Restricted Bands of operation

Restricted Bands of operation for FCC and ISSED are defined in FCC Part 15.205 and ISSED RSS-GEN, Issue 4 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.

3.9 Spurious Emissions (Radiated)

FCC Part 15.209

Test Results: Complies

Measurement Data:

Band-Edge

	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dBμV/m	dB	
Peak Detector	43.1	54.9	74	30.9	19.1
Average Detector	23.1	34.9	54	30.9	19.1

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

See attached plots.

Duty Cycle Correction Factor Calculation:

Duty Cycle = slot length / (frame length * Minimum Number of Channels) = 0.0389

Duty Cycle Correction factor = $-20 \times \log(\text{Duty Cycle})$ = 28.2 dB

Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 10 m

Tested in speech mode with active connection

Frequency MHz	Dist. corr. Factor dB	Field strength @3m QP Det., dBμV/m	Limit dBμV/m	Margin dB
	0			
	0			
	0			
	0			

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	
	Radiated emission limit @3 meters	
Frequency (MHz)	Quasi Peak (μV/m)	Quasi Peak (dBμV/m)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
960 - 1000	500	54.0

The limit above 1000 MHz is specified for Average Detector, when the measurement is performed with a Peak Detector a Duty-Cycle Correction Factor must be calculated to find the corresponding Average Detector value.

Radiated Emissions, 1-25 GHz

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
GHz	L,M,H	dB	dB μ V/m	dB	dB μ V/m	dB
	L	0		20	74	
	M	0		20	74	
	H	0		20	74	
Other freqs	L,M,H	0	None detected	20	74	>20

Average Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dB μ V/m	dB	dB μ V/m	dB
	L	0		20	54	
	M	0		20	54	
	H	0		20	54	
Other freqs	L,M,H	/	None detected	20	54	>20

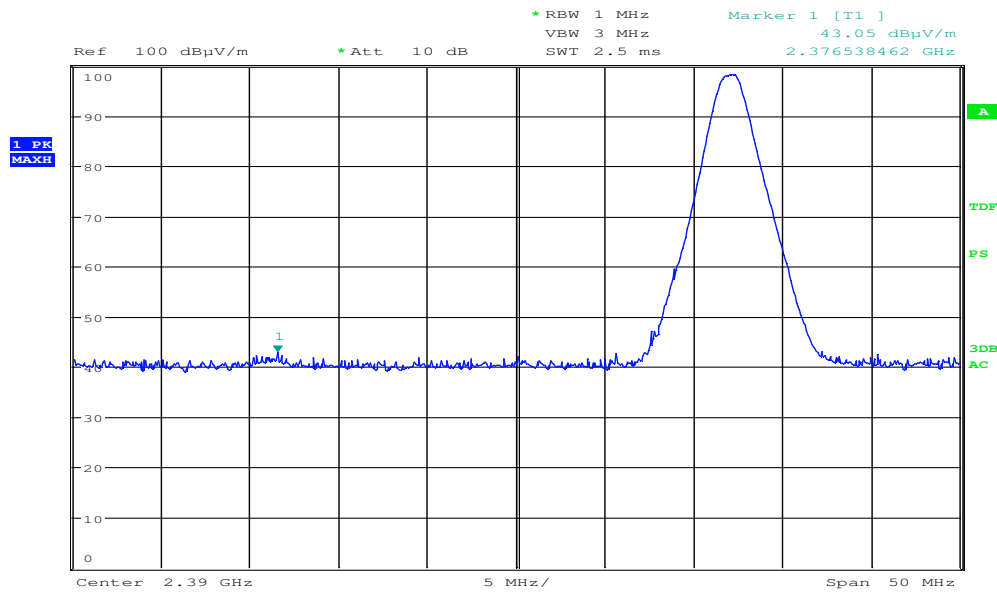
Average Detector values are calculated from Peak values by Duty Cycle Correction Factor.

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

See plots.

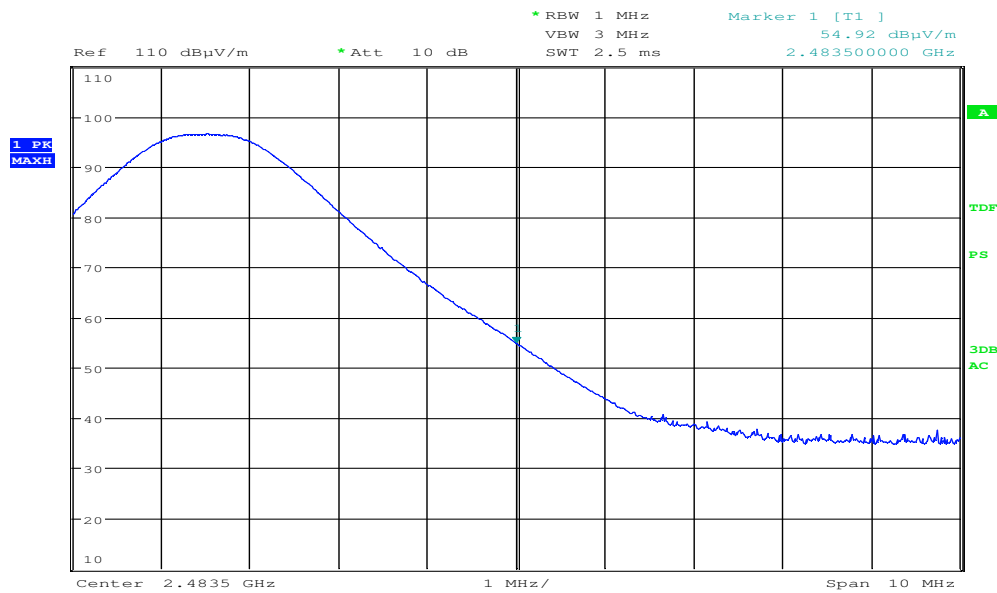
Requirements/Limit

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 (MHz)	AV (dBμV/m)	Peak (dBμV/m)
Above 1 GHz	54.0	74.0



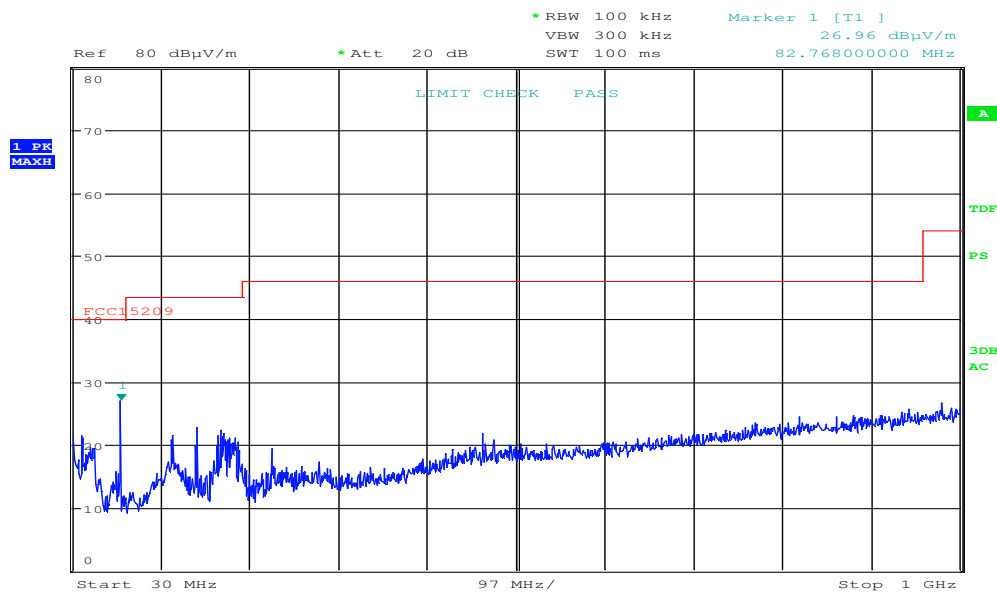
Date: 12.OCT.2018 16:33:49

Lower Band Edge, Peak, 2402MHz (Max: VP)



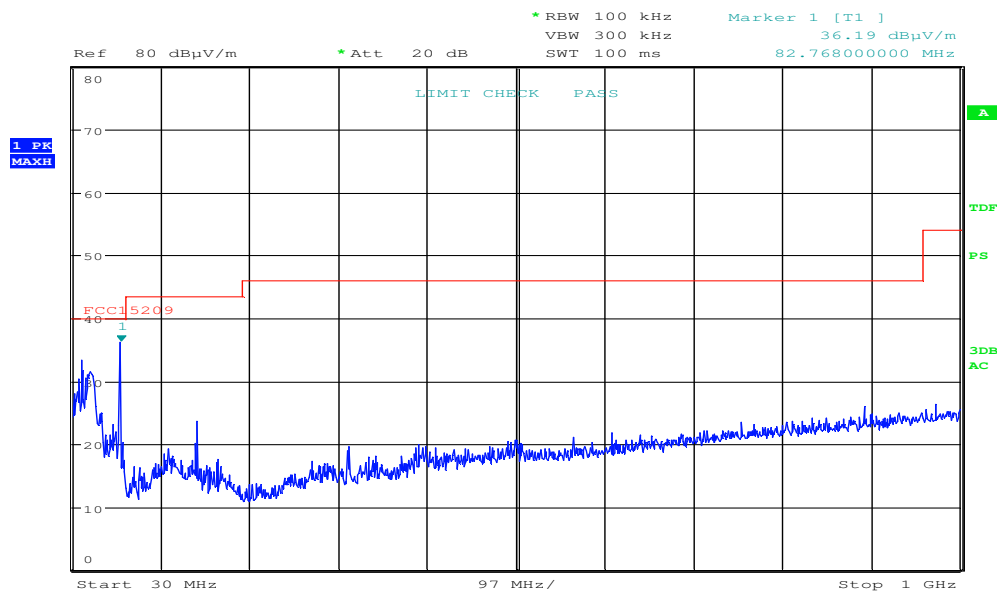
Date: 12.OCT.2018 15:46:54

Upper Band Edge, Peak, 2480MHz (Max: VP)



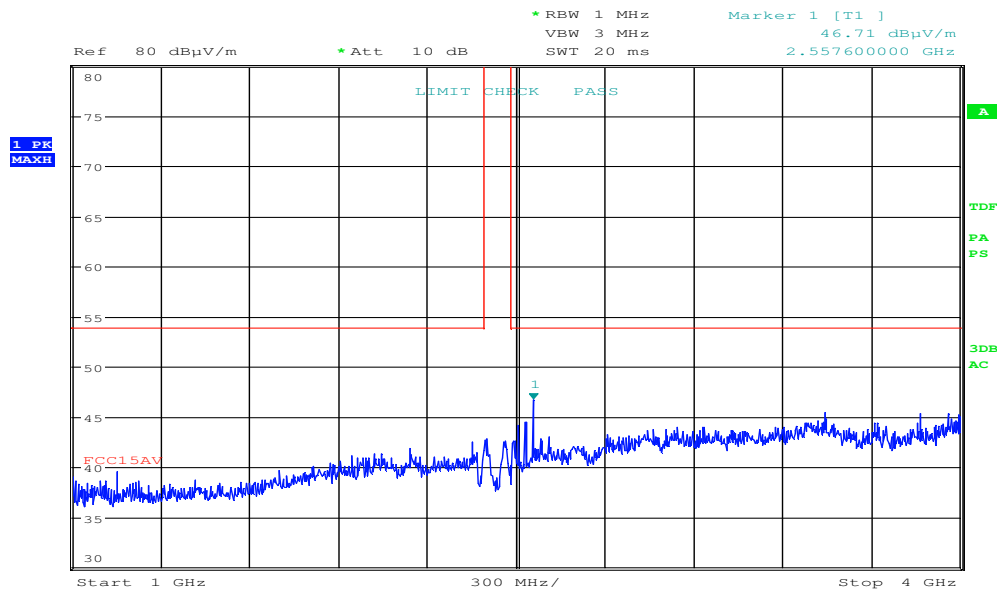
Date: 15.OCT.2018 10:13:19

Radiated Emissions, 30 – 1000 MHz, Hopping, HP



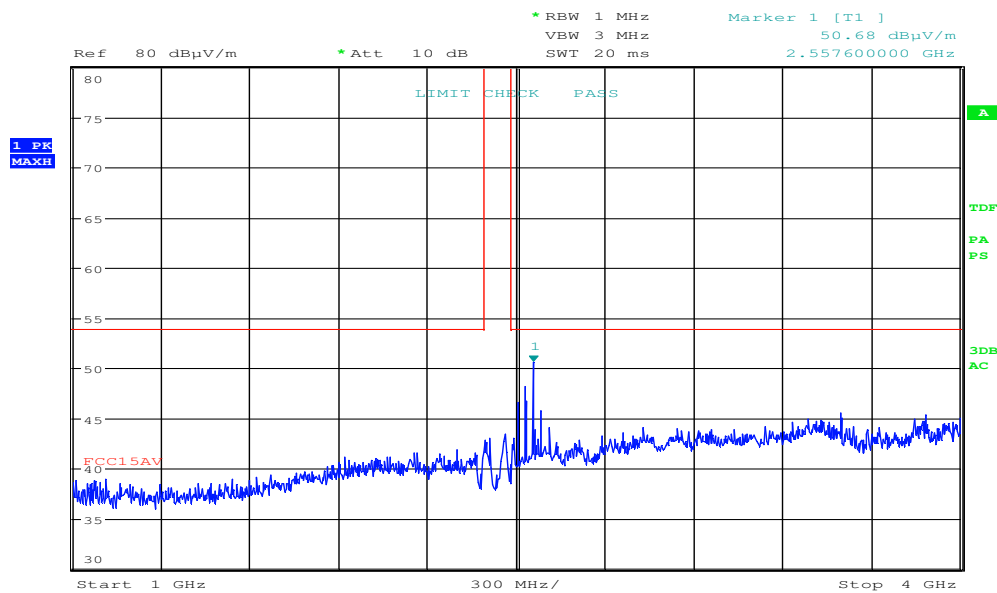
Date: 15.OCT.2018 10:11:15

Radiated Emissions, 30 – 1000 MHz, Hopping, VP



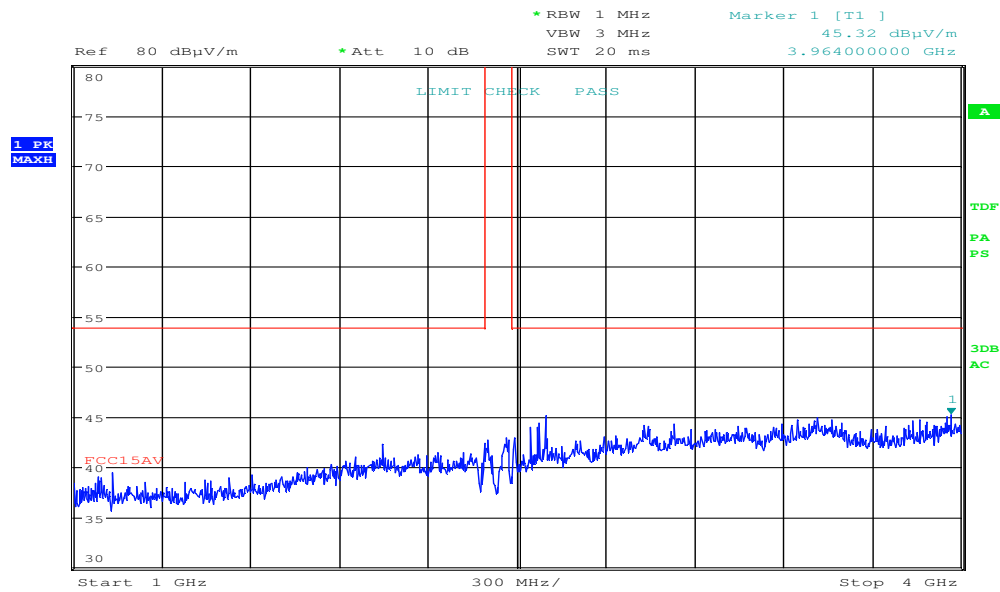
Date: 12.OCT.2018 16:12:34

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



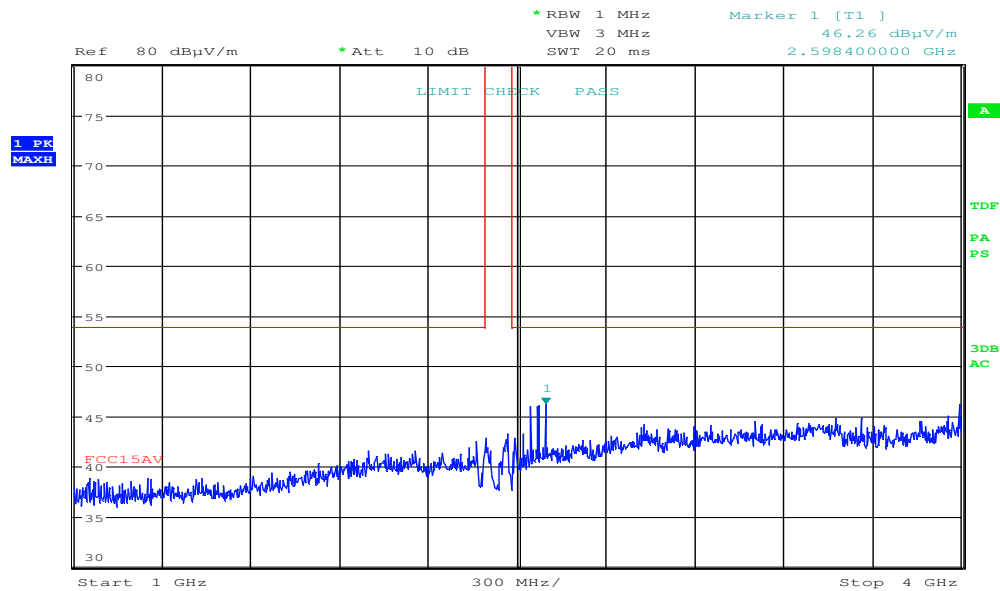
Date: 12.OCT.2018 16:10:40

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



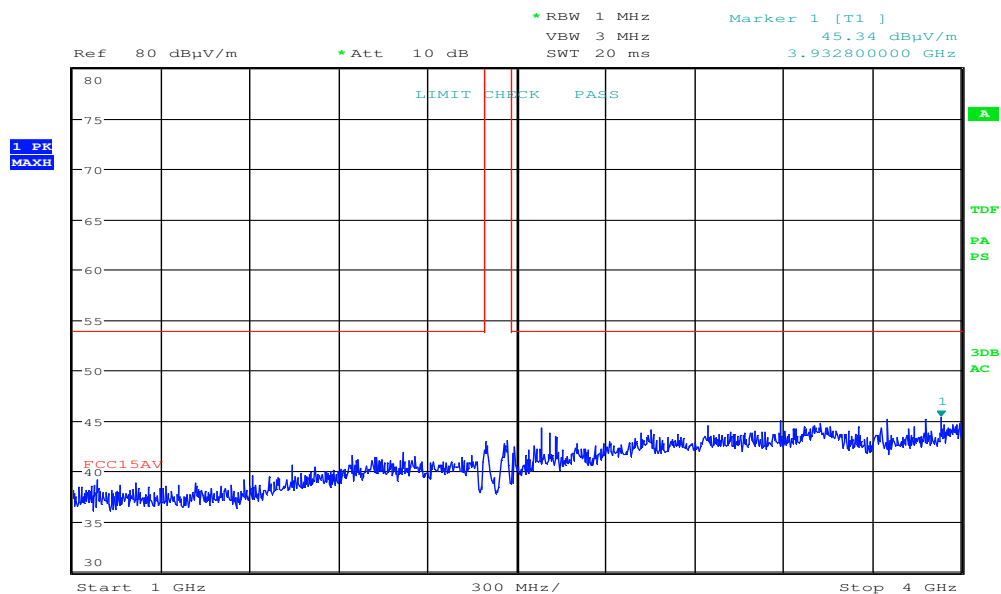
Date: 12.OCT.2018 16:45:34

Radiated Emissions, 1000 -4000 MHz, 2441MHz, HP



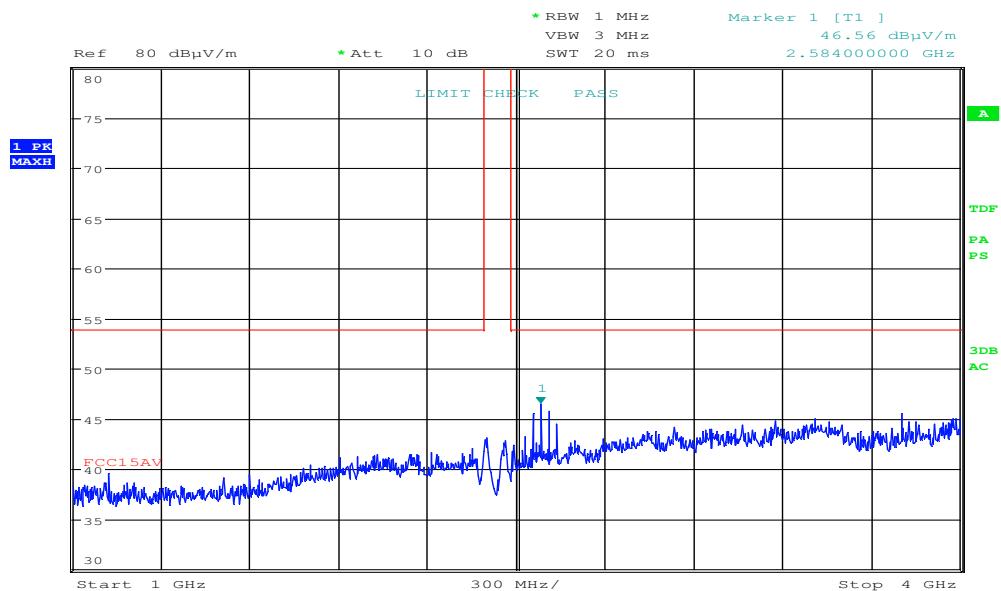
Date: 12.OCT.2018 16:43:40

Radiated Emissions, 1000 -4000 MHz, 2441MHz, VP



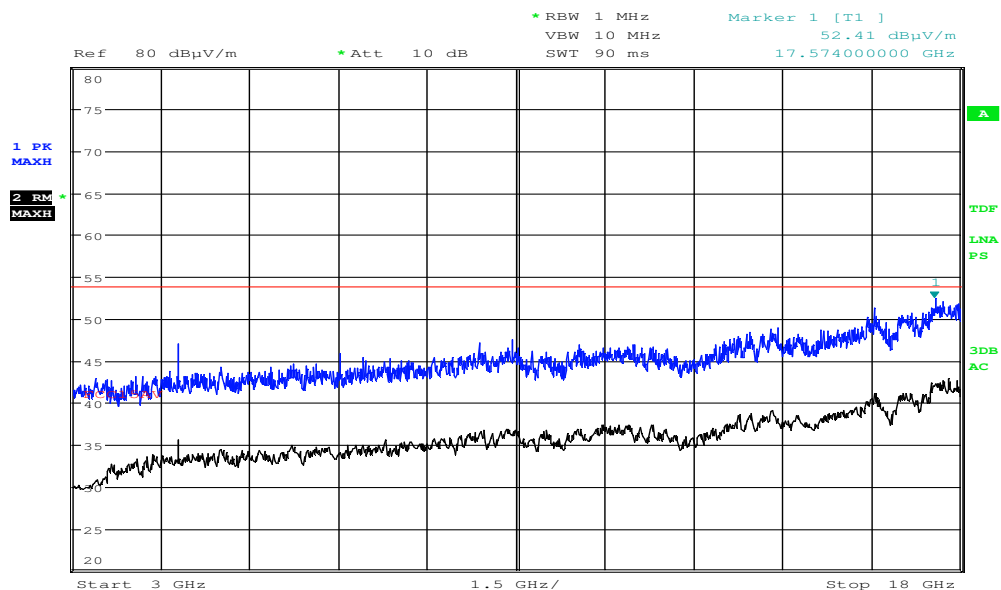
Date: 12.OCT.2018 16:05:15

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



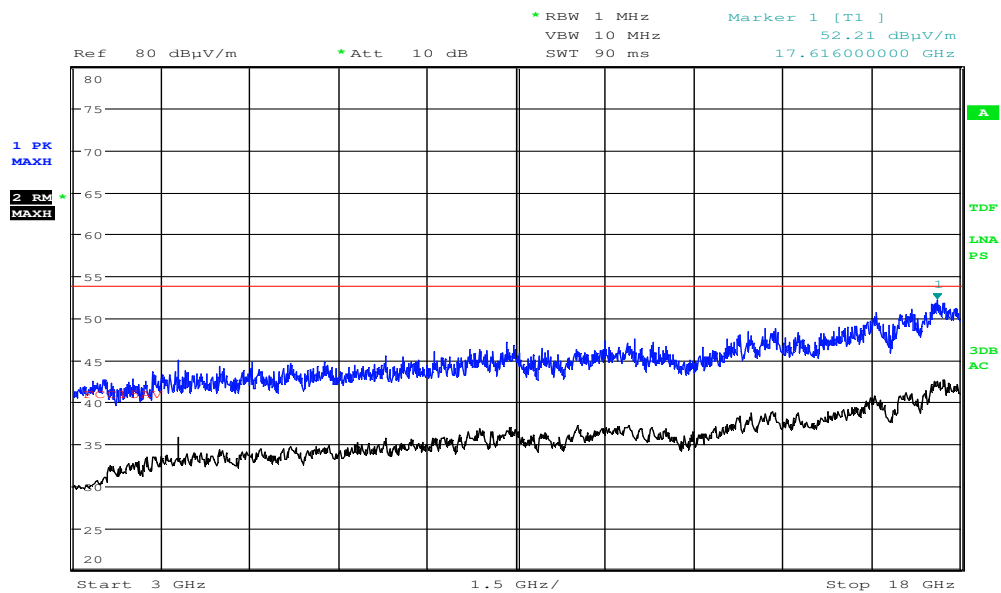
Date: 12.OCT.2018 16:03:21

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



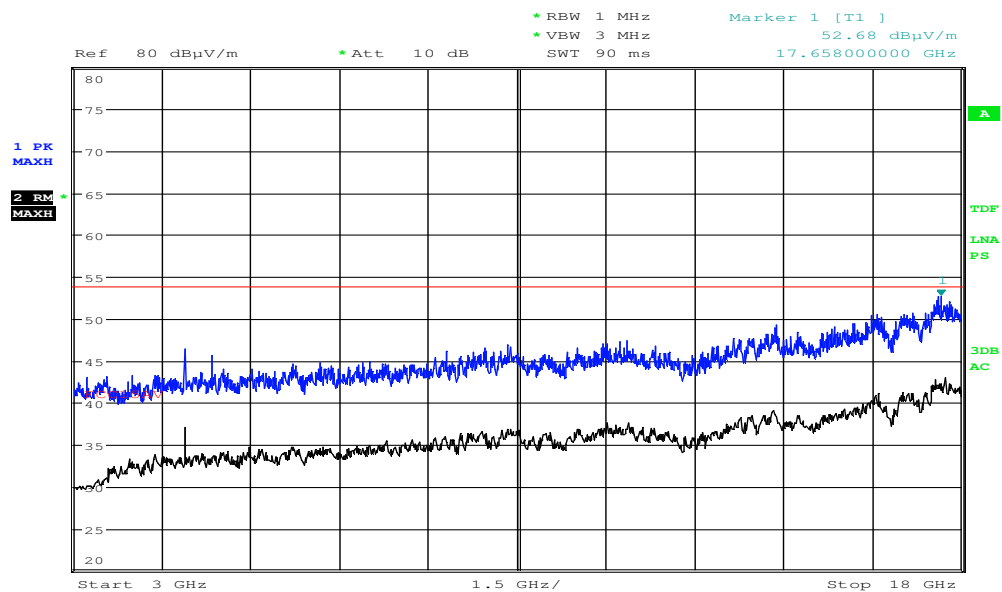
Date: 12.OCT.2018 15:03:21

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



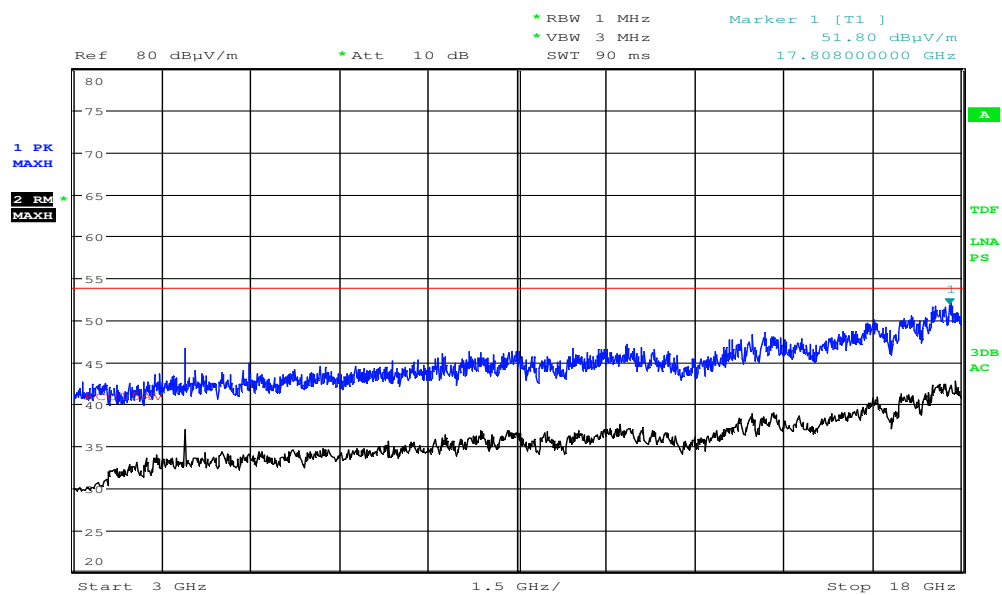
Date: 12.OCT.2018 15:01:26

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



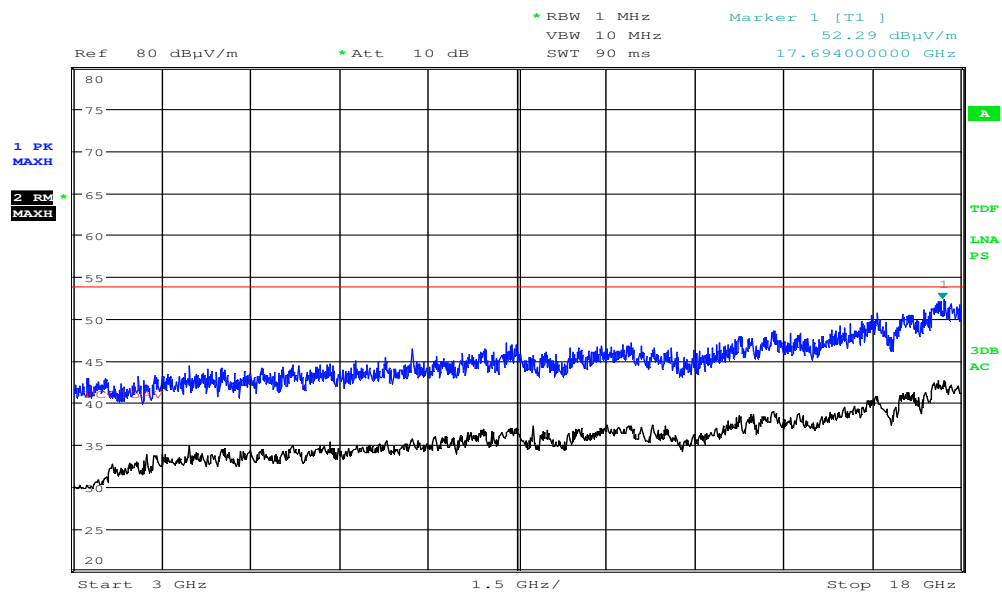
Date: 12.OCT.2018 14:53:39

Radiated Emissions, 3000 -18000 MHz, 2441MHz, HP



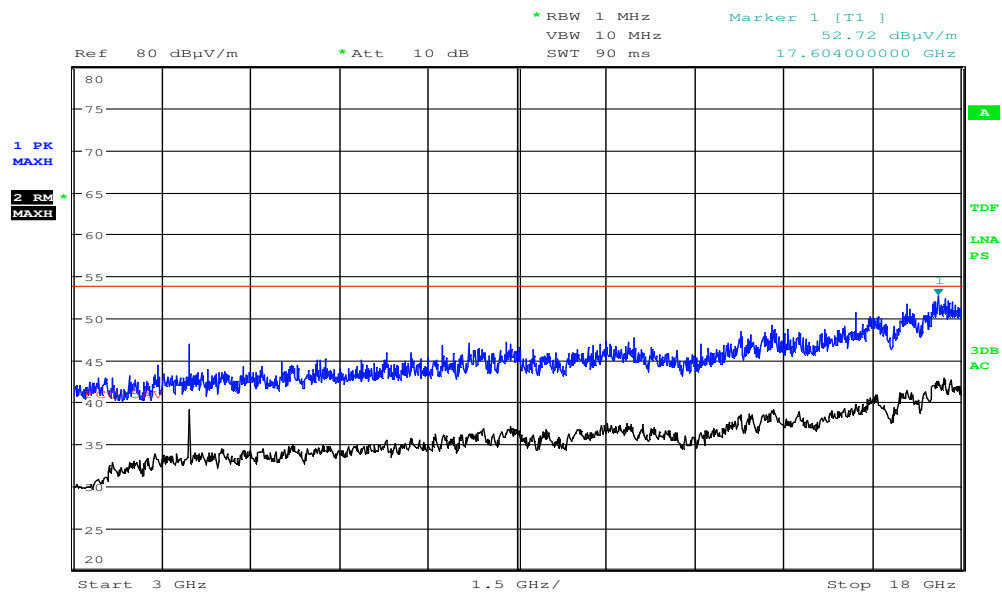
Date: 12.OCT.2018 14:51:44

Radiated Emissions, 3000 -18000 MHz, 2441MHz, VP



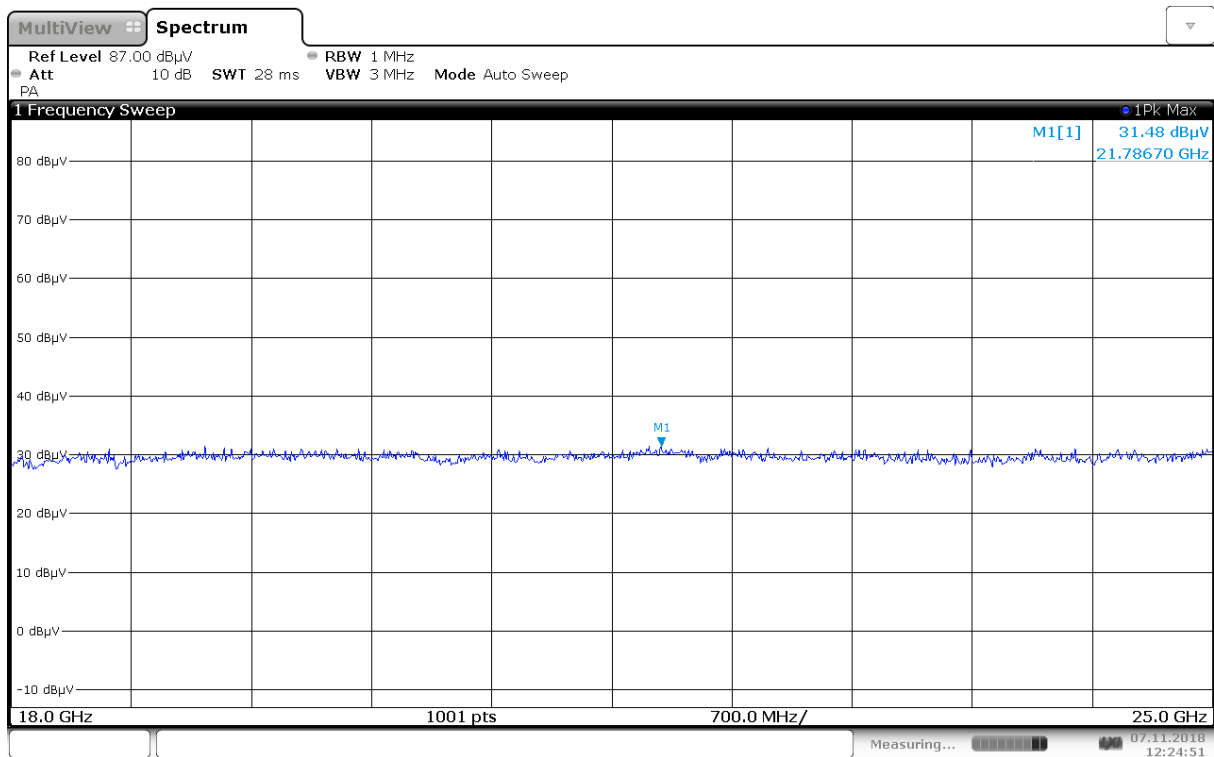
Date: 12.OCT.2018 15:21:37

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



Date: 12.OCT.2018 15:19:43

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



Pre-scan, 18-25 GHz, 2441MHz

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	2018.01	2019.01
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2018.03	2019.03
3	6810.17B	Attenuator	Suhner	LR 1669	COU	
4	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	COU	
5	JB3	BiLog Antenna	Sunol Sciences	N-4525	2017.11	2020.11
6	317	Pre-amplifier	Sonoma Inst.	LR 1687	2018.07	2019.07
7	3115	Horn Antenna	EMCO	LR 1330	2016.10	2021.10
8	3117-PA	Horn Antenna with PreAmp	EMCO	LR 1717	2017.12	2018.12
9	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2018.07	2019.07
10	638	Antenna Horn	Narda	LR 098	N/A	
11	Model 87V	Multimeter	Fluke	LR 1597	2018.02	2019.02
12	6812B	AC Power Source	Hewlett Packard	LR 1515	COU	
13	ESC13	Measuring Receiver	Rohde & Schwarz	N-4259	2017.10	2019.10
14	ENV216	Two Line V-Network	Rohde & Schwarz	LR 1665	2017.11	2019.11
15	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

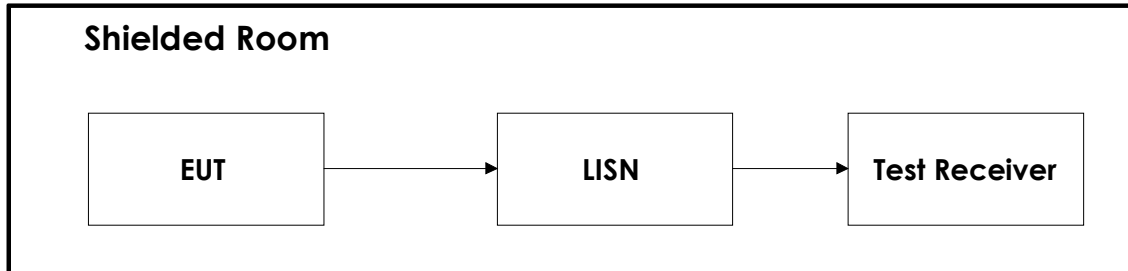
COU = Cal on use

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

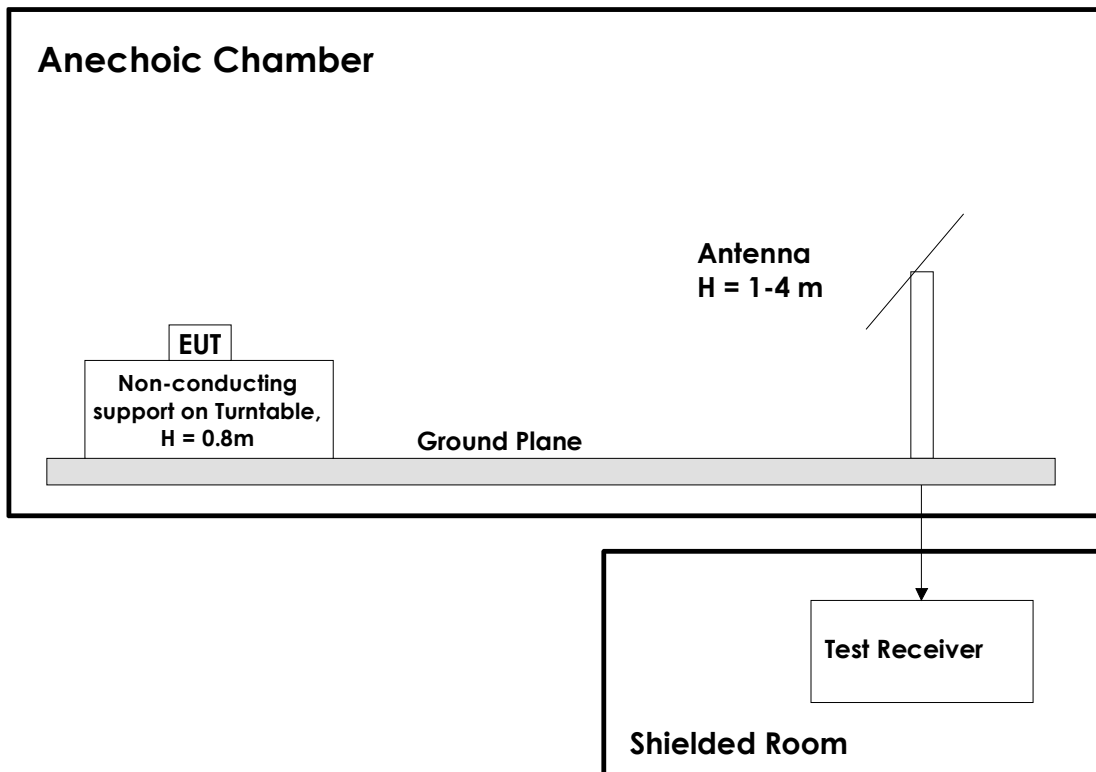
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.40.10	Power Line Conducted test software
2	Rohde & Schwarz	EMC32	10.40.10	Radiated Emission test software
3	Rohde & Schwarz	GPIBShot	2.7	Screenshots from R&S Spectrum Analyzers
4	Agilent	Intuitlink Data Capture	2.1.0	Screenshots from HP 53310A

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.

Revision history

Version	Date	Comment	Sign
1.0	2018.11.21	First edition	FS