

Test Report



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

Equipment Under Test: Bluetooth Low Energy Module

Model: BGM13P32A
BGM13P32E
BGM13P22A
BGM13P22E

Manufacturer: Silicon Laboratories Finland Oy
Bertel Jungin aukio 3
FI-02600 ESPOO
FINLAND

Customer: Silicon Laboratories Finland Oy
Bertel Jungin aukio 3
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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: 2 February 2018

Issued by:


Jani Tuomela
Testing Engineer

Date: 2 February 2018

Checked by:


Rauno Repo
Testing Engineer

Table of Contents

PRODUCT DESCRIPTION	3
Equipment Under Test (EUT)	3
Description of the EUT	3
Ratings and declarations	3
Power Supply	3
Mechanical Size of the EUT	3
Samples	4
GENERAL REMARKS	5
Disclaimer	5
SUMMARY OF TESTING	6
EUT Test Conditions during Testing	6
TEST RESULTS	8
Conducted Emissions In The Frequency Range 150 kHz - 30 MHz	8
Maximum Peak Conducted Output Power	11
Transmitter Radiated Spurious Emissions 30 - 26500 MHz	24
Transmitter Band Edge Measurement and Conducted Spurious Emissions	45
6 dB Bandwidth of the Channel	61
Power Spectral Density	69
99% Occupied Bandwidth	77
TEST EQUIPMENT	89

Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	BGM13P32A, BGM13P32E, BGM13P22A, BGM13P22E
Type:	Bluetooth Low Energy Module
Serial no:	-
FCC ID:	QOQBGM13P
IC:	5123A-BGM13P

Description of the EUT

BGM13P is a Bluetooth low energy module with two antenna variants. Variant A is equipped with chip antenna while the E variant has RF pin 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):	2402 - 2480 MHz
Channels:	40
Channel separation:	2 MHz
Effective conducted power:	19.60 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
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Samples

EUT	Description
1. BGM13P32A	Original A variant, equipped with chip antenna
2. BGM13P32A	Modified A variant, Short RF cable added for conducted tests
3. BGM13P32E	Original E variant with RF pin for external antenna
4. BGM13P22A	Modified A variant, Short RF cable added for conducted tests
5. BGM13P22E	Original E variant with RF pin for external antenna

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.

During conducted measurements, the EUT was connected to WSTK development board.

During radiated measurements, E variant was connected to WSTK development board and the A variant was having simplified board with reduced functionality.

Following channels and settings were used during the tests;

EUT 1. BGM13P32A

- Radiated Emissions Within the Restricted Bands (channels: 0, 19, 39)
- Conducted Emissions on Power Supply Lines tests (channel: 19)

Channel	Frequency (MHz)	Power setting	PHY	Low energy transmit	Packet Length	Advertise pulse interval
0	2402	200	125K Coded	PRBS9 (GFSK)	255	-
19	2440	200	125K Coded	PRBS9 (GFSK)	255	-
39	2480	200	125K Coded	PRBS9 (GFSK)	255	-

EUT 3. BGM13P32E

- Radiated Emissions Within the Restricted Bands (channels: 0, 19, 38, 39), channel 39 was used only for band edge measurement.
- Conducted Emissions on Power Supply Lines tests (channel 19)

Channel	Frequency (MHz)	Power setting	PHY	Low energy transmit	Packet Length	Advertise pulse interval
0	2402	200	125K Coded	PRBS9 (GFSK)	255	-
19	2440	200	125K Coded	PRBS9 (GFSK)	255	-
38	2478	200	125K Coded	PRBS9 (GFSK)	255	-
39	2480	200	-	PRBS9 (GFSK)	-	20ms

Summary of Testing

EUT2. BGM13P32A and EUT3. BGM13P32E

- Maximum Peak Conducted Output Power (channels: 0, 19, 38, 39)
- 6 dB Bandwidth (channels: 0, 19, 38, 39)
- Power Spectral Density (channels: 0, 19, 38, 39)
- 99% Occupied Bandwidth (channels: 0, 19, 38, 39)
- 100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions tests (channels: 0, 19, 38, 39)

Channel	Frequency (MHz)	Power setting	PHY	Low energy transmit	Packet Length	Advertise pulse interval
0	2402	145	125K Coded	PRBS9 (GFSK)	255	-
0	2402	200	1M Coded	PRBS9 (GFSK)	255	-
19	2440	145	125K Coded	PRBS9 (GFSK)	255	-
19	2440	200	1M Coded	PRBS9 (GFSK)	255	-
38	2478	145	125K Coded	PRBS9 (GFSK)	255	-
39	2480	145	-	PRBS9 (GFSK)	-	20ms
39	2480	200	1M Coded	PRBS9 (GFSK)	255	-

EUT4. BGM13P22A and EUT5. BGM13P22E

- Maximum Peak Conducted Output Power (channels: 0, 19, 39)
- 6 dB Bandwidth (channels: 0, 19, 39)

Channel	Frequency (MHz)	Power setting	PHY	Low energy transmit	Packet Length	Advertise pulse interval
0	2402	104	125K Coded	PRBS9 (GFSK)	255	-
19	2440	104	125K Coded	PRBS9 (GFSK)	255	-
39	2480	104	125K Coded	PRBS9 (GFSK)	255	-

Test Facility

Testing Laboratory / address: FCC registration number: 904175 Industry Canada registration number: 8708A-2	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
Test Site:	Kara5m

TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard: ANSI C63.10 (2013)
Tested by: JAT
Date: 14 September 2017
Temperature: 23 ± 3°C
Humidity: 20 - 60 % 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.

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.

Conducted Emissions on Power Supply Lines

Final measurements from the worst frequencies

Conducted Emission Mains FCC Part 15 Class B with ENV216

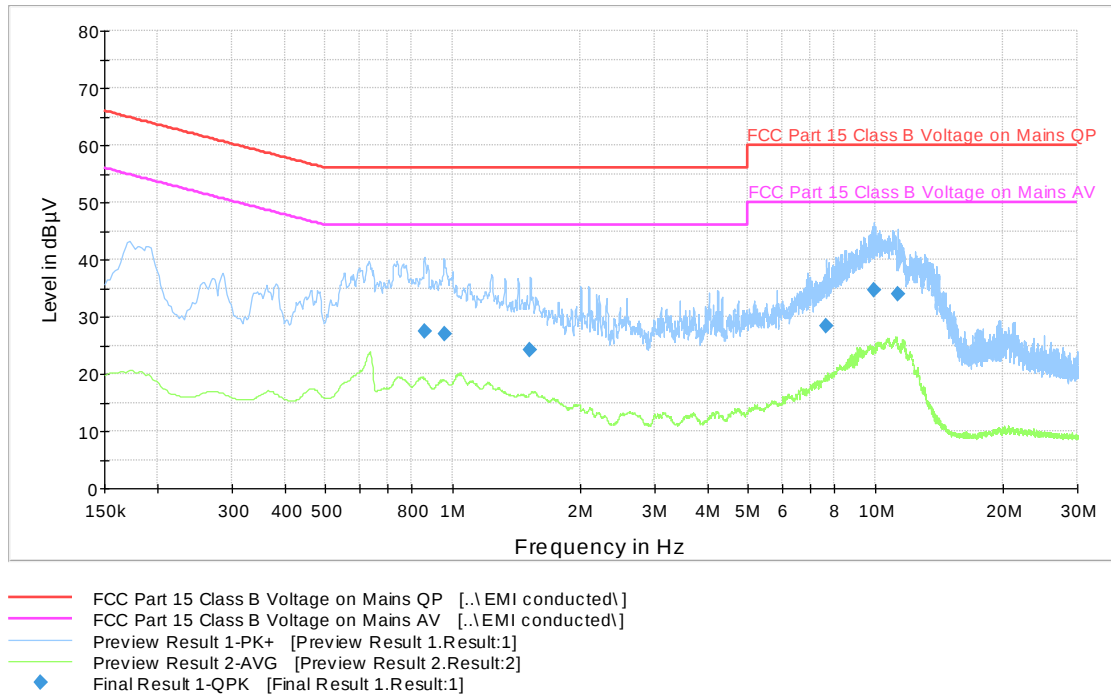


Figure 1: The measured curves with peak- and average detector (A).

Table 1: Final QuasiPeak measurements from the worst frequencies (A)

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.858000	27.5	1000.0	9.000	L1	10.0	28.5	56.0
0.955750	27.0	1000.0	9.000	L1	10.0	29.0	56.0
1.521750	24.3	1000.0	9.000	L1	9.9	31.7	56.0
7.663500	28.3	1000.0	9.000	L1	10.2	31.7	60.0
9.887500	34.7	1000.0	9.000	L1	10.3	25.3	60.0
11.268250	33.8	1000.0	9.000	L1	10.3	26.2	60.0

Conducted Emissions on Power Supply Lines

Conducted Emission Mains FCC Part 15 Class B with ENV216

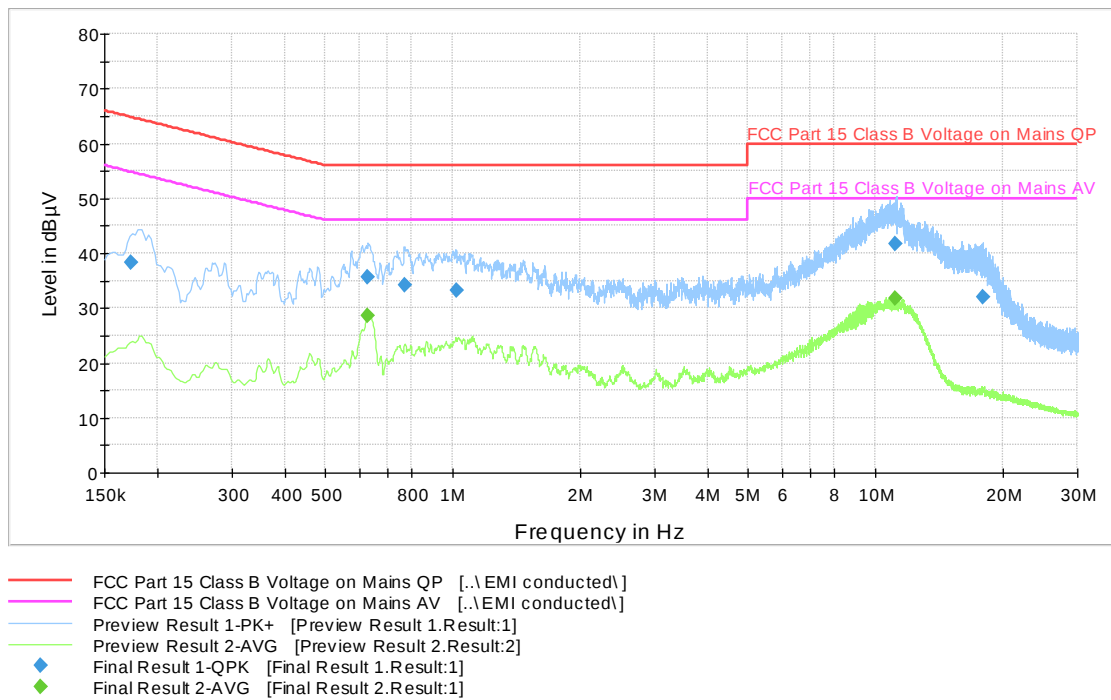


Figure 2: The measured curves with peak- and average detector (E).

Table 2: Final QuasiPeak measurements from the worst frequencies (E)

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.173250	38.2	1000.0	9.000	N	10.1	26.6	64.8
0.626750	35.6	1000.0	9.000	N	10.3	20.4	56.0
0.771250	34.2	1000.0	9.000	L1	10.0	21.8	56.0
1.022250	33.2	1000.0	9.000	L1	10.0	22.8	56.0
11.164000	41.6	1000.0	9.000	L1	10.3	18.4	60.0
17.936250	32.0	1000.0	9.000	L1	10.5	28.0	60.0

Table 3: Final Average measurements from the worst frequencies (E)

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.628500	28.7	1000.0	9.000	N	10.3	17.3	46.0
11.166750	31.8	1000.0	9.000	L1	10.3	18.2	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: MIH, JAT
Date: 20 September – 30 January 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH
Measurement uncertainty: ± 2.87 dB 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 4: Maximum conducted output power (EUT 2), power setting 145

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	13.20	30	16.80	PASS
19 Mid	12.77	30	17.23	PASS
38 High	12.58	30	17.42	PASS
39 High	12.61	30	17.39	PASS

Table 5: Maximum conducted output power (EUT 2), power setting 200, PHY 1M coded

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	19.60	30	10.40	PASS
19 Mid	19.28	30	10.78	PASS
39 High	19.00	30	11.00	PASS

Maximum Peak Conducted Output Power

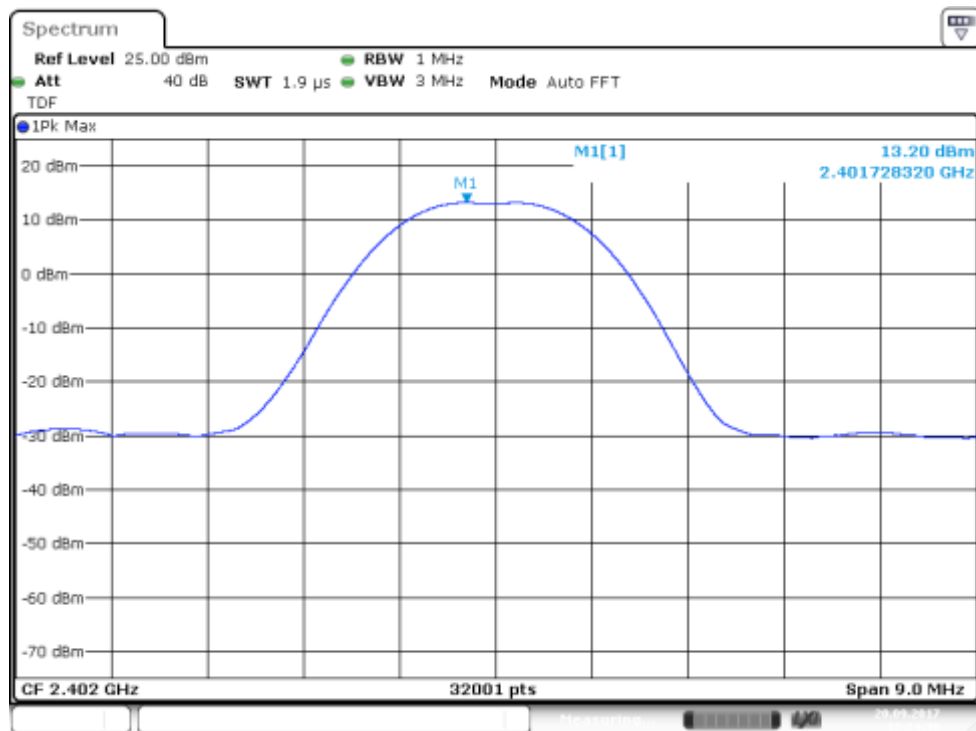


Figure 3: Conducted power, Channel 0 low (EUT 2), power setting 145

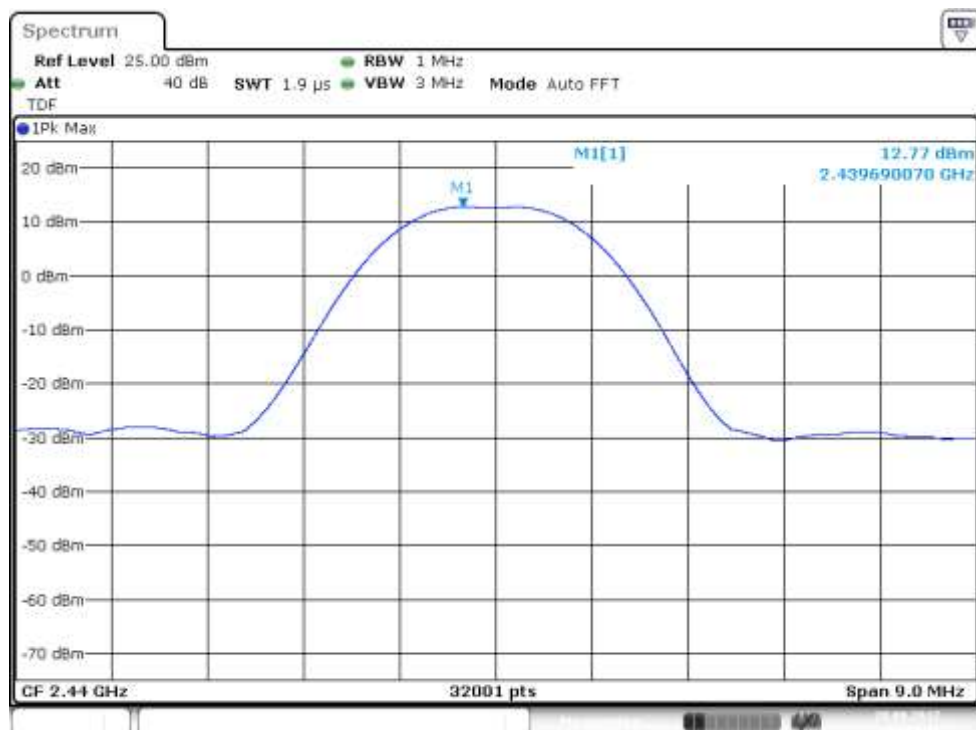


Figure 4: Conducted power, Channel 19 mid (EUT 2), power setting 145

Maximum Peak Conducted Output Power

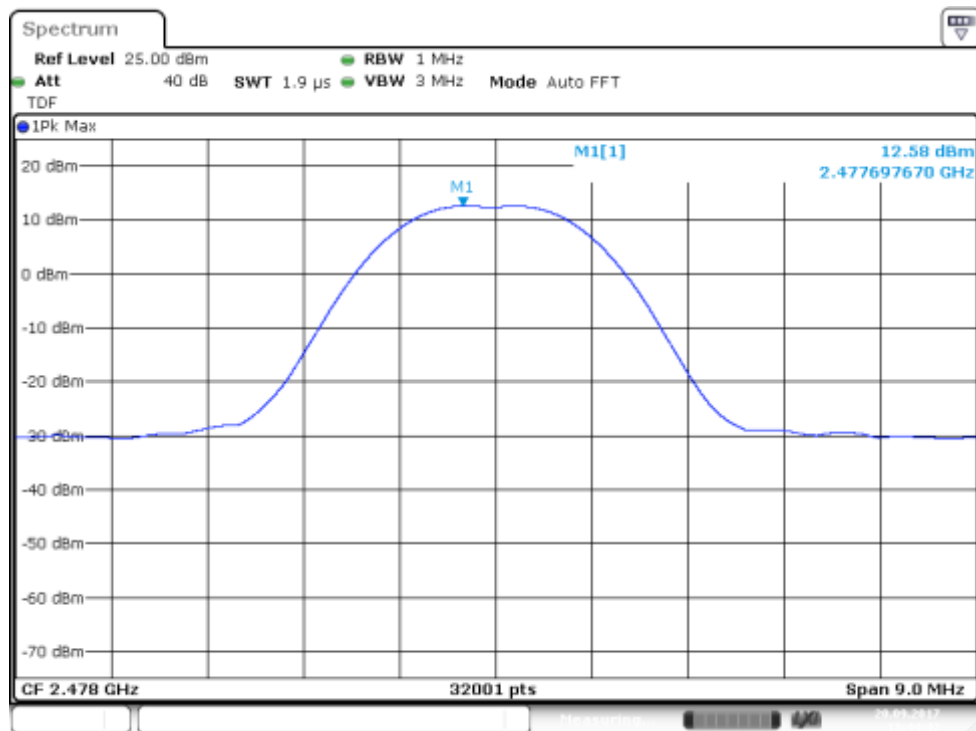


Figure 5: Conducted power, Channel 38 high (EUT 2), power setting 145

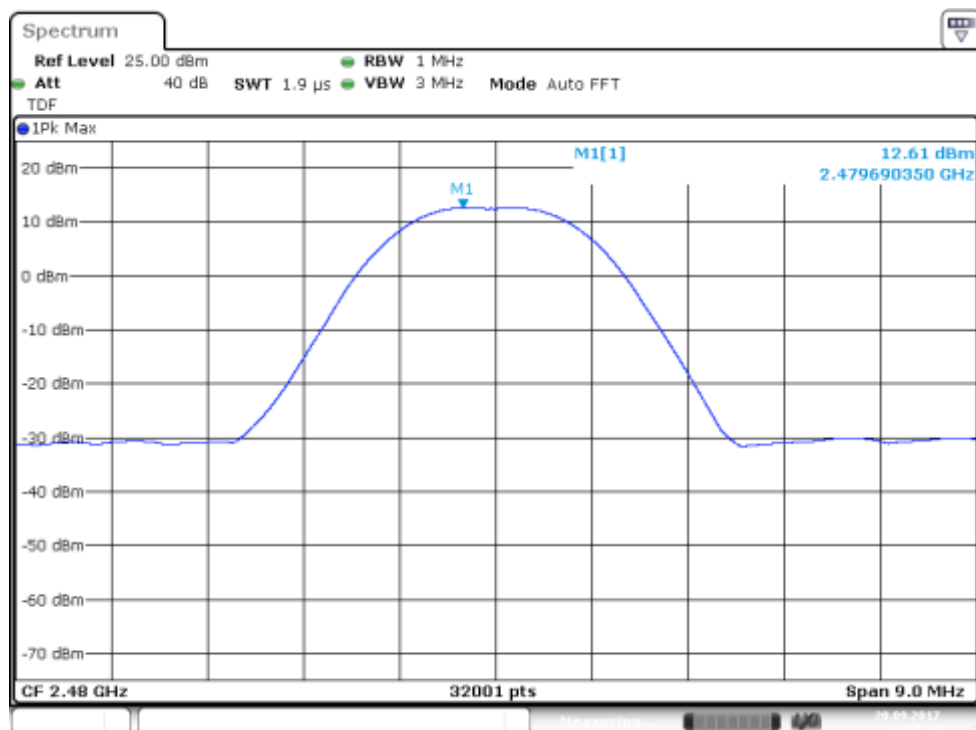


Figure 6: Conducted power, Channel 39 high (EUT 2), power setting 145

Maximum Peak Conducted Output Power

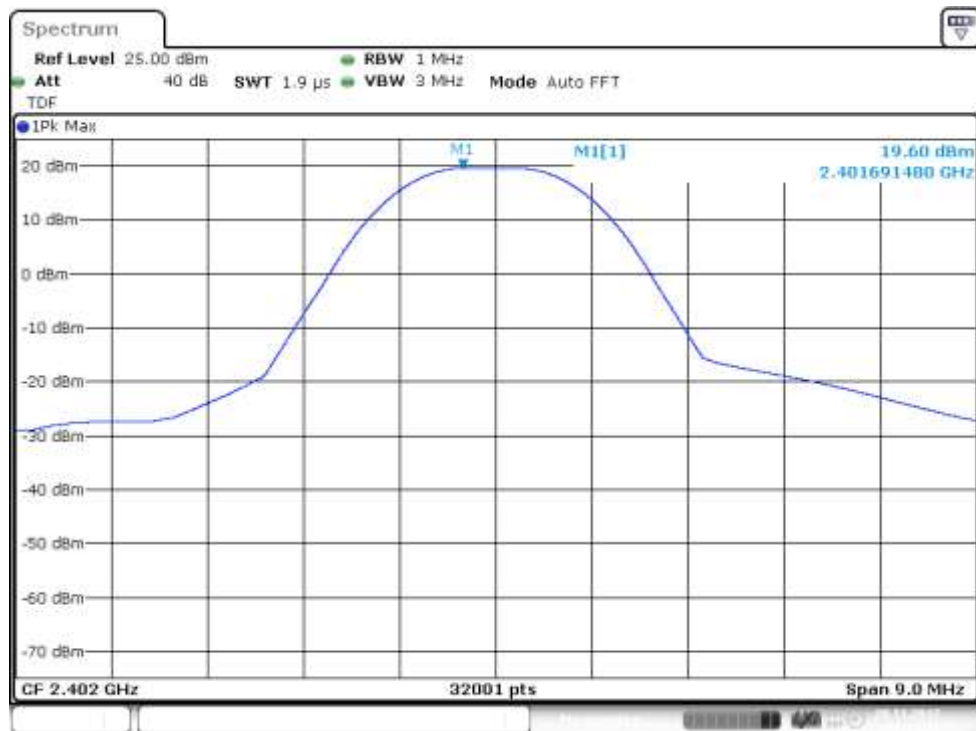


Figure 7: Conducted power, Channel 0 low (EUT 2), power setting 200, PHY 1M coded

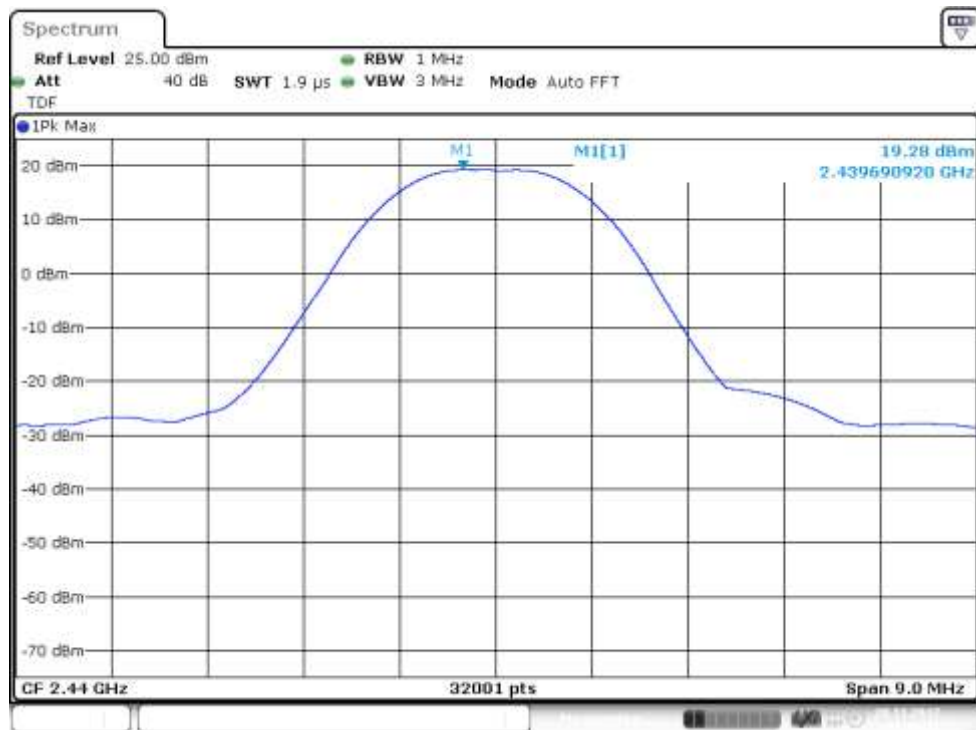


Figure 8: Conducted power, Channel 19 mid (EUT 2), power setting 200, PHY 1M coded

Maximum Peak Conducted Output Power

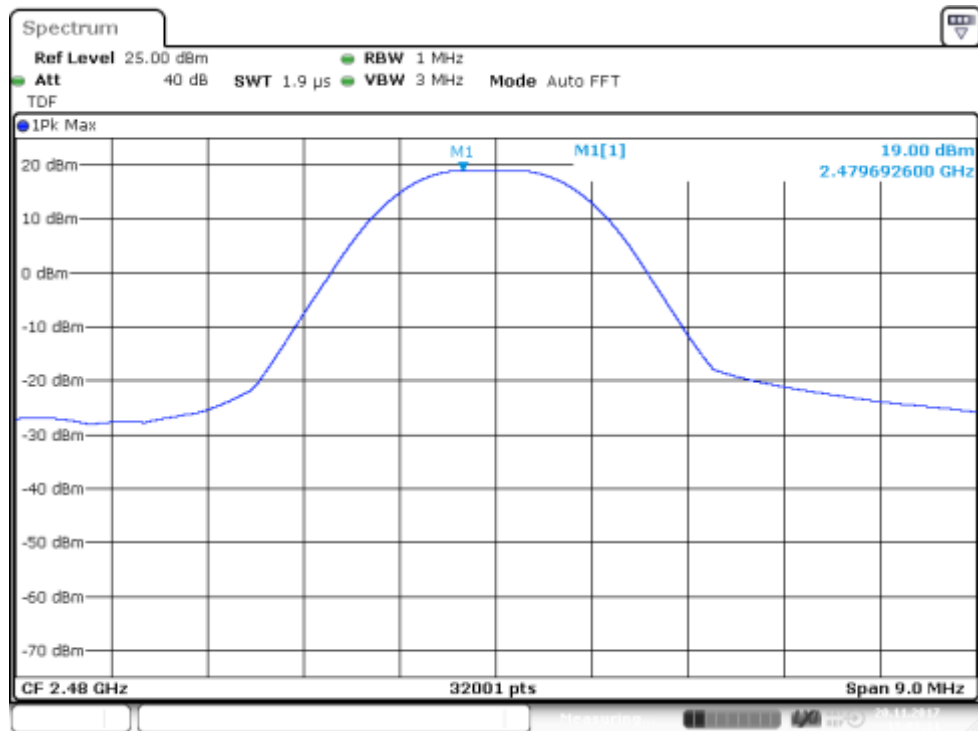


Figure 9: Conducted power, Channel 39 high (EUT 2), power setting 200, PHY 1M coded

Maximum Peak Conducted Output Power

Table 6: Maximum conducted output power (EUT 3), power setting 145

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	13.25	30	16.75	PASS
19 Mid	13.01	30	16.99	PASS
38 High	12.78	30	17.22	PASS
39 High	12.82	30	17.18	PASS

Table 7: Maximum conducted output power (EUT 3), power setting 200, PHY 1M coded

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	18.96	30	11.04	PASS
19 Mid	18.71	30	11.29	PASS
39 High	19.20	30	11.80	PASS

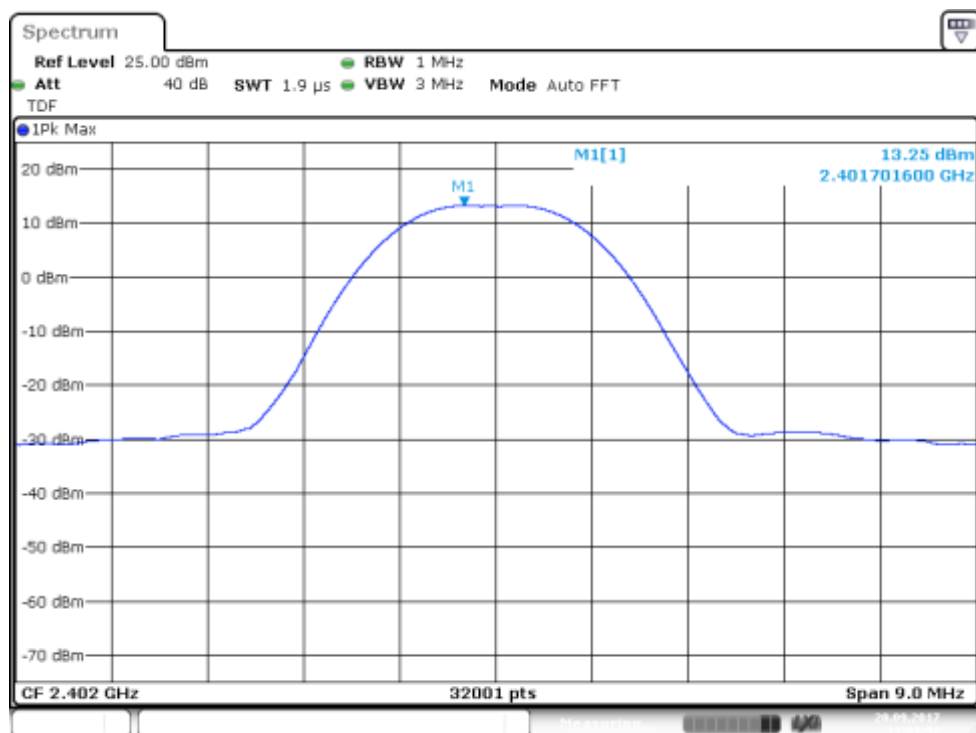


Figure 10: Conducted power, Channel 0 low (EUT 3), power setting 145

Maximum Peak Conducted Output Power

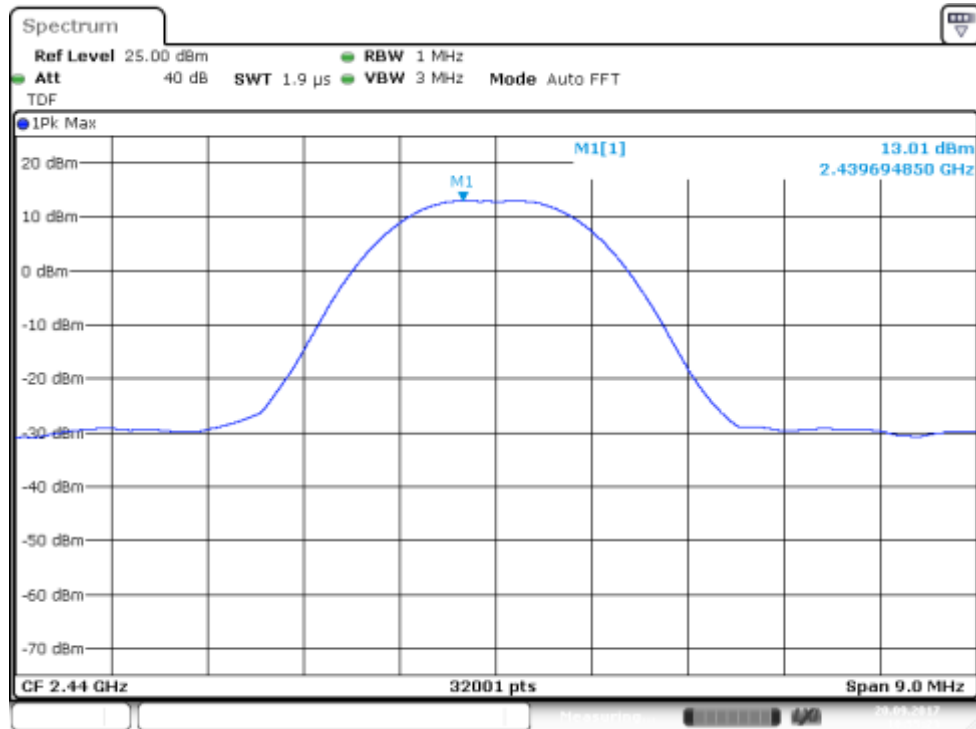


Figure 11: Conducted power, Channel 19 mid (EUT 3), power setting 145

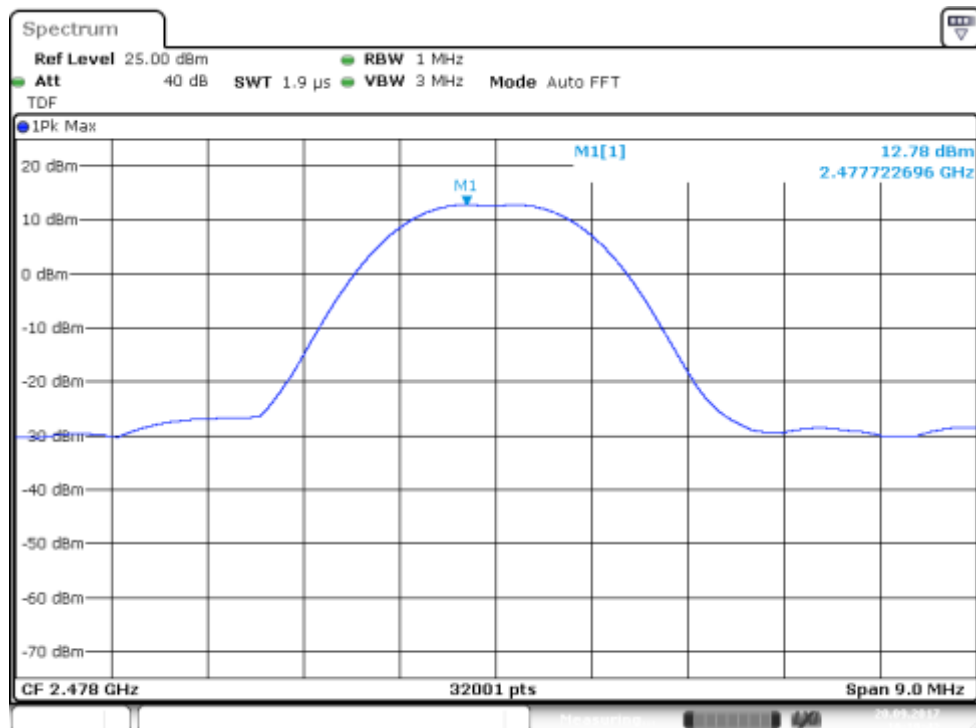


Figure 12: Conducted power, Channel 38 high (EUT 3), power setting 145

Maximum Peak Conducted Output Power

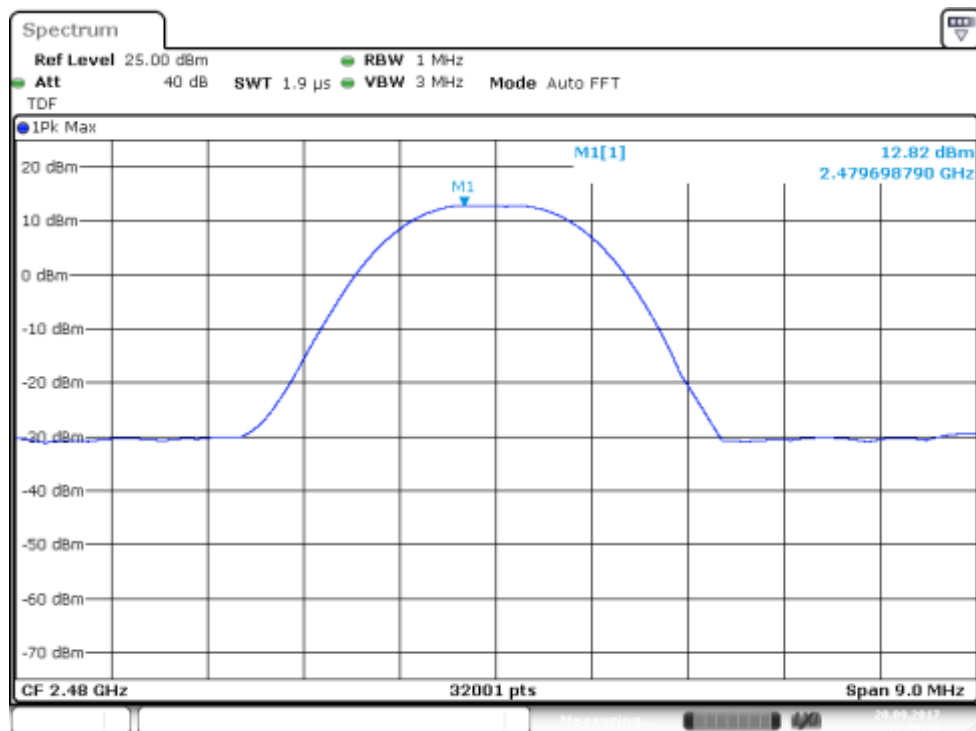


Figure 13: Conducted power, Channel 39 high (EUT 3), power setting 145

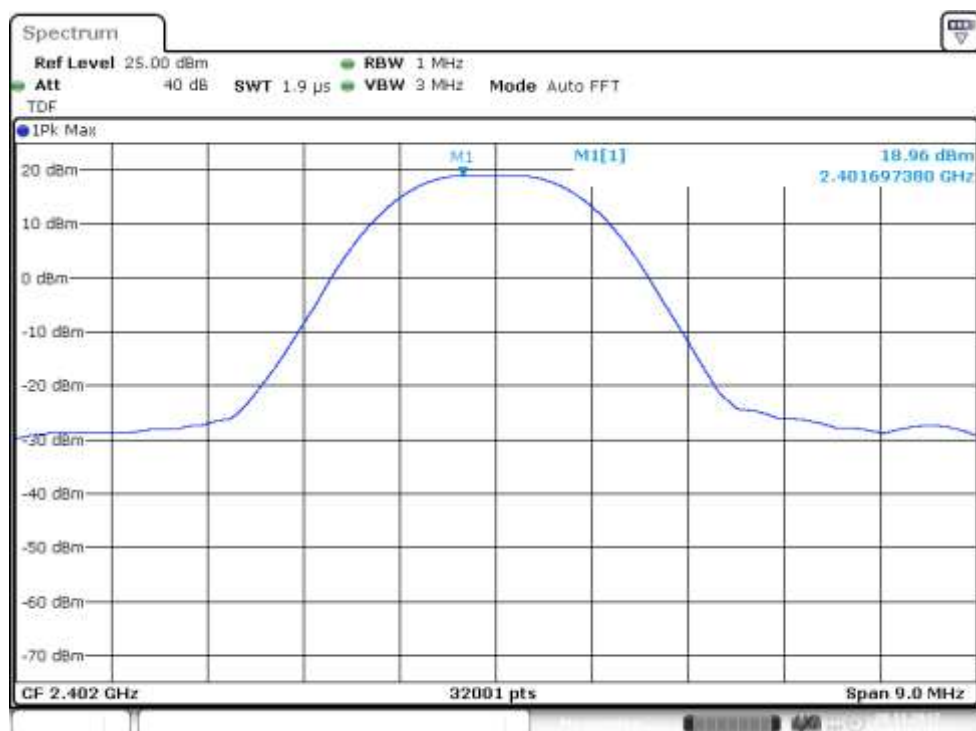


Figure 14: Conducted power, Channel 0 low (EUT 3), power setting 200, PHY 1M coded

Maximum Peak Conducted Output Power

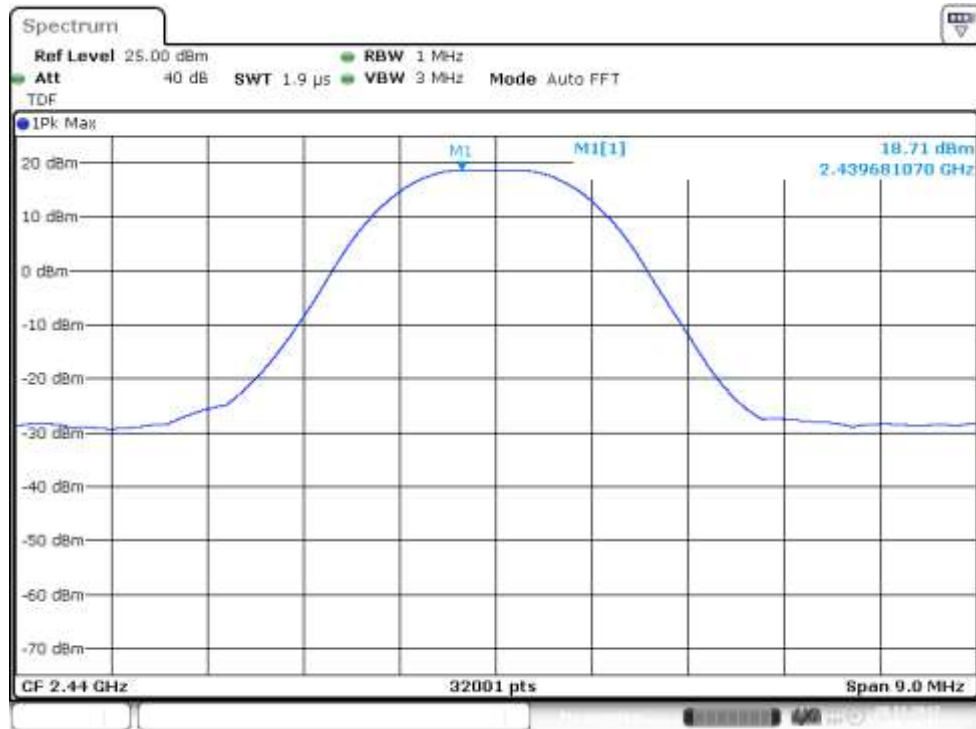


Figure 15: Conducted power, Channel 19 mid (EUT 3), power setting 200, PHY 1M coded



Figure 16: Conducted power, Channel 39 high (EUT 3), power setting 200, PHY 1M coded

Maximum Peak Conducted Output Power

Table 8: Maximum conducted output power (EUT 4), power setting 104

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	11.31	30	18.69	PASS
19 Mid	10.95	30	19.05	PASS
39 High	10.74	30	19.26	PASS

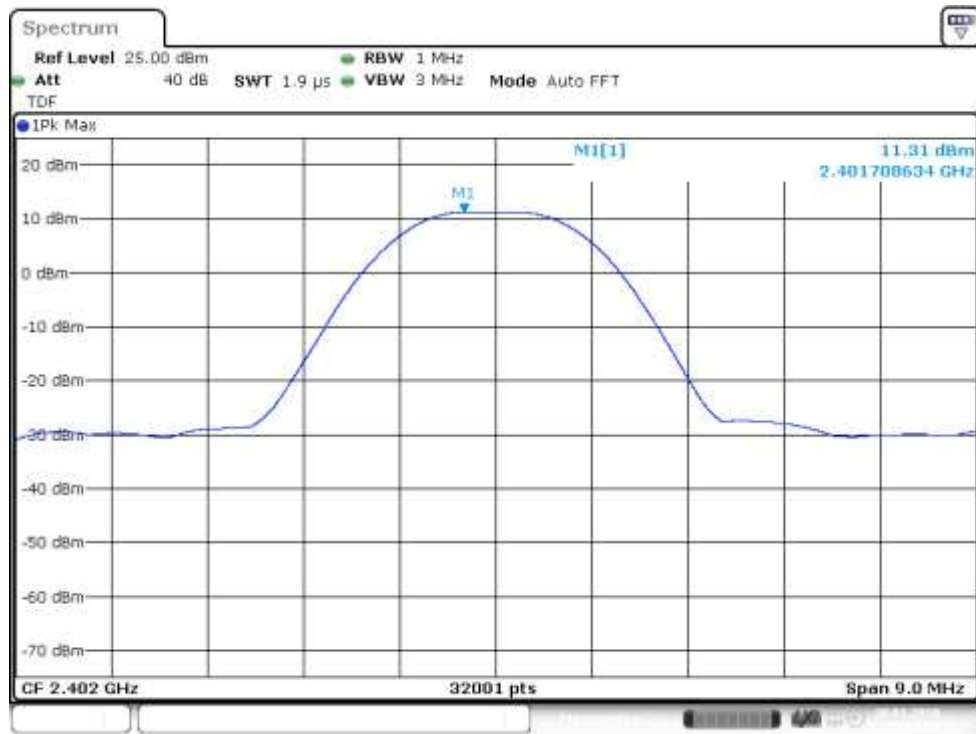


Figure 17: Conducted power, Channel 0 low (EUT 4), power setting 104

Maximum Peak Conducted Output Power

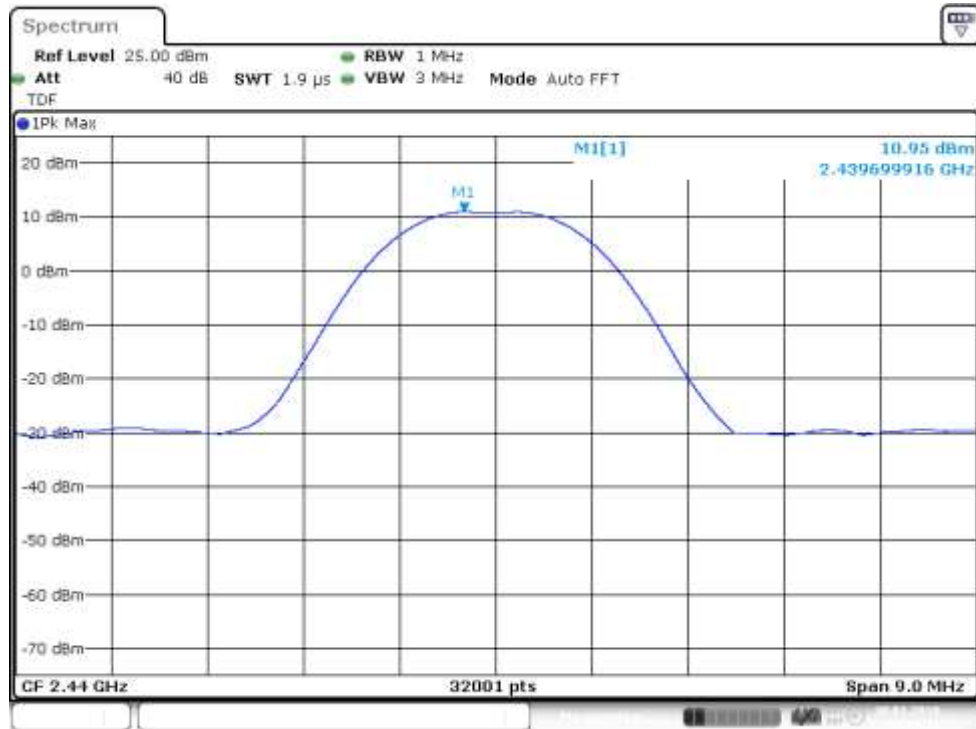


Figure 18: Conducted power, Channel 19 mid (EUT 4), power setting 104

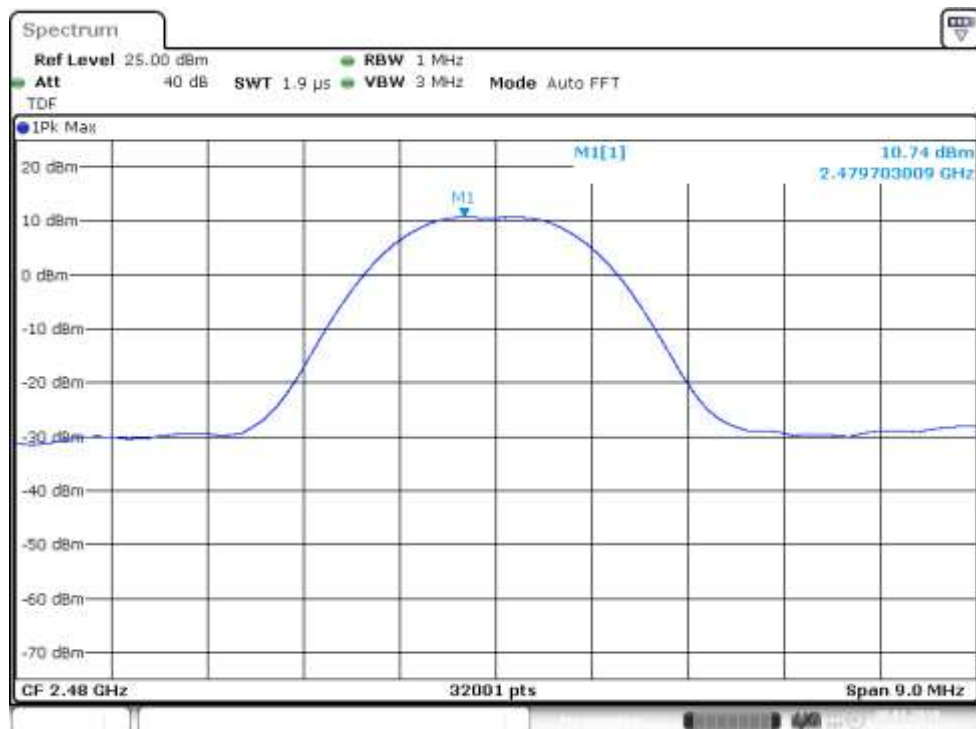


Figure 19: Conducted power, Channel 39 high (EUT 4), power setting 104

Maximum Peak Conducted Output Power

Table 9: Maximum conducted output power (EUT 5), power setting 104

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
0 Low	10.60	30	19.40	PASS
19 Mid	10.19	30	19.81	PASS
39 High	9.94	30	20.06	PASS

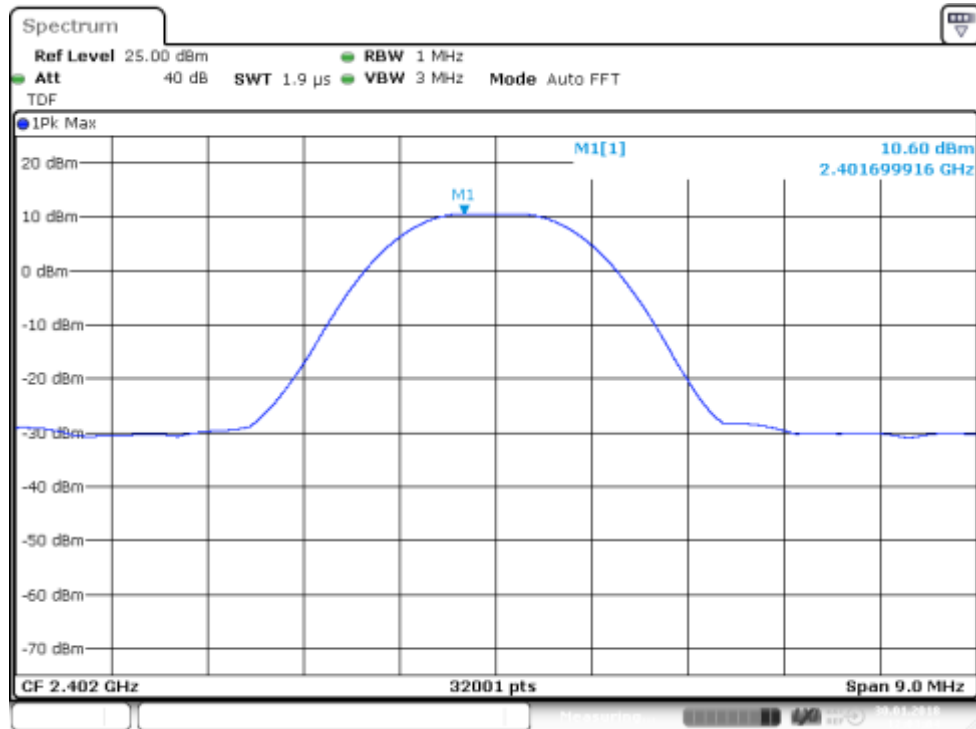


Figure 20: Conducted power, Channel 0 low (EUT 5), power setting 104

Maximum Peak Conducted Output Power

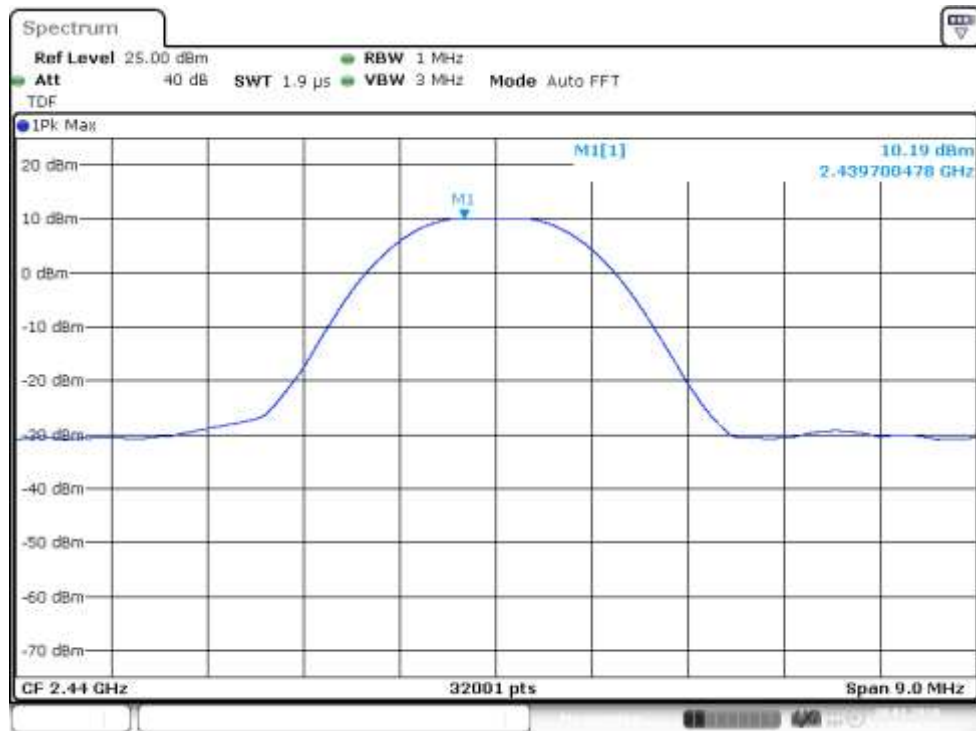


Figure 21: Conducted power, Channel 19 mid (EUT 5), power setting 104

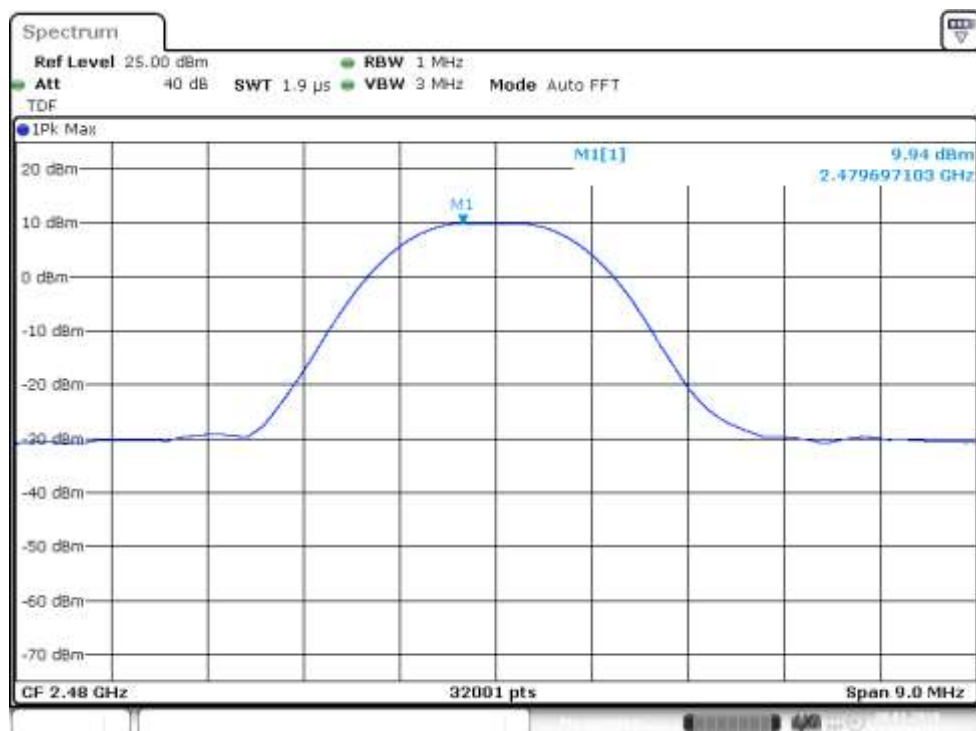


Figure 22: Conducted power, Channel 39 high (EUT 5), power setting 104

Transmitter Radiated Spurious Emissions 30 - 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: MIH & JAT
Date: 12 September 2017 -
19 September 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 [μ V/m]	Limit [dB μ 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

Transmitter Radiated Spurious Emissions

Low channel (0)

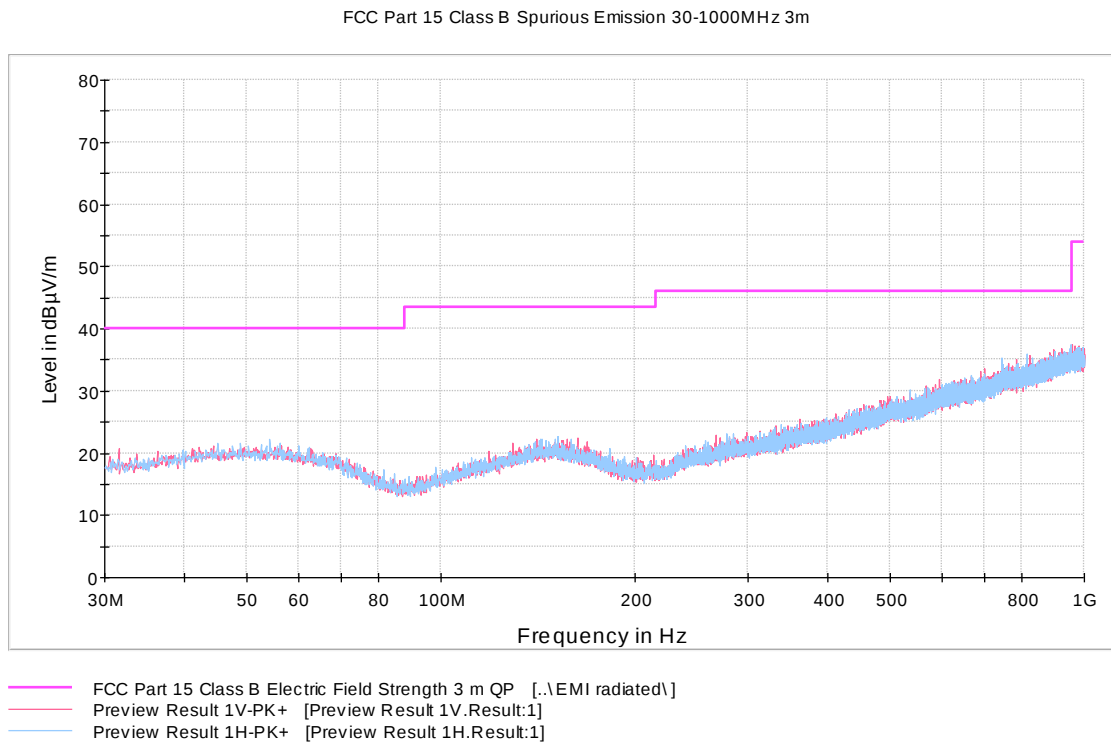


Figure 23: Channel 0 low 30 MHz – 1000 MHz (A)

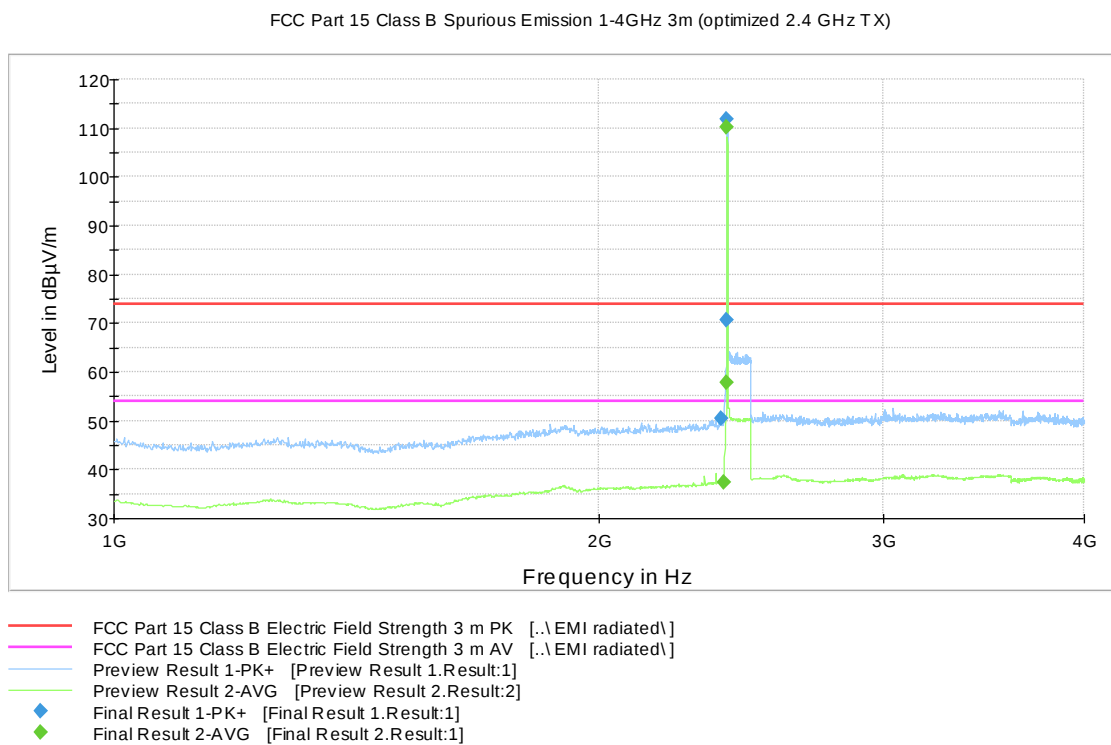


Figure 24: Channel 0 low 1 GHz – 4 GHz (A)

Transmitter Radiated Spurious Emissions

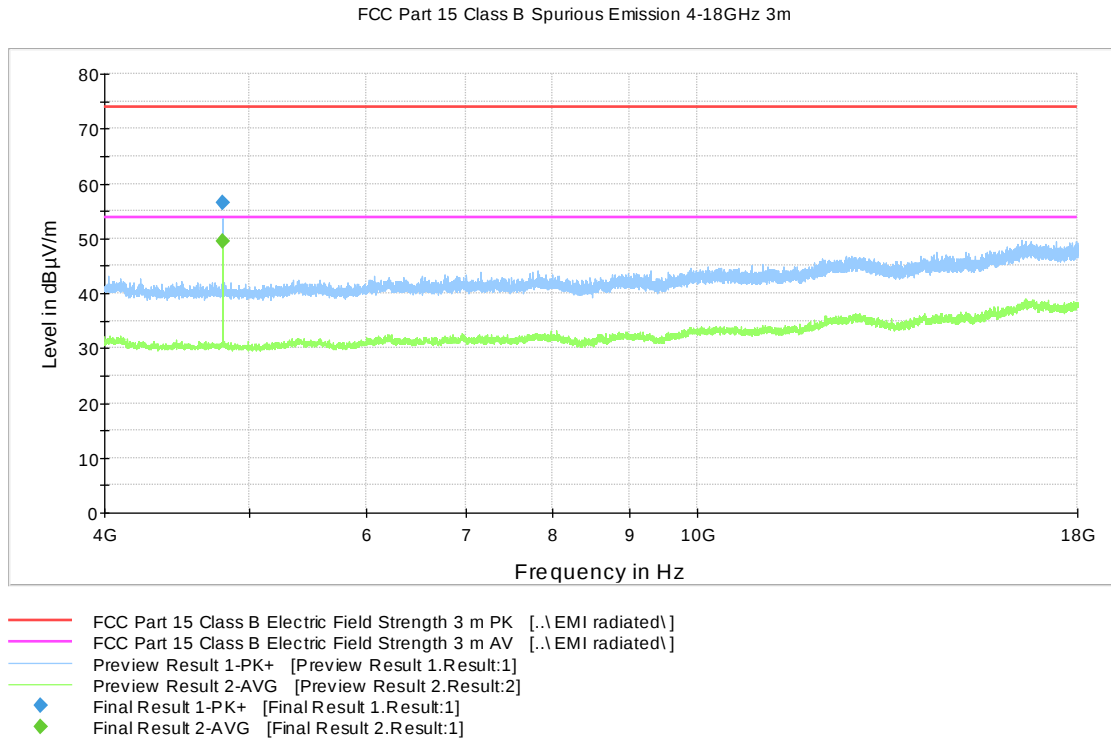


Figure 25: Channel 0 low 4 GHz – 18 GHz (A)

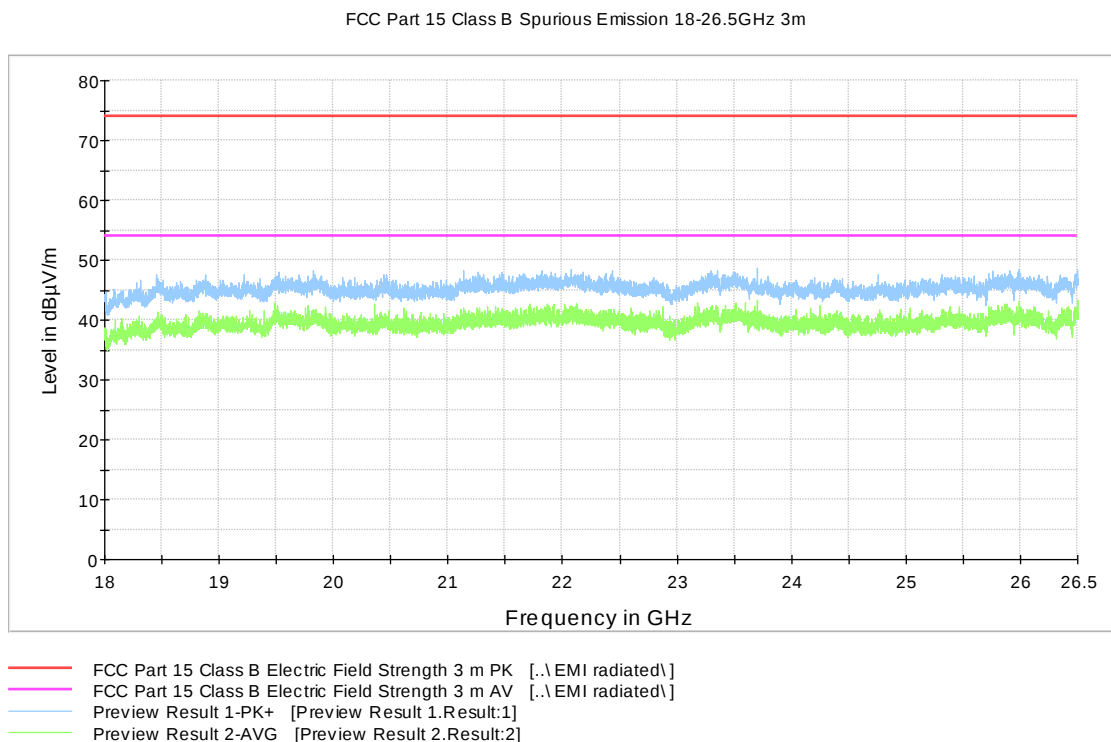


Figure 26: Channel 0 low 18 GHz – 26.5 GHz (A)

Transmitter Radiated Spurious Emissions

Table 10: Peak results, channel 0 low (A)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2380.000000	50.5	1000.0	1000.000	394.0	V	0.0	14.5	23.4	73.9
2400.000000	70.7	1000.0	1000.000	221.0	H	264.0	14.7	21.2	91.9
4803.900000	56.5	1000.0	1000.000	247.0	V	185.0	8.3	17.4	73.9

Table 11: Average results, channel 0 low (A)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2389.200000	37.4	1000.0	1000.000	303.0	V	18.0	14.6	16.5	53.9
4804.000000	49.4	1000.0	1000.000	246.0	V	185.0	8.3	4.5	53.9

Middle channel (19)

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

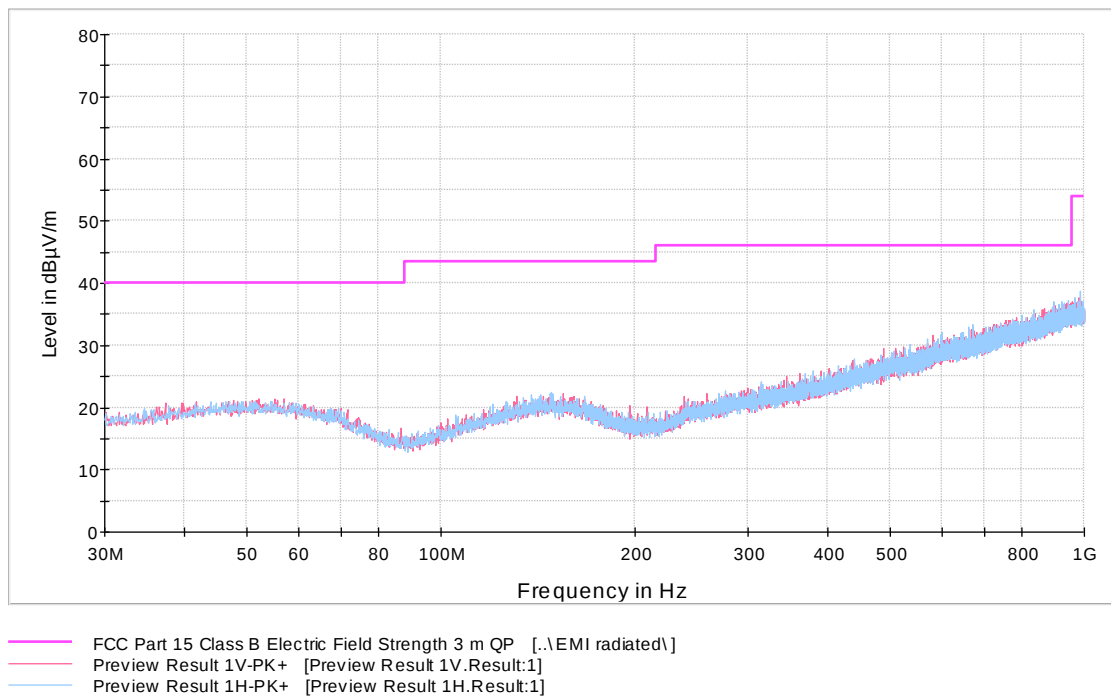


Figure 27: Channel 19 mid 30 MHz – 1000 MHz (A)

Transmitter Radiated Spurious Emissions

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

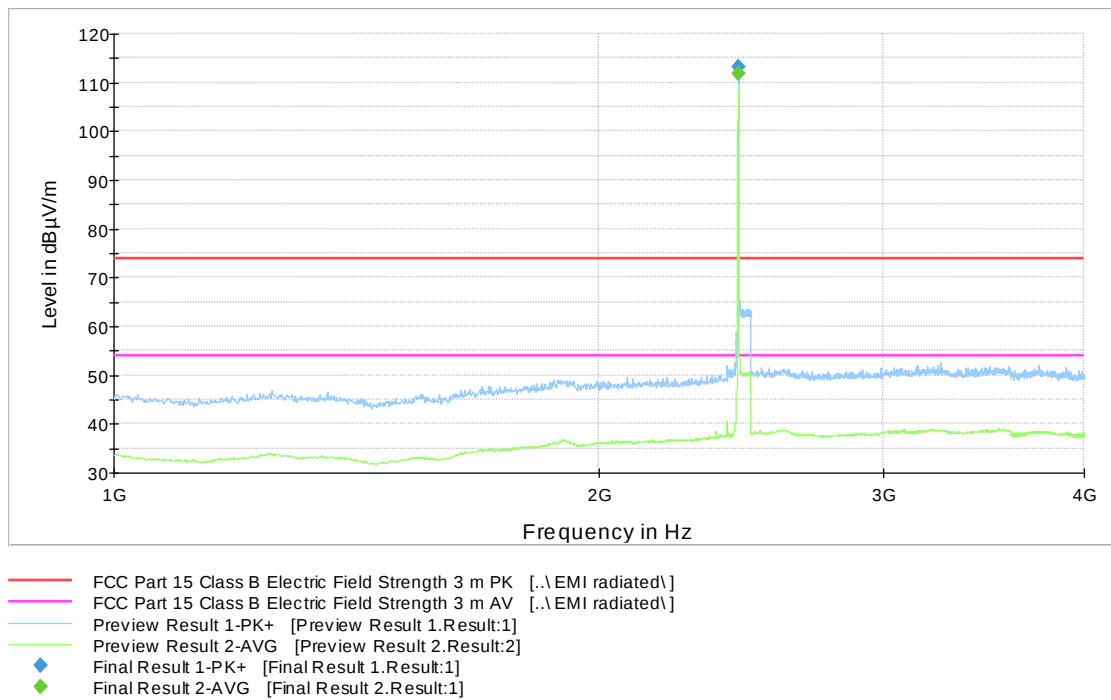


Figure 28: Channel 19 mid 1 GHz – 4 GHz (A)

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

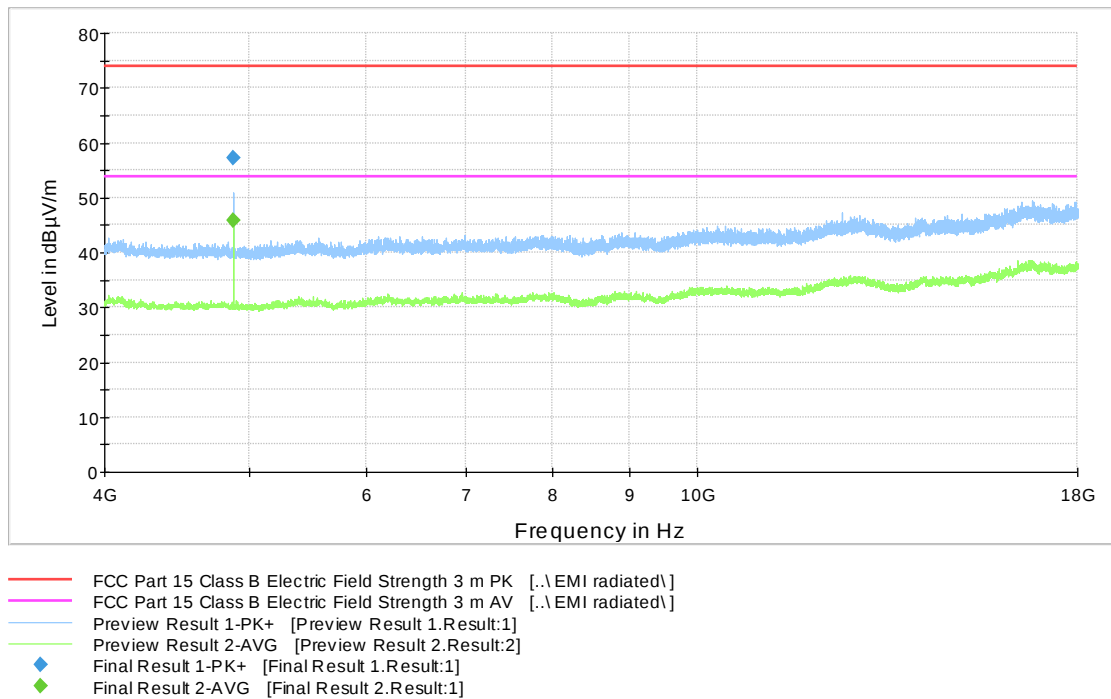


Figure 29: Channel 19 mid 4 GHz – 18 GHz (A)

Transmitter Radiated Spurious Emissions

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

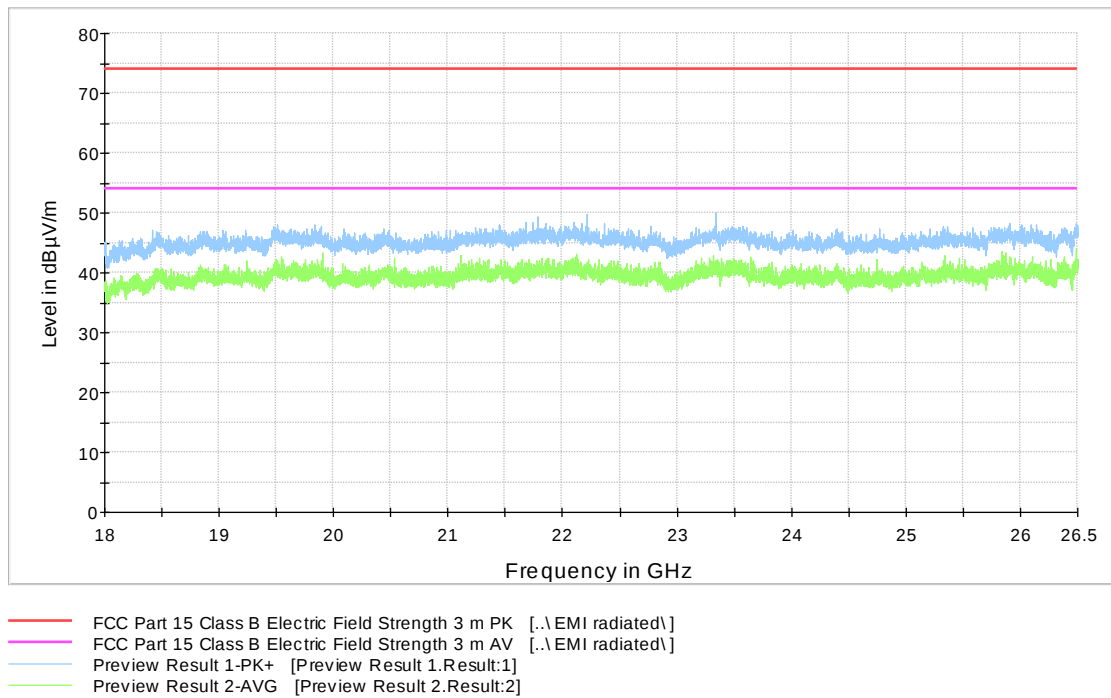


Figure 30: Channel 19 mid 18 GHz – 26.5 GHz (A)

Table 12: Peak results, channel 19 mid (A)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4880.100000	57.3	1000.0	1000.000	150.0	H	289.0	8.3	16.7	73.9

Table 13: Average results, channel 19 mid (A)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4879.900000	45.9	1000.0	1000.000	150.0	H	289.0	8.3	8.0	53.9

Transmitter Radiated Spurious Emissions

High channel (39)

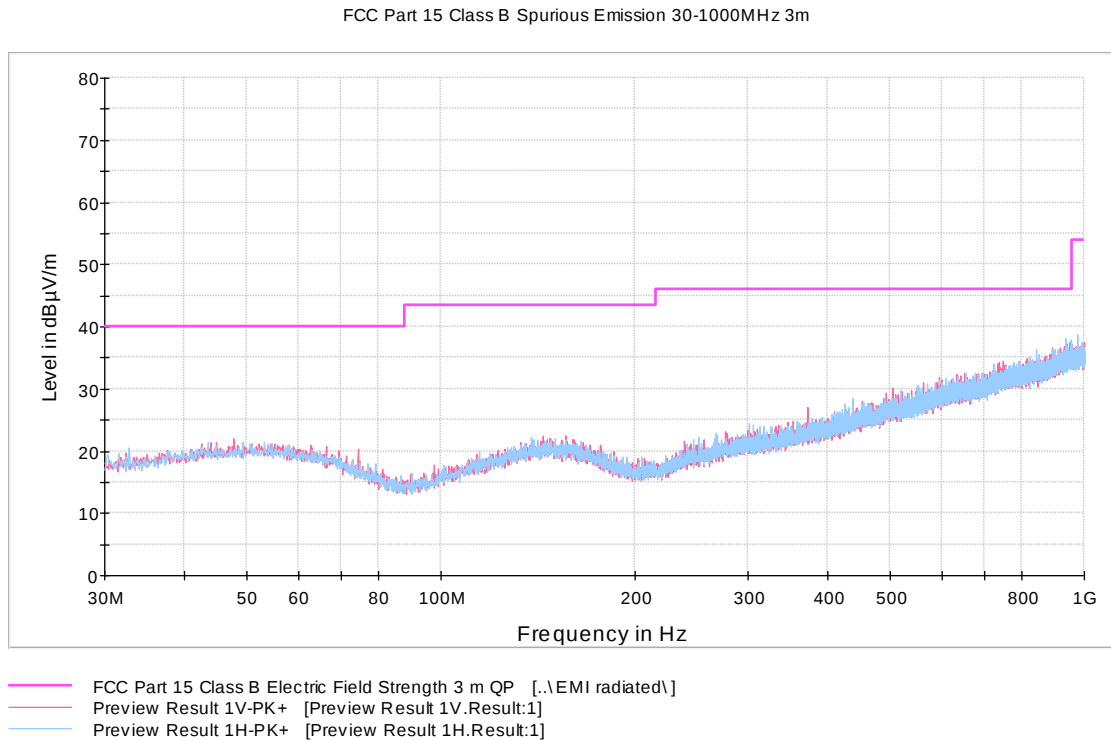


Figure 31: Channel 39 high 30 MHz – 1000 MHz (A)

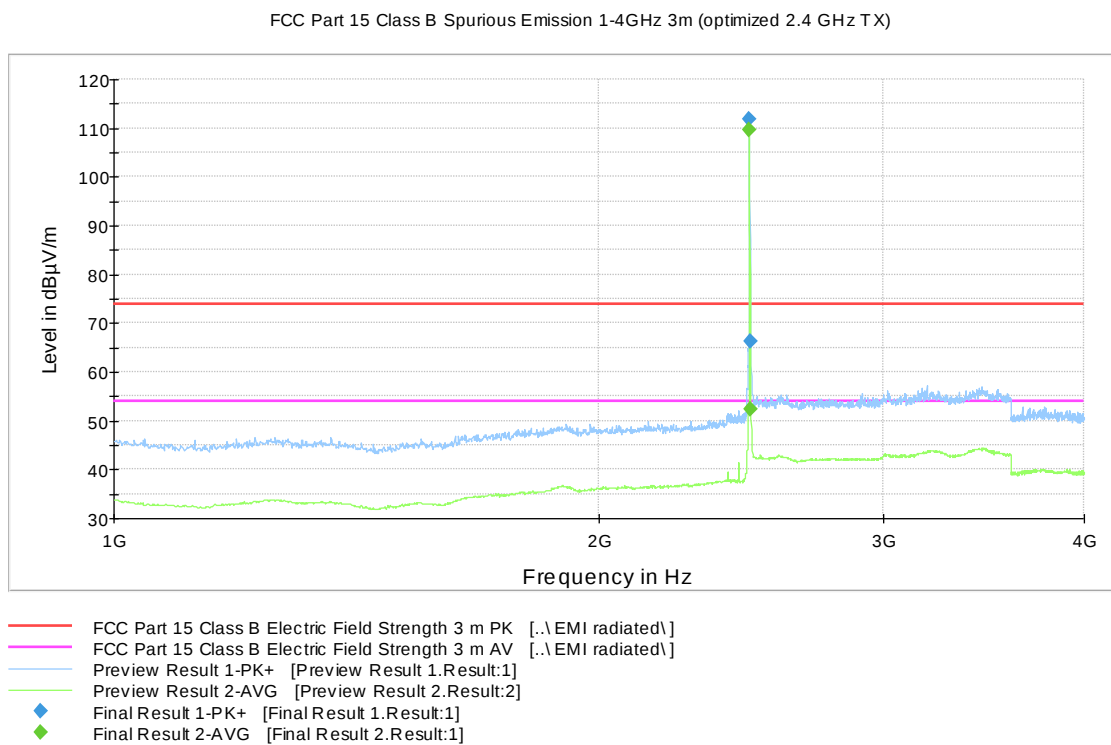


Figure 32: Channel 39 high 1 GHz – 4 GHz (A)

Transmitter Radiated Spurious Emissions

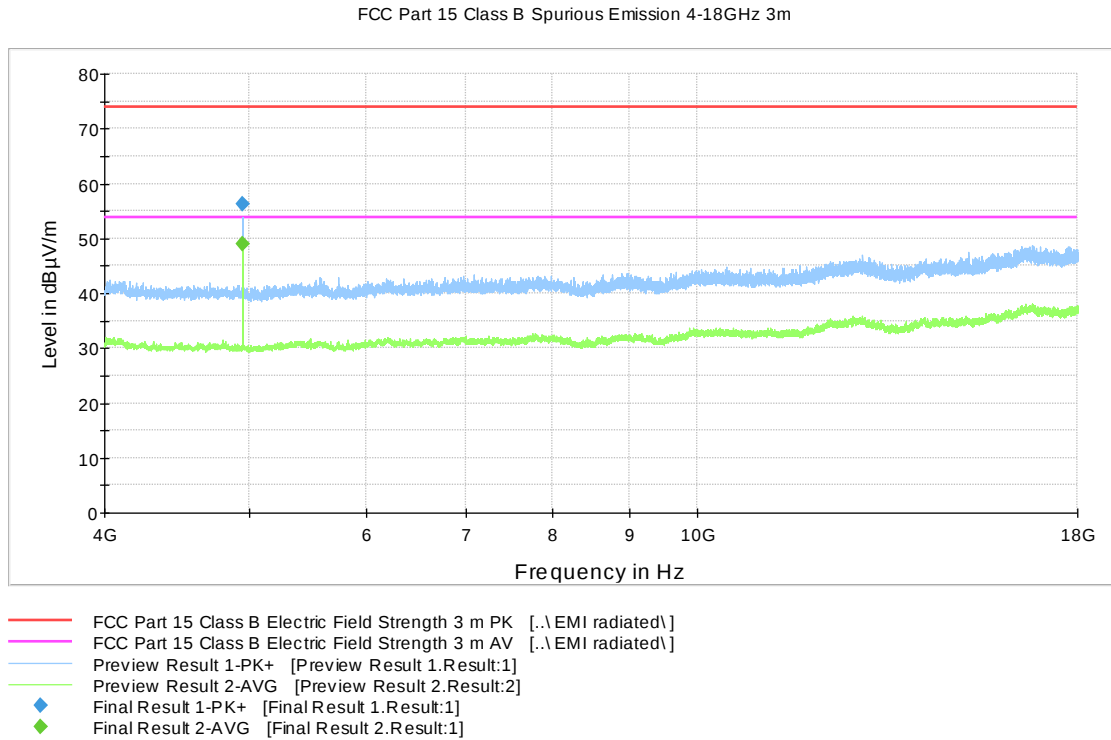


Figure 33: Channel 39 high 4 GHz – 18 GHz (A)

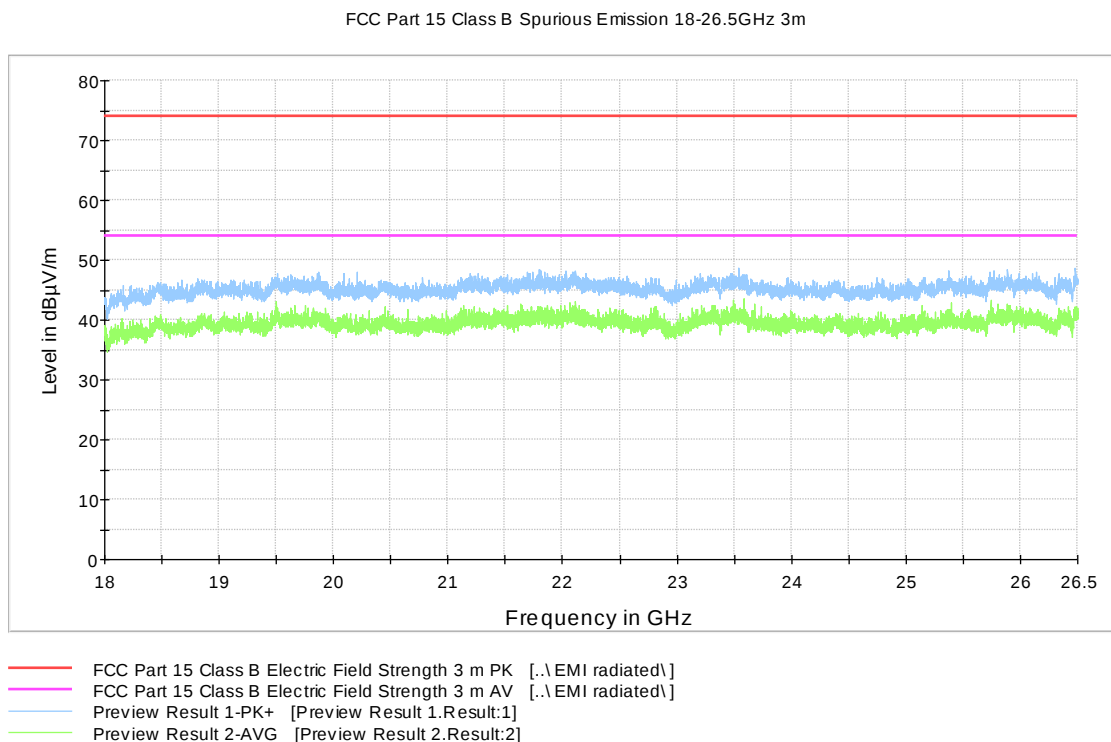


Figure 34: Channel 39 high 18 GHz – 26.5 GHz (A)

Transmitter Radiated Spurious Emissions

Table 14: Peak results, channel 39 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	66.2	1000.0	1000.000	243.0	H	333.0	14.7	7.7	73.9
4956.000000	56.1	1000.0	1000.000	261.0	H	293.0	8.2	17.8	73.9

Table 15: Average results, channel 39 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	52.3	1000.0	1000.000	242.0	H	209.0	14.7	1.6	53.9
4955.900000	49.0	1000.0	1000.000	150.0	H	293.0	8.2	4.9	53.9

Radiated Band Edge results

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

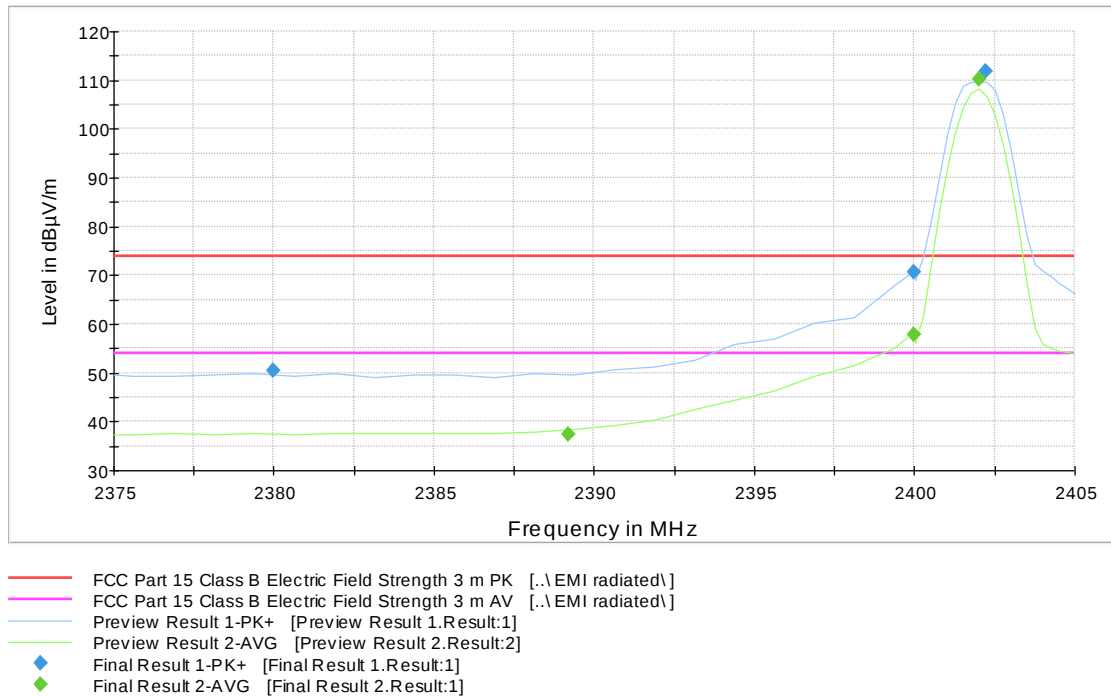

Figure 35: Radiated Band Edge measurement graph, Channel 0 low (A)

Table 16: Peak results, channel 0 low (A)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2380.000000	50.5	1000.0	1000.000	394.0	V	0.0	14.5	23.4	73.9
2400.000000	70.7	1000.0	1000.000	221.0	H	264.0	14.7	21.2	91.9

Table 17: Average results, channel 0 low (A)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2389.200000	37.4	1000.0	1000.000	303.0	V	18.0	14.6	16.5	53.9

Transmitter Radiated Spurious Emissions

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

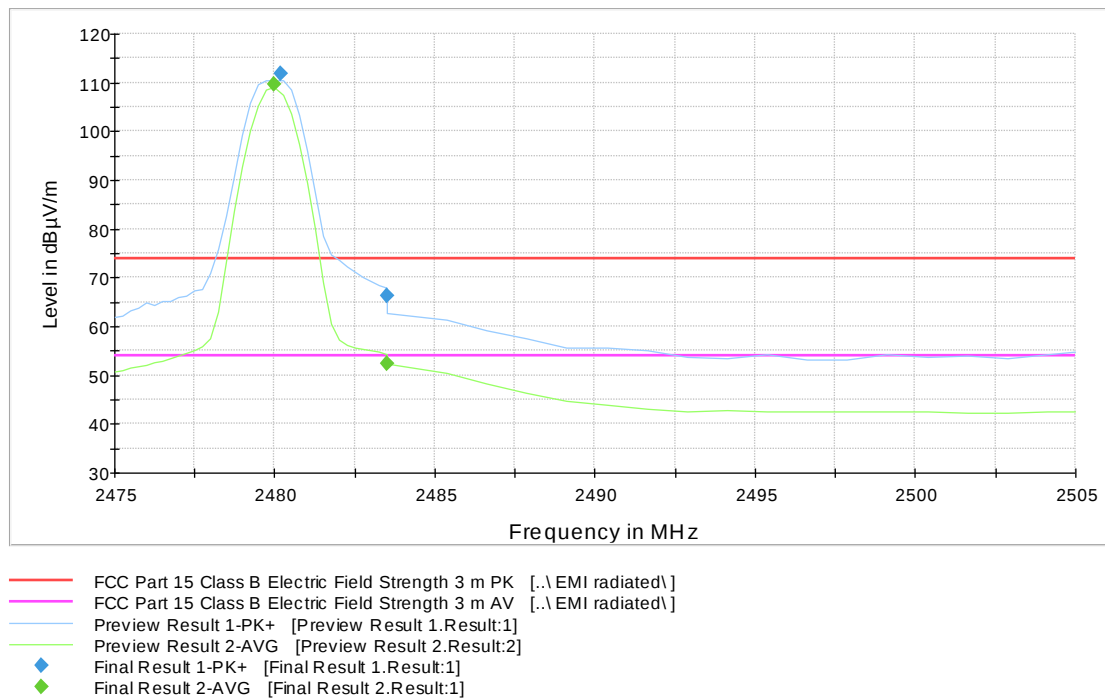


Figure 36: Radiated Band Edge measurement graph, Channel 39 high (A)

Table 18: Peak results, channel 39 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	66.2	1000.0	1000.000	243.0	H	333.0	14.7	7.7	73.9

Table 19: Average results, channel 39 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	52.3	1000.0	1000.000	242.0	H	209.0	14.7	1.6	53.9

Transmitter Radiated Spurious Emissions

Low channel (0)

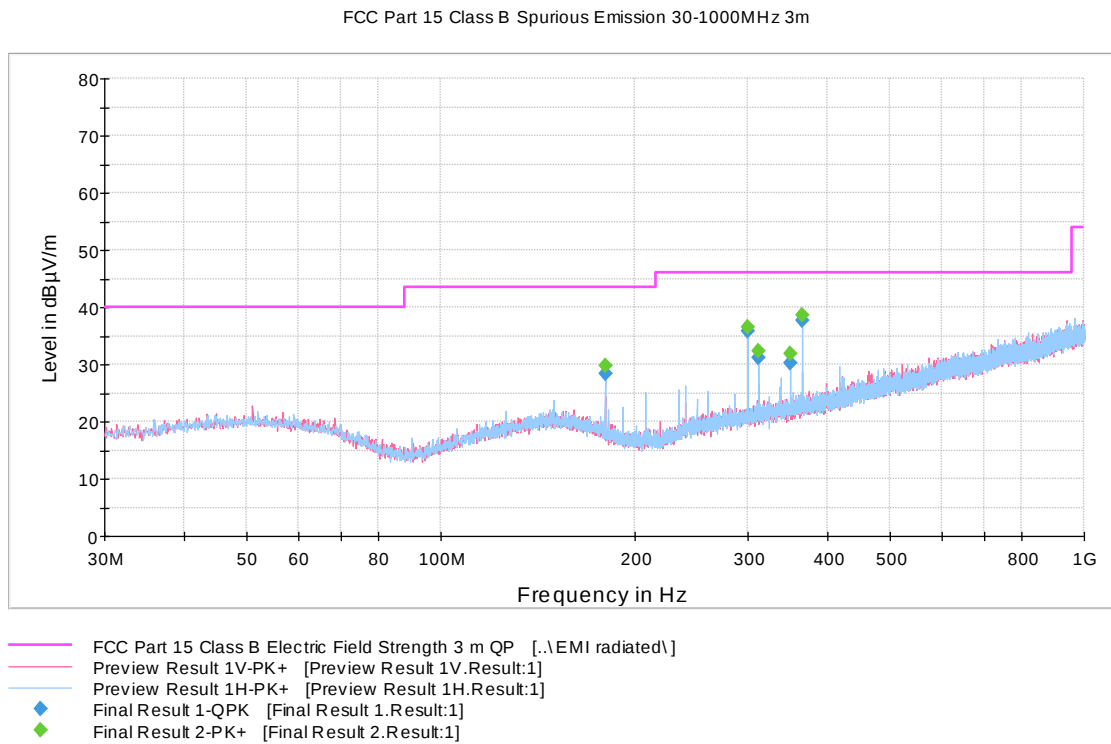


Figure 37: Channel 0 low 30 MHz – 1000 MHz (E)

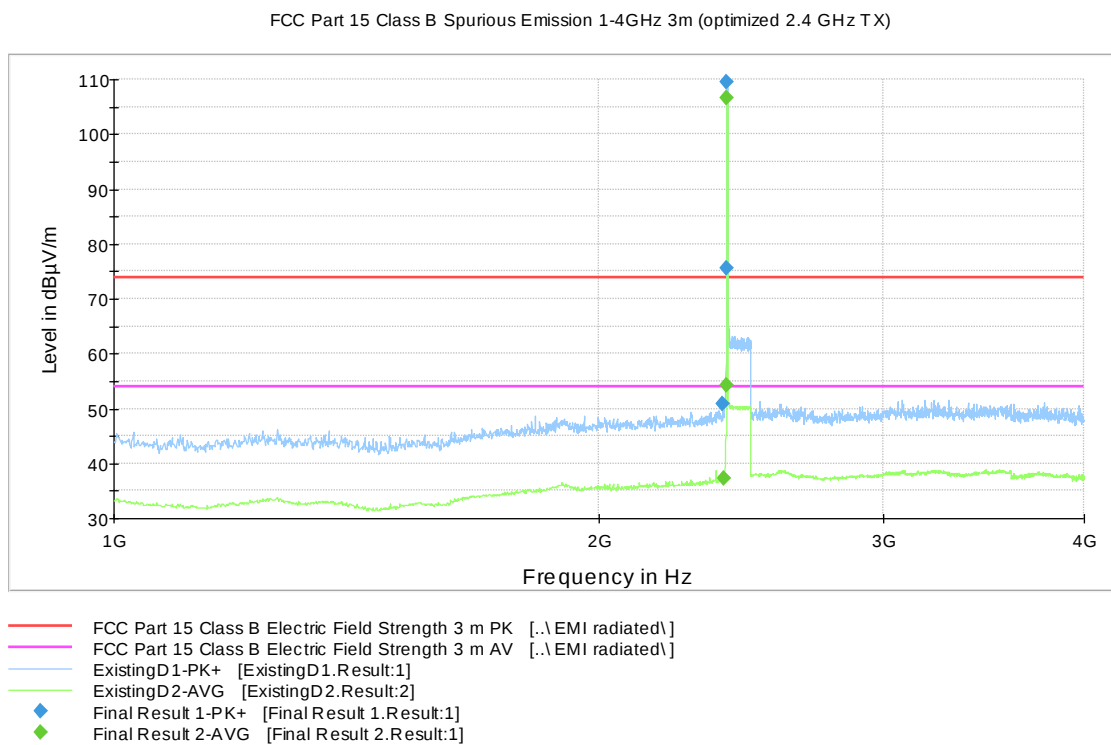


Figure 38: Channel 0 low 1 GHz – 4 GHz (E)

Transmitter Radiated Spurious Emissions

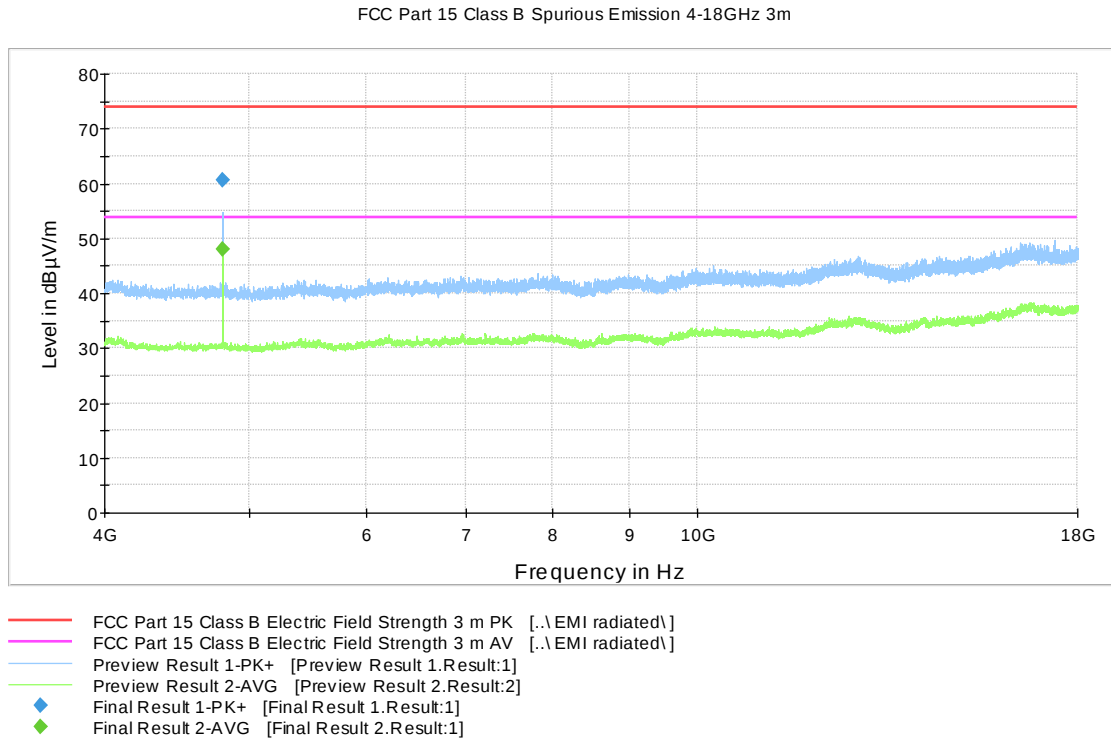


Figure 39: Channel 0 low 4 GHz – 18 GHz (E)

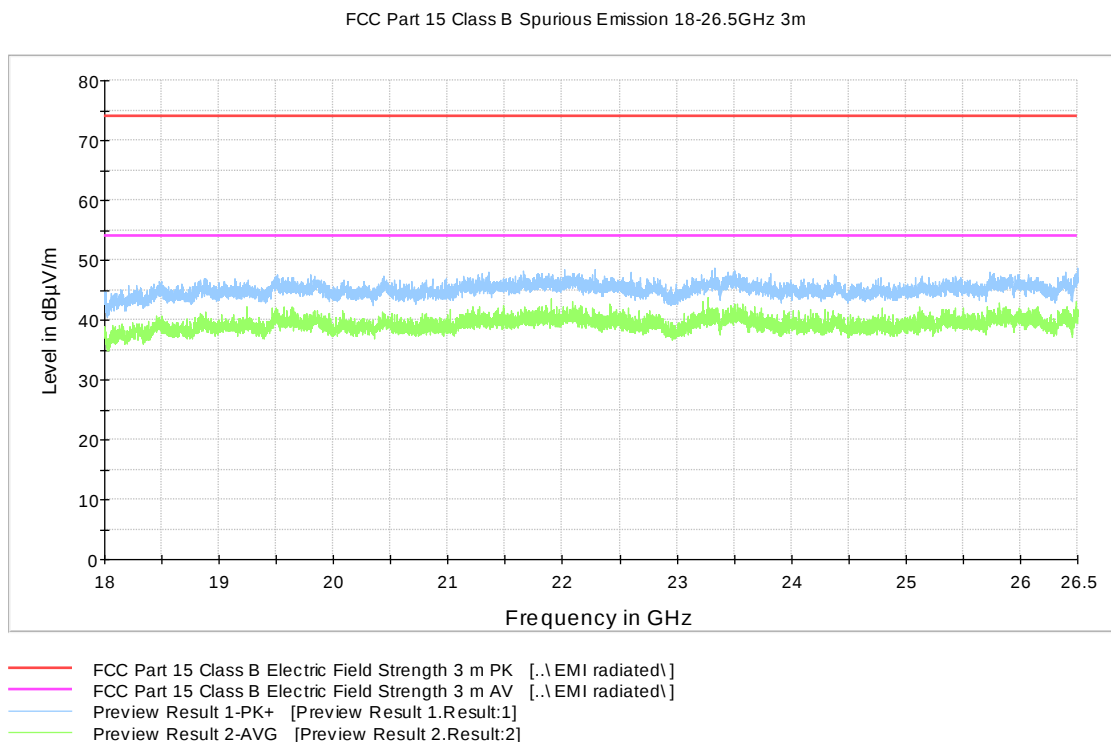


Figure 40: Channel 0 low 18 GHz – 26.5 GHz (E)

Transmitter Radiated Spurious Emissions

Table 20: Peak results, channel 0 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	50.9	1000.0	1000.000	203.0	V	163.0	14.6	23.0	73.9
2400.000000	75.6	1000.0	1000.000	232.0	V	234.0	14.7	13.9	89.5
4804.100000	60.6	1000.0	1000.000	150.0	V	320.0	8.3	13.3	73.9

Table 21: Average results, channel 0 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	37.2	1000.0	1000.000	265.0	V	237.0	14.6	16.7	53.9
4804.000000	48.1	1000.0	1000.000	179.0	V	203.0	8.3	5.8	53.9

Table 22: Quasi-peak results, channel 0 low (E)

Frequency (MHz)	QuasiP (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
180.022000	28.5	1000.0	120.000	178.0	H	197.0	13.0	15.0	43.5
300.008000	35.7	1000.0	120.000	100.0	H	342.0	15.3	10.3	46.0
312.019000	31.1	1000.0	120.000	100.0	H	0.0	15.7	14.9	46.0
349.983000	30.2	1000.0	120.000	100.0	H	242.0	16.5	15.8	46.0
364.011000	37.6	1000.0	120.000	100.0	H	239.0	16.9	8.4	46.0

Middle channel (19)

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

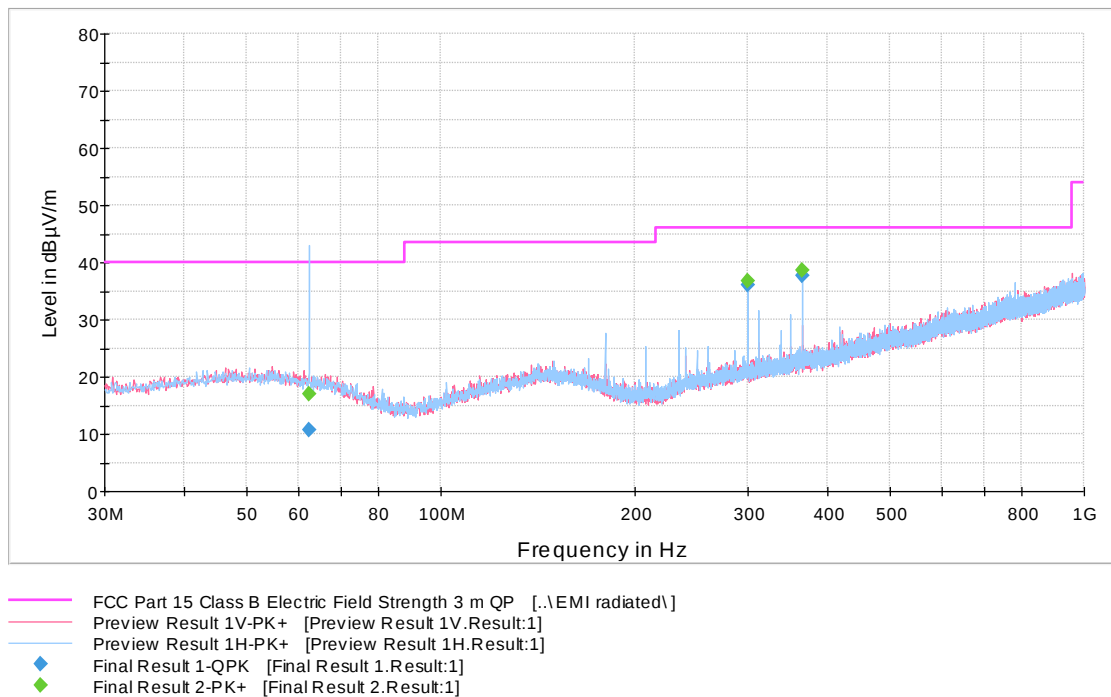


Figure 41: Channel 19 mid 30 MHz – 1000 MHz (E)

Transmitter Radiated Spurious Emissions

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

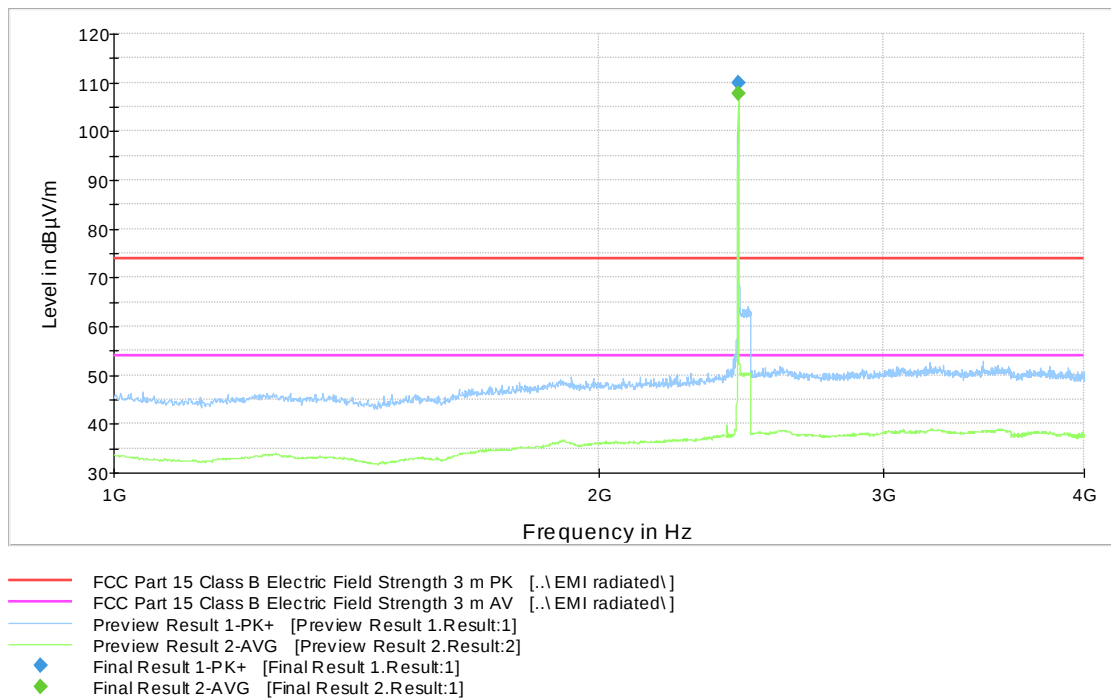


Figure 42: Channel 19 mid 1 GHz – 4 GHz (E)

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

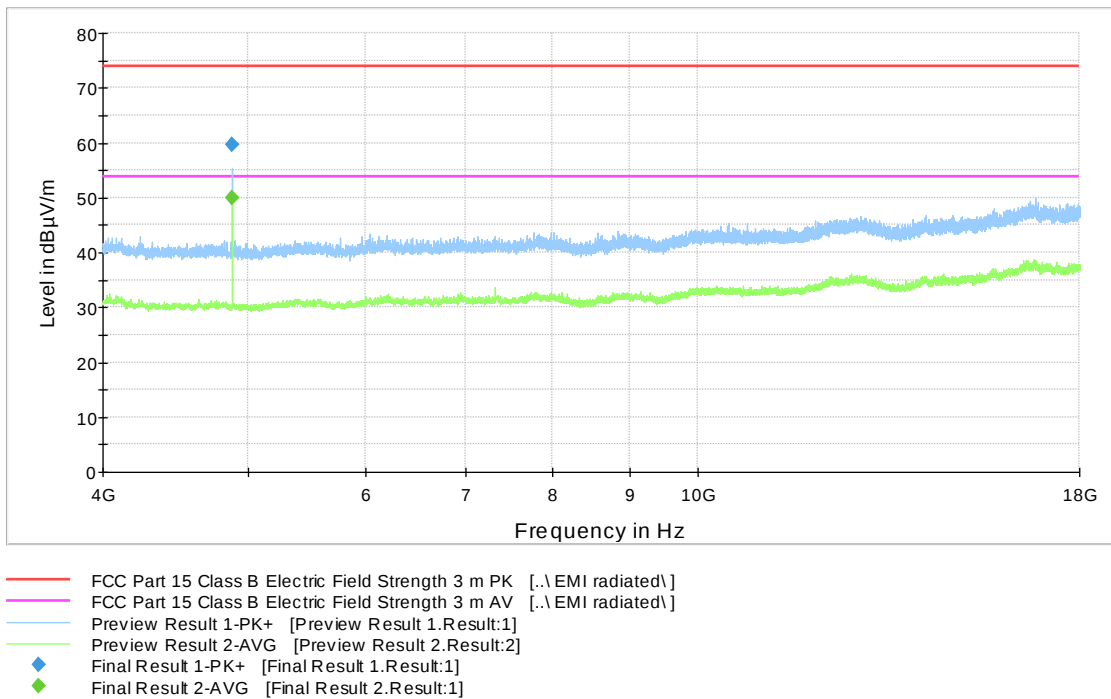


Figure 43: Channel 19 mid 4 GHz – 18 GHz (E)

Transmitter Radiated Spurious Emissions

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

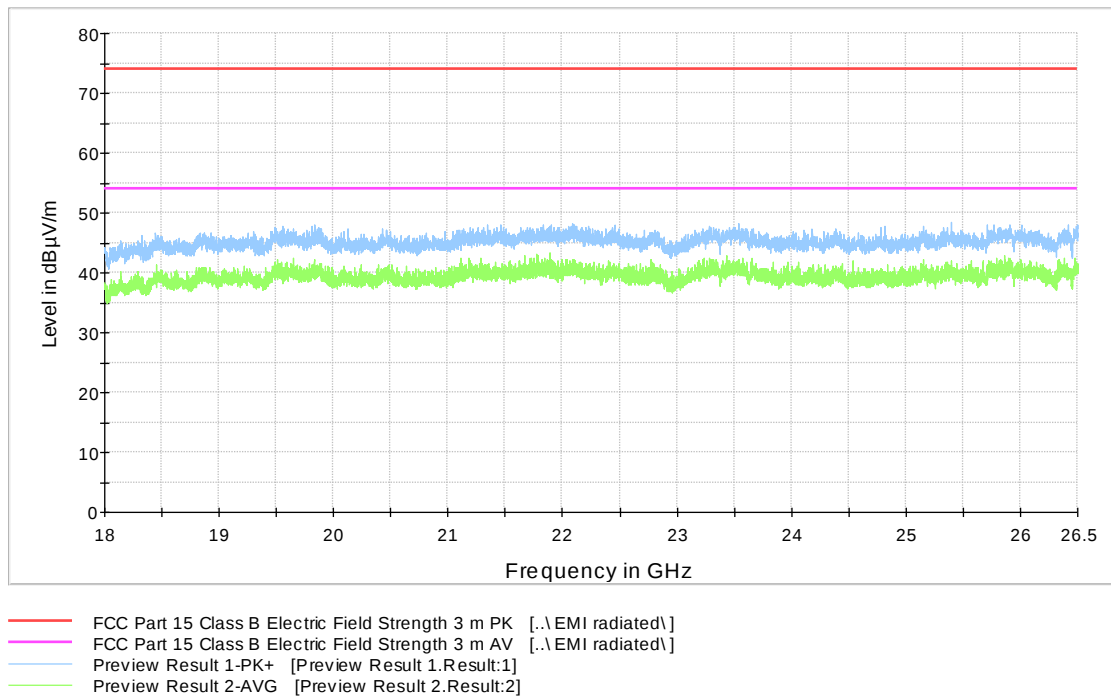


Figure 44: Channel 19 mid 18 GHz – 26.5 GHz (E)

Table 23: Peak results, channel 19 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	59.6	1000.0	1000.000	150.0	V	323.0	8.3	14.3	73.9

Table 24: Average results, channel 19 mid (E)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4879.900000	50.0	1000.0	1000.000	150.0	V	311.0	8.3	3.9	53.9

Table 25: Quasi-peak results, channel 19 mid (E)

Frequency (MHz)	QuasiP (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
62.358000	10.6	1000.0	120.000	336.0	H	89.0	13.6	29.4	40.0
300.011000	35.9	1000.0	120.000	100.0	H	164.0	15.3	10.1	46.0
364.011000	37.7	1000.0	120.000	100.0	H	242.0	16.9	8.3	46.0

Transmitter Radiated Spurious Emissions

High channel (38)

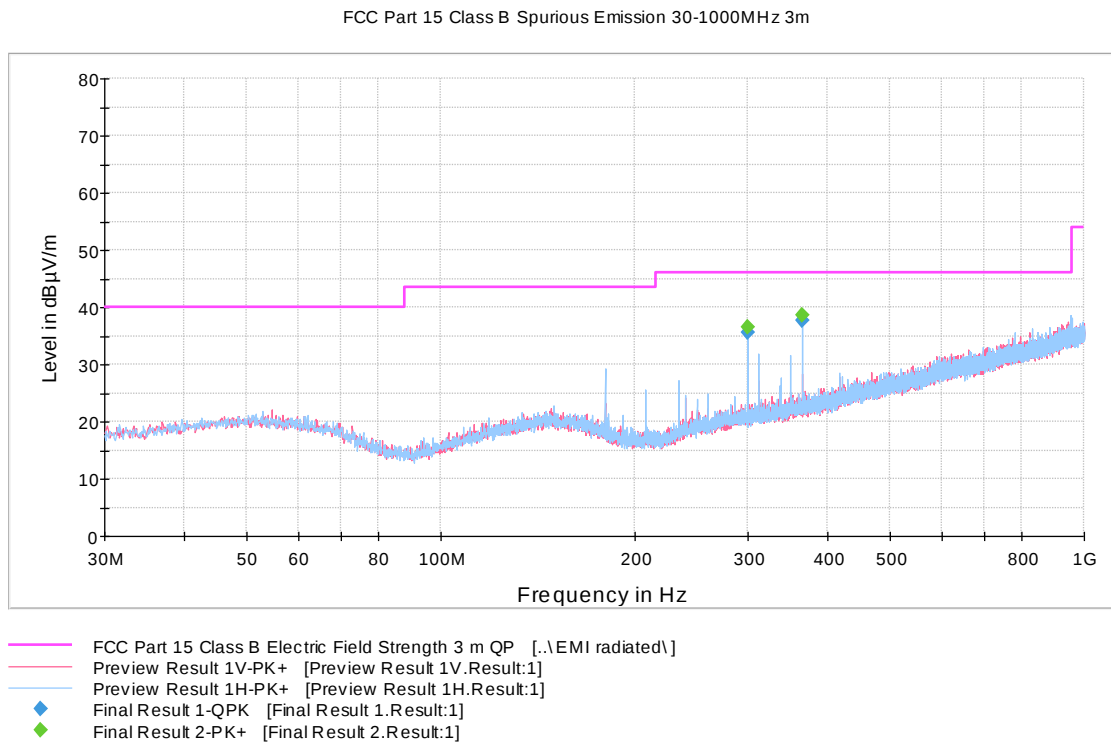


Figure 45: Channel 38 high 30 MHz – 1000 MHz (E)

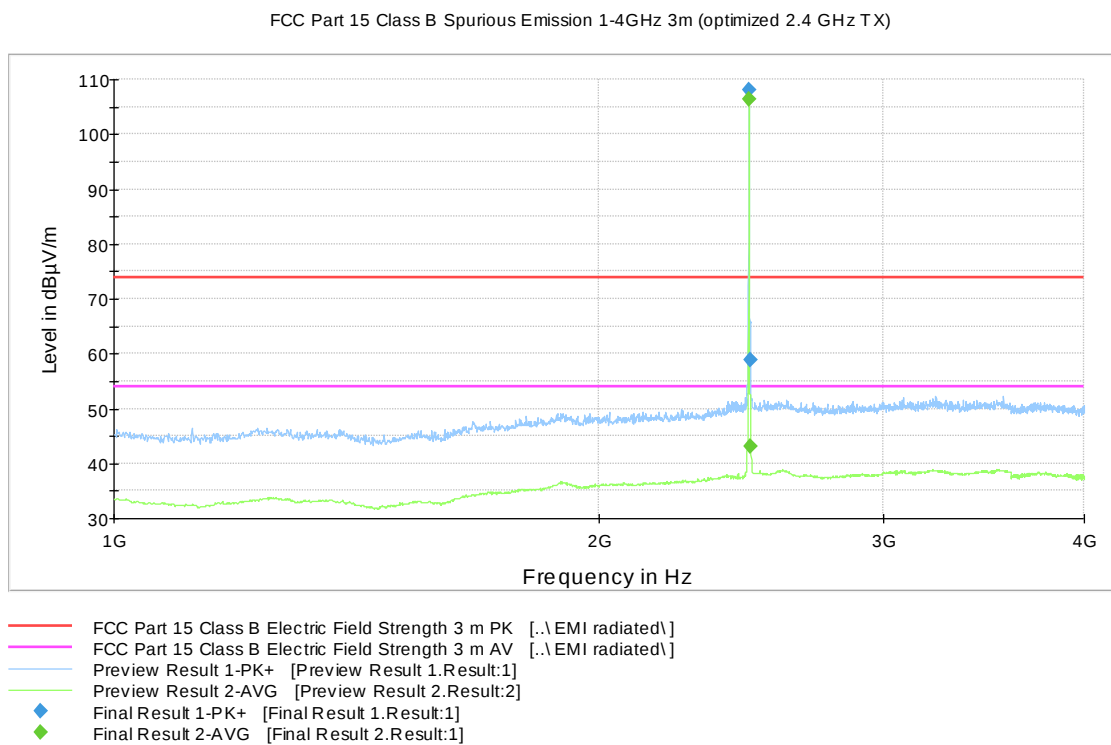


Figure 46: Channel 38 high 1 GHz – 4 GHz (E)

Transmitter Radiated Spurious Emissions

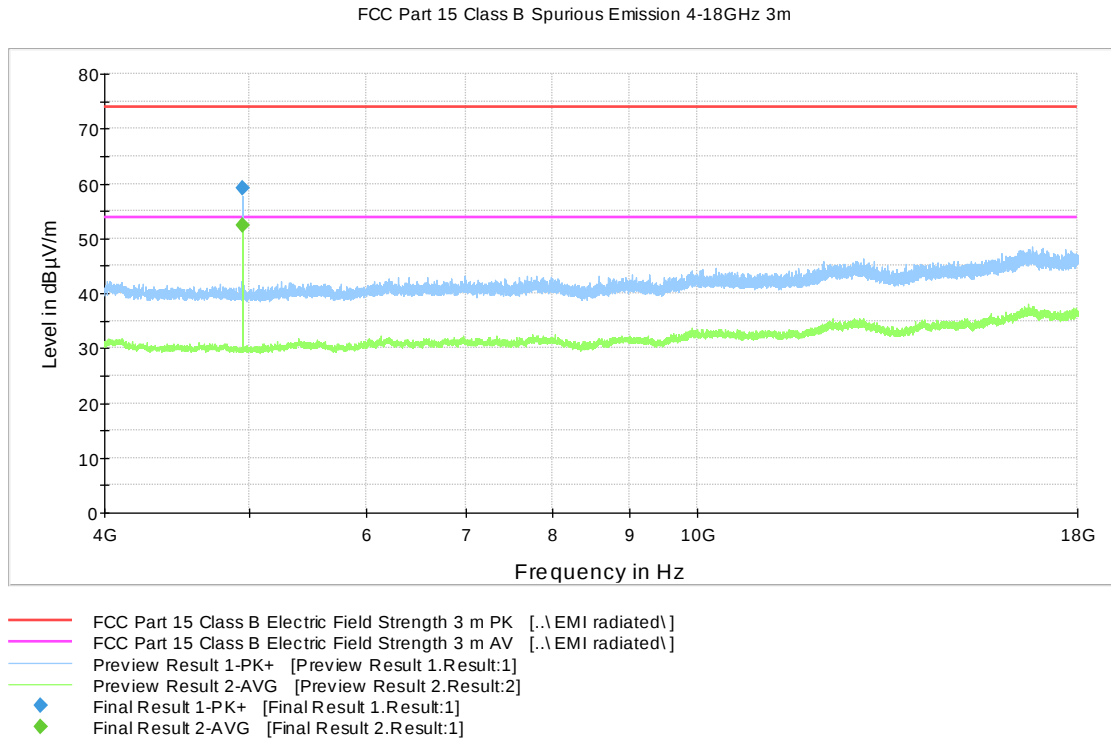


Figure 47: Channel 38 high 4 GHz – 18 GHz (E)

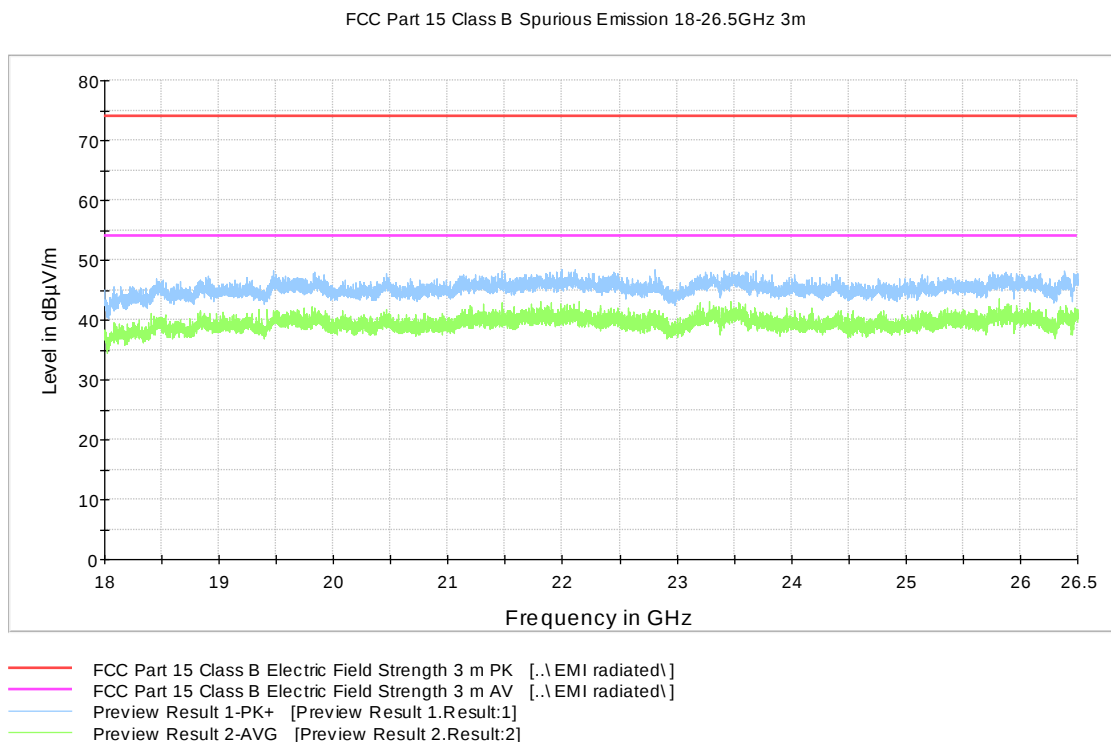


Figure 48: Channel 38 high 18 GHz – 26.5 GHz (E)

Transmitter Radiated Spurious Emissions

Table 26: Peak results, channel 38 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	58.8	1000.0	1000.000	150.0	V	17.0	14.7	15.1	73.9
4956.000000	59.2	1000.0	1000.000	150.0	V	323.0	8.2	14.7	73.9

Table 27: Average results, channel 38 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	43.2	1000.0	1000.000	203.0	V	21.0	14.7	10.7	53.9
4955.900000	52.4	1000.0	1000.000	150.0	V	323.0	8.2	1.5	53.9

Table 28: Quasi-peak results, channel 38 high (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	35.7	1000.0	120.000	100.0	H	349.0	15.3	10.3	46.0
364.028000	37.8	1000.0	120.000	100.0	H	239.0	16.9	8.2	46.0

Transmitter Radiated Spurious Emissions

Radiated Band Edge results

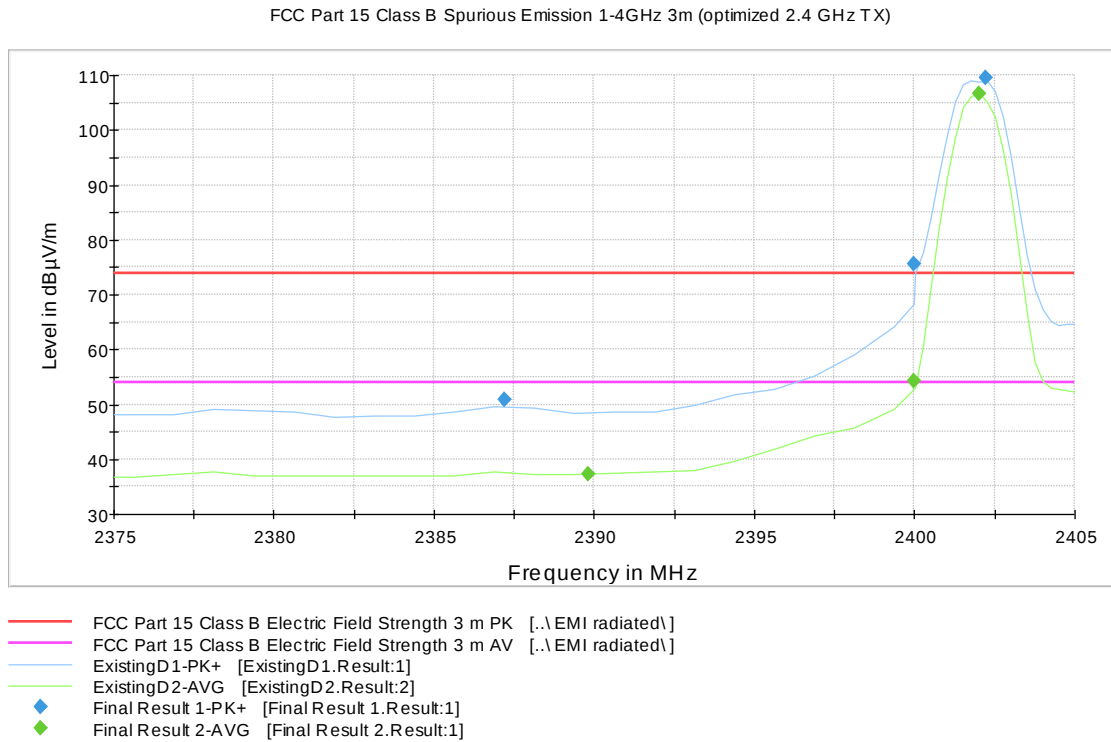


Figure 49: Radiated Band Edge measurement graph, Channel 0 low (E)

Table 29: Peak results, channel 0 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	50.9	1000.0	1000.000	203.0	V	163.0	14.6	23.0	73.9
2400.000000	75.6	1000.0	1000.000	232.0	V	234.0	14.7	13.9	89.5

Table 30: Average results, channel 0 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	37.2	1000.0	1000.000	265.0	V	237.0	14.6	16.7	53.9

Transmitter Radiated Spurious Emissions

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

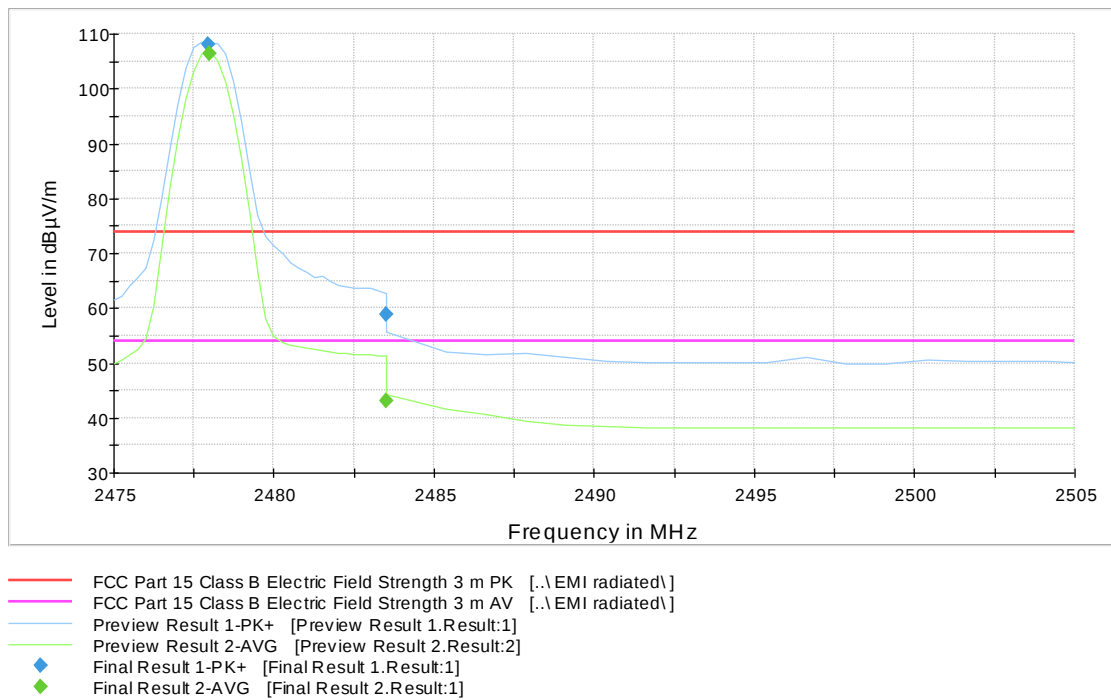


Figure 50: Radiated Band Edge measurement graph, Channel 38 high (E)

Table 31: Peak results, channel 38 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	58.8	1000.0	1000.000	150.0	V	17.0	14.7	15.1	73.9

Table 32: Average results, channel 38 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	43.2	1000.0	1000.000	203.0	V	21.0	14.7	10.7	53.9

Transmitter Radiated Spurious Emissions

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

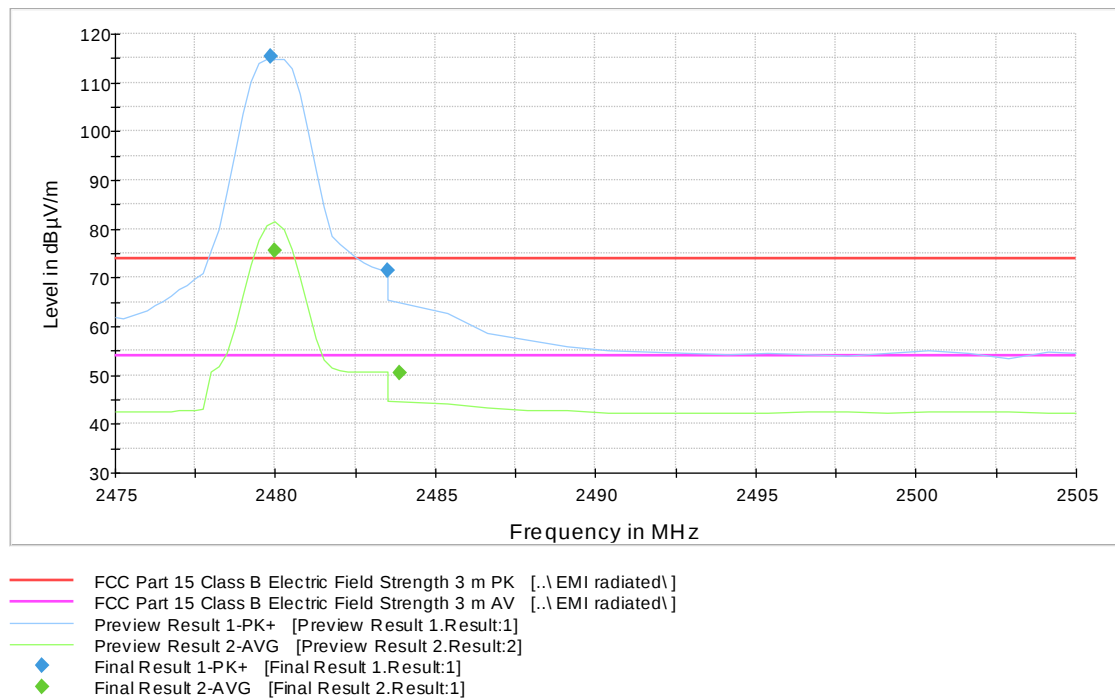


Figure 51: Radiated Band Edge measurement graph, Channel 39 high (E)

Table 33: Peak results, channel 39 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	71.5	1000.0	1000.000	150.0	V	355.0	14.7	2.4	73.9

Table 34: Average results, channel 39 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	50.5	1000.0	1000.000	150.0	V	6.0	14.7	3.4	53.9

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 11 September – 21 November 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 35: Band edge attenuation (A), power setting 145

Band Edge Attenuation		
Lower Band Edge (ch 0)	Upper Band Edge (ch 38)	Upper Band Edge (ch 39)
-47.66 dBc	-47.09 dBc	-49.55 dBc
Limit: -20 dBc		

Table 36: Band edge attenuation (A), power setting 200, PHY 1M coded

Band Edge Attenuation	
Lower Band Edge (ch 0)	Upper Band Edge (ch 39)
-55.38 dBc	-54.70 dBc
Limit: -20 dBc	

Table 37: Band edge attenuation (E), power setting 145

Band Edge Attenuation		
Lower Band Edge (ch 0)	Upper Band Edge (ch 38)	Upper Band Edge (ch 39)
-48.73 dBc	-48.465 dBc	-50.44 dBc
Limit: -20 dBc		

Table 38: Band edge attenuation (E), power setting 200, PHY 1M coded

Band Edge Attenuation	
Lower Band Edge (ch 0)	Upper Band Edge (ch 39)
-54.33 dBc	-55.87 dBc
Limit: -20 dBc	

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 39: Conducted spurious emissions, Channel 0 low (A), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
951,00	-69,15	-9,49	-59,66	PASS
2399,85	-43,44	-9,49	-33,95	PASS
3785,78	-65,34	-9,49	-55,85	PASS
4804,40	-46,47	-9,49	-36,98	PASS
9782,18	-60,88	-9,49	-51,39	PASS
12876,30	-58,73	-9,49	-49,24	PASS
15837,30	-56,52	-9,49	-47,03	PASS
16170,76	-55,02	-9,49	-45,53	PASS
19499,44	-56,78	-9,49	-47,29	PASS
24434,66	-55,32	-9,49	-45,83	PASS
25754,03	-56,16	-9,49	-46,67	PASS

Table 40: Conducted spurious emissions, Channel 19 mid (A), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
996,92	-68,73	-10,70	-58,04	PASS
1726,03	-49,70	-10,70	-39,00	PASS
2516,74	-64,03	-10,70	-53,33	PASS
4880,43	-47,28	-10,70	-36,59	PASS
7506,66	-60,54	-10,70	-49,85	PASS
12472,16	-58,71	-10,70	-48,01	PASS
15812,93	-56,18	-10,70	-45,49	PASS
16144,23	-55,40	-10,70	-44,70	PASS
19258,79	-56,69	-10,70	-45,99	PASS
24431,28	-56,72	-10,70	-46,02	PASS
26098,51	-56,19	-10,70	-45,49	PASS

Table 41: Conducted spurious emissions, Channel 38 high (A), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
870,28	-68,52	-10,70	-57,82	PASS
1728,39	-62,69	-10,70	-51,98	PASS
2483,52	-50,44	-10,70	-39,74	PASS
4956,36	-47,44	-10,70	-36,73	PASS
7530,28	-61,65	-10,70	-50,95	PASS
12537,22	-58,26	-10,70	-47,55	PASS
15507,69	-56,67	-10,70	-45,97	PASS
16202,26	-54,92	-10,70	-44,21	PASS
19211,63	-56,80	-10,70	-46,10	PASS
24533,75	-56,05	-10,70	-45,34	PASS
25622,46	-55,92	-10,70	-45,22	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 42: Conducted spurious emissions, Channel 39 high (A), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
950,03	-69,93	-8,11	-61,81	PASS
2364,80	-65,61	-8,11	-57,49	PASS
2483,90	-49,94	-8,11	-41,83	PASS
4960,39	-46,78	-8,11	-38,66	PASS
9830,93	-60,61	-8,11	-52,50	PASS
12839,08	-59,45	-8,11	-51,33	PASS
15504,13	-56,81	-8,11	-48,70	PASS
16162,14	-55,06	-8,11	-46,94	PASS
19679,06	-56,97	-8,11	-48,86	PASS
24476,28	-56,35	-8,11	-48,24	PASS
25152,78	-55,79	-8,11	-47,68	PASS

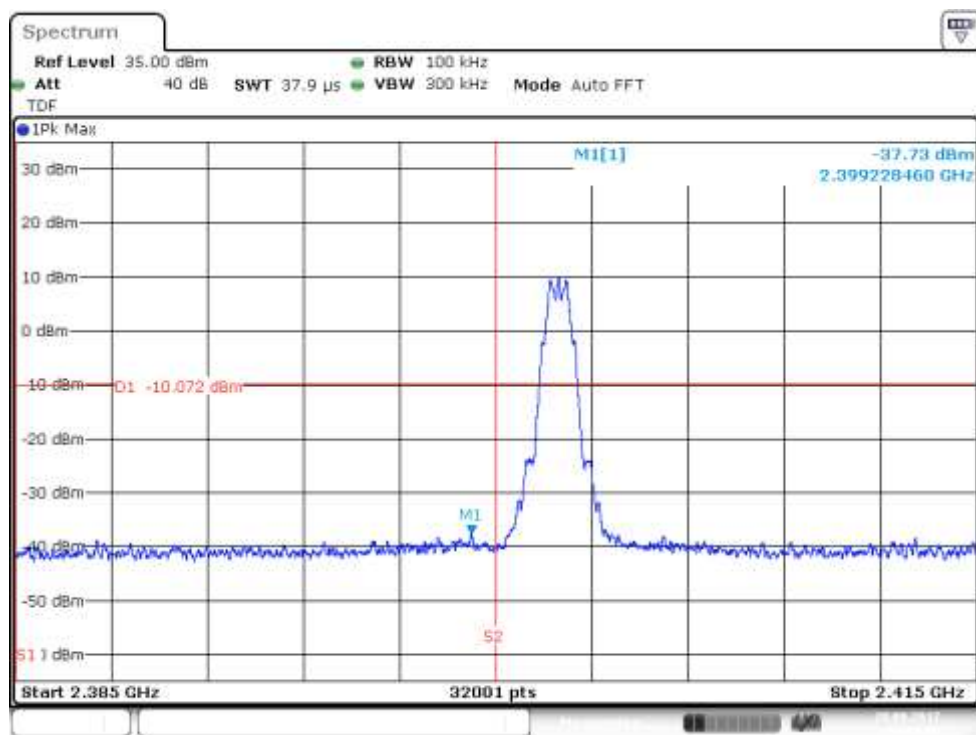


Figure 52: Lower Band Edge, channel 0 low (A), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

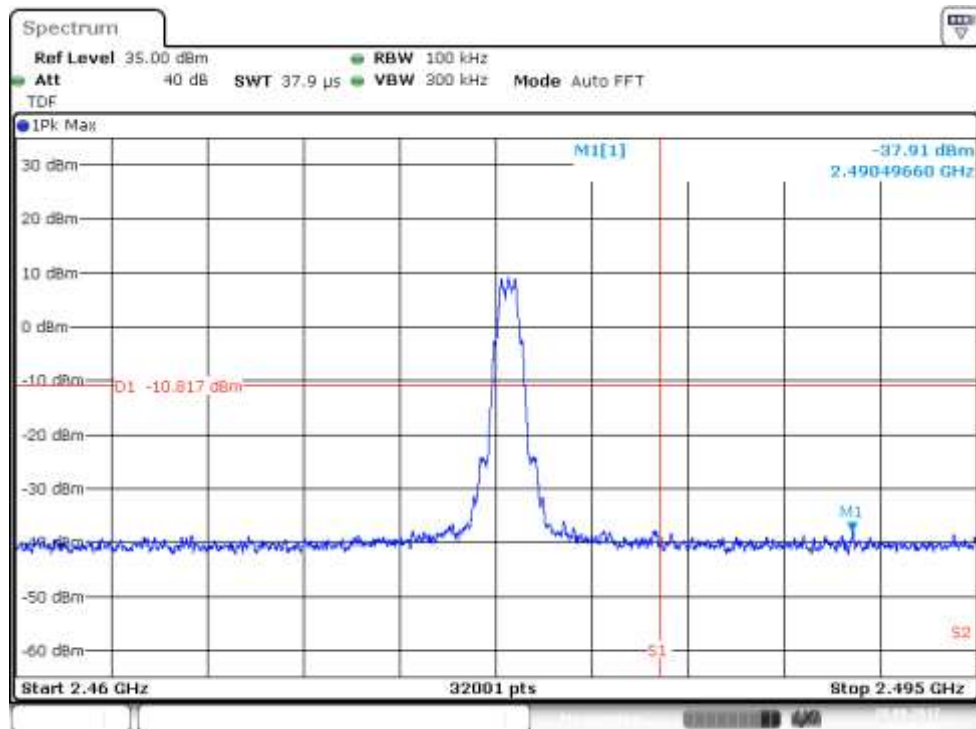


Figure 53: Upper Band Edge, channel 38 (A), power setting 145

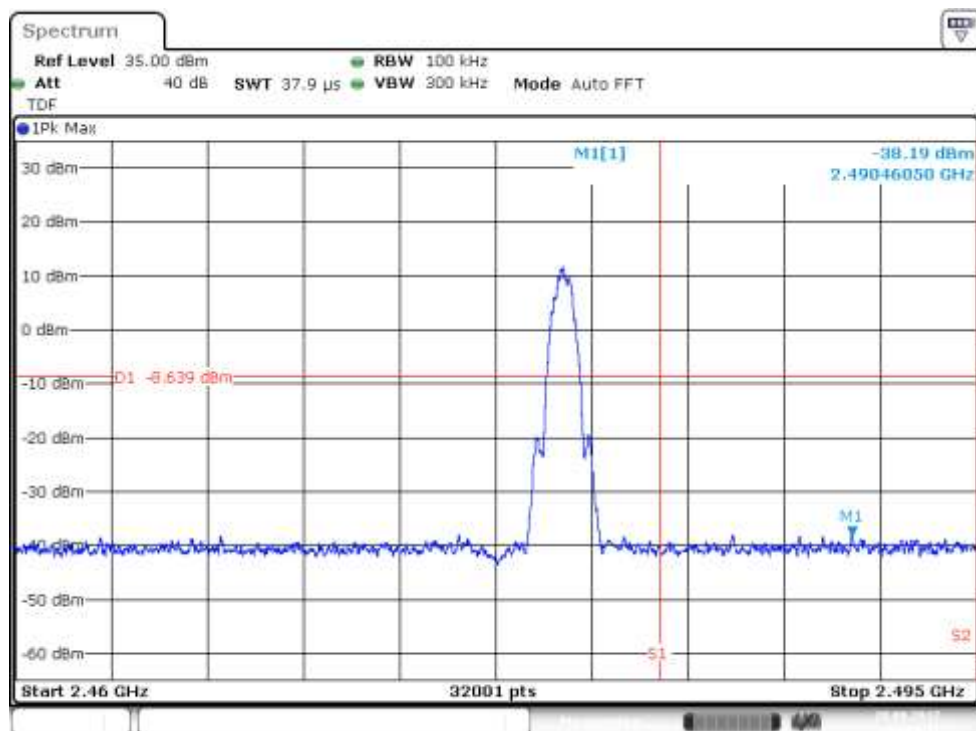


Figure 54: Upper Band Edge, channel 39 (A), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

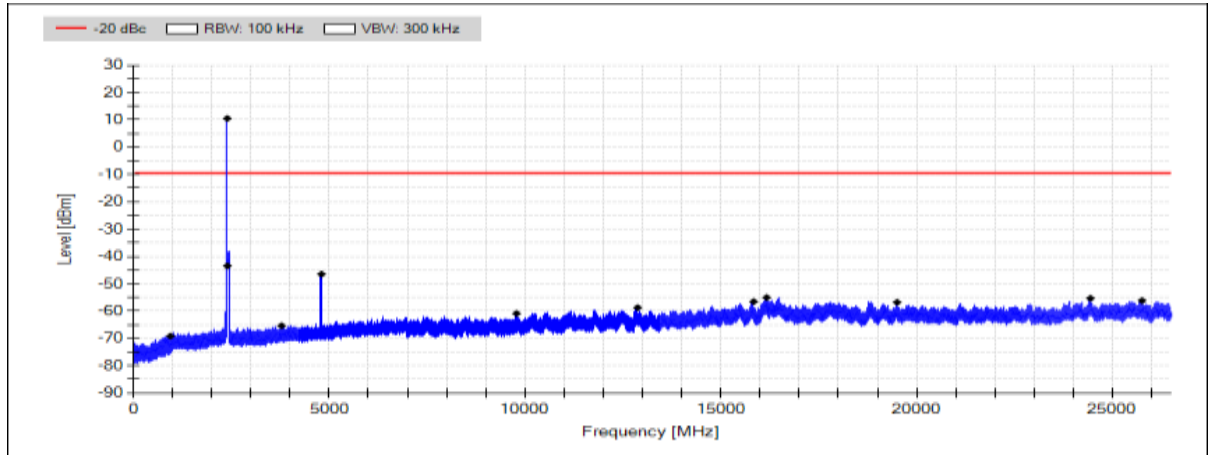


Figure 55: Conducted spurious emissions 30 - 26500 MHz channel 0 (A), power setting 145

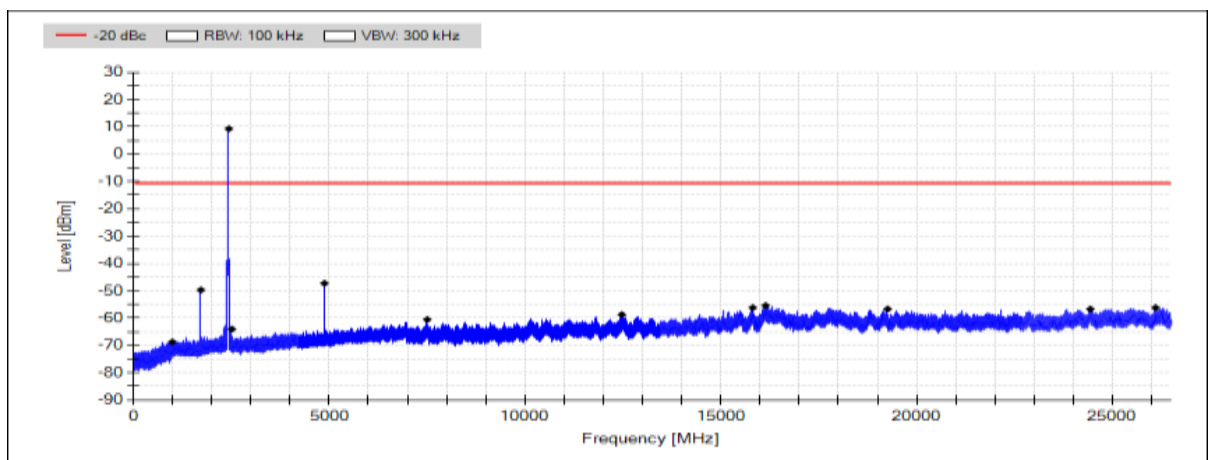


Figure 56: Conducted spurious emissions 30 - 26500 MHz channel 19 (A), power setting 145

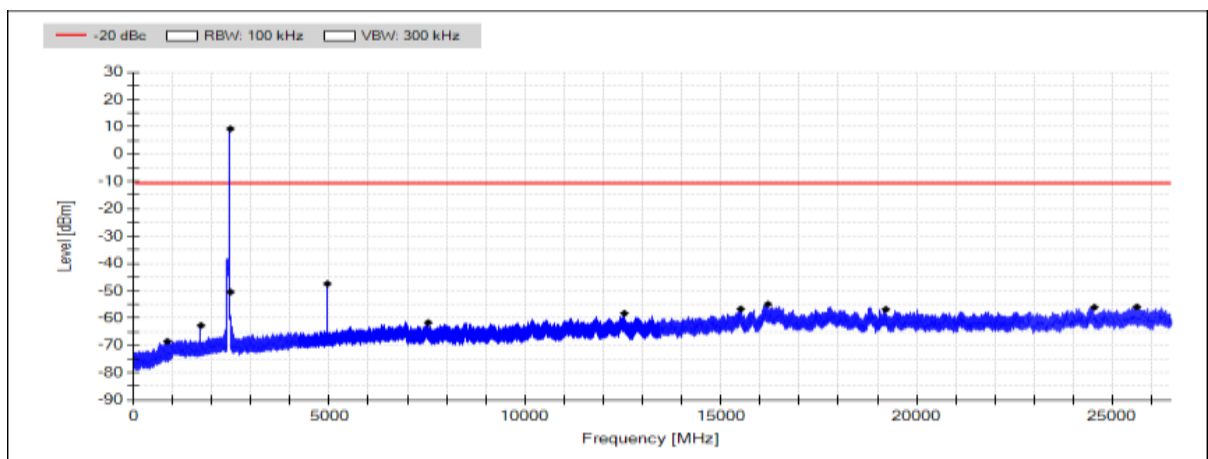


Figure 57: Conducted spurious emissions 30 - 26500 MHz channel 38 (A), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

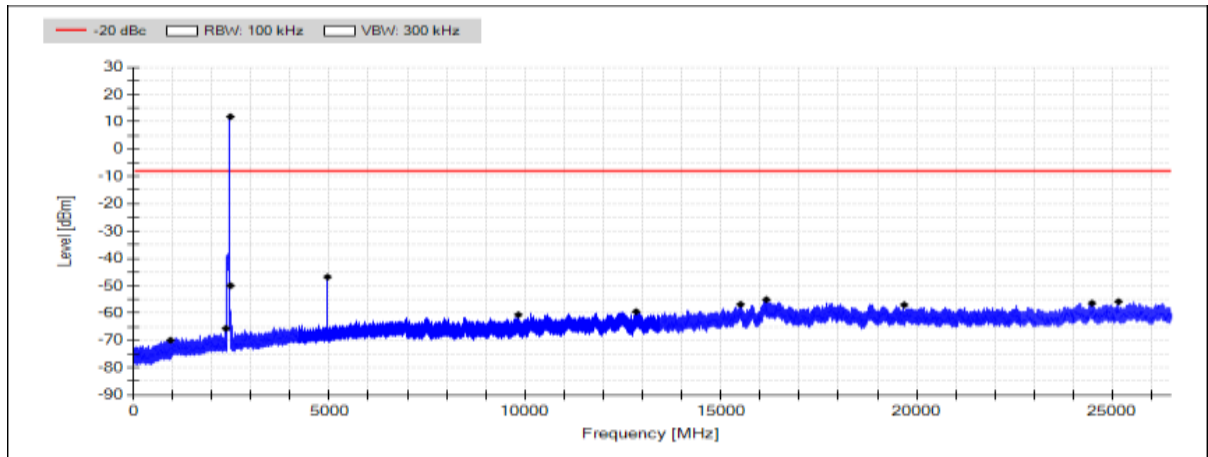


Figure 58: Conducted spurious emissions 30 - 26500 MHz channel 39 (A), power setting 145

Table 43: Conducted spurious emissions, Channel 0 low (A), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
991,04	-65,48	-0,51	-64,98	PASS
2399,80	-35,81	-0,51	-35,30	PASS
2517,12	-64,59	-0,51	-64,08	PASS
4804,40	-33,39	-0,51	-32,88	PASS
7995,36	-61,86	-0,51	-61,35	PASS
12452,19	-58,45	-0,51	-57,94	PASS
15840,40	-56,47	-0,51	-55,96	PASS
16122,48	-55,33	-0,51	-54,82	PASS
19222,60	-57,51	-0,51	-57,01	PASS
24463,72	-56,12	-0,51	-55,62	PASS
26249,16	-56,18	-0,51	-55,67	PASS

Table 44: Conducted spurious emissions, Channel 19 mid (A), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
671,44	-65,42	-0,72	-64,70	PASS
2363,40	-55,85	-0,72	-55,12	PASS
2516,98	-56,87	-0,72	-56,15	PASS
4879,39	-34,94	-0,72	-34,22	PASS
8293,76	-61,42	-0,72	-60,70	PASS
12581,09	-58,23	-0,72	-57,51	PASS
15482,19	-56,61	-0,72	-55,89	PASS
16139,64	-55,36	-0,72	-54,64	PASS
20736,90	-57,53	-0,72	-56,81	PASS
24472,06	-56,32	-0,72	-55,60	PASS
26126,11	-56,18	-0,72	-55,45	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 45: Conducted spurious emissions, Channel 39 high (A), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
910,63	-64,95	-0,97	-63,97	PASS
2364,67	-57,50	-0,97	-56,52	PASS
2483,52	-40,71	-0,97	-39,73	PASS
4959,45	-34,96	-0,97	-33,99	PASS
9822,30	-60,70	-0,97	-59,72	PASS
12558,87	-58,55	-0,97	-57,58	PASS
15500,94	-56,84	-0,97	-55,86	PASS
16120,32	-55,00	-0,97	-54,03	PASS
19487,25	-57,00	-0,97	-56,03	PASS
24442,06	-56,24	-0,97	-55,27	PASS
26281,97	-55,34	-0,97	-54,37	PASS

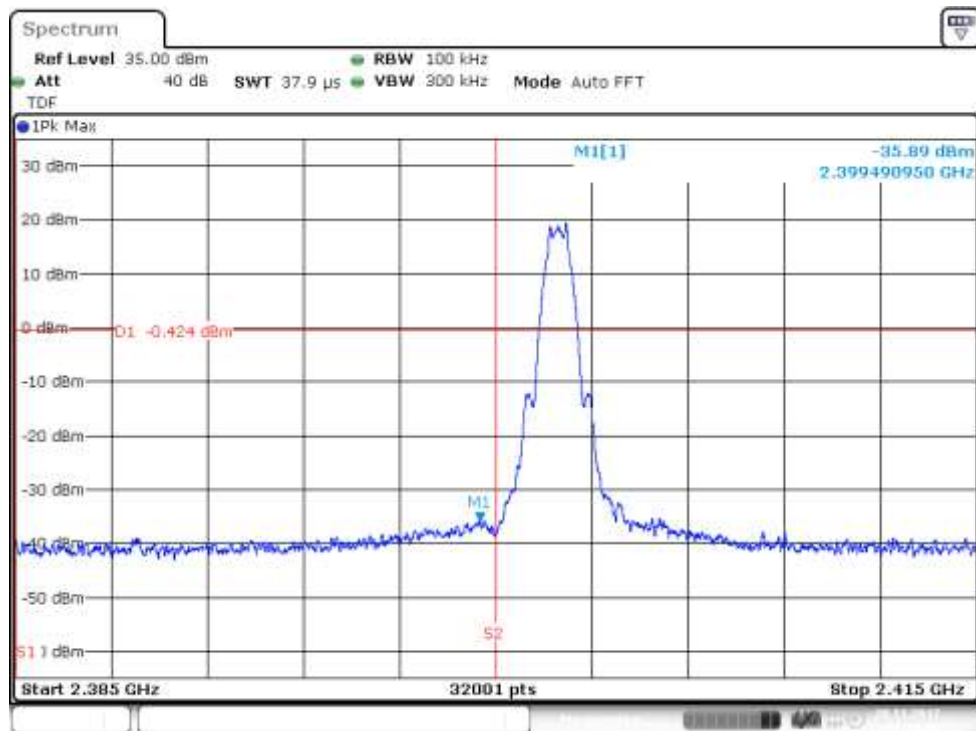


Figure 59: Lower Band Edge, channel 0 low (A), power setting 200, PHY 1M coded

Transmitter Band Edge Measurement and Conducted Spurious Emissions

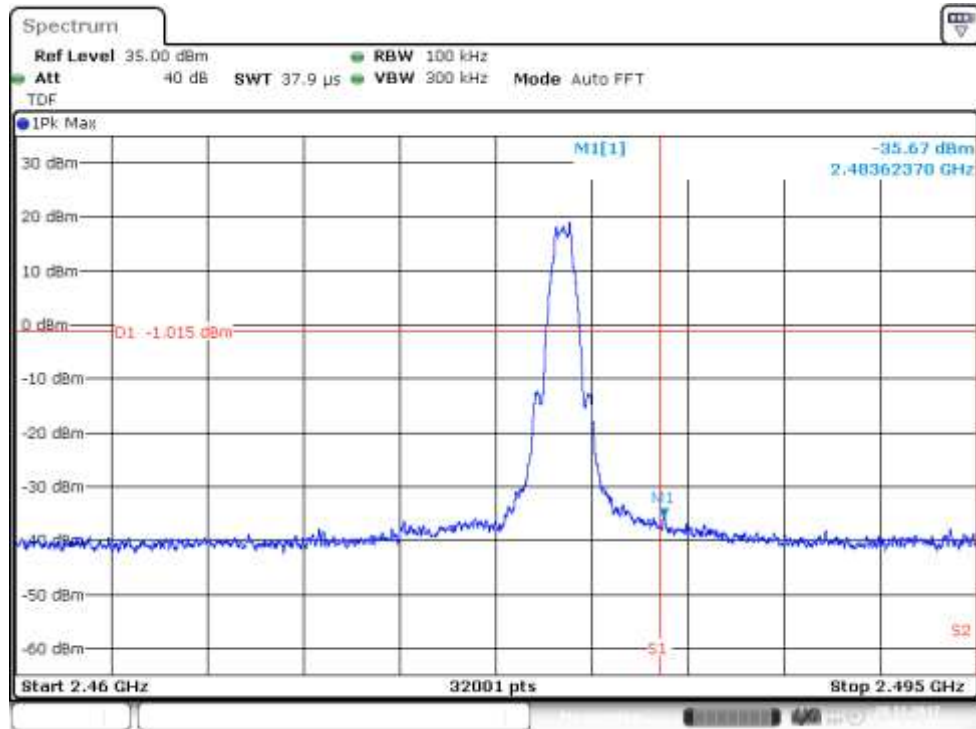


Figure 60: Upper Band Edge, channel 39 (A), power setting 200, PHY 1M coded

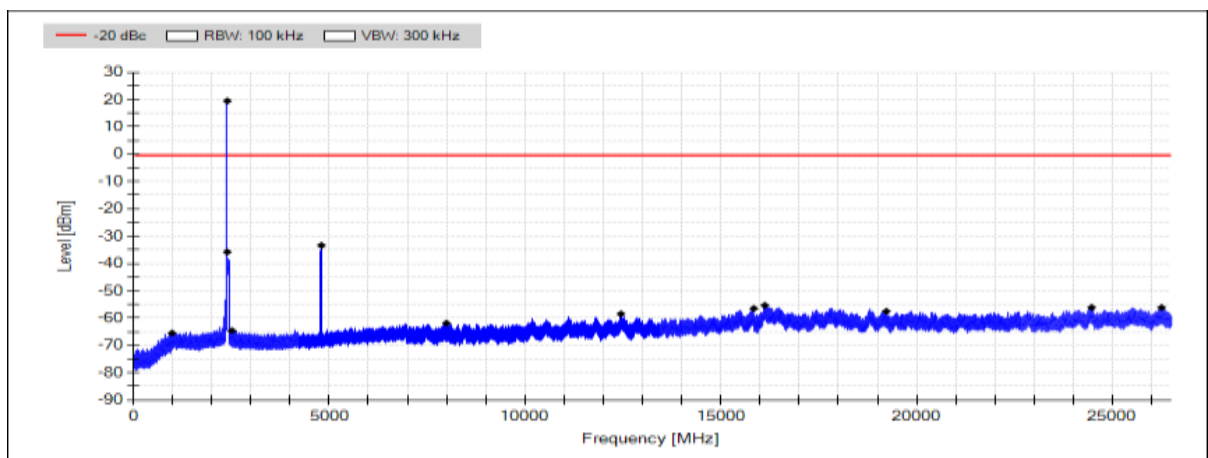


Figure 61: Conducted spurious emissions 30 - 26500 MHz channel 0 (A), power setting 200, PHY 1M coded

Transmitter Band Edge Measurement and Conducted Spurious Emissions

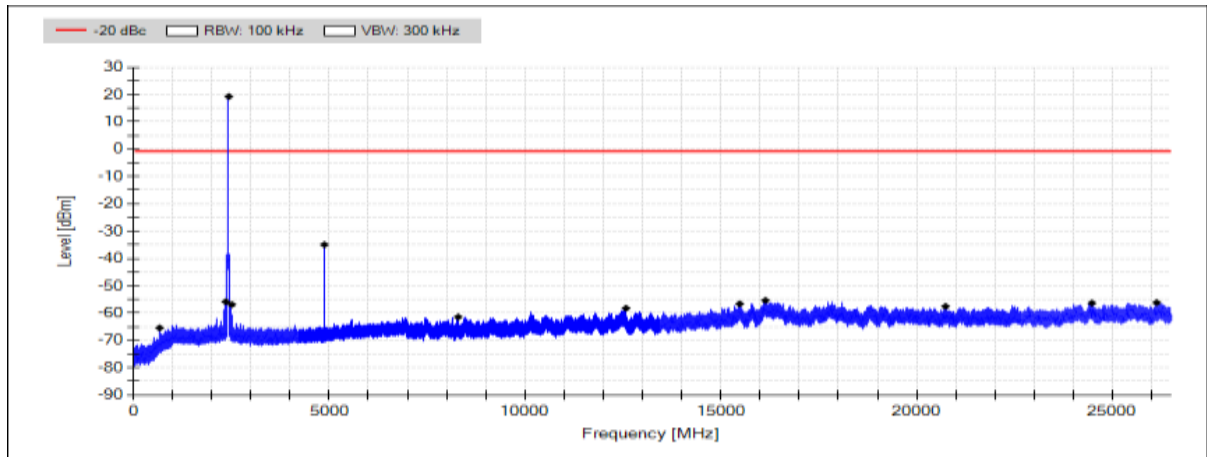


Figure 62: Conducted spurious emissions 30 - 26500 MHz channel 19 (A), power setting 200, PHY 1M coded

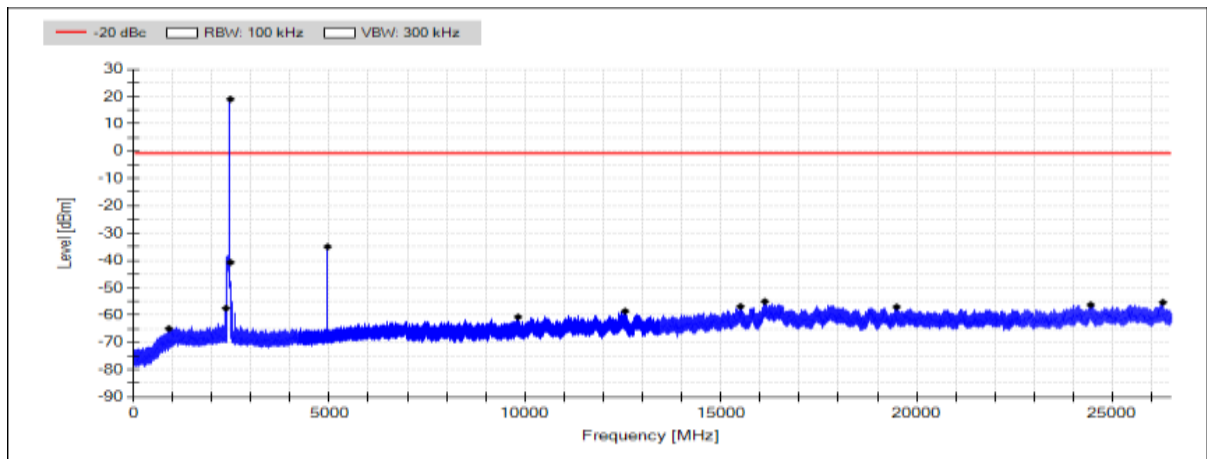


Figure 63: Conducted spurious emissions 30 - 26500 MHz channel 39 (A), power setting 200, PHY 1M coded

Table 46: Conducted spurious emissions Channel 0 low (E), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
949,12	-68,21	-9,65	-58,56	PASS
2399,98	-41,85	-9,65	-32,20	PASS
3622,00	-65,40	-9,65	-55,75	PASS
4804,40	-37,63	-9,65	-27,98	PASS
9795,58	-61,73	-9,65	-52,08	PASS
12547,62	-58,20	-9,65	-48,55	PASS
15505,44	-56,69	-9,65	-47,05	PASS
16155,29	-55,02	-9,65	-45,38	PASS
19821,27	-57,05	-9,65	-47,41	PASS
24830,55	-56,20	-9,65	-46,56	PASS
25428,59	-56,39	-9,65	-46,74	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 47: Conducted spurious emissions, channel 19 mid (E), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
950,76	-68,22	-9,90	-58,32	PASS
2362,97	-62,95	-9,90	-53,05	PASS
2516,93	-64,20	-9,90	-54,31	PASS
4879,49	-38,70	-9,90	-28,80	PASS
9834,49	-61,01	-9,90	-51,12	PASS
12924,77	-58,71	-9,90	-48,81	PASS
15823,71	-56,86	-9,90	-46,97	PASS
16180,42	-54,61	-9,90	-44,71	PASS
19492,31	-56,79	-9,90	-46,90	PASS
23943,33	-56,20	-9,90	-46,30	PASS
26108,44	-56,06	-9,90	-46,17	PASS

Table 48: Conducted spurious emissions, channel 38 high (E), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
901,68	-68,75	-10,49	-58,25	PASS
2383,83	-65,86	-10,49	-55,36	PASS
2483,57	-50,01	-10,49	-39,51	PASS
4956,36	-39,84	-10,49	-29,35	PASS
7487,34	-61,56	-10,49	-51,07	PASS
12520,72	-59,11	-10,49	-48,61	PASS
15496,16	-56,58	-10,49	-46,08	PASS
16118,07	-55,36	-10,49	-44,87	PASS
19497,38	-56,87	-10,49	-46,38	PASS
24438,50	-56,33	-10,49	-45,84	PASS
26248,59	-55,14	-10,49	-44,64	PASS

Table 49: Conducted spurious emissions, channel 39 high (E), power setting 145

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
719,82	-69,97	-8,51	-61,46	PASS
1765,01	-65,79	-8,51	-57,28	PASS
2483,90	-52,25	-8,51	-43,74	PASS
4960,39	-38,39	-8,51	-29,88	PASS
8476,19	-61,25	-8,51	-52,74	PASS
12502,06	-58,60	-8,51	-50,09	PASS
15516,31	-56,39	-8,51	-47,88	PASS
16124,36	-55,08	-8,51	-46,58	PASS
19200,48	-56,64	-8,51	-48,13	PASS
24828,58	-56,10	-8,51	-47,59	PASS
25573,10	-55,82	-8,51	-47,31	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

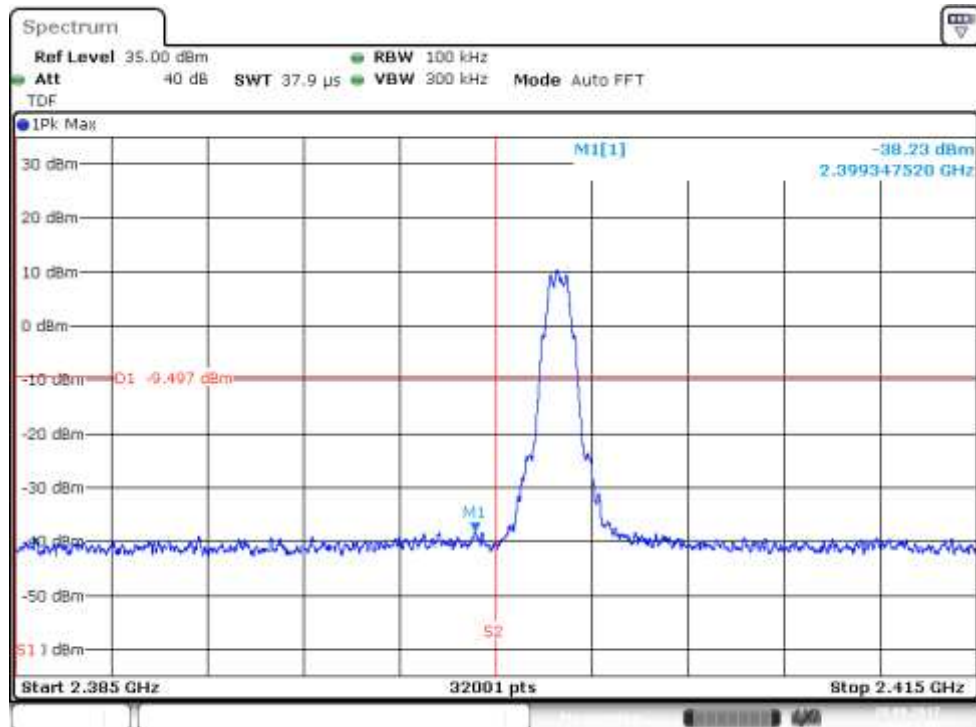


Figure 64: Lower Band Edge, channel 0 (E), power setting 145

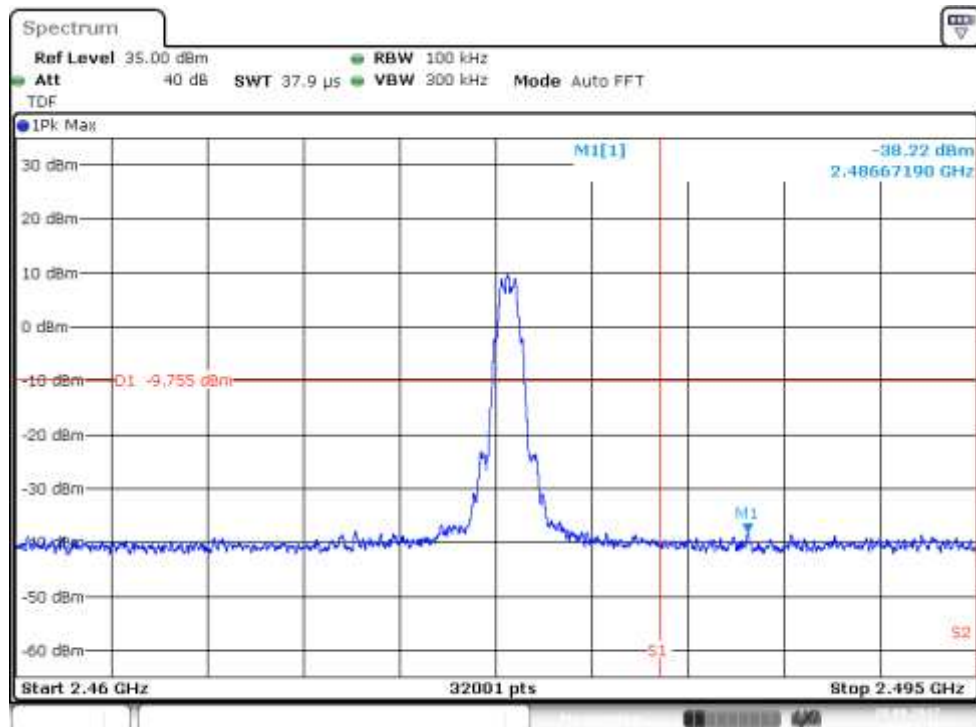


Figure 65: Upper Band Edge, channel 38 (E), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

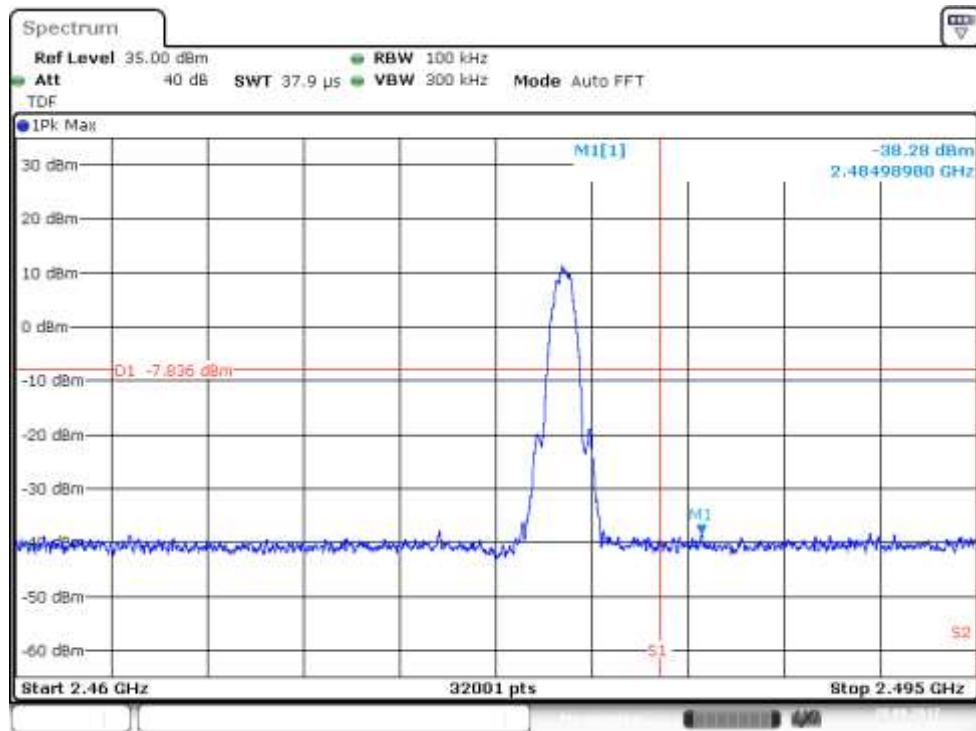


Figure 66: Upper Band Edge, channel 39 (E), power setting 145

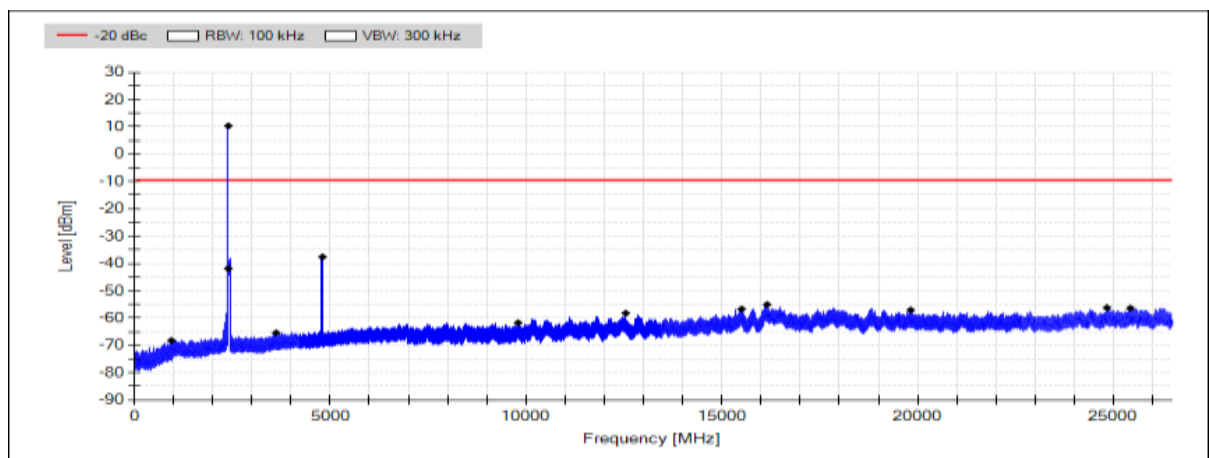


Figure 67: Conducted spurious emissions 30 - 26500 MHz channel 0 (E), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

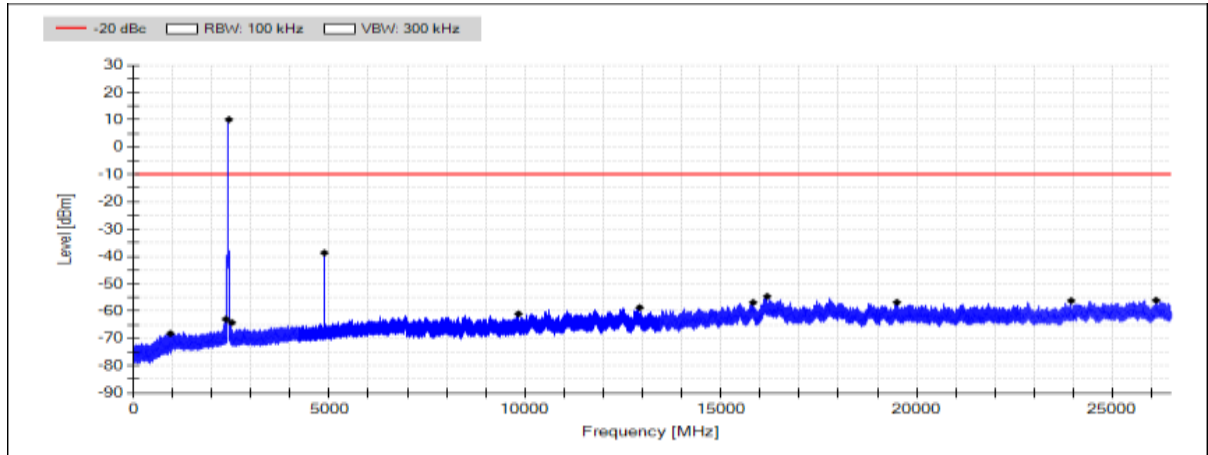


Figure 68: Conducted spurious emissions 30 - 26500 MHz channel 19 (E), power setting 145

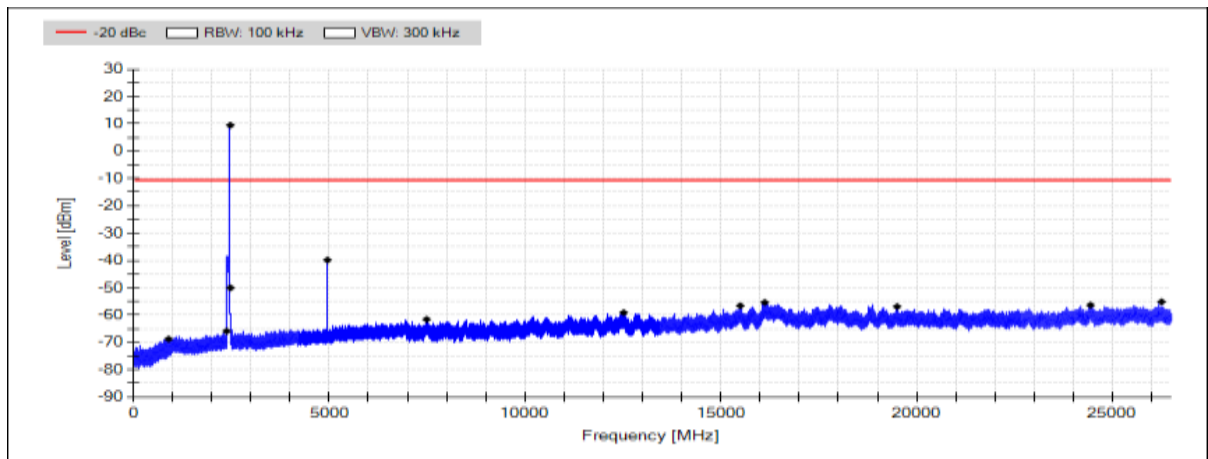


Figure 69: Conducted spurious emissions 30 - 26500 MHz channel 38 high (E), power setting 145

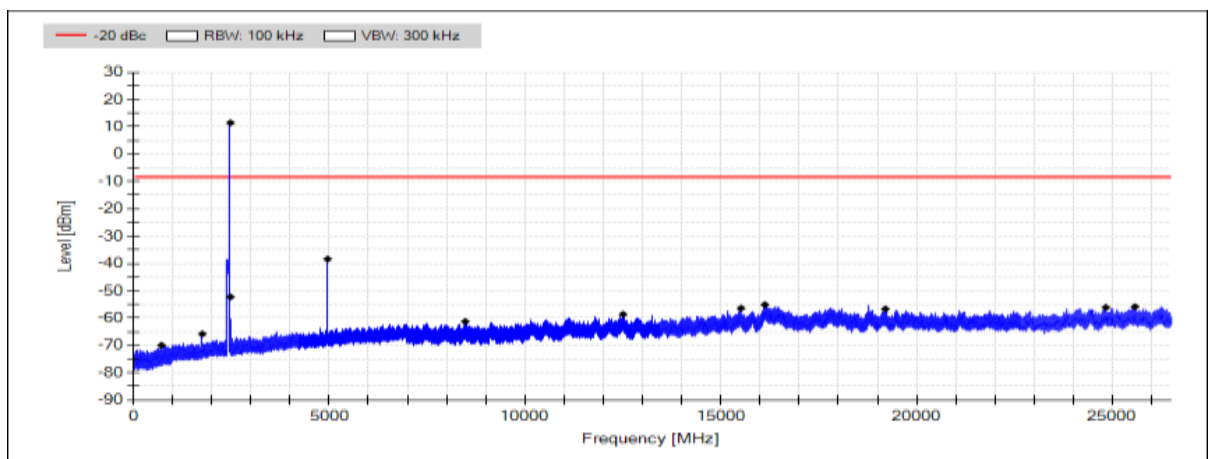


Figure 70: Conducted spurious emissions 30 - 26500 MHz channel 39 high (E), power setting 145

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 50: Conducted spurious emissions Channel 0 low (E), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
976,01	-65,49	-1,15	-64,34	PASS
2399,93	-37,63	-1,15	-36,48	PASS
2517,41	-60,35	-1,15	-59,20	PASS
4804,40	-39,01	-1,15	-37,87	PASS
9608,75	-58,25	-1,15	-57,10	PASS
12470,38	-59,02	-1,15	-57,87	PASS
15834,96	-57,04	-1,15	-55,89	PASS
16487,63	-55,16	-1,15	-54,01	PASS
19231,88	-57,28	-1,15	-56,13	PASS
24425,28	-56,13	-1,15	-54,98	PASS
25577,65	-56,32	-1,15	-55,17	PASS

Table 51: Conducted spurious emissions, channel 19 mid (E), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
987,62	-65,52	-1,29	-64,23	PASS
2363,14	-58,18	-1,29	-56,89	PASS
2517,03	-58,61	-1,29	-57,32	PASS
4880,43	-40,08	-1,29	-38,79	PASS
9760,80	-57,70	-1,29	-56,41	PASS
12517,53	-59,03	-1,29	-57,74	PASS
15791,37	-56,68	-1,29	-55,39	PASS
16142,45	-55,11	-1,29	-53,82	PASS
19433,35	-57,33	-1,29	-56,04	PASS
24820,62	-56,35	-1,29	-55,06	PASS
26268,61	-55,76	-1,29	-54,47	PASS

Table 52: Conducted spurious emissions, channel 39 high (E), power setting 200, PHY 1M coded

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
993,23	-65,12	-1,01	-64,11	PASS
2364,80	-63,69	-1,01	-62,68	PASS
2484,00	-38,45	-1,01	-37,44	PASS
4959,45	-39,05	-1,01	-38,04	PASS
9920,83	-57,56	-1,01	-56,55	PASS
12473,00	-57,65	-1,01	-56,64	PASS
15789,68	-56,76	-1,01	-55,75	PASS
16141,61	-54,75	-1,01	-53,74	PASS
19188,20	-56,26	-1,01	-55,25	PASS
24473,47	-56,08	-1,01	-55,07	PASS
25598,13	-55,91	-1,01	-54,90	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

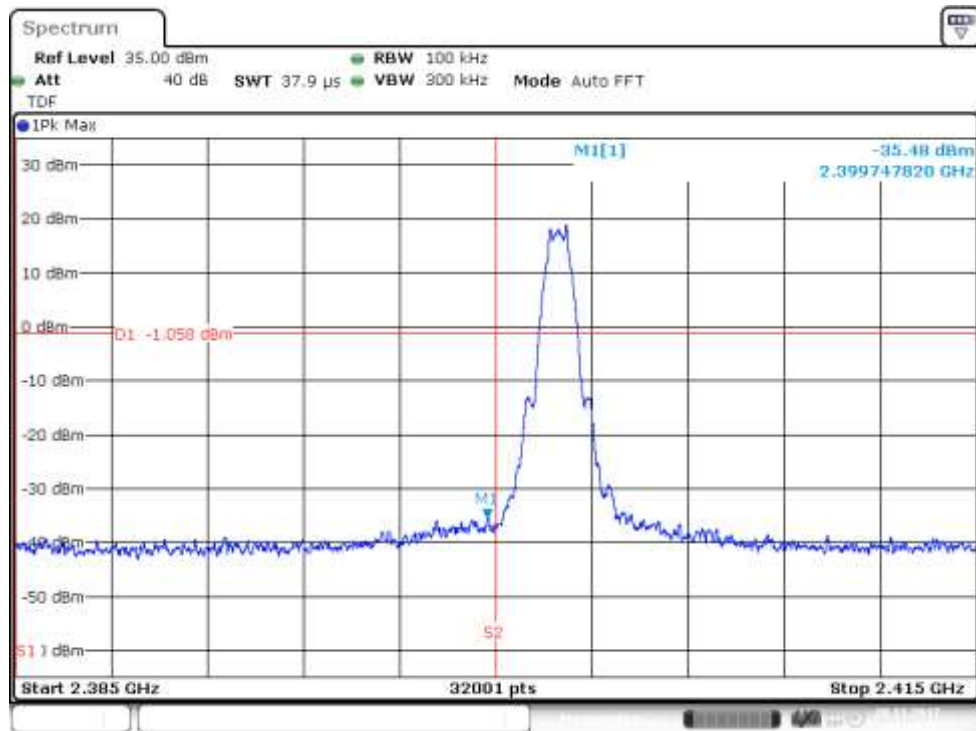


Figure 71: Lower Band Edge, channel 0 (E), power setting 200, PHY 1M coded

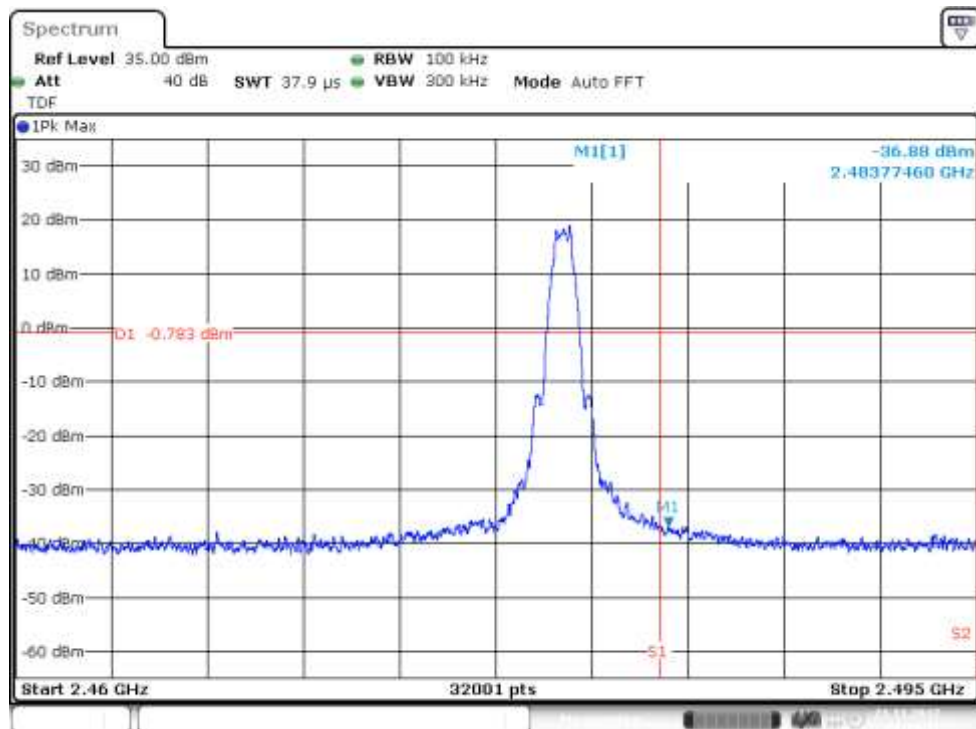


Figure 72: Upper Band Edge, channel 39 (E), power setting 200, PHY 1M coded

Transmitter Band Edge Measurement and Conducted Spurious Emissions

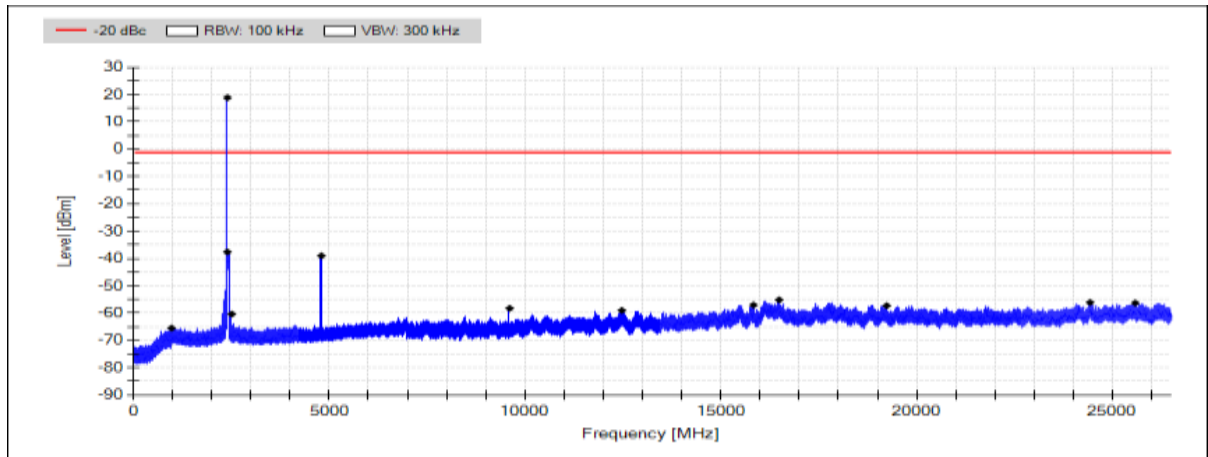


Figure 73: Conducted spurious emissions 30 - 26500 MHz channel 0 (E), power setting 200, PHY 1M coded

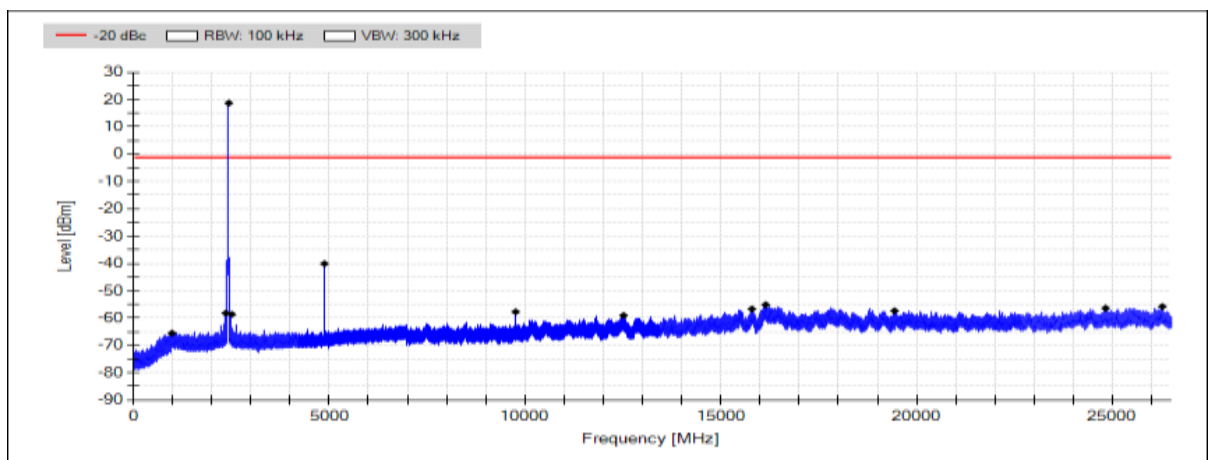


Figure 74: Conducted spurious emissions 30 - 26500 MHz channel 19 (E), power setting 200, PHY 1M coded

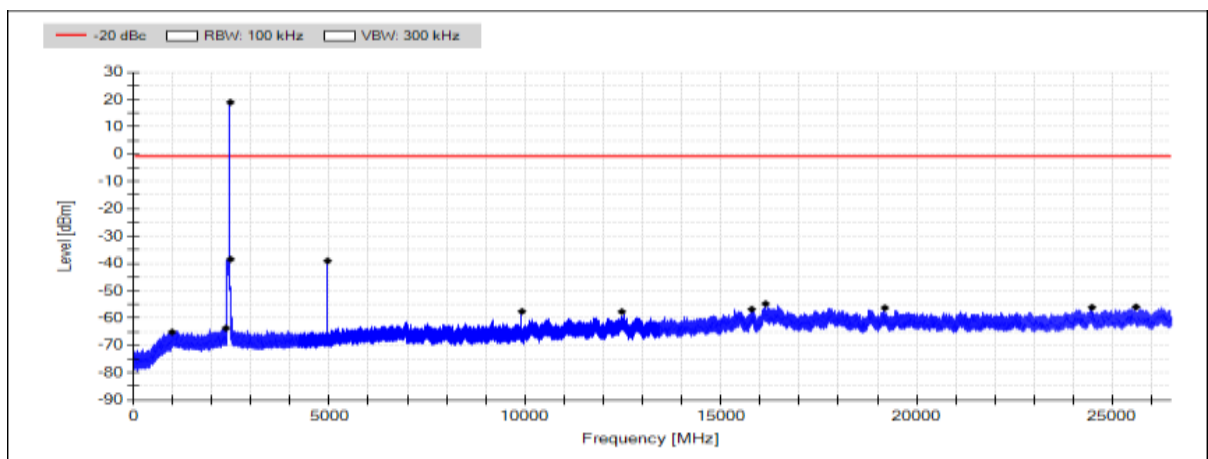


Figure 75: Conducted spurious emissions 30 - 26500 MHz channel 39 (E), power setting 200, PHY 1M coded

6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 11 September – 21 November 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 53: 6 dB bandwidth test results (A), power setting 145

Channel	6 dB BW [kHz]	Minimum limit [kHz]
0 Low	689.0	500
19 Mid	688.0	
38 High	662.0	
39 High	753.0	

Table 54: 6 dB bandwidth test results (A), power setting 200, PHY 1M coded

Channel	6 dB BW [kHz]	Minimum limit [kHz]
0 Low	656.0	500
19 Mid	659.0	
39 High	656.0	

Table 55: 6 dB bandwidth test results (E), power setting 145

Channel	6 dB BW [kHz]	Minimum limit [kHz]
0 Low	701.0	500
19 Mid	698.0	
38 High	686.0	
39 High	607.0	

Table 56: 6 dB bandwidth test results (E), power setting 200, PHY 1M coded

Channel	6 dB BW [kHz]	Minimum limit [kHz]
0 Low	659.0	500
19 Mid	729.0	
39 High	653.0	

6 dB Bandwidth of the Channel

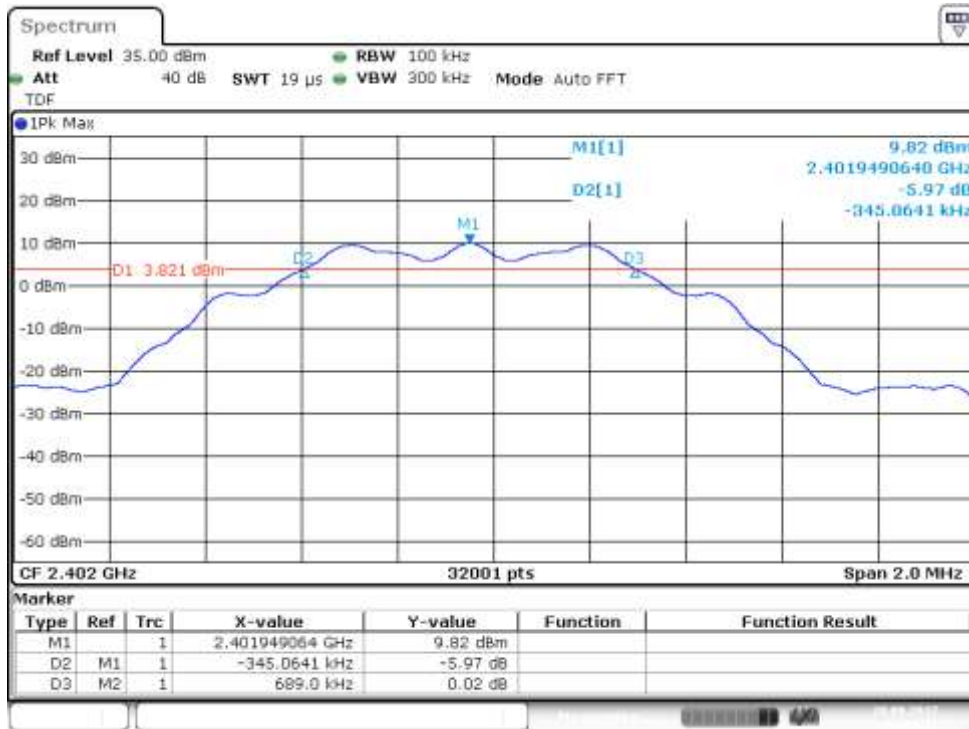


Figure 76: 6 dB bandwidth, channel 0 low (A), power setting 145

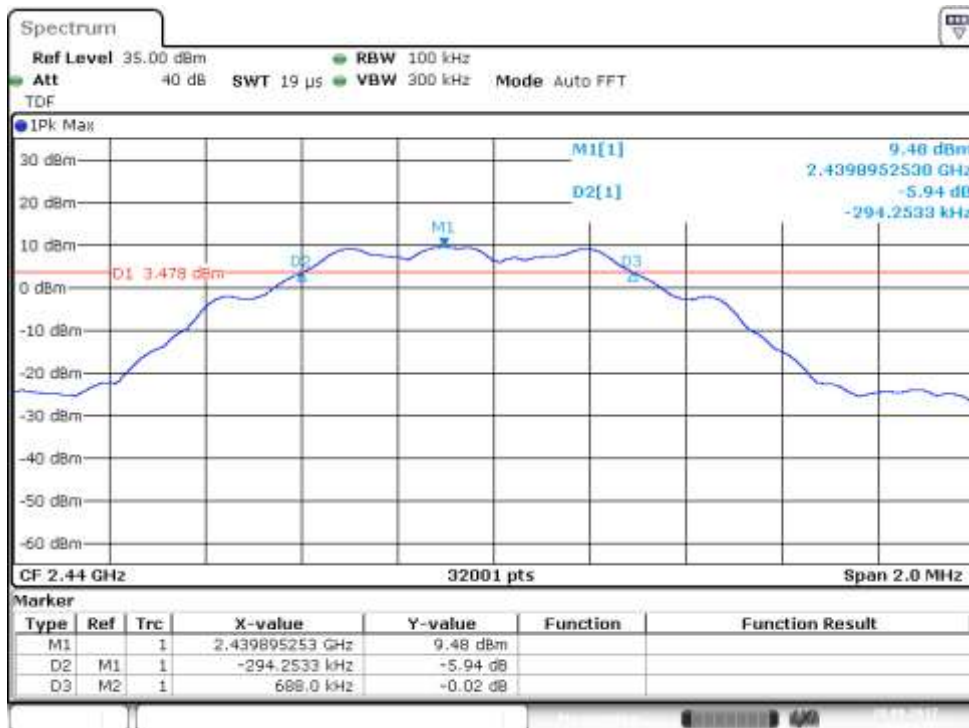


Figure 77: 6 dB bandwidth, channel 19 mid (A), power setting 145

6 dB Bandwidth of the Channel

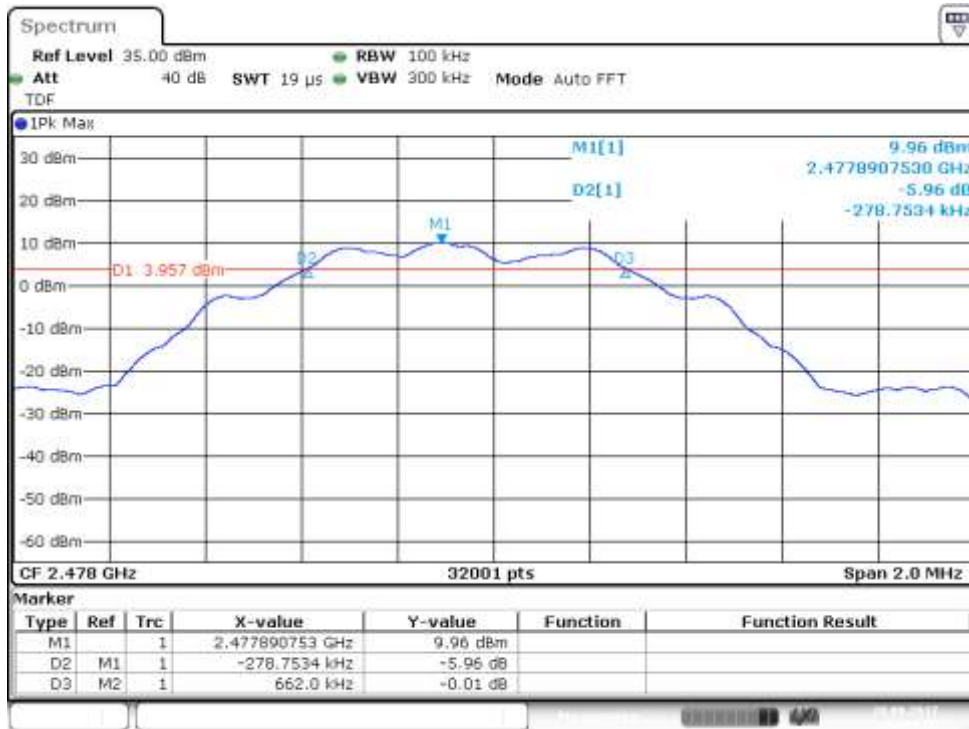


Figure 78: 6 dB bandwidth, channel 38 high (A), power setting 145

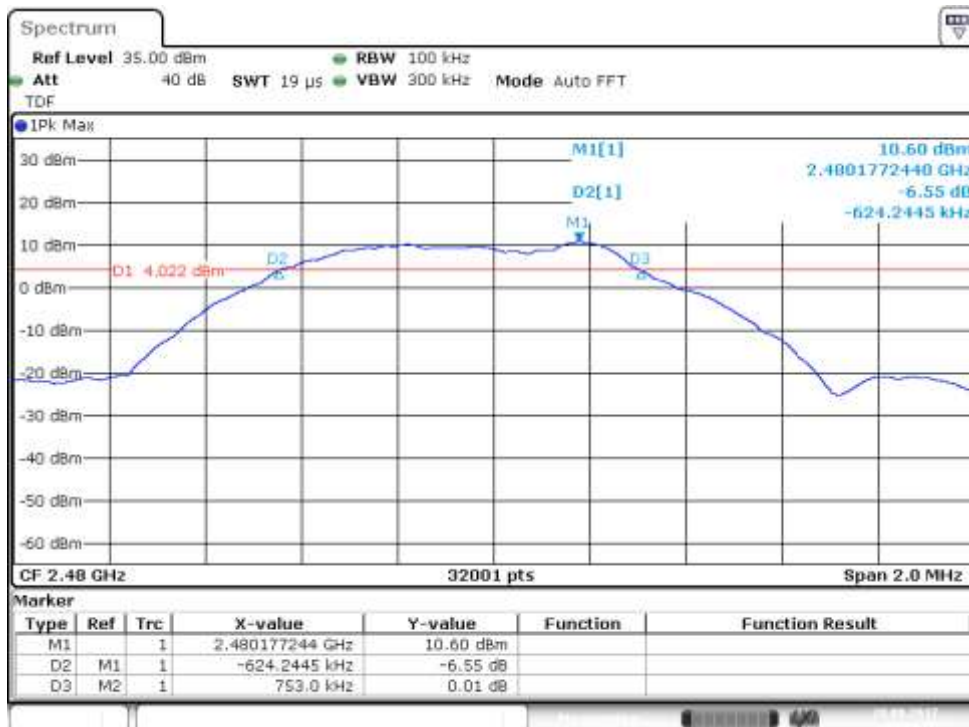


Figure 79: 6 dB bandwidth, channel 39 high (A), power setting 145

6 dB Bandwidth of the Channel

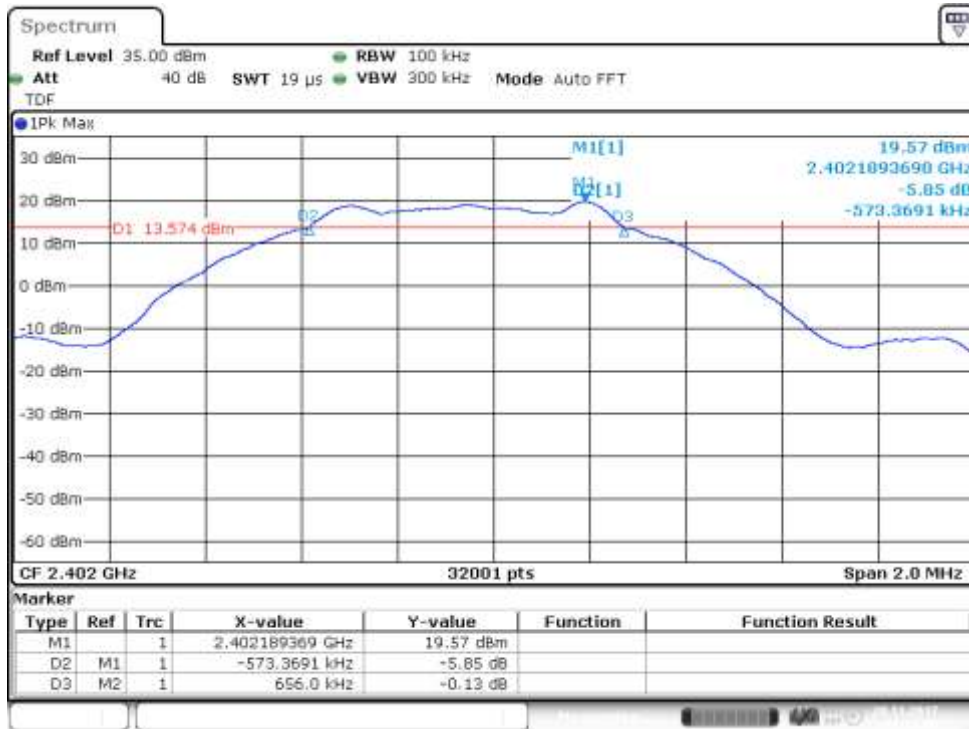


Figure 80: 6 dB bandwidth, channel 0 low (A), power setting 200, PHY 1M coded

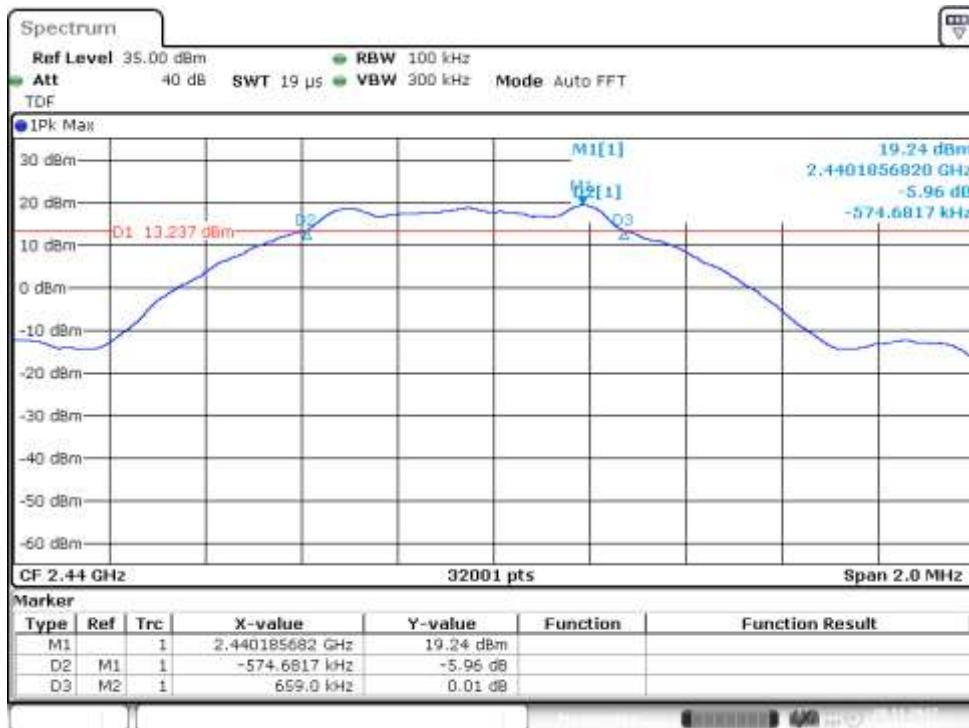


Figure 81: 6 dB bandwidth, channel 19 mid (A), power setting 200, PHY 1M coded

6 dB Bandwidth of the Channel

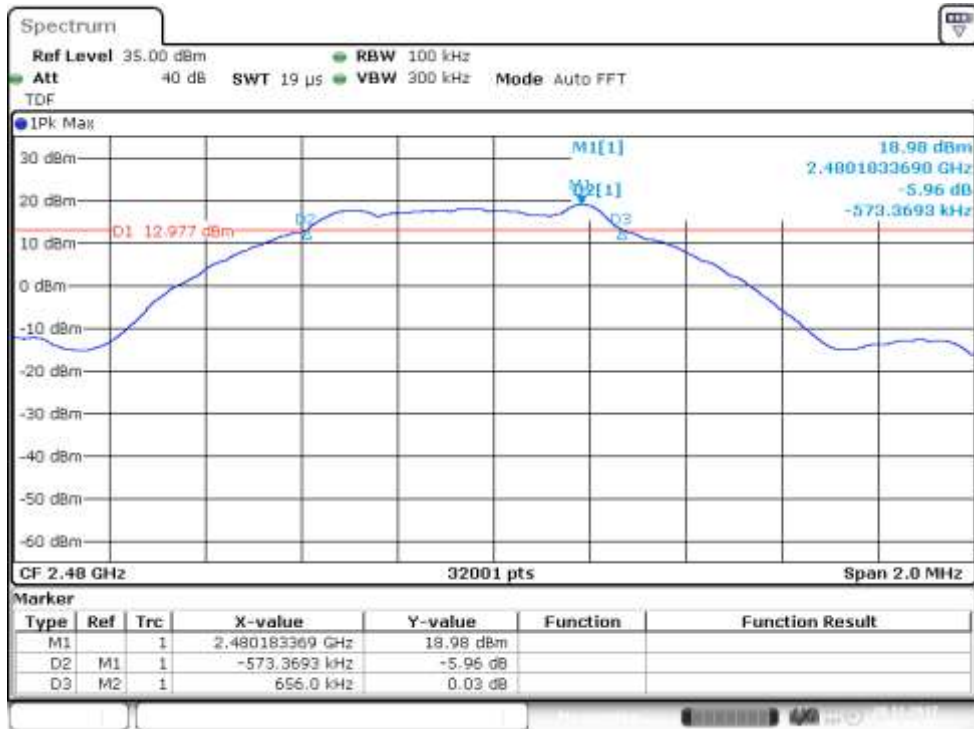


Figure 82: 6 dB bandwidth, channel 39 high (A), power setting 200, PHY 1M coded

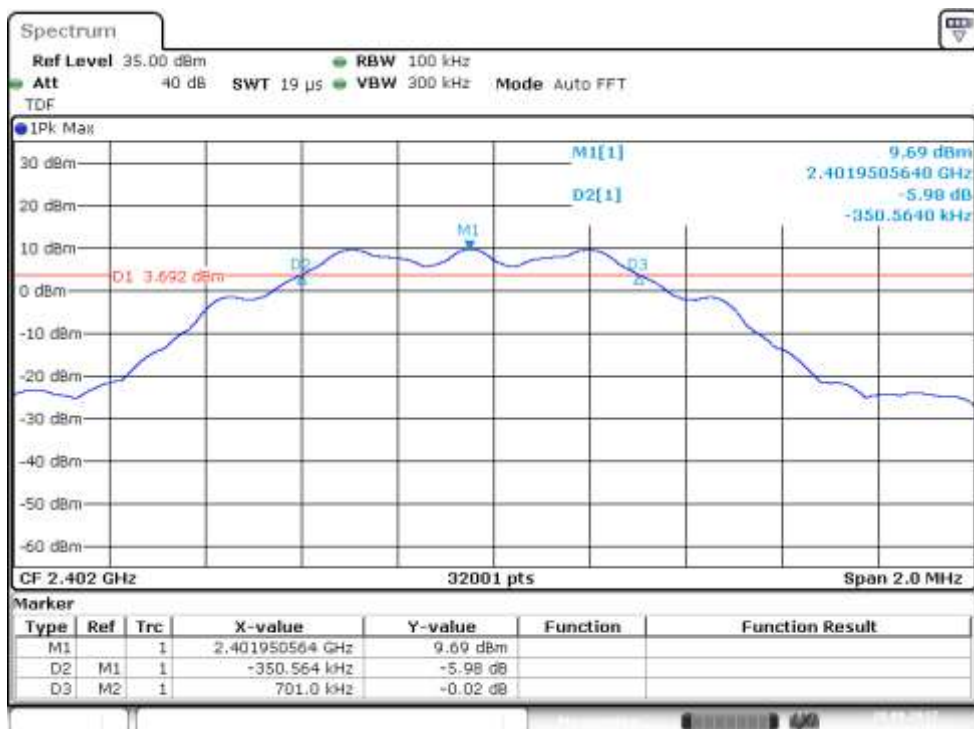


Figure 83: 6 dB bandwidth, channel 0 low (E), power setting 145

6 dB Bandwidth of the Channel

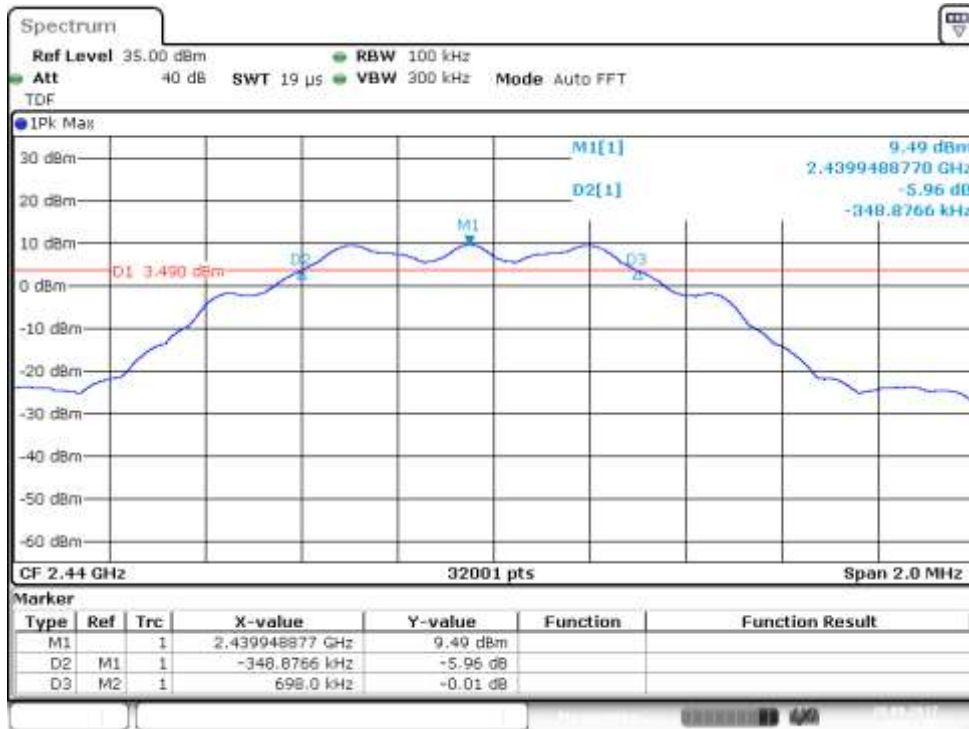


Figure 84: 6 dB bandwidth, channel 19 mid (E), power setting 145

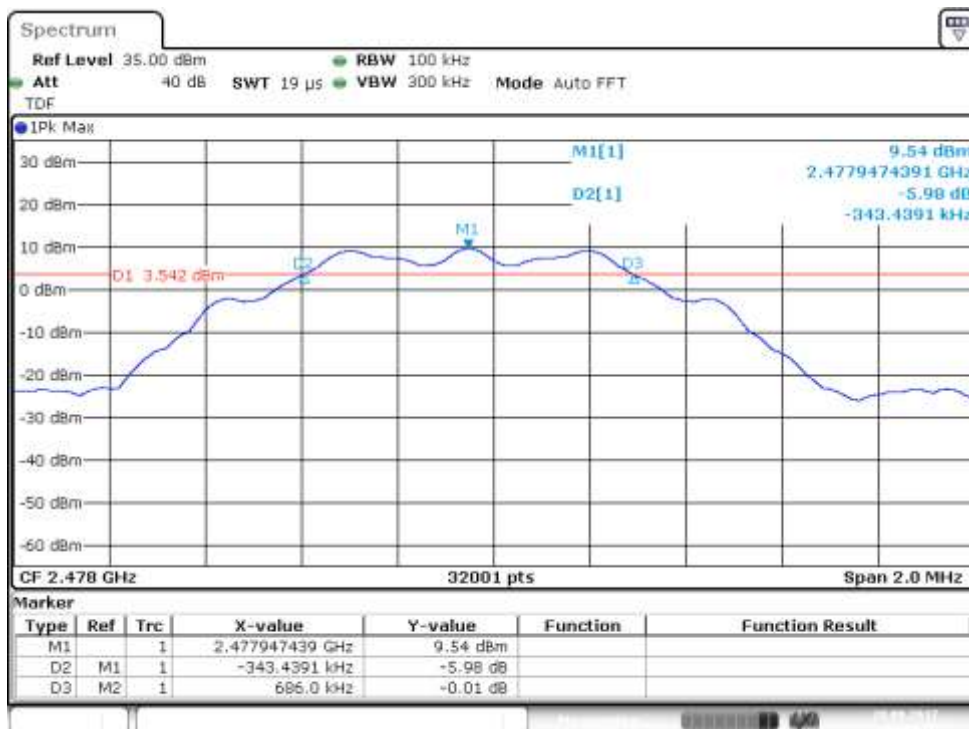


Figure 85: 6 dB bandwidth, channel 38 high (E), power setting 145

6 dB Bandwidth of the Channel

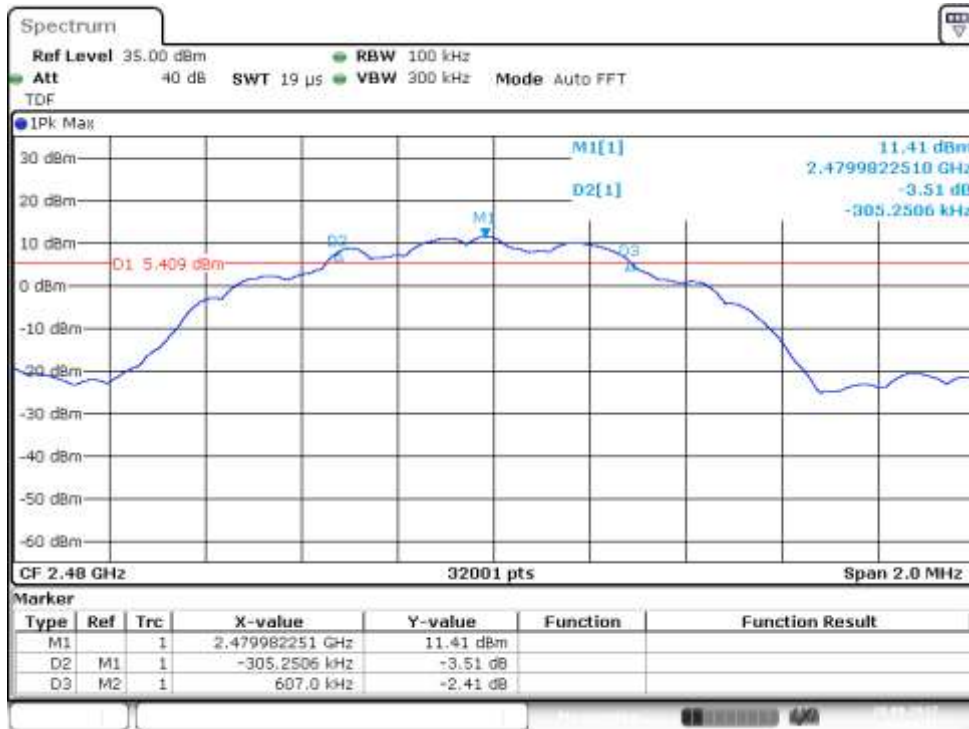


Figure 86: 6 dB bandwidth, channel 39 high (E), power setting 145

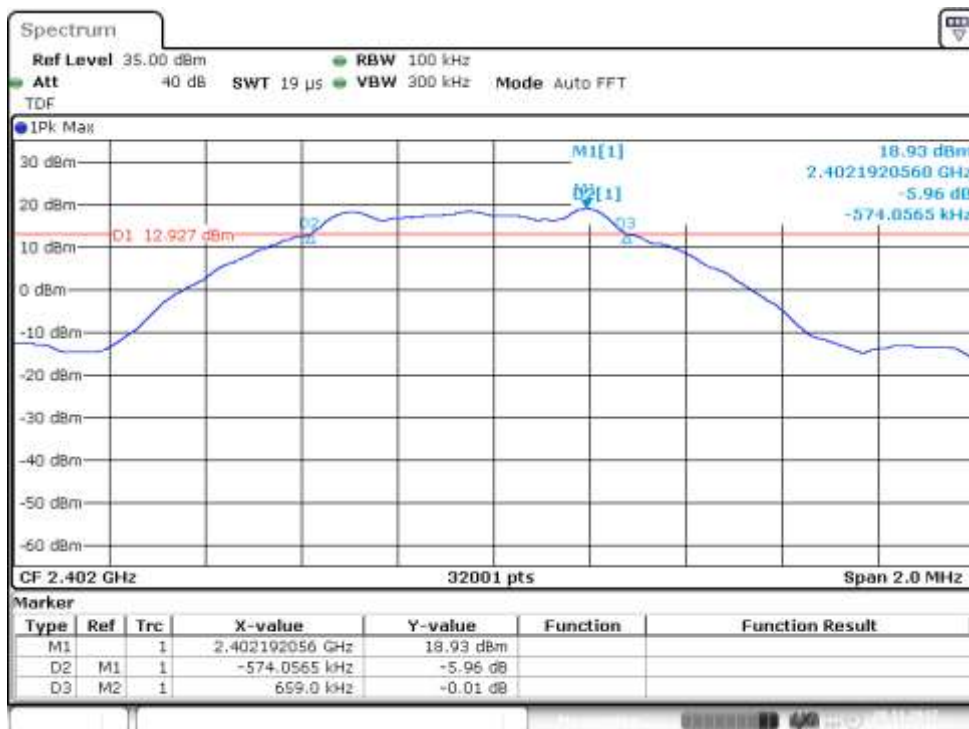


Figure 87: 6 dB bandwidth, channel 0 low (E), power setting 200, PHY 1M coded

6 dB Bandwidth of the Channel

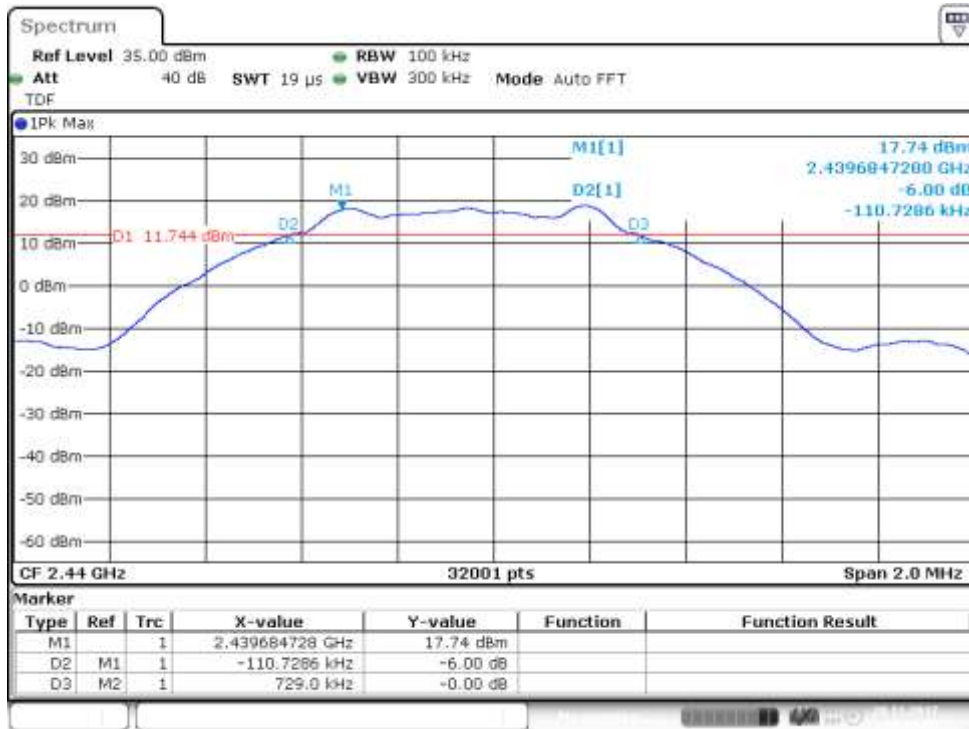


Figure 88: 6 dB bandwidth, channel 19 mid (E), power setting 200, PHY 1M coded



Figure 89: 6 dB bandwidth, channel 39 high (E), power setting 200, PHY 1M coded

Power Spectral Density

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 11 September – 21 November 2017
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 57: Power spectral density test results (A), power setting 145

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
0 Low	7.04	+8.00
19 Mid	6.63	
38 High	6.40	
39 High	-2.87	

Table 58: Power spectral density test results (A), power setting 200, PHY 1M coded

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
0 Low	3.12	+8.00
19 Mid	2.81	
39 High	2.56	

Table 59: Power spectral density test results (E), power setting 145

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
0 Low	7.14	+8.00
19 Mid	6.89	
38 High	6.64	
39 High	-1.87	

Table 60: Power spectral density test results (E), power setting 200, PHY 1M coded

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
0 Low	2.48	+8.00
19 Mid	2.23	
39 High	2.77	

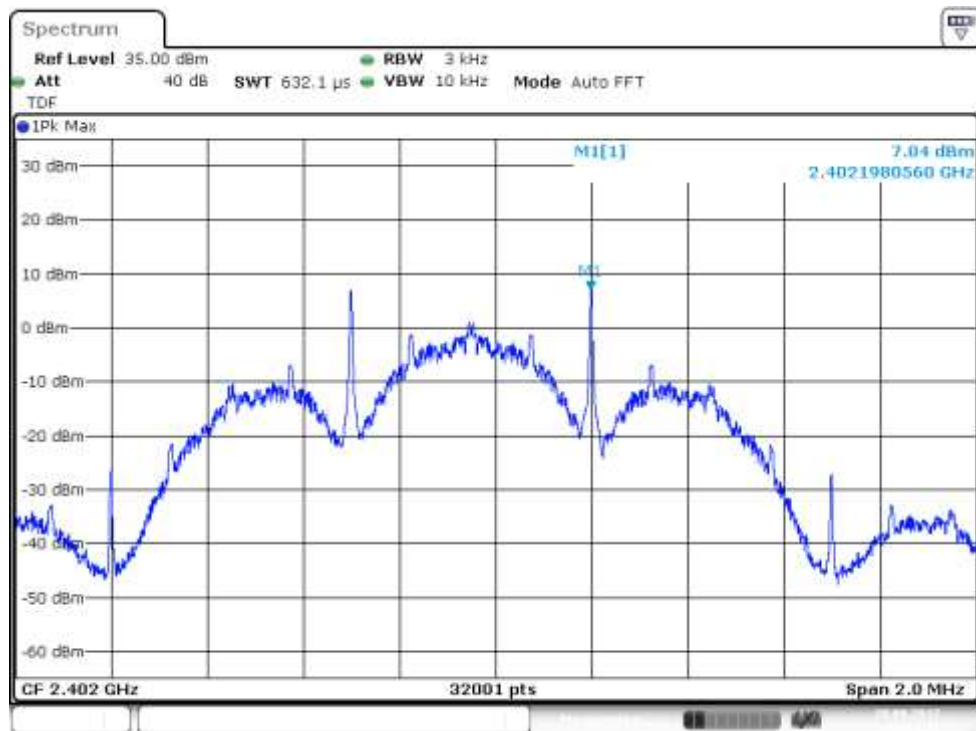


Figure 90: Power spectral density, channel 0 low (A), power setting 145

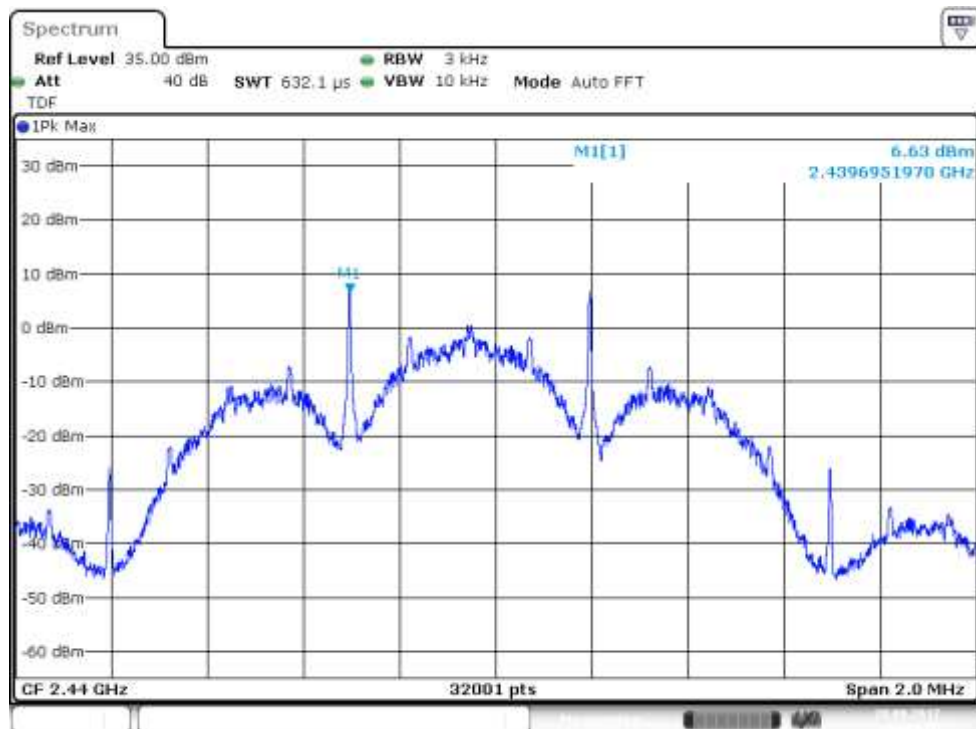


Figure 91: Power spectral density, channel 19 mid (A), power setting 145

Power Spectral Density

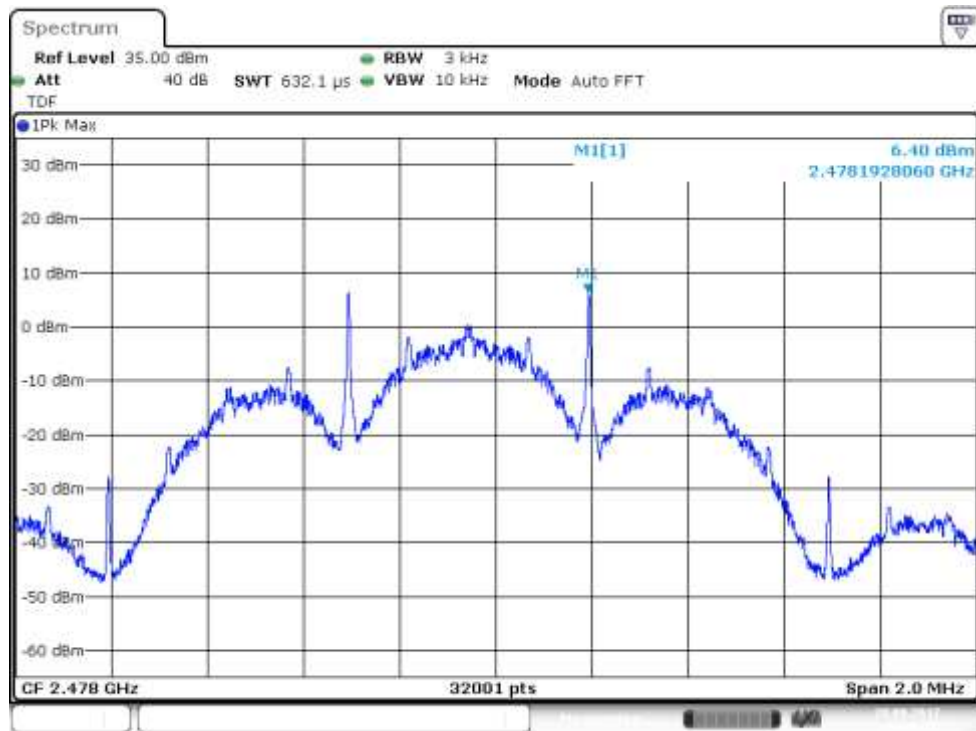


Figure 92: Power spectral density, channel 38 high (A), power setting 145

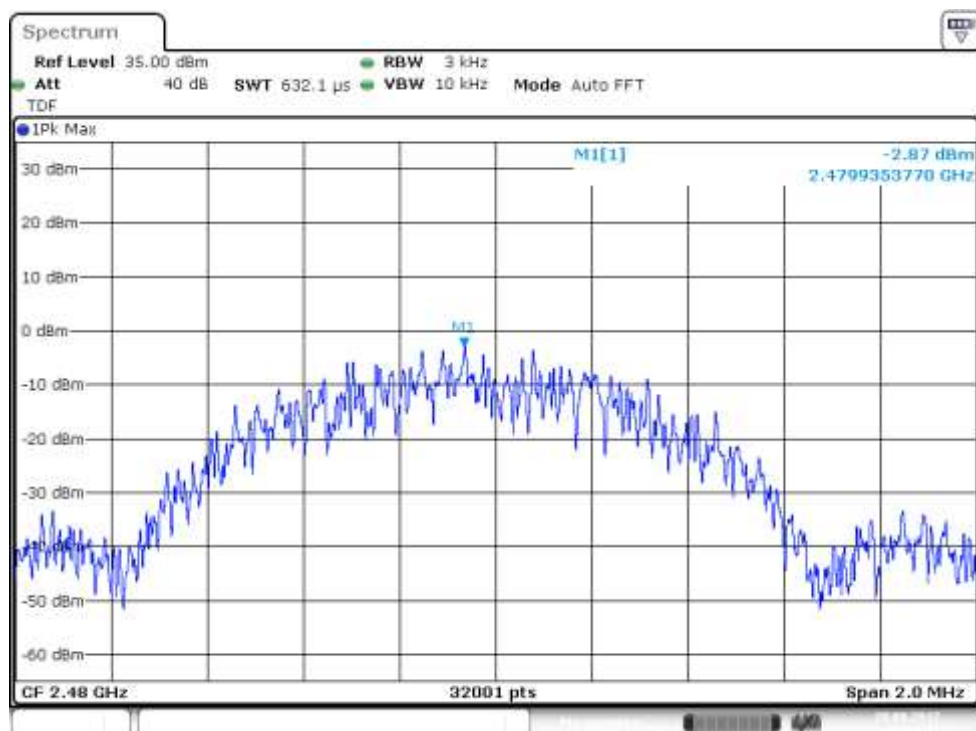


Figure 93: Power spectral density, channel 39 high (A), power setting 145

Power Spectral Density

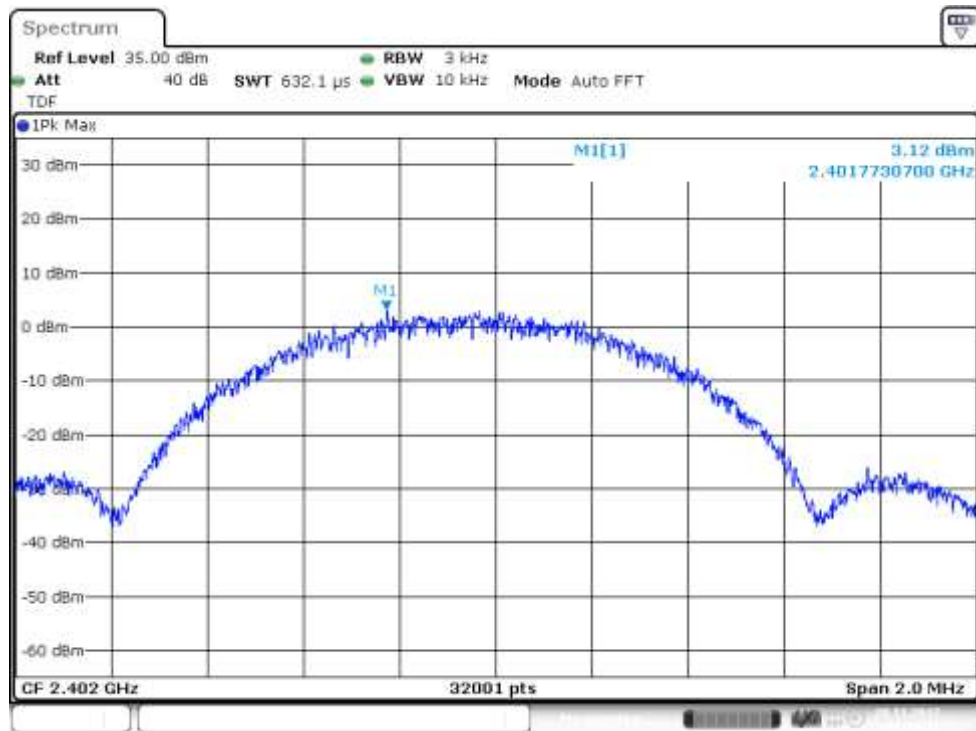


Figure 94: Power spectral density, channel 0 low (A), power setting 200, PHY 1M coded

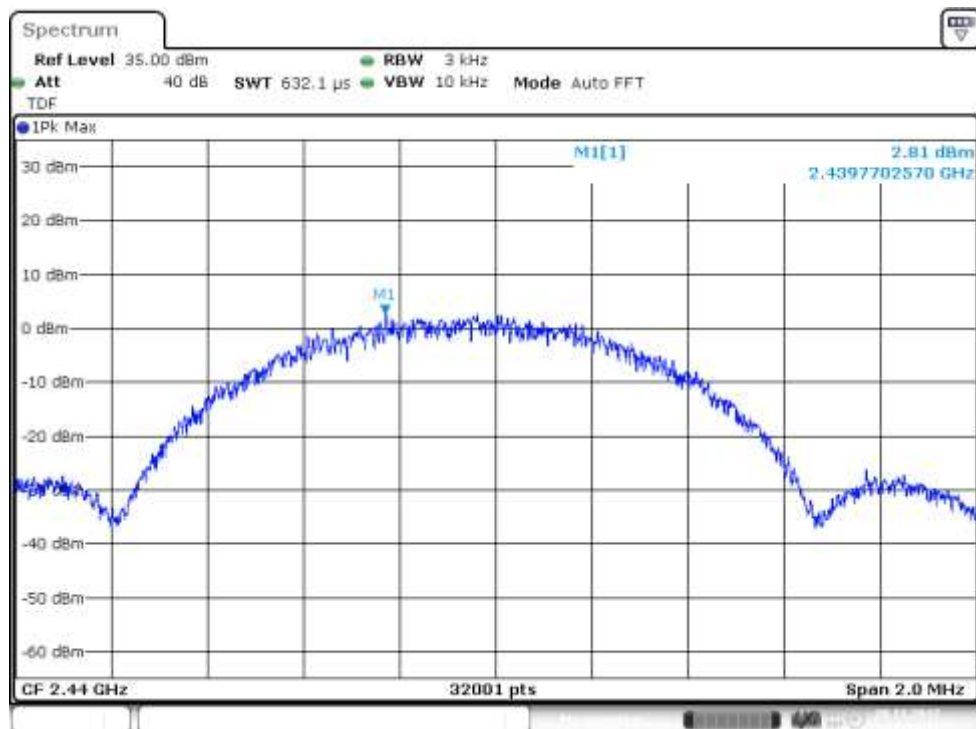


Figure 95: Power spectral density, channel 19 mid (A), power setting 200, PHY 1M coded

Power Spectral Density

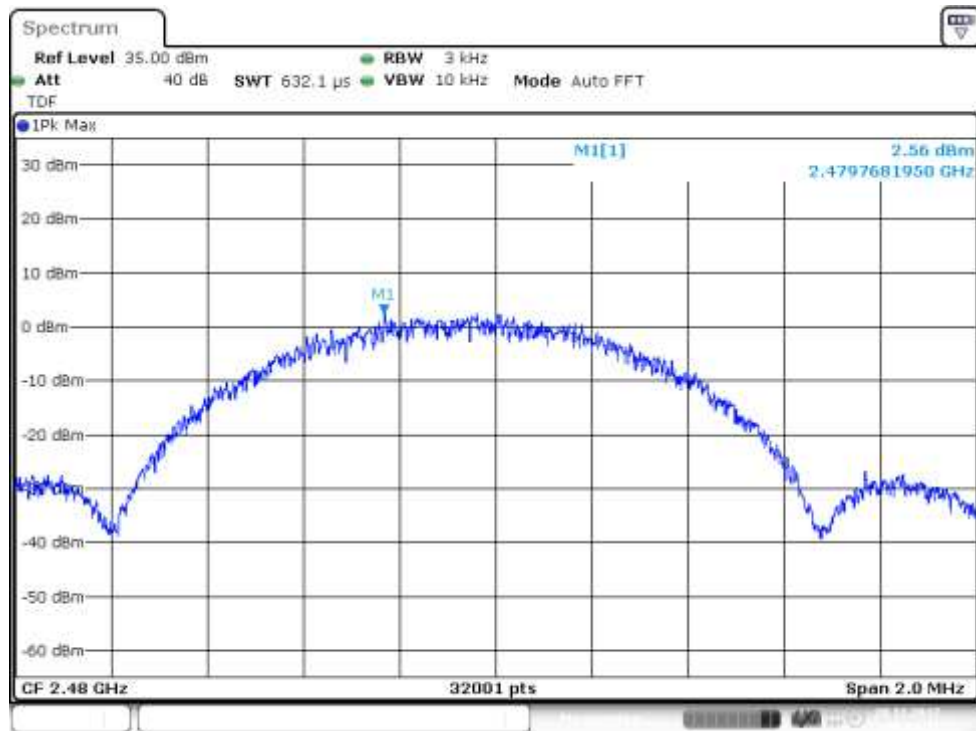


Figure 96: Power spectral density, channel 39 high (A), power setting 200, PHY 1M coded

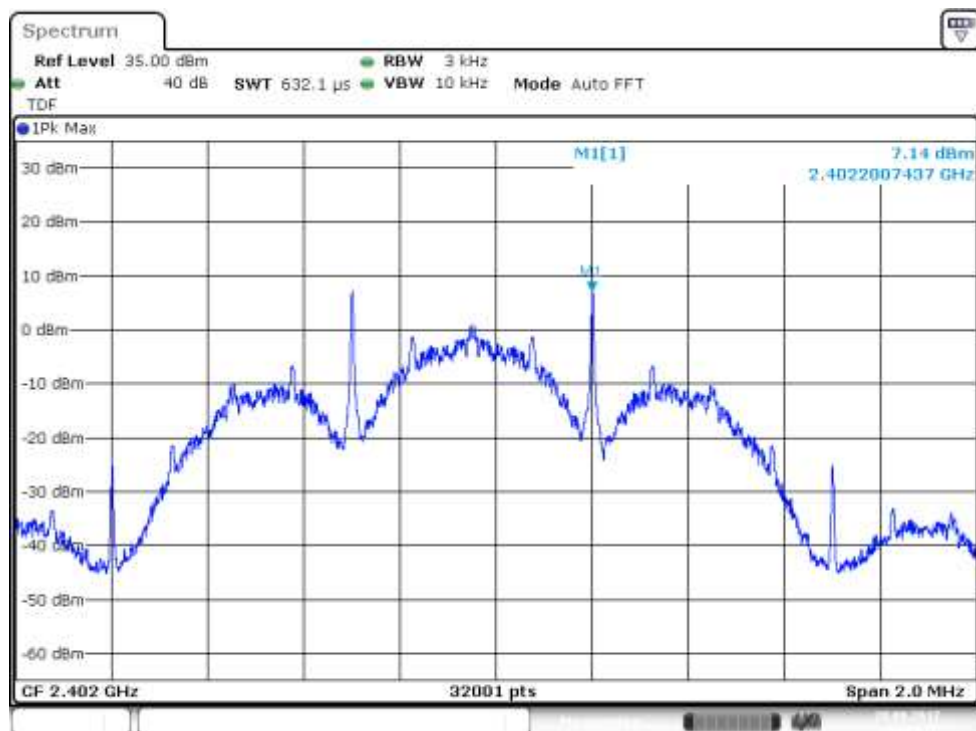


Figure 97: Power spectral density, channel 0 low (E), power setting 145

Power Spectral Density

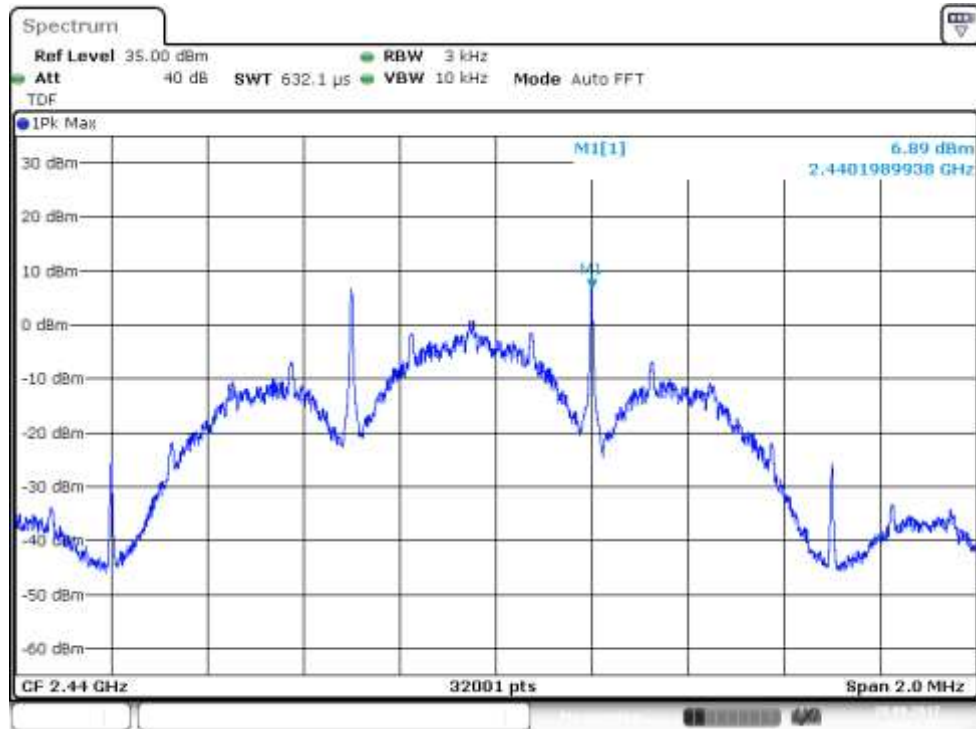


Figure 98: Power spectral density, channel 19 mid (E), power setting 145

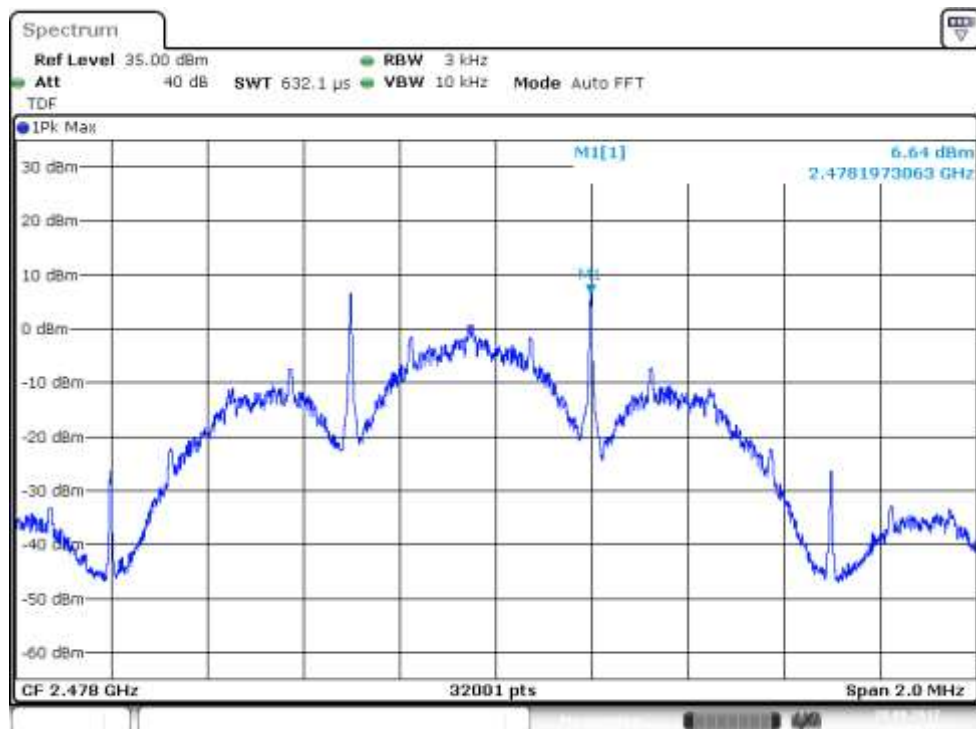


Figure 99: Power spectral density, channel 38 high (E), power setting 145

Power Spectral Density

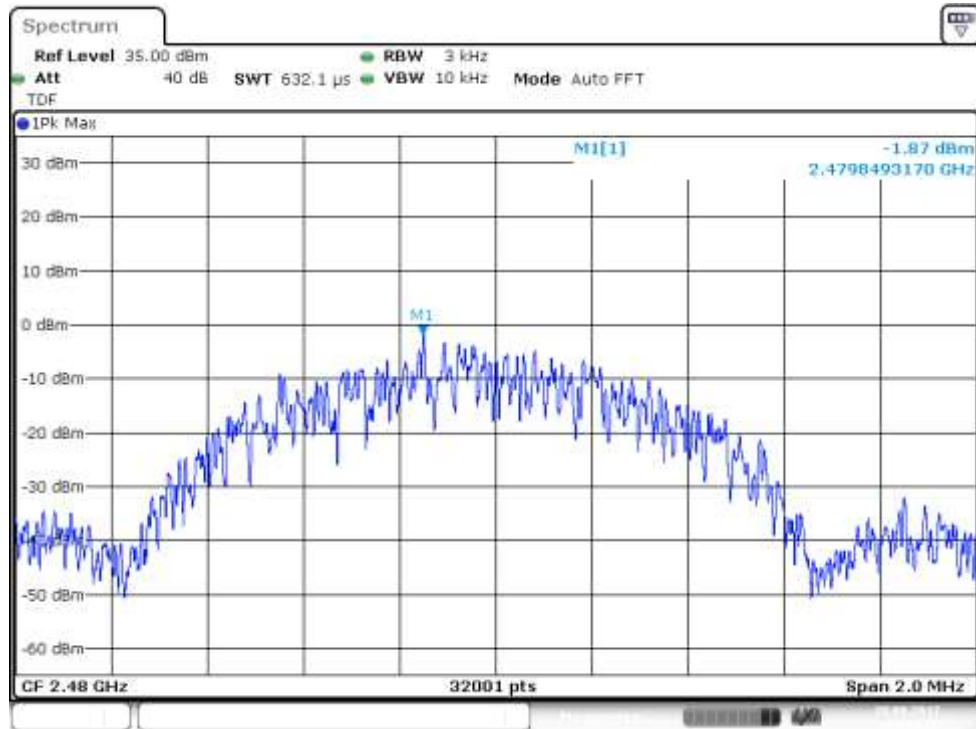


Figure 100: Power spectral density, channel 39 high (E), power setting 145

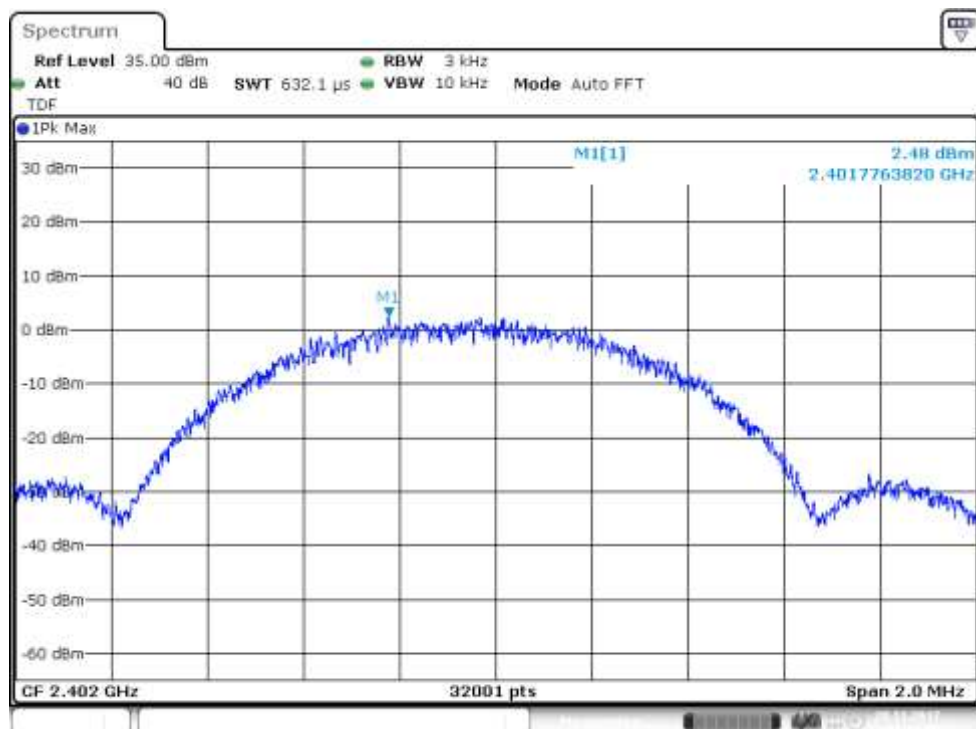


Figure 101: Power spectral density, channel 0 low (E), power setting 200, PHY 1M coded

Power Spectral Density

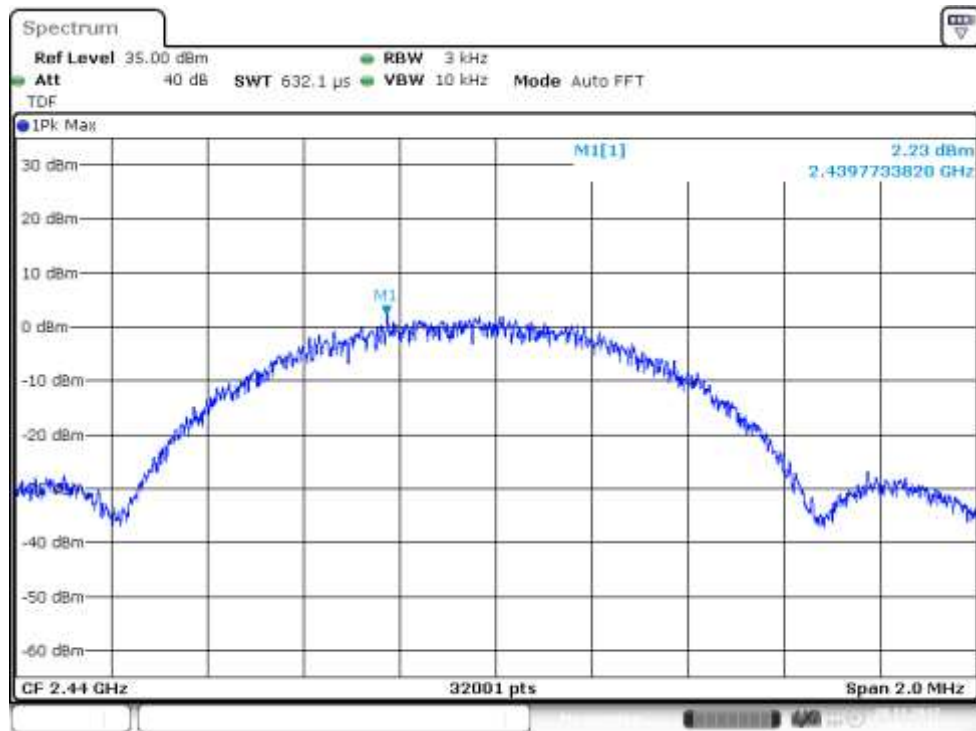


Figure 102: Power spectral density, channel 19 mid (E), power setting 200, PHY 1M coded

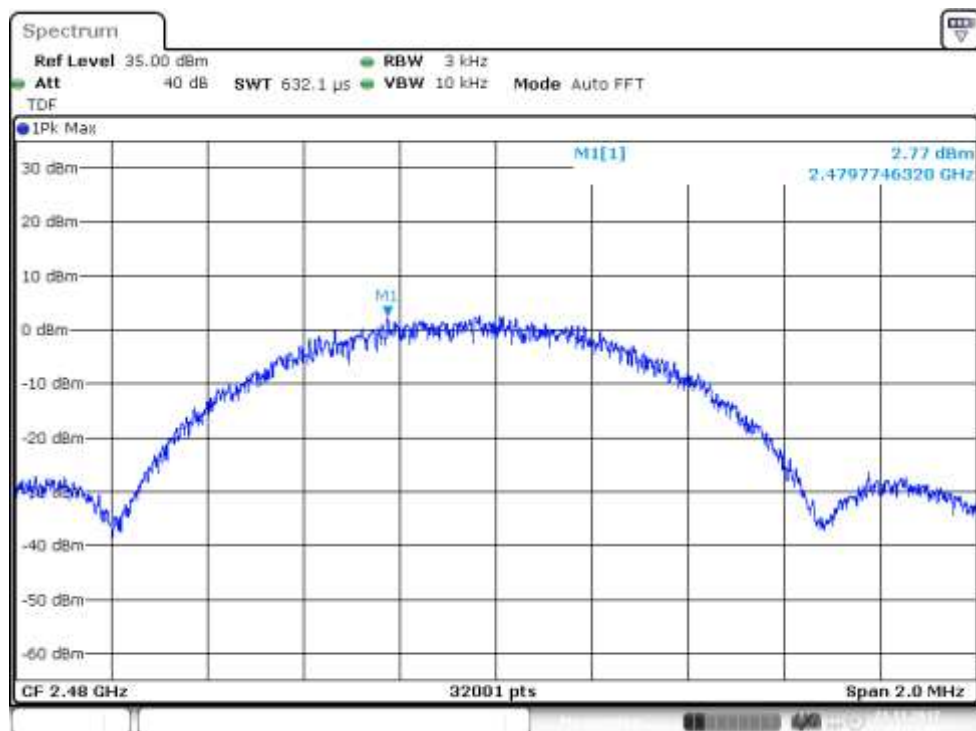


Figure 103: Power spectral density, channel 39 high (E), power setting 200, PHY 1M coded

99% Occupied Bandwidth

Standard: RSS-GEN (2014)
Tested by: MIH, JAT
Date: 11 September – 31 January 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

RSS-GEN 6.6

Results:

Table 61: 99% occupied bandwidth test results (EUT 2), power setting 145

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.047967251	PASS
19 Mid	-	1.060716853	PASS
38 High	-	1.060591857	PASS
39 High	-	1.057341958	PASS

Table 62: 99% occupied bandwidth test results (EUT 2), power setting 200, PHY 1M coded

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.039842505	PASS
19 Mid	-	1.041342458	PASS
39 High	-	1.043467392	PASS



Figure 104: 99% OBW, Channel 0 low (EUT 2), power setting 145



Figure 105: 99% OBW, Channel 19 mid (EUT 2), power setting 145



Figure 106: 99% OBW, Channel 38 high (EUT 2), power setting 145



Figure 107: 99% OBW, Channel 39 high (EUT 2), power setting 145

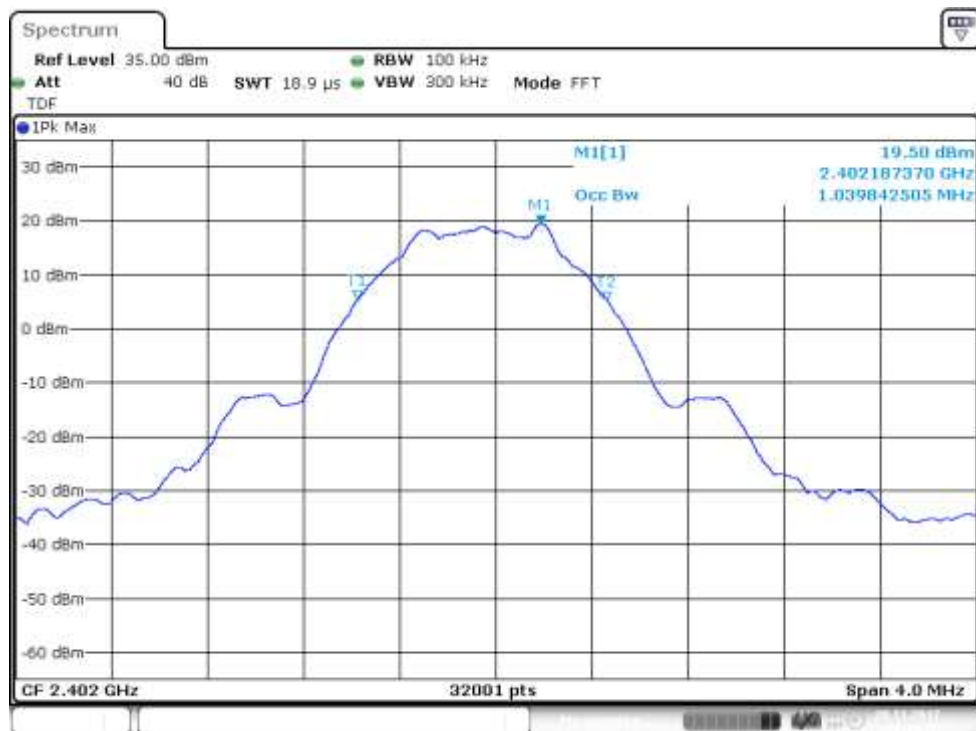


Figure 108: 99% OBW, Channel 0 low (EUT 2), power setting 200, PHY 1M coded

99 % Occupied Bandwidth

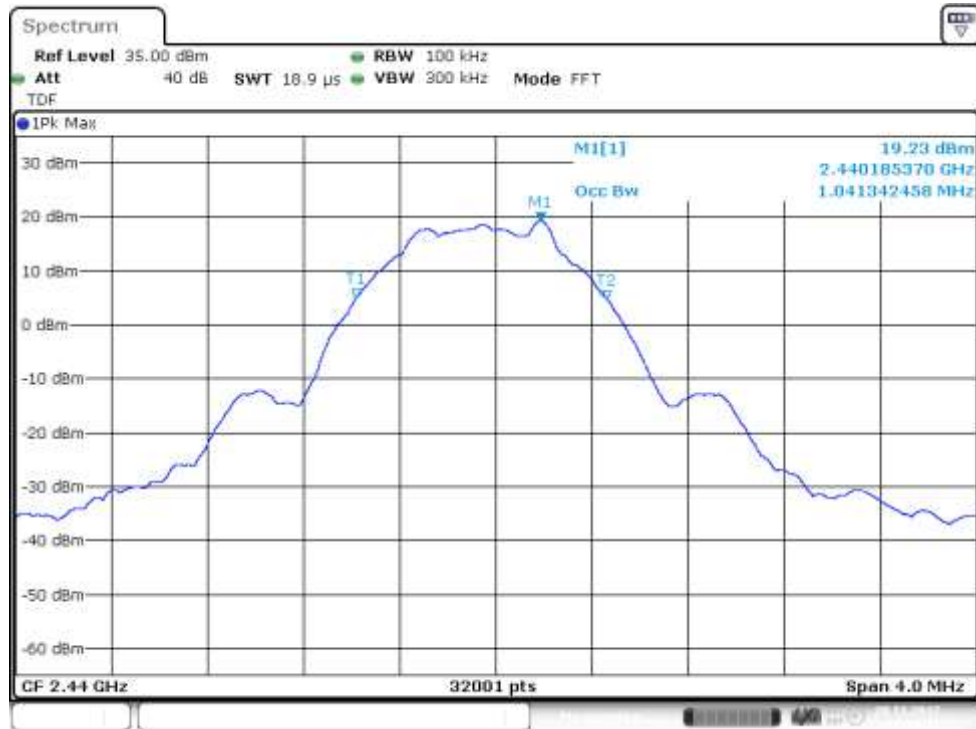


Figure 109: 99% OBW, Channel 19 mid (EUT 2), power setting 200, PHY 1M coded

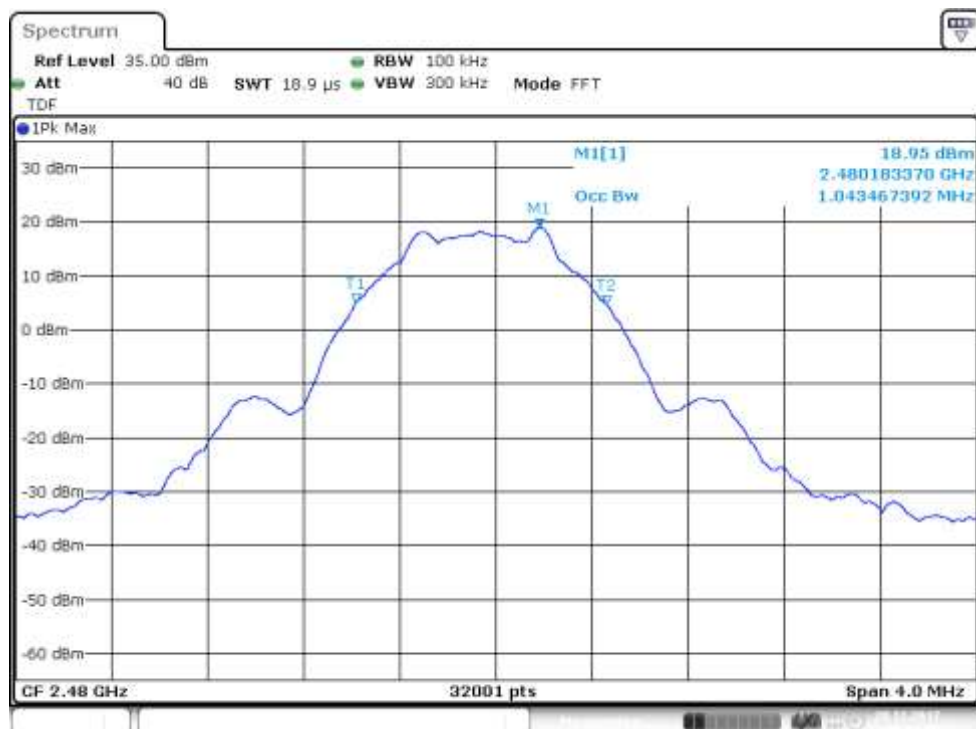


Figure 110: 99% OBW, Channel 39 high (EUT 2), power setting 200, PHY 1M coded

Table 63: 99% occupied bandwidth test results (EUT 3), power setting 145

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.064466735	PASS
19 Mid	-	1.063466767	PASS
38 High	-	1.049967187	PASS
39 High	-	1.051967126	PASS

Table 64: 99% occupied bandwidth test results (EUT 3), power setting 200, PHY 1M coded

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.040217493	PASS
19 Mid	-	1.041467454	PASS
39 High	-	1.043217399	PASS



Figure 111: 99% OBW, Channel 0 low (EUT 3), power setting 145



Figure 112: 99% OBW, Channel 19 mid (EUT 3), power setting 145



Figure 113: 99% OBW, Channel 38 high (EUT 3), power setting 145



Figure 114: 99% OBW, Channel 39 high (EUT 3), power setting 145



Figure 115: 99% OBW, Channel 0 low (EUT 3), power setting 200, PHY 1M coded

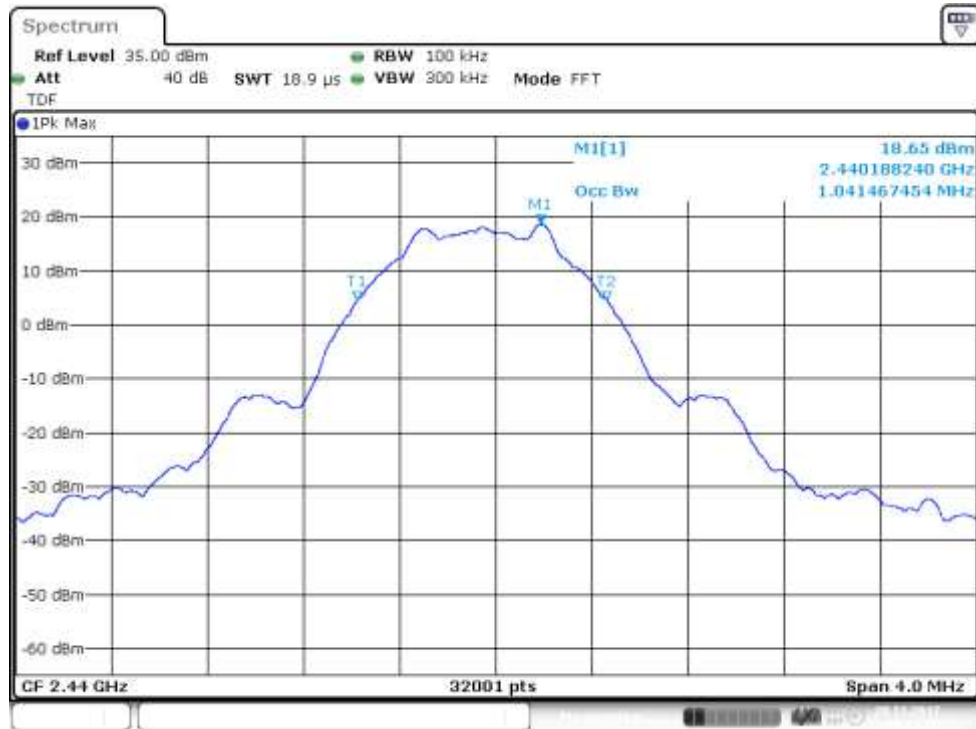


Figure 116: 99% OBW, Channel 19 mid (EUT 3), power setting 200, PHY 1M coded

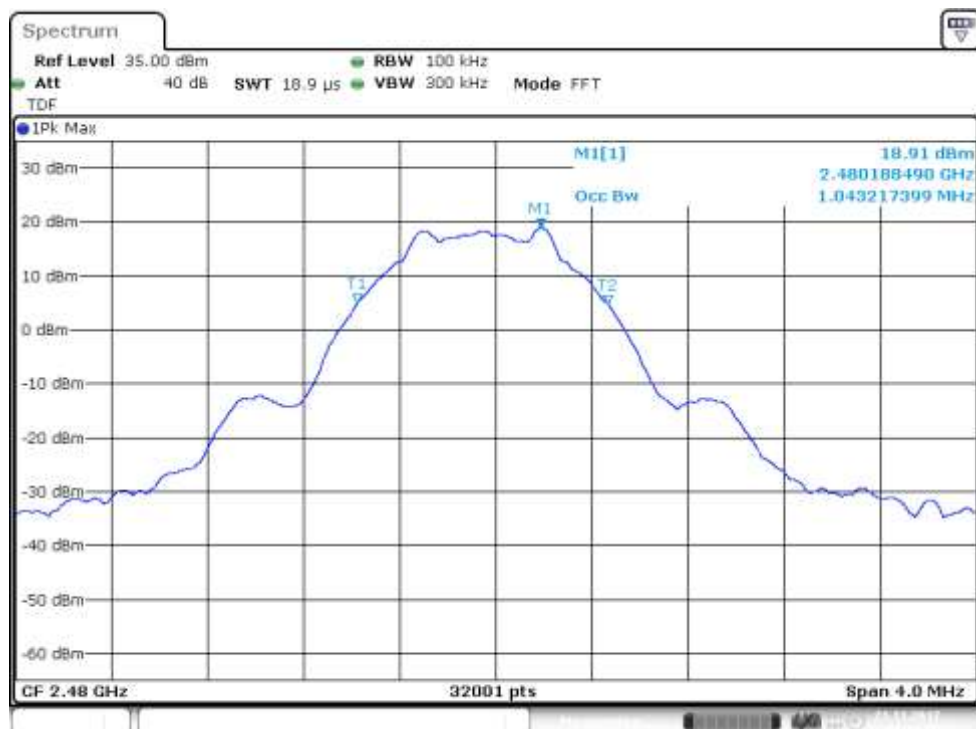


Figure 117: 99% OBW, Channel 39 high (EUT 3), power setting 200, PHY 1M coded

Table 65: 99% occupied bandwidth test results (EUT 4), power setting 104

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.039717509	PASS
19 Mid	-	1.049842192	PASS
39 High	-	1.052342114	PASS


Figure 118: 99% OBW, Channel 0 low (EUT 4), power setting 104

Figure 119: 99% OBW, Channel 19 mid (EUT 4), power setting 104



Figure 120: 99% OBW, Channel 39 high (EUT 4), power setting 104

Table 66: 99% occupied bandwidth test results (EUT 5), power setting 104

Channel	Limit	99 % BW [MHz]	Result
0 Low	-	1.053092091	PASS
19 Mid	-	1.055092028	PASS
39 High	-	1.050842161	PASS

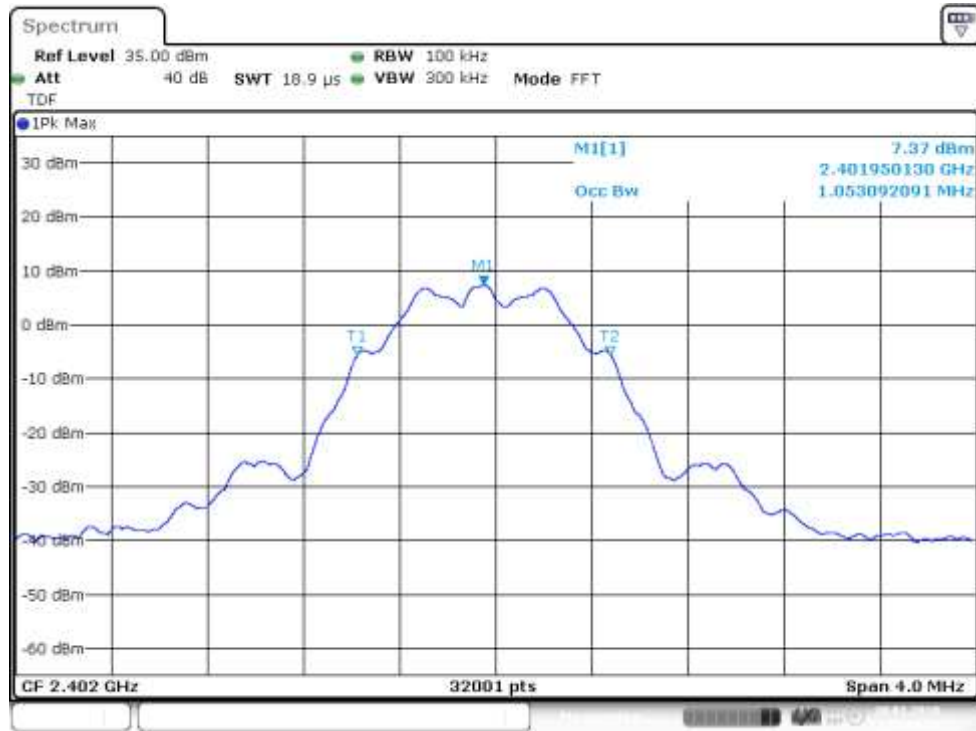

Figure 121: 99% OBW, Channel 0 low (EUT 5), power setting 104

Figure 122: 99% OBW, Channel 19 mid (EUT 5), power setting 104



Figure 123: 99% OBW, Channel 39 high (EUT 5), power setting 104

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