Test Report

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

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS

Equipment Under Test:	ZigBee module
Model:	MGM12P32GA MGM12P32GE
Manufacturer:	Silicon Laboratories Finland Oy Bertel Jungin aukio 3 FI-02600 ESPOO FINLAND
Customer:	Silicon Laboratories Finland Oy Bertel Jungin aukio 3 FI-02600 ESPOO FINLAND
FCC Rule Part:	15.247: 2016
IC Rule Part:	RSS-247, Issue 2, 2017 RSS-GEN Issue 4, 2014
KDB:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (April 8, 2016)

Date: 29 June 2017
Issued by:
Emil Haverinen
Testing Engineer

Date: 29 June 2017
Checked by:
Janne Nyman
Compliance Specialist

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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	MGM12P32GA, MGM12P32GE
Type:	ZigBee module
Serial no:	-
FCC ID:	QOQMGM12P3
IC:	5123A-MGM12P3

Description of the EUT

MGM12P32G is a ZigBee module with two antenna variants. Variant A is equipped with chip antenna while the E variant has RF connector for the use of external antenna.

Classification of the device

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

Modifications Incorporated in the EUT

One sample was modified to allow conducted measurements to be made.

Ratings and declarations

Operating Frequency Range (OFR):	2405 - 2480 MHz
Channels:	15
Channel separation:	5 MHz
Effective conducted power:	17.10 dBm (Peak)
Modulation:	OQPSK
Integral Antenna gain:	A-variant: 1 dBi
External Antenna gain:	E-variant: 2.14 dBi

Power Supply

Operating voltage range: 2.0 - 3.8 VDC (tested with 3.3V regulated by the development board)

Separate AC/DC adaptor, Huawei model: HW-050100E01 (115 V, 60 Hz input / 5 V output) was used during the tests to power up the development board which feeds the module (EUT) during AC emissions test. Supply is not provided by the manufacturer. In other tests the development board was supplied with laboratory power supply.

Mechanical Size of the EUT

Height: 2 mm Width: 20 mm Length: 15 mm

Samples

Three samples were used in the tests, one with original antenna assembly and one with RF adaptor with short coaxial cable soldered to replace antenna. One sample had RF connector with short RF cable and antenna attached to it.

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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(d)	Maximum Peak Conducted Output Power	**PASS**
§15.247(a)(2) / RSS-247 5.2(a)	6 dB Bandwidth	**PASS**
§15.247(e) / RSS-247 5.2(b)	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 using software provided by the manufacturer. Normal modulation and duty cycle was applied in all the tests.

Conducted measurements were performed while the EUT was connected to WSTK development board. Conducted sample was modified with RF adapter cable except that channel 26 was measured with E variant sample.

Radiated measurements with A variant were performed while the EUT was placed on simplified board with reduced functionality.

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

Channel Low (Ch 11) = 2405 MHz

Channel Mid (Ch 19) = 2445 MHz

Channel High(1) (Ch 25) = 2475 MHz

Channel High(2) (Ch 26) = 2480 MHz

Two high channels were tested since power setting is lowered to 160(E) or 170(A rad) with the 2480 MHz frequency. The power setting is 199 in all other channels.

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:	RRE	
Date:	31 May 2017	
Temperature:	21 °C	
Humidity:	43 % RH	
Barometric pressure:	994 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.

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.

Final measurements from the worst frequencies

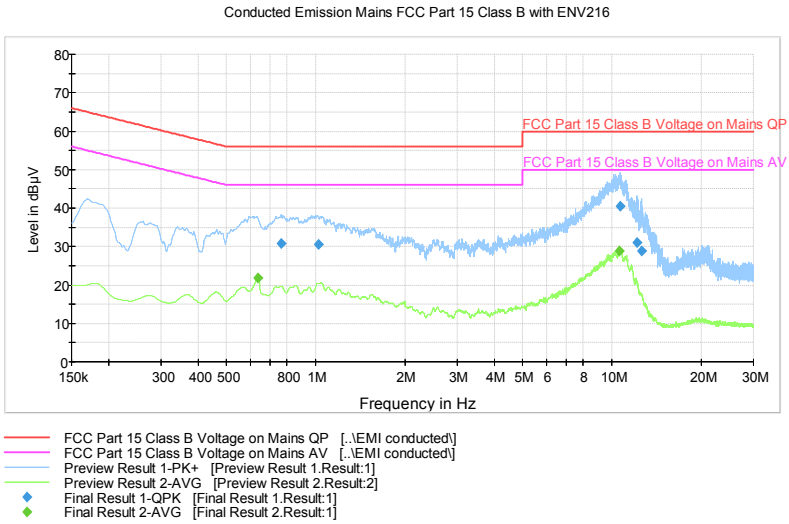

Figure 1: The measured curves with peak- and average detector.

Table 1: Final QuasiPeak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.765750	30.7	1000.0	9.000	L1	10.0	25.3	56.0
1.019750	30.5	1000.0	9.000	L1	10.0	25.5	56.0
10.658750	40.5	1000.0	9.000	L1	10.3	19.5	60.0
12.113000	31.1	1000.0	9.000	L1	10.3	28.9	60.0
12.630750	28.8	1000.0	9.000	L1	10.4	31.2	60.0

Table 2: Final Average measurements from the worst frequencies

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.635750	21.9	1000.0	9.000	N	10.3	24.1	46.0
10.580500	28.8	1000.0	9.000	L1	10.3	21.2	50.0

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

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	28 March 2017 - 28 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	
Measurement uncertainty:	± 2.87dB	Level of confidence 95 % (k = 2)

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

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.

Measured values are peak values.

Results:

Table 3: Maximum conducted output power

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	17.10	30	12.90	PASS
Mid	16.55	30	13.45	PASS
High(1)	16.18	30	13.82	PASS
High(2)	14.40	30	15.60	PASS

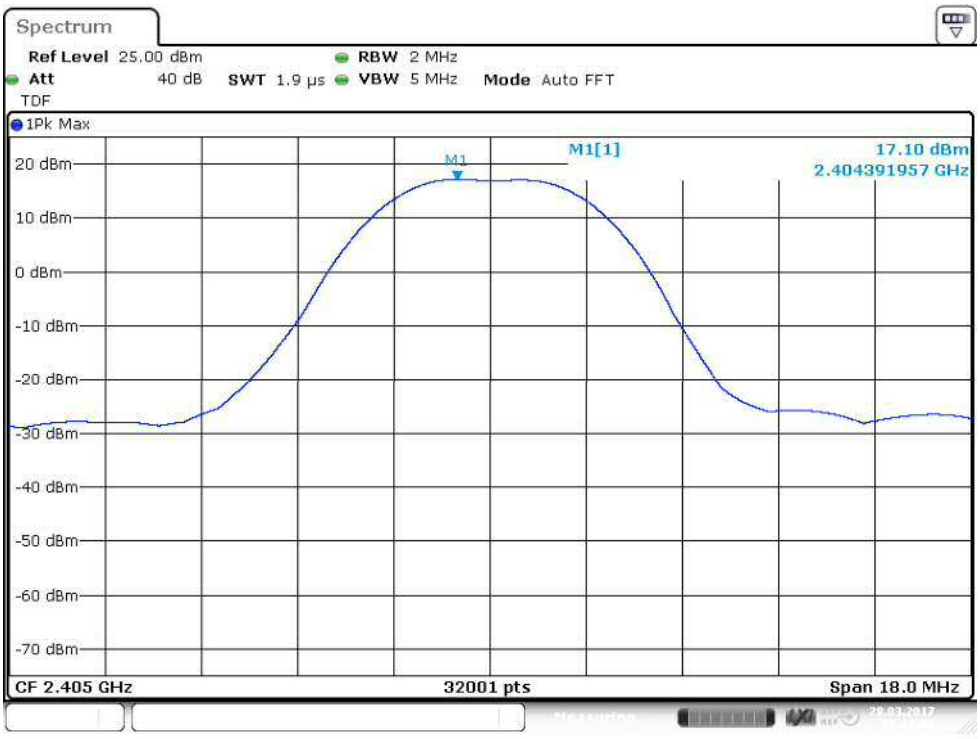

Figure 2: Conducted power (ch low)

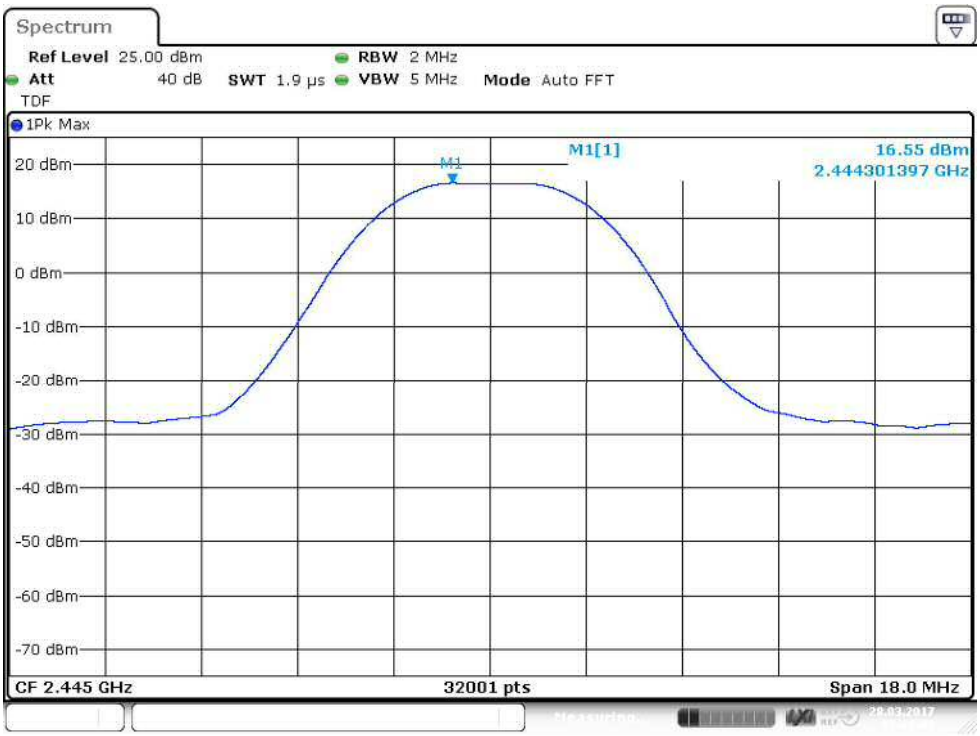

Figure 3: Conducted power (ch mid)

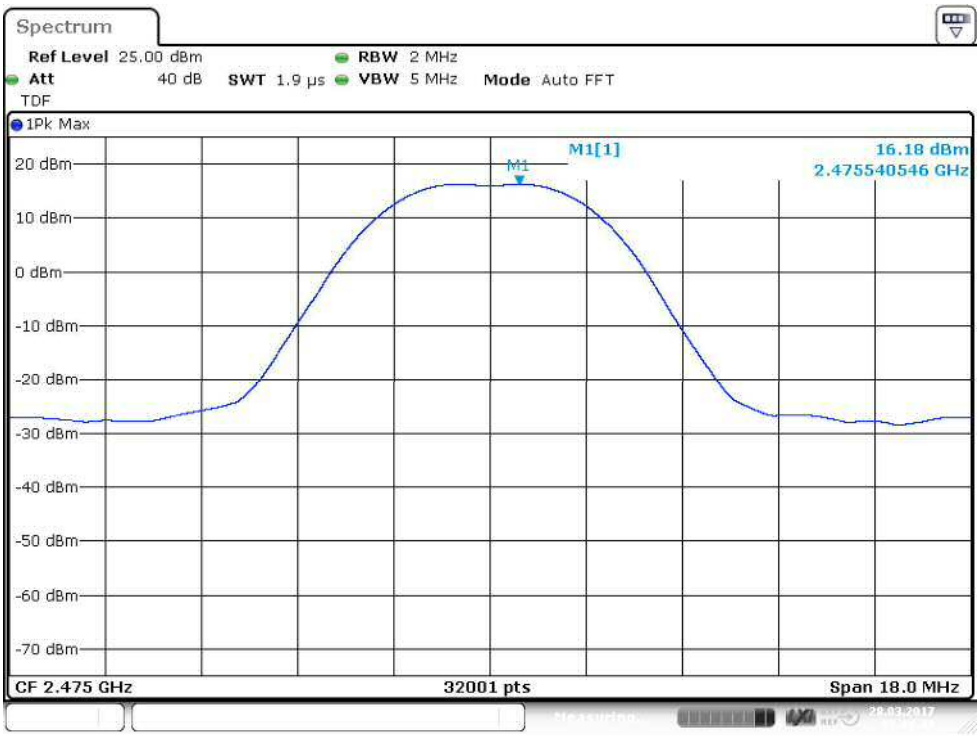

Figure 4: Conducted power (ch high(1))

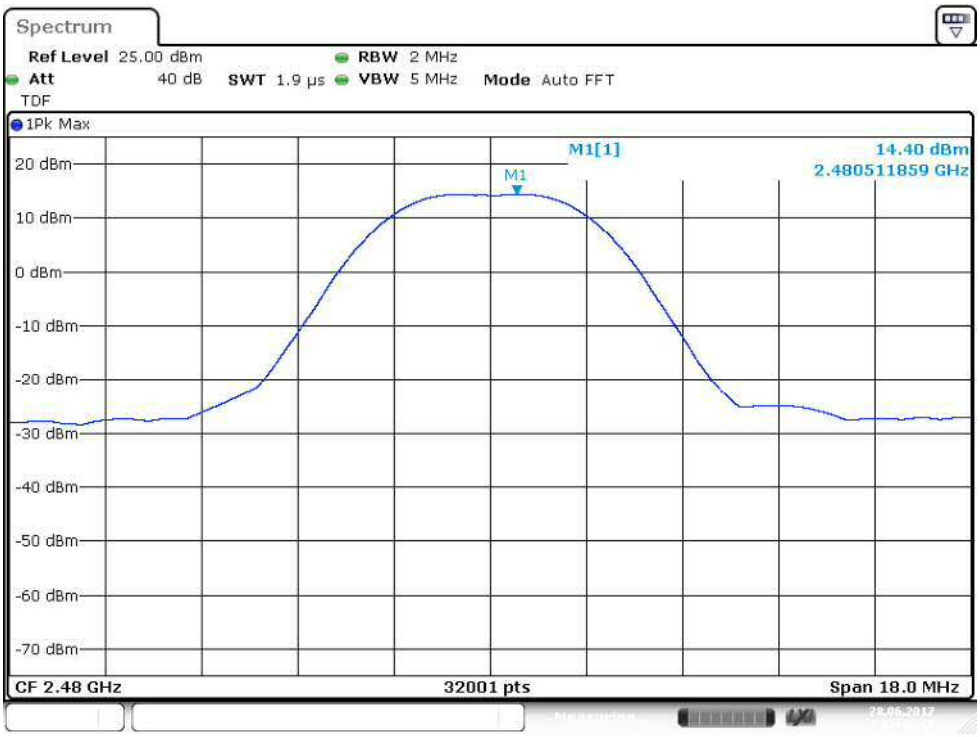

Figure 5: Conducted power (ch high(2))

Transmitter Radiated Spurious Emissions 30 - 26500 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	23 March 2017 - 18 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	
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).
Peak values of emissions below 1000 MHz measured for reference as well as transmitter fundamental.

Measurements were performed for both antenna variants.

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
30 - 80	100	40.0	Quasi-peak
88 - 216	150	43.5	Quasi-peak
216 - 960	200	46.0	Quasi-peak
960 - 1000	500	53.9	Quasi-peak
Above 1000	500	53.9	Average
Above 1000	5000	73.9	Peak

Low channel

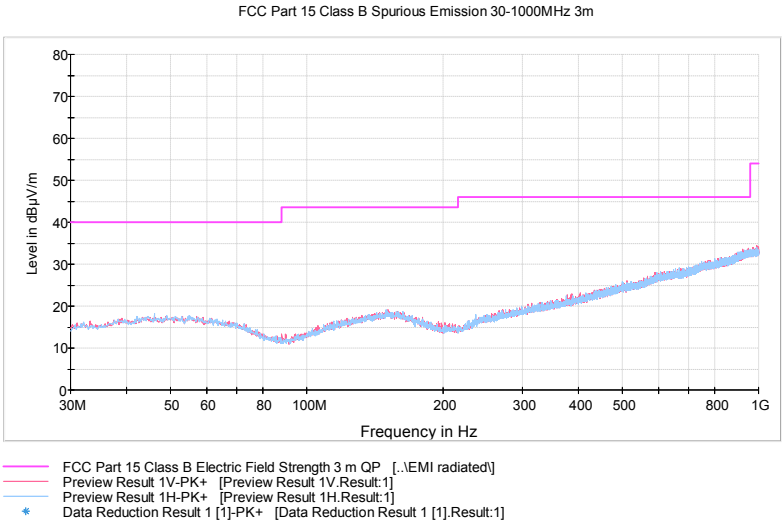

Figure 6: Low channel 30 MHz – 1000 MHz (A)

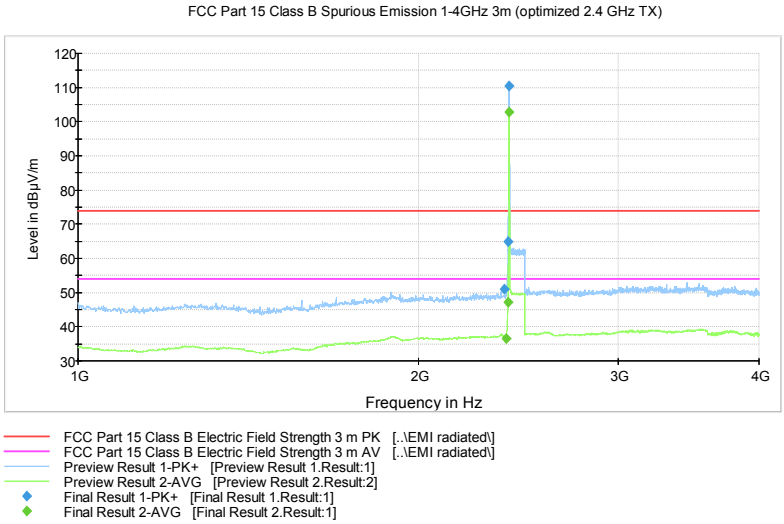

Figure 7: Low channel 1 GHz – 4 GHz (A)

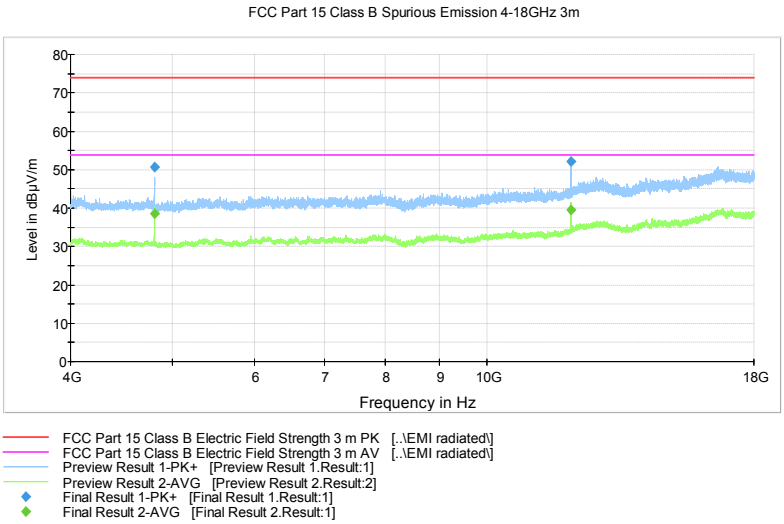

Figure 8: Low channel 4 GHz – 18 GHz (A)

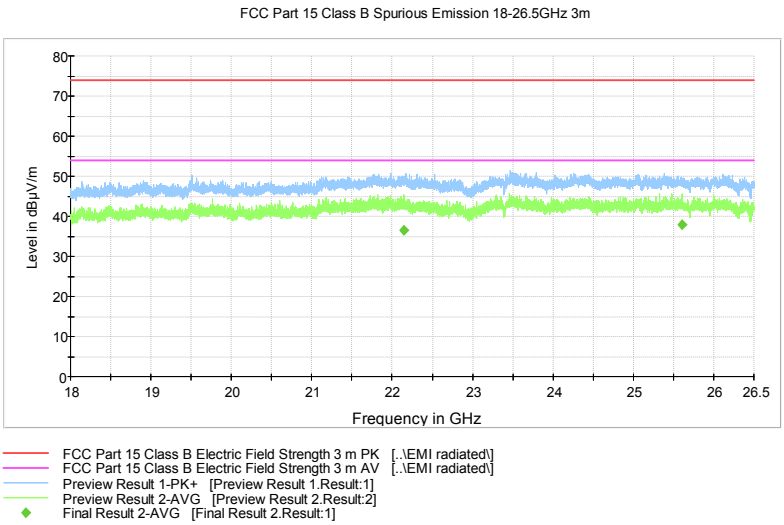

Figure 9: Low channel 18 GHz – 26.5 GHz (A)

Table 4: Peak results (ch low) (A)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2381.600000	50.9	1000.0	1000.000	378.0	V	9.0	14.5	23.0	73.9
2400.000000	64.8	1000.0	1000.000	222.0	H	96.0	14.7	9.1	73.9
4808.900000	50.7	1000.0	1000.000	248.0	V	317.0	8.3	23.2	73.9
12027.80000	52.1	1000.0	1000.000	150.0	H	35.0	18.9	21.8	73.9

Table 5: Average results (ch low) (A)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.800000	36.5	1000.0	1000.000	258.0	V	348.0	14.6	17.4	53.9
2400.000000	47.3	1000.0	1000.000	166.0	H	82.0	14.7	6.6	53.9
4811.000000	38.4	1000.0	1000.000	272.0	V	317.0	8.3	15.5	53.9
12027.80000	39.6	1000.0	1000.000	150.0	H	32.0	18.9	14.3	53.9

Middle channel

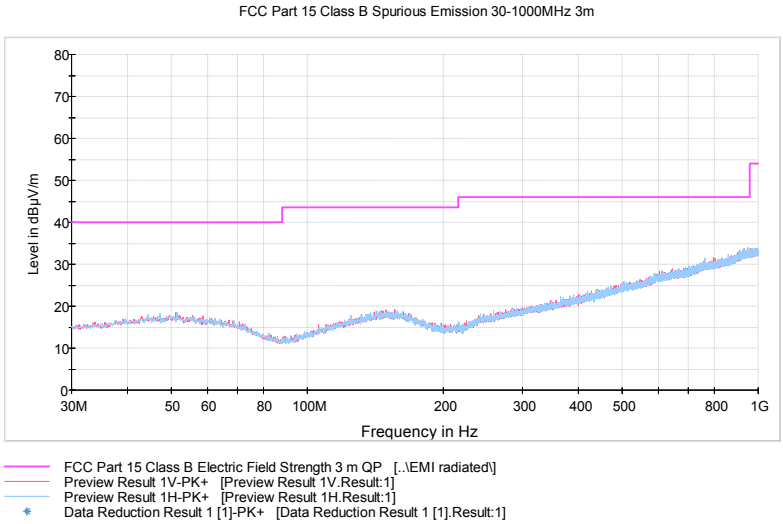

Figure 10: Mid channel 30 MHz – 1000 MHz (A)

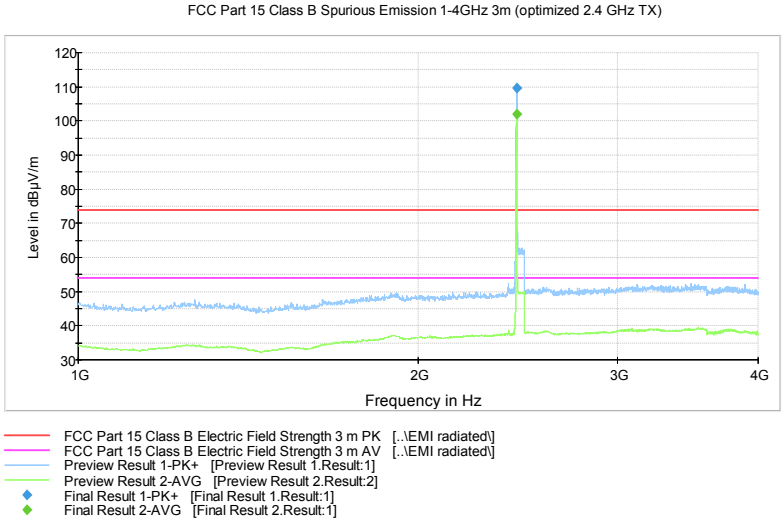

Figure 11: Mid channel 1 GHz – 4 GHz (A)

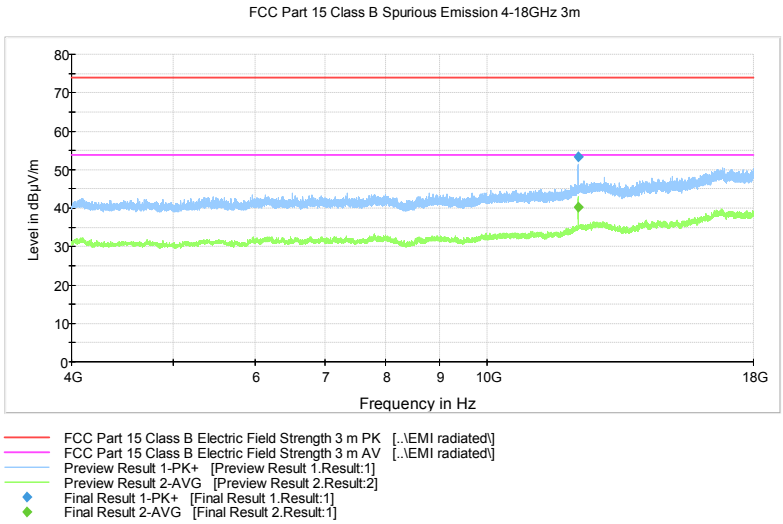

Figure 12: Mid channel 4 GHz – 18 GHz (A)

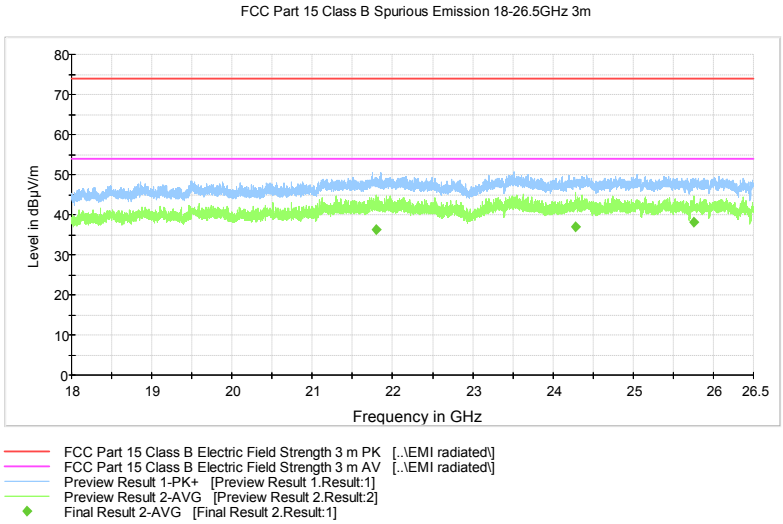

Figure 13: Mid channel 18 GHz – 26.5 GHz (A)

Table 6: Peak results (ch mid) (A)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
12227.40000	53.2	1000.0	1000.000	150.0	H	30.0	19.6	20.7	73.9

Table 7: Average results (ch mid) (A)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
12227.80000	40.3	1000.0	1000.000	150.0	H	35.0	19.6	13.6	53.9

High channel

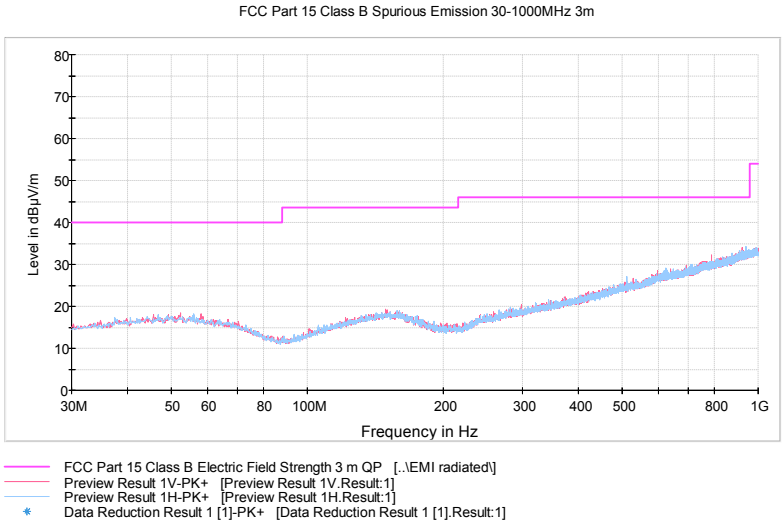

Figure 14: High channel 30 MHz – 1000 MHz (A)

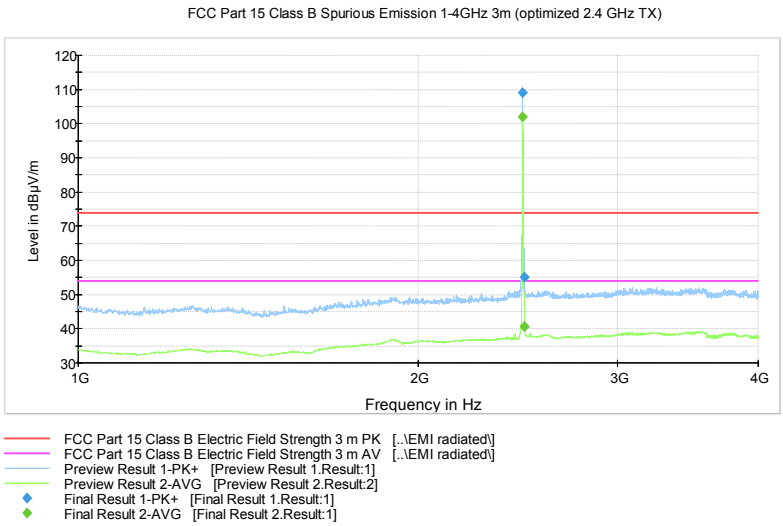

Figure 15: High channel 1 GHz – 4 GHz (A)

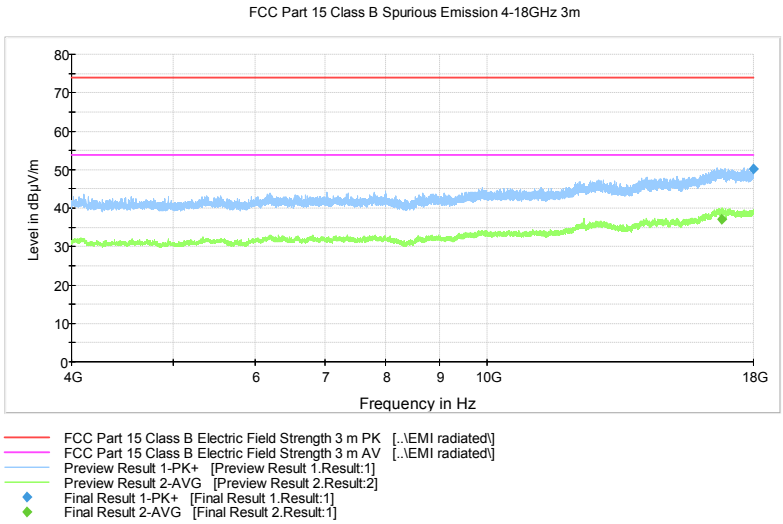

Figure 16: High channel 4 GHz – 18 GHz (A)

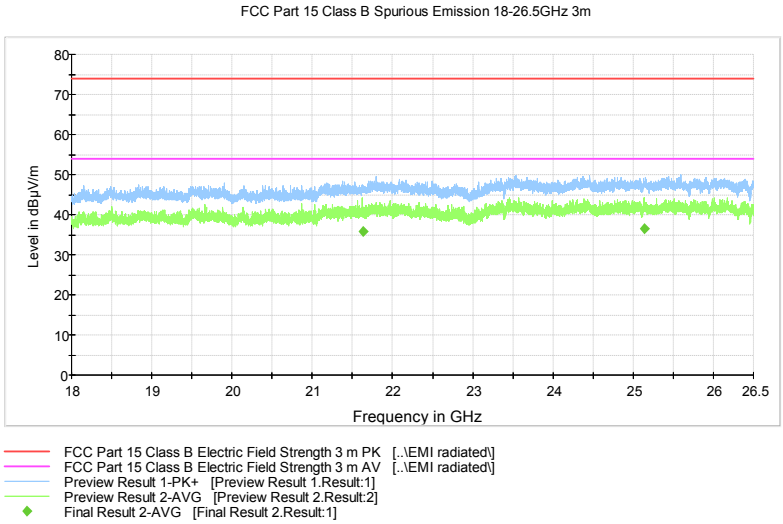

Figure 17: High channel 18 GHz – 26.5 GHz (A)

Table 8: Peak results (ch high) (A)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.700000	55.0	1000.0	1000.000	352.0	H	71.0	14.7	18.9	73.9
17987.60000	50.3	1000.0	1000.000	397.0	V	328.0	28.4	23.6	73.9

Table 9: Average results (ch high) (A)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	40.7	1000.0	1000.000	150.0	H	78.0	14.7	13.2	53.9
16794.90000	37.1	1000.0	1000.000	150.0	V	352.0	26.8	16.8	53.9

Radiated Band Edge results

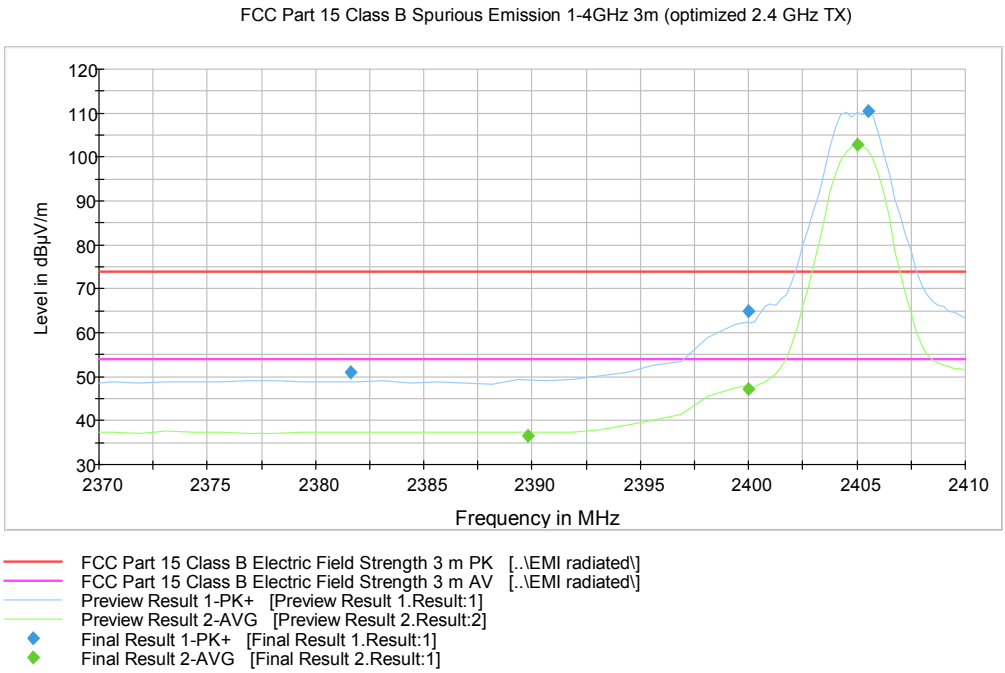

Figure 18: Radiated Band Edge measurement graph (ch low) (A)

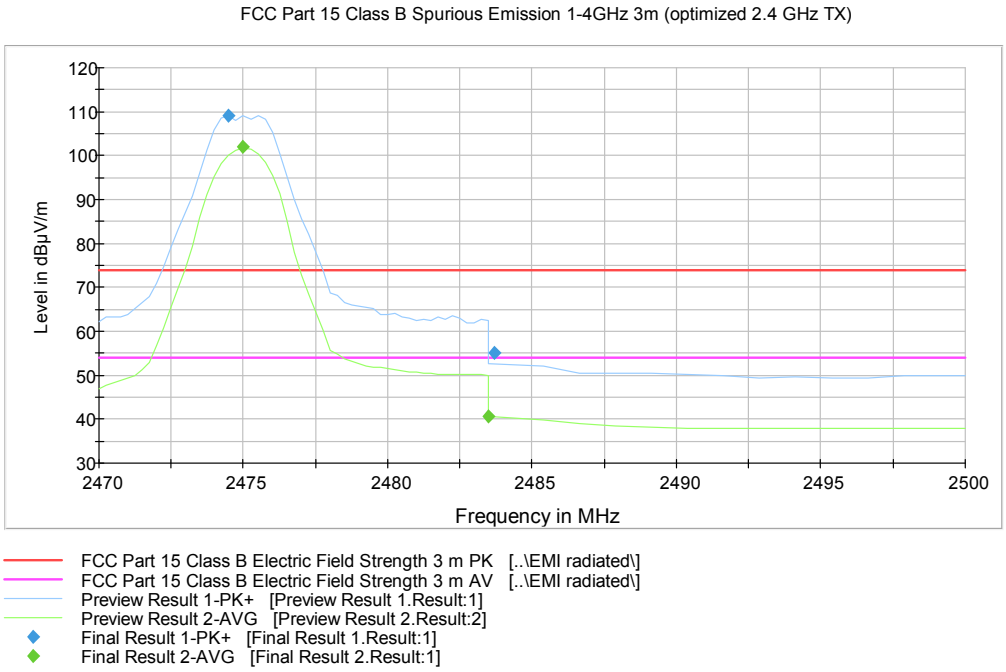

Figure 19: Radiated Band Edge measurement graph (ch high(1)) (A)

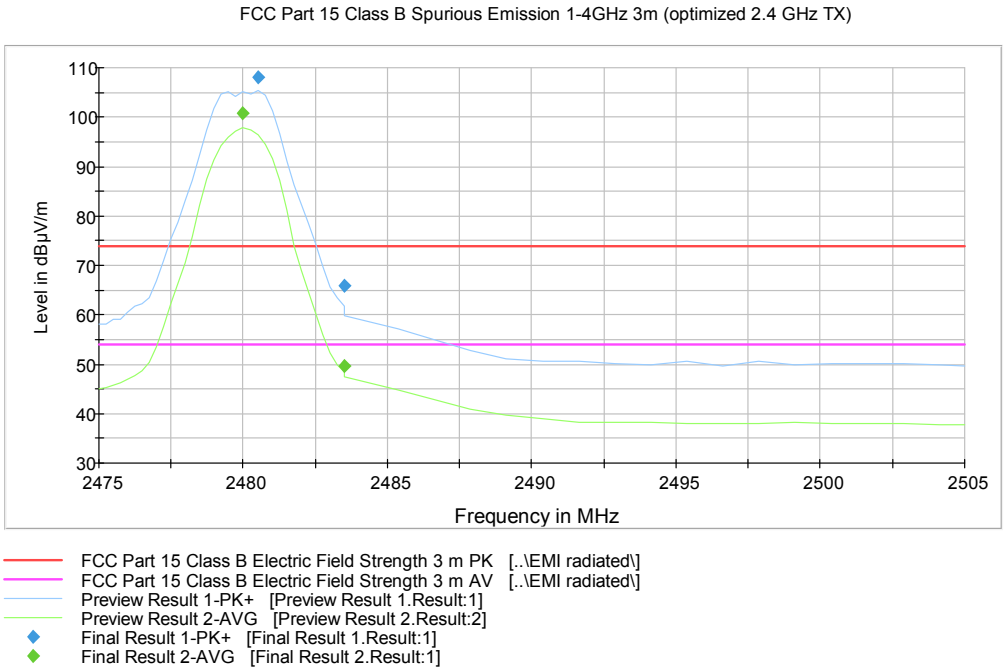

Figure 20: Radiated Band Edge measurement graph (ch high(2)) (A)

Table 10: Peak results (ch high(2)) (A)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	65.9	1000.0	1000.000	241.0	H	340.0	14.7	8.0	73.9

Table 11: Average results (ch high(2)) (A)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	49.7	1000.0	1000.000	241.0	H	341.0	14.7	4.2	53.9

Low channel

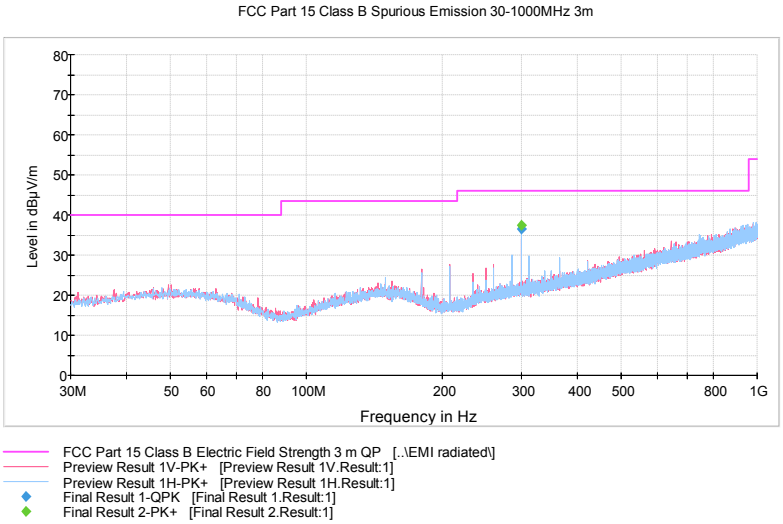

Figure 21: Low channel 30 MHz – 1000 MHz (E)

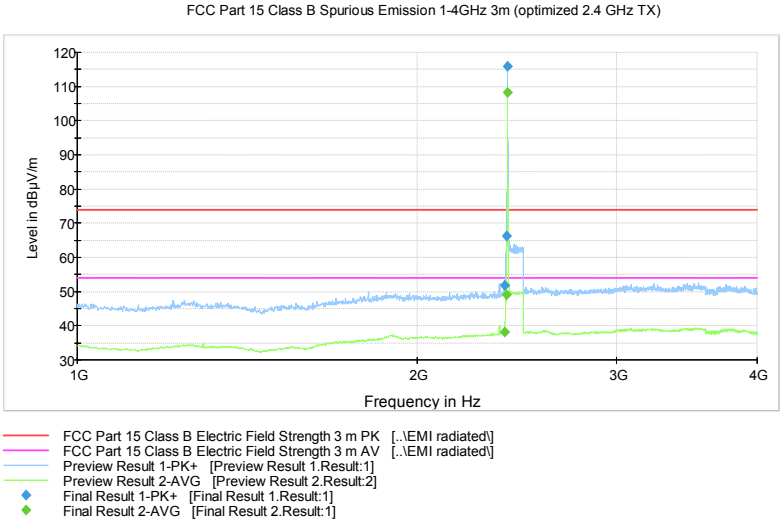

Figure 22: Low channel 1 GHz – 4 GHz (E)

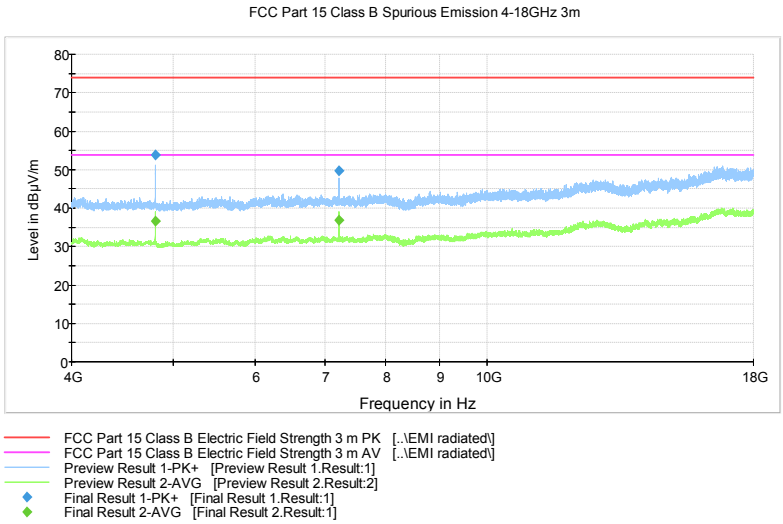

Figure 23: Low channel 4 GHz – 18 GHz (E)

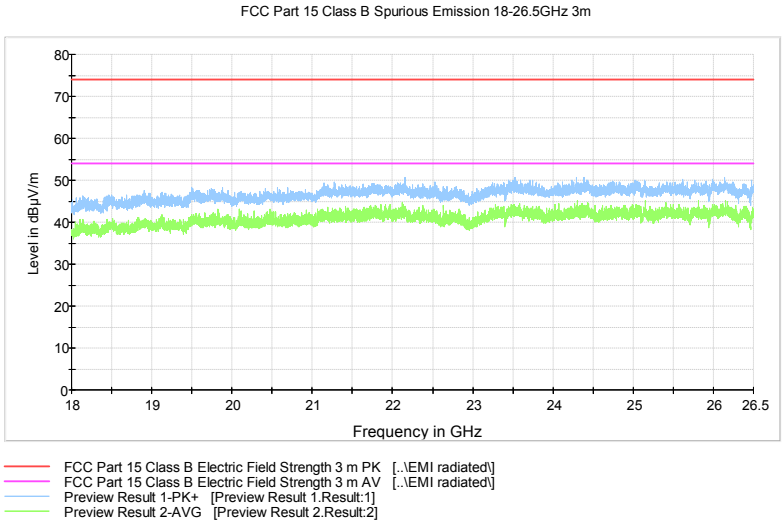

Figure 24: Low channel 18 GHz – 26.5 GHz (E)

Table 12: Peak results (ch low) (E)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.000000	51.9	1000.0	1000.000	150.0	V	322.0	14.6	22.0	73.9
2400.000000	66.3	1000.0	1000.000	150.0	V	305.0	14.7	7.6	73.9
4808.900000	53.7	1000.0	1000.000	179.0	V	259.0	8.3	20.2	73.9
7213.200000	49.8	1000.0	1000.000	150.0	V	72.0	12.1	24.1	73.9

Table 13: Average results (ch low) (E)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.800000	38.2	1000.0	1000.000	150.0	V	303.0	14.6	15.7	53.9
2400.000000	49.2	1000.0	1000.000	150.0	V	195.0	14.7	4.7	53.9
4810.900000	36.6	1000.0	1000.000	150.0	V	30.0	8.3	17.3	53.9
7216.500000	36.9	1000.0	1000.000	150.0	V	69.0	12.1	17.0	53.9

Table 14: Quasi-peak results (ch low) (E)

Frequency (MHz)	QuasiP (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.011000	36.5	1000.0	120.000	100.0	H	1.0	15.3	9.5	46.0

Middle channel

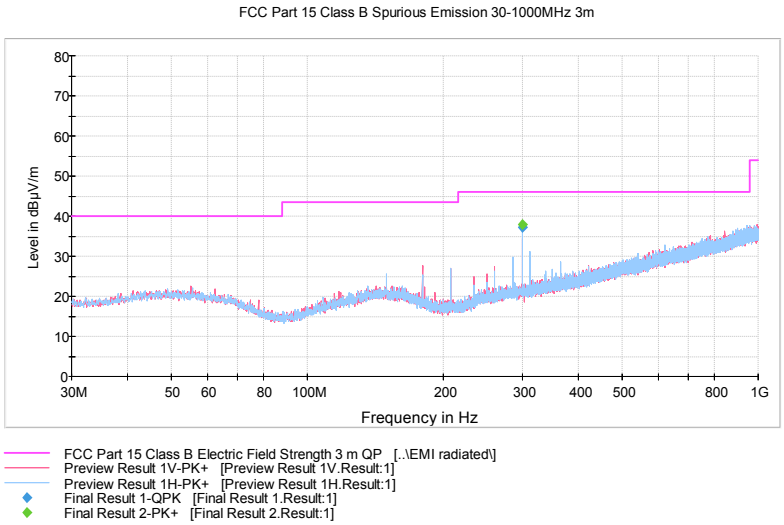

Figure 25: Mid channel 30 MHz – 1000 MHz (E)

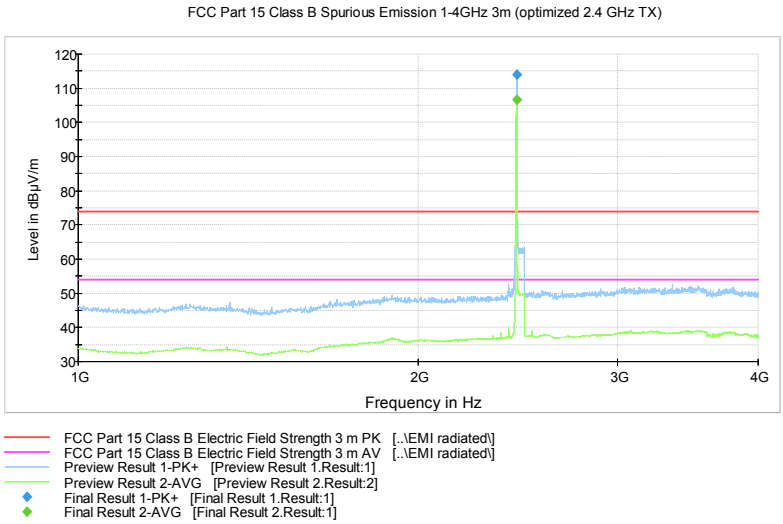

Figure 26: Mid channel 1 GHz – 4 GHz (E)

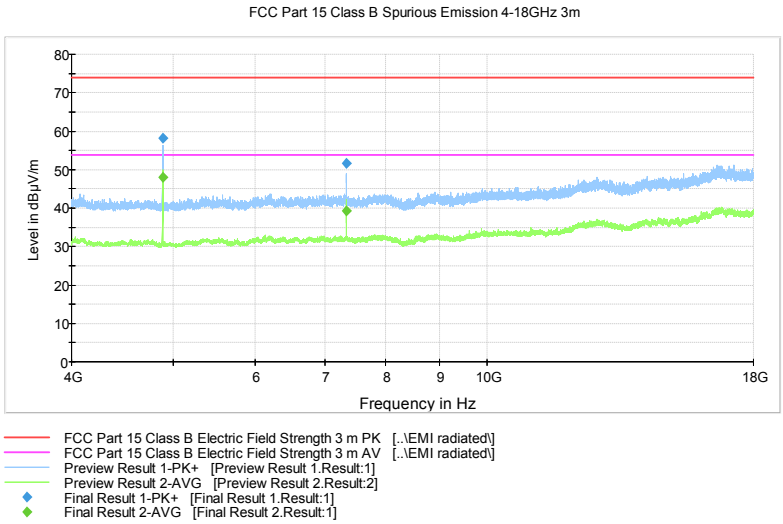

Figure 27: Mid channel 4 GHz – 18 GHz (E)

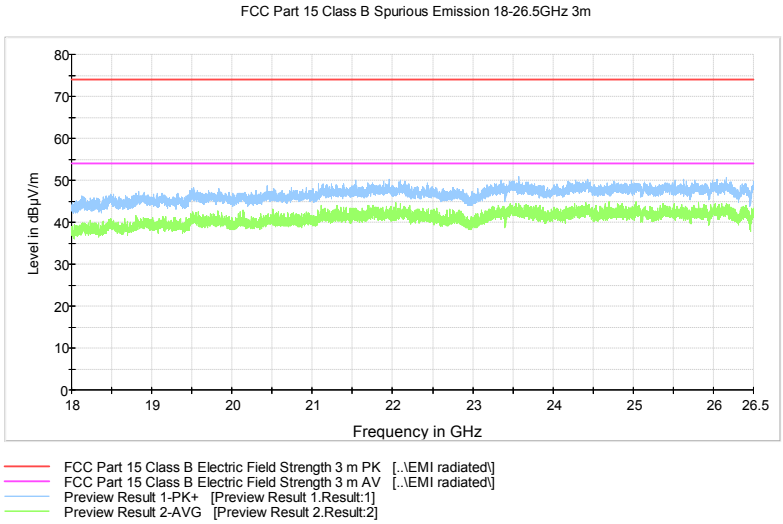

Figure 28: Mid channel 18 GHz – 26.5 GHz (E)

Table 15: Peak results (ch mid) (E)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4891.100000	58.2	1000.0	1000.000	166.0	V	270.0	8.3	15.7	73.9
7333.200000	51.7	1000.0	1000.000	150.0	V	50.0	12.2	22.2	73.9

Table 16: Average results (ch mid) (E)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4890.900000	48.0	1000.0	1000.000	166.0	V	270.0	8.3	5.9	53.9
7336.600000	39.2	1000.0	1000.000	150.0	V	47.0	12.2	14.7	53.9

Table 17: Quasi-peak results (ch mid) (E)

Frequency (MHz)	QuasiP (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.011000	37.2	1000.0	120.000	100.0	H	15.0	15.3	8.8	46.0

High channel

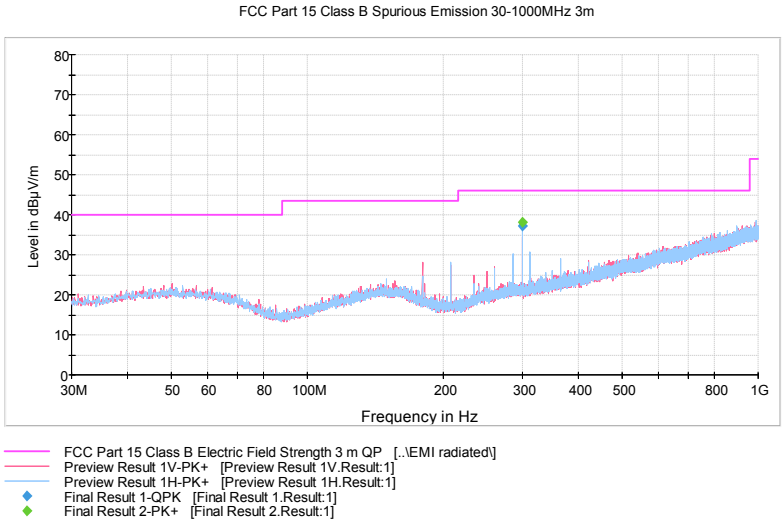

Figure 29: High channel 30 MHz – 1000 MHz (E)

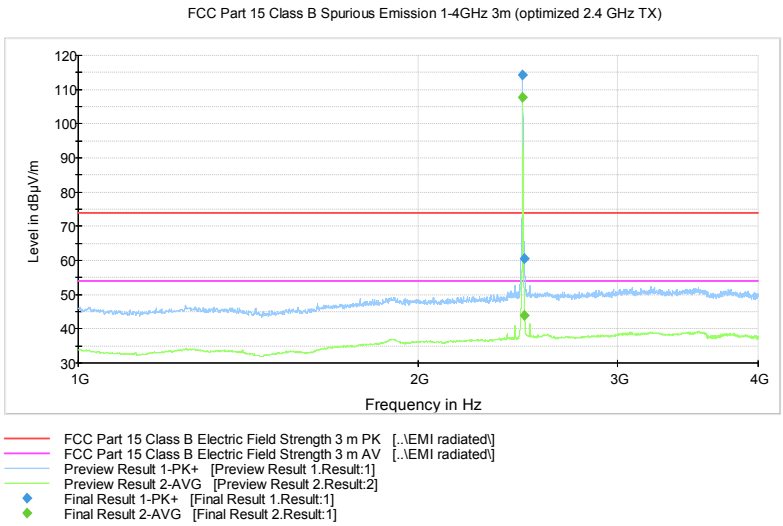

Figure 30: High channel 1 GHz – 4 GHz (E)

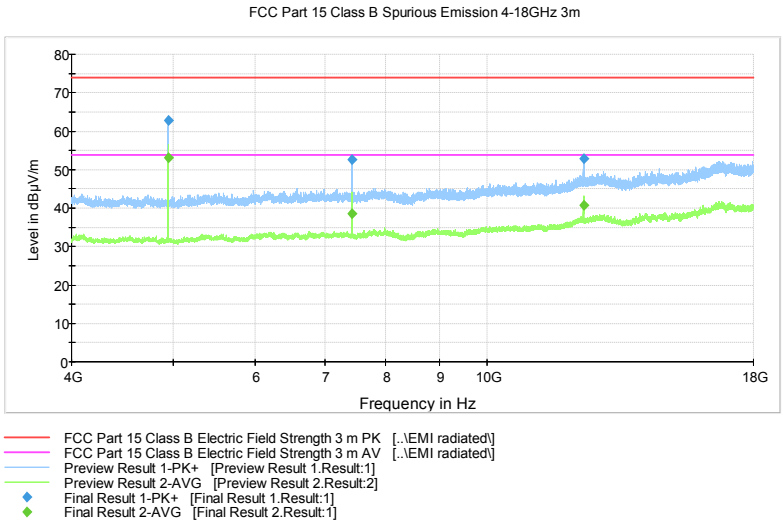

Figure 31: High channel 4 GHz – 18 GHz (E)

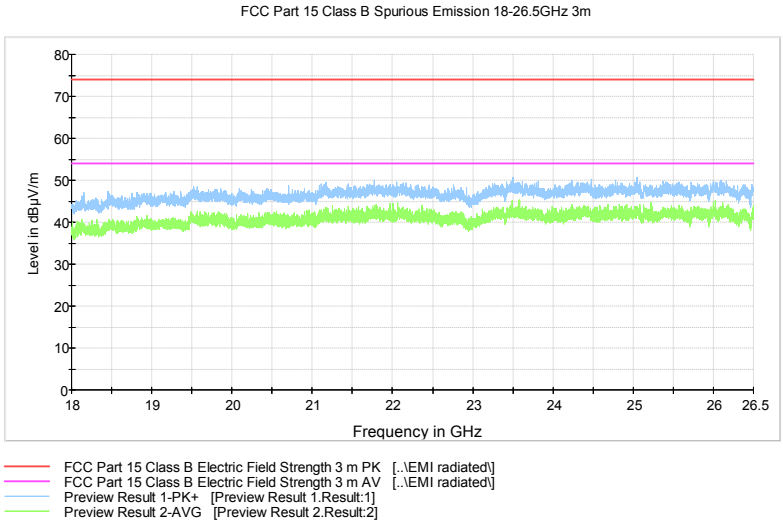

Figure 32: High channel 18 GHz – 26.5 GHz (E)

Table 18: Peak results (ch high) (E)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	60.7	1000.0	1000.000	215.0	V	165.0	14.7	13.2	73.9
4951.000000	62.9	1000.0	1000.000	166.0	V	219.0	8.2	11.0	73.9
7423.400000	52.6	1000.0	1000.000	150.0	V	50.0	12.1	21.3	73.9
12377.90000	52.9	1000.0	1000.000	150.0	V	256.0	19.6	21.0	73.9

Table 19: Average results (ch high) (E)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.900000	43.9	1000.0	1000.000	166.0	V	1.0	14.7	10.0	53.9
4950.900000	53.0	1000.0	1000.000	166.0	V	220.0	8.2	0.9	53.9
7426.600000	38.6	1000.0	1000.000	150.0	V	332.0	12.1	15.3	53.9
12377.60000	40.8	1000.0	1000.000	166.0	V	256.0	19.6	13.1	53.9

Table 20: Quasi-peak results (ch mid) (E)

Frequency (MHz)	QuasiP (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.008000	37.3	1000.0	120.000	100.0	H	7.0	15.3	8.7	46.0

Radiated Band Edge results

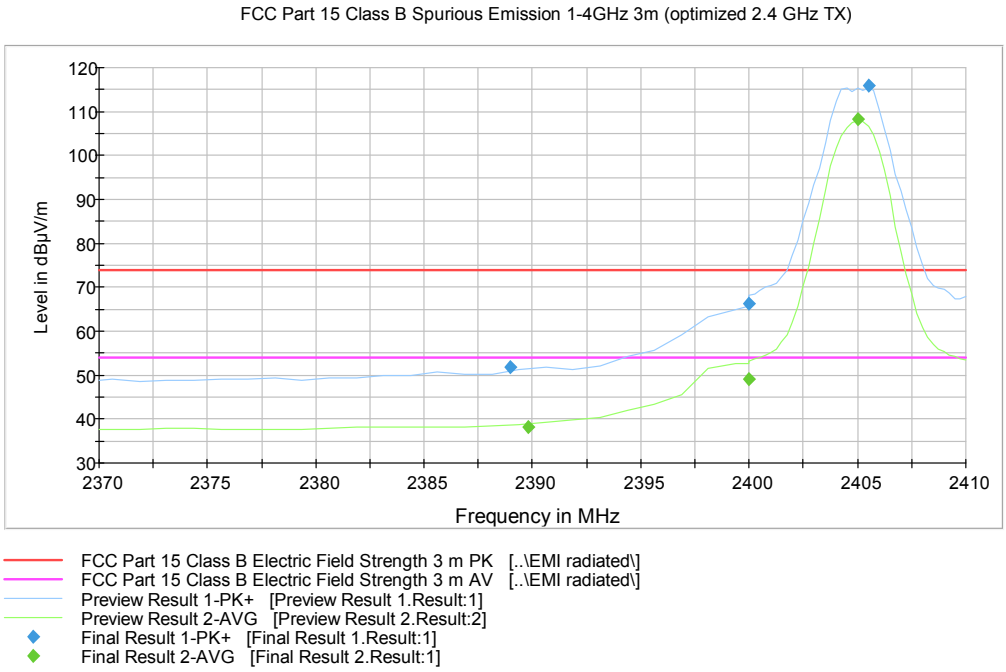

Figure 33: Radiated Band Edge measurement graph (ch low) (E)

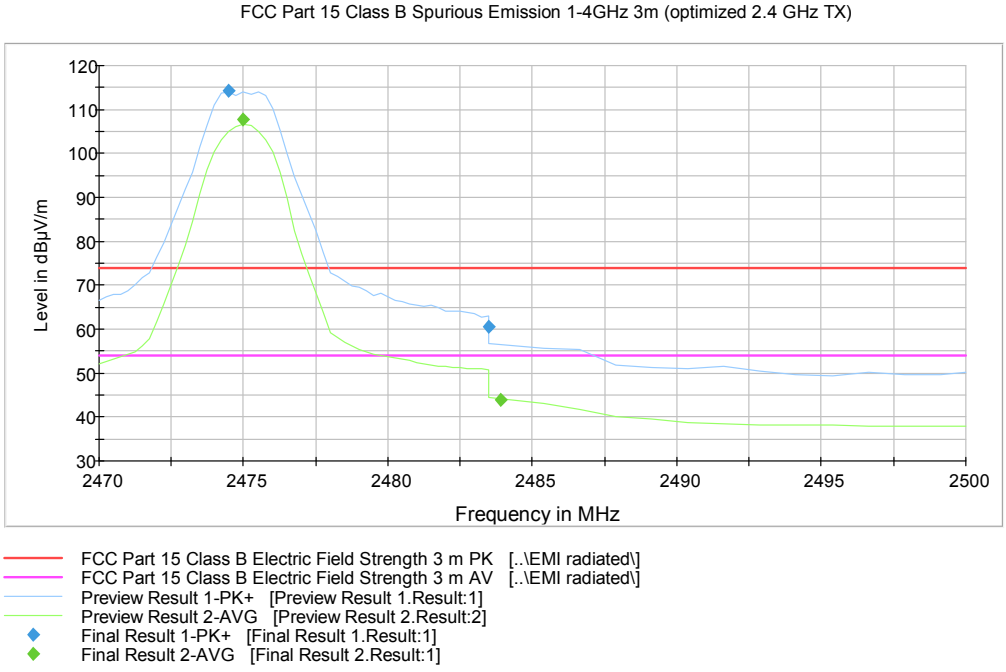

Figure 34: Radiated Band Edge measurement graph (ch high(1)) (E)

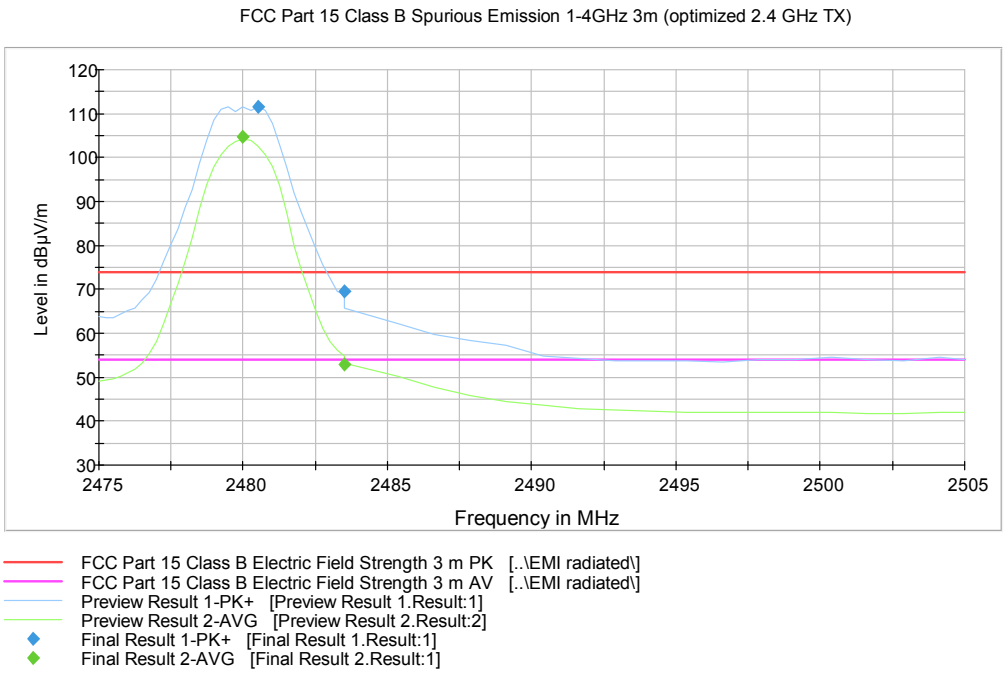

Figure 35: Radiated Band Edge measurement graph (ch high(2)) (E)

Table 21: Peak results (ch high(2)) (E)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	69.6	1000.0	1000.000	166.0	V	1.0	14.7	4.3	73.9

Table 22: Average results (ch high(2)) (E)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	53.0	1000.0	1000.000	218.0	V	167.0	14.7	0.9	53.9

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	23 March 2017 - 18 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	
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 23: Band edge attenuation

Band Edge Attenuation		
Lower Band Edge	**Upper Band Edge (high(1))**	**Upper Band Edge (high(2))**
-54.57 dBc	-54.09 dBc	-50.08 dBc
Limit: -20 dBc		

Table 24: Conducted spurious emissions (ch low)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
678.86	-67.63	-4.33	-63.30	PASS
2399.76	-44.11	-4.33	-39.78	PASS
2520.20	-63.05	-4.33	-58.72	PASS
4808.99	-37.53	-4.33	-33.20	PASS
7216.60	-53.71	-4.33	-49.38	PASS
12022.36	-49.01	-4.33	-44.67	PASS
15487.25	-57.44	-4.33	-53.11	PASS
16831.11	-54.27	-4.33	-49.94	PASS
19489.41	-57.66	-4.33	-53.33	PASS
24410.66	-57.21	-4.33	-52.88	PASS
25522.57	-56.04	-4.33	-51.71	PASS

Table 25: Conducted spurious emissions (ch mid)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
789.29	-66.78	-4.84	-61.93	PASS
2329.28	-55.66	-4.84	-50.82	PASS
2483.52	-58.51	-4.84	-53.66	PASS
4890.93	-38.97	-4.84	-34.12	PASS
7335.01	-52.01	-4.84	-47.17	PASS
12222.32	-45.24	-4.84	-40.39	PASS
15507.41	-57.53	-4.84	-52.68	PASS
17118.54	-52.07	-4.84	-47.23	PASS
19181.54	-57.45	-4.84	-52.60	PASS
24811.99	-57.44	-4.84	-52.59	PASS
25597.05	-56.35	-4.84	-51.50	PASS

Table 26: Conducted spurious emissions (ch high(1))

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
781.59	-67.44	-5.17	-62.27	PASS
2397.70	-55.09	-5.17	-49.93	PASS
2483.76	-50.92	-5.17	-45.76	PASS
4948.95	-37.59	-5.17	-32.43	PASS
7423.41	-49.50	-5.17	-44.34	PASS
12372.32	-48.57	-5.17	-43.40	PASS
15824.93	-57.00	-5.17	-51.83	PASS
17321.22	-53.04	-5.17	-47.88	PASS
20162.89	-58.22	-5.17	-53.06	PASS
24950.08	-57.34	-5.17	-52.17	PASS
25769.27	-56.38	-5.17	-51.21	PASS

Table 27: Conducted spurious emissions (ch high(2))

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
689.08	-67.98	-6.96	-61.02	PASS
1717.24	-60.72	-6.96	-53.76	PASS
2483.90	-41.22	-6.96	-34.26	PASS
4958.99	-47.40	-6.96	-40.45	PASS
7499.53	-61.57	-6.96	-54.61	PASS
12533.84	-58.58	-6.96	-51.62	PASS
15516.22	-56.88	-6.96	-49.93	PASS
16139.92	-55.33	-6.96	-48.37	PASS
19778.90	-57.01	-6.96	-50.05	PASS
24445.81	-56.46	-6.96	-49.50	PASS
25581.54	-56.24	-6.96	-49.28	PASS

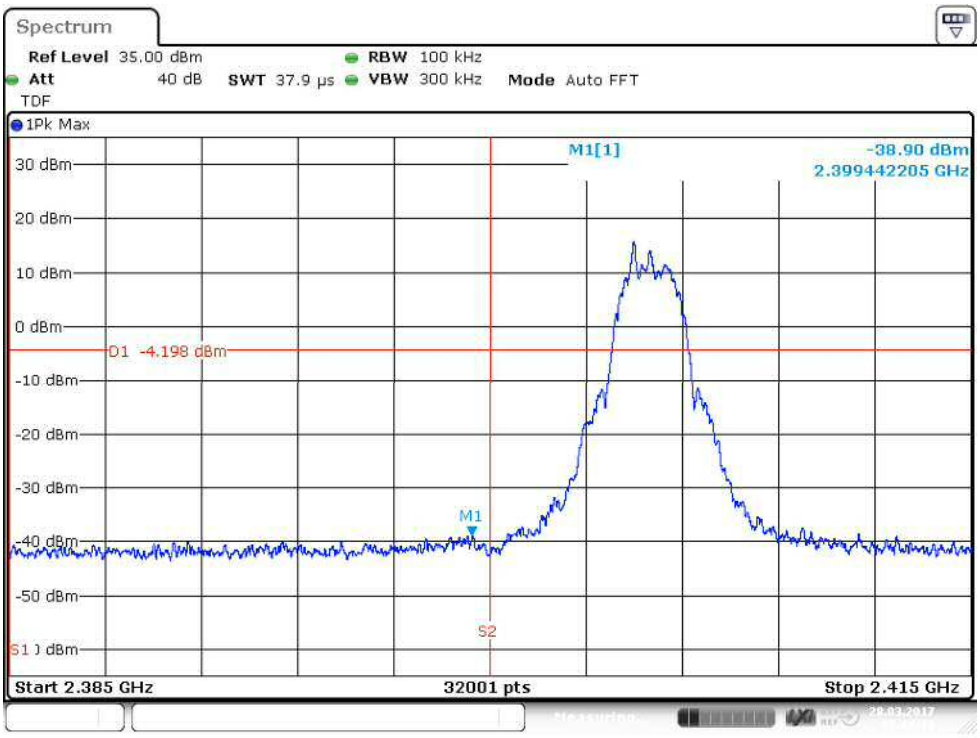

Figure 36: Lower Band Edge

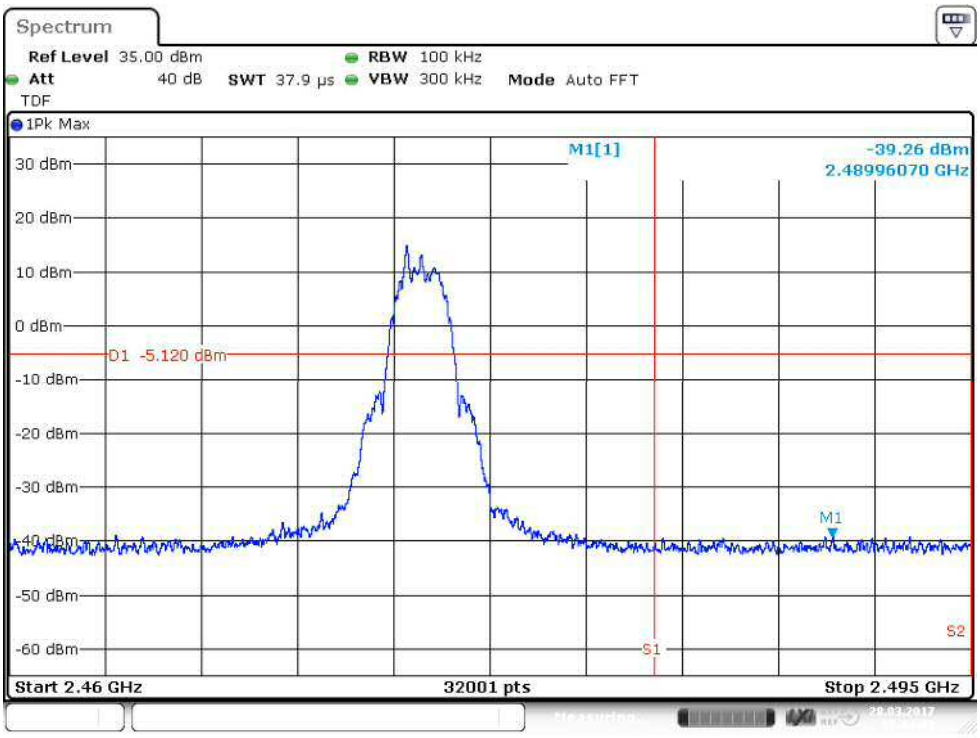

Figure 37: Upper Band Edge (high (1))

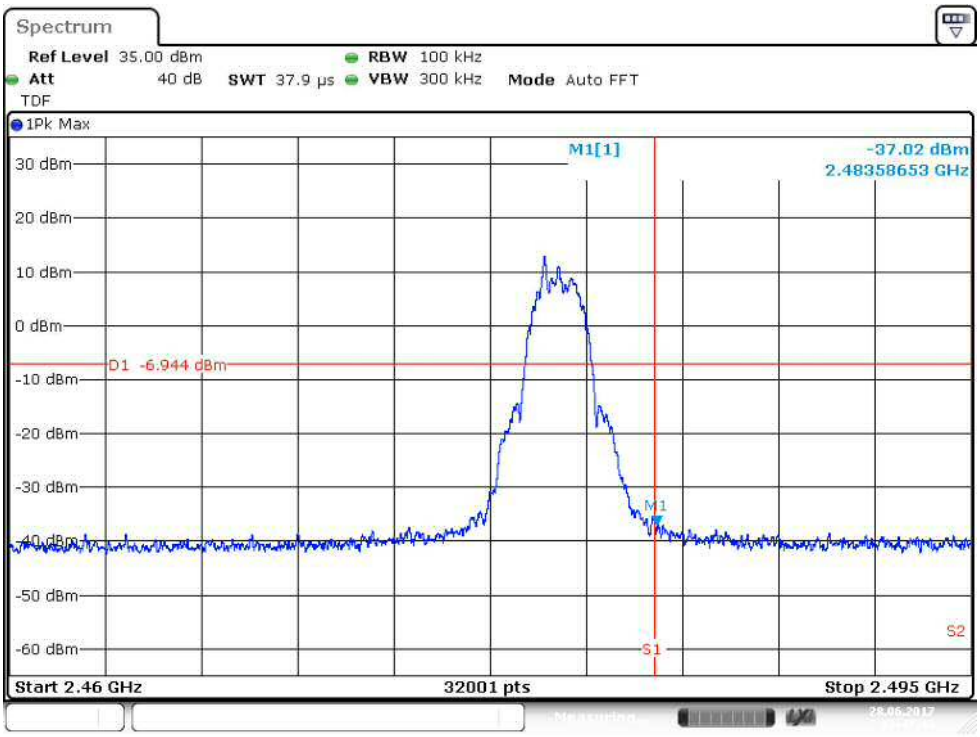

Figure 38: Upper Band Edge (high(2))

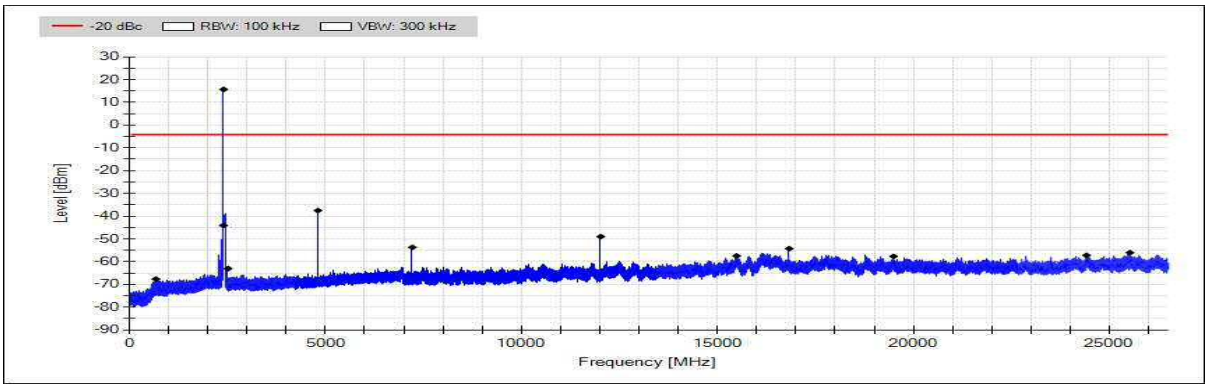

Figure 39: Conducted spurious emissions 30 - 26500 MHz channel low

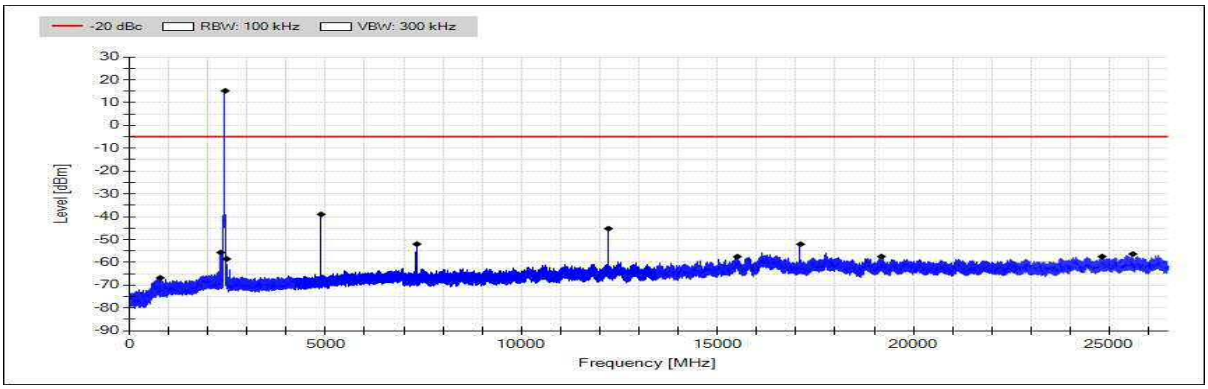

Figure 40: Conducted spurious emissions 30 - 26500 MHz channel mid

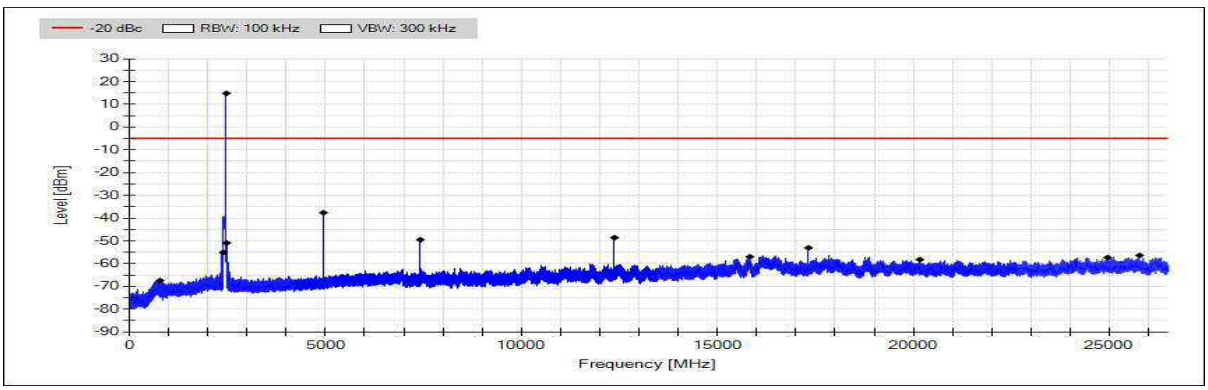

Figure 41: Conducted spurious emissions 30 - 26500 MHz channel high(1)

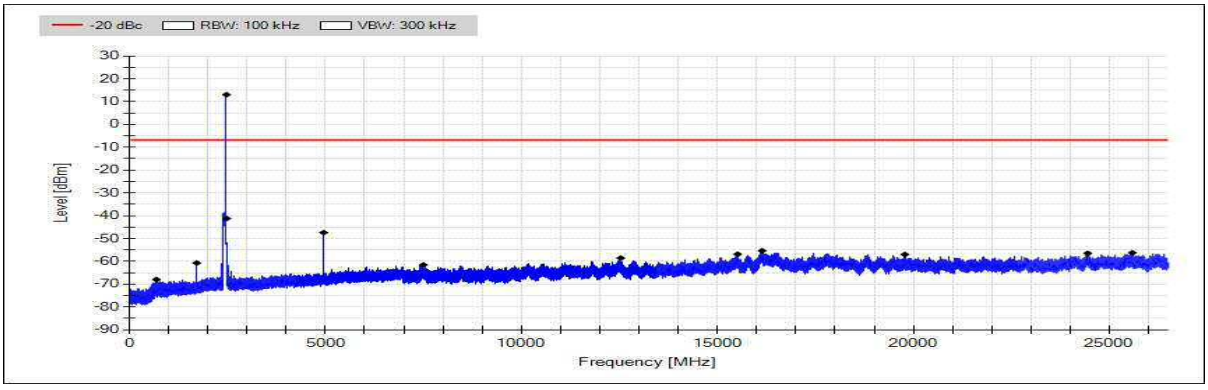

Figure 42: Conducted spurious emissions 30 - 26500 MHz channel high(2)

6 dB Bandwidth of the Channel

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	23 March 2017 - 18 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	

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

Results:

Table 28: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	1316	500
Mid	1317	
High(1)	1316	
High(2)	1320	

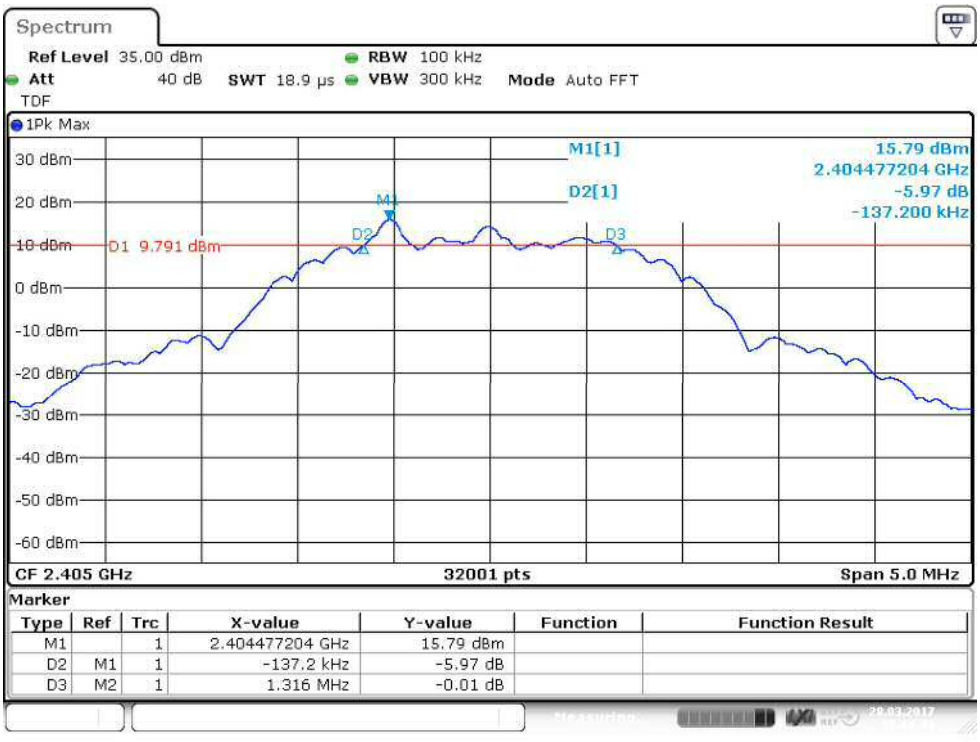

Figure 43: 6 dB bandwidth (ch low)

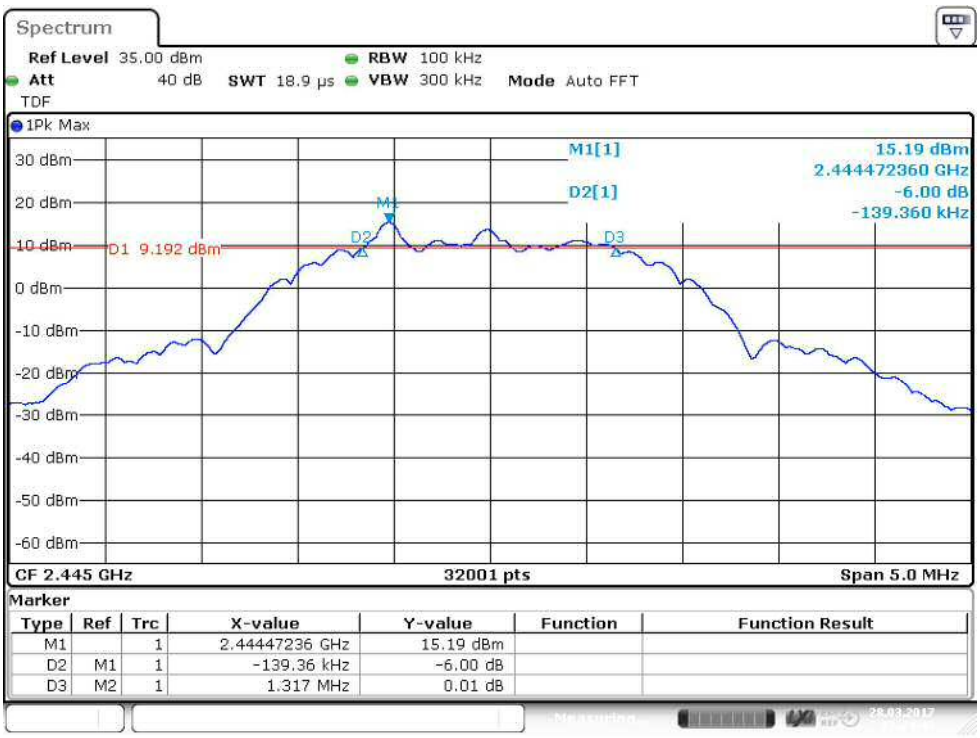

Figure 44: 6 dB bandwidth (ch mid)

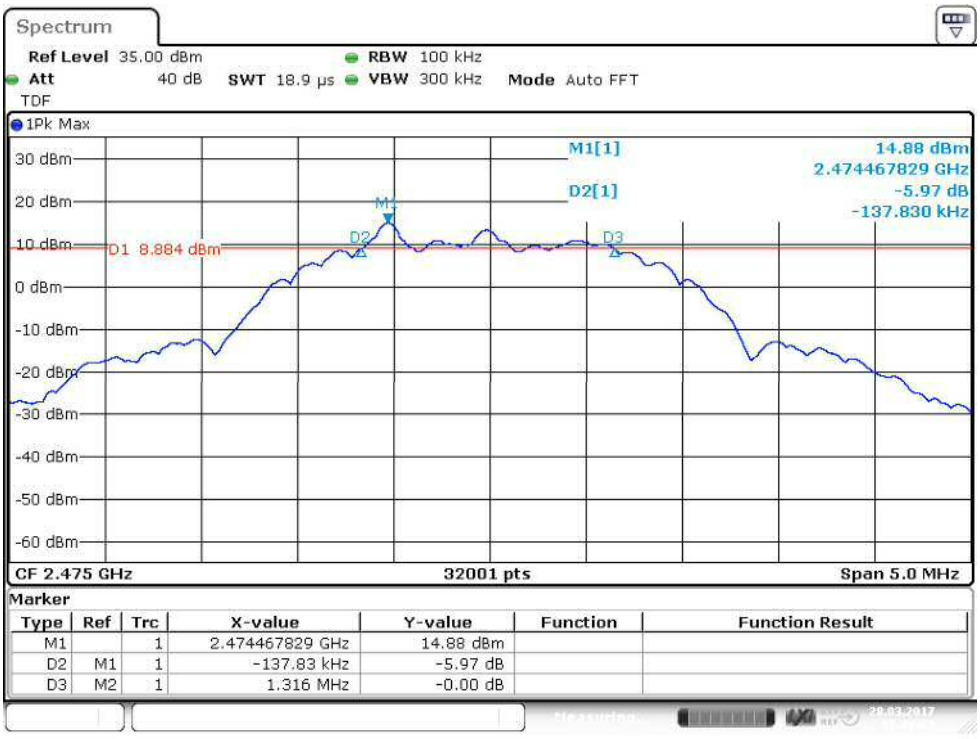

Figure 45: 6 dB bandwidth (ch high(1))

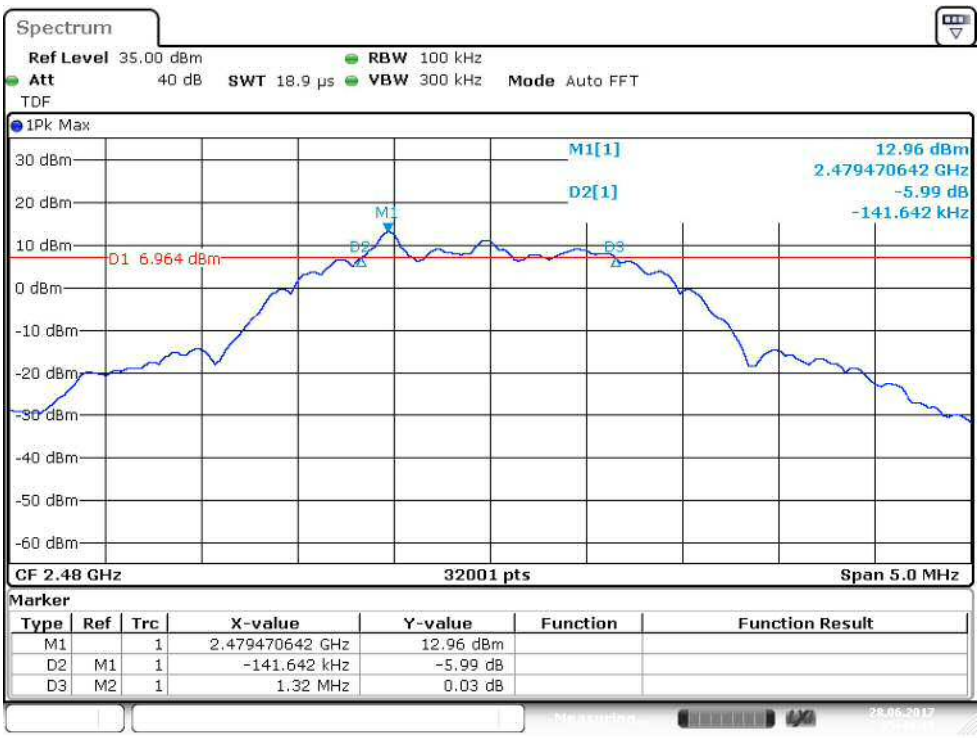

Figure 46: 6 dB bandwidth (ch high(2))

Power Spectral Density

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	28 March 2017 - 18 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	

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

Results:

Table 29: Power spectral density test results

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	+6.10	+8.00
Mid	+5.49	
High(1)	+5.19	
High(2)	+3.44	

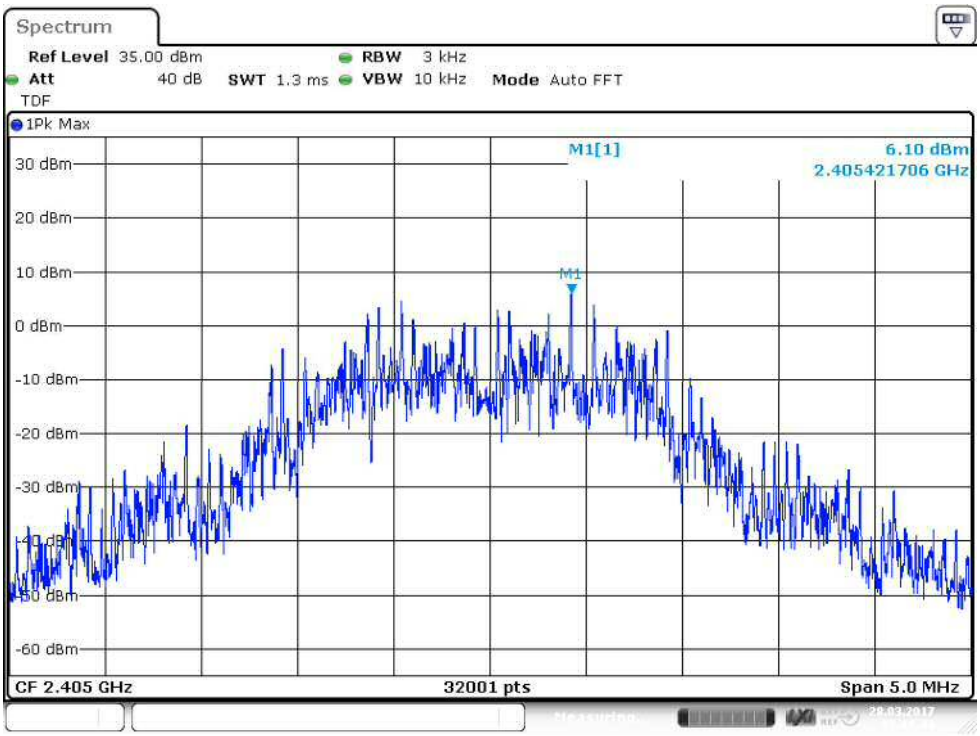

Figure 47: Power spectral density (ch low)

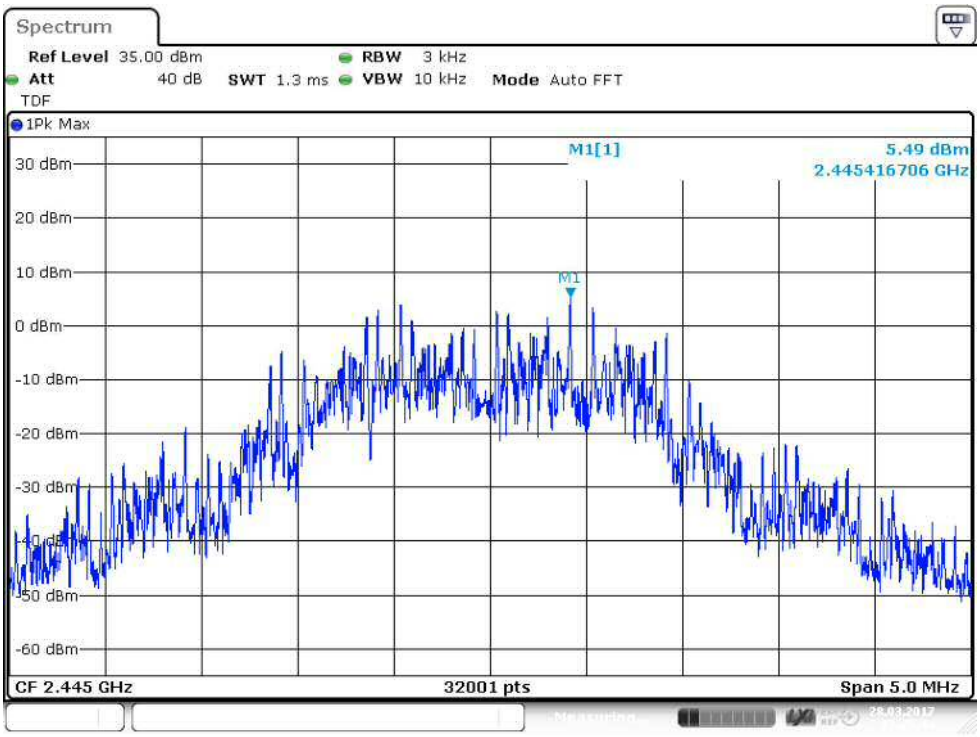

Figure 48: Power spectral density (ch mid)

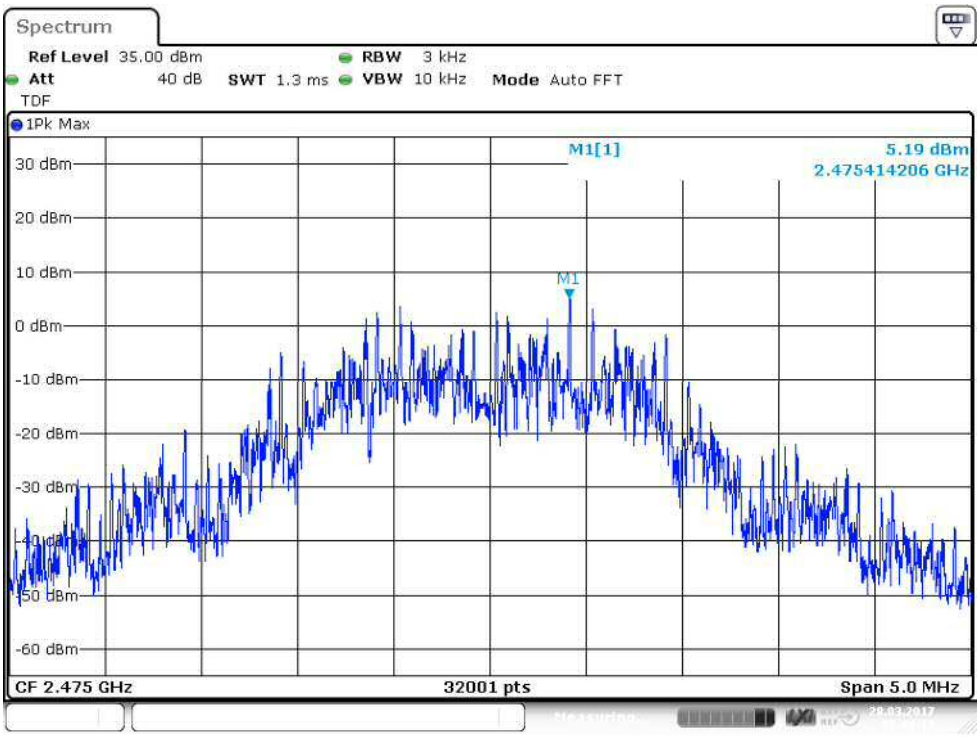

Figure 49: Power spectral density (ch high(1))

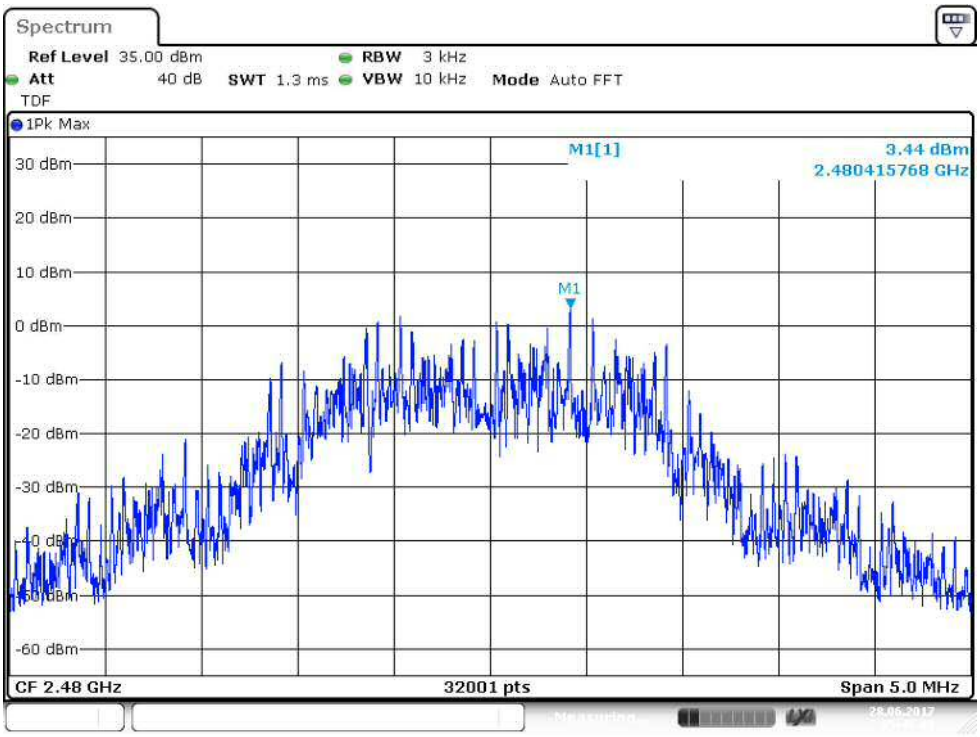

Figure 50: Power spectral density (ch high(2))

99% Occupied Bandwidth

Standard:	RSS-GEN	(2014)
Tested by:	EHA	
Date:	28 March 2017 - 18 June 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	

RSS-GEN 6.6

Table 30: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	2.219930627	PASS
Mid	-	2.231805256	PASS
High(1)	-	2.235555139	PASS
High(2)	-	2.231492766	PASS

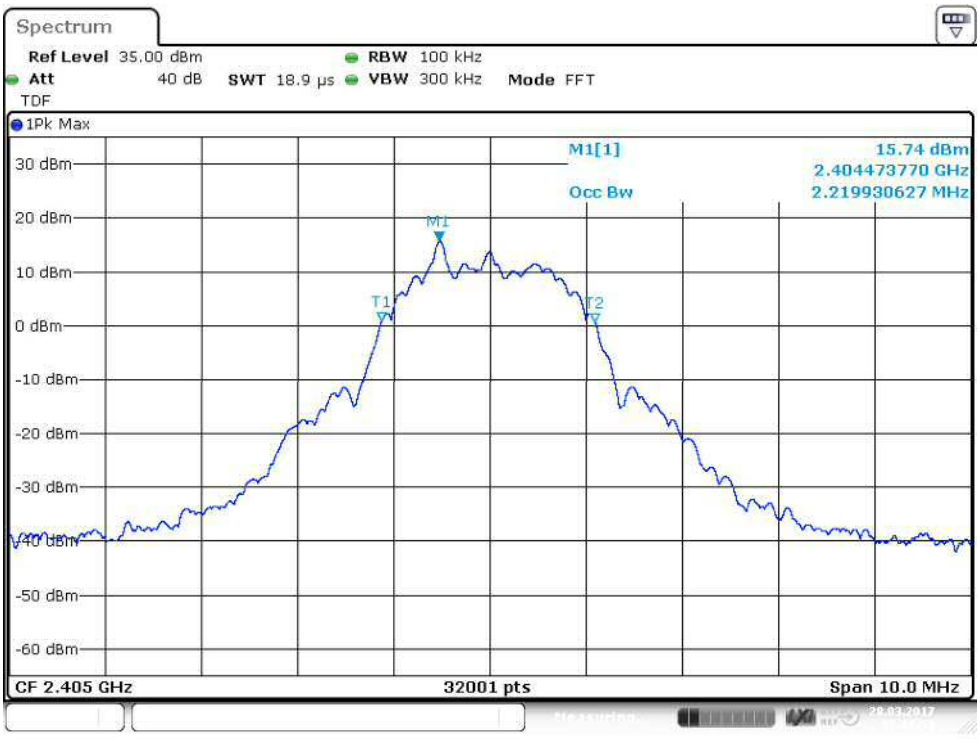

Figure 51: 99% OBW (ch low)

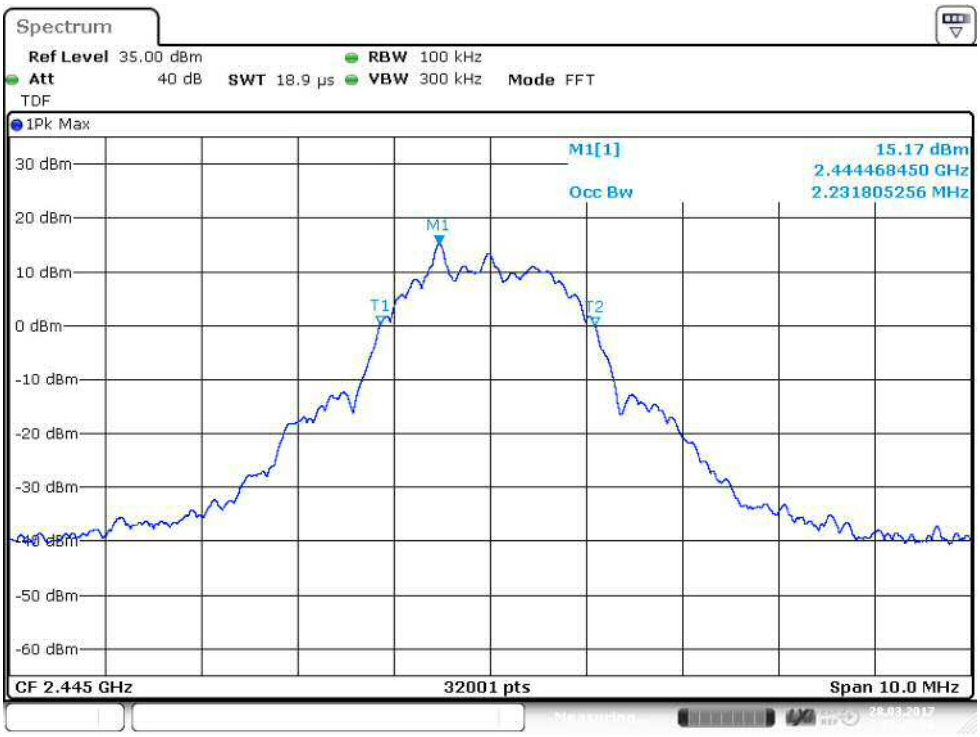

Figure 52: 99% OBW (ch mid)

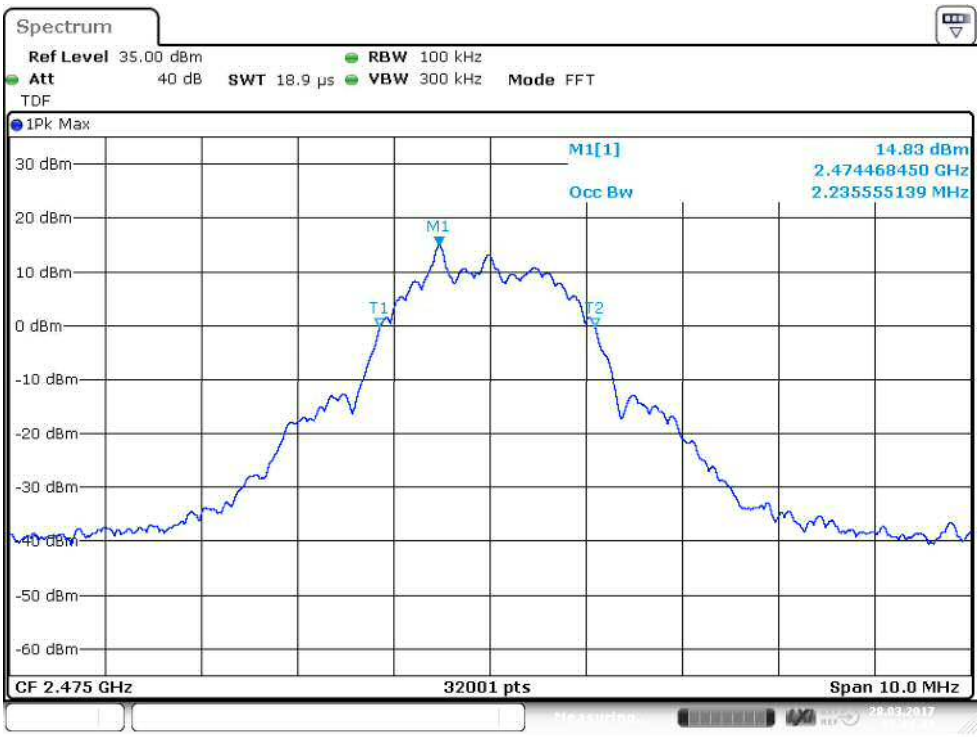

Figure 53: 99% OBW (ch high(1))

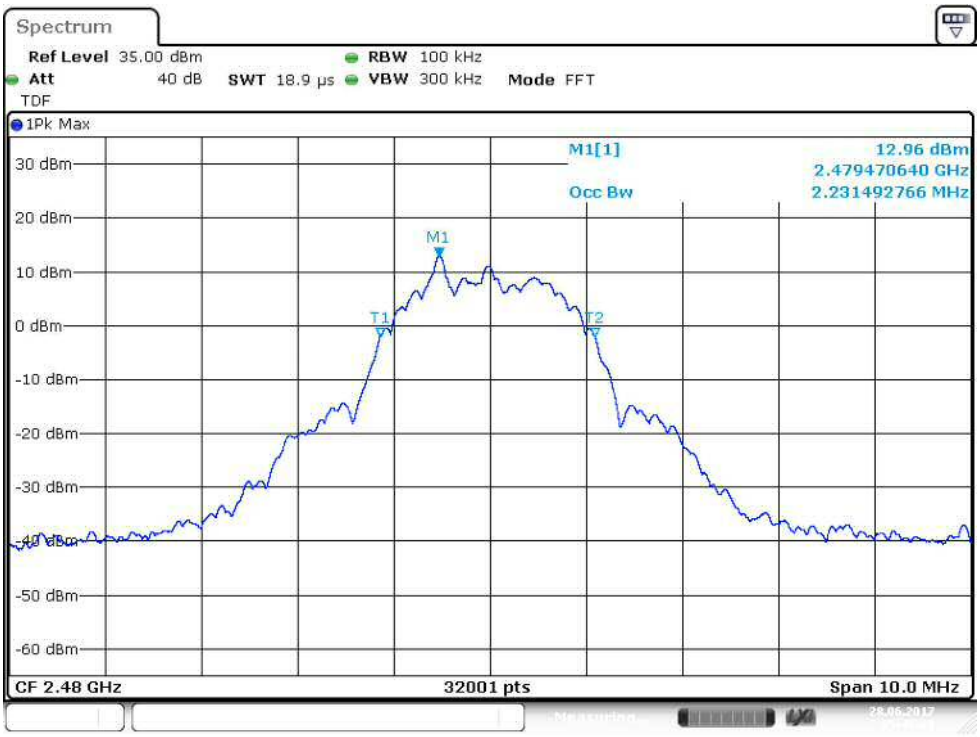

Figure 54: 99% OBW (ch high(2))

TEST EQUIPMENT

RF-Test Equipment

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2016-11-28	2017-11-28
POWER SUPPLY	DELTA	SM 130-25D	inv:10406	-	-
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2017-03-16	2018-03-16
ANTENNA	ETS LINDGREN	3160-10	inv:9151	2013-08-06	2018-08-06
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
ATTENUATOR	PASTERNACK	10dB DC-40GHz	-	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2016-06-10	2017-07-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2016-06-10	2017-07-10
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2016-10-25	2018-10-25
TEMPERATURE/ HUMIDITY METER	VAISALA	HMT 333	inv:8638	2017-02-21	2018-02-21
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv:10403	2017-03-01	2019-03-01