

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test: Bluetooth Smart Module

Model: BGM111

Manufacturer: Silicon Laboratories Finland Oy
Sinikalliontie 5A
FI-02630 ESPOO
FINLAND

Customer: Silicon Laboratories Finland Oy
Sinikalliontie 5A
FI-02630 ESPOO
FINLAND

FCC Rule Part: 15.247: 2015
IC Rule Part: RSS-247, Issue 1, 2015
RSS-GEN Issue 4, 2014

KDB: Guidance for Performing Compliance
Measurements on Digital Transmission Systems
(DTS) Operating Under §15.247 (June 9, 2015)

Date: November 23, 2015

Issued by:

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Niko Kotsalo
Testing Engineer

Date: November 23, 2015

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Timo Hietala
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Table of Contents

PRODUCT DESCRIPTION	3
Equipment Under Test (EUT)	3
Description of the EUT	3
Ratings and declarations	3
Power Supply	3
Mechanical Size of the EUT	3
Samples	4
GENERAL REMARKS	5
Disclaimer	5
SUMMARY OF TESTING	6
EUT Test Conditions During Testing	6
TEST RESULTS	7
Conducted Emissions In The Frequency Range 150 kHz - 30 MHz.	7
Maximum Peak Conducted Output Power	9
Transmitter Radiated Spurious Emissions 30 – 1000 MHz	12
Transmitter Radiated Spurious Emissions 1 000 – 26 500 MHz	16
Transmitter Band Edge Measurement and Conducted Spurious Emissions	27
6 dB Bandwidth of the Channel	35
Power Spectral Density	38
99% Occupied Bandwidth	41
TEST EQUIPMENT	44

Equipment Under Test (EUT)

Bluetooth Smart Module

Model: BGM111
Type: -
Serial no: -
FCC ID: QOQBGM111
IC: 5123A-BGM111

Description of the EUT

BGM111 is a Bluetooth 4.1 compliant Bluetooth smart module. BGM111 integrates: Bluetooth radio, software stack, GATT based profiles and it can host end user applications. Module is targeted at applications requiring high RF performance with low power consumption and can be operated using standard 3 V coin cell battery.

Classification of the device

Fixed device	☐
Mobile Device (Human body distance > 20cm)	☒
Portable Device (Human body distance < 20cm)	☐

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

Ratings and declarations

Operating Frequency Range (OFR): 2402 – 2480 MHz
Channels: 40
Channel separation: 2 MHz
99% Channel bandwidth: 1.099855282 MHz
Effective conducted power: 8.32 dBm
Transmission technique: DSSS
Modulation: GFSK
Integral Antenna gain: 1 dBi

Power Supply

Operating voltage range: 2.4 – 3.8 VDC

Mechanical Size of the EUT

Height: 2.2 mm	Width: 15.0 mm	Length: 15.0 mm
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Samples

Two samples were used in the testing. Normal commercial sample with integral antenna for radiated emissions and a sample with integral antenna removed and replaced with 50Ω coaxial cable and SMA-connector for conducted RF tests. During the tests the EUT was set into continuous transmit and was set to the channel under test. Normal test modulation and maximum transmit power was used in all tests. No modifications were done during the tests.

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only. This document cannot be reproduced except in full, without prior approval of the Company.

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	PASS
§15.247(b)(3) / RSS-247 5.4(4)	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-247 5.2(1)	6 dB Bandwidth	PASS
§15.247(e) / RSS-247 5.2(2)	Power Spectral Density	PASS
RSS-GEN 6.6	99% Occupied Bandwidth	PASS
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within The Restricted Bands	PASS

EUT Test Conditions During Testing

The EUT was in continuous transmit mode during all the tests. The hopping was stopped and the EUT was configured into the wanted channel. Normal modulation and duty cycle was applied in all the tests.

Following channels were used during the tests when the hopping was stopped:

Channel Low (Ch 0) = 2402 MHz

Channel Mid (Ch 20) = 2442 MHz

Channel High (Ch 39) = 2480 MHz

Test Facility

☐ Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
☒ Testing Location / address: FCC registration number: 178986 Industry Canada registration number: 8708A-2	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz.

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 13.11.2015
Temperature: 22 °C
Humidity: 37 % RH
Barometric pressure: 1008.7 hPa
Measurement uncertainty: ± 2.9 dB

Level of confidence 95 % (k = 2)

FCC Rule: 15.207 (a)
RSS-GEN 8.8

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

During the test the EUT was powered from the separate power supply through the LISN.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

Conducted Emission Mains FCC Part 15 Class B with ENV216

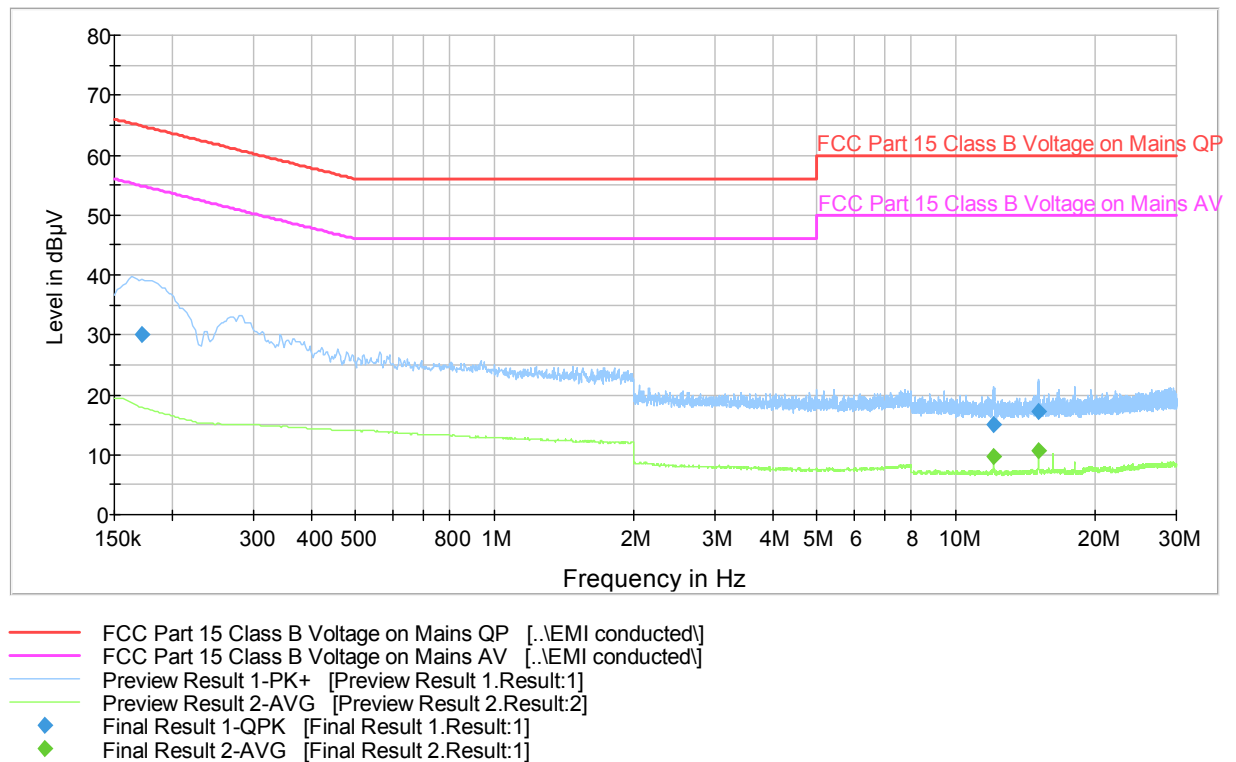


Figure 1. The measured curves with peak- and average detector

Final measurements from the worst frequencies

Table 1. Final QuasiPeak measurements from the worst frequencies.

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.172000	30.1	1000.0	9.000	On	L1	10.1	34.8	64.9	
12.030000	15.0	1000.0	9.000	On	N	10.5	45.0	60.0	
15.050000	17.2	1000.0	9.000	On	L1	10.7	42.8	60.0	

Table 2. Final Average measurements from the worst frequencies.

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
12.054000	9.7	1000.0	9.000	On	N	10.5	40.3	50.0	
15.055750	10.7	1000.0	9.000	On	L1	10.7	39.3	50.0	

Maximum Peak Conducted Output Power

Maximum Peak Conducted Output Power

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 2.10.2015
Temperature: 21 °C
Humidity: 25 %
Measurement uncertainty $\pm 2.87\text{dB}$ Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b)(3)
RSS-247 5.4(4)

For systems using digital modulation in the 2400-2483.5 MHz bands the limit is 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

Results:

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	8.32	30	21.68	PASS
Mid	8.21	30	21.79	PASS
High	7.85	30	21.15	PASS

Maximum Peak Conducted Output Power

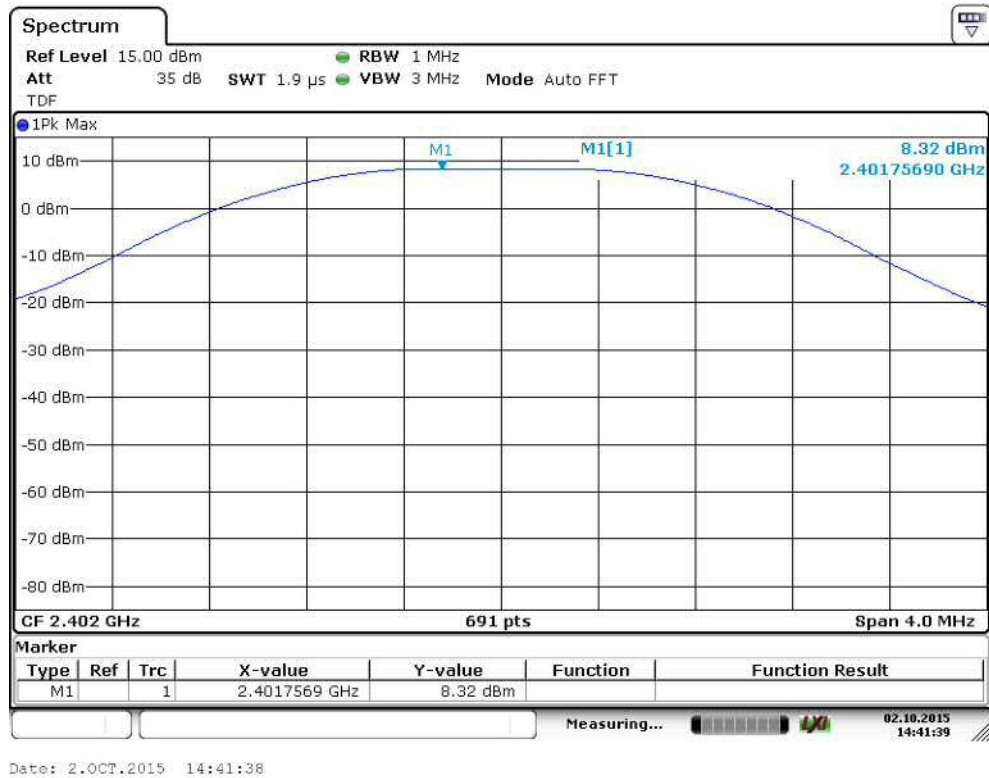


Figure 2. Channel Low.

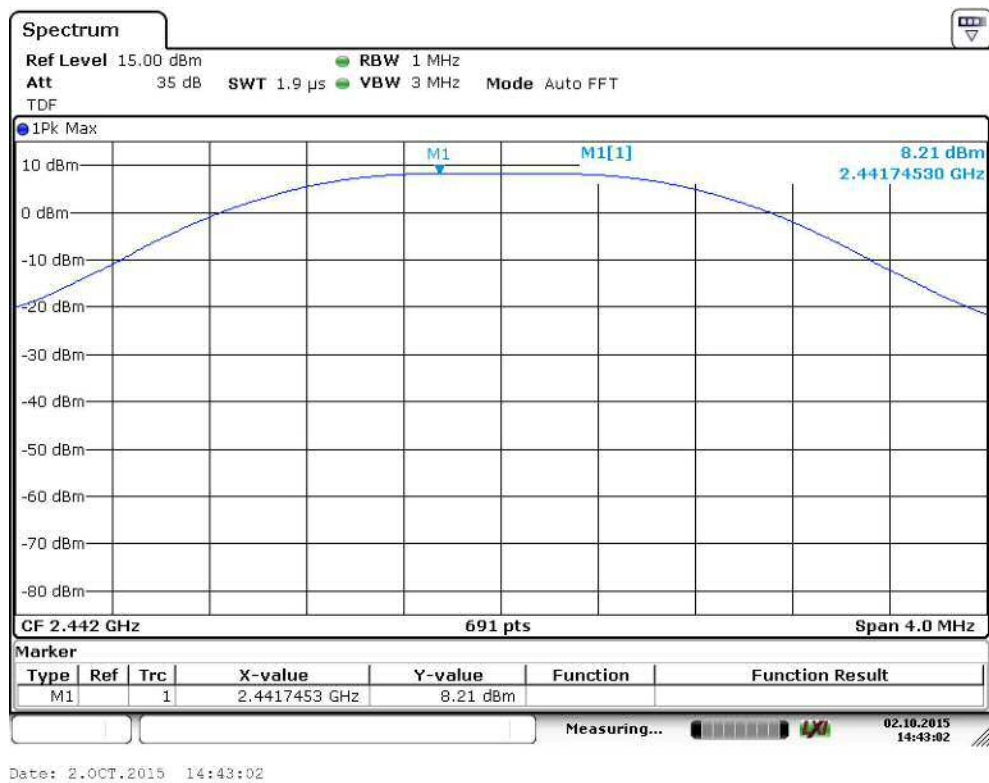
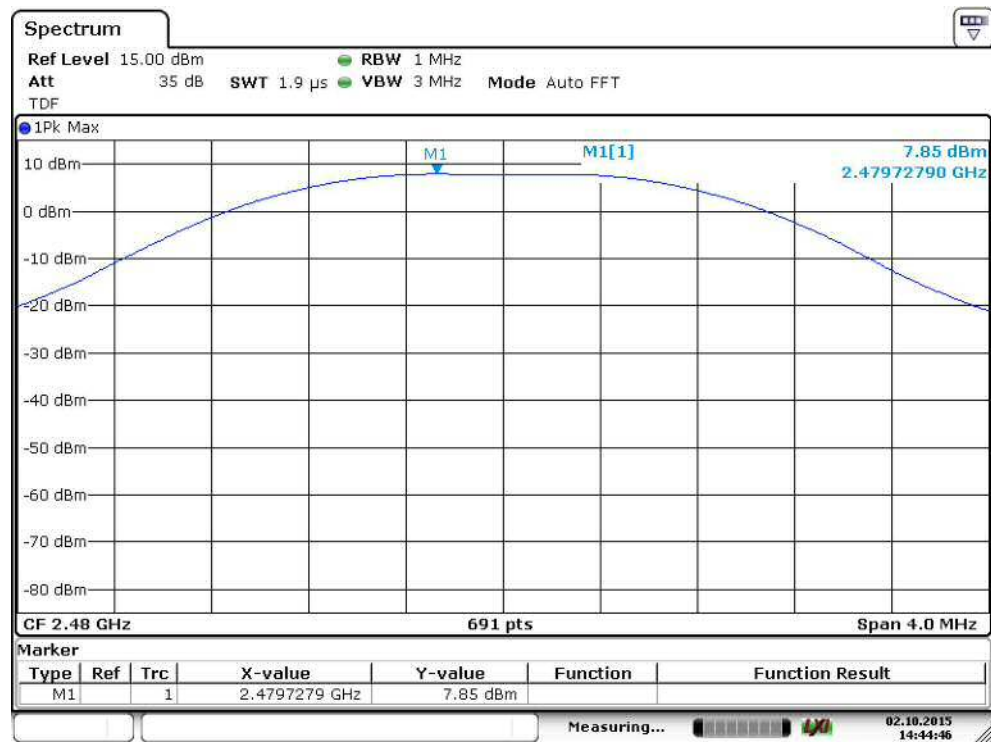


Figure 3. Channel Mid.

Maximum Peak Conducted Output Power



Date: 2.OCT.2015 14:44:45

Figure 4. Channel High.

Transmitter Radiated Spurious Emissions 30 – 1000 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	24.9. – 23.10.2015	
Humidity:	20 – 41 %	
Temperature:	21 – 25 °C	
Measurement uncertainty	± 4.51 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a)**RSS-247 5.5**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).
The QuasiPeak value is the measured value corrected with the correction factor.

Transmitter Radiated Spurious Emissions

Measured Peak Values In The Frequency Range 30 MHz - 1000 MHz.

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

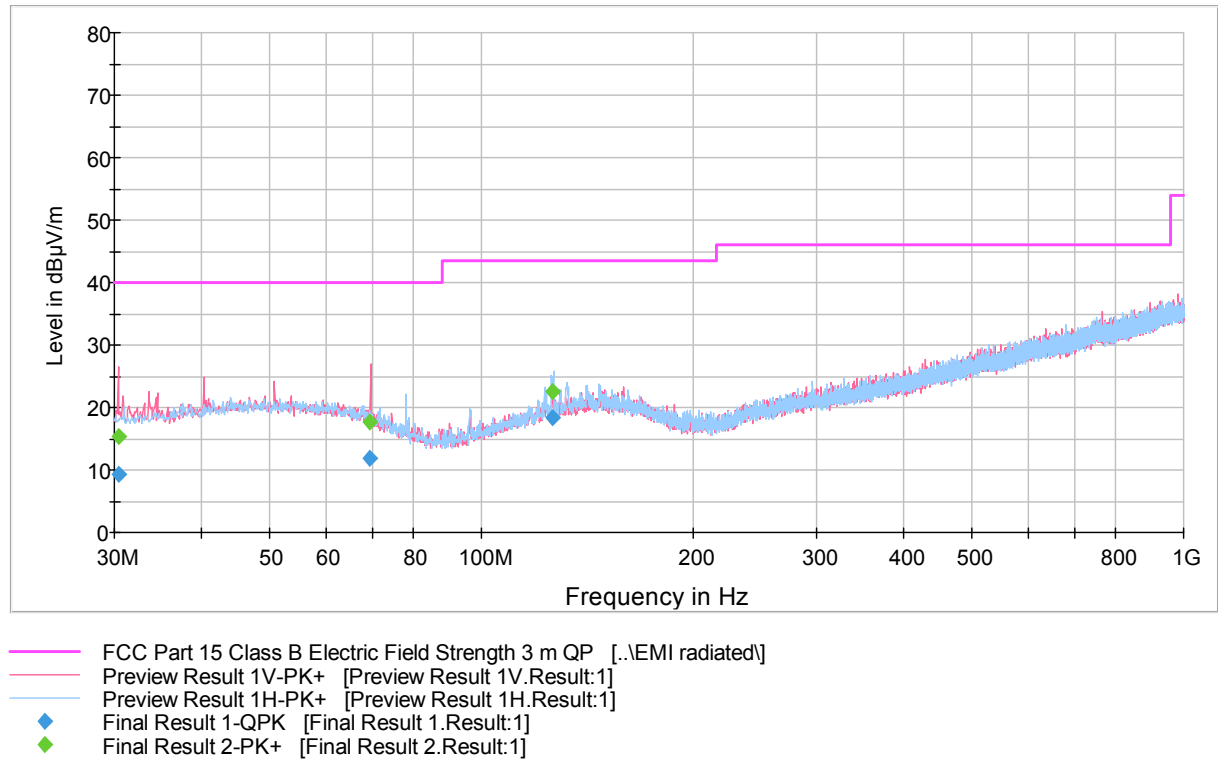


Figure 5. Measured curve with peak-detector channel low.

Final measurements from the worst frequencies

Table 3. Final results.

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
30.480000	9.2	1000.0	120.000	122.0	V	91.0	13.0	30.8	40.0	
69.219000	12.0	1000.0	120.000	100.0	V	85.0	12.6	28.0	40.0	
126.392000	18.3	1000.0	120.000	158.0	H	116.0	12.9	25.2	43.5	

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

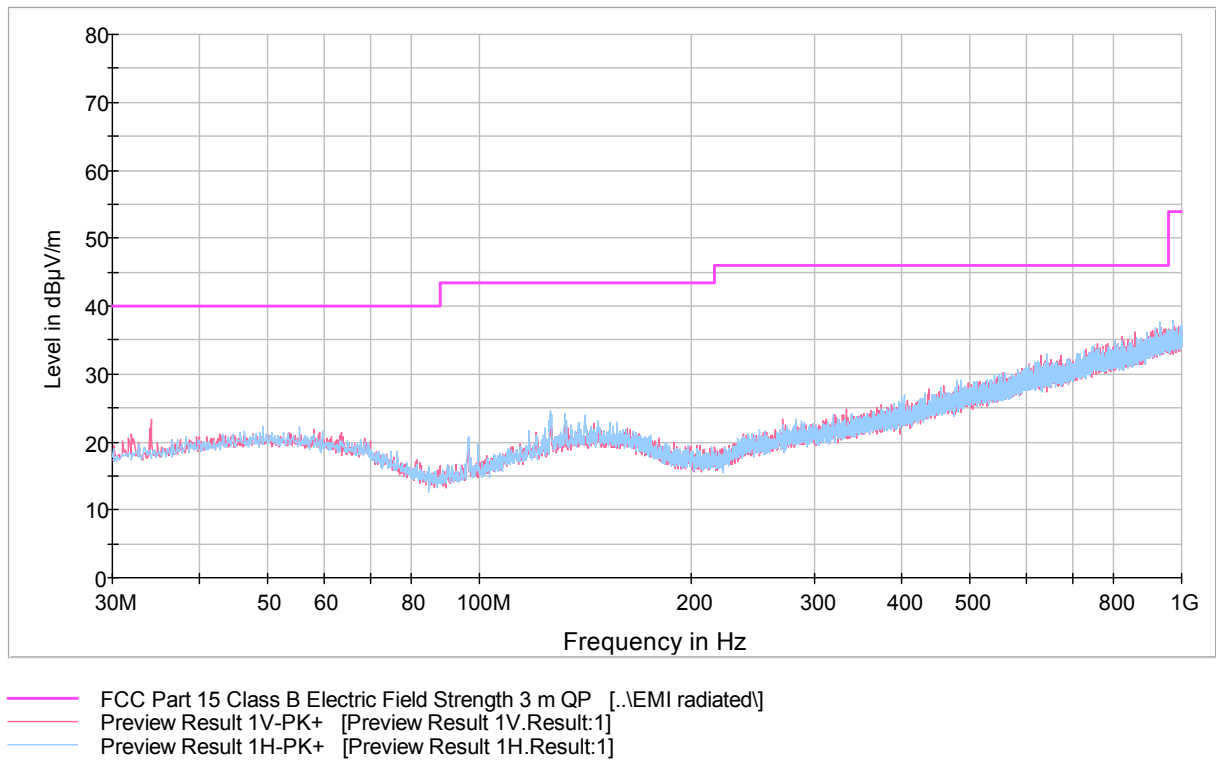
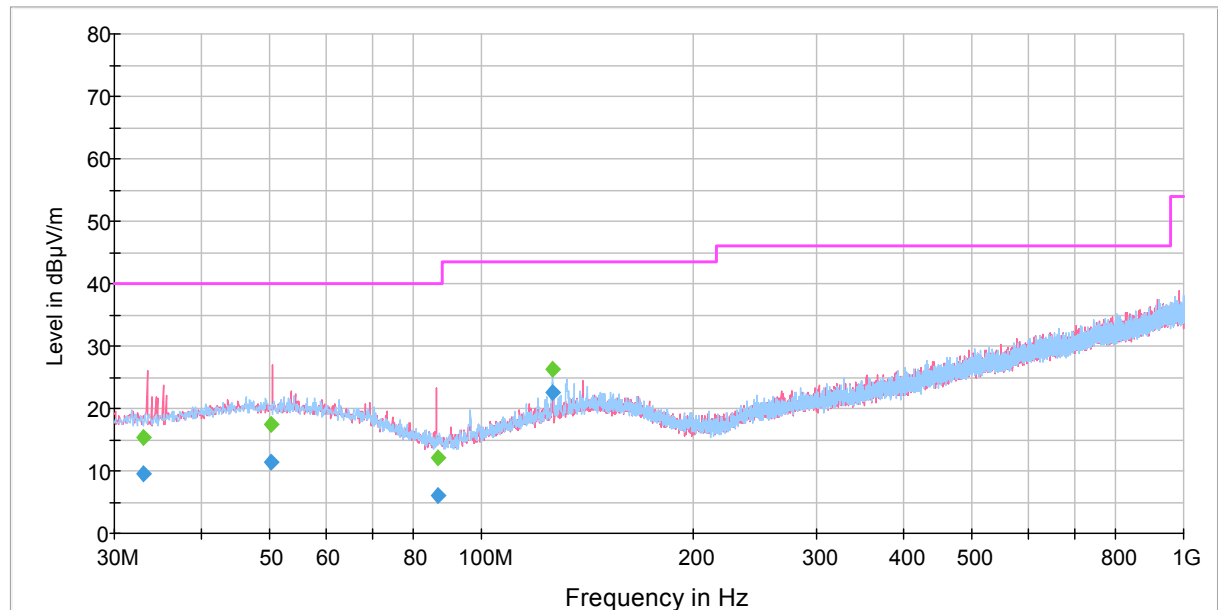


Figure 6. Measured curve with peak-detector channel mid.

No final measurements were made due to the low emissions level.

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m



- FCC Part 15 Class B Electric Field Strength 3 m QP [..\EMI radiated\]
- Preview Result 1V-PK+ [Preview Result 1V.Result:1]
- Preview Result 1H-PK+ [Preview Result 1H.Result:1]
- ◆ Final Result 1-QPK [Final Result 1.Result:1]
- ◆ Final Result 2-PK+ [Final Result 2.Result:1]

Figure 7. Measured curve with peak-detector channel high.

Final measurements from the worst frequencies

Table 4. Final results.

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
32.995000	9.6	1000.0	120.000	265.0	V	38.0	13.1	30.4	40.0	
50.170000	11.4	1000.0	120.000	337.0	V	38.0	14.6	28.6	40.0	
86.737000	6.1	1000.0	120.000	199.0	V	38.0	8.7	33.9	40.0	
126.367000	22.6	1000.0	120.000	215.0	H	316.0	12.9	20.9	43.5	

Transmitter Radiated Spurious Emissions

Transmitter Radiated Spurious Emissions 1 000 – 26 500 MHz

Measured Peak and Average Values In The Frequency Range 1 000 MHz – 4 000 MHz.

The correction factor in the final result tables contains the sum of the transducers (antenna + amplifier + cables).
The Max Peak and Average values are measured values corrected with the correction factor.

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

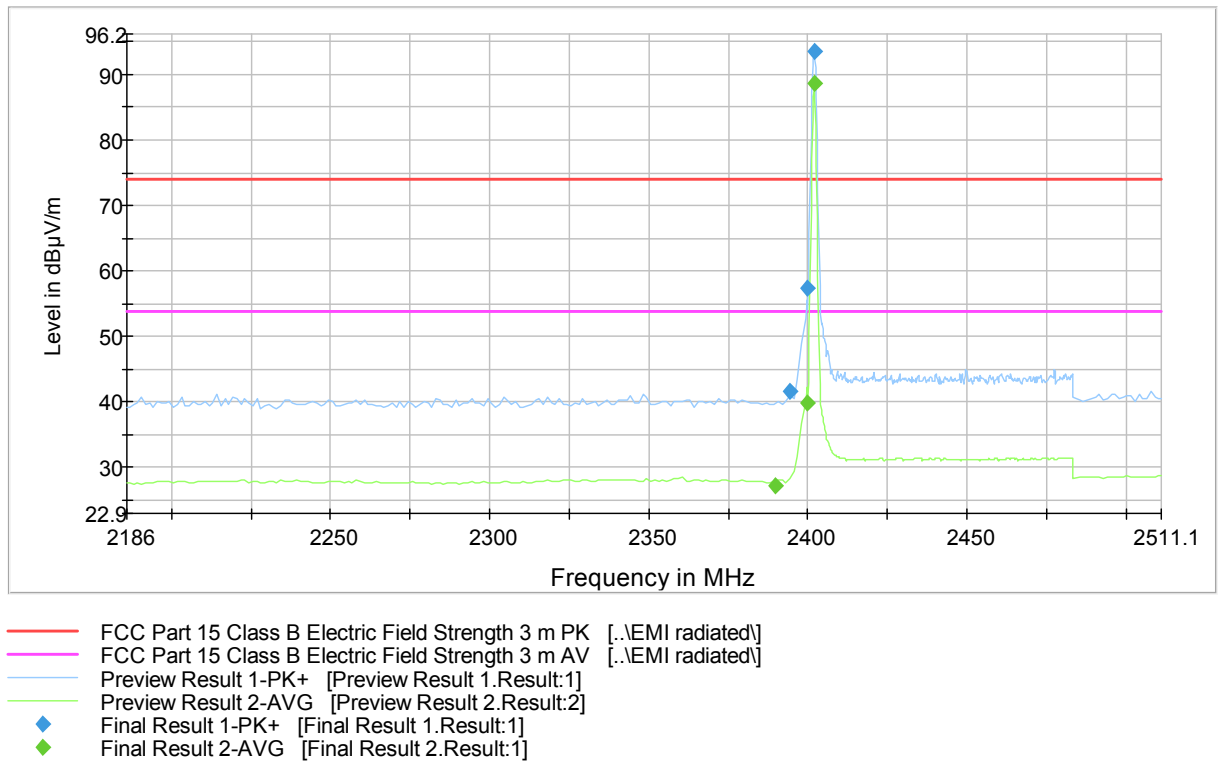


Figure 8. Measured curve with peak- and average detector channel low.

Final measurements from the worst frequencies

Table 5. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2394.200000	41.5	1000.0	1000.000	247.0	V	128.0	3.9	32.4	73.9	
2400.000000	57.4	1000.0	1000.000	236.0	H	73.0	3.9	16.5	73.9	
2402.200000	93.6	1000.0	1000.000	259.0	H	65.0	3.9	-19.7	73.9	Carrier

Table 6. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2390.000000	27.2	1000.0	1000.000	383.0	V	75.0	3.8	26.7	53.9	
2400.000000	39.9	1000.0	1000.000	233.0	H	78.0	3.9	14.0	53.9	
2402.000000	88.6	1000.0	1000.000	256.0	H	61.0	3.9	-34.7	53.9	Carrier

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

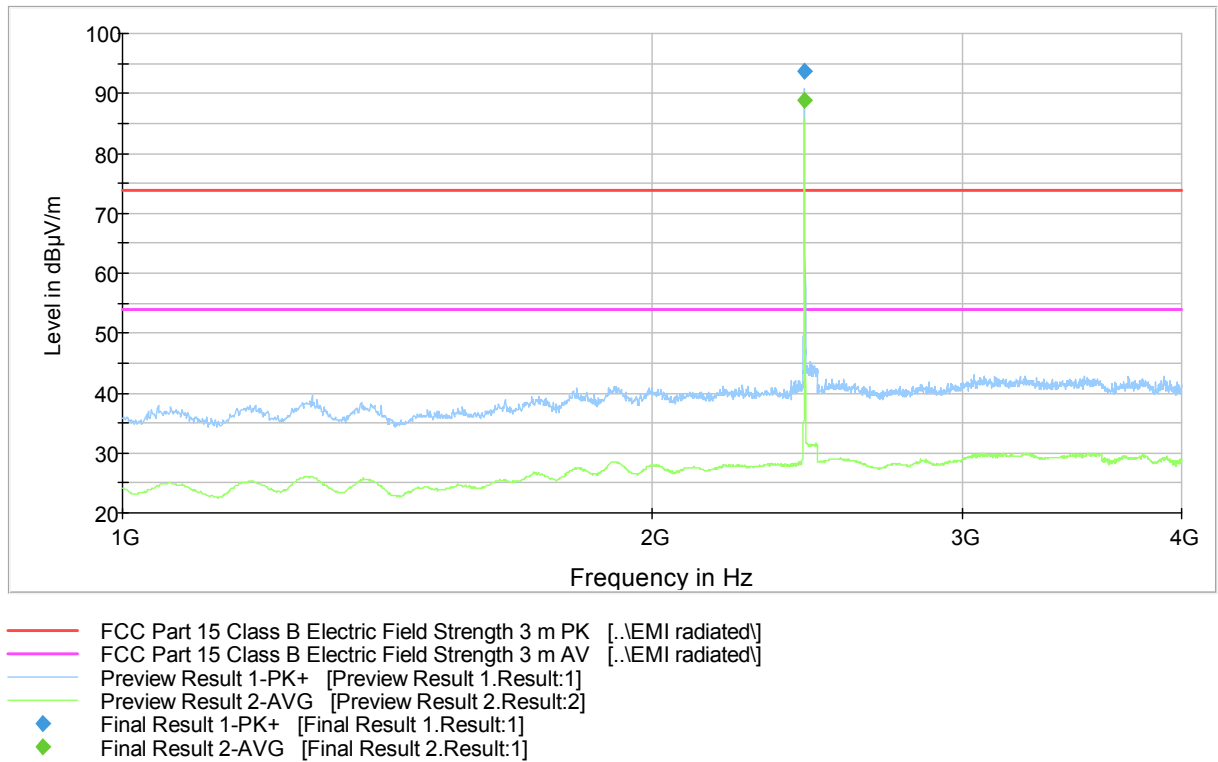


Figure 9. Measured curve with peak- and average detector channel mid.

Final measurements from the worst frequencies

Table 7. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2441.750000	93.6	1000.0	1000.000	264.0	H	53.0	3.8	-19.7	73.9	Carrier

Table 8. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2442.000000	88.7	1000.0	1000.000	264.0	H	53.0	3.8	-34.8	53.9	Carrier

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

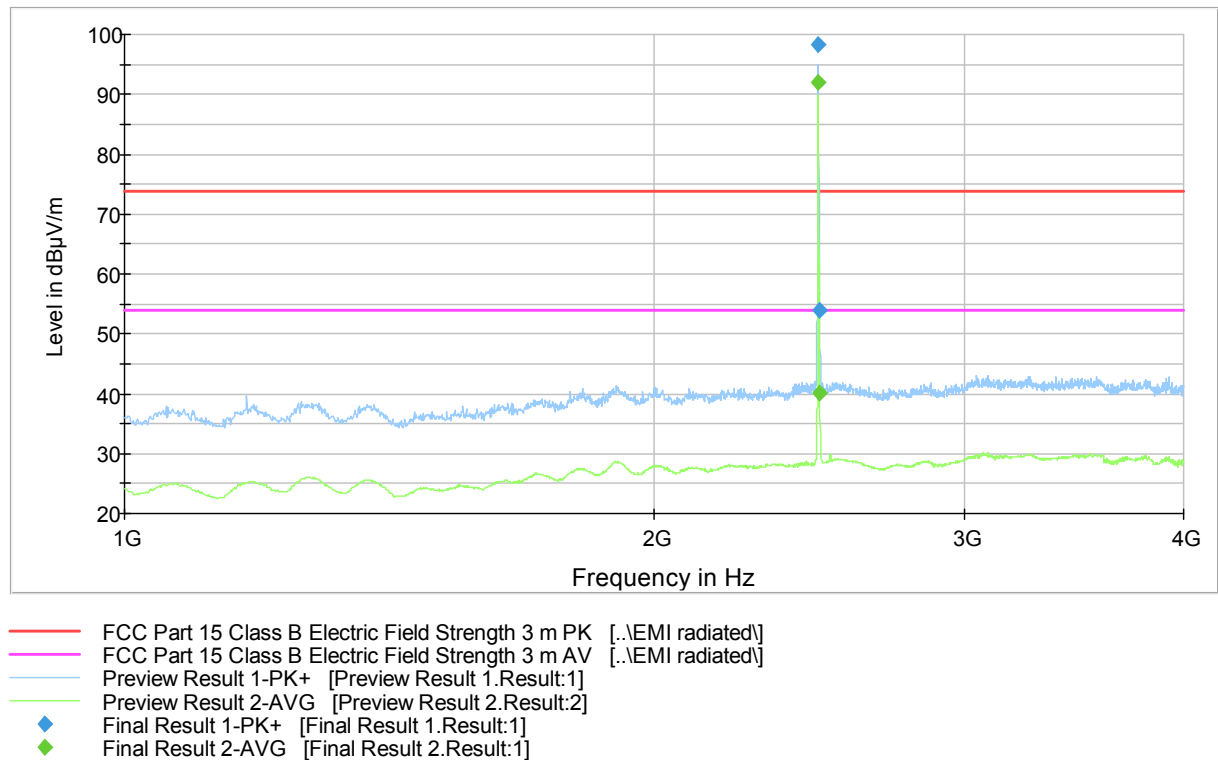


Figure 10. Measured curve with peak- and average detector channel high.

Final measurements from the worst frequencies

Table 9. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.250000	98.4	1000.0	1000.000	250.0	H	78.0	4.2	-24.5	73.9	Carrier
2483.500000	54.0	1000.0	1000.000	176.0	H	83.0	4.2	19.9	73.9	

Table 10. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.000000	92.0	1000.0	1000.000	250.0	H	84.0	4.2	-38.1	53.9	Carrier
2483.500000	40.1	1000.0	1000.000	248.0	H	83.0	4.2	13.8	53.9	

Transmitter Radiated Spurious Emissions

Measured Peak and Average Values In The Frequency Range 4 000 MHz – 18 000 MHz.

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

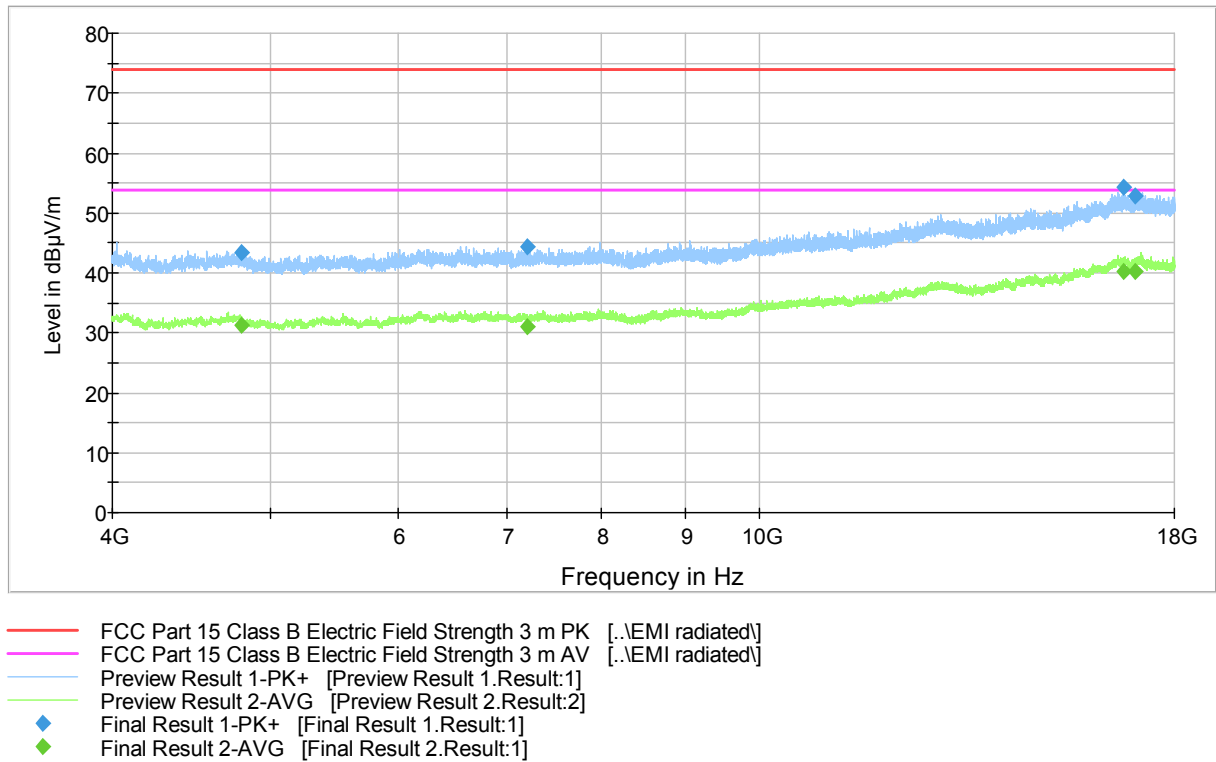


Figure 11. Measured curve with peak- and average detector channel low.

Final measurements from the worst frequencies

Table 11. Final Max Peak results.

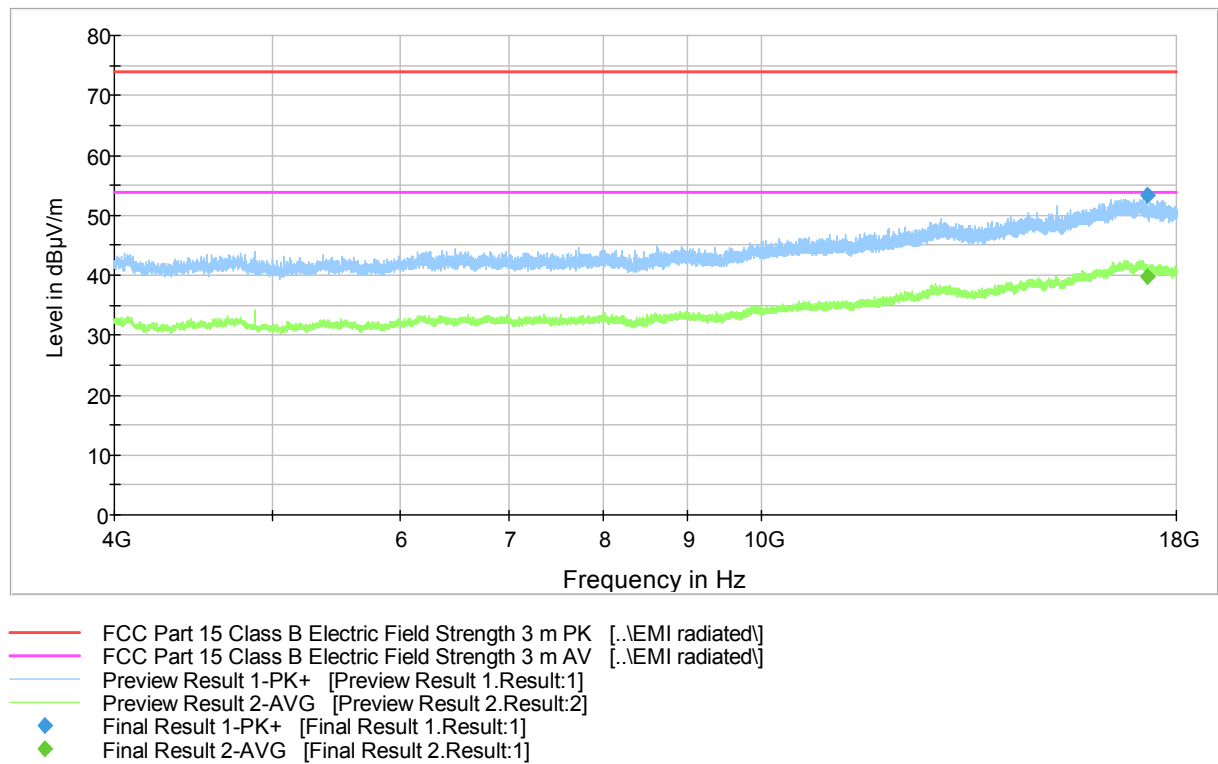
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
4805.300000	43.5	1000.0	1000.000	185.0	V	299.0	10.0	30.4	73.9	
7203.100000	44.3	1000.0	1000.000	224.0	H	44.0	12.3	29.6	73.9	
16755.600000	54.2	1000.0	1000.000	377.0	V	294.0	25.4	19.7	73.9	
17034.000000	52.9	1000.0	1000.000	162.0	V	198.0	25.6	21.0	73.9	

Table 12. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
4804.100000	31.3	1000.0	1000.000	184.0	V	304.0	10.0	22.6	53.9	
7205.700000	31.0	1000.0	1000.000	339.0	H	32.0	12.3	22.9	53.9	
16757.400000	40.4	1000.0	1000.000	366.0	V	271.0	25.4	13.5	53.9	
17034.000000	40.1	1000.0	1000.000	400.0	V	159.0	25.6	13.8	53.9	

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

**Figure 12.** Measured curve with peak- and average detector channel mid.**Final measurements from the worst frequencies****Table 13.** Final Max Peak results.

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
17280.700000	53.4	1000.0	1000.000	384.0	H	330.0	25.3	20.5	73.9	

Table 14. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
17273.700000	39.7	1000.0	1000.000	384.0	H	330.0	25.3	14.2	53.9	

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

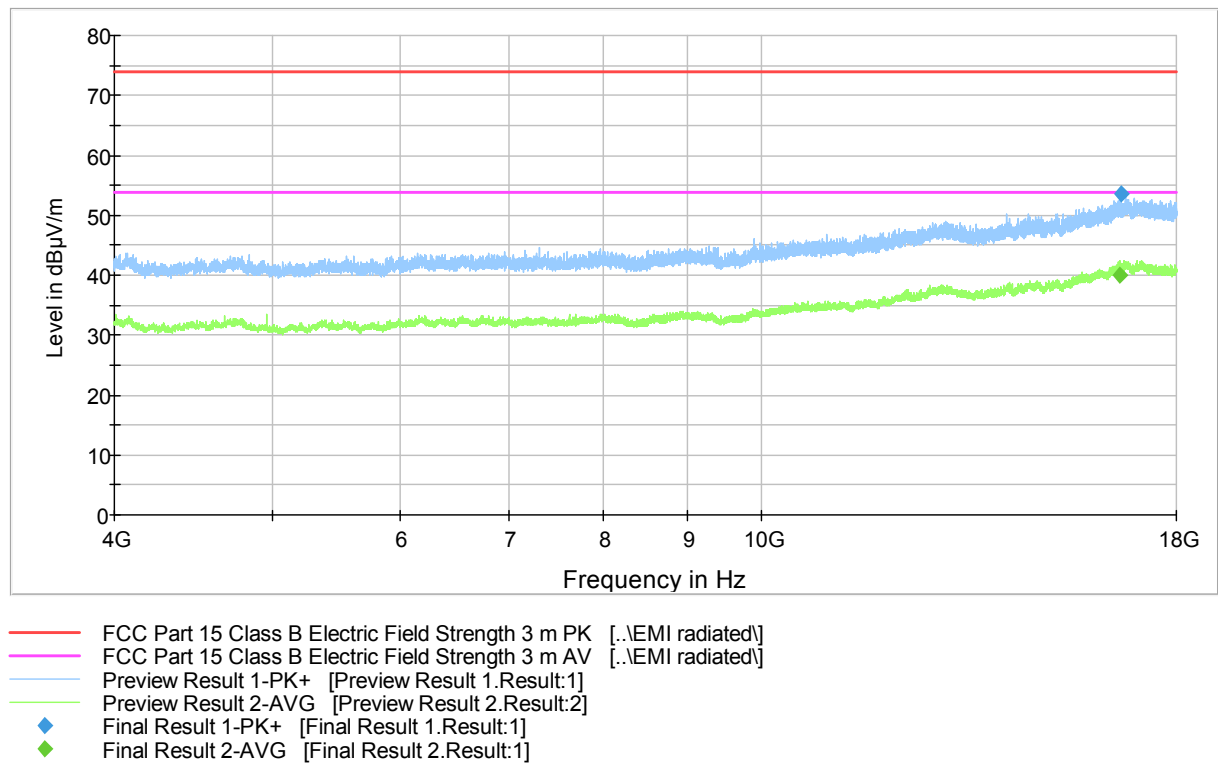


Figure 13. Measured curve with peak- and average detector channel high.

Final measurements from the worst frequencies

Table 15. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
16640.500000	53.6	1000.0	1000.000	311.0	V	58.0	25.2	20.3	73.9	

Table 16. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
16608.100000	39.9	1000.0	1000.000	323.0	V	31.0	25.1	14.0	53.9	

Transmitter Radiated Spurious Emissions

Measured Peak and Average Values In The Frequency Range 18 000 MHz – 26 500 MHz.

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m

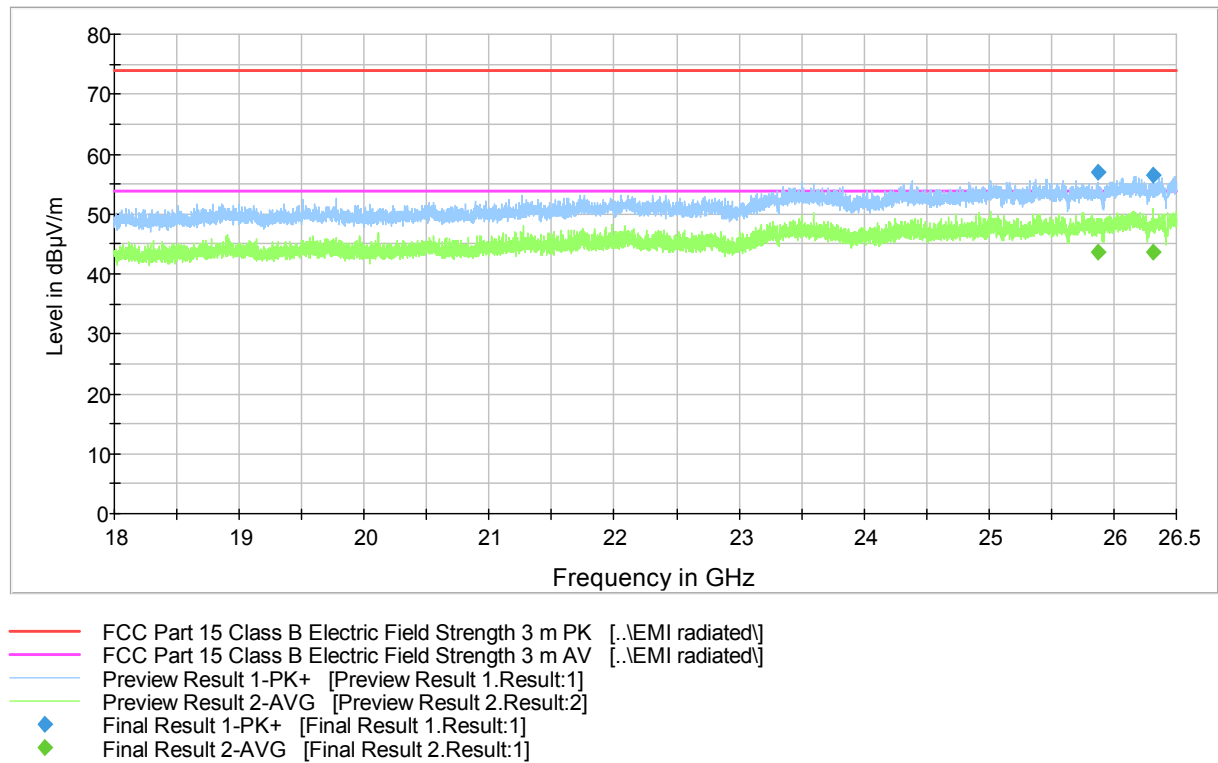


Figure 14. Measured curve with peak- and average detector. Channel Low.

Final measurements from the worst frequencies

Table 17. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
25869.550000	56.9	1000.0	1000.000	232.0	V	74.0	34.6	17.0	73.9	
26316.550000	56.5	1000.0	1000.000	360.0	V	229.0	35.5	17.4	73.9	

Table 18. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
25869.150000	43.7	1000.0	1000.000	209.0	V	109.0	34.6	10.2	53.9	
26317.000000	43.6	1000.0	1000.000	192.0	V	271.0	35.5	10.3	53.9	

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m

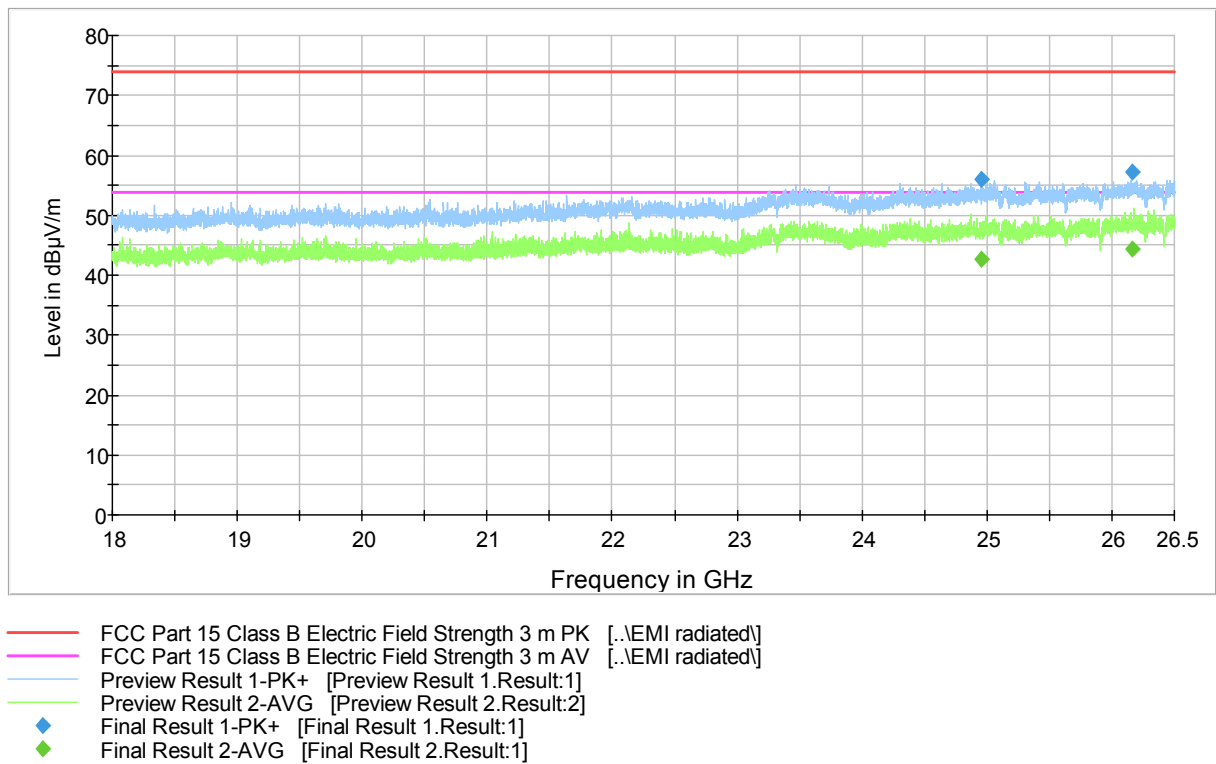


Figure 15. Measured curve with peak- and average detector channel mid.

Final measurements from the worst frequencies

Table 19. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
24959.600000	56.0	1000.0	1000.000	219.0	H	83.0	32.8	17.9	73.9	
26162.850000	57.3	1000.0	1000.000	341.0	H	224.0	35.2	16.6	73.9	

Table 20. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
24958.200000	42.6	1000.0	1000.000	201.0	H	30.0	32.8	11.3	53.9	
26166.250000	44.4	1000.0	1000.000	400.0	V	261.0	35.2	9.5	53.9	

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m

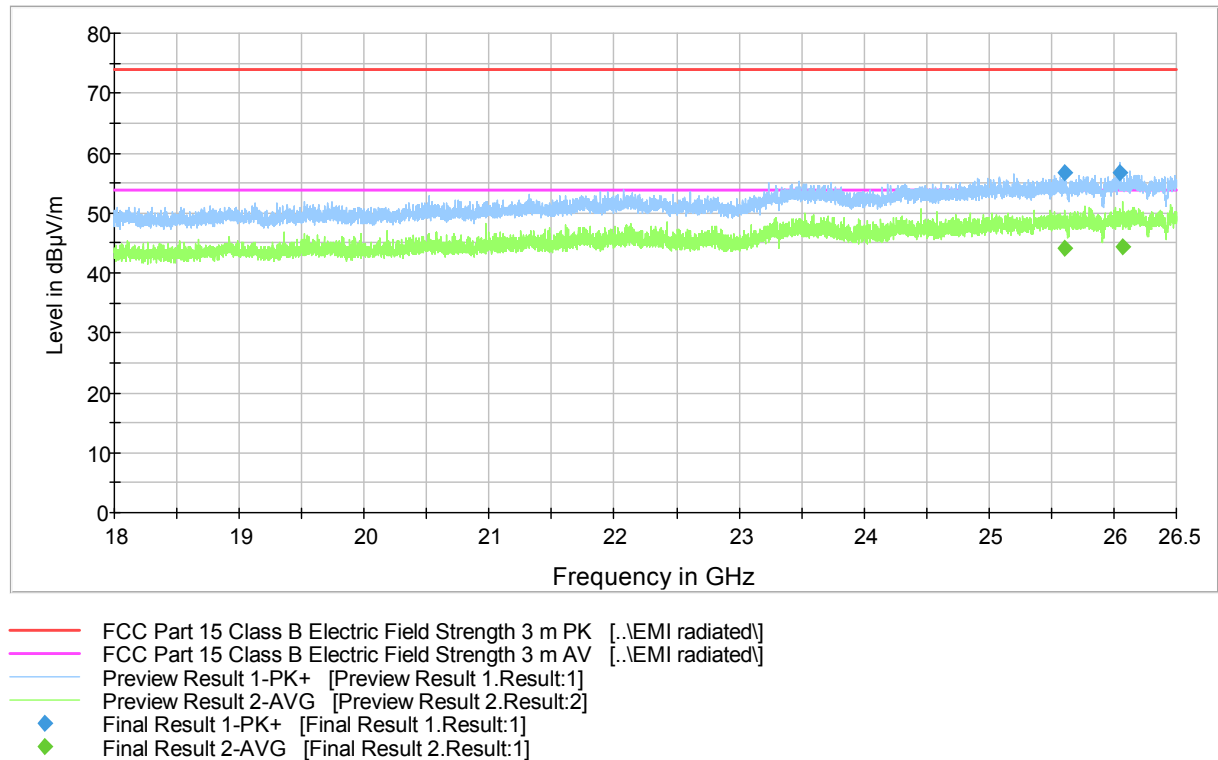


Figure 16. Measured curve with peak- and average detector channel high.

Final measurements from the worst frequencies

Table 21. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
25607.500000	56.8	1000.0	1000.000	296.0	H	291.0	34.3	17.1	73.9	
26045.100000	56.8	1000.0	1000.000	400.0	V	162.0	34.8	17.1	73.9	

Table 22. Final Average results.

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
25605.300000	44.0	1000.0	1000.000	400.0	H	332.0	34.3	9.9	53.9	
26065.850000	44.3	1000.0	1000.000	400.0	V	153.0	34.9	9.6	53.9	

Transmitter Radiated Spurious Emissions

Radiated band edge measurement results

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

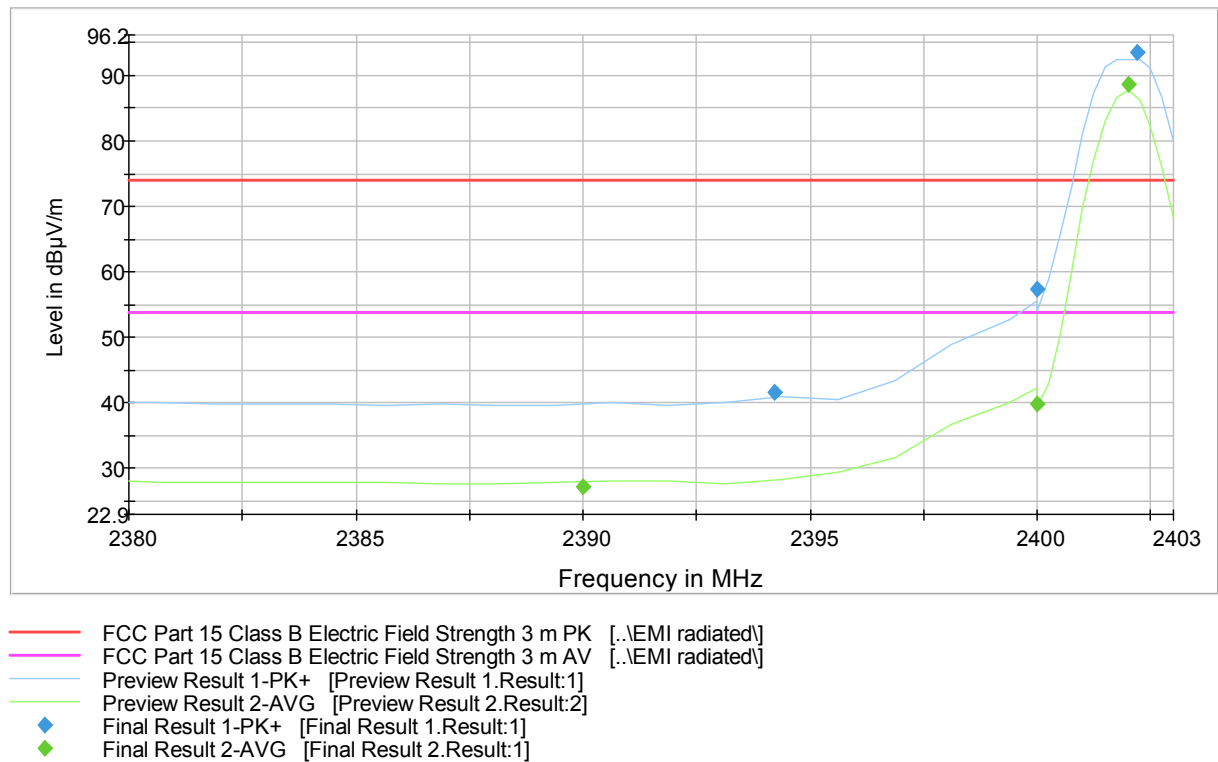


Figure 17. Measured curve with peak- and average detector. Lower band edge.

Final measurements from the worst frequencies

Table 23. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2394.200000	41.5	1000.0	1000.000	247.0	V	128.0	3.9	32.4	73.9	
2400.000000	57.4	1000.0	1000.000	236.0	H	73.0	3.9	16.5	73.9	
2402.200000	93.6	1000.0	1000.000	259.0	H	65.0	3.9	-19.7	73.9	Carrier

Table 24. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2390.000000	27.2	1000.0	1000.000	383.0	V	75.0	3.8	26.7	53.9	
2400.000000	39.9	1000.0	1000.000	233.0	H	78.0	3.9	14.0	53.9	
2402.000000	88.6	1000.0	1000.000	256.0	H	61.0	3.9	-34.7	53.9	Carrier

Transmitter Radiated Spurious Emissions

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)

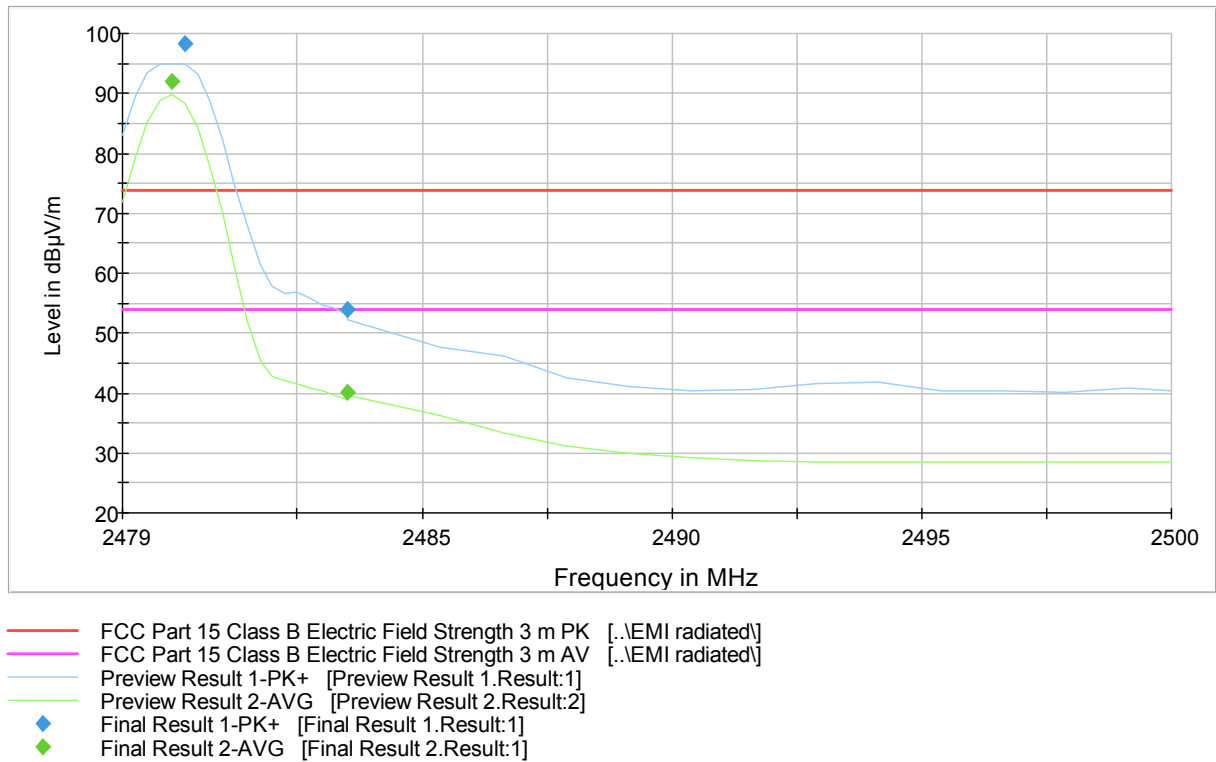


Figure 18. Measured curve with peak- and average detector. Upper band edge.

Final measurements from the worst frequencies

Table 25. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.250000	98.4	1000.0	1000.000	250.0	H	78.0	4.2	-24.5	73.9	Carrier
2483.500000	54.0	1000.0	1000.000	176.0	H	83.0	4.2	19.9	73.9	

Table 26. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.000000	92.0	1000.0	1000.000	250.0	H	84.0	4.2	-38.1	53.9	Carrier
2483.500000	40.1	1000.0	1000.000	248.0	H	83.0	4.2	13.8	53.9	

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 8.10 – 16.11.2015
Humidity: 25 %
Temperature: 21 °C
Measurement uncertainty ± 2.87 dB Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a) RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Table 27. Band edge attenuation.

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-42.83 dBc	-45.76 dBc
Limit: -20dBc	

Table 28. Conducted spurious emissions.

Conducted Spurious Emissions					
Channel	Frequency	Measured Attenuation [dBm]	EIRP Limit [dBc]	Margin [dB]	Result
-	-	-	-20.0	-	-
-	-	-	-20.0	-	-
-	-	-	-20.0	-	-

No significant emissions were detected close to the limit.

Conducted spurious emissions limit is calculated from electric field strength result. Following formula was used in calculating electric field strength limit to EIRP:

$$E = \text{EIRP} - 20 \log D + 104.8$$

where,

D = specified measurement distance

E = Electric field strength

EIRP = equivalent isotropic radiated

Transmitter Band Edge Measurement and Conducted Spurious Emissions

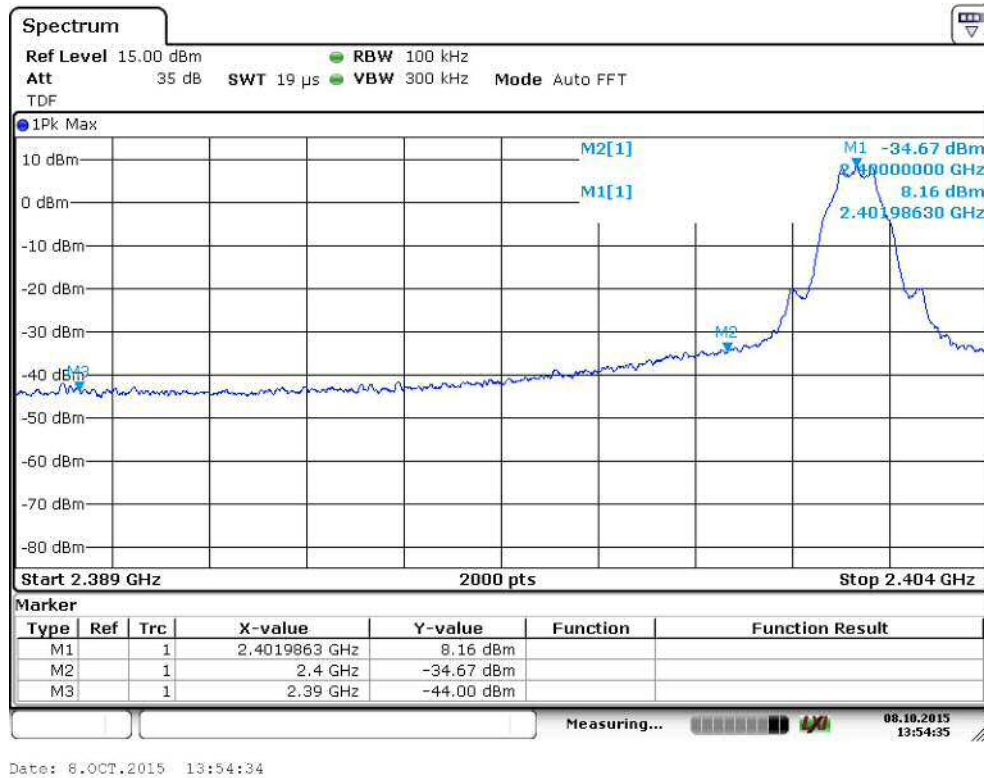


Figure 19. Lower Band Edge.

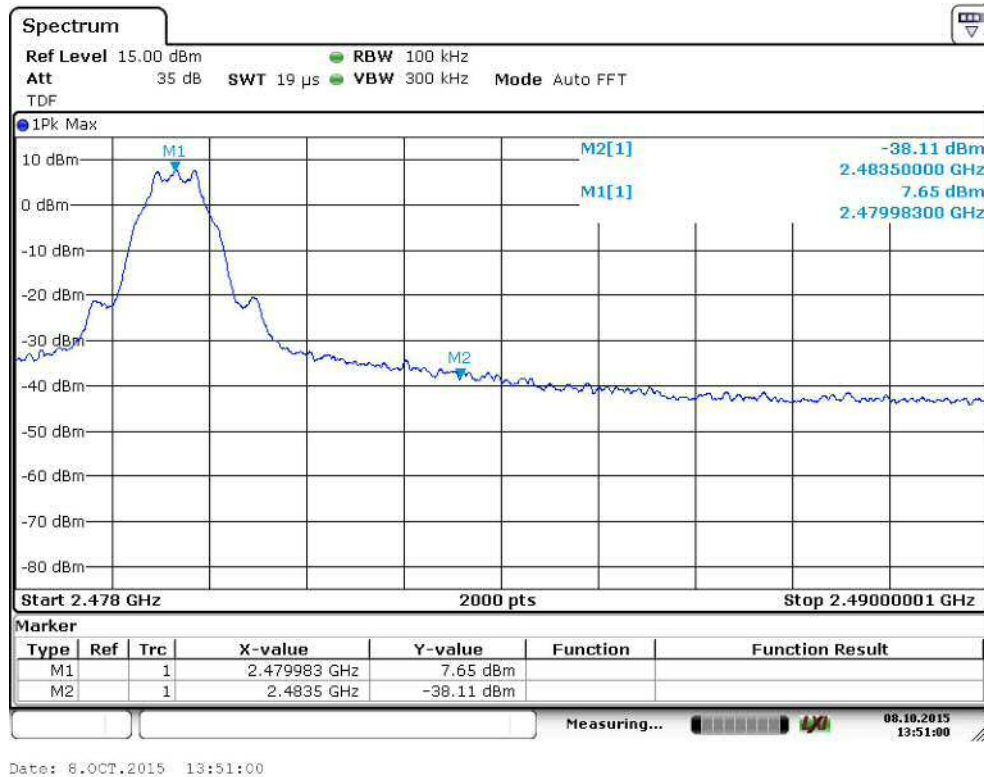


Figure 20. Upper Band Edge.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

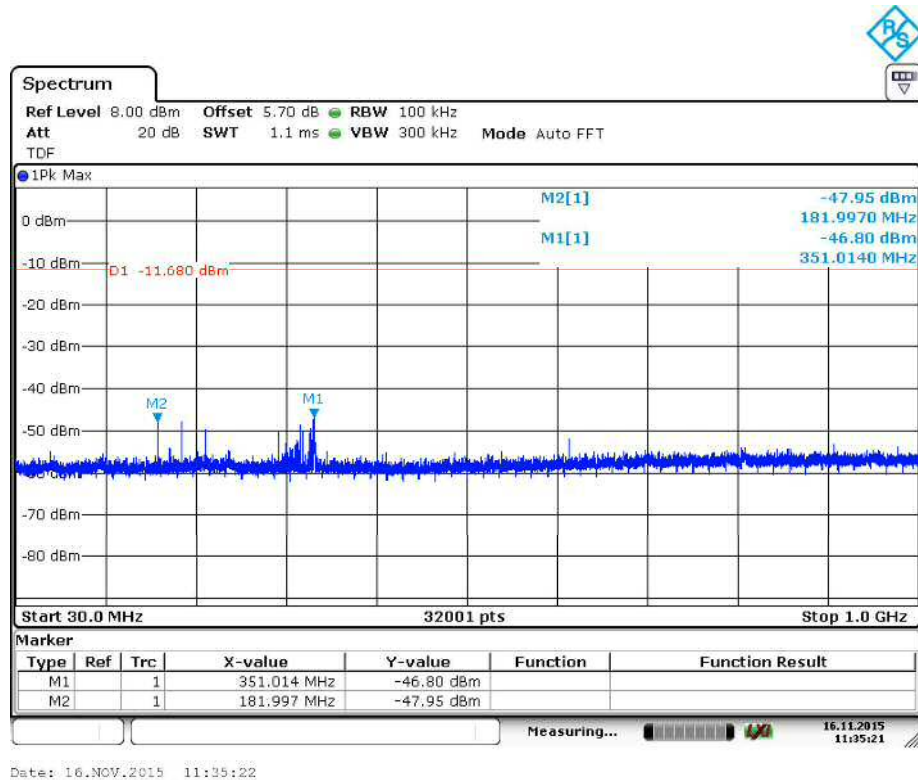


Figure 21. Conducted Spurious Emissions 30 – 1 000 MHz channel low.

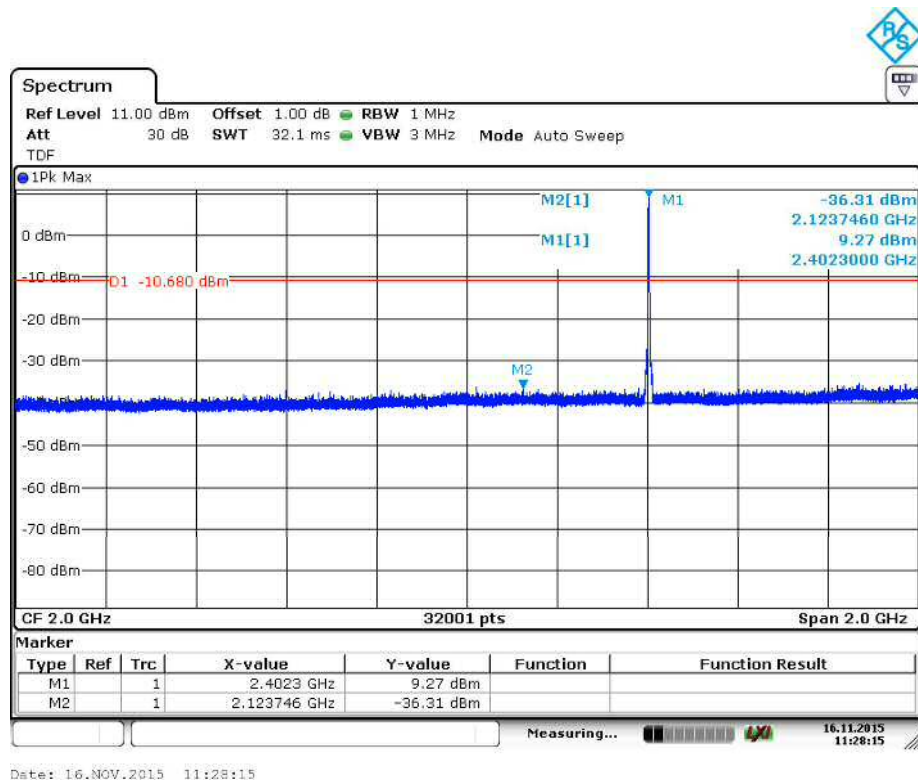


Figure 22. Conducted Spurious Emissions 1 000 – 3 000 MHz. Channel Low.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

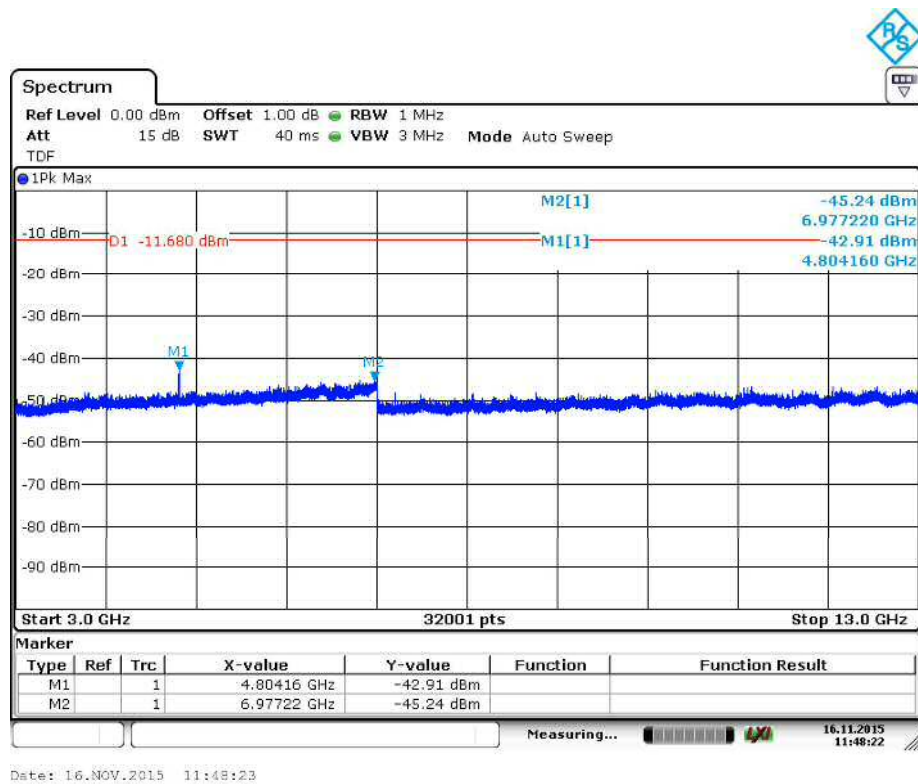


Figure 23. Conducted Spurious Emissions 3 000 – 13 000 MHz channel low.

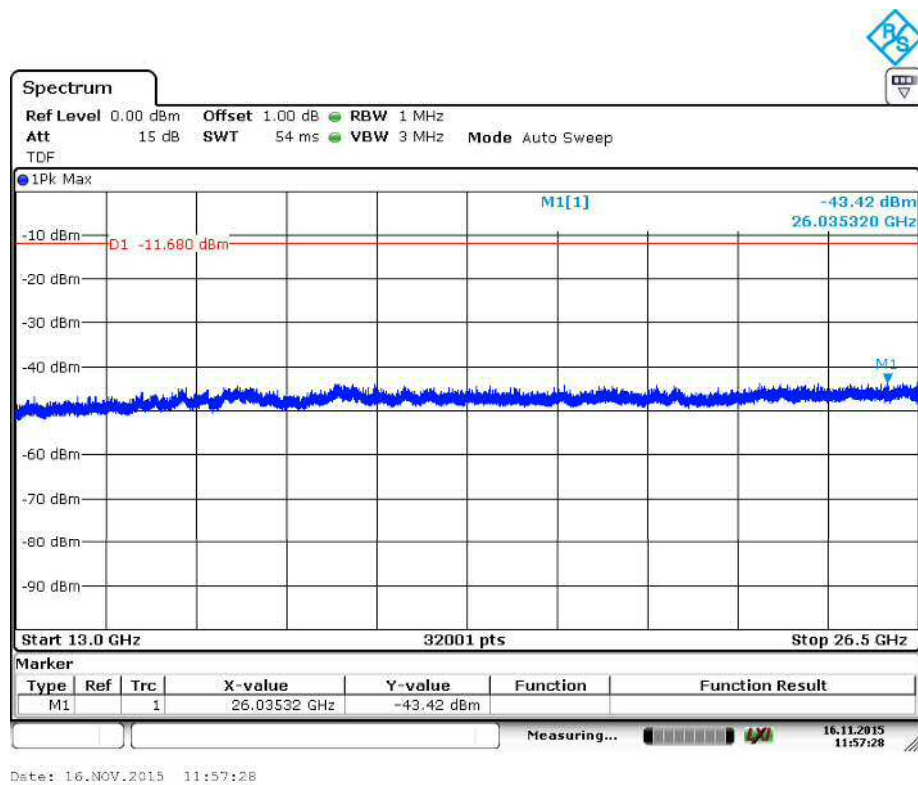


Figure 24. Conducted Spurious Emissions 13 000 – 26 500 MHz channel low.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

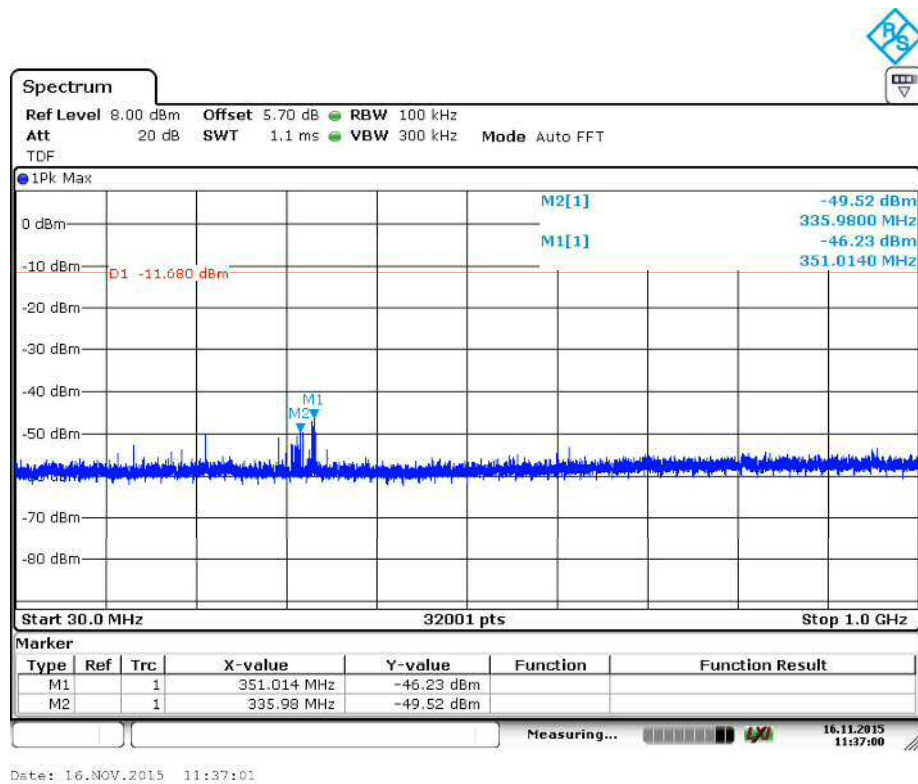


Figure 25. Conducted Spurious Emissions 30 – 1 000 MHz channel mid.

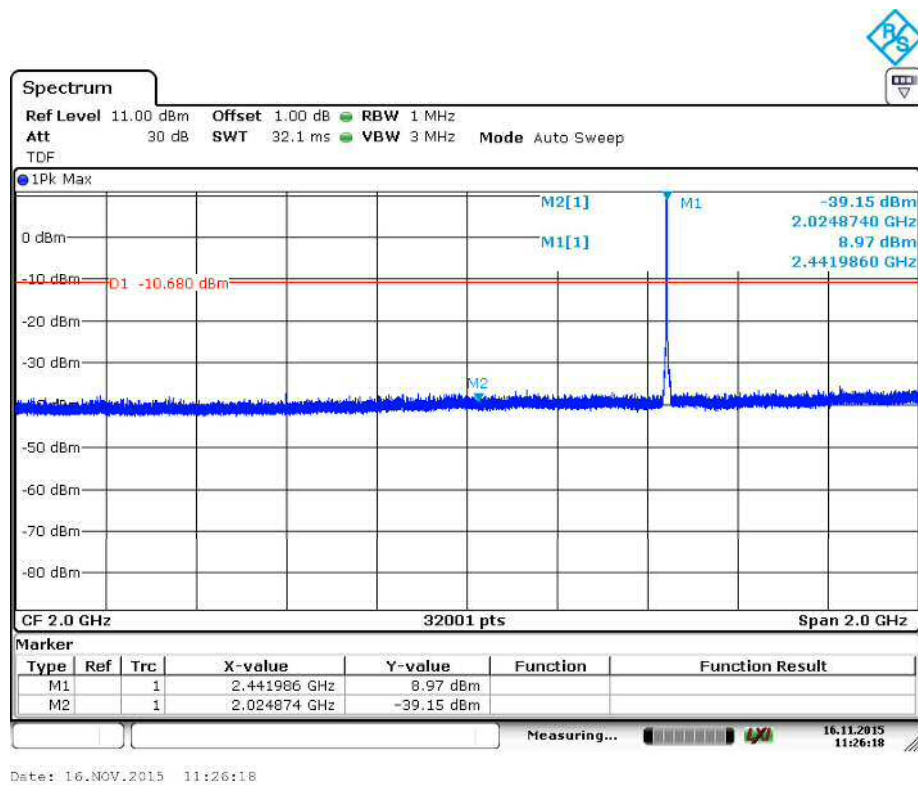


Figure 26. Conducted Spurious Emissions 1 000 – 3 000 MHz channel mid.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

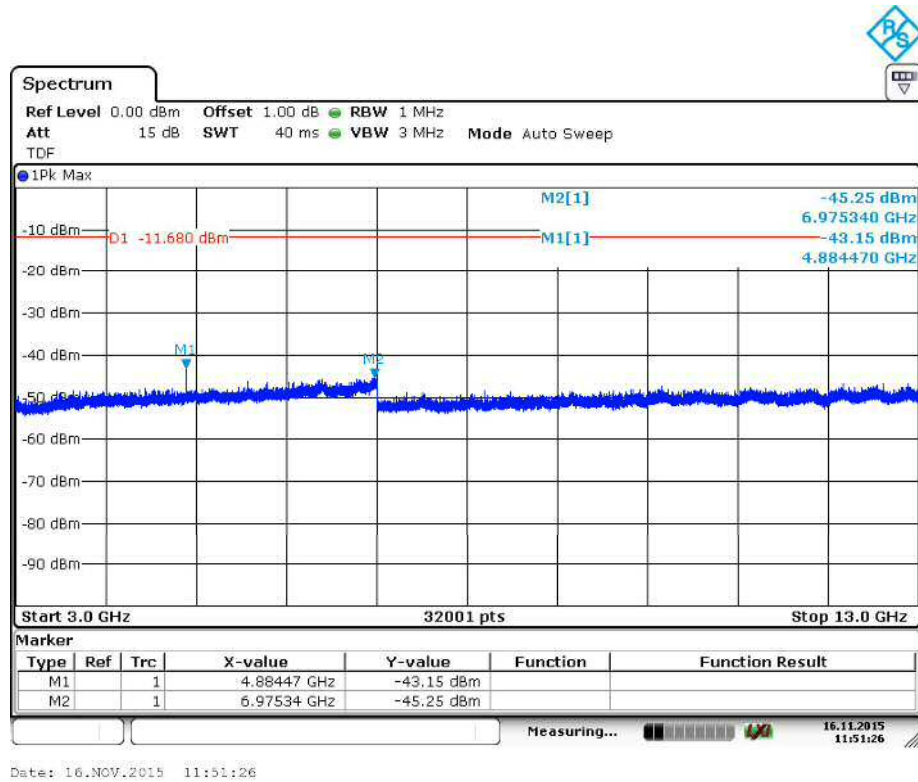


Figure 27. Conducted Spurious Emissions 3 000 – 13 000 MHz channel mid.

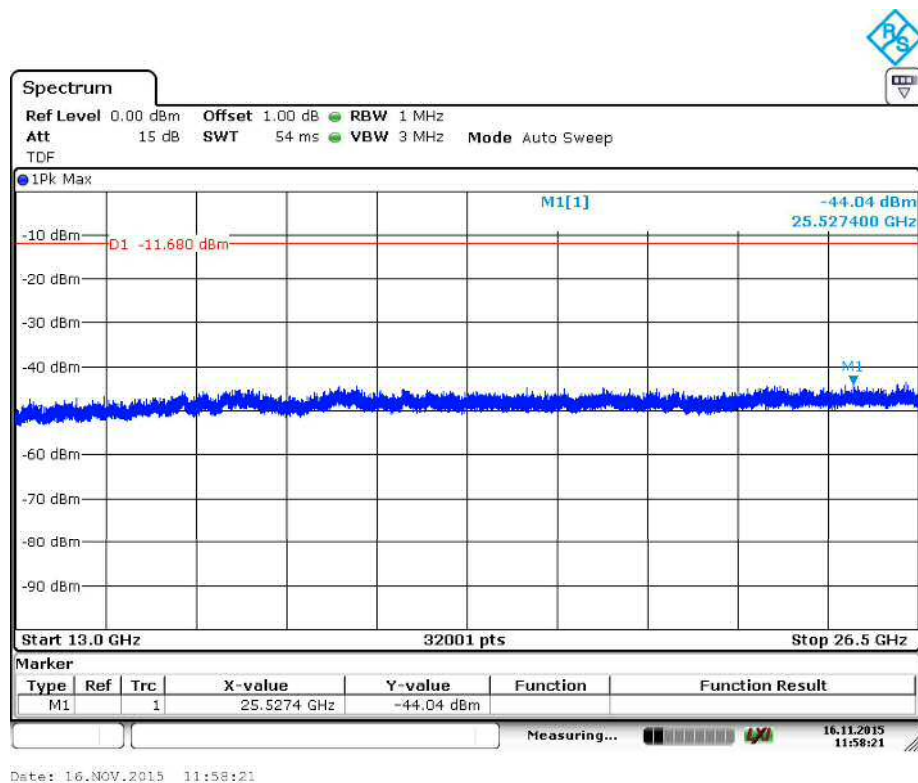


Figure 28. Conducted Spurious Emissions 13 000 – 26 500 MHz channel mid.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

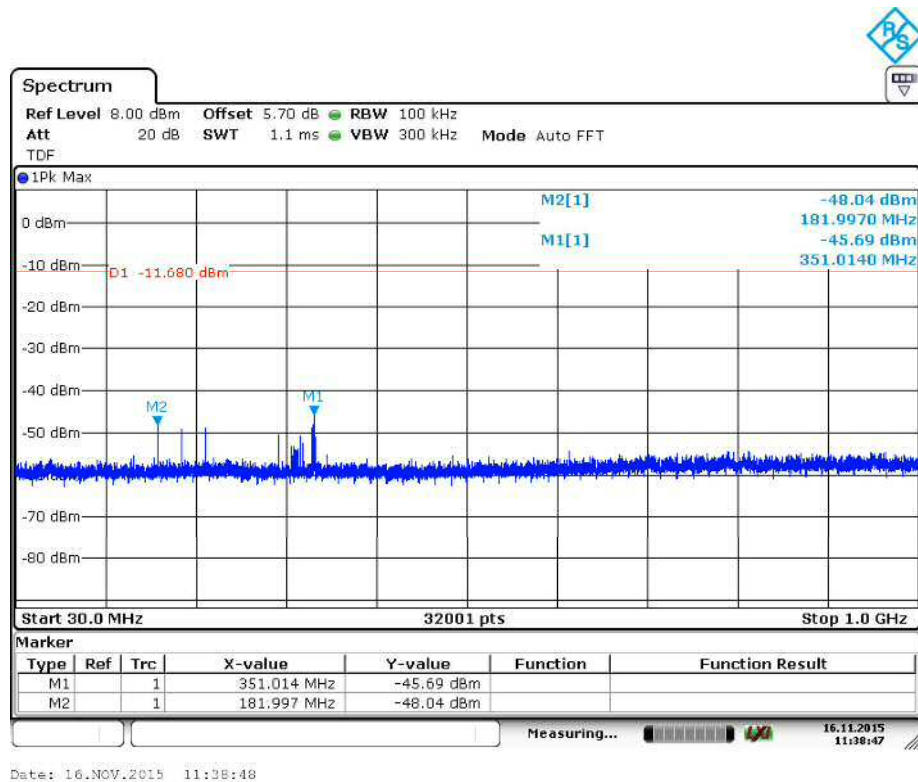


Figure 29. Conducted Spurious Emissions 30 – 1 000 MHz channel high.

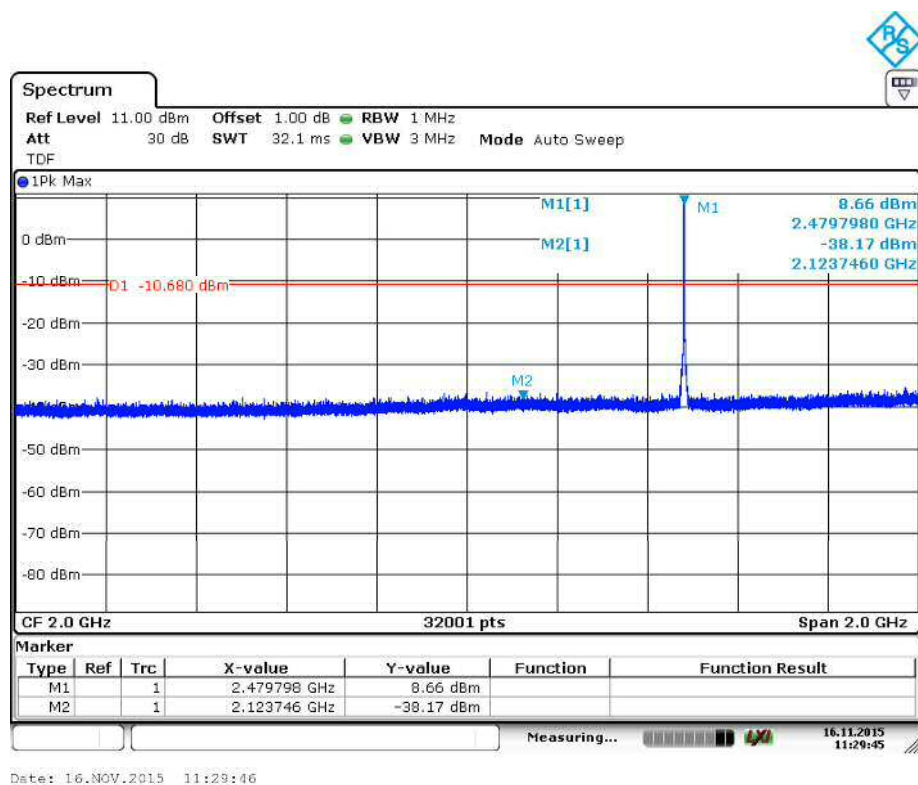


Figure 30. Conducted Spurious Emissions 1 000 – 3 000 MHz channel high.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

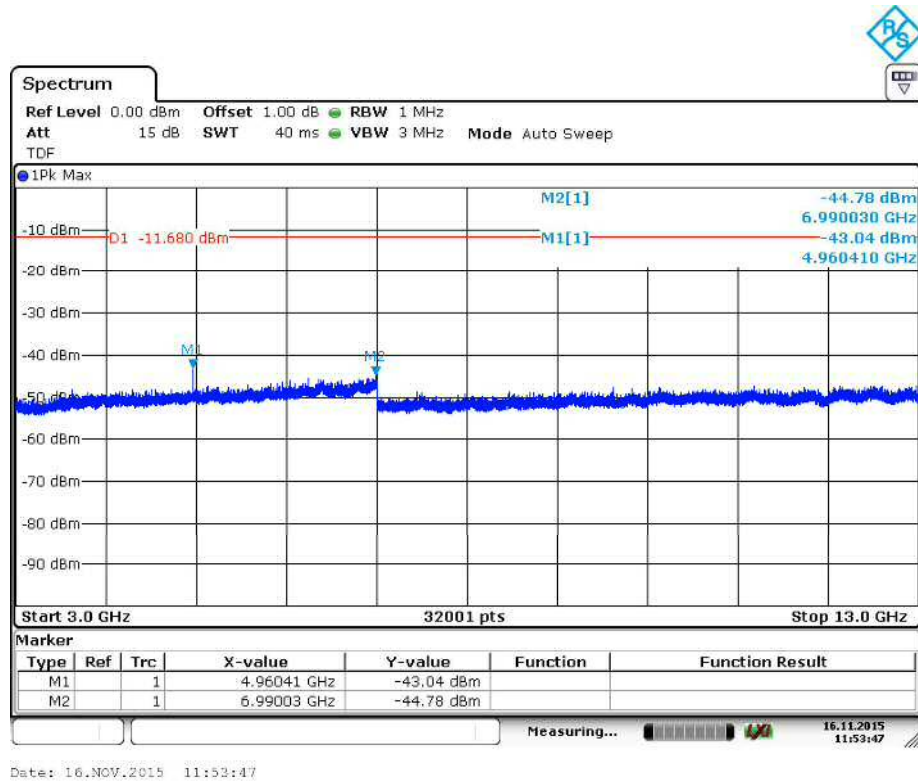


Figure 31. Conducted Spurious Emissions 3 000 – 13 000 MHz channel high.

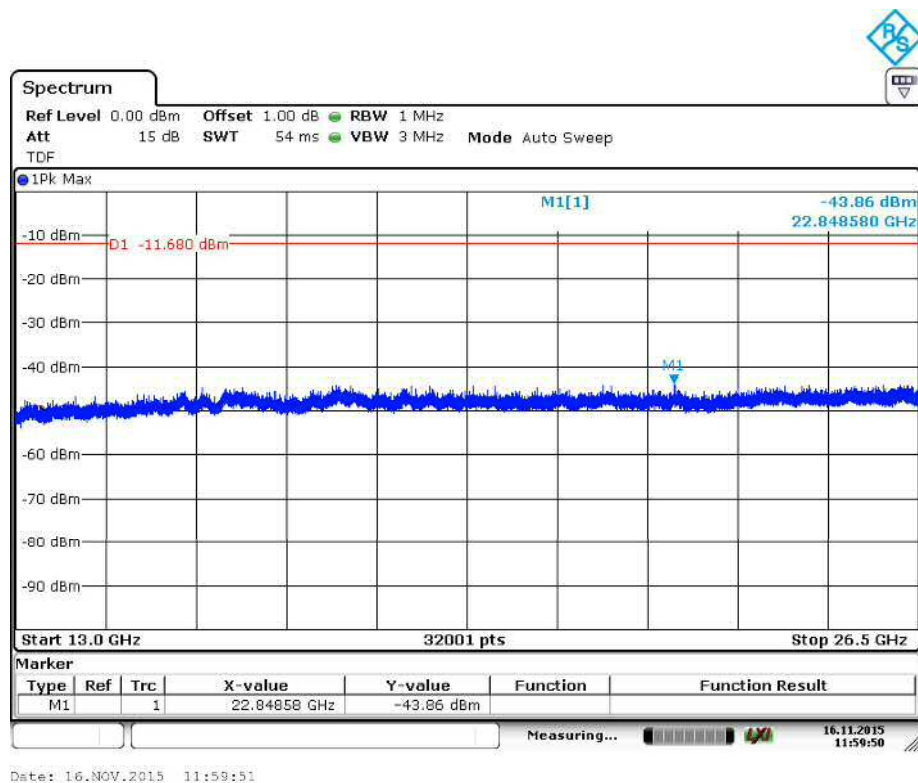


Figure 32. Conducted Spurious Emissions 13 000 – 26 500 MHz channel high.

6 dB Bandwidth of the Channel

6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 2.10.2015
Humidity: 25 %
Temperature: 21 °C

FCC Rule: 15.247(a)(2)
RSS-247 5.2(1)

Results:

Table 29. 6 dB bandwidth test results.

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	680.00	500
Mid	680.00	
High	680.00	

6 dB Bandwidth of the Channel

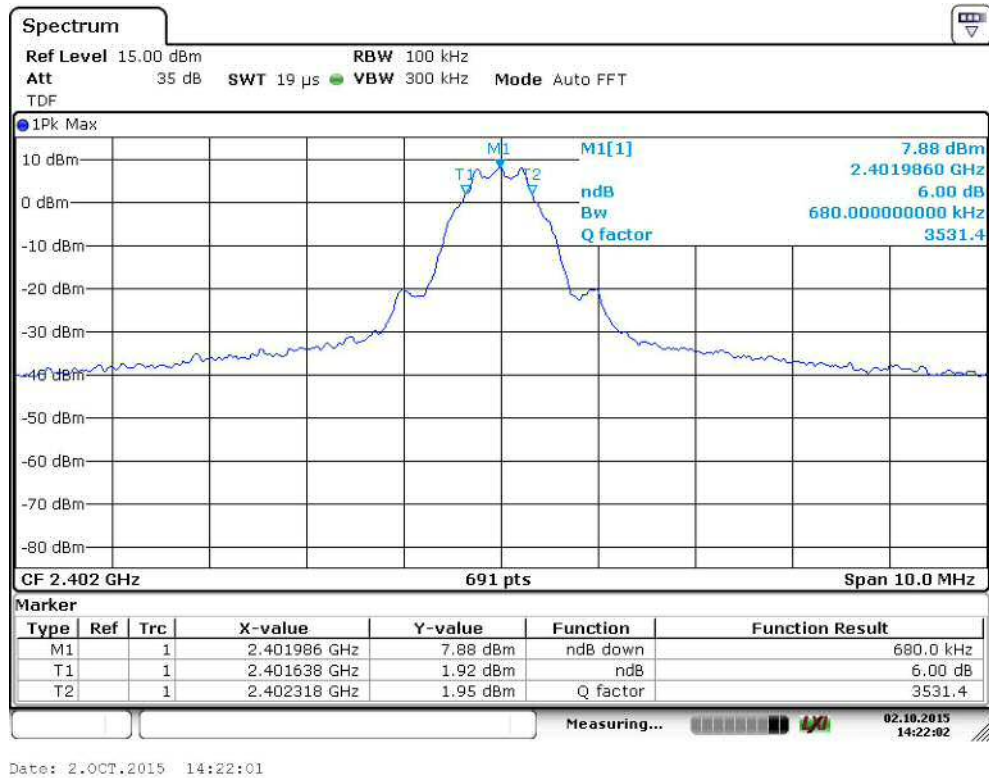


Figure 33. 6 dB bandwidth of the channel low.



Figure 34. 6 dB bandwidth of the channel mid.

6 dB Bandwidth of the Channel

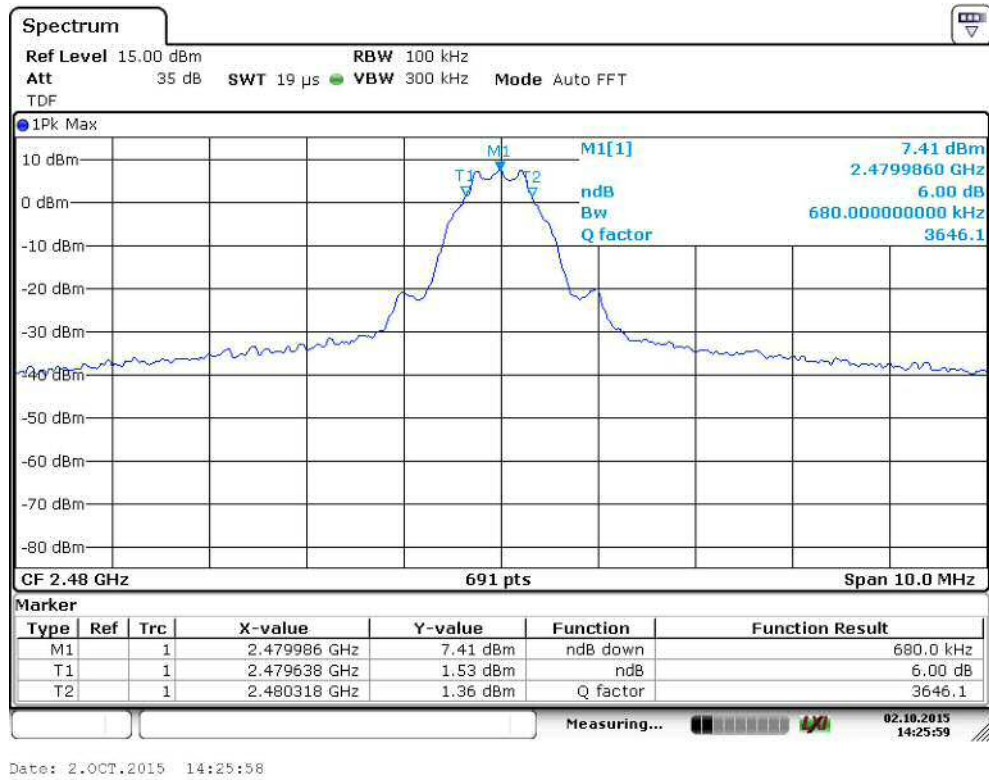


Figure 35. 6 dB bandwidth of the channel high.

Power Spectral Density

Standard: ANSI C63.10 (2013)
Tested by: NKO
Date: 16.11.2015
Humidity: 25 %
Temperature: 21 °C

FCC Rule: 15.247(e)
RSS-247 5.2(2)

Results:
Table 30. Power Spectral Density test results.

Channel	PSD dBm/10 kHz	Maximum limit [dBm/3kHz]
Low	3.70	+8.00
Mid	3.65	
High	3.31	

Power Spectral Density

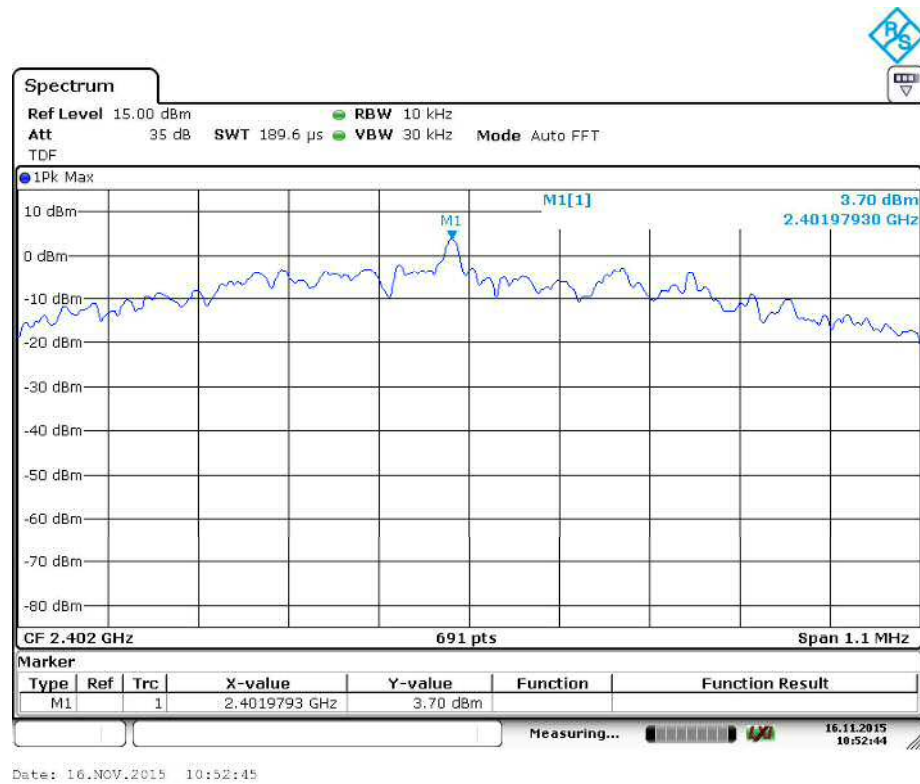


Figure 36. Power Spectral Density of the channel low.

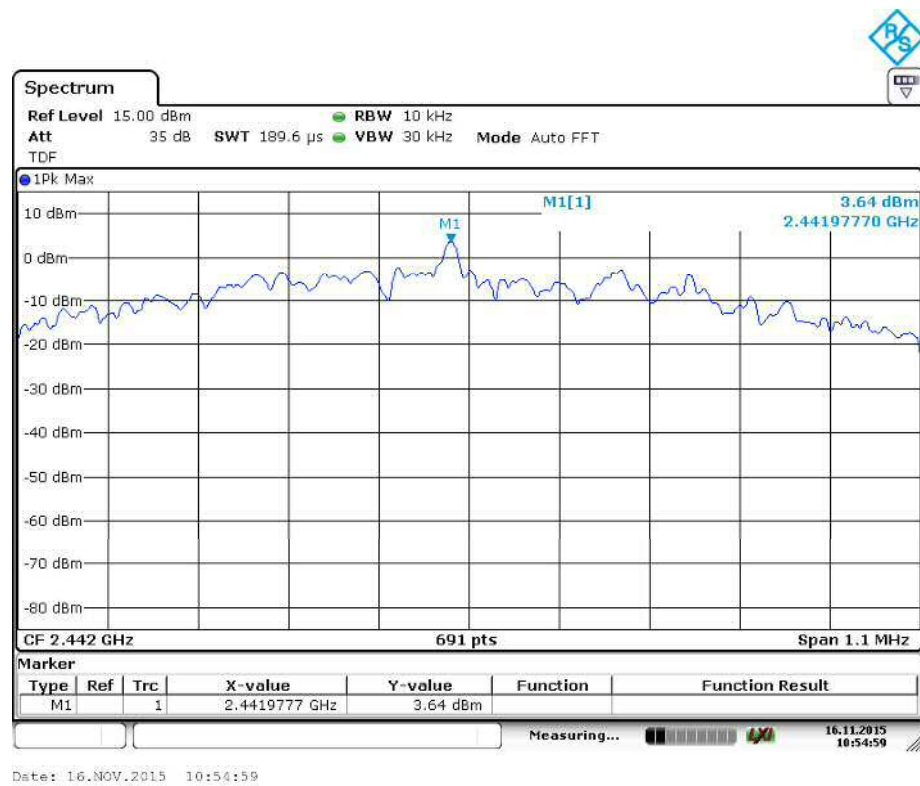


Figure 37. Power Spectral Density of the channel mid.

Power Spectral Density

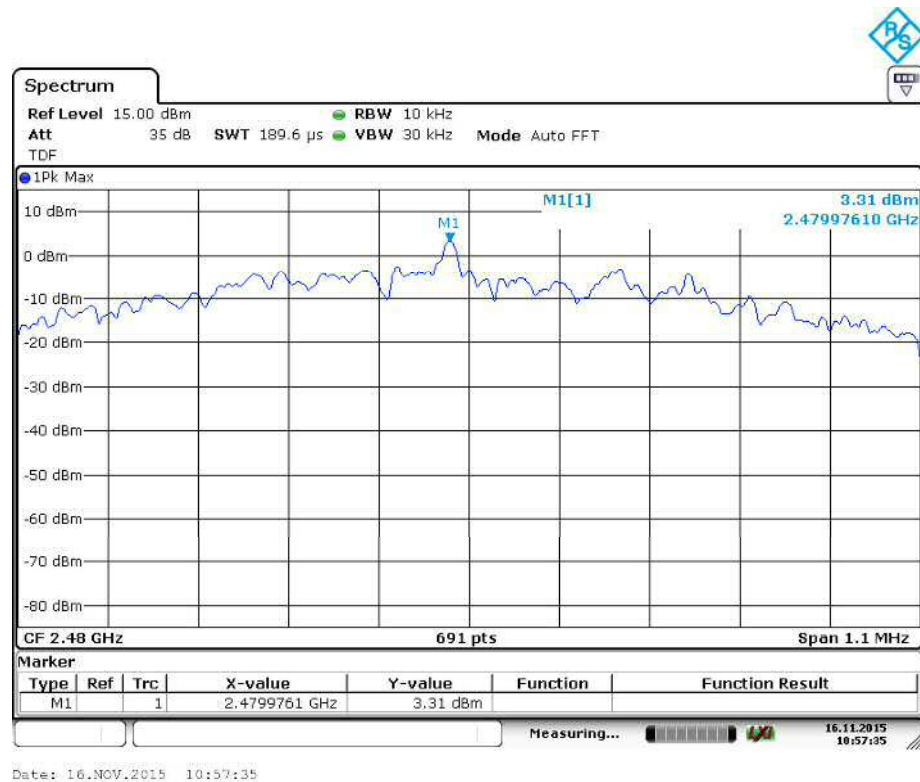


Figure 38. Power Spectral Density of the channel high.

99% Occupied Bandwidth

Standard: RSS-GEN (2014)
Tested by: NKO
Date: 2.10.2015
Humidity: 25 %
Temperature: 21 °C

RSS-GEN 6.6**Table 31.** 99 % OBW test results.

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.099855282	PASS
Mid	-	1.099855282	PASS
High	-	1.085383502	PASS

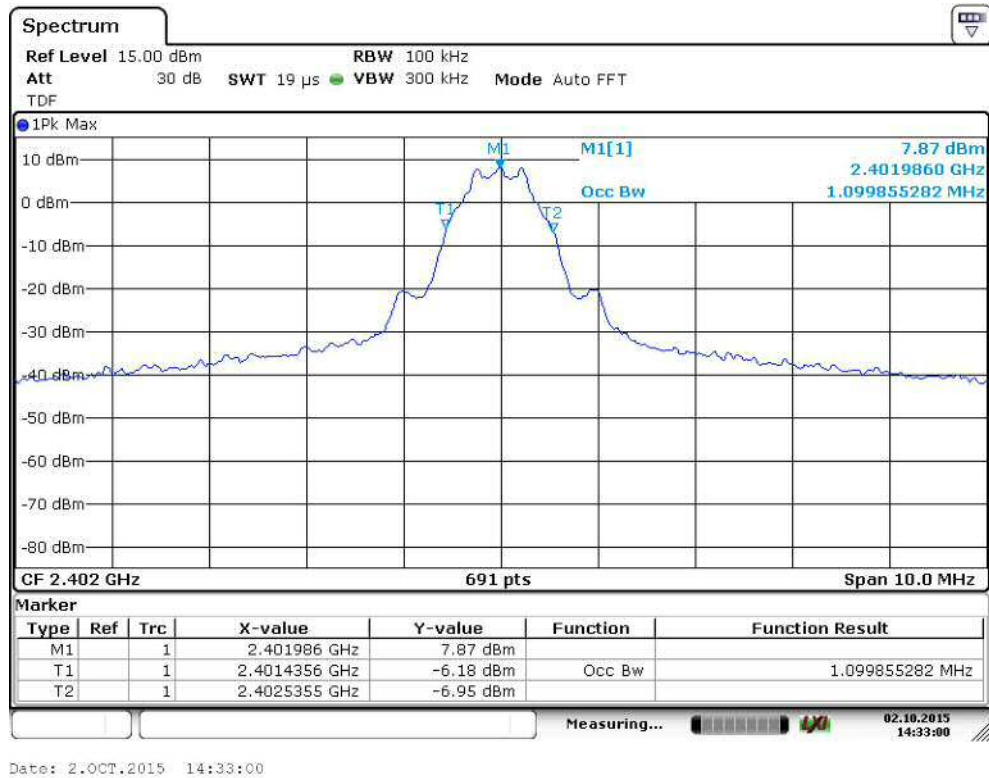


Figure 39. 99 % OBW channel low.

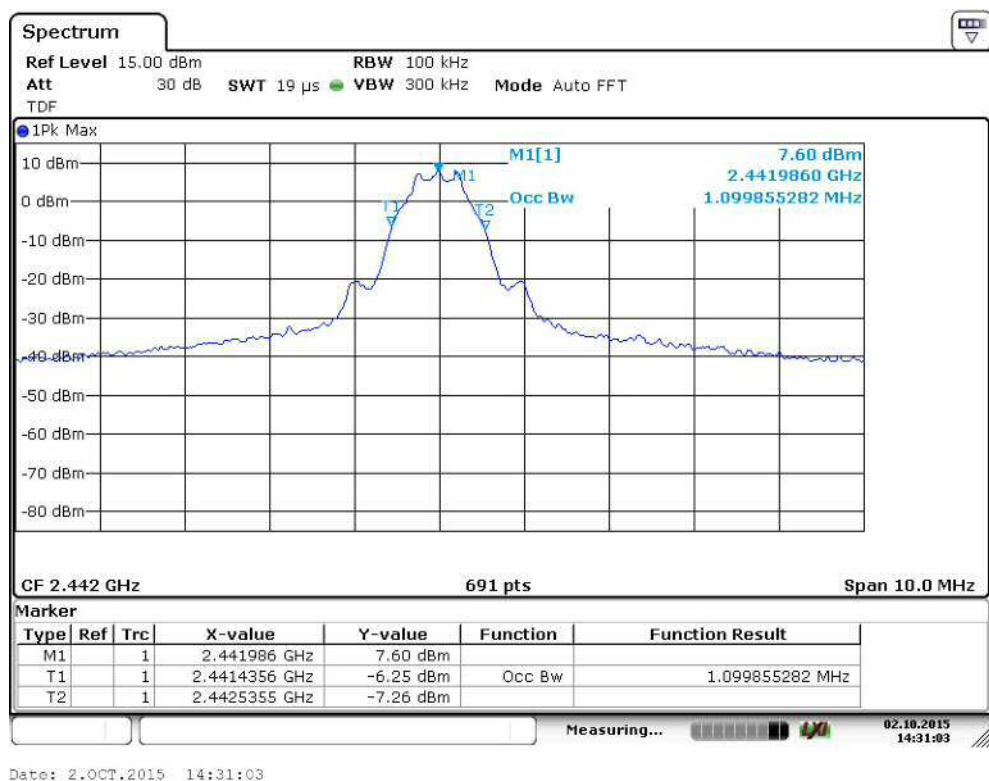
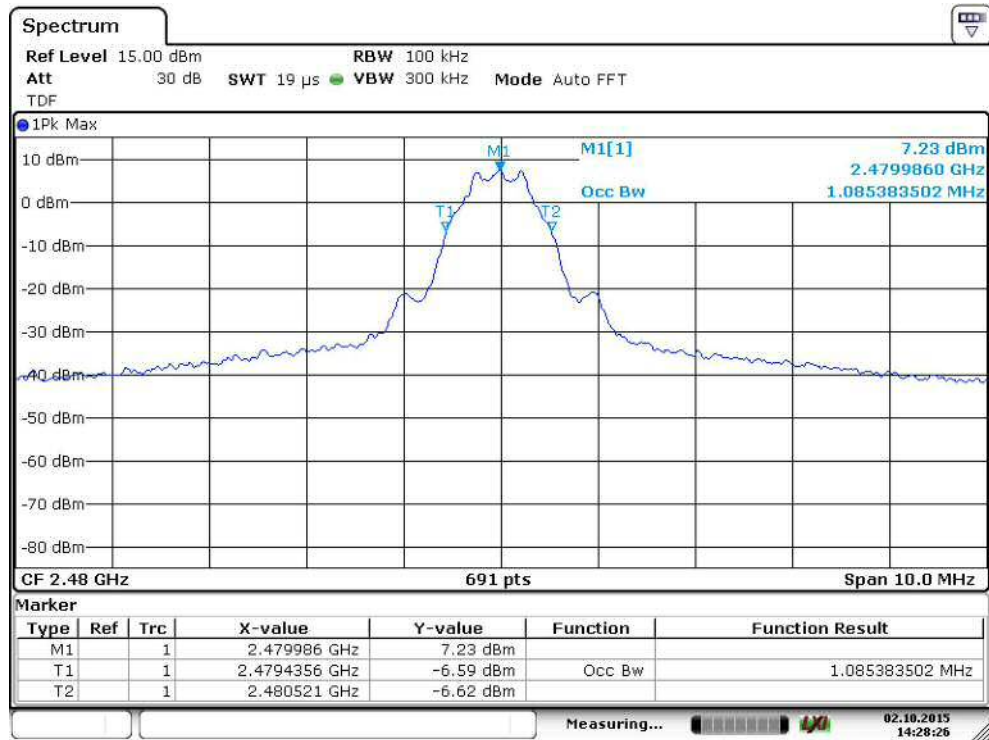


Figure 40. 99 % OBW channel mid.



Date: 2.OCT.2015 14:28:25

Figure 41. 99 % OBW channel high.

TEST EQUIPMENT

Equipment	Manufacturer	Type	Serial no	Inv.no	Cal. due
EMI RECEIVER	ROHDE & SCHWARZ	ESU 26	100185	8453	2016-07-01
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	101068	9093	2016-07-01
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
ANTENNA (30-1000 MHz)	SCHWARZBECK	VULB 9168	8168-503	8911	2016-05-04
ANTENNA MAST	DEISEL	MA240	240/455	5017	-
TURNTABLE	DEISEL	DS420	-	5015	-
CONTROLLER	COMTEST	HD100	100/457	5018	-
ANTENNA (1-18 GHz)	EMCO	3117	29617	7293	2017-03-03
ANTENNA (18-26.5 GHz)	EMCO	3160- 09	030232-022	7294	2016-06-28
PREAMPLIFIER (0.5-26GHz)	HP	83017A	3950M00102	5226	2016-08-26
ATTENUATOR 10 dB	HUBER & SUHNER	6810.17B	-	-	2016-08-26
HIGH PASS FILTER	WAINWRIGHT	WHKX	10	8267	2016-08-26
AC Power Source	CALIFORNIA INSTRUMENTS	5001 iX Series II	58209	7826	-

All used measurement equipment was calibrated (if required).