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:	Bluetooth Smart Module
Model:	BGM11S1A BGM11S2A BGM11S1N BGM11S2N
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:	5 May 2017	Date:	5 May 2017
Issued by:	Rauno Repo Testing Engineer	Checked by:	Emil Haverinen Testing Engineer

Table of Contents

Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	BGM11S1A, BGM11S2A, BGM11S1N, BGM11S2N
Type:	Bluetooth Smart Module
Serial no:	-
FCC ID:	QOQ11
IC:	5123A-11

Description of the EUT

BGM11S1A, BMG11S2A, BGM11S1N and BGM11S2N is a family of Bluetooth 4.2 compliant Bluetooth SiP modules. The difference between A-variant and N-variant modules is that A has integrated antenna and N has RF connector for use of external antenna. Max power for S1 variants is 3 dBm and for S2 variants 10 dBm.

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
Effective conducted power:	10.29 dBm (Peak)
Transmission technique:	DSSS
Modulation:	GFSK
Integral Antenna gain:	A-variant: 1 dBi
External Antenna gain:	N-variant: 2.14 dBi

Power Supply

Operating voltage range: 2.0 - 3.8 VDC (tested with 3.32V 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: 6 mm

Samples

Two samples were used in the tests (Internal antenna and External antenna model). Power settings were set according to the model under test. Development board was used in all other tests except radiated spurious emissions with internal antenna model.

Disclaimer

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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. Tests were performed using power setting 104 (S2-variants) and 30 (S1-variants).

Conducted measurements were performed to N-variant while SMA adapter with a short cable was connected to EUTs RF connector.

Radiated measurements were performed to both variants. General 2.14 dBi antenna was connected to RF connector of N-variants with a short RF cable. A-variants were using integrated 1 dBi antenna.

During transmitter spurious emissions test for A-variant, the sample was removed from the development board and tested separately.

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

Channel Low (Ch 0) = 2402 MHz

Channel Mid (Ch 19) = 2440 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

TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	28 February 2017	
Temperature:	22 °C	
Humidity:	20 % RH	
Barometric pressure:	990 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

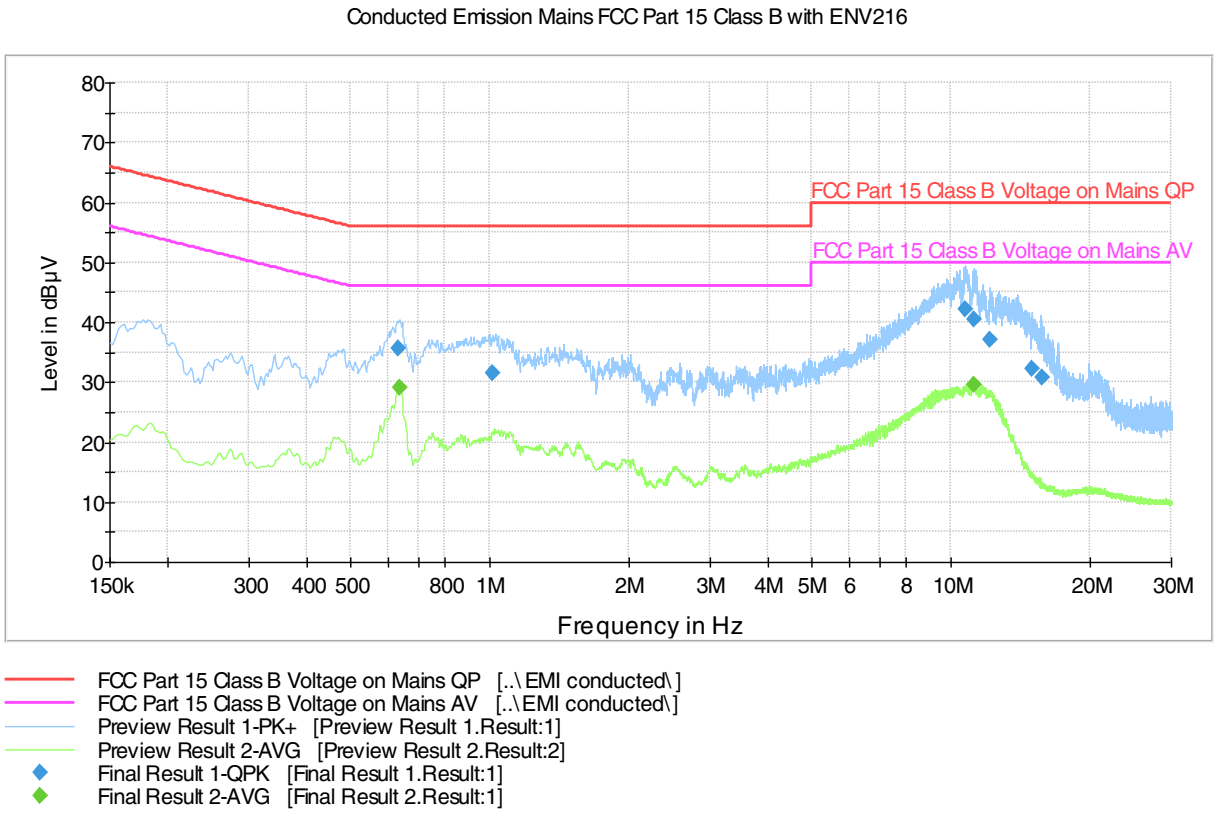

Figure 1: The measured curves with peak- and average detector.

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)
0.634500	35.7	1000.0	9.000	L1	10.1	20.3	56.0
1.012750	31.5	1000.0	9.000	L1	10.0	24.5	56.0
10.709750	42.1	1000.0	9.000	N	10.6	17.9	60.0
11.195500	40.6	1000.0	9.000	N	10.6	19.4	60.0
12.123500	37.1	1000.0	9.000	N	10.6	22.9	60.0
14.980750	32.3	1000.0	9.000	N	10.6	27.7	60.0
15.703250	30.9	1000.0	9.000	N	10.6	29.1	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)
0.639750	29.1	1000.0	9.000	L1	10.1	16.9	46.0
11.182250	29.7	1000.0	9.000	N	10.6	20.3	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	MIH
Date:	23 February 2017	28 February 2017
Temperature:	23 ± 3 °C	23 ± 3 °C
Humidity:	20 - 60 % RH	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 (power setting 104)

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	10.29	30	19.71	PASS
Mid	9.75	30	20.25	PASS
High	9.45	30	20.55	PASS

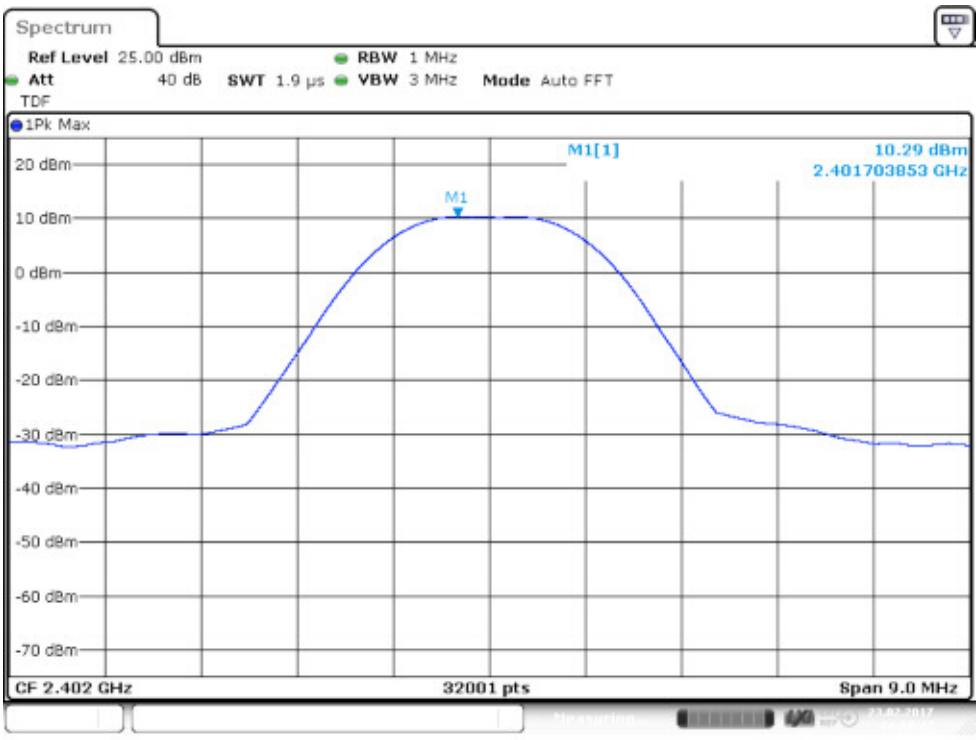

Figure 2: Conducted power (ch low)

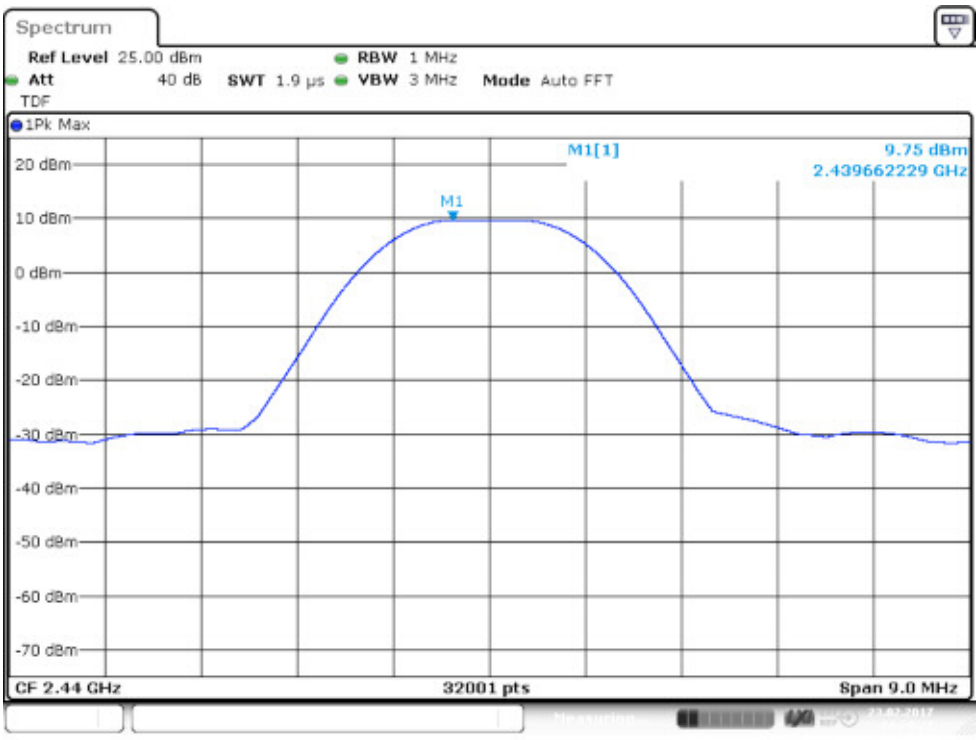

Figure 3: Conducted power (ch mid)

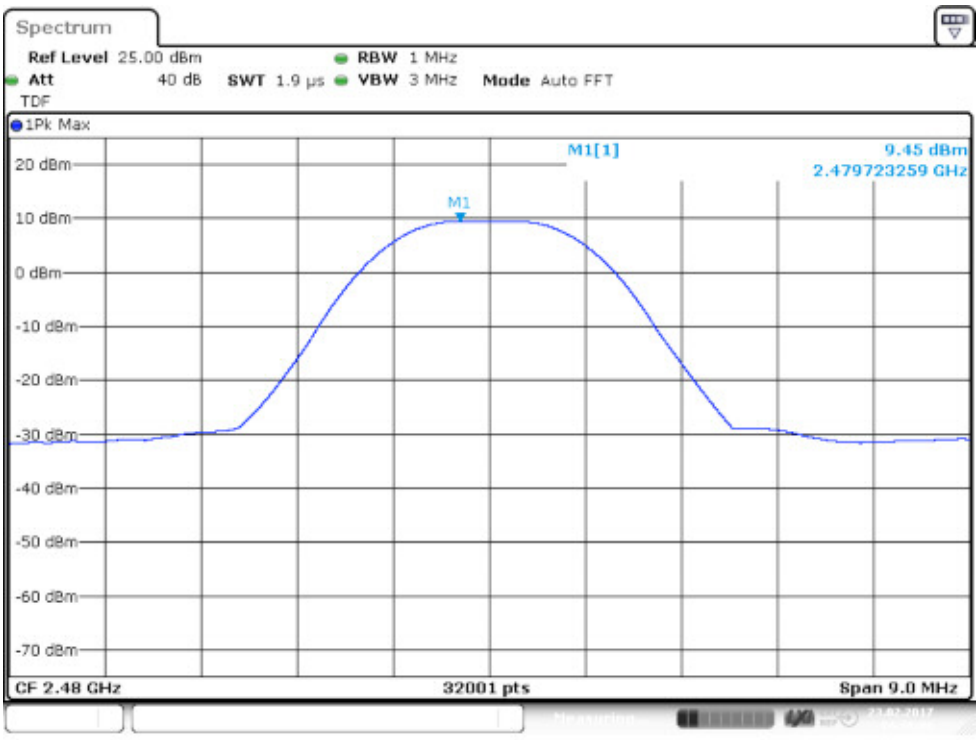

Figure 4: Conducted power (ch high)

Table 4: Maximum conducted output power (power setting 30)

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	1.90	30	28.10	PASS
Mid	1.49	30	28.51	PASS
High	1.23	30	28.77	PASS

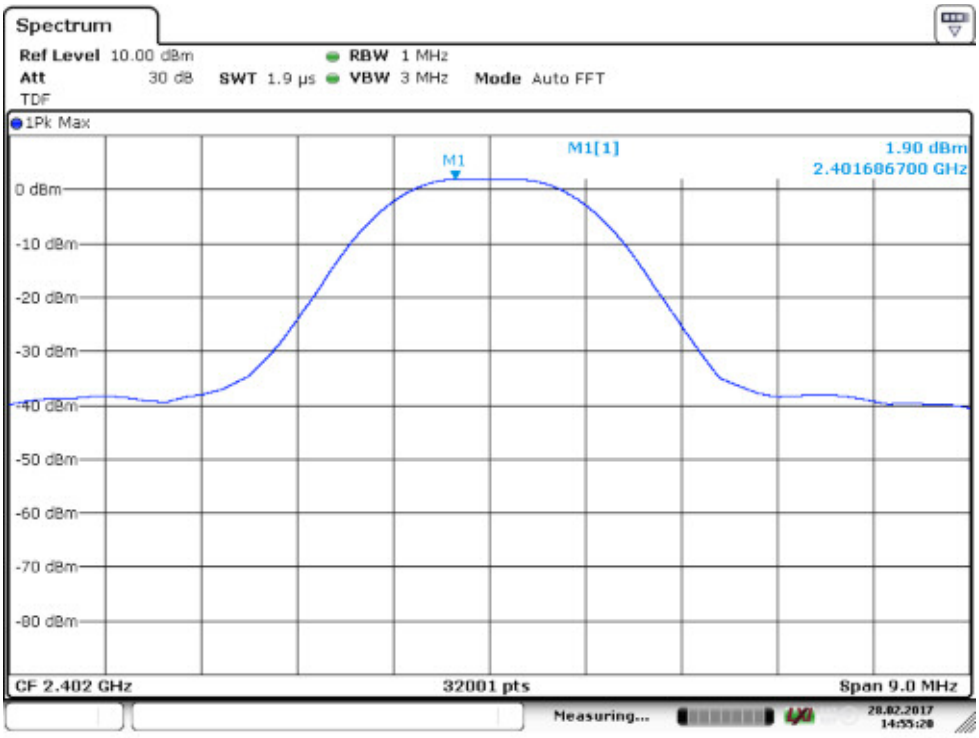

Figure 5: Conducted power (ch low)

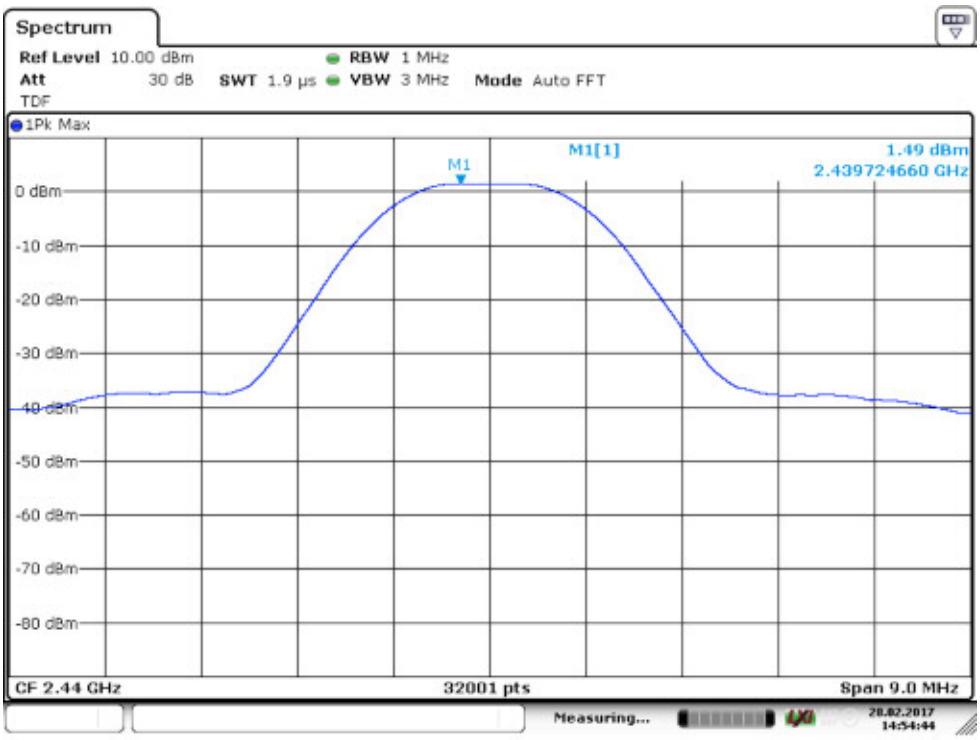

Figure 6: Conducted power (ch mid)

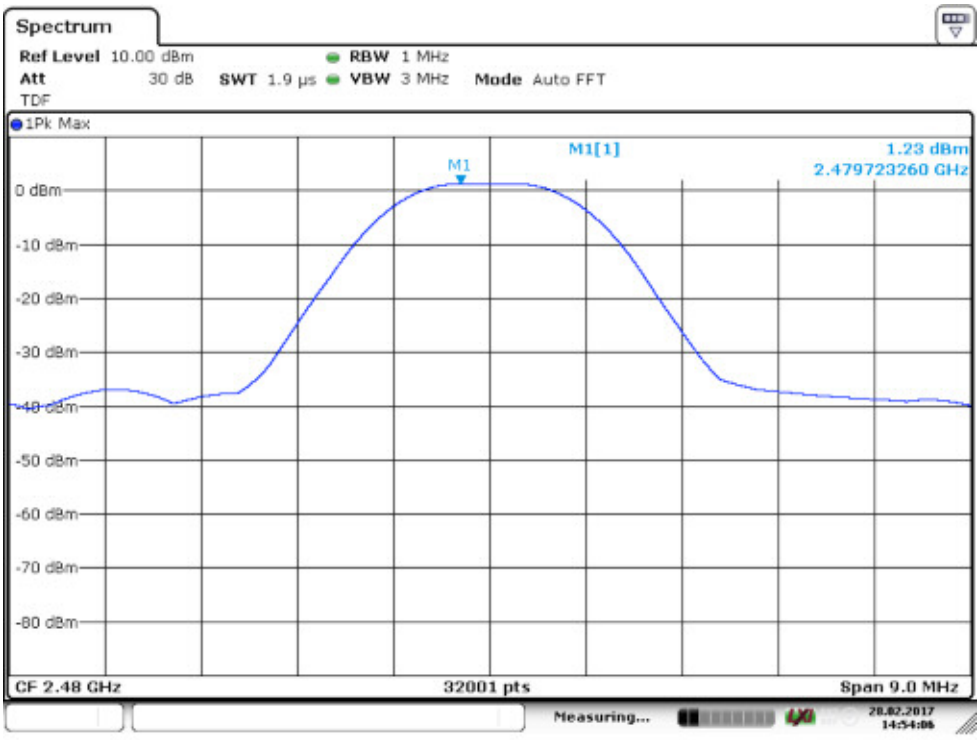

Figure 7: Conducted power (ch low)

Transmitter Radiated Spurious Emissions 30 - 26500 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	RRE / EHA	
Date:	20 – 22 February 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, A-variant (power setting 104)

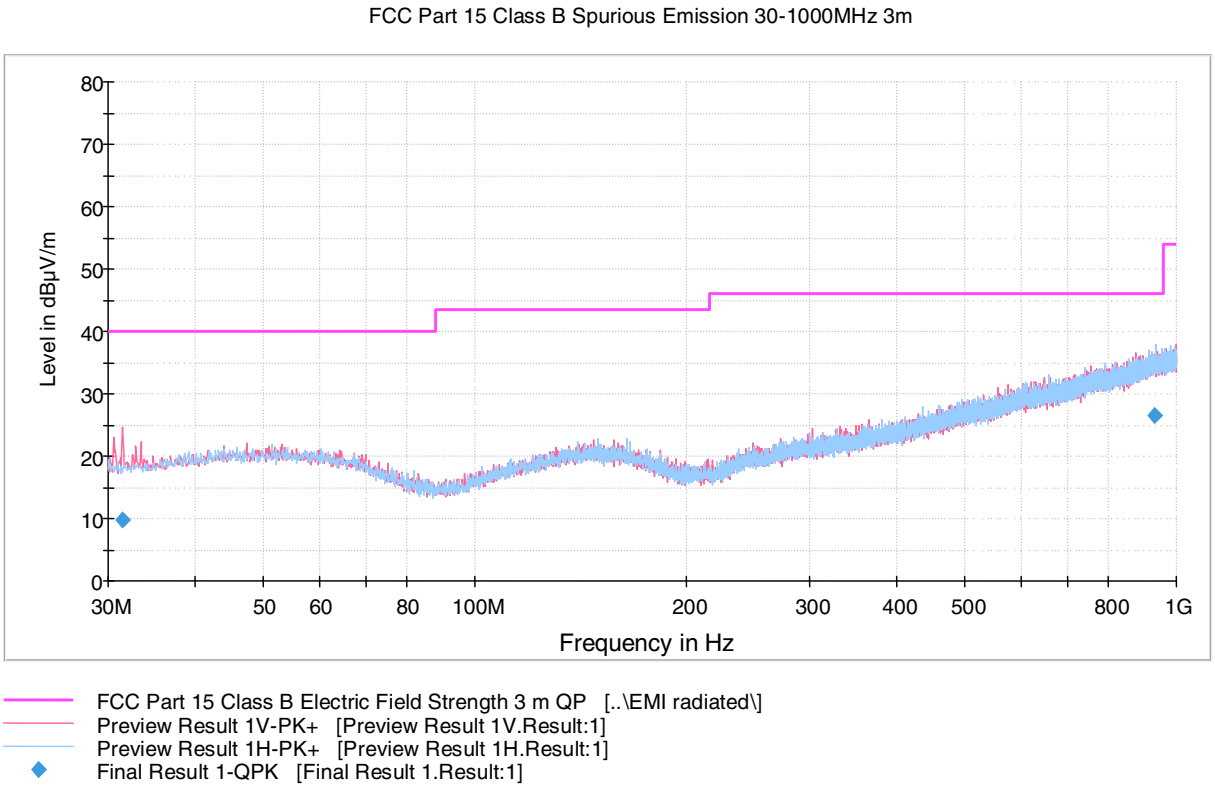

Figure 8: Low channel 30 MHz – 1000 MHz

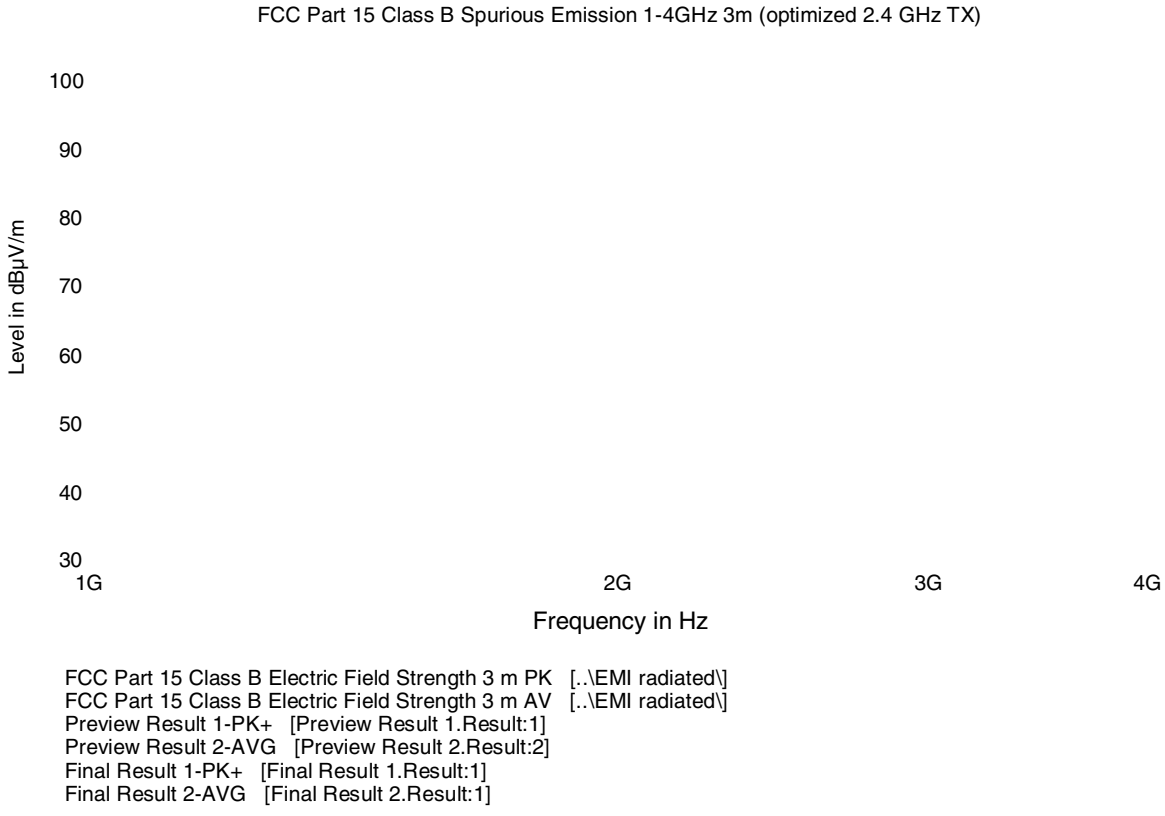

Figure 9: Low channel 1 GHz – 4 GHz

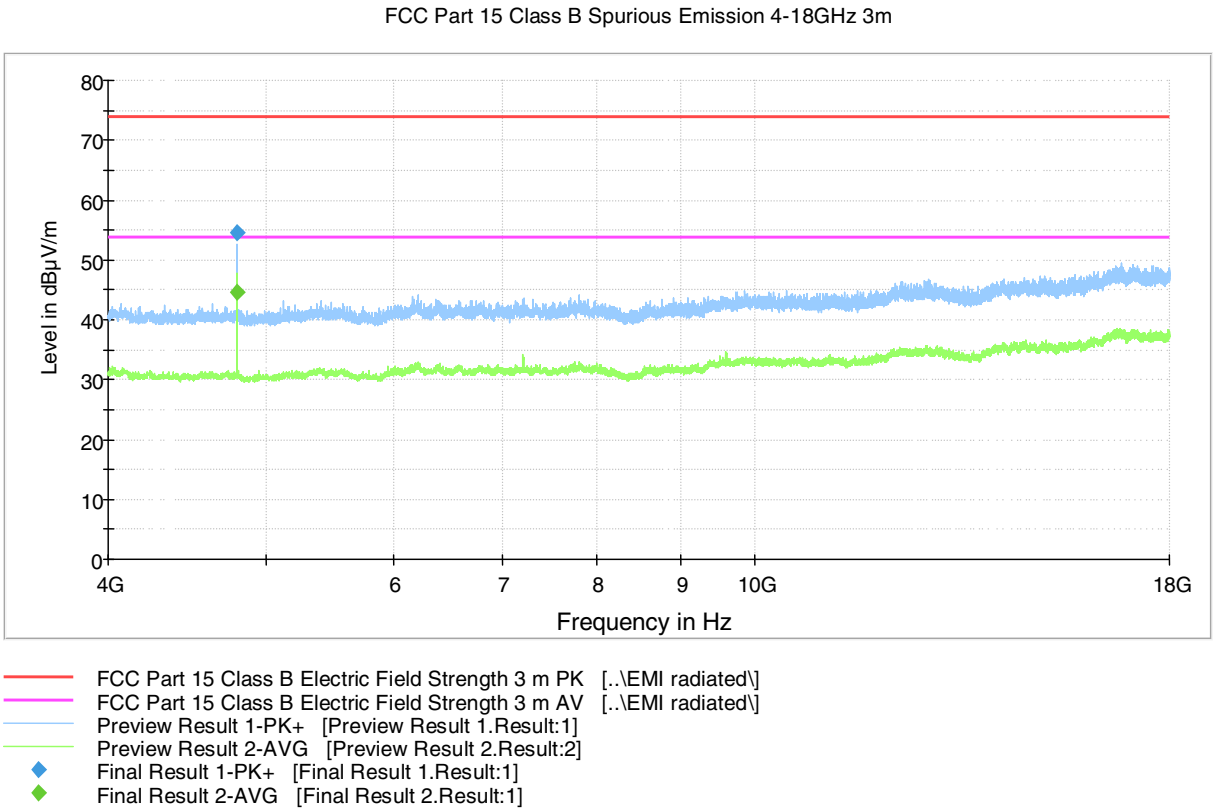

Figure 10: Low channel 4 GHz – 18 GHz

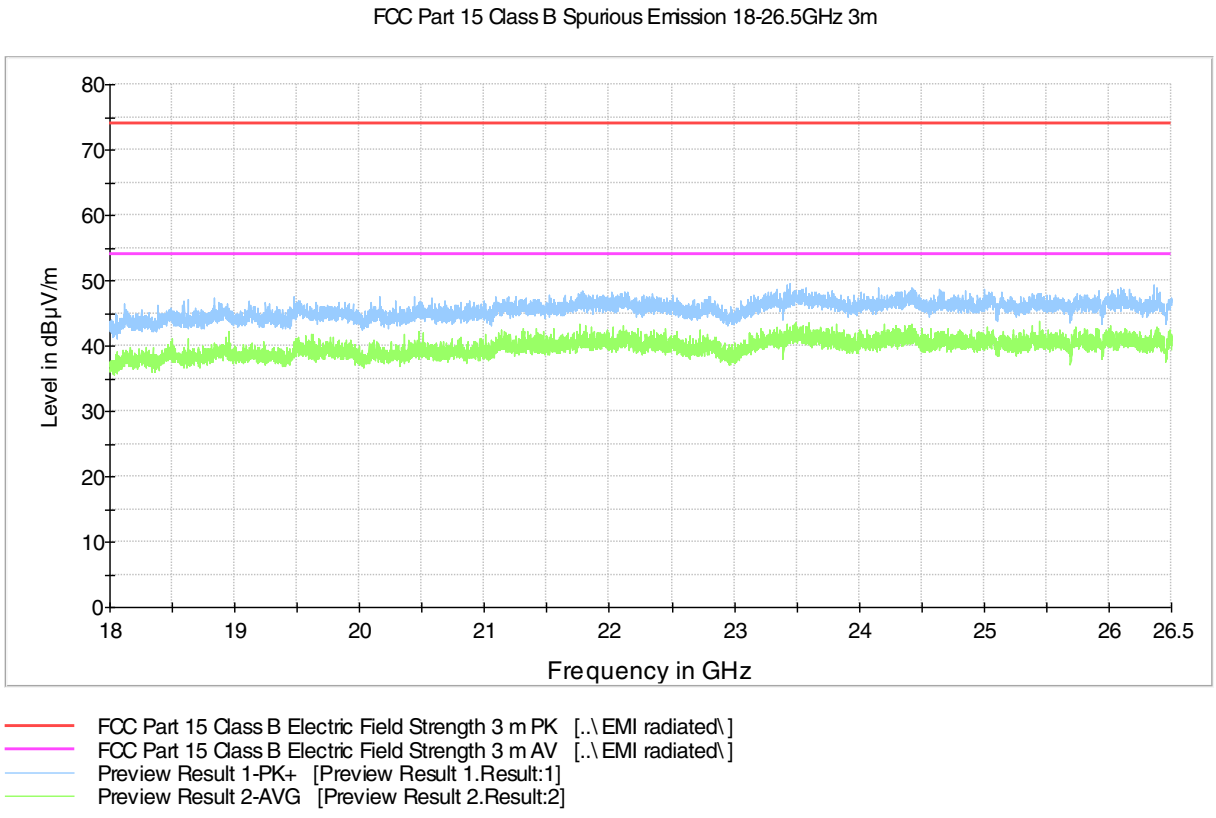

Figure 11: Low channel 18 GHz – 26.5 GHz

Table 5: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.535000	9.7	1000.0	120.000	317.0	V	167.0	13.1	30.3	40.0
932.781000	26.5	1000.0	120.000	138.0	H	275.0	27.6	19.5	46.0

Table 6: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2382.600000	49.5	1000.0	1000.000	400.0	V	109.0	14.9	24.4	73.9
2400.000000	59.1	1000.0	1000.000	254.0	H	86.0	15.1	14.8	73.9
4804.500000	54.6	1000.0	1000.000	150.0	H	105.0	8.9	19.3	73.9

Table 7: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2382.800000	35.9	1000.0	1000.000	400.0	V	279.0	14.9	18.0	53.9
2400.000000	42.6	1000.0	1000.000	280.0	H	85.0	15.1	11.3	53.9
4804.000000	44.6	1000.0	1000.000	150.0	H	106.0	8.9	9.3	53.9

Middle channel, A-variant (power setting 104)

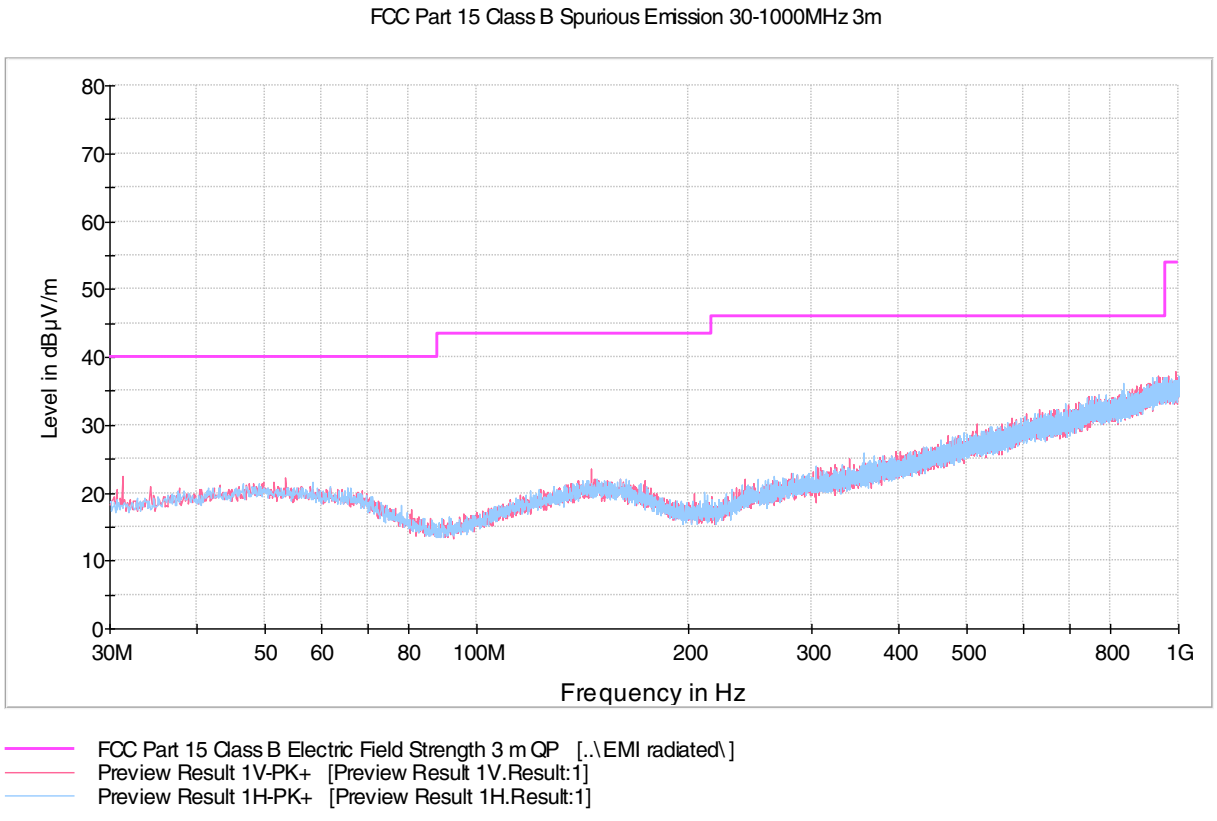

Figure 12: Mid channel 30 MHz – 1000 MHz

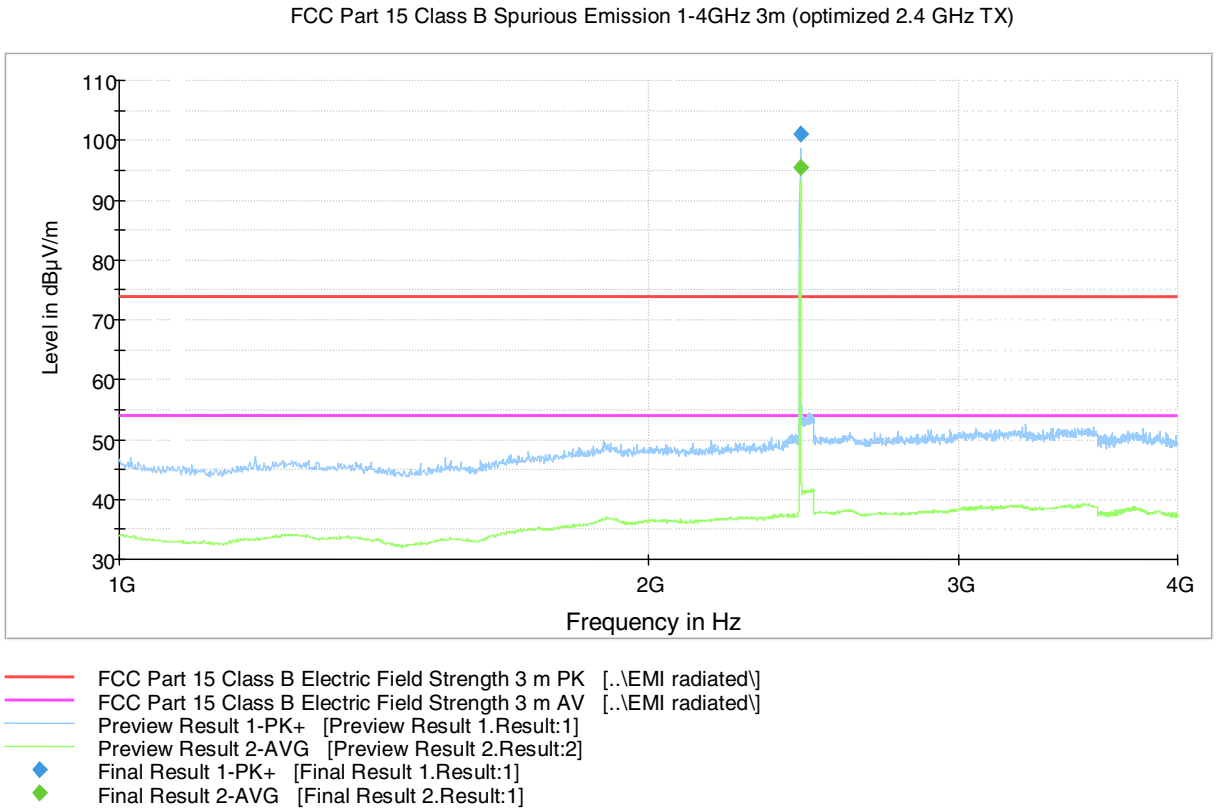

Figure 13: Mid channel 1 GHz – 4 GHz

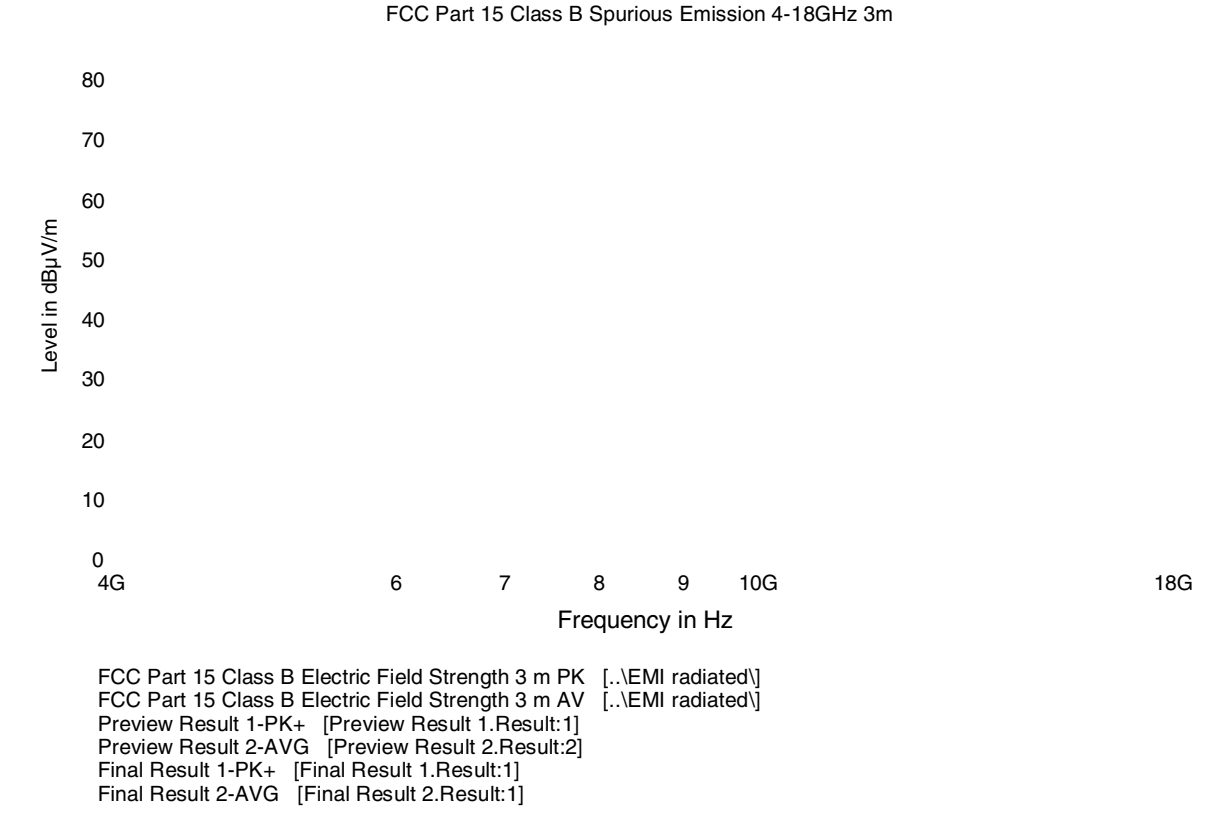

Figure 14: Mid channel 4 GHz – 18 GHz

Figure 15: Mid channel 18 GHz – 26.5 GHz

Table 8: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4879.400000	52.8	1000.0	1000.000	166.0	H	119.0	8.9	21.1	73.9
7320.600000	46.8	1000.0	1000.000	150.0	V	182.0	12.7	27.1	73.9
16772.60000	50.8	1000.0	1000.000	288.0	V	336.0	27.3	23.1	73.9

Table 9: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4879.900000	42.5	1000.0	1000.000	166.0	H	119.0	8.9	11.4	53.9
7319.200000	34.6	1000.0	1000.000	150.0	V	159.0	12.7	19.3	53.9
16711.10000	36.1	1000.0	1000.000	150.0	H	235.0	27.1	17.8	53.9

High channel, A-variant (power setting 104)

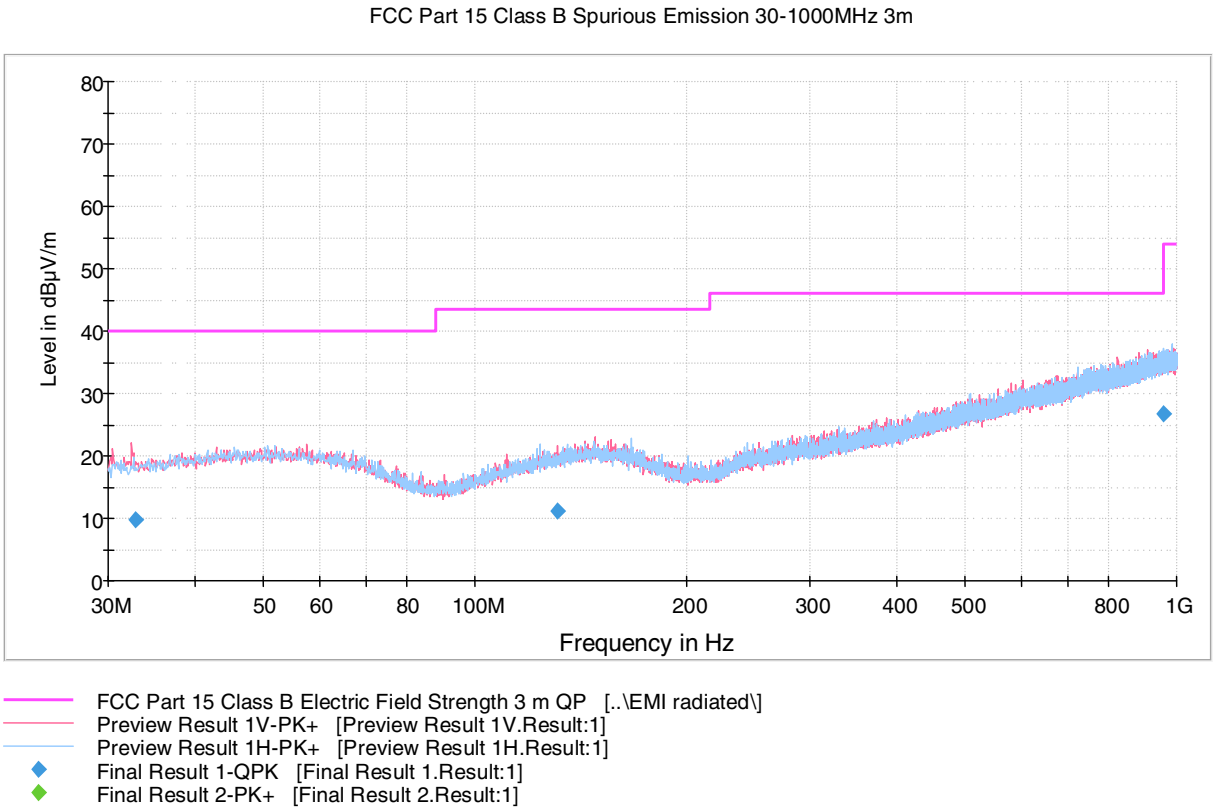

Figure 16: High channel 30 MHz – 1000 MHz

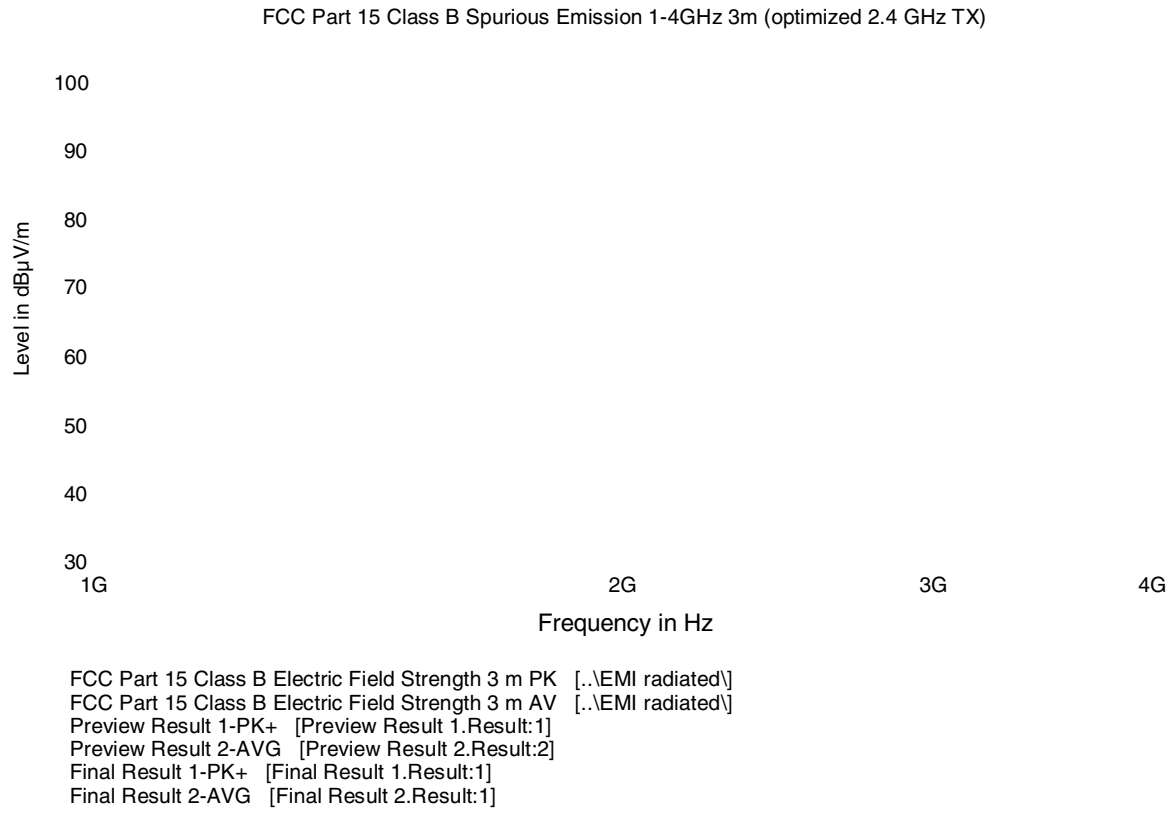

Figure 17: High channel 1 GHz – 4 GHz

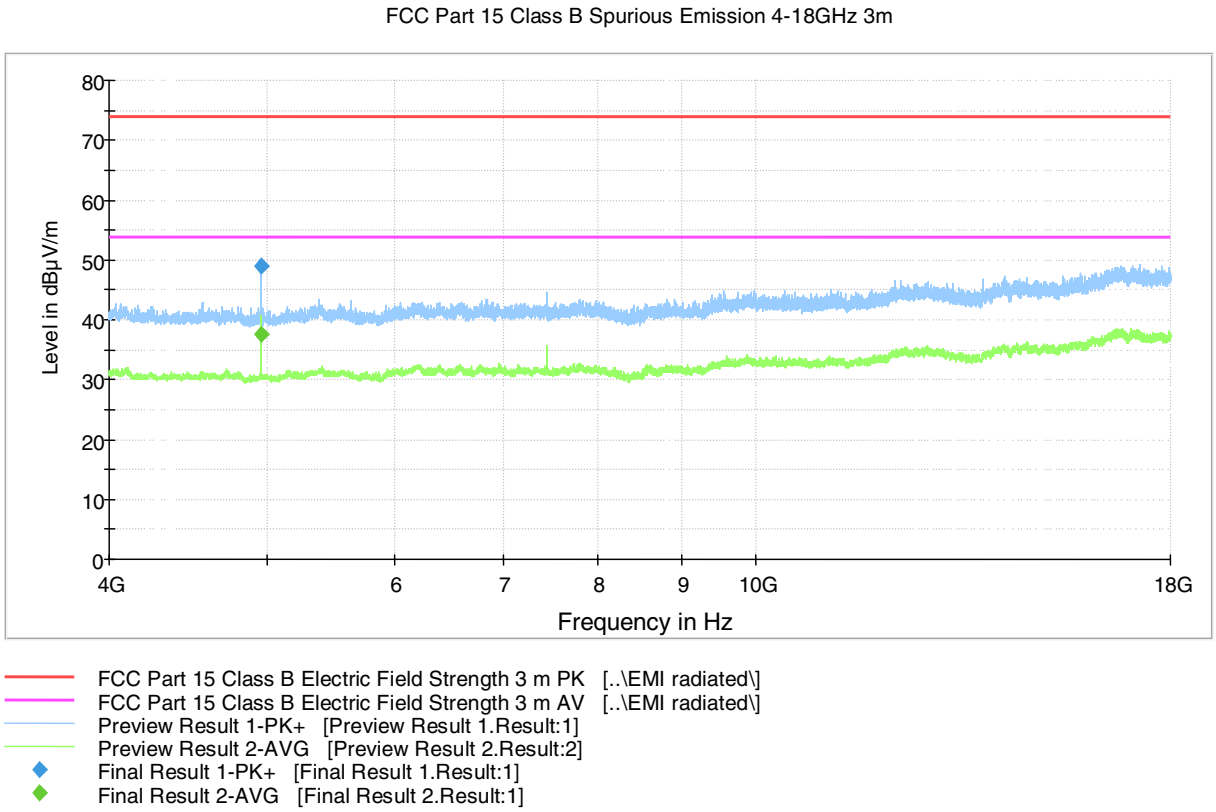

Figure 18: High channel 4 GHz – 18 GHz

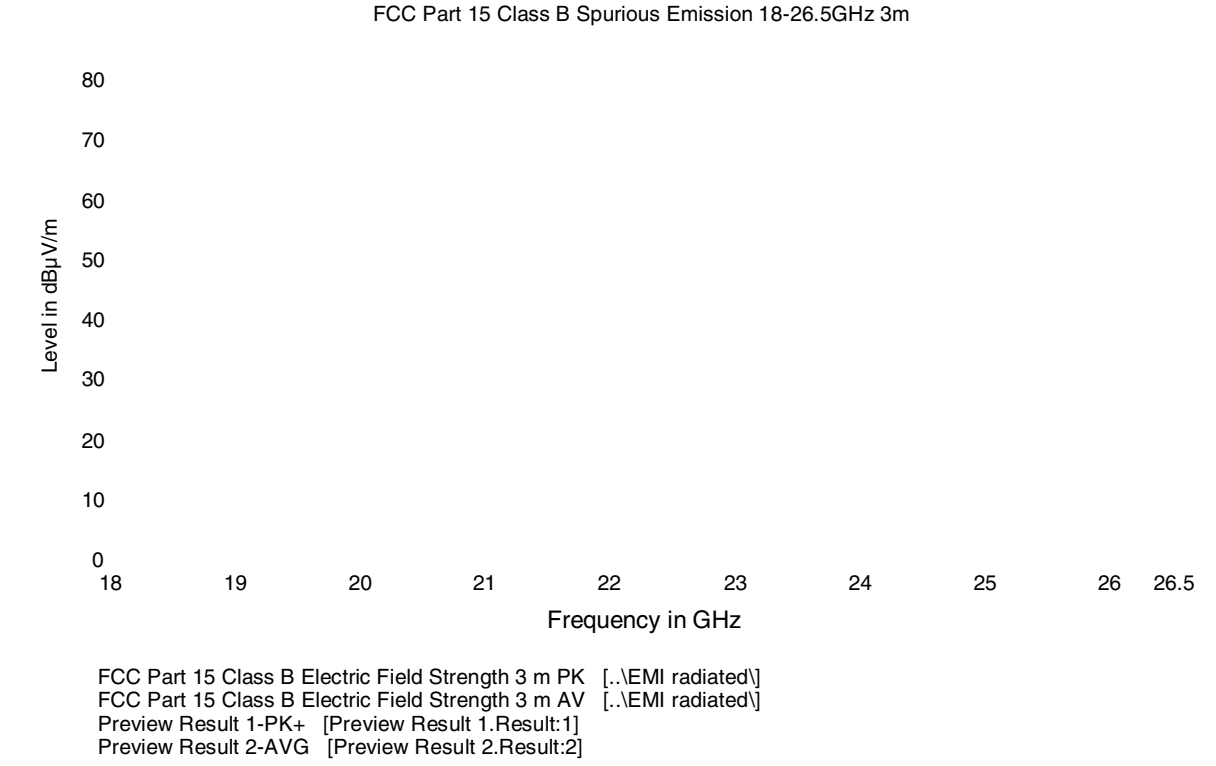

Figure 19: High channel 18 GHz – 26.5 GHz

Table 10: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
32.785000	9.8	1000.0	120.000	339.0	V	166.0	13.2	30.2	40.0
131.308000	11.1	1000.0	120.000	304.0	V	76.0	13.4	32.4	43.5
957.154000	26.8	1000.0	120.000	330.0	H	92.0	27.8	19.2	46.0

Table 11: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.700000	55.2	1000.0	1000.000	150.0	H	237.0	15.1	18.7	73.9
4959.400000	49.1	1000.0	1000.000	257.0	H	115.0	8.8	24.8	73.9

Table 12: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	39.1	1000.0	1000.000	241.0	H	235.0	15.1	14.8	53.9
4959.900000	37.7	1000.0	1000.000	232.0	H	120.0	8.8	16.2	53.9

Radiated Band Edge results, A-variant (power setting 104)

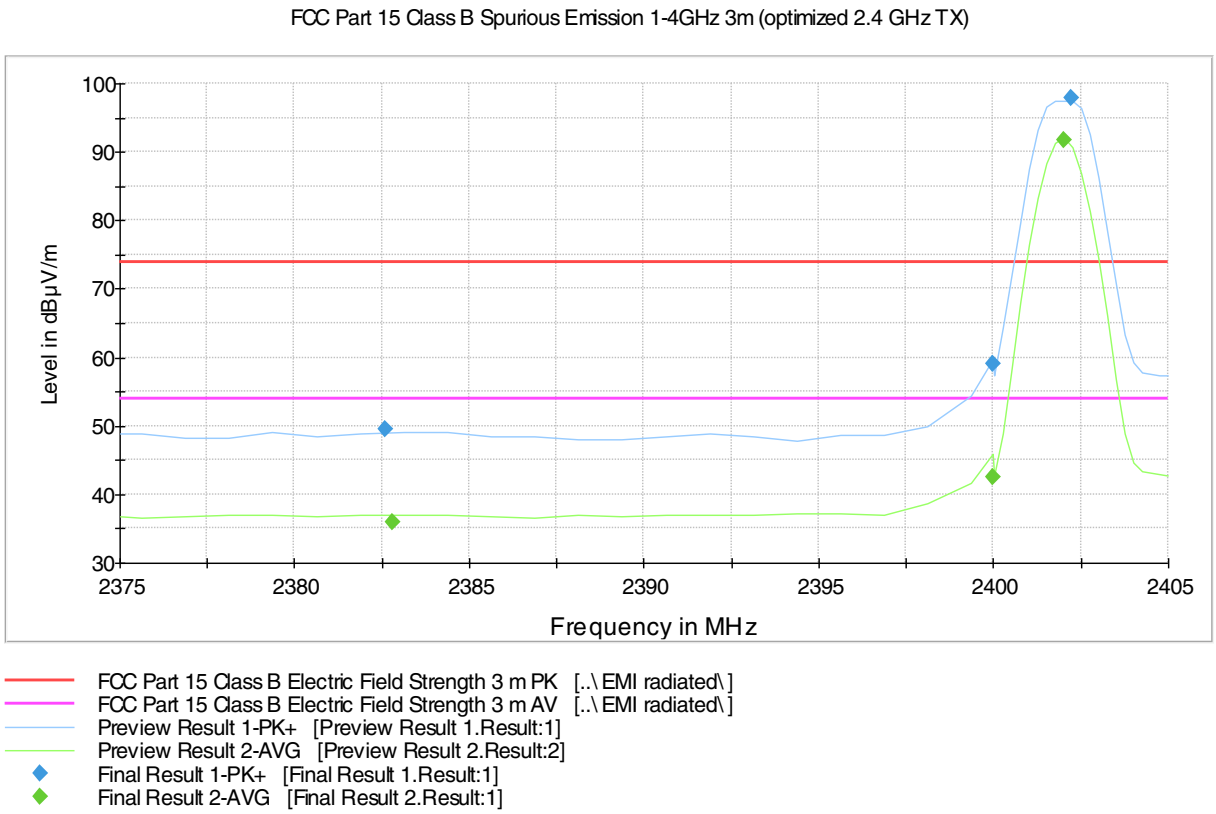

Figure 20: Radiated Band Edge measurement graph (ch low), A-variant

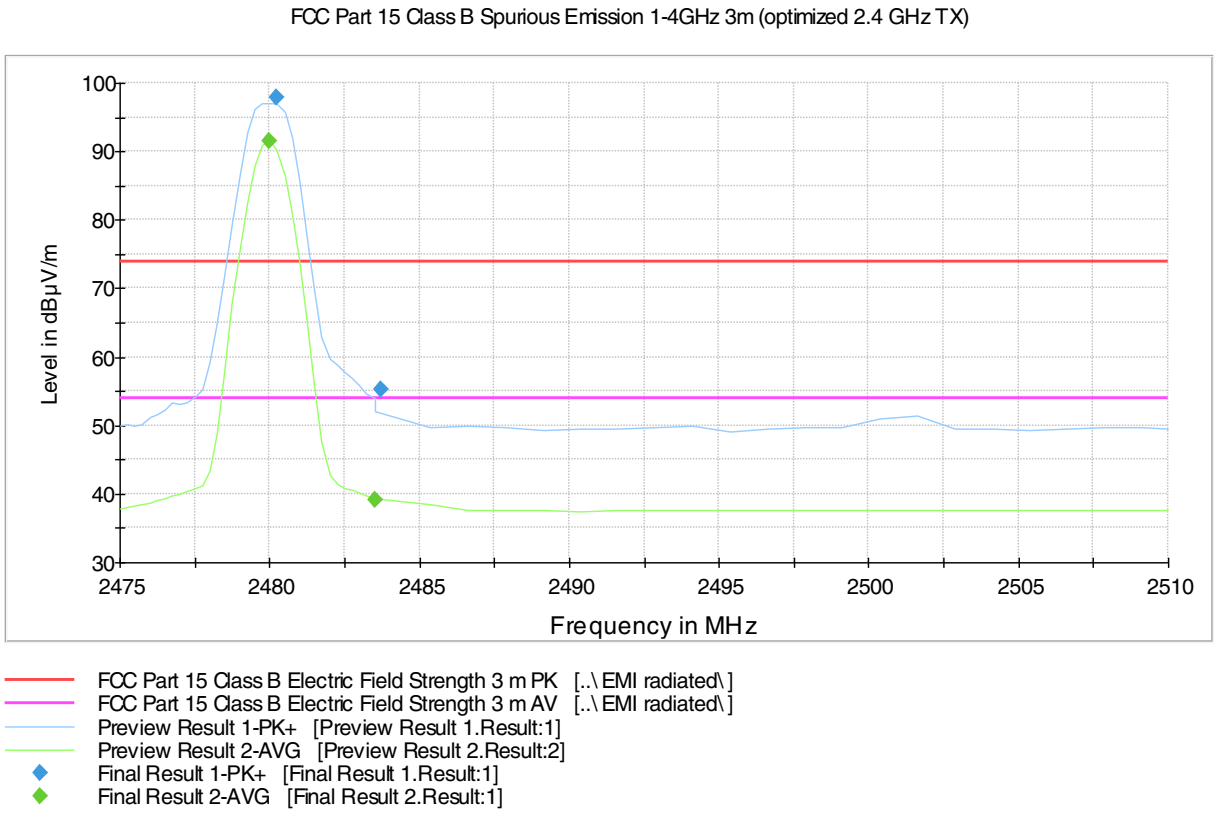

Figure 21: Radiated Band Edge measurement graph (ch low), A-variant

Low channel, N-variant (power setting 104)

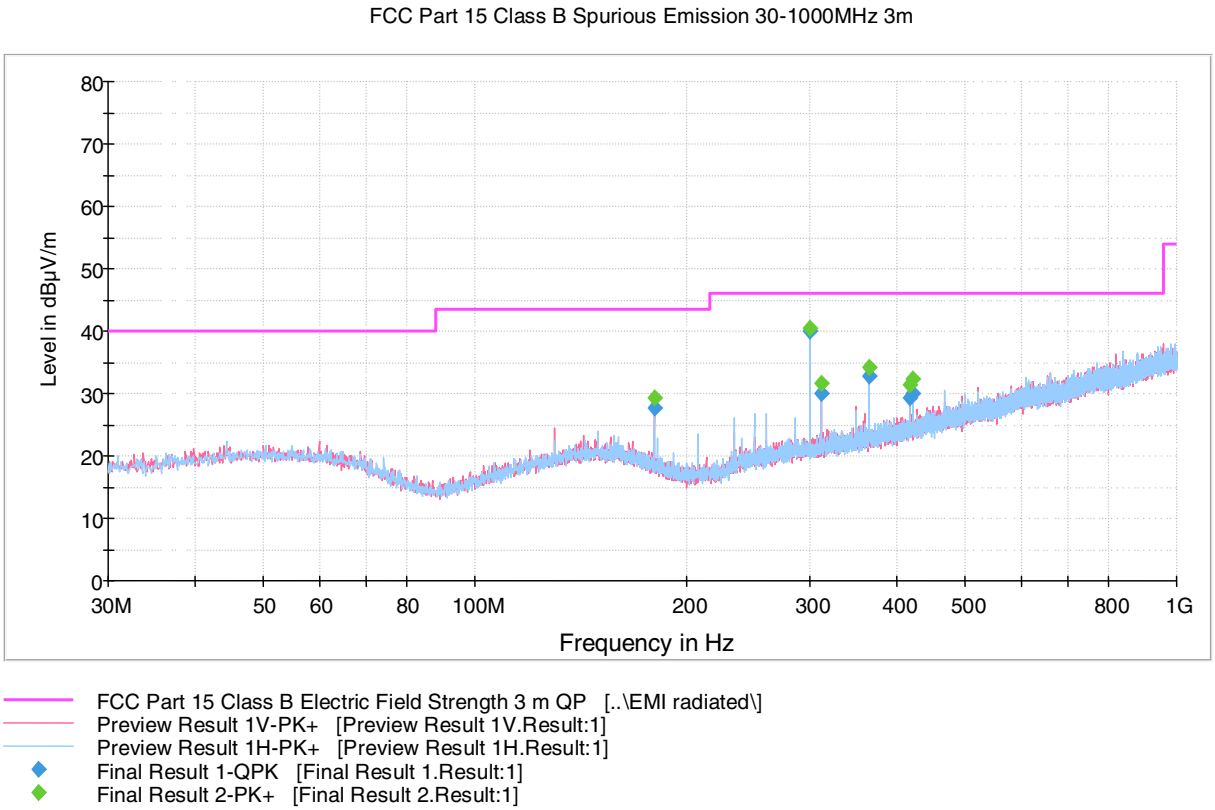

Figure 22: Low channel 30 MHz – 1000 MHz

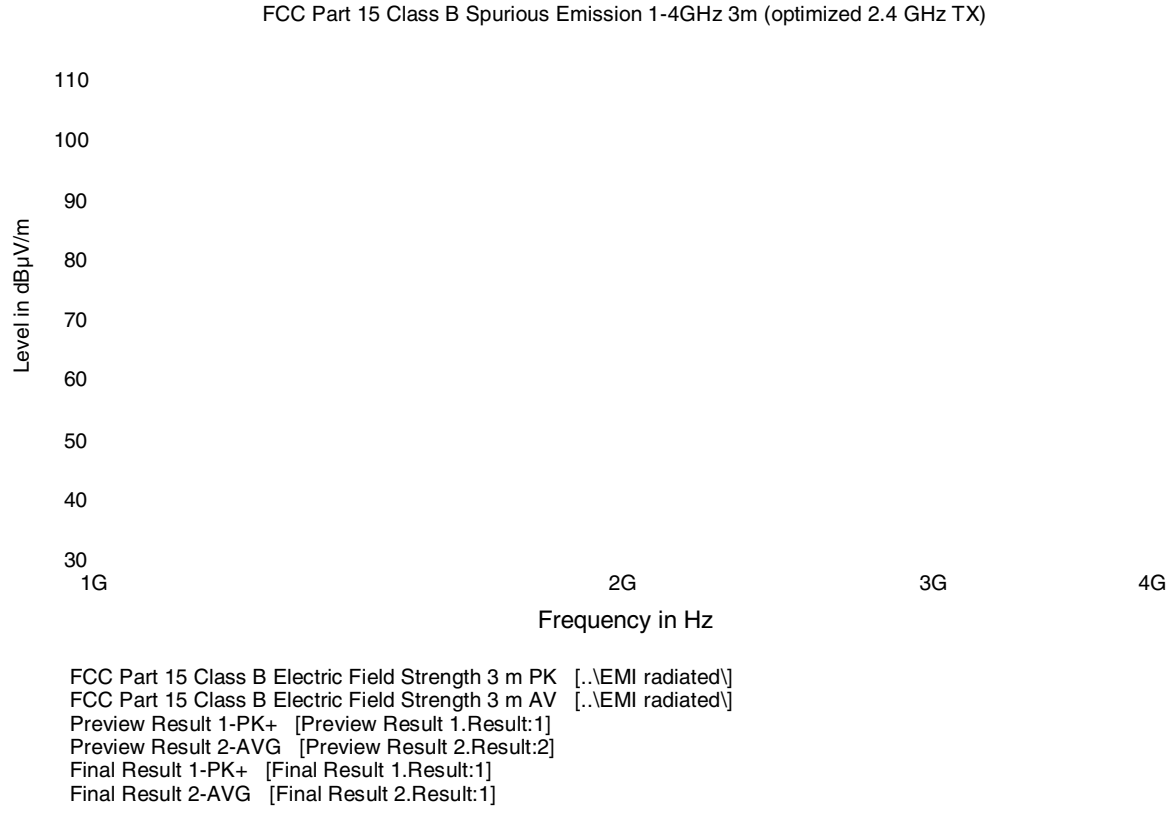

Figure 23: Low channel 1 GHz – 4 GHz

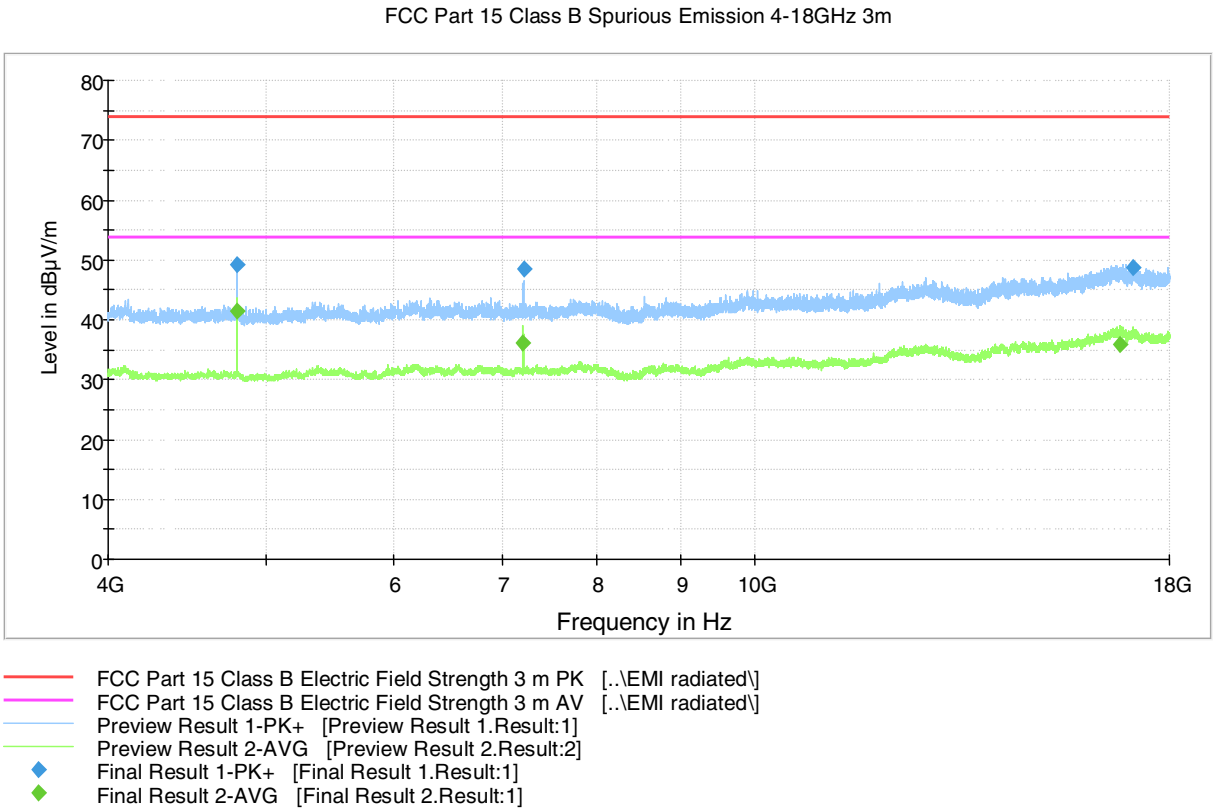

Figure 24: Low channel 4 GHz – 18 GHz

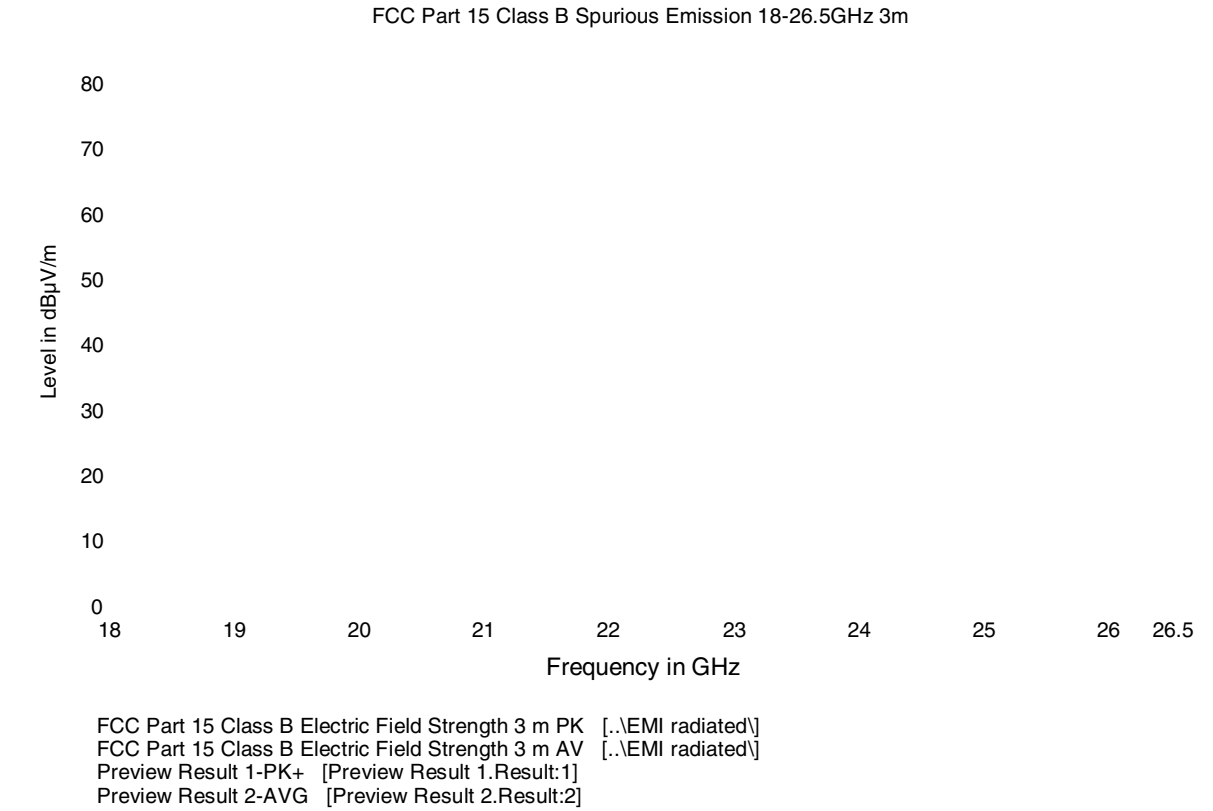

Figure 25: Low channel 18 GHz – 26.5 GHz

Table 13: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.022000	27.7	1000.0	120.000	197.0	H	139.0	13.0	15.8	43.5
300.011000	39.9	1000.0	120.000	100.0	H	152.0	15.3	6.1	46.0
312.019000	30.0	1000.0	120.000	100.0	H	241.0	15.7	16.0	46.0
364.011000	32.7	1000.0	120.000	100.0	H	159.0	16.9	13.3	46.0
416.020000	29.2	1000.0	120.000	100.0	H	148.0	18.3	16.8	46.0
420.037000	29.9	1000.0	120.000	129.0	V	159.0	18.4	16.1	46.0

Table 14: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2384.200000	49.7	1000.0	1000.000	203.0	H	309.0	14.8	24.2	73.9
2400.000000	68.6	1000.0	1000.000	207.0	V	256.0	14.9	5.3	73.9
4803.400000	49.2	1000.0	1000.000	166.0	H	10.0	8.9	24.7	73.9
7206.700000	48.5	1000.0	1000.000	150.0	V	119.0	12.7	25.4	73.9
17087.00000	48.8	1000.0	1000.000	380.0	V	43.0	27.8	25.1	73.9

Table 15: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2390.000000	36.4	1000.0	1000.000	150.0	V	252.0	14.8	17.5	53.9
2400.000000	50.0	1000.0	1000.000	205.0	V	249.0	14.9	3.9	53.9
4803.800000	41.5	1000.0	1000.000	179.0	V	230.0	8.9	12.4	53.9
7205.300000	36.0	1000.0	1000.000	150.0	V	119.0	12.7	17.9	53.9
16795.40000	35.9	1000.0	1000.000	150.0	V	164.0	27.4	18.0	53.9

Middle channel, N-variant (power setting 104)

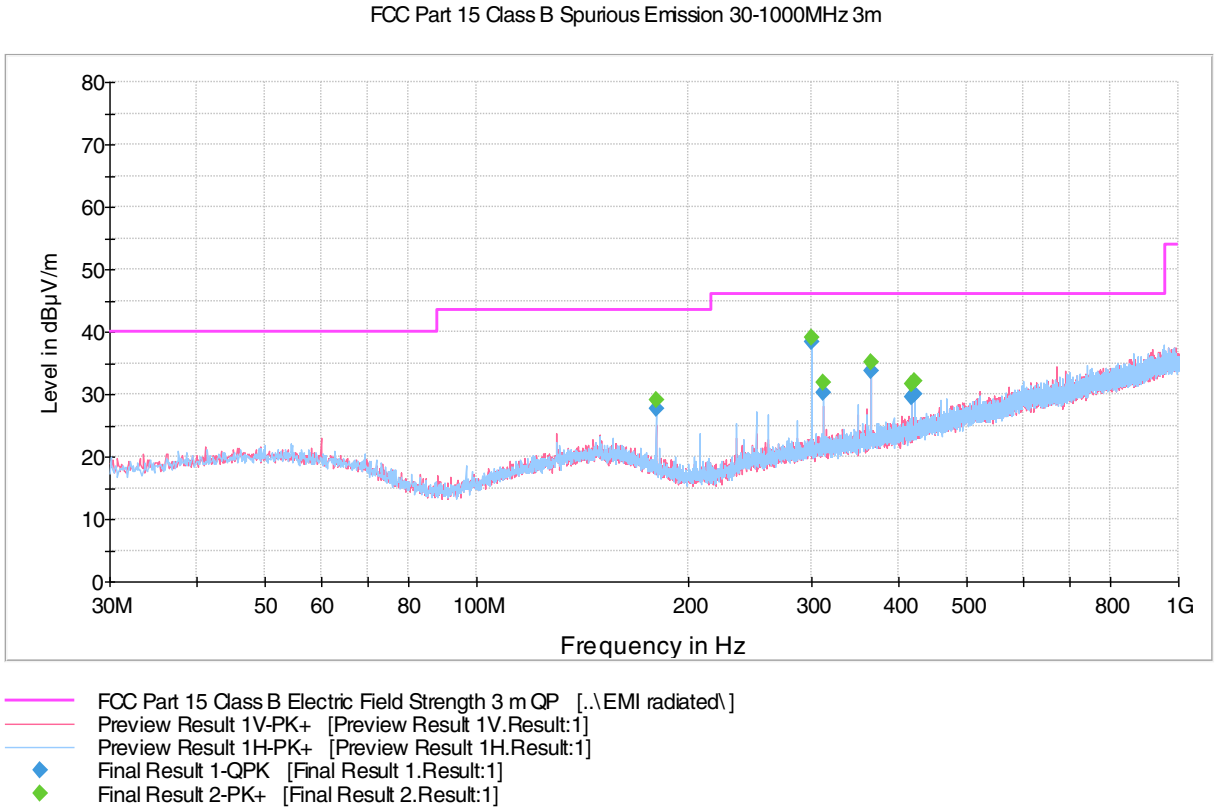

Figure 26: Mid channel 30 MHz – 1000 MHz

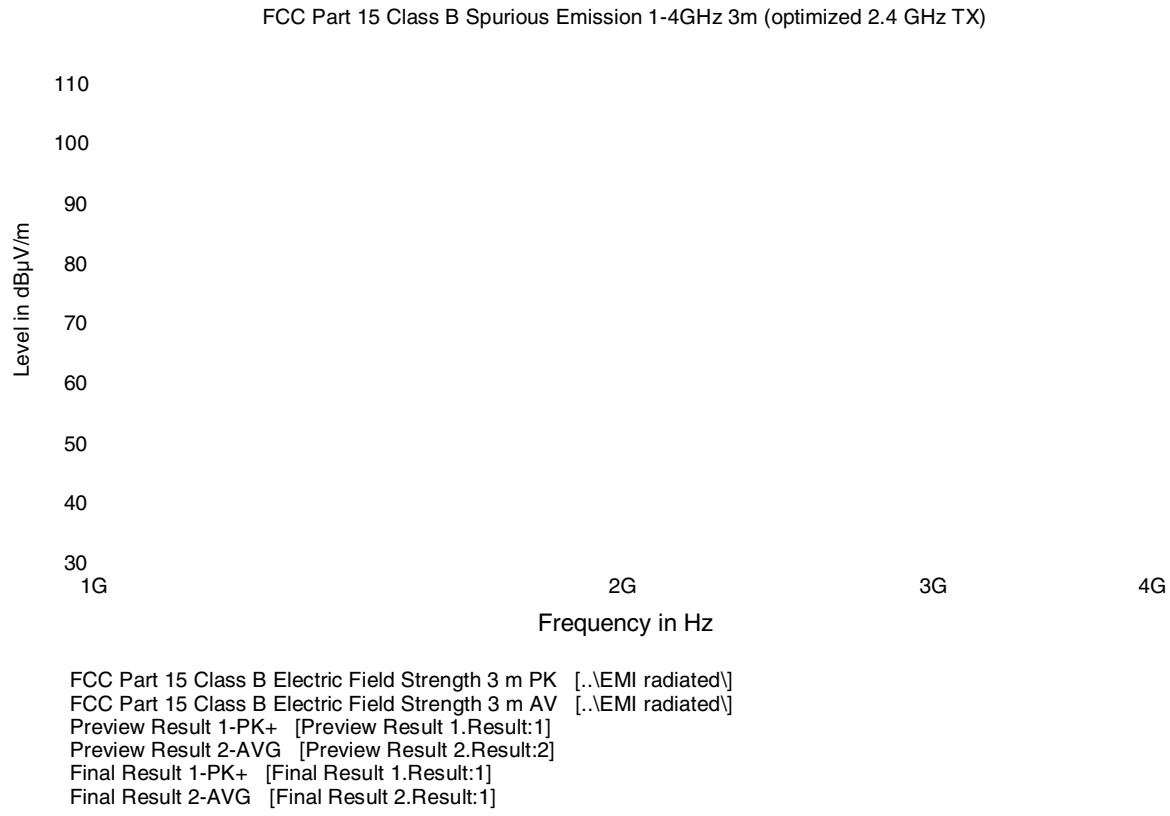

Figure 27: Mid channel 1 GHz – 4 GHz

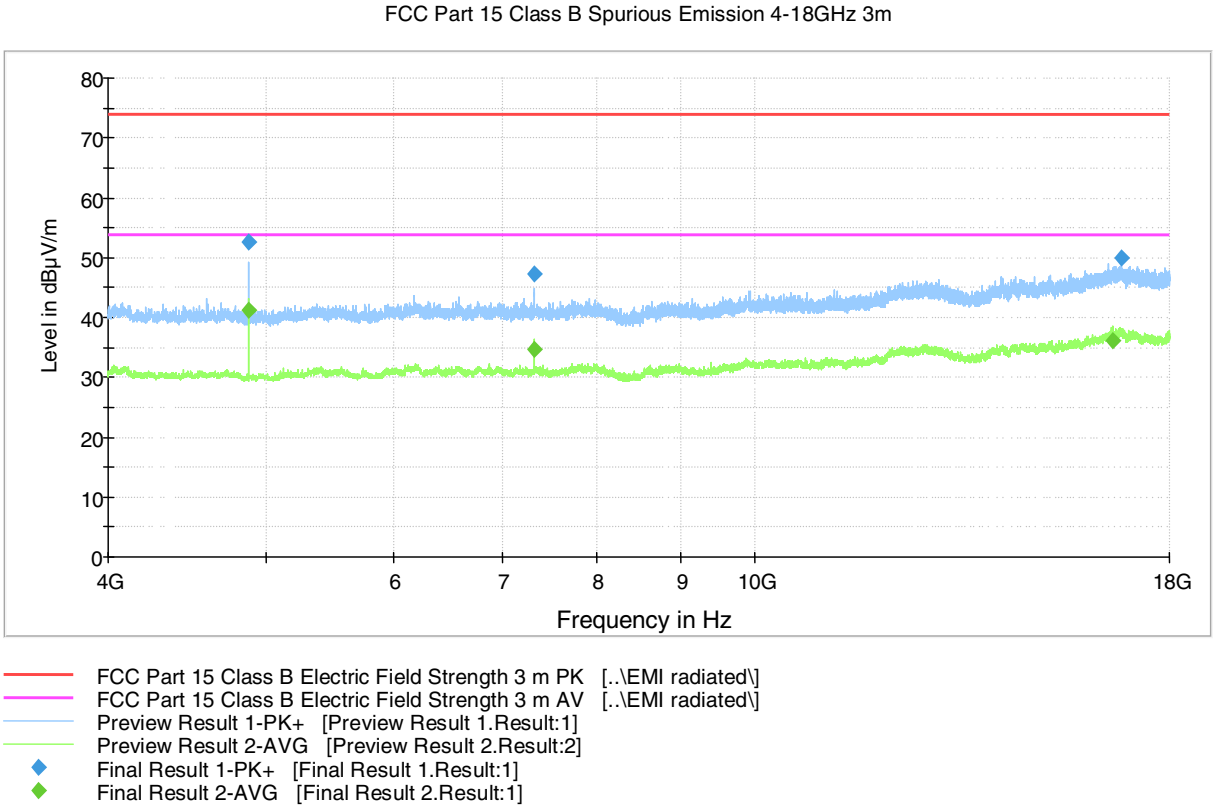

Figure 28: Mid channel 4 GHz – 18 GHz

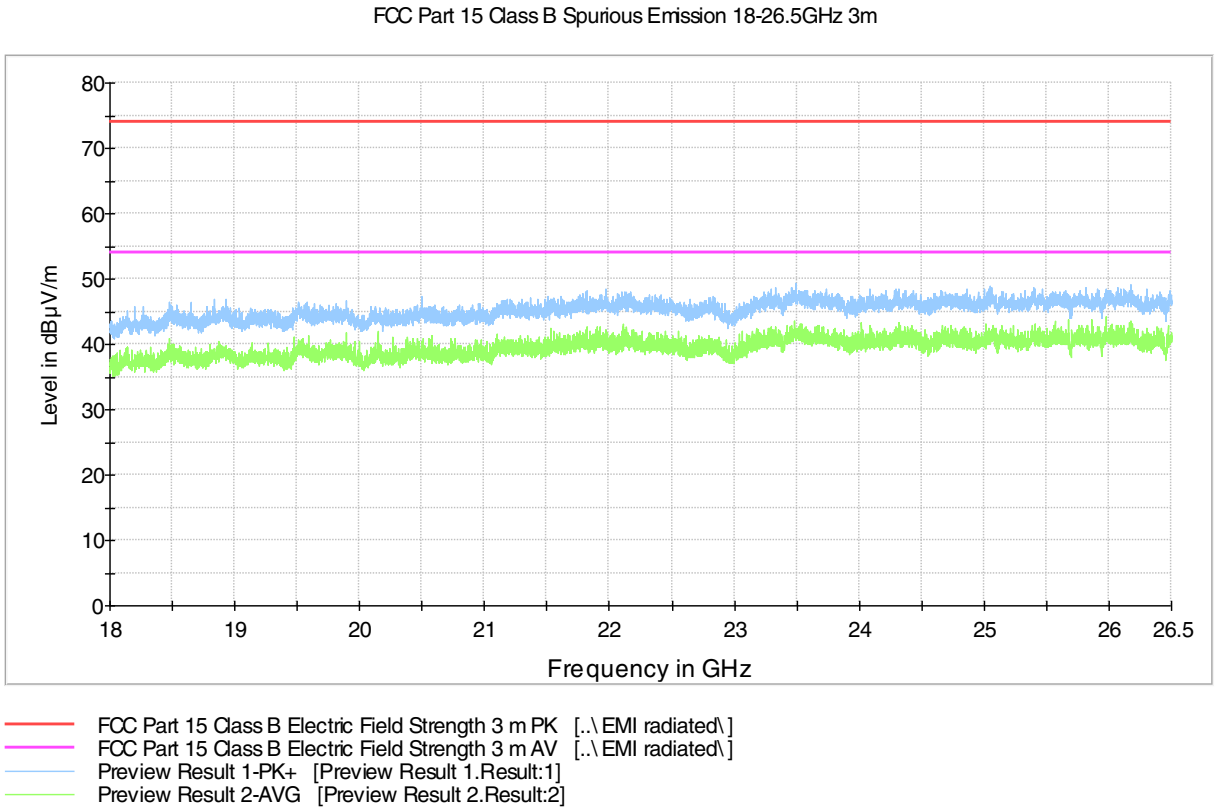

Figure 29: Mid channel 18 GHz – 26.5 GHz

Table 16: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	27.7	1000.0	120.000	137.0	H	148.0	13.0	15.8	43.5
300.008000	38.4	1000.0	120.000	100.0	H	234.0	15.3	7.6	46.0
312.019000	30.3	1000.0	120.000	100.0	H	242.0	15.7	15.7	46.0
364.011000	33.8	1000.0	120.000	156.0	V	92.0	16.9	12.2	46.0
416.020000	29.5	1000.0	120.000	100.0	H	90.0	18.3	16.5	46.0
420.037000	30.0	1000.0	120.000	100.0	H	90.0	18.4	16.0	46.0

Table 17: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4879.900000	52.7	1000.0	1000.000	179.0	V	359.0	8.9	21.2	73.9
7319.200000	47.4	1000.0	1000.000	150.0	V	36.0	12.7	26.6	73.9
16818.00000	49.9	1000.0	1000.000	150.0	V	159.0	27.5	24.0	73.9

Table 18: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4879.900000	41.2	1000.0	1000.000	179.0	V	6.0	8.9	12.7	53.9
7319.200000	34.6	1000.0	1000.000	150.0	V	123.0	12.7	19.3	53.9
16622.00000	36.2	1000.0	1000.000	400.0	H	289.0	27.0	17.7	53.9

High channel, N-variant (power setting 104)

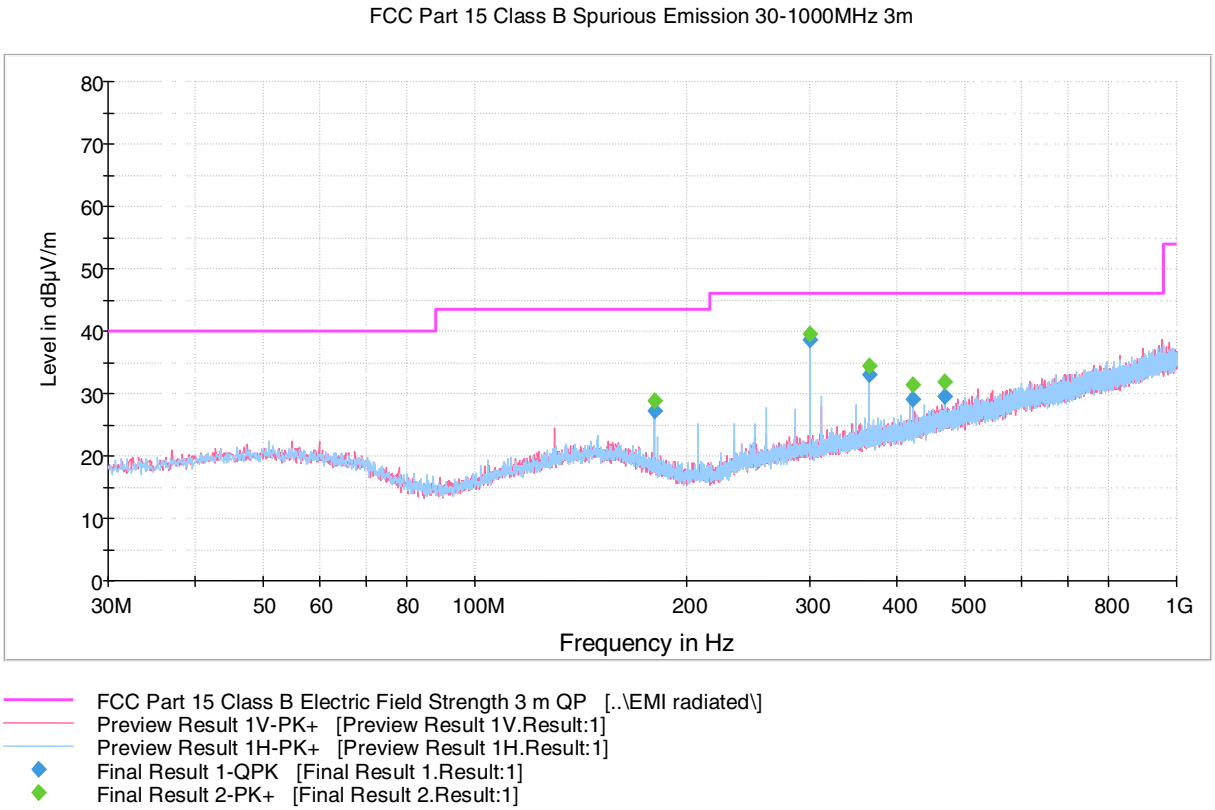

Figure 30: High channel 30 MHz – 1000 MHz

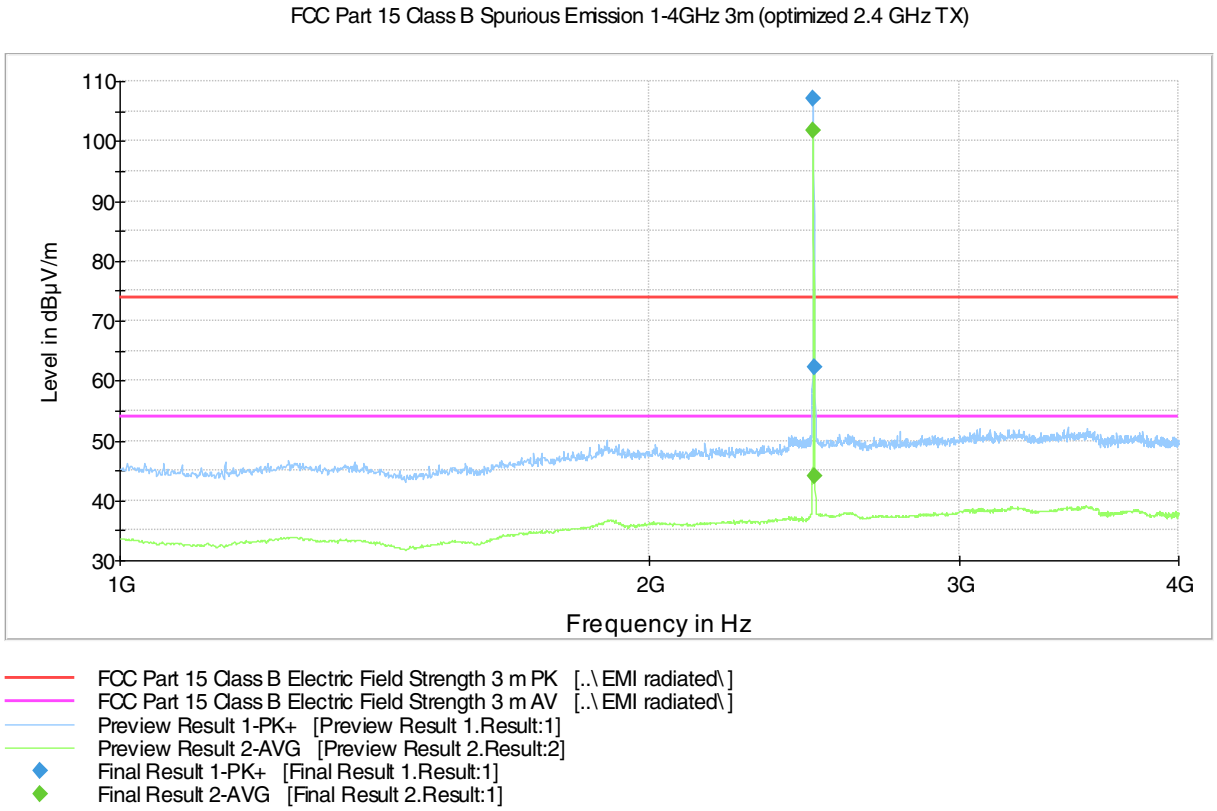

Figure 31: High channel 1 GHz – 4 GHz

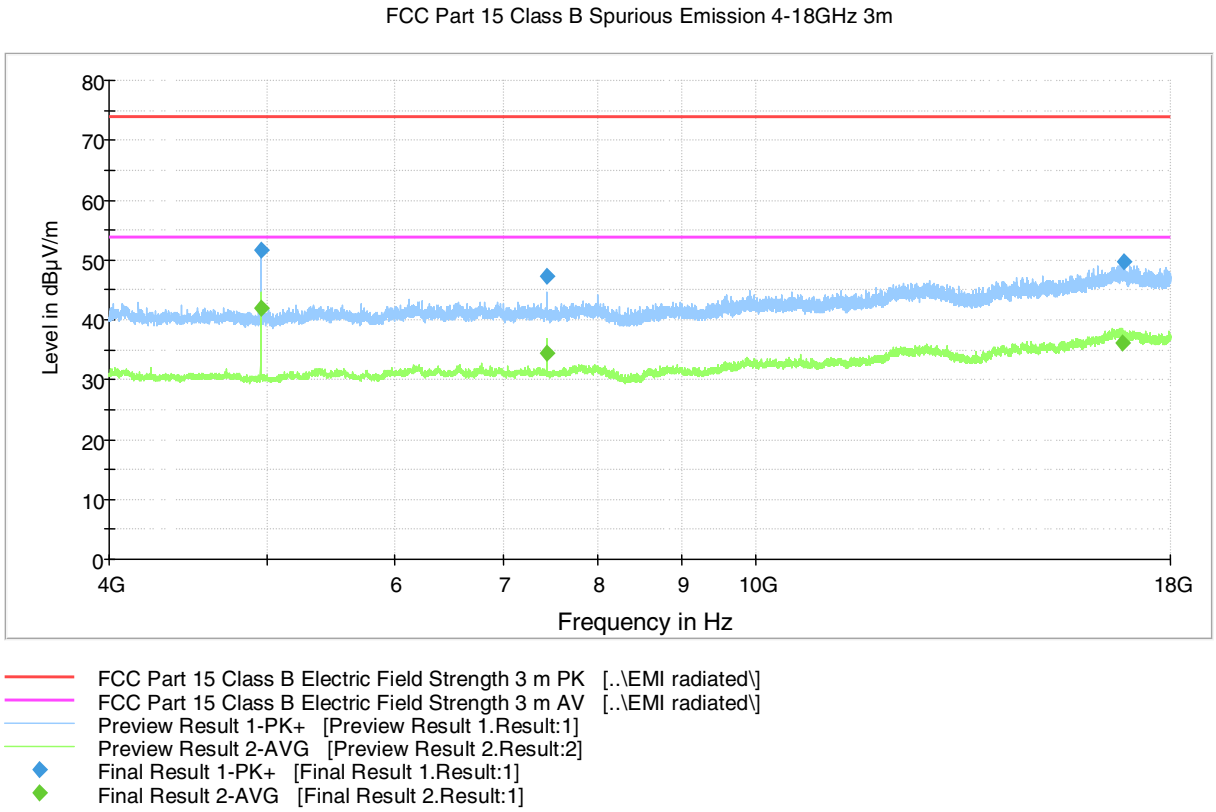

Figure 32: High channel 4 GHz – 18 GHz

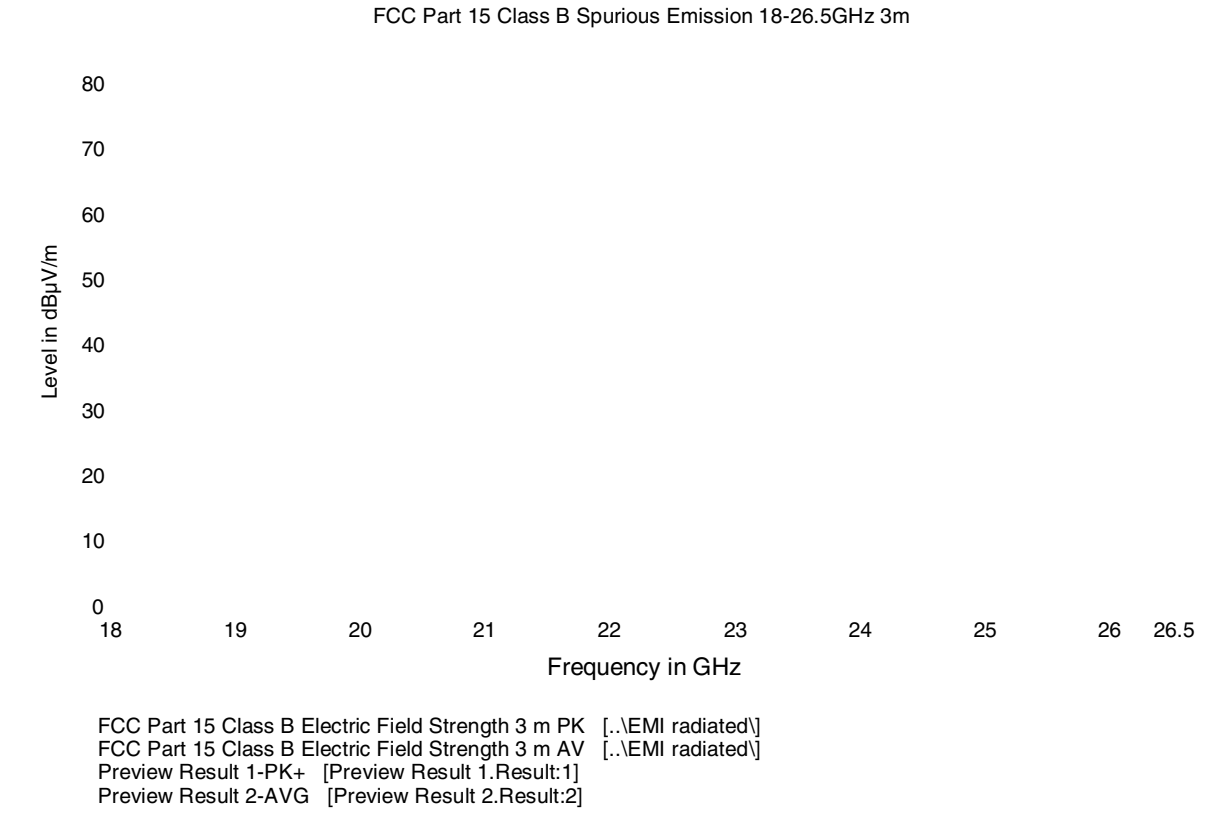

Figure 33: High channel 18 GHz – 26.5 GHz

Table 19: Quasi-peak results (ch high)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	27.3	1000.0	120.000	205.0	H	148.0	13.0	16.2	43.5
300.028000	38.7	1000.0	120.000	100.0	H	154.0	15.3	7.3	46.0
364.031000	33.0	1000.0	120.000	100.0	H	167.0	16.9	13.0	46.0
420.037000	29.1	1000.0	120.000	100.0	H	65.0	18.4	16.9	46.0
468.032000	29.6	1000.0	120.000	100.0	V	192.0	19.5	16.4	46.0

Table 20: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	62.3	1000.0	1000.000	203.0	V	166.0	15.0	11.6	73.9
4959.800000	51.6	1000.0	1000.000	150.0	V	10.0	8.8	22.3	73.9
7440.700000	47.3	1000.0	1000.000	150.0	V	94.0	12.7	26.6	73.9
16850.80000	49.6	1000.0	1000.000	272.0	V	76.0	27.5	24.3	73.9

Table 21: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	44.0	1000.0	1000.000	166.0	V	270.0	15.0	9.9	53.9
4959.900000	42.0	1000.0	1000.000	166.0	V	6.0	8.8	11.9	53.9
7439.300000	34.5	1000.0	1000.000	150.0	V	96.0	12.7	19.4	53.9
16803.30000	36.2	1000.0	1000.000	150.0	V	340.0	27.5	17.7	53.9

Radiated Band Edge results, N-variant (power setting 104)

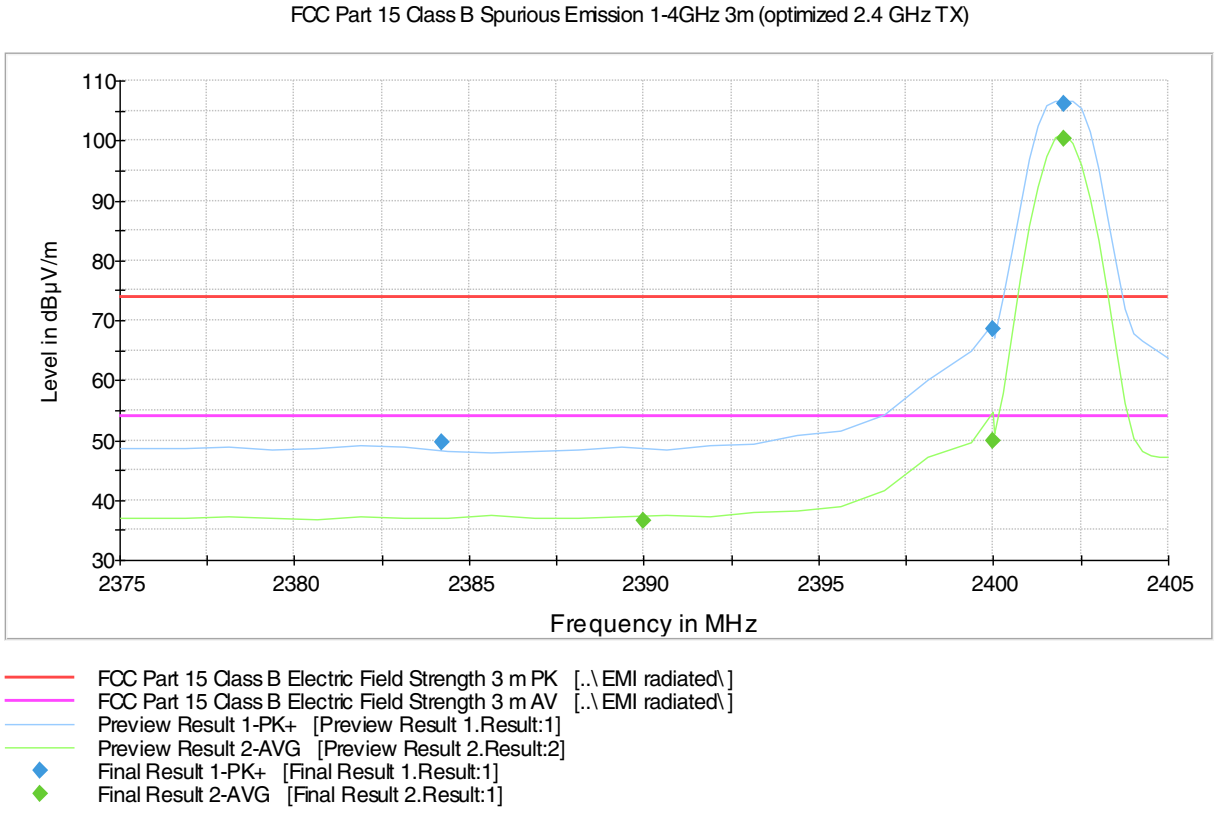

Figure 34: Radiated Band Edge measurement graph (ch low), N-variant

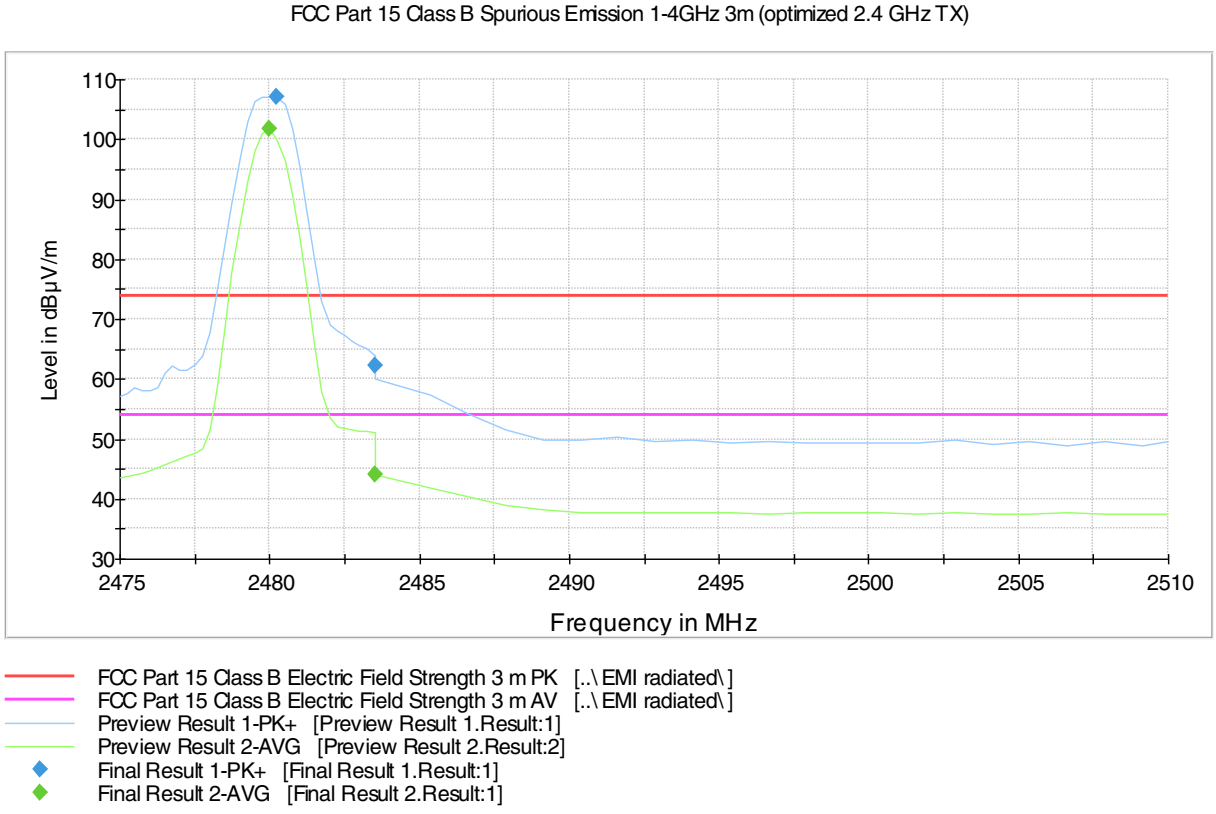

Figure 35: Radiated Band Edge measurement graph (ch high), N-variant

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	23 February 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)).

Power setting was 104.

Table 22: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge	**Upper Band Edge**
-48.97 dBc	-47.59 dBc
Limit: -20 dBc	

Table 23: Conducted spurious emissions (ch low)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
889.23	-69.69	-10.57	-59.13	PASS
2399.15	-44.83	-10.57	-34.27	PASS
3996.42	-66.28	-10.57	-55.71	PASS
4803.46	-40.58	-10.57	-30.01	PASS
7206.76	-57.56	-10.57	-46.99	PASS
12466.34	-59.30	-10.57	-48.73	PASS
15515.84	-56.69	-10.57	-46.13	PASS
16322.35	-56.28	-10.57	-45.71	PASS
19889.14	-57.74	-10.57	-47.17	PASS
24134.20	-56.64	-10.57	-46.08	PASS
25725.02	-56.91	-10.57	-46.34	PASS

Table 24: Conducted spurious emissions (ch mid)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
990.95	-70.36	-11.00	-59.36	PASS
2274.64	-67.46	-11.00	-56.46	PASS
3737.63	-65.86	-11.00	-54.86	PASS
4879.49	-42.21	-11.00	-31.21	PASS
7320.76	-54.81	-11.00	-43.82	PASS
12860.46	-59.39	-11.00	-48.39	PASS
15793.43	-56.99	-11.00	-45.99	PASS
16178.82	-55.73	-11.00	-44.74	PASS
19912.39	-57.83	-11.00	-46.83	PASS
24415.16	-57.22	-11.00	-46.23	PASS
25696.14	-57.13	-11.00	-46.13	PASS

Table 25: Conducted spurious emissions (ch high)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
886.20	-70.52	-11.22	-59.30	PASS
2290.26	-67.20	-11.22	-55.98	PASS
2483.52	-50.93	-11.22	-39.71	PASS
4960.49	-43.07	-11.22	-31.85	PASS
7440.66	-57.12	-11.22	-45.90	PASS
12488.00	-58.99	-11.22	-47.77	PASS
15497.47	-57.13	-11.22	-45.91	PASS
16110.76	-55.95	-11.22	-44.73	PASS
20775.62	-58.30	-11.22	-47.08	PASS
24449.38	-57.23	-11.22	-46.01	PASS
25441.53	-56.99	-11.22	-45.77	PASS

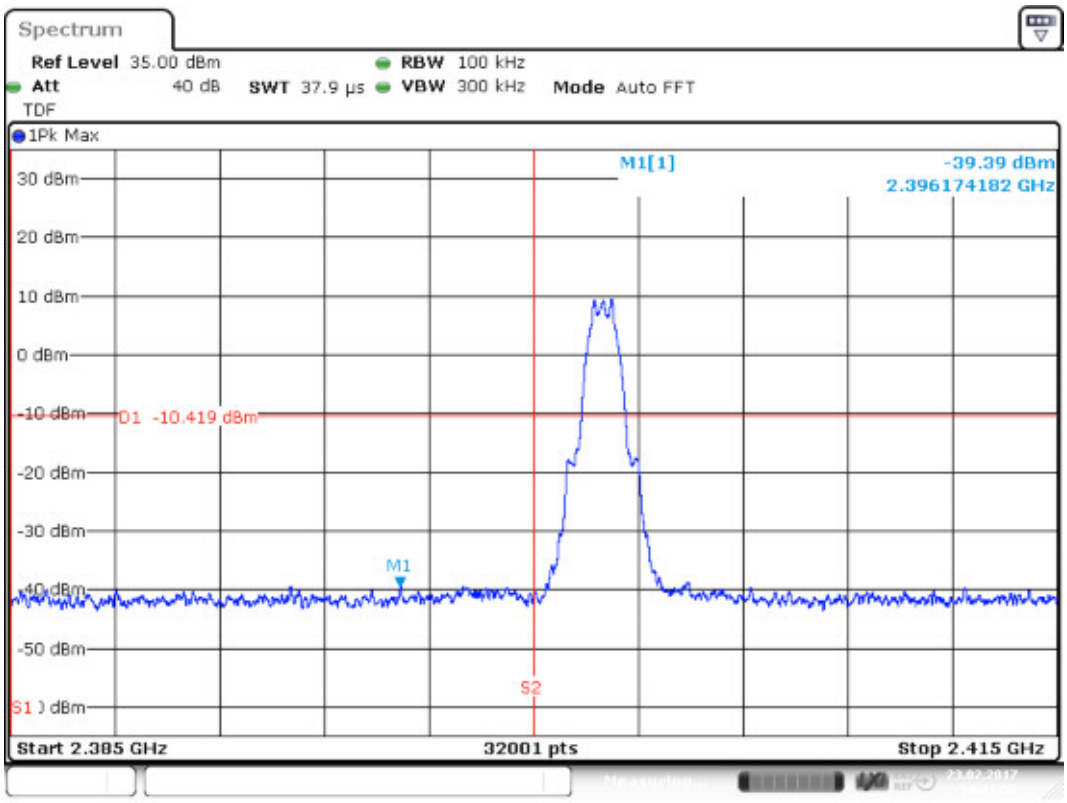

Figure 36: Lower Band Edge

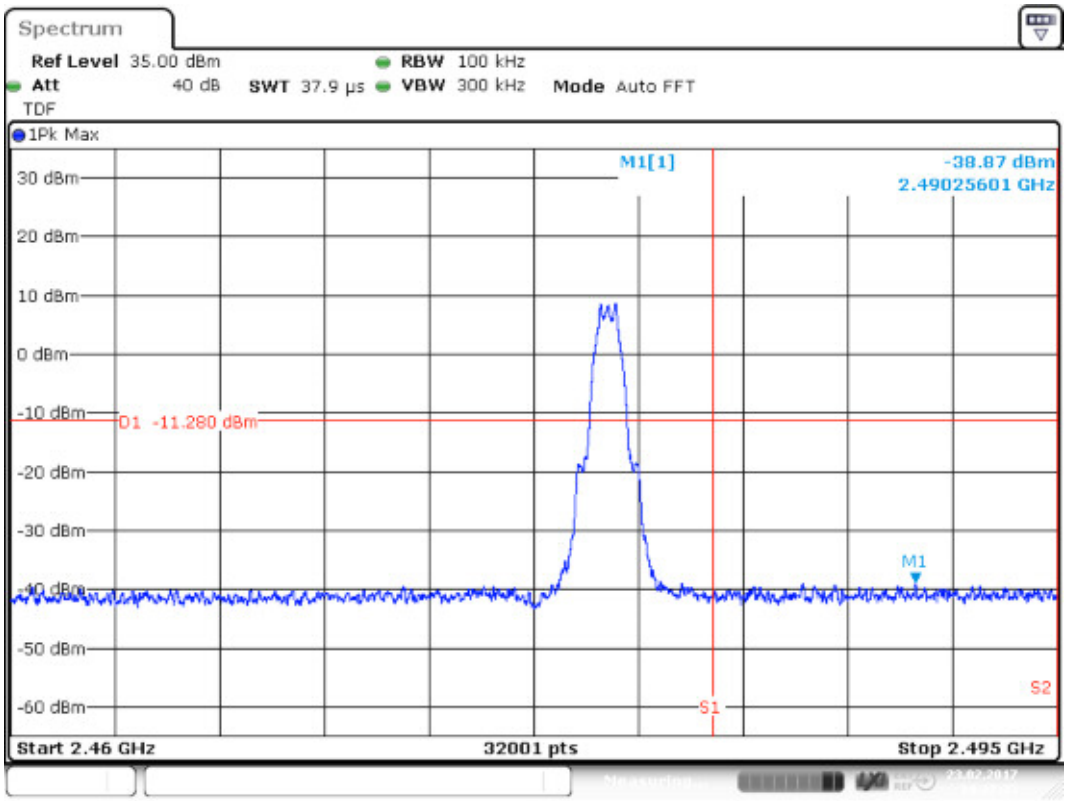

Figure 37: Upper Band Edge

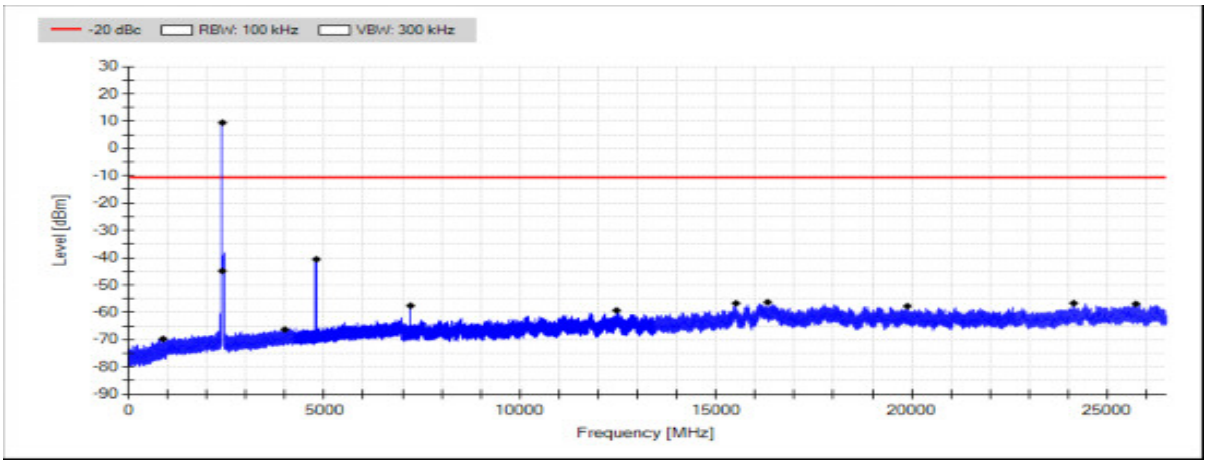

Figure 38: Conducted spurious emissions 30 - 26500 MHz channel low

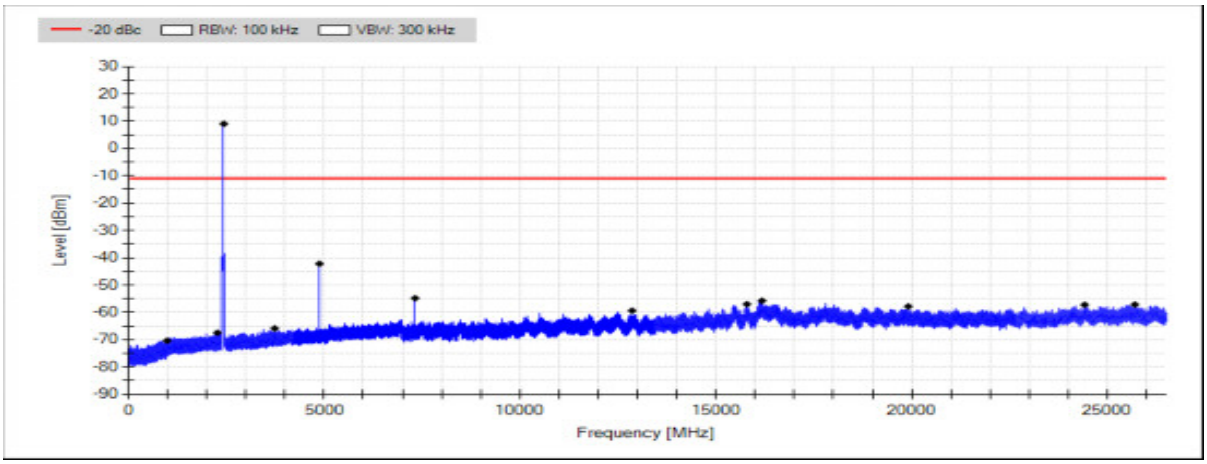

Figure 39: Conducted spurious emissions 30 - 26500 MHz channel mid

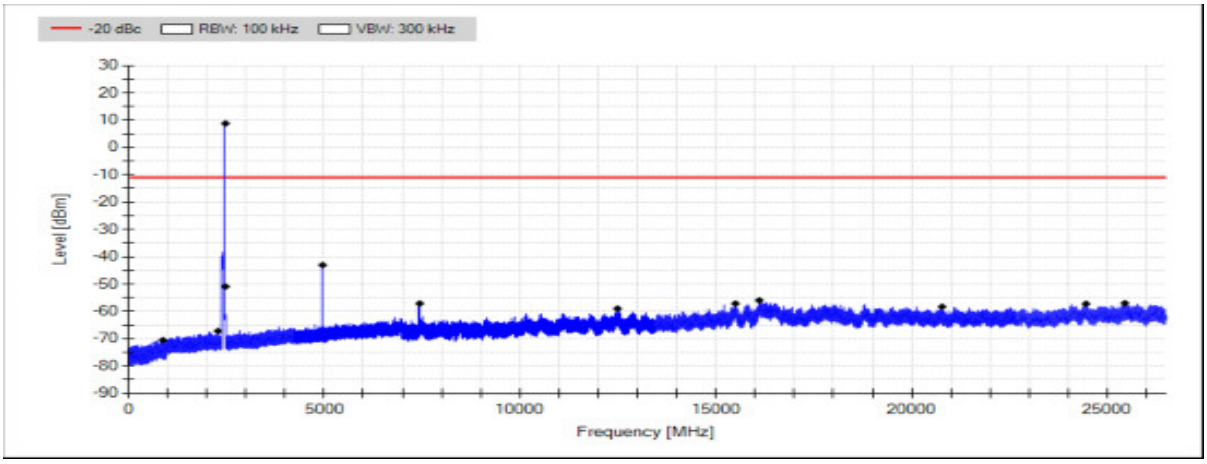

Figure 40: Conducted spurious emissions 30 - 26500 MHz channel high

6 dB Bandwidth of the Channel

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	23 February - 4 May 2017	
Temperature:	23 ± 3 °C	
Humidity:	20 - 60 % RH	

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

Results:

Table 26: 6 dB bandwidth test results (power setting 104)

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	771.16	500
Mid	771.10	
High	770.98	

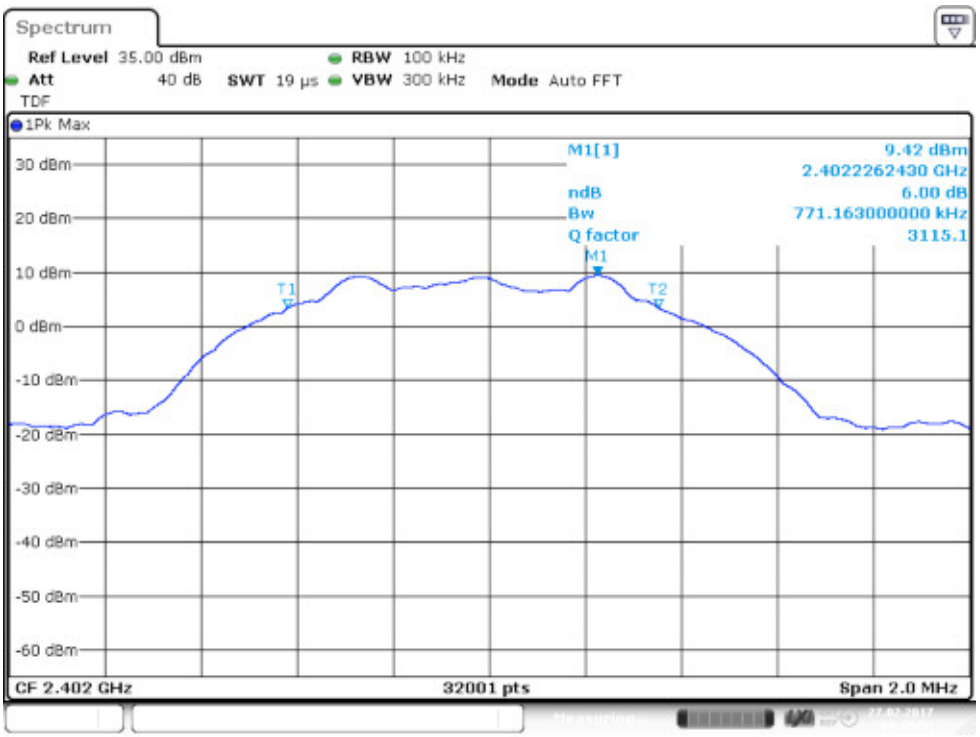

Figure 41: 6 dB bandwidth (ch low)

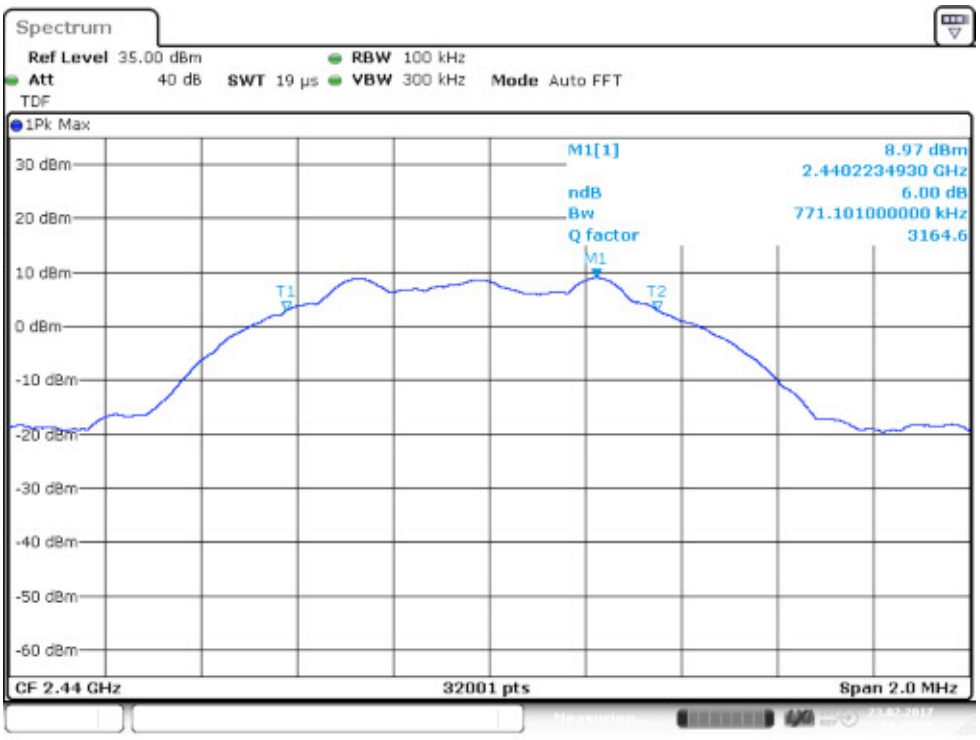

Figure 42: 6 dB bandwidth (ch mid)

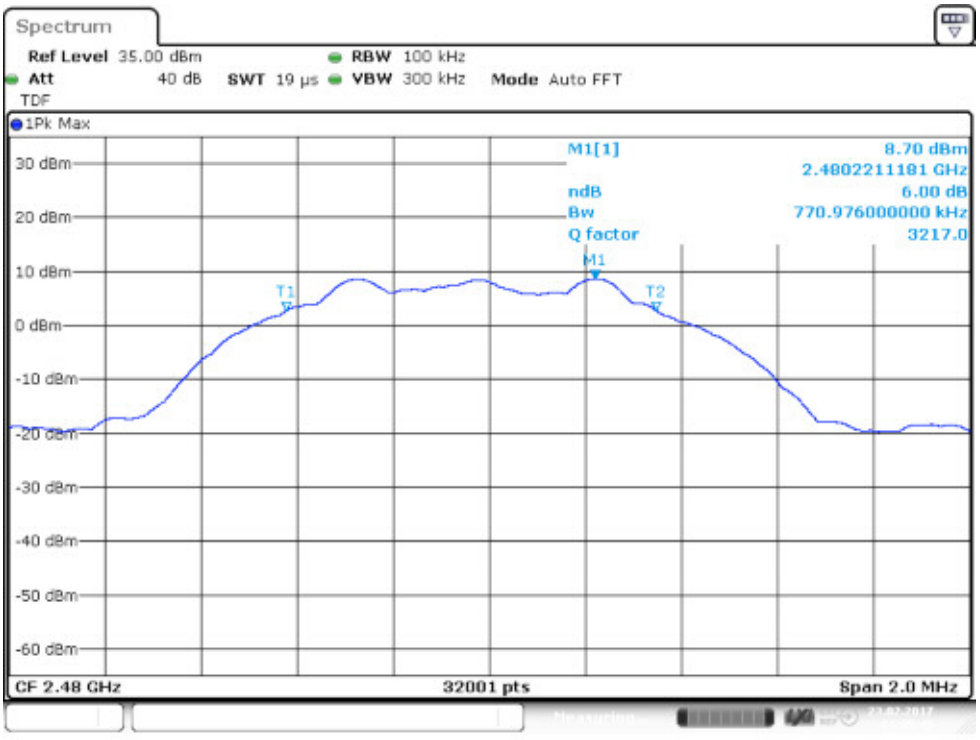

Figure 43: 6 dB bandwidth (ch high)

Table 27: 6 dB bandwidth test results (power setting 30)

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	758.0	500
Mid	759.0	
High	755.0	

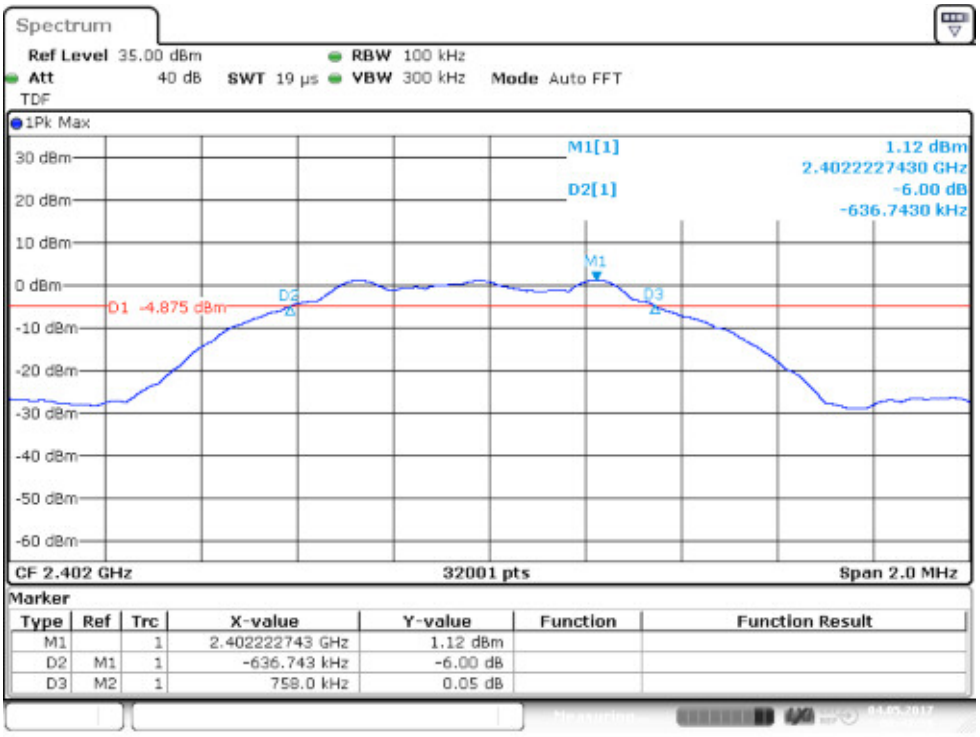

Figure 44: 6 dB bandwidth (ch low)

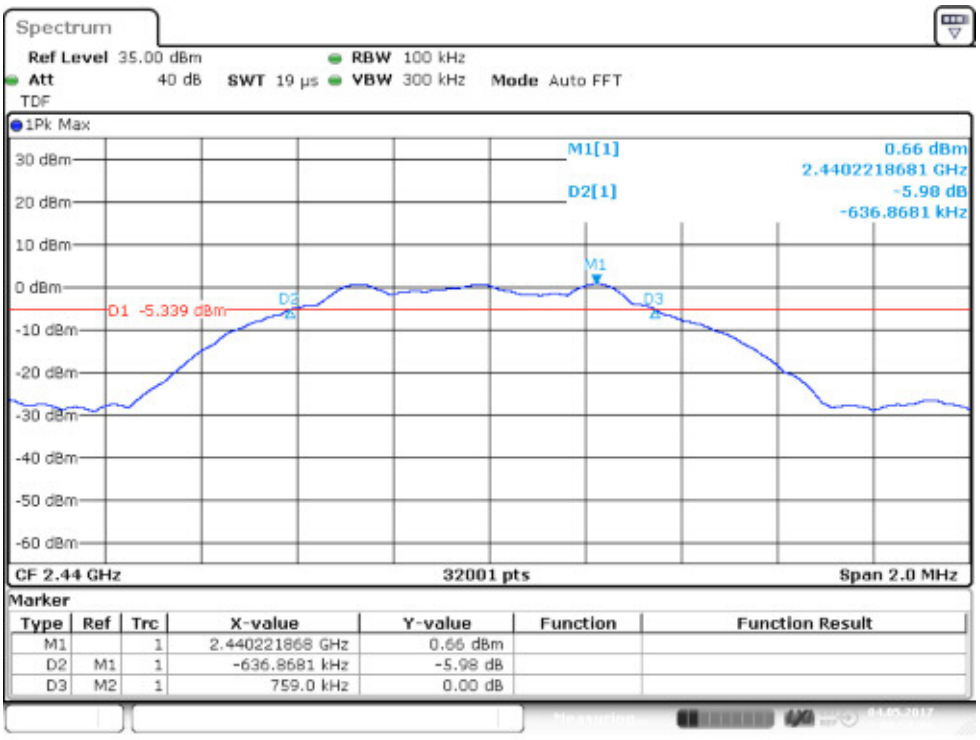

Figure 45: 6 dB bandwidth (ch mid)

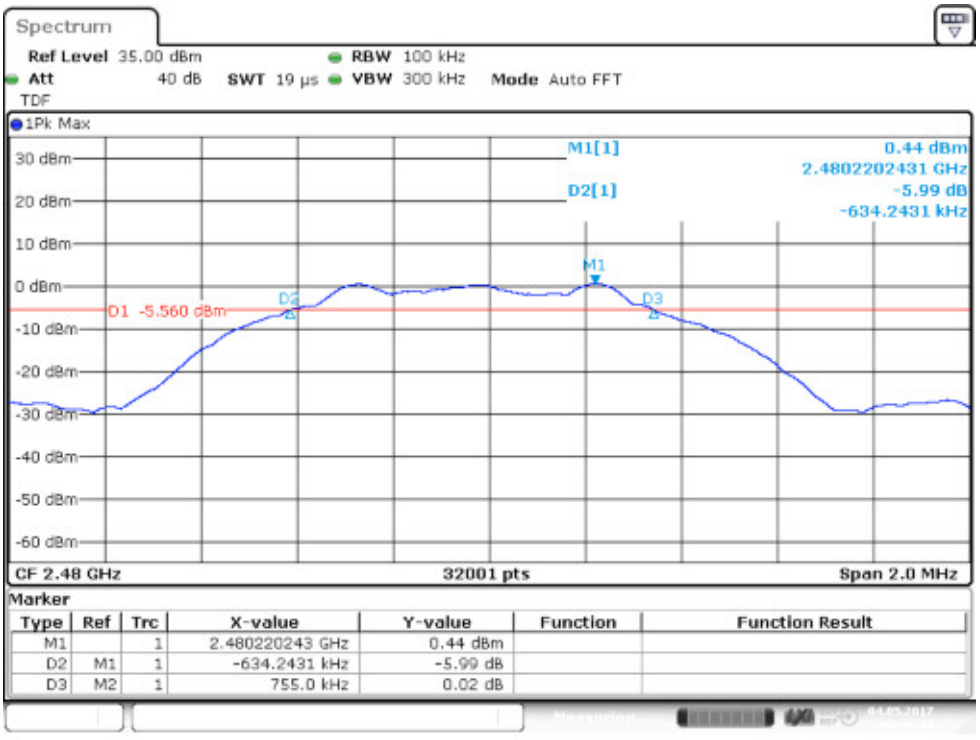

Figure 46: 6 dB bandwidth (ch high)

Power Spectral Density

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

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

Results:

Table 28: Power spectral density test results (power setting 104)

Channel	PSD dBm/10 kHz	Maximum limit [dBm/3kHz]
Low	-5.80	+8.00
Mid	-6.35	
High	-6.63	

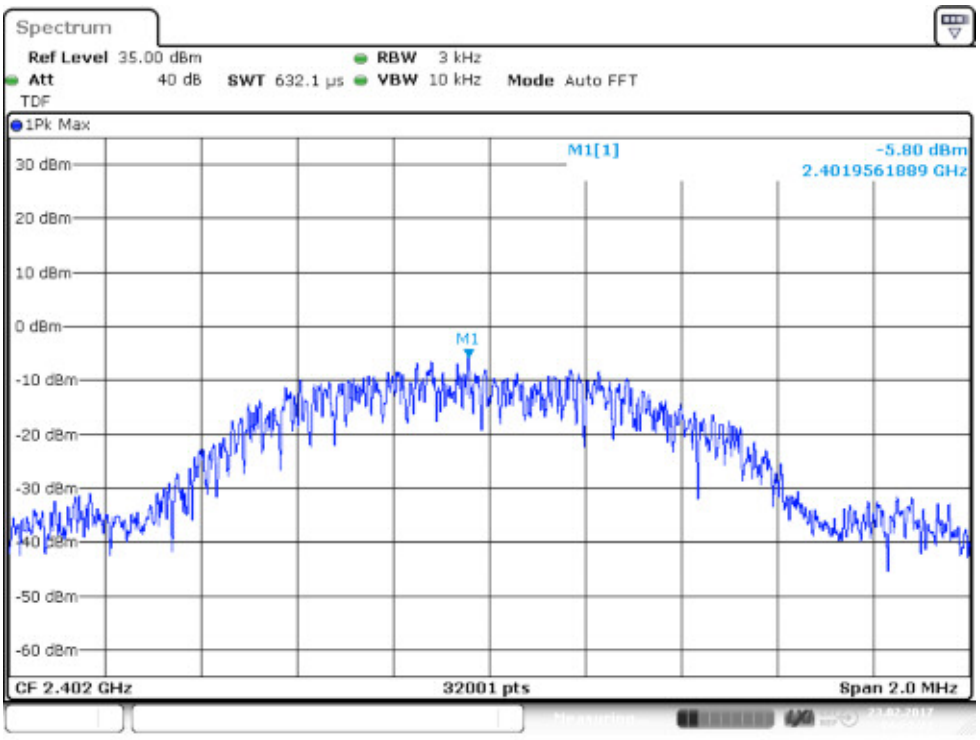

Figure 47: Power spectral density (ch low)

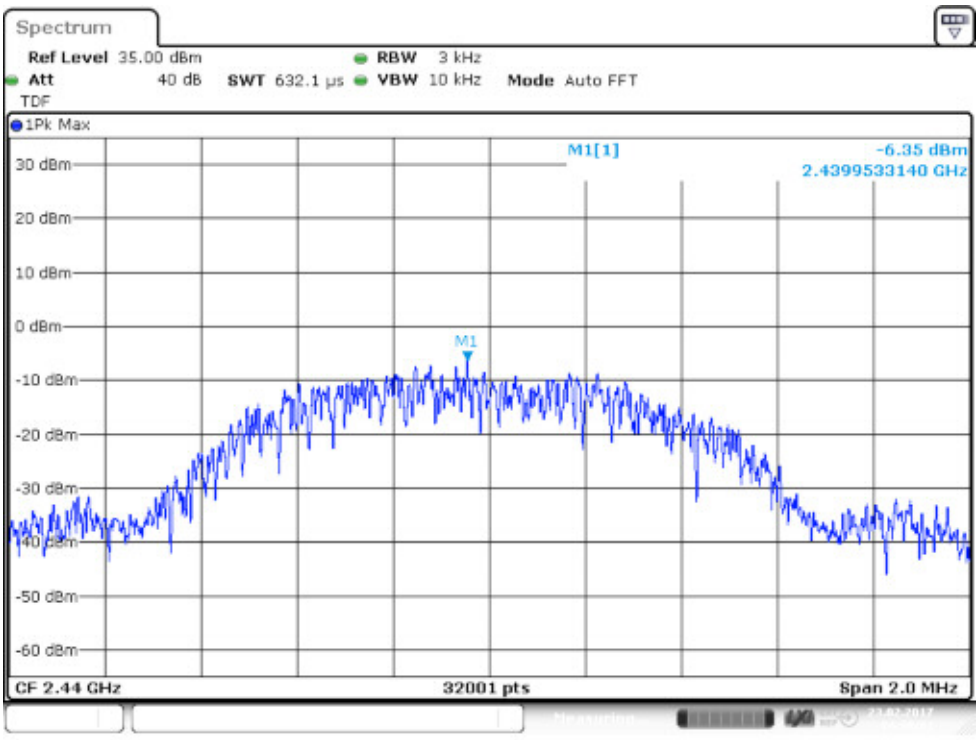

Figure 48: Power spectral density (ch mid)

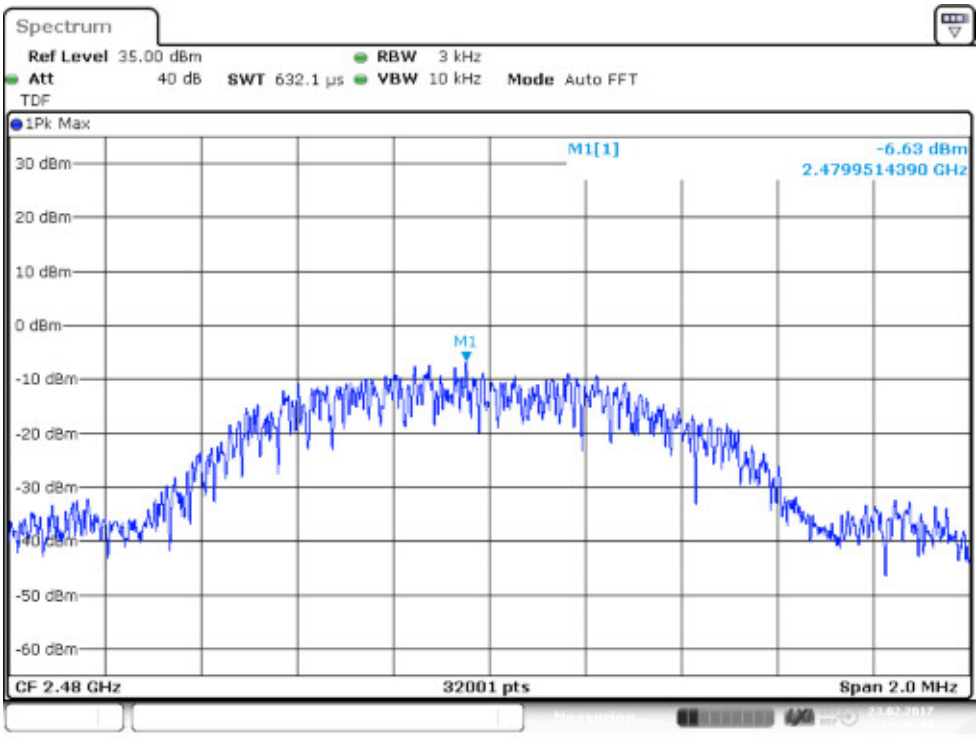

Figure 49: Power spectral density (ch high)

99% Occupied Bandwidth

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

RSS-GEN 6.6

Table 29: 99% occupied bandwidth test results (power setting 104)

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.116340114	PASS
Mid	-	1.116090122	PASS
High	-	1.116090122	PASS

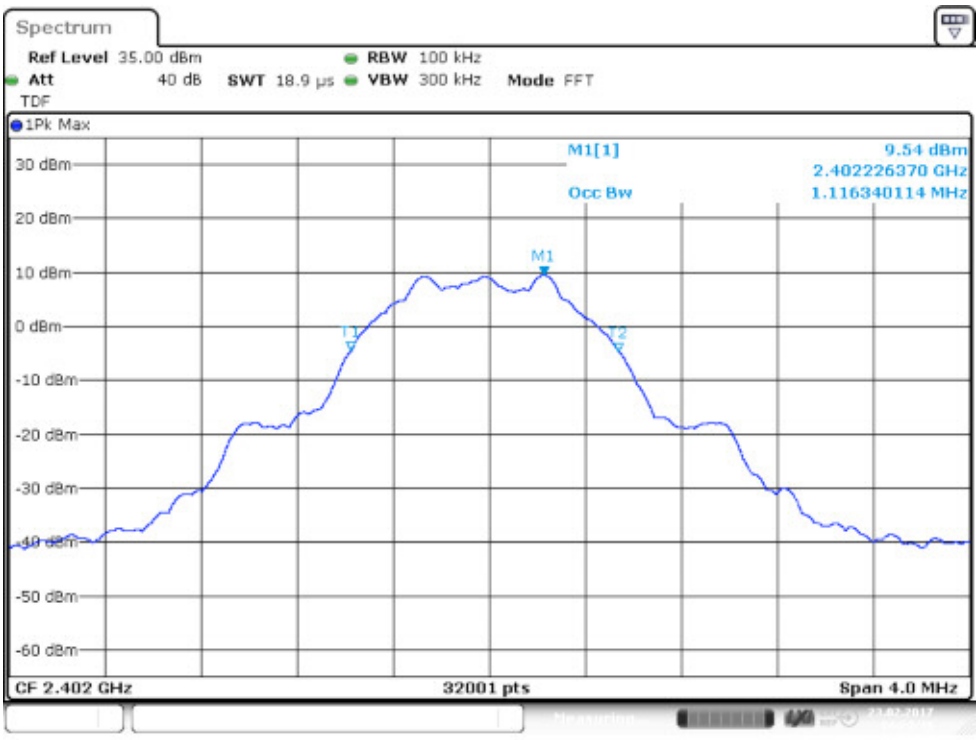

Figure 50: 99% OBW (ch low)

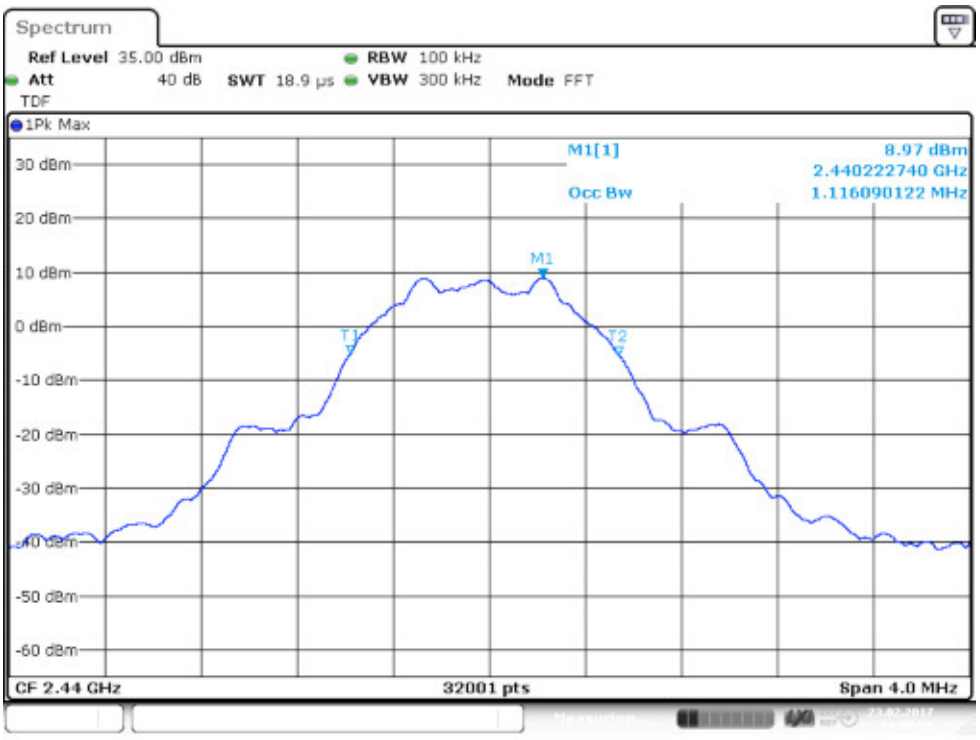

Figure 51: 99% OBW (ch mid)

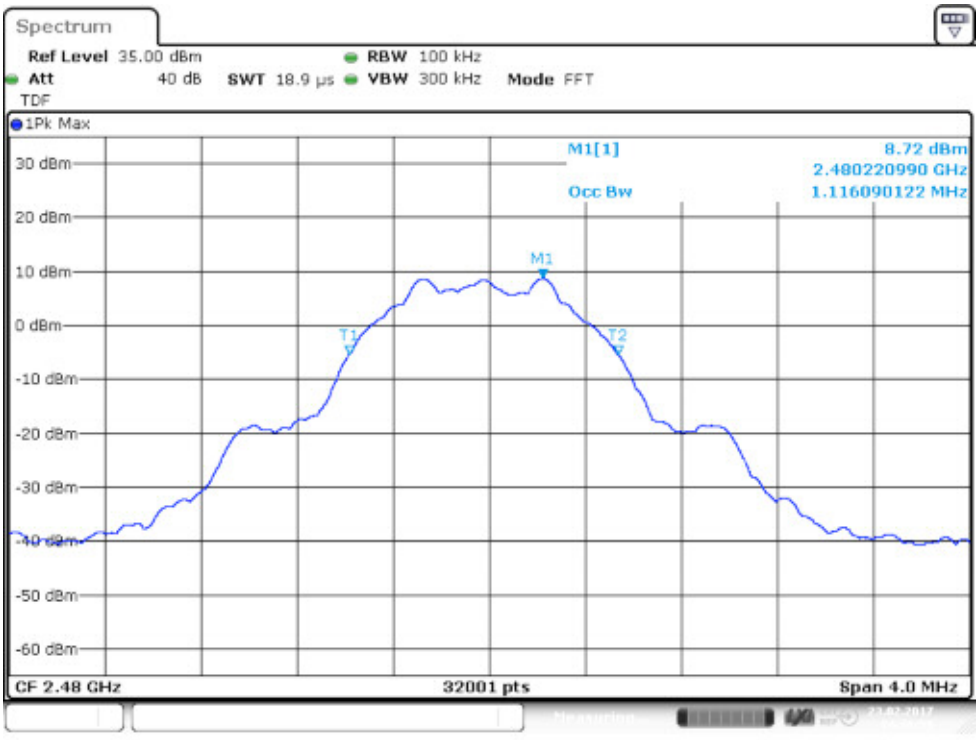

Figure 52: 99% OBW (ch high)

Table 30: 99% occupied bandwidth test results (power setting 30)

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.097715696	PASS
Mid	-	1.097215712	PASS
High	-	1.096215743	PASS

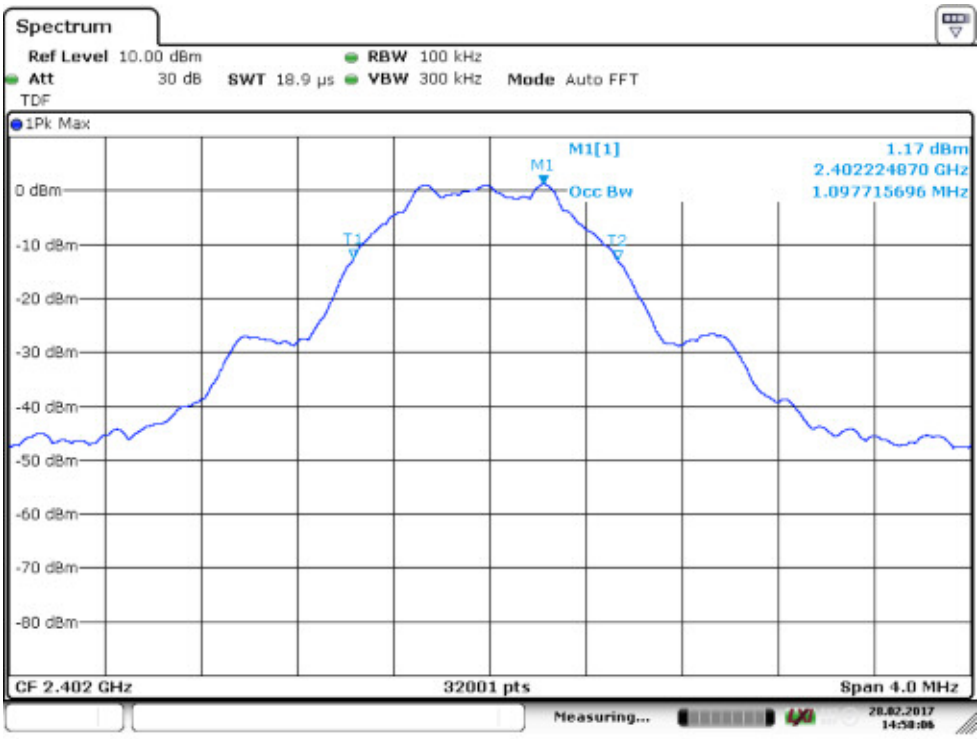

Figure 53: 99% OBW (ch low)

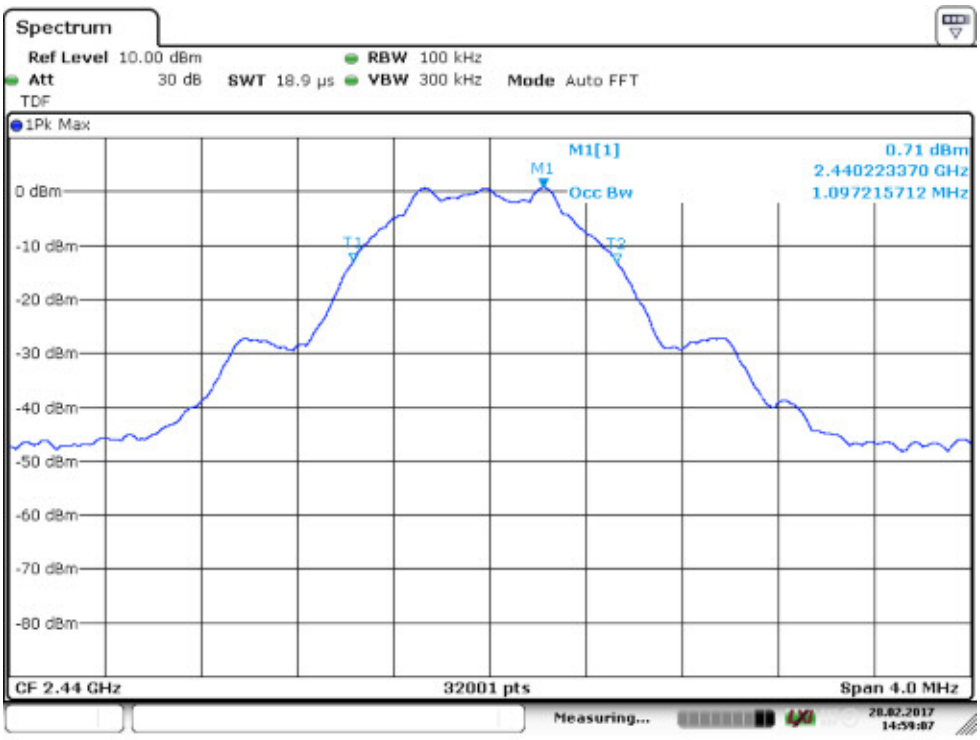

Figure 54: 99% OBW (ch mid)

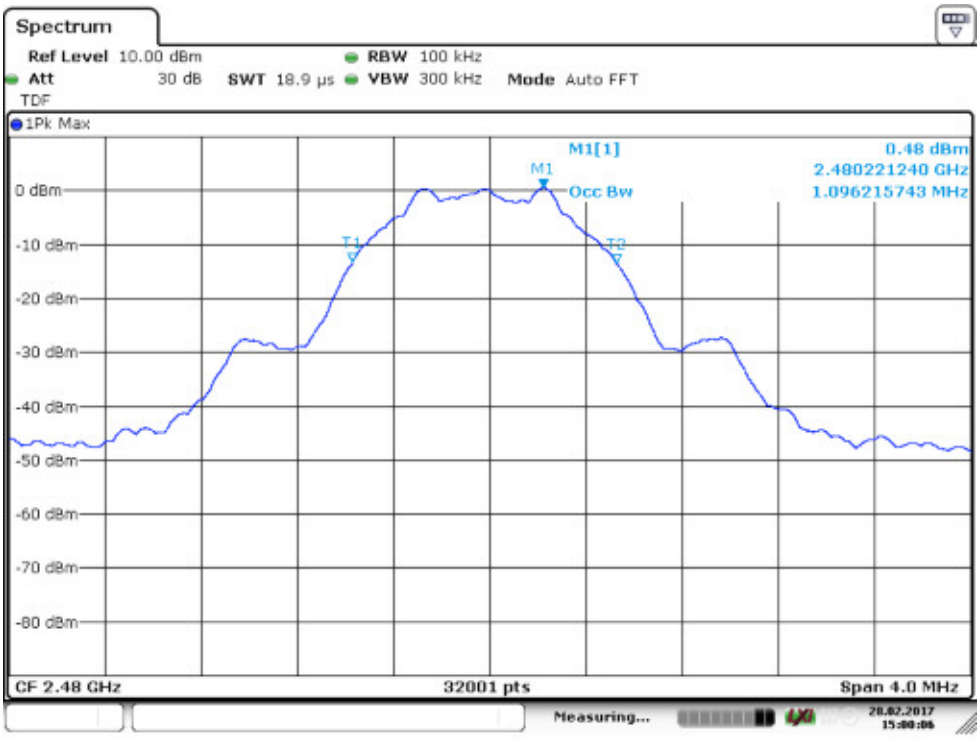

Figure 55: 99% OBW (ch high)

TEST EQUIPMENT

RF-Test Equipment

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
MONITORING ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
MONITORING SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2016-11-28	2017-11-28
PREAMPLIFIER	MERCURY SYSTEMS	ALS1826-41-12	-	2016-09-02	2017-09-02
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2016-03-16	2017-03-16
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2016-06-10	2017-06-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2016-06-10	2017-06-10
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2016-10-25	2018-10-25
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	sn:10	2016-01-22	2017-01-22
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2017-02-23	2018-02-23