Test Report

FINAS
Finnish Accreditation Service
T004 (EN ISO/IEC 17025)

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test:	802.11 b/g/n Wi-Fi Module
Model:	WGM110
Manufacturer:	Silicon Laboratories Finland Oy PO. BOX 120 FI-02631 ESPOO FINLAND
Customer:	Silicon Laboratories Finland Oy PO. BOX 120 FI-02631 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:	January 7, 2016	Date:	January 7, 2016
Issued by:	Niko Kotsalo Testing Engineer	Checked by:	Timo Hietala Testing Engineer

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Equipment Under Test (EUT)

802.11 b/g/n Wi-Fi Module	
Model:	WGM110
Type:	-
Serial no:	-
FCC ID:	QOQ-WGM110
IC:	5123A-WGM110

Description of the EUT

The WGM110 is a 802.11b/g/n radio module. WGM110 integrates 802.11b/g/n radio, a microcontroller, Wi-Fi and IP stacks, an HTTP server and multiple protocols such as TCP and UDP.

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):	2412 – 2462 MHz
Channels:	11
Channel separation:	5 MHz
99% Channel bandwidth:	17.340 MHz
Conducted power:	15.35 dBm
Transmission technique:	DSSS
Modulation:	CCK, QPSK, OFDM
Integral Antenna gain:	1 dBi

Power Supply

Operating voltage range:	2.7 – 4.8 VDC

AC/DC power supply was used powering the EUT when conducted emissions and radiated emission were tested.

Manufacturer:	Samsung
Model:	GB4943-2001
Rated voltage:	100-240 VAC
Rated current:	~2.0 A max
Rated frequency:	50-60 Hz
Output voltage:	+5 VDC
Output current:	2.0 A

Mechanical Size of the EUT

Height: 2.0 mm	Width:14.4 mm	Length: 21 mm

Samples

Two samples were used in the testing. Normal commercial sample with integral antenna for radiated emissions testing 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 to transmit continuously 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.

Peripherals

- Samsung GB4943-2001 AC/DC power supply.

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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 EUT was configured into the wanted channel. Normal modulation and 100% duty cycle was applied in all the tests.

Conducted emissions from the AC mains and radiated emissions were measured with EUT powered from 5V AC/DC adapter attached to the evaluation board.

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

Channel Low (Ch 1) = 2412 MHz

Channel Mid (Ch 6) = 2437 MHz

Channel High (Ch 11) = 2462 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

TEST RESULTS

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

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	21.12.2015	
Temperature:	21 °C	
Humidity:	35 % RH	
Barometric pressure:	989.5 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 (dBµV)	
	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.

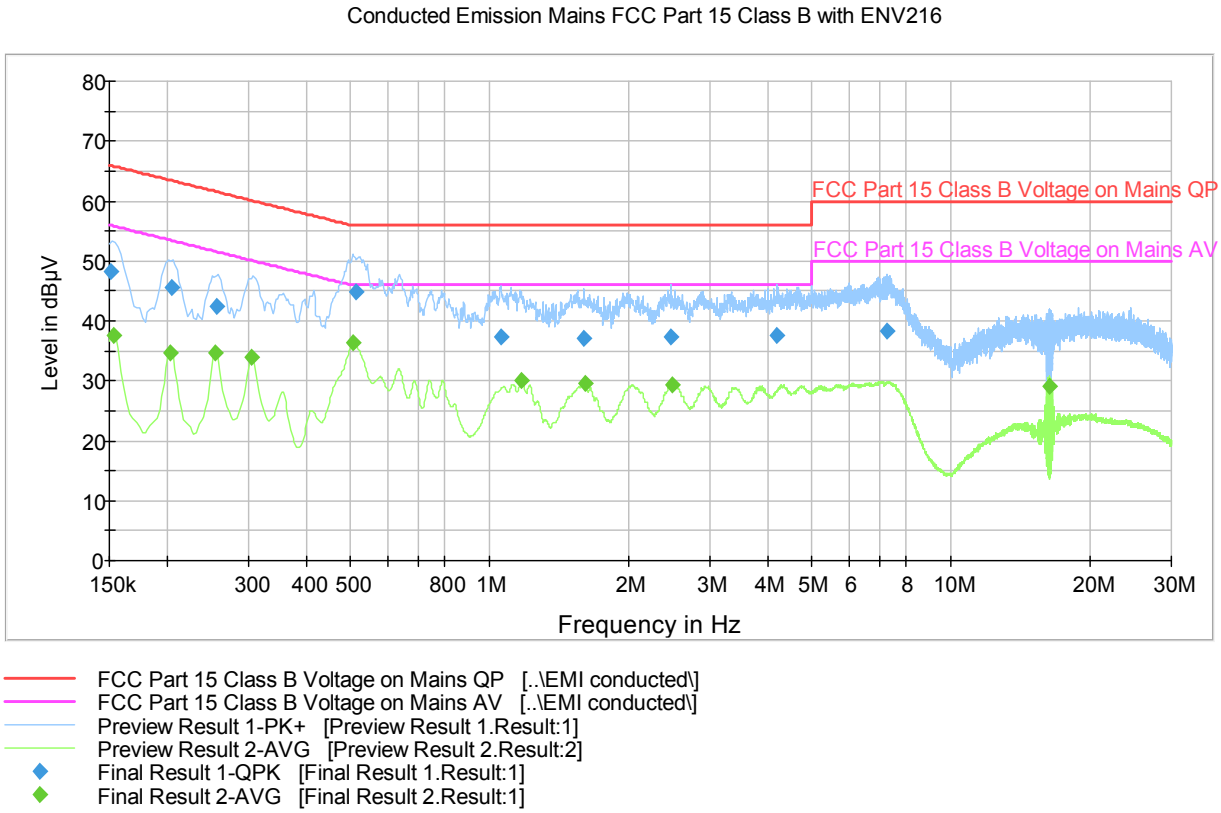

Figure 1. The measured curves with peak- and average detector

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
0.151000	48.2	1000.0	9.000	On	N	9.8	17.8	65.9	
0.204250	45.5	1000.0	9.000	On	N	9.9	17.9	63.4	
0.257000	42.5	1000.0	9.000	On	N	9.7	19.1	61.5	
0.514500	44.8	1000.0	9.000	On	N	10.0	11.2	56.0	
1.055500	37.4	1000.0	9.000	On	L1	9.9	18.6	56.0	
1.602750	37.2	1000.0	9.000	On	L1	9.9	18.8	56.0	
2.466000	37.3	1000.0	9.000	On	L1	10.0	18.7	56.0	
4.179250	37.6	1000.0	9.000	On	L1	10.0	18.4	56.0	
7.246500	38.4	1000.0	9.000	On	N	10.3	21.6	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
0.153000	37.5	1000.0	9.000	On	L1	9.9	18.3	55.8	
0.204000	34.8	1000.0	9.000	On	L1	9.9	18.7	53.4	
0.254750	34.6	1000.0	9.000	On	L1	9.7	17.0	51.6	
0.305250	34.0	1000.0	9.000	On	L1	9.8	16.1	50.1	
0.505750	36.3	1000.0	9.000	On	L1	10.0	9.7	46.0	
1.170250	30.0	1000.0	9.000	On	L1	9.9	16.0	46.0	
1.606250	29.6	1000.0	9.000	On	L1	9.9	16.4	46.0	
2.491750	29.4	1000.0	9.000	On	L1	10.0	16.6	46.0	
16.307500	29.0	1000.0	9.000	On	L1	10.8	21.0	50.0	

Average Conducted Output Power

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	6.10.2015	
Temperature:	21 °C	
Humidity:	25 %	
Measurement uncertainty	± 2.87dB	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. Average conducted output power was measured with average power meter.

Results:

802.11b

Data rate [Mbps]	Conducted power [dBm]			Limit [dBm]	Result
	Low channel	Mid channel	High channel		
1	15.35	14.94	14.88	30	PASS
2	14.95	14.90	14.64	30	PASS
5.5	15.05	14.90	14.80	30	PASS
11	15.00	14.79	14.72	30	PASS

802.11g

Data rate [Mbps]	Conducted power [dBm]			Limit [dBm]	Result
	Low channel	Mid channel	High channel		
6	13.07	12.91	12.89	30	PASS
9	12.95	12.91	12.88	30	PASS
12	13.10	12.80	12.59	30	PASS
18	13.08	12.89	12.78	30	PASS
24	12.93	12.81	12.52	30	PASS
36	12.83	12.64	12.40	30	PASS
48	12.70	12.54	12.61	30	PASS
54	12.62	12.40	12.28	30	PASS

802.11n

Data rate [Mbps]	Conducted power [dBm]			Limit [dBm]	Result
	Low channel	Mid channel	High channel		
7.2	12.00	12.90	12.70	30	PASS
14.4	12.84	12.70	12.64	30	PASS
21.7	12.74	12.68	12.48	30	PASS
28.9	12.63	12.60	12.38	30	PASS
43.3	12.50	12.33	12.45	30	PASS
57.8	12.52	12.32	12.18	30	PASS
65	12.40	12.34	12.19	30	PASS
72.2	12.36	12.31	12.10	30	PASS

Transmitter Radiated Spurious Emissions 30 – 1000 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	24.9. – 10.12.2015	
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.

Radiated spurious emissions measurements were tested with 1Mbps data rate.

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

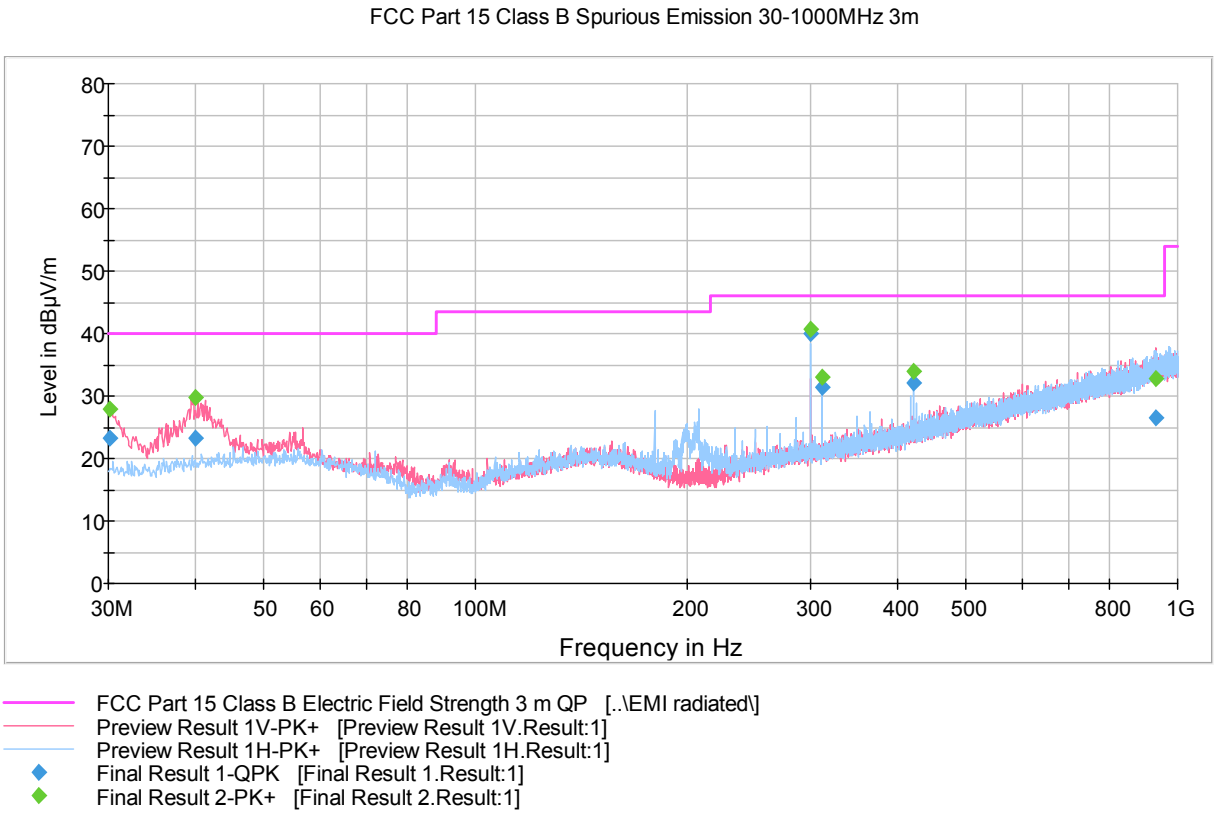

Figure 2. Measured curve with peak-detector channel low.

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
30.080000	23.3	1000.0	120.000	100.0	V	145.0	13.0	16.7	40.0	
39.889000	23.2	1000.0	120.000	100.0	V	109.0	14.0	16.8	40.0	
300.011000	39.9	1000.0	120.000	100.0	H	88.0	15.3	6.1	46.0	
312.019000	31.5	1000.0	120.000	100.0	H	100.0	15.7	14.5	46.0	
420.017000	32.0	1000.0	120.000	227.0	H	26.0	18.4	14.0	46.0	
931.729000	26.5	1000.0	120.000	211.0	V	110.0	27.6	19.5	46.0	

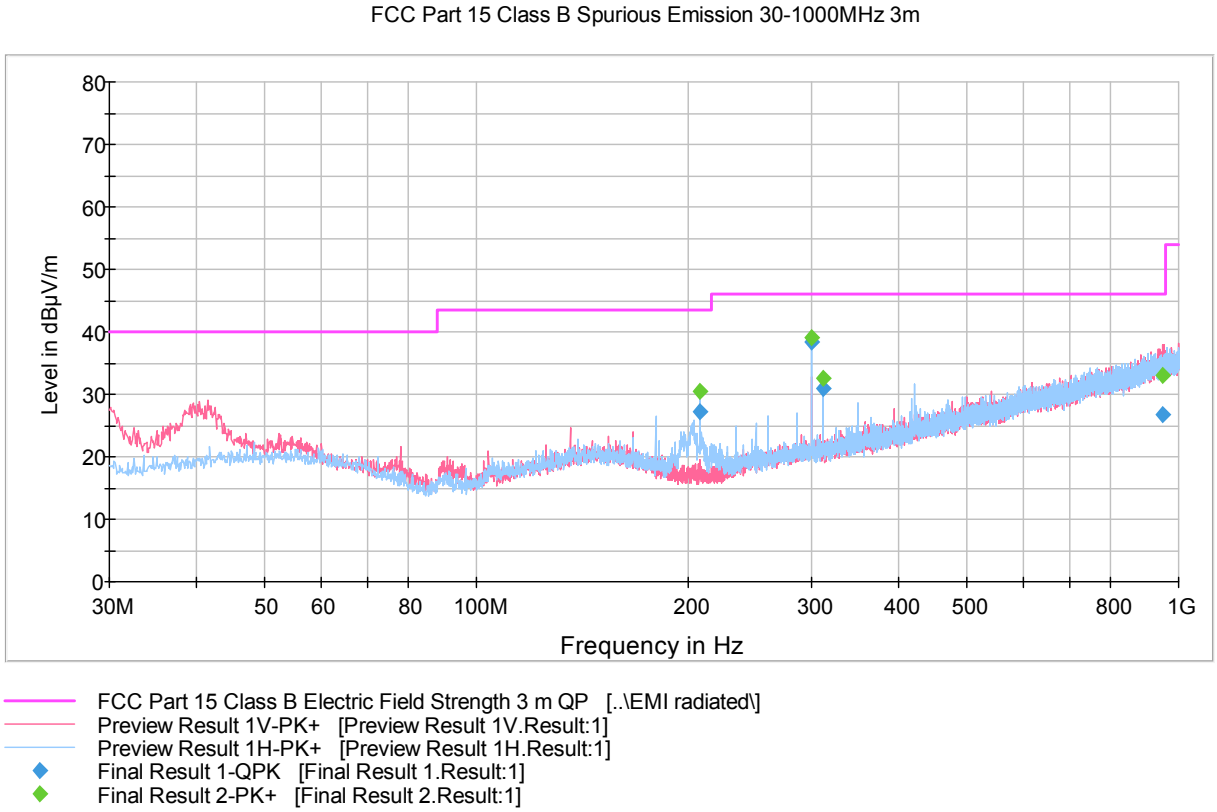

Figure 3. Measured curve with peak-detector channel mid.

Table 4. Final QP results.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
208.015000	27.3	1000.0	120.000	137.0	H	105.0	11.5	16.2	43.5	
300.028000	38.3	1000.0	120.000	100.0	H	221.0	15.3	7.7	46.0	
312.019000	30.8	1000.0	120.000	100.0	H	90.0	15.7	15.2	46.0	
950.442000	26.8	1000.0	120.000	138.0	V	0.0	27.8	19.2	46.0	

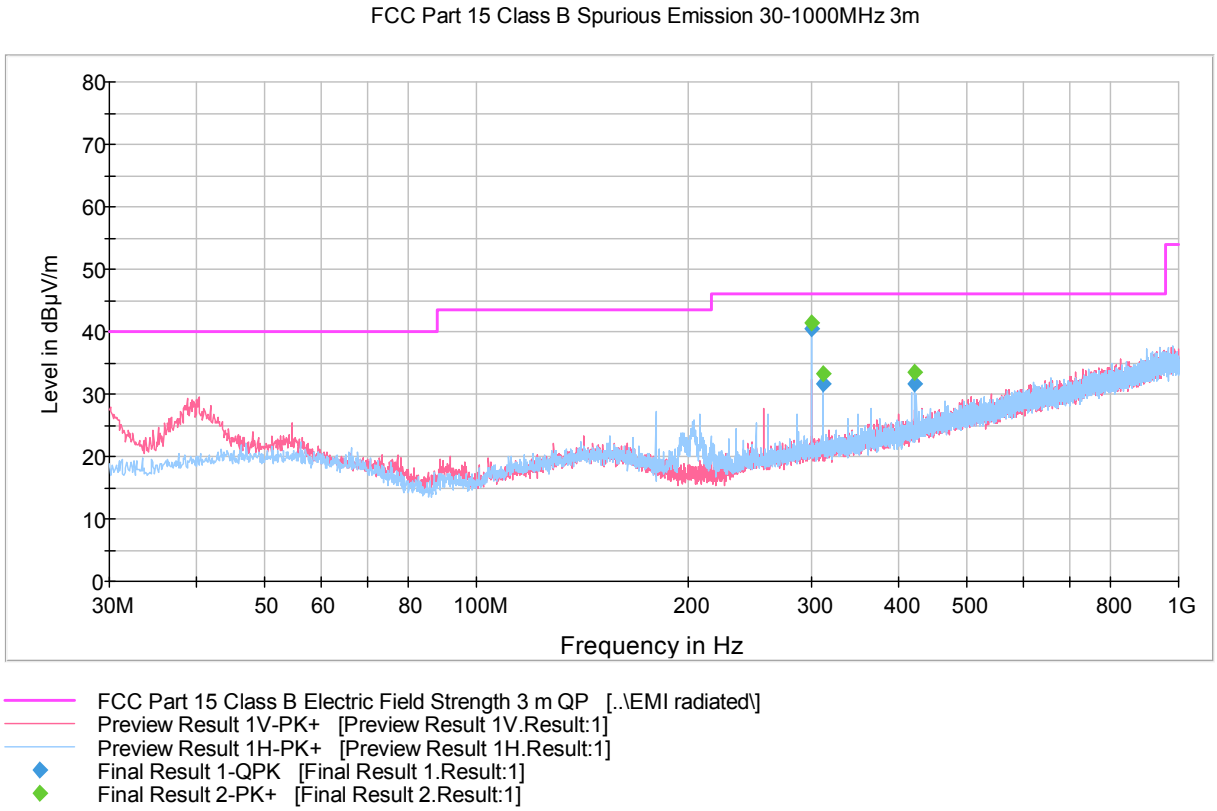

Figure 4. Measured curve with peak-detector channel high.

Final measurements from the worst frequencies

Table 5. 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
300.008000	40.6	1000.0	120.000	100.0	H	87.0	15.3	5.4	46.0	
312.019000	31.5	1000.0	120.000	100.0	H	96.0	15.7	14.5	46.0	
420.037000	31.6	1000.0	120.000	258.0	H	25.0	18.4	14.4	46.0	

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.

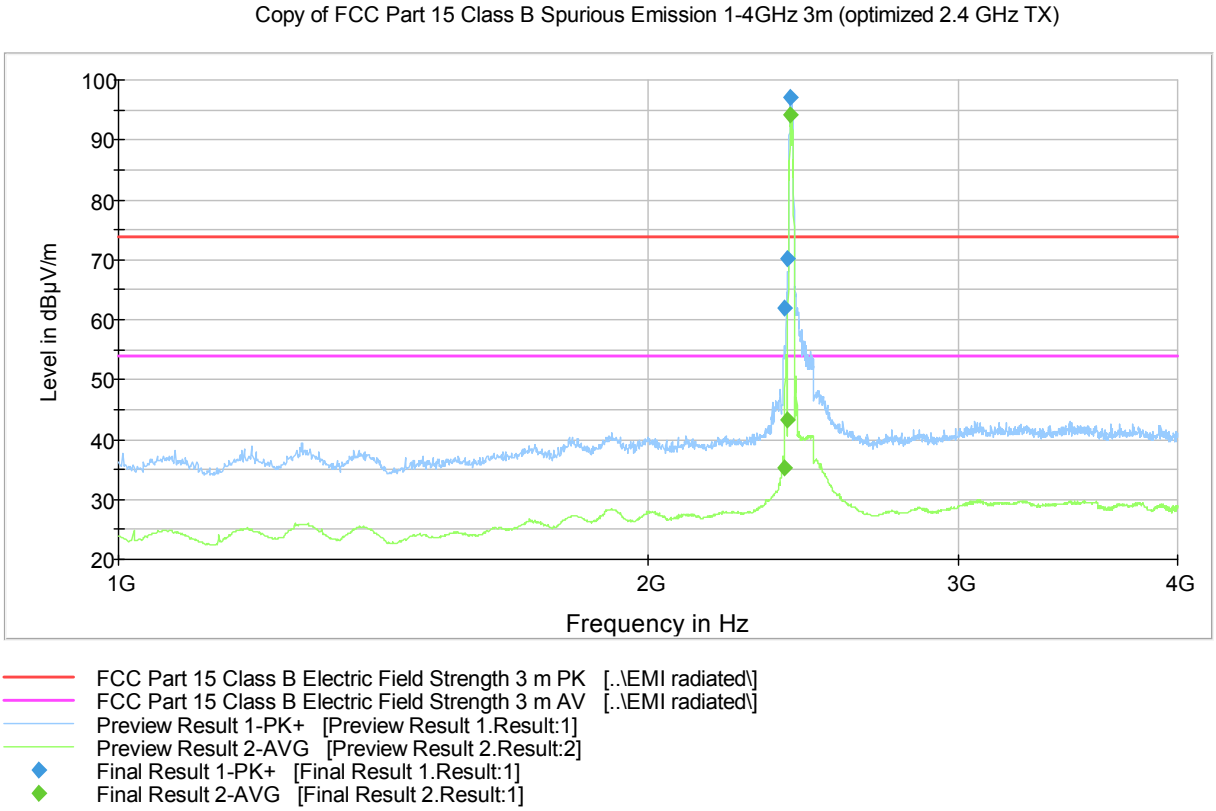

Figure 5. Measured curve with peak- and average detector channel low.

Final measurements from the worst frequencies

Table 6. 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
2390.000000	62.0	1000.0	1000.000	160.0	V	285.0	3.8	11.9	73.9	
2400.000000	70.2	1000.0	1000.000	194.0	V	280.0	3.9	3.7	73.9	
2411.000000	97.0	1000.0	1000.000	153.0	V	280.0	3.9	-23.1	73.9	Carrier

Table 7. 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	35.2	1000.0	1000.000	193.0	V	280.0	3.8	18.7	53.9	
2400.000000	43.3	1000.0	1000.000	153.0	V	280.0	3.9	10.6	53.9	
2411.000000	94.1	1000.0	1000.000	152.0	V	280.0	3.9	-40.2	53.9	Carrier

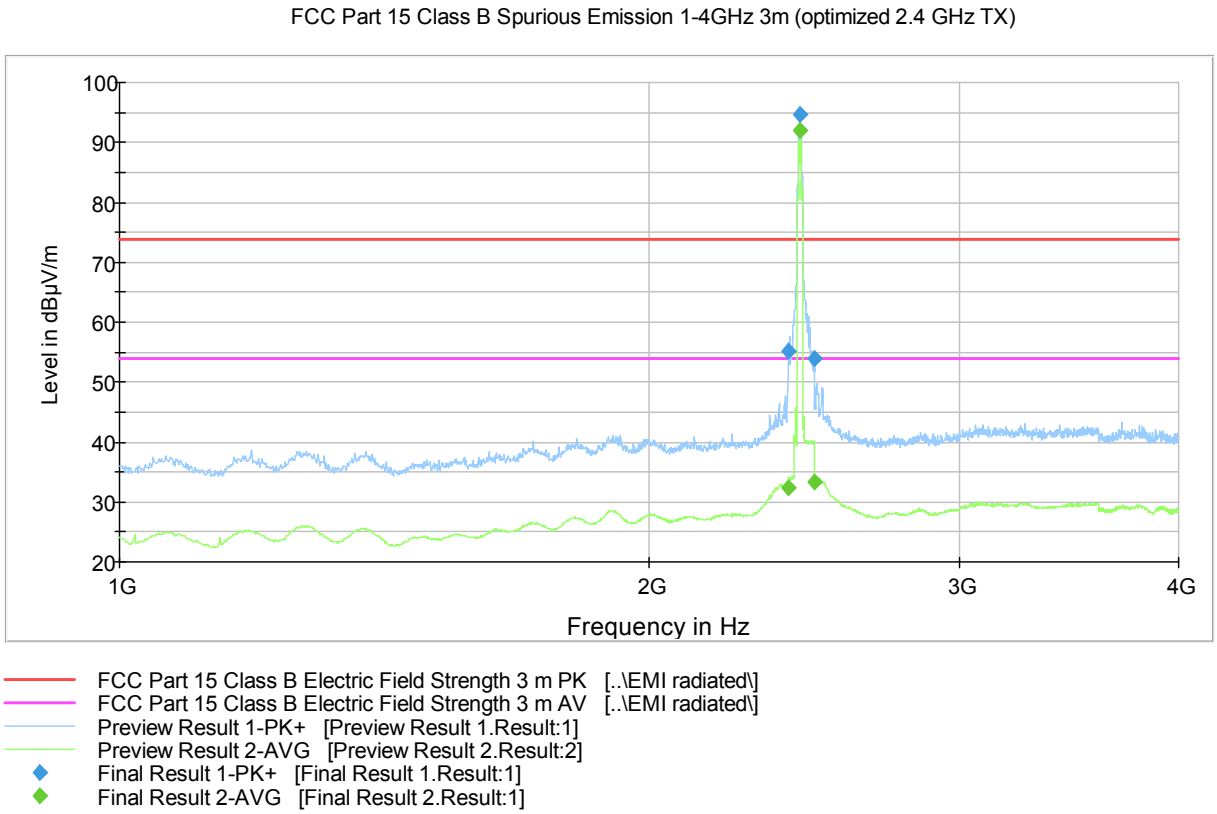

Figure 6. Measured curve with peak- and average detector channel mid.

Final measurements from the worst frequencies

Table 8. 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
2399.400000	55.1	1000.0	1000.000	216.0	H	317.0	3.9	18.8	73.9	
2437.800000	94.6	1000.0	1000.000	217.0	H	279.0	3.9	-20.7	73.9	Carrier
2484.300000	54.0	1000.0	1000.000	225.0	H	279.0	4.2	19.9	73.9	

Table 9. 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
2400.000000	32.3	1000.0	1000.000	297.0	H	291.0	3.9	21.6	53.9	
2437.750000	92.1	1000.0	1000.000	216.0	H	277.0	3.9	-38.2	53.9	Carrier
2485.300000	33.4	1000.0	1000.000	185.0	H	273.0	4.3	20.5	53.9	

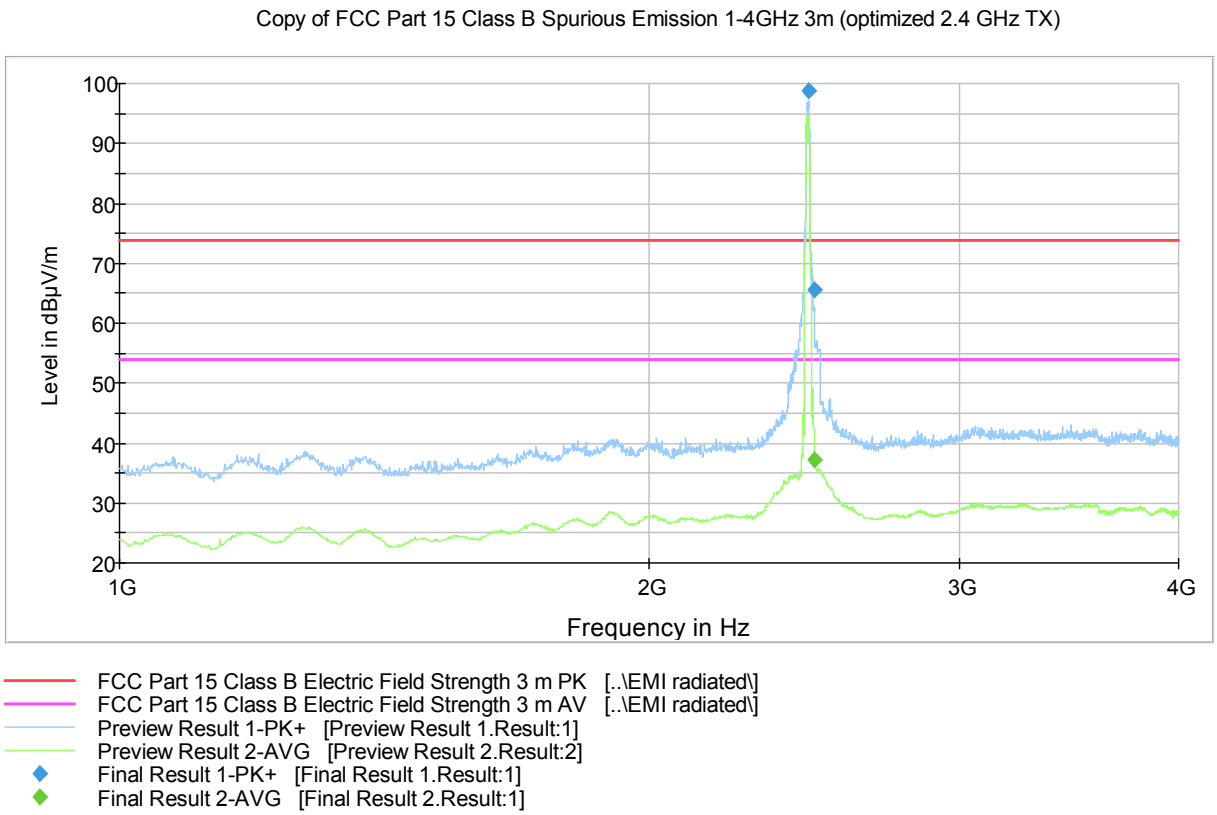

Figure 7. Measured curve with peak- and average detector channel high.

Final measurements from the worst frequencies

Table 10. 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
2463.000000	98.7	1000.0	1000.000	113.0	V	94.0	4.0	-24.8	73.9	Carrier
2483.500000	65.5	1000.0	1000.000	129.0	V	70.0	4.2	8.4	73.9	

Table 11. 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
2483.500000	37.2	1000.0	1000.000	129.0	V	89.0	4.2	16.7	53.9	

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

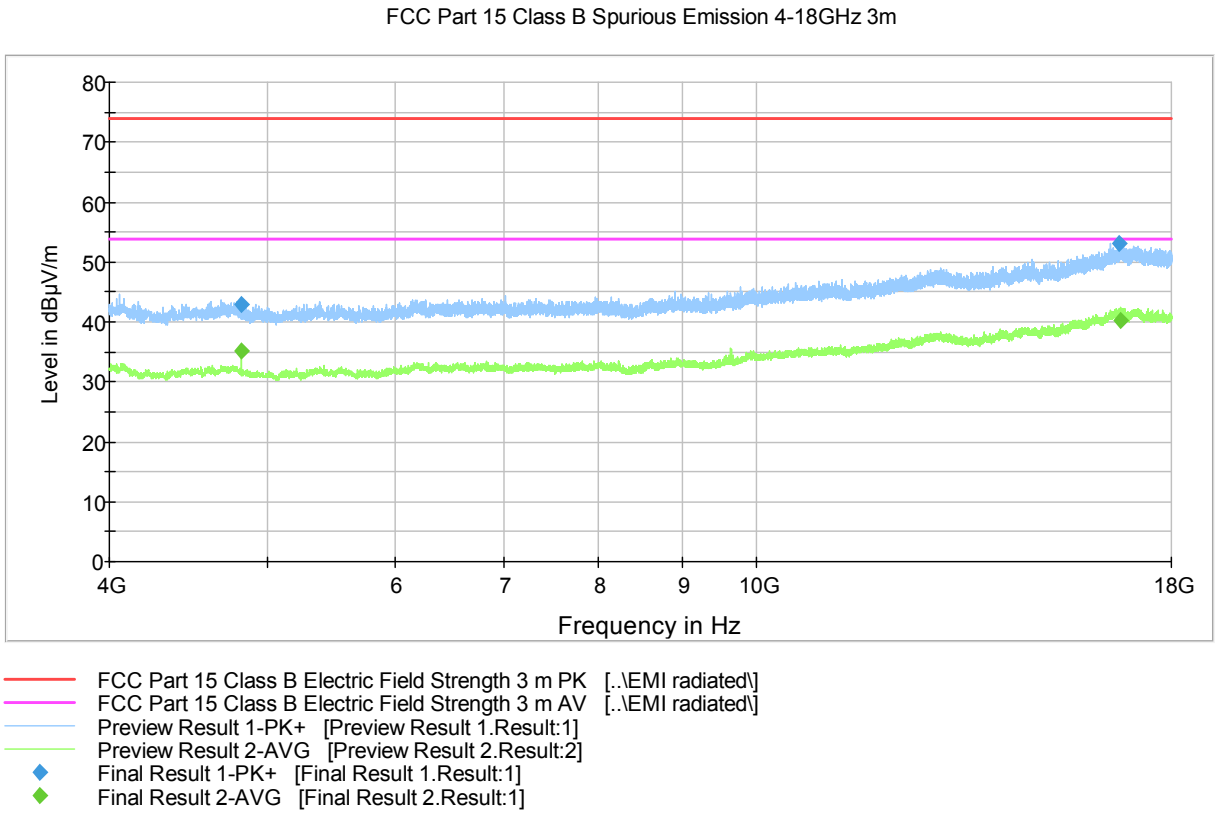

Figure 8. Measured curve with peak- and average detector channel low.

Final measurements from the worst frequencies

Table 12. 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
4826.600000	43.0	1000.0	1000.000	354.0	H	226.0	10.0	30.9	73.9	
16706.000000	53.0	1000.0	1000.000	180.0	V	296.0	25.3	20.9	73.9	

Table 13. 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
4824.100000	35.2	1000.0	1000.000	218.0	H	-4.0	10.0	18.7	53.9	
16762.700000	40.1	1000.0	1000.000	382.0	V	307.0	25.4	13.8	53.9	

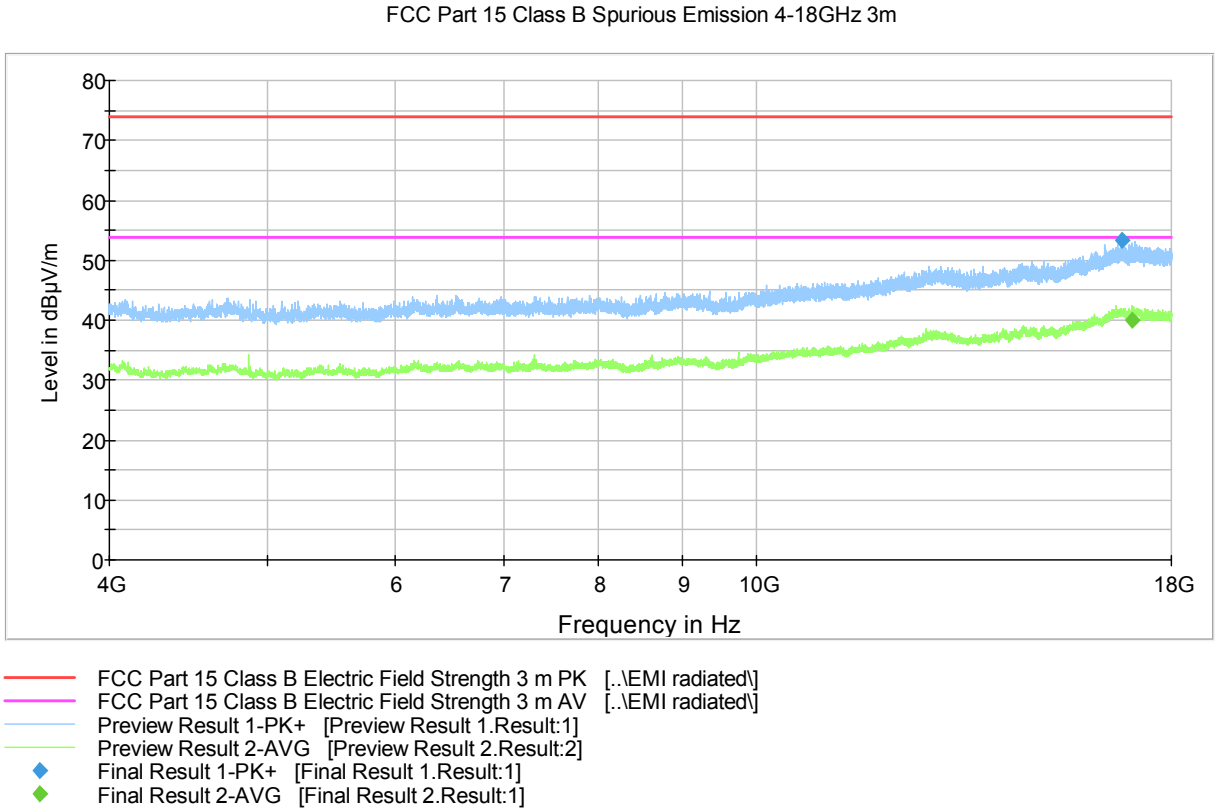

Figure 9. Measured curve with peak- and average detector channel mid.

Final measurements from the worst frequencies

Table 14. 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
16769.200000	53.4	1000.0	1000.000	233.0	H	71.0	25.5	20.5	73.9	

Table 15. 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
17034.100000	39.9	1000.0	1000.000	378.0	H	185.0	25.6	14.0	53.9	

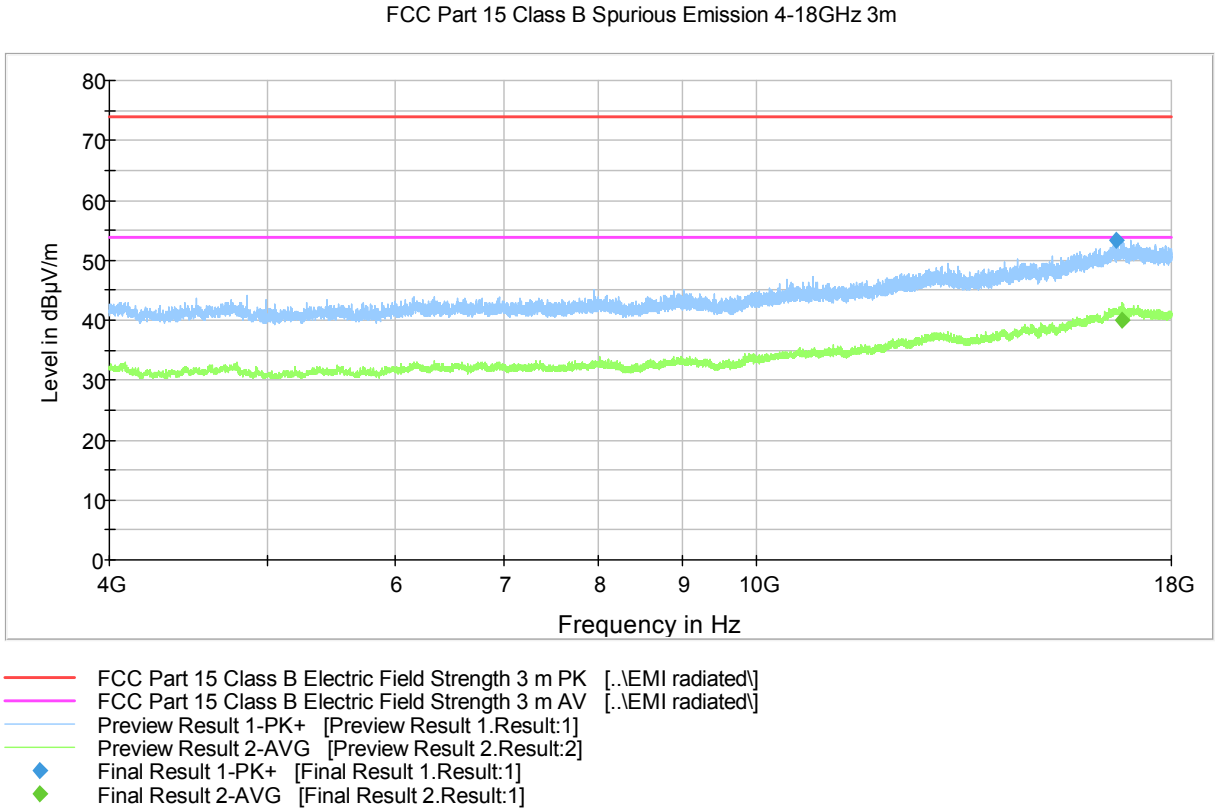

Figure 10. Measured curve with peak- and average detectorc channel high.

Final measurements from the worst frequencies

Table 16. 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
16663.500000	53.3	1000.0	1000.000	262.0	V	332.0	25.2	20.6	73.9	

Table 17. 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
16778.400000	40.1	1000.0	1000.000	298.0	H	286.0	25.5	13.8	53.9	

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

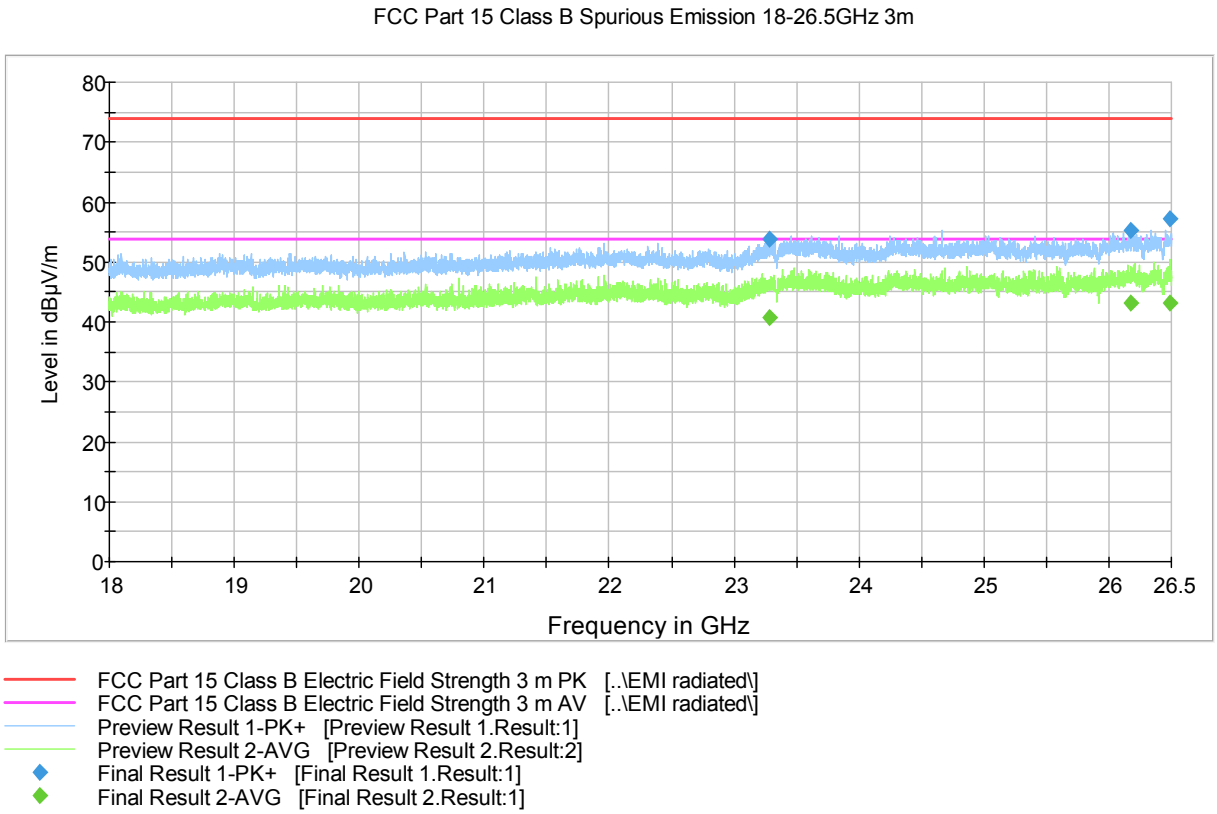

Figure 11. Measured curve with peak- and average detector. Channel Low.

Final measurements from the worst frequencies

Table 18. 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
23286.750000	53.7	1000.0	1000.000	319.0	V	71.0	31.6	20.2	73.9	
26177.800000	55.4	1000.0	1000.000	326.0	V	151.0	35.2	18.5	73.9	
26484.750000	57.1	1000.0	1000.000	395.0	H	120.0	35.8	16.8	73.9	

Table 19. 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
23281.300000	40.6	1000.0	1000.000	376.0	V	209.0	31.6	13.3	53.9	
26176.400000	43.0	1000.0	1000.000	100.0	V	187.0	35.2	10.9	53.9	
26488.750000	43.1	1000.0	1000.000	100.0	H	141.0	35.8	10.8	53.9	

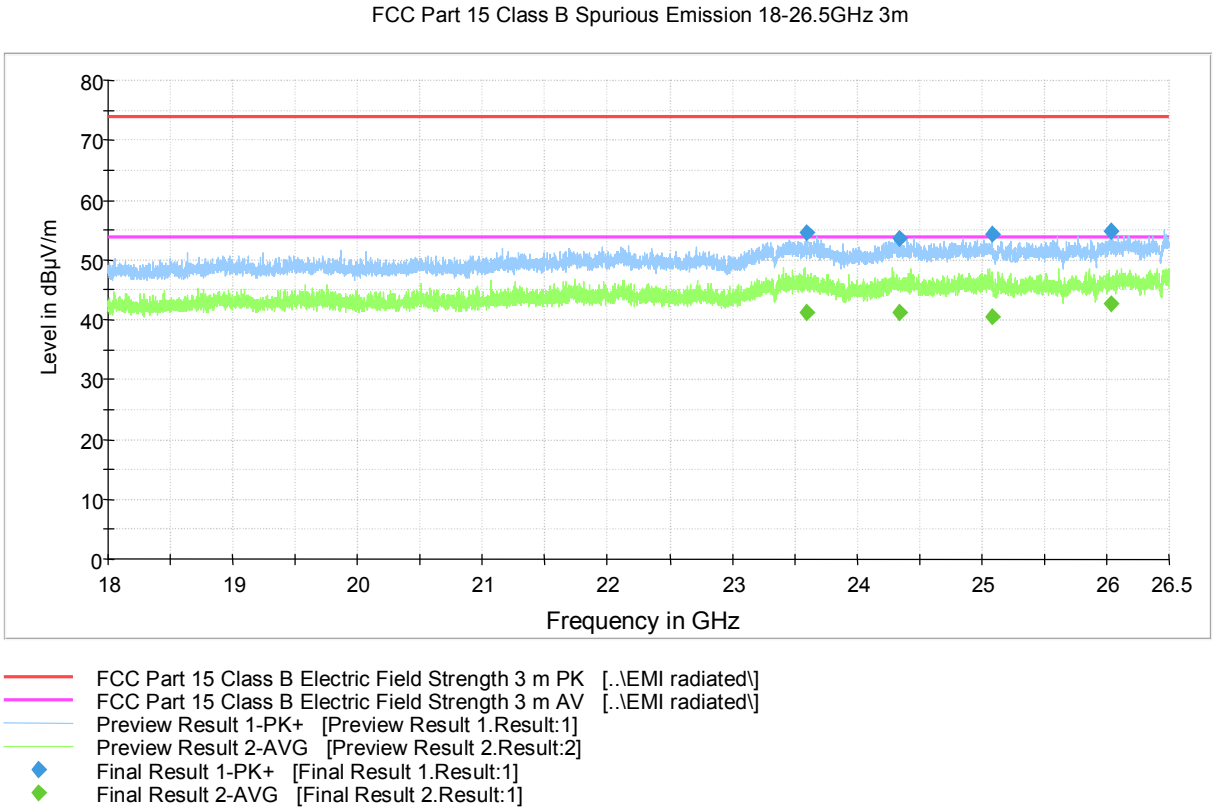

Figure 12. Measured curve with peak- and average detector channel mid.

Final measurements from the worst frequencies

Table 20. 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
23597.400000	54.4	1000.0	1000.000	137.0	V	346.0	31.9	19.5	73.9	
24339.100000	53.7	1000.0	1000.000	344.0	V	268.0	32.4	20.2	73.9	
25081.500000	54.4	1000.0	1000.000	100.0	V	354.0	33.2	19.5	73.9	
26033.300000	54.7	1000.0	1000.000	279.0	H	160.0	34.8	19.2	73.9	

Table 21. 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
23595.000000	41.3	1000.0	1000.000	100.0	V	4.0	31.9	12.6	53.9	
24335.100000	41.3	1000.0	1000.000	100.0	V	266.0	32.4	12.6	53.9	
25079.900000	40.5	1000.0	1000.000	100.0	V	325.0	33.2	13.4	53.9	
26035.500000	42.6	1000.0	1000.000	400.0	H	161.0	34.8	11.3	53.9	

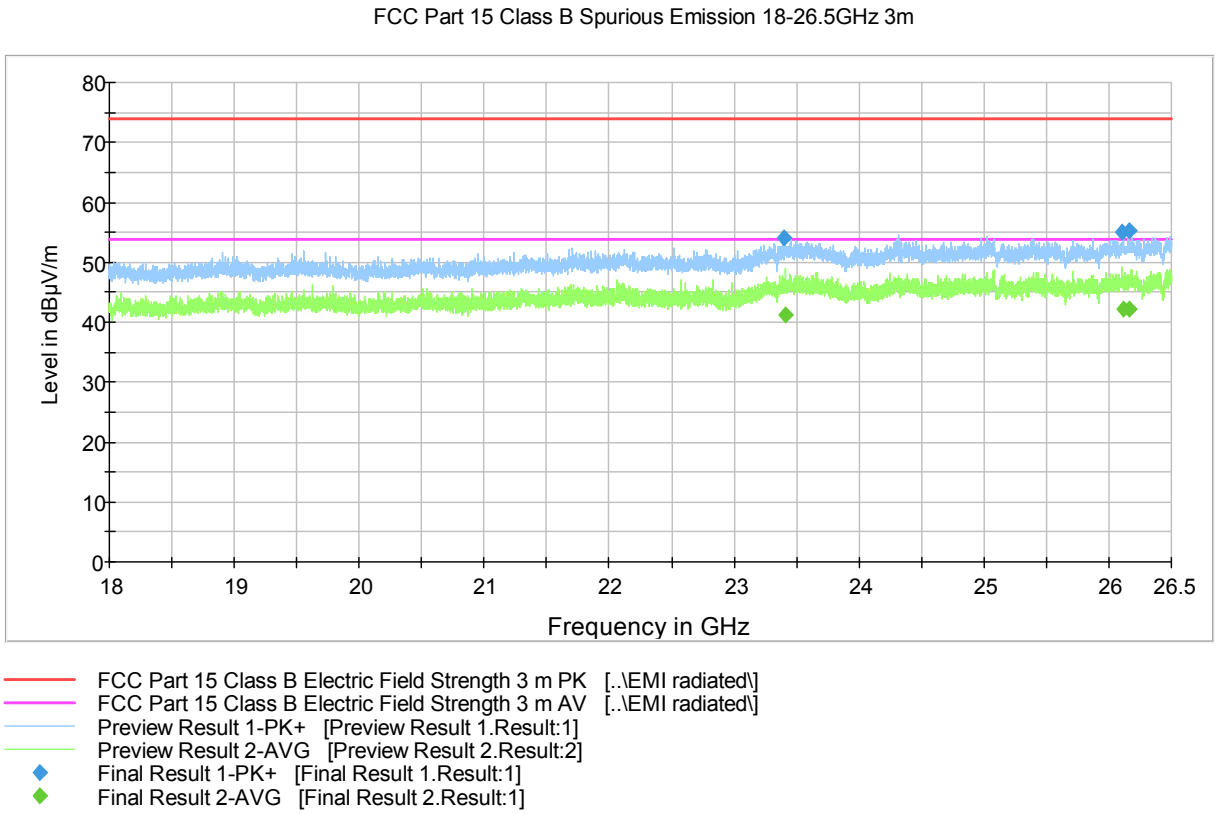

Figure 13. Measured curve with peak- and average detector channel high.

Final measurements from the worst frequencies

Table 22. 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
23404.650000	53.9	1000.0	1000.000	217.0	H	102.0	31.7	20.0	73.9	
26102.300000	55.0	1000.0	1000.000	129.0	H	113.0	34.9	18.9	73.9	
26158.900000	55.3	1000.0	1000.000	201.0	V	200.0	35.2	18.6	73.9	

Table 23. 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
23411.850000	41.1	1000.0	1000.000	384.0	H	120.0	31.7	12.8	53.9	
26111.900000	42.2	1000.0	1000.000	391.0	H	113.0	35.0	11.7	53.9	
26160.300000	42.1	1000.0	1000.000	129.0	V	260.0	35.2	11.8	53.9	

Radiated band edge measurement results

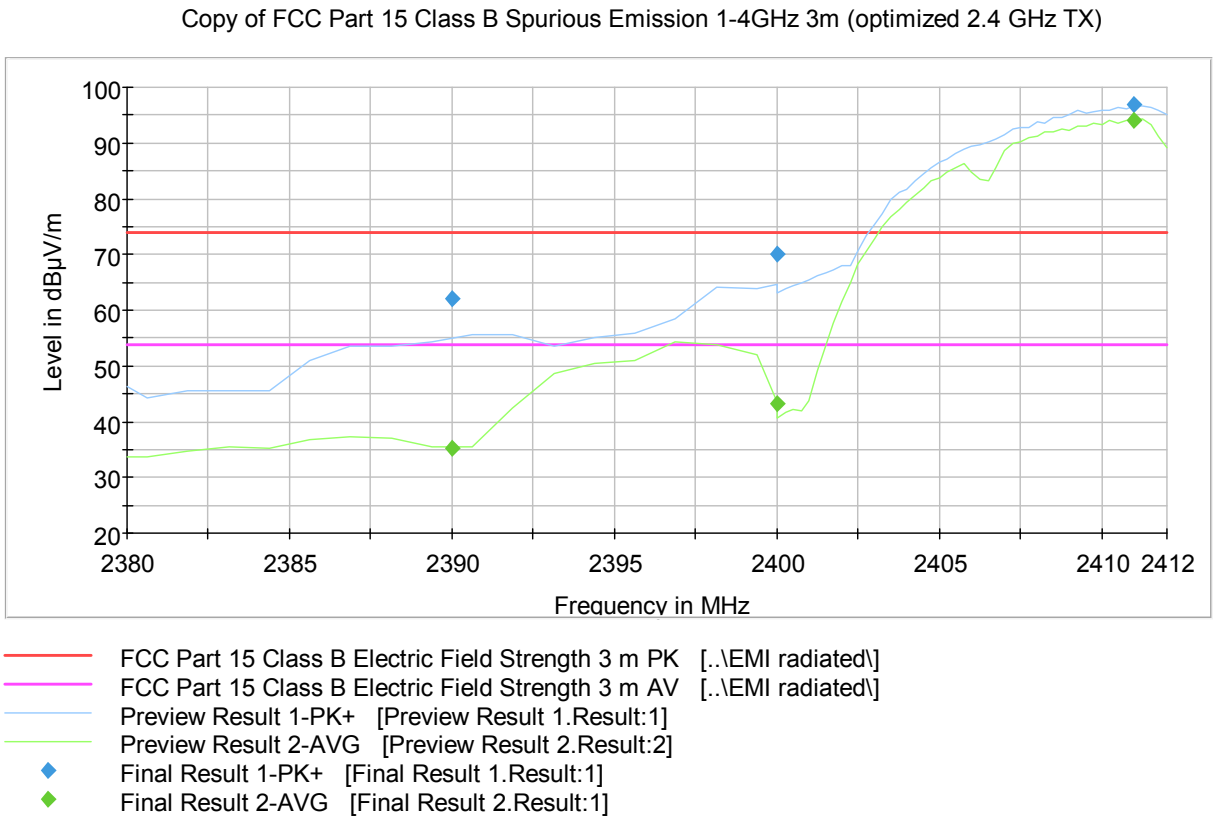

Figure 14. Measured curve with peak- and average detector. Lower band edge.

Final measurements from the worst frequencies

Table 24. 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
2390.000000	62.0	1000.0	1000.000	160.0	V	285.0	3.8	11.9	73.9	
2400.000000	70.2	1000.0	1000.000	194.0	V	280.0	3.9	3.7	73.9	
2411.000000	97.0	1000.0	1000.000	153.0	V	280.0	3.9	-23.1	73.9	Carrier

Table 25. 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	35.2	1000.0	1000.000	193.0	V	280.0	3.8	18.7	53.9	
2400.000000	43.3	1000.0	1000.000	153.0	V	280.0	3.9	10.6	53.9	
2411.000000	94.1	1000.0	1000.000	152.0	V	280.0	3.9	-40.2	53.9	Carrier

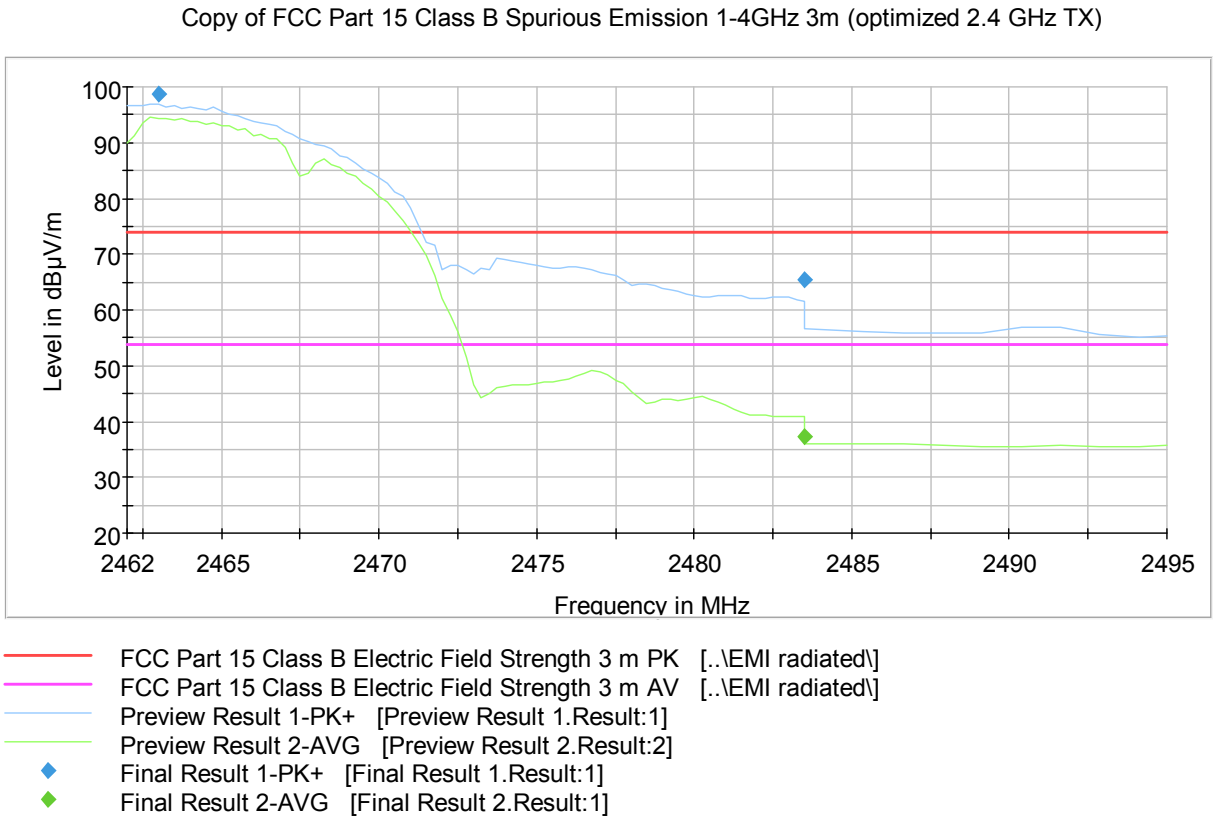

Figure 15. Measured curve with peak- and average detector. Upper band edge.

Final measurements from the worst frequencies

Table 26. 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
2463.000000	98.7	1000.0	1000.000	113.0	V	94.0	4.0	-24.8	73.9	Carrier
2483.500000	65.5	1000.0	1000.000	129.0	V	70.0	4.2	8.4	73.9	

Table 27. 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
2483.500000	37.2	1000.0	1000.000	129.0	V	89.0	4.2	16.7	53.9	

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	8.10 – 30.12.2015	
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 28. Band edge attenuation 1mbps data rate.

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-36.61 dBc	-47.98 dBc
Limit: -30dBc	

Table 29. Band edge attenuation 54mbps data rate.

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-38.91 dBc	-44.95 dBc
Limit: -30dBc	

Table 30. Conducted spurious emissions.

Conducted Spurious Emissions						
Data Rate [Mbps]	**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.

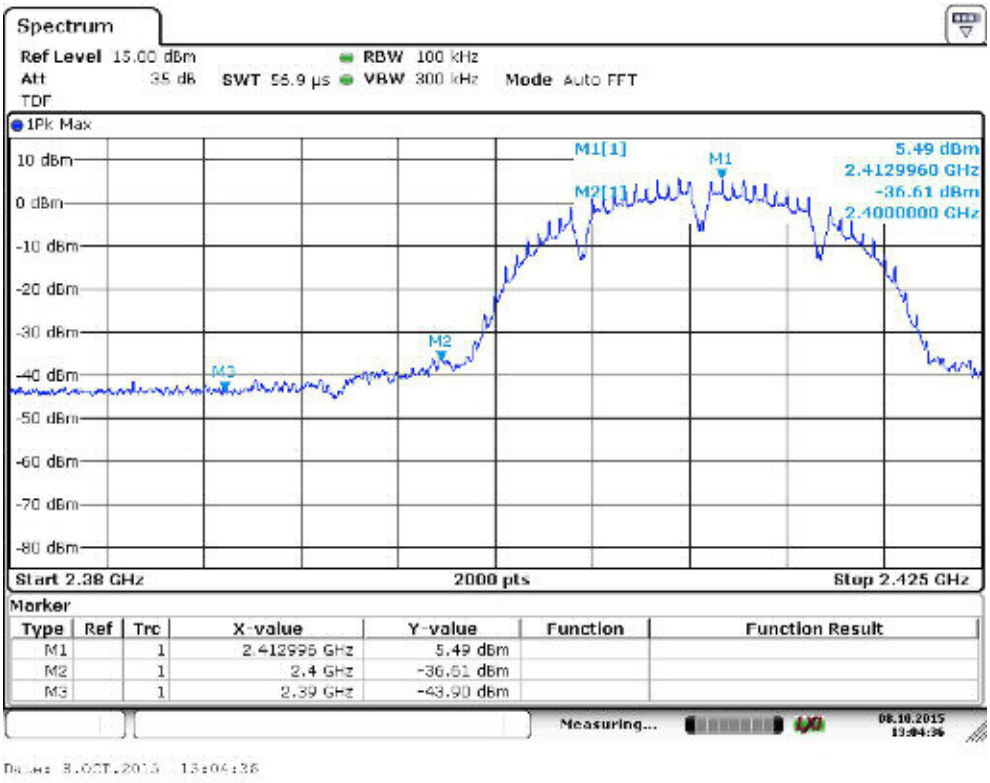

Figure 16. Lower Band Edge 1Mbps.

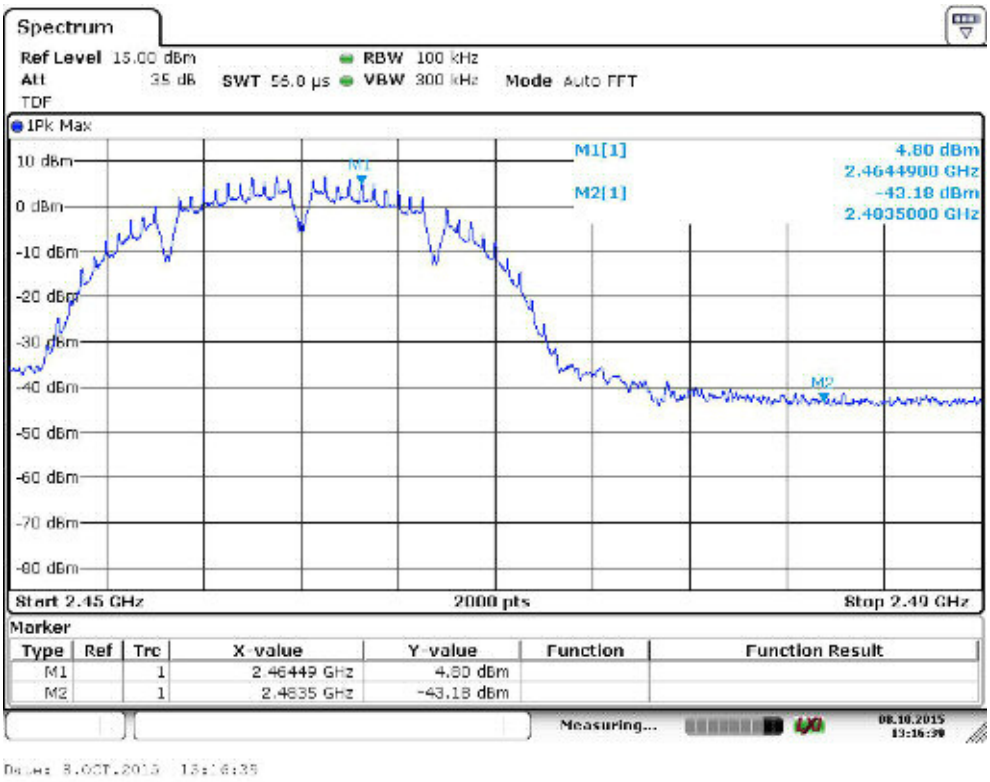

Figure 17. Upper Band Edge 1Mbps

.

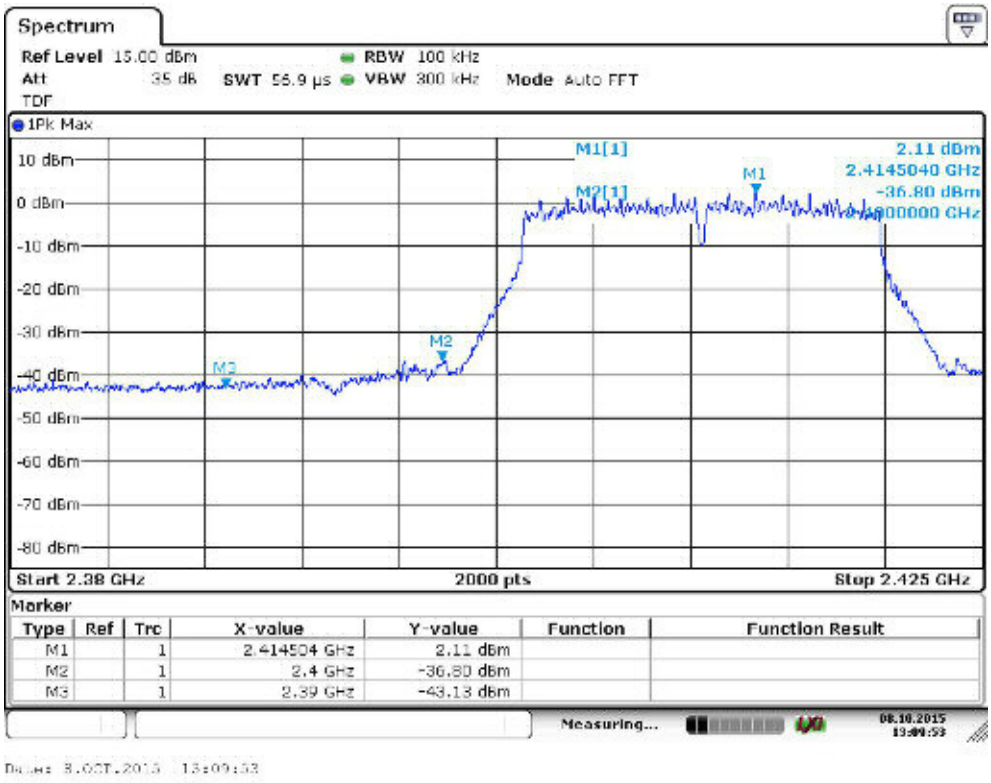

Figure 18. Lower Band Edge 54Mbps.

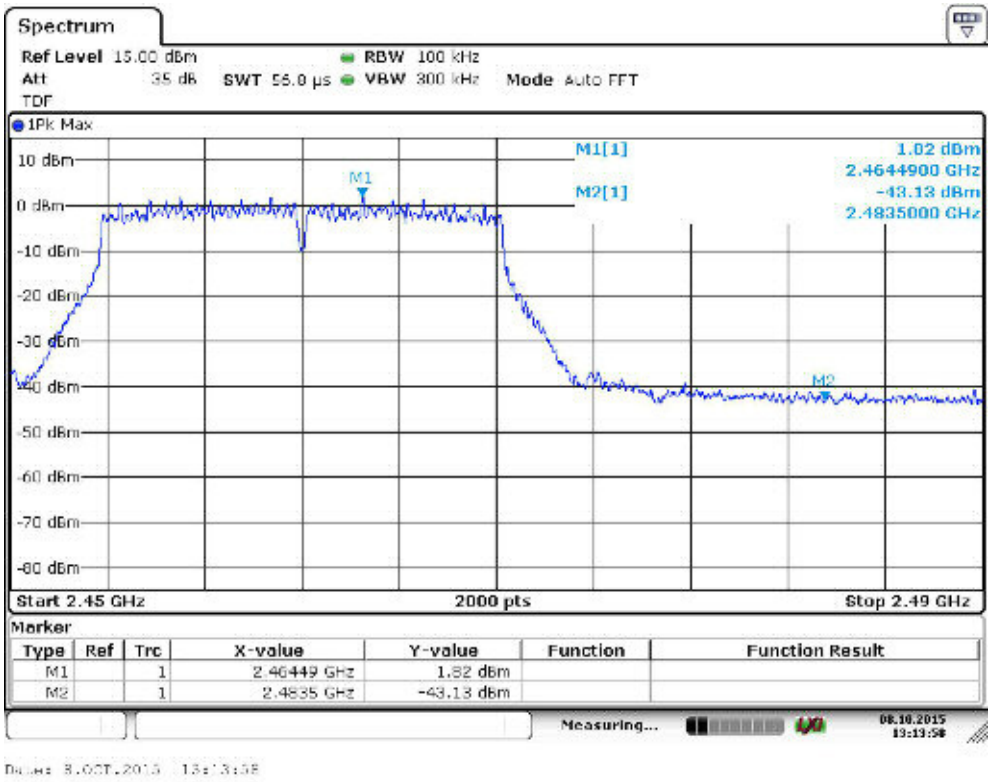

Figure 19. Upper Band Edge 54Mbps.

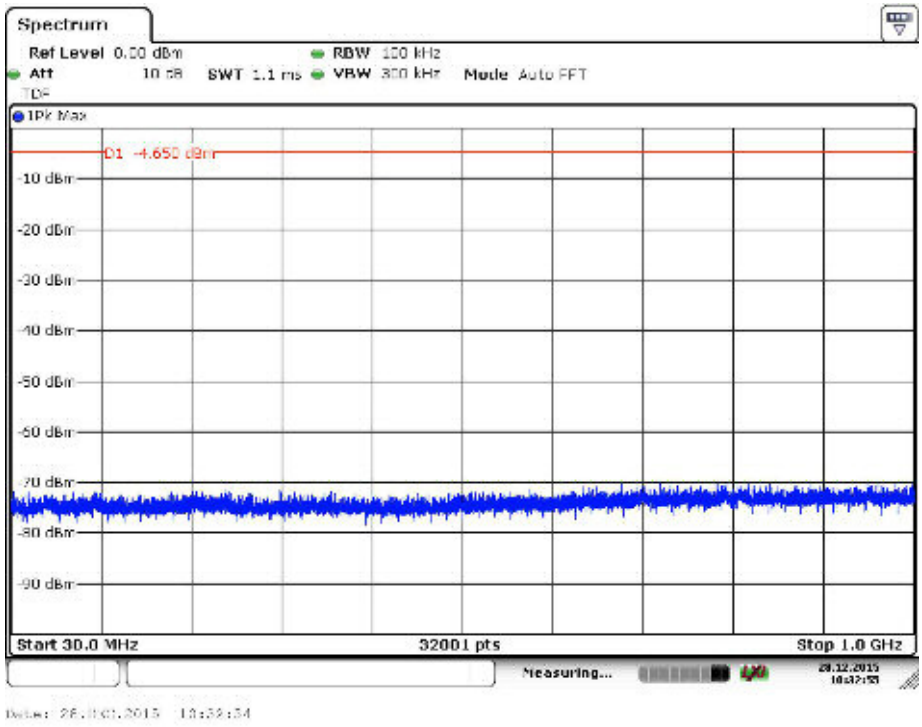

Figure 20. Conducted Spurious Emissions 30 – 1 000 MHz channel low 1 Mbps.

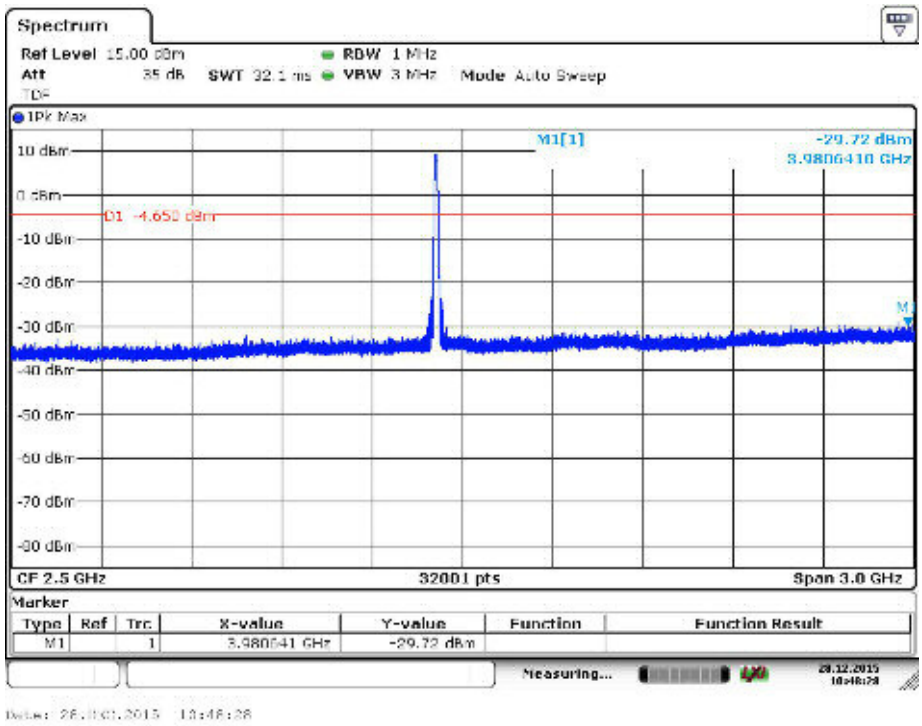

Figure 21. Conducted Spurious Emissions 1 000 – 4 000 MHz. Channel Low 1 Mbps.

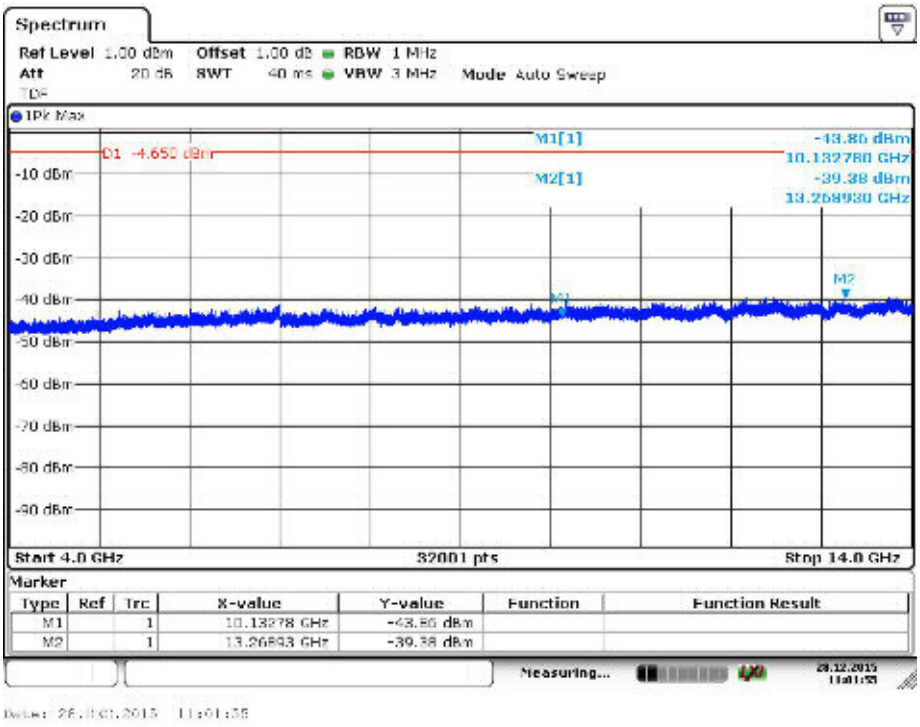

Figure 22. Conducted Spurious Emissions 4 000 – 14 000 MHz channel low 1 Mbps.

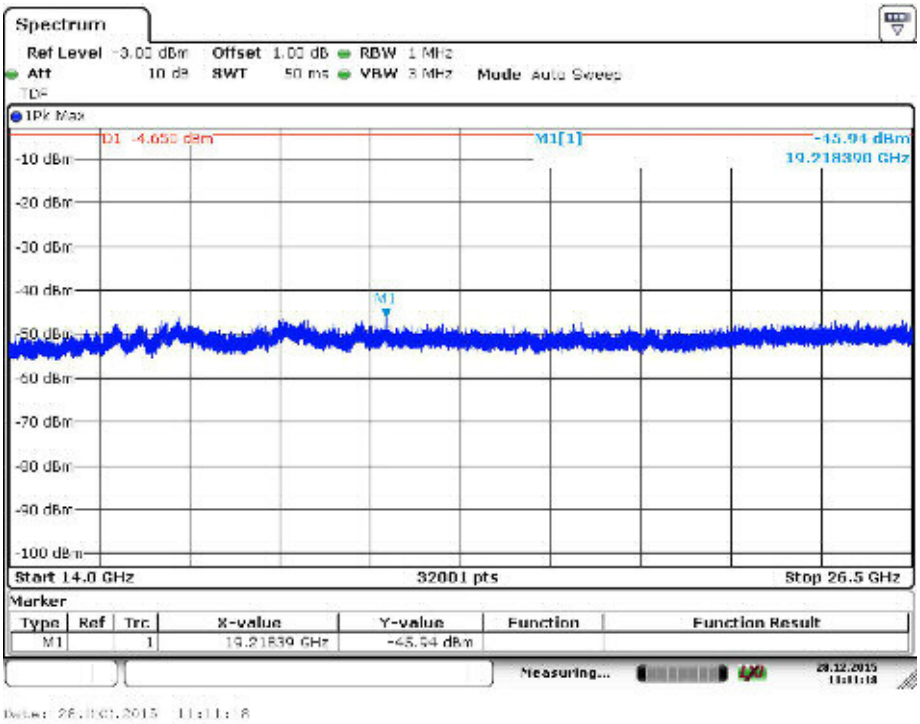

Figure 23. Conducted Spurious Emissions 14 000 – 26 500 MHz channel low 1 Mbps.

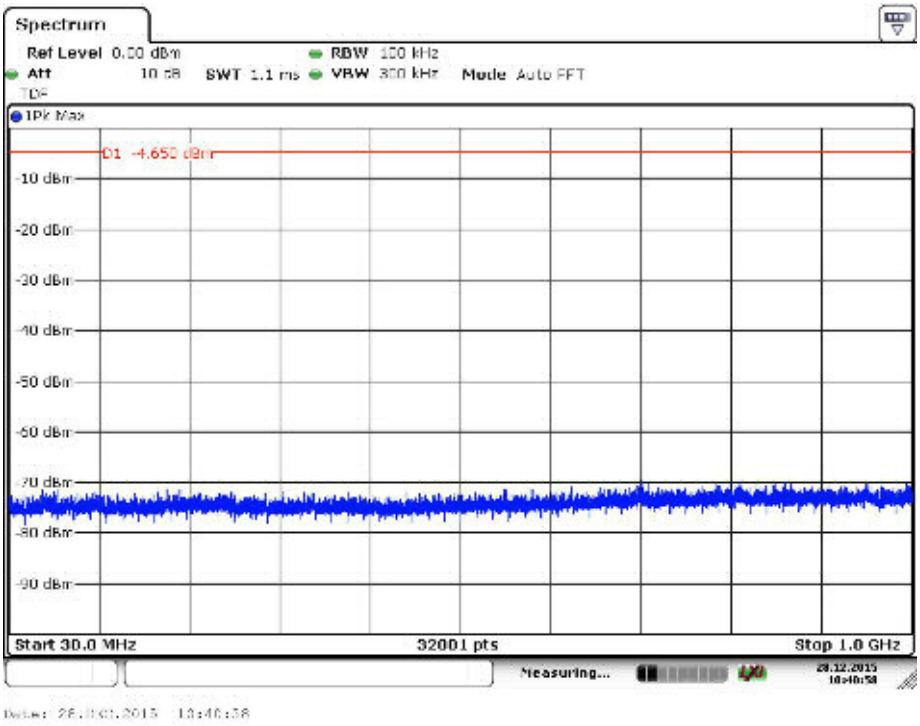

Figure 24. Conducted Spurious Emissions 30 – 1 000 MHz channel middle 1 Mbps.

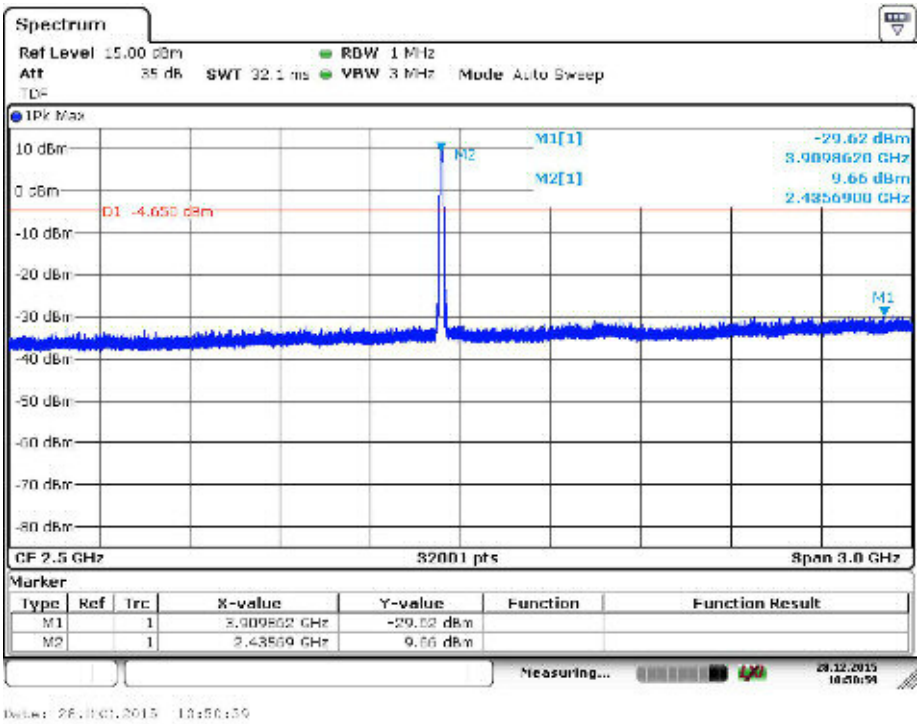

Figure 25. Conducted Spurious Emissions 1 000 – 4 000 MHz channel middle 1 Mbps.

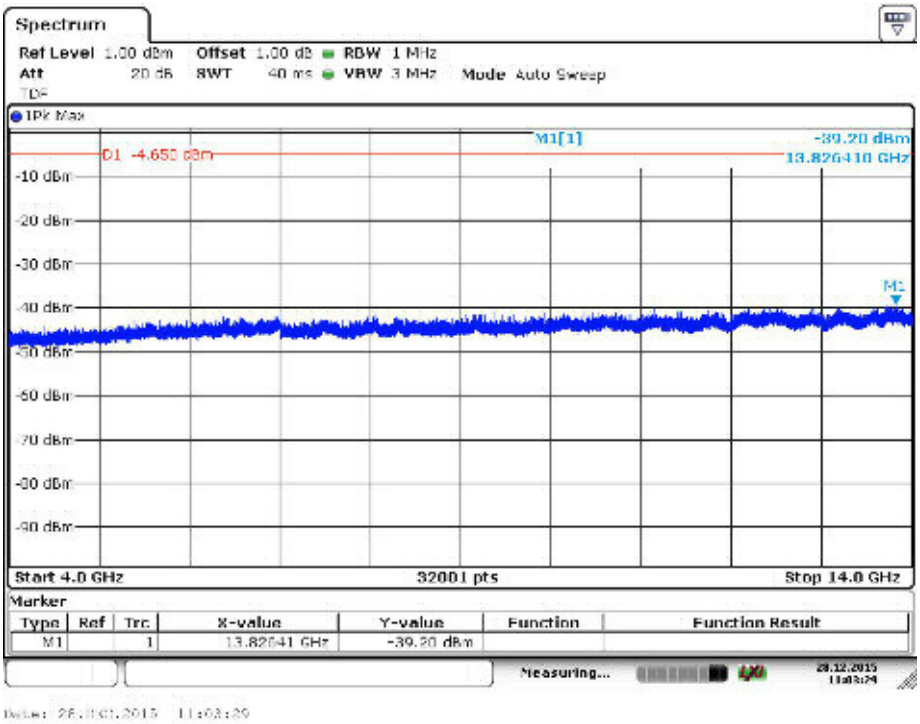

Figure 26. Conducted Spurious Emissions 4 000 – 14 000 MHz channel middle 1 Mbps.

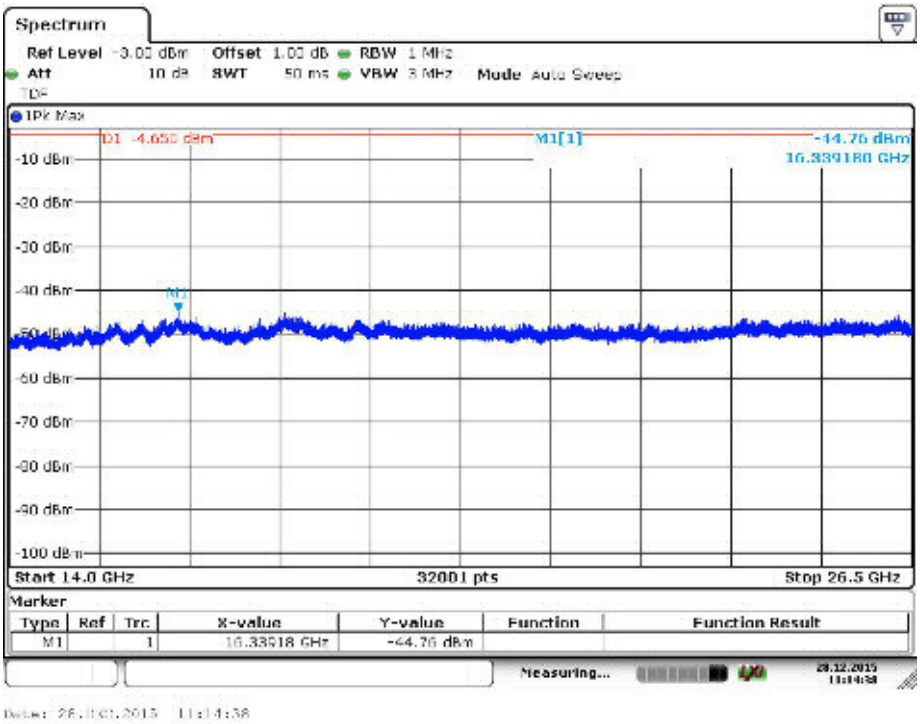

Figure 27. Conducted Spurious Emissions 14 000 – 26 500 MHz channel middle 1 Mbps.

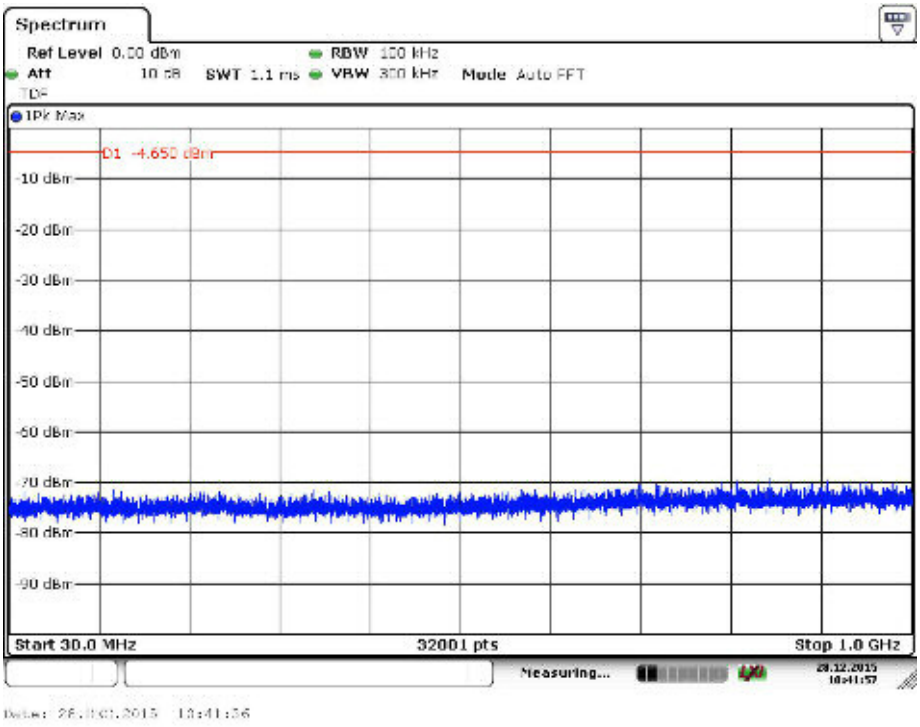

Figure 28. Conducted Spurious Emissions 30 – 1 000 MHz channel high 1 Mbps.

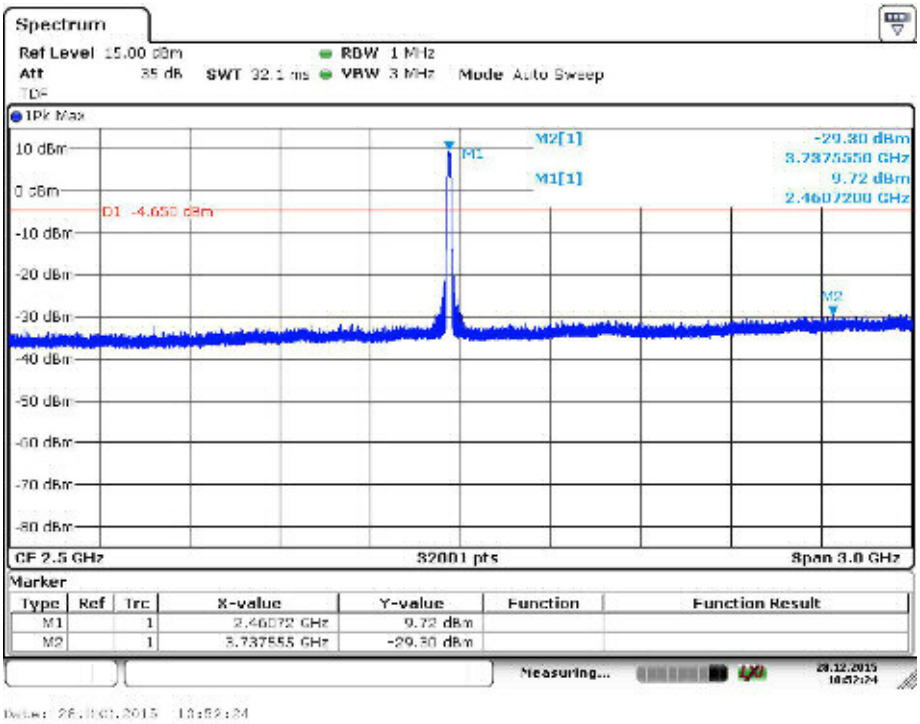

Figure 29. Conducted Spurious Emissions 1 000 – 4 000 MHz channel high 1 Mbps.

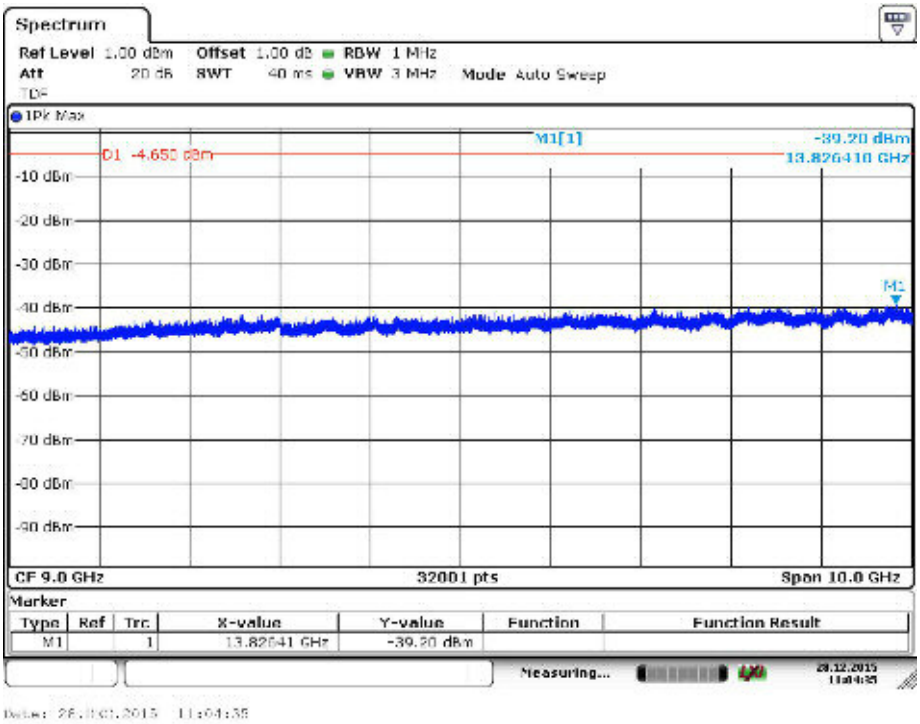

Figure 30. Conducted Spurious Emissions 4 000 – 14 000 MHz channel high 1 Mbps.

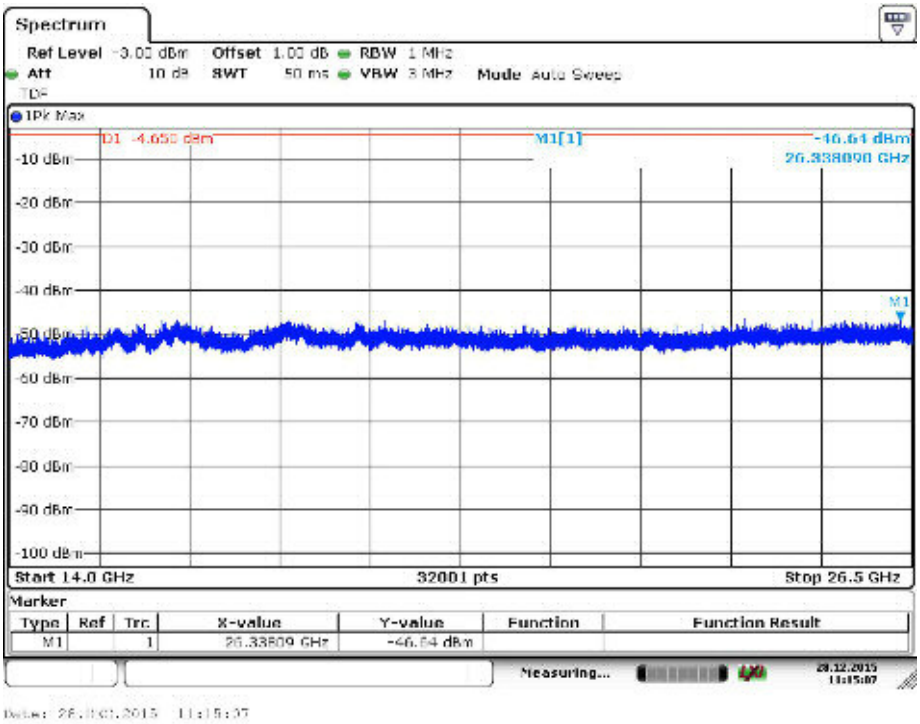

Figure 31. Conducted Spurious Emissions 14 000 – 26 500 MHz channel high 1 Mbps.

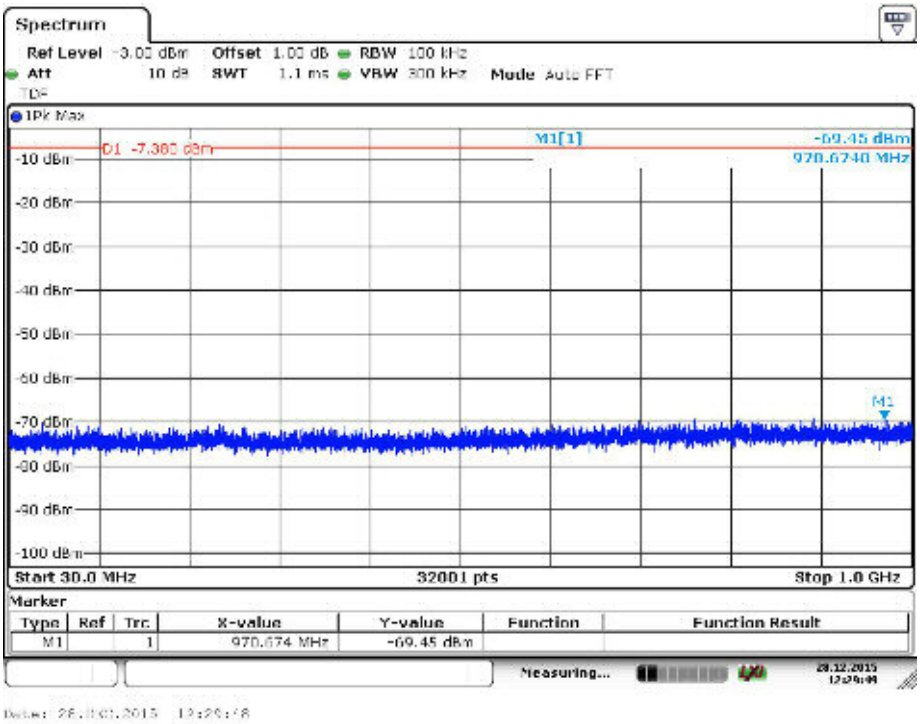

Figure 32. Conducted Spurious Emissions 30 – 1000 MHz channel low 54 Mbps.

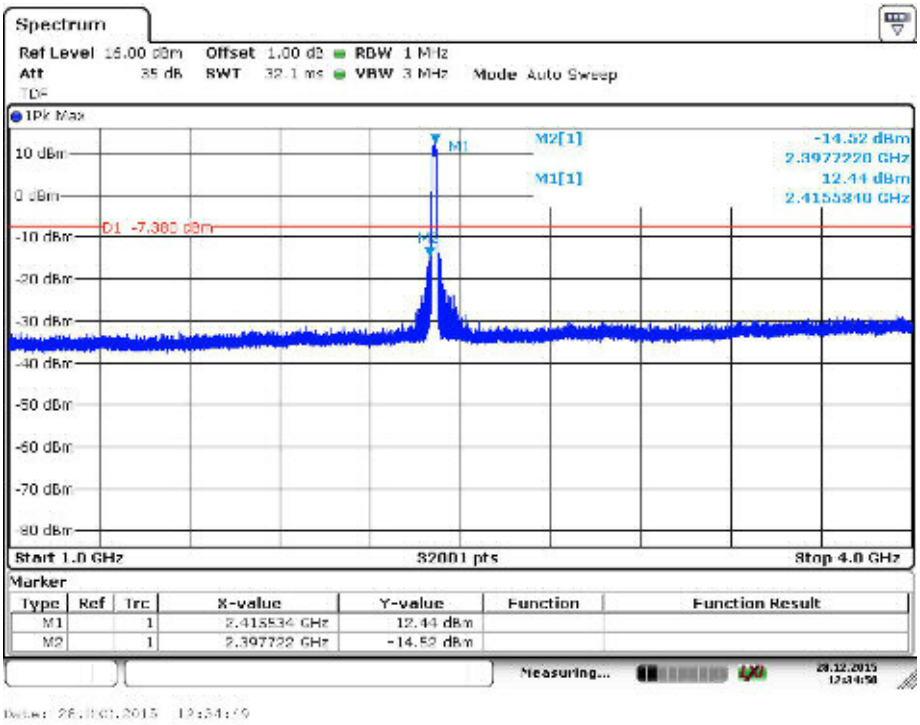

Figure 33. Conducted Spurious Emissions 1000 - 4000 MHz channel low 54 Mbps.

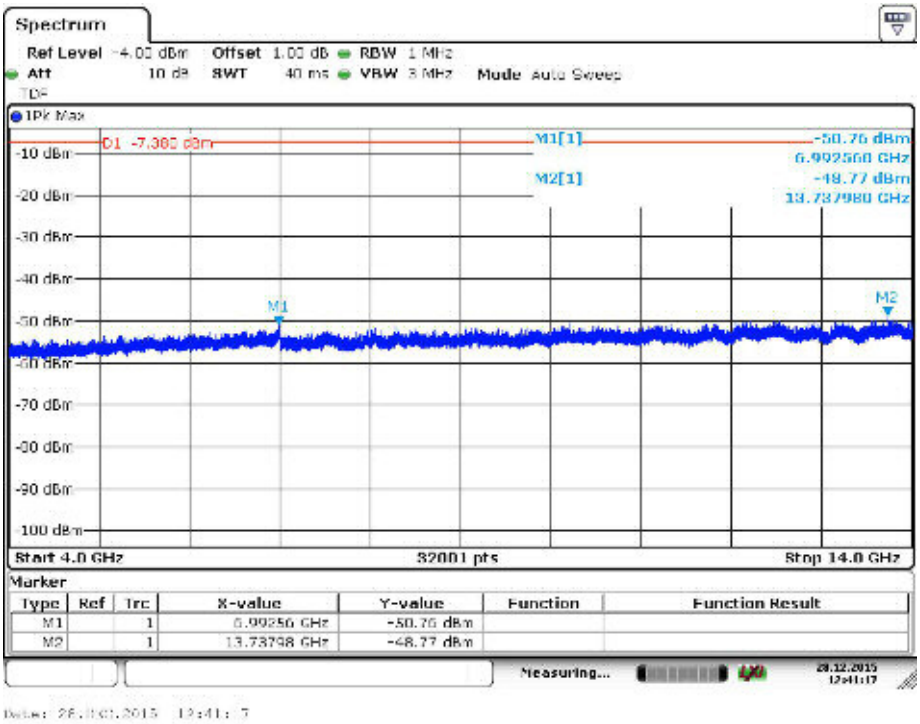

Figure 34. Conducted Spurious Emissions 4000 – 14 000 MHz channel low 54 Mbps.

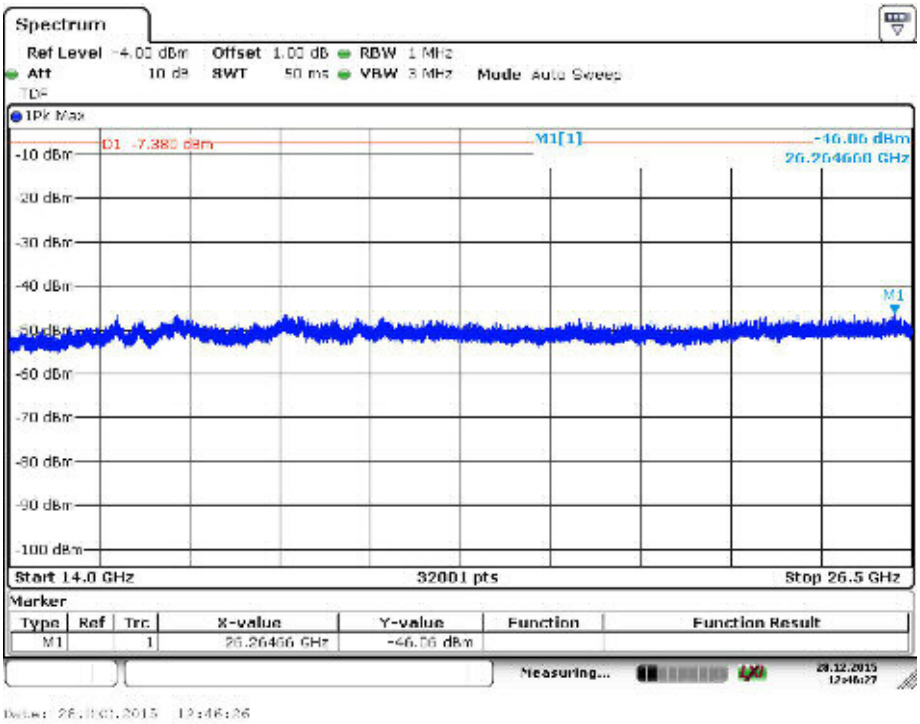

Figure 35. Conducted Spurious Emissions 14 000 – 26 500 MHz channel low 54 Mbps.

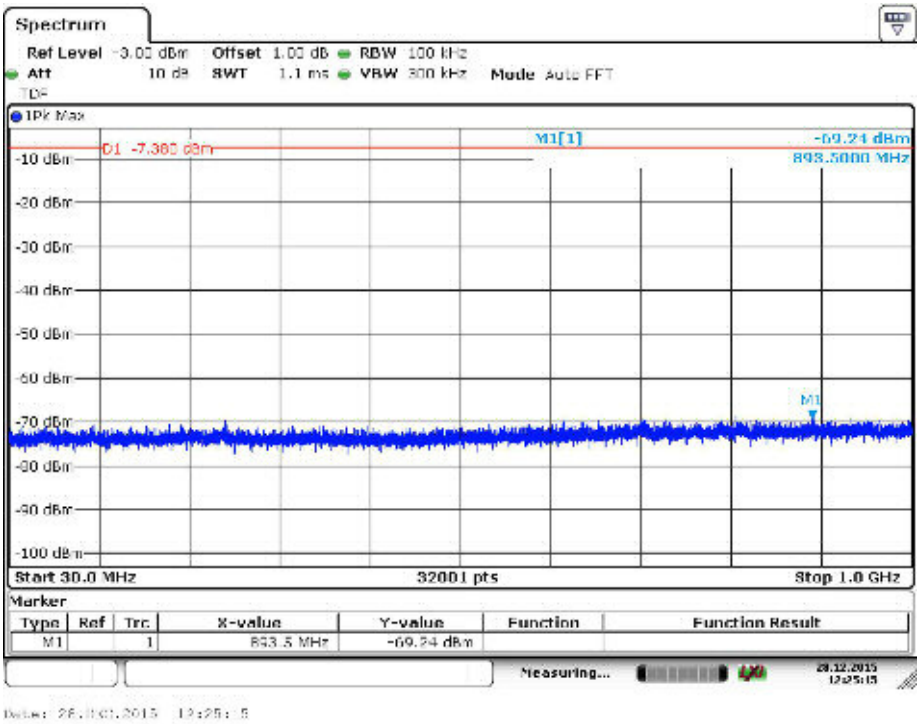

Figure 36. Conducted Spurious Emissions 30 – 1000 MHz channel Middle 54Mbps.

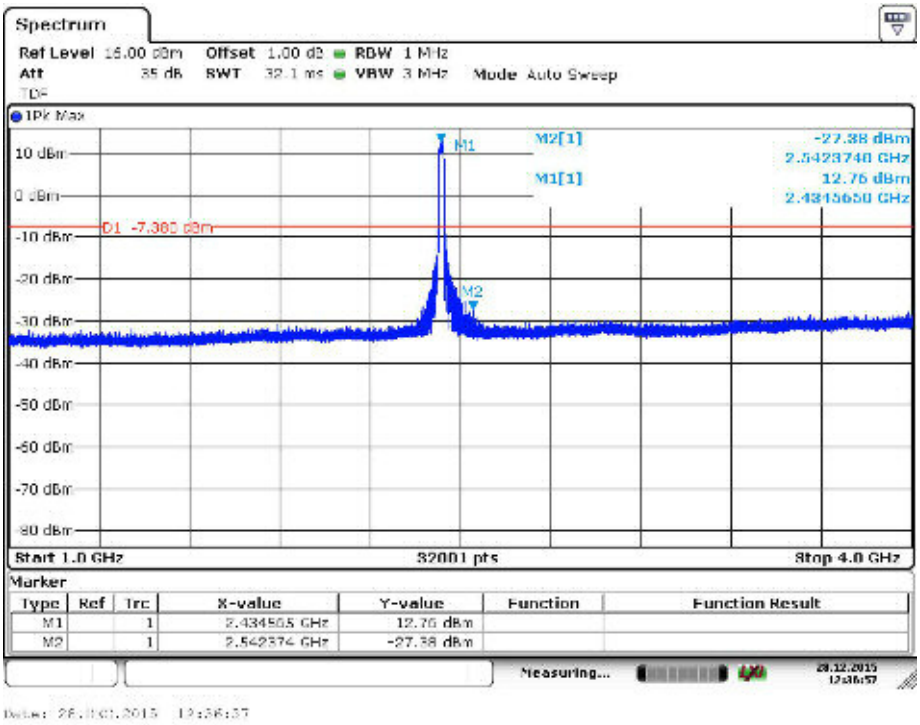

Figure 37. Conducted Spurious Emissions 1000 – 4000 MHz channel Middle 54Mbps.

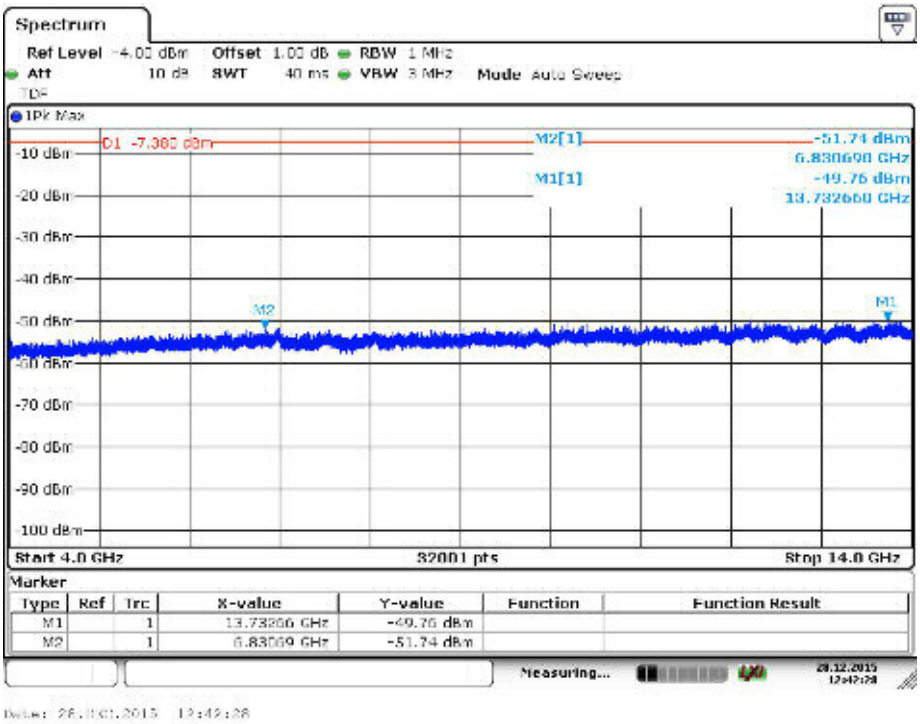

Figure 38. Conducted Spurious Emissions 4000 - 14 000 MHz channel Middle 54Mbps.

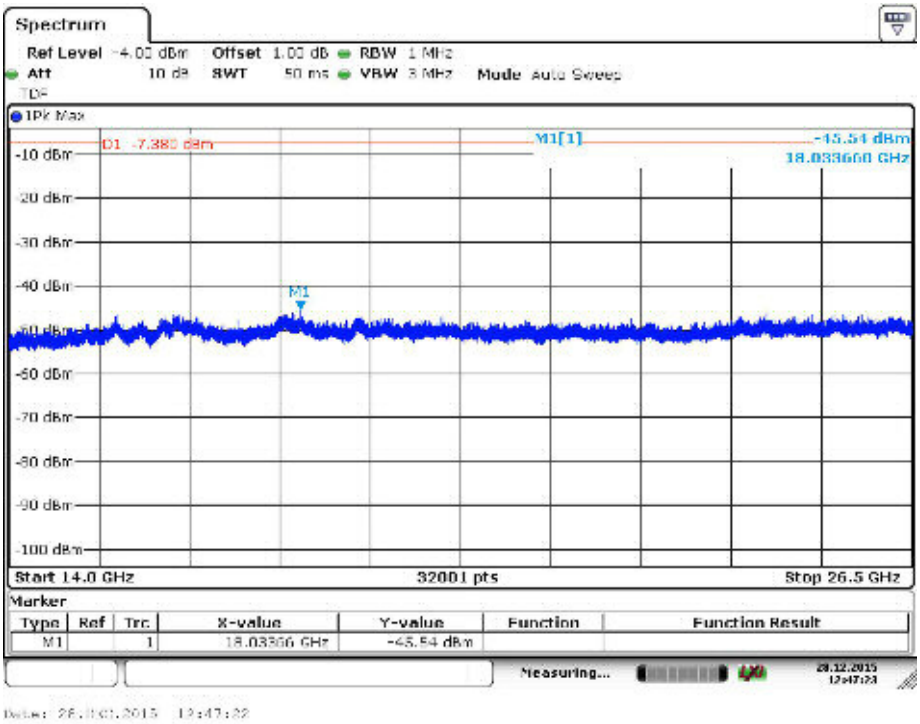

Figure 39. Conducted Spurious Emissions 14 000 – 26 500 MHz channel Middle 54Mbps.

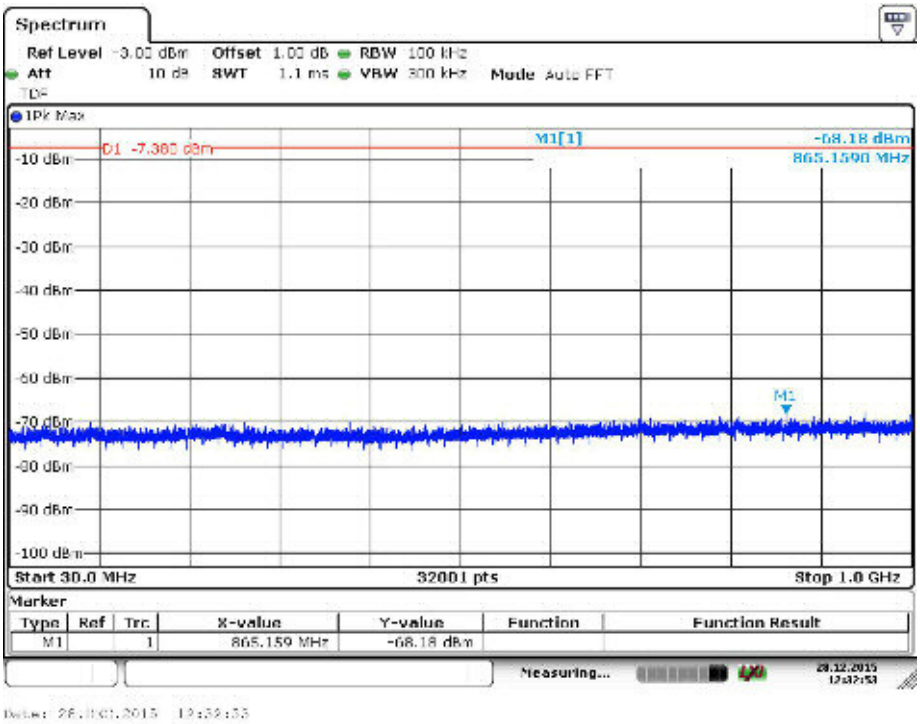

Figure 40. Conducted Spurious Emissions 30 – 1000 MHz channel High 54Mbps.

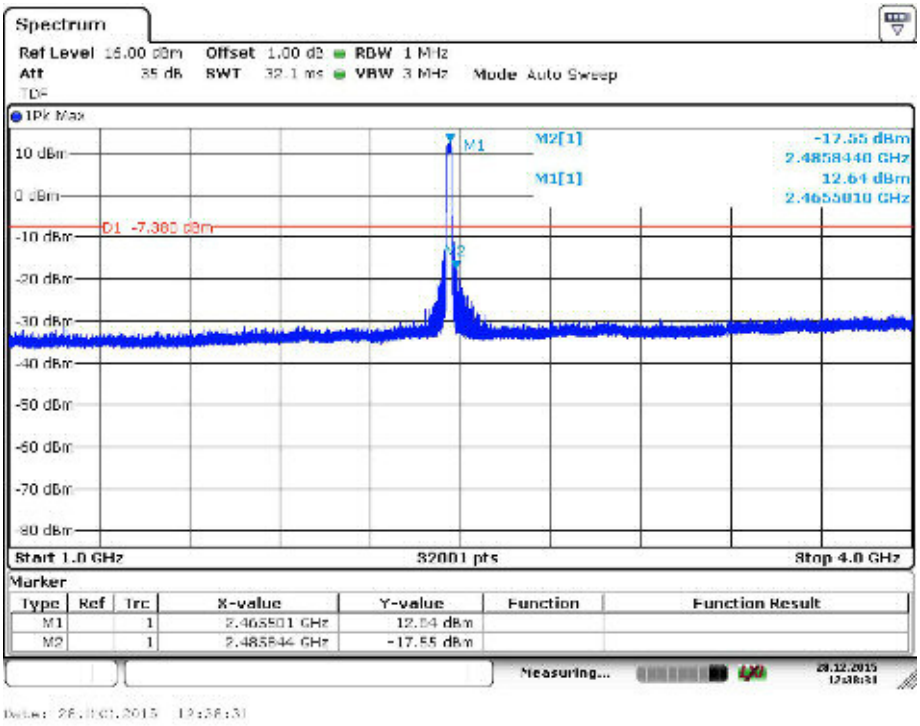

Figure 41. Conducted Spurious Emissions 1000 - 4000 MHz channel High 54Mbps.

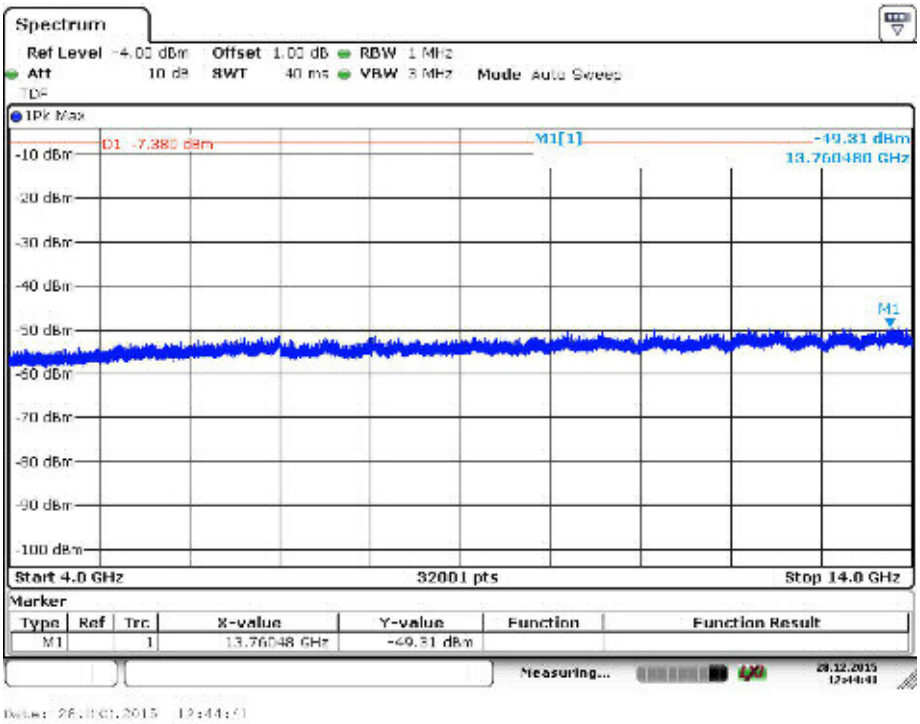

Figure 42. Conducted Spurious Emissions 4000 – 14 000 MHz channel High 54Mbps.

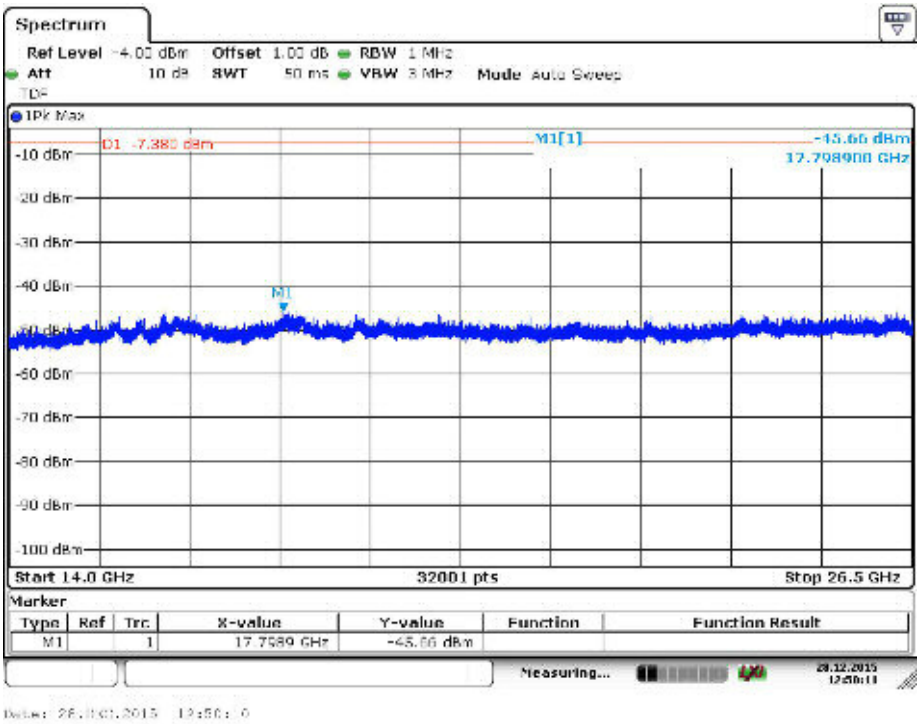

Figure 43. Conducted Spurious Emissions 14 000 – 26 500 MHz channel High 54Mbps.

6 dB Bandwidth of the Channel

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	6.10. - 8.10.2015	
Humidity:	25 %	
Temperature:	21 °C	

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

Results:

Table 31. 6 dB bandwidth test results 1Mbps.

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	10082.00	500
Mid	10081.00	
High	10095.00	

Table 32. 6 dB bandwidth test results 54Mbps.

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	16480.00	500
Mid	16480.00	
High	16480.00	

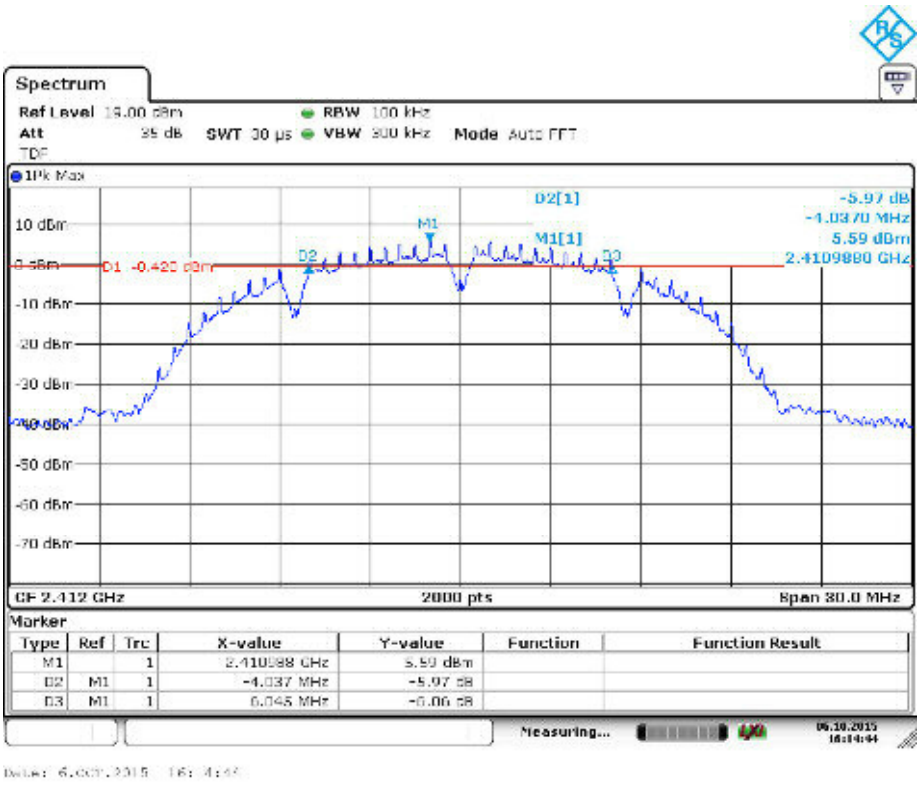

Figure 44. 6 dB bandwidth of the channel low 1Mbps.

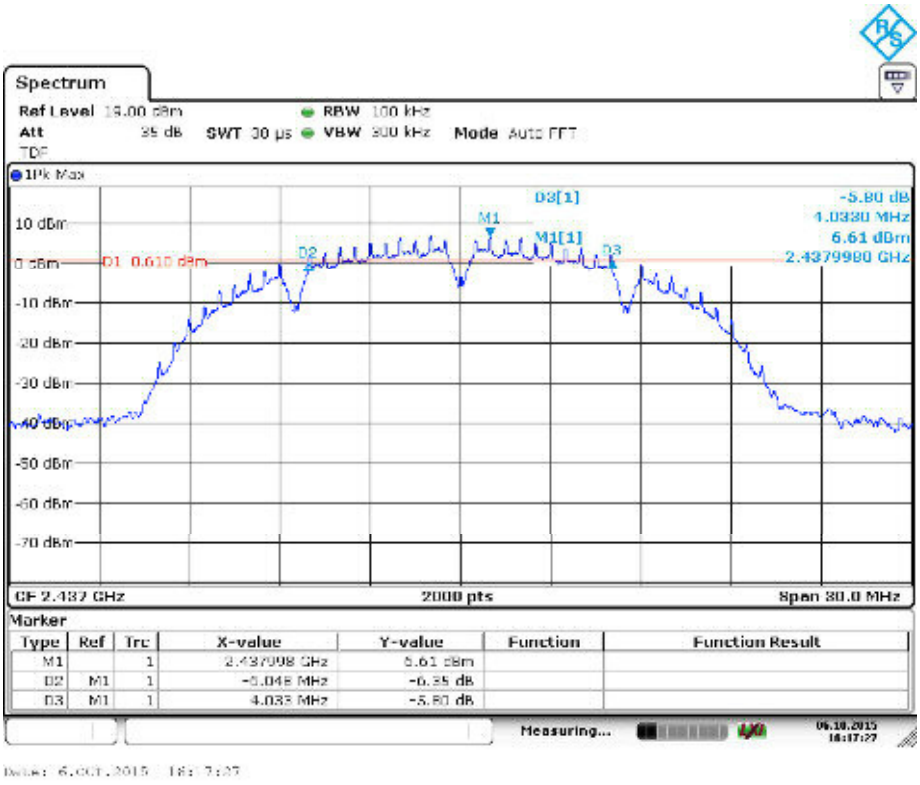

Figure 45. 6 dB bandwidth of the channel middle 1Mbps.

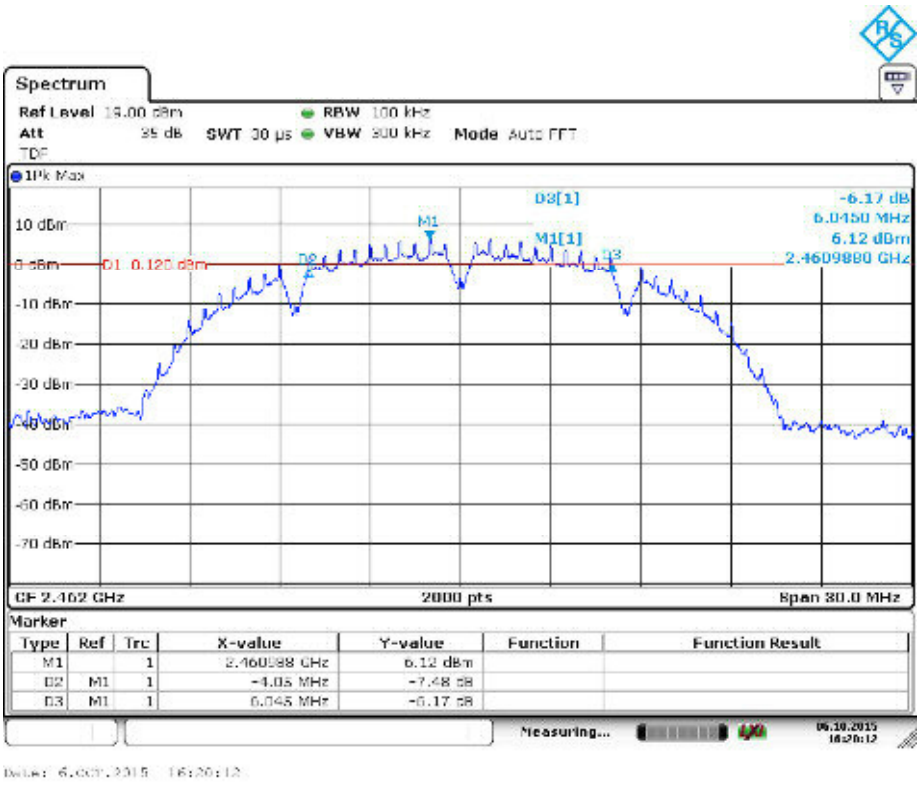

Figure 46. 6 dB bandwidth of the channel high 1Mbps.

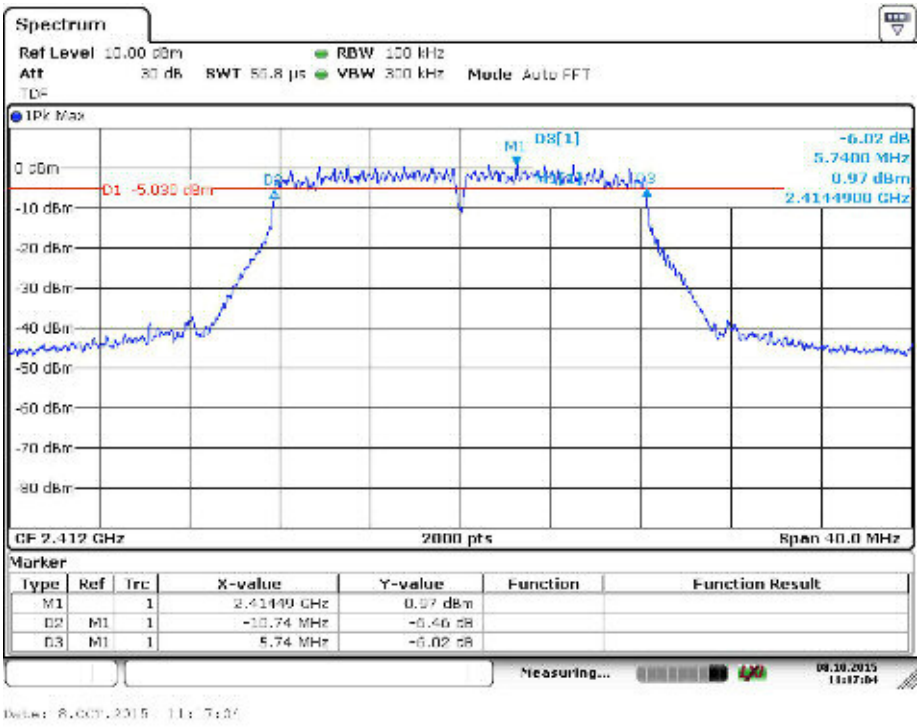

Figure 47. 6 dB bandwidth of the channel low 54Mbps.

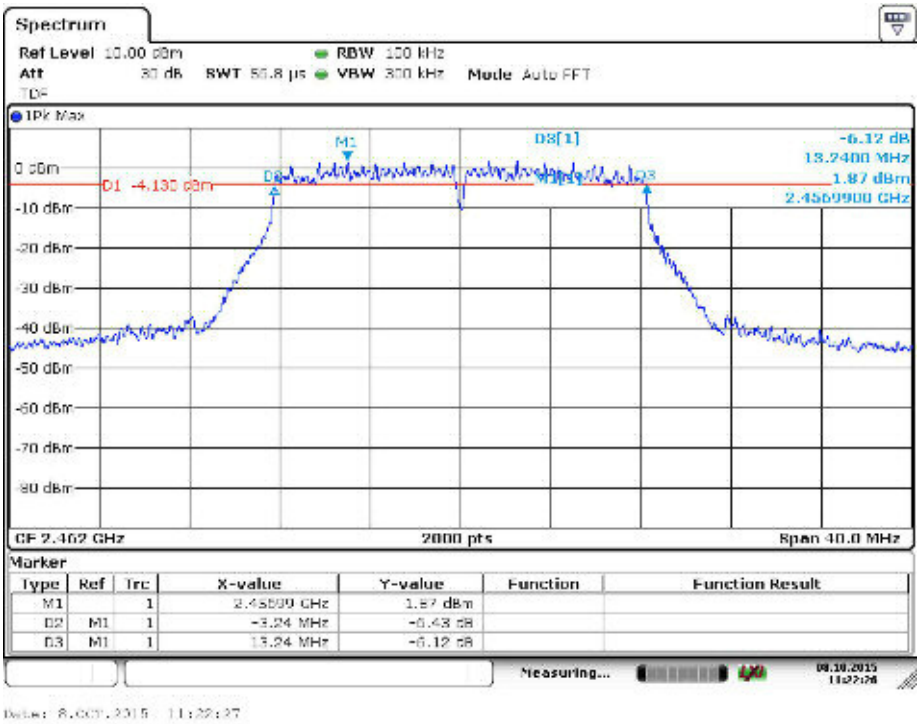

Figure 48. 6 dB bandwidth of the channel middle 54Mbps.

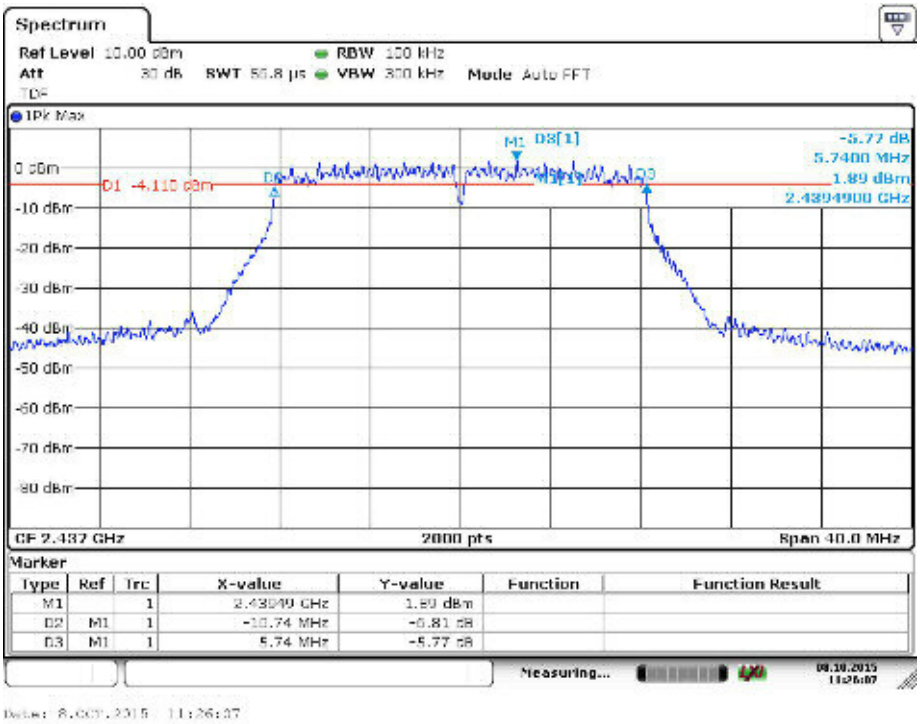

Figure 49. 6 dB bandwidth of the channel high 54Mbps.

Power Spectral Density

Standard:	ANSI C63.10	(2013)
Tested by:	NKO	
Date:	28.12.2015	
Humidity:	25 %	
Temperature:	21 °C	

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

Results:

Table 33. Power Spectral Density test results 1Mbps.

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	5.08	+8.00
Mid	6.72	
High	6.50	

Table 34 . Power Spectral Density test results 54Mbps.

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-11.54	+8.00
Mid	-12.03	
High	-12.06	

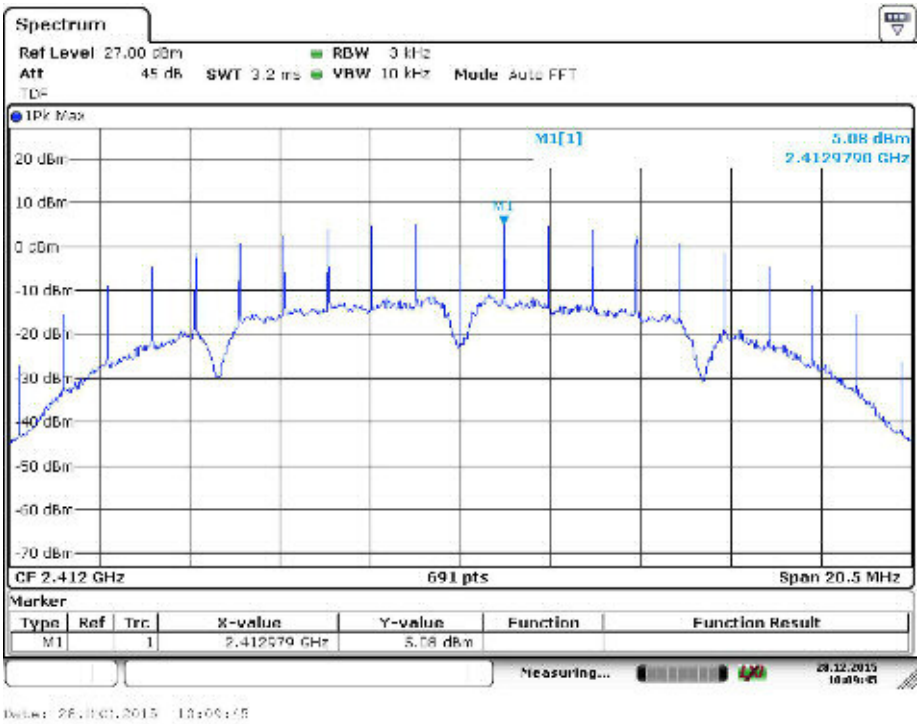

Figure 50. Power Spectral Density of the channel low 1Mbps.

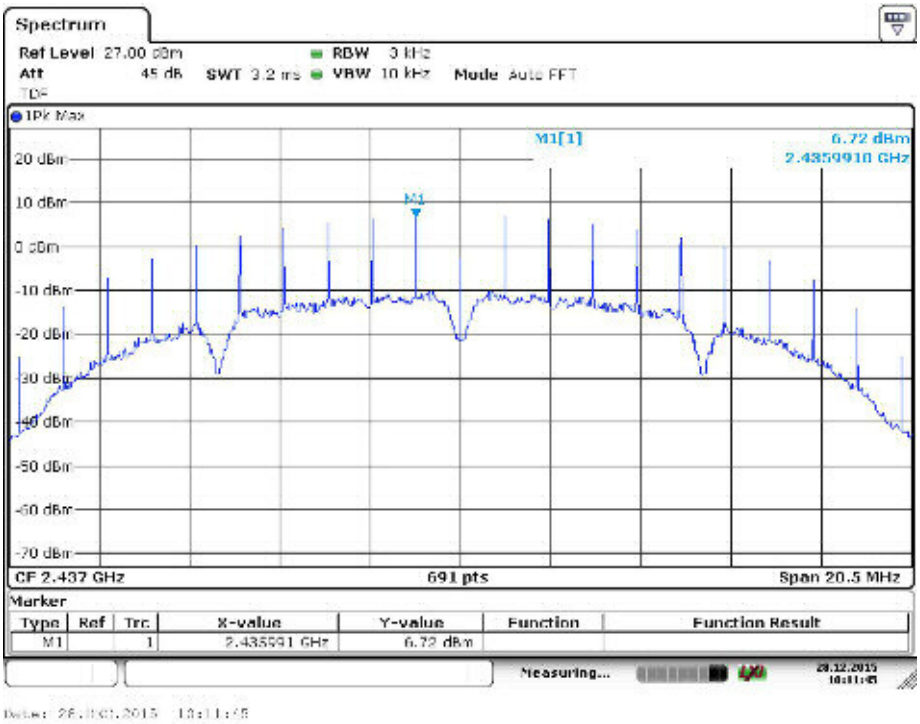

Figure 51. Power Spectral Density of the channel mid 1Mbps.

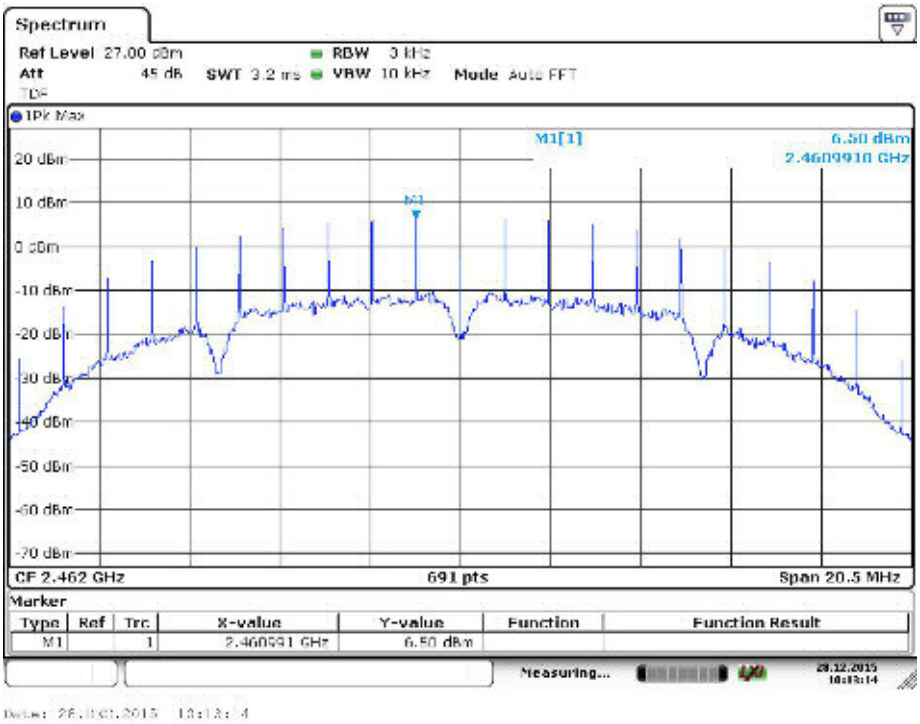

Figure 52. Power Spectral Density of the channel high 1Mbps.

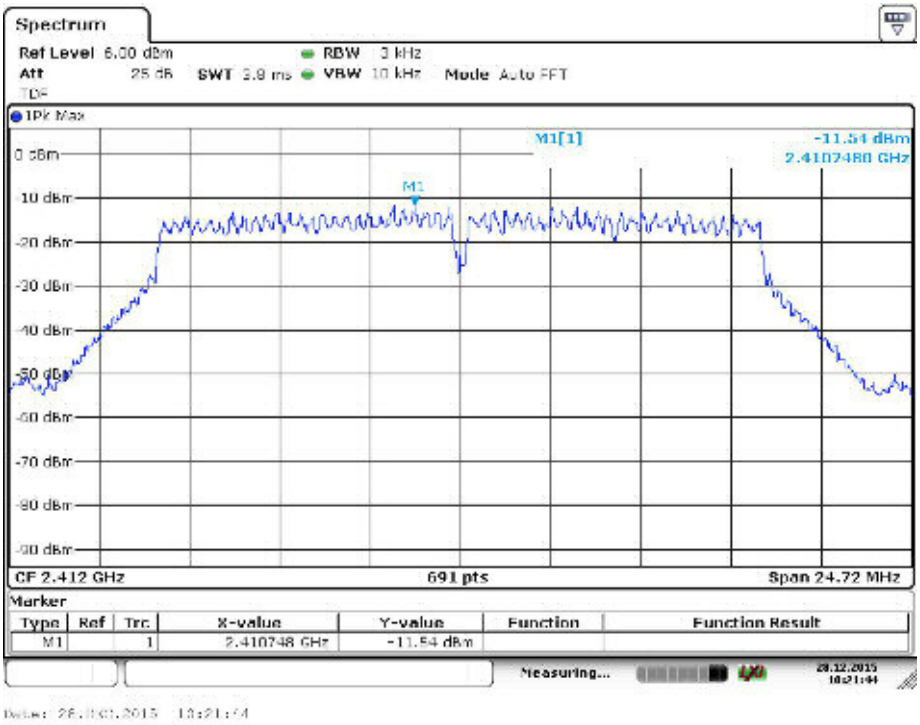

Figure 53. Power Spectral Density of the channel low 54Mbps.

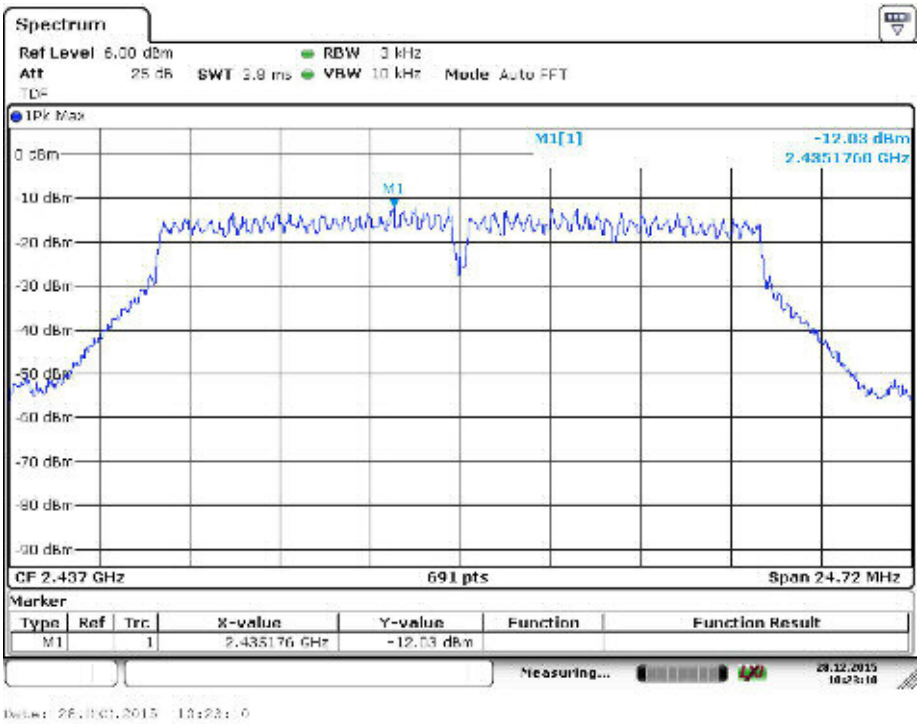

Figure 54. Power Spectral Density of the channel middle 54Mbps.

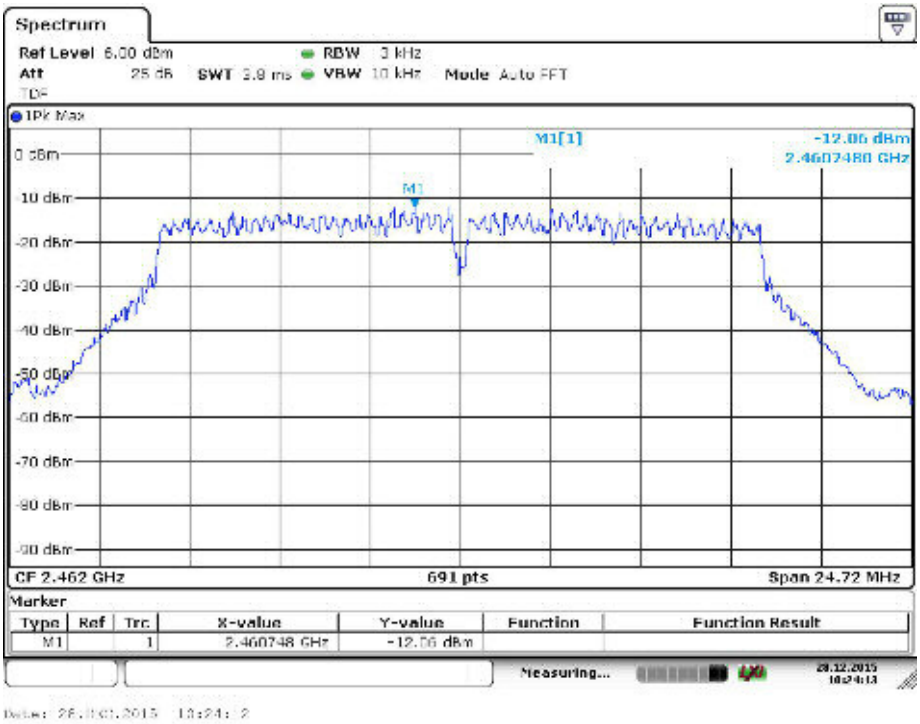

Figure 55. Power Spectral Density of the channel high 54Mbps.

99% Occupied Bandwidth

Standard:	RSS-GEN	(2014)
Tested by:	NKO	
Date:	8.10.2015	
Humidity:	25 %	
Temperature:	21 °C	

RSS-GEN 6.6

Table 35. 99 % OBW test results 1Mbps.

Channel	Limit	99 % BW [MHz]	Result
Low	-	15.480	PASS
Mid	-	15.440	PASS
High	-	15.420	PASS

Table 36. 99% OBW test results 54 Mbps.

Channel	Limit	99 % BW [MHz]	Result
Low	-	17.320	PASS
Mid	-	17.320	PASS
High	-	17.340	PASS

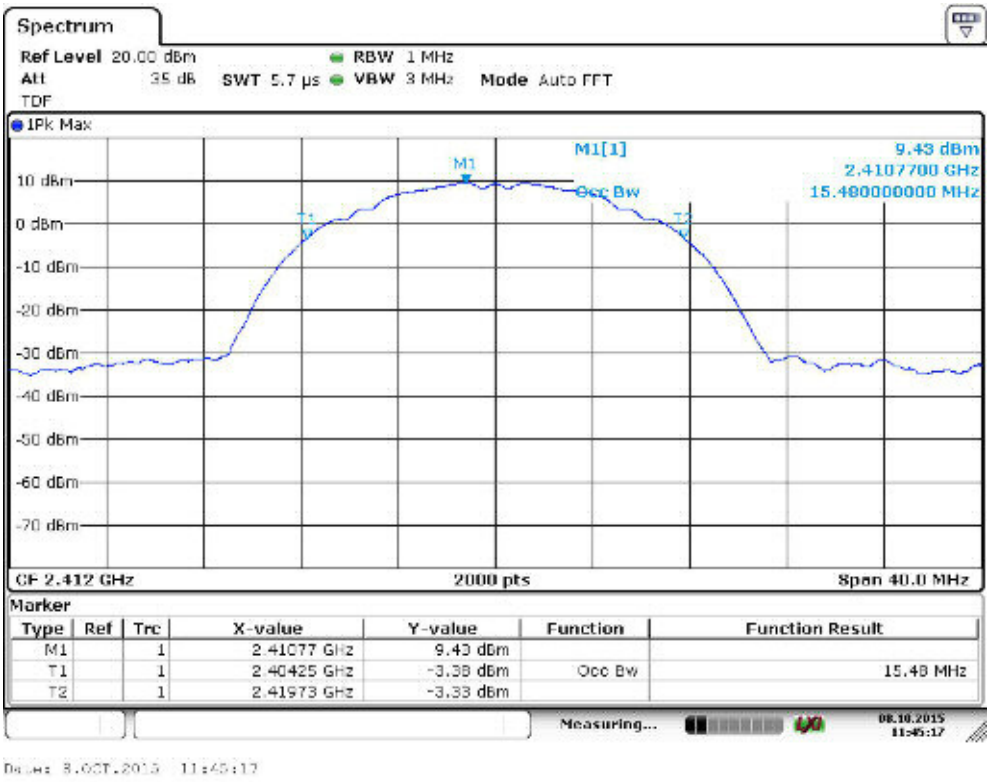

Figure 56. 99 % OBW channel low 1Mbps.

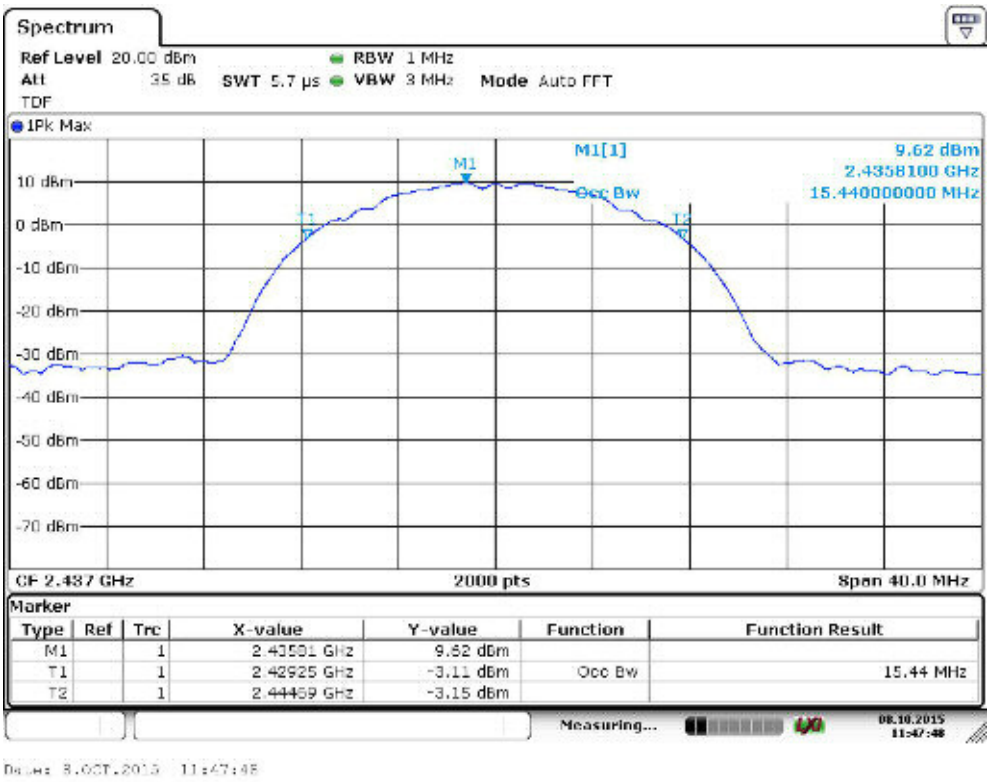

Figure 57. 99 % OBW channel middle 1Mbps.

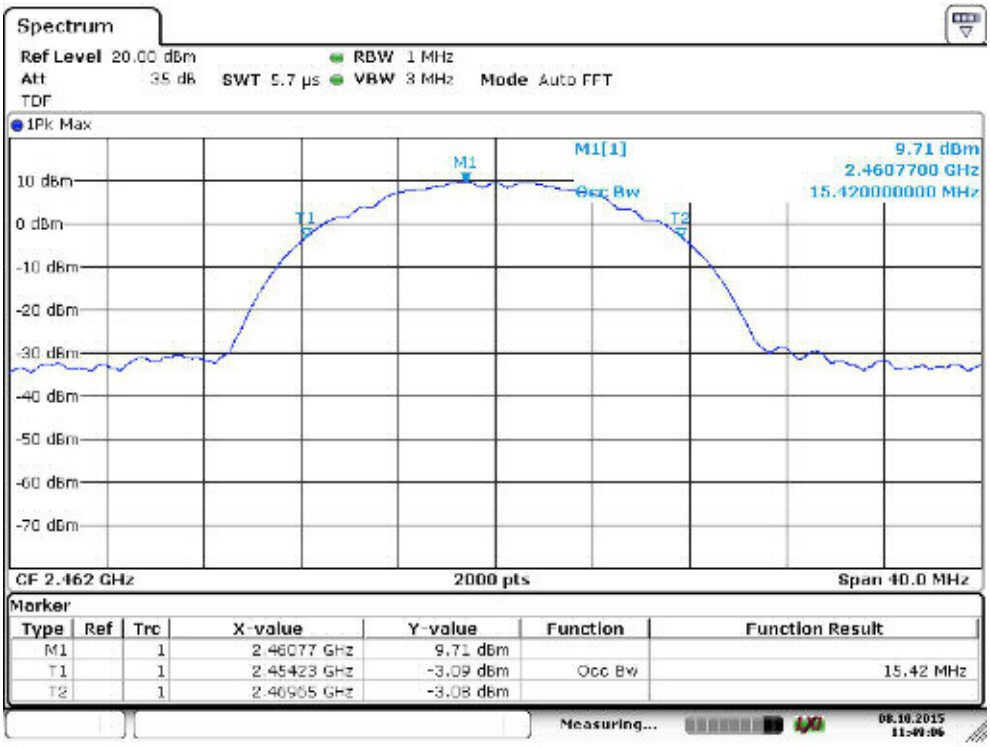

Figure 58. 99 % OBW channel high 1Mbps.

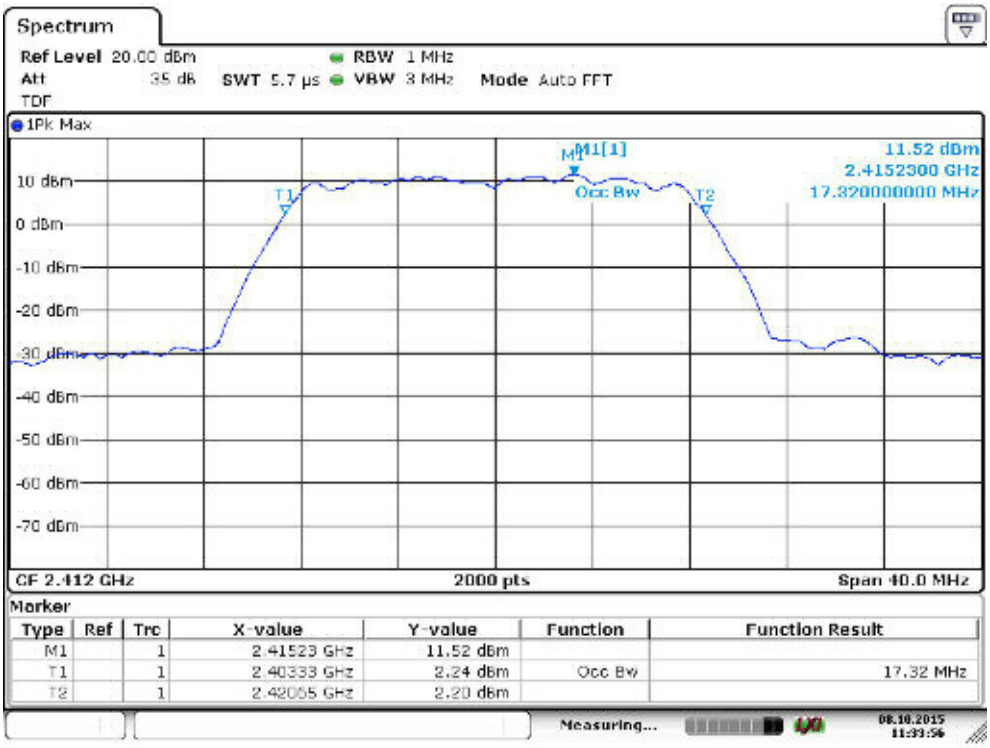

Figure 59. 99 % OBW channel low 54Mbps.

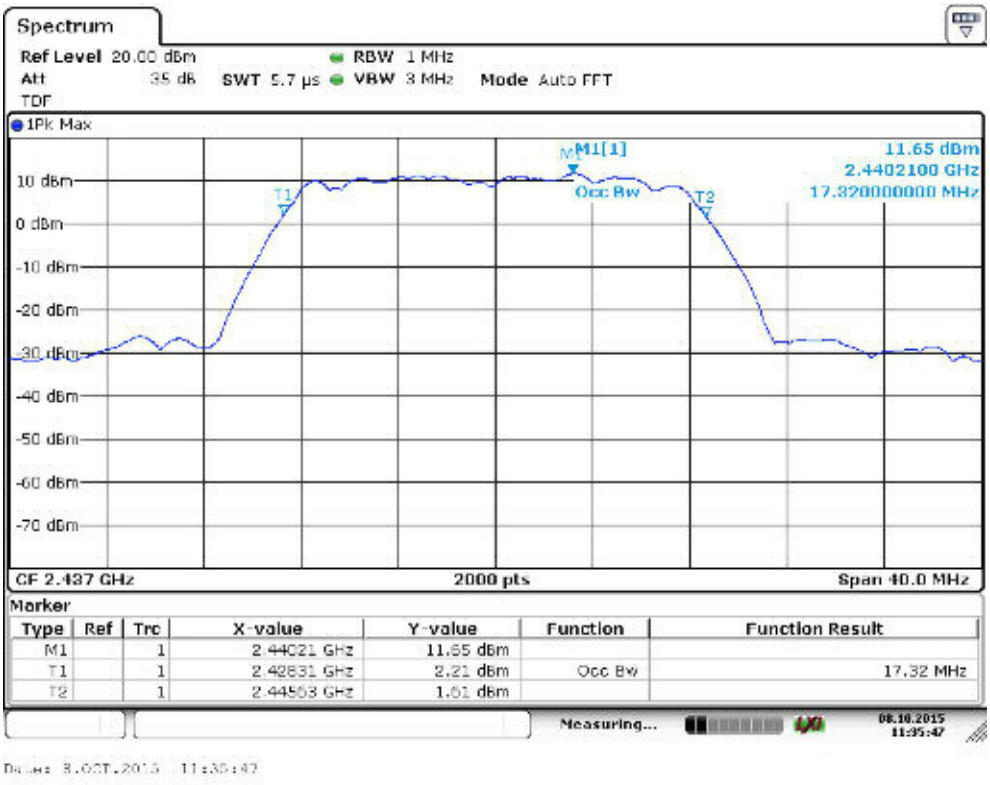

Figure 60. 99 % OBW channel middle 54Mbps.

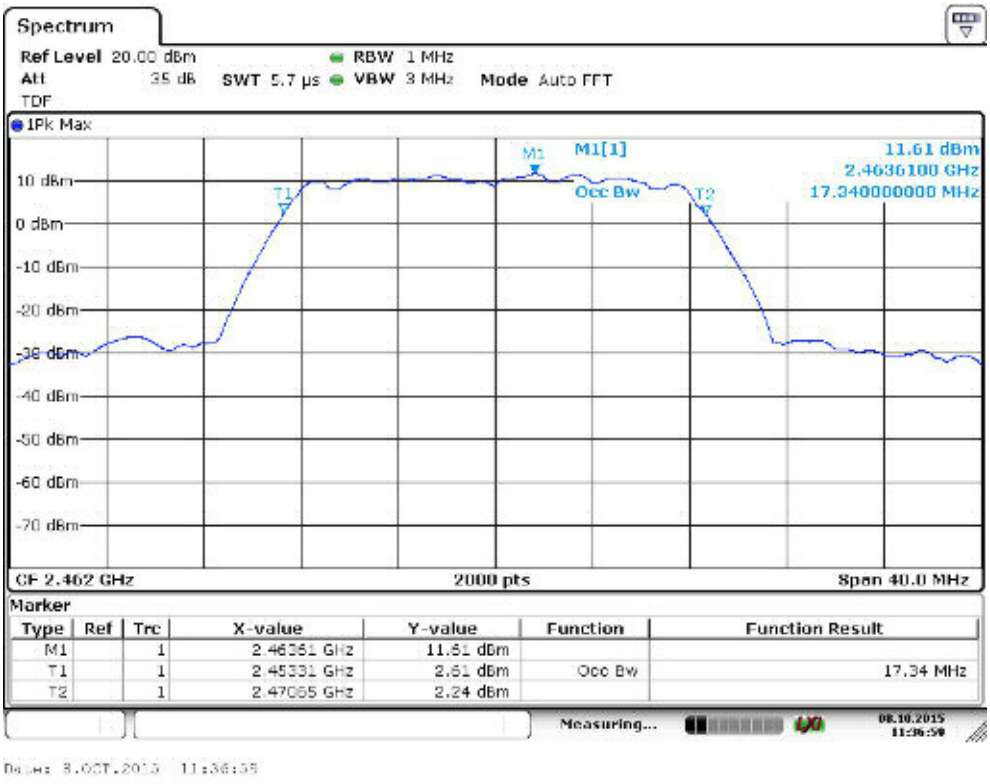

Figure 61. 99 % OBW channel high 54Mbps.

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	-	-	-
LISN	ROHDE & SCHWARZ	ENV216	101466	9611	2016-10-14
AVG POWER SENSOR	ROHDE & SCHWARZ	NRP-Z91	100267	9878	2016-03-11
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).