Report No. 1-296055

Test Report

Product	Zigbee EN4 module
Name and address of the applicant	ASSA ABLOY Hospitality AS Postboks 340, Anolitveien 1-3, 1402 Ski, Norway
Name and address of the manufacturer	ASSA ABLOY Hospitality AS Postboks 340, Anolitveien 1-3, 1402 Ski, Norway
Model	683081150RC
Rating	6Vdc, 500mA
Trademark	ASSA ABLOY
Serial number	/
Additional information	IEEE 802.15.4 based 2.4GHz Zigbee radio module
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	296055
Tested in period	2016.11.04
Issue date	2017.02.24
Name and address of the testing laboratory	Nemko Instituttveien 6 Kjeller, Norway FCC No: 994405 IC OATS: 2040D-1 TEL: +47 22 96 03 30 FAX: +47 22 96 05 50

Prepared by [G.Suhanthakumar]	Approved by [Frode Sveinsen]

Template version: B

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1 INFORMATION

1.1 Test Item

Name :	Zigbee EN 4
FCC ID :	Y7V-683081150C1
Industry Canada ID :	9514A-683081150C1
Model/version :	683081150RC
Serial number :	/
Hardware identity and/or version:	Rev-B
Software identity and/or version :	3.0.58
Frequency Range :	2405 - 2480MHz
Tunable Bands :	None
Number of Channels :	16
Channel BW:	5 MHz
Type of Modulation :	ZigBee uses Offset quadrature phase-shift keying (OQPSK)
User Frequency Adjustment :	N/A
Rated Output Power :	0.74m W*
Type of Power Supply :	5Vdc (nominal)
Antenna Connector :	None (PCB antenna)
No of antennas:	1
Antenna Diversity Supported :	None
Desktop Charger :	None

***For all channels the power setting 12 & PA(Ext power 1).

Description of Test Item

The EUT is an IEEE 802.15.4 based zigbee radio module. And it is only powered with DC Voltage.

1.2 Normal test conditions

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	5Vdc

The values are the limit registered during the test period.

1.3 Test Engineer(s)

G.Suhanthakumar

1.4 Test Equipment

See list of test equipment in clause 5.

1.5 Description of modification for Modification Filing

Not applicable.

1.6 Family List Rational

Not Applicable.

1.7 Additional Comments

The measurements were done with the EUT powered by DC voltage. During the test external DC power is used. 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 tracable 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 2.

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 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

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 4 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)	N/A
Antenna Requirement	15.203	8.3 (RSS-GEN)	Complies[2]
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)	N/A
Pseudorandom Hopping Algorithm	15.247(a)(1)	5.1 (3) (RSS-247)	N/A
Time of Occupancy	15.247(a)(1)(iii)	5.1 (5) (RSS-247)	N/A
Occupied Bandwidth	15.247(a)(1)	5.1 (7) (RSS-247)	Complies
Occupied Bandwidth	N/A	6.6 (RSS-GEN)	
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	Complies
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	Complies
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] The tested equipment has integrated antennas only.

3 TEST RESULTS

3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suhanthakumar	**Date of Test: 2016.11.04**

Measurement procedure: **ANSI C63.4-2014 using 50 µH/50 ohms LISN.**

Test Results: **Complies.**

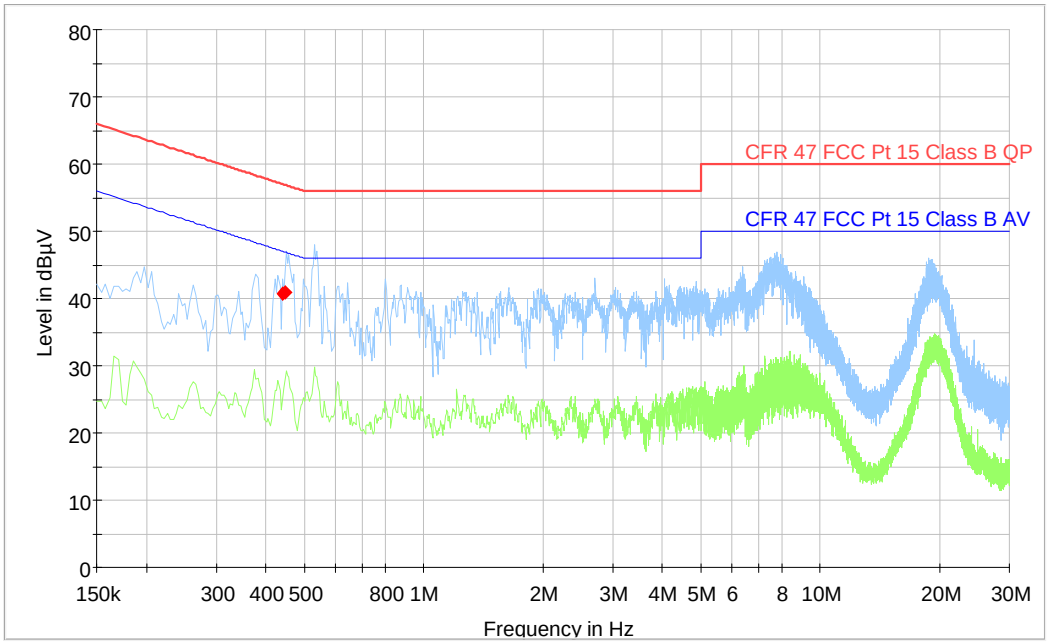
Measurement Data: **See attached graph, (Peak detector).**

AC/DC adapter type CMP:S008CM0500120

Input voltage to AC/DD adapter: 120Vac/60Hz

Highest measured value (L1 and N):

Full Spectrum



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.440	40.68	---	57.06	16.38	1000.0	9.000	L1	GND	10.1
0.448	40.91	---	56.91	16.00	1000.0	9.000	L1	GND	10.1

3.2 Minimum 6 dB Bandwidth

Para. No.: 15.247 (a)(2)

Test Performed By: G.Suhanthakumar	**Date of Test: 2016.11.04**

Test Results: Complies

Measurement Data:

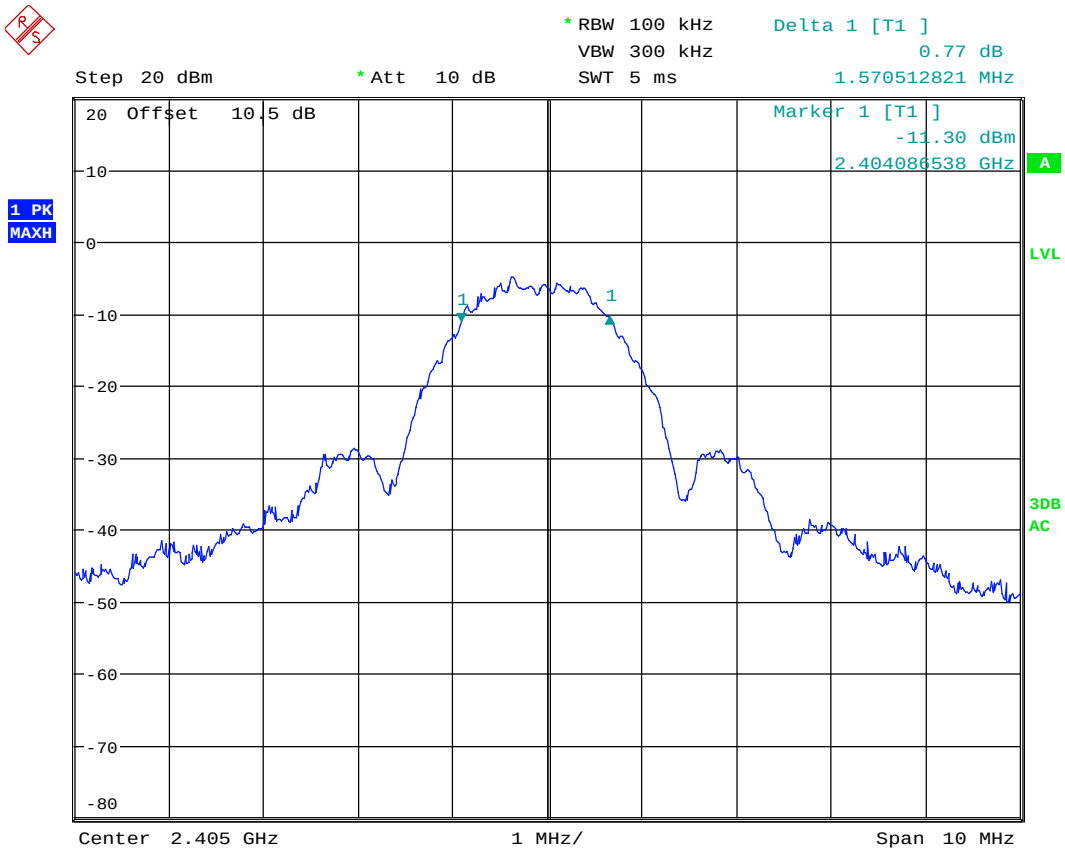
Measured 6 dB Bandwidth (MHz)		
2405MHz	**2440 MHz**	**2480MHz**
1.57	1.59	1.62

Fully charged battery is used.

Requirements:

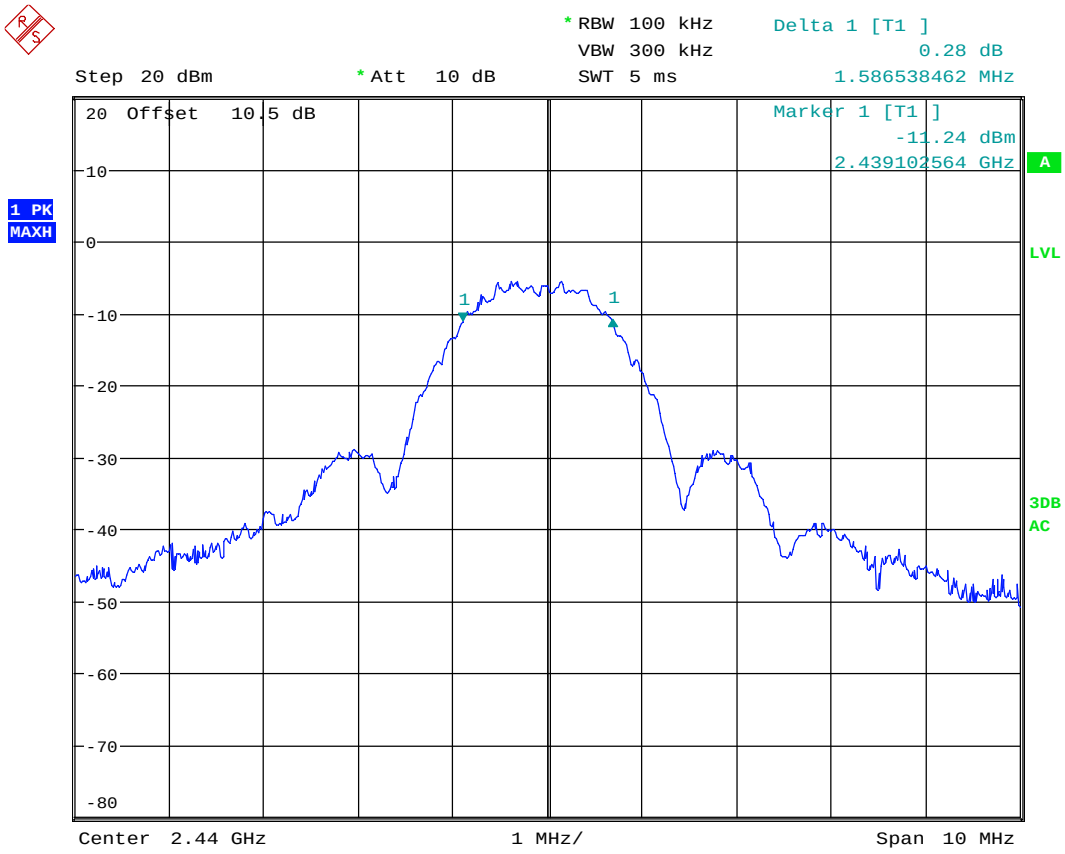
For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

No requirements for Frequency Hopping Systems.



Date: 4.NOV.2016 14:41:03

6 dB Bandwidth at 2405 MHz



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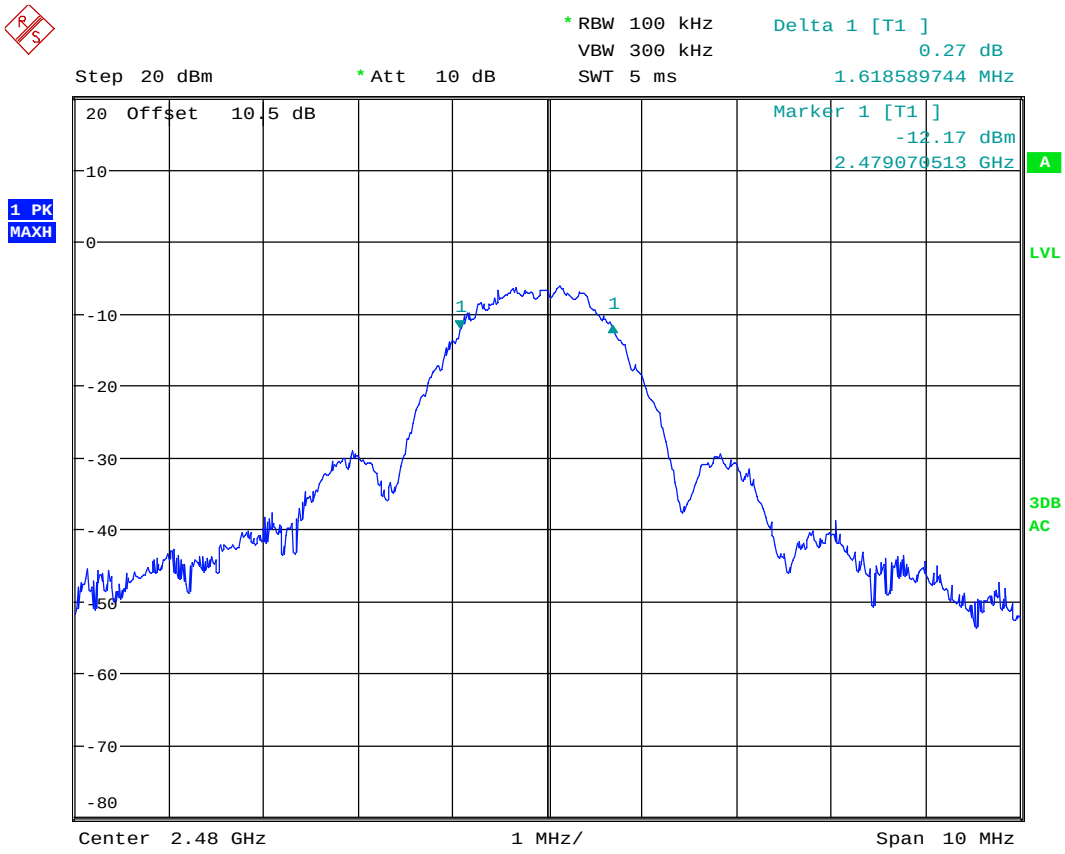
6 dB Bandwidth at 2440 MHz



Date: 4.NOV.2016 14:53:06

6 dB Bandwidth at 2480 MHz

3.3 99% Bandwidth

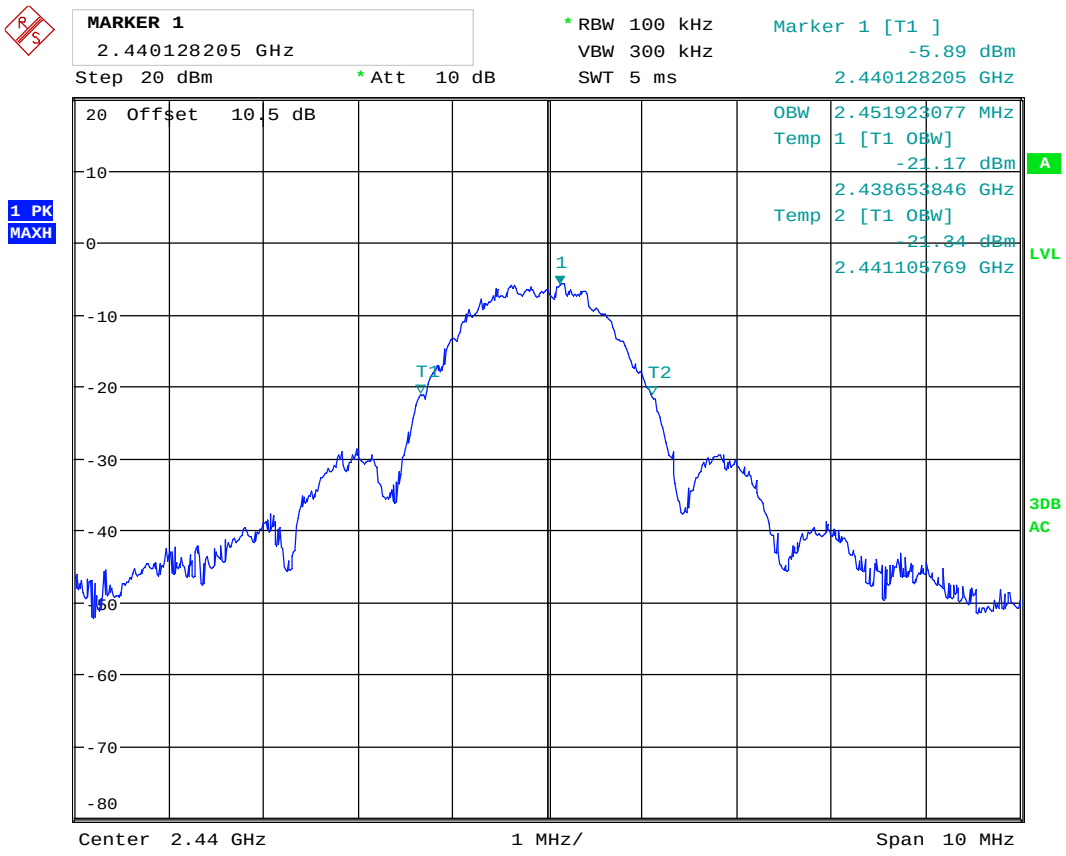
Test Performed By: G.Suhanthakumar	Date of Test: 2016.11.04

Measurement Data:

Measured 99% Bandwidth (MHz)
2440 MHz
2.45

Requirements:

No requirements. Reported for information only.



Date: 4.NOV.2016 14:51:33

99% Bandwidth at 2440 MHz

3.4 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suhanthakumar	**Date of Test: 2016.11.04**

Test Results: Complies

Measurement Data:

RF channel	**2405 MHz**	**2440 MHz**	**2480 MHz**
Measured Maxium Field strength (dBµV/m) –VP	97.17	96.66	96.09
Calc. Radiated Power (dBm)	1.94	1.43	0.86
Calc. Radiated Power (mW)	1.56	1.39	1.22
Measured Conducted Power (dBm)	-1.31	-1.43	-1.91
Measured Conducted Power (mW)	0.74	0.72	0.64
Calculated Antenna Gain (dBi)	3.3	2.9	2.8

Antenna gain = 10*log (EIRP/Conducted power) dBi

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

The maximum field strength is obtained in XY plane and Vertical polarization.

See attached graph.

Detachable antenna? ☐ Yes ☒ No

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

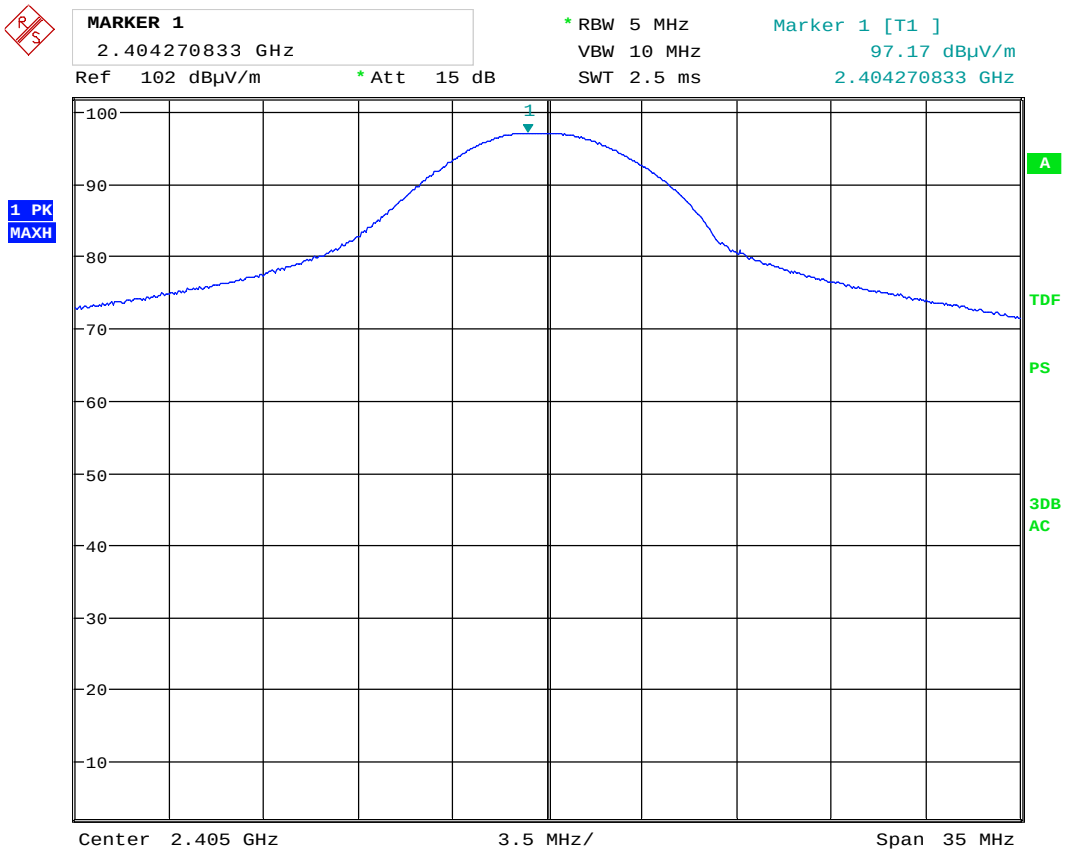
Type of antenna connector: N/A

Requirements:

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

For 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.



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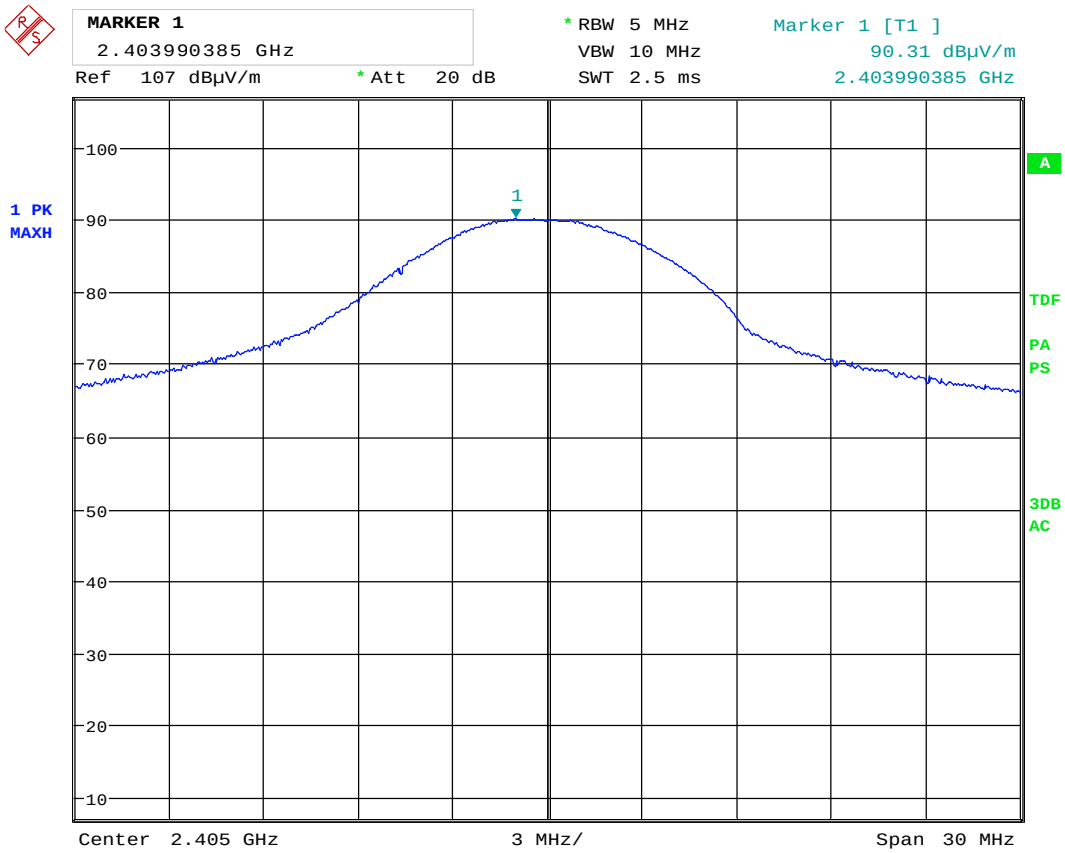
Radiated Field strength, VP , 2405 MHz



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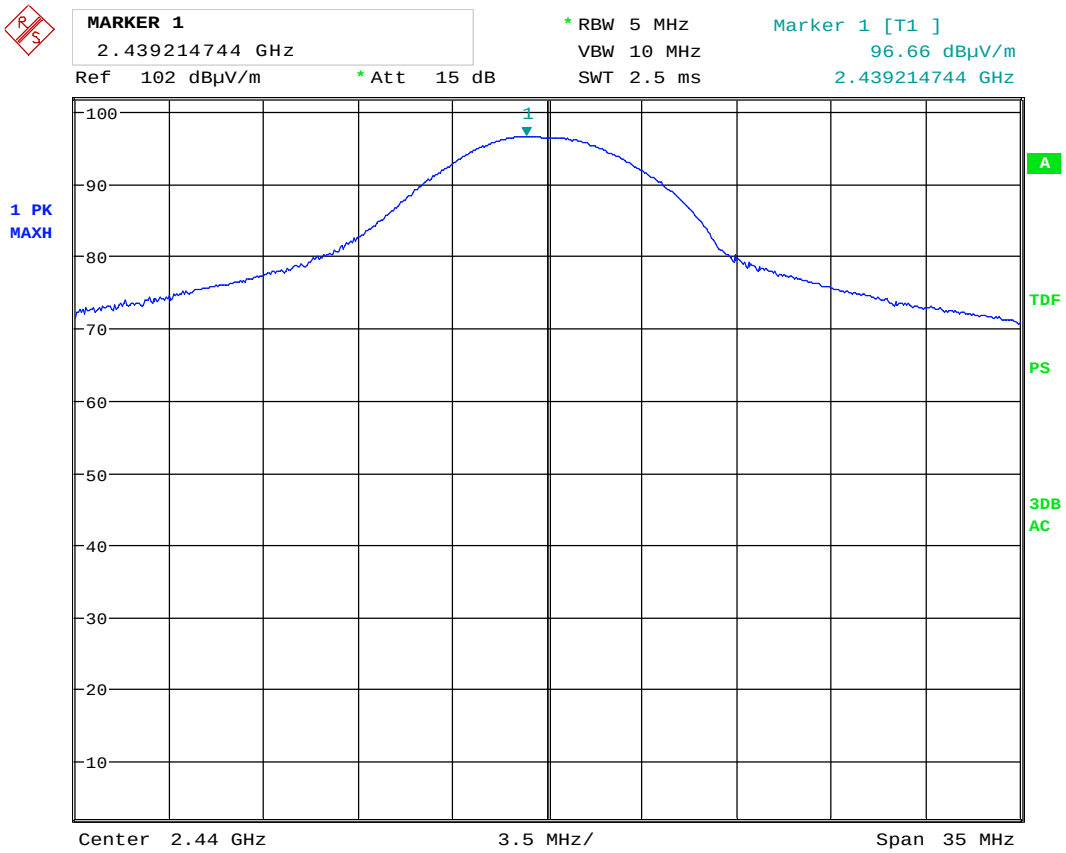
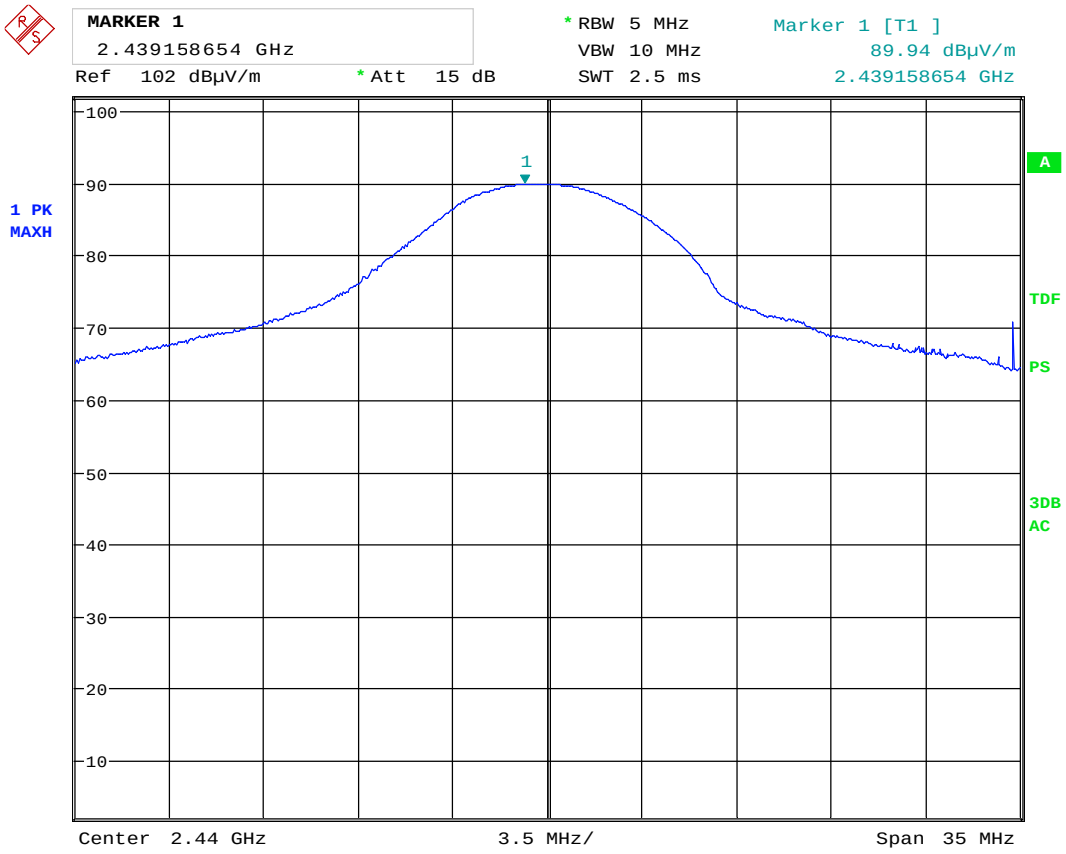
Radiated field strength, HP, 2405 MHz



Date: 4.NOV.2016 11:11:18

Radiated field strength, VP, 2440 MHz



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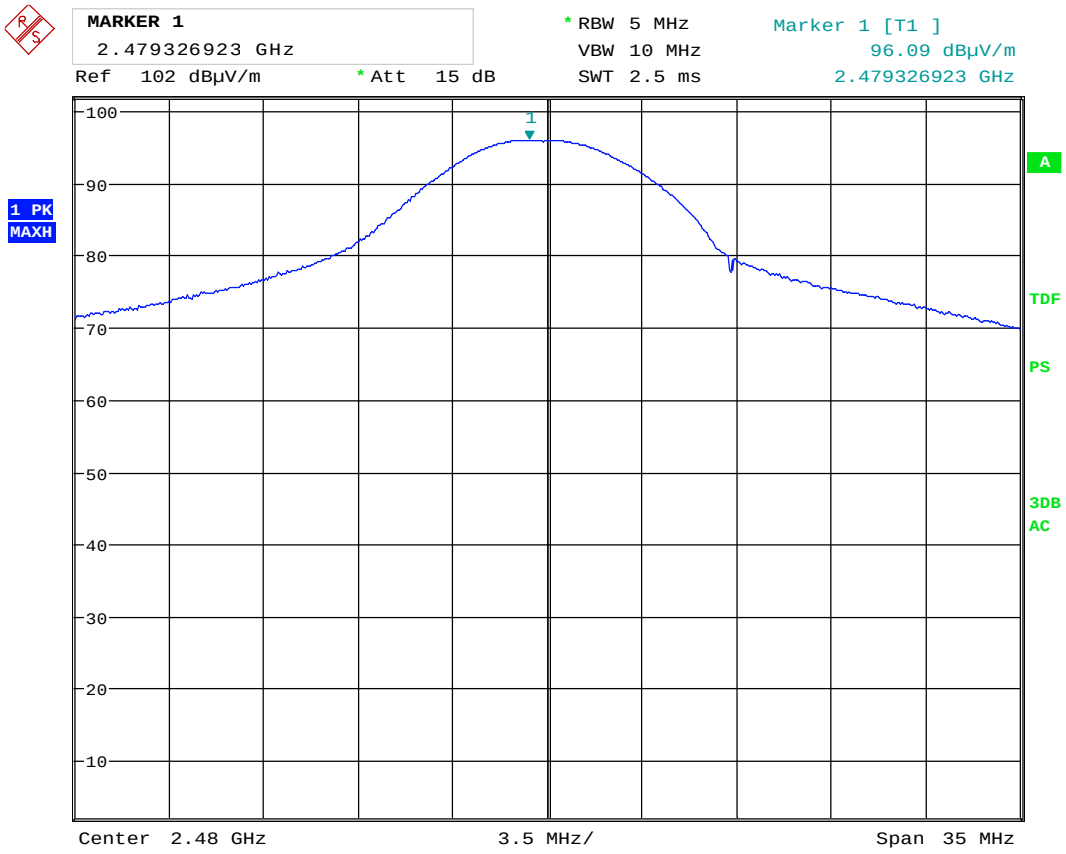
Radiated field strength, HP, 2440 MHz



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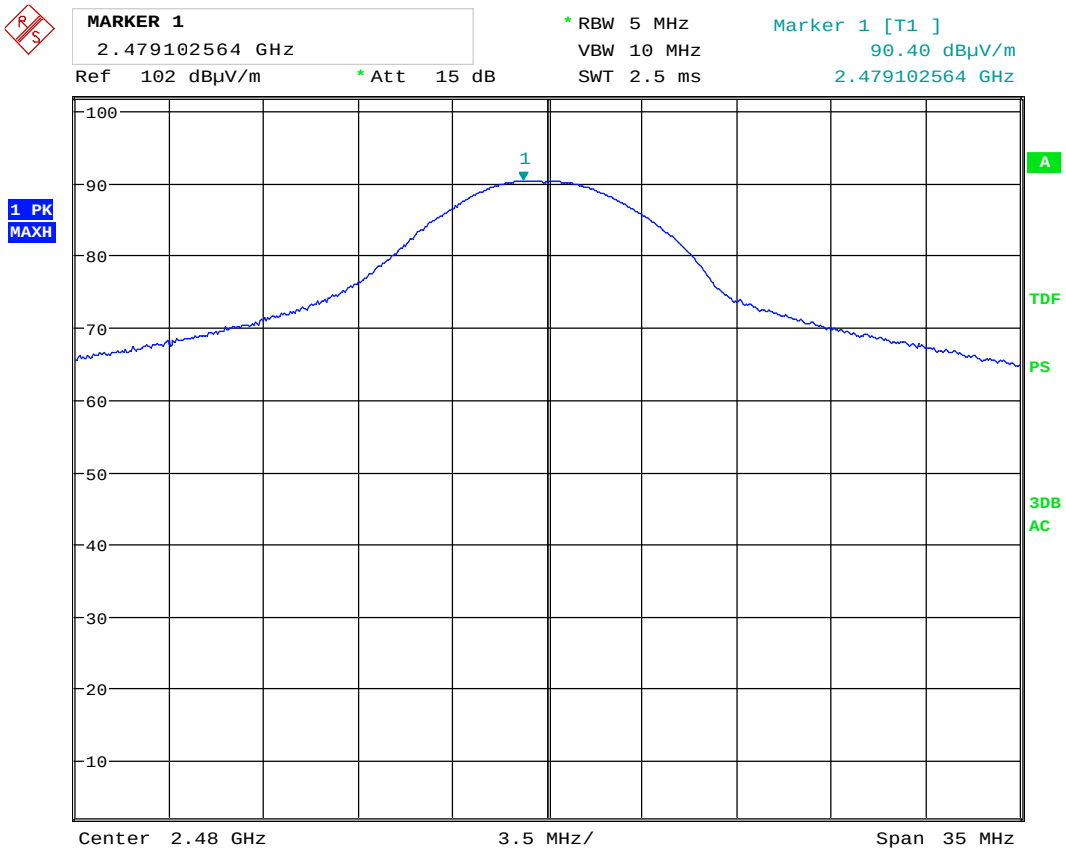
Radiated field strength, VP, 2480 MHz



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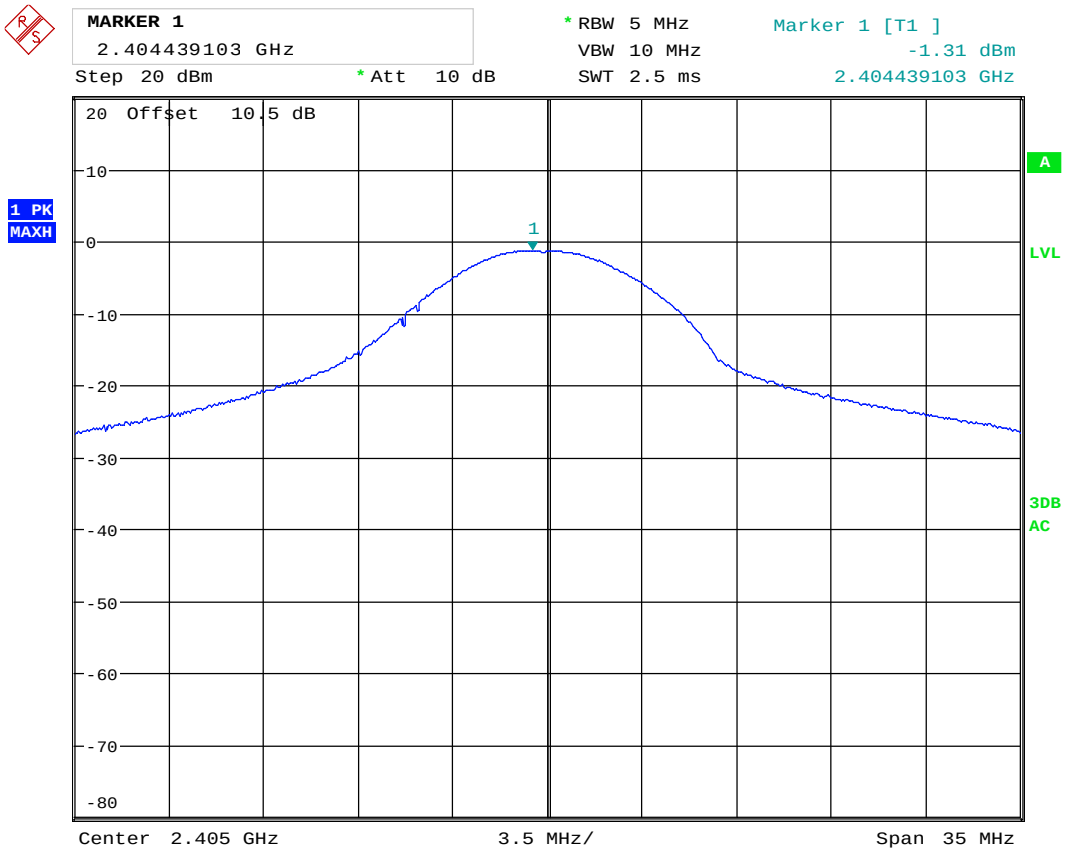
Radiated field strength, HP, 2480 MHz



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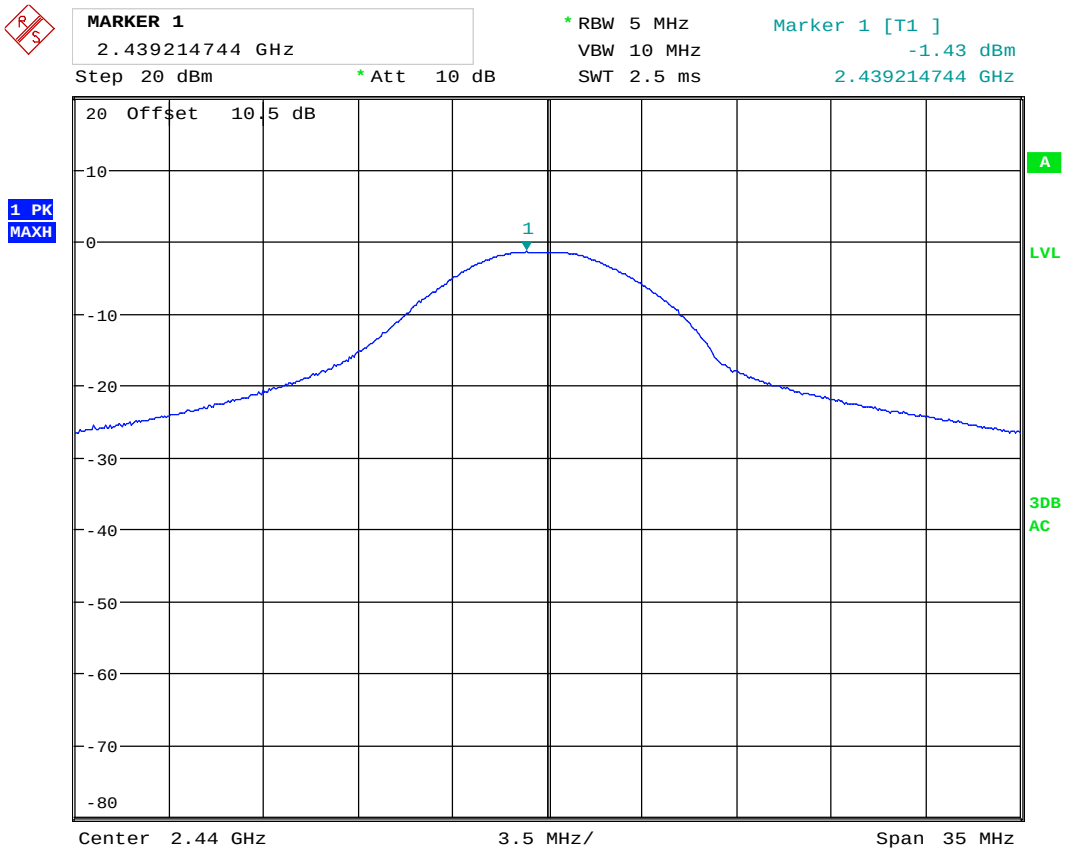
Conducted power – 2405MHz



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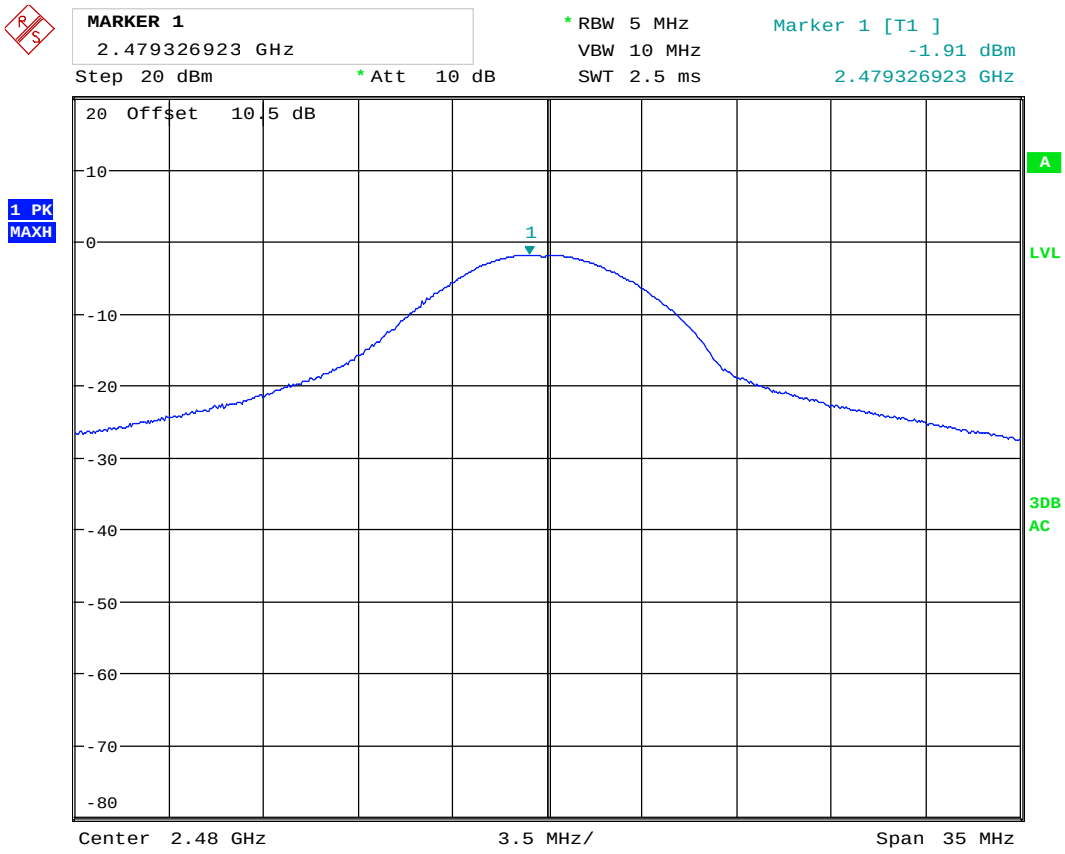
Conducted power – 2440MHz



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Conducted power – 2480MHz

3.5 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suhanthakumar	Date of Test: 2016.11.04

Test Results: Complies

Measurement Data:

Band-edge, @3m

Frequency	Measured Field Strength @3m, dBµV/m	Detector	Duty Cycle Correction (dB)	Limit dBµV/m	Margin dB
2.39 GHz	61.64	PK	-	74	12.36
	41.64	AV	20	54	12.36
2.4835 GHz	72.95	PK	-	74	1.05
	52.95	AV	20	54	1.05

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

See attached plots.

Duty Cycle Calculation:

Pollperiod: 20s

CSMA/CA frame transmission 2.368 ms (default random back-off exponent of 3)

Data Frame transmission 4.256 ms (full frame)

Maximum transmission is one CSMA/CA and one Data Frame per poll period.

Duty Cycle Calculation: (2.368ms+4.256ms)/100ms = 6.624%

Duty Cycle Correction Factor Calculation: -20x $\log_{10}$(0.06624) dB = 23.6 dB

Duty Cycle Correction Factor is 20 dB

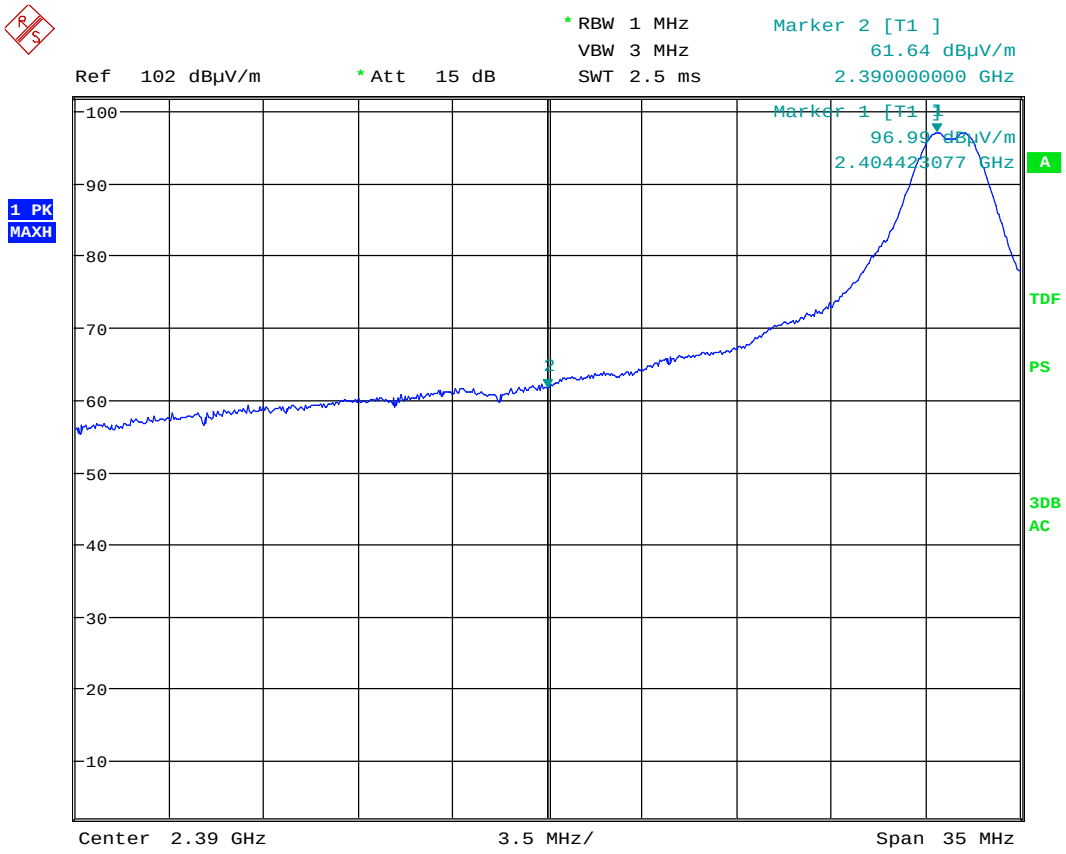
RF conducted power to 25 GHz see attached graph.

Maximum RF level outside operating band:

RF ch 1: 41.9 dB/C, margin >30 dB

RF ch 8: 46.2 dB/C, margin >30 dB

RF ch 16: 49.0 dB/C, margin >30 dB



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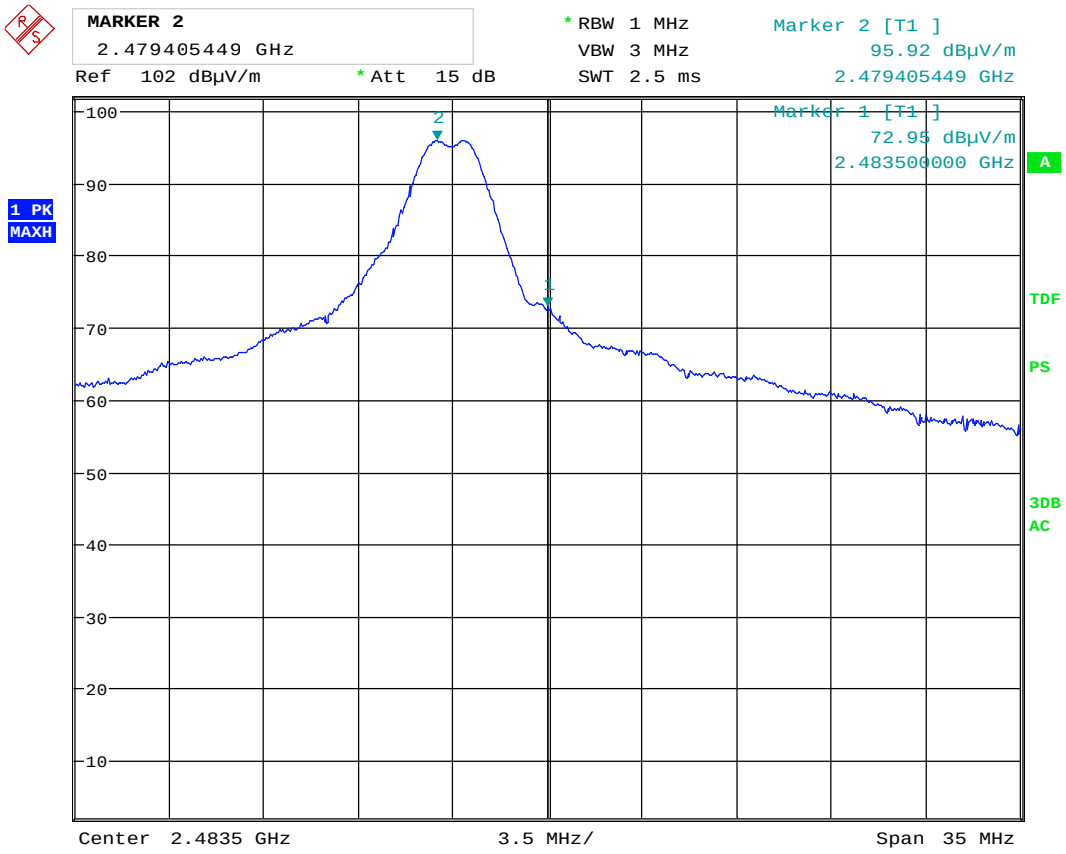
Band Edge, 2390 MHz, Peak Detector



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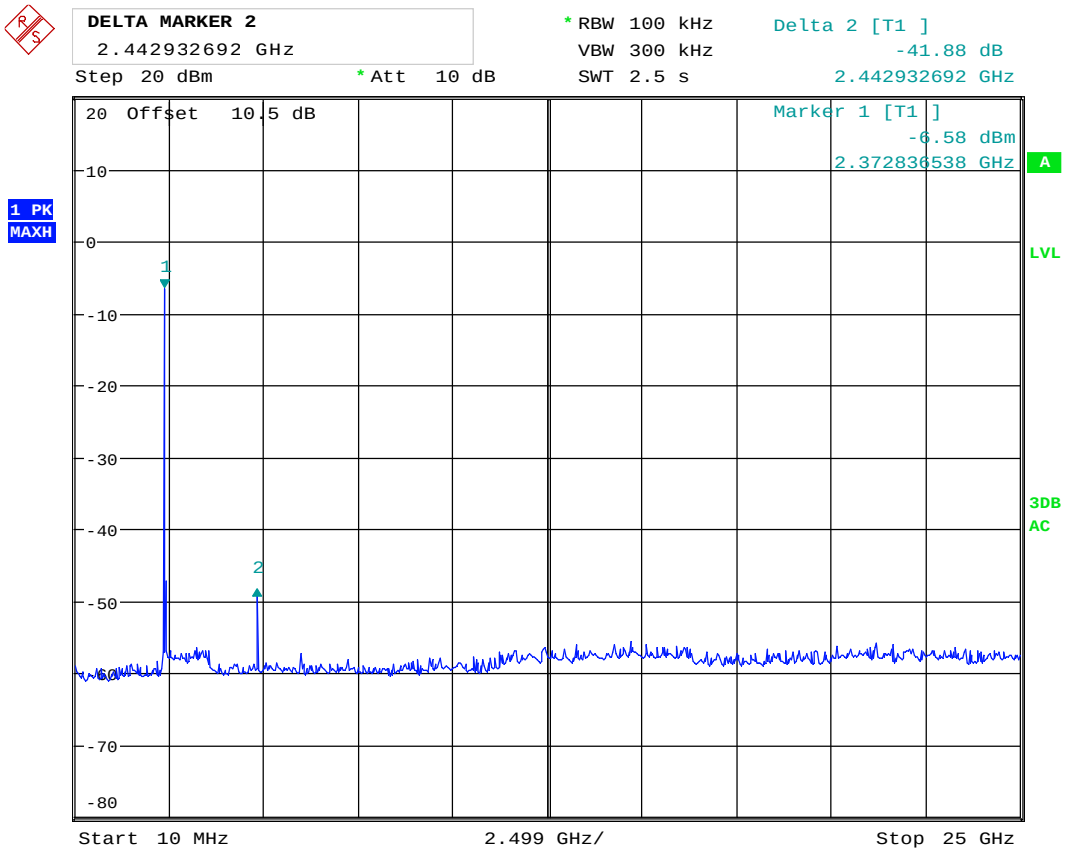
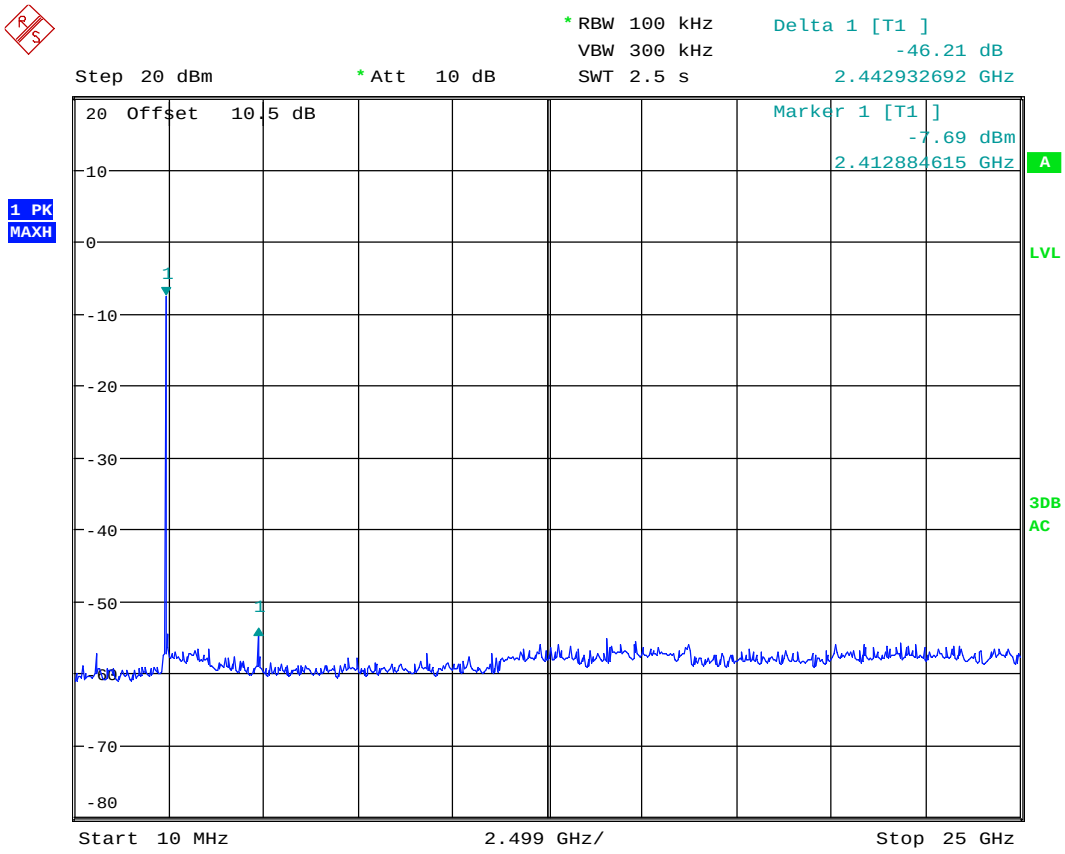
Band Edge, 2483.5 MHz, Peak Detector



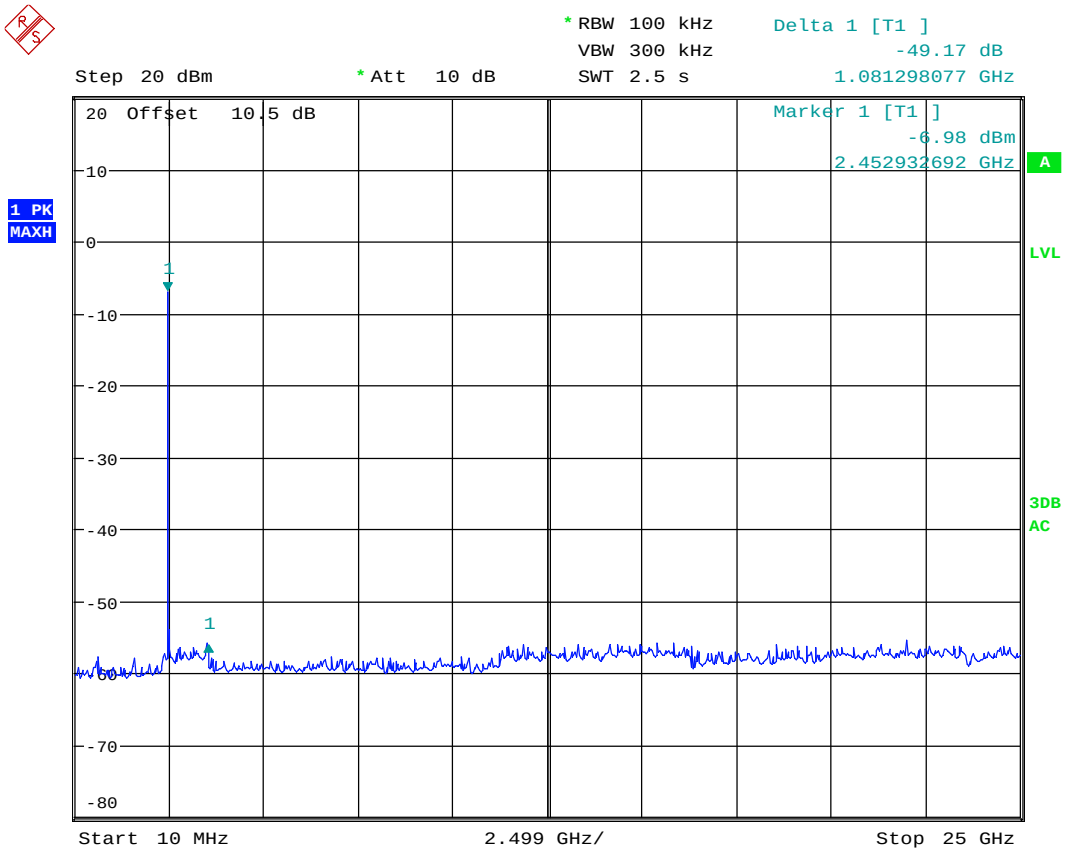
Date: 4.NOV.2016 14:46:02

Conducted spurious emissions, 10MHz – 25GHz - ch2405MHz



Date: 4.NOV.2016 14:46:53

Conducted spurious emissions, 10MHz – 25GHz - ch2440MHz



Date: 4.NOV.2016 14:54:44

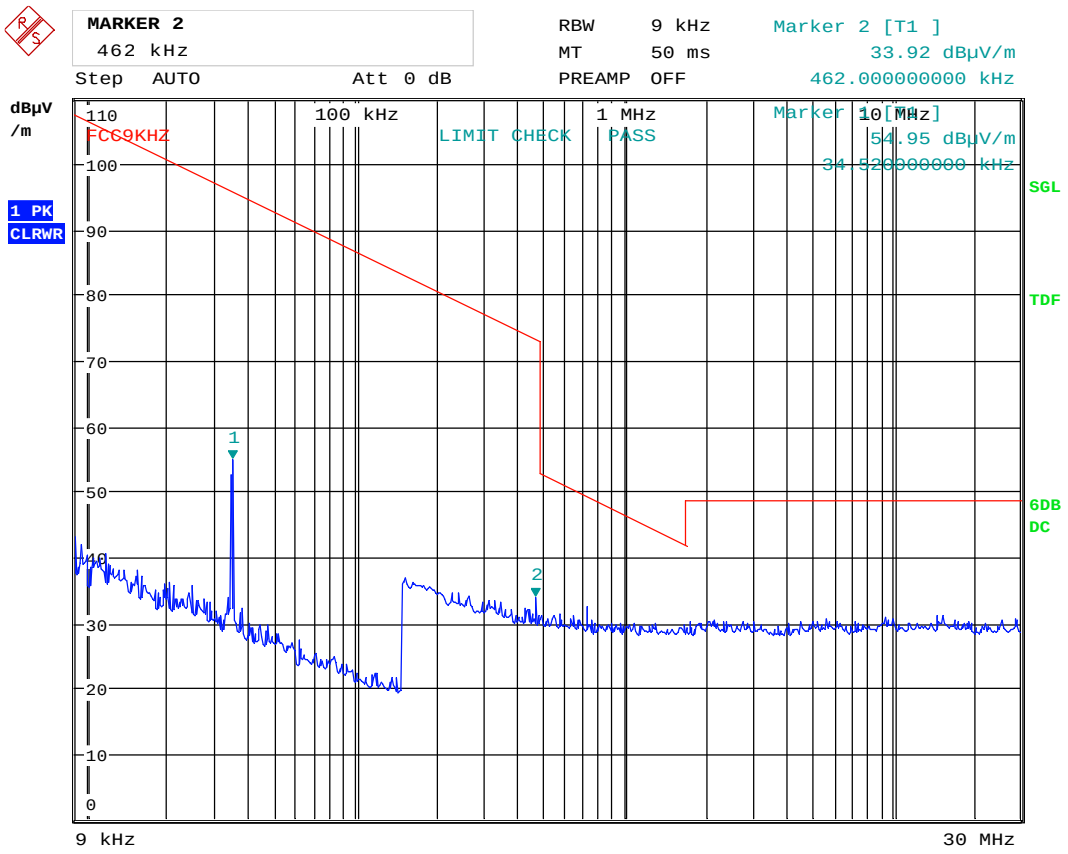
Conducted spurious emissions, 10MHz – 25GHz - ch2480MHz

Radiated emissions 10 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).



Date: 4.NOV.2016 14:20:27

Radiated Emissions, 9 kHz – 30 MHz @10m

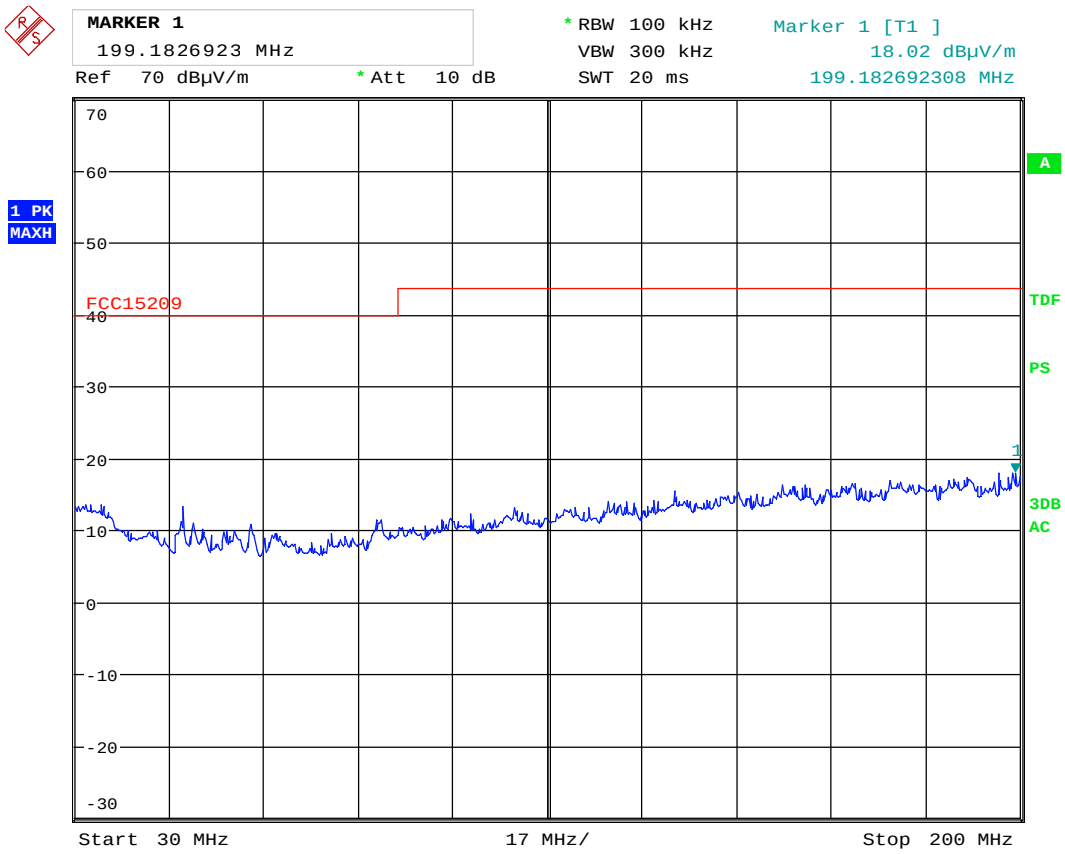
Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 3 m.

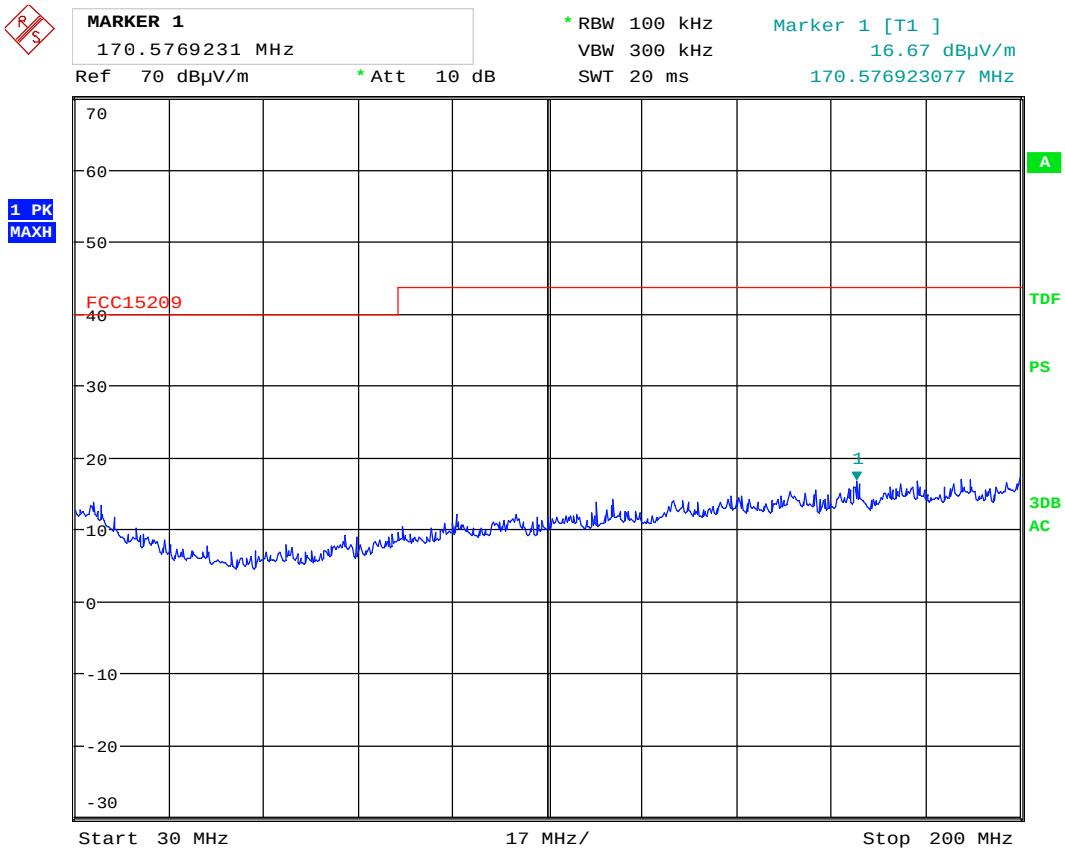
Frequency	Operational condition	Detector	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz			dBµV/m	metres	dBµV/m	dB
/	TX on	PK	/	3	40.0	/

See attached graphs.



Date: 4.NOV.2016 13:26:43

Radiated Emissions, 30 – 200 MHz, VP, @3m, PK scan



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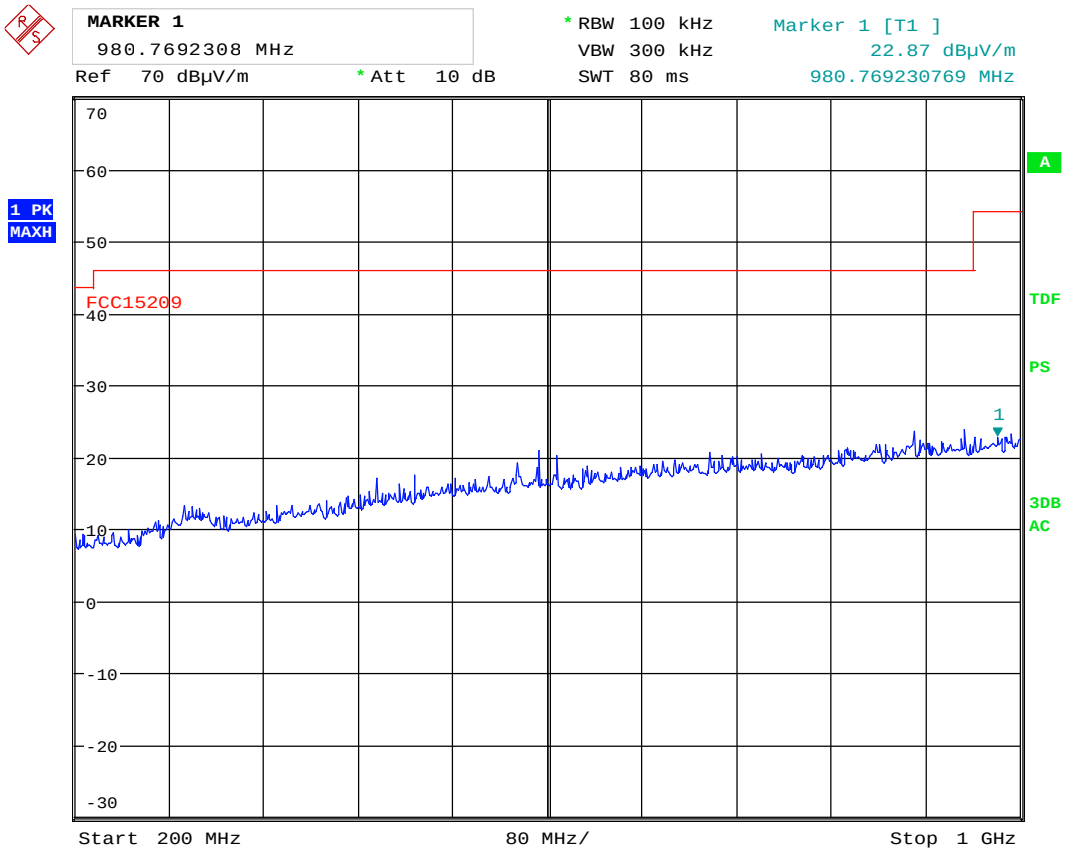
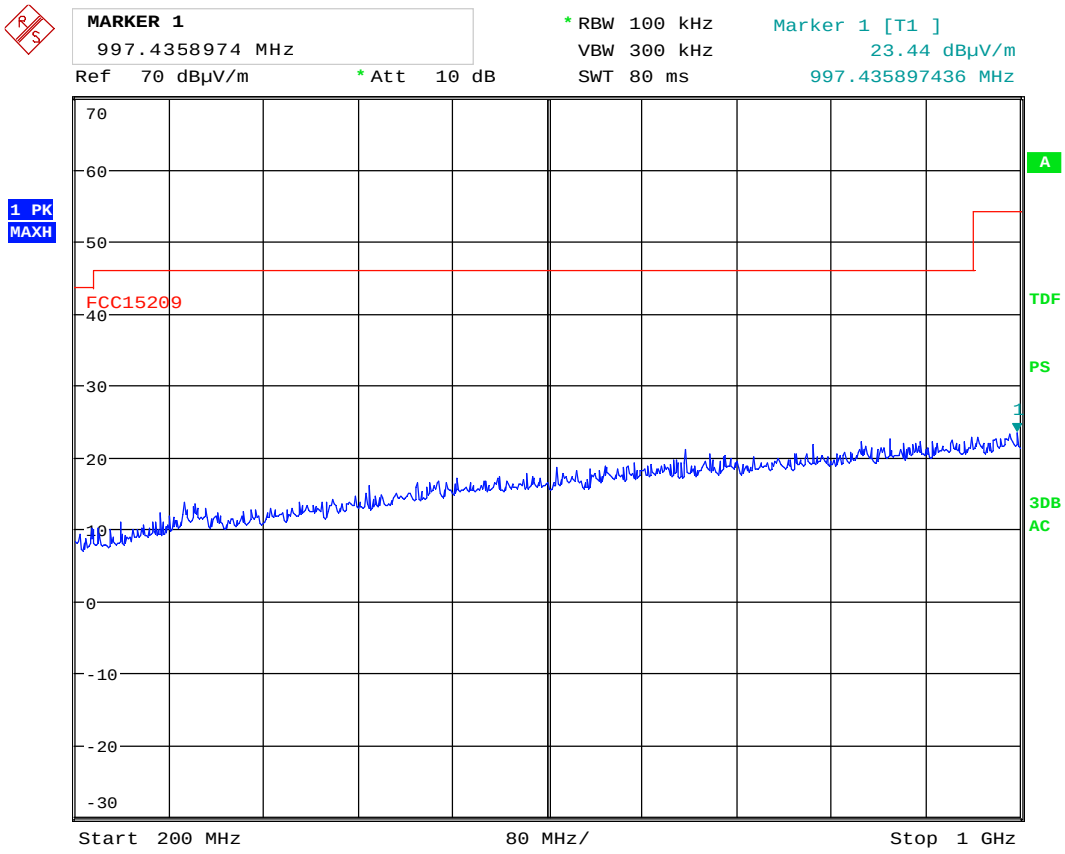
Radiated Emissions, 30 – 200 MHz, HP, @3m, PK scan



Date: 4.NOV.2016 13:54:56

Radiated Emissions, 200 - 1000 MHz, VP , @3m, PK scan



Date: 4.NOV.2016 13:56:06

Radiated Emissions, 200 - 1000MHz, HP , @3m, PK scan

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 8 GHz)
1m (8 – 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	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dBµV/m	dB	dBµV/m	dB
4.81	L	0	47.38	0	74	>20
4.88	M	0	47.69	0	74	>20
4.96	H	0	49.25	0	74	>20
7.380	L	0	51.59	0	74	>20
7.320	M	0	51.35	0	74	>20
7.440	H	0	52.75	0	74	>20
Other freqs	L,M,H	0	< 54	0	74	>20

Average Calculation:

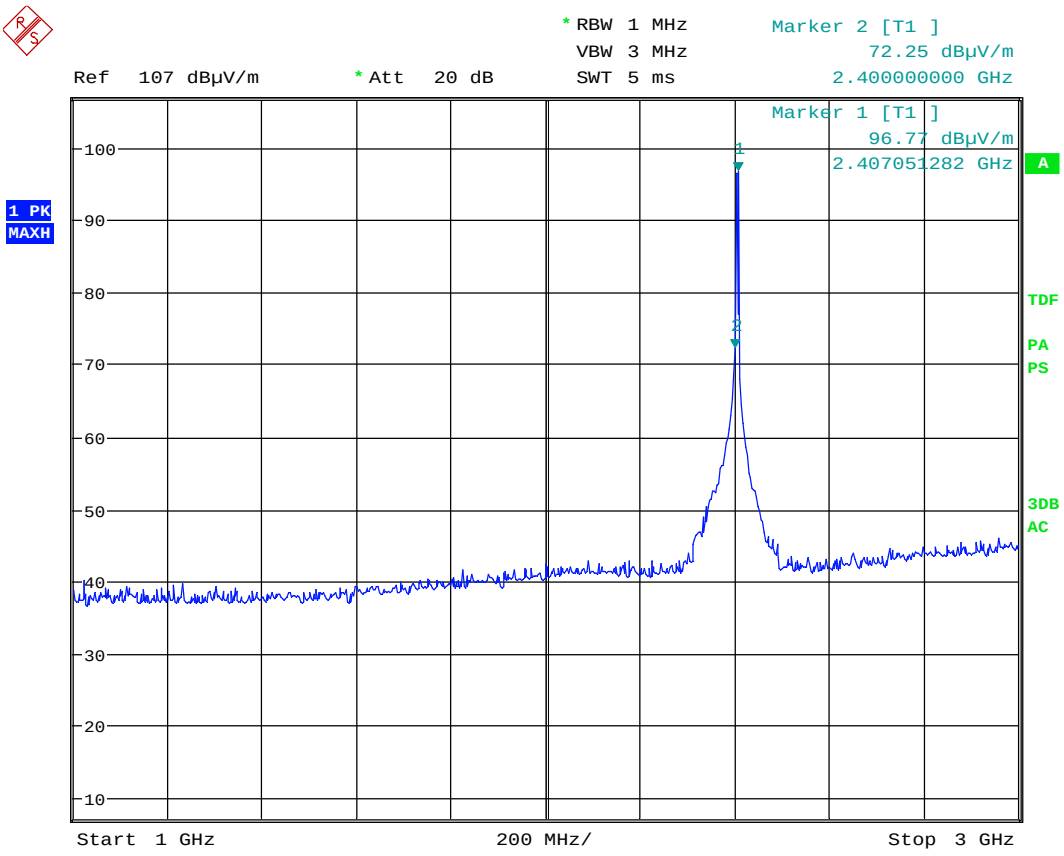
Frequency	RF channel	Dist. corr. factor	Field strength, Average Detector	Duty cycle corr. factor	Limit	Margin
GHz	L,M,H	dB	dBµV/m	dB	dBµV/m	dB
4.81	L	0	-	20	54	>20
4.88	M	0	-	20	54	>20
4.96	H	0	-	20	54	>20
7.215	L	0	-	20	54	>20
7.320	M	0	-	20	54	>20
7.440	H	0	-	20	54	>20
Other freqs	L,M,H	/	< 54	0	54	>20

Maximum obtained in vertical polarization.

Tested according to KDB 558074 D01 DTS Meas Guidance v03r05, Section 12.2.4

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

See plots.



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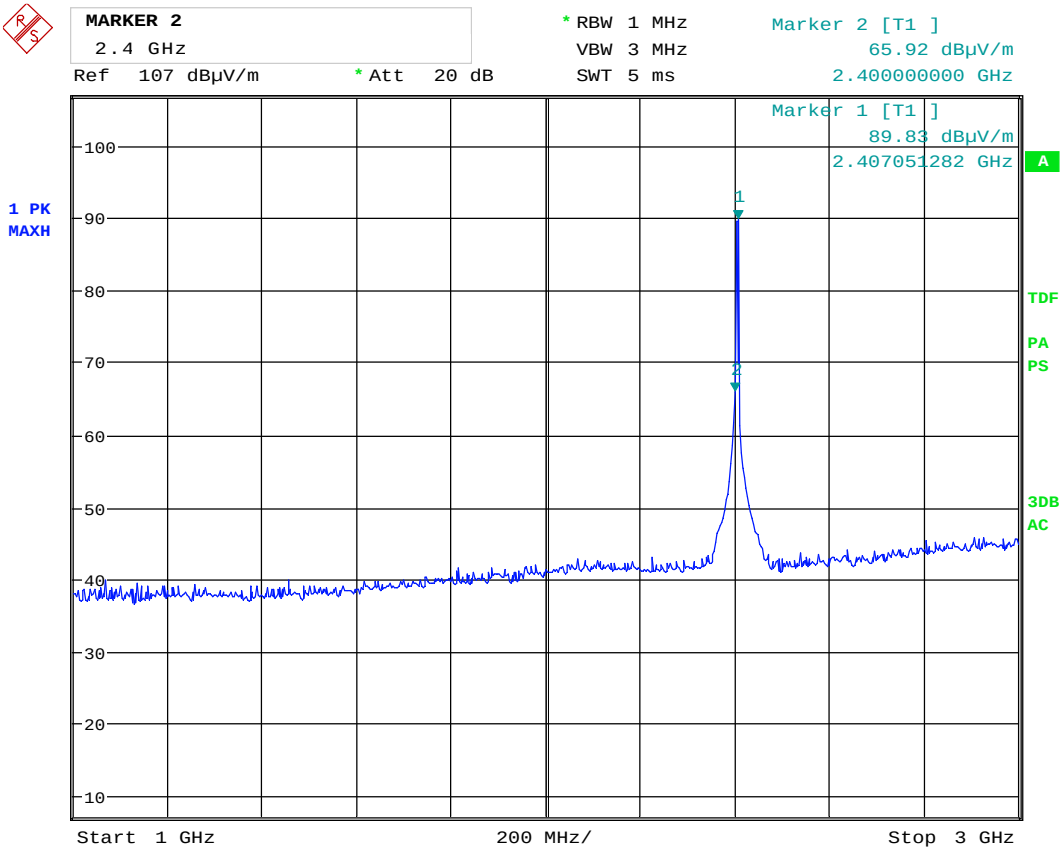
Radiated Emissions, 2405MHz, 1 – 3 GHz, VP, @3m – Pre-scan with Peak detector



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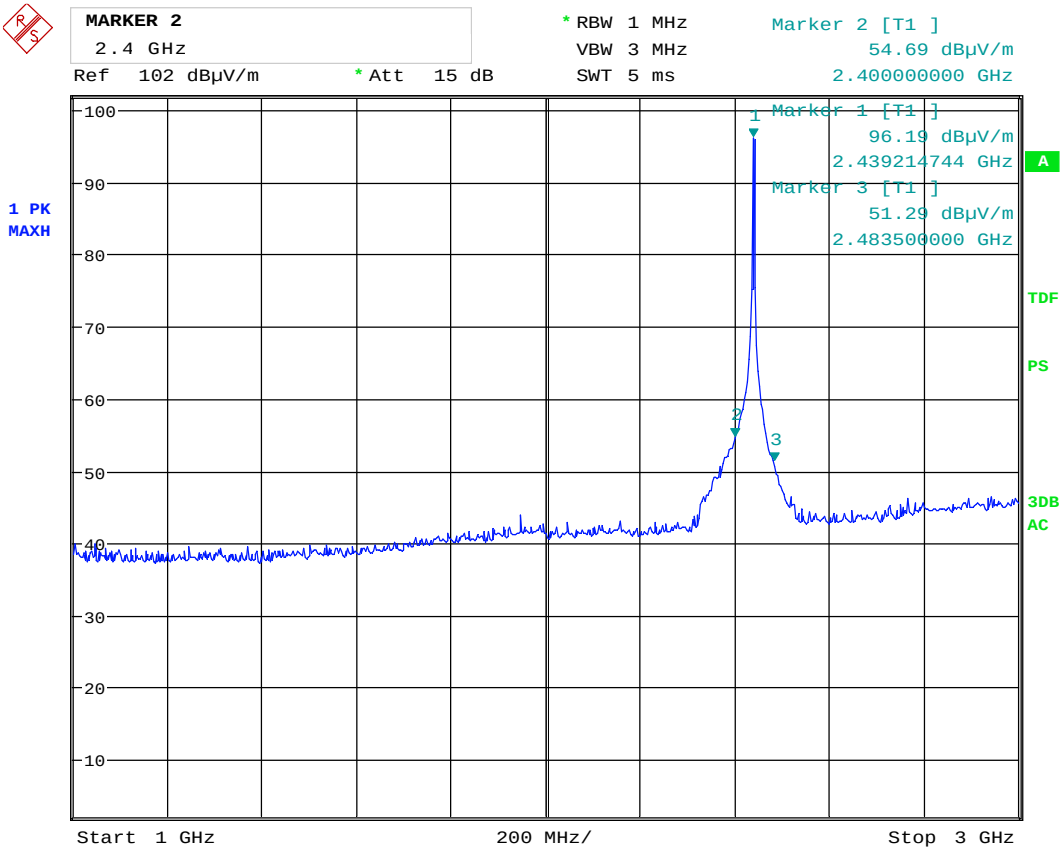
Radiated Emissions, 2405 MHz, 1 – 3 GHz, HP, @3m – Pre-scan with Peak detector



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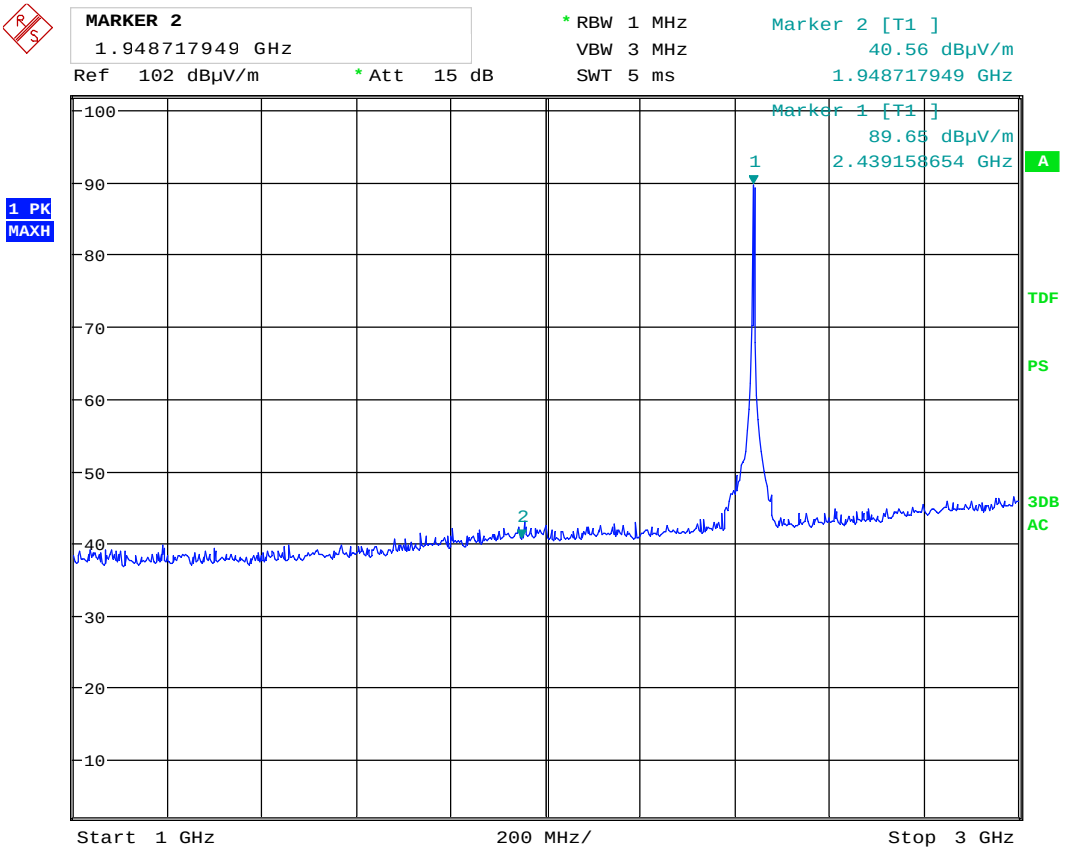
Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, VP, @3m – Pre-scan with Peak detector



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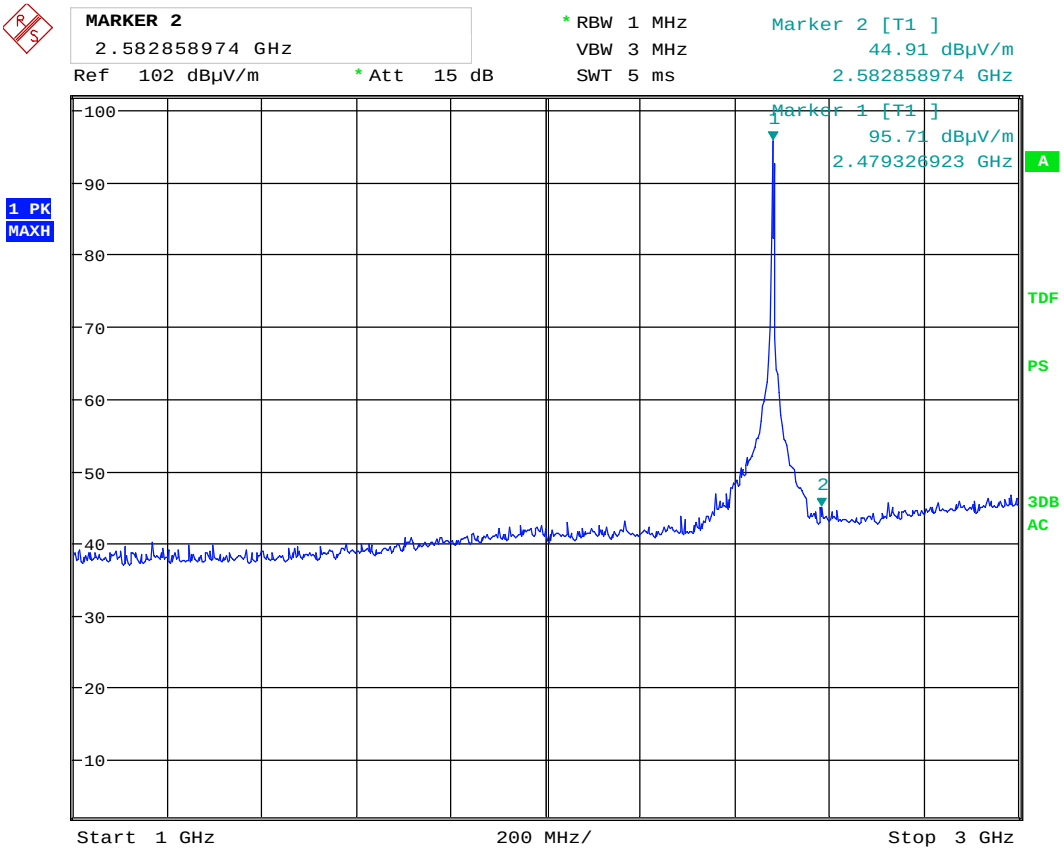
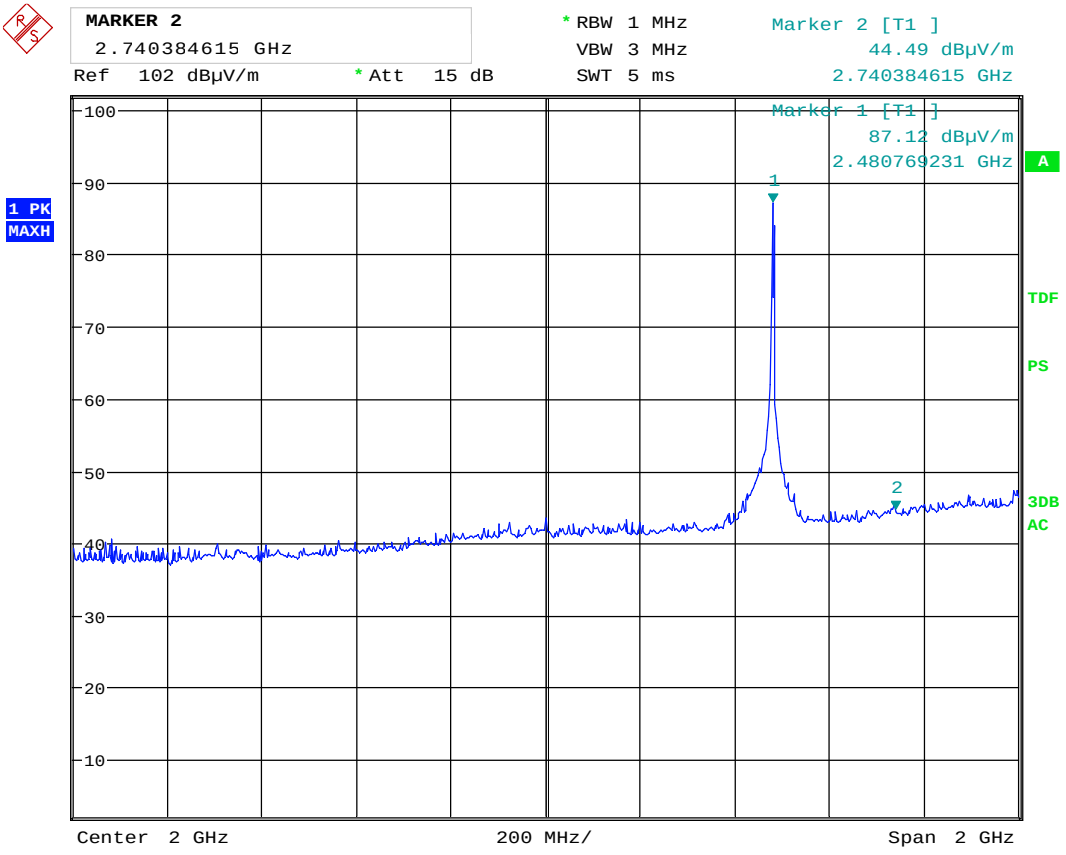
Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, HP, @3m – Pre-scan with Peak detector



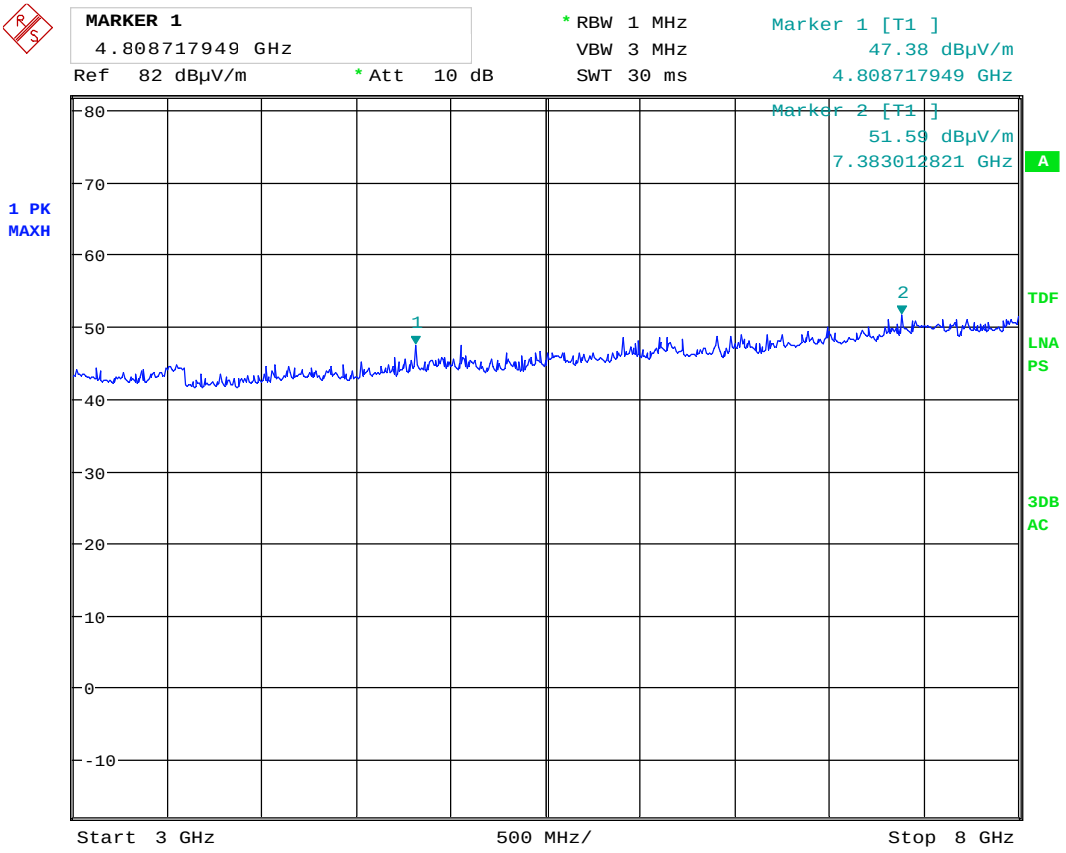
Date: 4.NOV.2016 11:29:38

Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, VP, @3m – Pre-scan with Peak detector



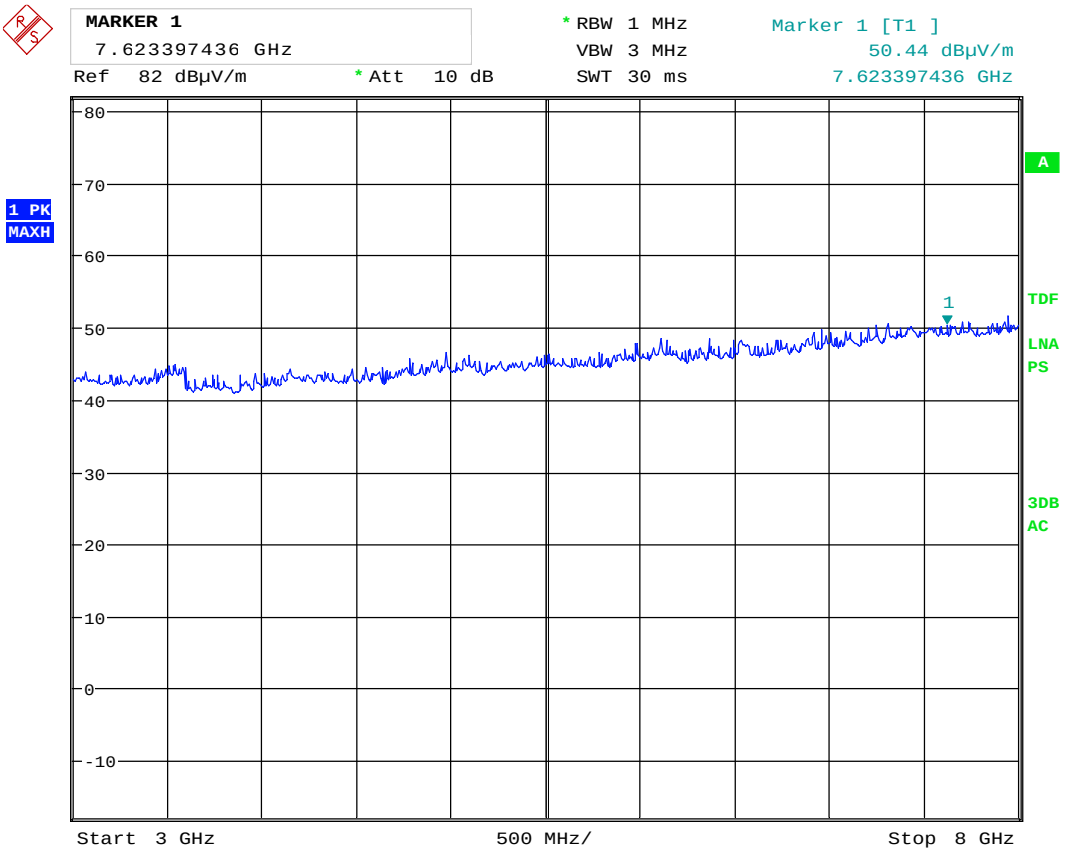
Date: 4.NOV.2016 11:22:59

Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, HP, @3m – Pre-scan with Peak detector



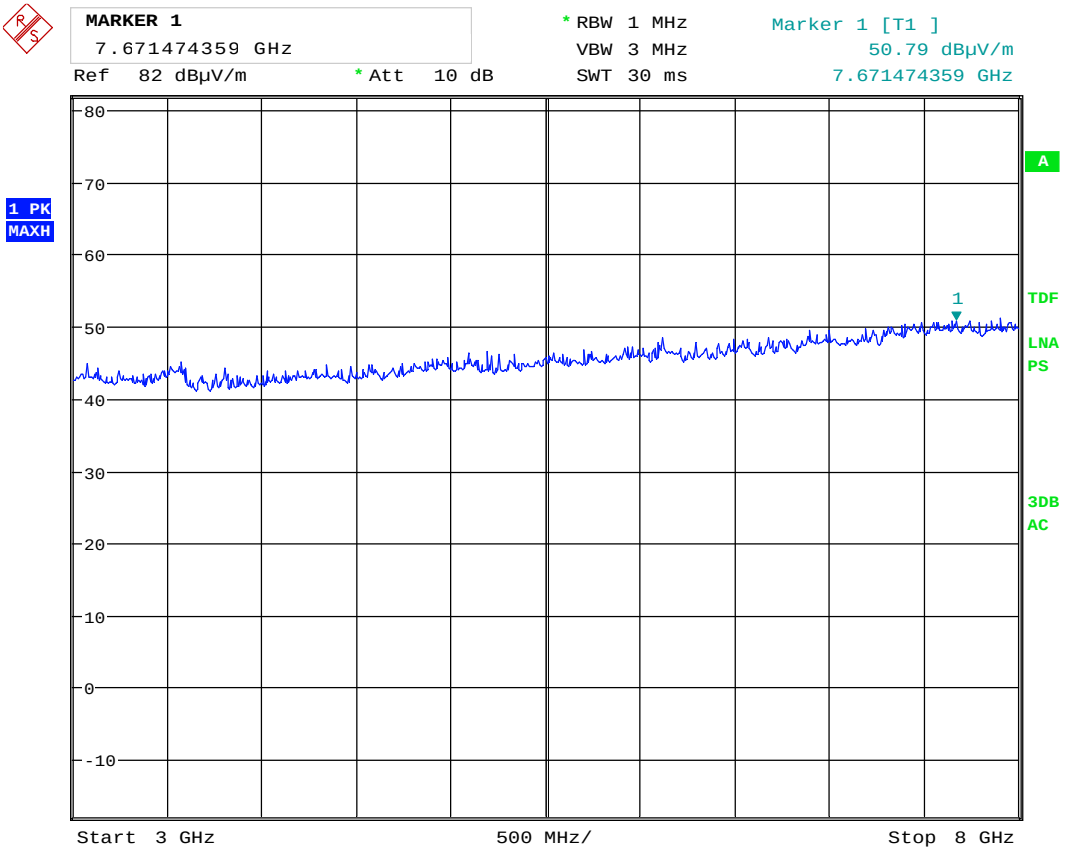
Date: 4.NOV.2016 12:33:56

Radiated Emissions ch. 2405 MHz, 3 – 8 GHz, VP, @3m – Pre-scan with Peak detector



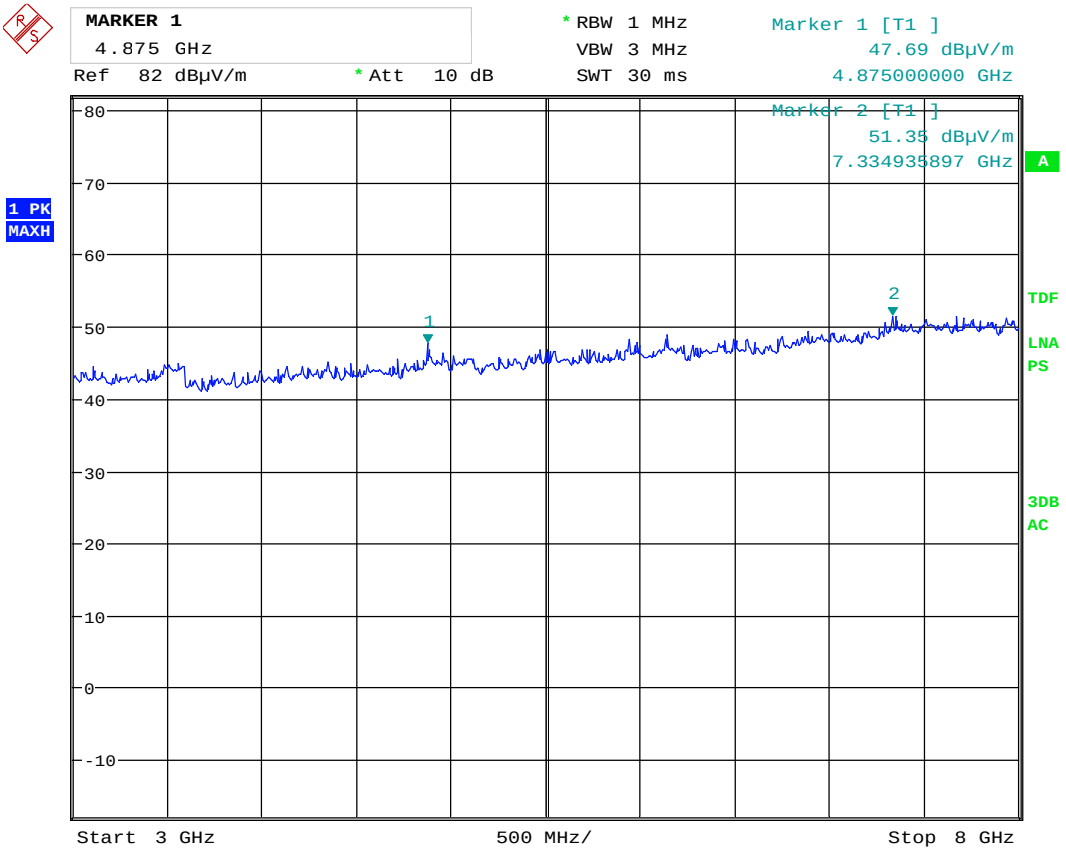
Date: 4.NOV.2016 12:37:59

Radiated Emissions ch. 2405 MHz, 3 – 8 GHz, HP, @3m – Pre-scan with Peak detector



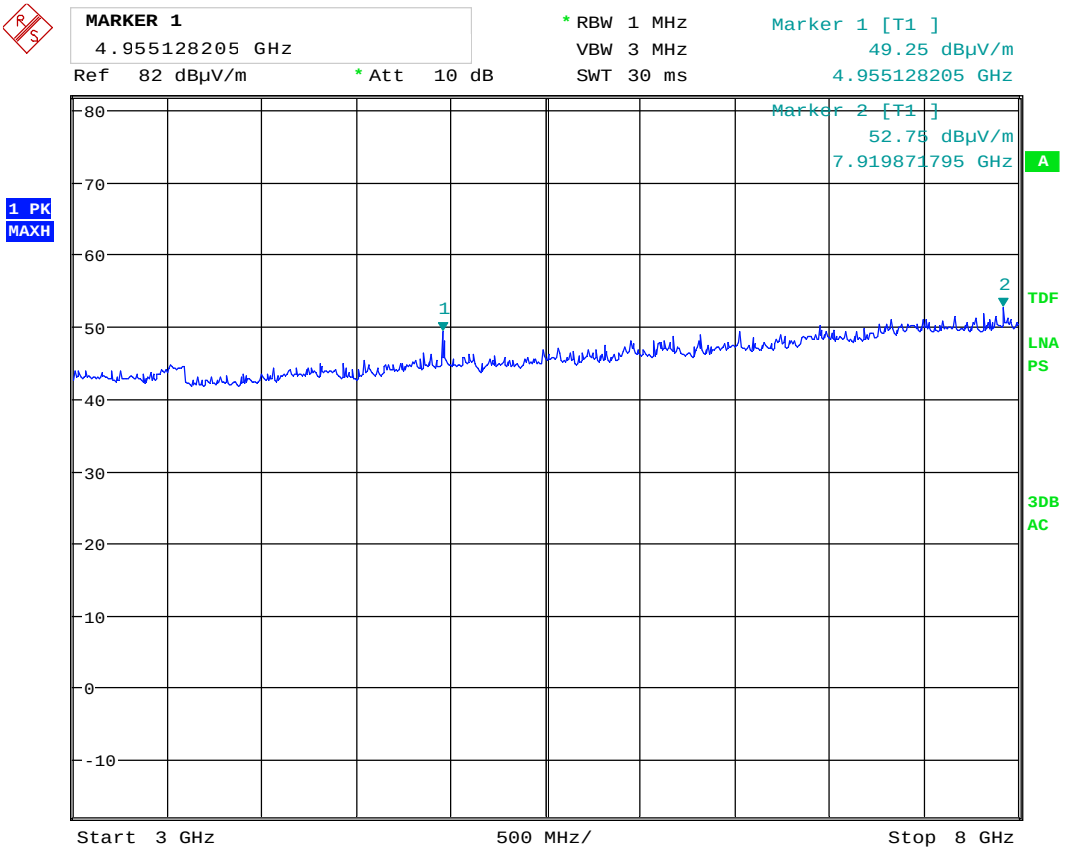
Date: 4.NOV.2016 12:38:44

Radiated Emissions ch. 2440 MHz, 3 – 8 GHz, HP, @3m – Pre-scan with Peak detector



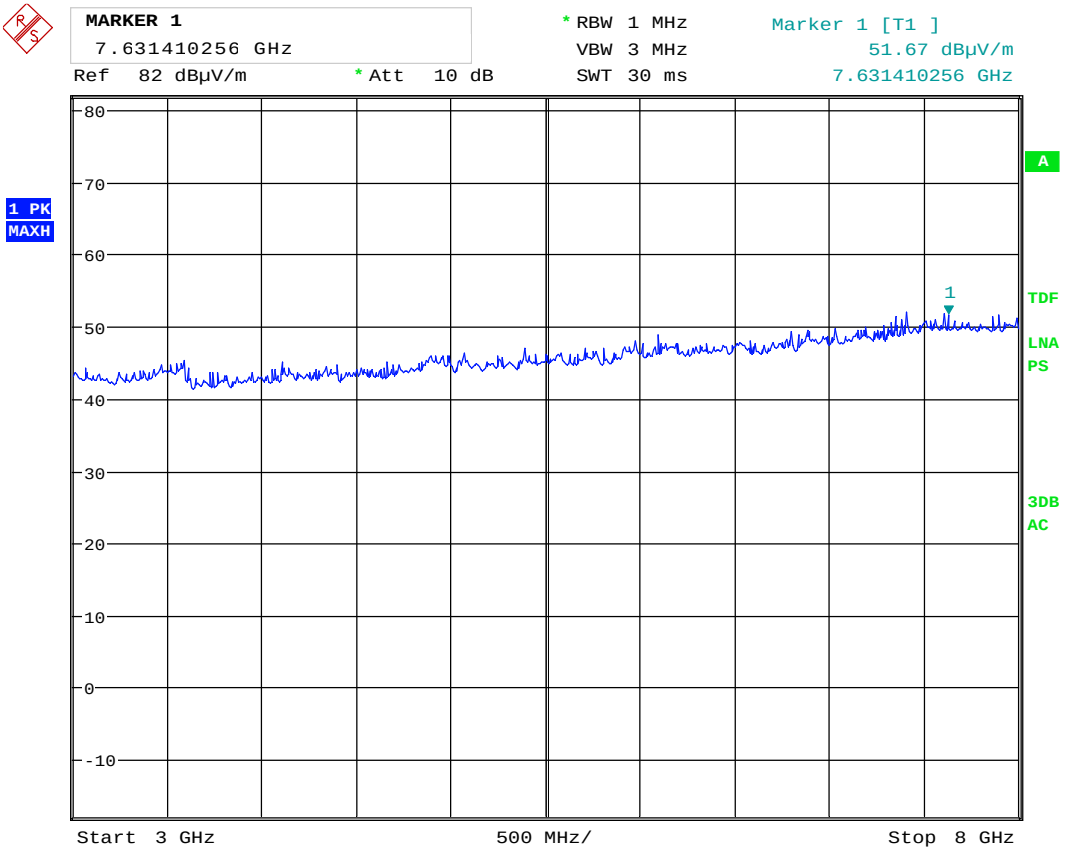
Date: 4.NOV.2016 12:39:39

Radiated Emissions ch. 2440 MHz, 3 – 8 GHz, VP, @3m – Pre-scan with Peak detector



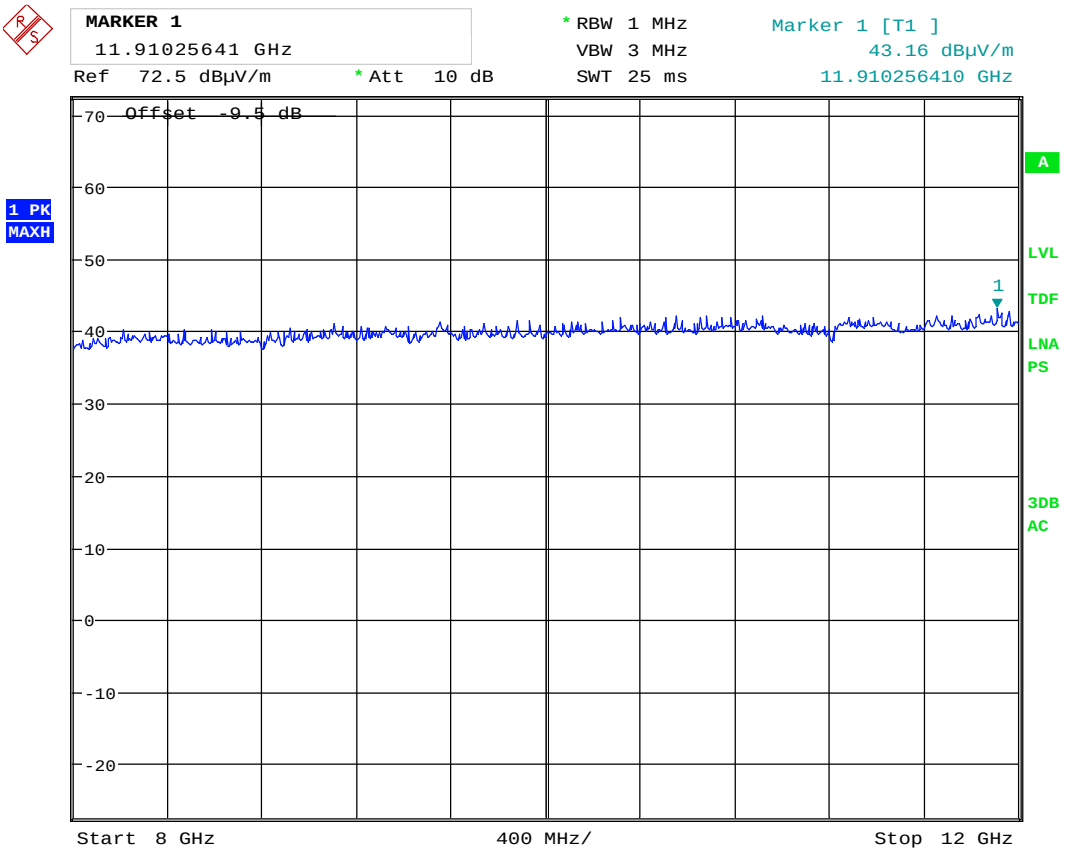
Date: 4.NOV.2016 12:40:38

Radiated Emissions ch. 2480 MHz, 3 – 8 GHz, VP, @3m – Pre-scan with Peak detector



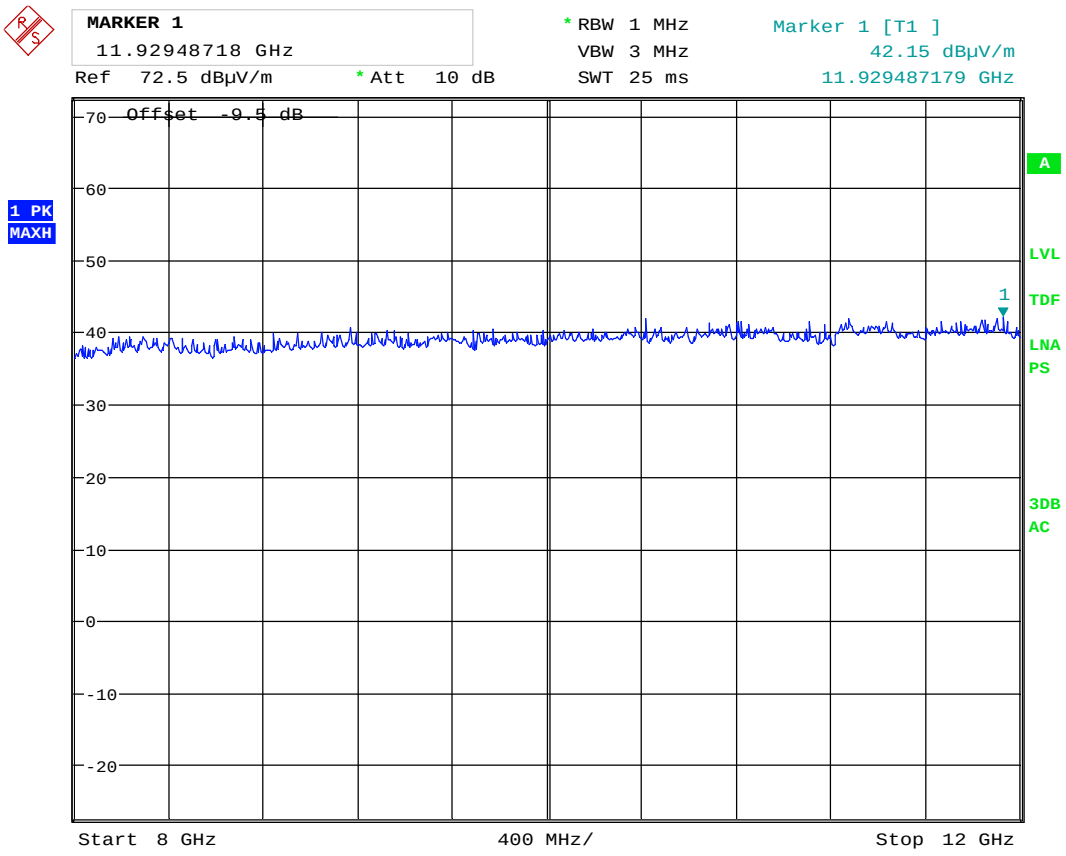
Date: 4.NOV.2016 12:43:38

Radiated Emissions ch. 2480 MHz, 3 – 8 GHz, HP, @3m – Pre-scan with Peak detector



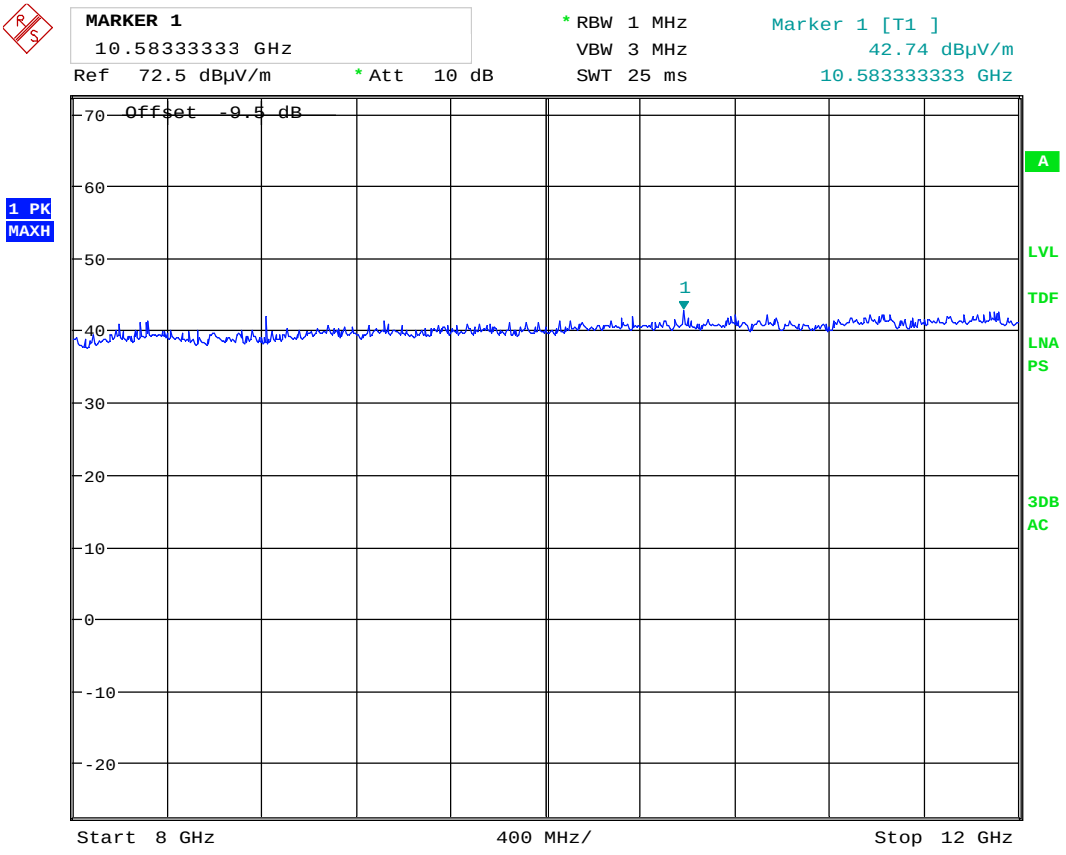
Date: 4.NOV.2016 13:00:21

Radiated Emissions ch. 2405 MHz, 8 – 12 GHz, VP, @1m – Pre-scan with Peak detector , Distance Correction factor of -9.5 dB is included in the plot



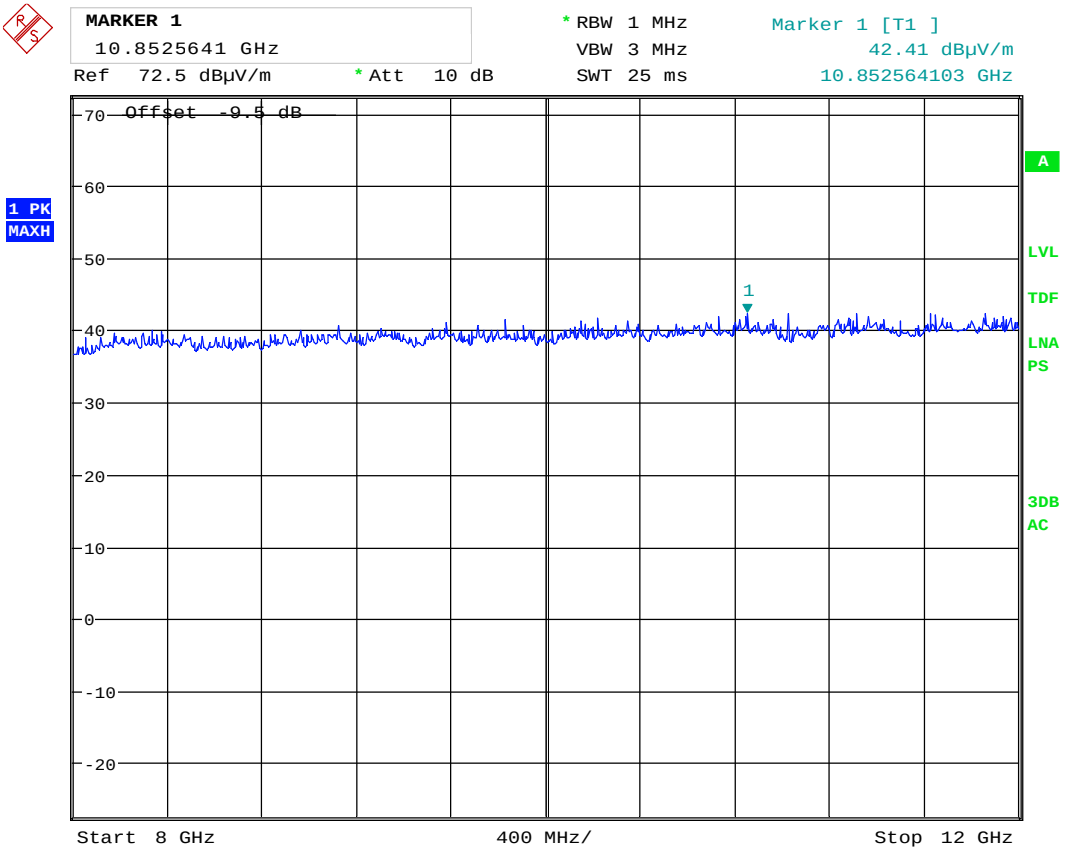
Date: 4.NOV.2016 13:00:53

Radiated Emissions ch. 2405 MHz, 8 – 12 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



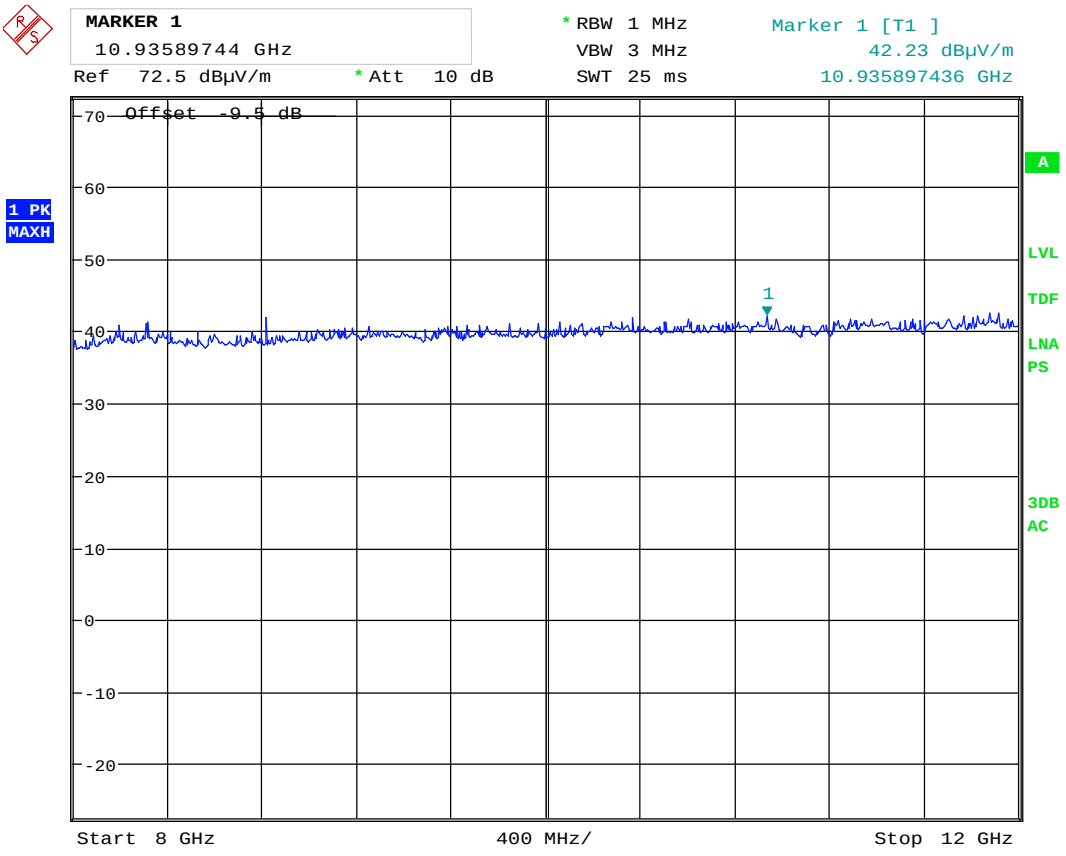
Date: 4.NOV.2016 12:58:49

Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, VP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



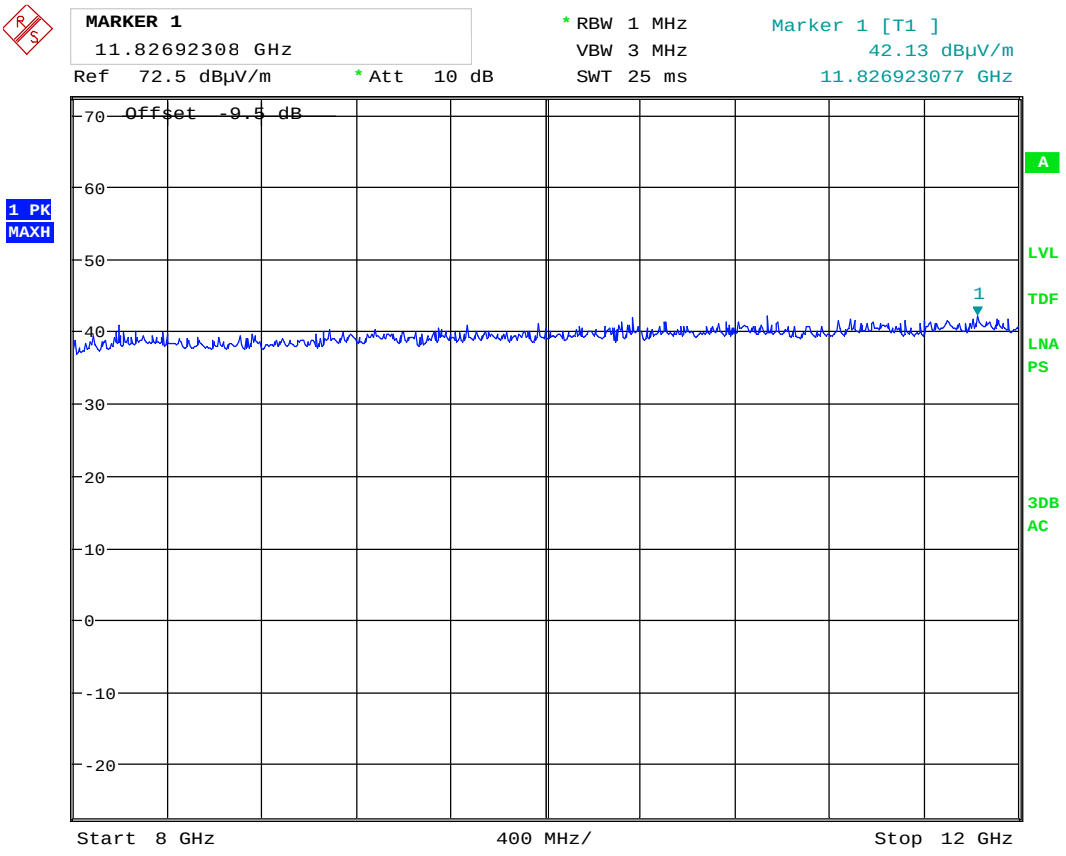
Date: 4.NOV.2016 12:59:16

Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



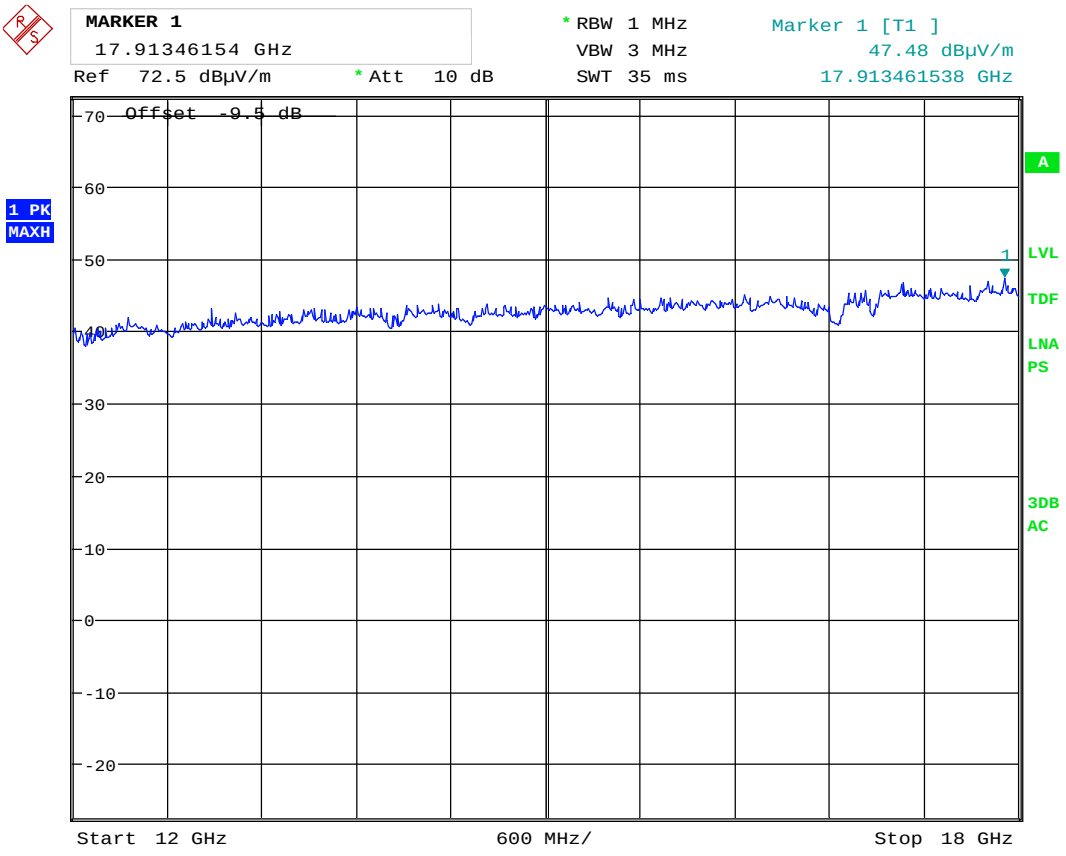
Date: 4.NOV.2016 12:58:19

Radiated Emissions ch. 2480 MHz, 8 – 12 GHz, VP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



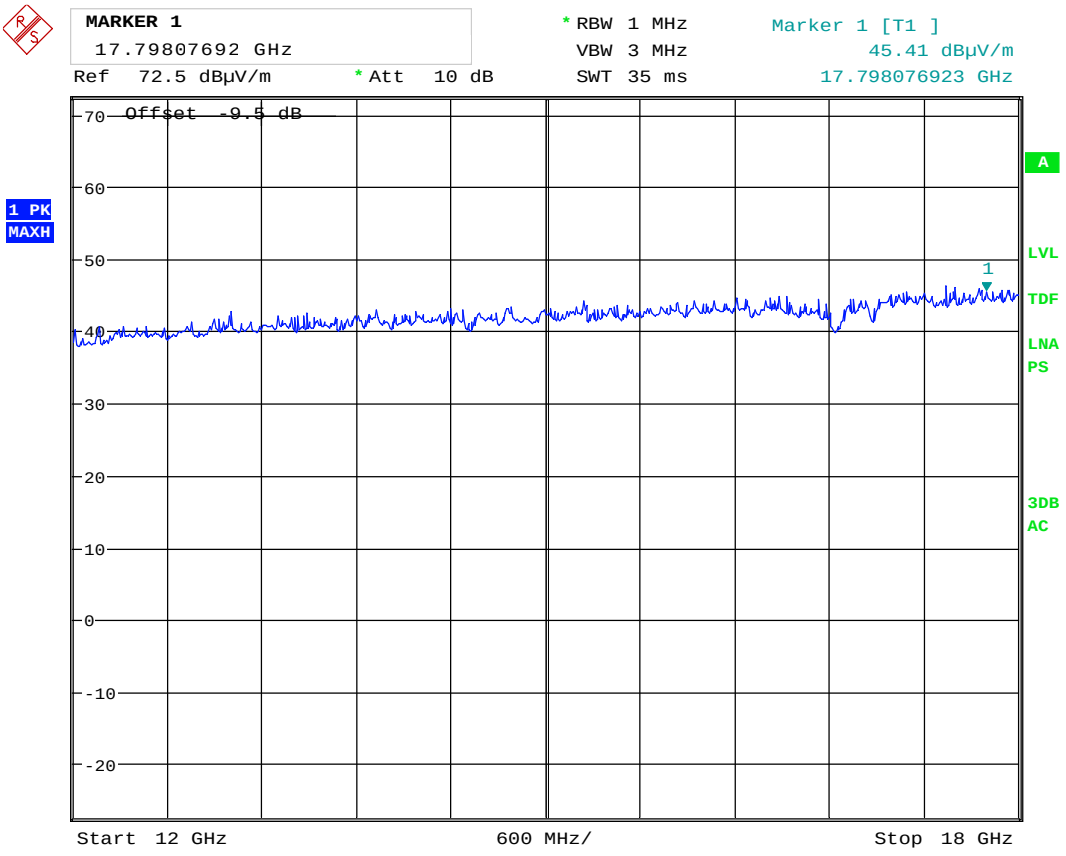
Date: 4.NOV.2016 12:58:01

Radiated Emissions ch. 2480 MHz, 8 – 12 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



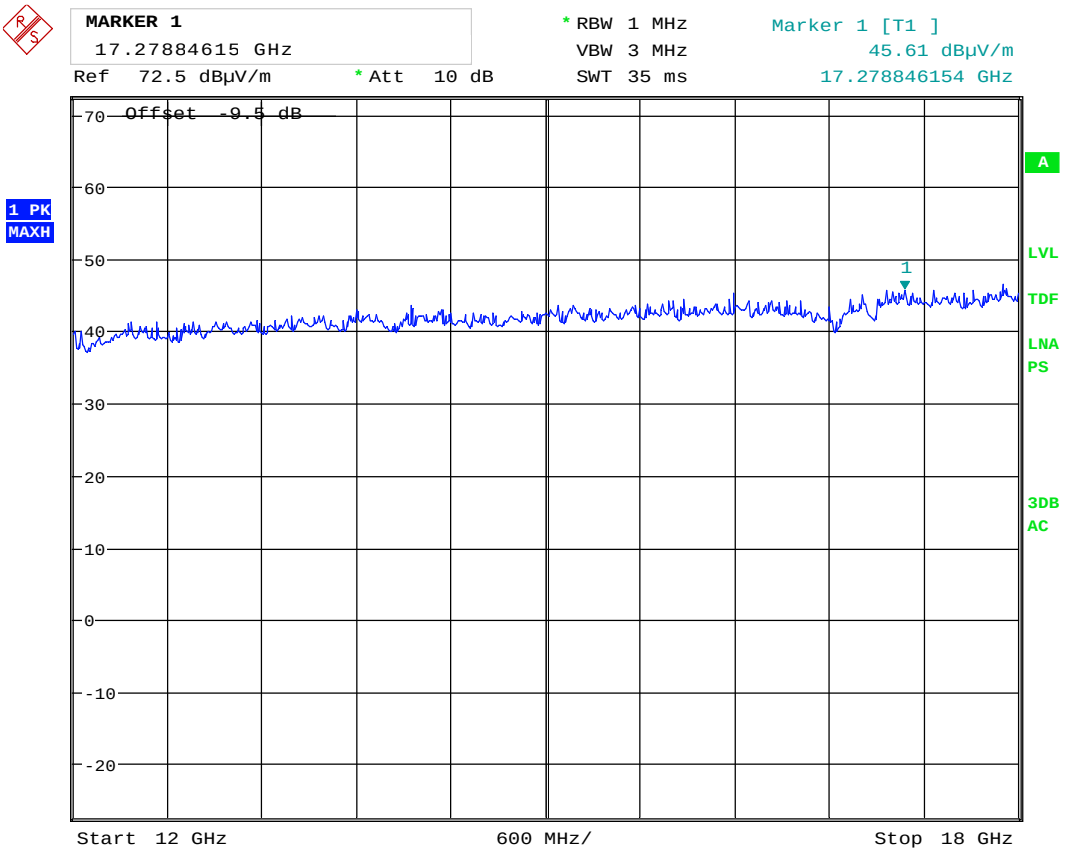
Date: 4.NOV.2016 13:03:17

Radiated Emissions ch. 2405 MHz, 12 – 18 GHz, VP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



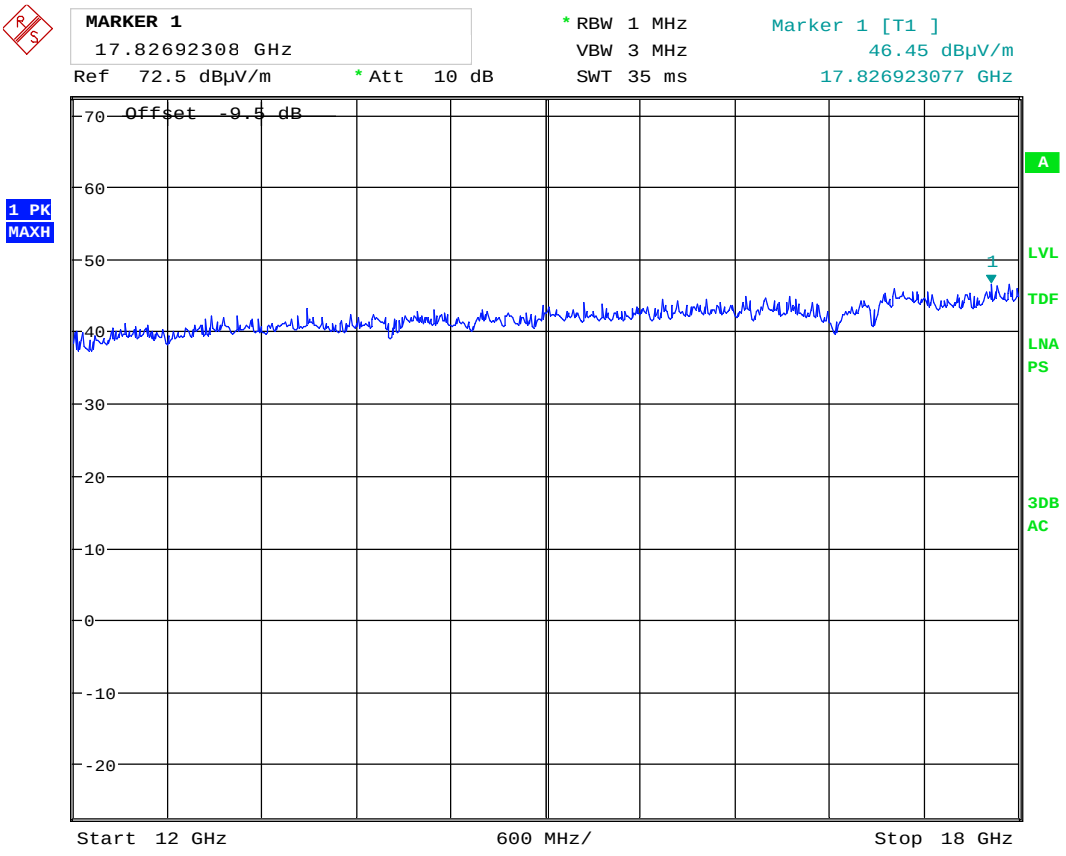
Date: 4.NOV.2016 13:03:57

Radiated Emissions ch. 2405 MHz, 12 – 18 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5dB is included in the plot



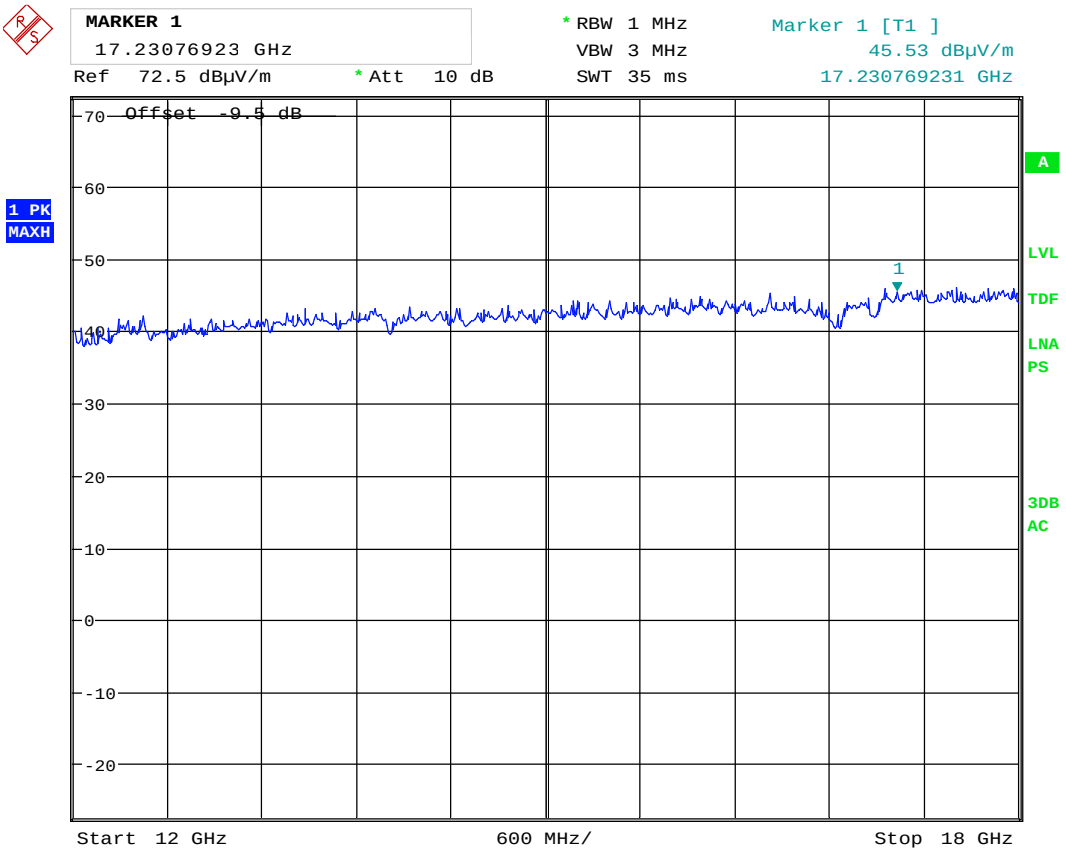
Date: 4.NOV.2016 13:05:01

Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, VP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is included in the plot



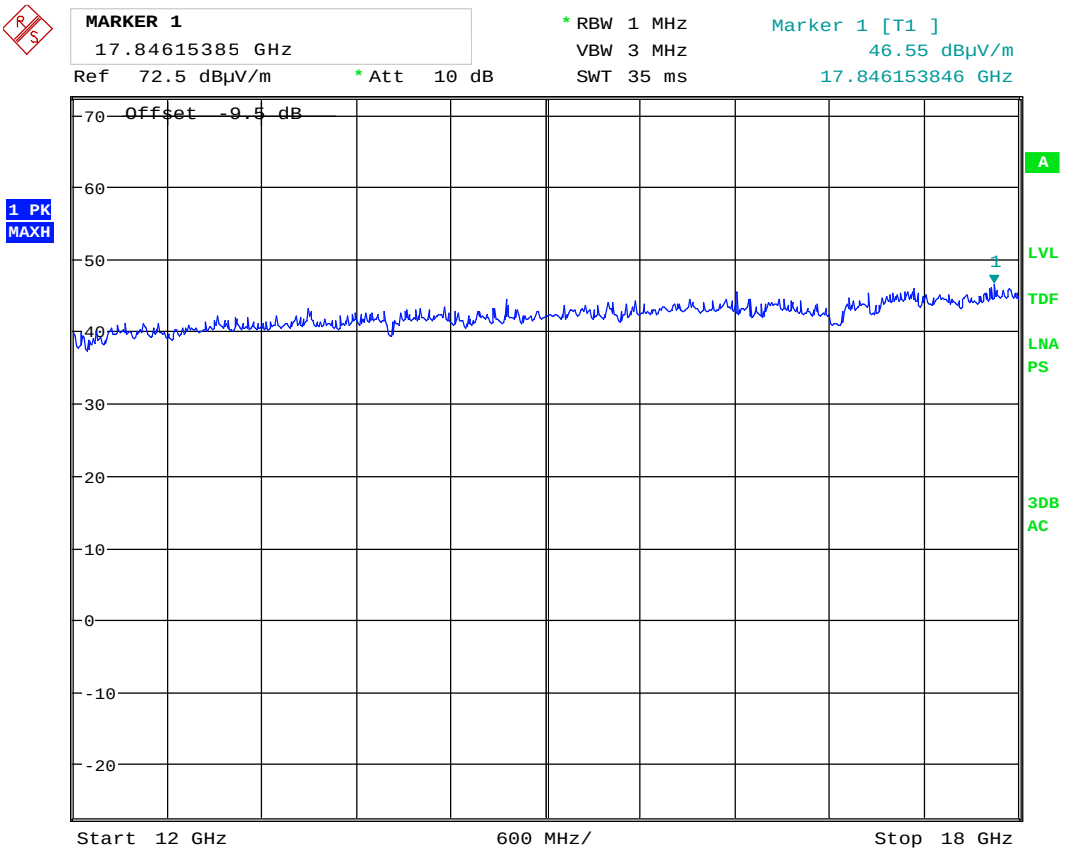
Date: 4.NOV.2016 13:04:39

Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5dB is not included in the plot



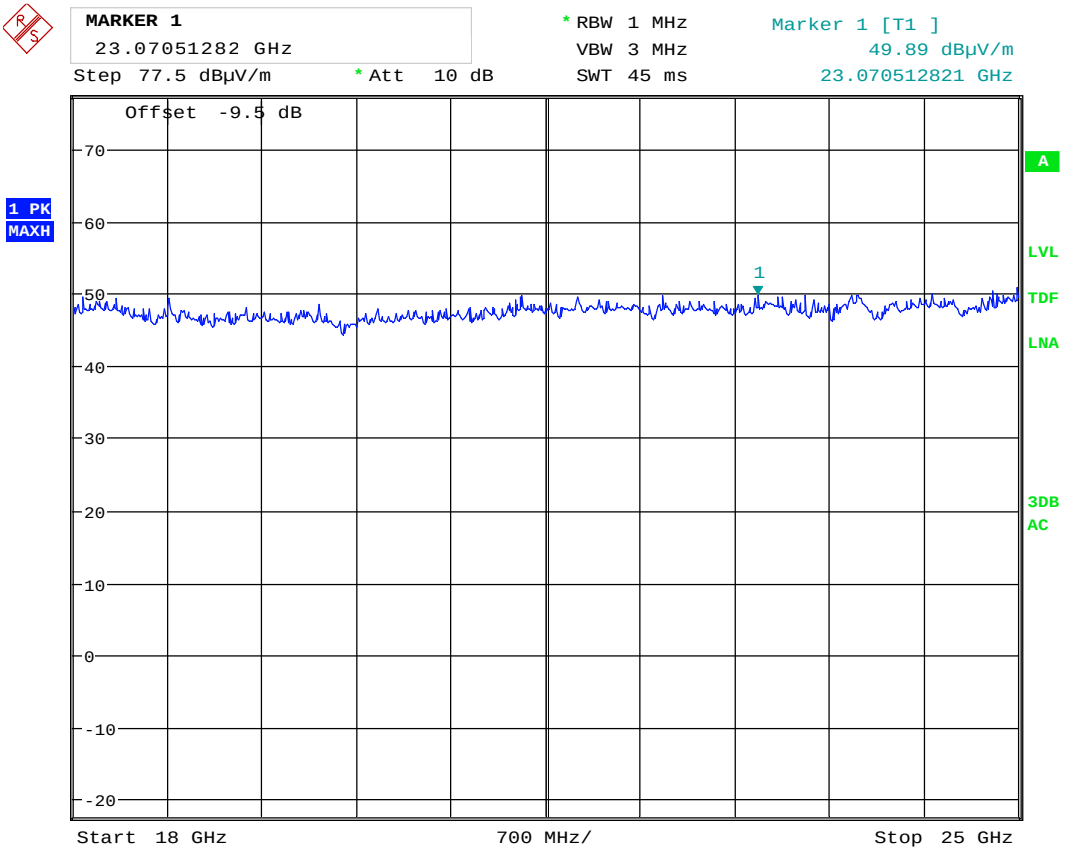
Date: 4.NOV.2016 13:05:42

Radiated Emissions ch. 2480 MHz, 12 – 18 GHz, VP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5 dB is not included in the plot



Date: 4.NOV.2016 13:06:06

Radiated Emissions ch. 2480 MHz, 12 – 18 GHz, HP, @1m – Pre-scan with Peak detector, Distance Correction factor of -9.5dB is not included in the plot



Date: 4.NOV.2016 14:34:31

Radiated Emissions ch. 2440 MHz, 18 – 25 GHz, VP/HP, Pre-scan with Peak detector,

3.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar	**Date of Test: 2016.11.04**

Test Results: Passed

Measured and Calculated Data:

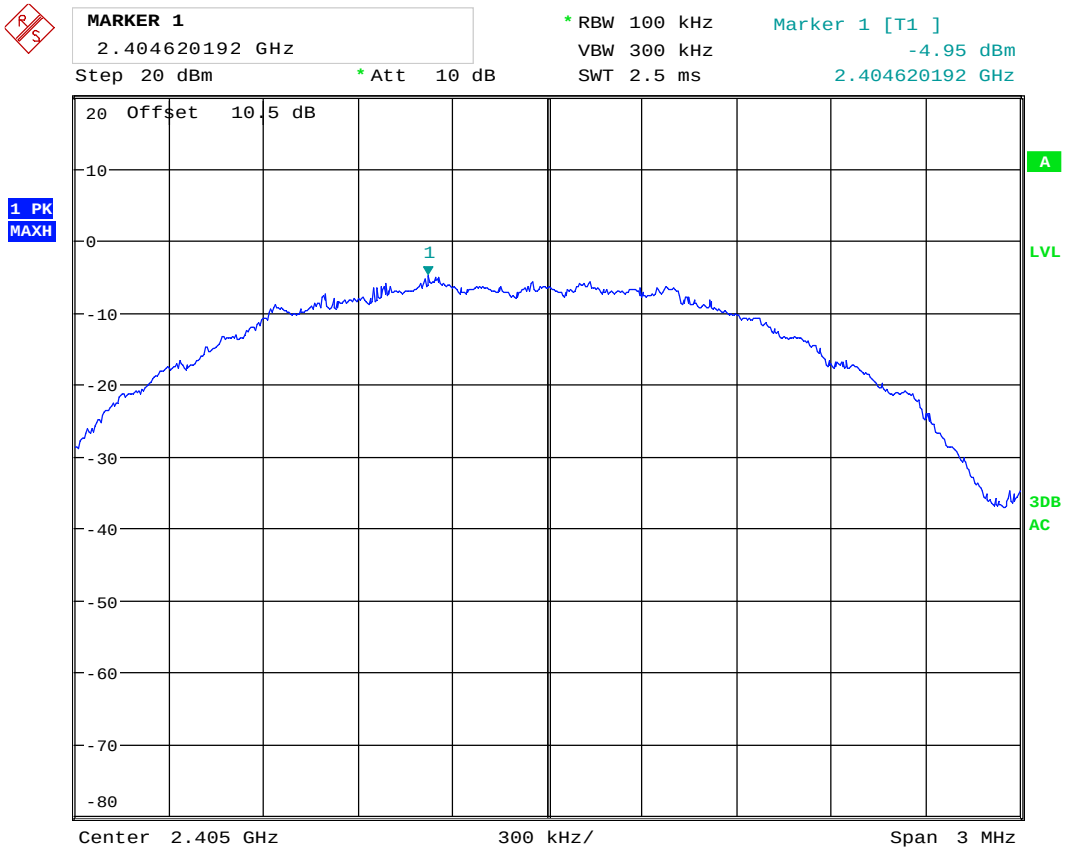
	calculated peak PSD dBm
Power Spectral Density @2405 MHz	-20.15
Power Spectral Density @2440 MHz	-20.62
Power Spectral Density @2480 MHz	-21.35

The measured values with 100 kHz RBW are corrected by a Bandwidth Correction Factor of -15.2 dB.

Requirements:

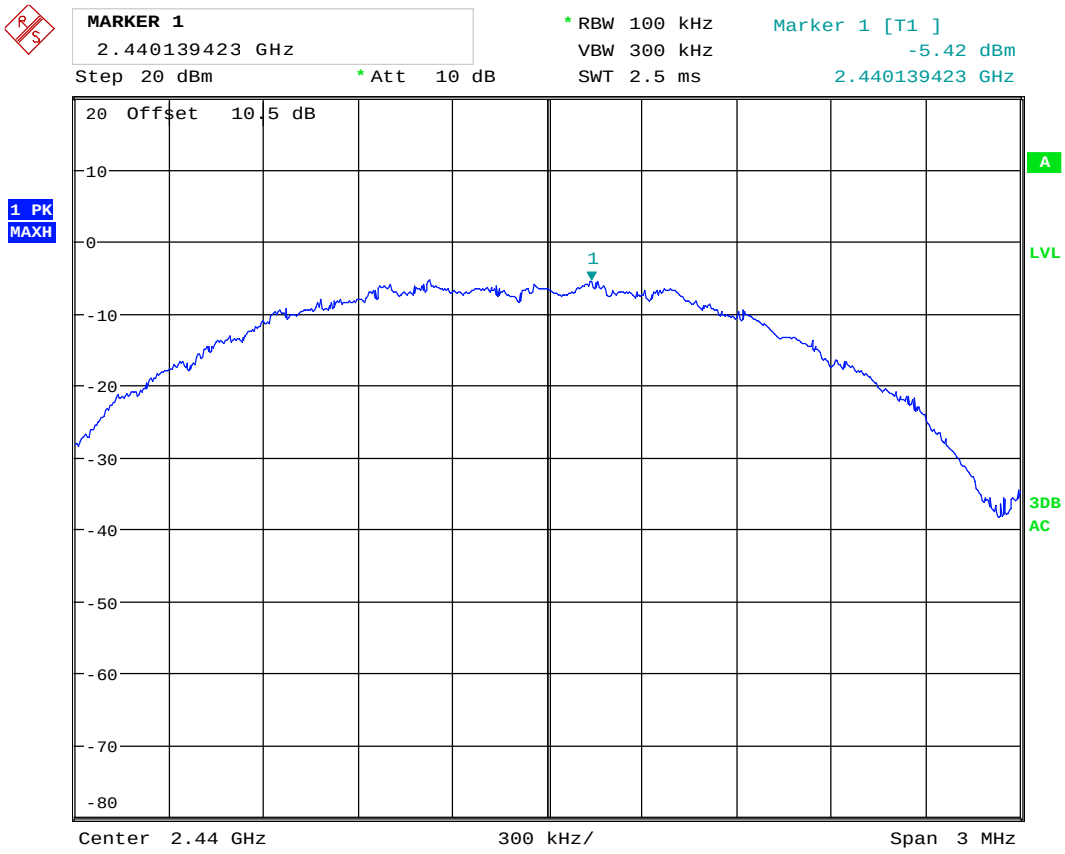
The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

No requirements for Frequency Hopping Systems.



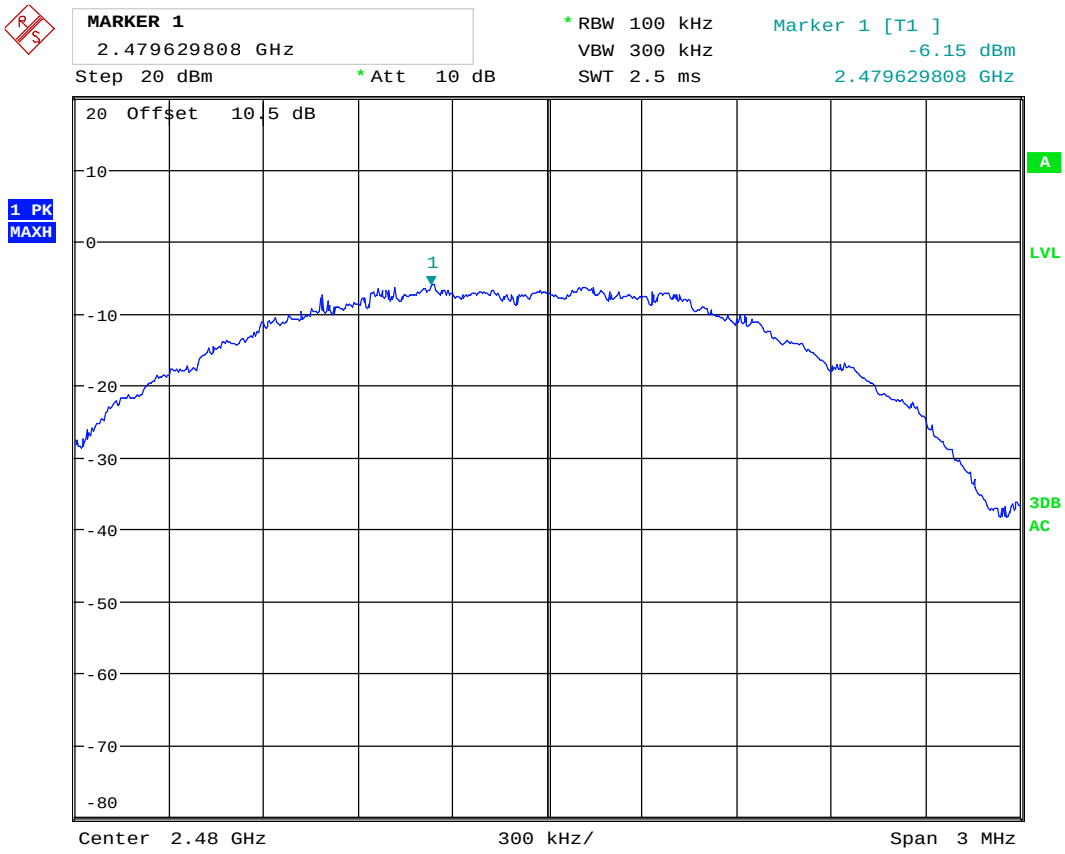
Date: 4.NOV.2016 14:45:10

PSD Measurement - 2405MHz



Date: 4.NOV.2016 14:51:58

PSD Measurement – 2440MHz



Date: 4.NOV.2016 14:52:33

PSD Measurement - 2480MHz

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

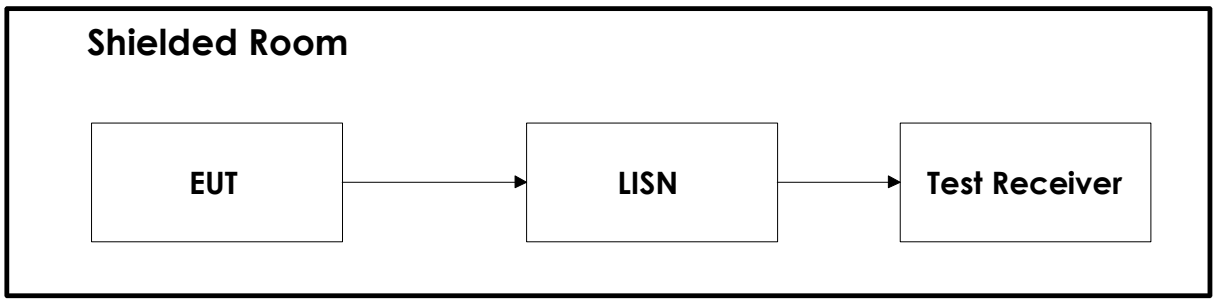
5 LIST OF TEST EQUIPMENT

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.

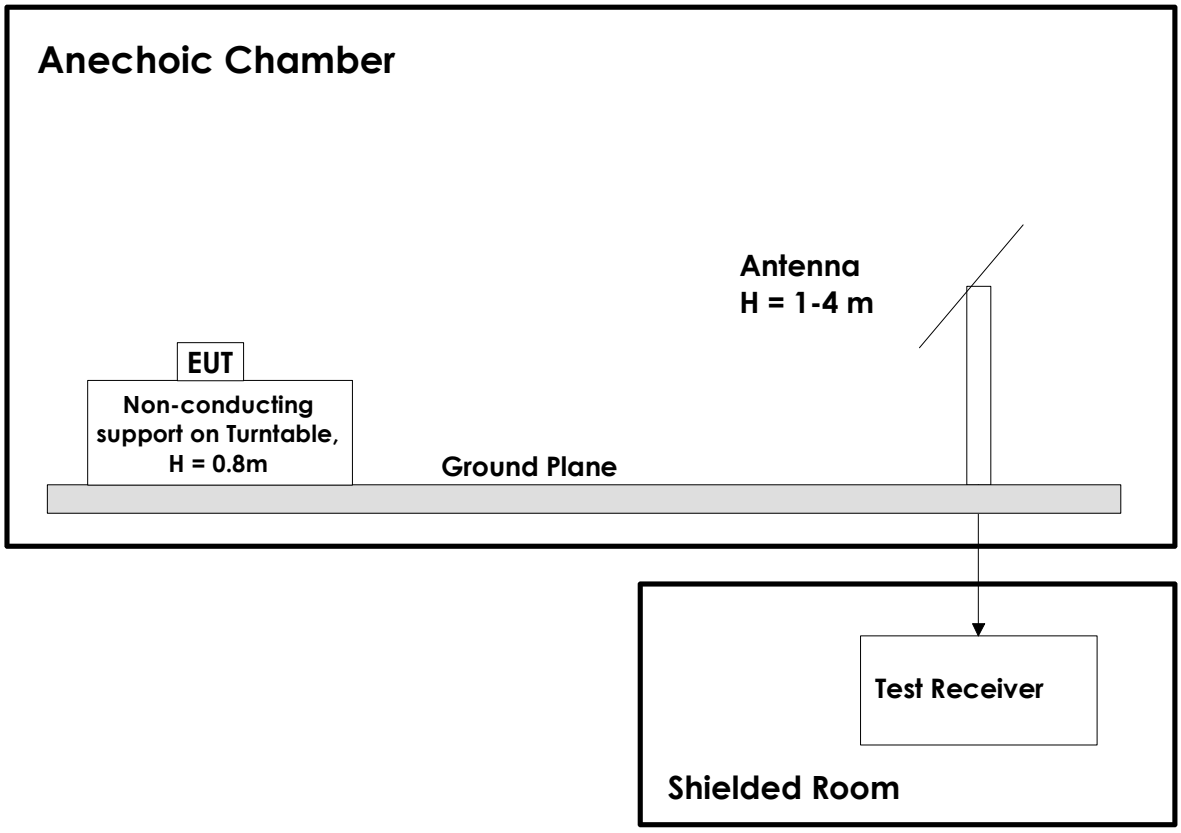
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1.	ESU40	EMI Receiver	Rohde & Schwarz	LR1639	2015.11	2016.11
2.	FSW26	Spectrum Analyzer	Rohde & Schwarz	LR 1640	2015.11	2016.11
3.	HFH2-Z2	Active Loop antenna	Rohde & Schwarz	LR1660	2014.10	2017.10
4.	3115	Antenna horn	EMCO	LR 1330	2010.08	2017.08
5.	EMCO 3104C	Biconical Antenna	Rohde & Schwarz	LR 1262	2014.04	2017.04
6.	EMCO 3146	Log Periodic antenna	Rohde & Schwarz	LR 1221	2014.08	2017.08
7.	643	Antenna Horn	Narda	LR 093	2009.10	2019.10
8.	PM7320X	Antenna Horn	Sivers Lab	LR 102	2009.10	2019.10
9.	DBF-520-20	Antenna Horn	Systron Donner	LR 100	2009.10	2019.10
10.	638	Antenna Horn	Narda	LR 1480	2009.10	2019.10
11.	4768-10	Attenuator	Narda	LR 1356	Cal b4 use	
12.	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
13.	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2016.09	2017.09
14.	HP 10855A	Pre-amplifier	Hewlett Packard	LR 1445	2016.10	2017.10
15.	Model 87 V	Multimeter	Fluke	LR 1597	2016.10	2018.10
16.	6812B	Power source	Agilent	LR 1515	2015.12	2017.12
17.	D001	DC power supply	Farnell	LT 5150	Cal b4 use	

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



Revision history

Version	Date	Comment	Sign
00	2017.02.24	First test report	gns