

Test Report

Product	Digital Video Encoder/Decoder with WLAN and BT
Name and address of the applicant	Cisco Systems, Inc.
Name and address of the manufacturer	Cisco Norway AS Philip Pedersens vei 1 1366 Lysaker, Norway
Model	TTC7-23
Rating	120V AC
Trademark	Cisco
Serial number	/
Additional information	Bluetooth, 802.11a/b/g/n/ac
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Industry Canada RSS-247, Issue 1 Low Power Licence-Exempt Radiocommunications Devices
Order number	310377
Tested in period	2012.07.08 and 2016.12.01 to 2016.12.02
Issue date	2017.02.07
Name and address of the testing laboratory	 FCC No: 994405 IC OATS: 2040D-1 Instituttveien 6 Kjeller, Norway TEL: +47 22 96 03 30 FAX: +47 22 96 05 50
 Prepared by [Frode Sveinsen]  Approved by [G. Suhanthakumar]	
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1 INFORMATION

1.1 Test Item

Name :	Cisco
FCC ID :	TTC7-23
Industry Canada ID :	LDK7-23-1377
Model/version :	2461L-7231377
Serial number :	/
Hardware identity and/or version:	Rev. E
Software identity and/or version :	S01828-1.0.0 Alpha7 72c2185
Frequency Range :	2402 – 2480 MHz
Number of Channels :	Bluetooth Low energy: 39 Bluetooth: 79
Operating Modes :	Bluetooth or Bluetooth Low Energy
Type of Modulation :	GFSK, $\pi/4$ -DQPSK, 8DPSK
Output Power :	GFSK: 11.56 mW 8PSK: 9.93 mW BLE: 6.46 mW
Antenna Connector :	Internal Antenna connected to PCB with U-FL connector
Antenna Diversity Supported :	No
Power Supply :	FSP070-AHAN2

Description of Test Item

The EUT is a digital video encoder/decoder with WiFi and Bluetooth transceivers. The WiFi and Bluetooth transceivers are contained in a module from NVIDIA with single modular certification (FCC ID: VOB-P2180), however the antennas used in this EUT are not certified.

1.2 Normal test condition

Temperature:	21.6 – 23.2 °C
Relative humidity:	22 - 42 %
Normal test voltage:	120 V AC

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Frode Sveinsen
Kristian Osvoll (Power Line Conducted Test)

1.4 Description of modification for Modification Filing

Not applicable.

1.5 Family List Rationale

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: U-FL (The antennas are internal with connector on the PCB)

Ref. FCC §15.203

1.7 Comments

This report covers only limited radiated tests to show compliance with the new antenna in this EUT. All other radio tests for DSS are covered by UL reports no. 15U21878-E1V2. Radio tests for BLE are covered by UL report no. 15U21878-E2V1.

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 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".

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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 ¹
Number of Operating Frequencies	15.31(m)	5.1 (6) (RSS-247)	Complies ¹
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) (RSS-247)	Complies ¹
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3) (RSS-247)	Complies ¹
Time of Occupancy	15.247(a)(1)(iii)	5.1 (5) (RSS-247)	Complies ¹
Occupied Bandwidth	15.247(a)(1)	5.1 (7) (RSS-247)	Complies ¹
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies ¹
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5 (RSS-247)	Complies ¹
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5 (RSS-247) 6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

¹ Covered by UL Report No. 15U21878-E1V2 (FCC ID: VOB-P2180)

3 TEST RESULTS

3.1 Power Line Conducted Emissions

FCC Part 15.207 (a)

ISED RSS-GEN Issue 4, Clause 8.8

Test Performed By: Kristian Osvoll

Date of Test: 22-Dec-2016

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

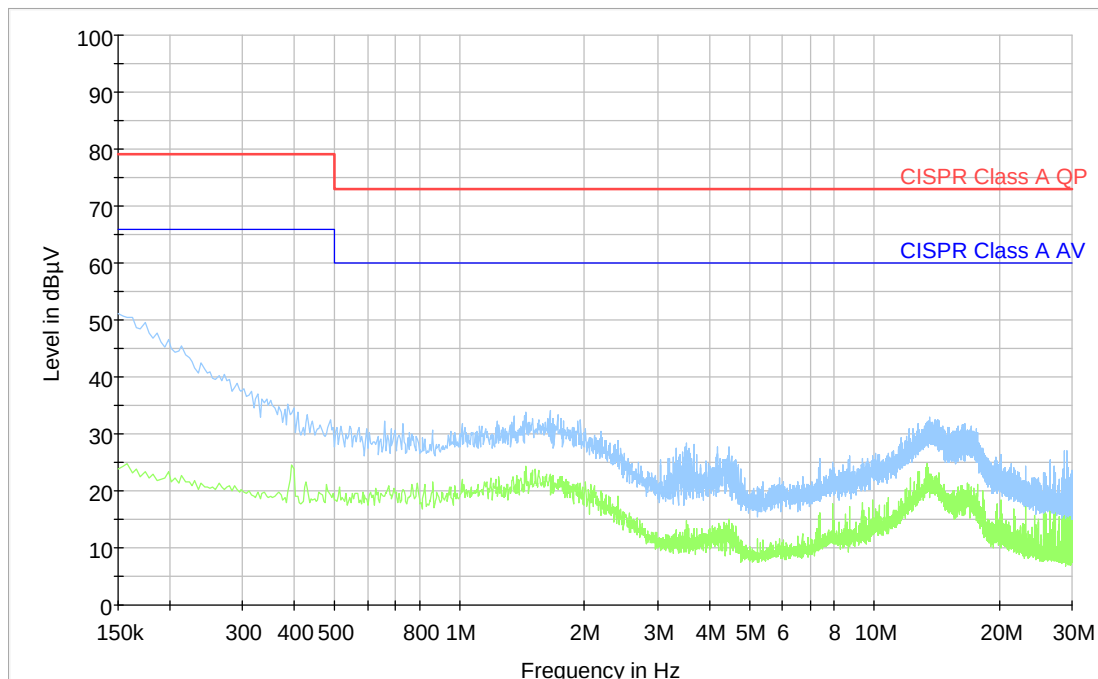
Test Results: Complies.

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

Highest measured value (L1 and N):

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)
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Full Spectrum



All emissions are below the limits in FCC 15.207

3.2 Peak Power Output

FCC Part 15.247 (b)

ISED RSS-247 Issue 1, Clause 5.4.4

Test Results: Complies

Measurement Data:

	2402 MHz	2440 MHz	2480 MHz
Conducted Power (dBm)	7.21	10.63*	9.29
Conducted Power (mW)	5.3	11.6*	8.5
Field Strength (dBμV/m)	104.89	108.08	105.46
EIRP, Calculated (mW)	9.25	19.28	10.55
Antenna gain (dBi)	2.5	2.2	0.9

*Measured on 2441 MHz

Conducted Power is from UL Test Report No. 15U21878-E1V2 (FCC ID: VOB-P2180)

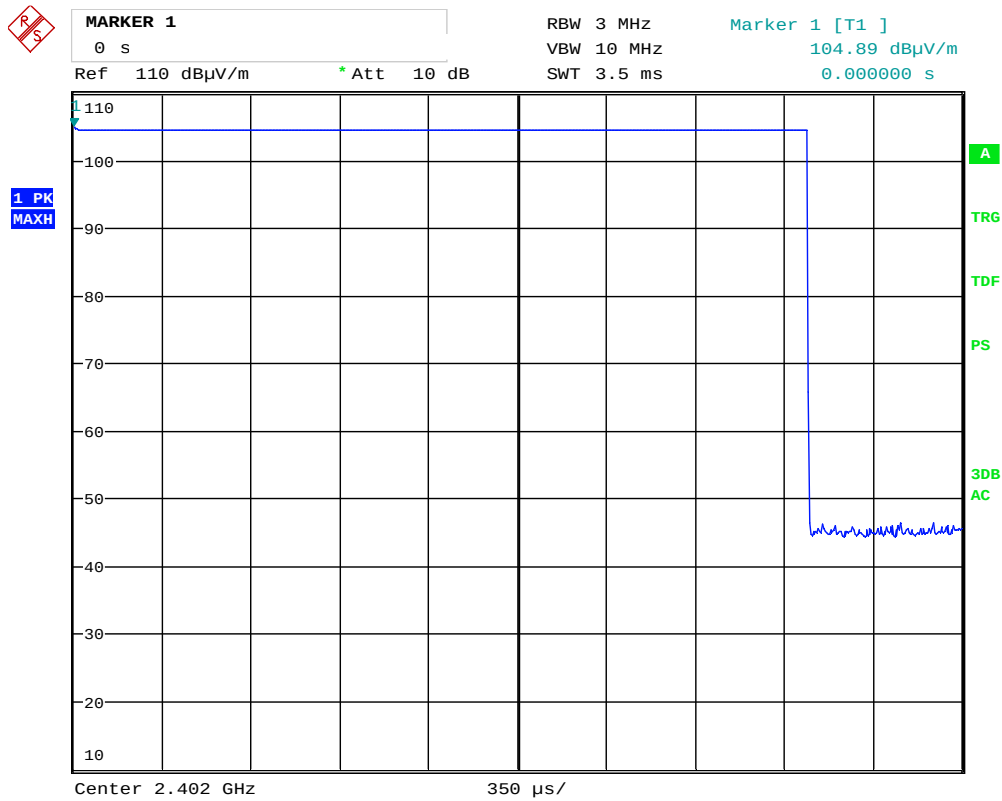
Antenna gain = $10 \cdot \log(\text{EIRP} / \text{Conducted power})$ dBi

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

See attached plots.

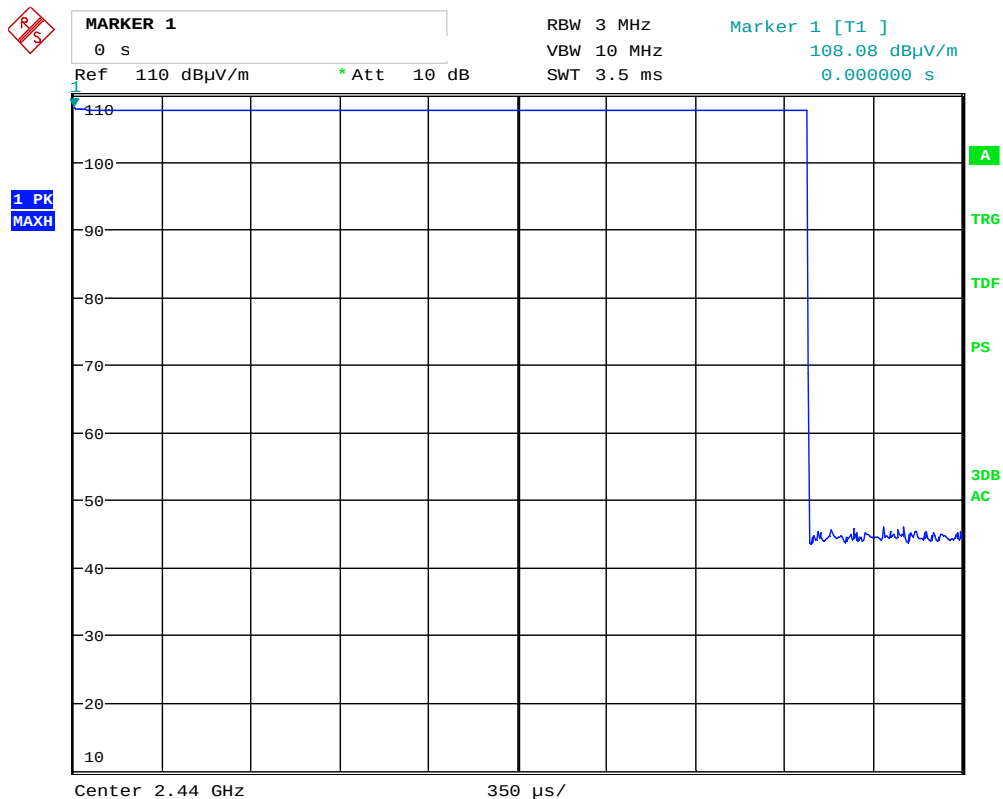
Requirements:

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.



Date: 8.JUL.2016 09:28:32

Field Strength @3m, 2402MHz, HP, Max



Date: 8.JUL.2016 10:01:49

Field Strength @3m, 2440MHz, HP, Max



MARKER 1

0 s

RBW 3 MHz

Marker 1 [T1]

VBW 10 MHz

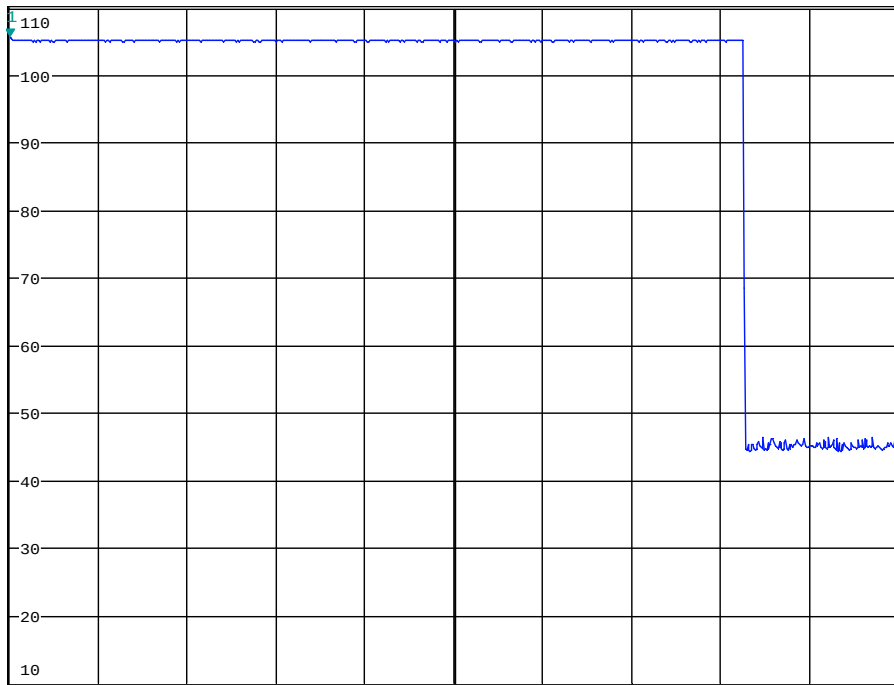
105.46 dBμV/m

SWT 3.5 ms

0.000000 s

Ref 110 dBμV/m * Att 10 dB

1 PK
MAXH



Center 2.48 GHz

350 μs/

Date: 8.JUL.2016 09:59:10

Field Strength @3m, 2480MHz, HP, Max

3.3 Spurious Emissions Band Edge (Radiated)

FCC 15.205, 15.209

ISED RSS-GEN, Issue 4, Clause 8.9

Test Results: Complies

Measurement Data:

	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dBμV/m	dB	
Peak Detector	42.4	61.1	74	31.6	12.9
Average Detector	22.4	41.1	54	31.6	12.9

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

See attached plots.

Duty Cycle Correction Factor Calculation:

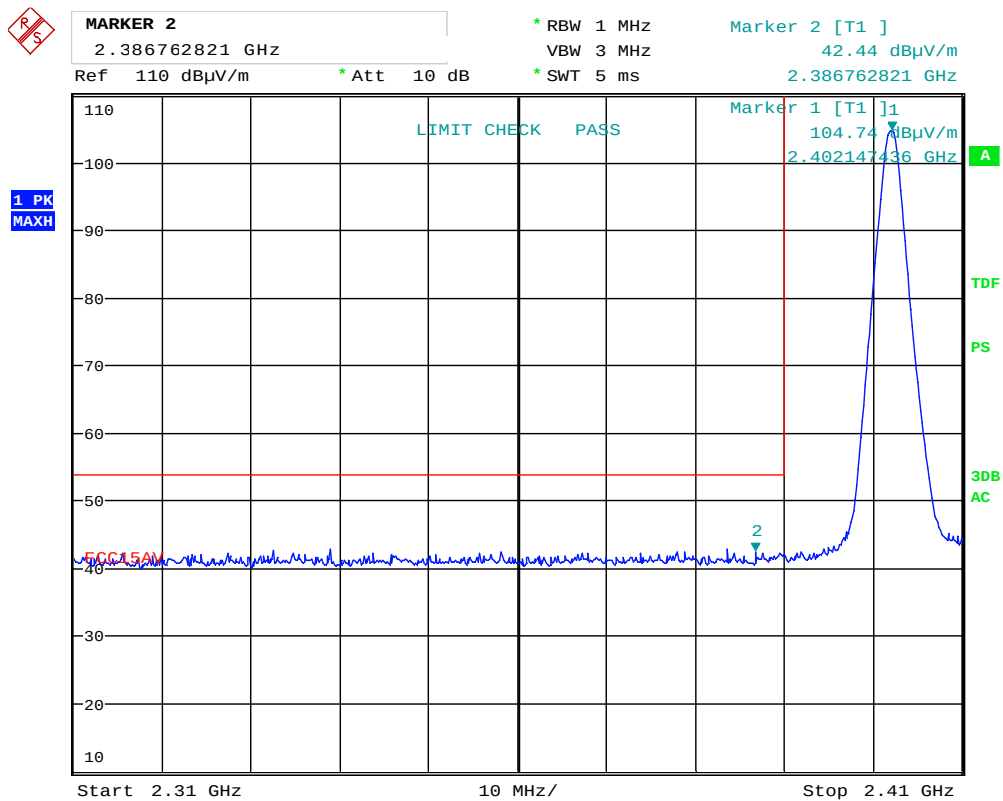
Calculated from values in UL report no. 15U21878-E1V2.

Mode	On Time (ms)	Period (ms)	Duty Cycle (linear)	Number of Hopping Channels	Calculated Duty Cycle Correction Factor (dB)	Duty Cycle Correction Factor (dB)
GFSK	2.884	3.738	0.772	79	40.2	20
8PSK	1.044	3.750	0.278	79	49.1	20

Duty Cycle Correction factor = $-20 \times \log(\text{Duty Cycle} / \text{Number of Hopping Channels})$

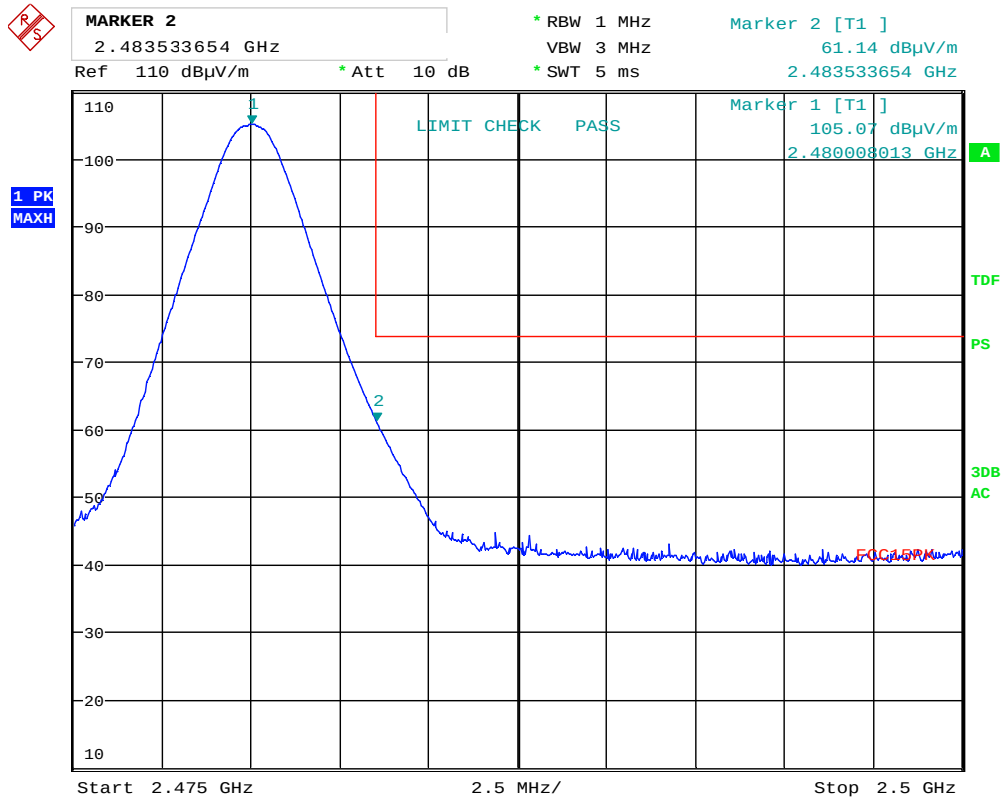
Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB

Correction Factors above are used with field strength values and are valid when EUT is operating in hopping mode with 79 hopping channels..



Date: 8.JUL.2016 09:44:06

Lower Band Edge, 2402MHz, Peak, @3m



Date: 8.JUL.2016 09:47:16

Upper Band Edge, 2480MHz, Peak, @3m

3.4 Radiated Emissions, below 1GHz

FCC 15.205, 15.209

ISED RSS-GEN, Issue 4, Clause 8.9

Test Results: Complies

Measurement Data:

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 3m

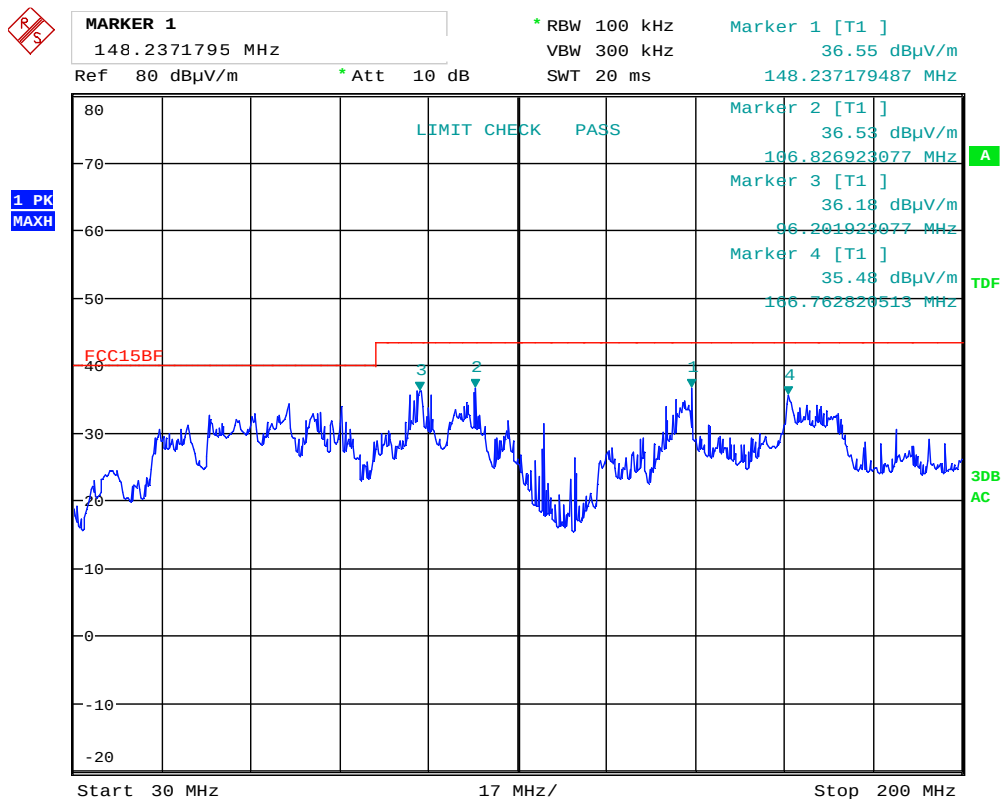
Tested with all connections active

Frequency	Antenna Polarization	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	metres	dB μ V/m	dB
37.356	VP	34.0	3	40	5.5
51.25	VP	34.4	3	40	5.1
68.413	VP	30.9	3	40	8.6
96.202	HP	27.9	3	43.5	15.6
106.827	HP	25.3	3	43.5	18.2
148.237	HP	23.9	3	43.5	19.6
166.763	HP	28.6	3	43.5	14.9

See attached plots.

Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 4, Clause 8.9 @ frequencies defined in 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
Above 960	500	54.0



Date: 9.SEP.2016 14:52:07

Radiated Emissions, 30 -200MHz, HP



MARKER 4

88.84615385 MHz

Ref 80 dB μ V/m

* Att 10 dB

* RBW 100 kHz

VBW 300 kHz

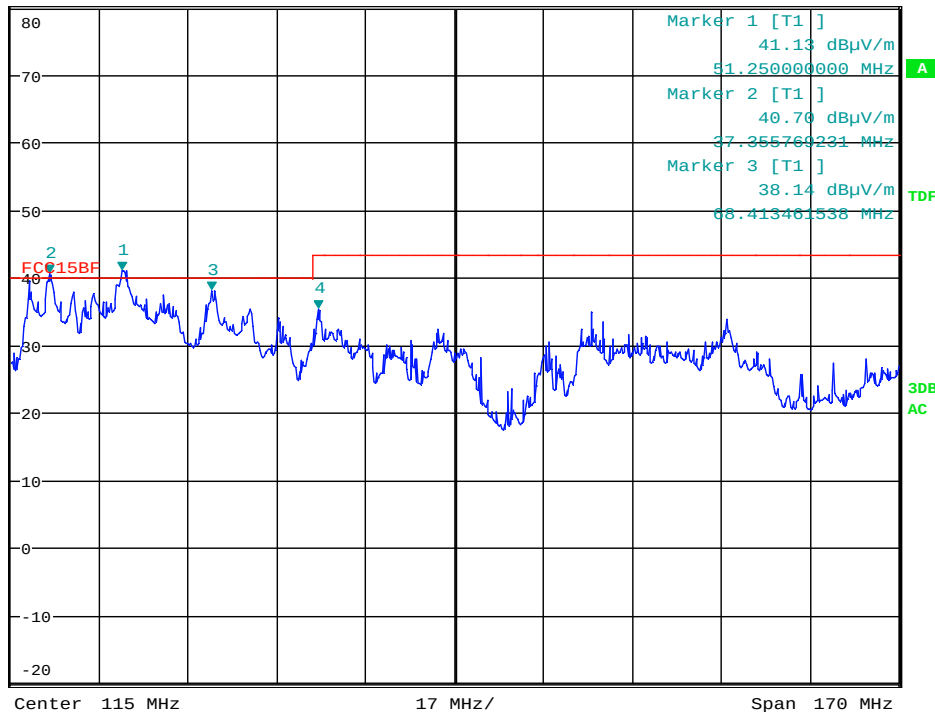
SWT 20 ms

Marker 4 [T1]

35.30 dB μ V/m

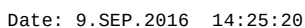
88.846153846 MHz

1 PK
MAXH



Date: 9.SEP.2016 14:34:49

Radiated Emissions, 30 -200MHz, VP



Radiated Emissions, 200 -1000MHz, HP



MARKER 1

528.2051282 MHz

Ref 80 dBμV/m

* Att 10 dB

* RBW 100 kHz

VBW 300 kHz

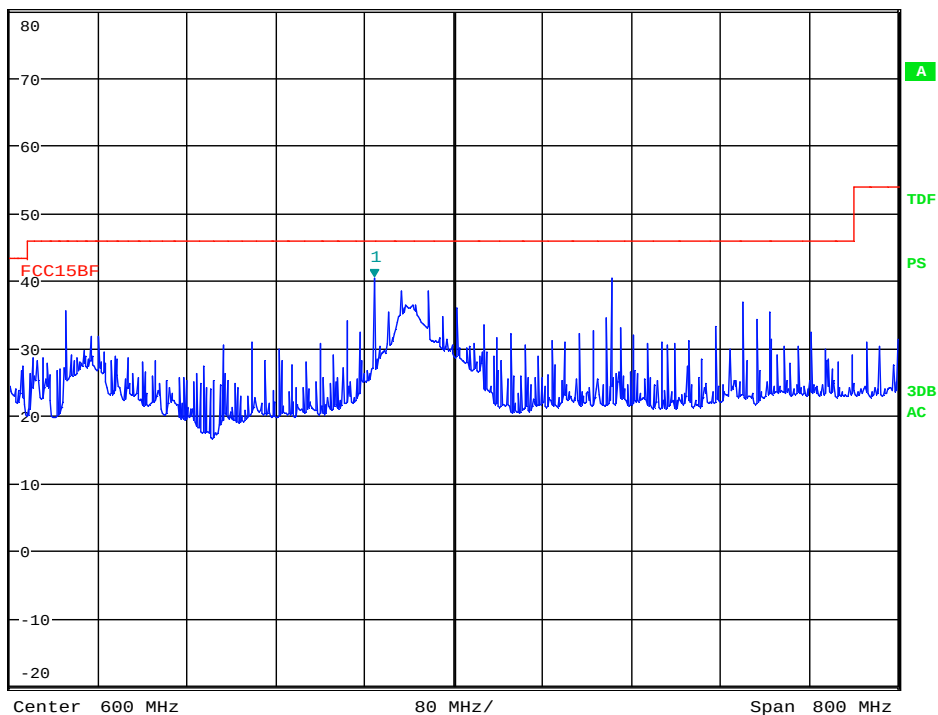
SWT 80 ms

Marker 1 [T1]

40.34 dBμV/m

528.205128205 MHz

1 PK
MAXH



Date: 9.SEP.2016 14:21:40

Radiated Emissions, 200 -1000MHz, VP

3.5 Radiated Emissions, above 1GHz

FCC 15.205, 15.209

ISED RSS-GEN, Issue 4, Clause 8.9

Test Results: Complies

Measurement Data:

Radiated Emissions, 1-25 GHz

Measuring distance: 1.0 - 8.5 GHz: 3m
8.0 - 25.0 GHz: 1m

Peak Detector:

Frequency	RF channel	Dist. corr. factor	Field strength, Peak Detector, 3m	Limit	Margin
MHz	L,M,H	dB	dB μ V/m	dB μ V/m	dB
4880	M	0	39.5	74	34.5
Other freqs	L,M,H	0	None detected	74	>20

Peak Detector values are below the Average Detector limit.

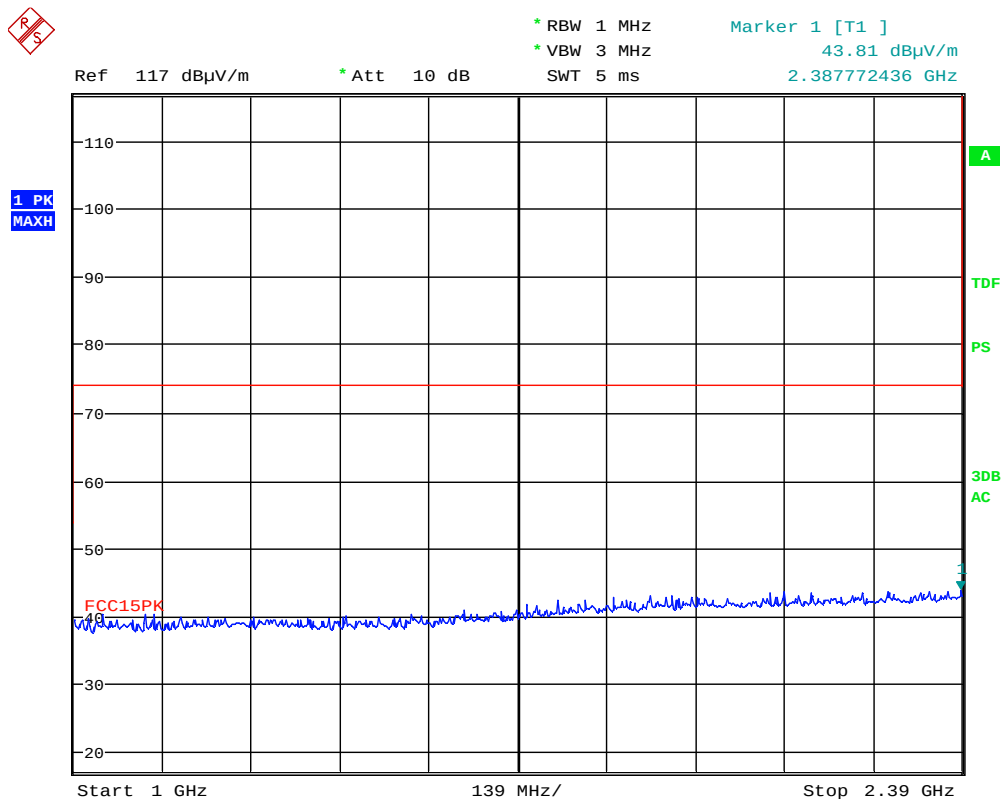
Antenna factor, amplifier gain and cable loss are included in Spectrum Analyzer "Transducer factor".

Distance correction factor are included in the plots.

See attached plots.

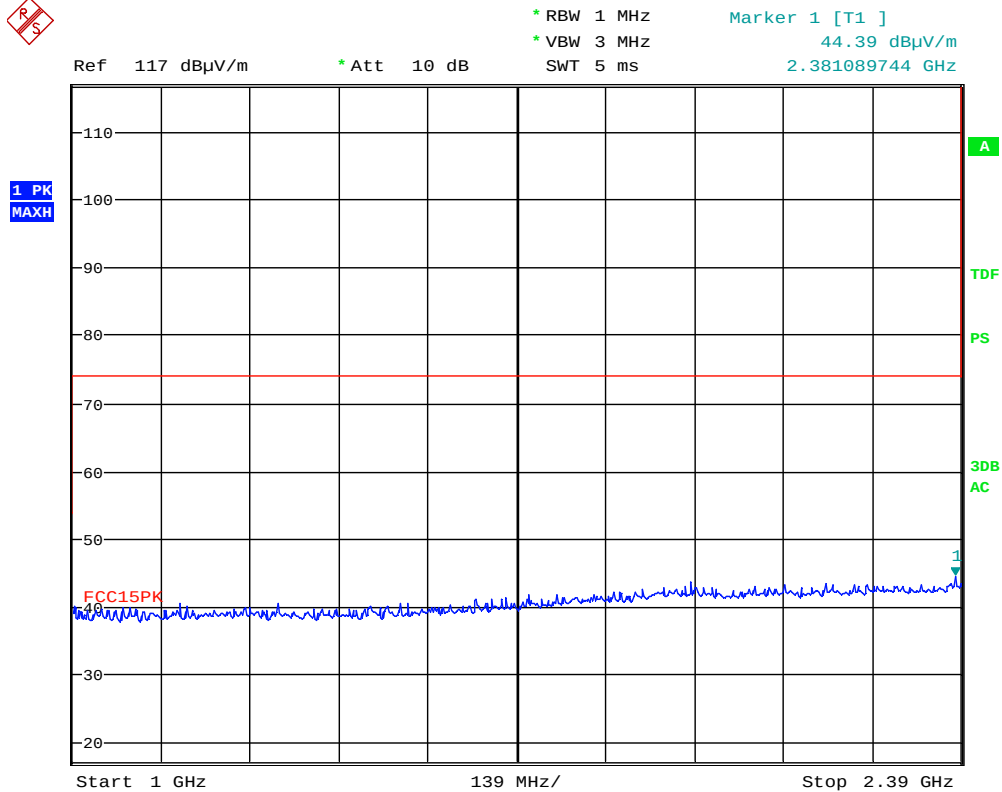
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 4, 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



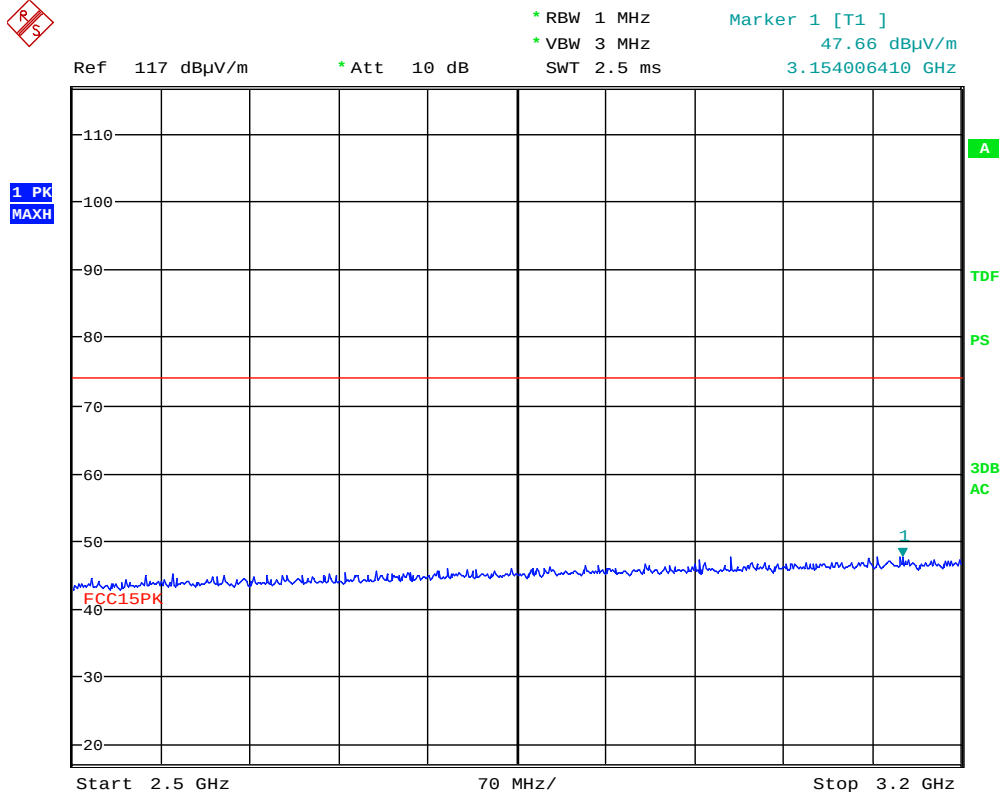
Date: 8.JUL.2016 10:06:48

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



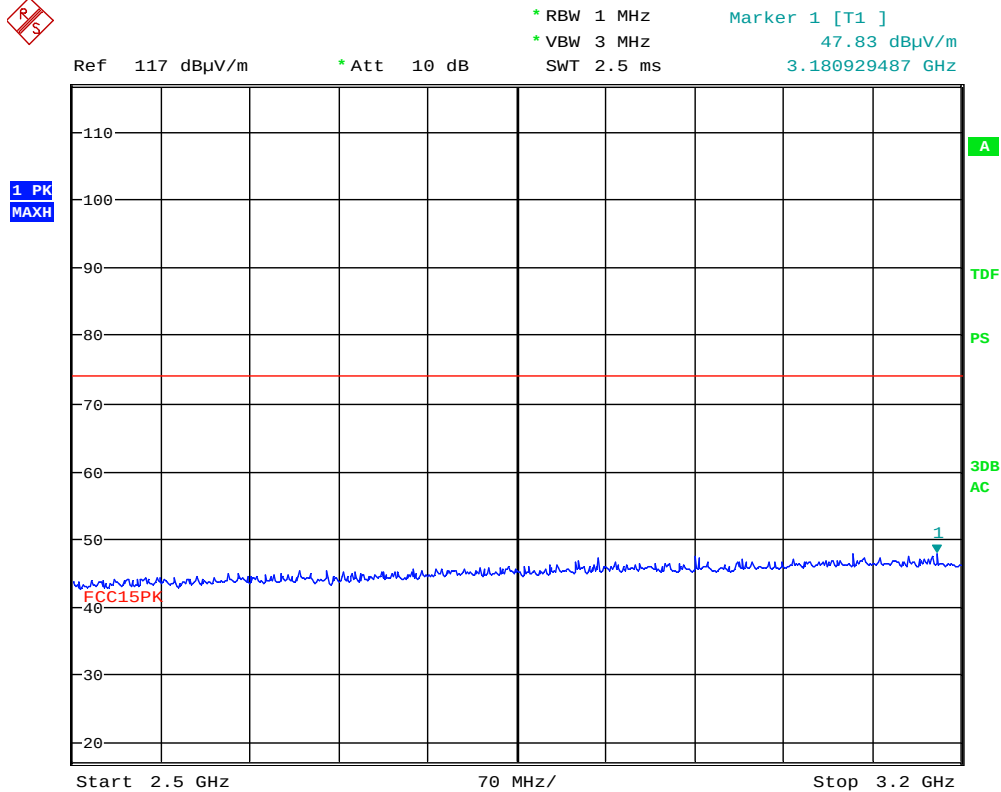
Date: 8.JUL.2016 10:04:56

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



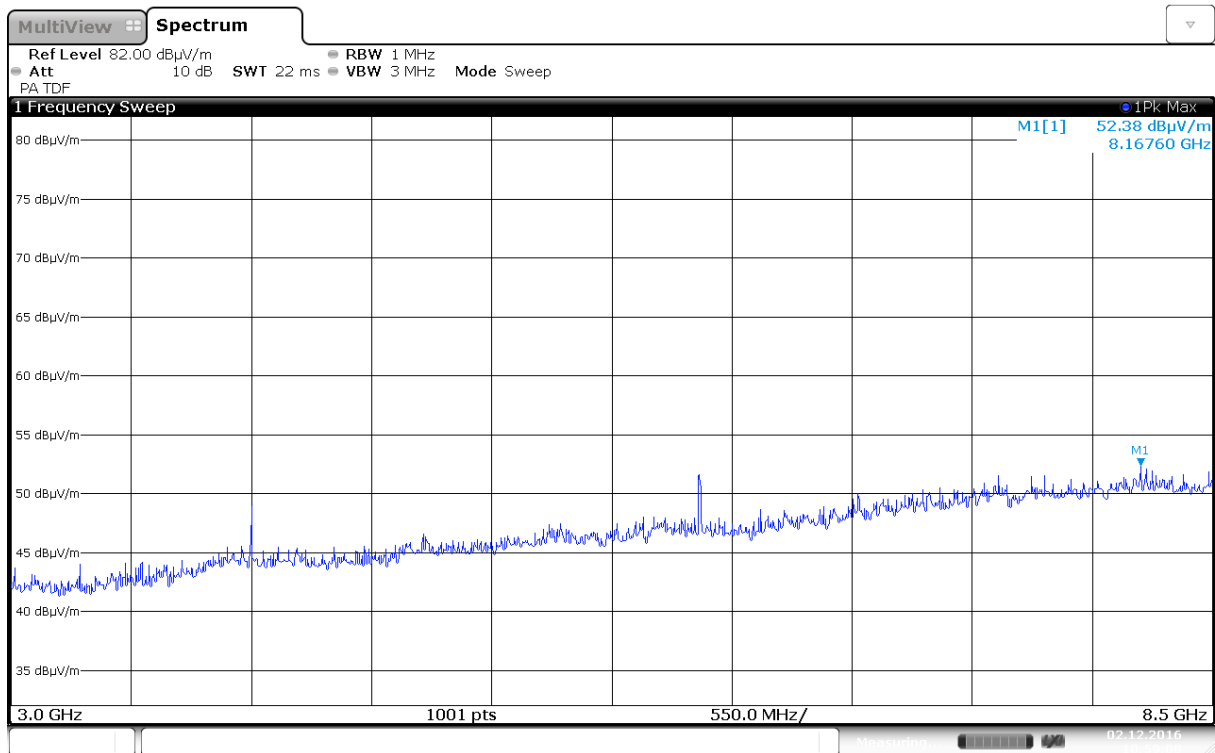
Date: 8.JUL.2016 10:15:29

Radiated Emissions, 2500 -3200MHz, 2480MHz, HP

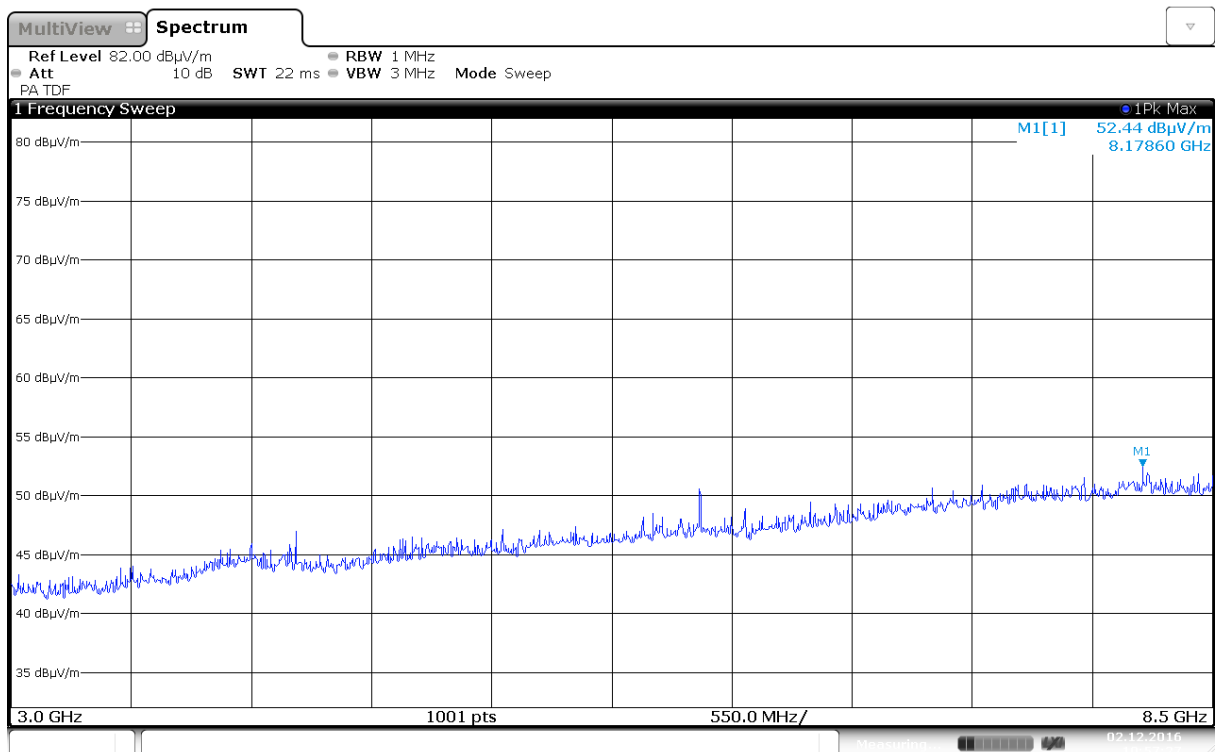


Date: 8.JUL.2016 10:13:37

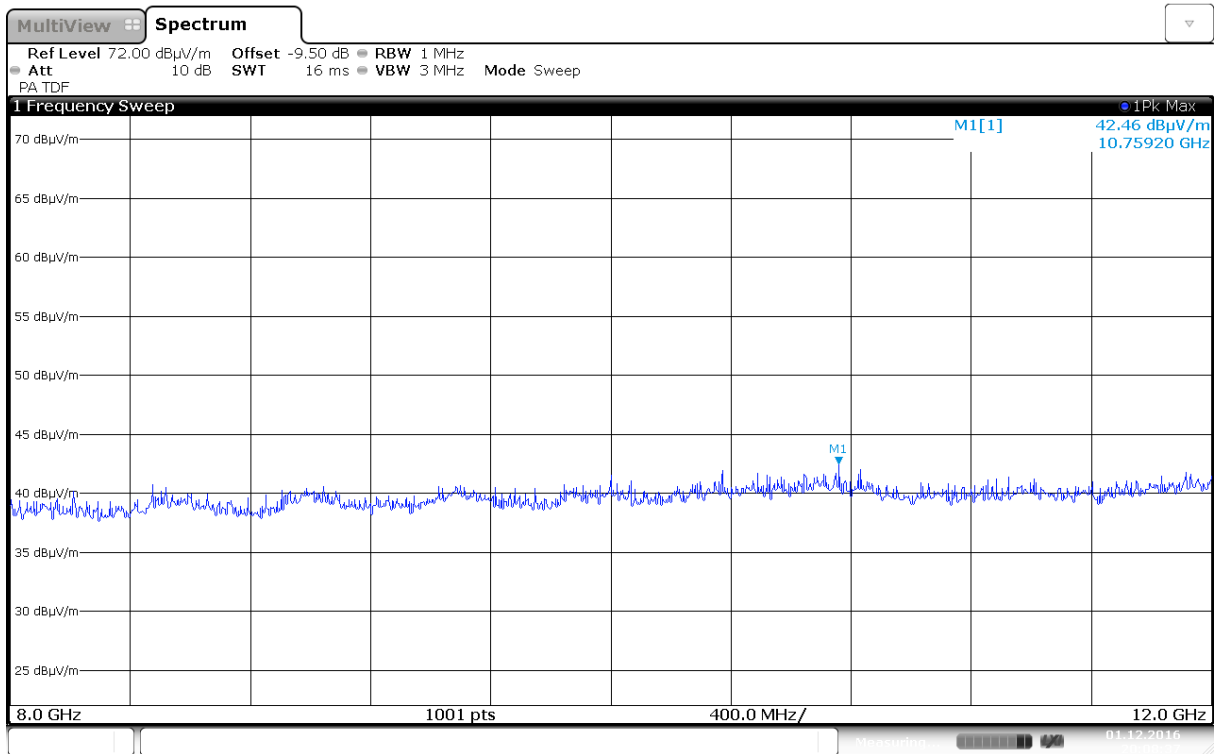
Radiated Emissions, 2500 -3200MHz, 2480MHz, VP



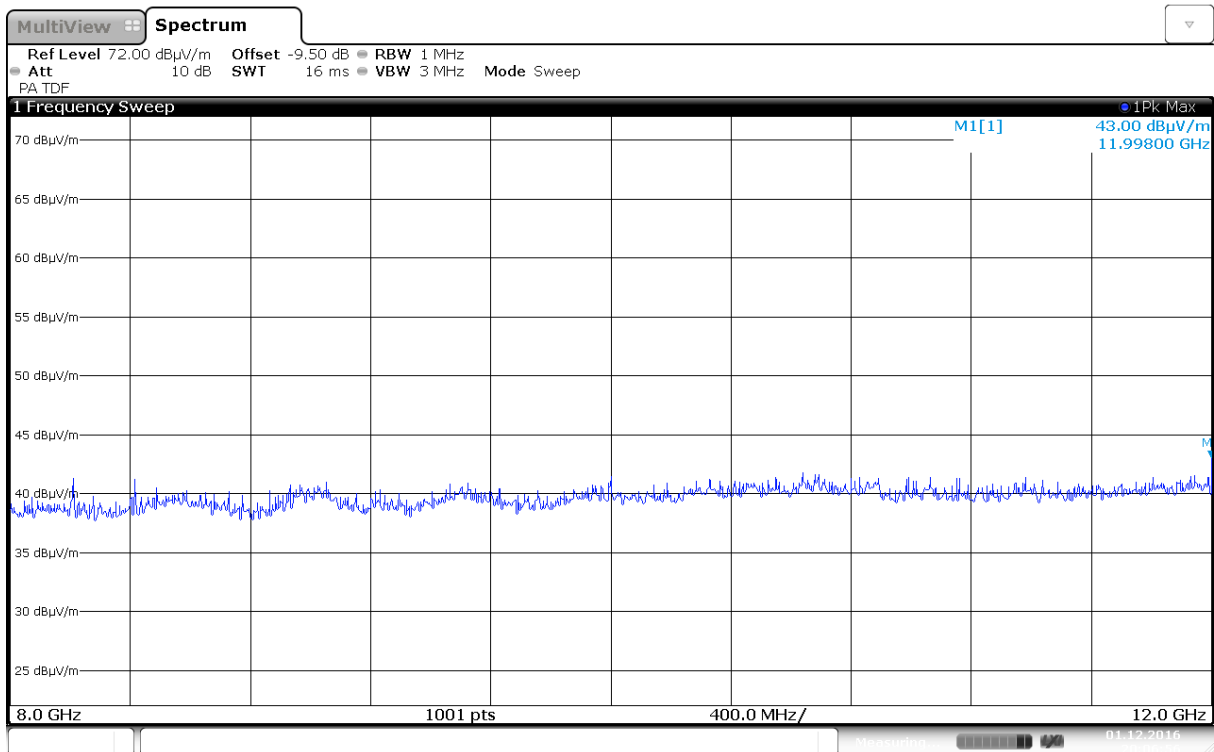
Radiated Emissions, 3000 -8500MHz, 2440MHz, HP



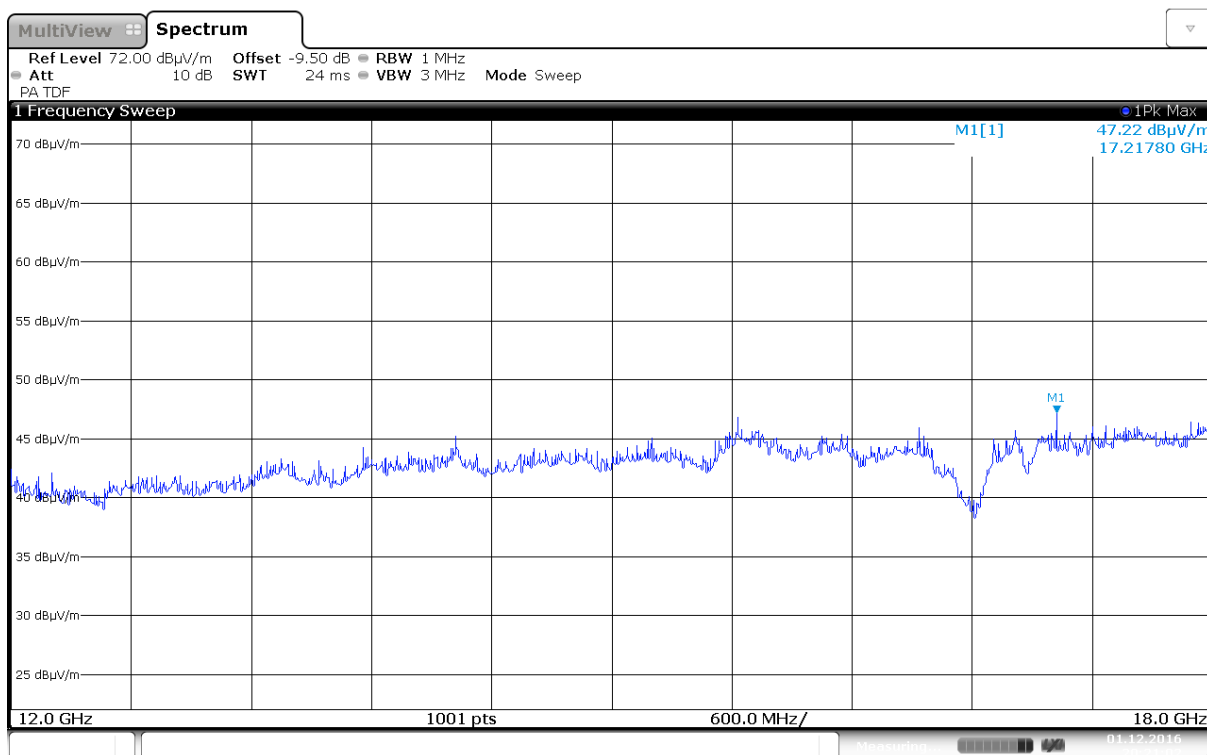
Radiated Emissions, 3000 -8500MHz, 2440MHz, VP



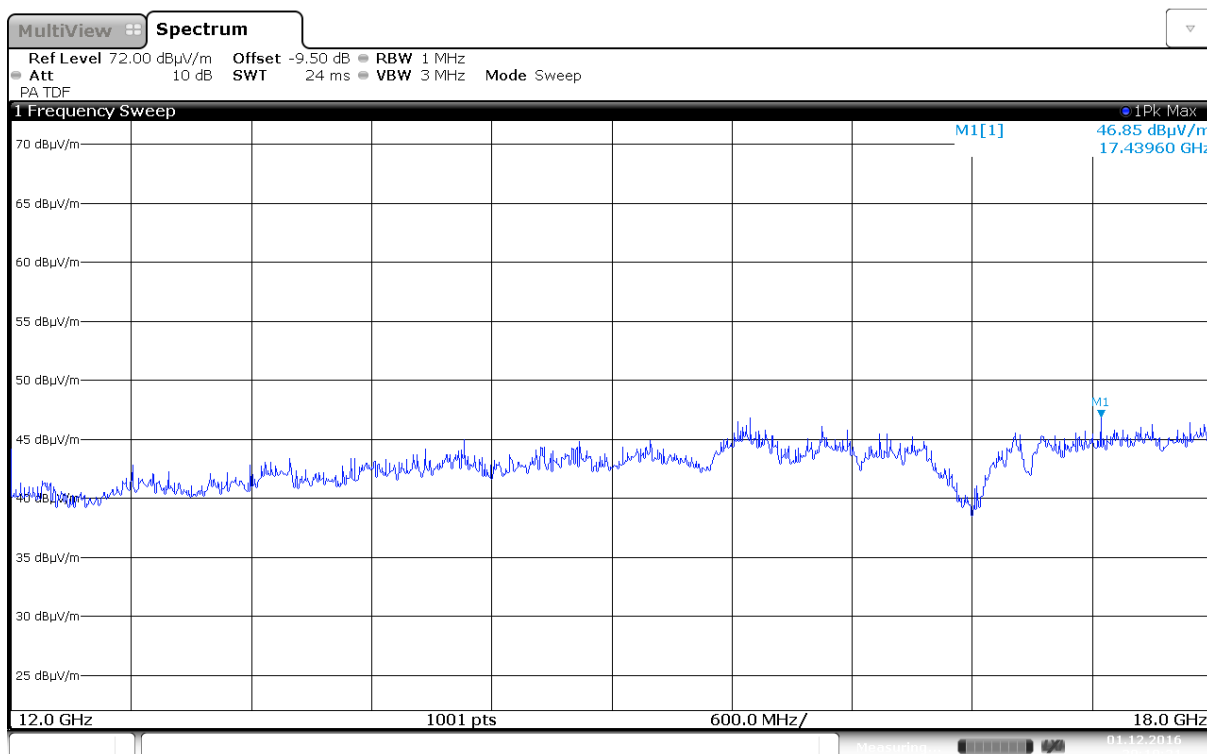
Radiated Emissions, 8000 -12000MHz, 2440MHz, HP, @1m



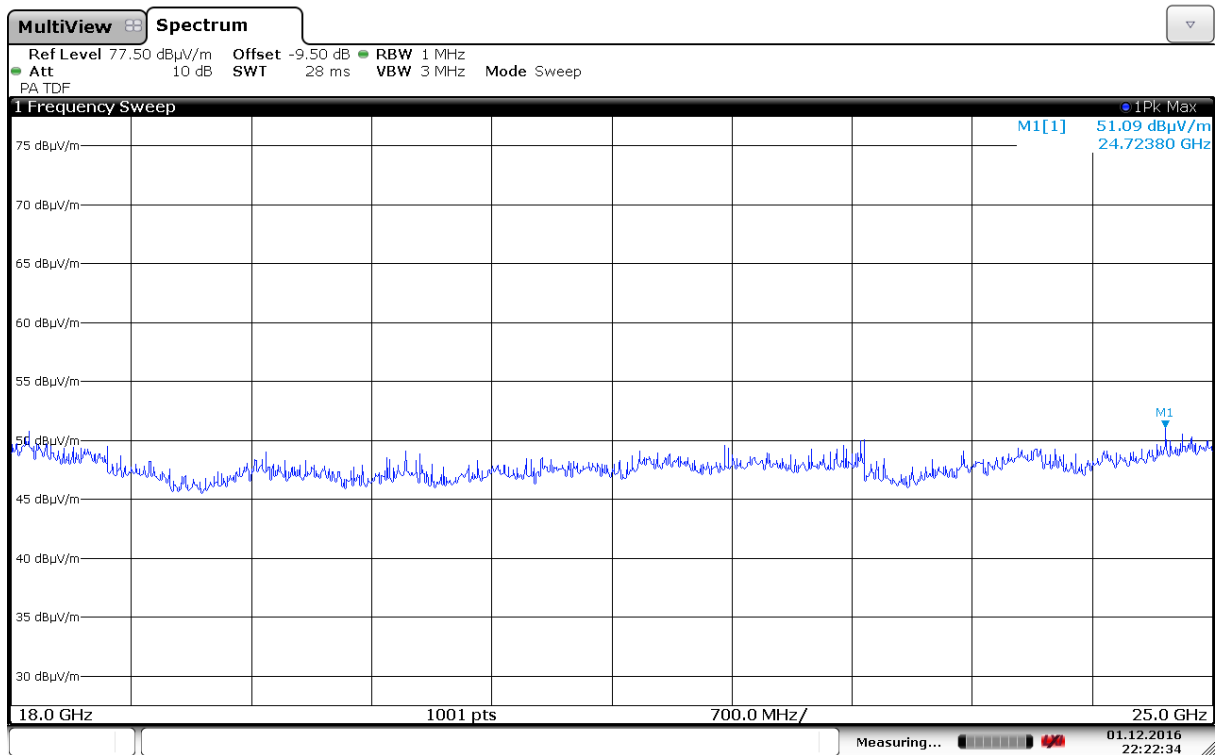
Radiated Emissions, 8000 -12000MHz, 2440MHz, VP, @1m



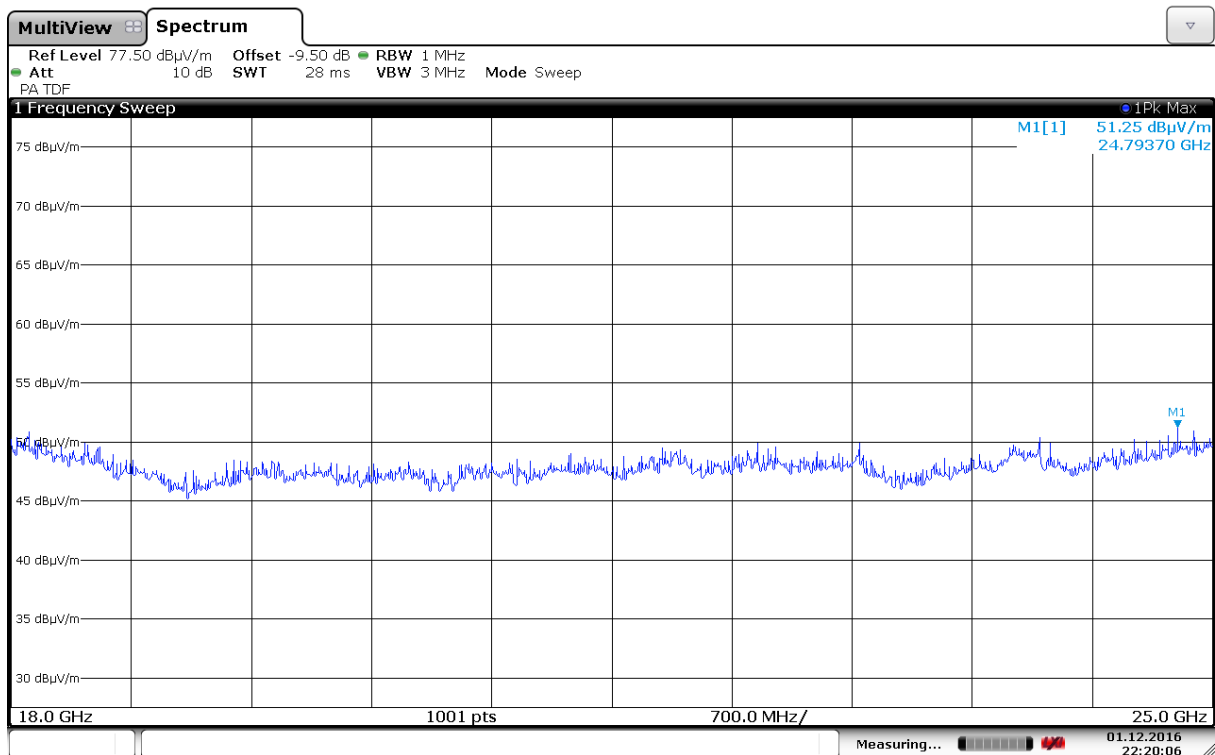
Radiated Emissions, 12000 -18000MHz, 2440MHz, HP, @1m



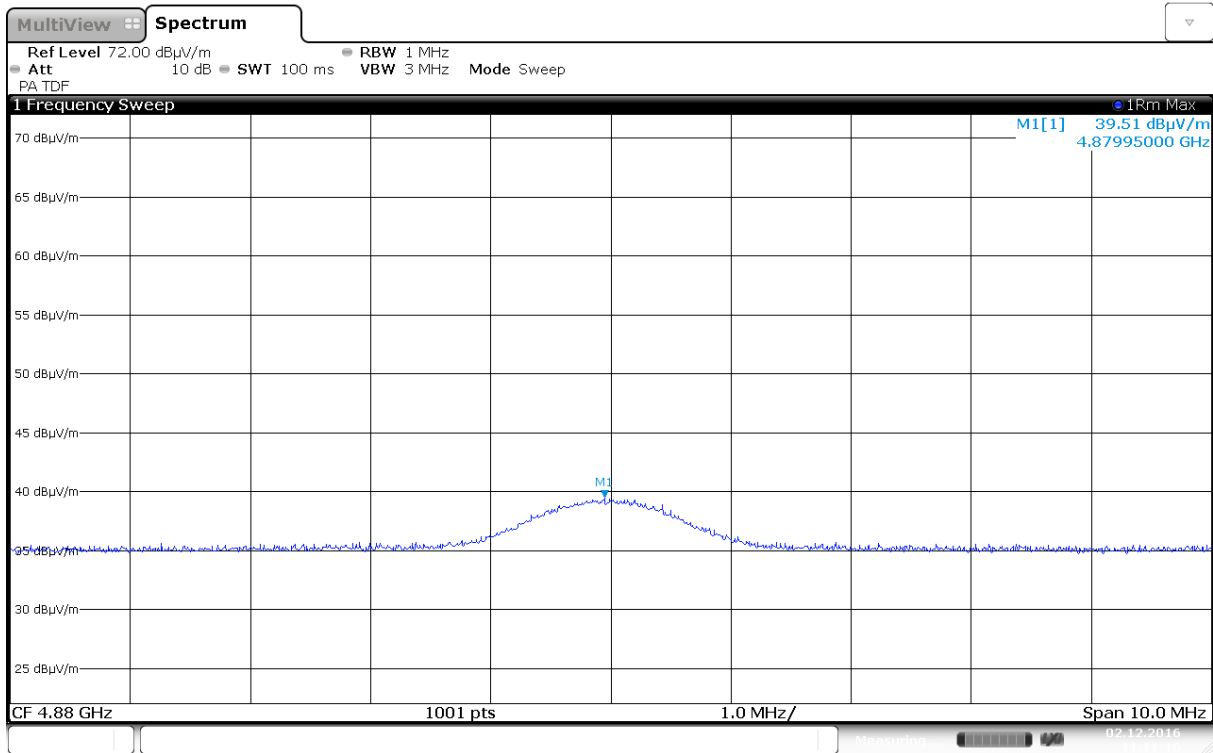
Radiated Emissions, 12000 -18000MHz, 2440MHz, VP, @1m



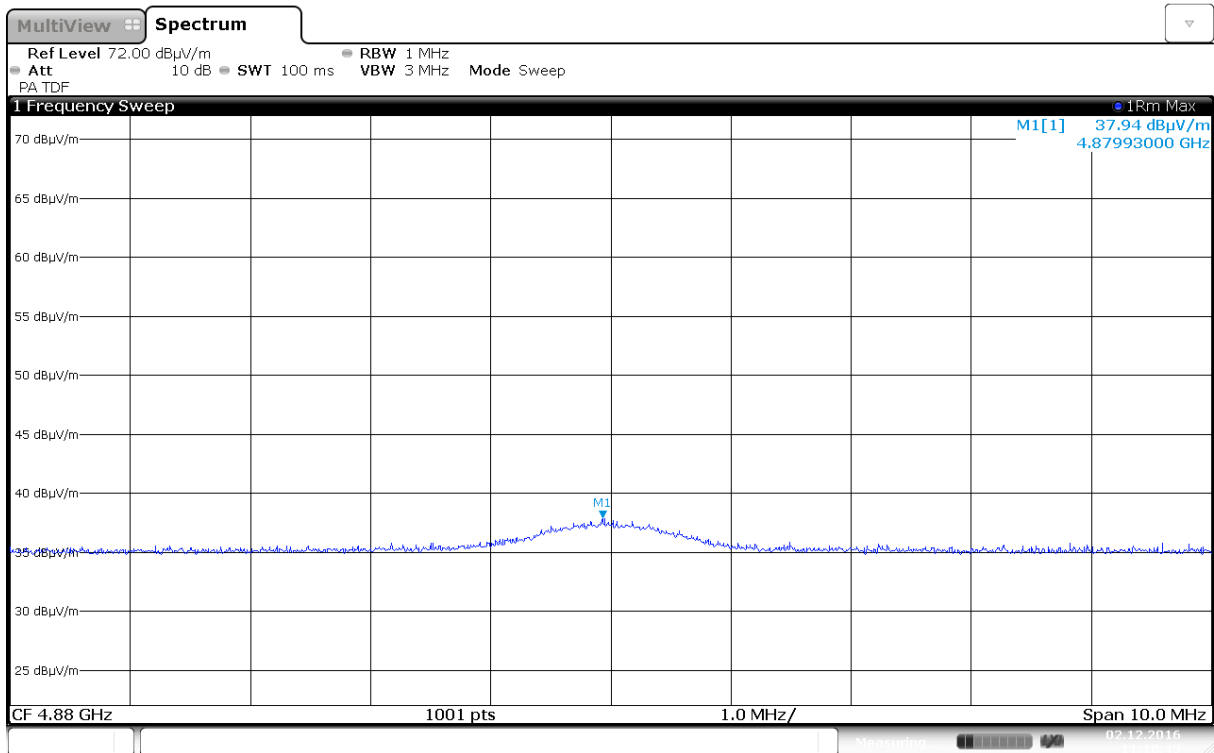
Radiated Emissions, 18000 -25000MHz, 2440MHz, HP, @1m



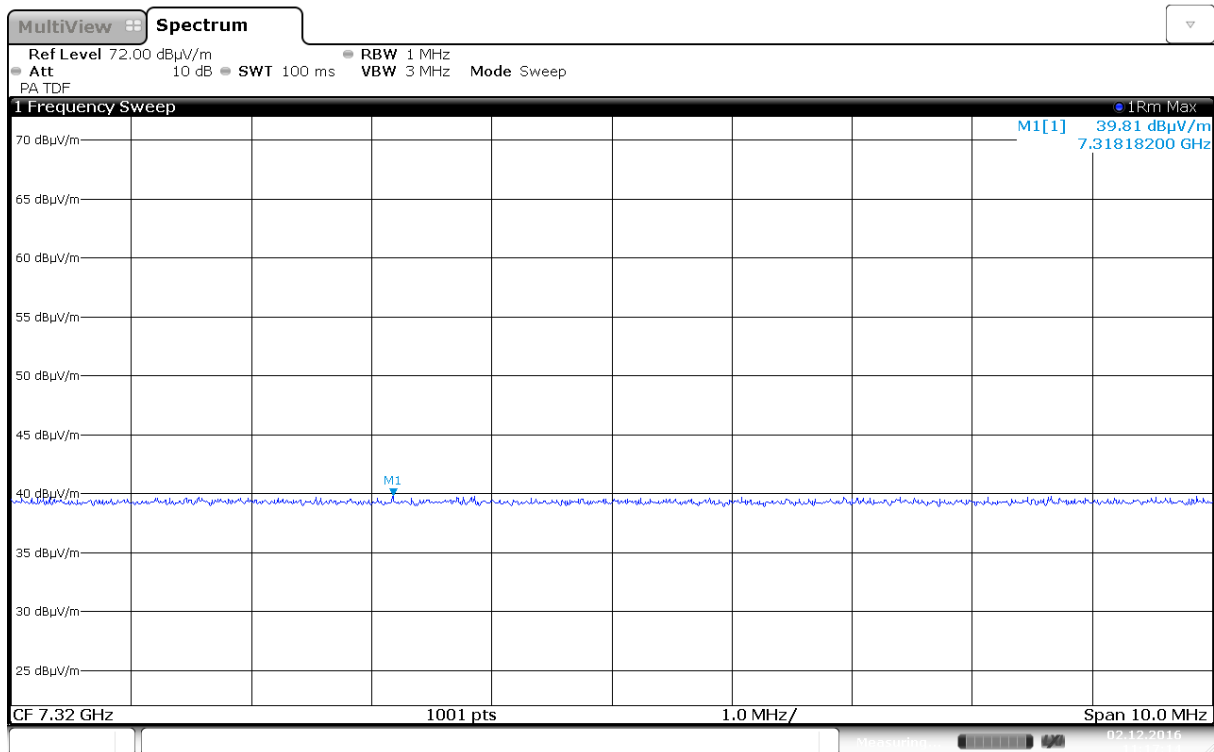
Radiated Emissions, 18000 -25000MHz, 2440MHz, VP, @1m



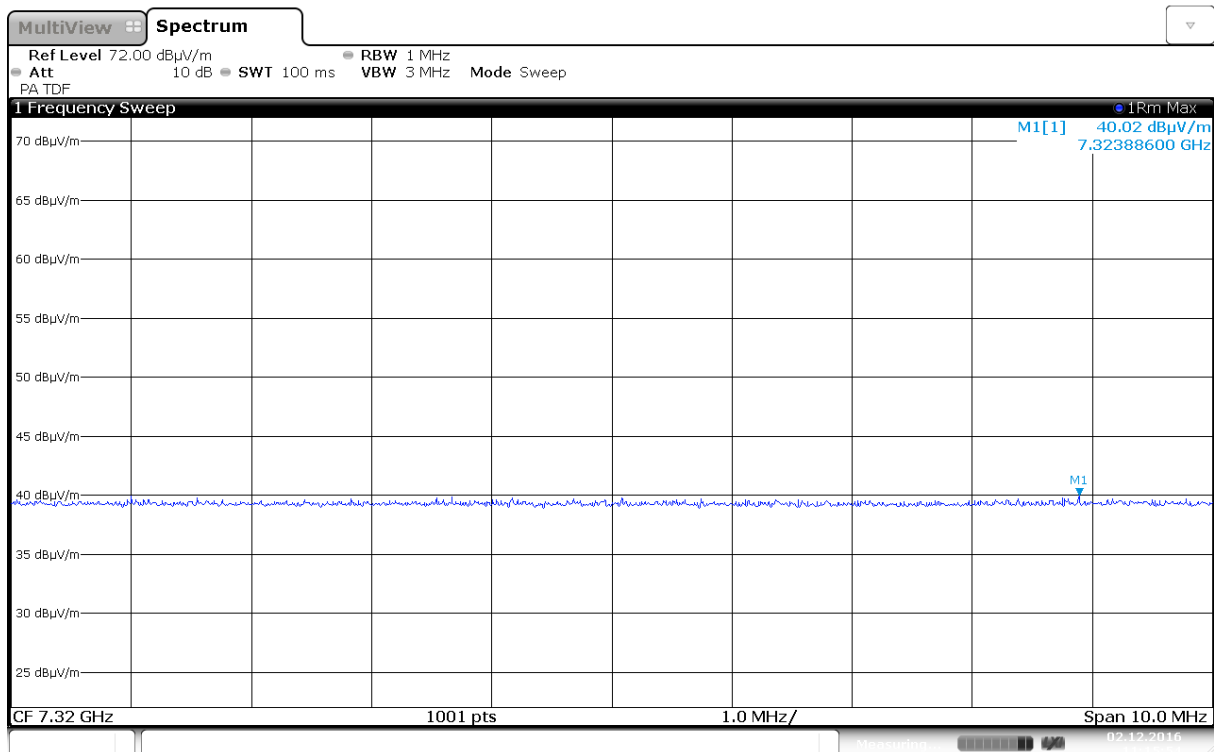
Radiated Emissions, 4880MHz, 2440MHz, HP, @1m



Radiated Emissions, 4880MHz, 2440MHz, VP, @1m



Radiated Emissions, 7320MHz, 2440MHz, HP, @1m



Radiated Emissions, 7320MHz, 2440MHz, VP, @1m

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

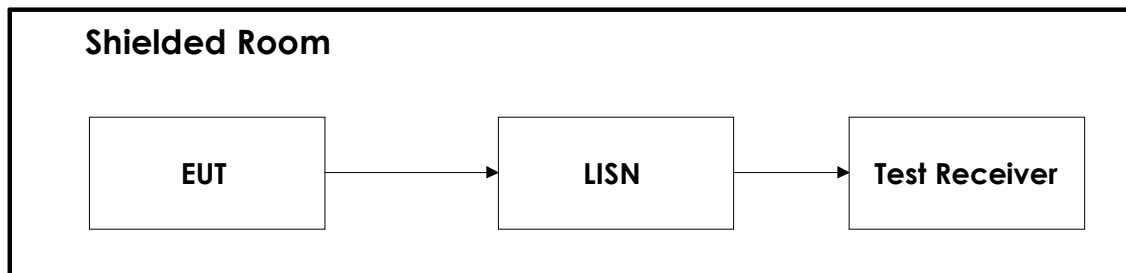
To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model	Description	Manufacturer	Asset no.	Cal. date	Cal. Due
1	FSW40	Spectrum Analyzer	Rohde & Schwarz	LR 1690	2016.07	2017.07
2	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2015.11 2016.12	2016.11 2017.12
3	ESR7	Measuring Receiver	Rohde & Schwarz	LR 1675	2015.12	2016.12
4	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
5	317	Preamplifier	Sonoma Instrument	LR 1687	2016.05	2017.05
6	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2016.10	2017.10
7	6812B	AC Power Source	Agilent	LR1515	2015.12	2016.12
8	3115	Horn Antenna	EMCO	LR 1330	2016.10	2021.10
9	642	Antenna Horn	Narda	LR 220	2009.01	2019.01
10	PM7320X	Antenna Horn	Sivers Lab	LR 102	2009.01	2019.01
11	DBF-520-20	Antenna Horn	Systron Donner	LR 100	2009.01	2019.01
12	638	Antenna Horn	Narda	LR 1480	2010.06	2020.06
14	637	Antenna Horn	Narda	LR 099	2007.04	2017.04
15	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2018.12
16	HL223	LogPeriod Antenna	Rohde & Schwarz	LR 1261	2013.12	2018.12

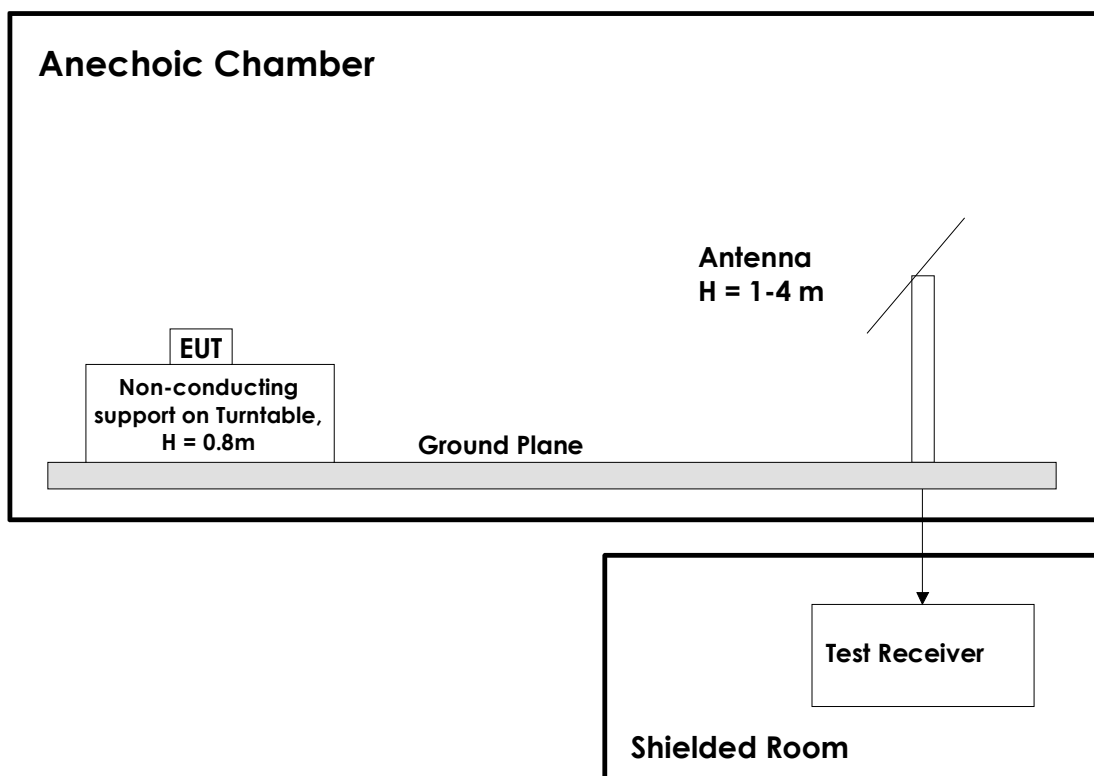
Test Software List			
Description	Manufacturer	Model	Version
EMC Software for Conducted tests	Rohde & Schwarz	EMC32	9.26.00

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



Drawing above shows tests below 1 GHz. At frequencies above 1GHz the turntable height was 1.5m and the ground plane between EUT and measuring antenna was covered by floor absorbers.

Revision history

Version	Date	Comment	Sign
1.0	2016.12.23	First edition	FS
1.1	2017.02.07	Corrected test setup for radiated tests	FS