

Test Report



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

Equipment Under Test: Multi-Protocol Wireless Module

Model: MGM12P22GA
MGM12P22GE

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: 21 August 2017

Issued by:

A handwritten signature in blue ink, appearing to read "Emil Haverinen".

Emil Haverinen
Testing Engineer

Date: 21 August 2017

Checked by:

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Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	MGM12P22GA, MGM12P22GE
Type:	Multi-Protocol Wireless Module
Serial no:	-
FCC ID:	QOQMGM12P2
IC:	5123A-MGM12P2

Description of the EUT

MGM12P22G is a multi-protocol wireless 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.

This test report contains test results for Bluetooth Low Energy.

Classification of the device

Fixed device	<input type="checkbox"/>
Mobile Device (Human body distance > 20cm)	<input checked="" type="checkbox"/>
Portable Device (Human body distance < 20cm)	<input checked="" type="checkbox"/>

Modifications Incorporated in the EUT

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

Ratings and declarations

Operating Frequency Range (OFR):	2402 - 2480 MHz
Channels:	40
Channel separation:	2 MHz
Effective conducted power:	9.07 dBm (Peak)
Modulation:	GFSK
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

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

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.

Conducted measurements were performed while the EUT was connected to WSTK development board. Conducted measurements were performed to 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 0) = 2402 MHz

Channel Mid (Ch 19) = 2440 MHz

Channel High (Ch 39) = 2480 MHz

Power setting 199 was used for A variant and power setting 186 for E variant during radiated measurements.

Power setting 199 was used for conducted measurements.

Test Facility

<input type="checkbox"/>	Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
<input checked="" type="checkbox"/>	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: EHA
Date: 2 August 2017
Temperature: 22 °C
Humidity: 44 % RH
Barometric pressure: 1001 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. **Conducted Emission was measured from the highest power level module MGM12P32**

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

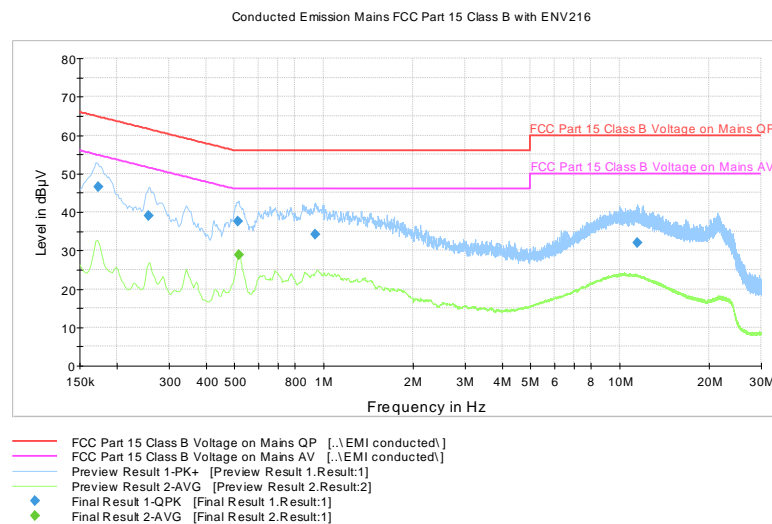


Figure 1: The measured curves with peak- and average detector.

Maximum Peak Conducted Output Power
Table 1: Final QuasiPeak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.173000	46.5	1000.0	9.000	L1	10.3	18.3	64.8
0.256500	38.9	1000.0	9.000	L1	9.7	22.6	61.5
0.515250	37.5	1000.0	9.000	L1	10.1	18.5	56.0
0.938000	34.2	1000.0	9.000	L1	10.0	21.8	56.0
11.470250	32.0	1000.0	9.000	L1	10.3	28.0	60.0

Table 2: Final Average measurements from the worst frequencies

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.517250	28.8	1000.0	9.000	N	10.3	17.2	46.0

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

Maximum Peak Conducted Output Power

Standard: ANSI C63.10 (2013)
Tested by: JAT & EHA
Date: 11 August 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	9.07	30	20.93	PASS
Mid	8.72	30	21.28	PASS
High	8.68	30	21.32	PASS

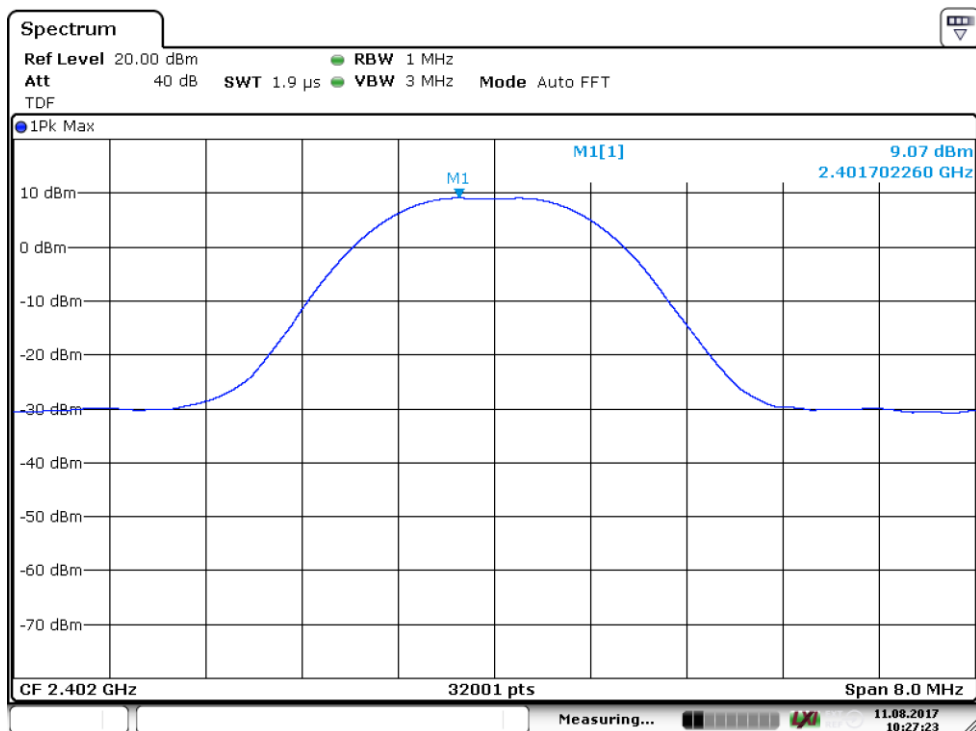


Figure 2: Conducted power (ch low)

Maximum Peak Conducted Output Power

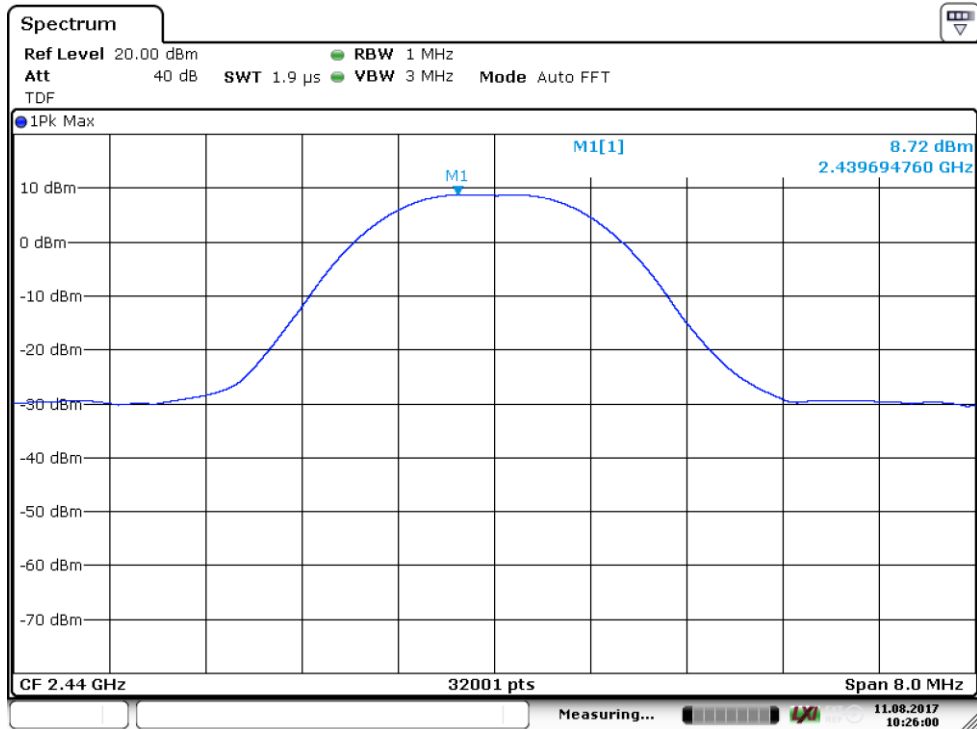


Figure 3: Conducted power (ch mid)

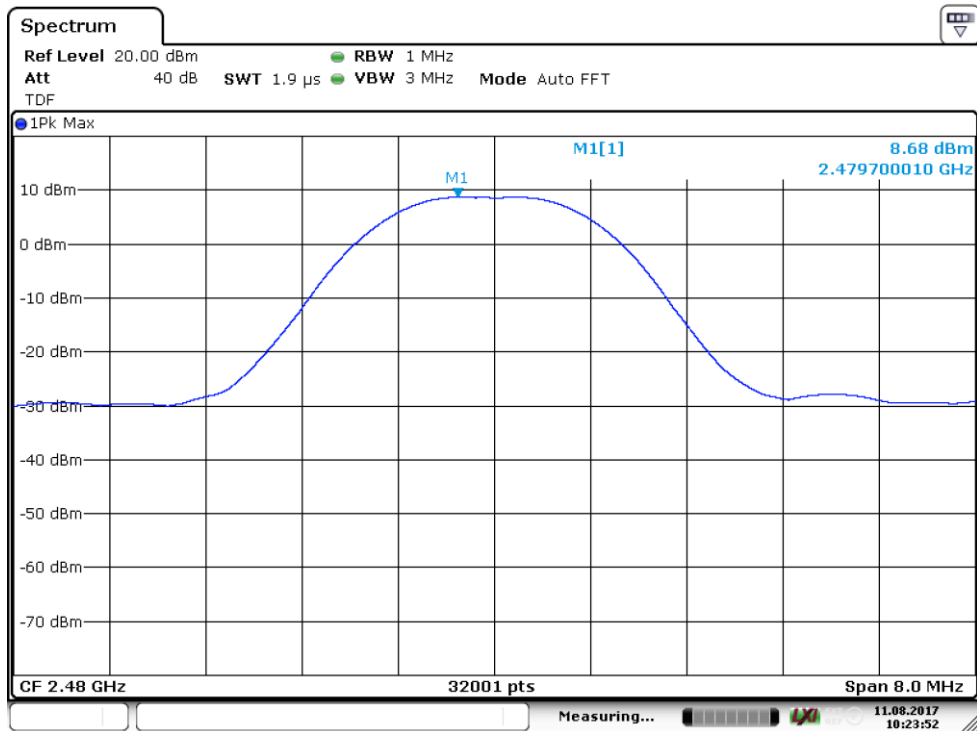


Figure 4: Conducted power (ch high)

Transmitter Radiated Spurious Emissions 30 - 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: EHA & JAT
Date: 26 July 2017 - 8 August 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 [$\mu\text{V/m}$]	Limit [dB $\mu\text{V/m}$]	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

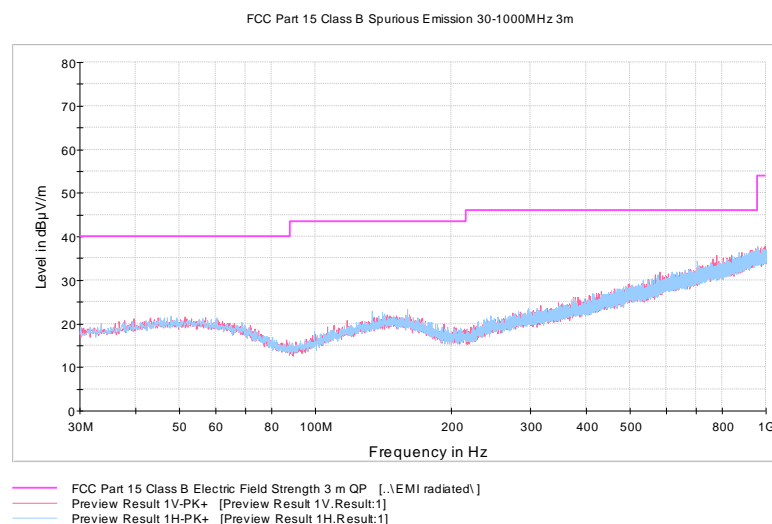


Figure 5: Low channel 30 MHz – 1000 MHz (A)

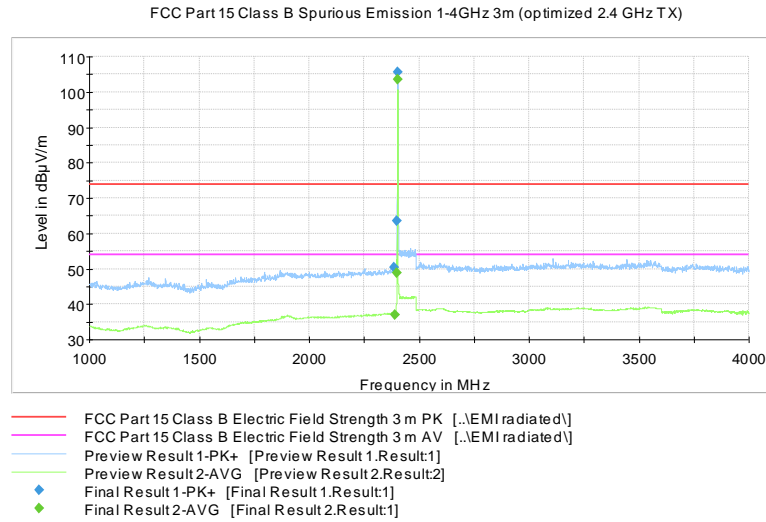


Figure 6: Low channel 1 GHz – 4 GHz (A)

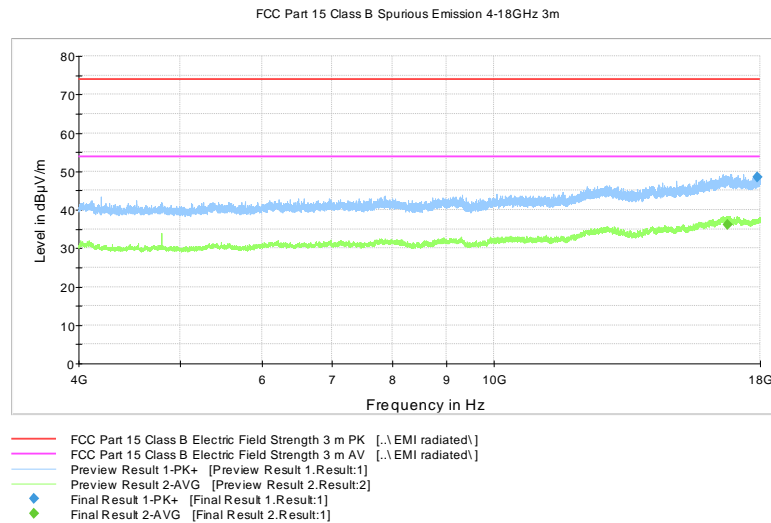


Figure 7: Low channel 4 GHz – 18 GHz (A)

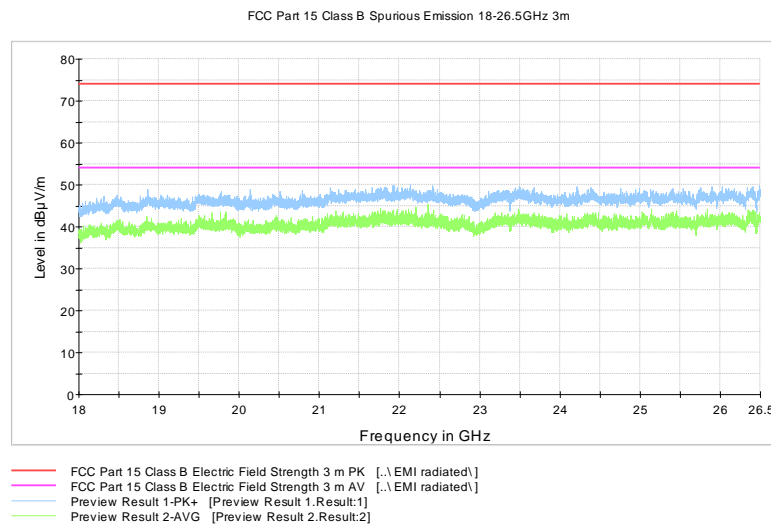


Figure 8: Low channel 18 GHz – 26.5 GHz (A)

Transmitter Radiated Spurious Emissions

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)
2384.000000	50.4	1000.0	1000.000	178.0	H	0.0	14.5	23.5	73.9
2400.000000	63.5	1000.0	1000.000	207.0	H	260.0	14.7	22.2	85.7
17897.80000	48.6	1000.0	1000.000	337.0	V	293.0	28.0	25.3	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)
2389.600000	37.0	1000.0	1000.000	379.0	V	317.0	14.6	16.9	53.9
2400.000000	48.8	1000.0	1000.000	150.0	H	256.0	14.7	5.1	53.9
16744.30000	36.2	1000.0	1000.000	400.0	V	261.0	26.6	17.7	53.9

Middle channel

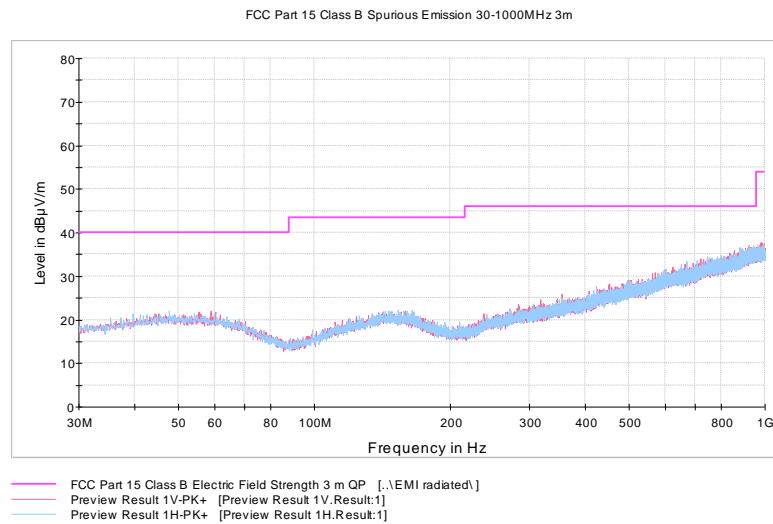


Figure 9: Mid channel 30 MHz – 1000 MHz (A)

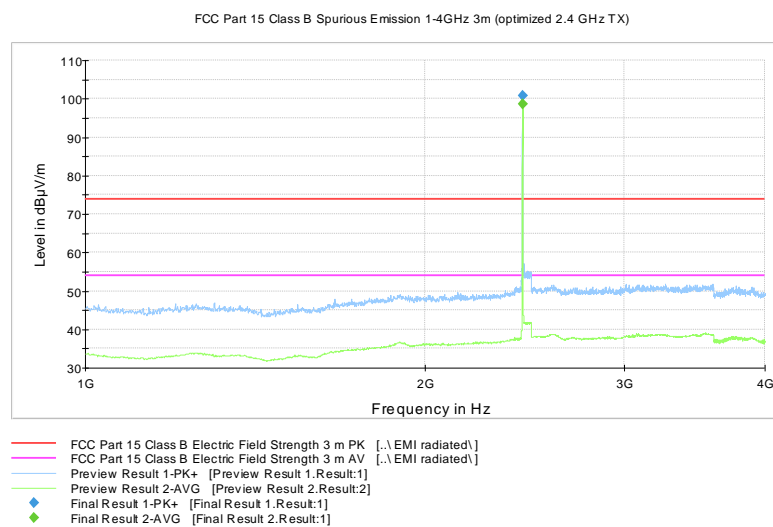


Figure 10: Mid channel 1 GHz – 4 GHz (A)

Transmitter Radiated Spurious Emissions

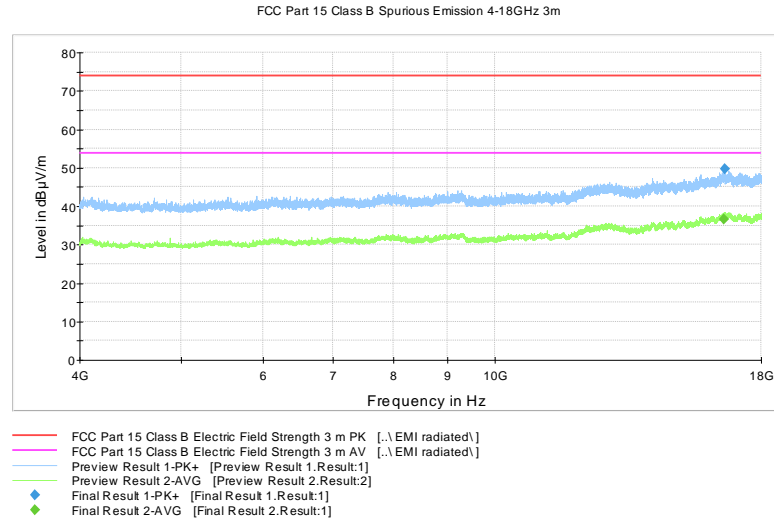


Figure 11: Mid channel 4 GHz – 18 GHz (A)

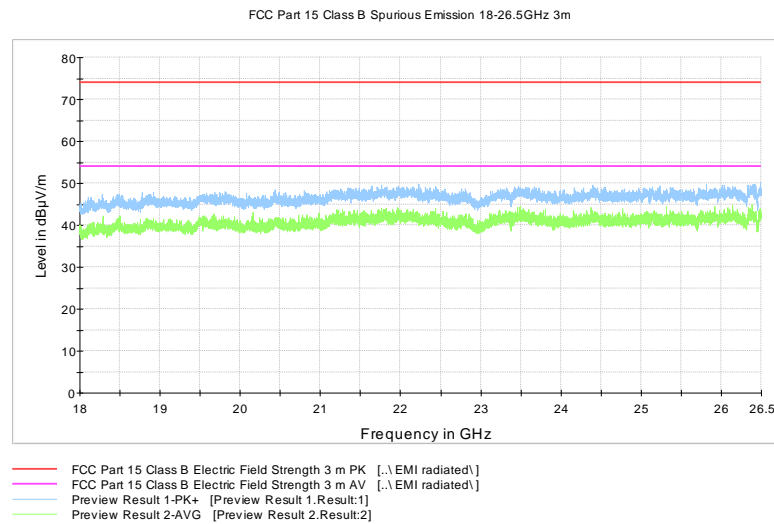


Figure 12: Mid channel 18 GHz – 26.5 GHz (A)

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)
16616.60000	49.8	1000.0	1000.000	393.0	H	152.0	26.3	24.1	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)
16596.00000	36.7	1000.0	1000.000	400.0	V	263.0	26.2	17.2	53.9

High channel

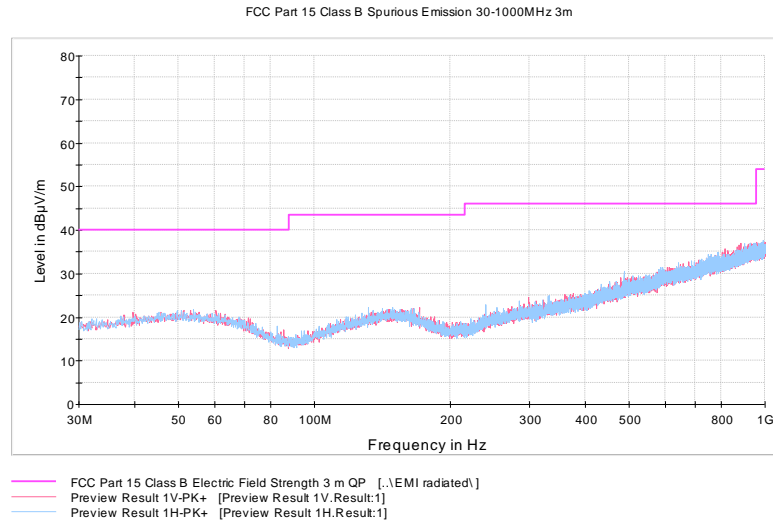


Figure 13: High channel 30 MHz – 1000 MHz (A)

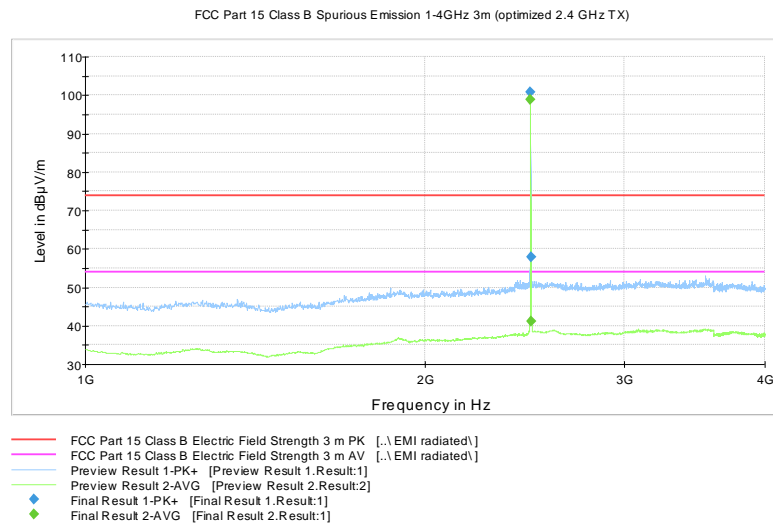


Figure 14: High channel 1 GHz – 4 GHz (A)

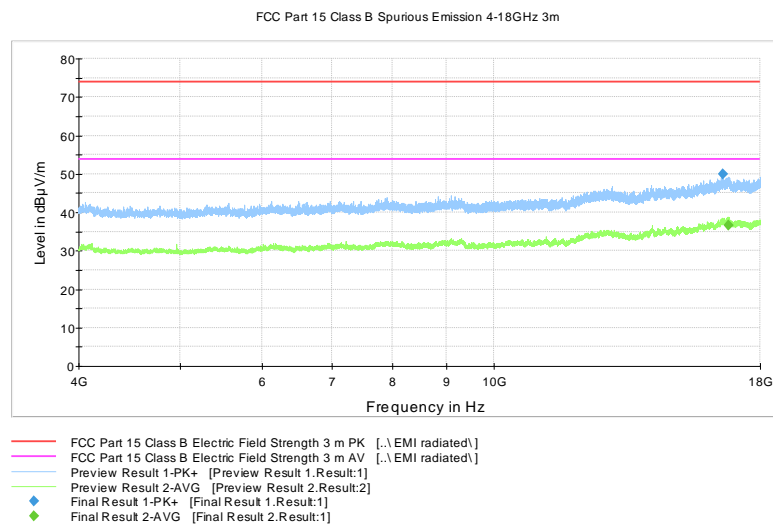


Figure 15: High channel 4 GHz – 18 GHz (A)

Transmitter Radiated Spurious Emissions

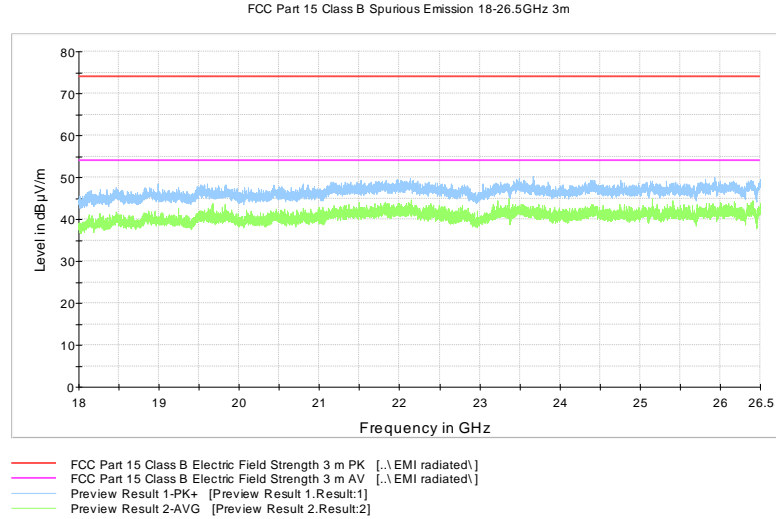


Figure 16: High channel 18 GHz – 26.5 GHz (A)

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)
2483.500000	57.9	1000.0	1000.000	241.0	H	264.0	14.7	16.0	73.9
16582.30000	49.9	1000.0	1000.000	400.0	H	64.0	26.2	24.0	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	41.2	1000.0	1000.000	228.0	H	265.0	14.7	12.7	53.9
16781.50000	36.5	1000.0	1000.000	400.0	H	352.0	26.8	17.4	53.9

Transmitter Radiated Spurious Emissions

Radiated Band Edge results

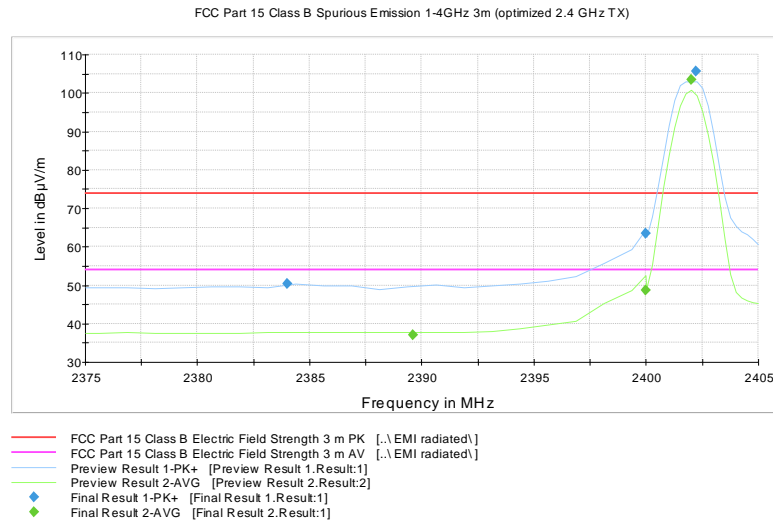


Figure 17: Radiated Band Edge measurement graph (ch low) (A)

Table 10: 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)
2384.000000	50.4	1000.0	1000.000	178.0	H	0.0	14.5	23.5	73.9
2400.000000	63.5	1000.0	1000.000	207.0	H	260.0	14.7	22.2	85.7

Table 11: 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)
2389.600000	37.0	1000.0	1000.000	379.0	V	317.0	14.6	16.9	53.9
2400.000000	48.8	1000.0	1000.000	150.0	H	256.0	14.7	5.1	53.9

Transmitter Radiated Spurious Emissions

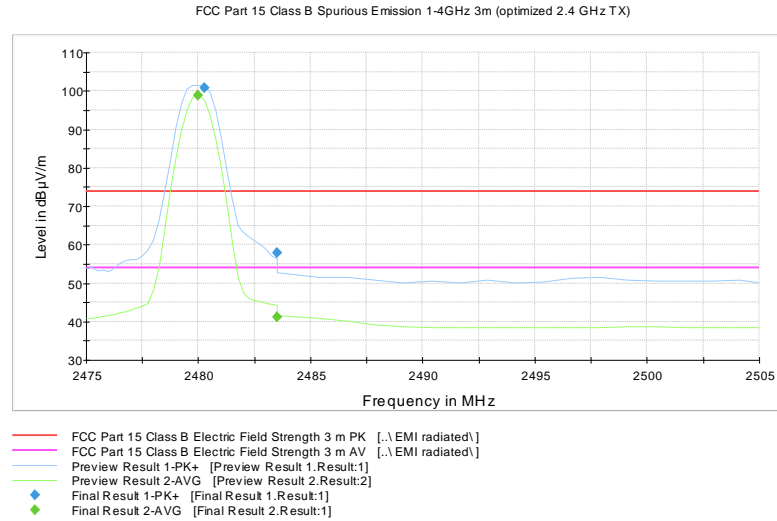


Figure 18: Radiated Band Edge measurement graph (ch high) (A)

Table 12: 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)
2483.500000	57.9	1000.0	1000.000	241.0	H	264.0	14.7	16.0	73.9

Table 13: 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	41.2	1000.0	1000.000	228.0	H	265.0	14.7	12.7	53.9

Low channel

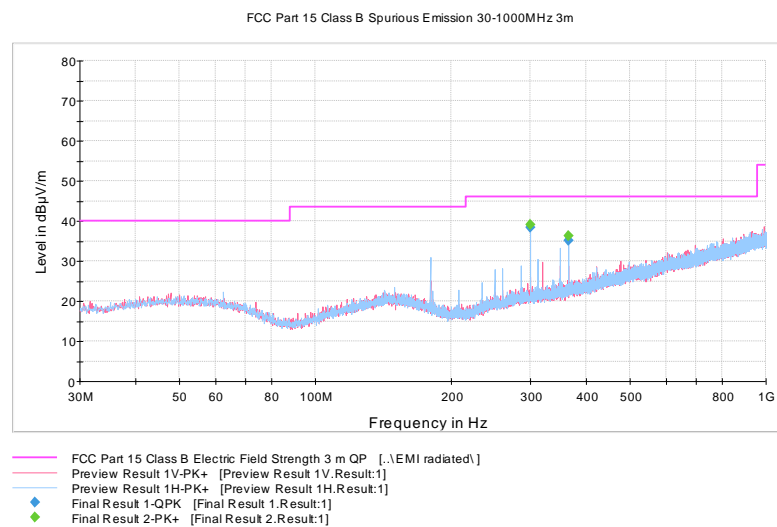


Figure 19: Low channel 30 MHz – 1000 MHz (E)

Transmitter Radiated Spurious Emissions

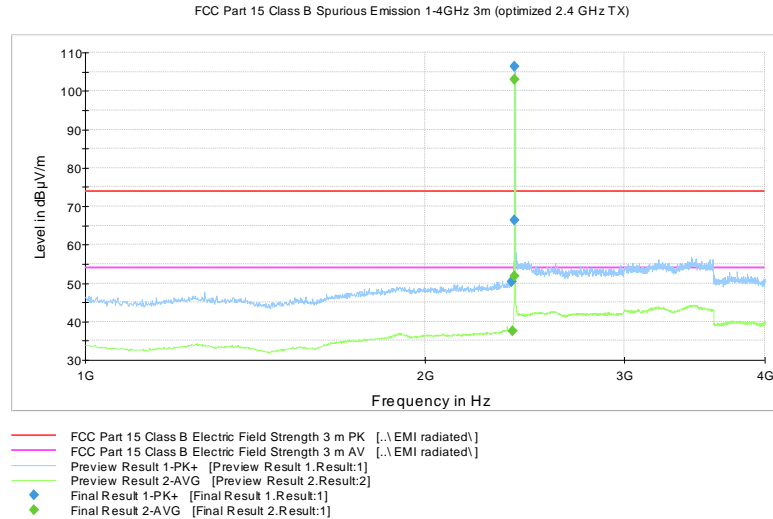


Figure 20: Low channel 1 GHz – 4 GHz (E)

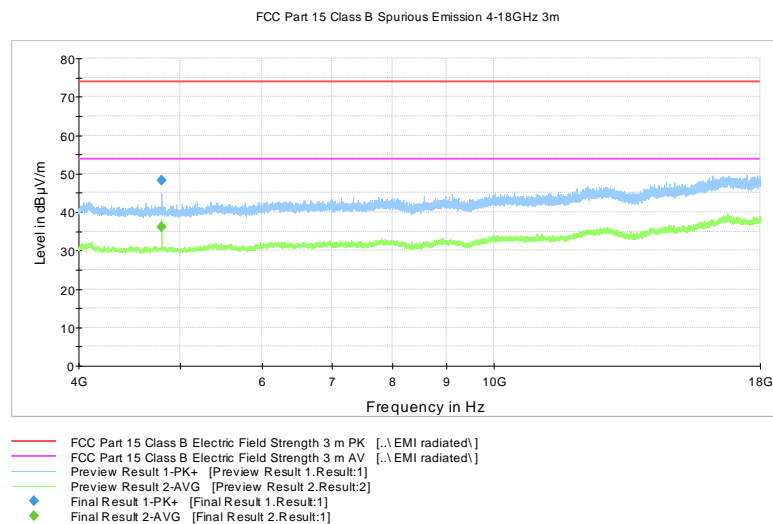


Figure 21: Low channel 4 GHz – 18 GHz (E)

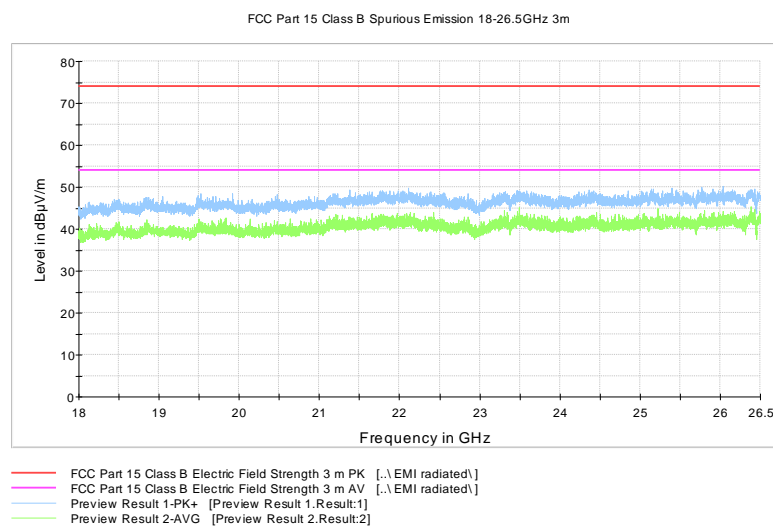


Figure 22: Low channel 18 GHz – 26.5 GHz (E)

Transmitter Radiated Spurious Emissions

Table 14: 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)
2387.200000	50.4	1000.0	1000.000	253.0	H	57.0	14.6	23.5	73.9
2400.000000	66.3	1000.0	1000.000	166.0	V	153.0	14.7	20.1	86.4
4804.000000	48.3	1000.0	1000.000	179.0	V	214.0	8.3	25.6	73.9

Table 15: 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)
2389.600000	37.5	1000.0	1000.000	191.0	V	155.0	14.6	16.4	53.9
2400.000000	51.8	1000.0	1000.000	178.0	V	157.0	14.7	2.1	53.9
4804.000000	36.1	1000.0	1000.000	167.0	V	214.0	8.3	17.8	53.9

Table 16: 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	39.1	1000.0	120.000	100.0	H	6.0	15.3	6.9	46.0
364.011000	36.2	1000.0	120.000	100.0	H	40.0	16.9	9.8	46.0

Middle channel

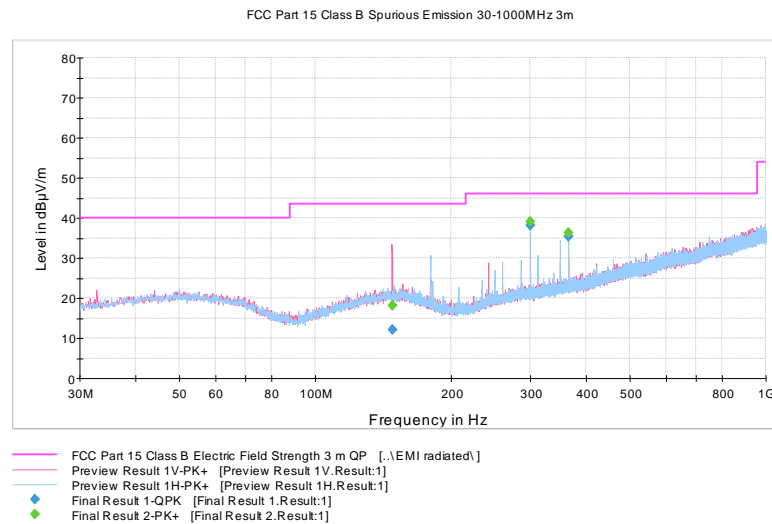


Figure 23: Mid channel 30 MHz – 1000 MHz (E)

Transmitter Radiated Spurious Emissions

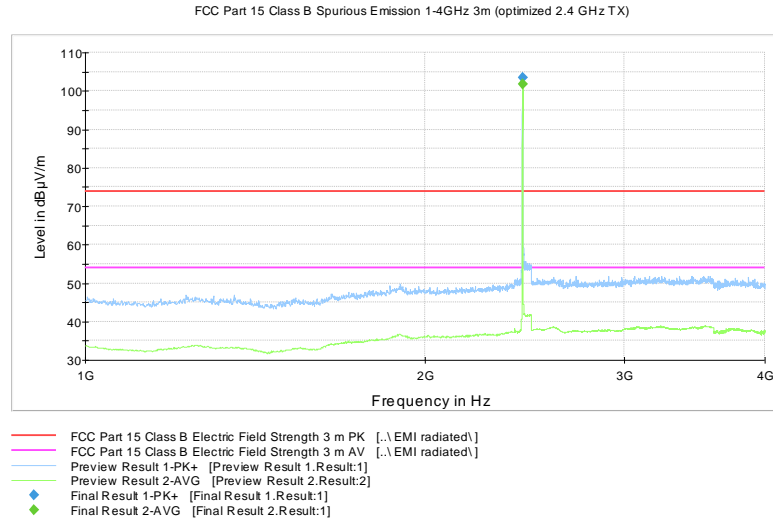


Figure 24: Mid channel 1 GHz – 4 GHz (E)

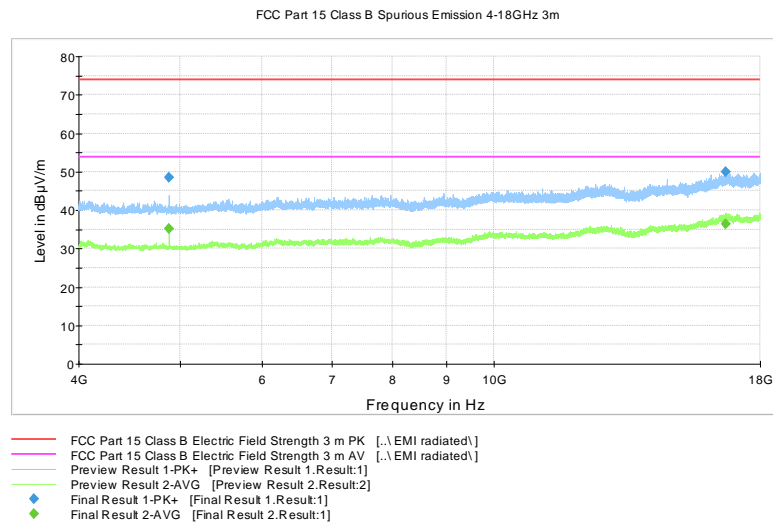


Figure 25: Mid channel 4 GHz – 18 GHz (E)

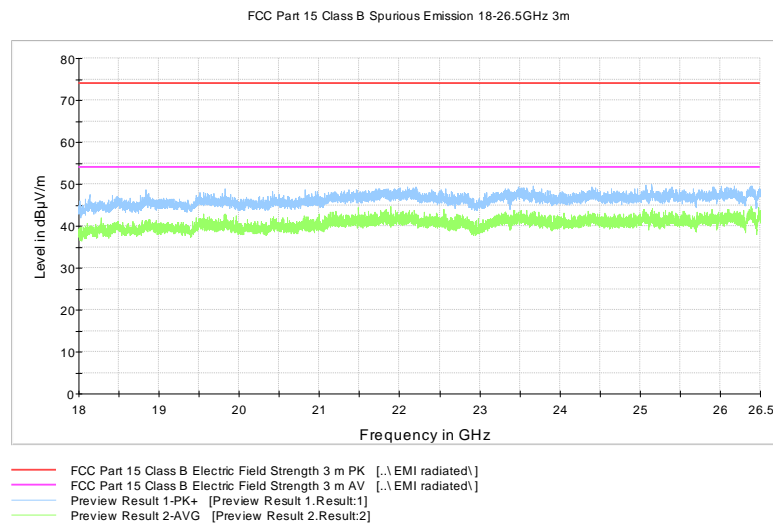


Figure 26: Mid channel 18 GHz – 26.5 GHz (E)

Transmitter Radiated Spurious Emissions

Table 17: 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)
4880.000000	48.6	1000.0	1000.000	150.0	V	215.0	8.3	25.3	73.9
16676.40000	50.0	1000.0	1000.000	391.0	V	345.0	26.4	23.9	73.9

Table 18: 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)
4880.000000	35.3	1000.0	1000.000	150.0	V	215.0	8.3	18.6	53.9
16691.10000	36.3	1000.0	1000.000	400.0	V	228.0	26.4	17.6	53.9

Table 19: 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)
148.372000	12.1	1000.0	120.000	292.0	V	106.0	14.5	31.4	43.5
300.008000	38.3	1000.0	120.000	100.0	H	5.0	15.3	7.7	46.0
364.008000	35.3	1000.0	120.000	100.0	H	48.0	16.9	10.7	46.0

High channel

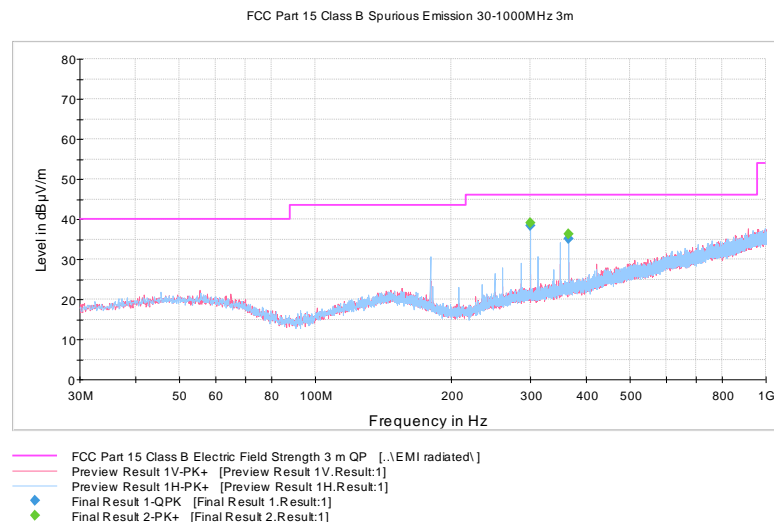


Figure 27: High channel 30 MHz – 1000 MHz (E)

Transmitter Radiated Spurious Emissions

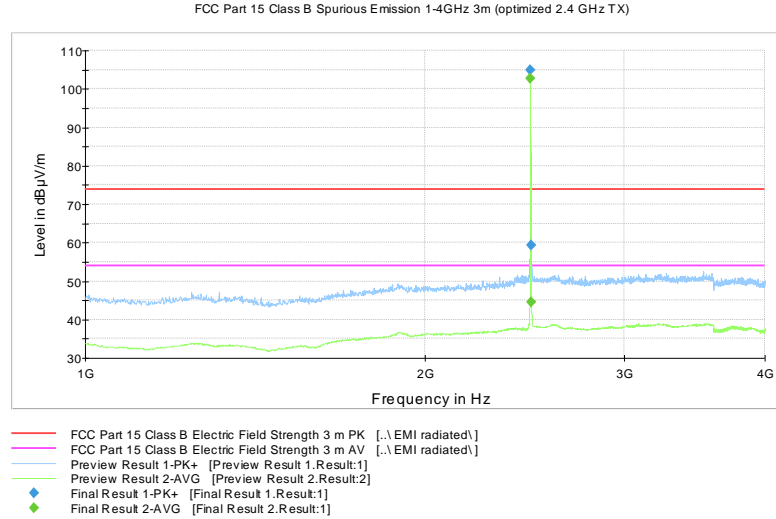


Figure 28: High channel 1 GHz – 4 GHz (E)

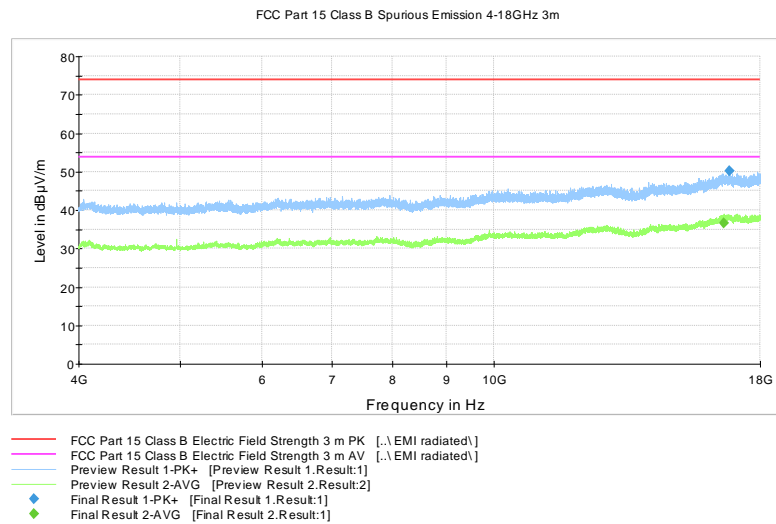


Figure 29: High channel 4 GHz – 18 GHz (E)

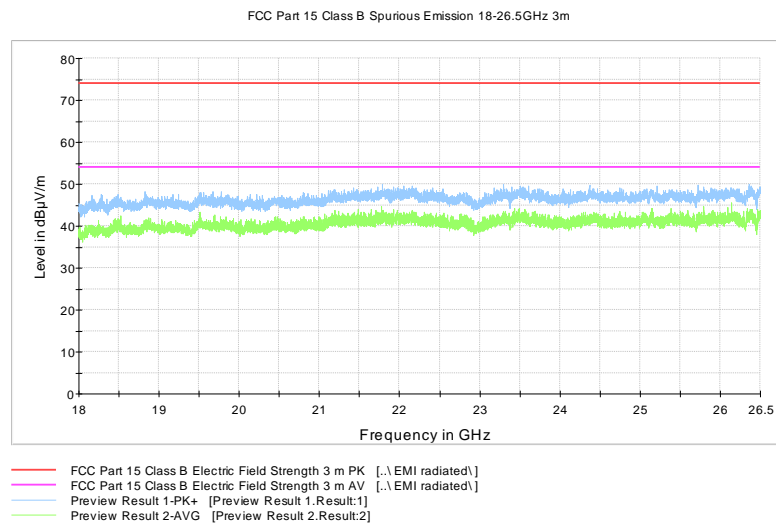


Figure 30: High channel 18 GHz – 26.5 GHz (E)

Transmitter Radiated Spurious Emissions

Table 20: 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	59.3	1000.0	1000.000	253.0	V	6.0	14.7	14.6	73.9
16811.20000	50.1	1000.0	1000.000	400.0	H	311.0	26.8	23.8	73.9

Table 21: 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)
2483.500000	44.4	1000.0	1000.000	203.0	V	354.0	14.7	9.5	53.9
16609.00000	36.5	1000.0	1000.000	400.0	V	353.0	26.3	17.4	53.9

Table 22: 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	38.3	1000.0	120.000	100.0	H	7.0	15.3	7.7	46.0
364.011000	35.2	1000.0	120.000	100.0	H	48.0	16.9	10.8	46.0

Transmitter Radiated Spurious Emissions

Radiated Band Edge results

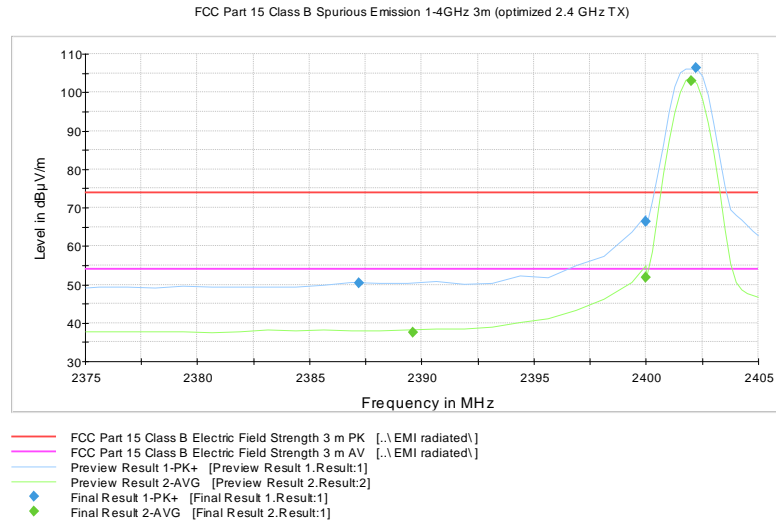


Figure 31: Radiated Band Edge measurement graph (ch low) (E)

Table 23: 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)
2387.200000	50.4	1000.0	1000.000	253.0	H	57.0	14.6	23.5	73.9
2400.000000	66.3	1000.0	1000.000	166.0	V	153.0	14.7	20.1	86.4

Table 24: 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)
2389.600000	37.5	1000.0	1000.000	191.0	V	155.0	14.6	16.4	53.9
2400.000000	51.8	1000.0	1000.000	178.0	V	157.0	14.7	2.1	53.9

Transmitter Radiated Spurious Emissions

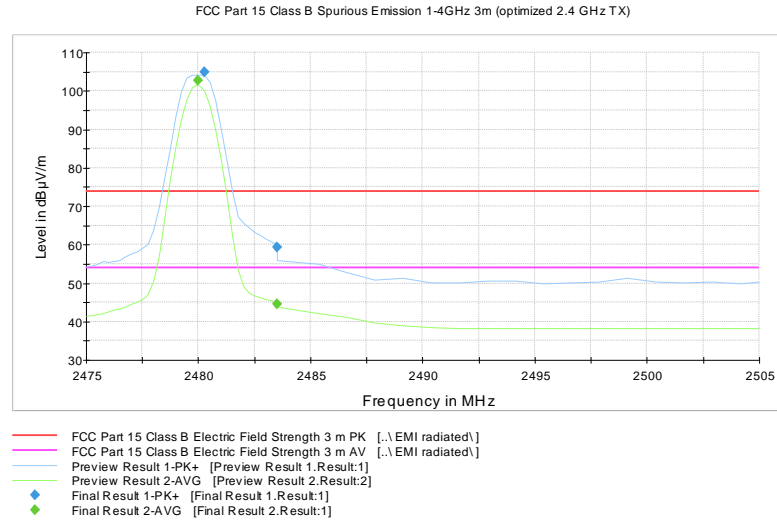


Figure 32: Radiated Band Edge measurement graph (ch high) (E)

Table 25: 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	59.3	1000.0	1000.000	253.0	V	6.0	14.7	14.6	73.9

Table 26: 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)
2483.500000	44.4	1000.0	1000.000	203.0	V	354.0	14.7	9.5	53.9

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	EHA & JAT	
Date:	11 August 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 27: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-50.88 dBc	-50.40 dBc
Limit: -20 dBc	

Table 28: Conducted spurious emissions (ch low)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
708,11	-69,40	-11,02	-58,39	PASS
2399,98	-46,06	-11,02	-35,04	PASS
3608,87	-65,66	-11,02	-54,64	PASS
4804,40	-53,92	-11,02	-42,90	PASS
8482,66	-61,24	-11,02	-50,22	PASS
12447,50	-58,40	-11,02	-47,38	PASS
15494,38	-56,47	-11,02	-45,46	PASS
16491,84	-55,24	-11,02	-44,22	PASS
21128,01	-56,69	-11,02	-45,67	PASS
22859,15	-56,21	-11,02	-45,19	PASS
25735,61	-56,02	-11,02	-45,01	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 29: Conducted spurious emissions (ch mid)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
954,09	-69,36	-11,31	-58,05	PASS
1714,39	-63,78	-11,31	-52,46	PASS
3820,23	-65,27	-11,31	-53,95	PASS
4879,49	-53,00	-11,31	-41,69	PASS
9808,99	-61,25	-11,31	-49,93	PASS
12537,97	-58,51	-11,31	-47,19	PASS
15497,94	-57,21	-11,31	-45,90	PASS
16177,23	-54,92	-11,31	-43,61	PASS
19535,16	-56,95	-11,31	-45,63	PASS
24435,13	-55,73	-11,31	-44,41	PASS
25793,73	-55,12	-11,31	-43,81	PASS

Table 30: Conducted spurious emissions (ch high)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
952,00	-69,28	-11,32	-57,96	PASS
2259,85	-66,51	-11,32	-55,19	PASS
2483,76	-51,18	-11,32	-39,85	PASS
4960,39	-52,47	-11,32	-41,15	PASS
8501,78	-61,27	-11,32	-49,95	PASS
12481,63	-59,05	-11,32	-47,73	PASS
15529,16	-56,88	-11,32	-45,55	PASS
16464,09	-55,10	-11,32	-43,78	PASS
19199,45	-57,06	-11,32	-45,73	PASS
24167,29	-55,61	-11,32	-44,29	PASS
25575,68	-55,87	-11,32	-44,55	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

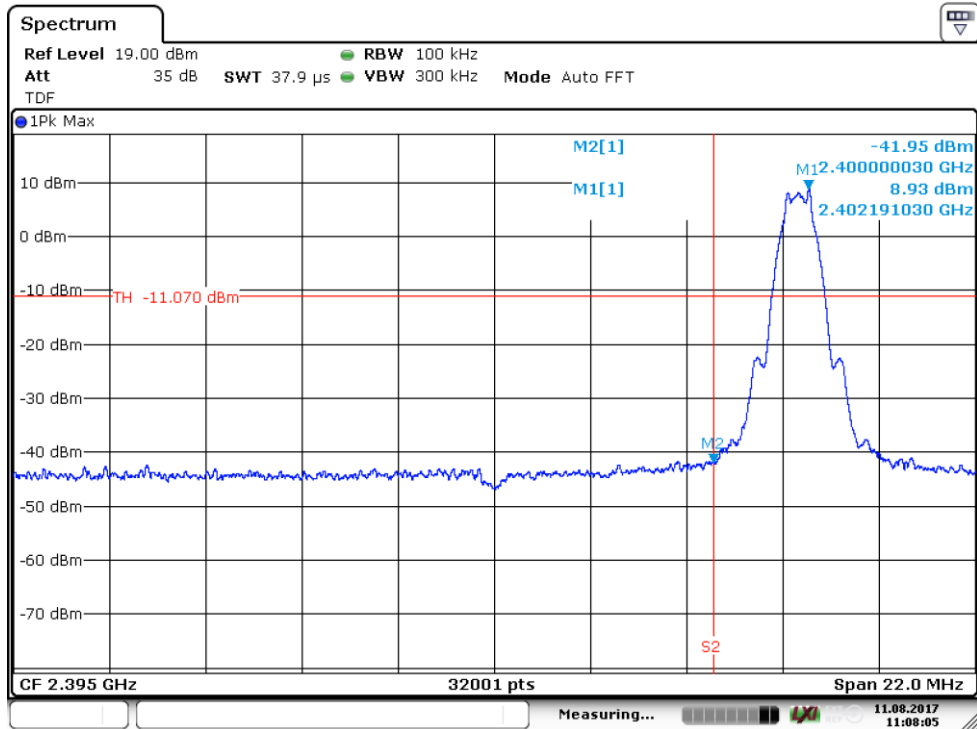


Figure 33: Lower Band Edge

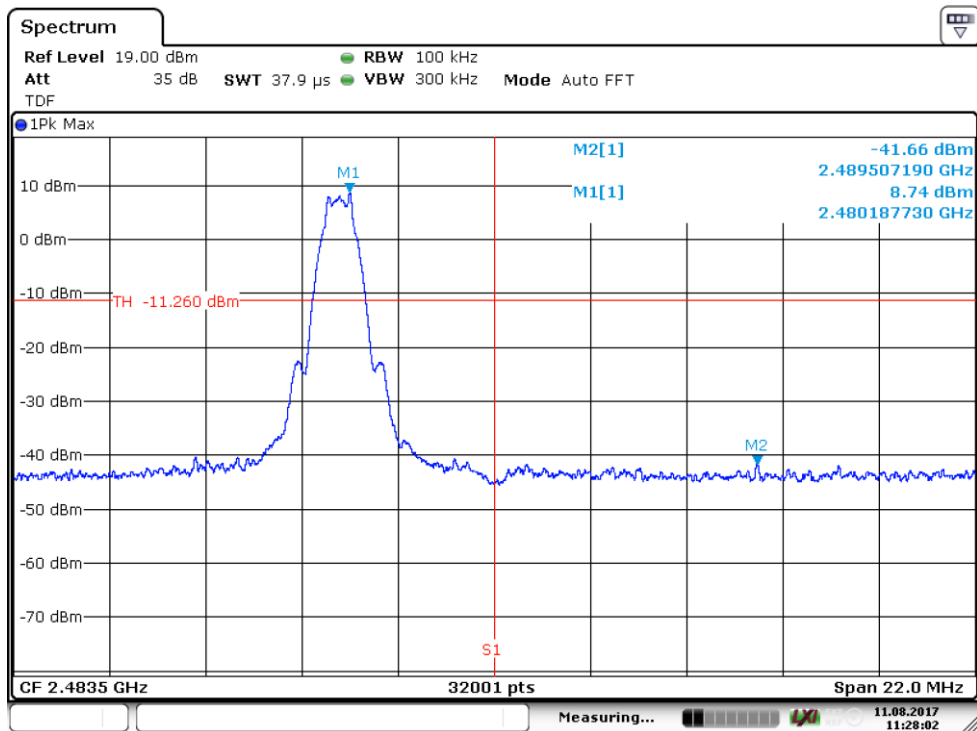


Figure 34: Upper Band Edge

Transmitter Band Edge Measurement and Conducted Spurious Emissions

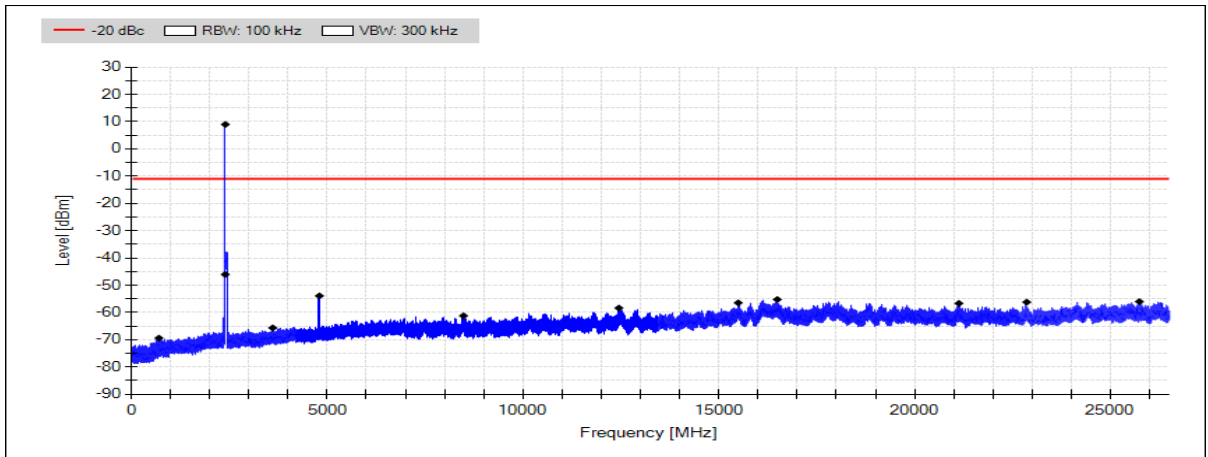


Figure 35: Conducted spurious emissions 30 - 26500 MHz channel low

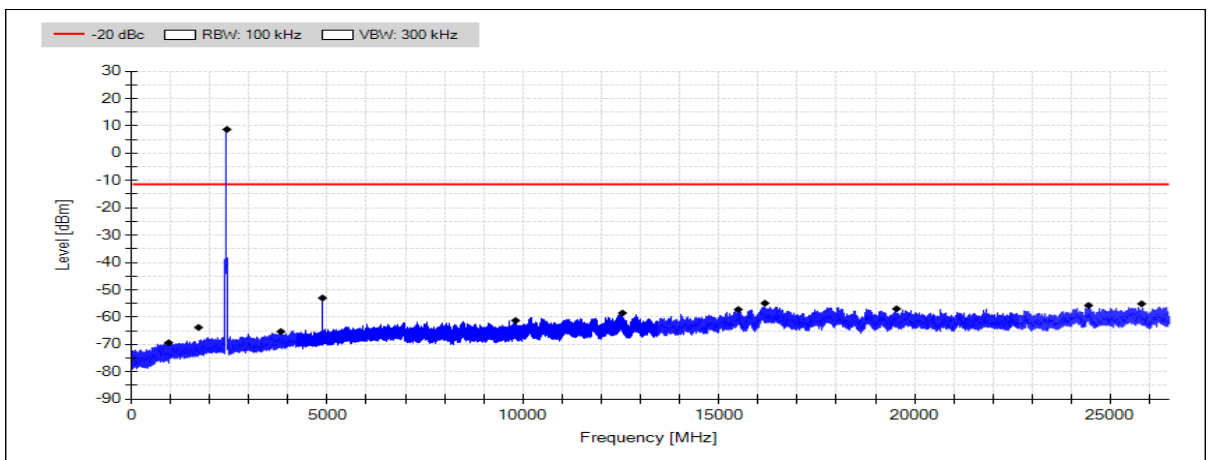


Figure 36: Conducted spurious emissions 30 - 26500 MHz channel mid

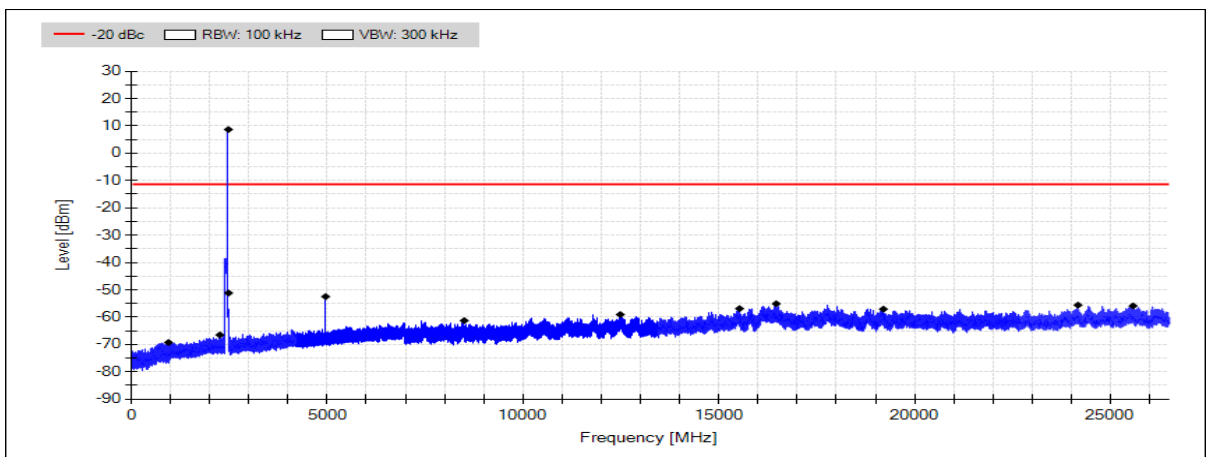


Figure 37: Conducted spurious emissions 30 - 26500 MHz channel high

6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2013)
Tested by: EHA & JAT
Date: 11 August 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 31: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	650.45	500
Mid	651.23	
High	650.60	

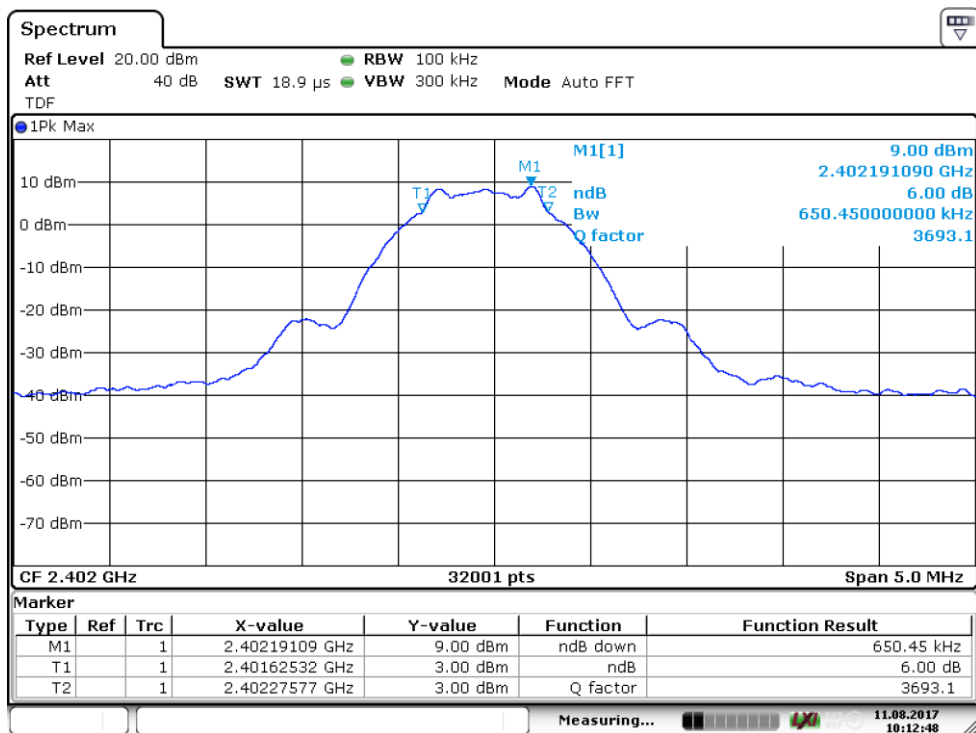


Figure 38: 6 dB bandwidth (ch low)

6 dB Bandwidth of the Channel

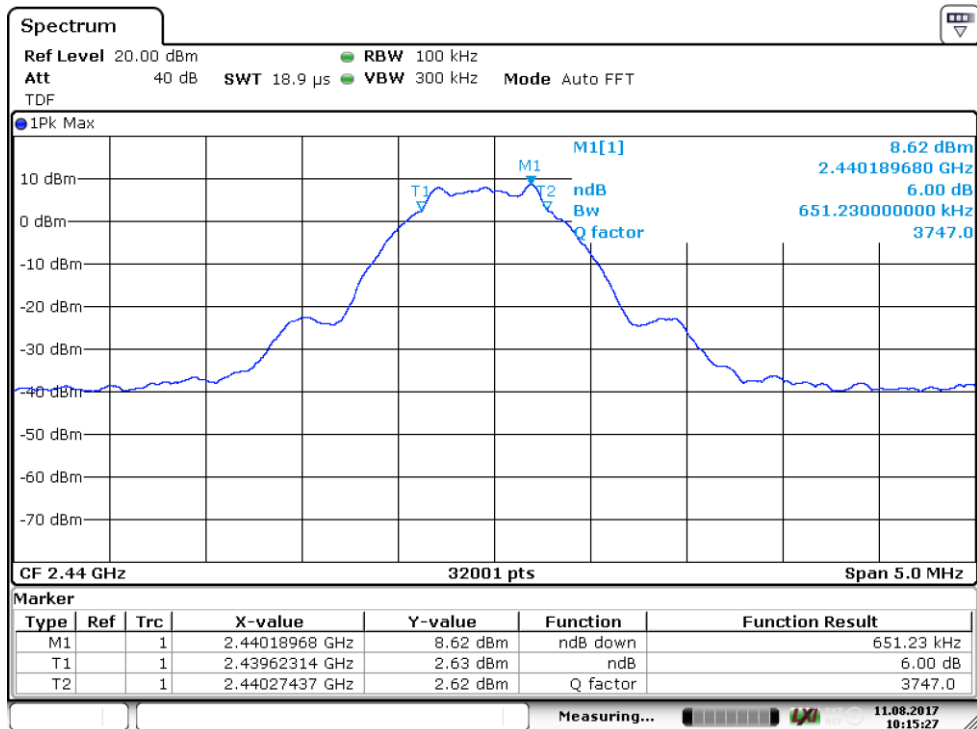


Figure 39: 6 dB bandwidth (ch mid)

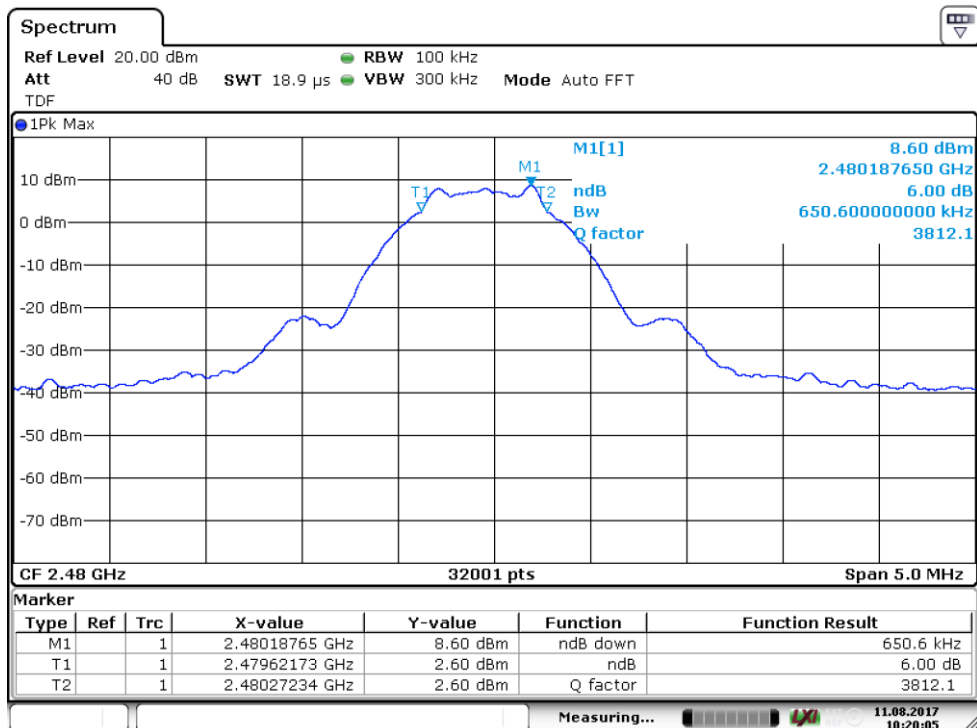


Figure 40: 6 dB bandwidth (ch high)

Power Spectral Density

Standard: ANSI C63.10 (2013)
Tested by: EHA & JAT
Date: 11 August 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 32: Power spectral density test results

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-7.43	+8.00
Mid	-7.78	
High	-7.79	

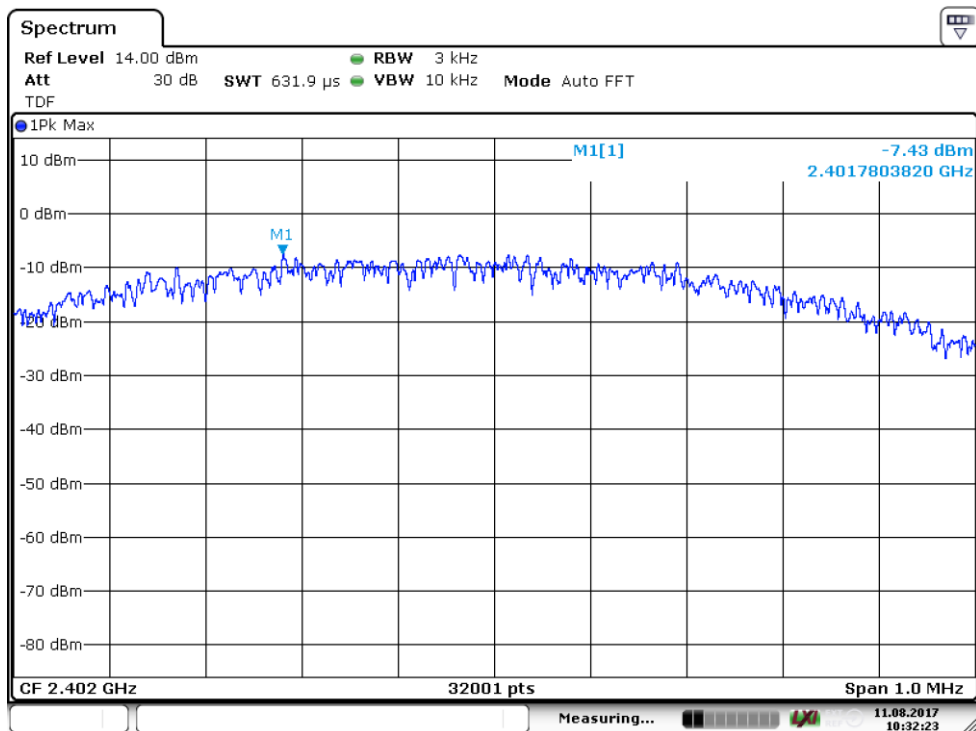


Figure 41: Power spectral density (ch low)

Power Spectral Density

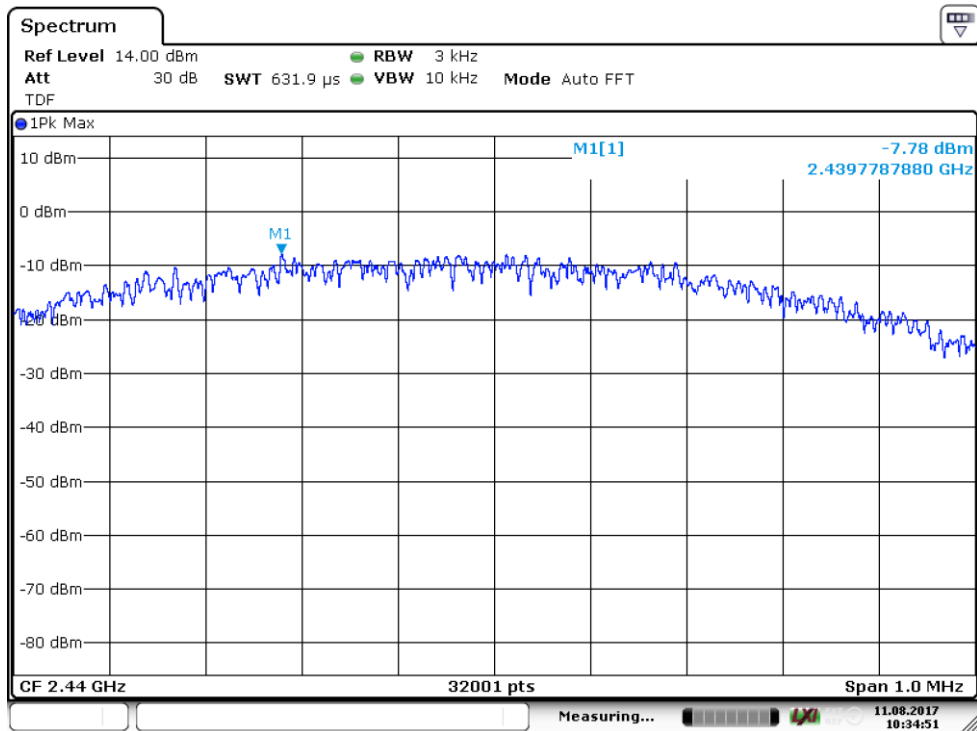


Figure 42: Power spectral density (ch mid)

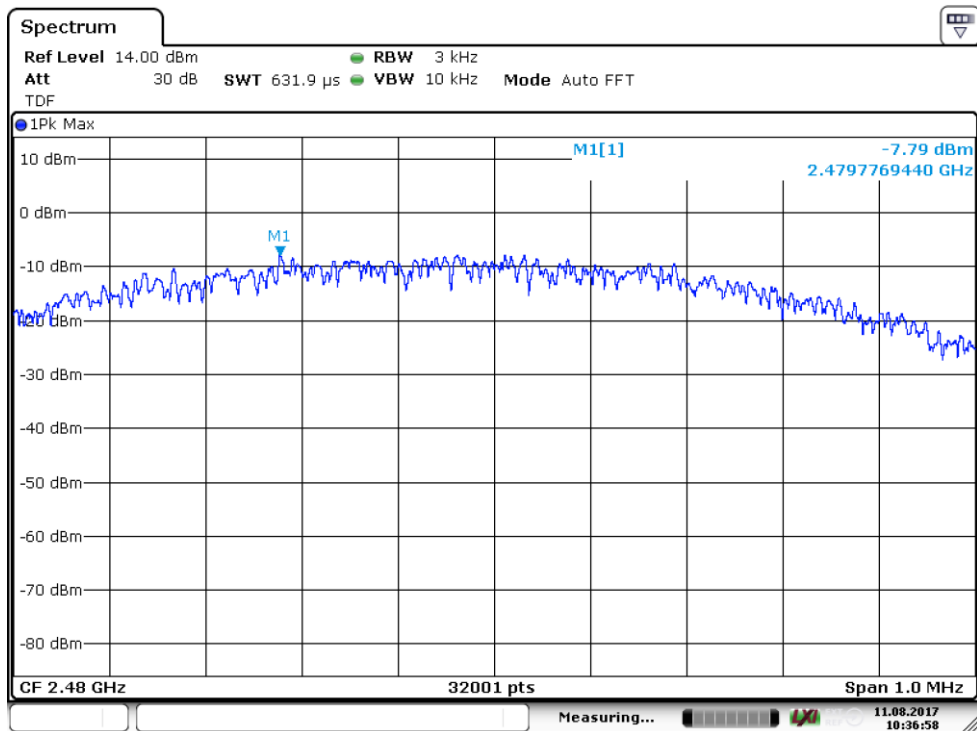


Figure 43: Power spectral density (ch high)

99% Occupied Bandwidth

Standard: RSS-GEN (2014)
Tested by: EHA
Date: 11 August 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

RSS-GEN 6.6

Table 33: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.046217306	PASS
Mid	-	1.045279835	PASS
High	-	1.049654698	PASS

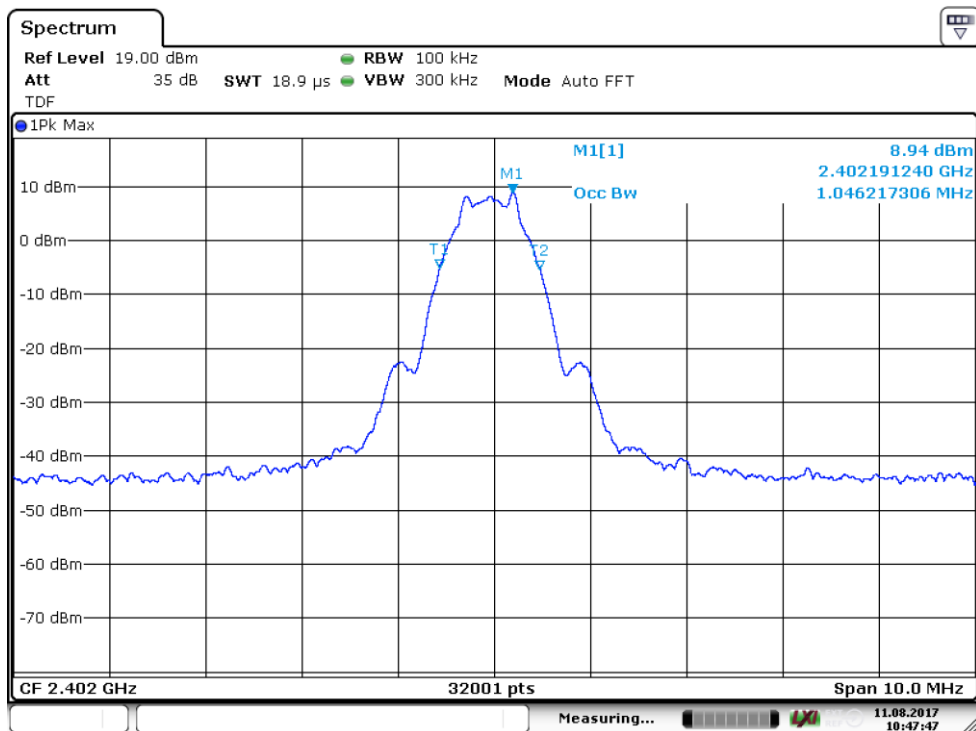


Figure 44: 99% OBW (ch low)

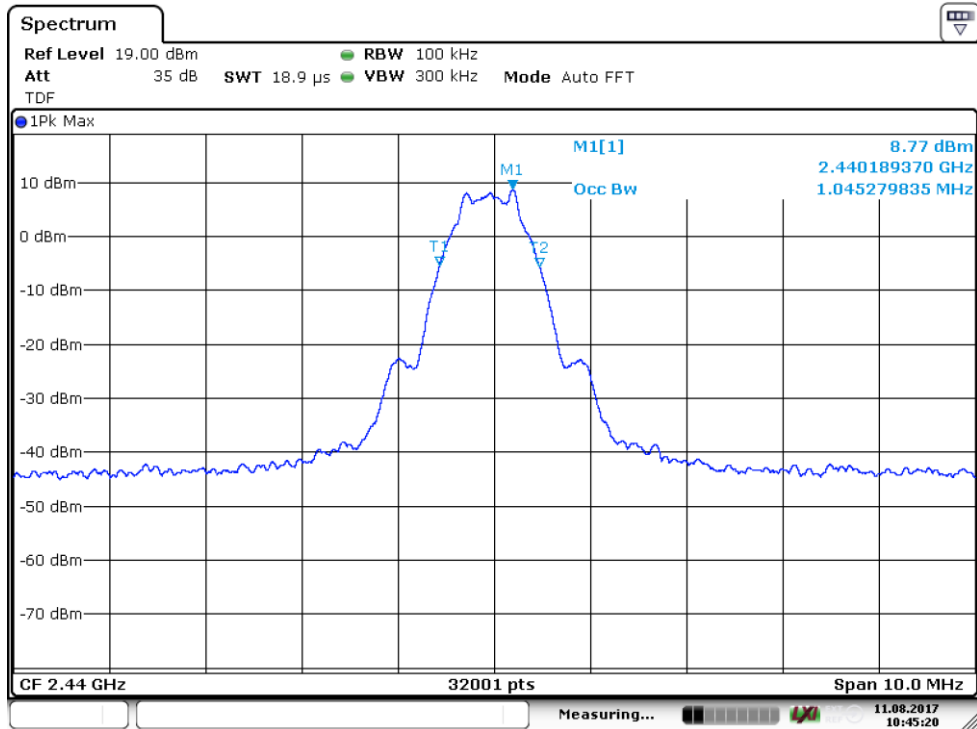


Figure 45: 99% OBW (ch mid)

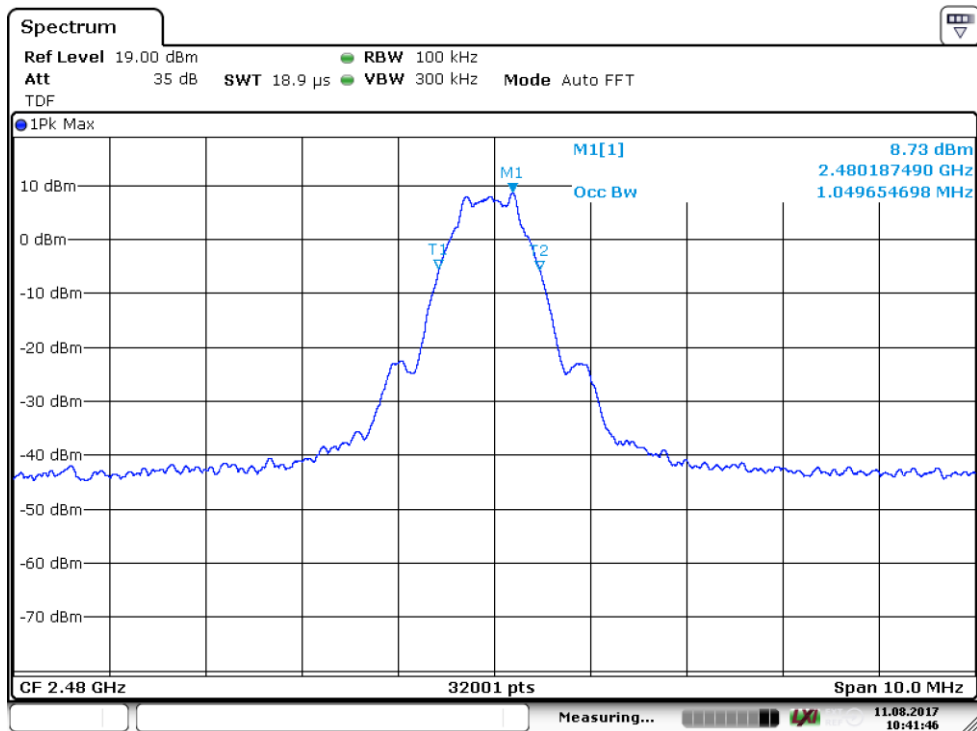


Figure 46: 99% OBW (ch high)

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	PASTERNAK	10dB DC-40GHz	-	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2017-07-10	2018-07-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2017-07-07	2018-07-07
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