

Test Report

Product	Bluetooth Transceiver in UPCS Base Station
Name and address of the applicant	Panasonic System Networks Co., Ltd. 1-62,4-Chome, Minoshima, Hakata-ku, Fukuoka 812-8531, Japan
Name and address of the manufacturer	Panasonic System Networks Co., Ltd. 1-62,4-Chome, Minoshima, Hakata-ku, Fukuoka 812-8531, Japan
Model	KX-TGF570 KX-TGF590C
Rating	5.5V DC (AC Adaptor, 1.5A; 100-240 V AC, 50/60 Hz, 1.2-0.6 A)
Trademark	Panasonic
Serial number	/
Additional information	Bluetooth 2.1, DECT 6.0
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Industry Canada RSS-247, Issue 1 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Order number	319568
Tested in period	2016.11.08 to 2016.11.14
Issue date	2016.12.13
Name and address of the testing laboratory	 FCC No: 994405 IC OATS: 2040D-1 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50 Instituttveien 6 Kjeller, Norway
 Prepared by [Frode Sveinsen]  Approved by [G. Suhanthakumar]	
This report shall not be reproduced except in full without the written approval of Nemko. Opinions and interpretations expressed within this report are not part of the current accreditation. This report was originally distributed electronically with digital signatures. For more information contact Nemko.	

CONTENTS

1	INFORMATION	3
1.1	Test Item.....	3
1.2	Test Environment.....	4
1.3	Test Engineer(s)	4
1.4	Test Equipment.....	4
2	TEST REPORT SUMMARY	5
2.1	General.....	5
2.2	Test Summary	6
2.3	Description of modification for Modification Filing	6
2.4	Comments	6
2.5	Family List Rational	6
3	TEST RESULTS.....	7
3.1	Power Line Conducted Emissions	7
3.2	Channel Separation	8
3.3	Pseudorandom Hopping Algorithm	11
3.4	Occupancy Time.....	12
3.5	Occupied Bandwidth.....	15
3.6	Peak Power Output.....	18
3.7	Spurious Emissions (Radiated)	22
4	LIST OF TEST EQUIPMENT	40
5	BLOCK DIAGRAM.....	41
5.1	Power Line Conducted Emission	41
5.2	Test Site Radiated Emission.....	41

1 INFORMATION

1.1 Test Item

Name :	Panasonic
Model/version :	KX-TGF570 (US model) KX-TGF590C (Canadian model)
FCC ID :	ACJ96NKX-TGF570
Industry Canada ID :	216A-KXTGF590
Serial number :	/
Hardware identity and/or version:	PNLB2670xx
Software identity and/or version :	SW201
Frequency Range :	2402 – 2480 MHz
Number of Channels :	Minimum 20 and Maximum 79 (Adaptive Frequency Hopping)
Type of Modulation :	Digital (GFSK)
User Frequency Adjustment :	None
Conducted Output Power :	0.0076 Watts (Peak)
Type of Power Supply :	AC Adaptor Model PNLV226
Antenna Connector :	None
Antenna Diversity Supported :	No
Desktop Charger :	N/A

Description of Test Item

The EUT is a Bluetooth Module in a DECT Base station.

The BT module in KX-TGF570 is identical to the BT Module in KX-TGE270 (FCC ID: ACJ96NKX-TGE270), all conducted test results are from Nemko Test Report No: 248567-3 for KX-TGE270.

The US and Canadian models KX-TGF570 and KX-TGF590C, are identical.

1.2 Test Environment

1.2.1 *Normal test condition*

Temperature:	21.9 – 23.1 °C
Relative humidity:	22 – 41 %
Normal test voltage:	120 V AC, 60 Hz

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen / Tore Løvlien

1.4 Test Equipment

See list of test equipment in clause 5.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 1.

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 3m and 10m.

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

☒ 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".

Nemko Group authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any reproduction of parts of this report requires approval in writing from Nemko Group.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Group accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 1, RSS-GEN Issue 4 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Number of Operating Frequencies	15.31(m)	5.1 (6)	Complies
Antenna Requirement	15.203	8.3 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	8.8 (RSS-GEN)	Complies
Channel Separation	15.247(a)(1)	5.1 (4)	Complies ³
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3)	Complies ³
Time of Occupancy	15.247(a)(1)(iii)	5.1 (5)	Complies ³
Occupied Bandwidth	15.247(a)(1)	5.1 (7)	Complies ³
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1)	N/A ¹
Peak Power Output	15.247(b)	5.4 (5)	Complies ³
Power Spectral Density	15.247(d)	5.2 (2)	N/A ¹
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5	Complies ²
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

¹ Not applicable for FHSS equipment

² The tested equipment has integrated antennas only

³ All Conducted test results are from Nemko Test report No 248567-3 and were tested on KX-TGE270

2.3 Description of modification for Modification Filing

Not applicable.

2.4 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.

2.5 Family List Rational

Not Applicable.

3 TEST RESULTS

3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: Tore Løvlien

Date of Test: 8-Nov-2016

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

Test Results: Complies.

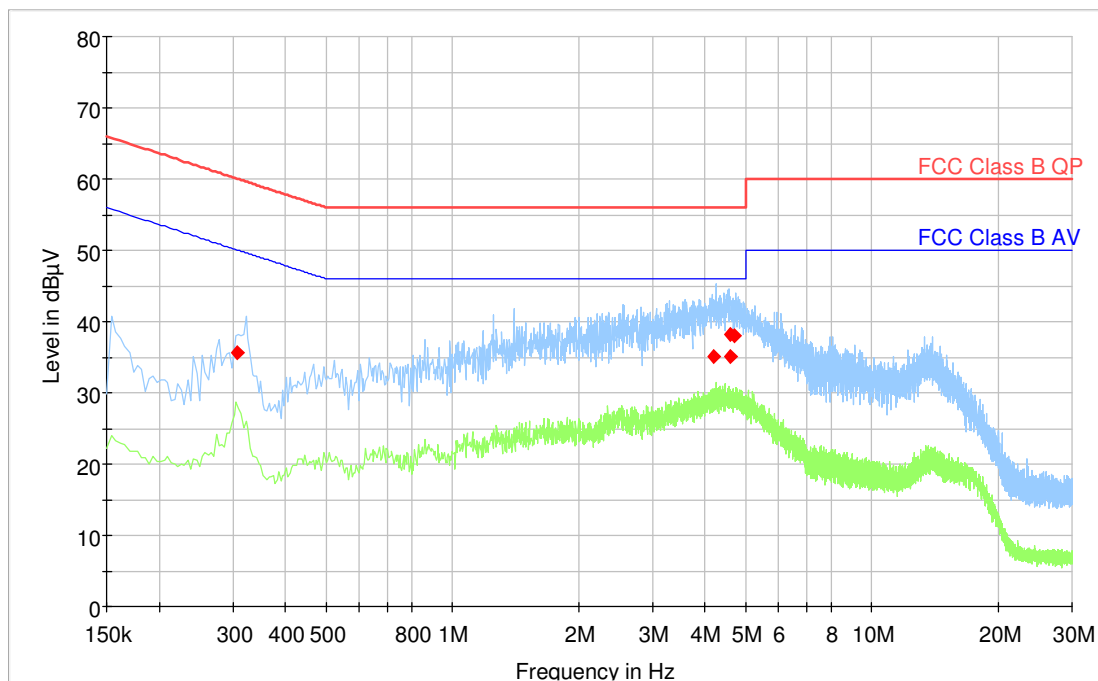
Measurement Data: See attached graph, (Peak detector).

Highest measured value (L1 and N):

120V 60Hz:

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.308	35.72	---	60.02	24.31	1000.0	9.000	N	GND	10.1
4.184	35.13	---	56.00	20.87	1000.0	9.000	L1	GND	10.1
4.592	38.20	---	56.00	17.80	1000.0	9.000	N	GND	10.1
4.600	35.07	---	56.00	20.93	1000.0	9.000	L1	GND	10.2
4.700	38.07	---	56.00	17.93	1000.0	9.000	N	GND	10.1

Full Spectrum



3.2 Channel Separation

Para. No.: 15.247 (a)(1)

Test Results: **Complies**

Measurement Data:

Channel Separation:	1.0 MHz
Nominal value for Channel Separation	1.0 MHz
20 dB BW of hopping channel, 2402MHz:	923.1 kHz
20 dB BW of hopping channel, 2441MHz:	921.1 kHz
20 dB BW of hopping channel, 2480MHz:	921.1 kHz

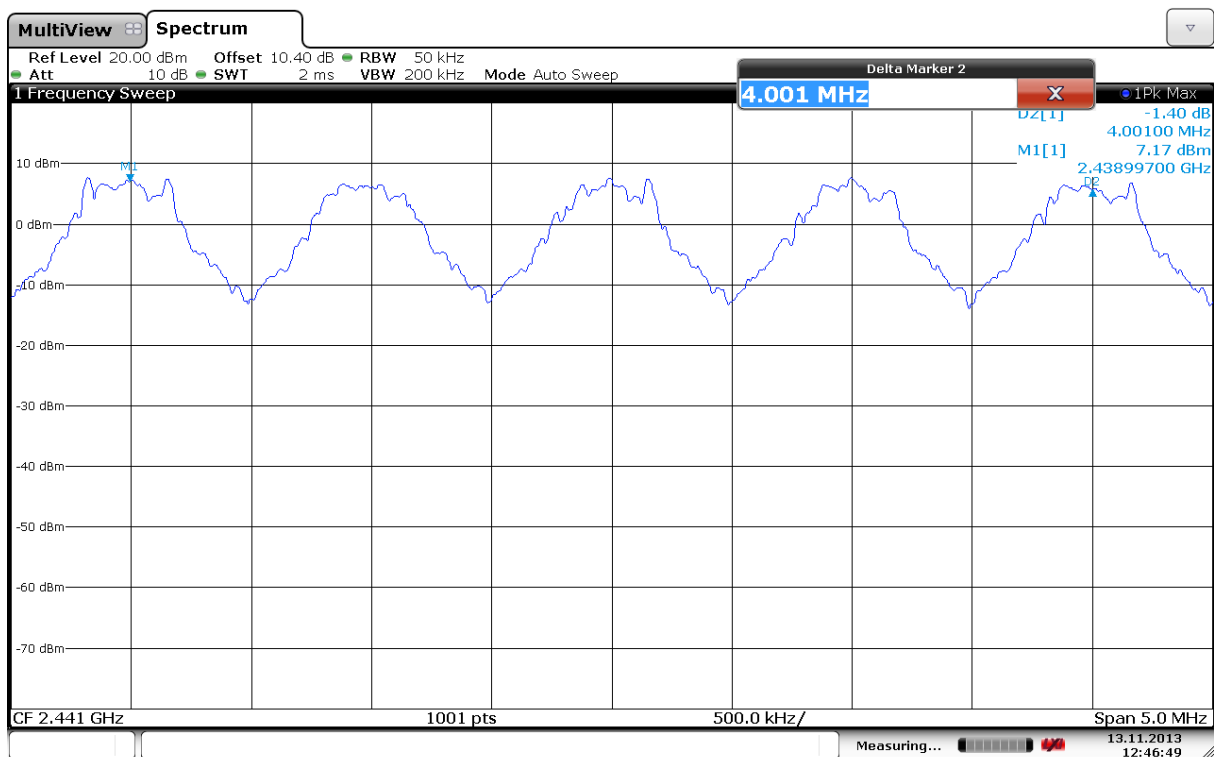
See attached plots

Requirement:

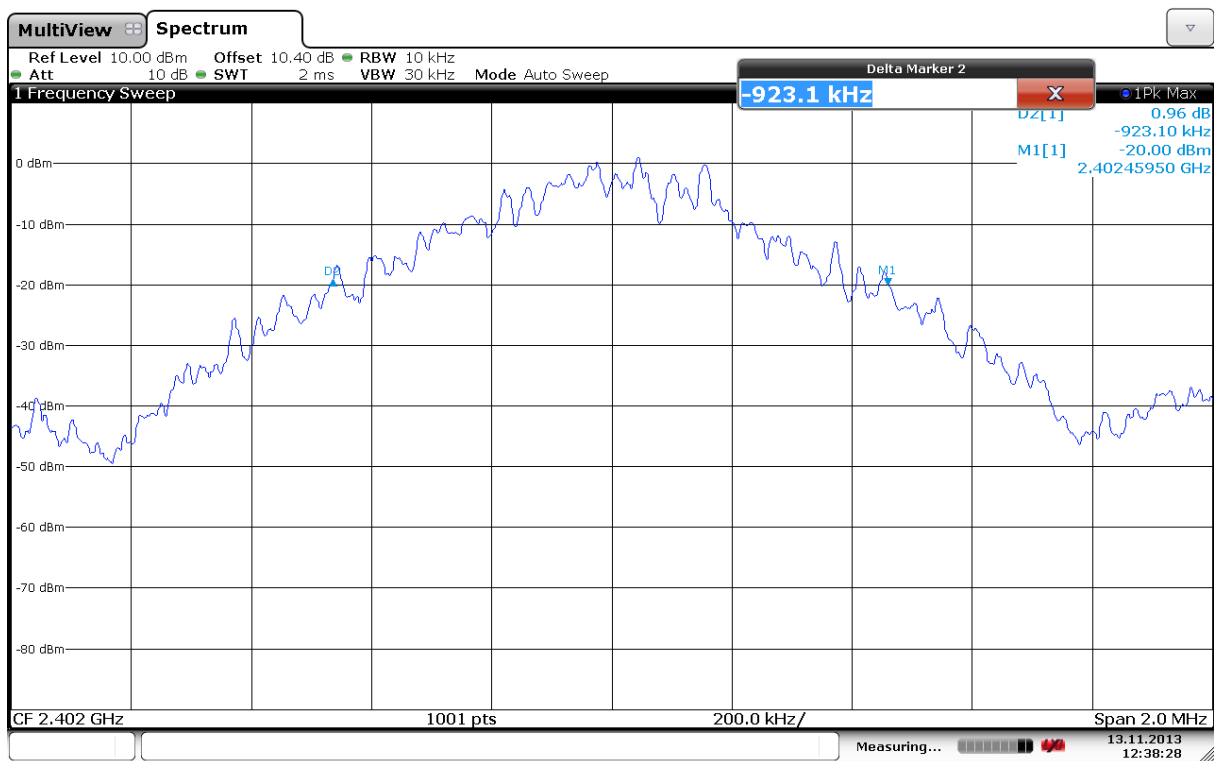
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

or:

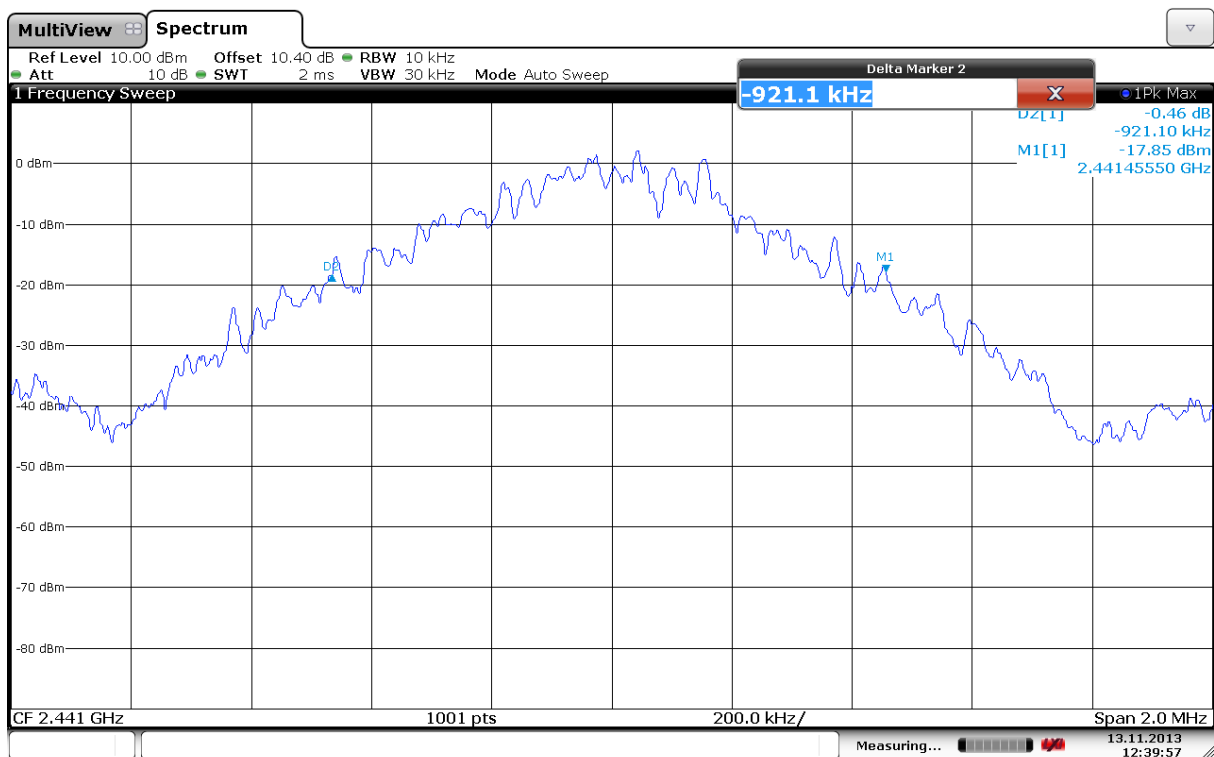
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.



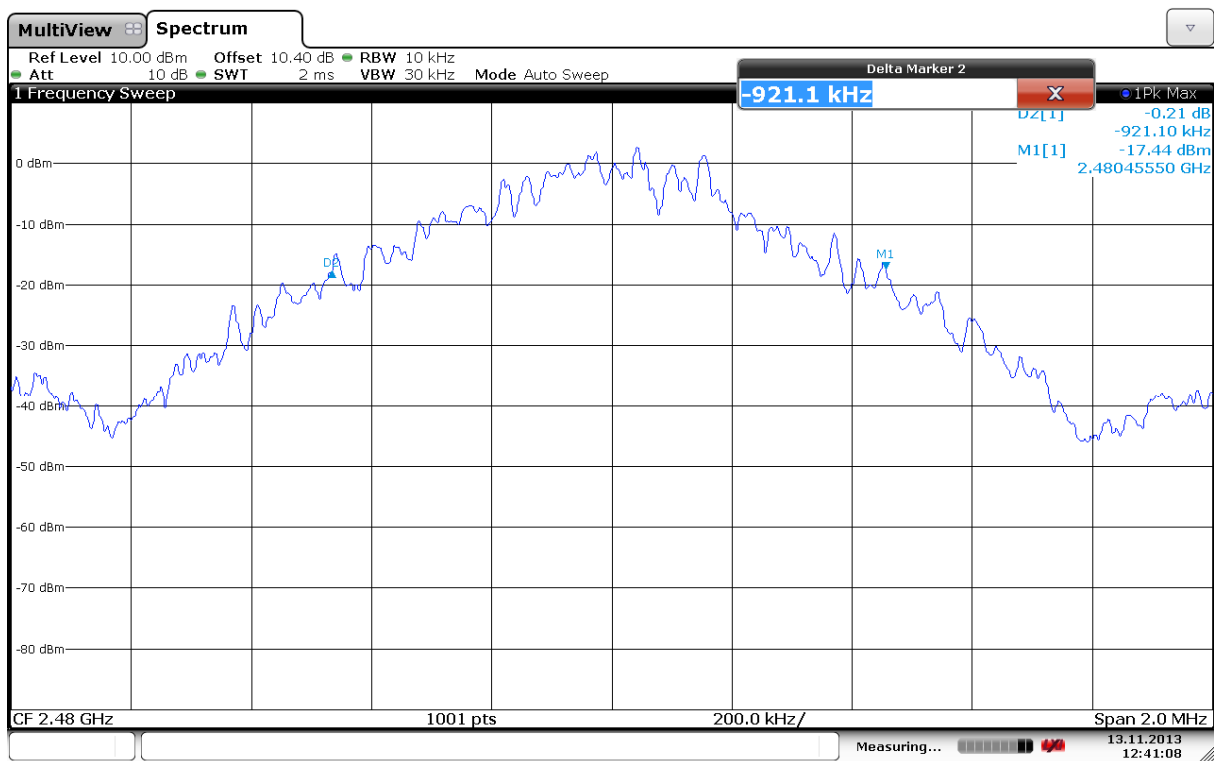
Channel Separation



20dB Bandwidth, 2402 MHz



20dB Bandwidth, 2441 MHz



20dB Bandwidth, 2480 MHz

3.3 Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Results: Complies

Measurement Data: The EUT follows the Bluetooth standard.

Requirements:

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

No requirements for Digital Transmission Systems.

3.4 Occupancy Time

Para. No.: 15.247 (a)(1)(iii)

Test Results: Complies

Measurement Data:

Minimum Number of RF Channels:	20
Maximum Number of RF Channels:	79
Maximum Length of RF Burst pr. channel	2.90 ms
Time between RF Burst on same RF Channel	75.0 ms (20 ch)
	296.25 ms (79 ch)
Time of Occupancy (20 and 79 ch mode)	309.3 ms

20 Ch Mode:

Time between RF burst on same channel: $3.75 \times 20 \text{ ms} = 75.0 \text{ ms}$

Time of occupancy: $(2.90 \times 400 \times 20) / 75.0 = 309.3 \text{ ms}$

79 Ch Mode:

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

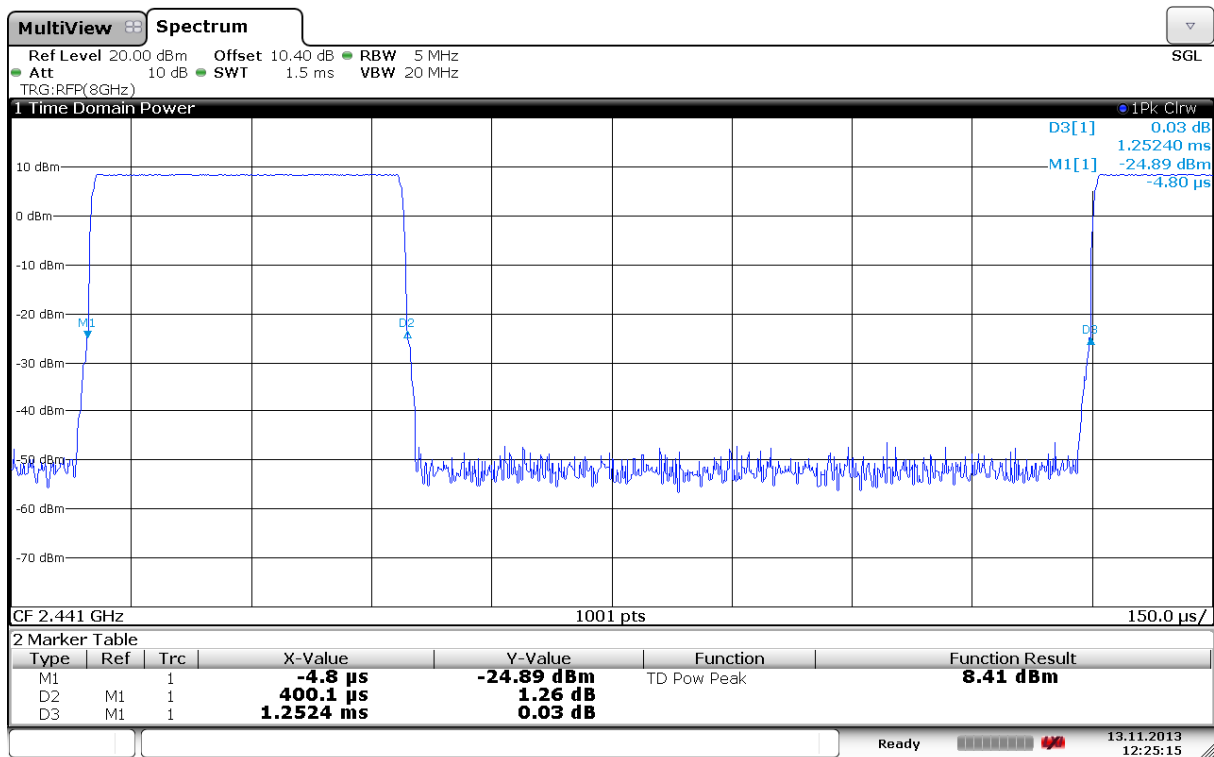
Time of occupancy: $(2.90 \times 400 \times 79) / 296.25 = 309.3 \text{ ms}$

See attached graph.

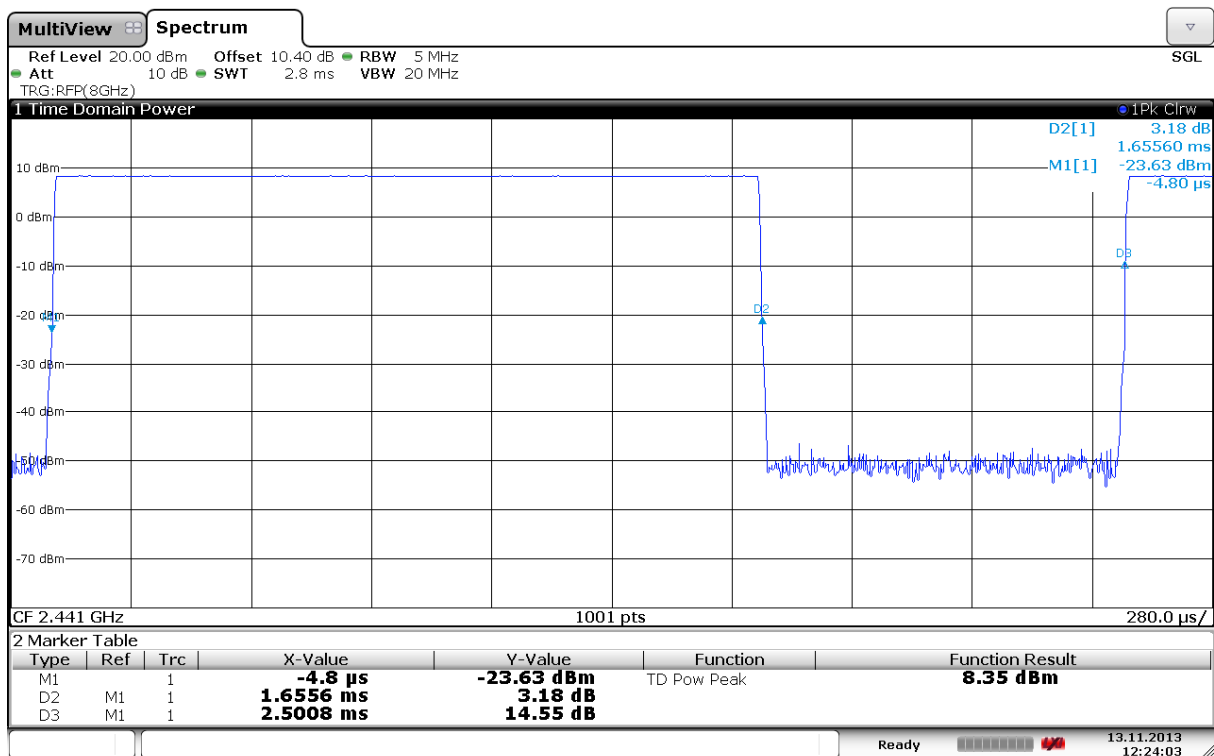
Requirements:

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.

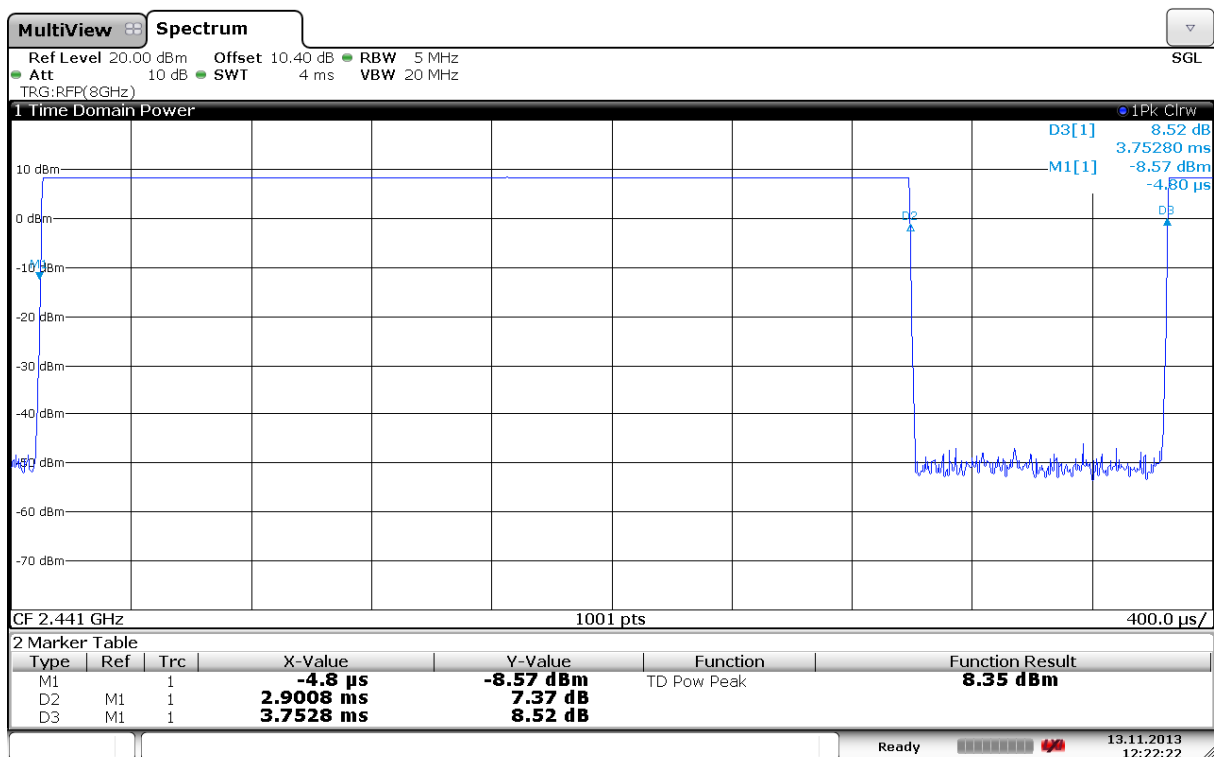
No requirements for Digital Transmission Systems.



Burst Length DH1



Burst Length DH3



Burst Length DH5

3.5 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Results: Complies

Measurement Data:

Number of RF Channels in use:	20 or 79 RF channels in use
Channel Centre Frequencies:	The channels are centered at each full MHz from 2402 to 2480 MHz

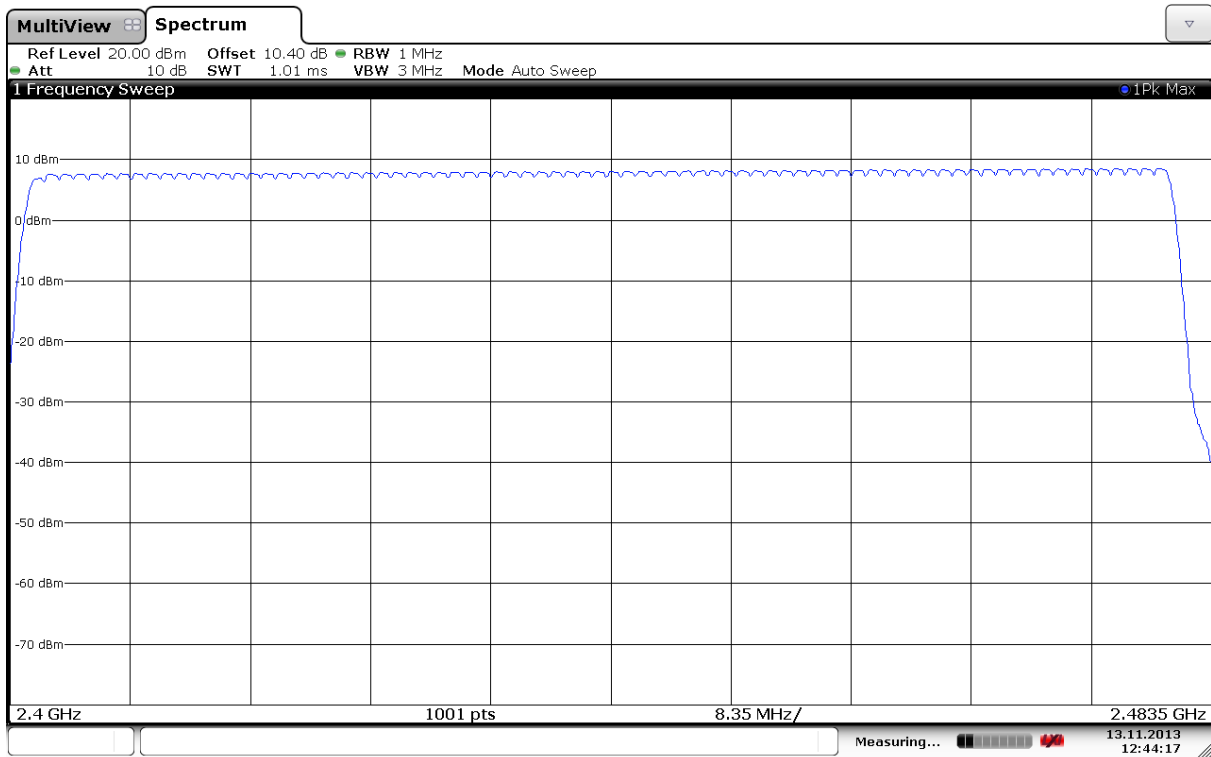
See attached plots.

Requirements:

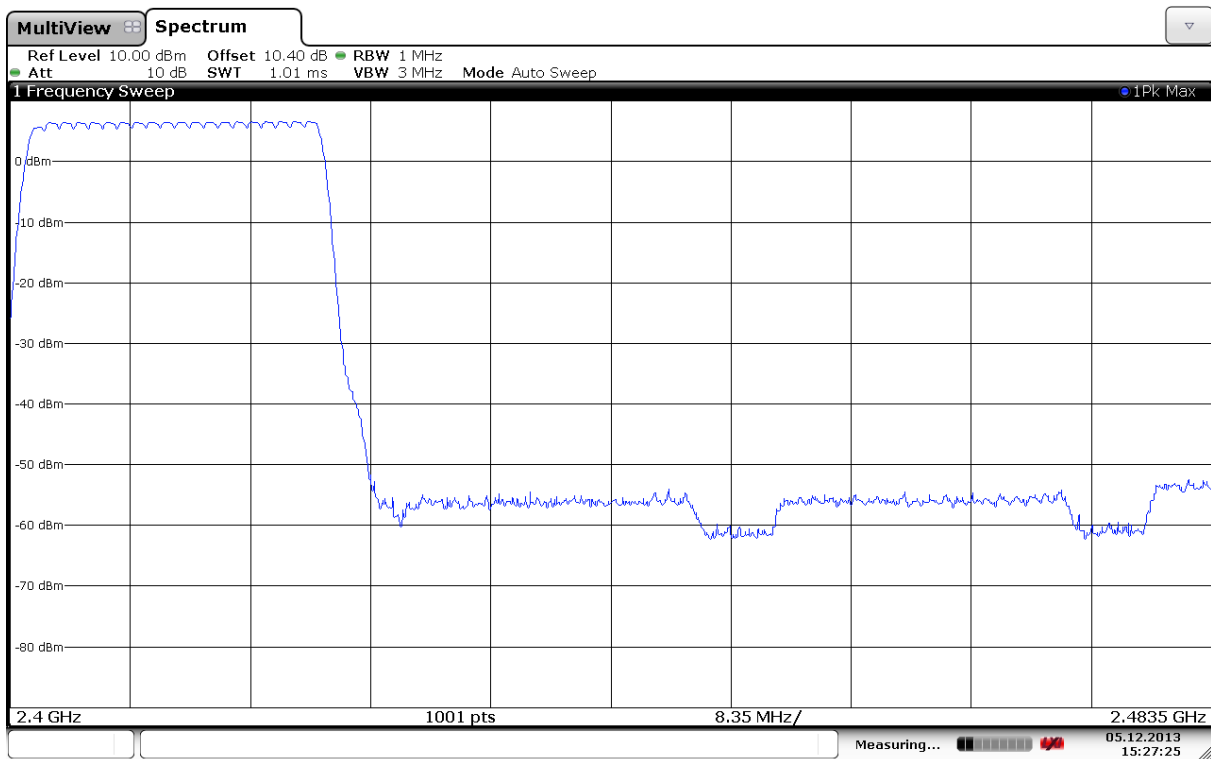
Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels.
No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.

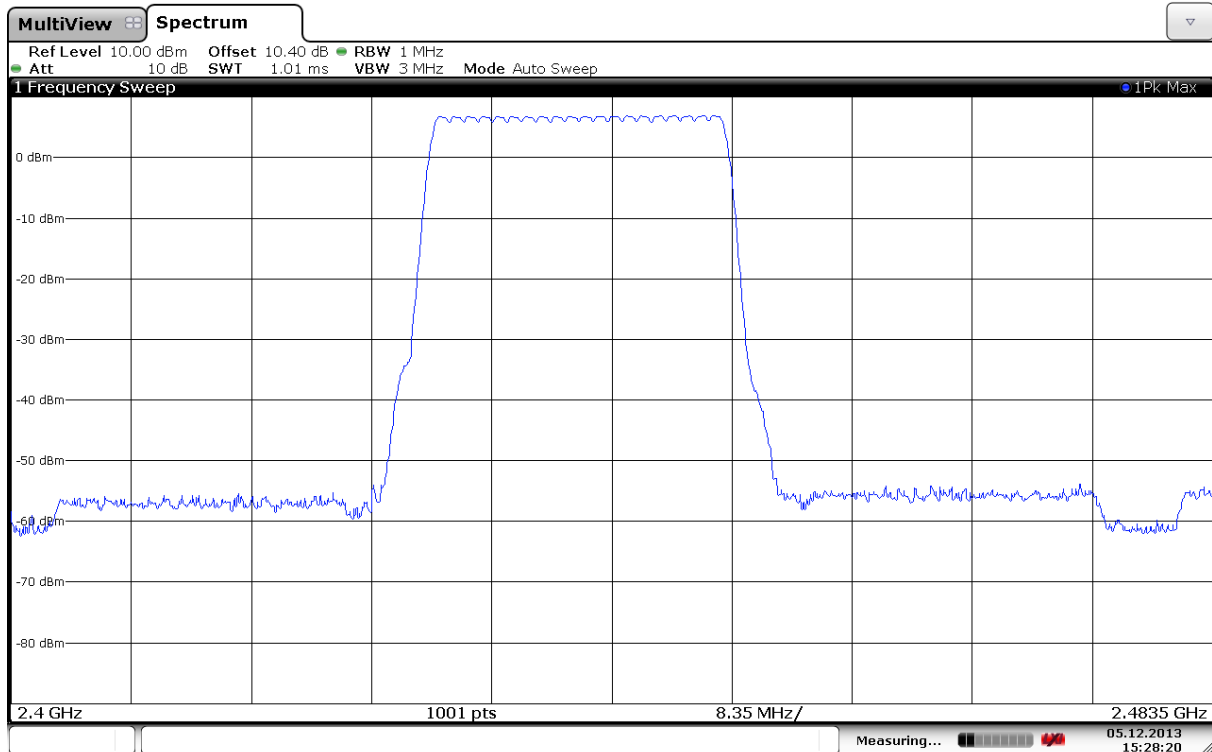
No requirement for 99% BW, reported for information only.



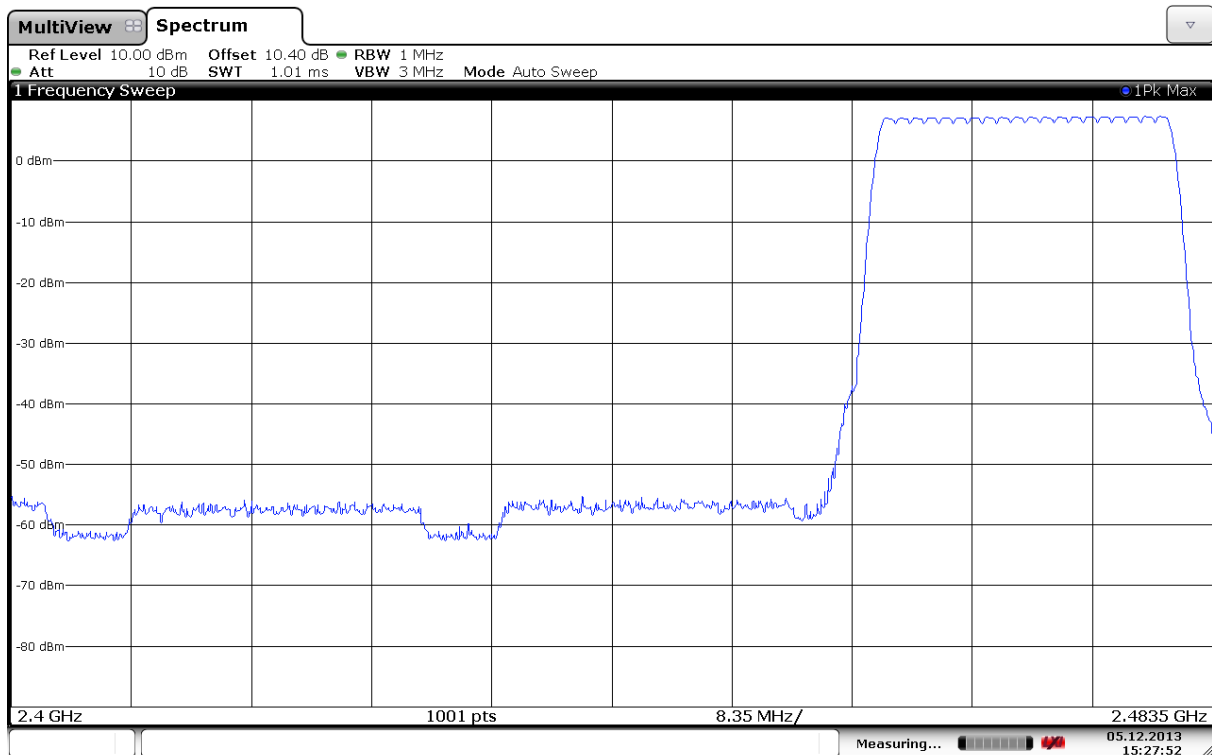
RF Channels in Use, 79 Ch



RF Channels in Use, 20 Ch, Low



RF Channels in Use, 20 Ch, Mid



RF Channels in Use, 20 Ch, High

3.6 Peak Power Output

Para. No.: 15.247 (b)

Test Results: Complies

Measurement Data:

	2402 MHz	2441 MHz	2480 MHz
Peak Power (dBm)	7.27	8.36	8.78
Peak Power (Watts)	0.0053	0.0069	0.0076
Field Strength (dBμV/m, @3m)	90.70	93.83	92.07
EIRP, Calculated (Watts)	0.00035	0.00072	0.00048
Antenna gain (dBi)	-11.8	-9.8	-11.9

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 v01r01.

See attached plots

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

☐ Yes ☐ No

Type of antenna connector: N/A

Requirements:

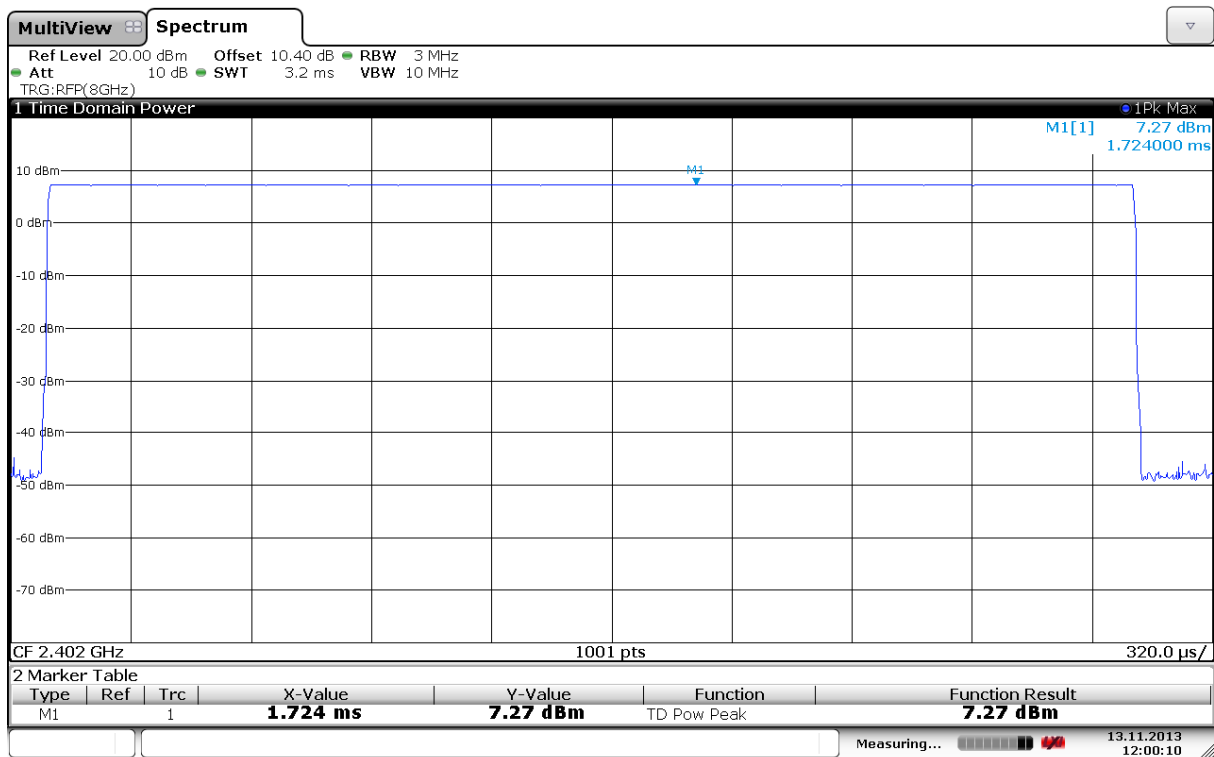
The maximum peak output power shall not exceed the following limits:

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

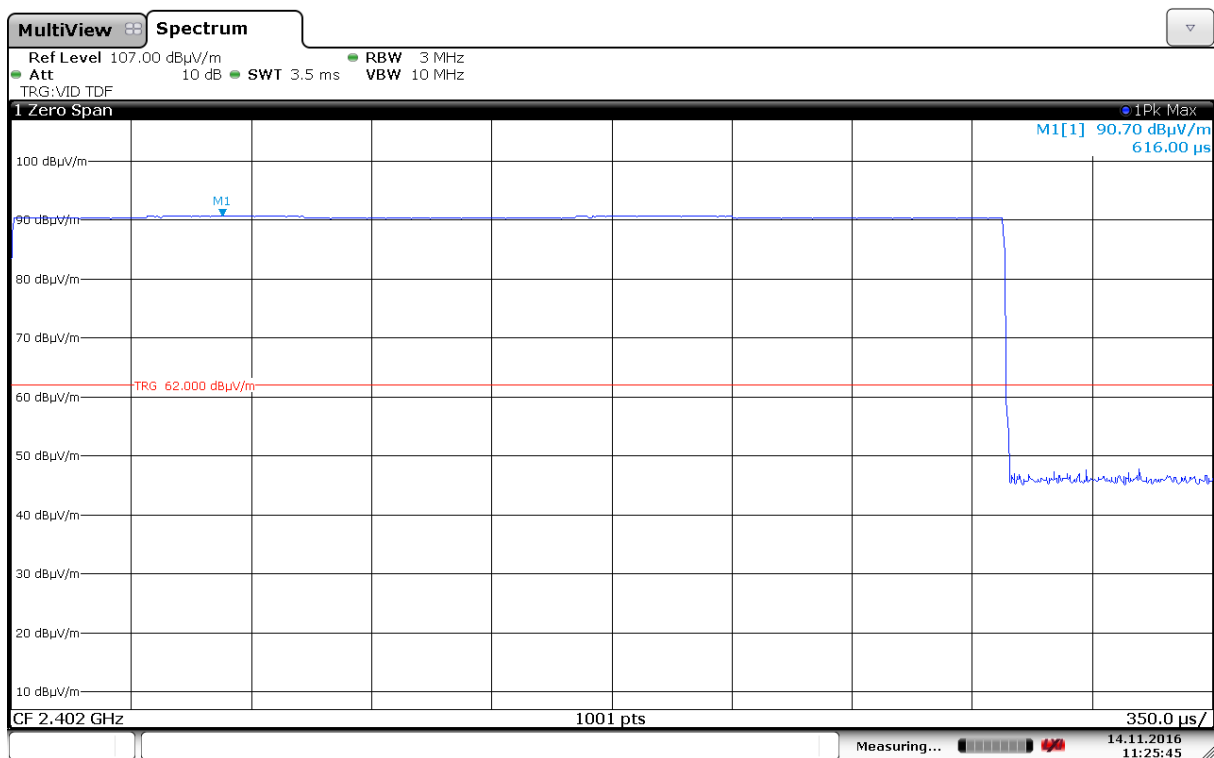
For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

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

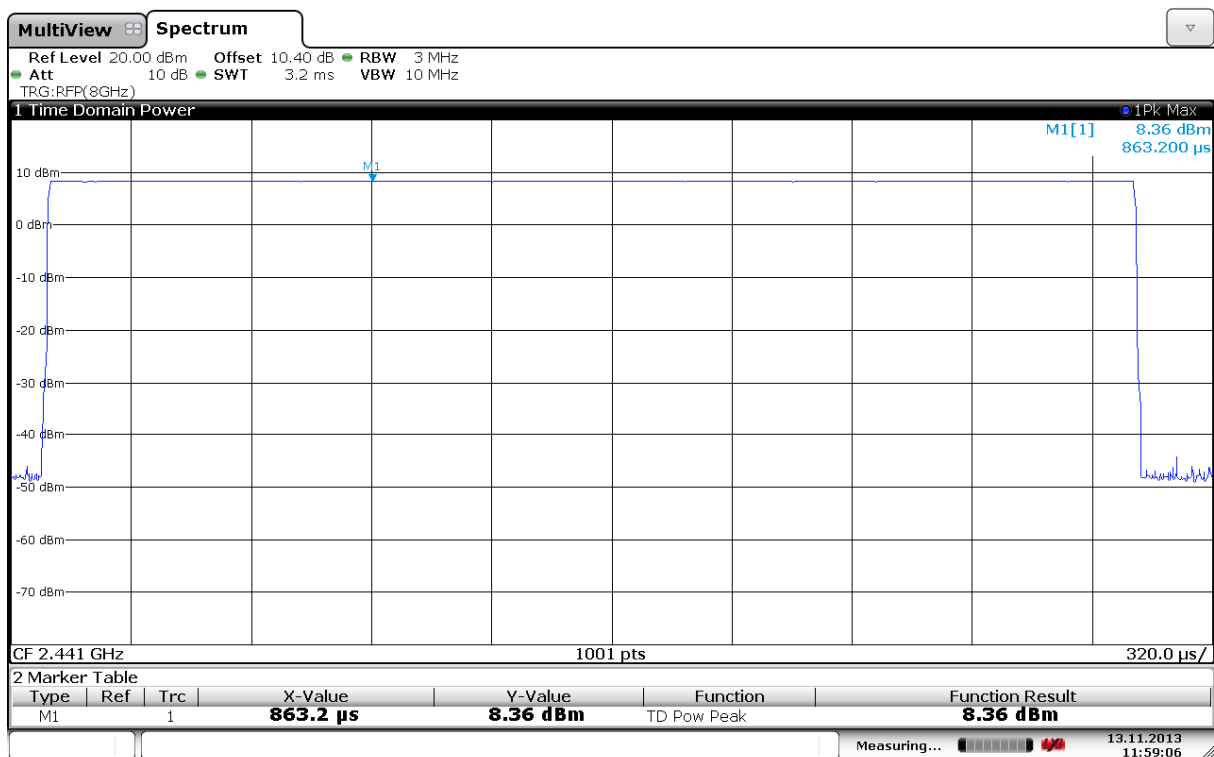
If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



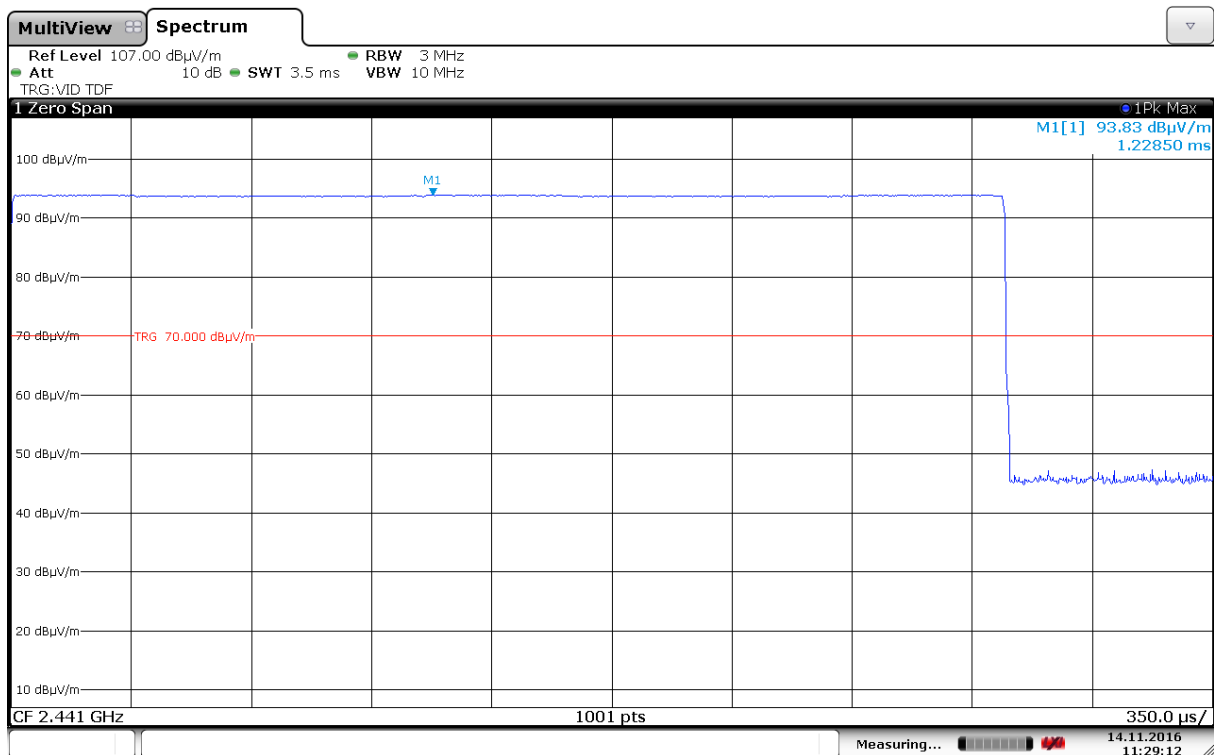
Conducted Power, 2402 MHz



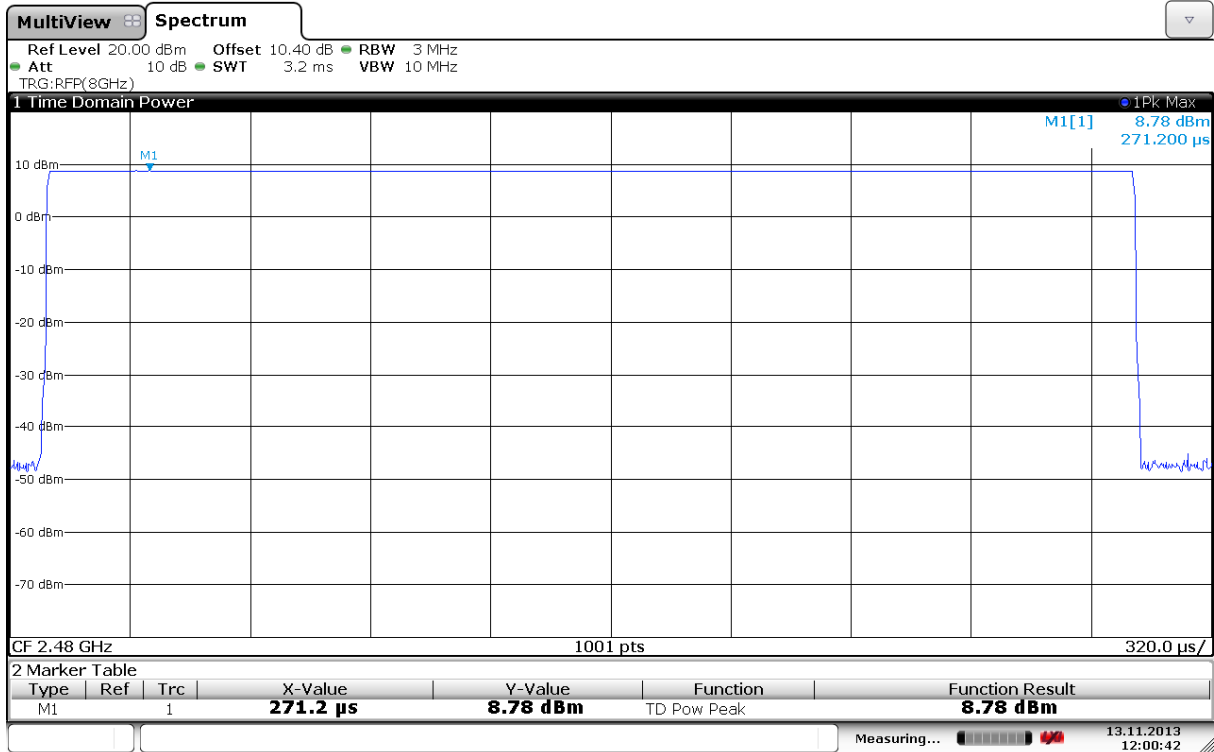
Radiated Power, 2402 MHz, VP, @3m



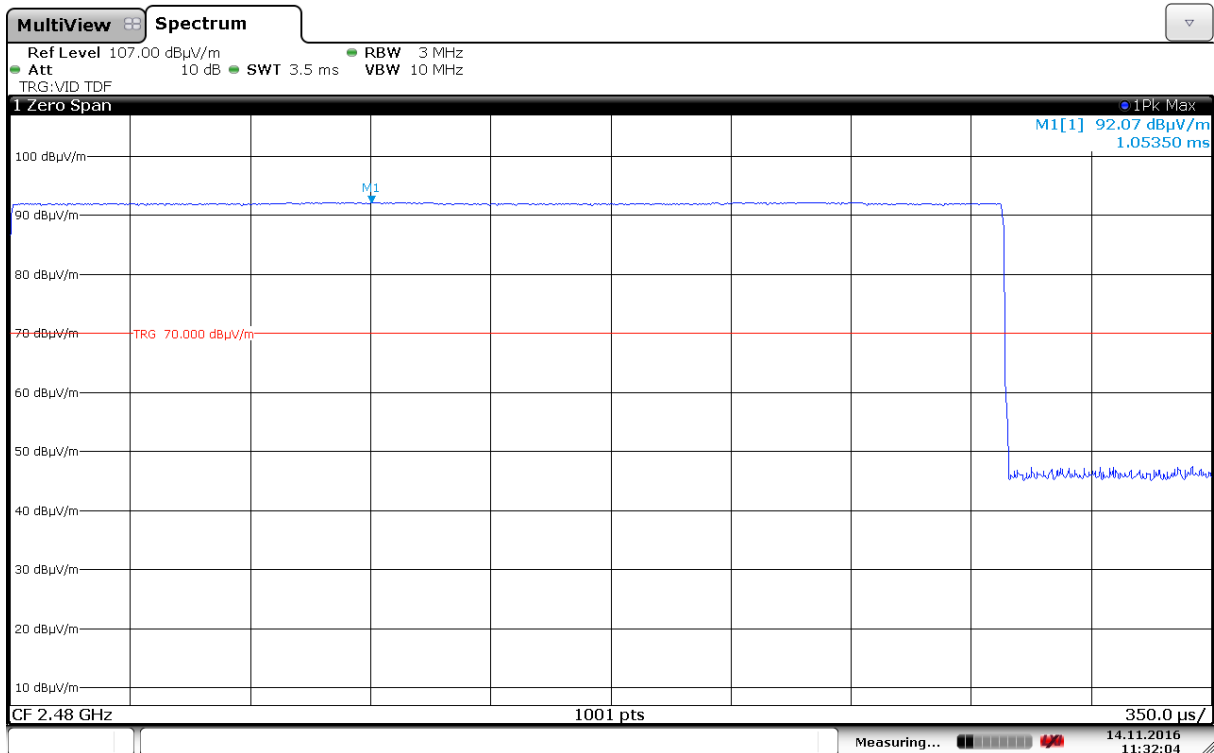
Conducted Power, 2441 MHz



Radiated Power, 2441 MHz, VP, @3m



Conducted Power, 2480 MHz



Radiated Power, 2480 MHz, VP, @3m

3.7 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Results: Complies

Measurement Data:

Band-Edge Spurious Emissions

	Measured field strength (dB μ V/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dB μ V/m	dB	
Peak Detector	42.1	52.4	74	31.9	21.6
Average Detector	22.1	32.4	54	31.9	21.6

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 * number of hopping channels)

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

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

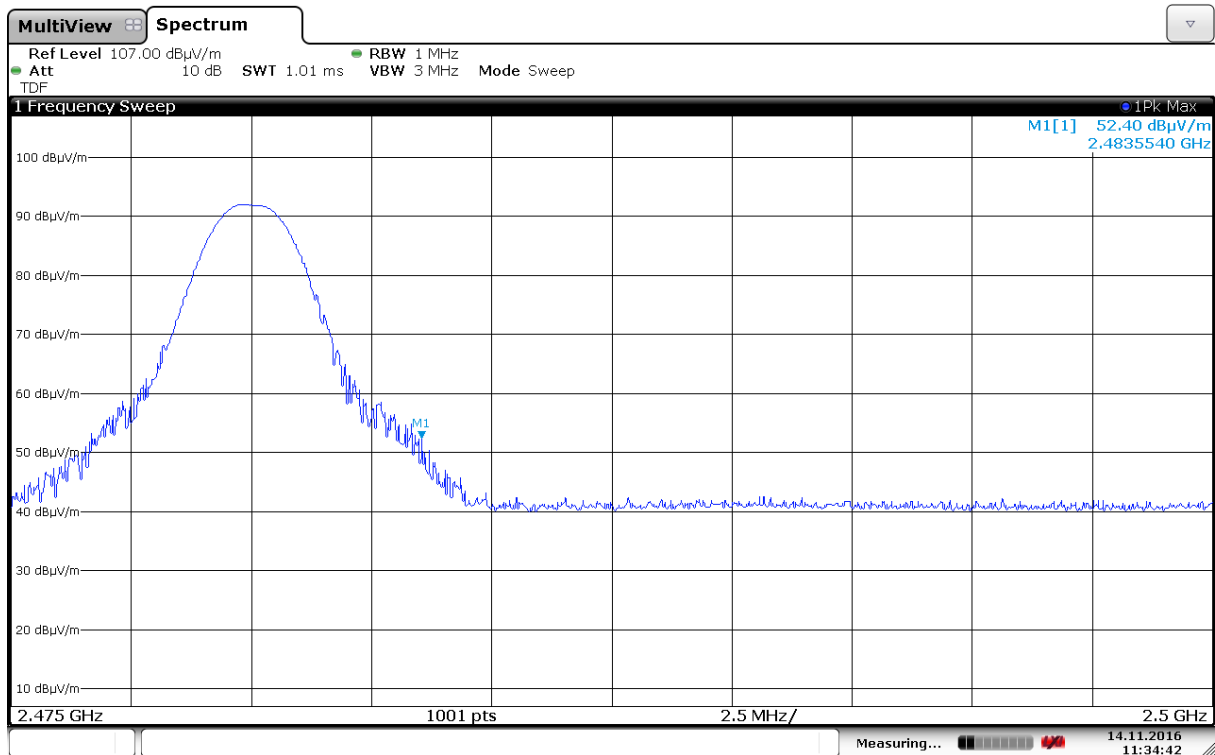
RF conducted power to 25 GHz see attached plots.

Maximum RF level outside operating band:

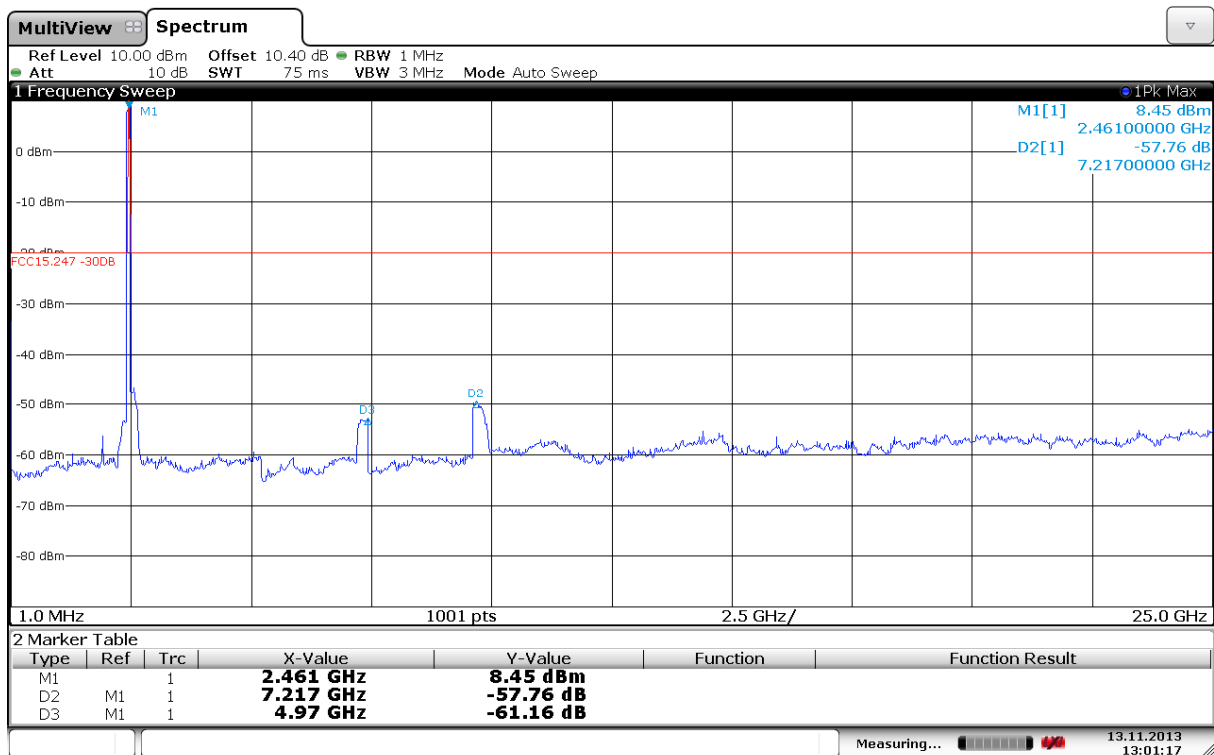
RF ch 00: >50 dB/C, margin >30 dB

RF ch 39: >50 dB/C, margin >30 dB

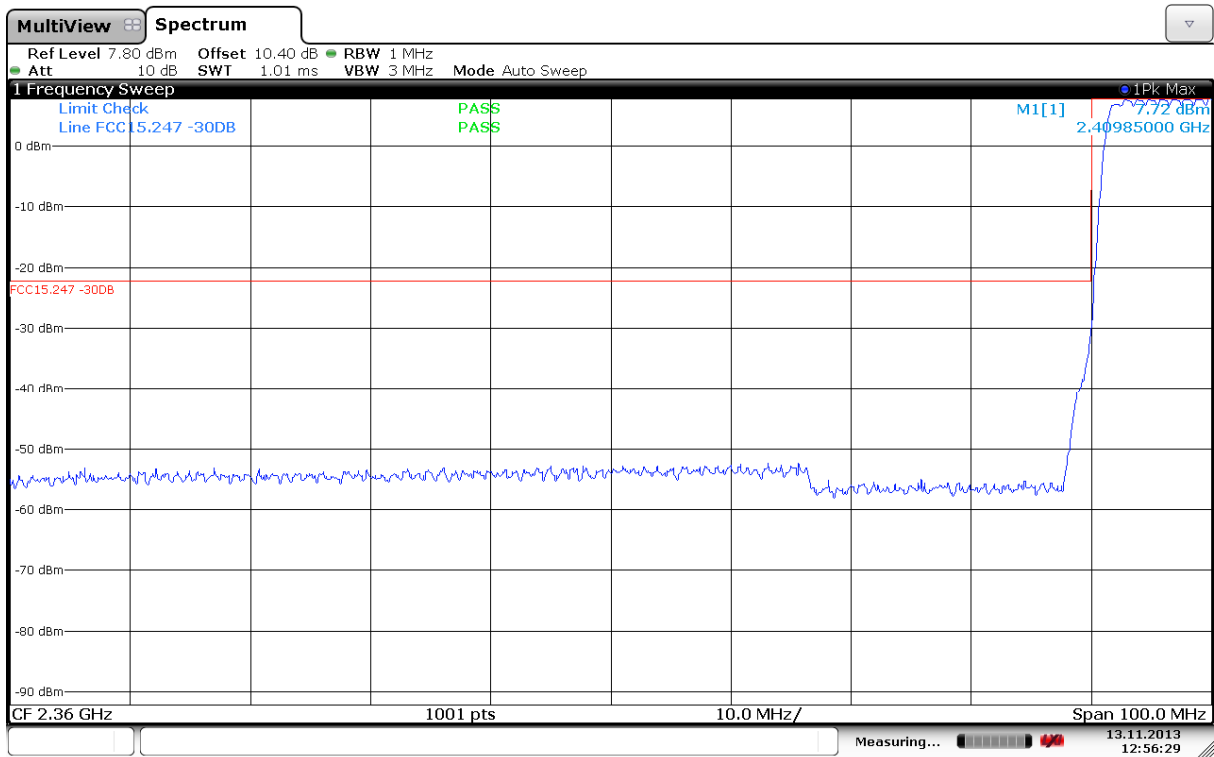
RF ch 78: >50 dB/C, margin >30 dB



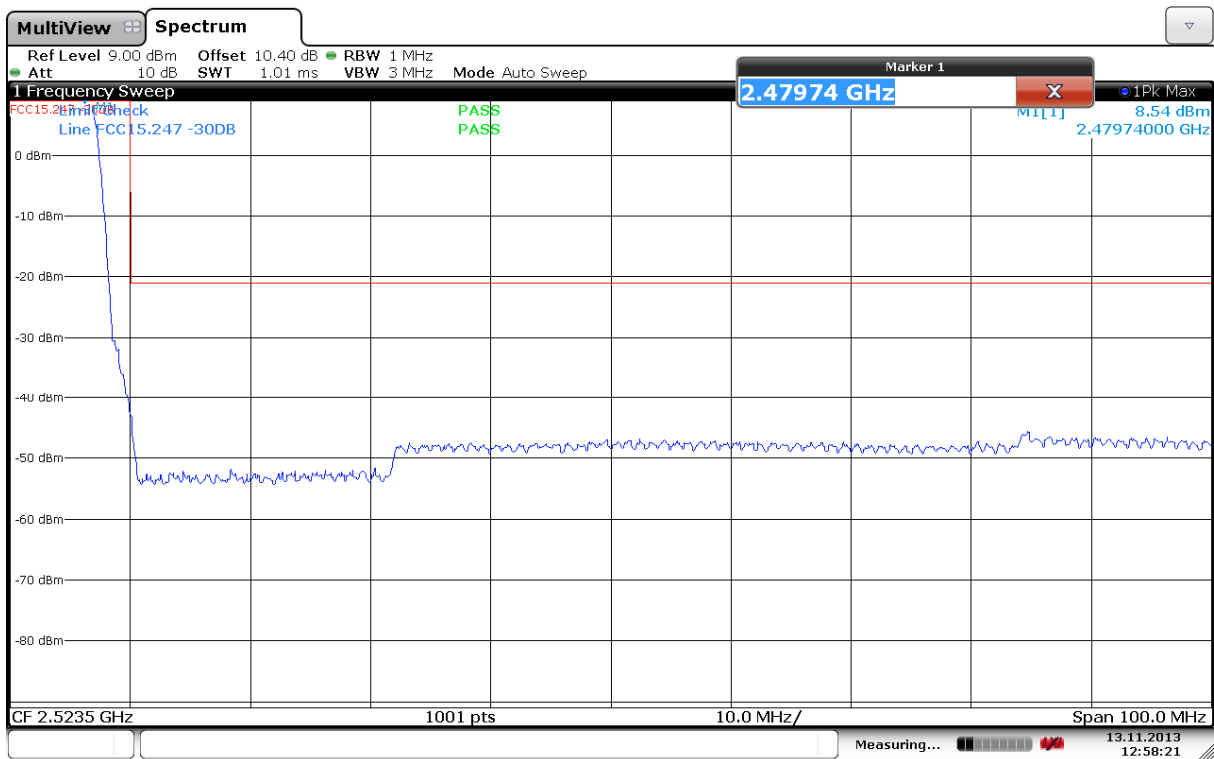
Upper Band Edge, Radiated, 2480 MHz, Peak



Conducted Emissions, 1MHz -25GHz, Hopping On



Conducted Emissions, 2310 -2410 MHz, Hopping ON



Conducted Emissions, 2473.5 -2573.5 MHz, Hopping ON

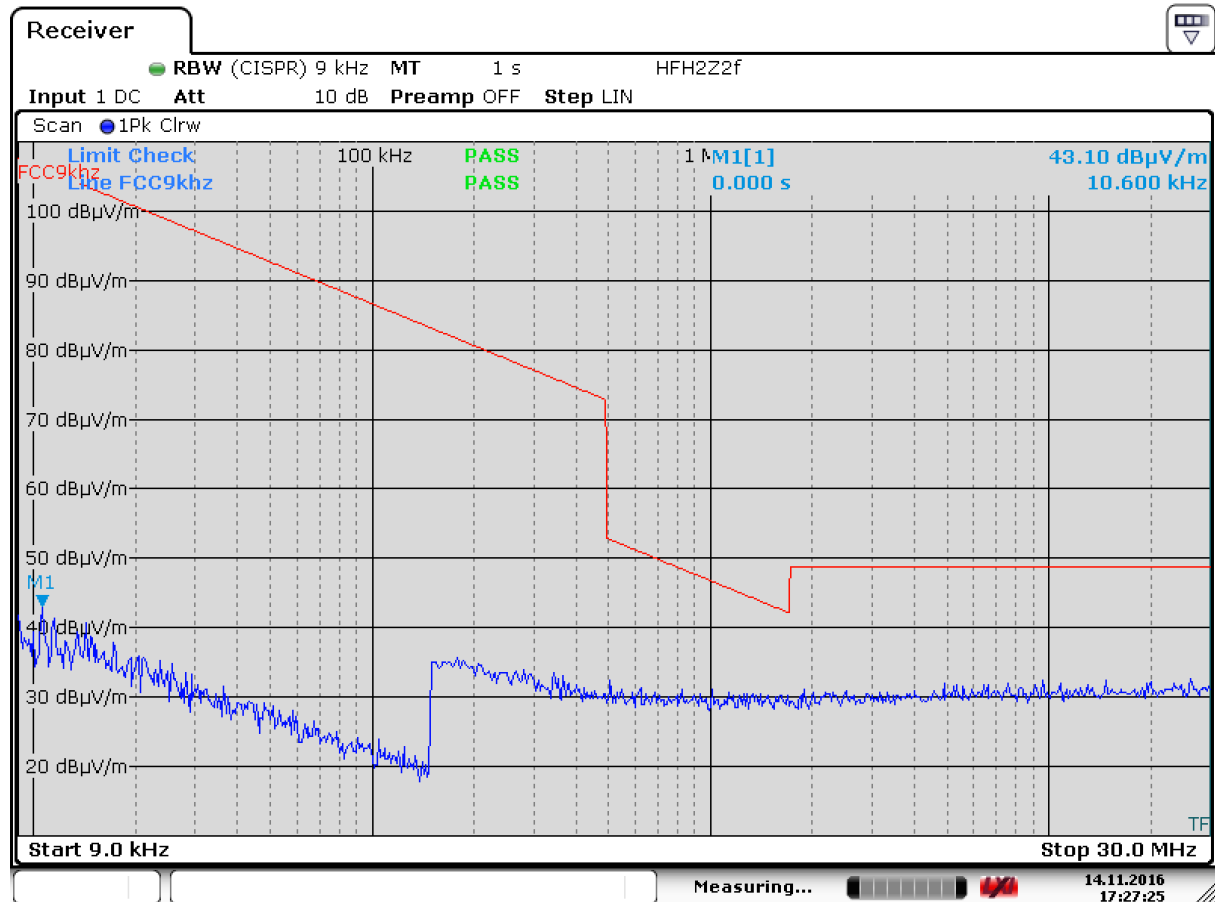
Radiated emission 9 kHz - 30 MHz.

Detector: Peak

Measuring distance 10m according to FCC 15.209.

Tested in hopping mode.

See attached plots.



Radiated emission 30 – 1000 MHz.

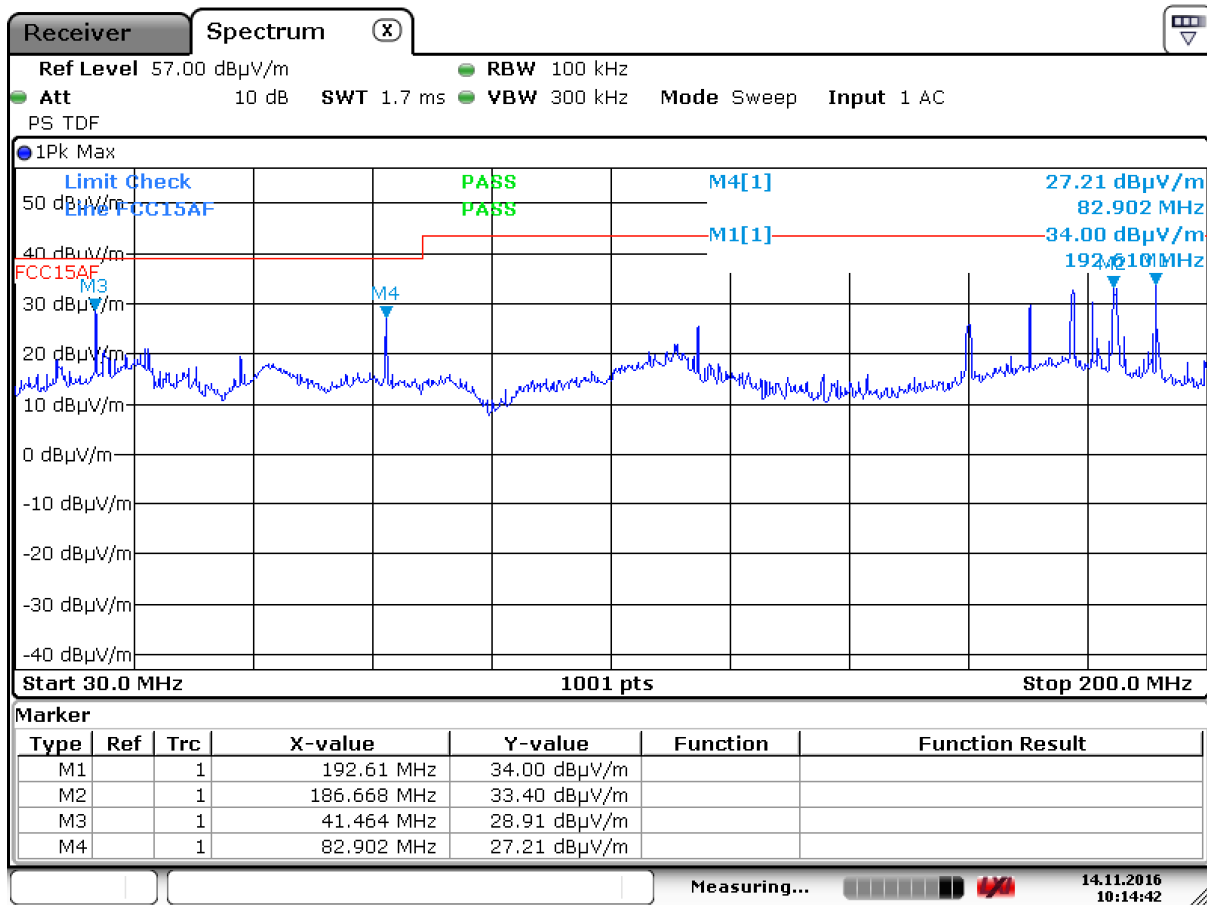
Detector: QuasiPeak

Measuring distance 3m according to FCC 15.209.

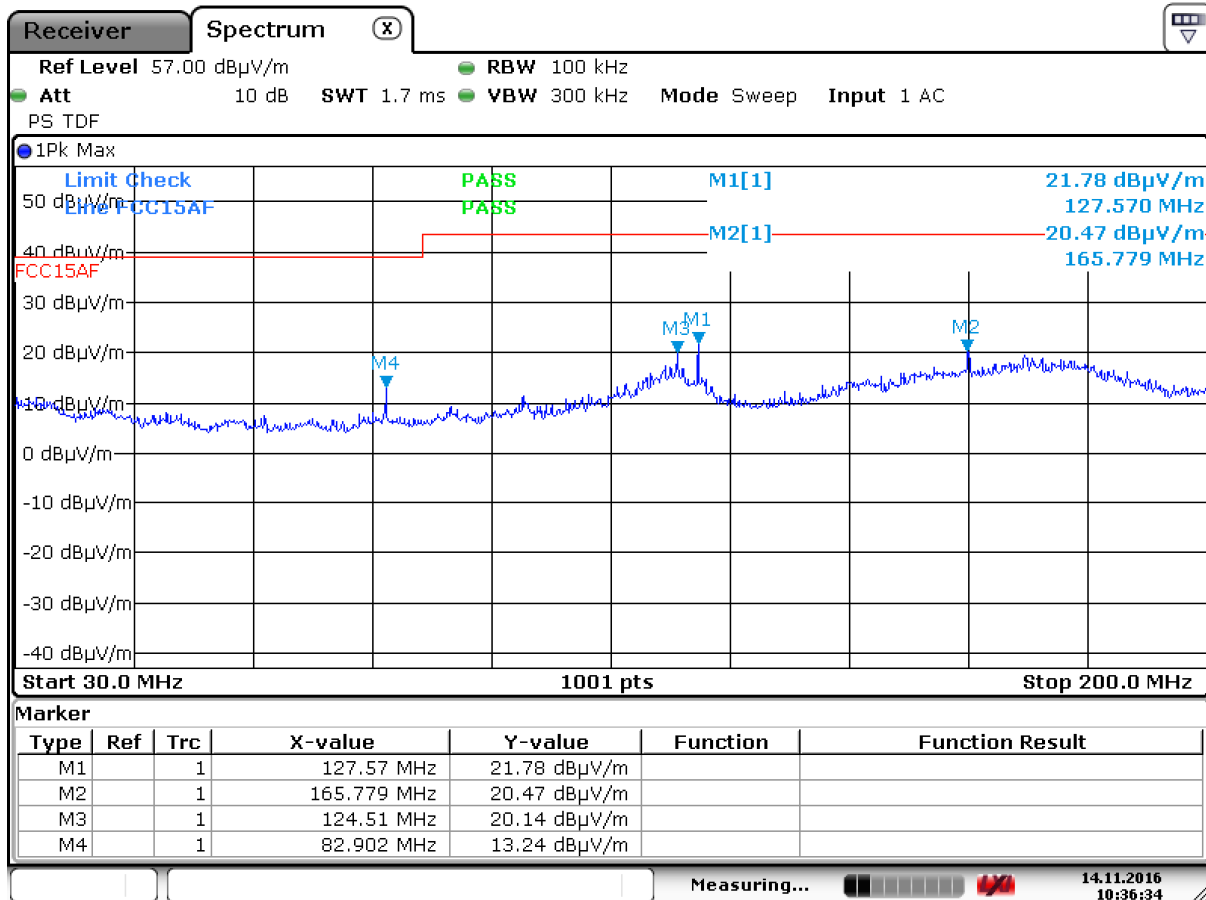
Tested in hopping mode.

Frequency	Operational condition	Polarization	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz			dB μ V/m	metres	dB μ V/m	dB
41.464	TX on	VP	15.5	3	39.5	24.0
82.902	TX on	VP	22.5	3	39.5	17.0
186.668	TX on	VP	11.8	3	43.5	31.7
192.610	TX on	VP	9.5	3	43.5	34.0
All others	TX on	VP/HP	<20	3	$\geq$ 39.5	>20

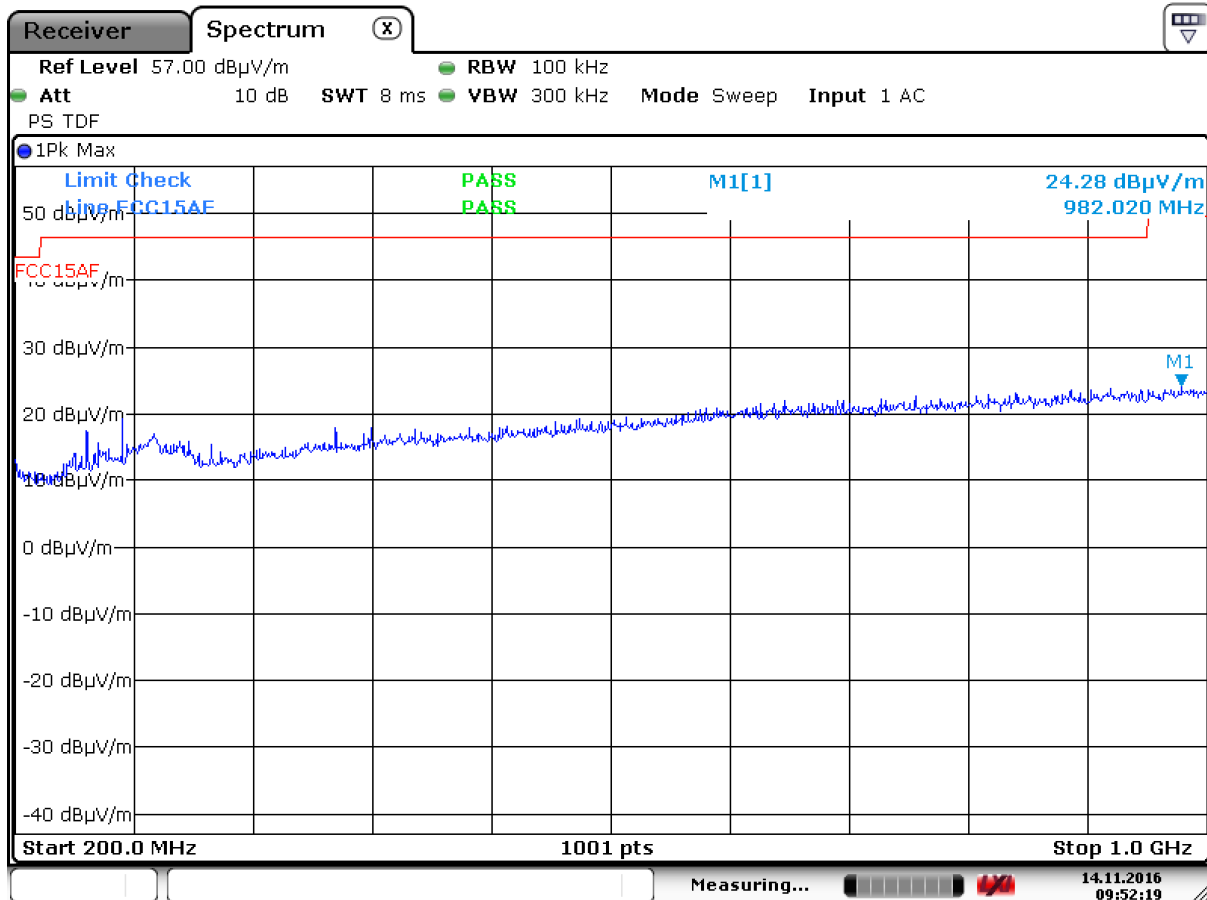
See attached plots.



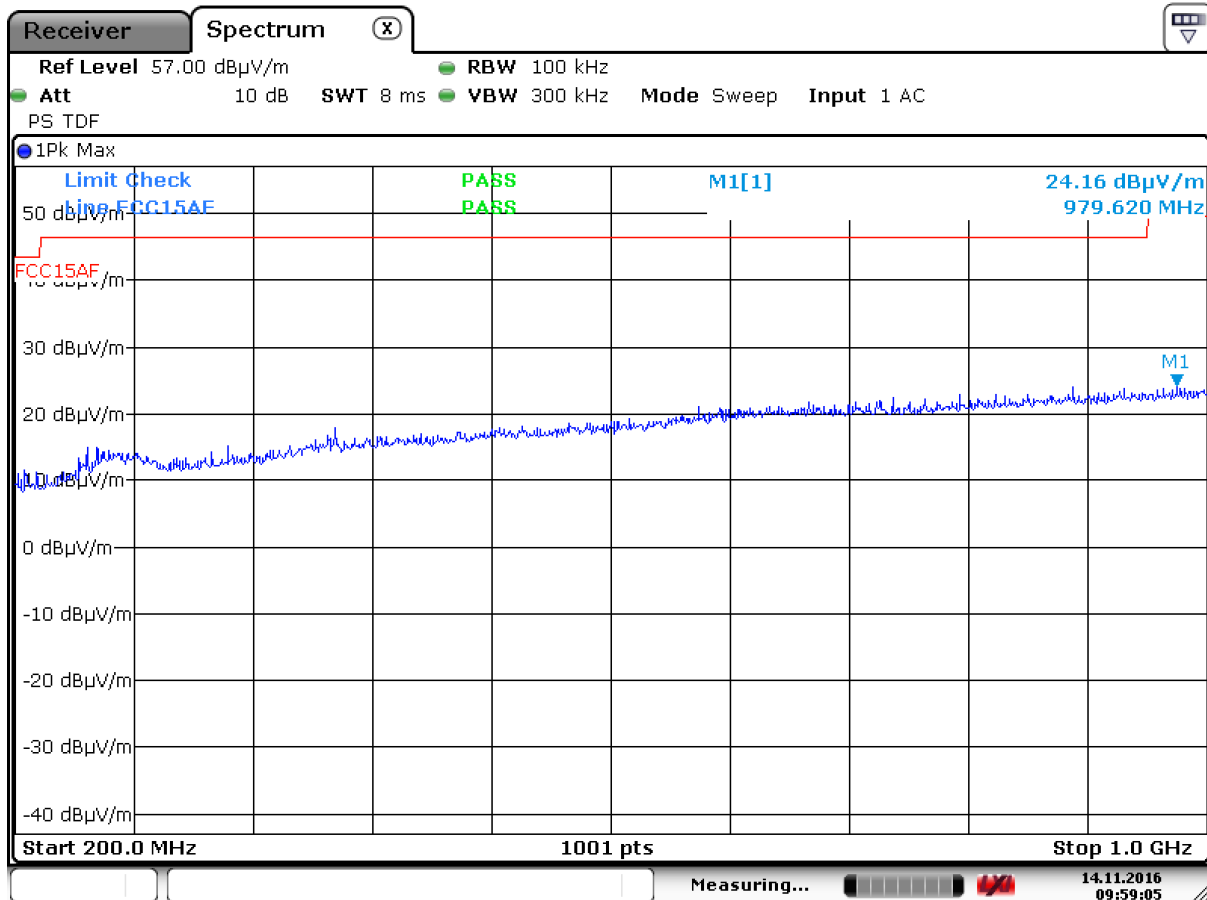
Radiated Emissions, 30 -200MHz, VP



Radiated Emissions, 30 -200MHz, HP



Radiated Emissions. 200 -1000MHz, VP



Radiated Emissions. 200 -1000MHz, HP

Radiated Emissions, 1 -25 GHz

Measuring distance: 3m (1 – 8.5 GHz)
1m (8.5 – 18 GHz)

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
All freqs	L,M,H	/	None detected	20	74	>20

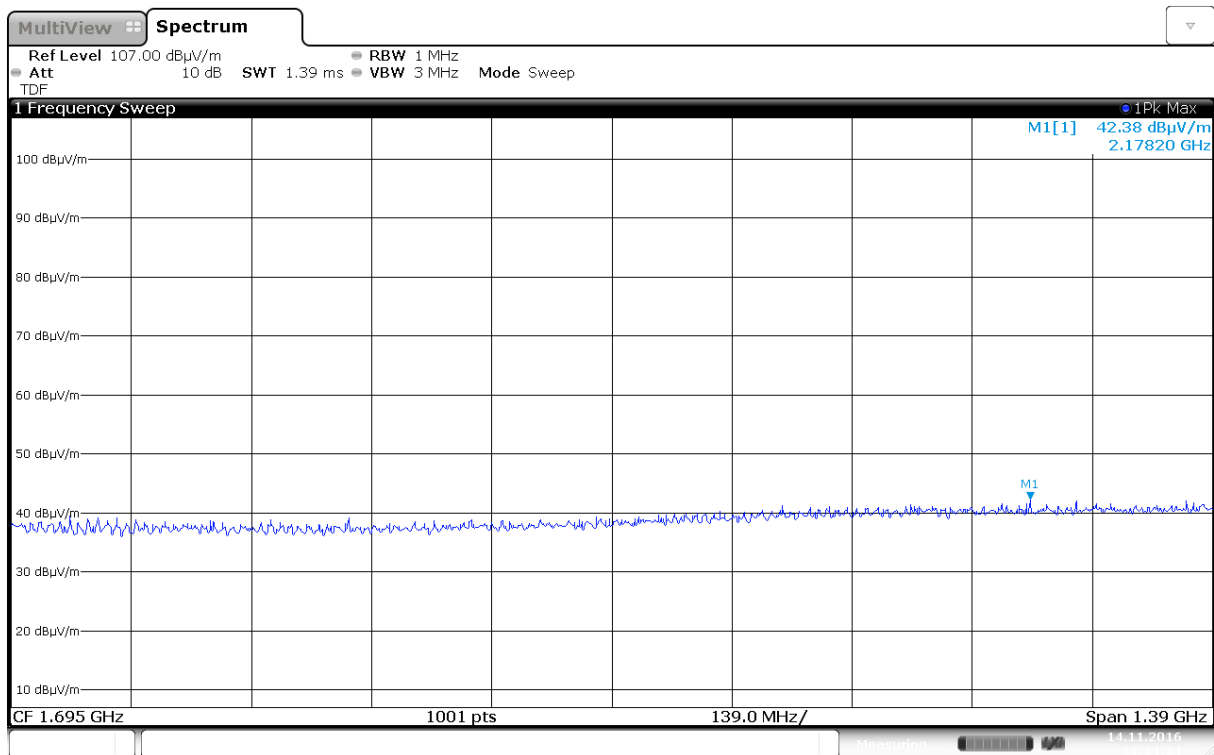
Average Detector values are calculated from Peak values by Duty Cycle Correction Factor.

All emissions are below the Average limit even when measured with Peak Detector.

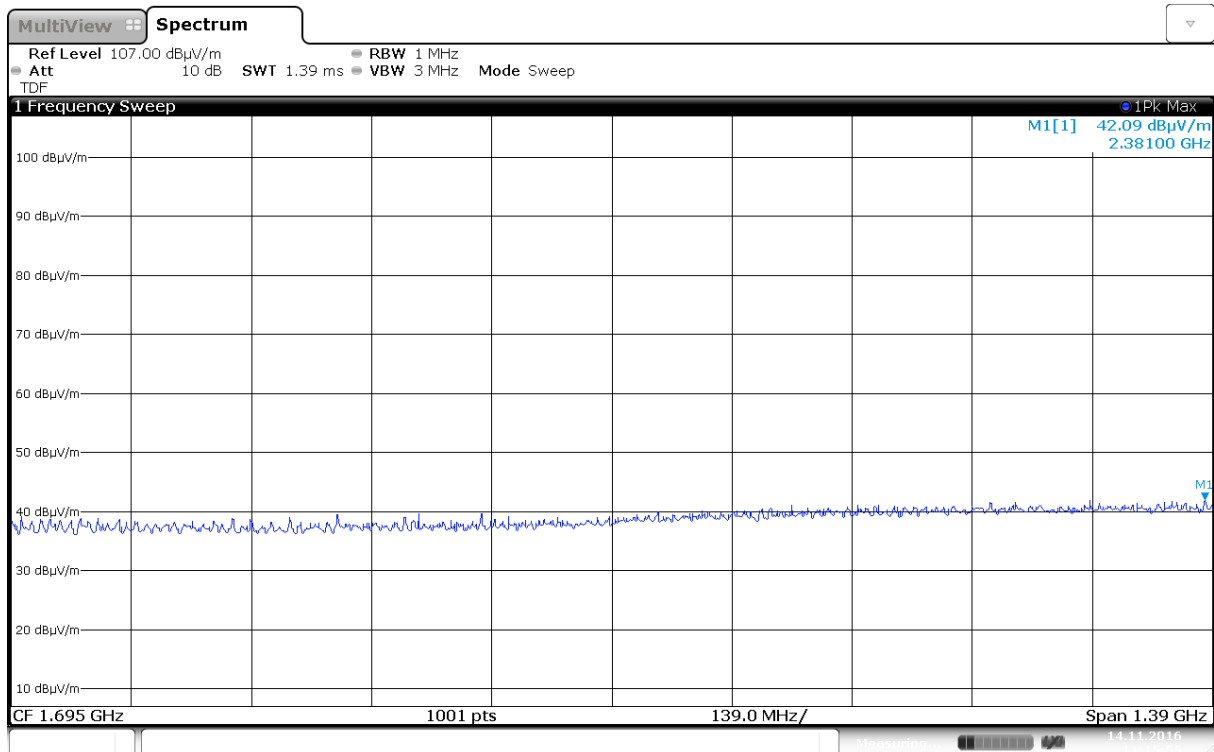
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

Distance correction factor is included on the plots when the measurement is performed @1m.

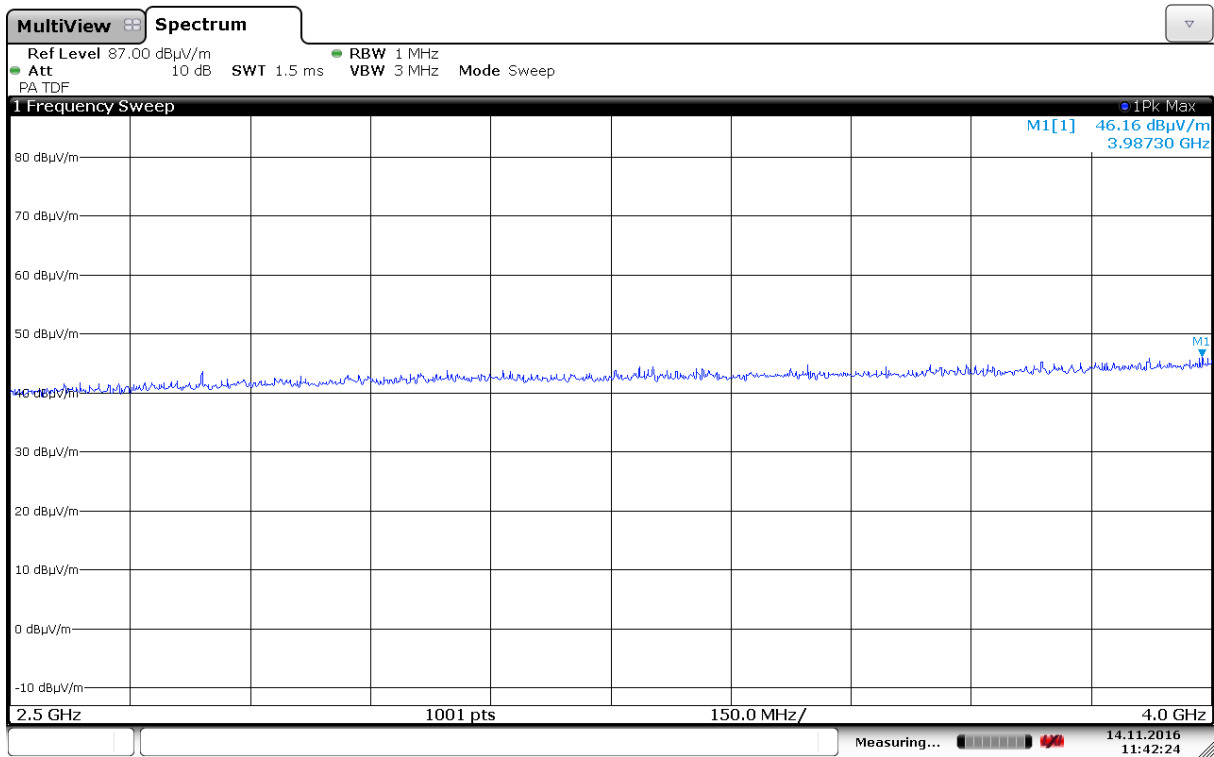
See plots.



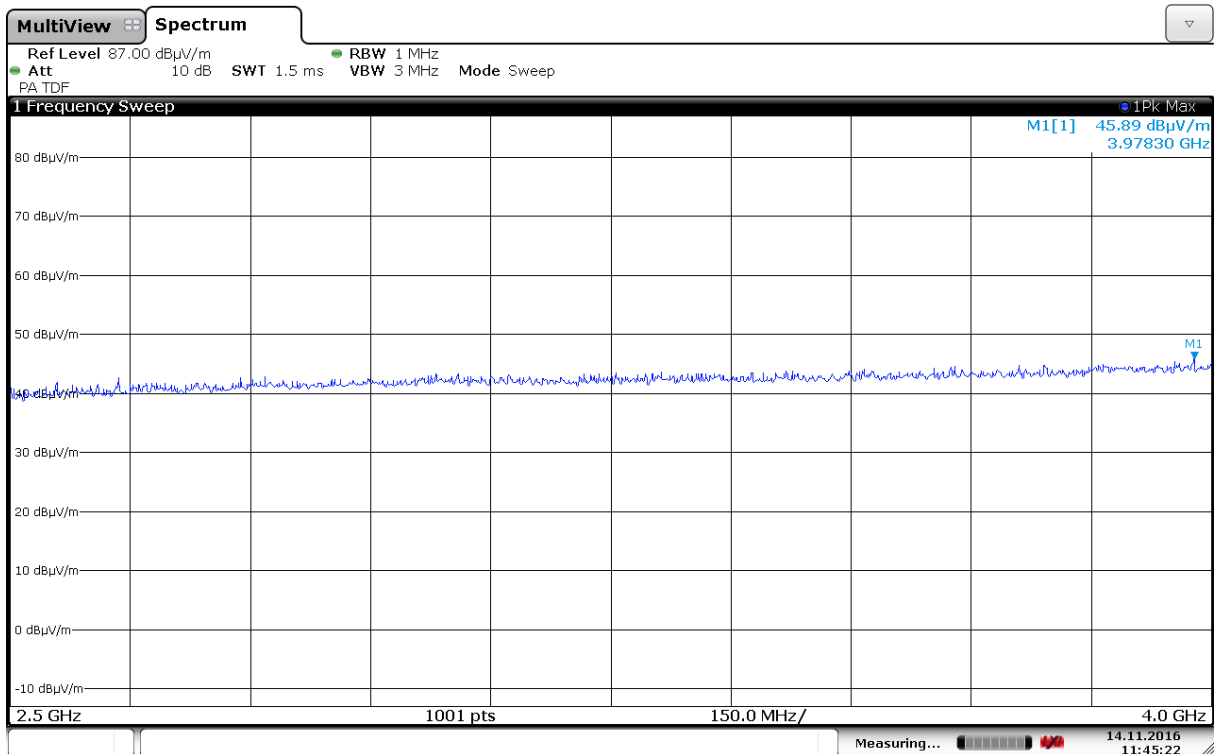
Radiated Emissions, 1000 -2390MHz, 2402MHz, VP



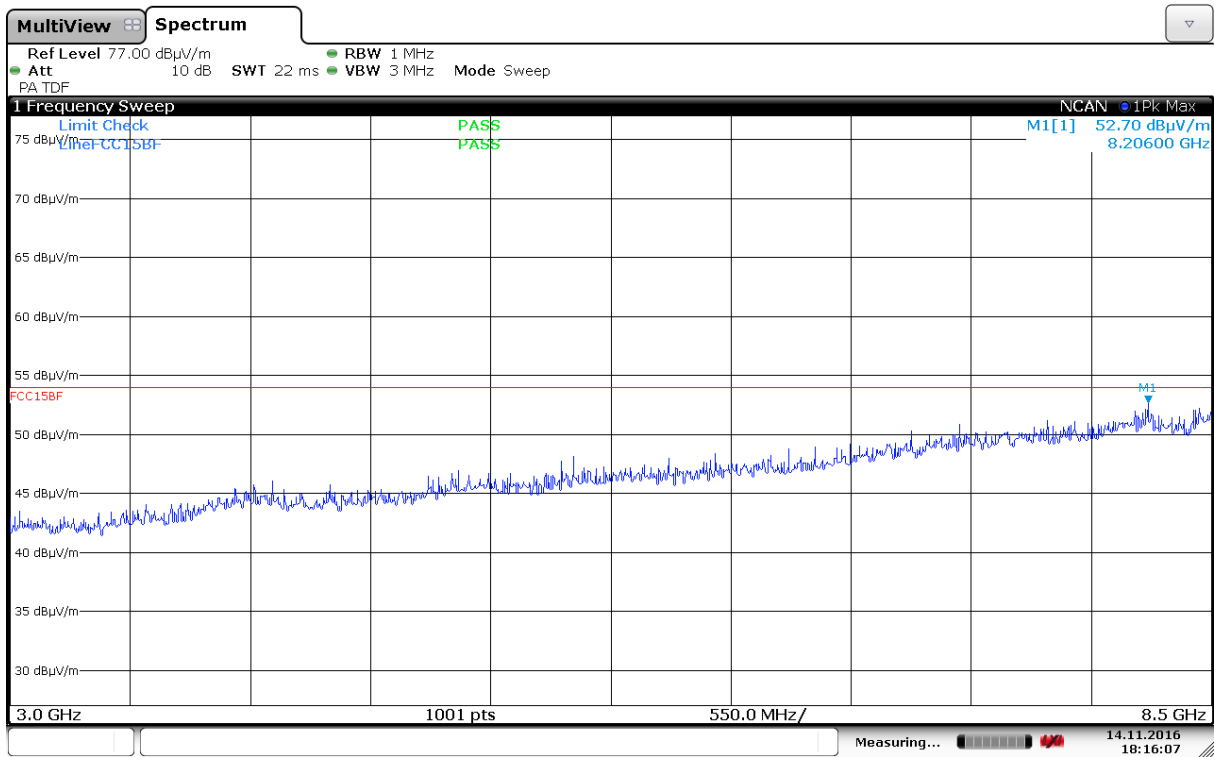
Radiated Emissions, 1000 -2390MHz, 2402MHz, HP



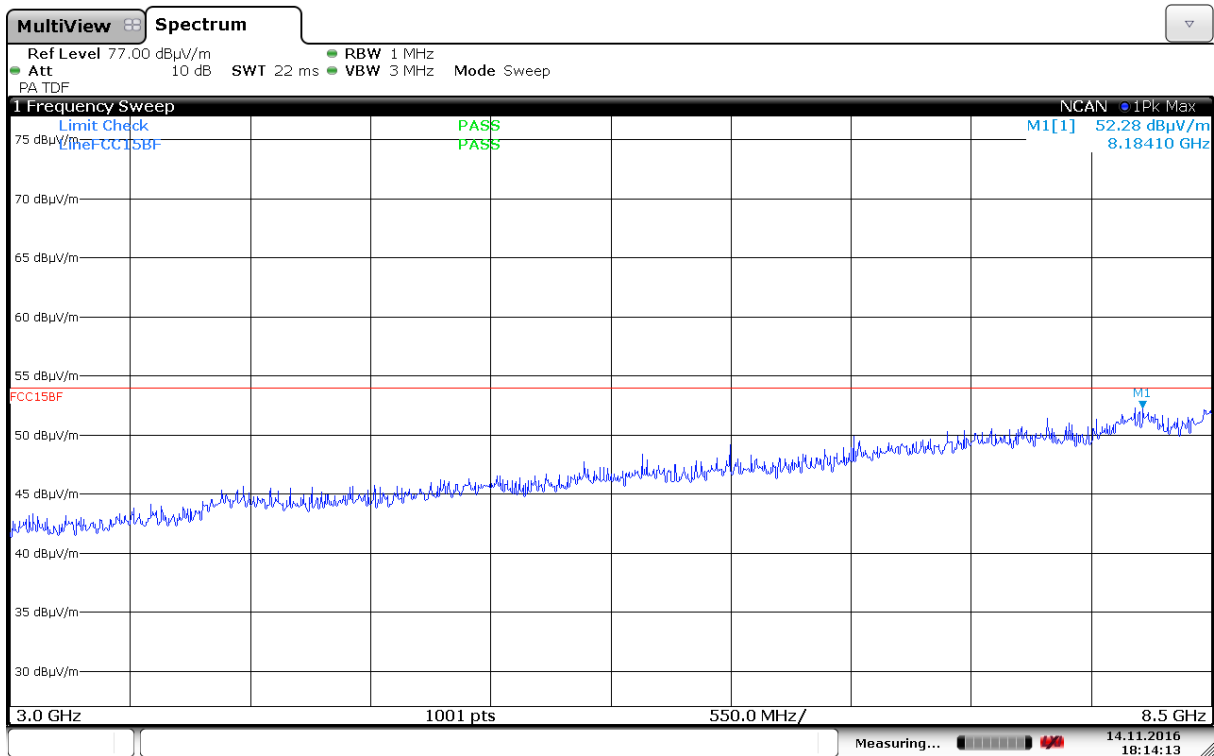
Radiated Emissions, 2500 -4000MHz, 2441MHz, VP



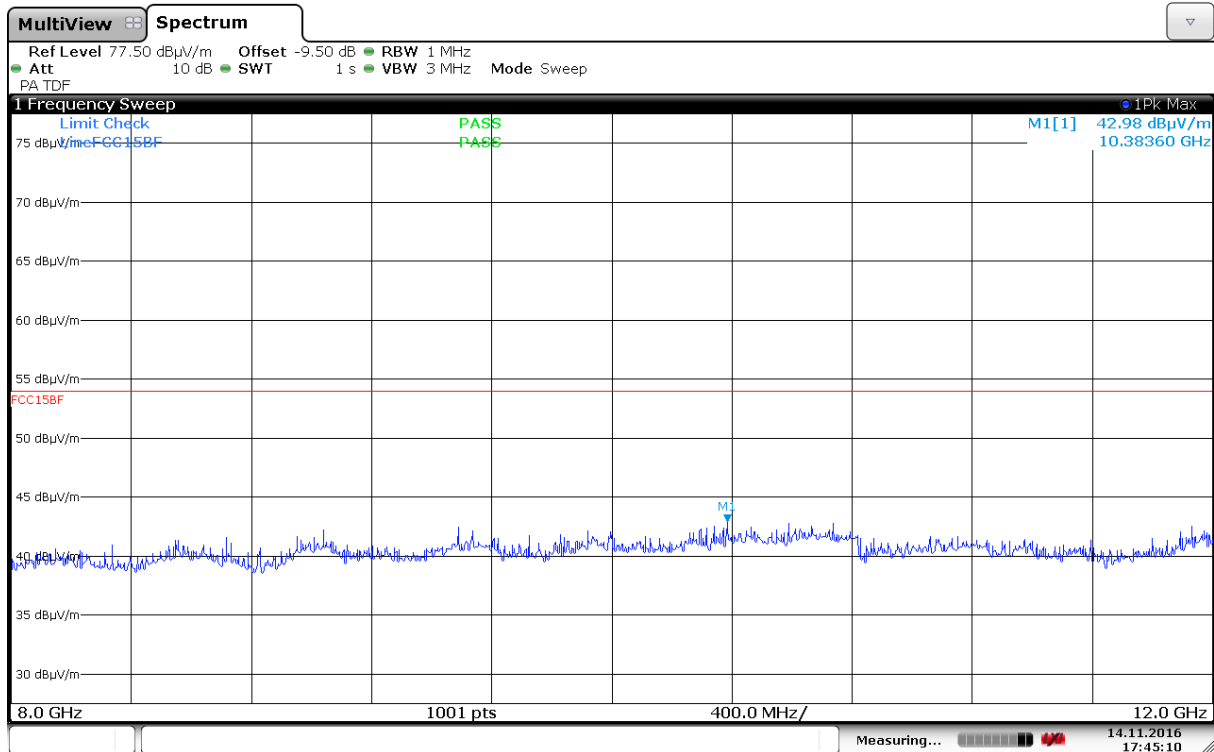
Radiated Emissions, 2500 -4000MHz, 2441MHz, HP



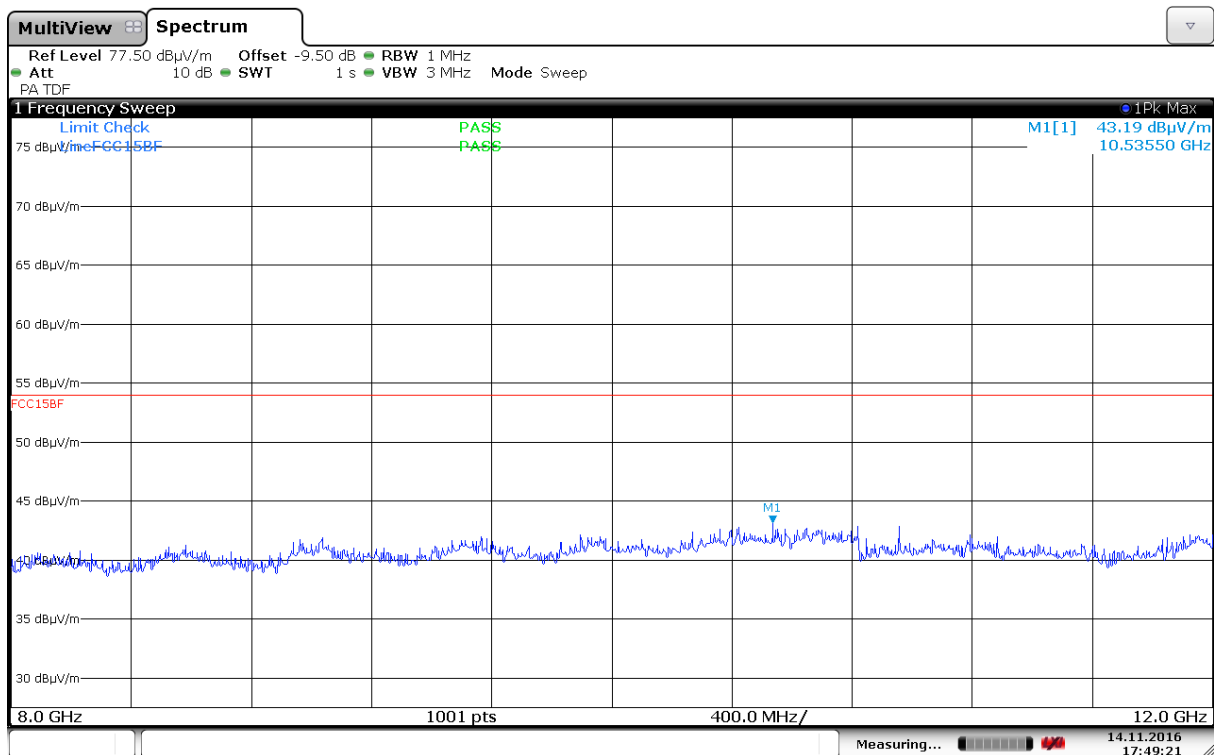
Radiated Emissions, 3000 -8500MHz, 2441MHz, VP



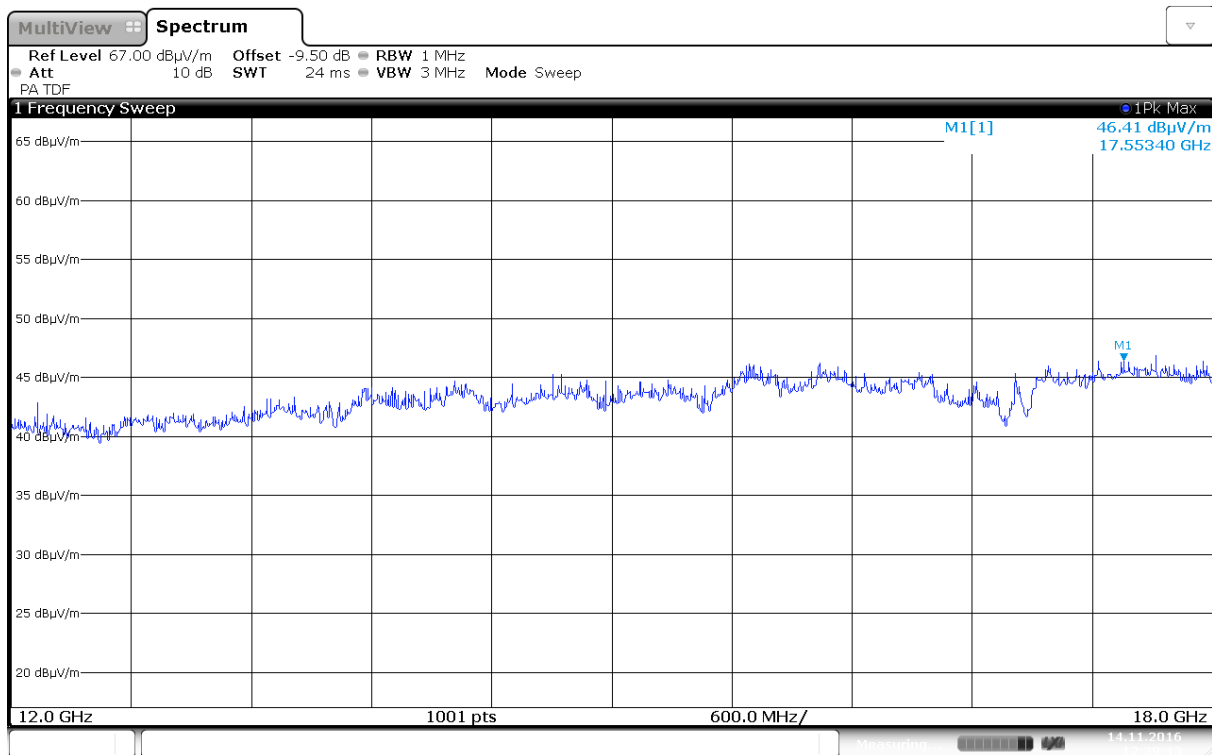
Radiated Emissions, 3000 -8500MHz, 2441MHz, HP



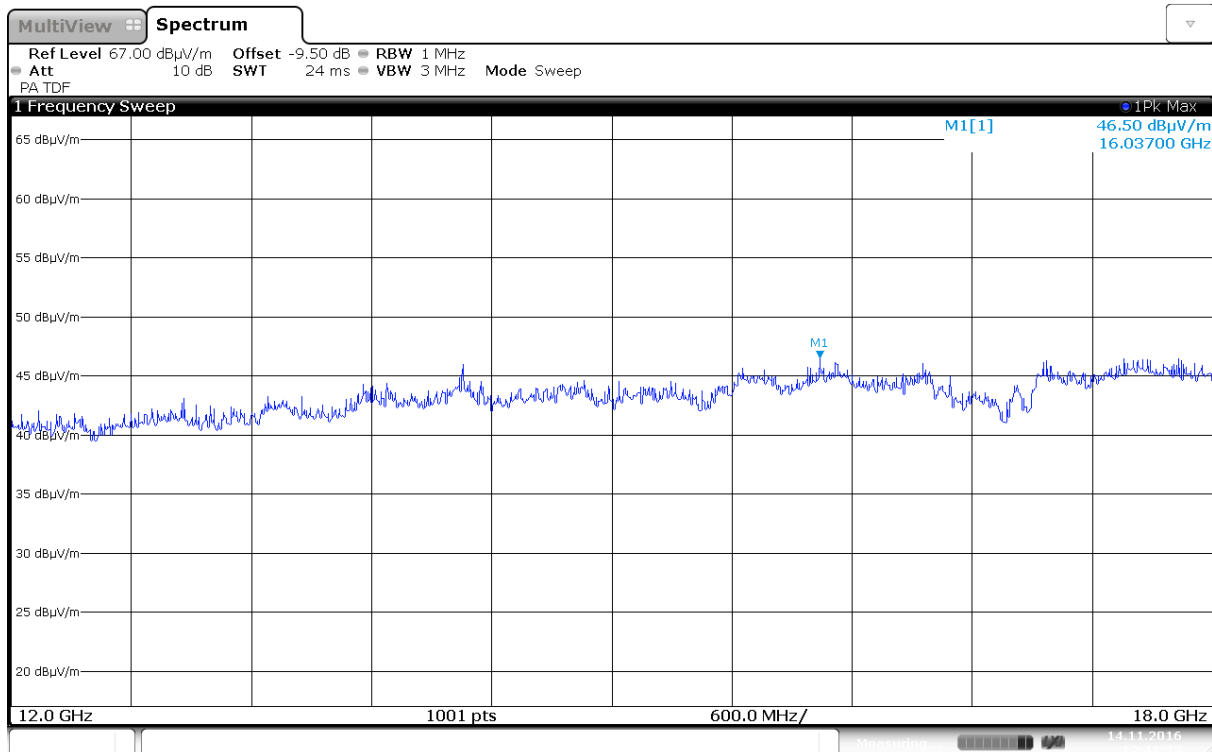
Radiated Emissions, 8000 -12000MHz, 2441MHz, VP, 1m



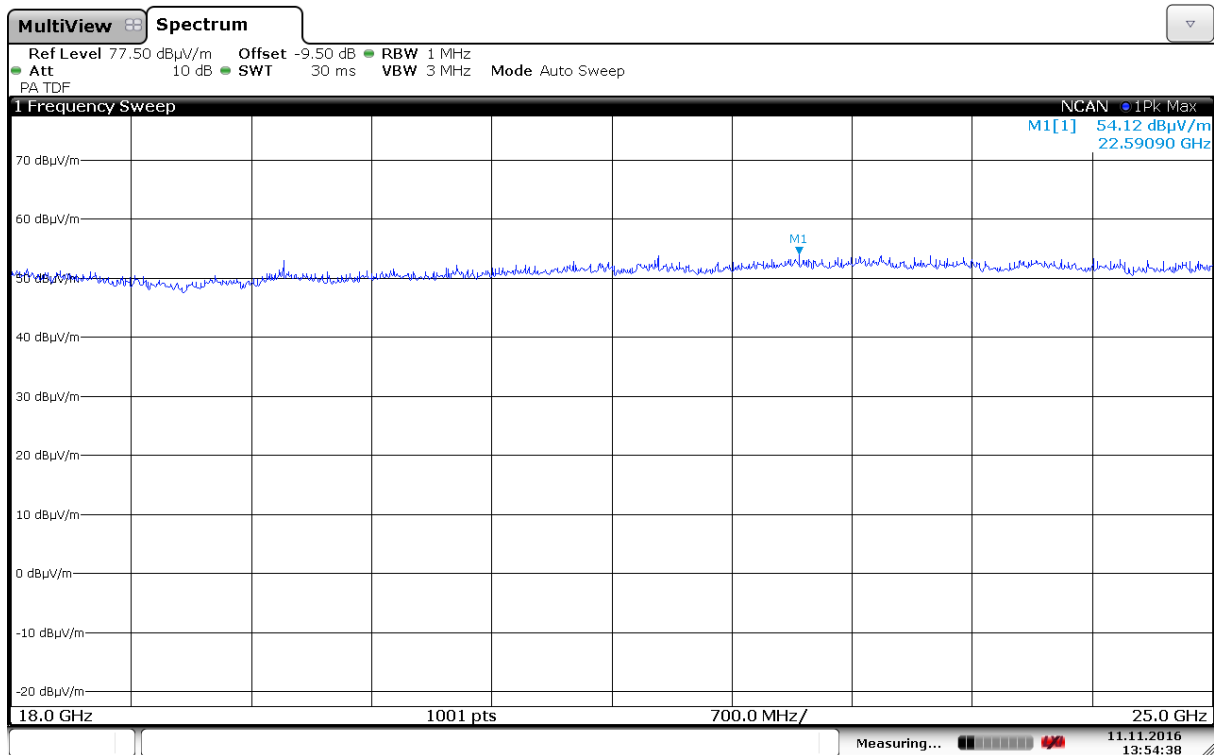
Radiated Emissions, 8000 -12000MHz, 2441MHz, HP, 1m



Radiated Emissions, 12000 -18000MHz, 2441MHz, VP, 1m



Radiated Emissions, 12000 -18000MHz, 2441MHz, HP, 1m



Prescan, 18000 -25000MHz, 2441MHz, 10cm

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

4 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.

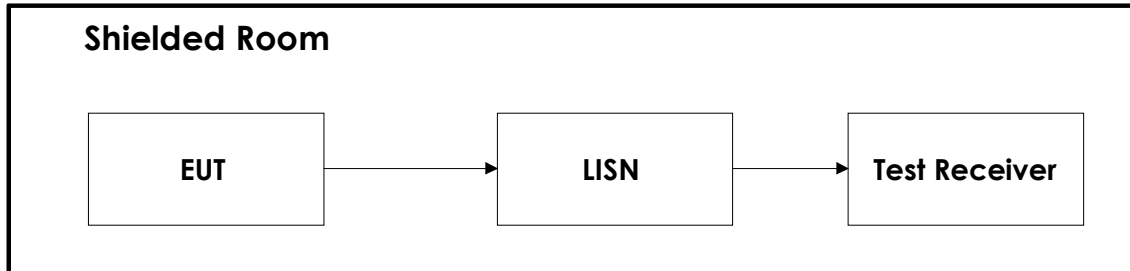
No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	FSW26	Spectrum Analyzer	Rohde & Schwarz	LR 1640	2015.11	2016.11
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2015.11	2016.11
4	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
5	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2017.12
6	HL223	LPDA antenna	Rohde & Schwarz	LR 1261	2013.12	2017.12
7	3115	Horn Antenna	EMCO	LR 1226	2013.12	2018.12
8	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2015.10 2016.10	2016.10 2017.10
9	642	Antenna Horn	Narda	LR 220	2009.01.26	2017.01.26
10	PM7320X	Antenna horn	Siverts lab	LR 103	2009.01.26	2017.01.26
11	DBF-520-20	Antenna horn	Systron Donner	LR 101	2009.01.26	2017.01.26
12	638	Antenna Horn	Narda	LR 1480	2010.06	2020.06
14	HFH2-Z2	Loop Antenna	Rohde & Schwarz	LR 1660	2014.10	2017.10
15	Model 87V	Multimeter	Fluke	N-4669	2016.10	2017.10
16	ESCI3	EMI Test receiver	Rohde & Schwarz	N-4259	2015.08	2017.08
17	ESH3-Z5	Two-line V-Network	Rohde & Schwarz	N-3403	2015.07	2017.07
18	ESH3-Z2	Pulse limiter	Rohde & Schwarz	N-3932	2015.03	2017.03
19	6812B	AC power Source	Agilent	LR 1515	2015.12	2016.12
20	ESR7	EMI Test Receiver	Rohde & Schwarz	LR 1675	2015.12	2016.12

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

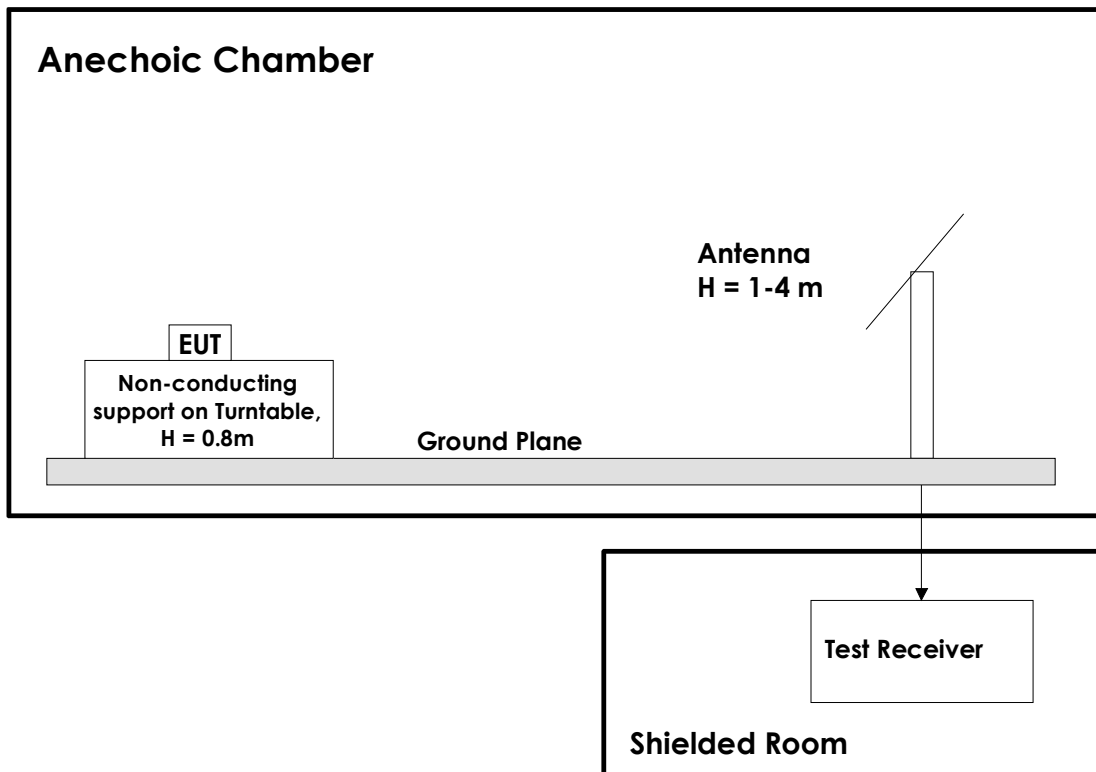
No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	9.26.00	Power-Line Conducted Emissions test software
2	Rohde & Schwarz	GPBshot	2.7	Screenshots from ESU40

5 BLOCK DIAGRAM

5.1 Power Line Conducted Emission



5.2 Test Site Radiated Emission



NOTE: For all tests above 1 GHz the turntable height is changed to 1.5m and the ground plane between the antenna and the EUT is covered by floor absorbers.

Revision history

Version	Date	Comment	Sign
1.0	2016.11.15	First Edition	FS
1.1	2016.12.13	Canadian model number corrected	FS