

Test Report

Product	Tracker
Name and address of the applicant	The Staaker Company Martin Lings vei 25, 1364 Fornebu, Norway
Name and address of the manufacturer	The Staaker Company Martin Lings vei 25, 1364 Fornebu, Norway
Model	STAAKER1 TRACKER
Rating	3.7Vdc , 2000mAh , Li battery
Trademark	
Serial number	/
Additional information	Contains 2.4GHz proprietary FHSS radio module and GPS receiver.
Tested according to	FCC Part 15.247 Frequency Hopping Transmitters / Digital Transmission Systems Industry Canada RSS-247, Issue 2 Low Power Licence-Exempt Radiocommunications Devices
Order number	328815
Tested in period	2017.06.16 – 2017.06.28
Issue date	2017.08.29
Name and address of the testing laboratory	 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[]	
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1 INFORMATION

1.1 Test Item

Name :	STAAKER
FCC ID :	2AL8U-820101
Industry Canada ID :	22766-820101
Model/version :	STAAKER1 TRACKER
Serial number :	/
Hardware identity and/or version:	820101
Software identity and/or version :	19.0.0
Frequency Range :	2412 – 2470 MHz
Tunable Bands :	None
Number of Channels :	15
Operating Modes :	TX/RX
Type of Modulation :	FSK
User Frequency Adjustment :	None
Rated Output Power :	21.04mW @ 50 ohm
Type of Power Supply :	3.7Vdc Li-Ion Battery
Antenna Connector :	Only integral antenna
Antenna Diversity Supported :	None
Desktop Charger :	N/A

Description of Test Item

Tracker for Staaker Drone operates in 2400 - 2483.5MHz ISM band using frequency hopping system.

1.2 Normal test condition

Temperature: 20 - 24 °C
Relative humidity: 20 - 50 %
Normal test voltage: 3.7Vdc

The values are the limit registered during the test period.

1.3 Test Engineer(s)

G.Suhanthakumar

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

All measurements were done with the EUT powered by a fully charged battery.

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 2.

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 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 2, RSS-GEN Issue 4 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	N/A ¹
Number of Operating Frequencies	15.31(m)	5.1 (6) (RSS-247)	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) (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	15.247(a)(1)	5.1 (7) (RSS-247)	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2 (1) (RSS-247)	N/A ²
Peak Power Output	15.247(b)	5.4 (RSS-247)	Complies
Power Spectral Density	15.247(d)	5.2 (2) (RSS-247)	N/A ²
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) 6.13 (RSS-GEN) 8.9 (RSS-GEN)	Complies

N/A¹: Battery operated

N/A²: FHSS system

3 TEST RESULTS

3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suwanthakumar

Date of Test: 2017.06.16

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

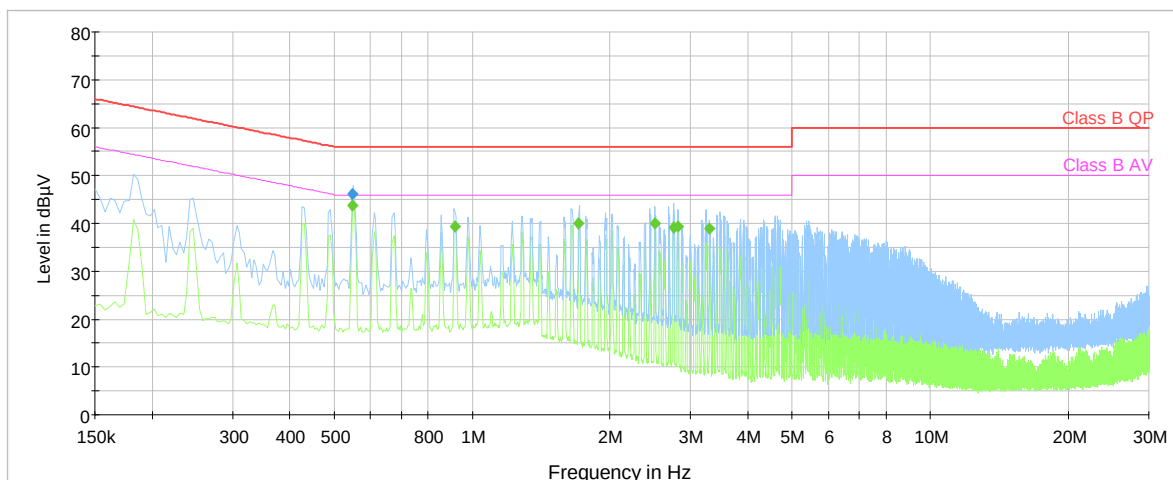
Test Results: Complies.

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

USB hub D-link: JTA0302E

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)
0.548	---	43.72	46.00	2.28	1000	9	L1	GND	10.1
0.548	46.14	---	56.00	9.86	1000	9	L1	GND	10.1
0.916	---	39.28	46.00	6.72	1000	9	L1	GND	10.1
1.708	---	40.01	46.00	5.99	1000	9	L1	GND	10.1
2.504	---	40.10	46.00	5.90	1000	9	L1	GND	10.1
2.748	---	39.07	46.00	6.93	1000	9	L1	GND	10.1
2.808	---	39.32	46.00	6.68	1000	9	L1	GND	10.1
3.296	---	38.85	46.00	7.15	1000	9	L1	GND	10.1



120Vac/60Hz

3.2 Channel Separation

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

Test Performed By: G.Suwanthakumar

Date of Test: 2017.06.24

Test Results: **Complies**

Measurement Data:

Minimum Channel Separation:	2.0 MHz
20 dB Bandwidth of hopping channel:	0.8 MHz
Minimum value for Channel Separation	2.00 MHz
Nominal value for Channel Separation	3.29 MHz

Channel bandwidth for 7 channel is 23.04MHz,

Channel separation is $23.04\text{MHz}/7 = 3.29\text{MHz}$

RF channel has no influence on 20 dB bandwidth.

See attached plots

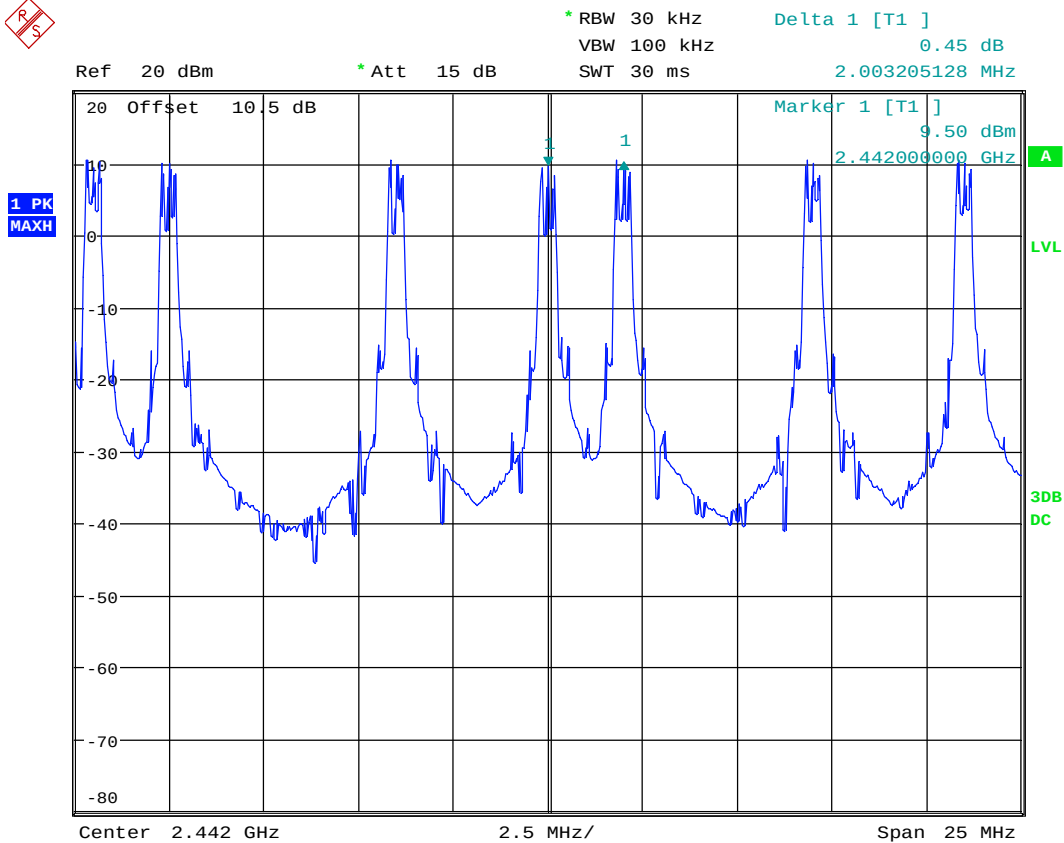
Requirement:

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:

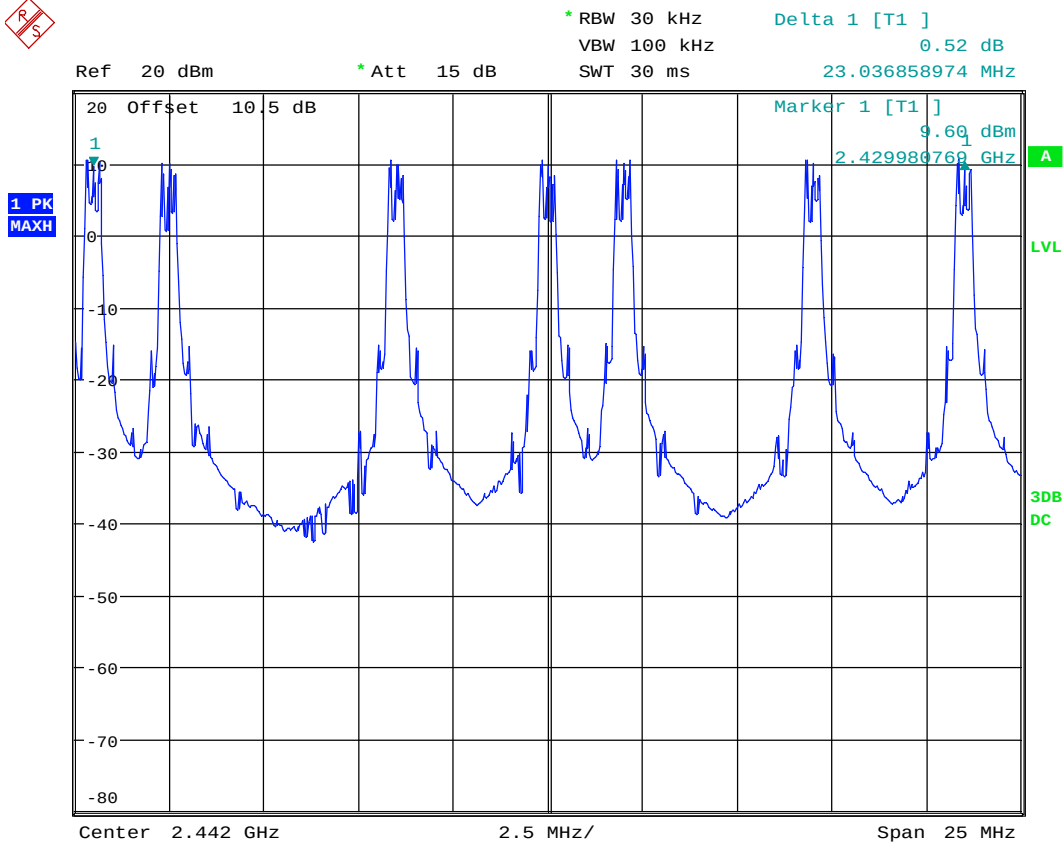
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.

No requirements for Digital Transmission Systems.



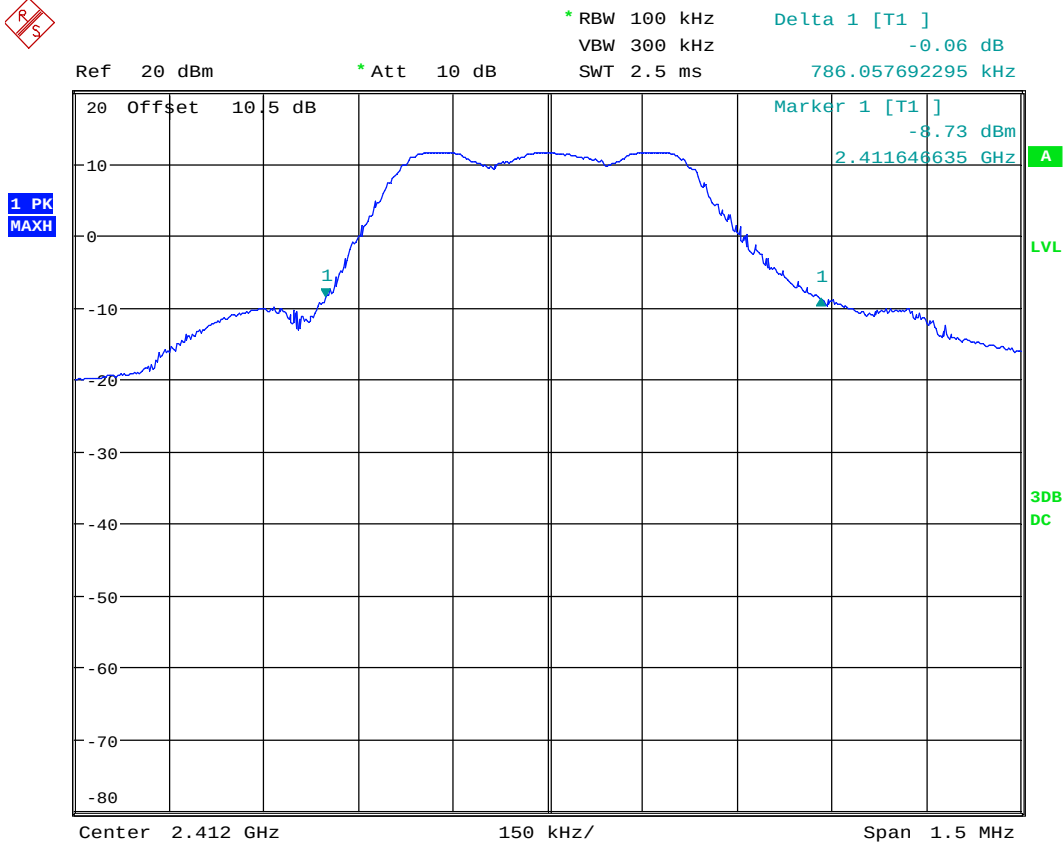
Date: 24.JUN.2017 08:10:29

Minimum Channel Separation



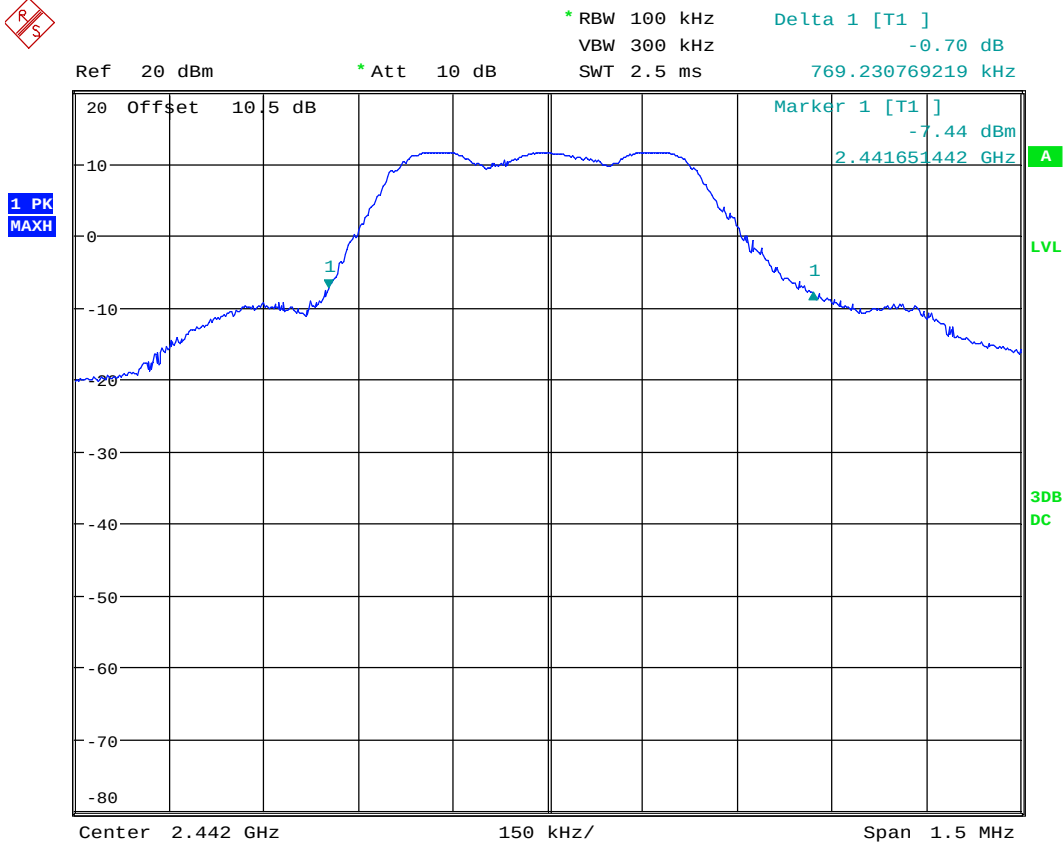
Date: 24.JUN.2017 08:12:20

Nominal Channel Separation



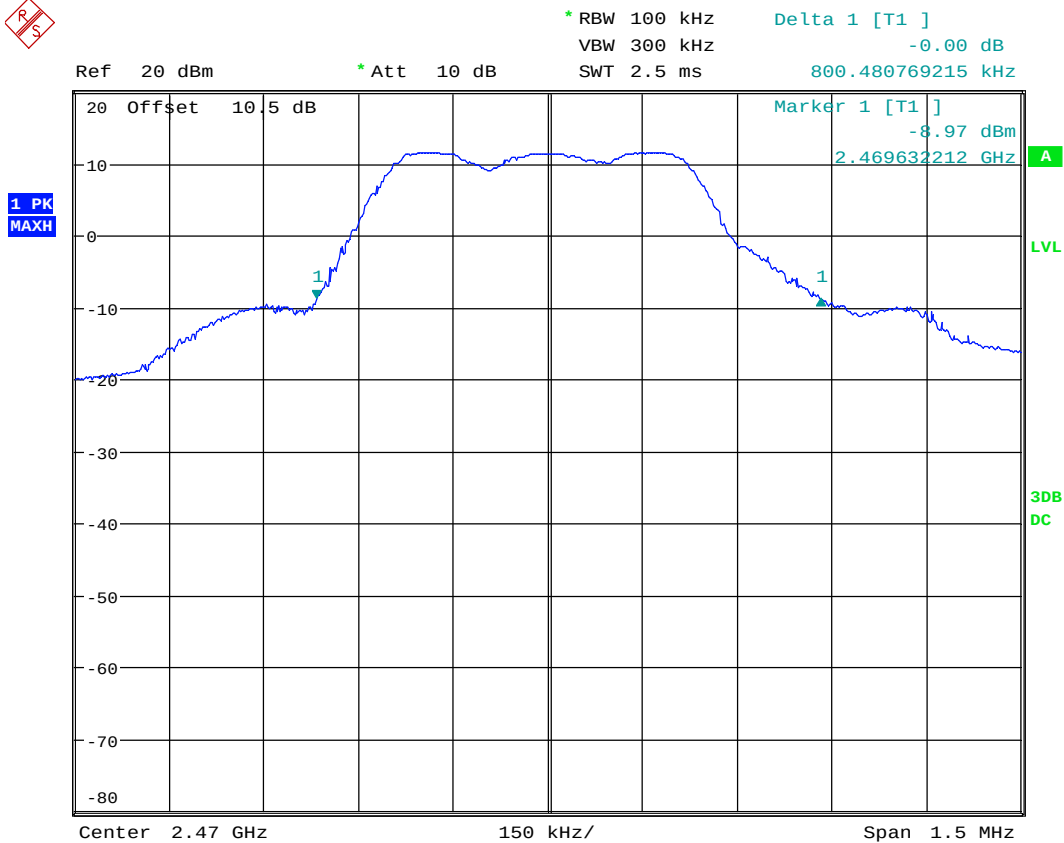
Date: 24.JUN.2017 08:40:28

20dB Bandwidth, 2412 MHz



Date: 24.JUN.2017 08:41:39

20dB Bandwidth, 2442MHz



Date: 24.JUN.2017 08:38:30

20dB Bandwidth, 2470 MHz

3.3 Pseudorandom Hopping Algorithm

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

Test Results: Complies

Measurement Data: /

Given in document “StaakerFrequencyHoppingDescriptionforFCC-rev1.0.pdf”

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:

Number of RF Channels:	15
Maximum Length of RF Burst pr. channel	0.34375 ms
Time between RF Burst on same RF Channel	9.19 ms
Time of Occupancy	0.22 s

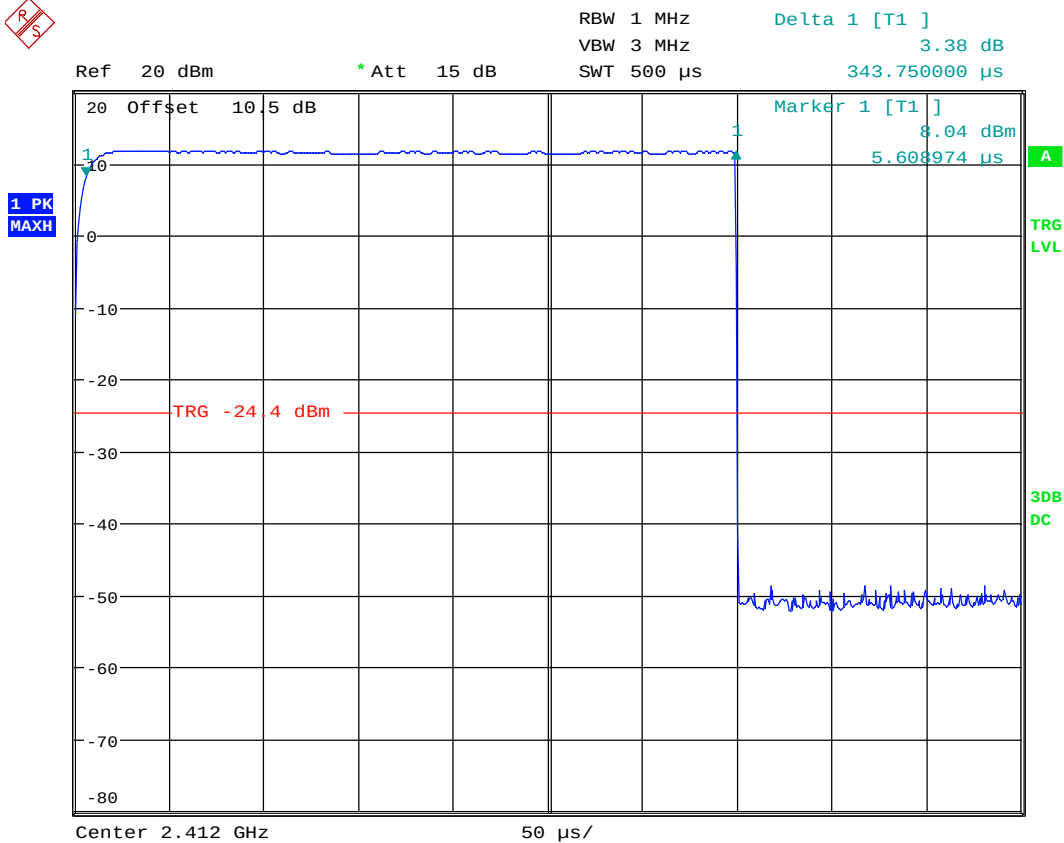
Time of occupancy: $(0.34375 \times 400 \times 15) / 9.19 = 224.42 \text{ ms}$

See attached graph.

Requirements:

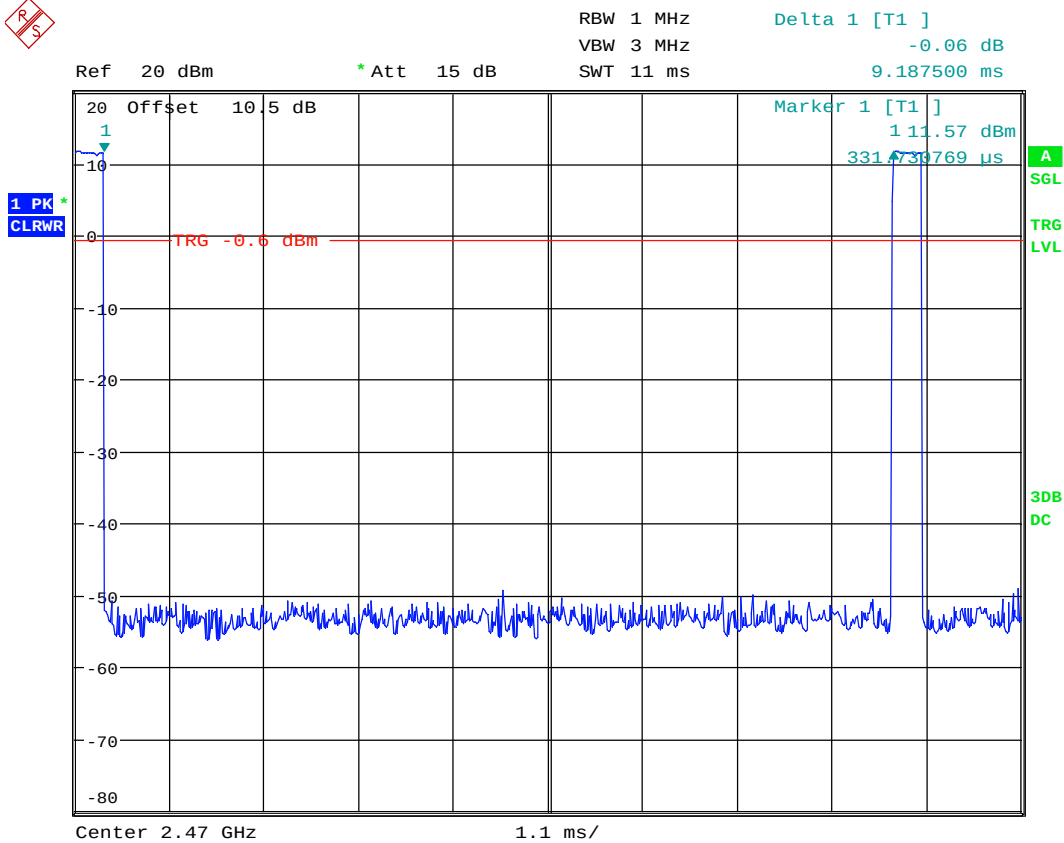
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

No requirements for Digital Transmission Systems.



Date: 24.JUN.2017 08:15:49

Burst Length



Date: 24.JUN.2017 08:20:51

Dwell Time

3.5 Occupied Bandwidth

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

Test Results: **Complies**

Measurement Data:

Number of RF Channels in use:	15
Channel Centre Frequencies:	2412 – 2470 MHz
99% BW Measured on Centre Channel (2442 MHz)	518.8 kHz

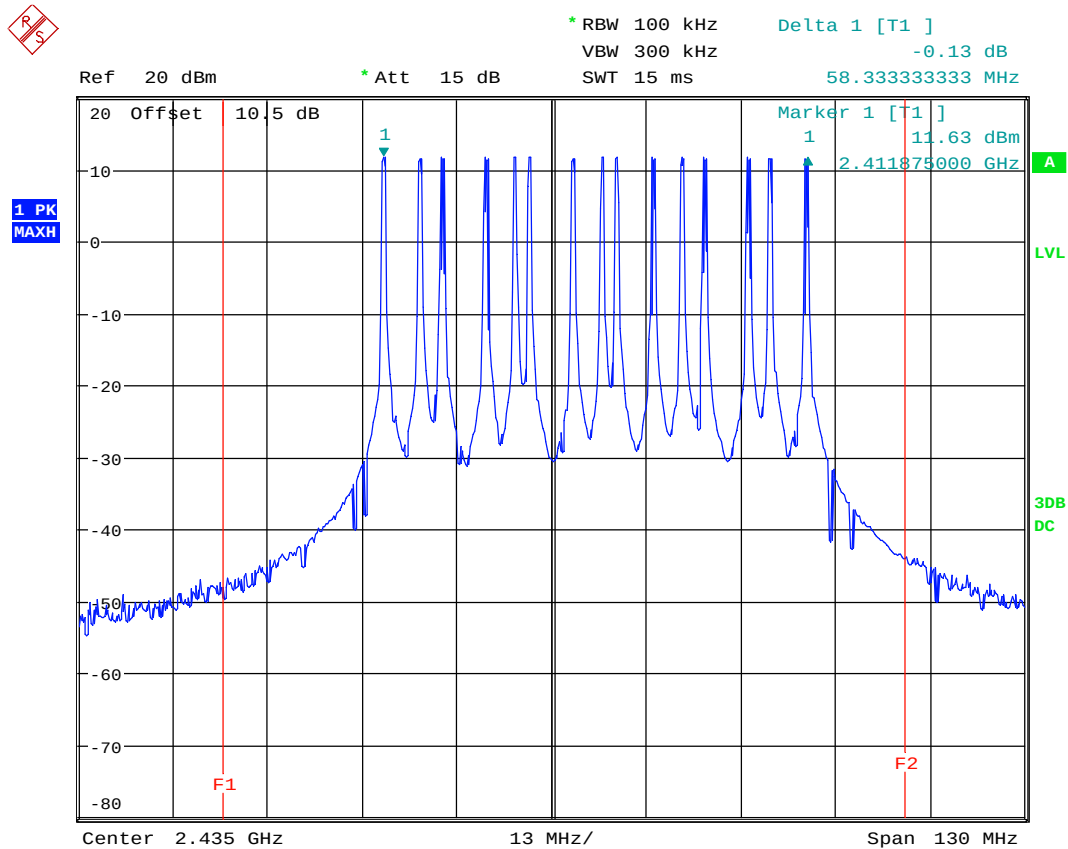
See attached plots.

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 requirements for Digital Transmission Systems.

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



Date: 24.JUN.2017 07:59:20

RF Channels in Use



Date: 28.JUN.2017 12:05:44

99% Bandwidth – ch2442MHz

3.6 Peak Power Output

FCC part 15.247 (b)

Test Results: Complies

Measurement Data:

	2412 MHz	2442 MHz	2470 MHz
Conducted Power (dBm)	13.2	12.5	11.7
Conducted Power (mWatts)	21.04	17.74	14.76
Field Strength (dBμV/m)-PK (VP)	106.4	106.1	103.8
EIRP, Calculated (mWatts)	13.07	12.11	7.20
Antenna gain (dBi)	-2.1	-1.7	-3.1

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

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.



MARKER 1

2.412144231 GHz

Ref 20 dBm

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

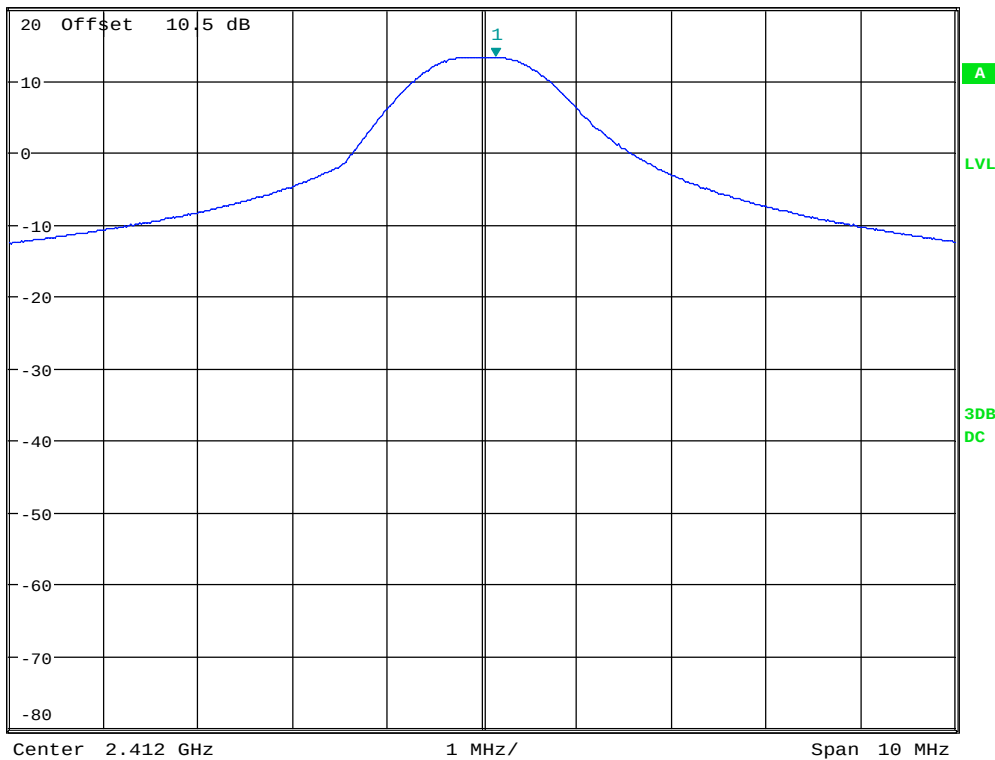
SWT 2.5 ms

Marker 1 [T1]

13.23 dBm

2.412144231 GHz

1 PK
MAXH



Date: 24.JUN.2017 08:47:36

Conducted power ch2412MHz



MARKER 1

2.441983974 GHz

Ref 20 dBm

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

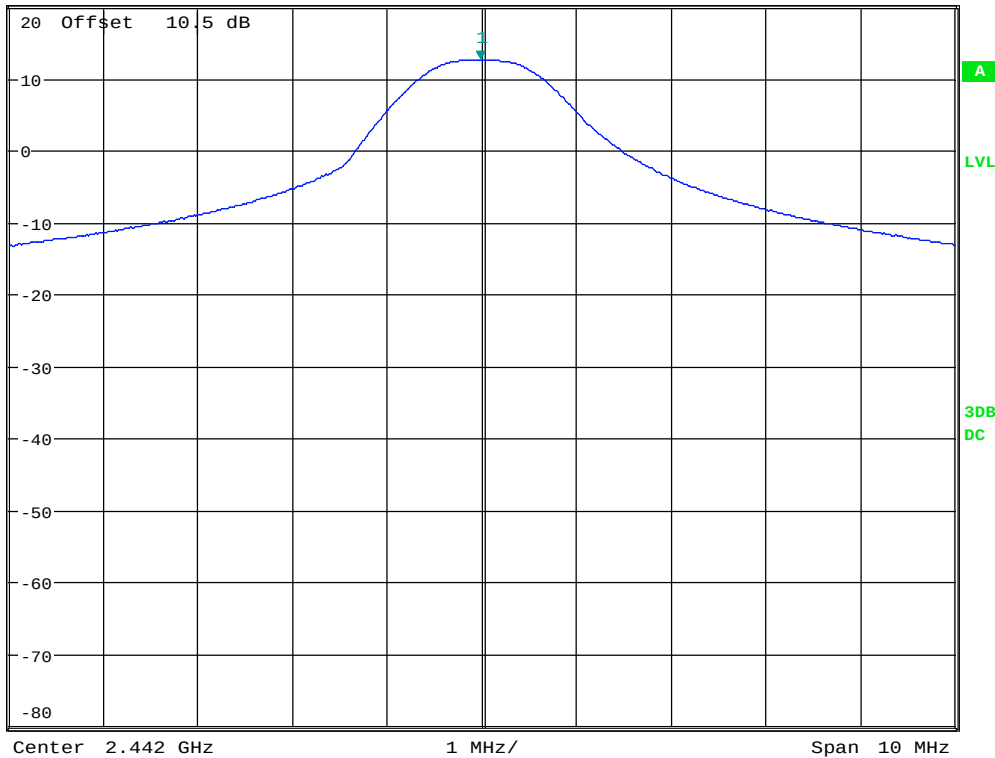
SWT 2.5 ms

Marker 1 [T1]

12.49 dBm

2.441983974 GHz

1 PK
MAXH



Date: 24.JUN.2017 08:51:31

Conducted power ch2442MHz



MARKER 1

2.469967949 GHz

Ref 20 dBm

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

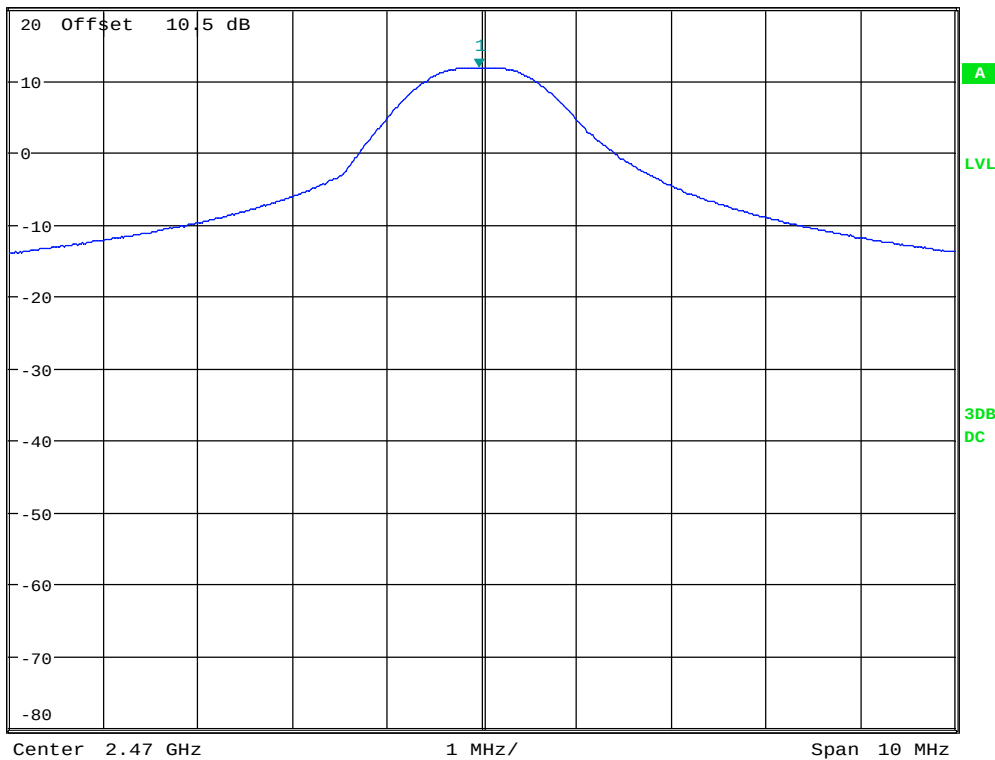
SWT 2.5 ms

Marker 1 [T1]

11.69 dBm

2.469967949 GHz

1 PK
MAXH



Date: 24.JUN.2017 08:53:52

Conducted power ch2470MHz



* RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
101.23 dBμV/m
2.411807692 GHz

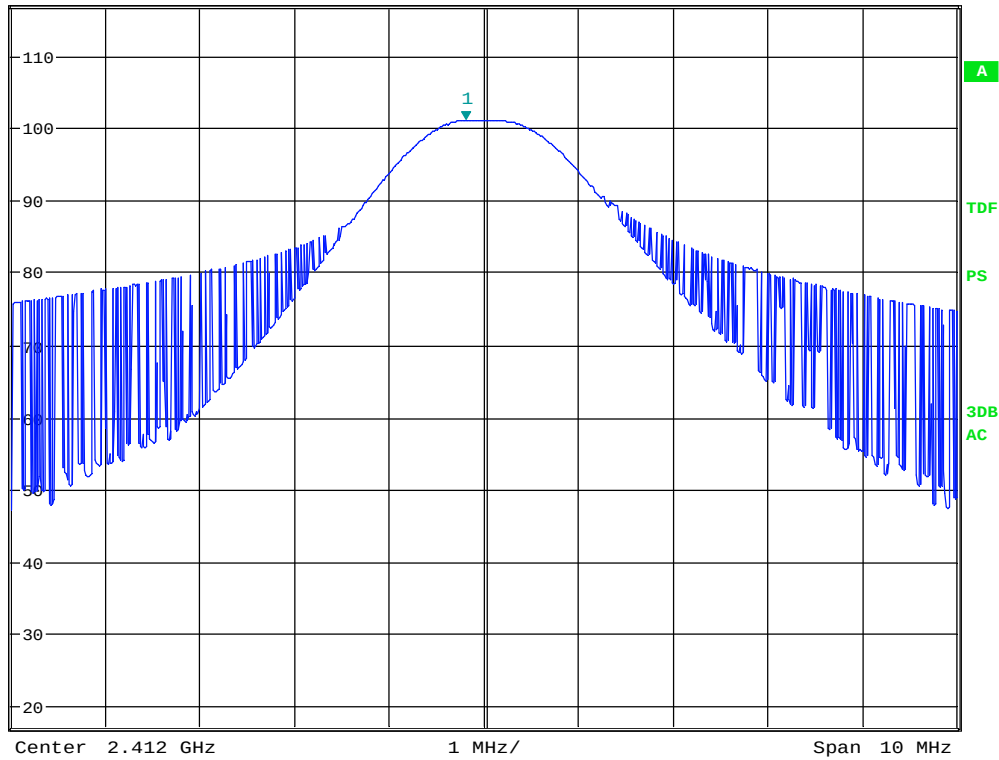
Ref 117 dBμV/m

* Att 10 dB

SWT 2.5 ms

2.411807692 GHz

1 PK
MAXH



Date: 23.JUN.2017 10:43:56

Field strength ch2412MHz – HP



* RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms
Marker 1 [T1]
106.39 dBμV/m
2.412000000 GHz

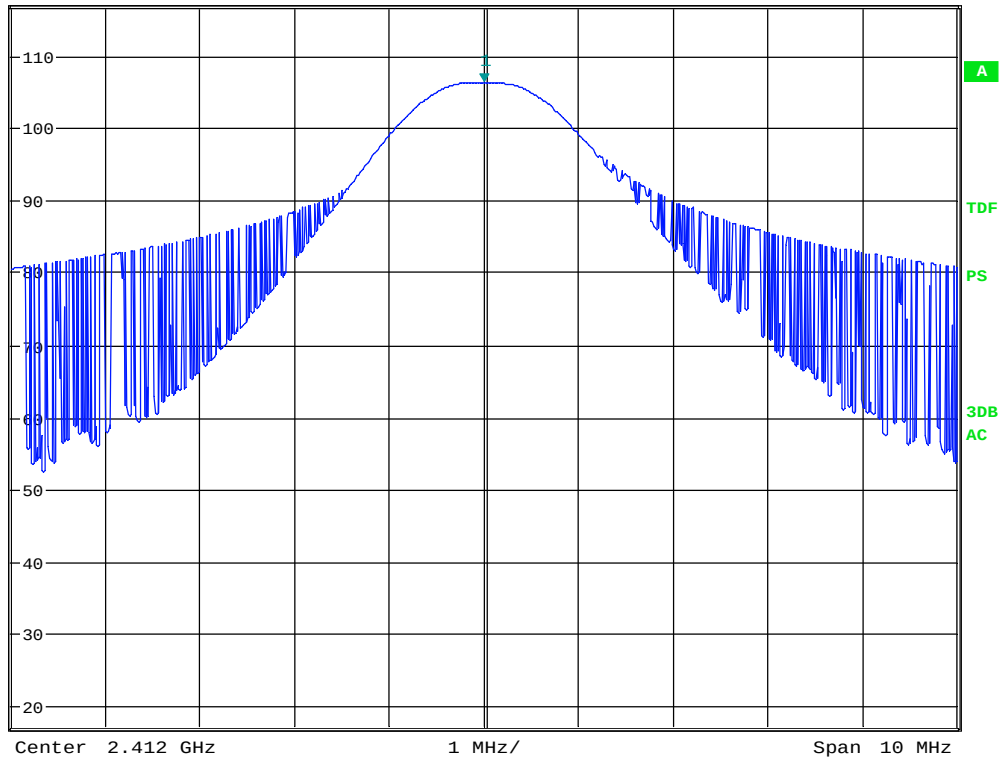
Ref 117 dBμV/m

* Att 10 dB

SWT 2.5 ms

2.412000000 GHz

1 PK
MAXH



Date: 23.JUN.2017 10:42:18

Field strength ch2412MHz – VP



MARKER 1

2.469919872 GHz

Ref 117 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

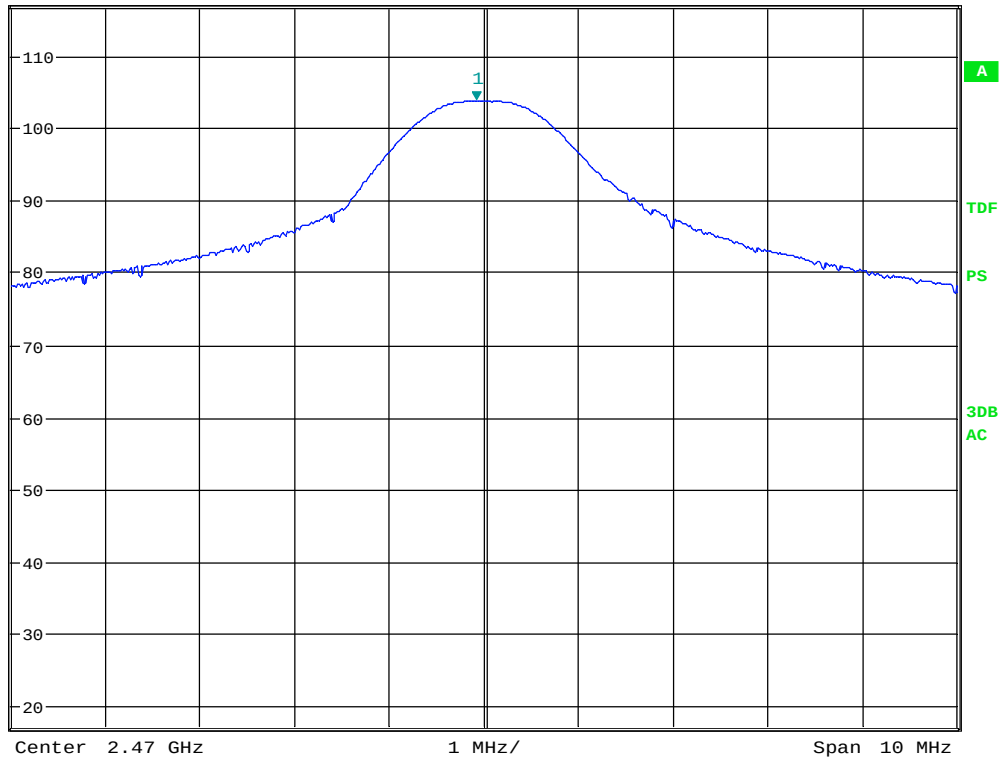
SWT 2.5 ms

Marker 1 [T1]

103.79 dBμV/m

2.469919872 GHz

1 PK
MAXH



Date: 23.JUN.2017 12:12:51

Field strength ch2442MHz – HP



MARKER 1

2.442016026 GHz

Ref 117 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

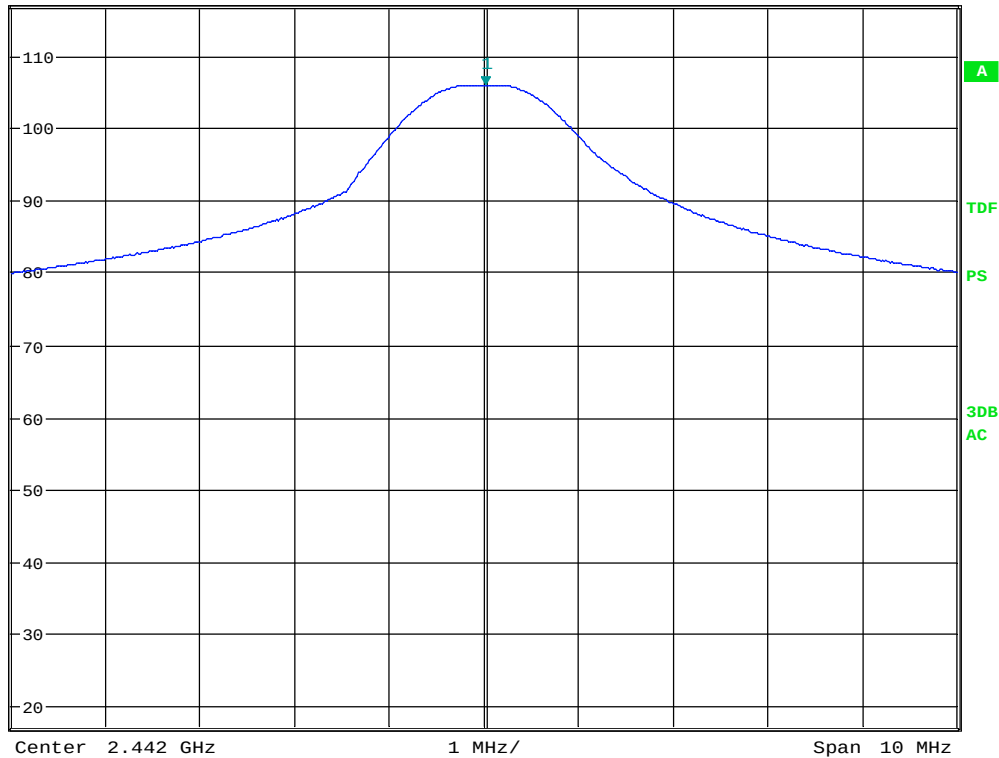
SWT 2.5 ms

Marker 1 [T1]

106.06 dBμV/m

2.442016026 GHz

1 PK
MAXH



Date: 23.JUN.2017 11:49:27

Field strength ch2442MHz – VP



MARKER 1

2.470128205 GHz

Ref 117 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

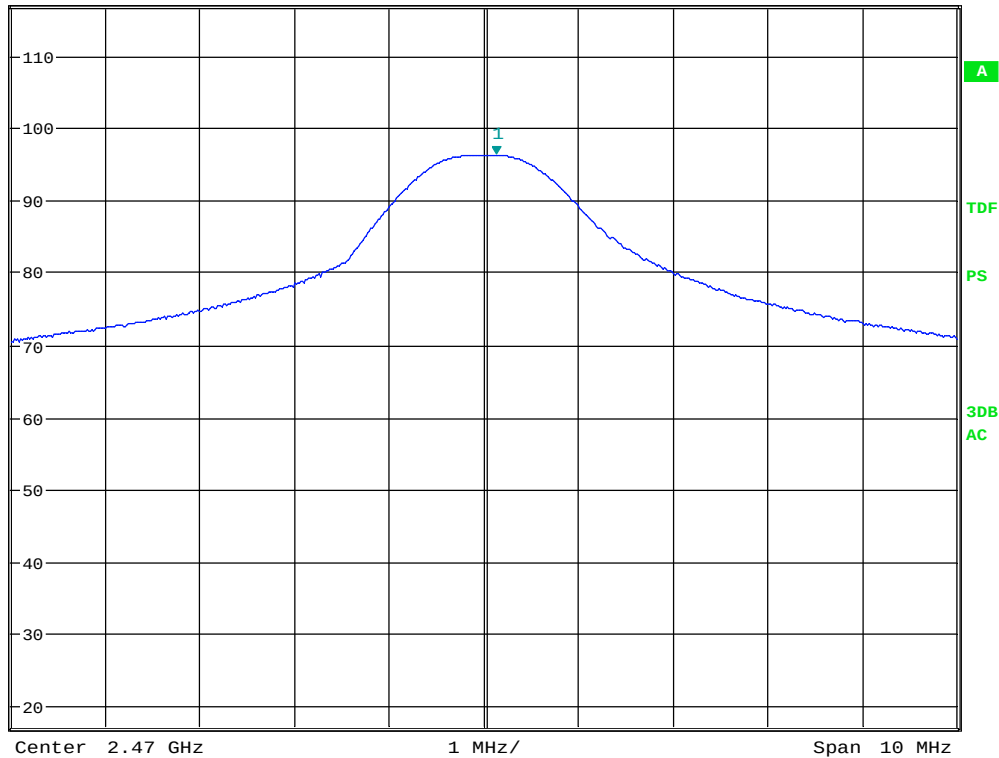
SWT 2.5 ms

Marker 1 [T1]

96.31 dBμV/m

2.470128205 GHz

1 PK
MAXH



Date: 23.JUN.2017 12:04:01

Field strength ch2470MHz – HP



MARKER 1

2.469919872 GHz

Ref 117 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

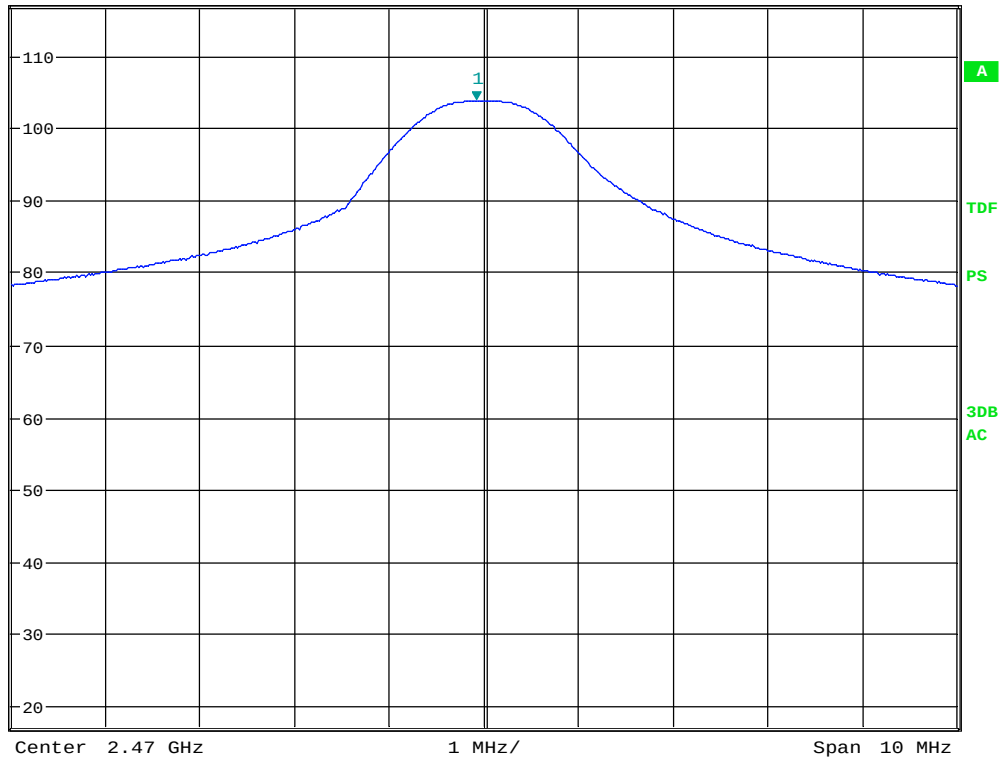
SWT 2.5 ms

Marker 1 [T1]

103.80 dBμV/m

2.469919872 GHz

1 PK
MAXH



Date: 23.JUN.2017 12:13:09

Field strength ch2470MHz – VP

3.7 Conducted Emissions at Antenna Connector

Para. No.: 15.247 (d)

RF conducted power to 25 GHz see attached plots. Peak measurements

Maximum RF level outside operating band:

RF in hopping mode: >54 dB/C, margin >20 dB

RF ch 2412: >40 dB/C, margin >20 dB

RF ch 2442: >40 dB/C, margin >30 dB

RF ch 2470: >40 dB/C, margin >30 dB

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.



MARKER 1

111.4663462 MHz

Ref 20 dBm

* Att 15 dB

* RBW 100 kHz

VBW 300 kHz

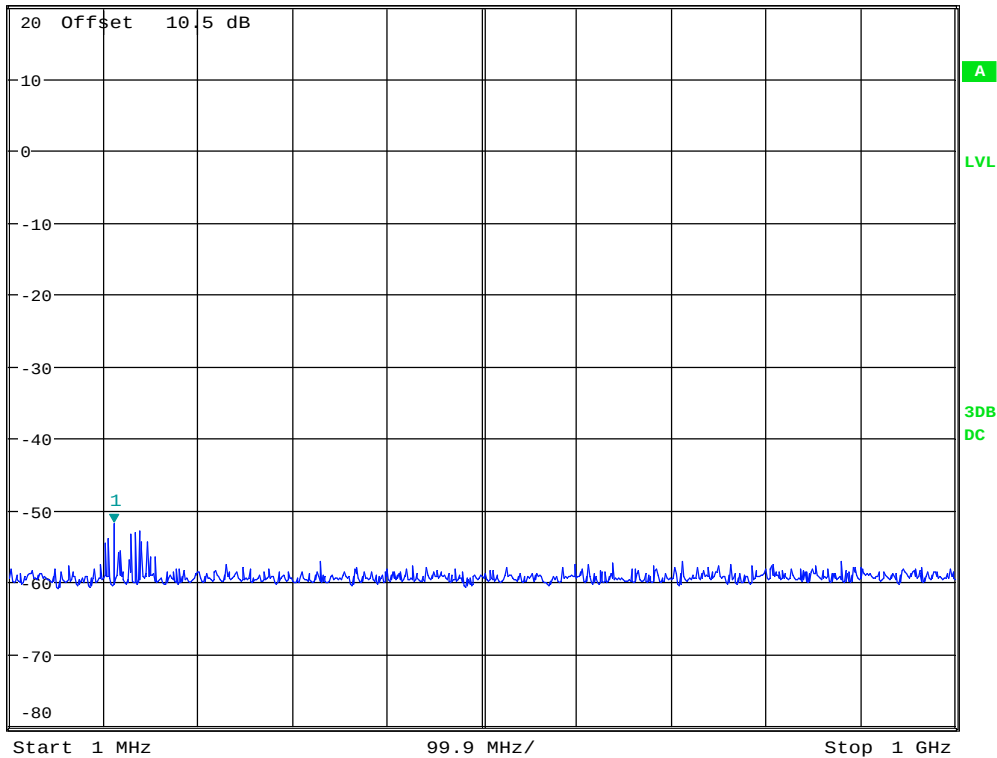
SWT 100 ms

Marker 1 [T1]

-51.76 dBm

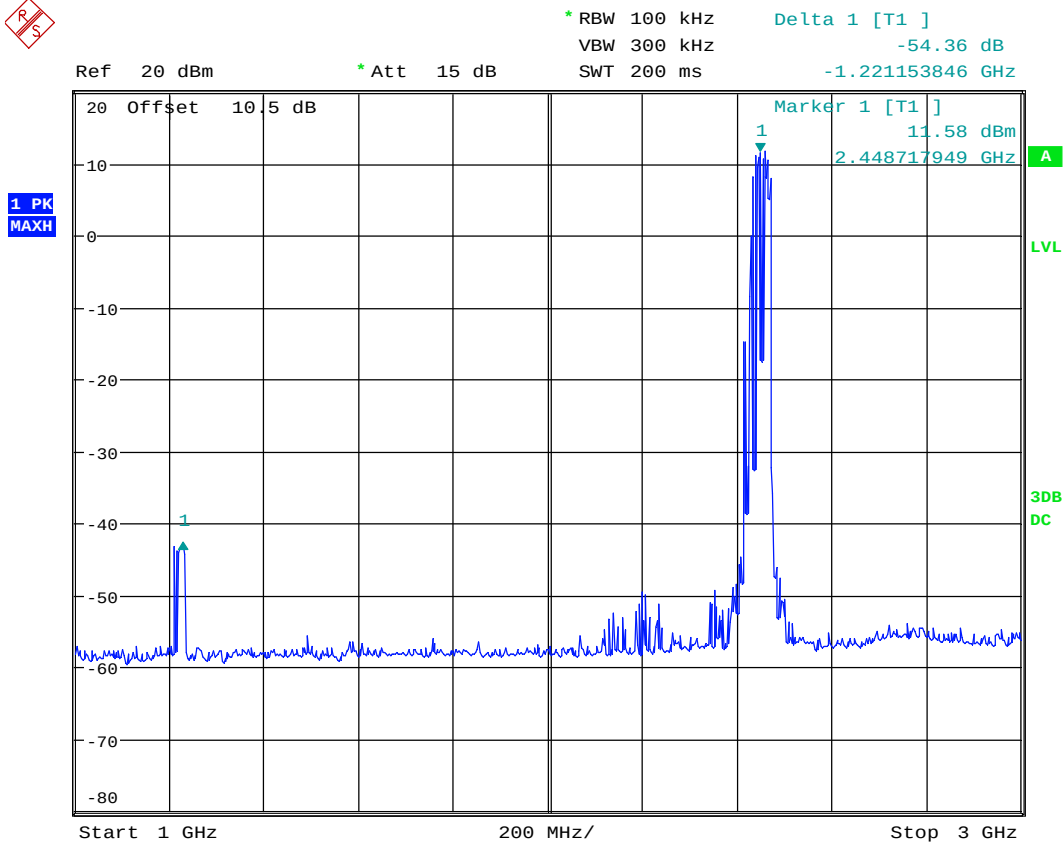
111.466346154 MHz

1 PK
MAXH



Date: 24.JUN.2017 07:40:40

Conducted spurious emissions 1MHz – 1GHz in hopping mode



Date: 24.JUN.2017 07:41:52

Conducted spurious emissions 1 - 3GHz in hopping mode



MARKER 1

7.330128205 GHz

* RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

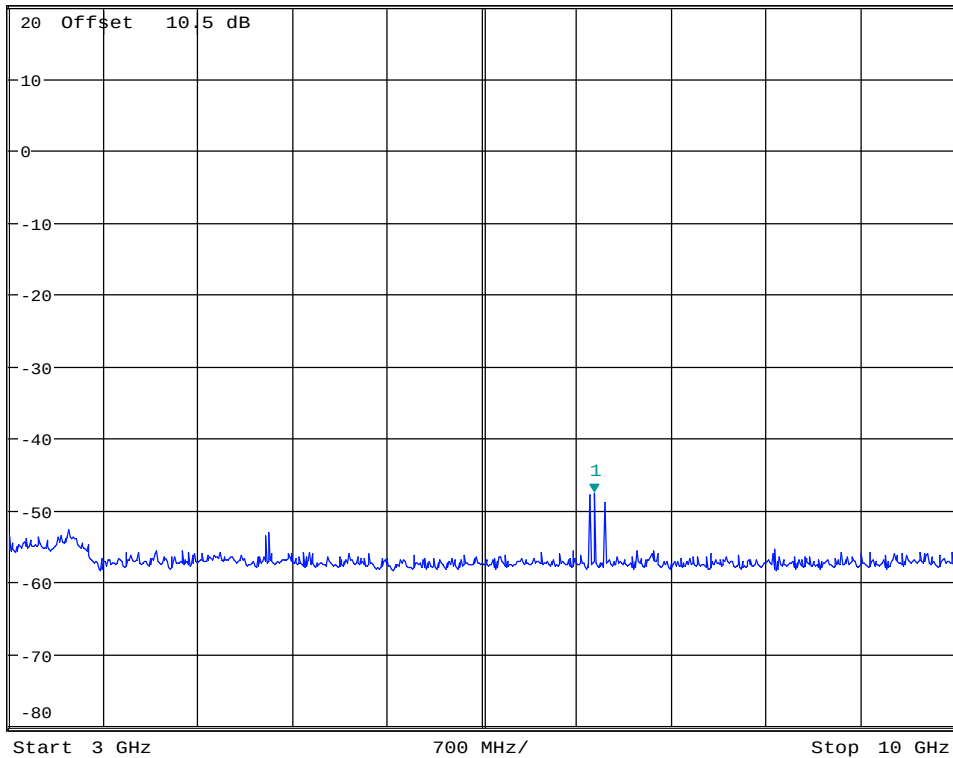
-47.45 dBm

Ref 20 dBm

* Att 15 dB

SWT 700 ms

7.330128205 GHz



Date: 24.JUN.2017 07:45:08

Conducted spurious emissions 3GHz – 10GHz in hopping mode



MARKER 1

24.6875 GHz

* RBW 100 kHz

Marker 1 [T1]

VBW 300 kHz

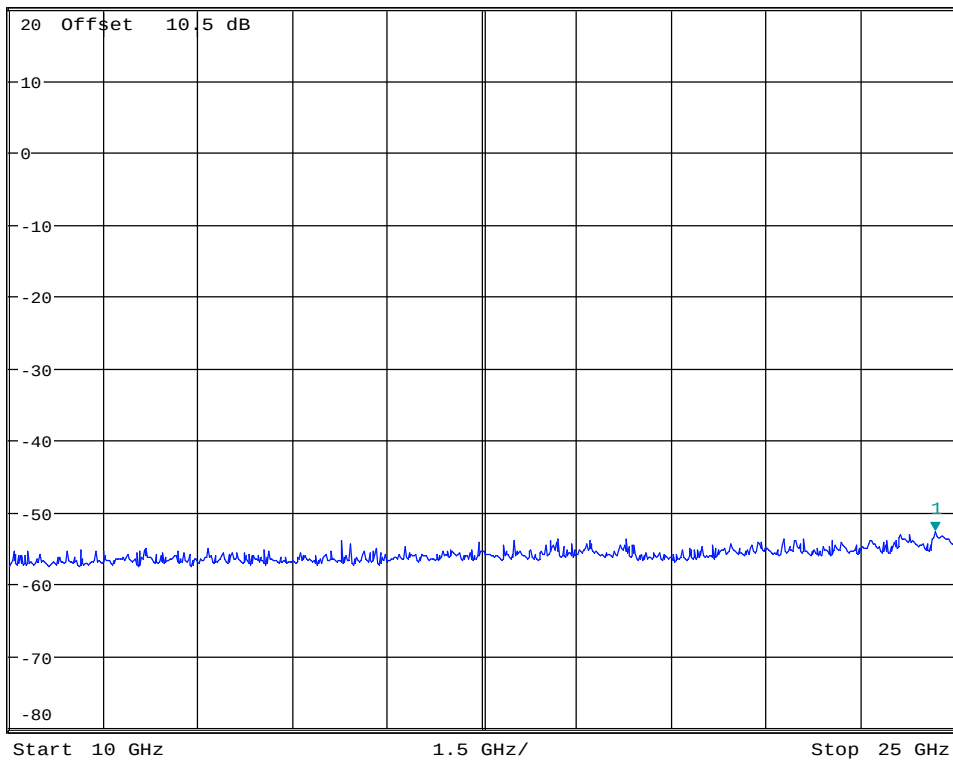
-52.62 dBm

Ref 20 dBm

* Att 15 dB

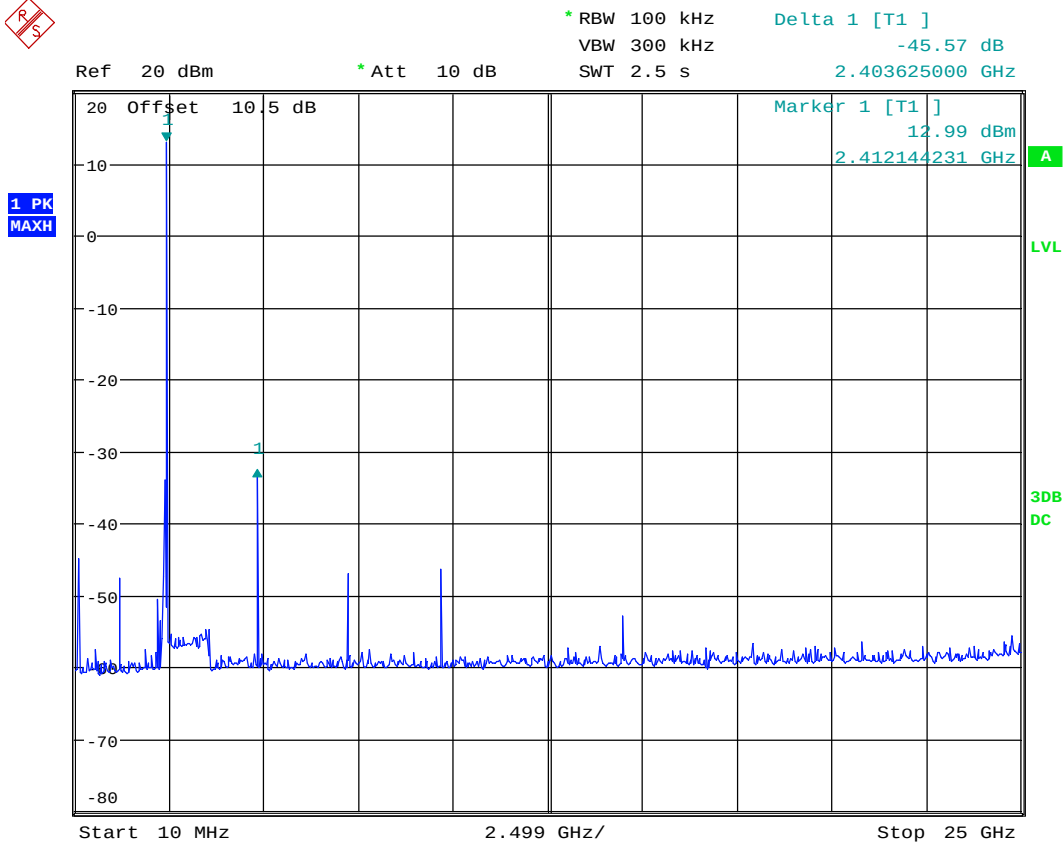
SWT 1.5 s

24.687500000 GHz



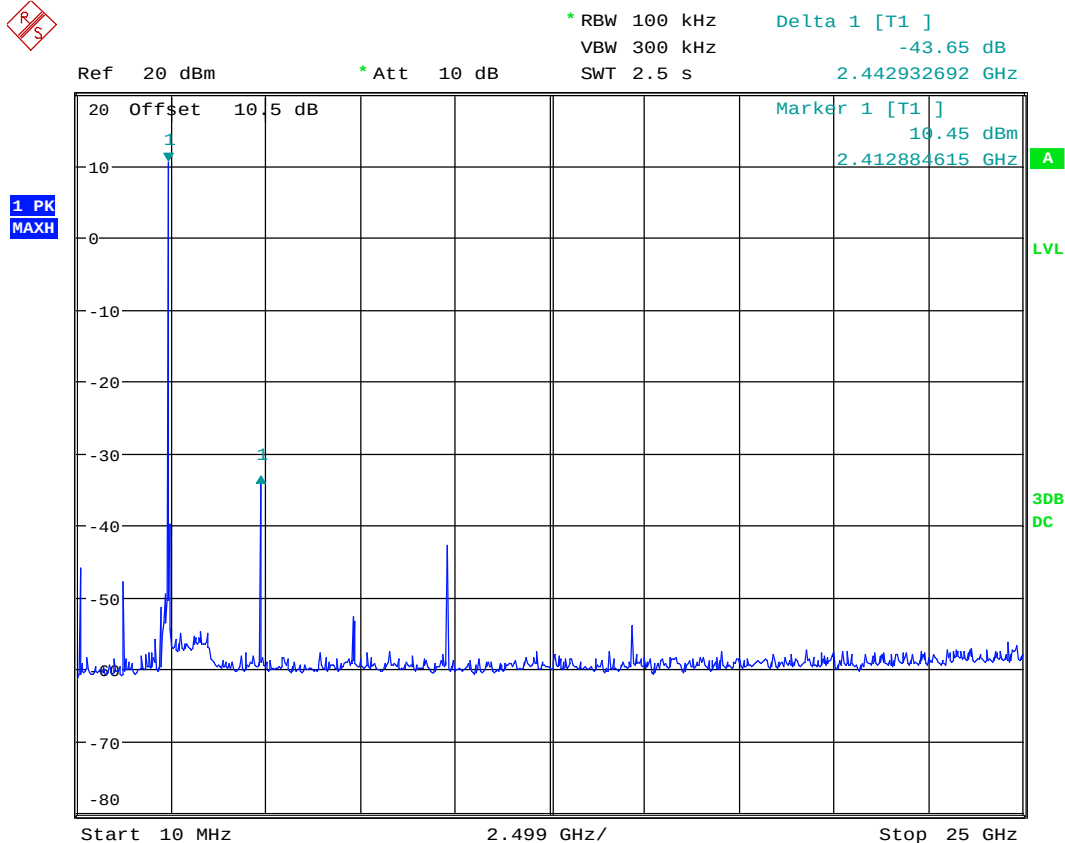
Date: 24.JUN.2017 07:46:59

Conducted spurious emissions 10GHz – 25GHz in hopping mode



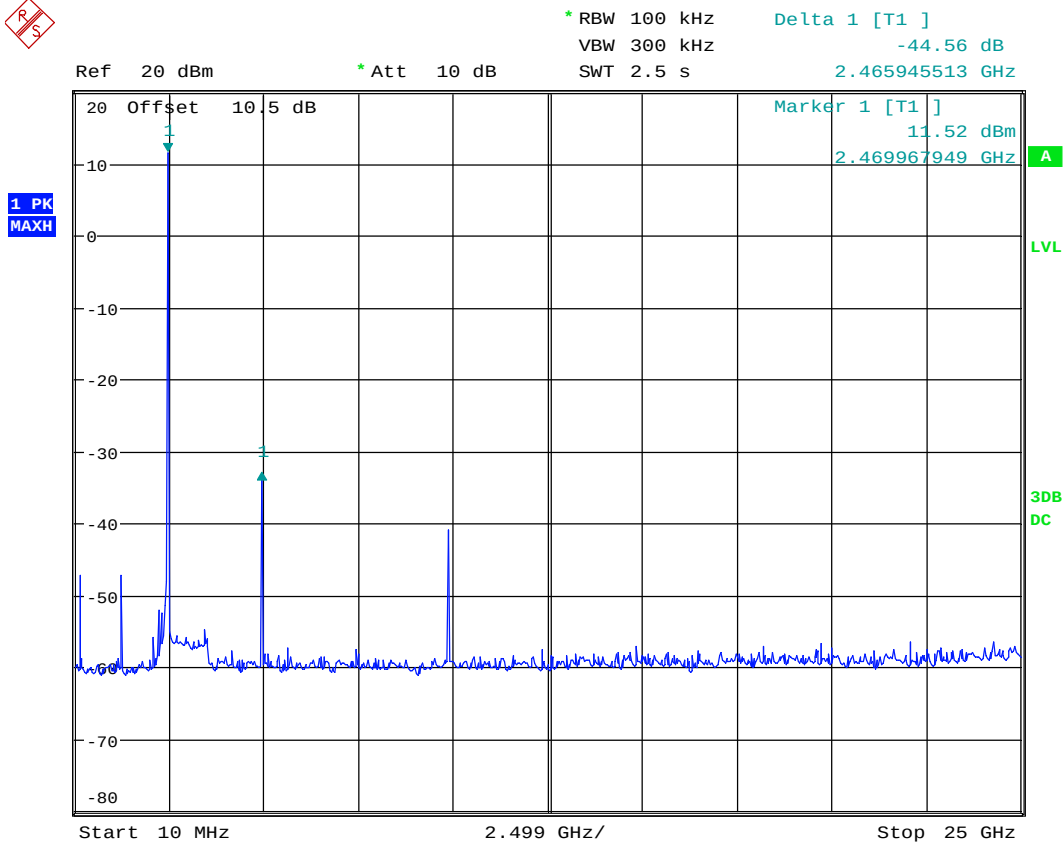
Date: 24.JUN.2017 08:48:08

Conducted spurious emissions 10MHz – 25GHz , ch2412MHz



Date: 24.JUN.2017 08:50:22

Conducted spurious emissions 10MHz – 25GHz , ch2442MHz



Date: 24.JUN.2017 08:54:23

Conducted spurious emissions 10MHz – 25GHz , ch2470MHz

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 4, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		3.6-4.4	3.5-4.4
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 123-138	108-138	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISSED, all other frequencies are common.

3.9 Spurious Emissions (Radiated)

FCC Part 15.247

Test Results: Complies

Measurement Data:

Band-edge conducted power

	Measured field strength (dBμV/m)		Limit	Margin	
	2390 MHz	2483.5 MHz	dBμV/m	dB	
Peak Detector	68.38	68.68	74	5.62	5.32
Average Detector	48.38	48.48	54	5.62	5.32

Average values are obtained with Duty Cycle correction from the peak value.

See attached plots.

Manufacturer declared DC= 1.05%

Duty Cycle Correction Factor Calculation:

Duty Cycle pr channel = slot length / frame length (0.34ms/100ms)=0.0034

Duty Cycle Correction factor = -20 x log(0.0034) = -49 dB

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

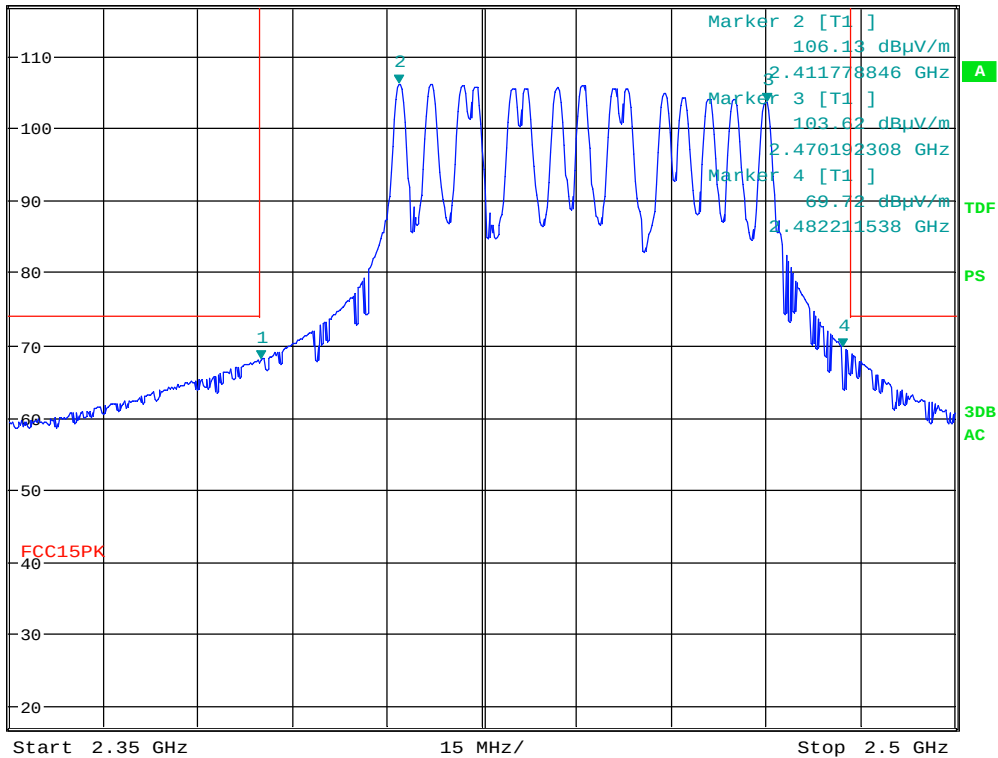


MARKER 1
2.39 GHz
Ref 117 dBμV/m * Att 10 dB

* RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms

Marker 1 [T1]
67.85 dBμV/m
2.390000000 GHz

1 PK
MAXH



Date: 23.JUN.2017 11:14:49

Band edge in hoping mode -PK



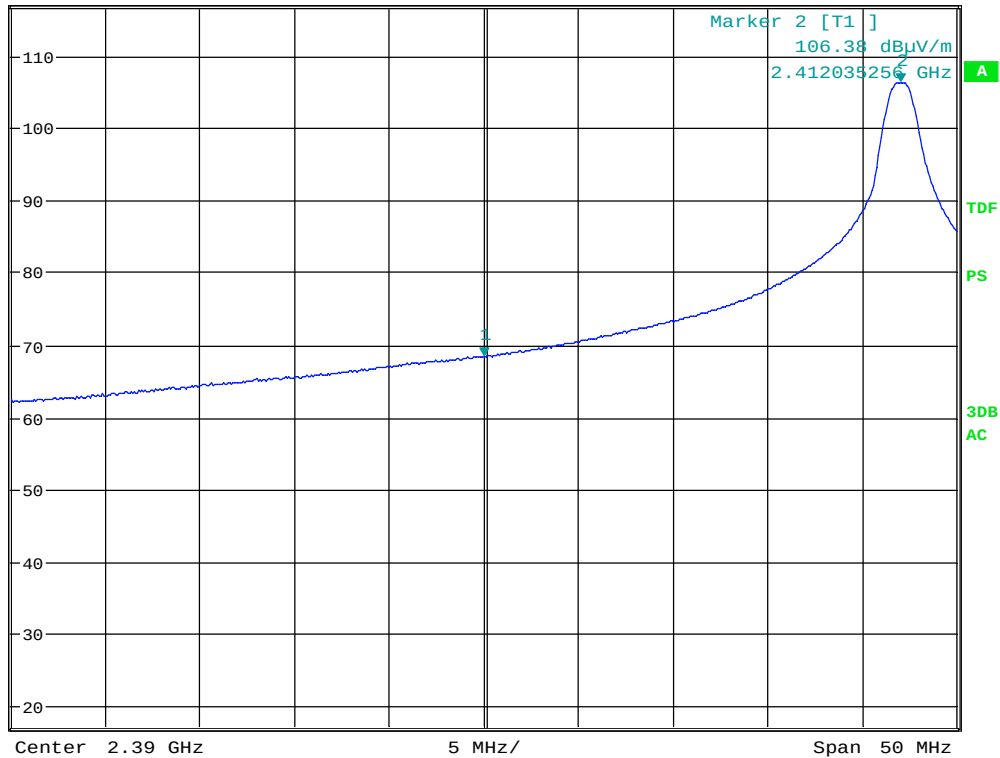
* RBW 1 MHz
VBW 3 MHz
SWT 2.5 ms

Marker 1 [T1]
68.38 dBμV/m
2.390000000 GHz

Ref 117 dBμV/m

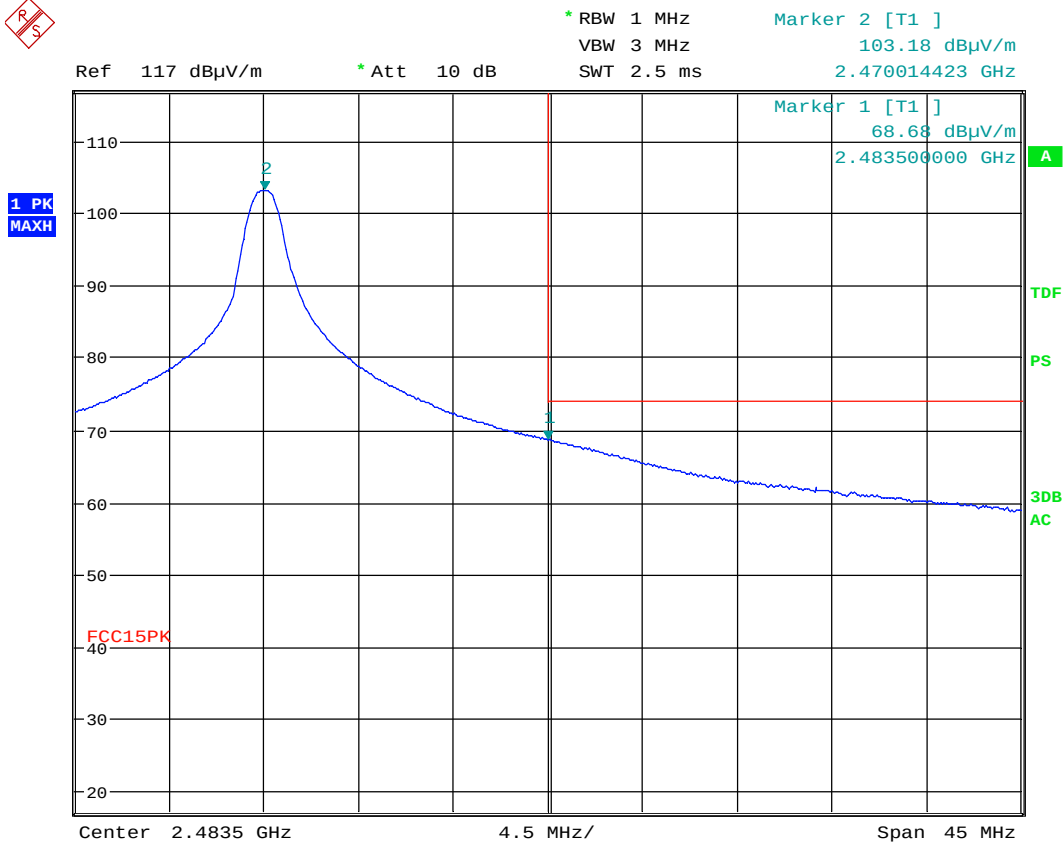
* Att 10 dB

1 PK
MAXH



Date: 23.JUN.2017 10:50:21

Lower band edge – ch2412MHz , PK



Date: 23.JUN.2017 12:01:37

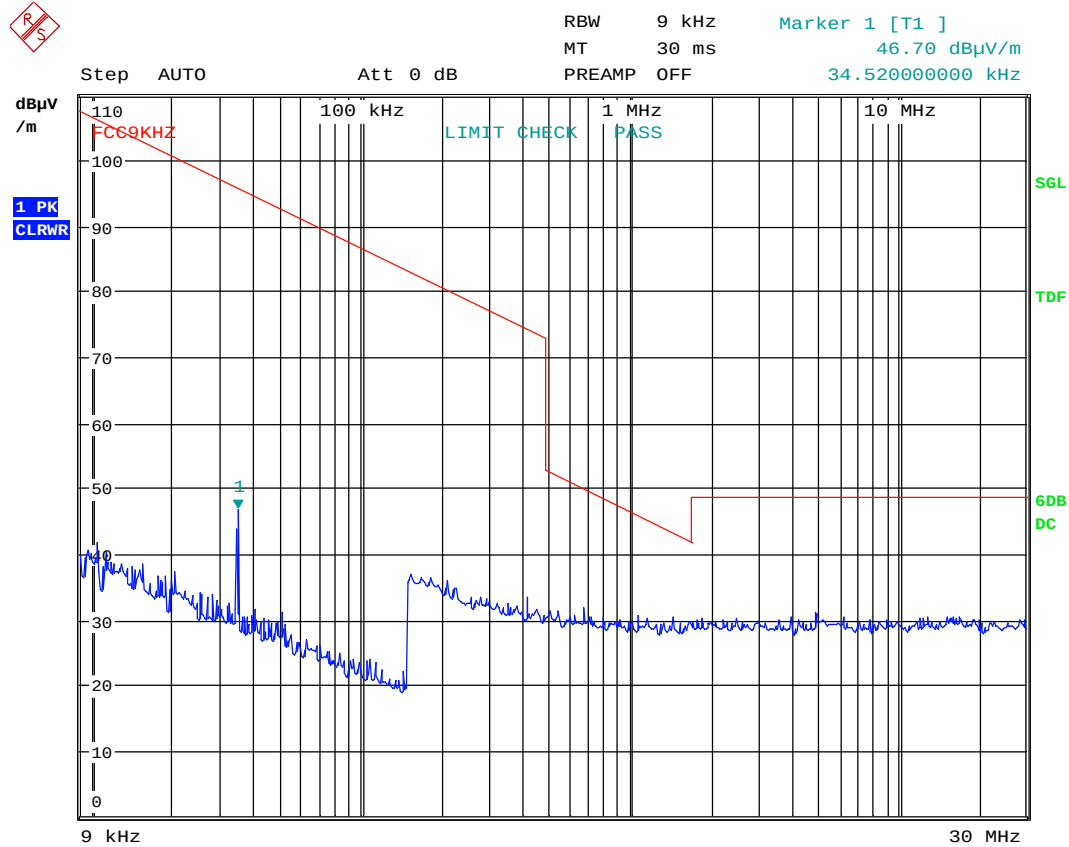
Upper band edge , ch2470MHz, PK

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: 23.JUN.2017 19:22:50

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

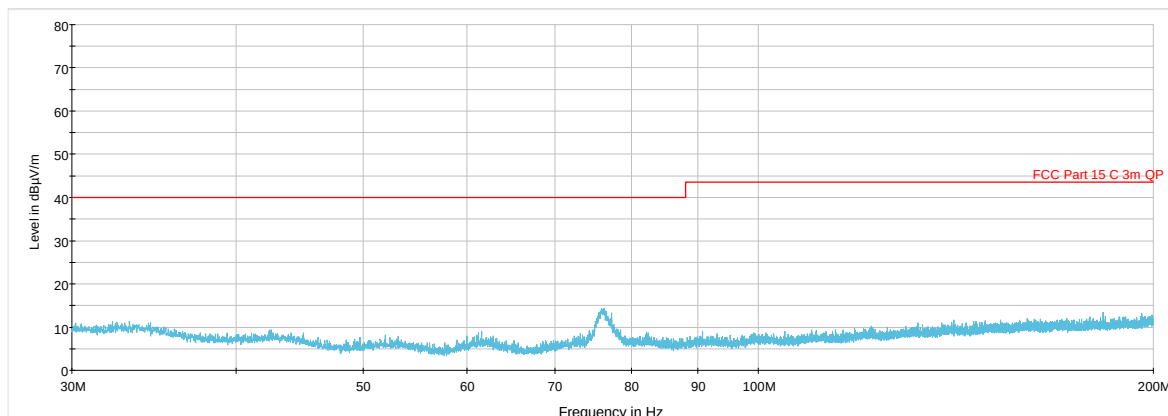
Measuring distance 3 m.

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
/	/	/	/	/	/	/	/	/

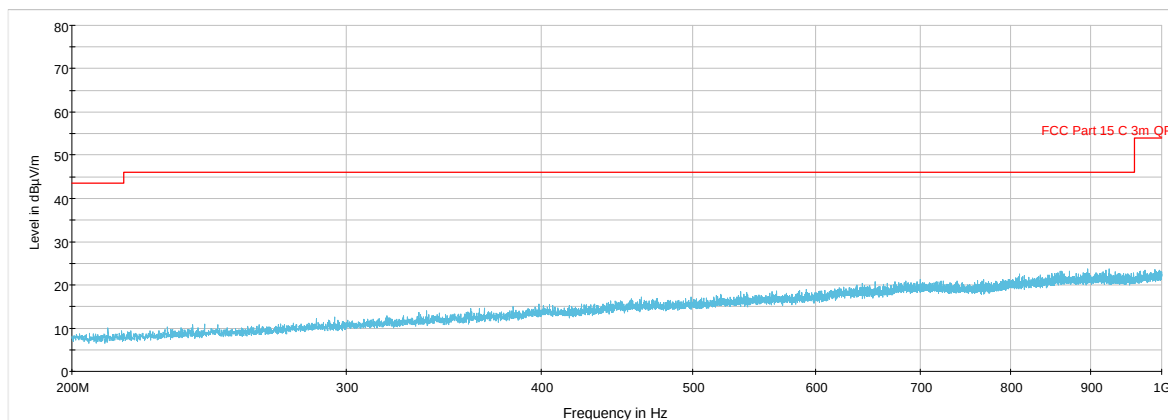
See attached graphs.

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)	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



30 – 200MHz – PK scan



200 – 1000MHz , PK scan

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 12 GHz)
1m (12 – 25 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
4.824	L	0	68.30	/	74	5.7
4.884	M	0	71.94	/	74	2.06
4.940	H	0	69.57	/	74	4.43
7.236	L	0	55.86	/	74	18.14
7.326	M	0	56.75	/	74	17.25
7.41	H	0	54.72	/	74	19.28
9.648	L	0	58.39	/	74	15.61
9.768	M	0	63.44	/	74	10.56
9.88	H	0	59.03	/	74	14.97
12.0645	L	-9.5	48.53	/	74	25.47
12.21	M	-9.5	48.71	/	74	25.29
12.35	H	-9.5	50.26	/	74	23.74
14.4774	L	-9.5	60.61	/	74	13.39
14.652	M	-9.5	61.49	/	74	12.51
14.82	H	-9.5	58.57	/	74	15.43
16.8903	L	-9.5	60.73	/	74	13.27
17.094	M	-9.5	54.63	/	74	19.37
17.29	H	-9.5	54.25	/	74	19.75
21.98	H	-9.5	53.82	/	74	20.18
Other freqs	L,M,H	/	None detected	/	74	>20

Distance correction is included in the graph.

Maximum is obtained in Vertical Polarization.

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
4.824	L	0	48.3	20	54	5.7
4.884	M	0	51.94	20	54	2.06
4.940	H	0	49.57	20	54	4.43
7.236	L	0	35.86	20	54	18.14
7.326	M	0	36.75	20	54	17.25
7.41	H	0	34.72	20	54	19.28
9.648	L	0	38.39	20	54	15.61
9.768	M	0	43.44	20	54	10.56
9.88	H	0	39.03	20	54	14.97
12.0645	L	-9.5	28.53	20	54	25.47
12.21	M	-9.5	28.71	20	54	25.29
12.35	H	-9.5	30.26	20	54	23.74
14.4774	L	-9.5	40.61	20	54	13.39
14.652	M	-9.5	41.49	20	54	12.51
14.82	H	-9.5	38.57	20	54	15.43
16.8903	L	-9.5	40.73	20	54	13.27
17.094	M	-9.5	34.63	20	54	19.37
17.29	H	-9.5	34.25	20	54	19.75
21.98	H	-9.5	33.82			20.18
Other freqs	L,M,H	/	None detected	/	54	>20

Distance correction is included in the graph.

Maximum is obtained in Vertical Polarization.

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 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



MARKER 1

4.823679487 GHz

Ref 82 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

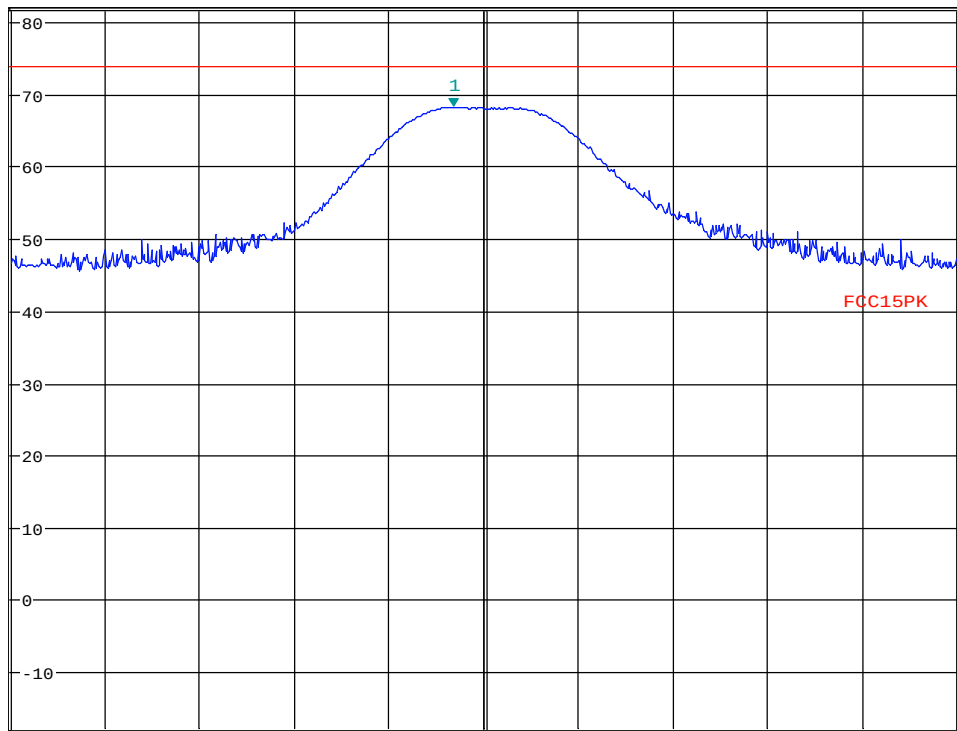
SWT 20 ms

Marker 1 [T1]

68.30 dBμV/m

4.823679487 GHz

1 PK
MAXH



Date: 23.JUN.2017 12:58:47

2nd harmonic , ch2412 , VP -PK



MARKER 1

4.884288462 GHz

Ref 82 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

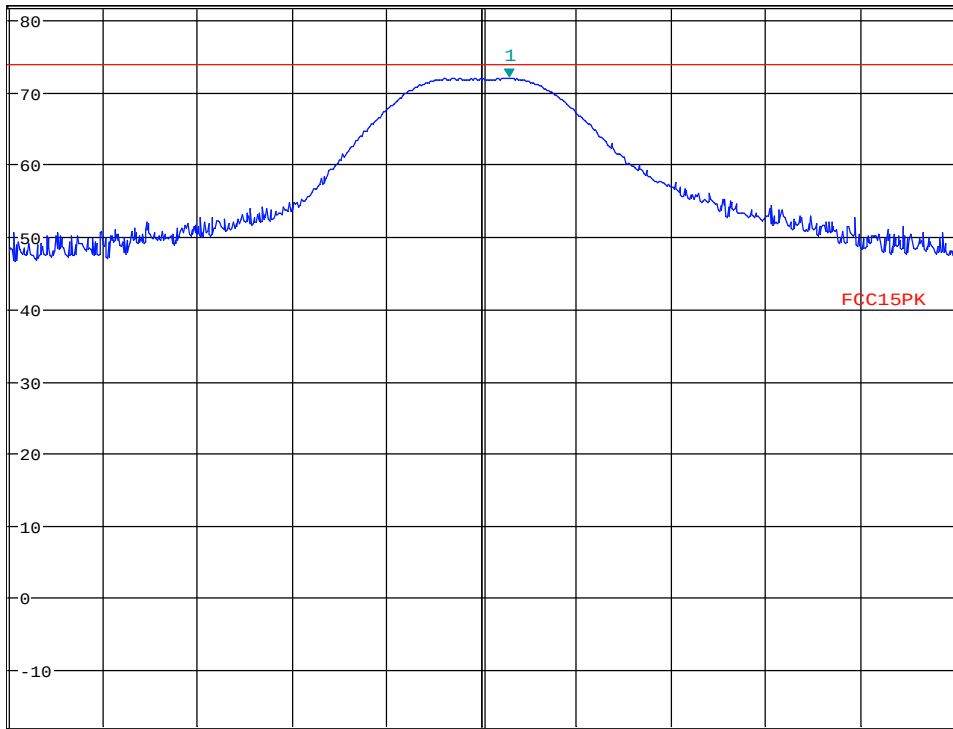
SWT 20 ms

Marker 1 [T1]

71.94 dBμV/m

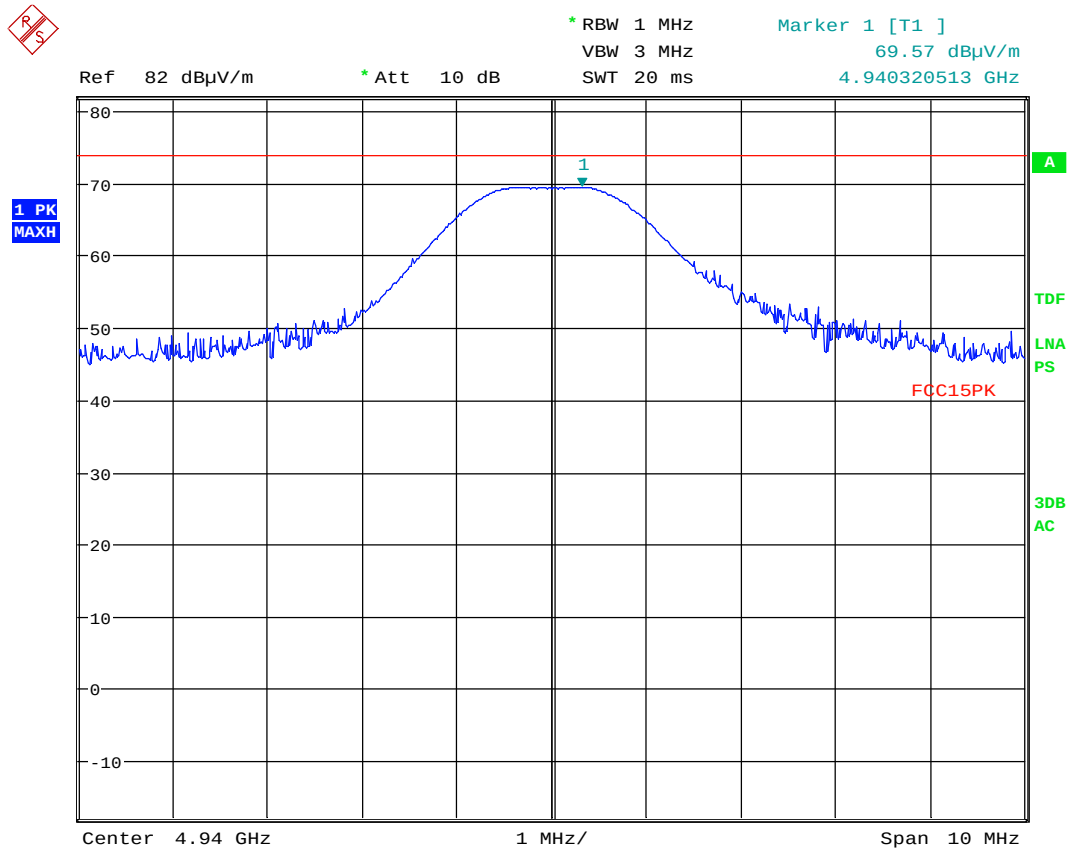
4.884288462 GHz

1 PK
MAXH



Date: 23.JUN.2017 13:01:26

2nd harmonic , ch2442 , VP -PK



Date: 23.JUN.2017 12:29:44

2nd harmonic , ch2470 , VP -PK



MARKER 1

7.235535256 GHz

Ref 82 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

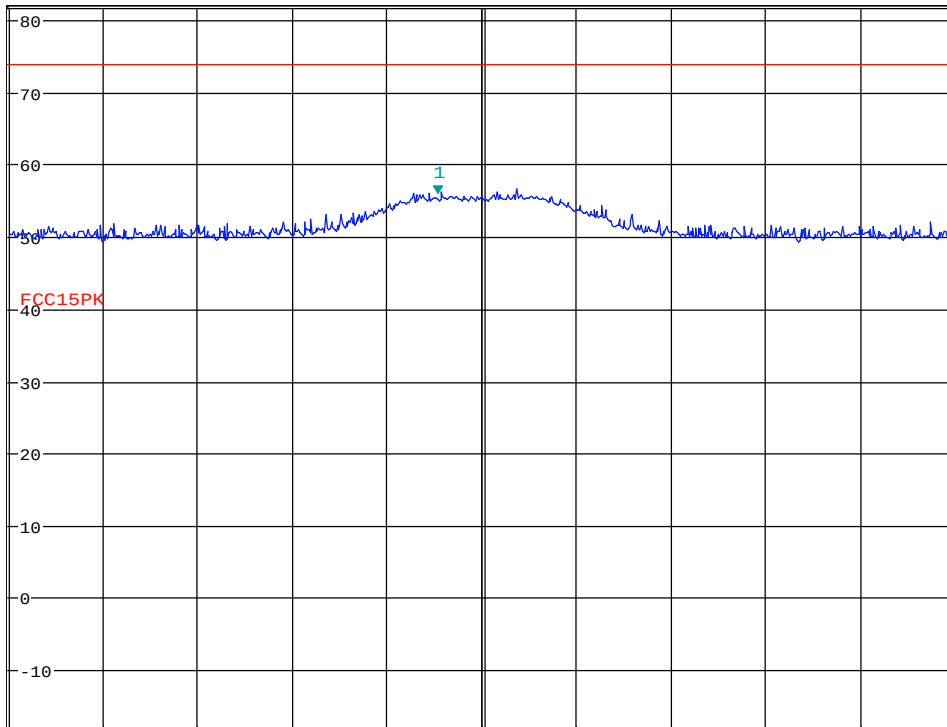
SWT 20 ms

Marker 1 [T1]

55.86 dBμV/m

7.235535256 GHz

1 PK
MAXH



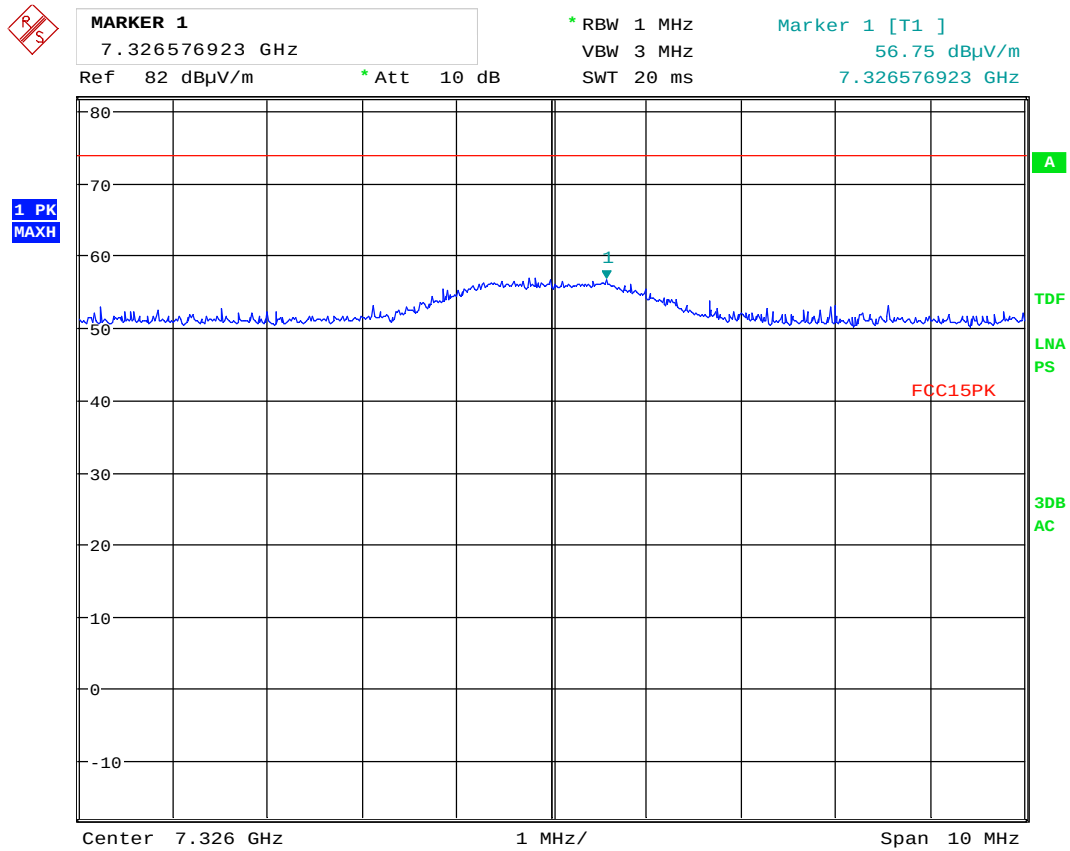
Center 7.236 GHz

1 MHz/

Span 10 MHz

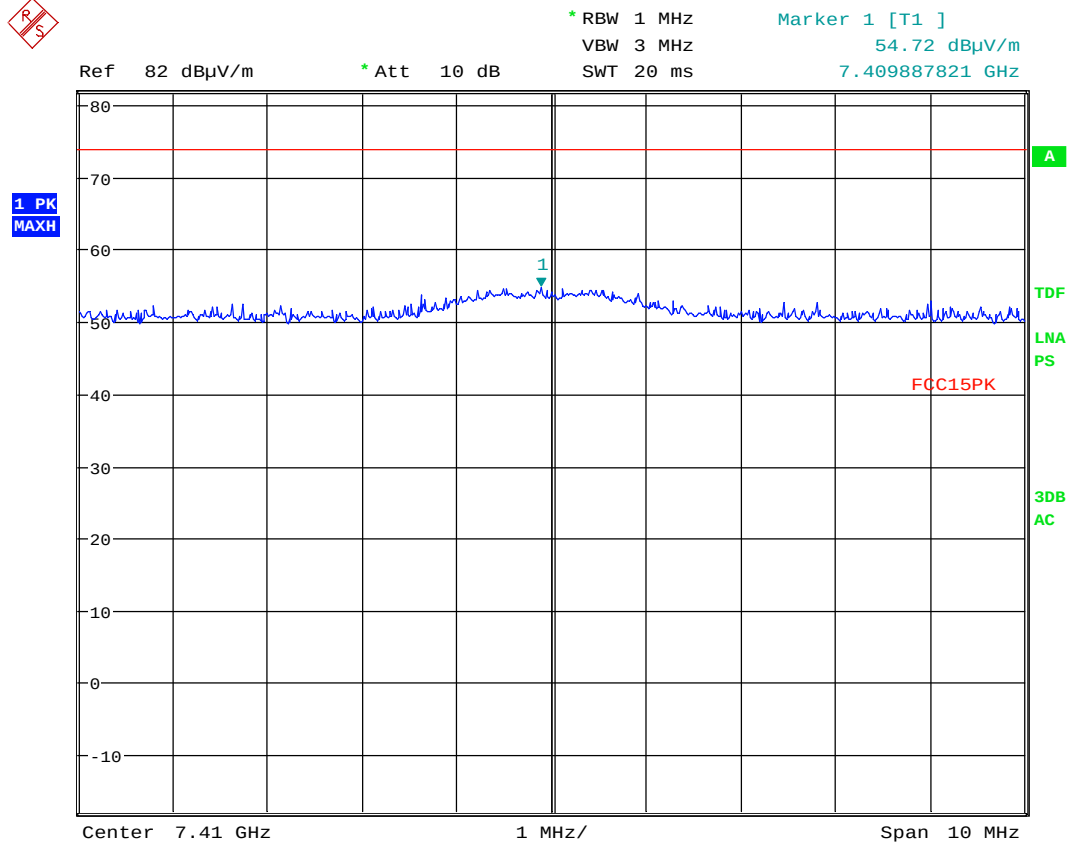
Date: 23.JUN.2017 12:56:51

3rd harmonic , ch2412 , VP -PK



Date: 23.JUN.2017 13:07:50

3rd harmonic , ch2442 , VP -PK



Date: 23.JUN.2017 12:41:43

3rd harmonic , ch2470 , VP -PK



MARKER 1

9.648673077 GHz

Ref 82 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

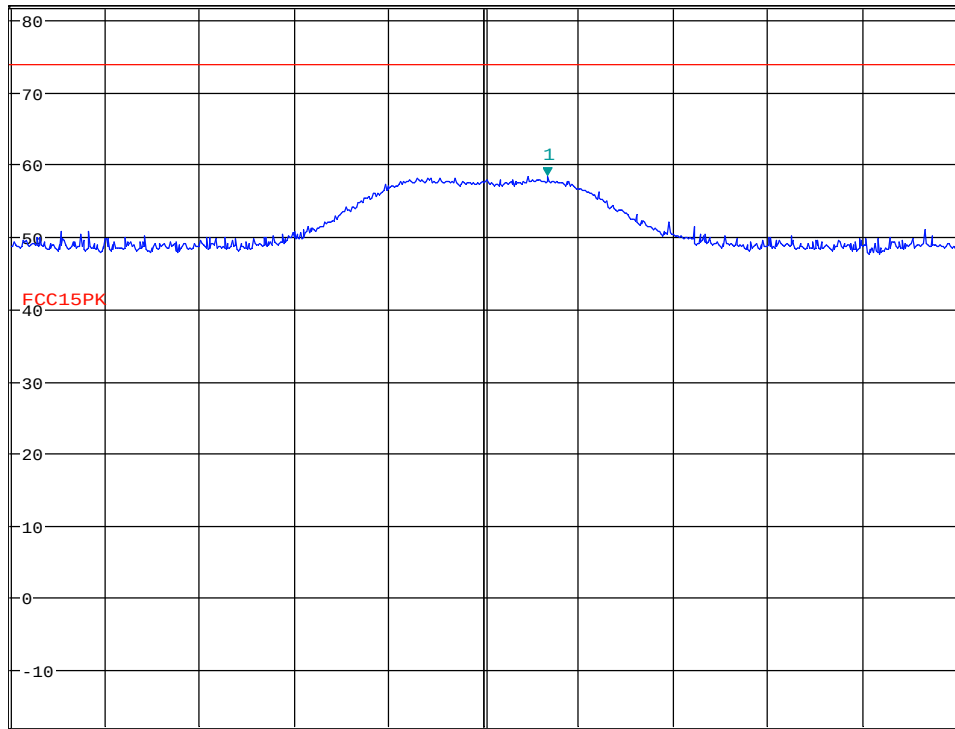
SWT 20 ms

Marker 1 [T1]

58.39 dBμV/m

9.648673077 GHz

1 PK
MAXH



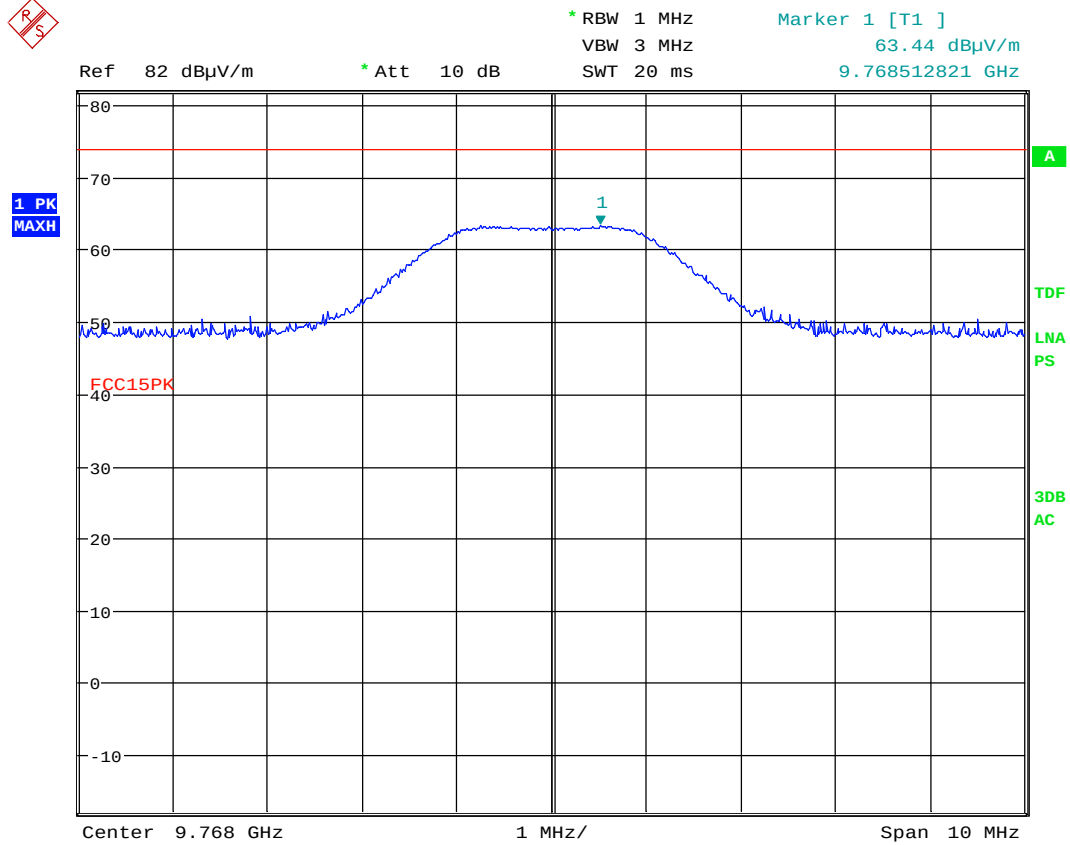
Center 9.648 GHz

1 MHz/

Span 10 MHz

Date: 23.JUN.2017 13:31:34

4th harmonic , ch2412 , HP -PK



Date: 23.JUN.2017 13:22:41

4th harmonic , ch2442 , HP -PK



MARKER 1

9.880384615 GHz

Ref 82 dB μ V/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

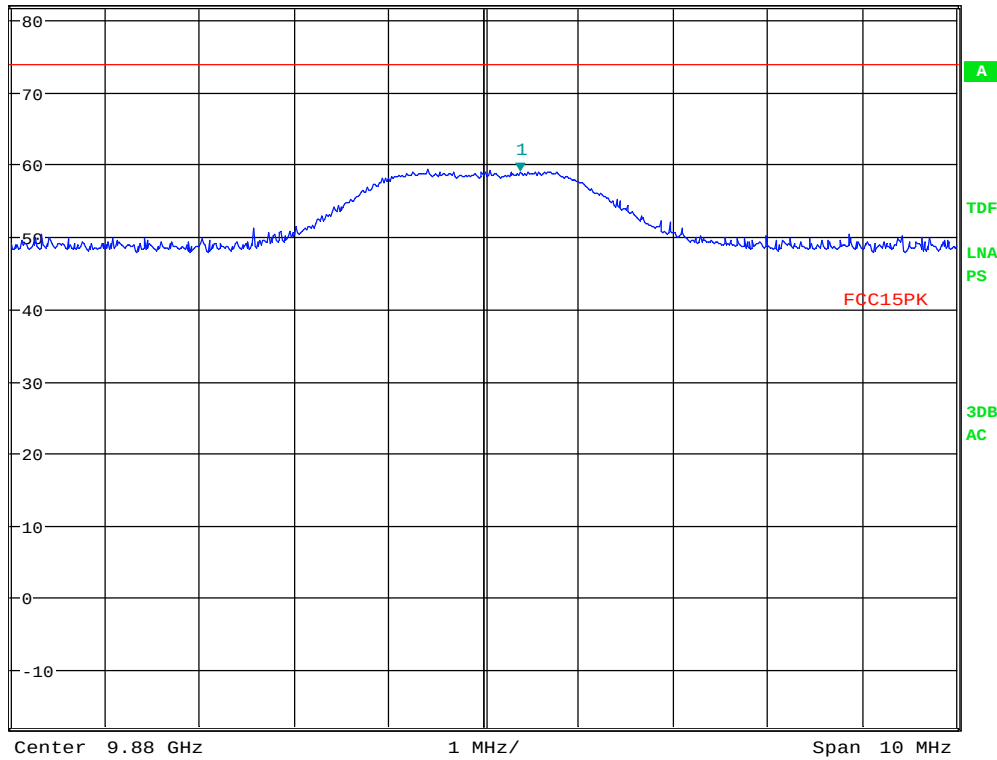
SWT 20 ms

Marker 1 [T1]

59.03 dB μ V/m

9.880384615 GHz

1 PK
MAXH



Date: 23.JUN.2017 13:35:00

4th harmonic , ch2470 , HP -PK



MARKER 1

12.059375 GHz

Ref 72.5 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

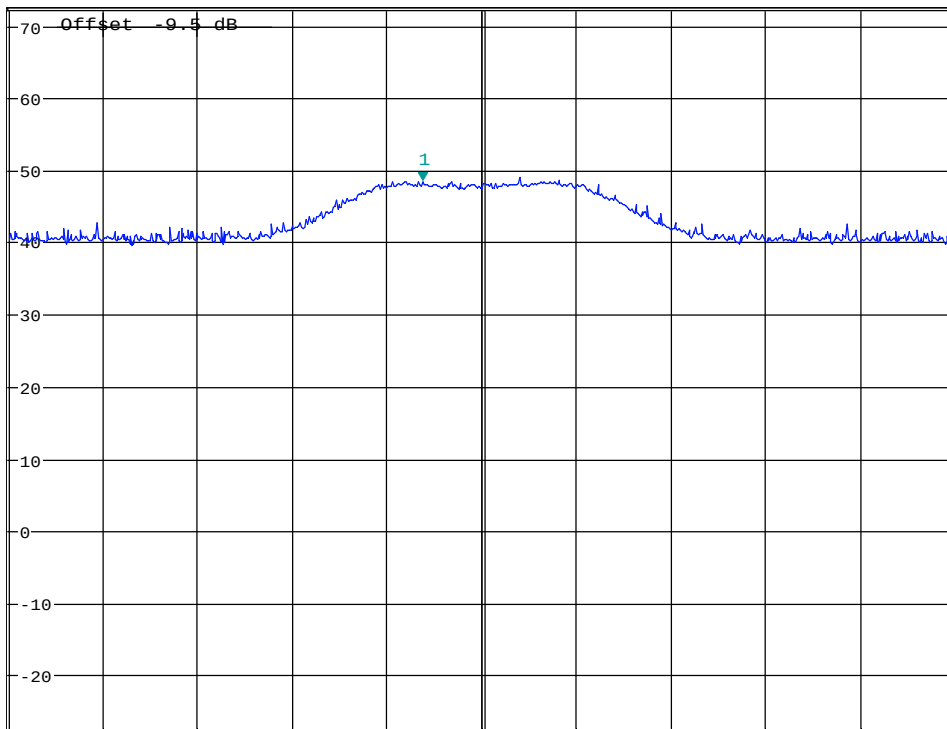
* SWT 200 ms

Marker 1 [T1]

48.53 dBμV/m

12.059375000 GHz

1 PK
MAXH



Center 12.06 GHz

1 MHz/

Span 10 MHz

A

LVL

TDF

LNA

PS

3DB

AC

Date: 23.JUN.2017 16:35:50

5th harmonic , ch2412 , VP -PK



MARKER 1

12.20958333 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

VBW 3 MHz

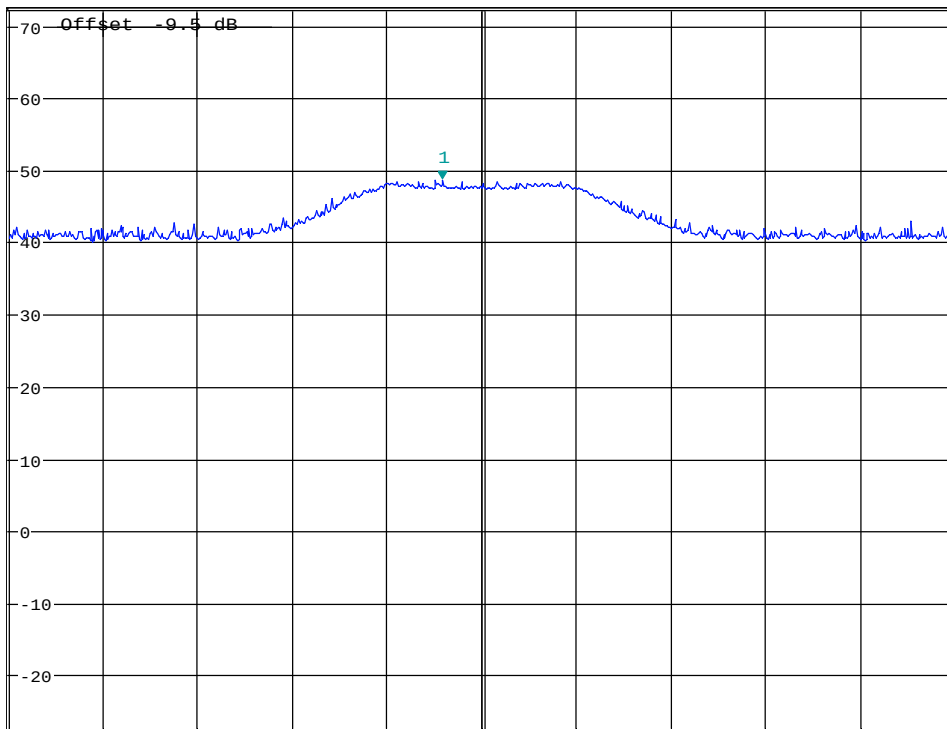
* SWT 200 ms

Marker 1 [T1]

48.71 dBμV/m

12.20958333 GHz

1 PK
MAXH



A

LVL

TDF

LNA

PS

3DB

AC

Date: 23.JUN.2017 16:41:29

5th harmonic , ch2442 , VP -PK



MARKER 1

12.35078526 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

VBW 3 MHz

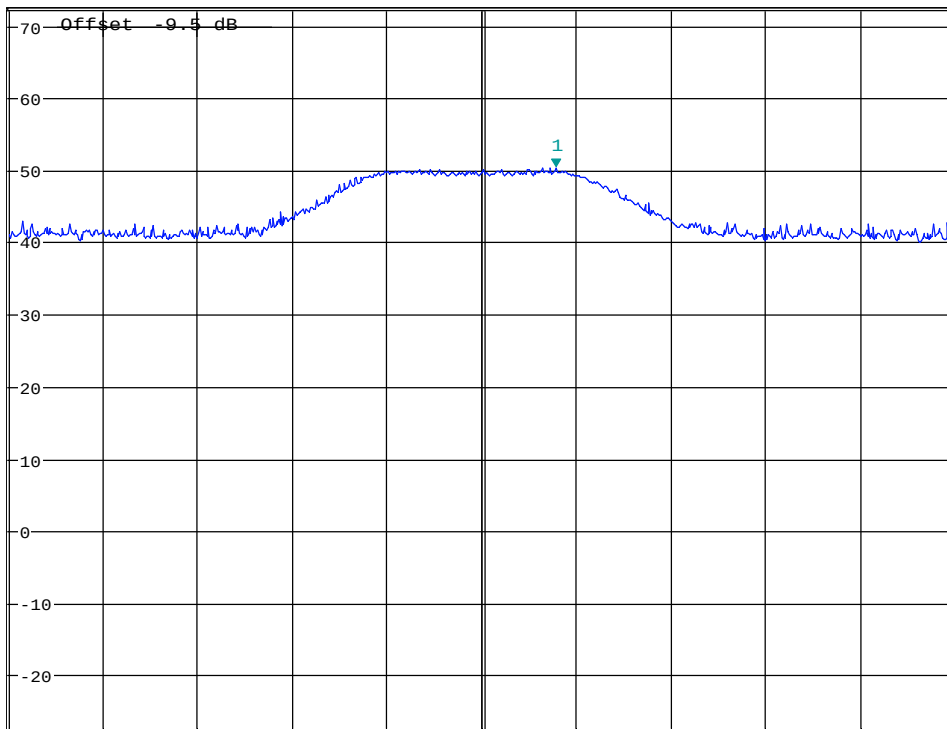
* SWT 200 ms

Marker 1 [T1]

50.26 dBμV/m

12.350785256 GHz

1 PK
MAXH



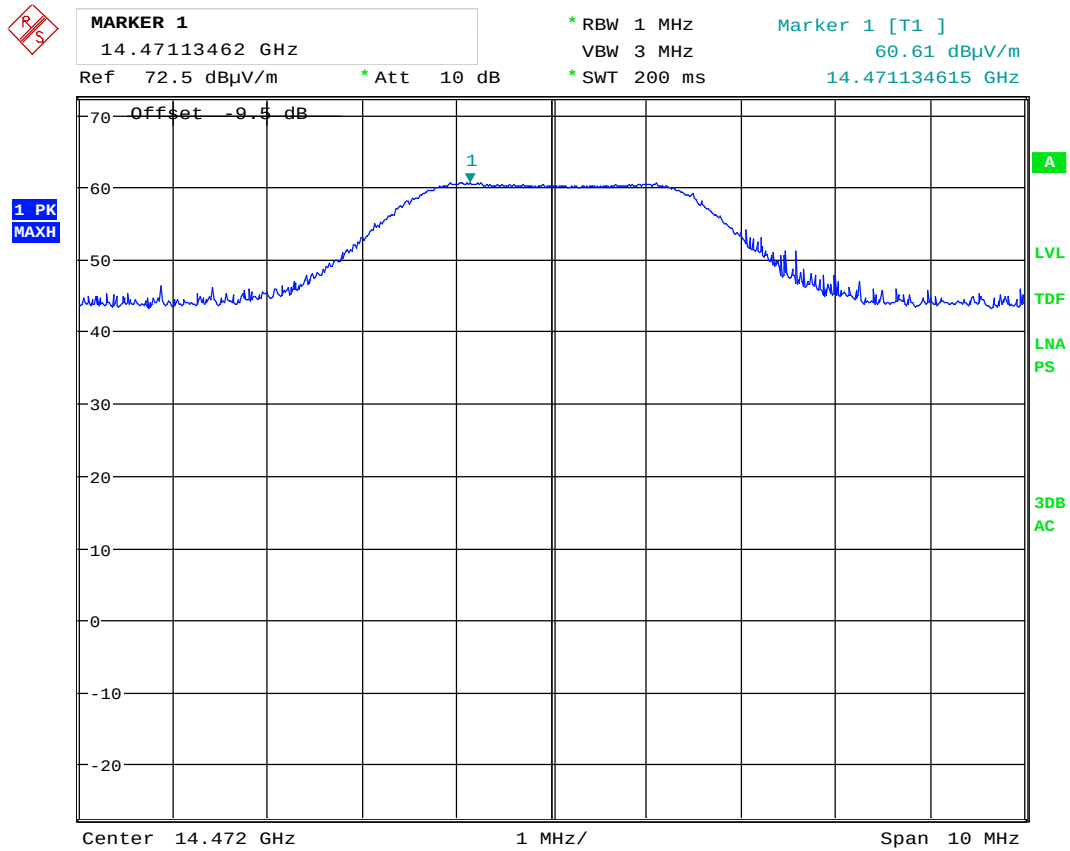
Center 12.35 GHz

1 MHz/

Span 10 MHz

Date: 23.JUN.2017 16:47:47

5th harmonic , ch2470 , VP -PK



Date: 23.JUN.2017 16:36:29

6th harmonic , ch2412 , VP -PK



MARKER 1

14.65116667 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

VBW 3 MHz

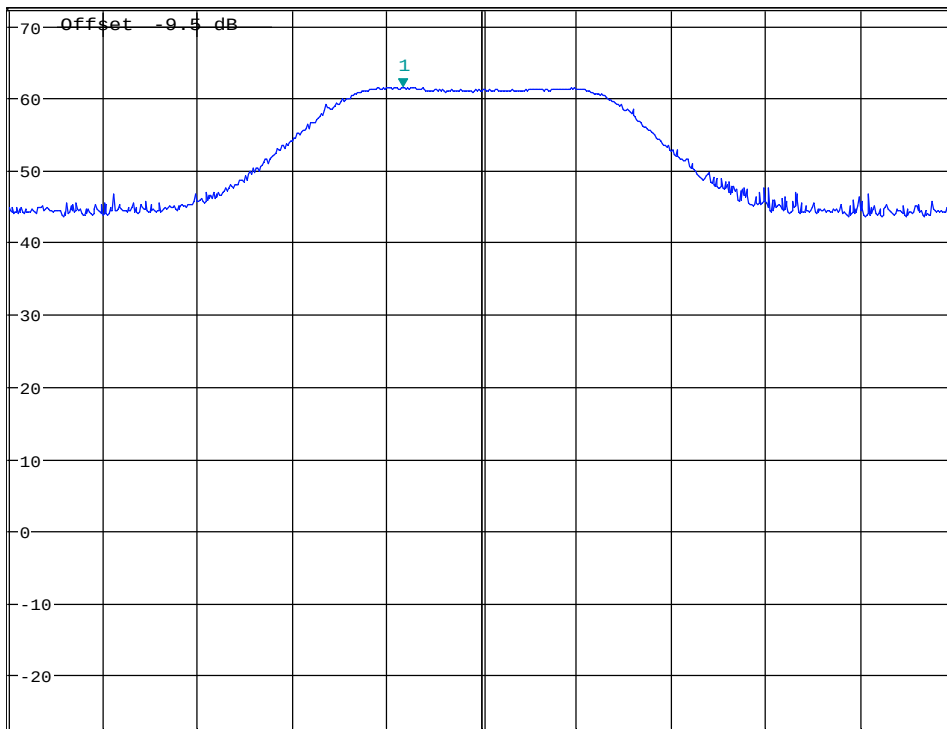
* SWT 200 ms

Marker 1 [T1]

61.49 dBμV/m

14.65116667 GHz

1 PK
MAXH



Center 14.652 GHz 1 MHz/ Span 10 MHz

A

LVL

TDF

LNA

PS

3DB

AC

Date: 23.JUN.2017 16:41:50

6th harmonic , ch2442 , VP -PK



MARKER 1

14.82102564 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

VBW 3 MHz

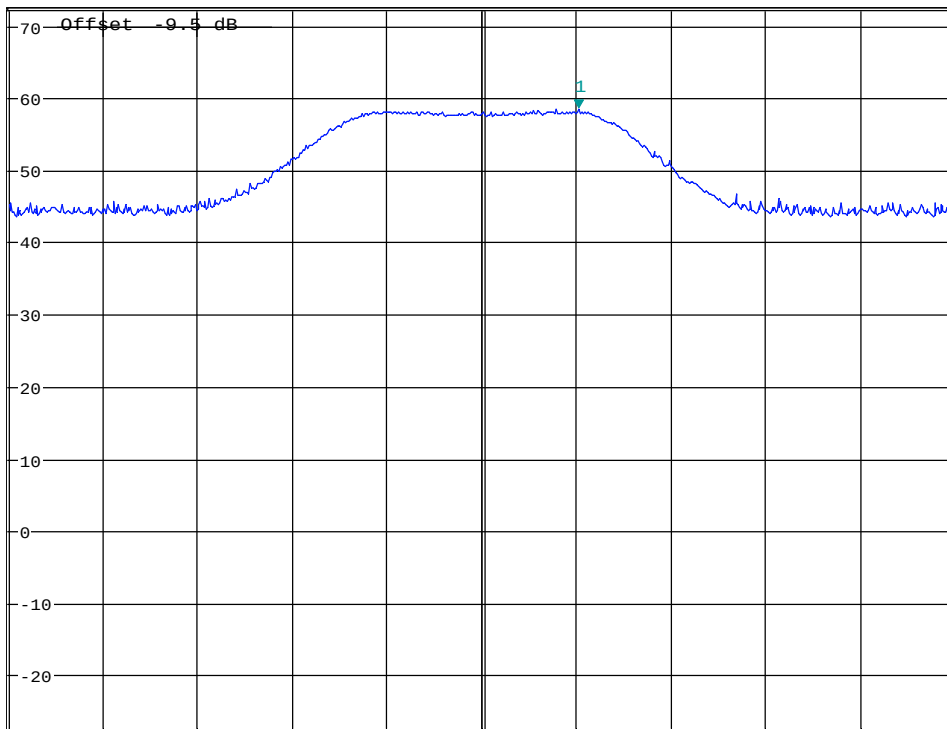
* SWT 200 ms

Marker 1 [T1]

58.57 dBμV/m

14.821025641 GHz

1 PK
MAXH



Center 14.82 GHz 1 MHz/ Span 10 MHz

A

LVL

TDF

LNA

PS

3DB

AC

Date: 23.JUN.2017 16:47:26

6th harmonic , ch2470 , VP -PK



MARKER 1

16.88291026 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

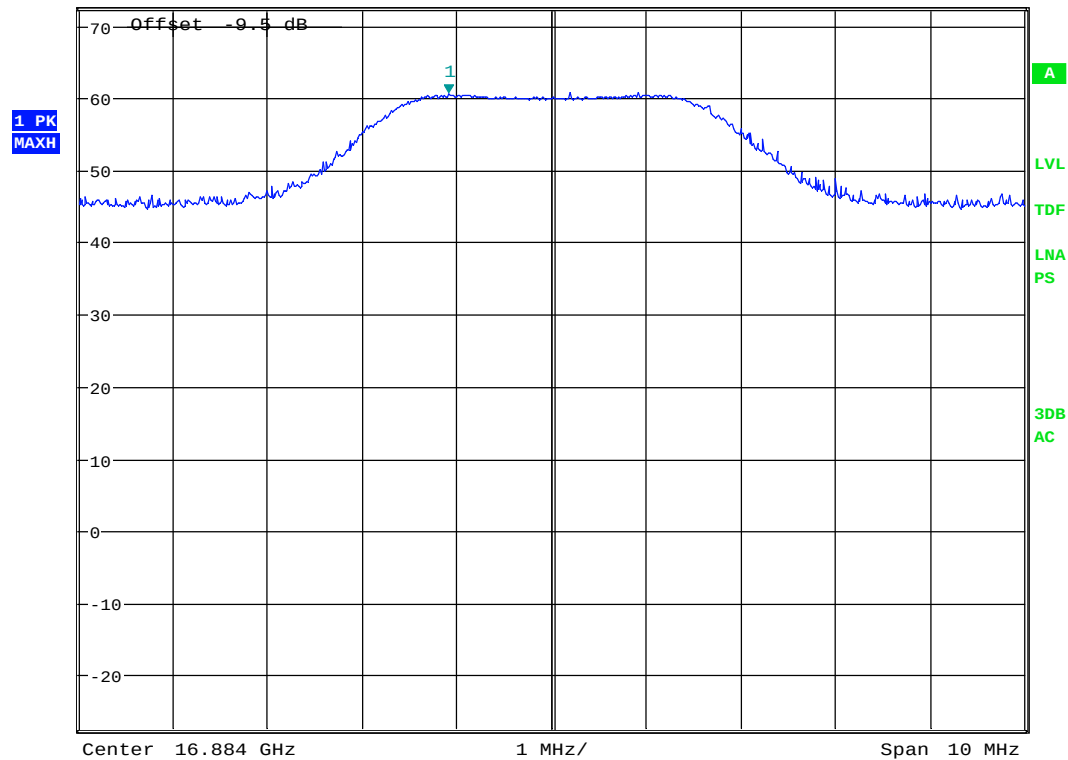
VBW 3 MHz

* SWT 200 ms

Marker 1 [T1]

60.73 dBμV/m

16.882910256 GHz



Date: 23.JUN.2017 16:36:51

7th harmonic , ch2412 , VP -PK



MARKER 1

17.09374359 GHz

Ref 72.5 dBμV/m * Att 10 dB

* RBW 1 MHz

VBW 3 MHz

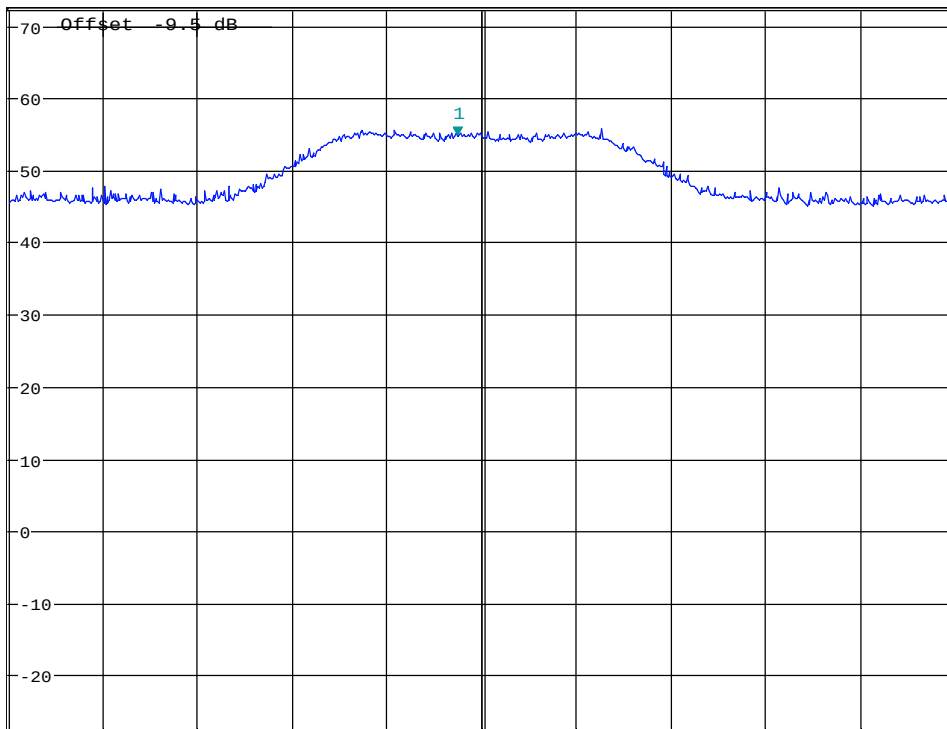
* SWT 200 ms

Marker 1 [T1]

54.65 dBμV/m

17.093743590 GHz

1 PK
MAXH



Center 17.094 GHz 1 MHz/ Span 10 MHz

Date: 23.JUN.2017 16:42:27

7th harmonic , ch2442 , VP -PK



MARKER 3

2.724358974 GHz

Ref 117 dBμV/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

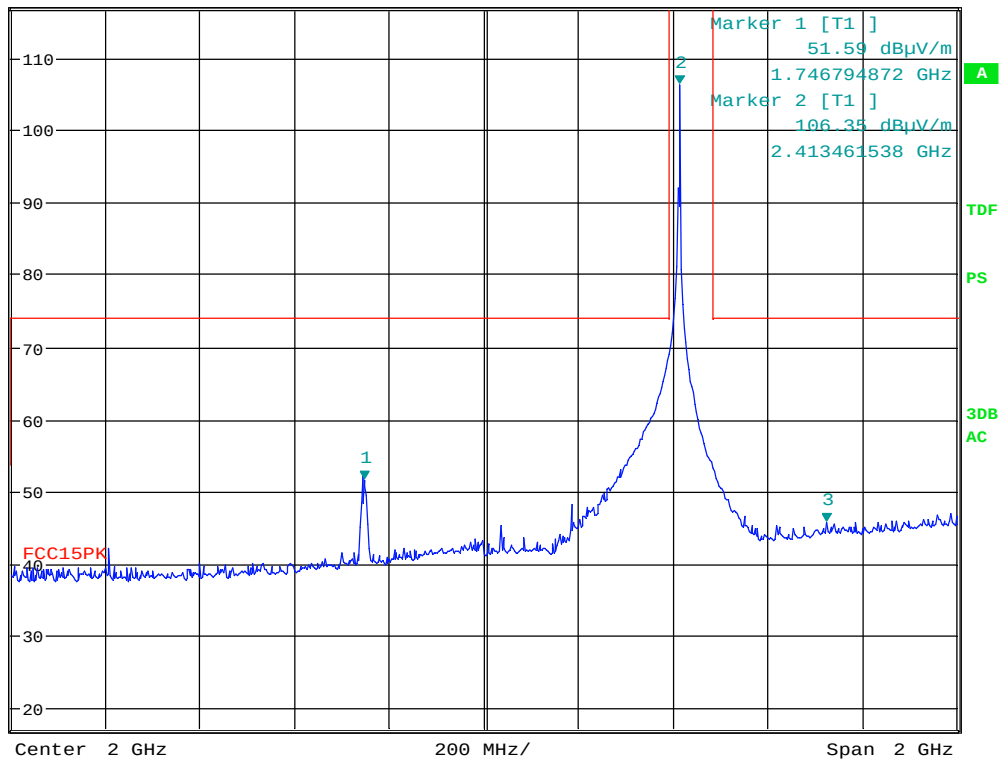
SWT 5 ms

Marker 3 [T1]

45.64 dBμV/m

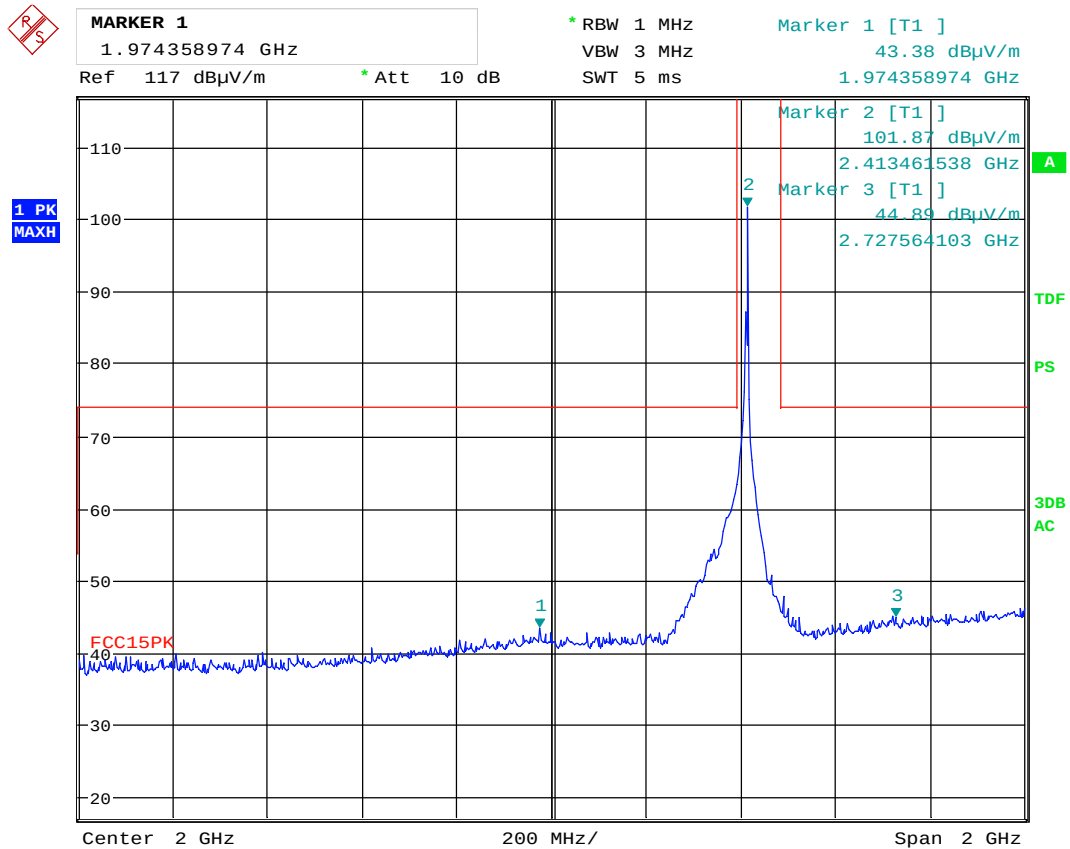
2.724358974 GHz

1 PK
MAXH



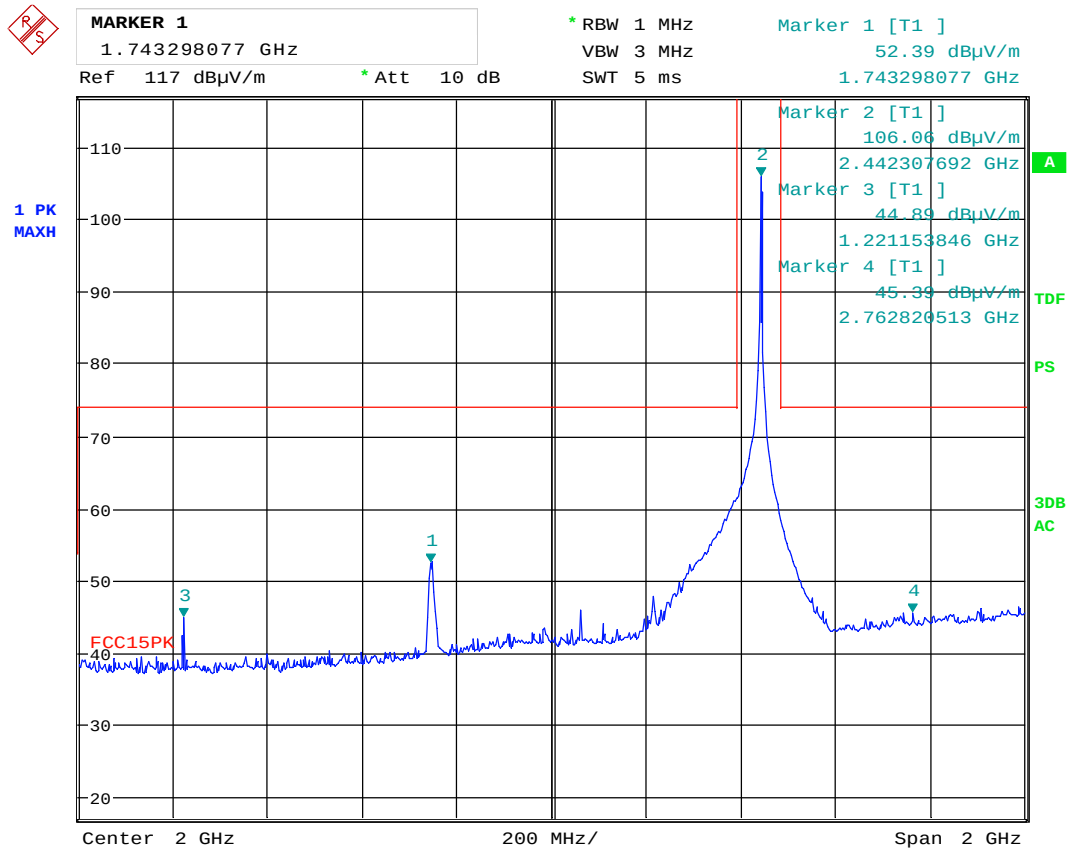
Date: 23.JUN.2017 10:55:50

VP, 1 - 3GHz -ch2412MHz- PK scan



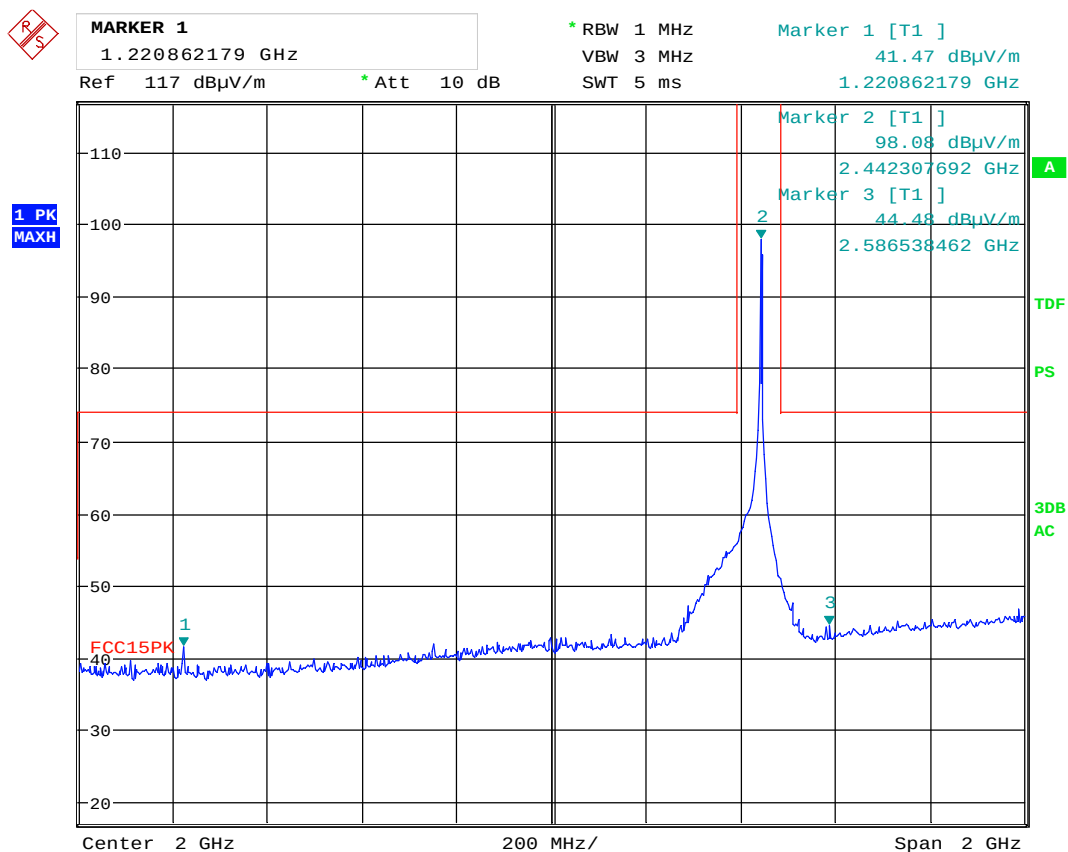
Date: 23.JUN.2017 10:57:19

HP, 1 - 3GHz -ch2412MHz- PK scan



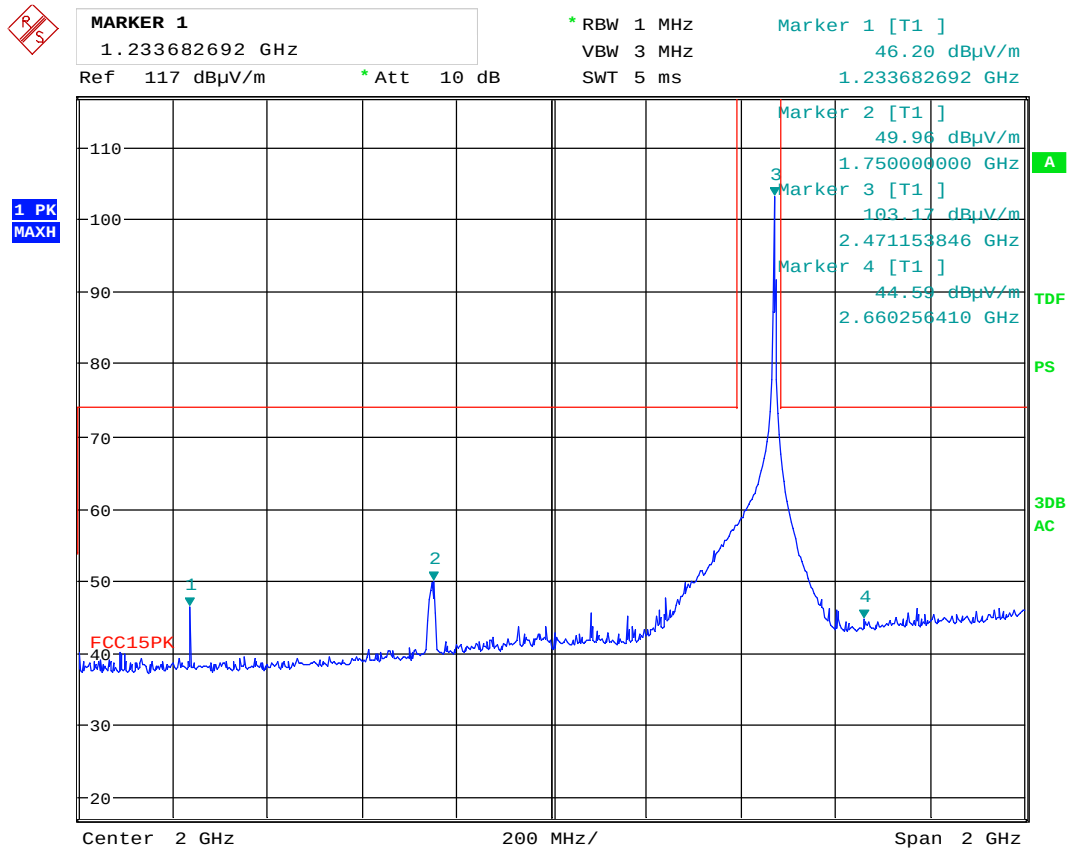
Date: 23.JUN.2017 11:50:23

VP, 1 - 3GHz -ch2442MHz- PK scan



Date: 23.JUN.2017 11:52:10

HP, 1 - 3GHz -ch2442MHz- PK scan

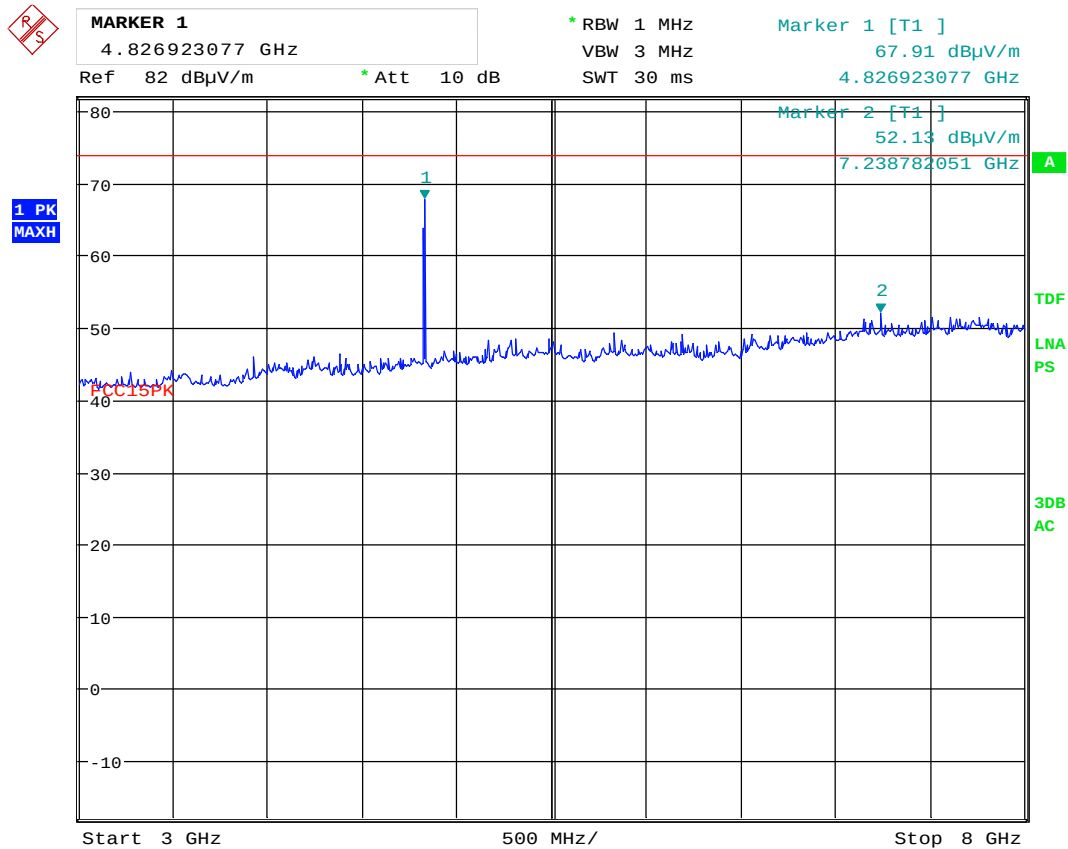


Date: 23.JUN.2017 11:58:26

VP, 1 - 3GHz -ch2470MHz- PK scan

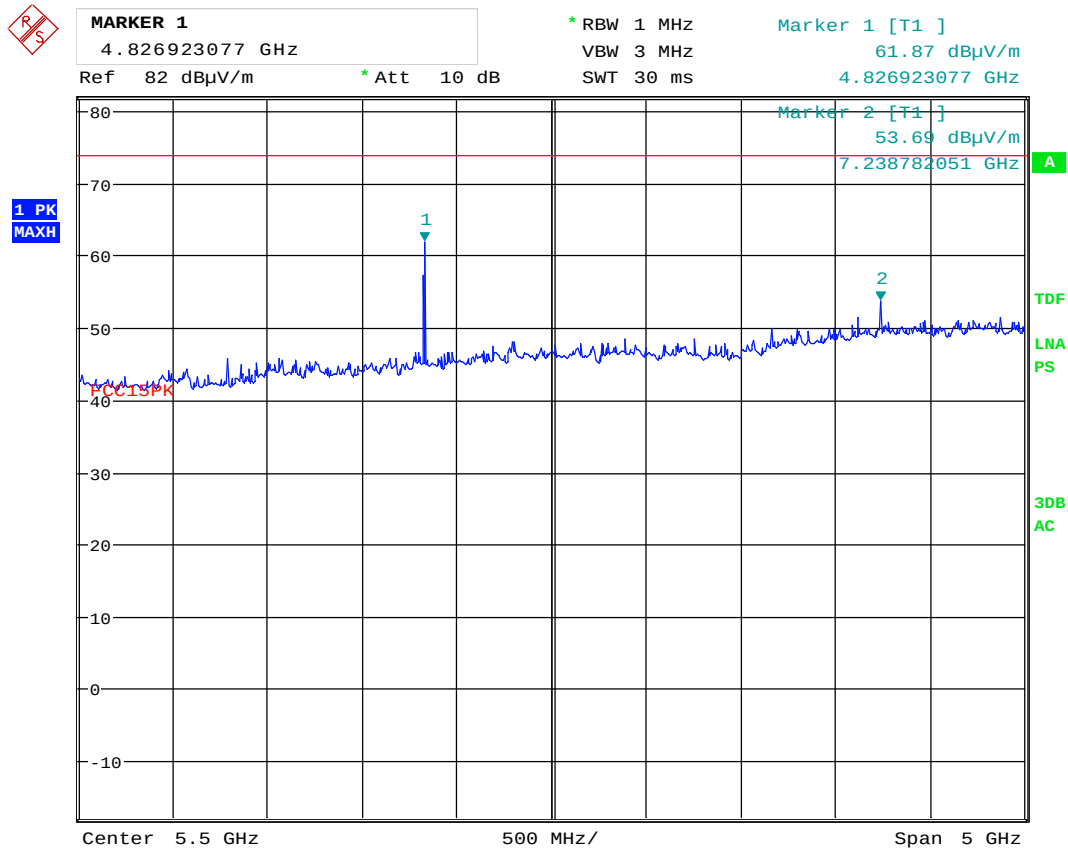


HP, 1 - 3GHz -ch2470MHz- PK scan



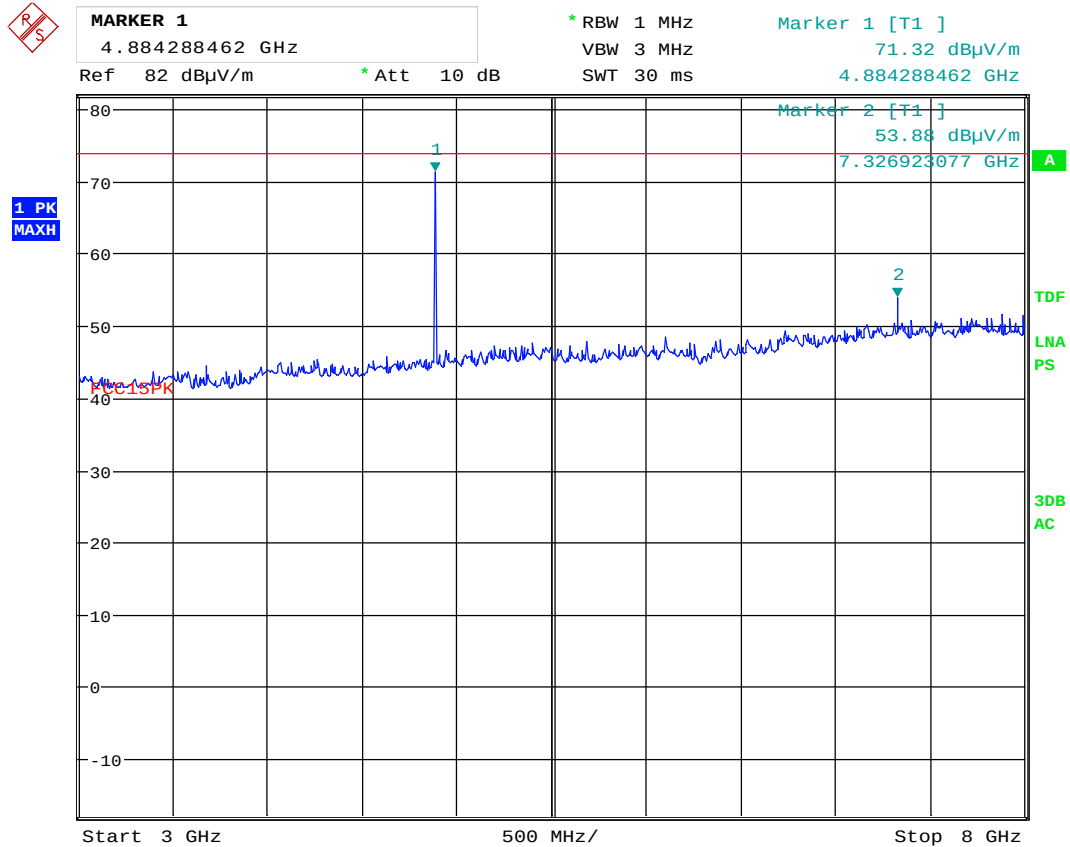
Date: 23.JUN.2017 12:57:53

VP, 3 - 8GHz -ch2412MHz- PK scan



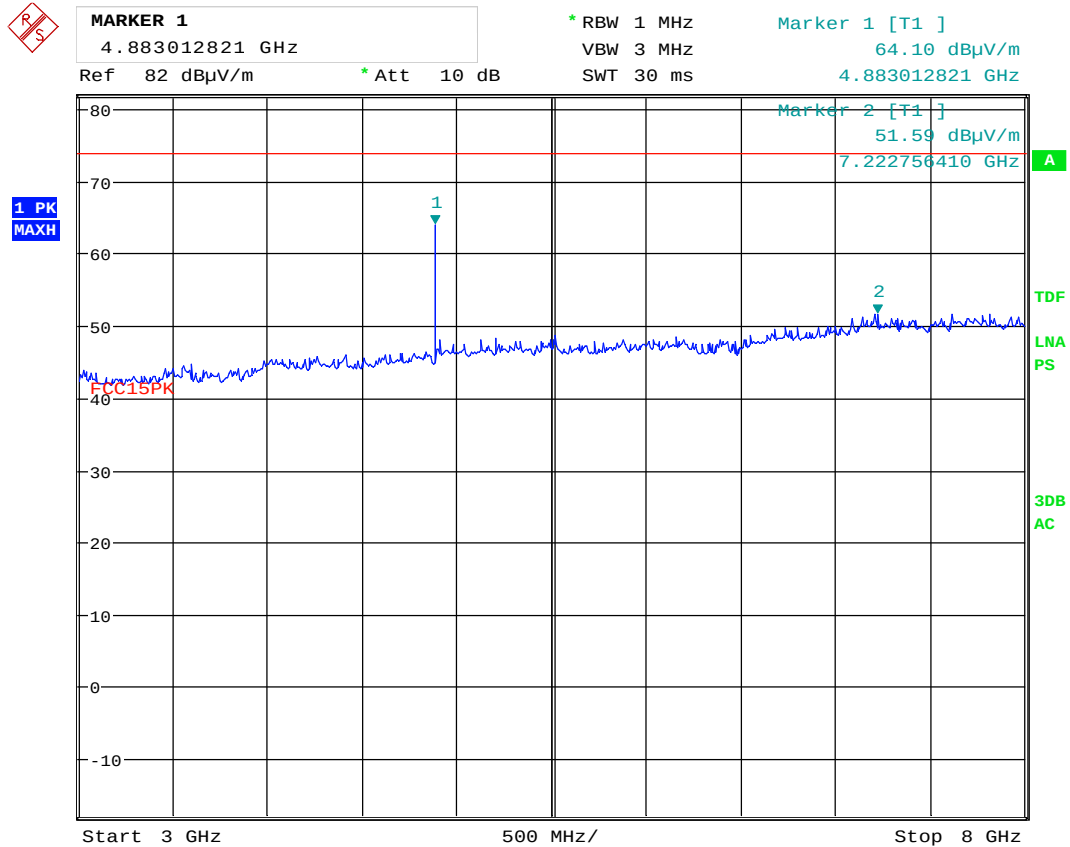
Date: 23.JUN.2017 12:56:11

HP, 3 - 8GHz -ch2412MHz- PK scan



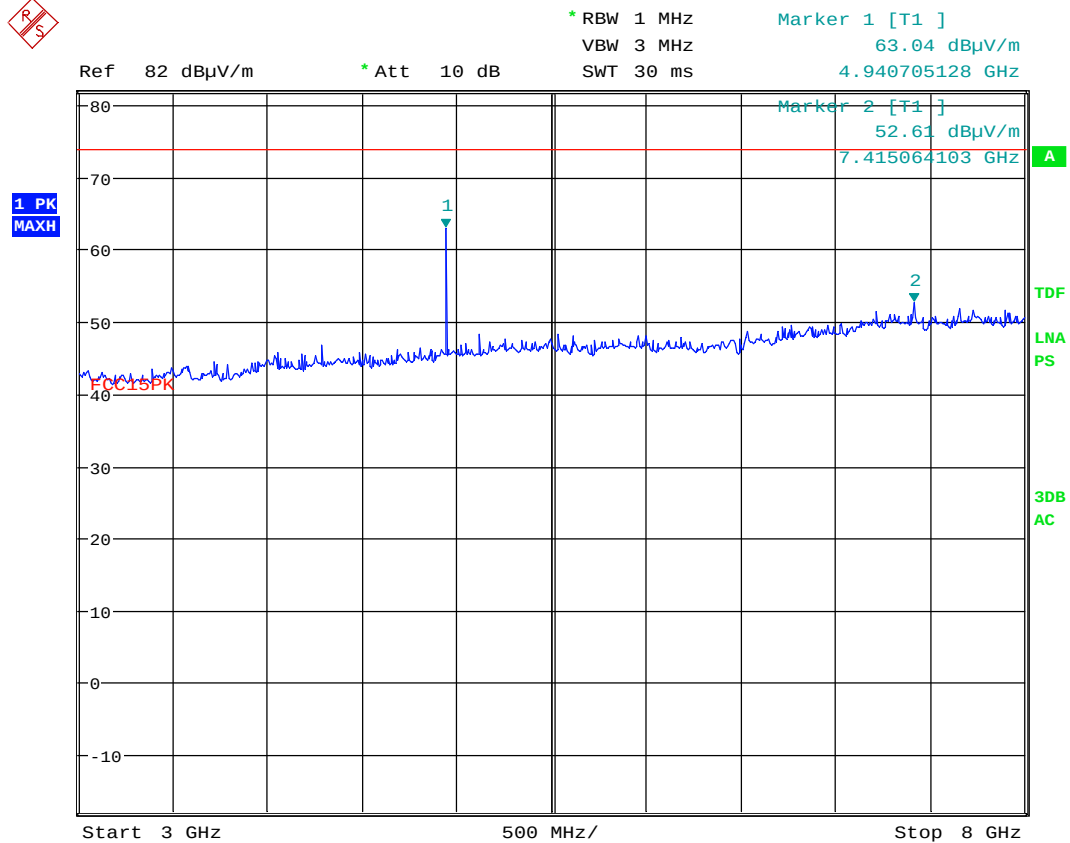
Date: 23.JUN.2017 13:02:01

VP, 3 - 8GHz -ch2442MHz- PK scan



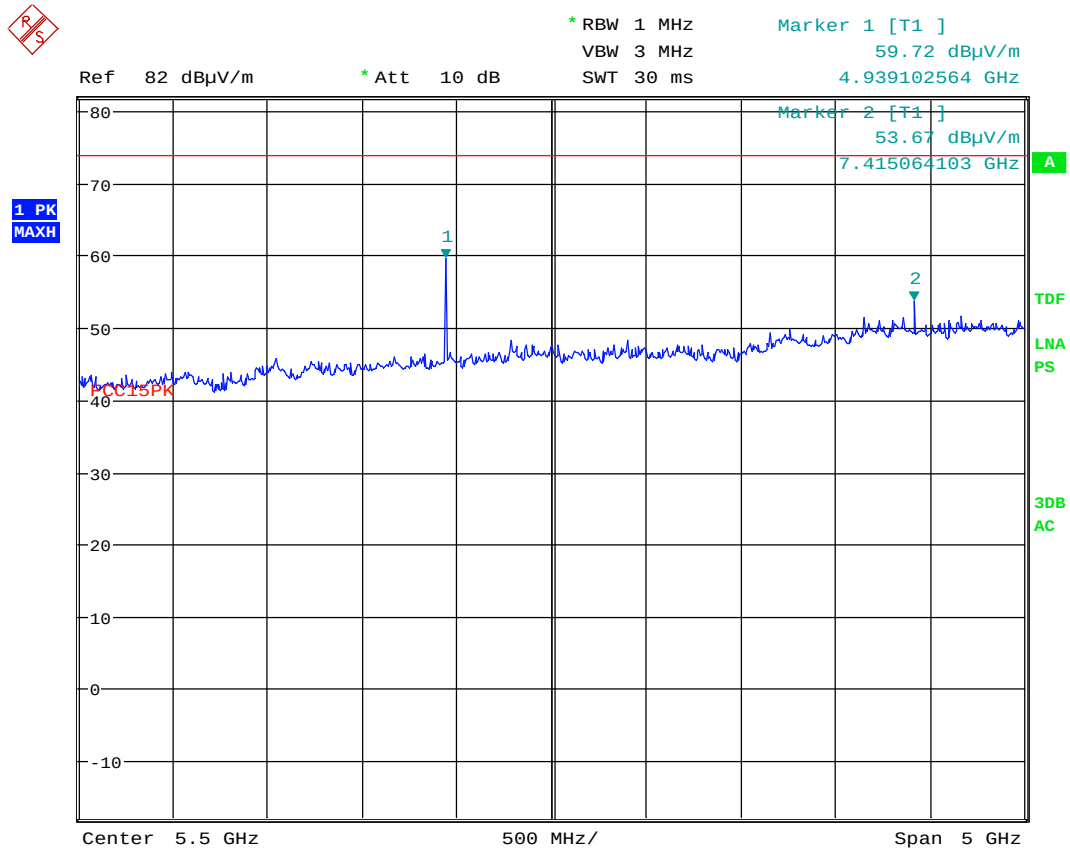
Date: 23.JUN.2017 13:04:36

HP, 3 - 8GHz -ch2442MHz- PK scan



Date: 23.JUN.2017 12:19:43

VP, 3 - 8GHz -ch2470MHz- PK scan



Date: 23.JUN.2017 12:53:25

HP, 3 - 8GHz -ch2470MHz- PK scan



MARKER 1

9.647435897 GHz

Ref 82 dB μ V/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

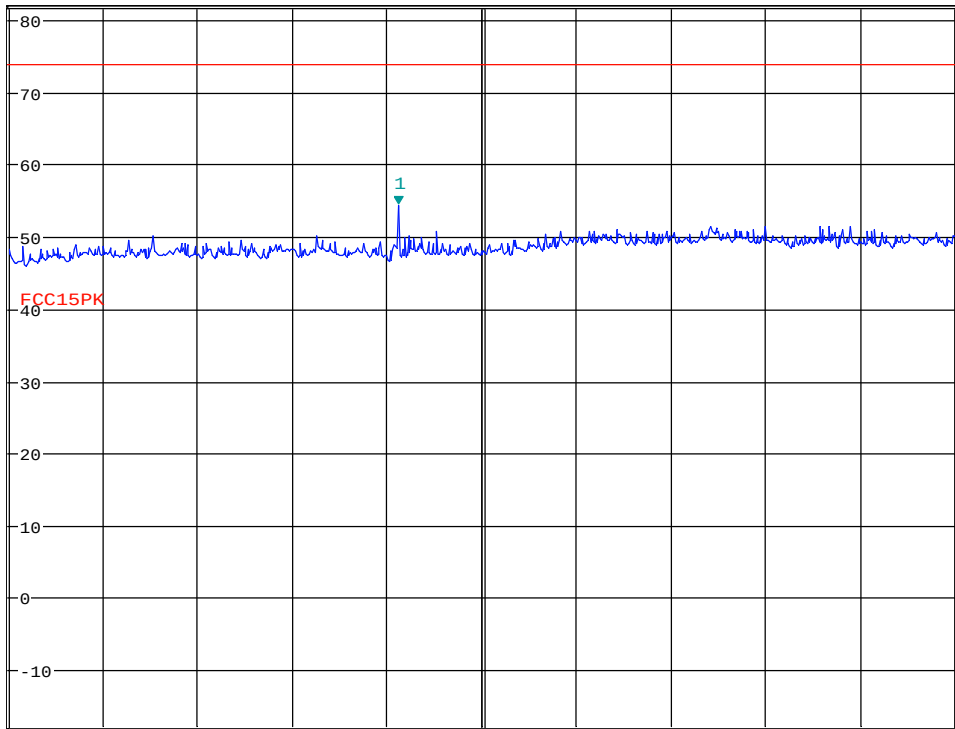
SWT 25 ms

Marker 1 [T1]

54.28 dB μ V/m

9.647435897 GHz

1 PK
MAXH



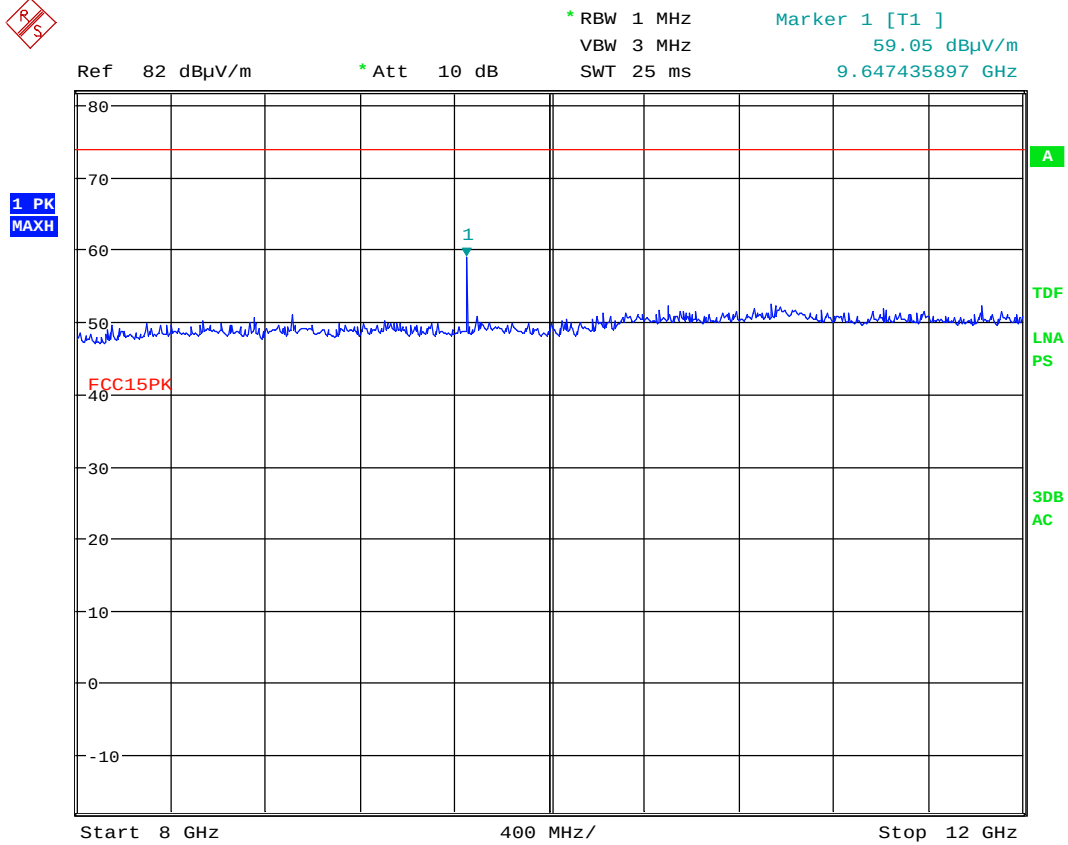
Start 8 GHz

400 MHz/

Stop 12 GHz

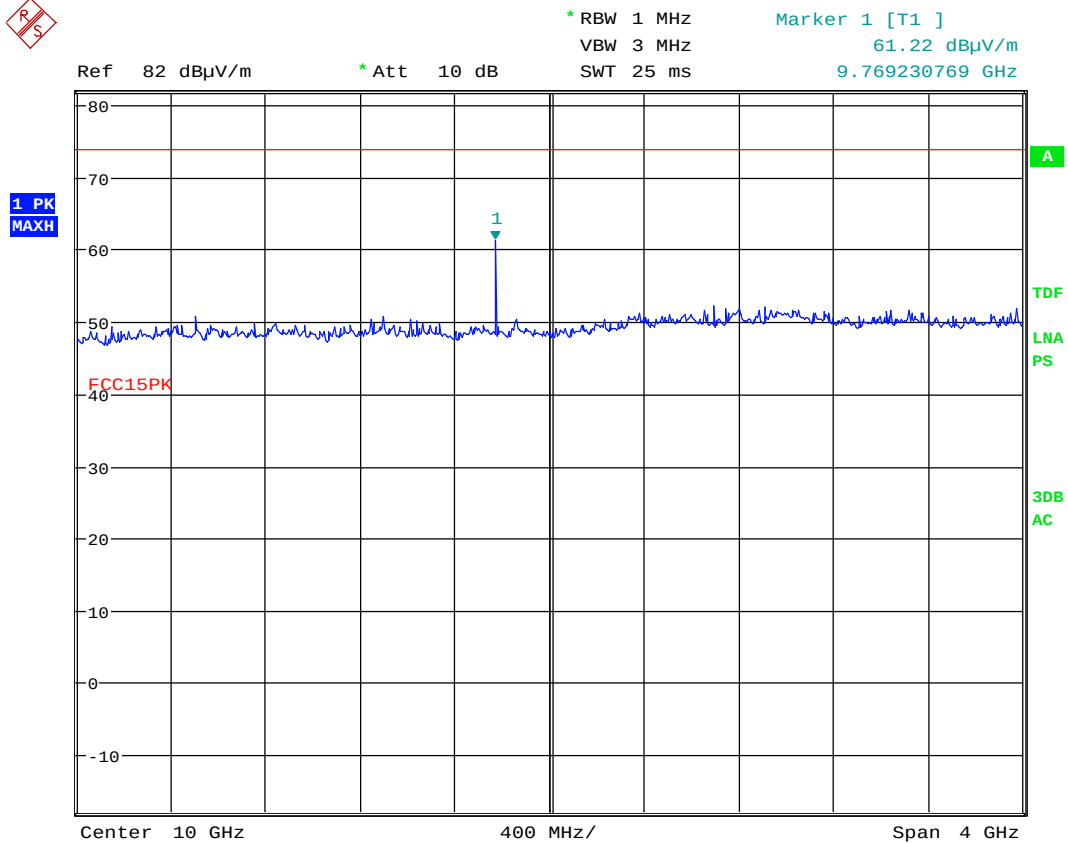
Date: 23.JUN.2017 13:29:55

VP, 8 - 12GHz -ch2412MHz- PK scan



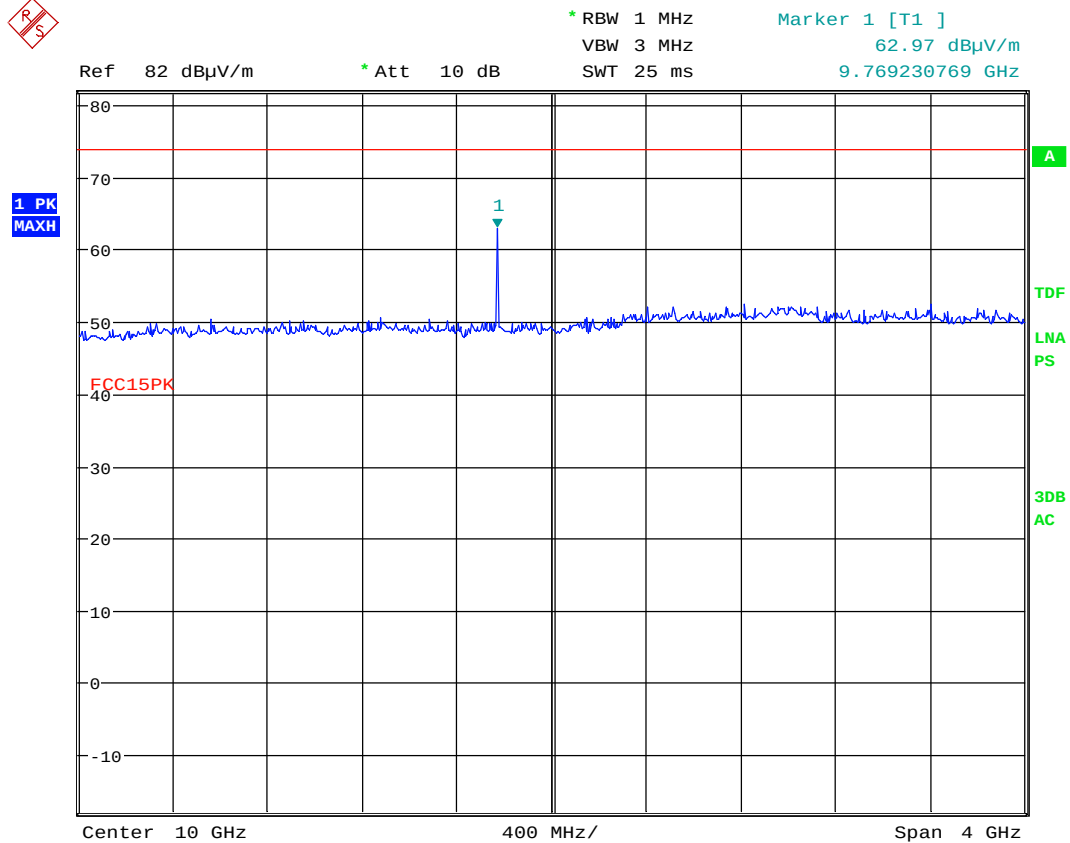
Date: 23.JUN.2017 13:31:06

HP, 8 - 12GHz -ch2412MHz- PK scan



Date: 23.JUN.2017 13:26:23

VP, 8 - 12GHz -ch2442MHz- PK scan



Date: 23.JUN.2017 13:25:22

HP, 8 - 12GHz -ch2442MHz- PK scan



MARKER 1

9.878205128 GHz

Ref 82 dB μ V/m

* Att 10 dB

* RBW 1 MHz

VBW 3 MHz

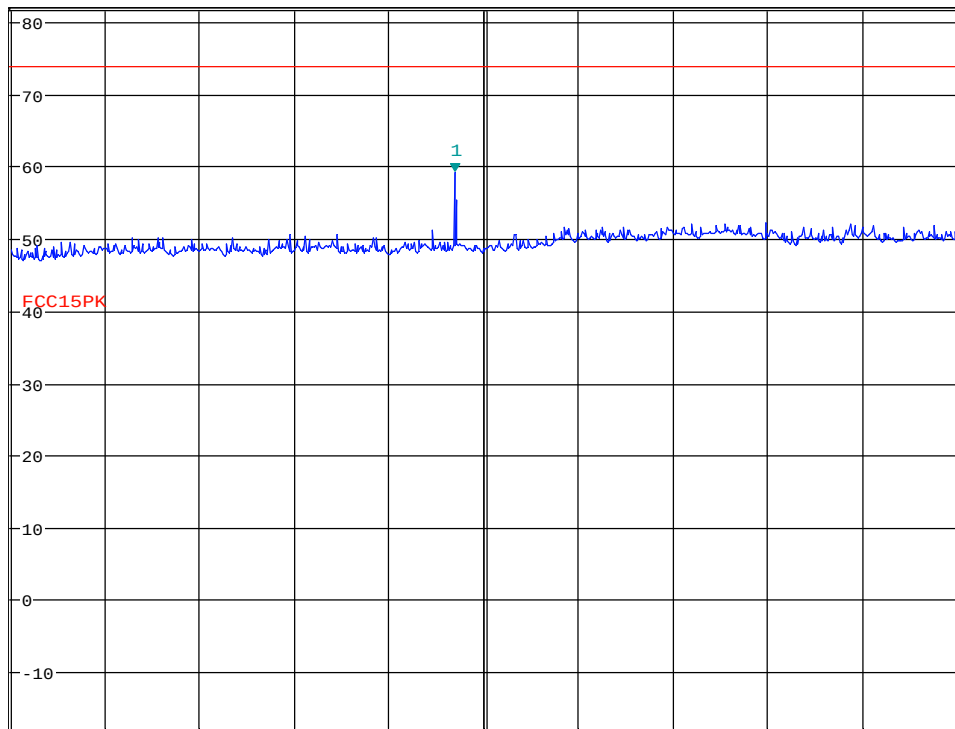
SWT 25 ms

Marker 1 [T1]

59.29 dB μ V/m

9.878205128 GHz

1 PK
MAXH



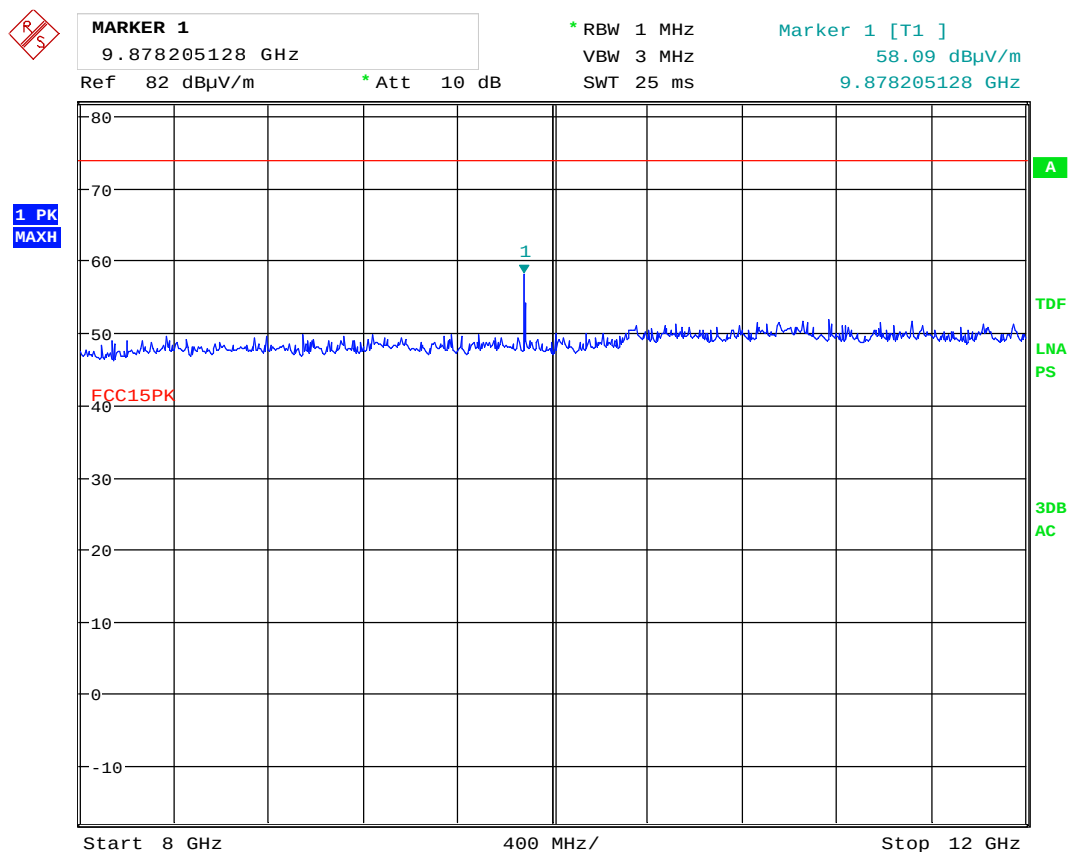
Start 8 GHz

400 MHz/

Stop 12 GHz

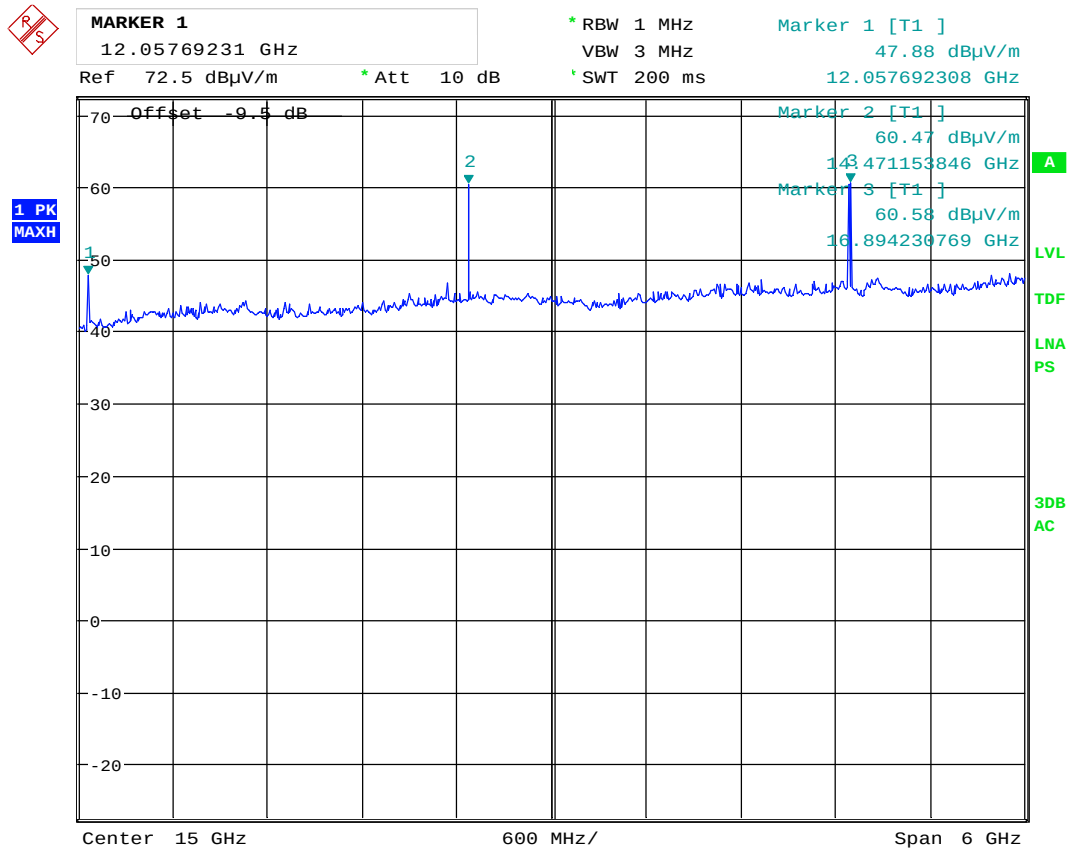
Date: 23.JUN.2017 13:36:34

VP, 8 - 12GHz -ch2470MHz- PK scan



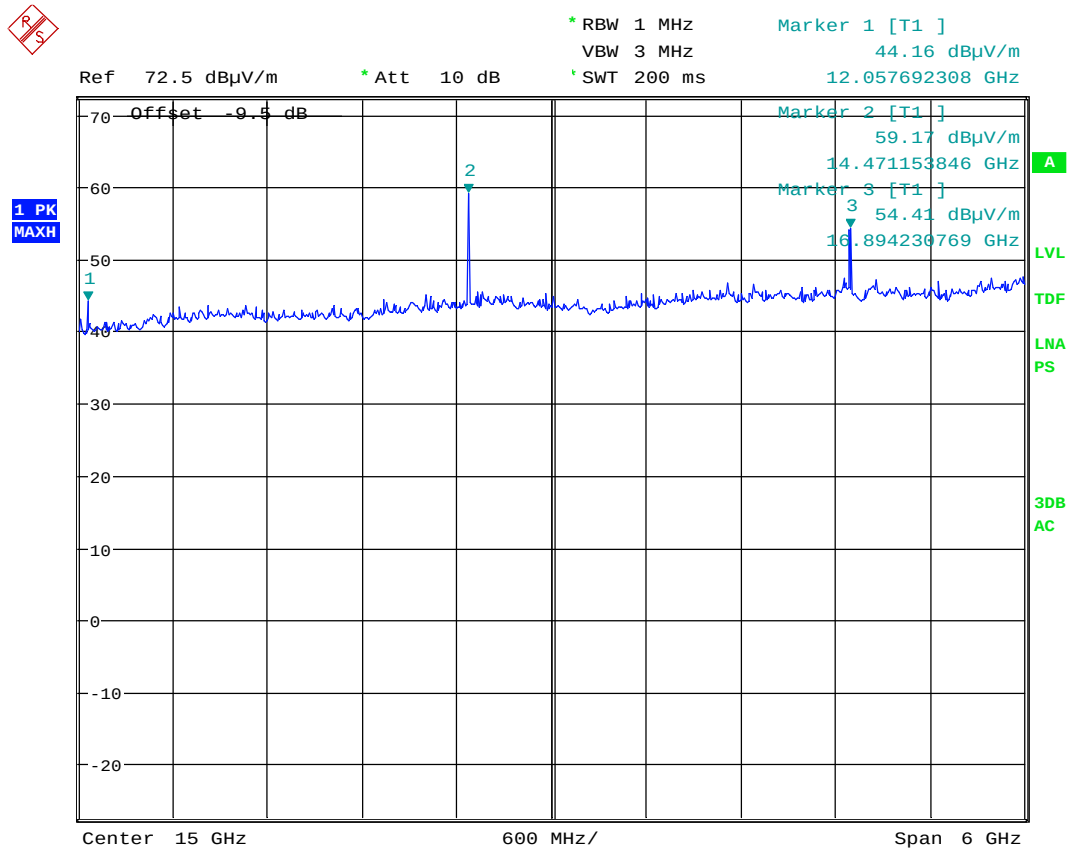
Date: 23.JUN.2017 13:35:24

HP, 8 - 12GHz -ch2470MHz- PK scan



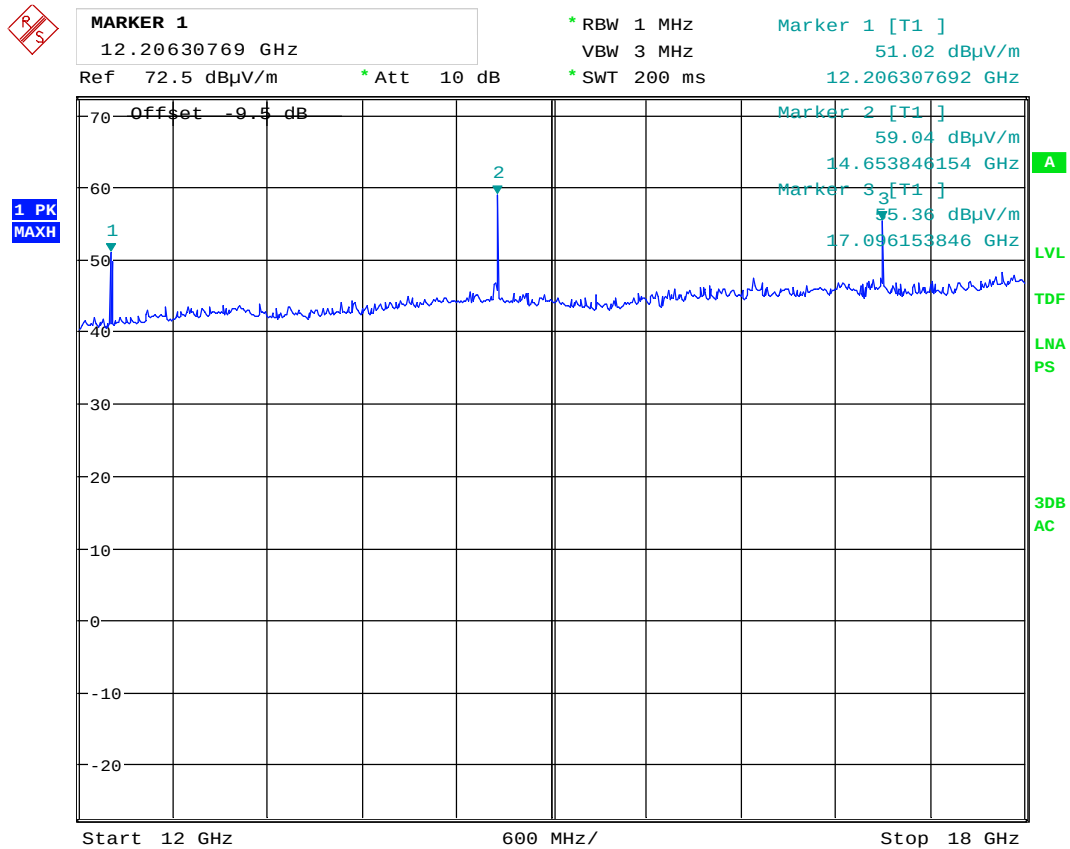
Date: 23.JUN.2017 16:34:05

VP, 12 - 18GHz –ch2412MHz- PK scan @ 1m distance (correction factor is given in the graph)



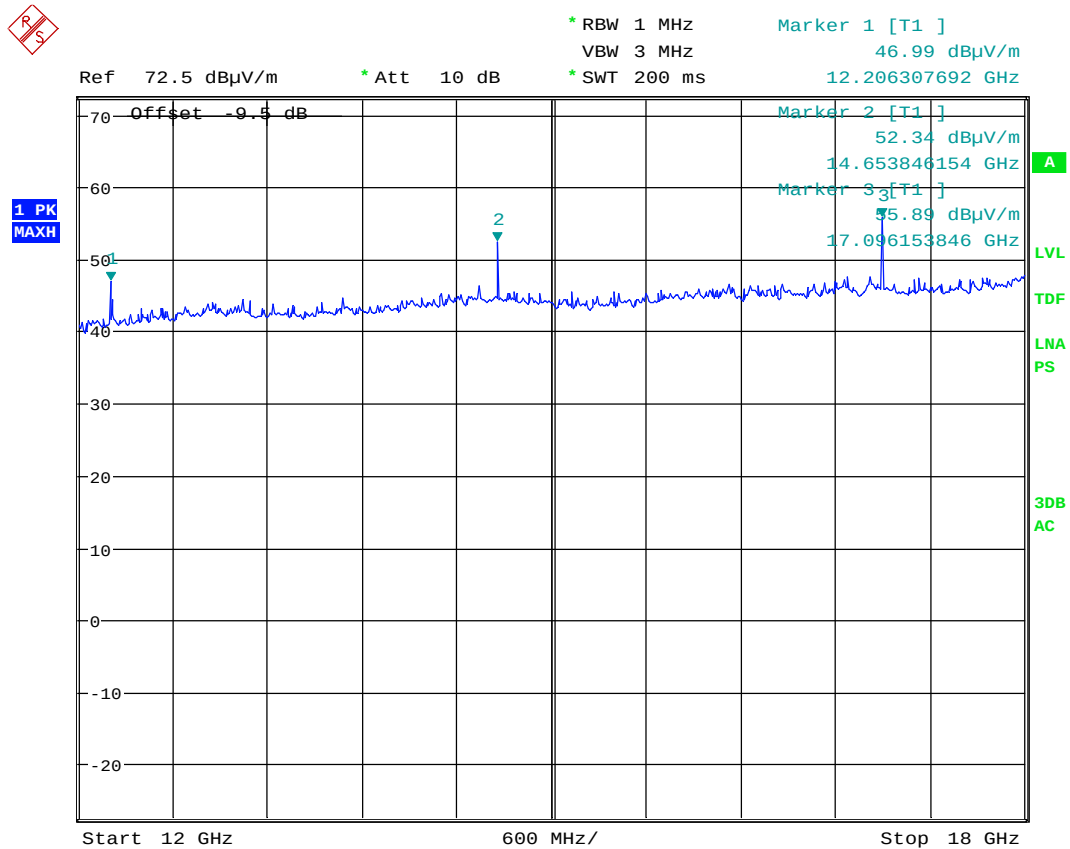
Date: 23.JUN.2017 16:35:03

HP, 12 - 18GHz -ch2412MHz- PK scan @ 1m distance (correction factor is given in the graph)



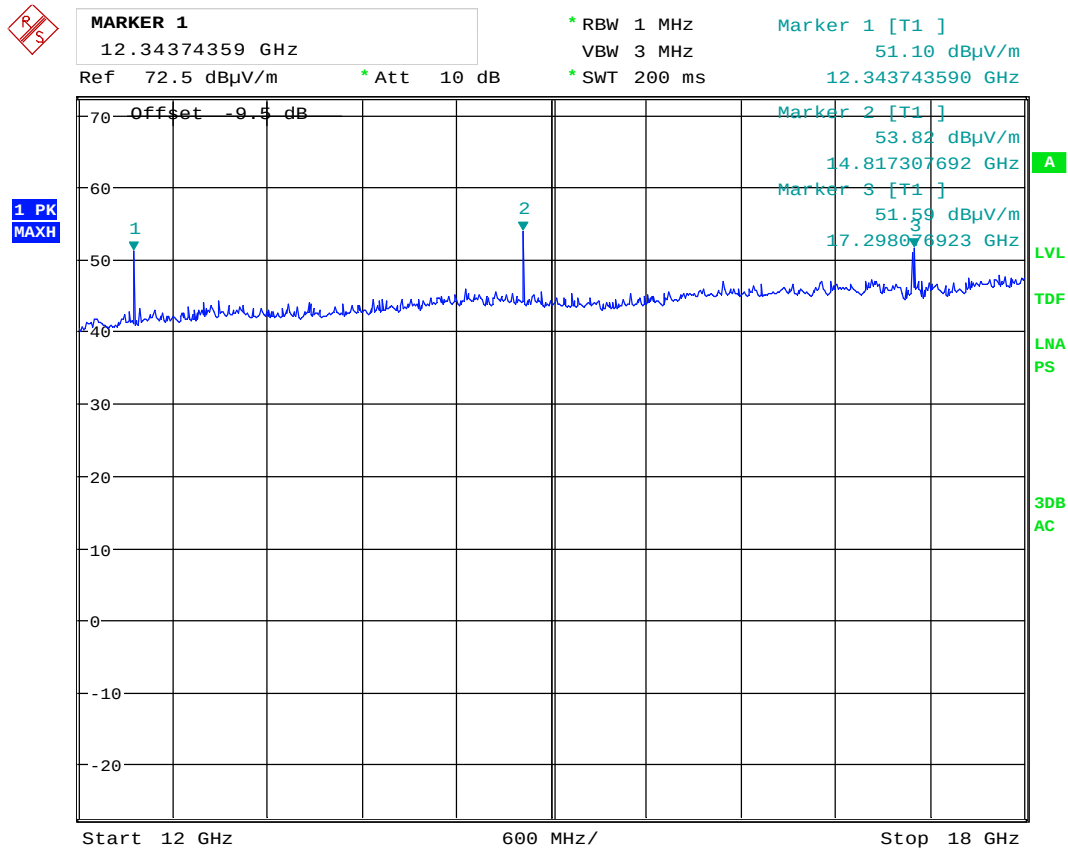
Date: 23.JUN.2017 16:39:58

VP, 12 - 18GHz -ch2442MHz- PK scan @ 1m distance (correction factor is given in the graph)



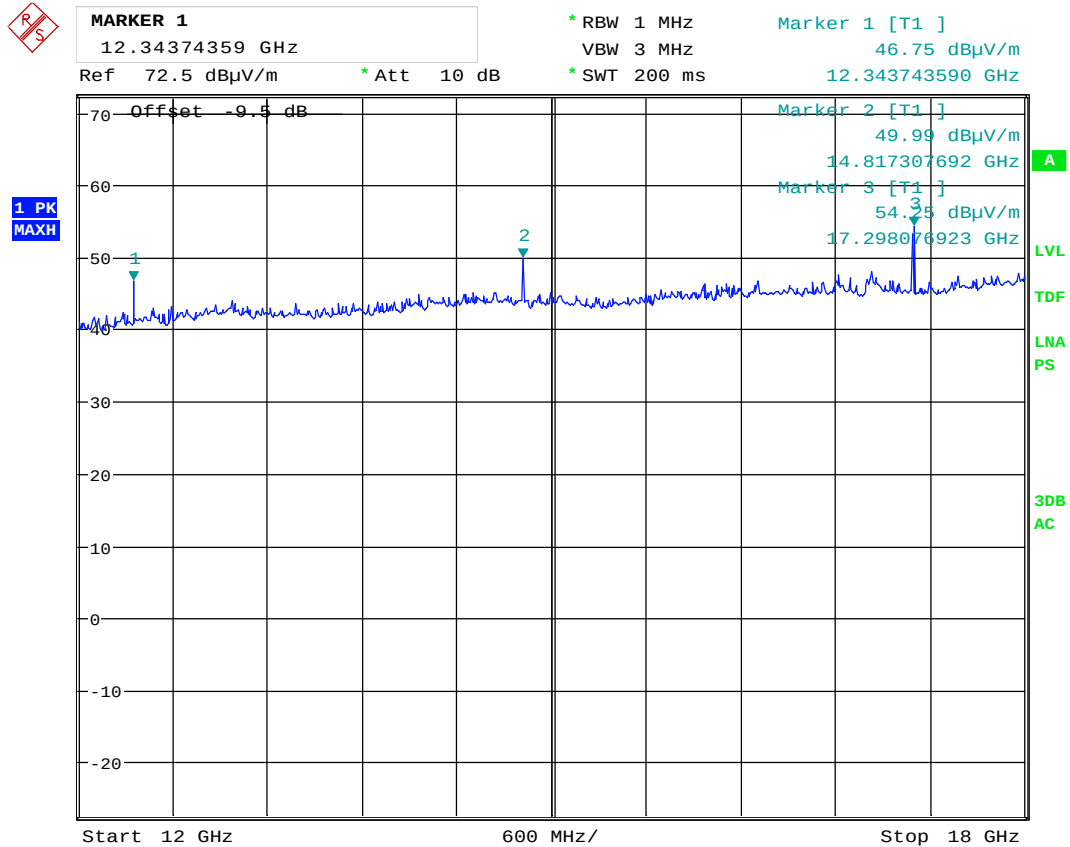
Date: 23.JUN.2017 16:40:47

HP, 12 - 18GHz -ch2442MHz- PK scan @ 1m distance (correction factor is given in the graph)



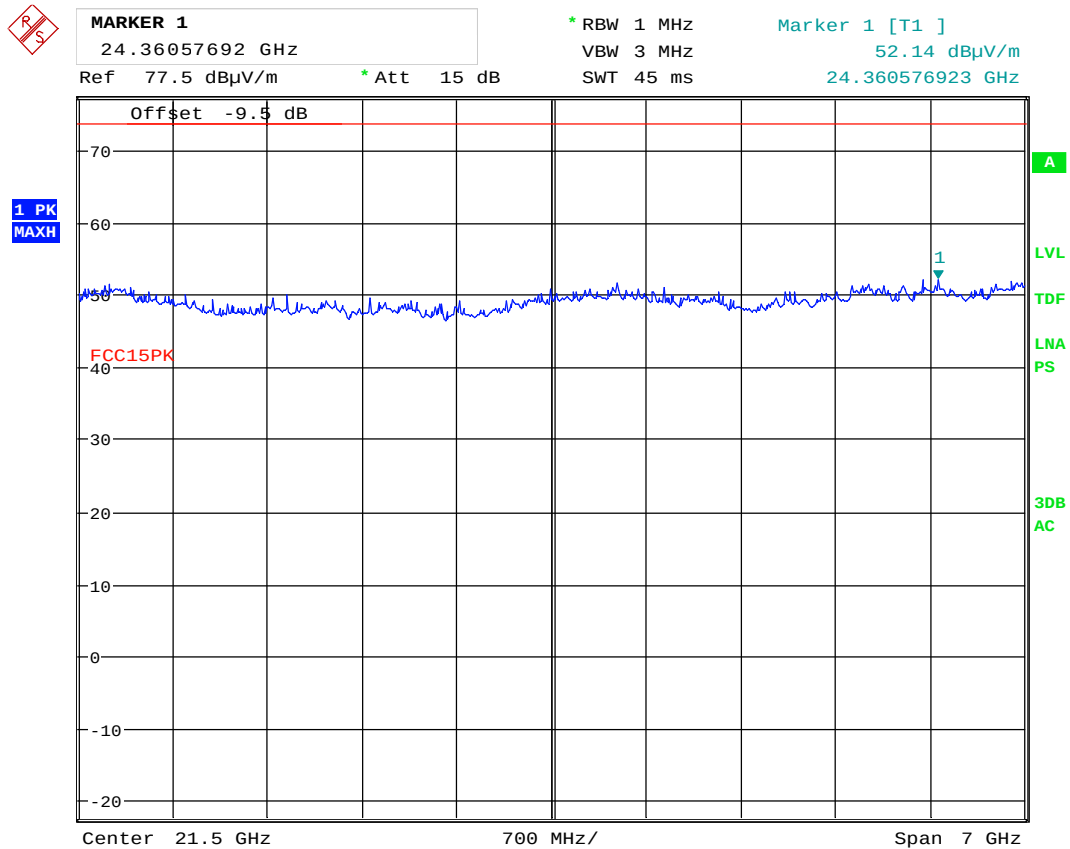
Date: 23.JUN.2017 16:45:26

VP, 12 - 18GHz -ch2470MHz- PK scan @ 1m distance (correction factor is given in the graph)



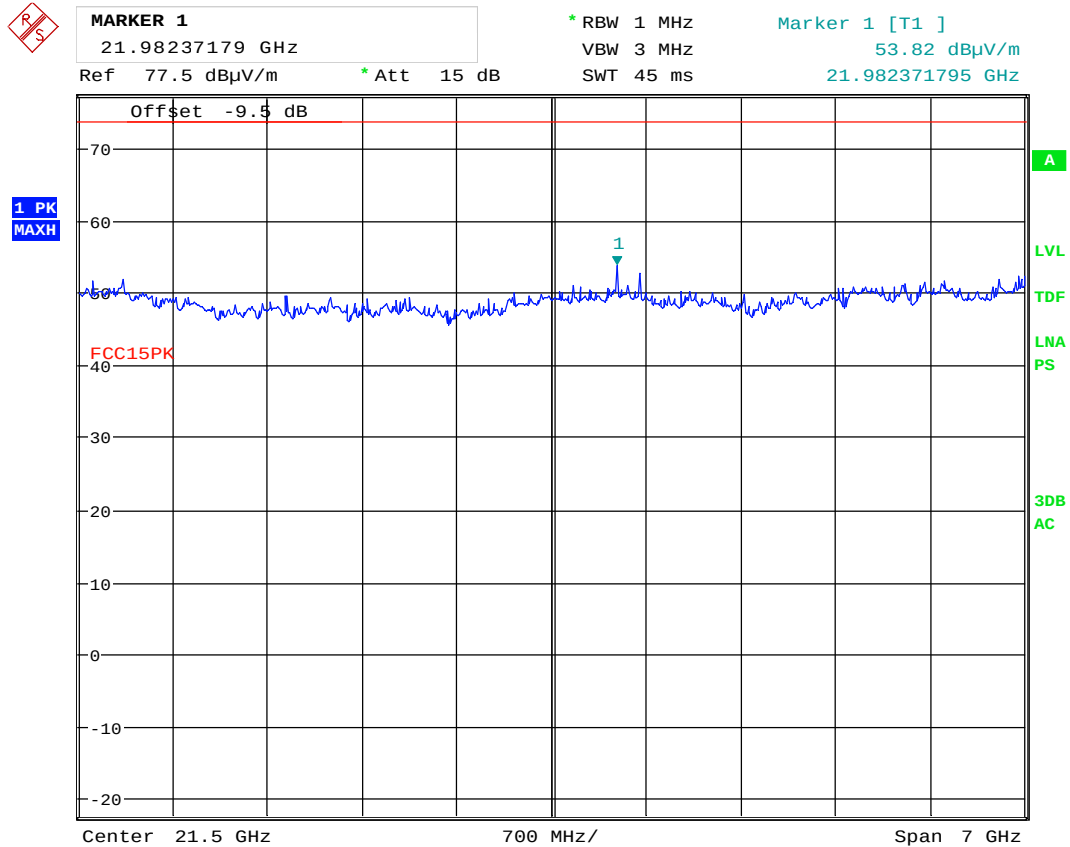
Date: 23.JUN.2017 16:46:02

HP, 12 - 18GHz -ch2470MHz- PK scan @ 1m distance (correction factor is given in the graph)



Date: 23.JUN.2017 18:42:15

VP, 18 - 25 GHz -- PK scan @ 1m distance (correction factor is given in the graph)



Date: 23.JUN.2017 18:43:30

HP, 18 - 25GHz - PK scan @ 1m distance (correction factor is given in the graph)

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

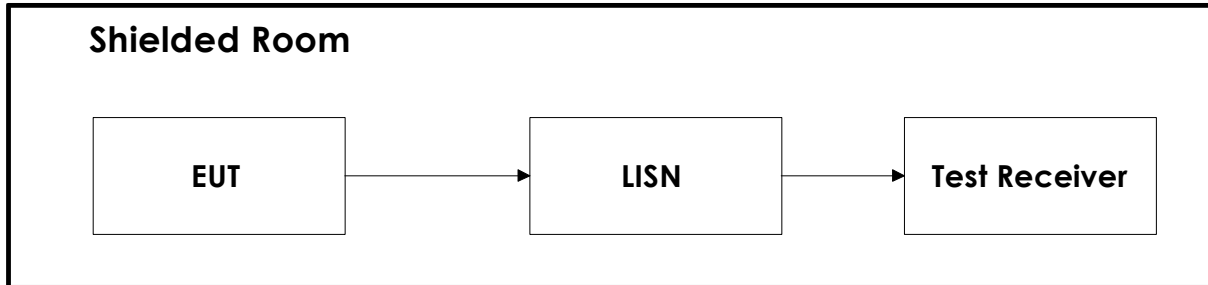
5 LIST OF TEST EQUIPMENT

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.

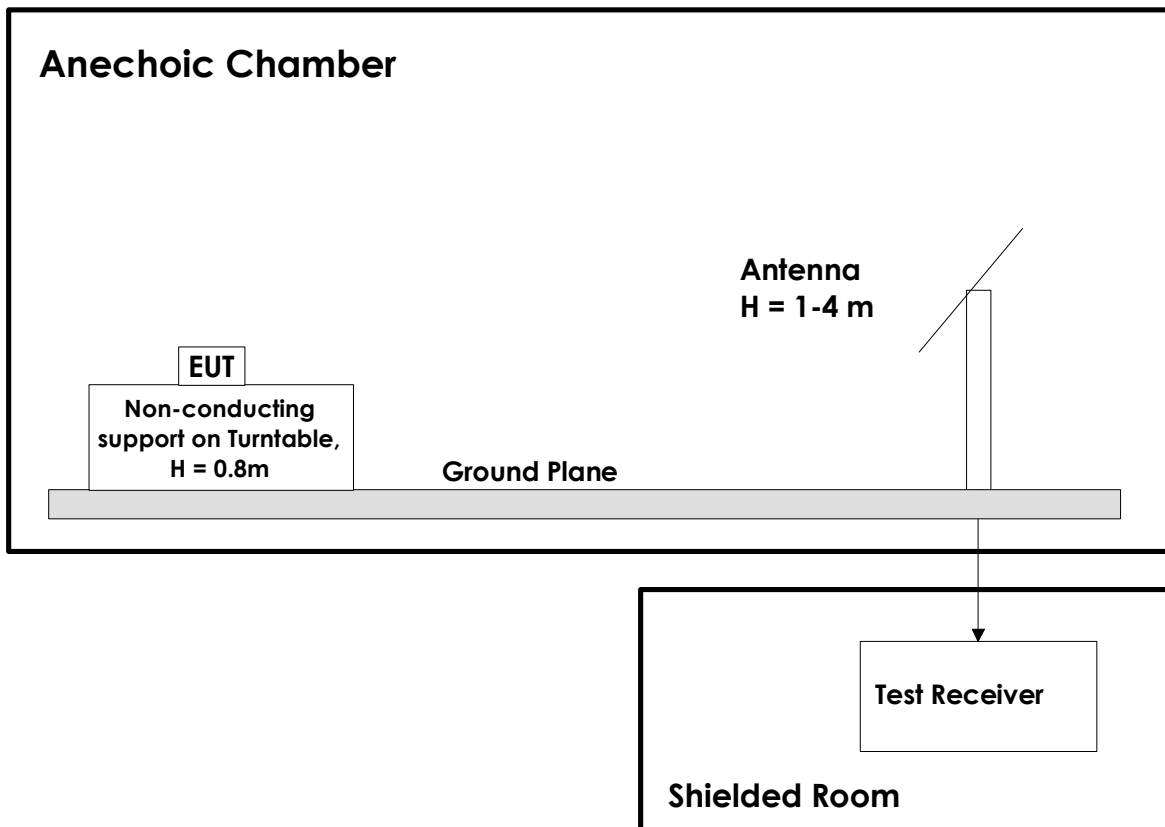
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1.	ESU40	EMI Receiver	Rohde & Schwarz	LR1639	2016.11	2017.11
2.	FSW26	Spectrum Analyzer	Rohde & Schwarz	LR 1640	2015.11	2017.11
3.	HFH2-Z2	Active Loop antenna	Rohde & Schwarz	LR1660	2014.10	2017.10
4.	3115	Antenna horn	EMCO	LR 1330	2010.08	2017.08
5.	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2016.12	2018.12
6.	HL223	Log Periodic antenna	Rohde & Schwarz	LR 1261	2016.12	2018.12
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	2016.10	2017.10
14	317	Pre-amplifier	Sonoma	LR 1687	2016.9	2017.9
15	Model 87 V	Multimeter	Fluke	LR 1597	2016.10	2018.10
16	6812B	Power source	Agilent	LR 1515	2015.12	2017.12
17	CPX400S	DC power supply	AIM TTI	LR 1710	Cal b4 use	

6 BLOCK DIAGRAM

6.1 Power Line Conducted Emission



6.2 Test Site Radiated Emission



Measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers.

Revision history

Version	Date	Comment	Sign
00	2017.07.04	First version	gns
01	2017.08.29	First revision	gns