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DAkkS Deutsche Akkreditierungsstelle
D-PL-18175-01-01
D-PL-18175-01-02
D-PL-18175-01-03
D-PL-18175-01-04

Report No. 343523-01-001

FCC TEST REPORT / IC TEST REPORT

Product	Remote Controller
Name and address of the applicant	CoastKey AS Østre Strandvei 52, 3482 Tofte, Norway
Name and address of the manufacturer	Same as above
Model	CR-1
Rating	3.0 V DC (Primary Batteries)
Trademark	CoastKey
Serial number	-
Additional information	Hand held remote controller
Tested according to	**FCC Part 15.249** Low Power Transmitter. 2400 – 2483.5 MHz band. **Industry Canada RSS-210, Issue 9** Licence-Exempt Radio Apparatus, Category I Equipment 2400 – 2483.5 MHz band
Order number	343523-01-001
Tested in period	2018-01-19 - 2018-03-06
Issue date	2018-03-15
Name and address of the testing laboratory	**Nemko GmbH & Co. KG** Reetzstraße 58 D-76327 Pfinztal Tel.: + 49 (0) 7240 – 63 - 0 Fax: + 49 (0) 7240 – 63 – 11 Bundesnetzagentur BNetzA-CAB-17/21-17 FCC No: 973501 IC OATS: 10921A-1

Prepared by [Dipl.-Ing. M. Korny]	Approved by [J. Stephansen]

Template version: B

CONTENTS

1 TEST INFORMATION

1.1 Test item

Name :	CoastKey
Model/version :	CR-1
FCC ID:	2AMN7CR-1
IC ID:	22885-CR1
Serial number :	/
Hardware identity and/or version:	v1
Software identity and/or version :	SP 001
Frequency Range :	2402 – 2480 MHz
Number of Channels :	3
Operating Modes :	TX
Type of Modulation :	GFSK
Data rate:	250 kbit/s
User Frequency Adjustment :	None, Software controlled
Rated Output Power :	8.32 mW (Radiated)
Type of Power Supply :	3Vdc , Lithium battery
Antenna Connector :	None
Number of antennas:	1
Antenna type:	PCB antenna
Antenna Diversity Supported :	None

Description of test item

Description of test item: Wireless unit for remote control of boat motors and other engines.

1.2 Normal test condition

Temperature:	20 - 26 °C
Relative humidity:	35 - 55 %
Normal test voltage:	3Vdc (1 x Lithium CR 2032)

The values are the limit registered during the test period.

1.3 Test Engineer(s)

Markus Korny

1.4 Description of modification for Modification Filing

Not applicable.

1.5 Family List Rational

Not Applicable.

1.6 Antenna Requirement

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

Type of antenna connector: N/A

Ref. FCC §15.203

1.7 Worst-Case Configuration and Mode

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

1.8 Comments

The output level is set to maximum in the software.

The radiated measurements are tested on three axis.
Fully charged primary batteries are used.

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 15.249 and Industry Canada RSS-210, Issue 9 and RSS-GEN, Issue 4.

Tests were performed in accordance with ANSI C63.4-2014 and and ANSI C63.10-2013.

Radiated tests were performed in a semi-anechoic shielded room (f < 1 GHz) and a fully-anechoic shielded room (f > 1 GHz) at a measuring distance of 3m.

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

DXT Equipment Code ☐ Family Listing

2.2 Test summary

Name of test	FCC Part 15 reference	RSS-GEN Issue 4 & RSS-210 Issue 9	Result
Supply Voltage Variations	15.31(e)	F.2.2 (RSS210) 6.11,8.11 (RSS-Gen)	N/A [2]
Antenna Requirement	15.203	6.7 (RSS-GEN)	Complies [1]
Power-line Conducted Emission	15.207(c)	8.8 (RSS-GEN)	N/A [2]
Occupied Bandwidth	N/A	6.6 RSS-GEN)	-
Peak Power Output	15.249(a)(c)	B.10(RSS210)	Complies
Band edge Emissions	15.249(d)	B.10(RSS210)	Complies
Spurious Emissions (Radiated)	15.249 (d),(e) 15.209 15.35 (b)	8.9,8.10 (RSS-GEN) B.10(RSS210)	Complies

[1] The tested equipment has integrated antennas only

[2] EUT is battery powered

RSS Gen issue 4 covers section 6 & 8

RSS 210 issue 9 covers Annex B

2.3 Description of modification for modification filing

Not applicable.

2.4 Comments

The channels are selected with the use of dedicated test software from the manufacturer.
The radiated measurements are tested on three axis.

2.5 Family list rationale

Not Applicable.

3 TEST RESULTS

3.1 99 % Occupied Bandwidth

Para. No.: 6.6 RSS-Gen

Test Performed By: Markus Korny	Date of Test: 2018-03-06

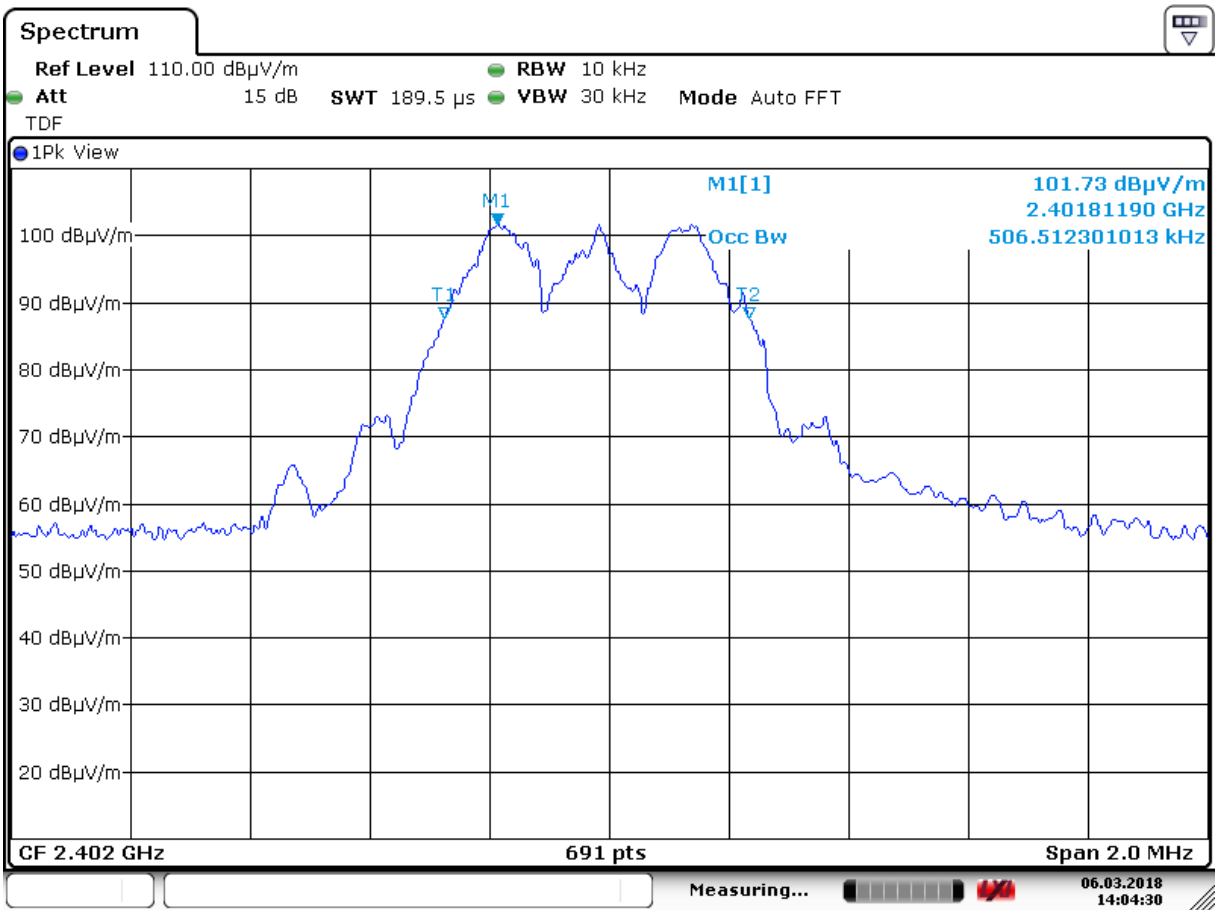
Test Results: Complies

Measurement Data:

99 % (kHz)
2402 MHz
506.5

Requirements:

For information only



Date: 6.MAR.2018 14:04:30

2480 MHz – 99% OCC BW

3.2 Peak power output

Para. No.: 15.249 (a) / B.10

Test Performed By: Markus Korny	**Date of Test: 2018-01-26**

Test Results: Complies

Measurement data:

Measured with Peak Detector:

RF channel	**2402 MHz**	**2426 MHz**	**2480 MHz**
Measured Maxium PK Field strength (dBµV/m) –HP *)	103.55	101.60	99.45
Calc. Radiated Power (dBm)	6.79	4.34	2.64
Calc. Radiated Power (mW)	8.32	6.37	4.22

*) Measurement was performed with 100% duty cycle.

Average Detector:

RF channel	**2402 MHz**	**2426 MHz**	**2480 MHz**
Measured Maxium Field strength,AV (dBµV/m) –HP	83.55	81.60	79.45

Duty cycle correction of 20 dB is used

Duty Cycle Correction Factor Calculation:

According to the manufacturer:

ON time : 0.94ms and OFF time : 300ms , Duty cycle : 0.31%

Duty Cycle Correction factor = -20 x log (Duty Cycle) = 20 log (0.94/300)= -50 dB

Maximum allowed Duty Cycle Correction: 20 dB

Radiated measurements are performed at 3 m distance.

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 Horizontal polarization

See attached graph.

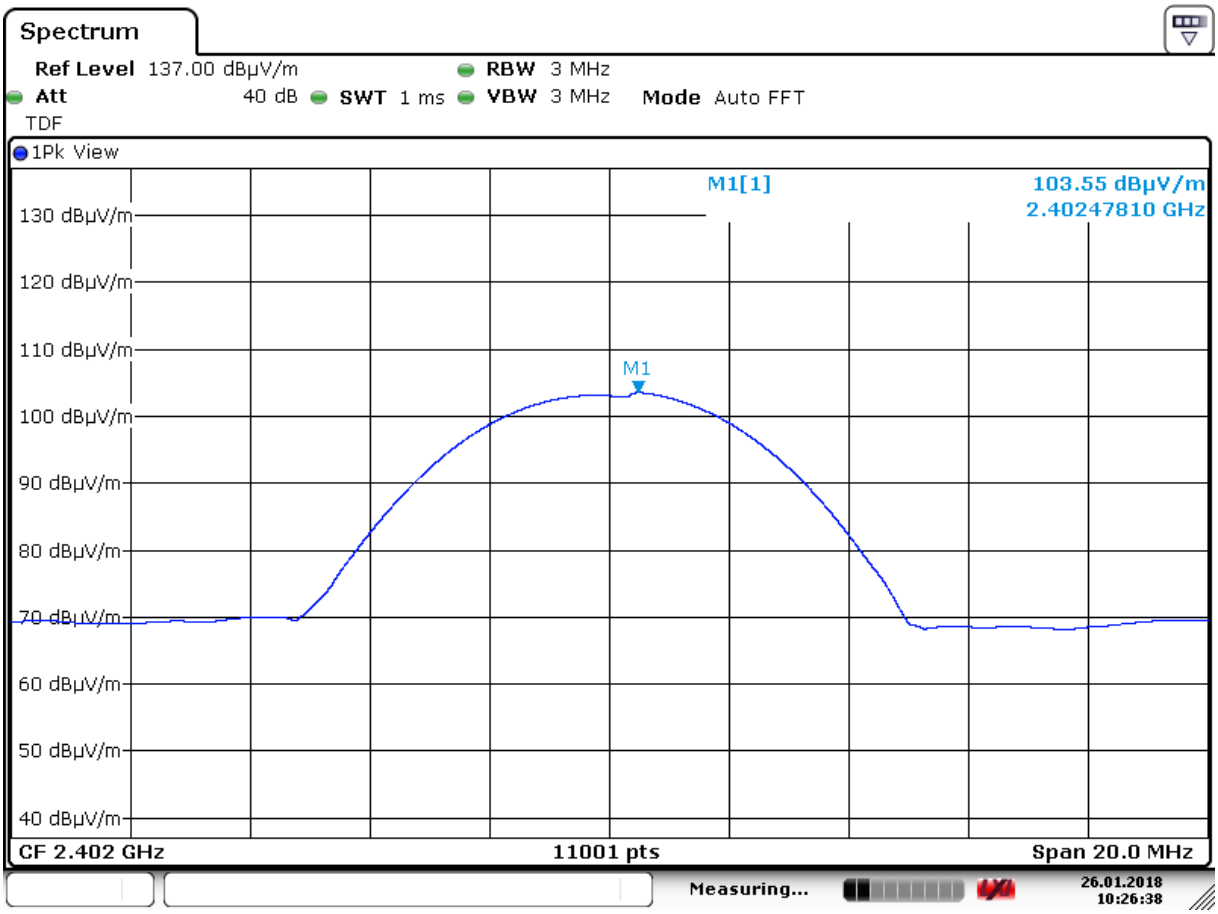
Detachable antenna? ☐ Yes ☒ No

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

Type of antenna connector: N/A

Requirements:

The maximum average output power shall be ≤ 94dBµV/m & Peak ≤ 114dBµV/m



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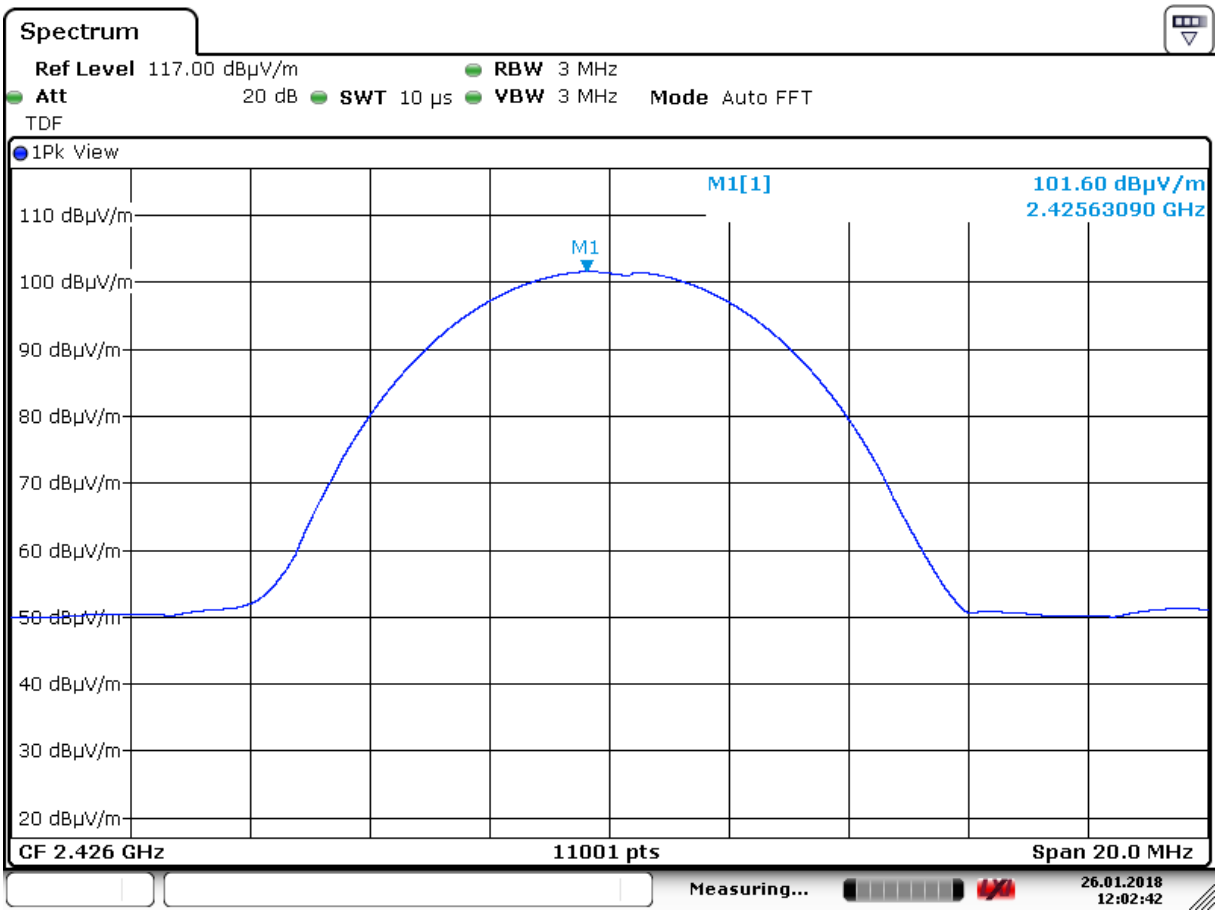
Radiated field strength, HP, 2402 MHz



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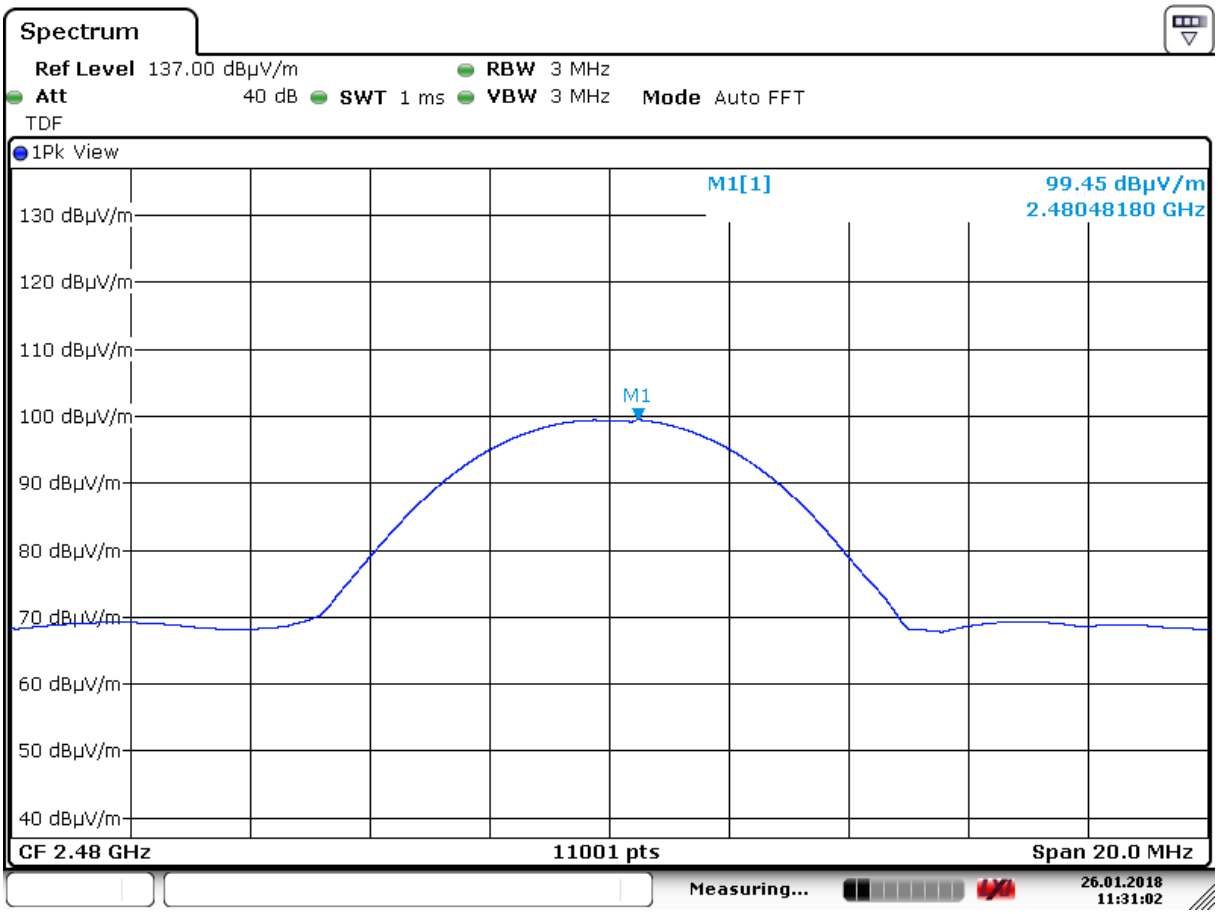
Radiated field strength, HP, 2426 MHz



Date: 26.JAN.2018 11:31:02

Radiated field strength, HP, 2480 MHz

3.3 Spurious emissions (radiated)

Para. No.: 15.209 / 15.249 (d) (e) / 8.9, 8.10, B10

Test Performed By: Markus Korny	**Date of Test: 2018-01-19; 2018-01-26; 2018-02-02**

Test Results: Complies

Measurement Data:

Radiated Emissions with antenna, 9 kHz -25 GHz

9 kHz -25 GHz measured at a distance of 3 m.

Measured with Peak Detector: Band-edge, @3m

Frequency	Measured Field Strength @3m, dBµV/m	Detector	Limit dBµV/m	Margin dB
2.4835 GHz	48.8	PK	74	>20
	-	AV	54	-

Duty Cycle Correction Factor Calculation:

According to the manufacturer:

ON time : 0.94ms and OFF time : 300ms , Duty cycle : 0.31%

Duty Cycle Correction factor = -20 x log (Duty Cycle) = 20 log (0.94/300)= -50 dB

Maximum allowed Duty Cycle Correction: 20 dB

See attached graphs.

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

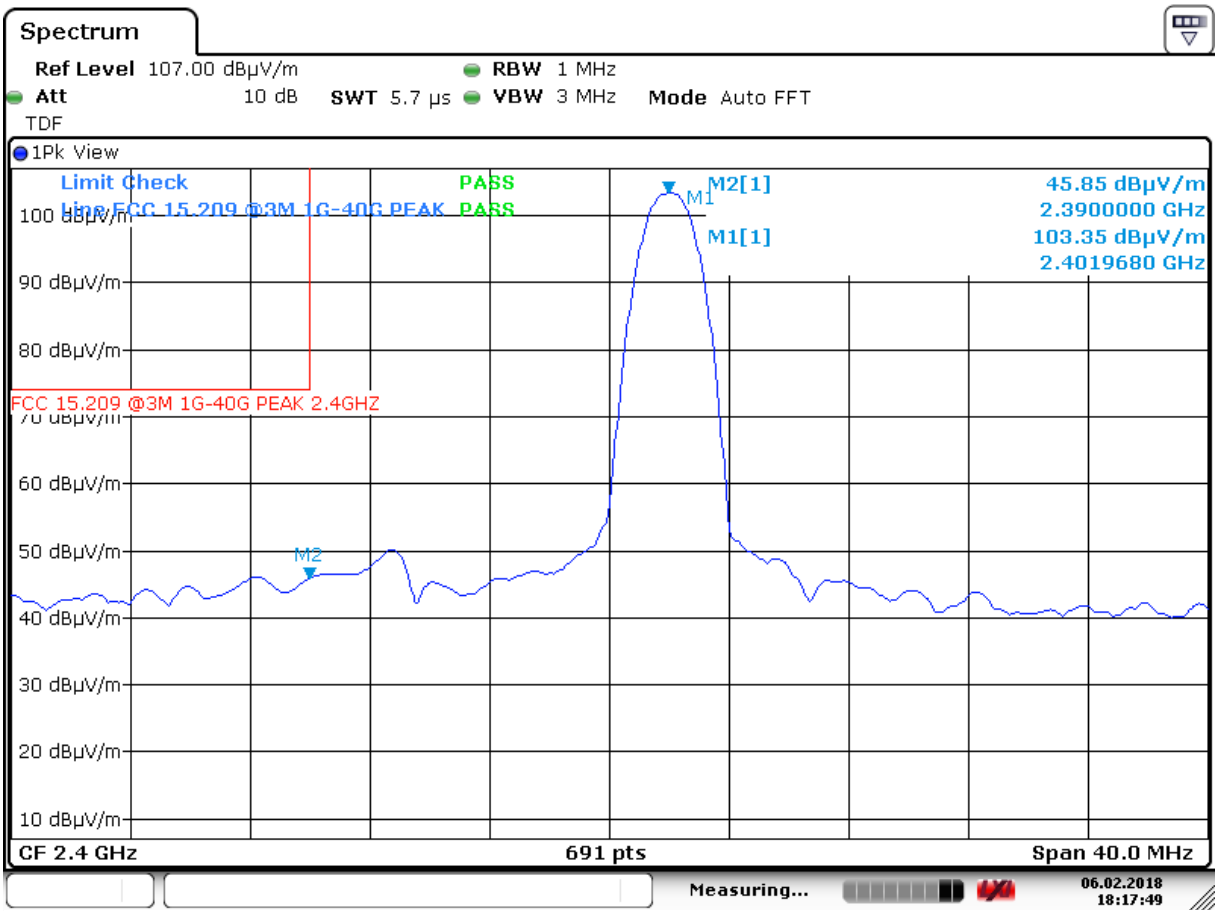
Requirement:

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of §15.249 are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

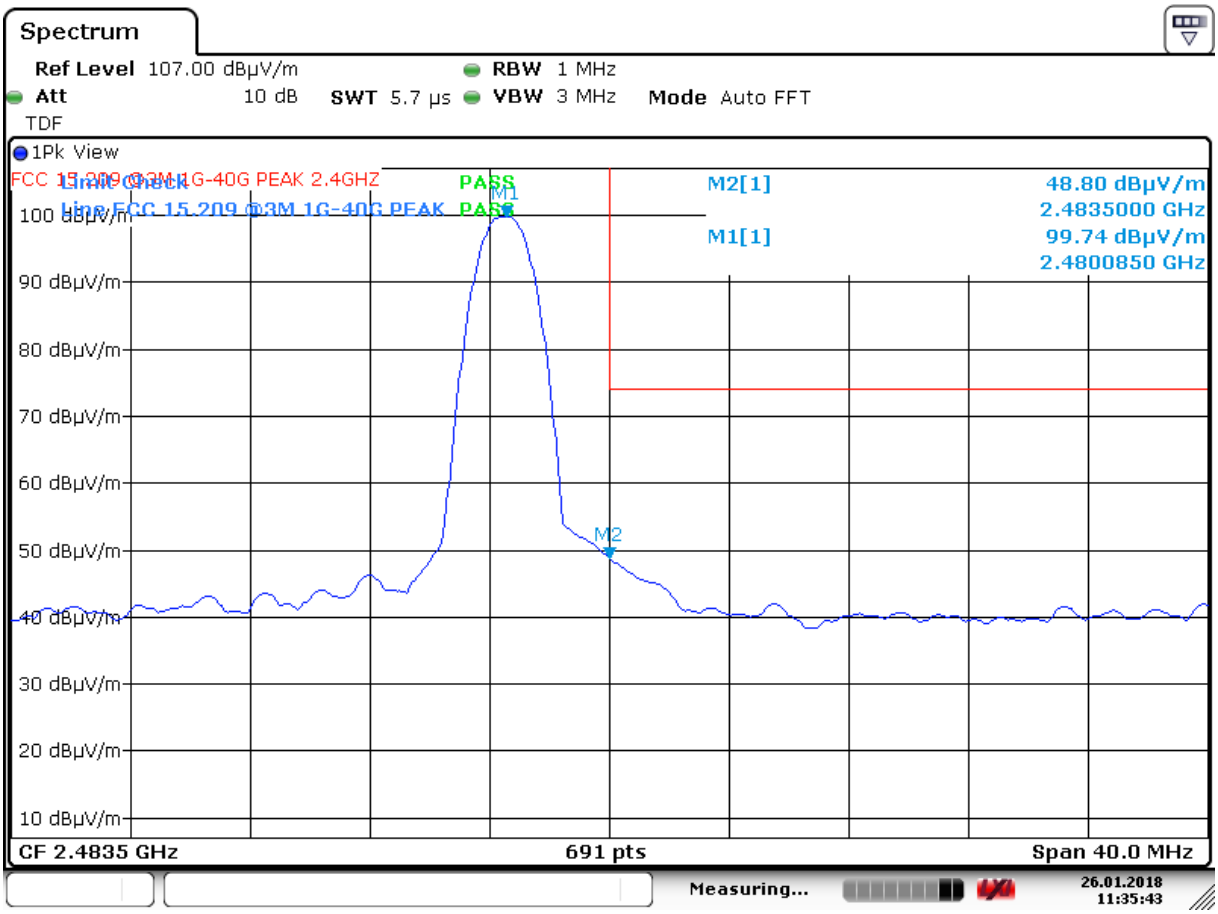
Requirements/Limit according §15.209

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



Date: 6.FEB.2018 18:17:49

Band Edge, 2390 MHz, Peak Detector



Date: 26.JAN.2018 11:35:43

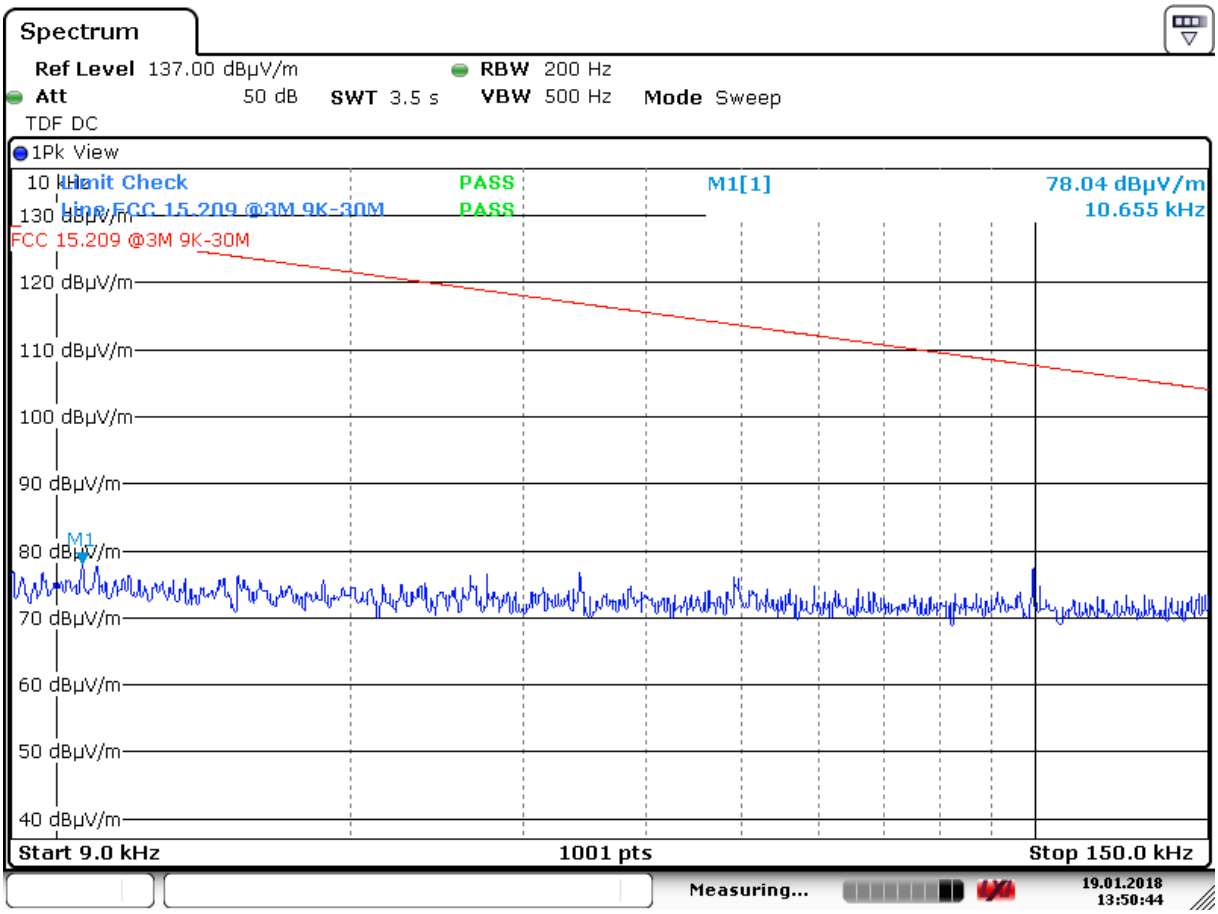
Band Edge, 2483.5 MHz, Peak Detector

Radiated emissions 9kHz – 30 MHz.

Measuring distance 3 m, measured with Peak detector.

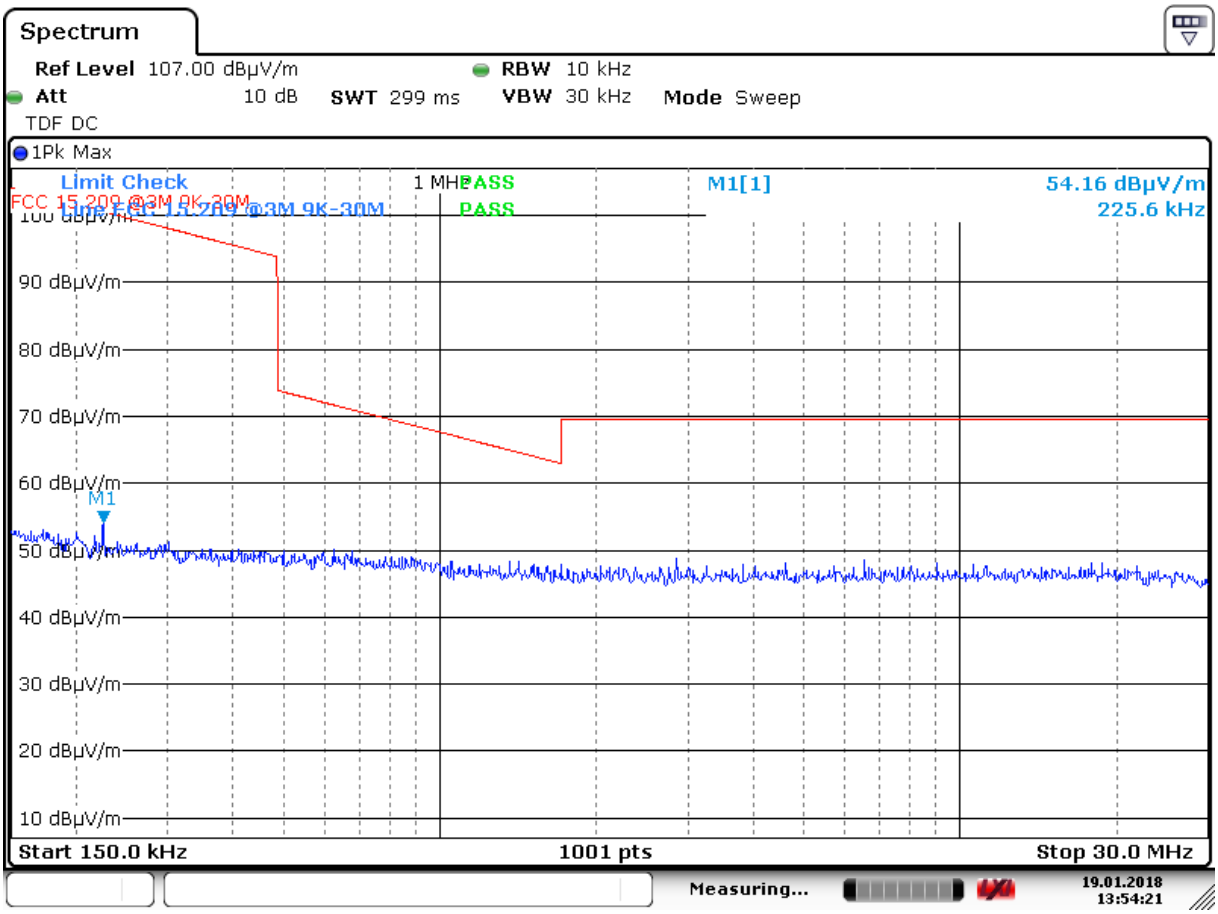
No component detected, see attached graph.

Limit is converted to 3 m using 40 dB/decade according to 15.31 (f) (2).



Date: 19.JAN.2018 13:50:43

Radiated Emissions, 9 kHz – 150 kHz @3m



Date: 19.JAN.2018 13:54:21

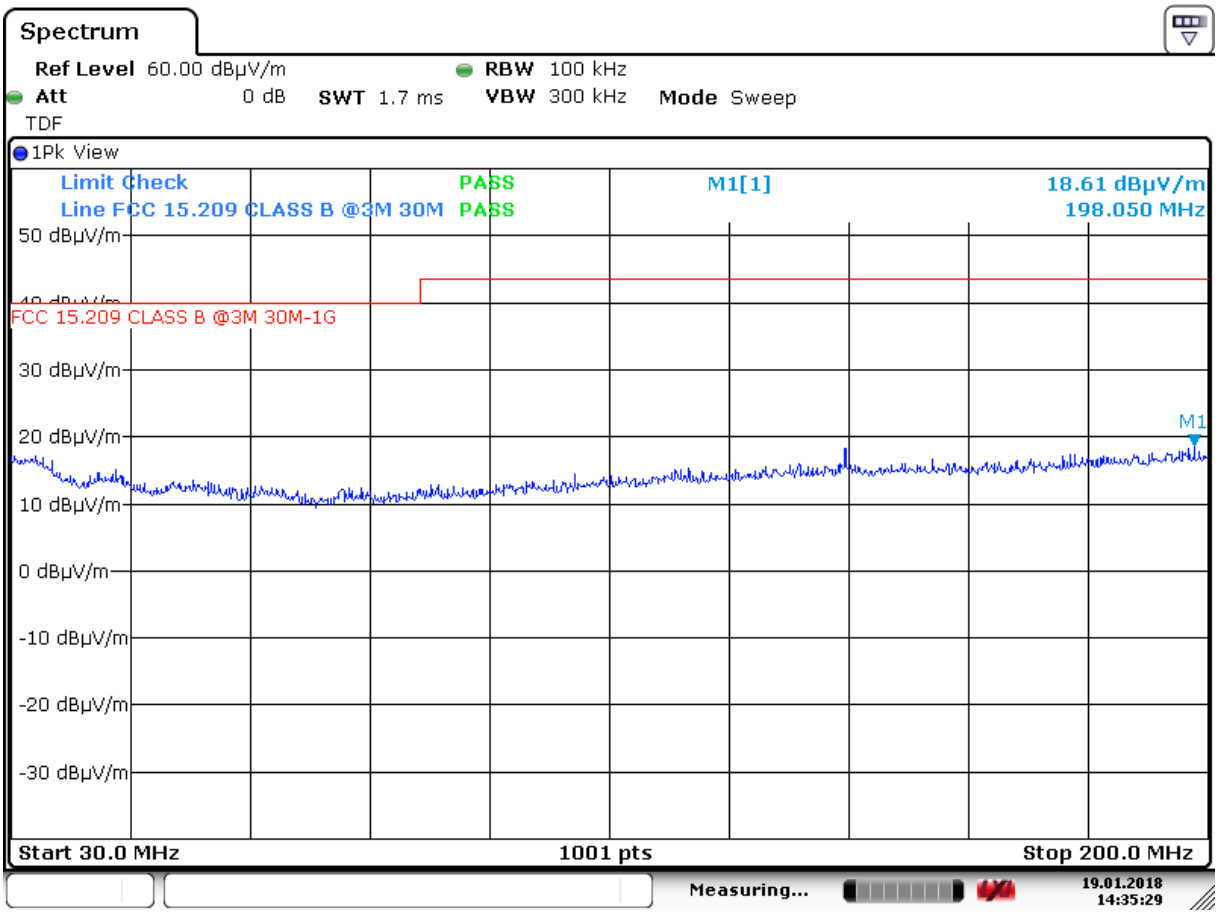
Radiated Emissions, 150 kHz - 30MHz @3m

Radiated emissions 30 – 1000 MHz.

Detector: Peak

Measuring distance 3 m.

The graph shows peak scan and highest values. Since there is no spurious found no QP values are measured.



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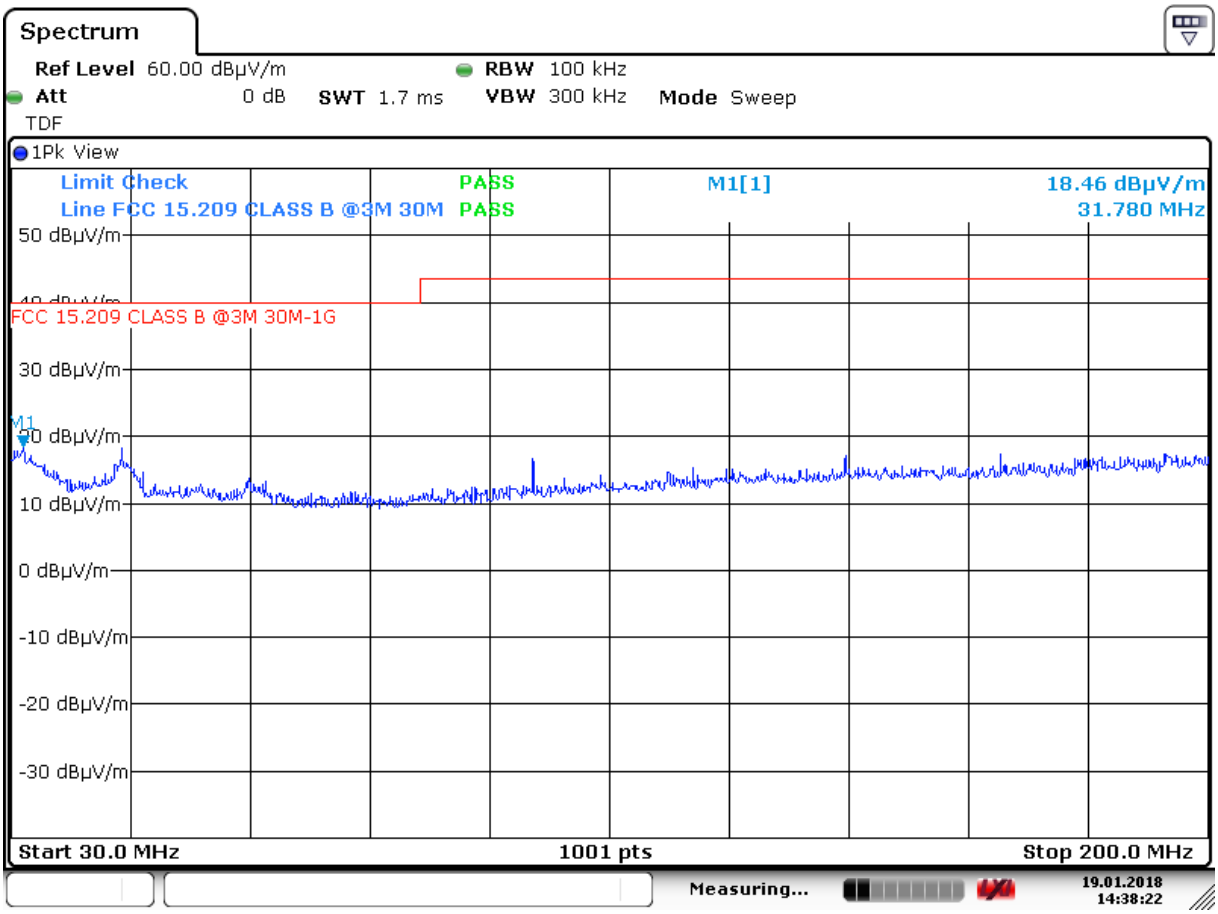
Radiated Emissions, 30 – 200 MHz, HP, @3m, PK scan



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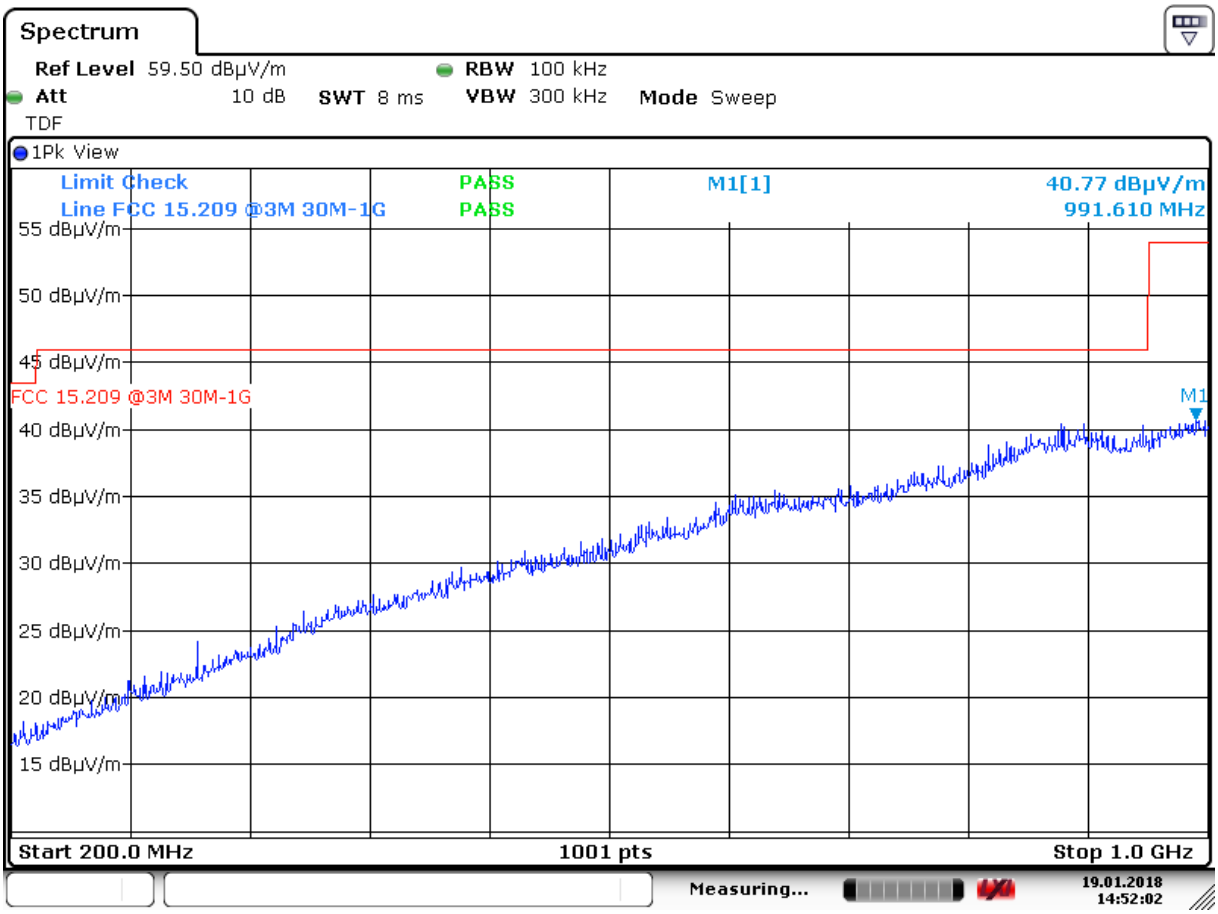
Radiated Emissions, 30 – 200 MHz, VP, @3m, PK scan



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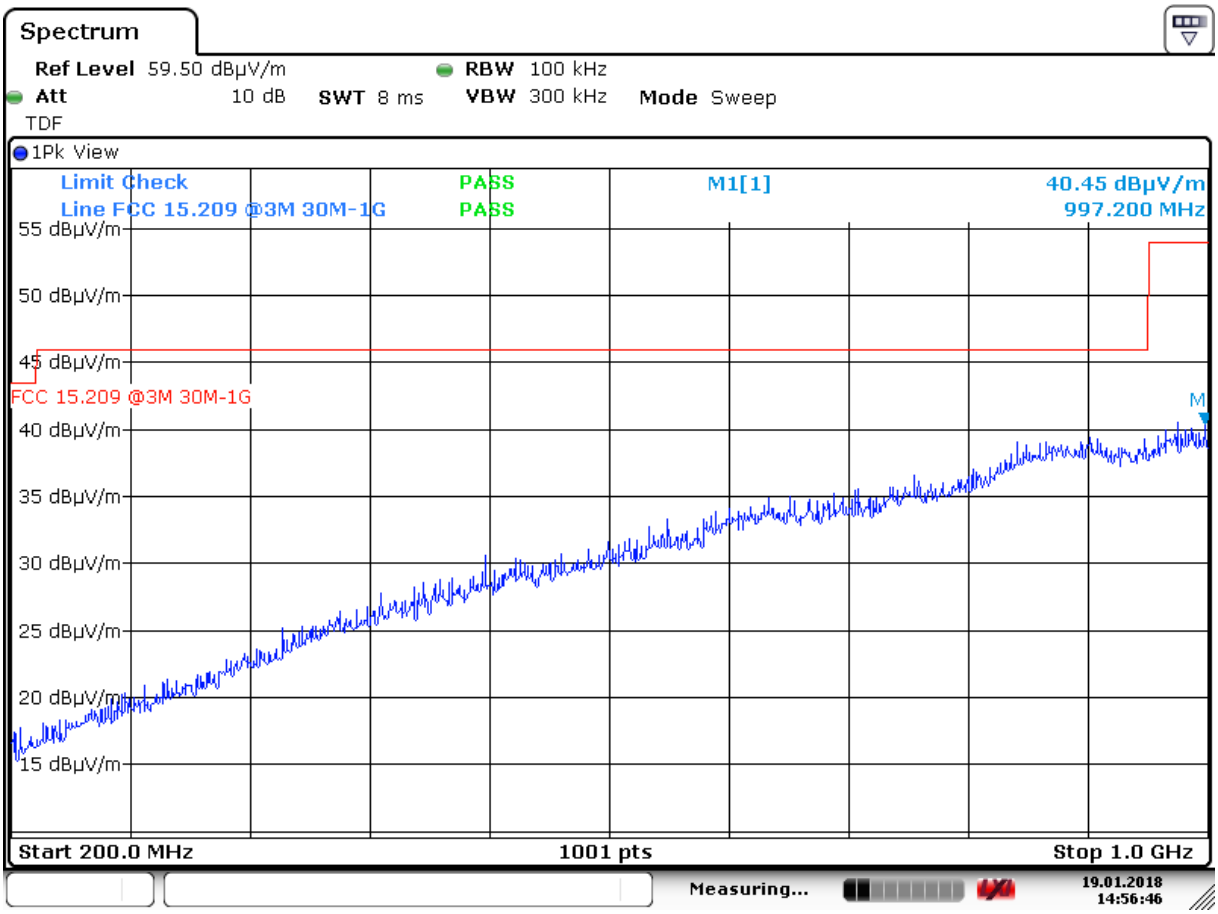
Radiated Emissions, 200 – 1000 MHz, HP, @3m, PK scan



Date: 19.JAN.2018 14:56:46

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

Radiated Emissions, 1-25 GHz

Measuring distance: 3m (1 – 25 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Measured with Peak Detector:

Frequency GHz	Channel	Field strength, Peak dBμV/m	Duty cycle corr. Factor dB	Limit dBμV/m	Margin dB
4803.5	2402	60.42	-	74	13.58
4852.2	2426	63.80	-	74	10.20
4959.6	2480	59.21	-	74	14.79
9608.4	2402	64.52	-	74	9.48
9704.1	2426	65.06	-	74	8.94
9919.7	2480	63.29	-	74	10.71
12010.7	2402	61.26	-	74	12.74
12129.4	2426	61.01	-	74	12.99
12399.9	2480	60.86	-	74	13.14
17994.0	All channels	63.13	-	74	10.87

Average Detector:

Frequency GHz	Channel	Field strength, Average dBμV/m	Duty cycle corr. Factor dB	Limit dBμV/m	Margin dB
4803.5	2402	40.42	20	54	13.58
4852.2	2426	43.80	20	54	10.20
4959.6	2480	39.21	20	54	14.79
9608.4	2402	44.52	20	54	9.48
9704.1	2426	45.06	20	54	8.94
9919.7	2480	43.29	20	54	10.71
12010.7	2402	41.26	20	54	12.74
12129.4	2426	41.01	20	54	12.99
12399.9	2480	40.86	20	54	13.14
17994.0	All channels	51.81	-	54	2.19

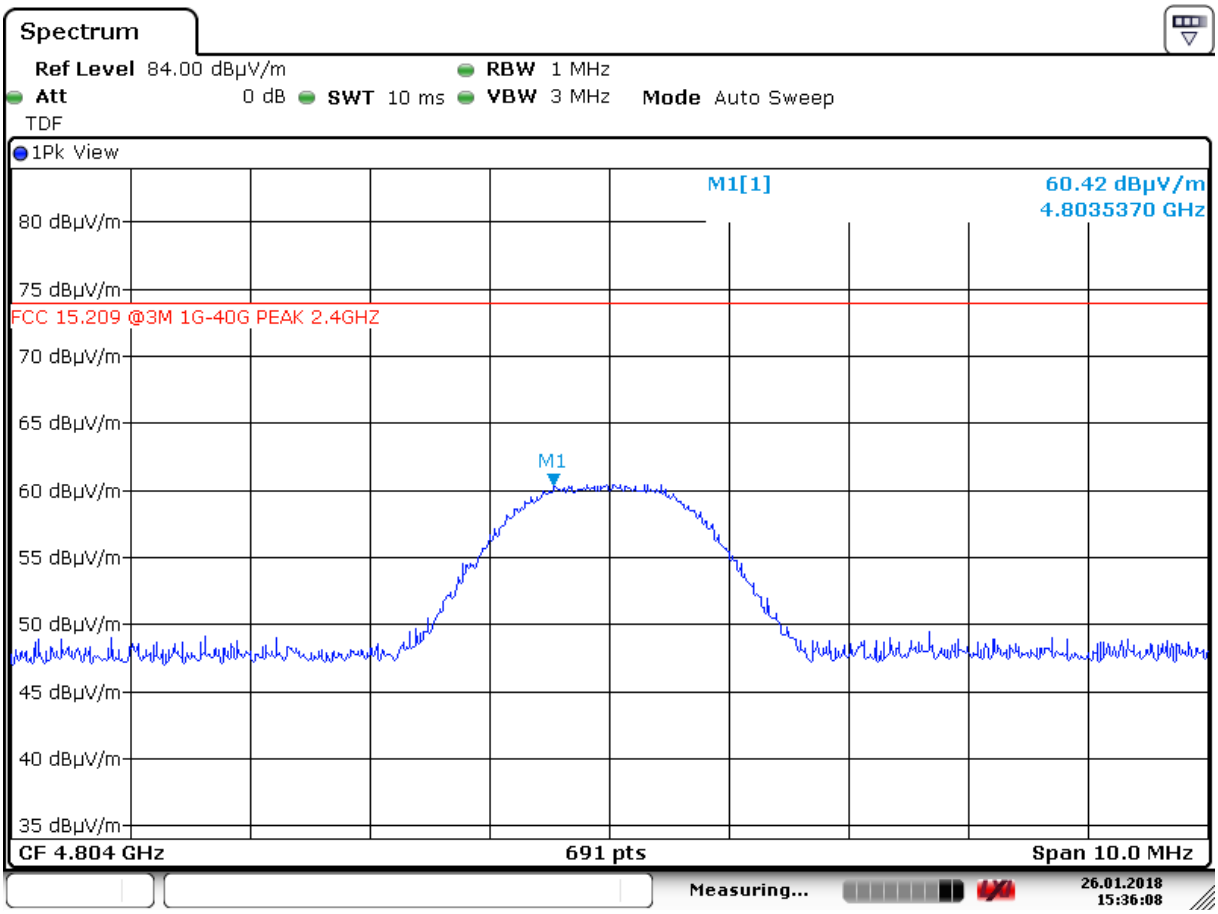
Duty Cycle Correction Factor Calculation:

According to the manufacturer:

ON time : 0.94ms and OFF time : 300ms , Duty cycle : 0.31%

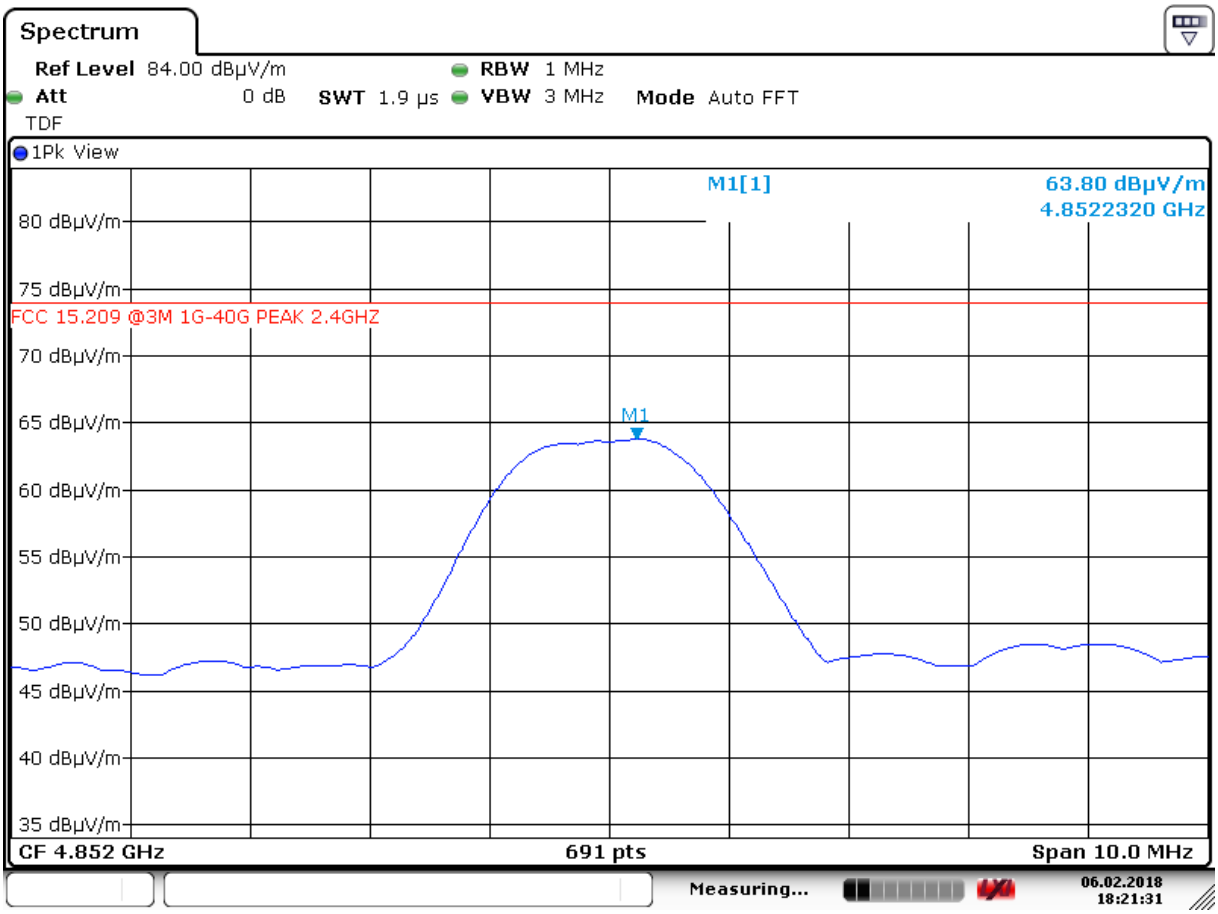
Duty Cycle Correction factor = -20 x log (Duty Cycle) = 20 log (0.94/300)= -50 dB

Maximum allowed Duty Cycle Correction: 20 dB



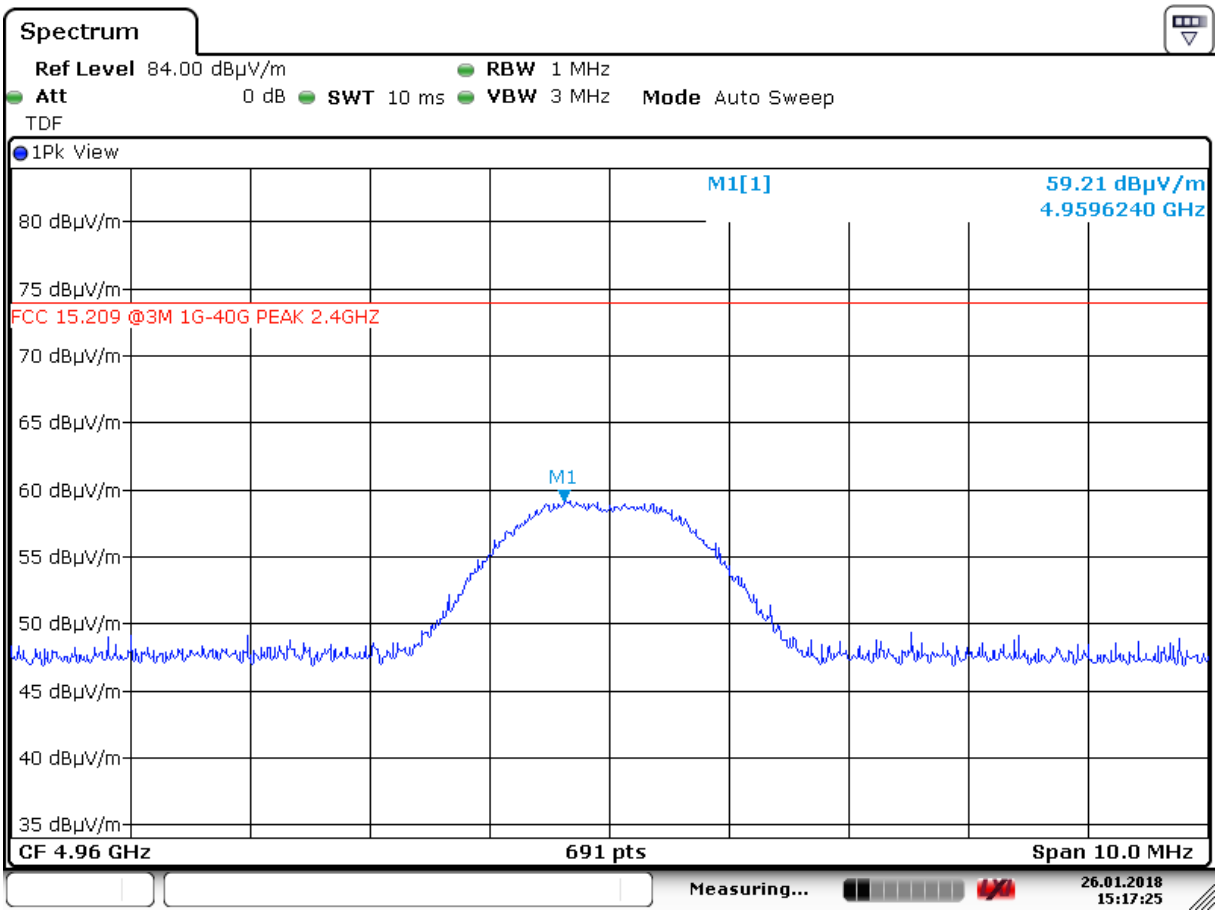
Date: 26.JAN.2018 15:36:08

2th harmonic – ch 2402 MHz, HP, Peak Detector



Date: 6.FEB.2018 18:21:32

2th harmonic – ch 2426 MHz, HP, Peak Detector



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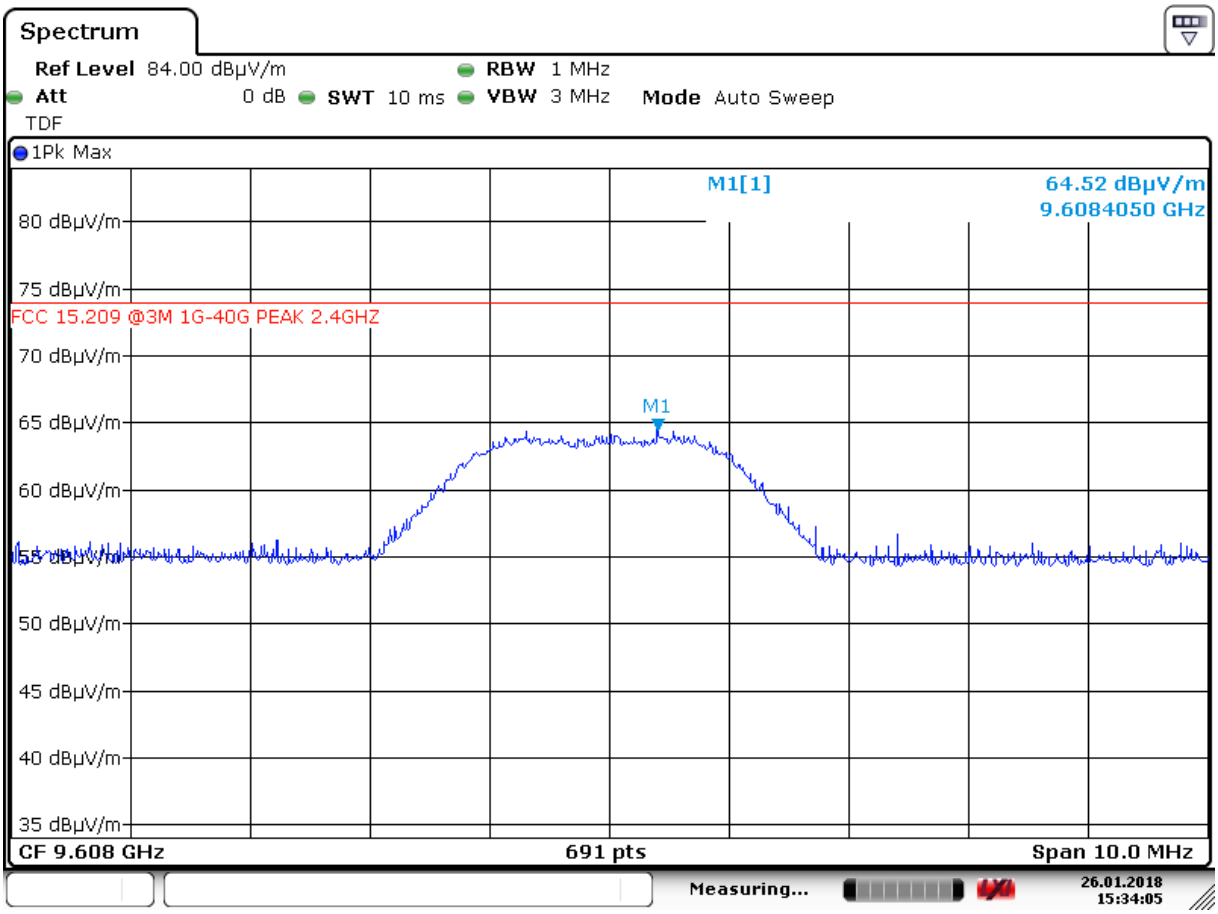
2th harmonic – ch 2480 MHz, HP, Peak Detector



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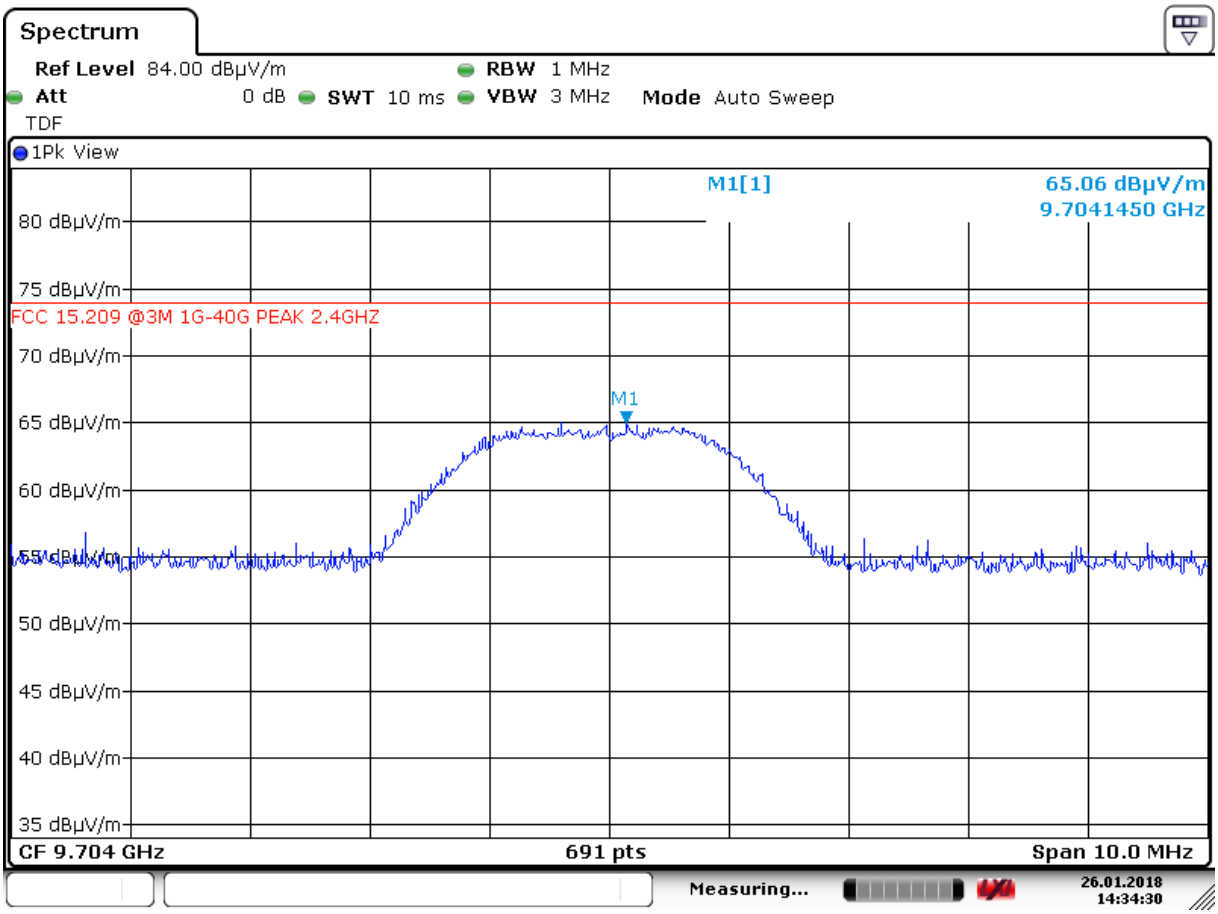
4th harmonic – ch 2402 MHz, HP, Peak Detector



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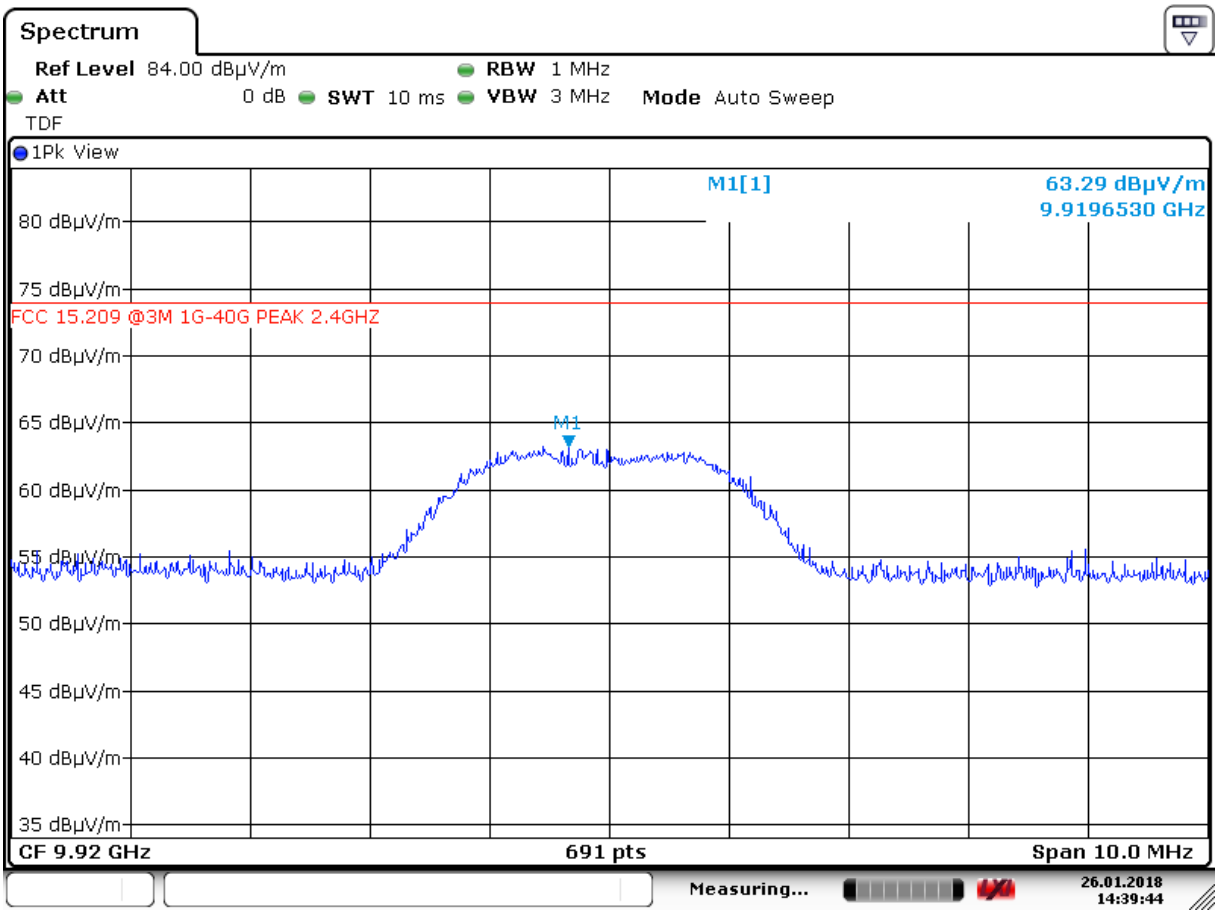
4th harmonic – ch 2426 MHz, VP, Peak Detector



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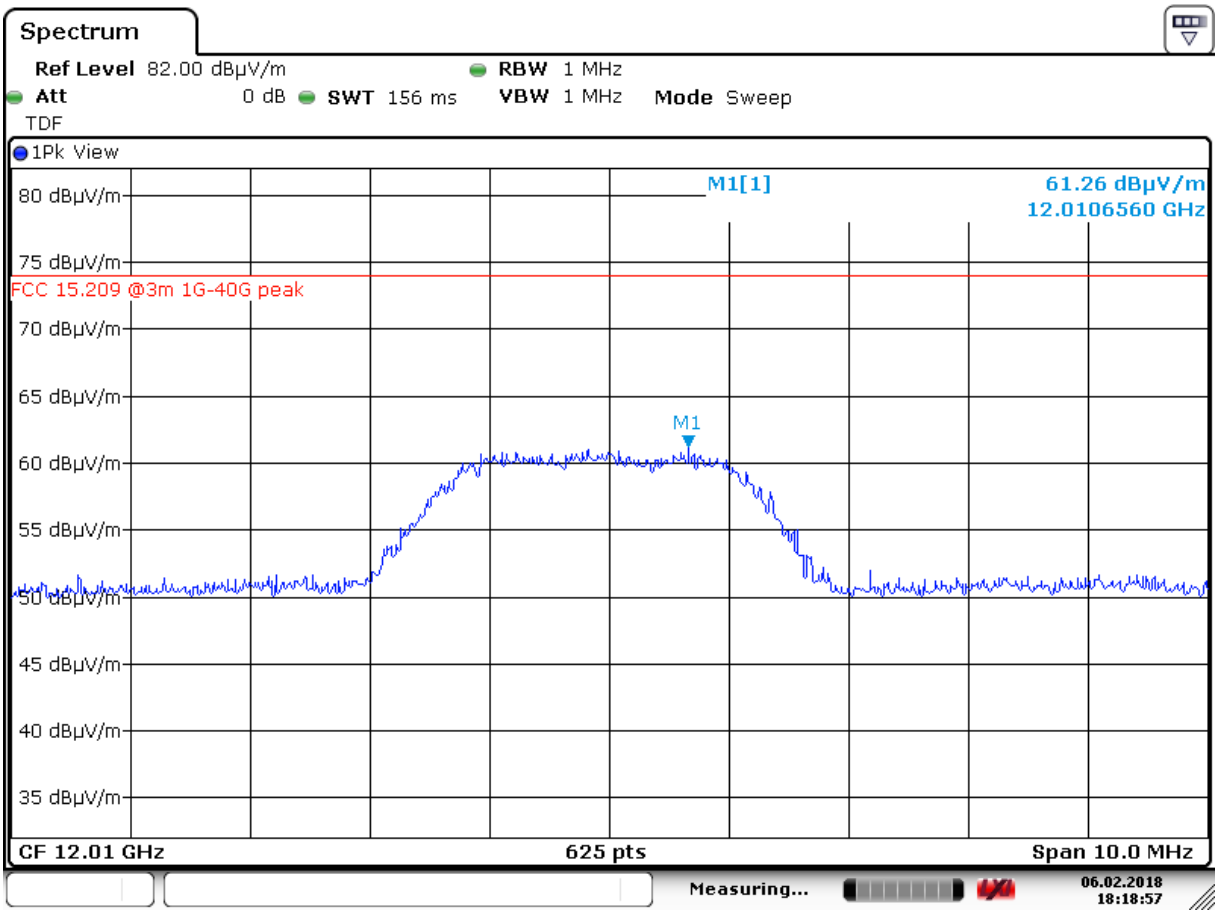
4th harmonic – ch 2480 MHz, VP, Peak Detector



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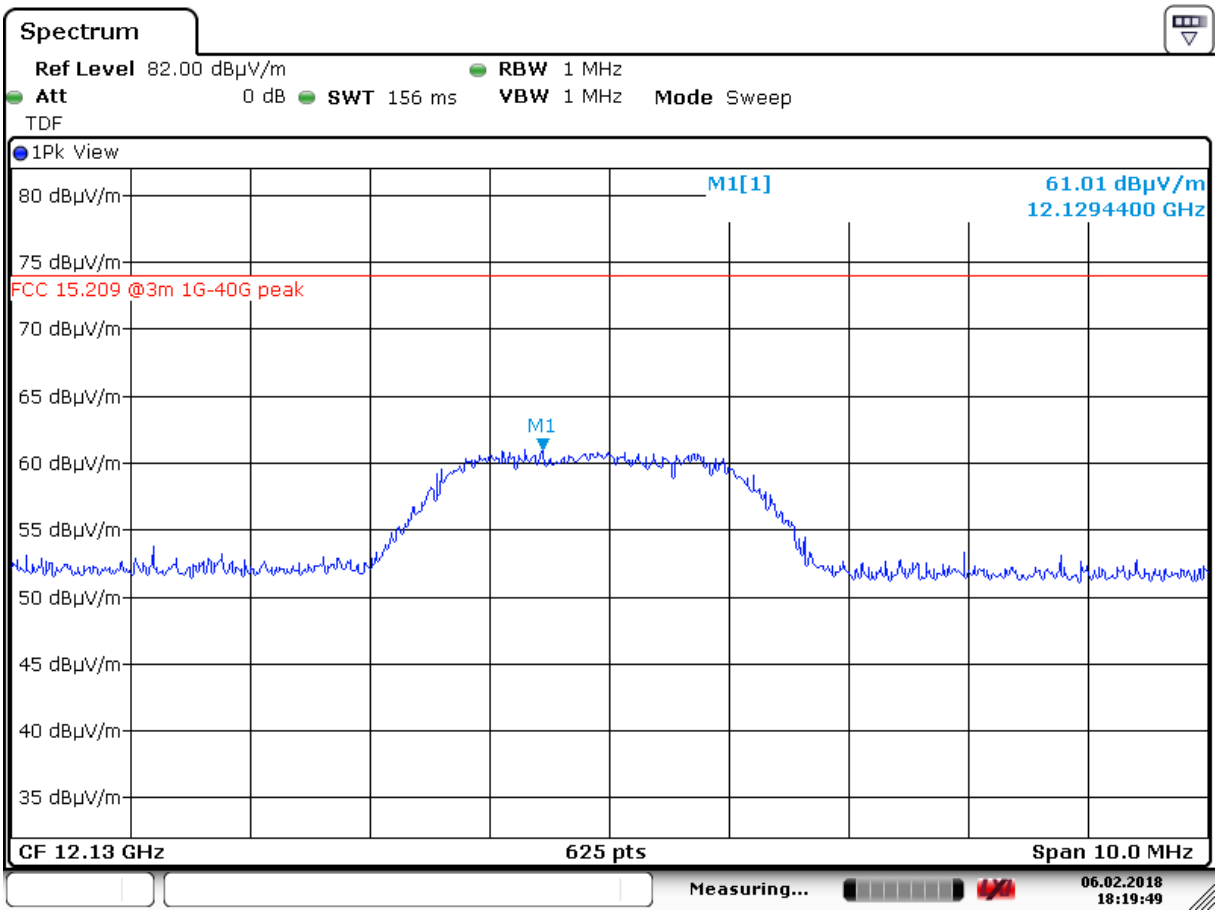
5th harmonic – ch 2402 MHz, VP, Peak Detector



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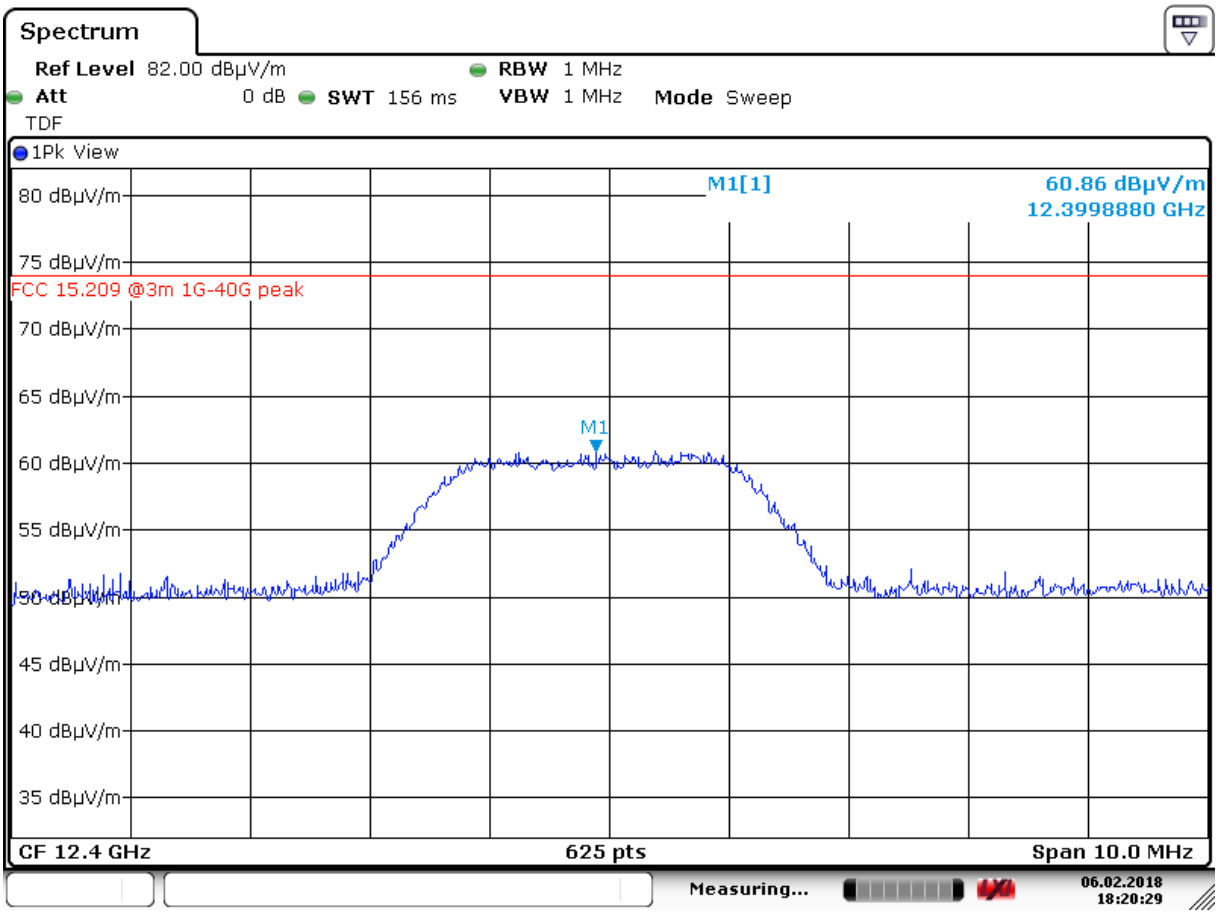
5th harmonic – ch 2426 MHz, VP, Peak Detector



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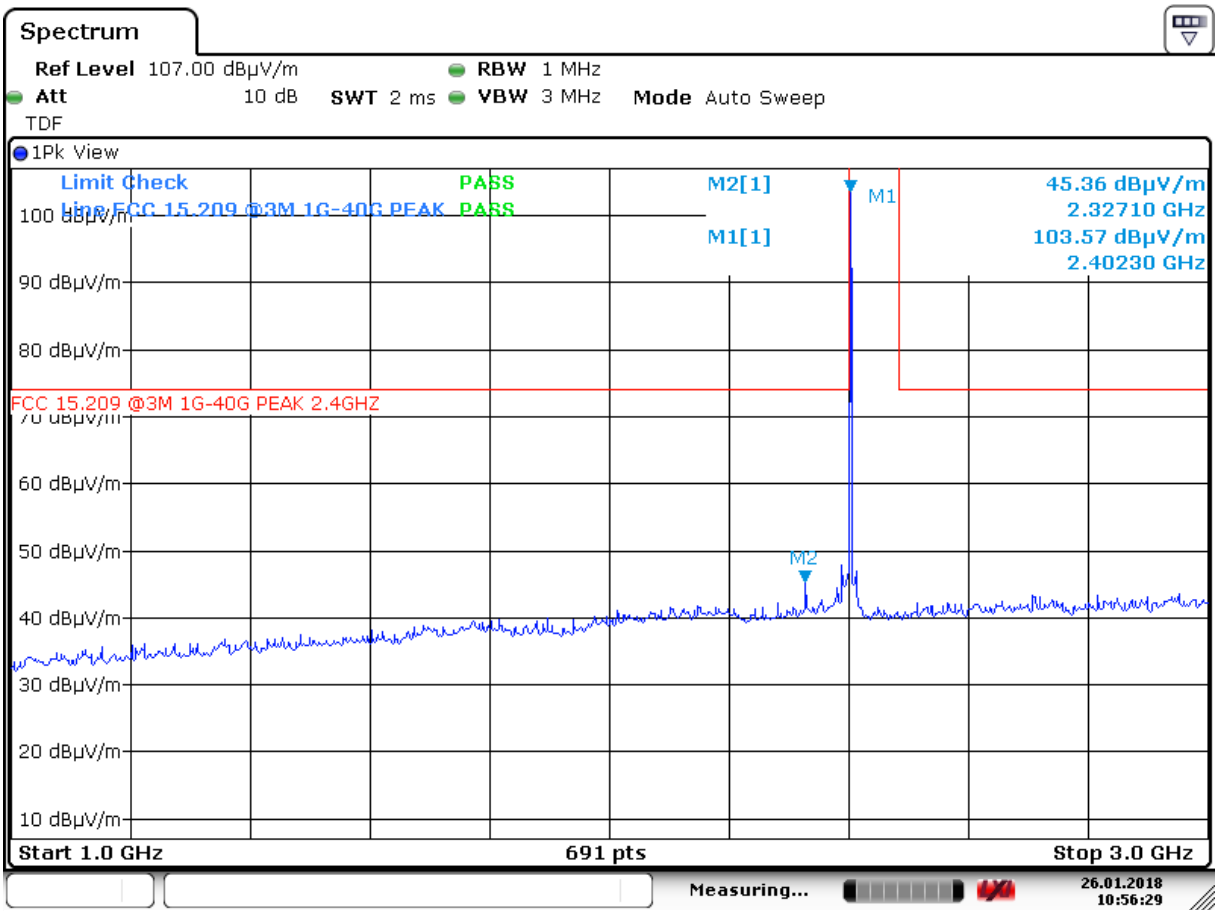
5th harmonic – ch 2480 MHz, VP, Peak Detector



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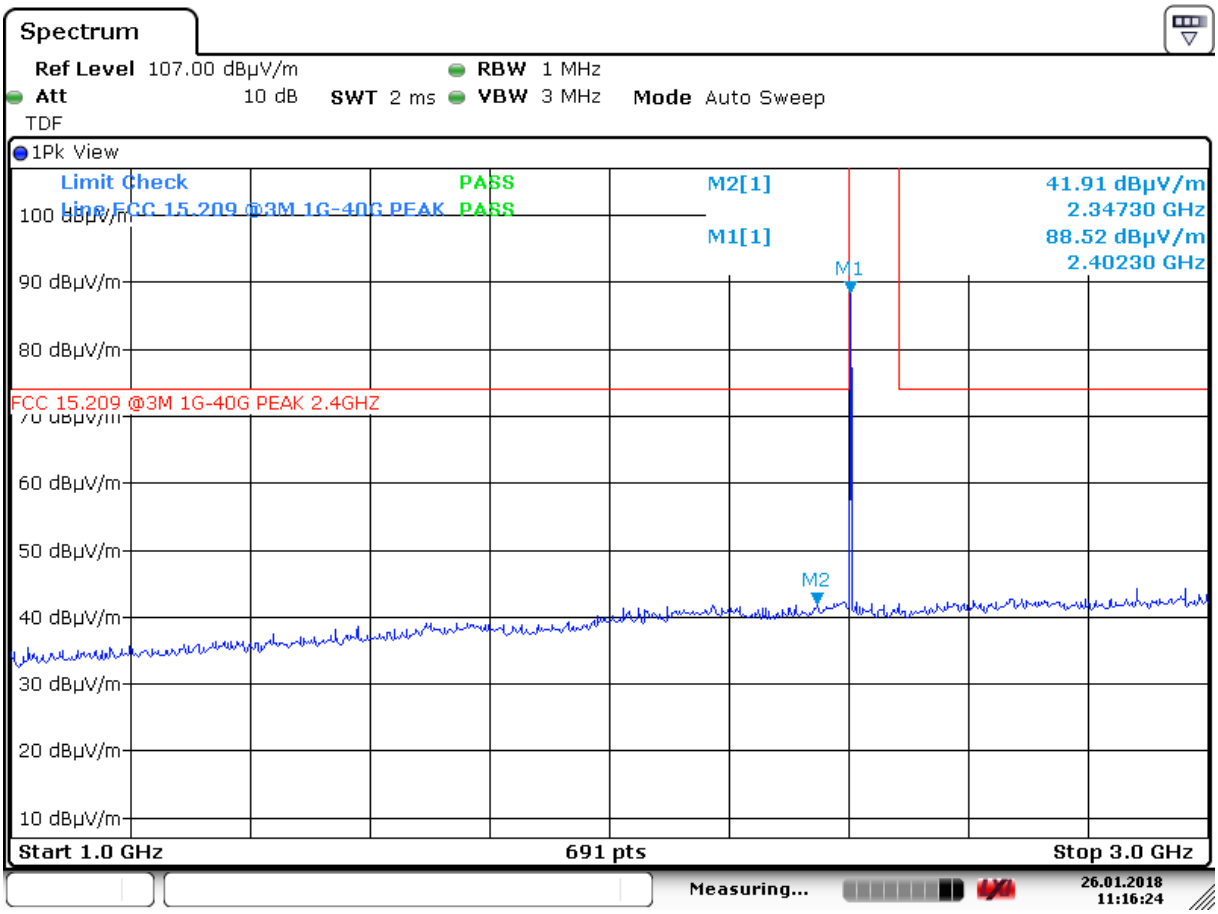
Radiated Emissions, 2402 MHz, 1 – 3 GHz, HP, @3m, PK scan



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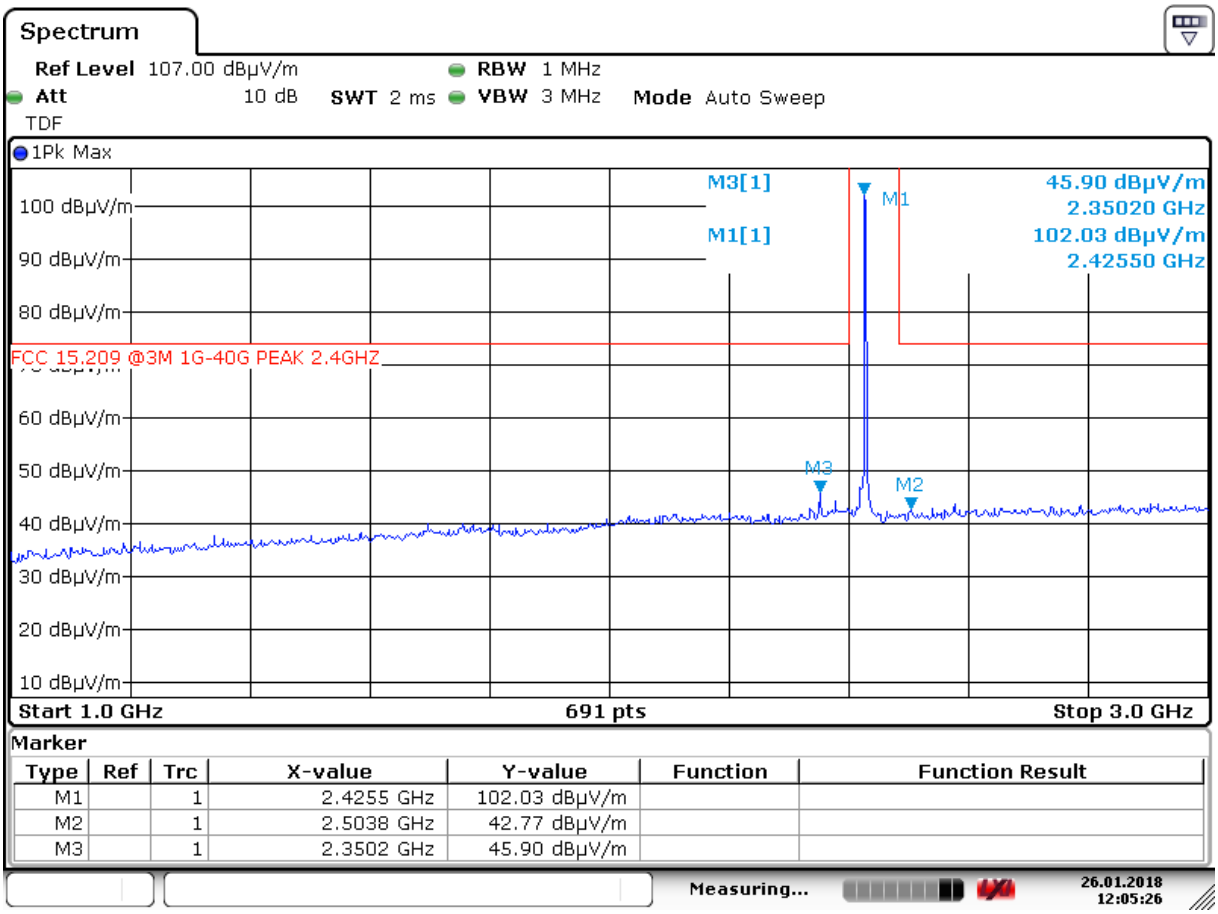
Radiated Emissions, 2402 MHz, 1 – 3 GHz, VP, @3m, PK scan



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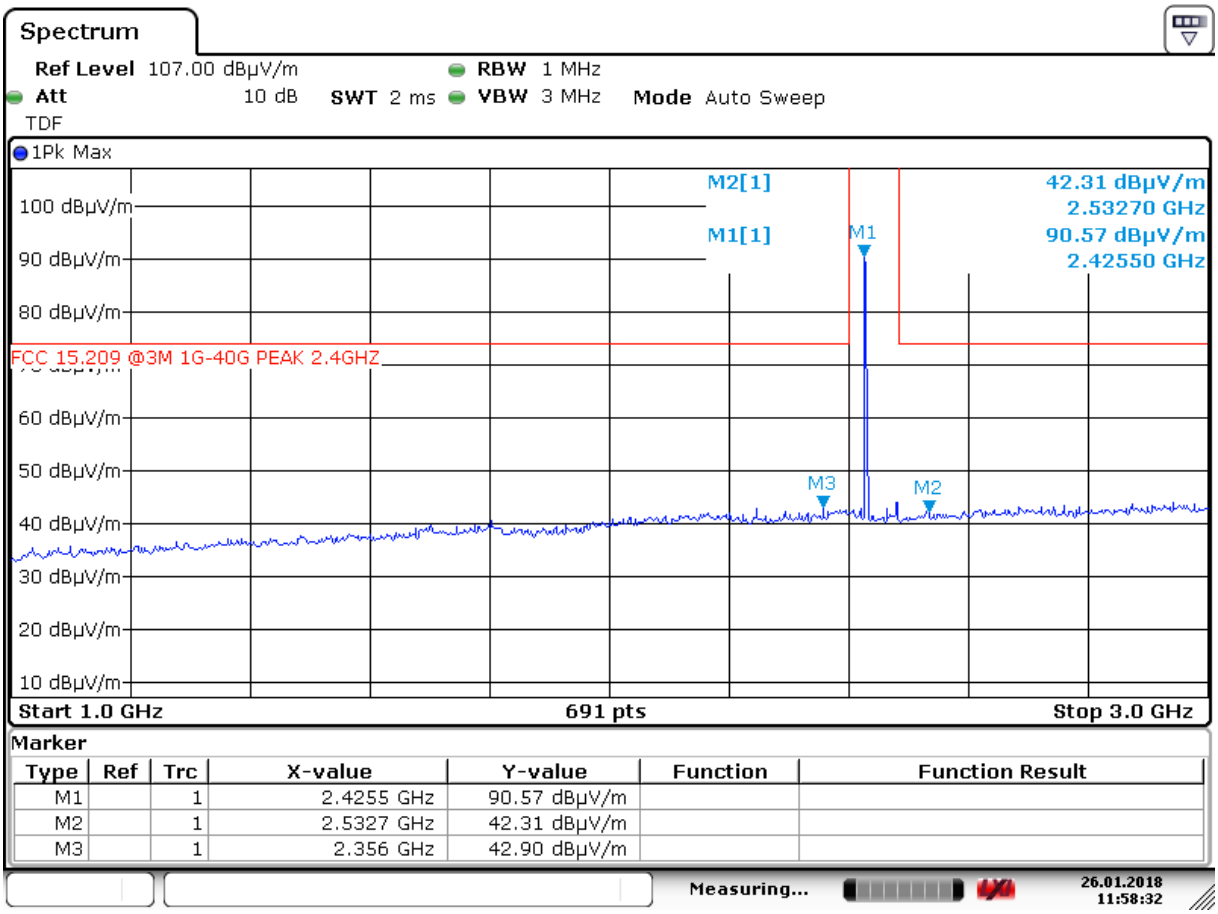
Radiated Emissions, 2426 MHz, 1 – 3 GHz, HP, @3m, PK scan



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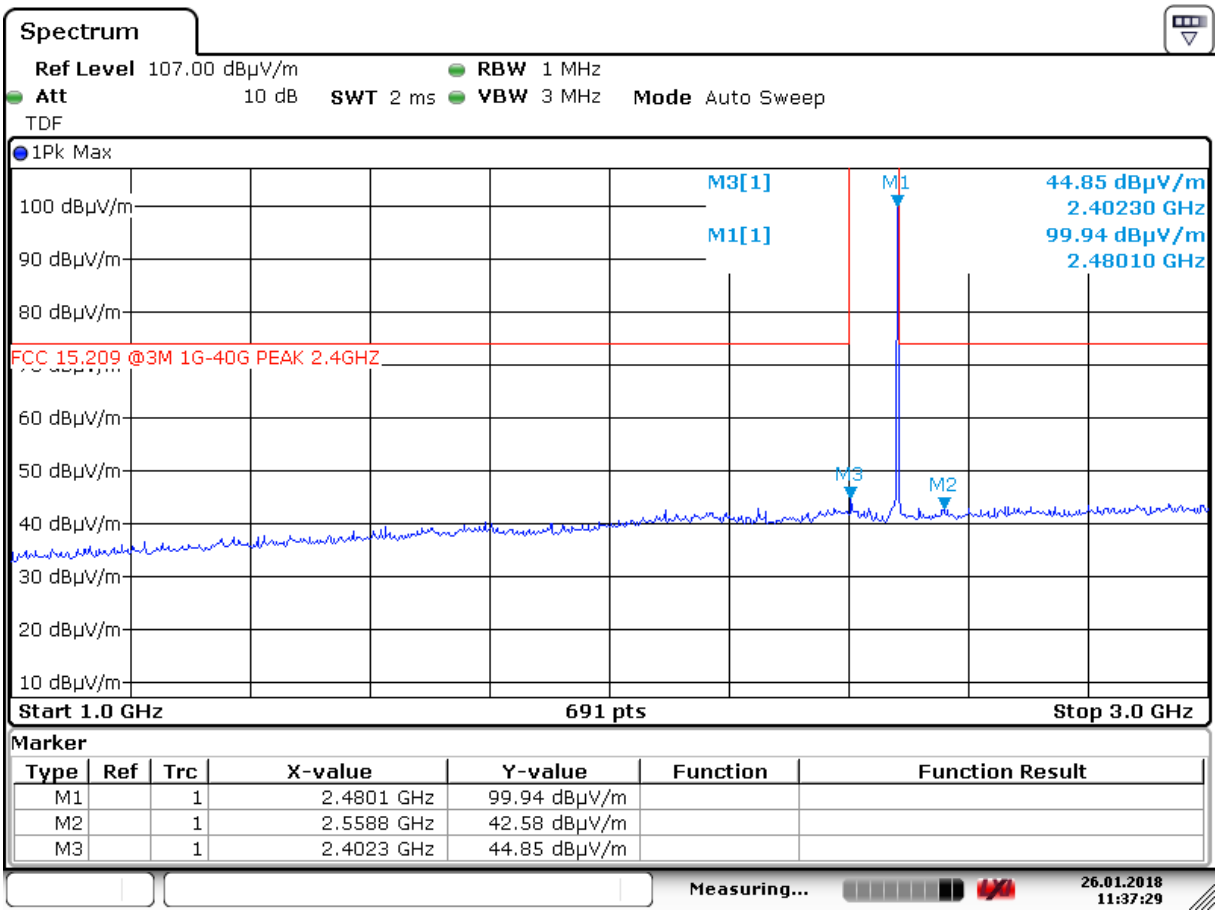
Radiated Emissions, 2426 MHz, 1 – 3 GHz, VP, @3m, PK scan



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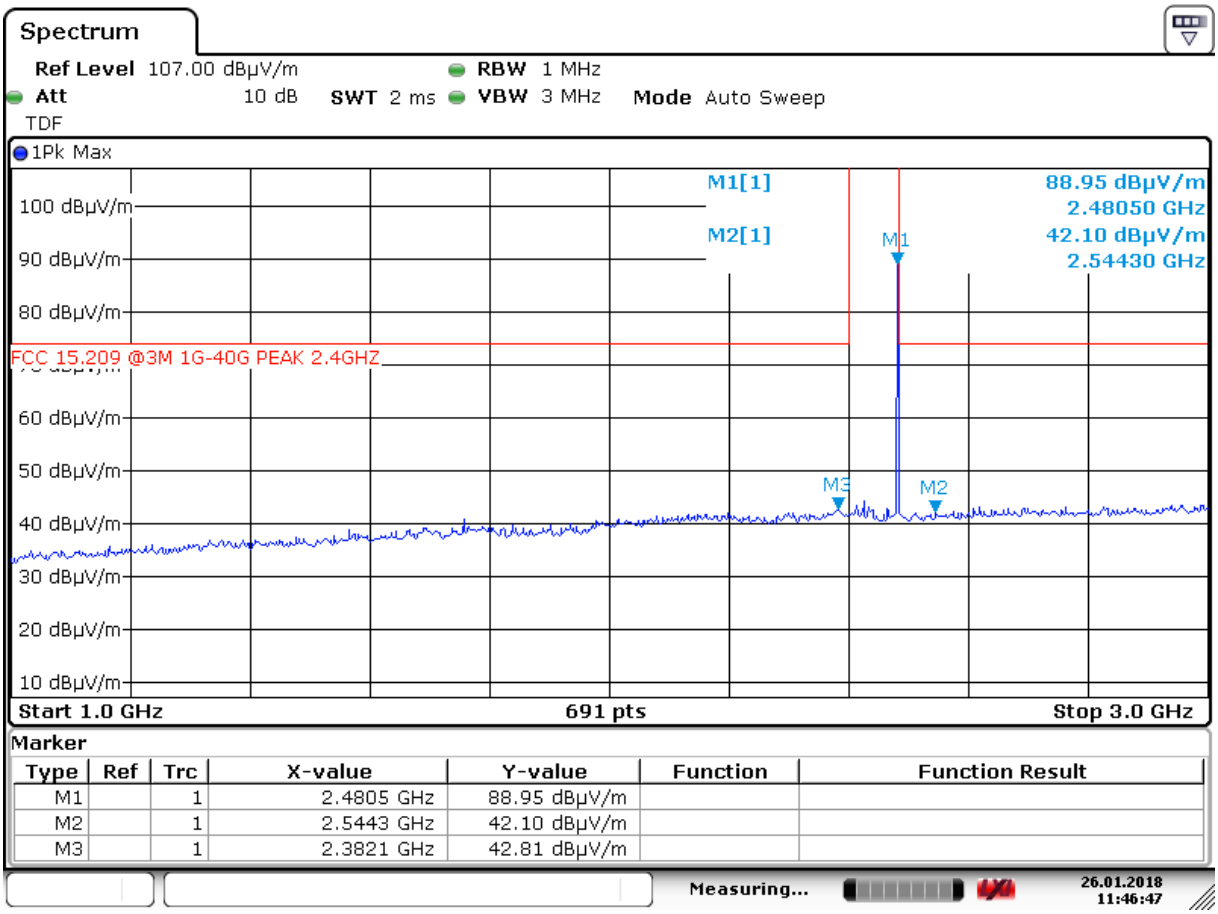
Radiated Emissions, 2480 MHz, 1 – 3 GHz, HP, @3m, PK scan



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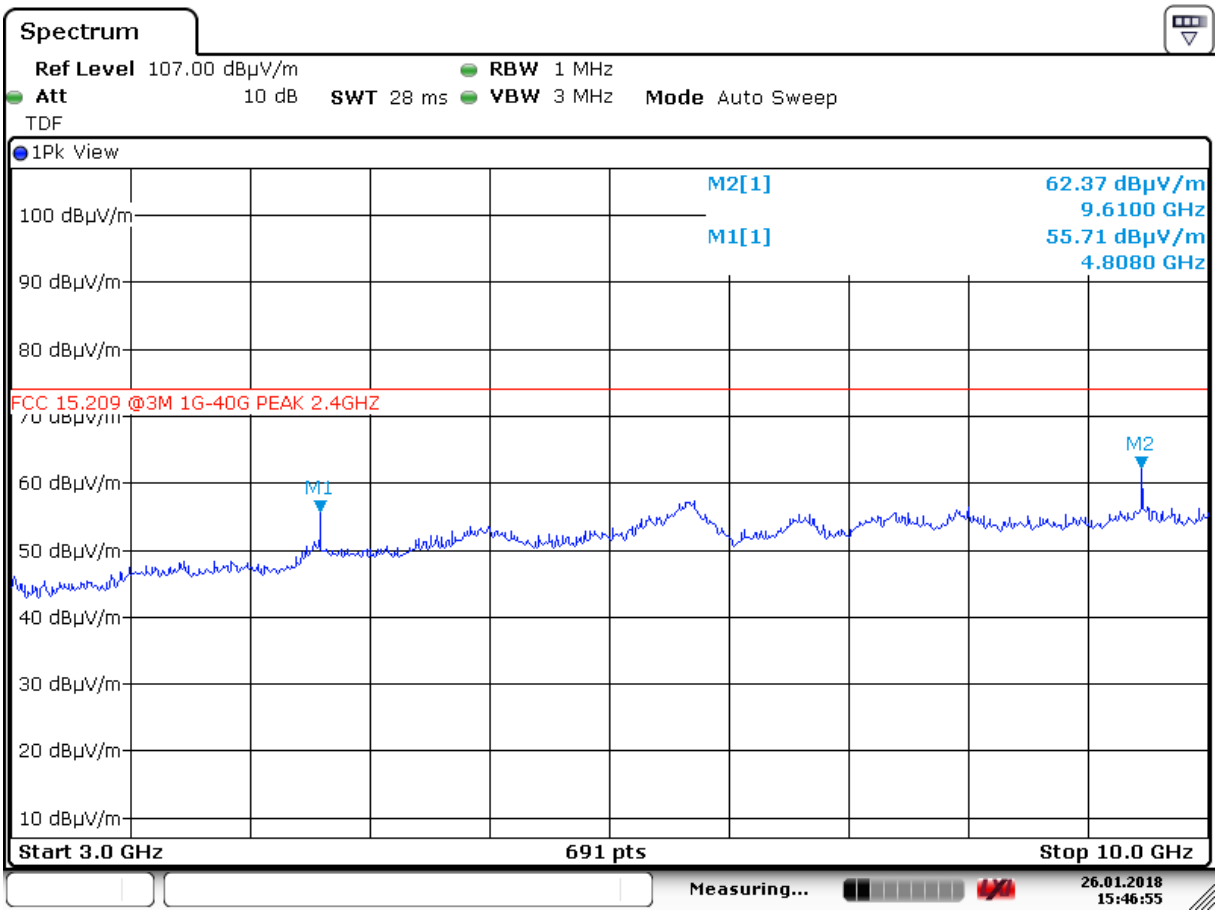
Radiated Emissions, 2480 MHz, 1 – 3 GHz, VP, @3m, PK scan



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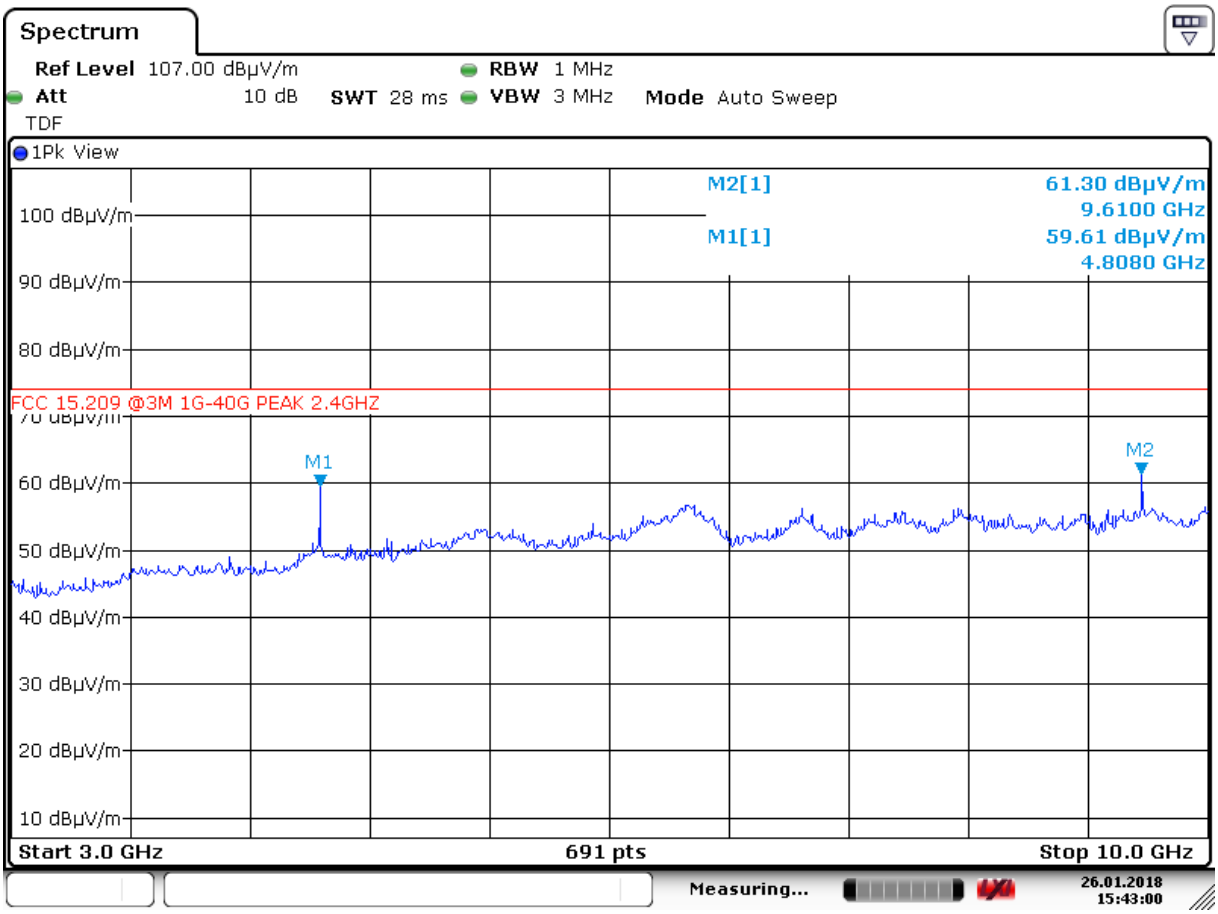
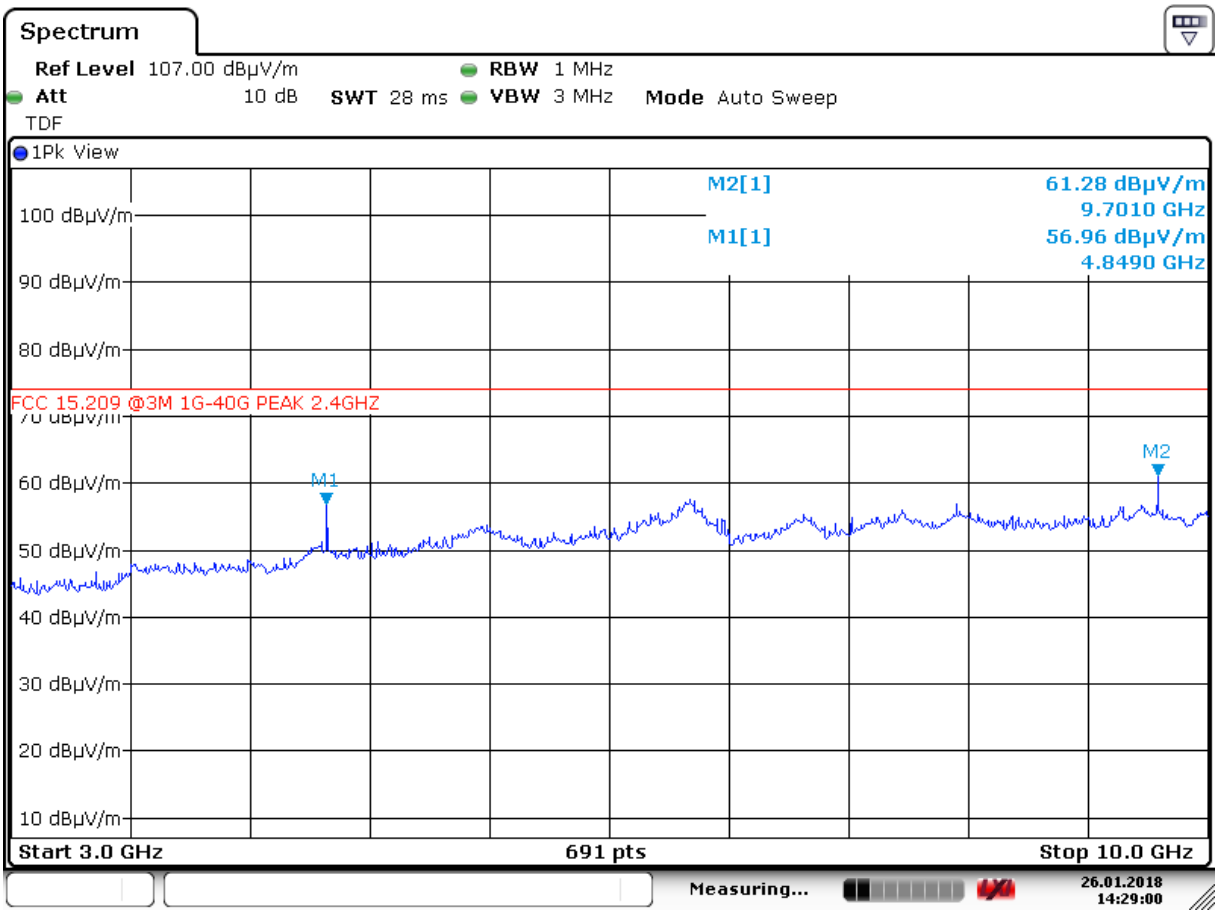
Radiated Emissions, 2402 MHz, 3 – 10 GHz, VP, @3m, PK scan



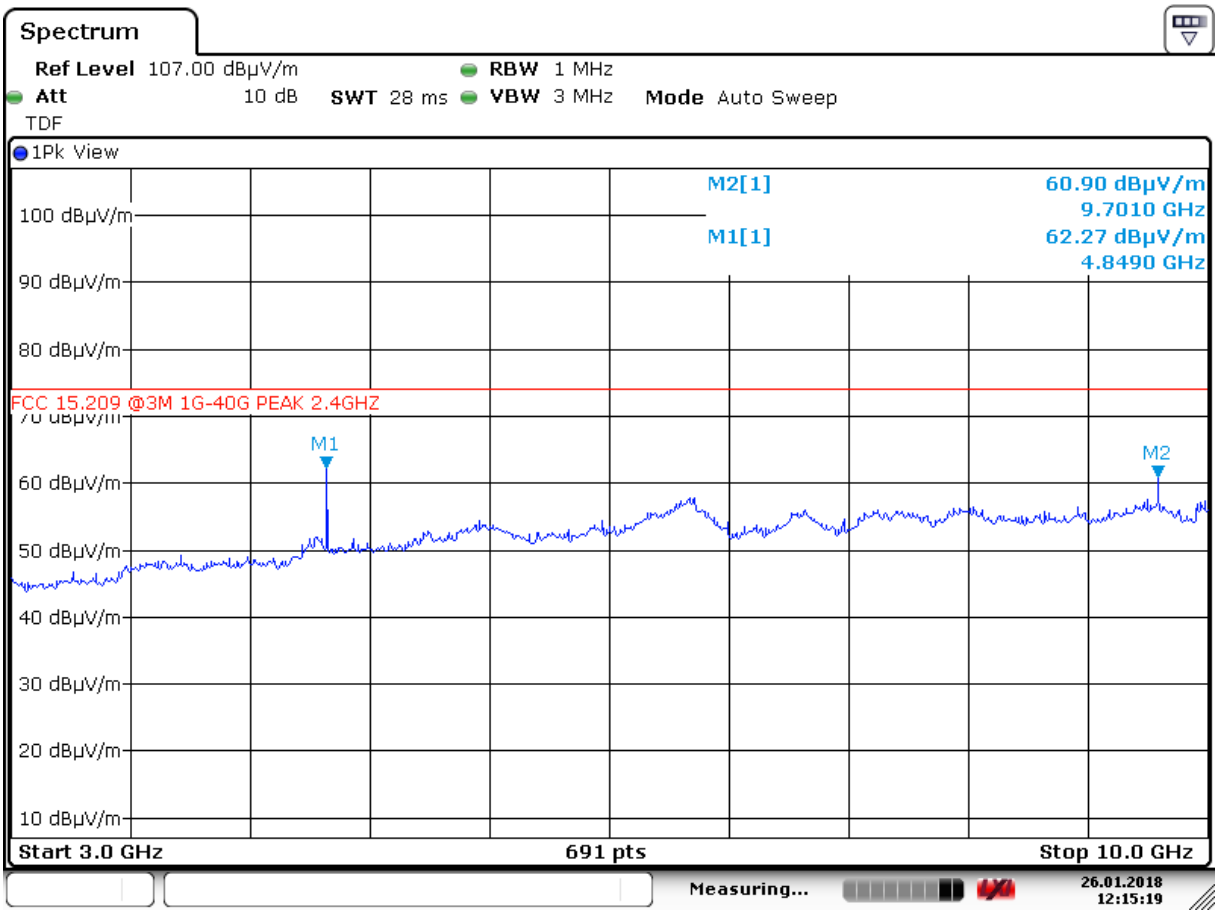
Date: 26.JAN.2018 15:43:01

Radiated Emissions, 2402 MHz, 3 – 10 GHz, HP, @3m, PK scan



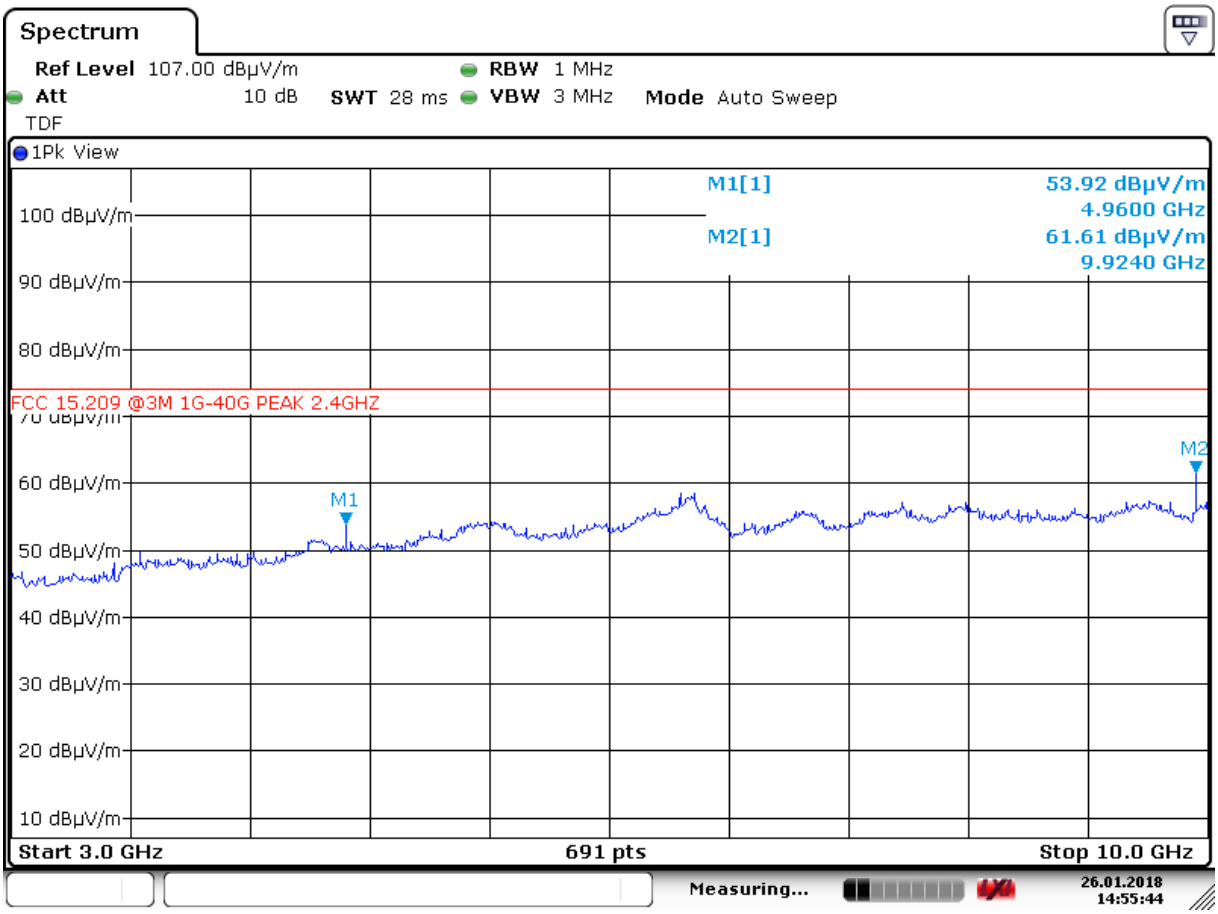
Date: 26.JAN.2018 14:29:00

Radiated Emissions, 2426 MHz, 3 – 10 GHz, VP, @3m, PK scan



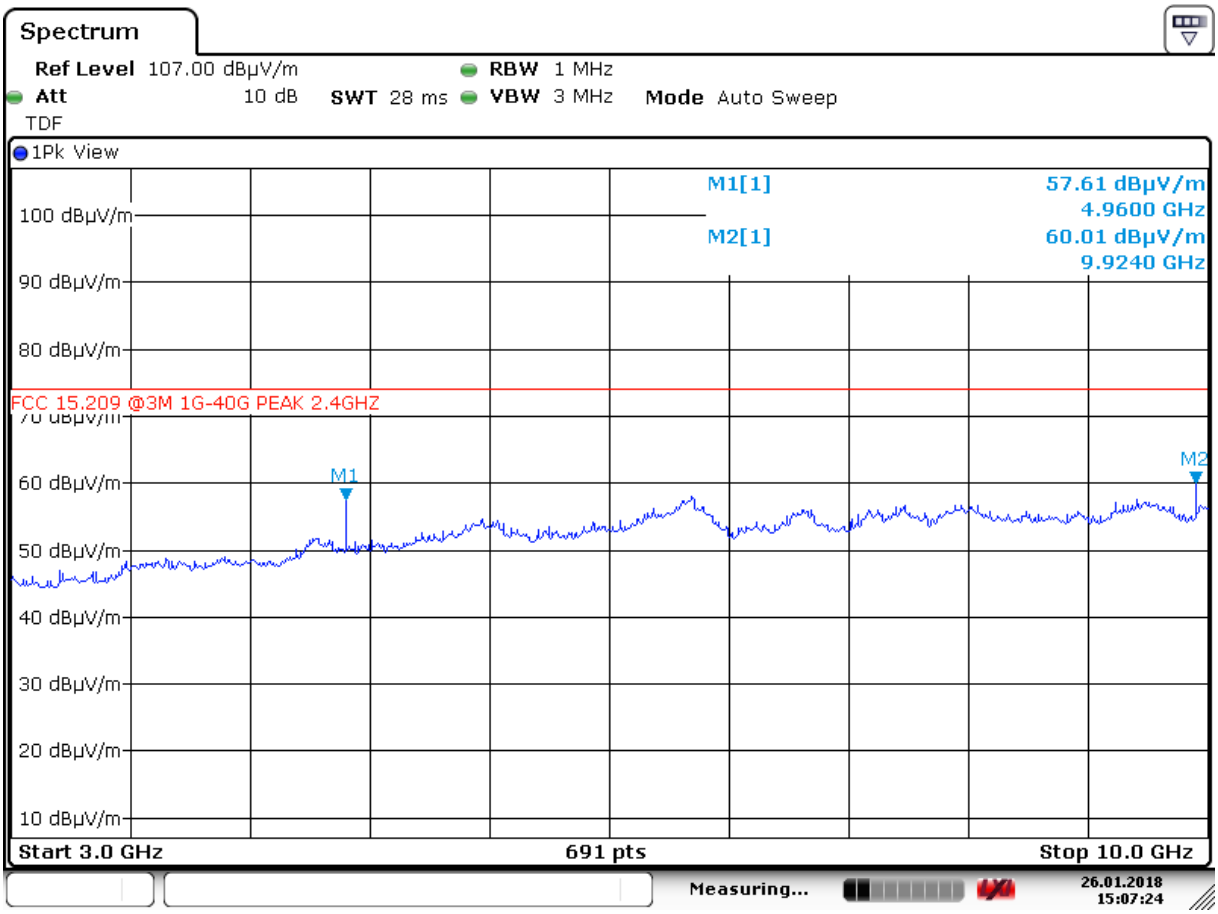
Date: 26.JAN.2018 12:15:20

Radiated Emissions, 2426 MHz, 3 – 10 GHz, HP, @3m, PK scan



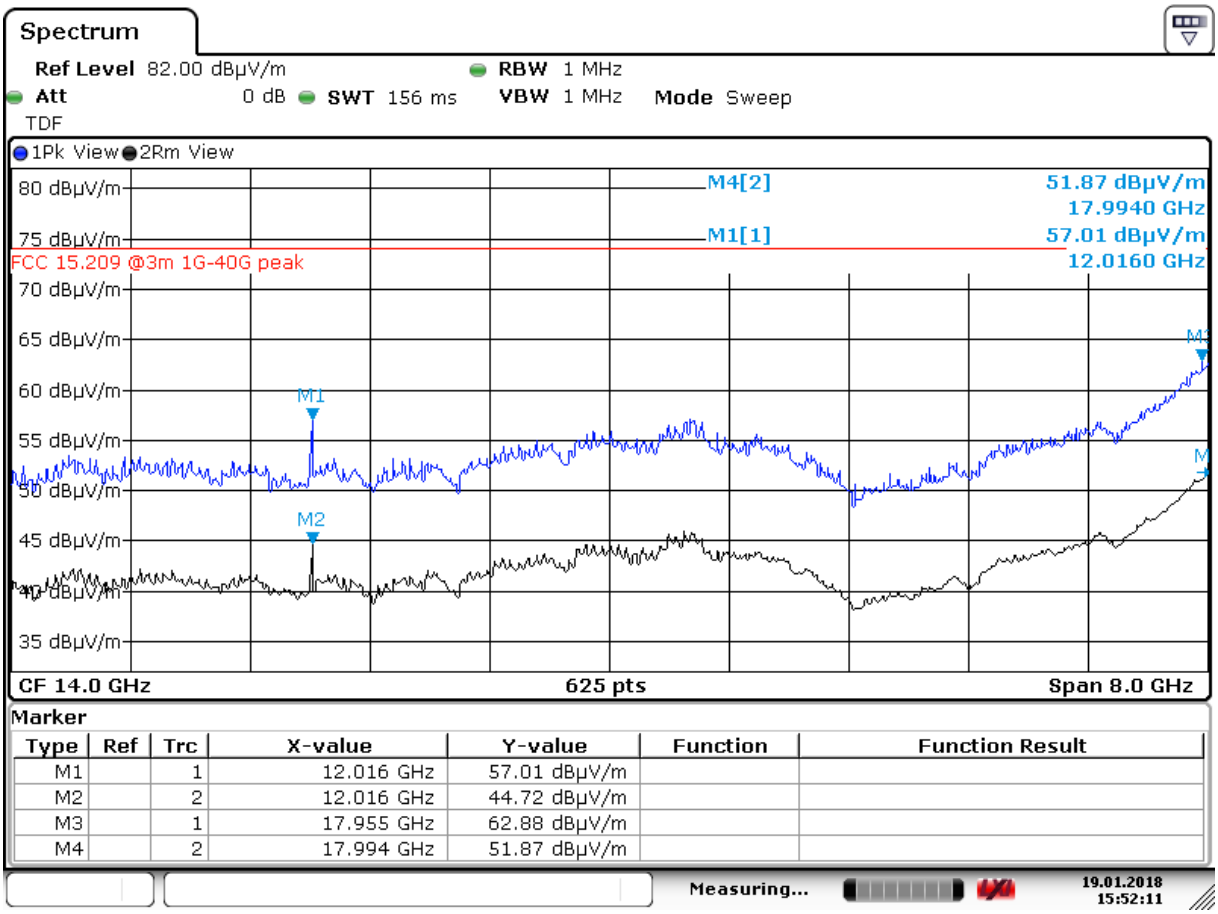
Date: 26.JAN.2018 14:55:44

Radiated Emissions, 2480 MHz, 3 – 10 GHz, VP, @3m, PK scan



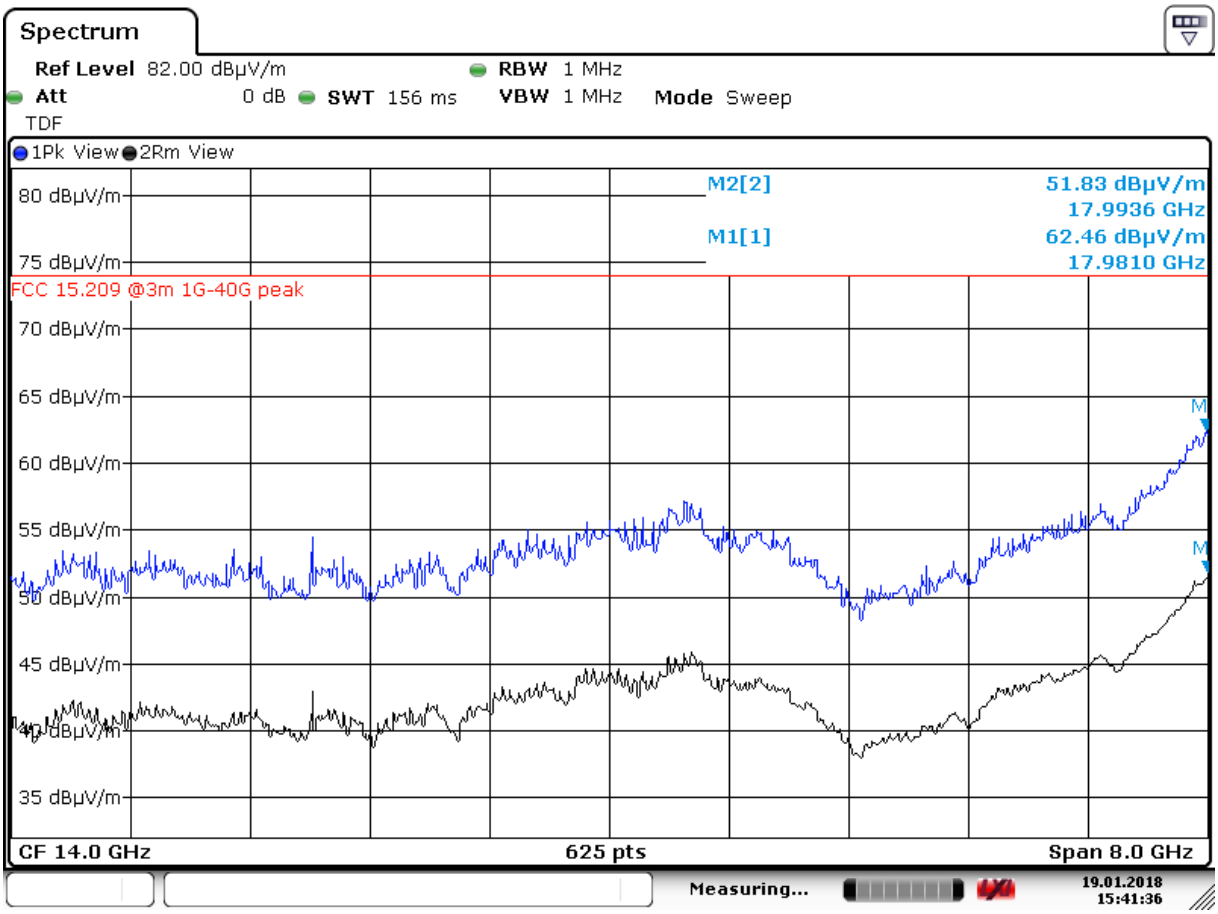
Date: 26.JAN.2018 15:07:24

Radiated Emissions, 2480 MHz, 3 – 10 GHz, HP, @3m, PK scan



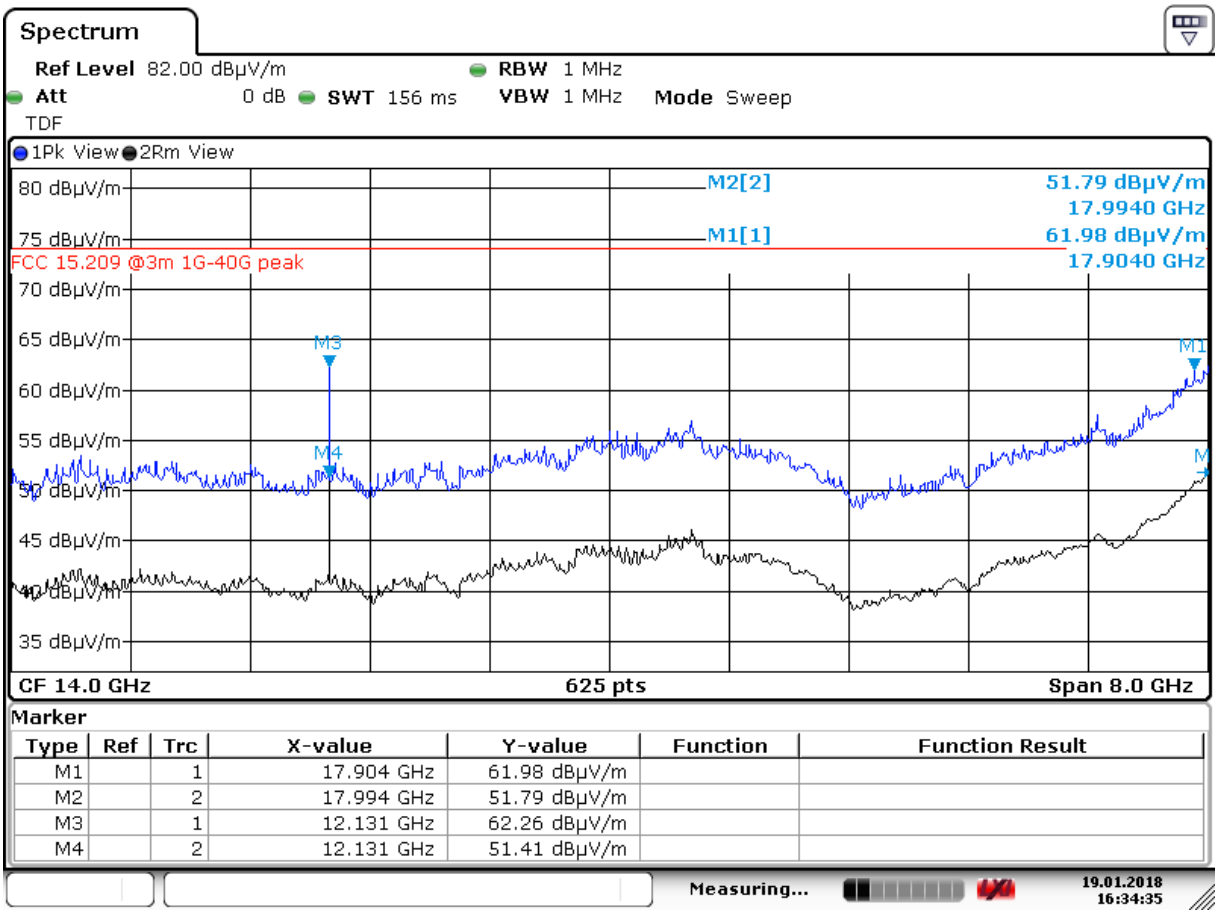
Date: 19.JAN.2018 15:52:11

Radiated Emissions, 2402 MHz, 10 – 18 GHz, VP, @3m, PK scan



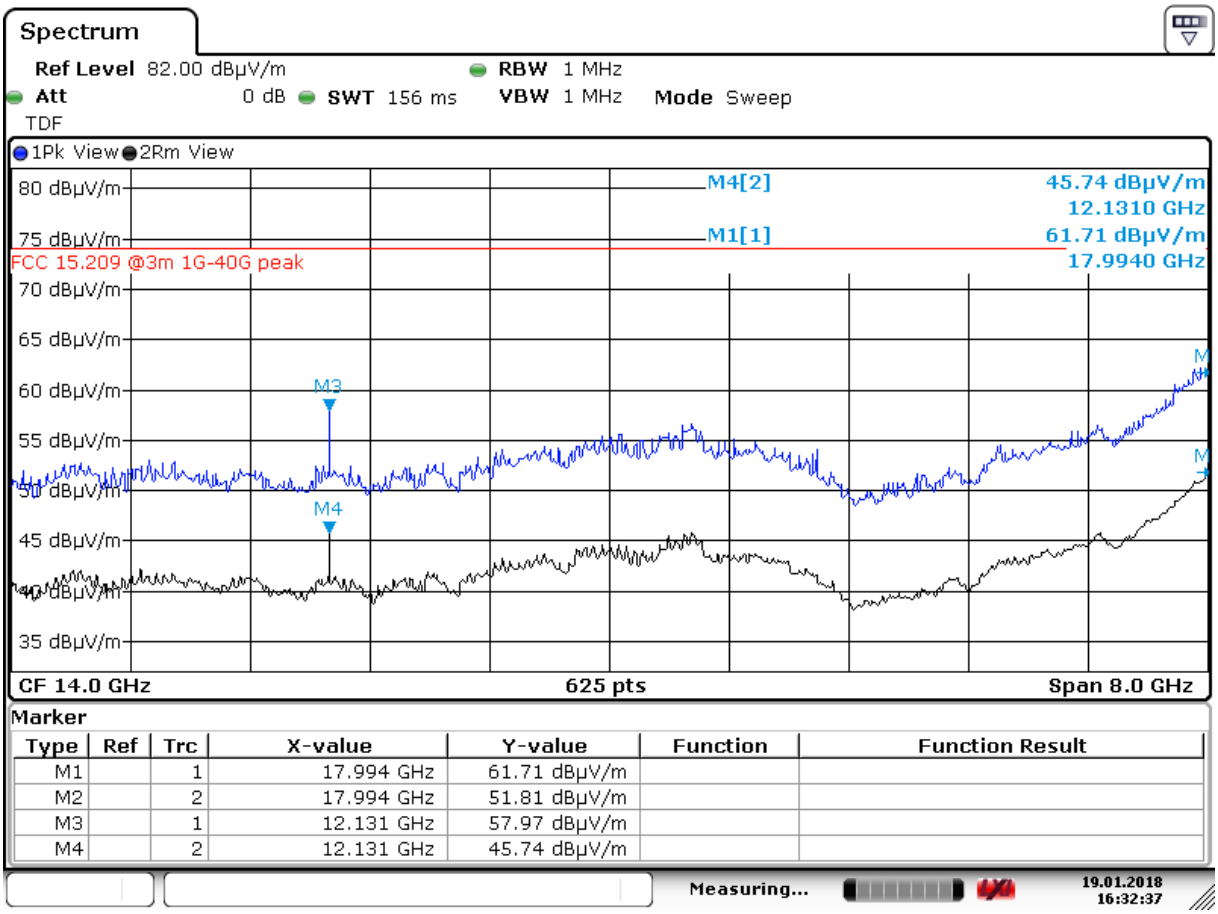
Date: 19.JAN.2018 15:41:35

Radiated Emissions, 2402 MHz, 10 – 18 GHz, HP, @3m, PK scan



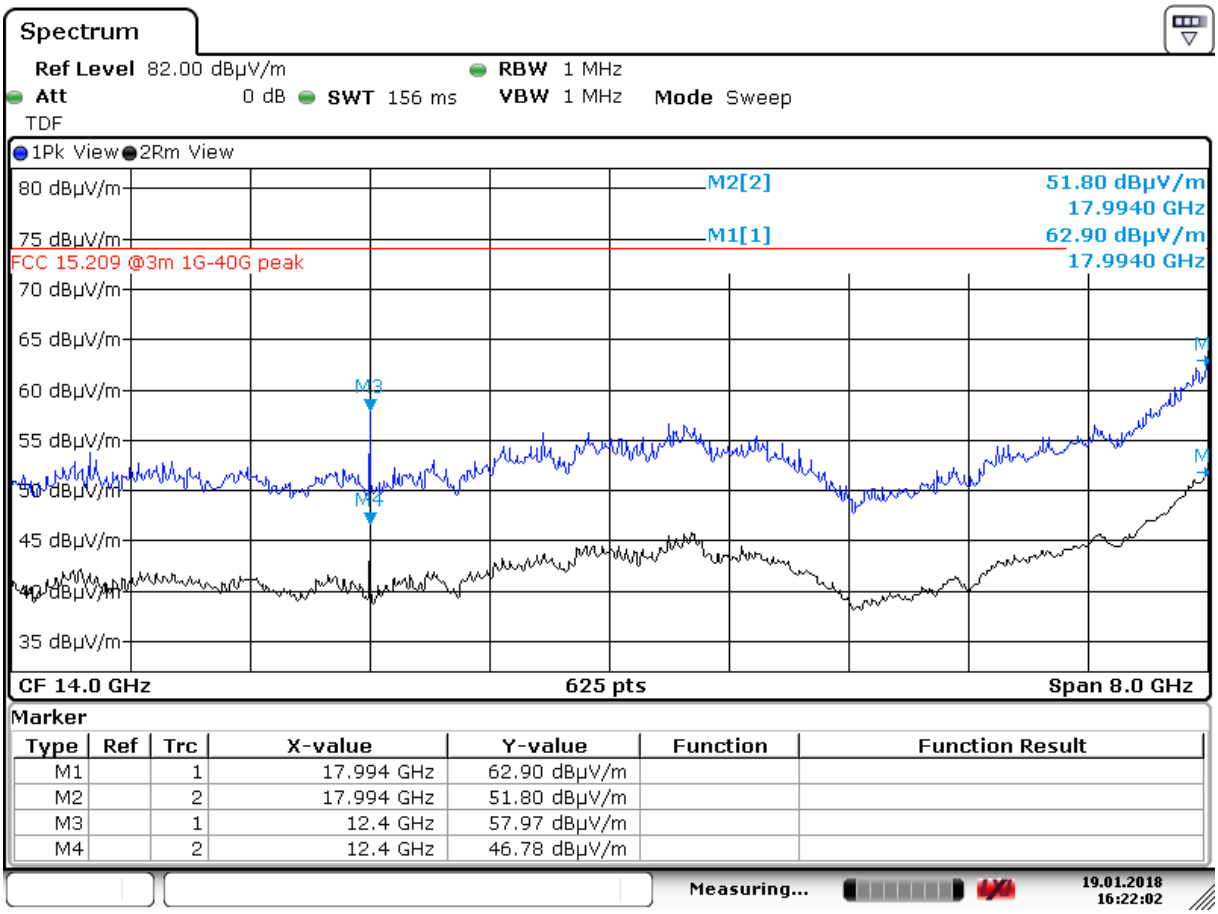
Date: 19.JAN.2018 16:34:35

Radiated Emissions, 2426 MHz, 10 – 18 GHz, VP, @3m, PK scan



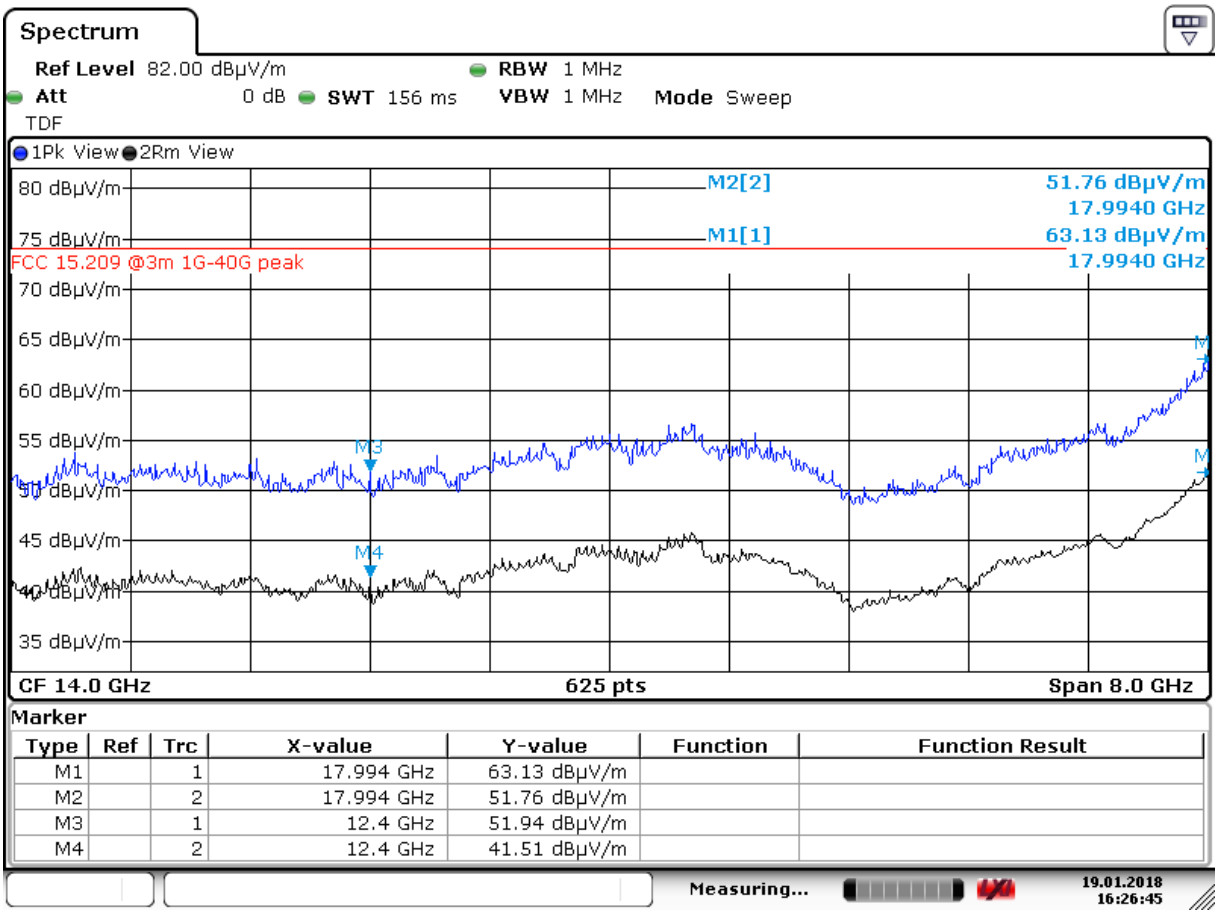
Date: 19.JAN.2018 16:32:37

Radiated Emissions, 2426 MHz, 10 – 18 GHz, HP, @3m, PK scan



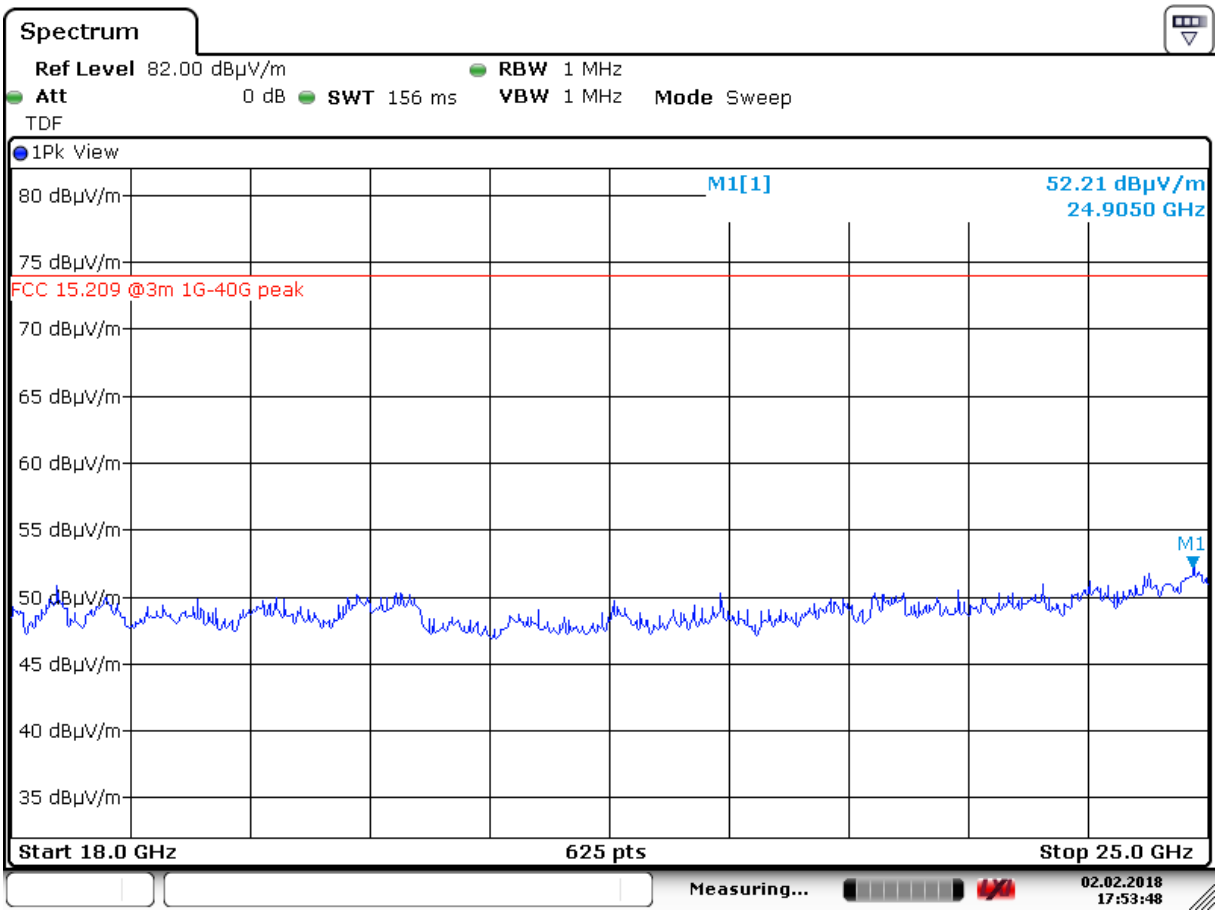
Date: 19.JAN.2018 16:22:01

Radiated Emissions, 2480 MHz, 10 – 18 GHz, VP, @3m, PK scan



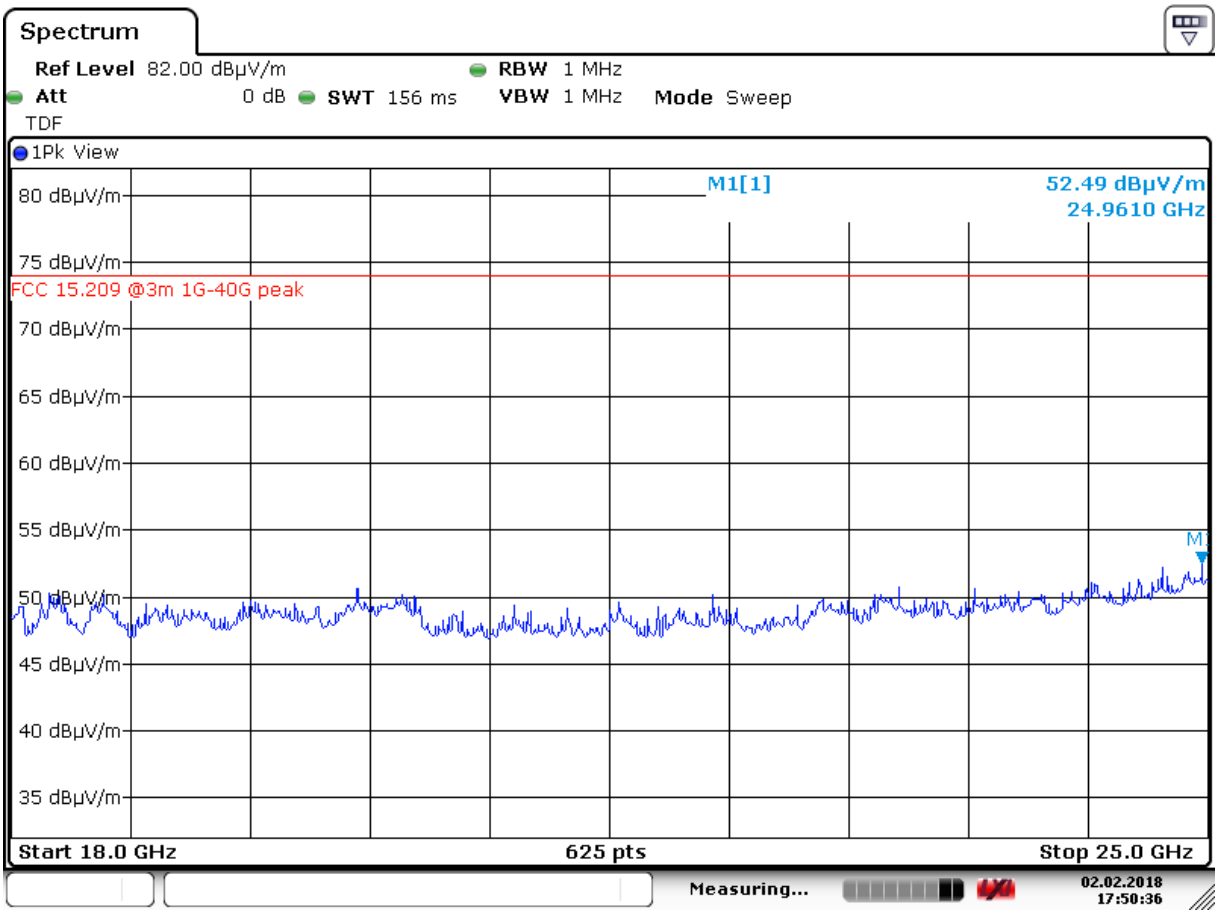
Date: 19.JAN.2018 16:26:45

Radiated Emissions, 2480 MHz, 10 – 18 GHz, HP, @3m, PK scan



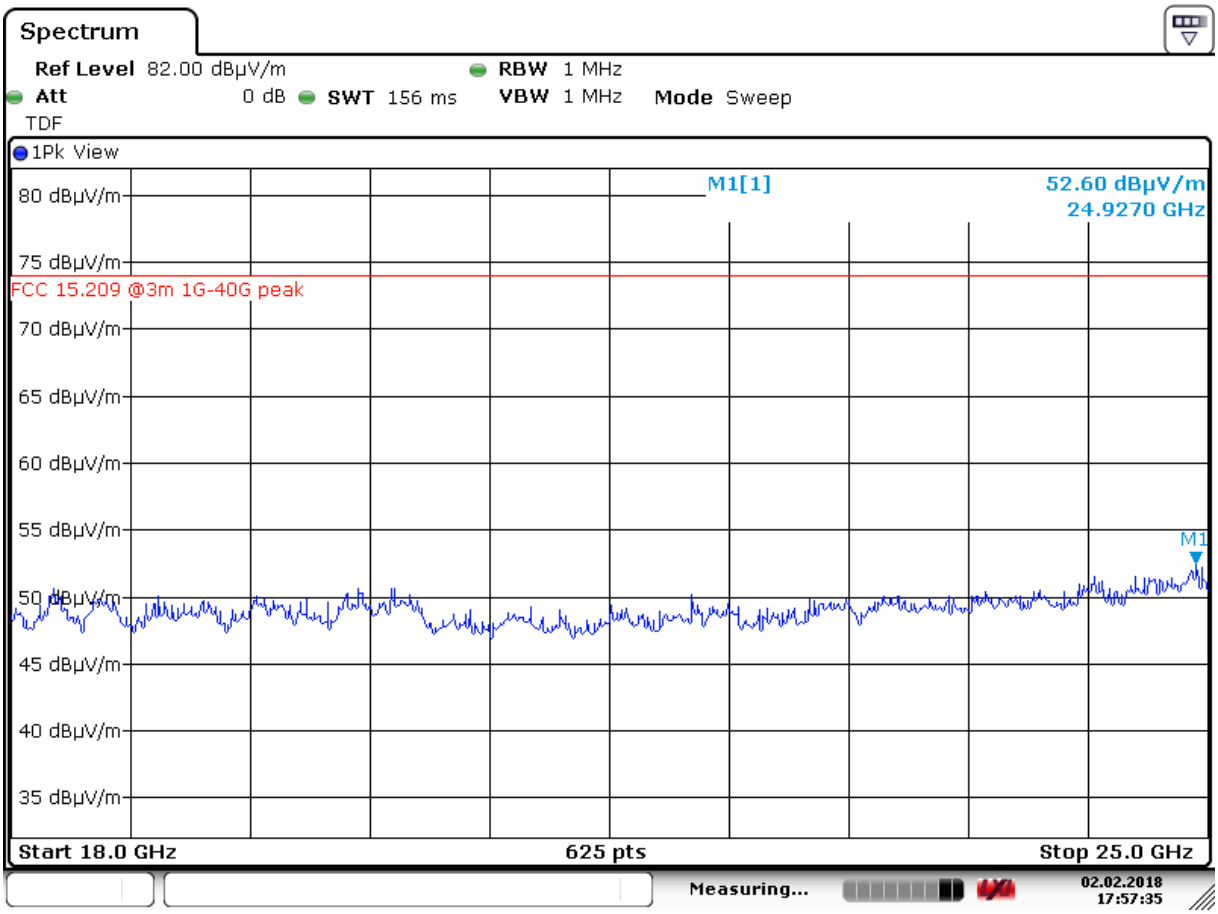
Date: 2.FEB.2018 17:53:49

Radiated Emissions, 2402 MHz, 18 – 25 GHz, VP, @3m, Pre- scan



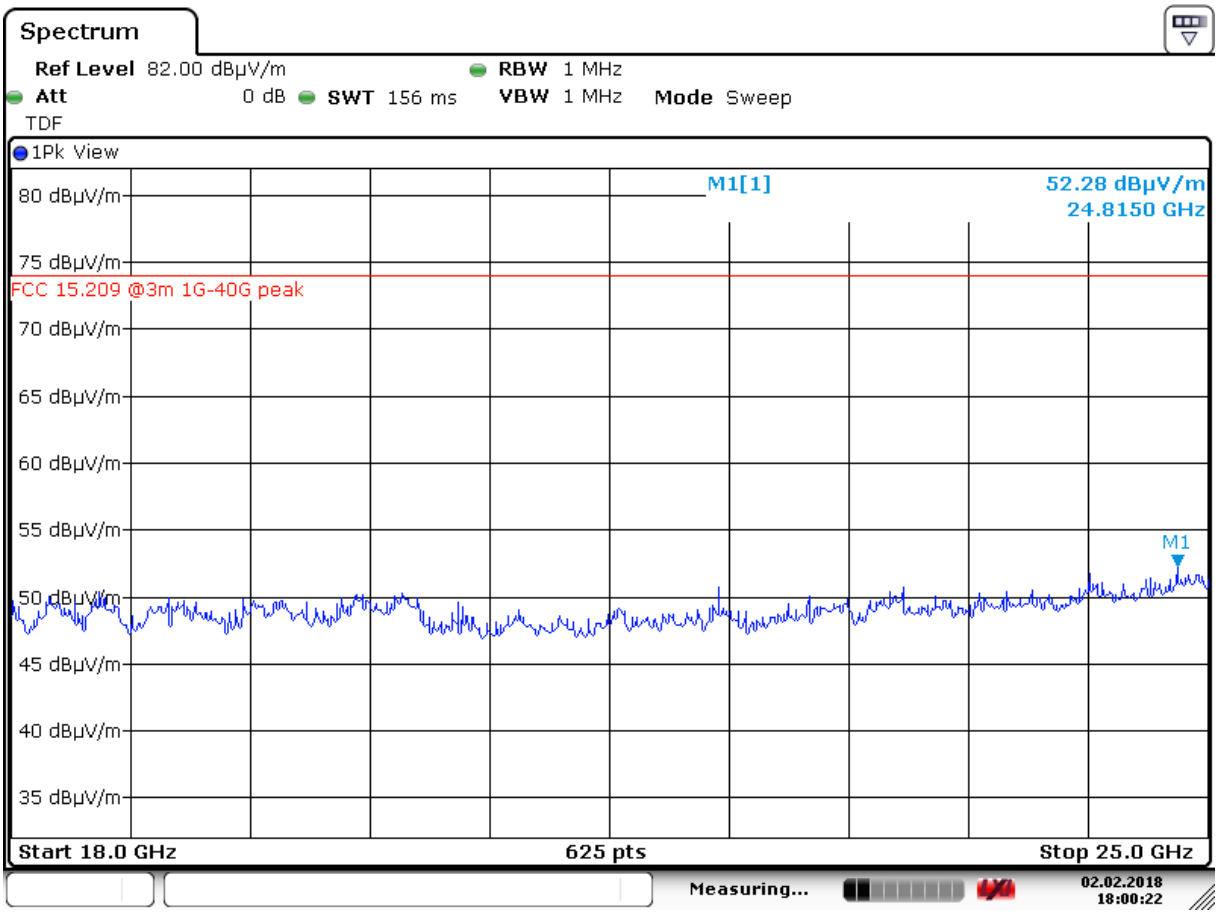
Date: 2.FEB.2018 17:50:37

Radiated Emissions, 2402 MHz, 18 – 25 GHz, HP, @3m, Pre- scan



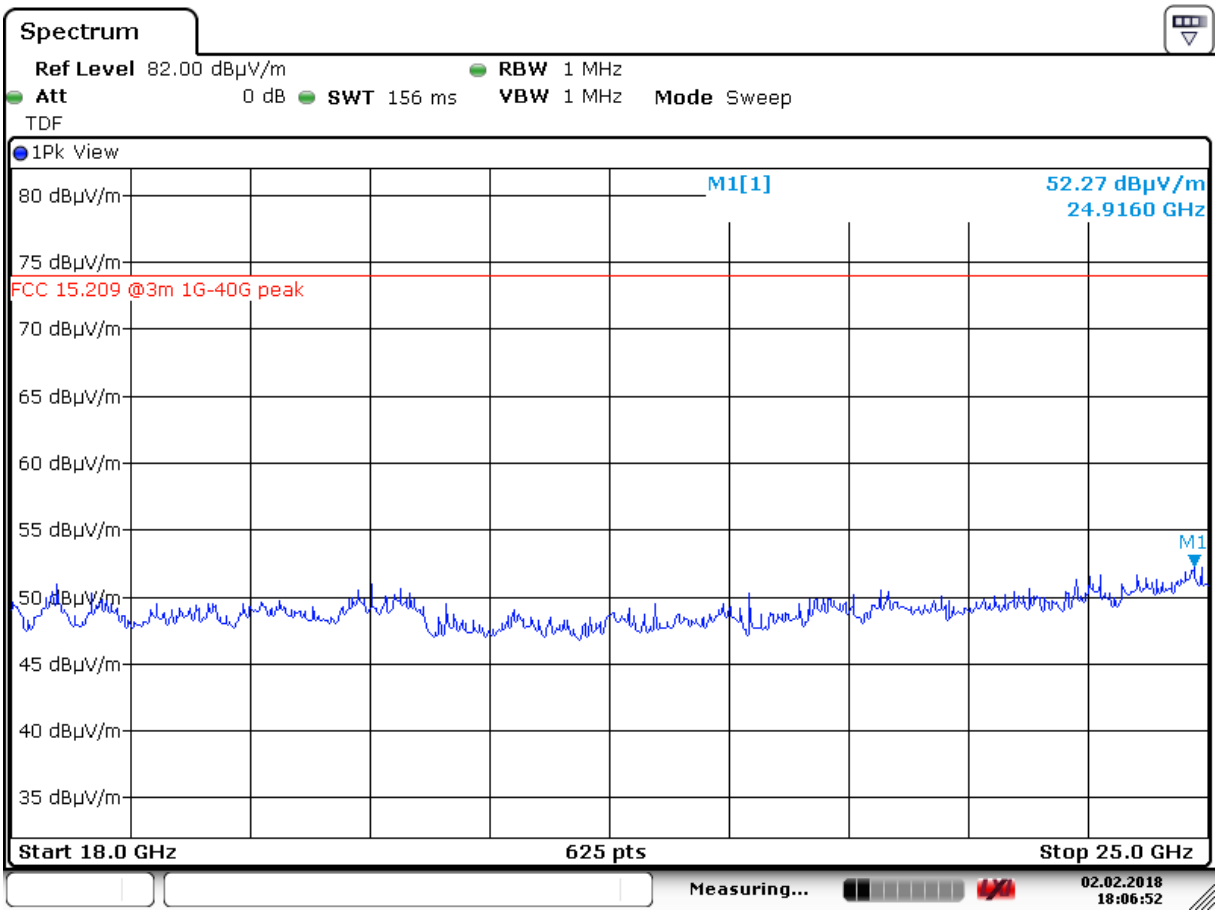
Date: 2.FEB.2018 17:57:36

Radiated Emissions, 2426 MHz, 18 – 25 GHz, VP, @3m, Pre- scan



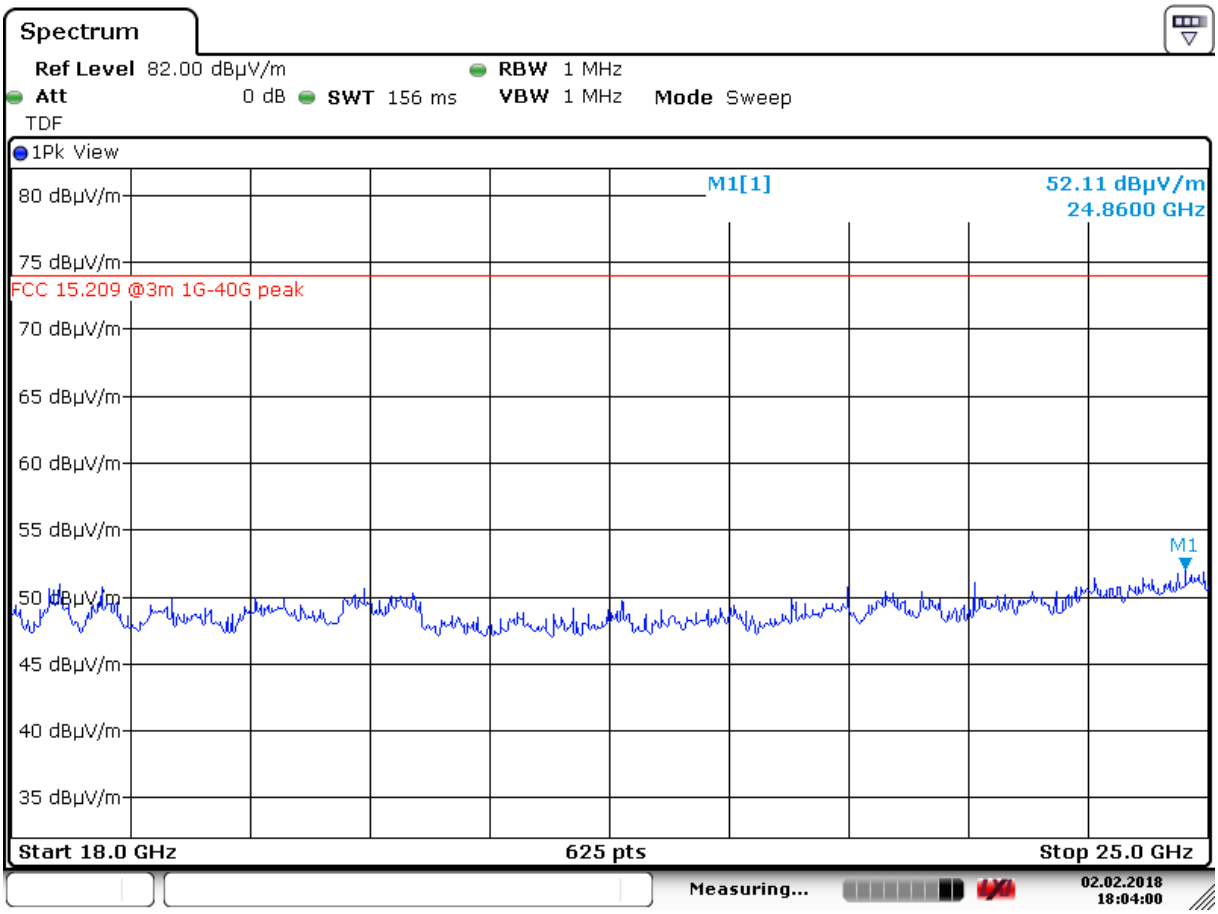
Date: 2.FEB.2018 18:00:23

Radiated Emissions, 2426 MHz, 18 – 25 GHz, HP, @3m, Pre- scan



Date: 2.FEB.2018 18:06:53

Radiated Emissions, 2480 MHz, 18 – 25 GHz, VP, @3m, Pre- scan



Date: 2.FEB.2018 18:04:01

Radiated Emissions, 2480 MHz, 18 – 25 GHz, HP, @3m, Pre- scan

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		**Uncertainty**
Output Power		±0.8 dB
Power Spectral Density		±0.8 dB
Out of Band Emissions, Conducted	**< 3.6 GHz**	±0.8 dB
	> 3.6 GHz	±1.2 dB
Spurious Emissions, Radiated	**< 200 MHz**	±4.77 dB
	200 MHz - 1 GHz	±5.02 dB
	1 GHz – 18 GHz	±4.94 dB
	> 18 GHz	±5.91 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		±3.58 %
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

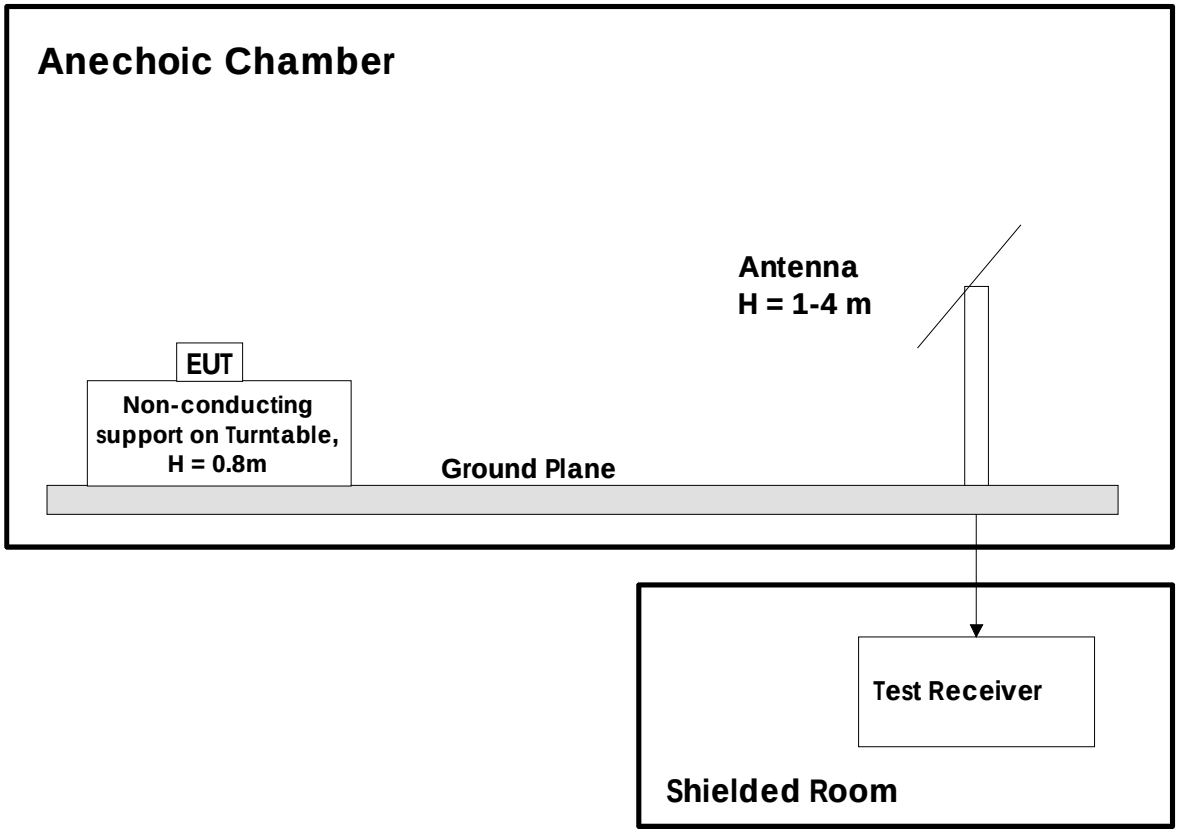
5 LIST OF TEST EQUIPMENT

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.

Ref No	*Instrument/ ancillary*	*Manufacturer*	*Type of instrument/ ancillary*	*Cal. Date*	*Cal. Due*
1-0039	Loop antenna	Rohde & Schwarz	HFH2-Z2	2017-09	2018-09
1-0040	Biconical antenna	Rohde & Schwarz	HK116	2015-08	2018-08
1-0055	LopPer antenna	Rohde & Schwarz	HL223	2015-08	2018-08
1-0080	Turntable	H. Deisel	DS 420	--	--
1-0256	Horn antenna	Schwarzbeck Mess-Elektronik	BBHA 9120	--	--
1-0361	Semi anechoic chamber	Reinhold & Mahla	3m	2017-06	2020-06
1-0364	Antenna cable 2	Kabelwerk Eupen	RF/Cord CMS / RG 214-N/7	2016-09	2019-09
1-0604	EMI test receiver	Rohde & Schwarz	ESU8	2017-09	2018-09
1-0611	Signal analyzer	Rohde & Schwarz	FSV 40	2017-09	2018-09
1-0614	Log.-per. antenna	Schwarzbeck Mess-Elektronik	STLP 9148 Stacked Log.-Per. Antenne	2016-11	2019-11
1-0615	Pre amplifier	Schwarzbeck Mess-Elektronik	BBV-9718 Broadband Preamplifier	2017-09	2018-09
1-0619	Coaxial cable (to SAC)	Huber+Suhner	SF106/2x11N-651/2m	2016-09	2019-09
1-0620	Antenna cable 3	Huber+Suhner	SF106/2x11N-651/3m	2016-09	2019-09
1-0770	Broadband Horn antenna	Schwarzbeck Mess-Elektronik	SHF-EHF Horn, 15-40GHz	2015-02	2018-02
1-0771	Broadband Horn antenna	Schwarzbeck Mess-Elektronik	SHF-EHF Horn, 15-40GHz	2015-02	2018-02
1-0781	Pre amplifier	Schwarzbeck Mess-Elektronik	BBV 9721	2017-09	2018-09
1-0782	Antenna cable	Huber & Suhner	FB142A	2015-07	2018-07
1-0789	High Pass Filter	Mini Circuits	VHF-1320+ 1700-3800 MHz	2016-09	2019-09
1-0790	High Pass Filter	Mini Circuits	VHF-3100+ 3400-9900MHz	2016-09	2019-09
1-0791	High Pass Filter	Mini Circuits	VHF-740+ 900-2200MHz	2016-09	2019-09
1-0870	10 dB Attenuator	Mini Circuits	BW-N10W5+	2016-09	2019-09
1-0924	Cable 1m	---	SMA	2016-09	2019-09
1-0925	Cable 1m	---	SMA	2016-09	2019-09
1-0926	Cable 1m	Harbour Industries	SMA	2016-09	2019-09
1-0927	Cable 1m	Harbour Industries	SMA	2016-09	2019-09
1-0966	RF power meter	DARE	RPR3006W	2017-07	2018-07

6 BLOCK DIAGRAM

6.1 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
01	2018-03-15	Change in IC ID	mk
00	2018-03-06	First version	mk