

Test Report



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

Equipment Under Test: Pill reminder device with Bluetooth low energy

Model: PSEN1B01

Manufacturer: Popit Oy
Metsänneidonkuja 6
FI-02130 ESPOO
FINLAND

Customer: Popit Oy
Metsänneidonkuja 6
FI-02130 ESPOO
FINLAND

FCC Rule Part: 15.247: 2017
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 5, 2017)

Date: 2 May 2018

Issued by: 
Mikko Halonen
Testing Engineer

Date: 2 May 2018

Checked by: 
Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

Trade mark: Popit
Model: PSEN1B01
Type: Pill reminder device with Bluetooth Low Energy
Serial no: -
FCC ID: 2APJS-PS1TYP
IC: 23793-PS1TYP

Description of the EUT

The EUT is a pill reminder device with Bluetooth Low Energy capabilities. The EUT uses replaceable CR2032 battery as a power source and it does not have any I/O ports for connecting ancillary equipment.

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: -8.37 dBm (Peak)
Modulation: GFSK
Antenna gain: 2 dBi

Power Supply

Operating voltage range: 2.2 - 3.3 VDC (tested with 3.0 VDC from laboratory power supply)

Normally the EUT is powered from CR2032 coin battery.

Mechanical Size of the EUT

Height: 13 mm

Width: 30 mm

Length: 45 mm

Samples

Two samples were used in tests, samples are listed in table below.

EUT	Description
1	Normal sample
2	Modified sample, Short RF cable added for conducted tests

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	N/A ¹⁾
§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

1) The EUT cannot be connected to public network, no input/output ports.

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 maximum transmit power was used in all tests.

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

Channel Low: 2402 MHz
Channel Mid: 2428 MHz
Channel High: 2480 MHz

Test Facility

Testing Laboratory / address: FCC registration number: 904175	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
Test Site:	☐ Kara 10, ISED Canada registration number: 8708A-1 ☒ Kara 5, ISED Canada registration number: 8708A-2 ☐ Laru 3 ☐ Kallio 10

Maximum Peak Conducted Output Power

TEST RESULTS

Maximum Peak Conducted Output Power

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 27 April 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 1: Maximum conducted output power

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	-8.37	30	38.37	PASS
Mid	-8.72	30	38.72	PASS
High	-9.51	30	39.51	PASS

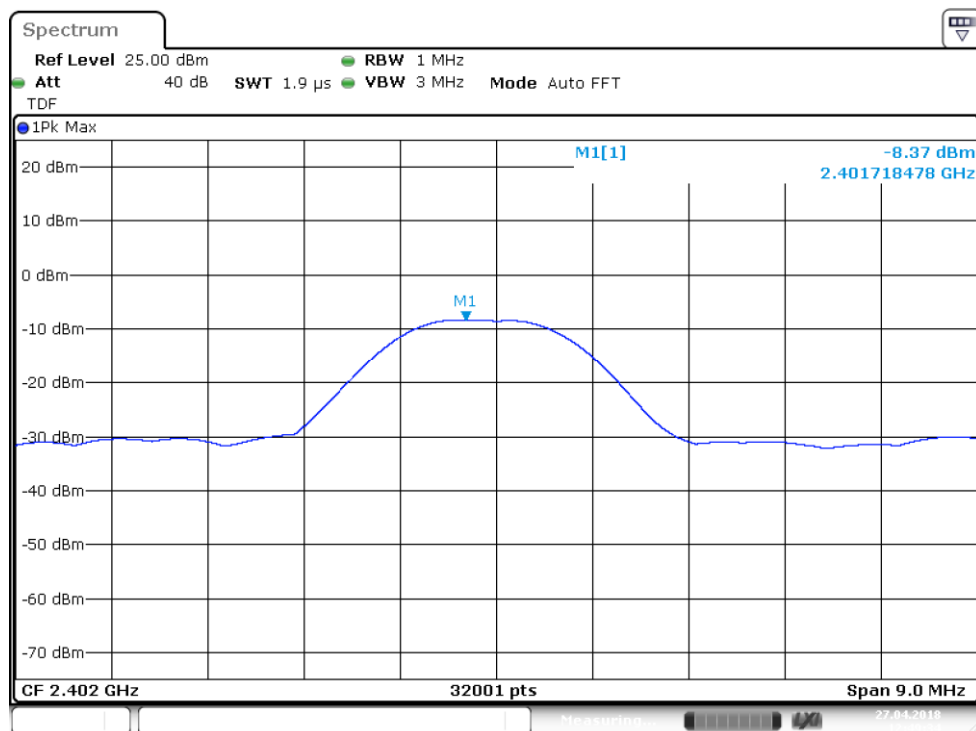


Figure 1: Conducted power, Channel low

Maximum Peak Conducted Output Power

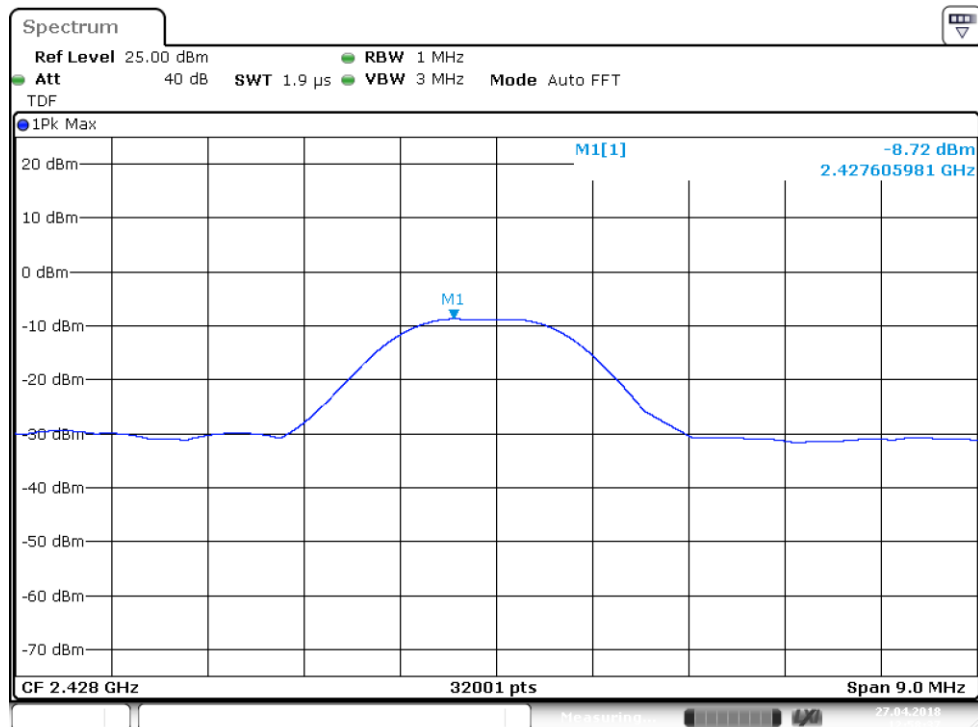


Figure 2: Conducted power, Channel mid

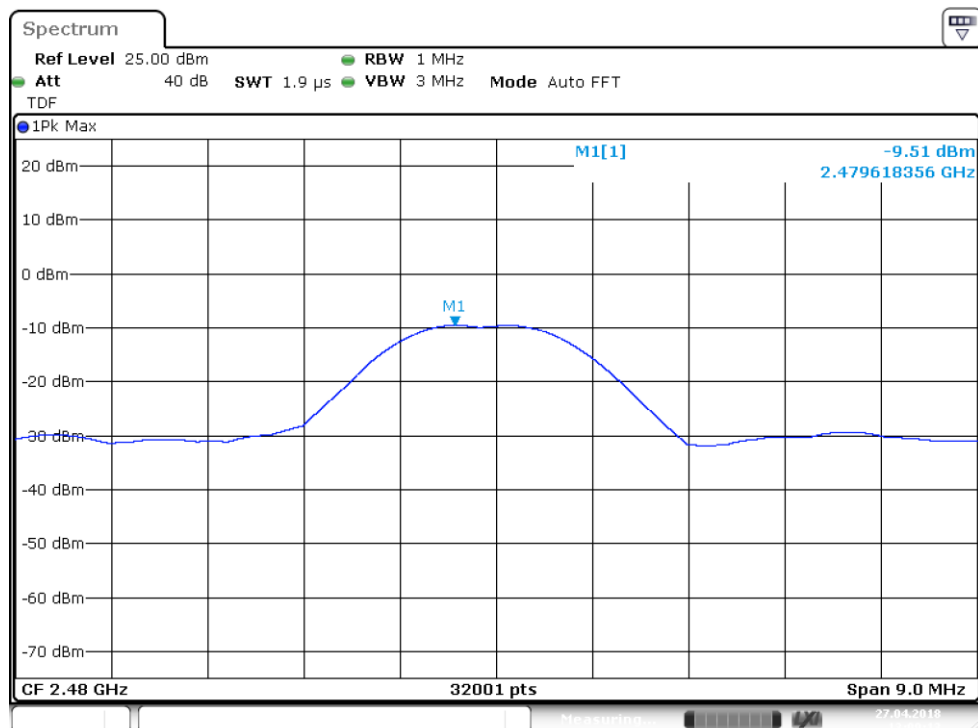


Figure 3: Conducted power, Channel high

Transmitter Radiated Spurious Emissions 9 kHz - 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: MIH / JSU
Date: 25 – 30 April 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH
Measurement uncertainty: ± 4.51 dB Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a)
RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables). Peak values of emissions below 1000 MHz measured for reference as well as transmitter fundamental.

Measurements were performed for both antenna variants.

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

Transmitter Radiated Spurious Emissions

Low channel

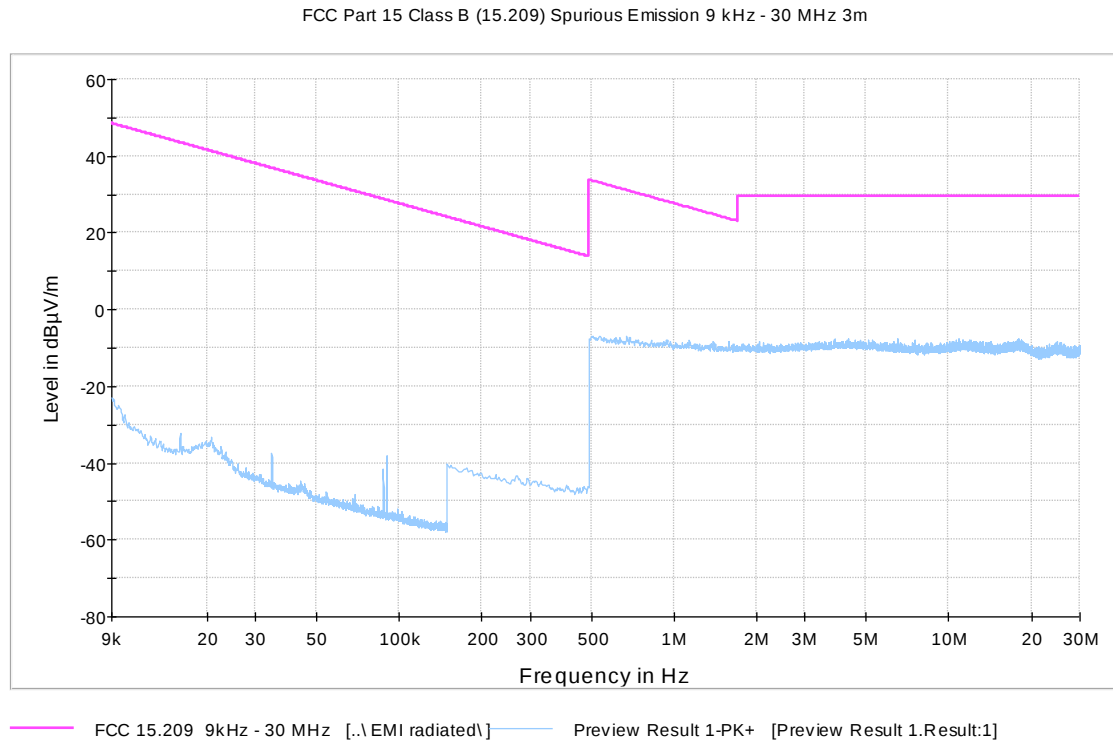


Figure 4: Channel low 9 kHz – 30 MHz

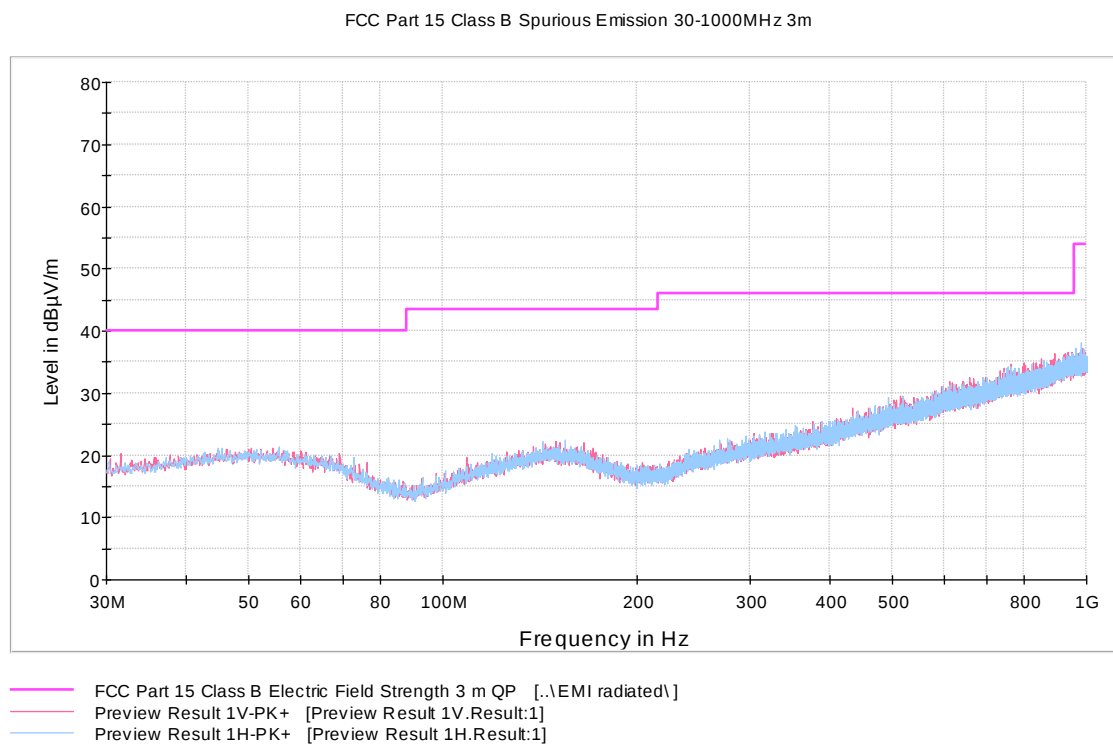


Figure 5: Channel low 30 MHz – 1000 MHz

Transmitter Radiated Spurious Emissions

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

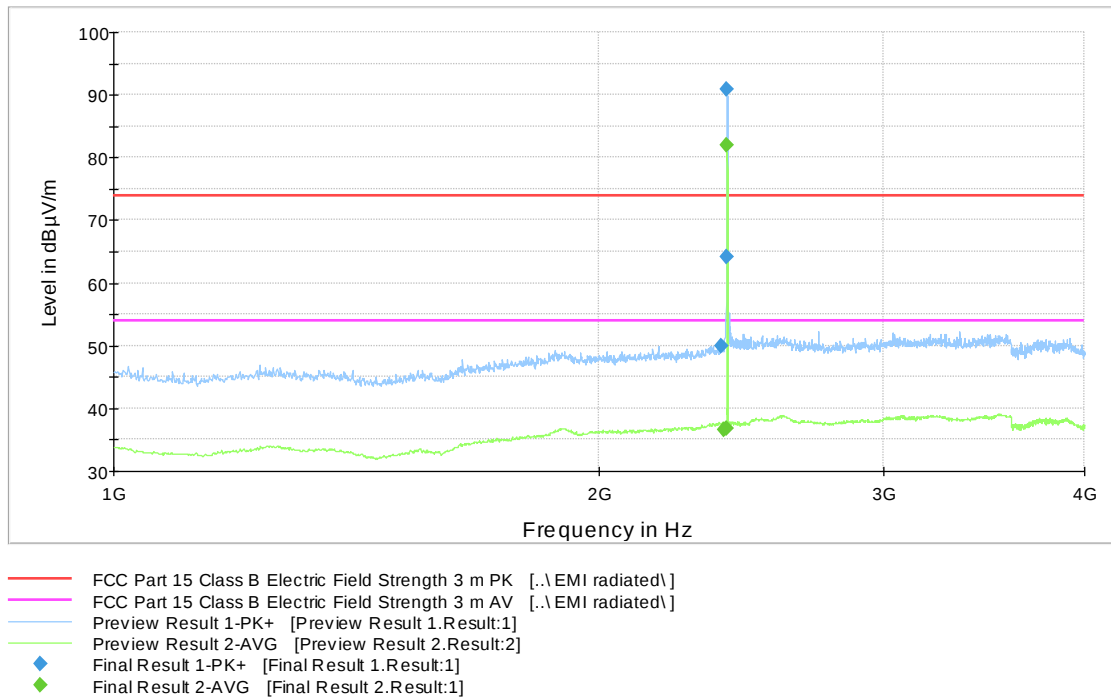


Figure 6: Channel low 1 GHz – 4 GHz

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

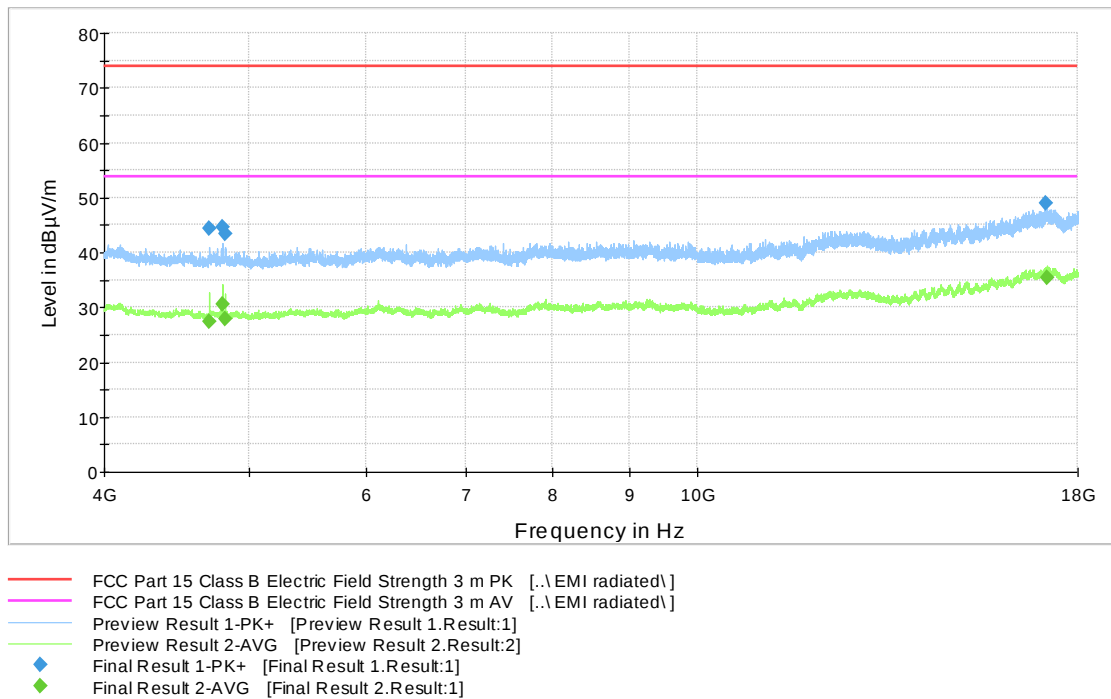


Figure 7: Channel low 4 GHz – 18 GHz

Transmitter Radiated Spurious Emissions

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

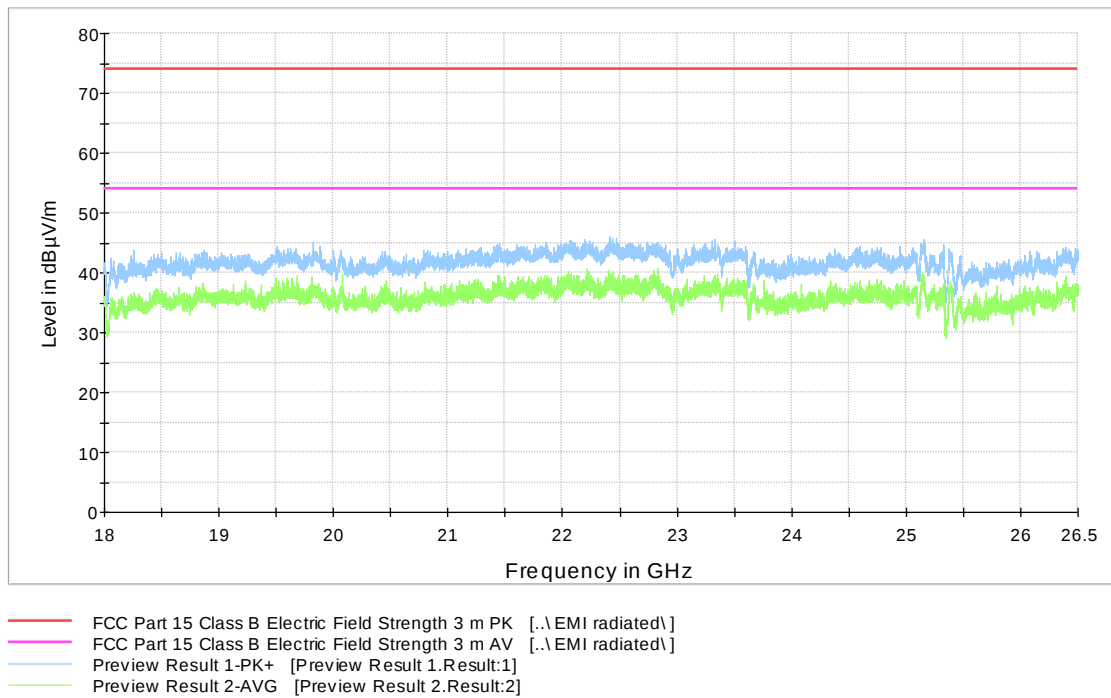


Figure 8: Channel low 18 GHz – 26.5 GHz

Table 2: Peak results, channel low

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2380.000000	50.0	1000.0	1000.000	150.0	V	195.0	14.5	23.9	73.9
2400.000000	64.2	1000.0	1000.000	305.0	H	46.0	14.7	9.7	73.9
4705.700000	44.4	1000.0	1000.000	150.0	V	214.0	8.4	29.5	73.9
4804.200000	44.6	1000.0	1000.000	150.0	V	190.0	8.4	29.3	73.9
4824.400000	43.5	1000.0	1000.000	150.0	V	161.0	8.4	30.4	73.9
17125.80000	49.0	1000.0	1000.000	150.0	V	269.0	28.9	24.9	73.9

Table 3: Average results, channel low

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2389.600000	36.5	1000.0	1000.000	400.0	V	275.0	14.6	17.4	53.9
2399.600000	36.8	1000.0	1000.000	240.0	V	96.0	14.7	17.1	53.9
4705.300000	27.3	1000.0	1000.000	150.0	V	211.0	8.4	26.6	53.9
4803.300000	30.6	1000.0	1000.000	150.0	V	174.0	8.4	23.3	53.9
4822.200000	27.8	1000.0	1000.000	350.0	V	62.0	8.4	26.1	53.9
17174.60000	35.4	1000.0	1000.000	400.0	V	101.0	28.8	18.5	53.9

Transmitter Radiated Spurious Emissions

Middle channel

FCC Part 15 Class B (15.209) Spurious Emission 9 kHz - 30 MHz 3m

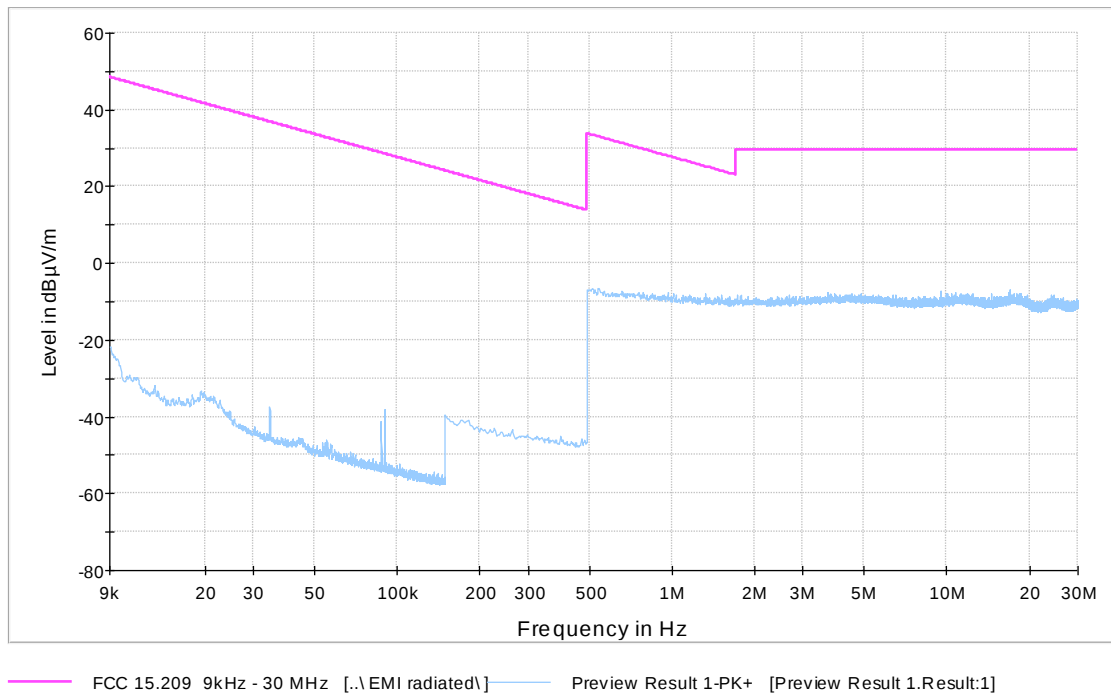


Figure 9: Channel mid 9 kHz – 30 MHz

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

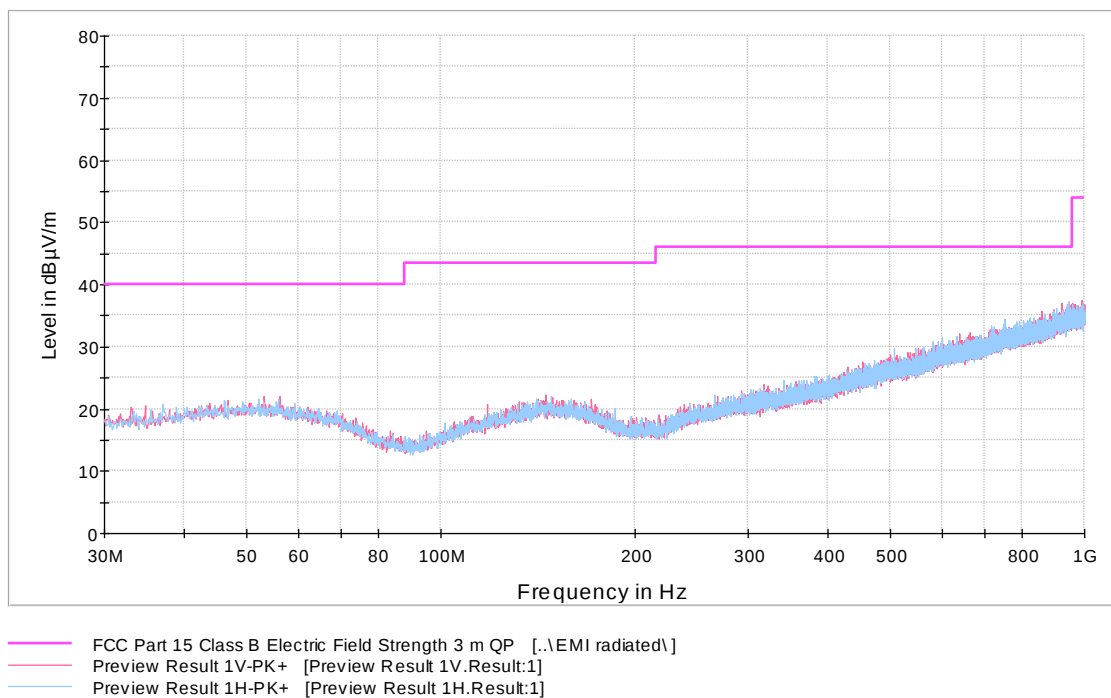


Figure 10: Channel mid 30 MHz – 1000 MHz

Transmitter Radiated Spurious Emissions

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

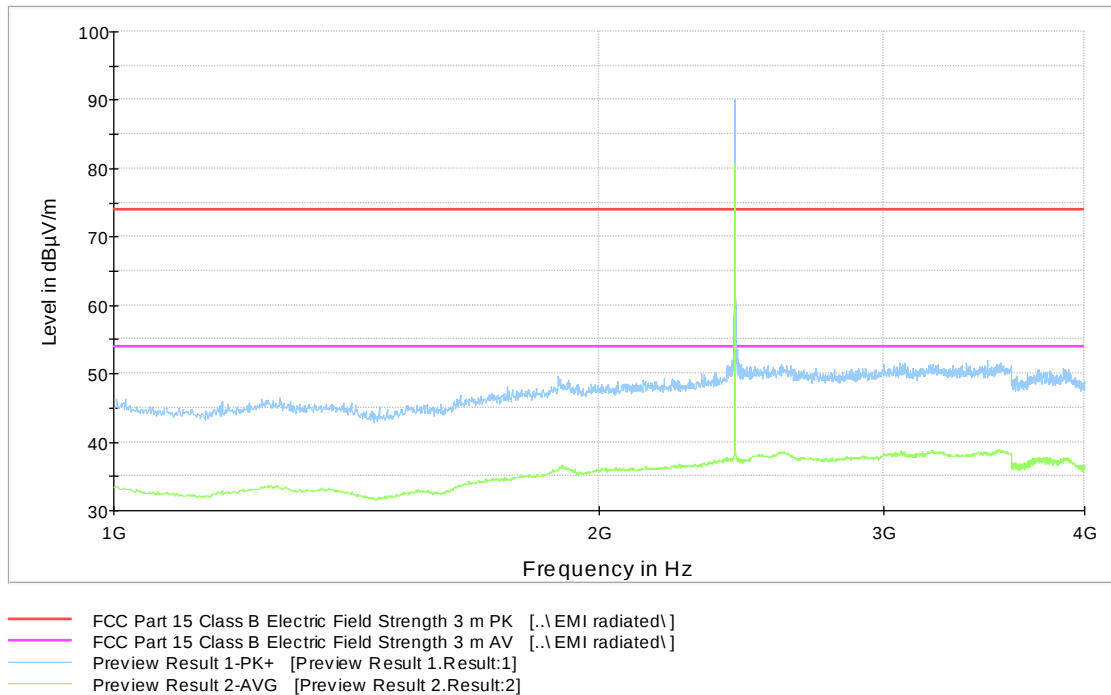


Figure 11: Channel mid 1 GHz – 4 GHz

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

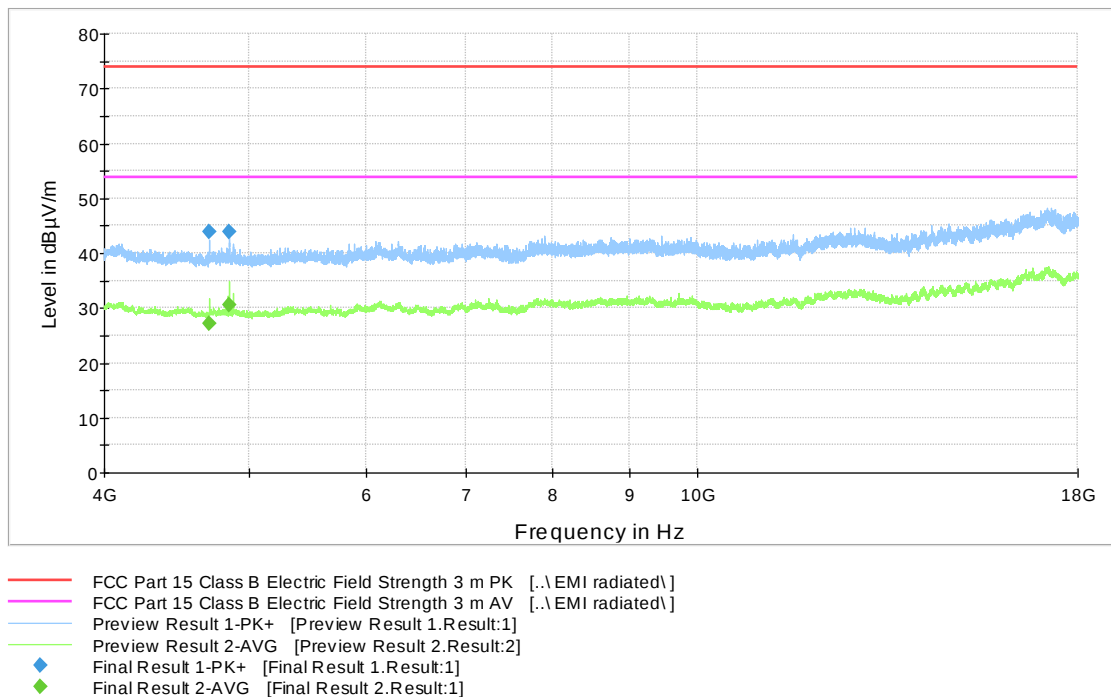


Figure 12: Channel mid 4 GHz – 18 GHz

Transmitter Radiated Spurious Emissions

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

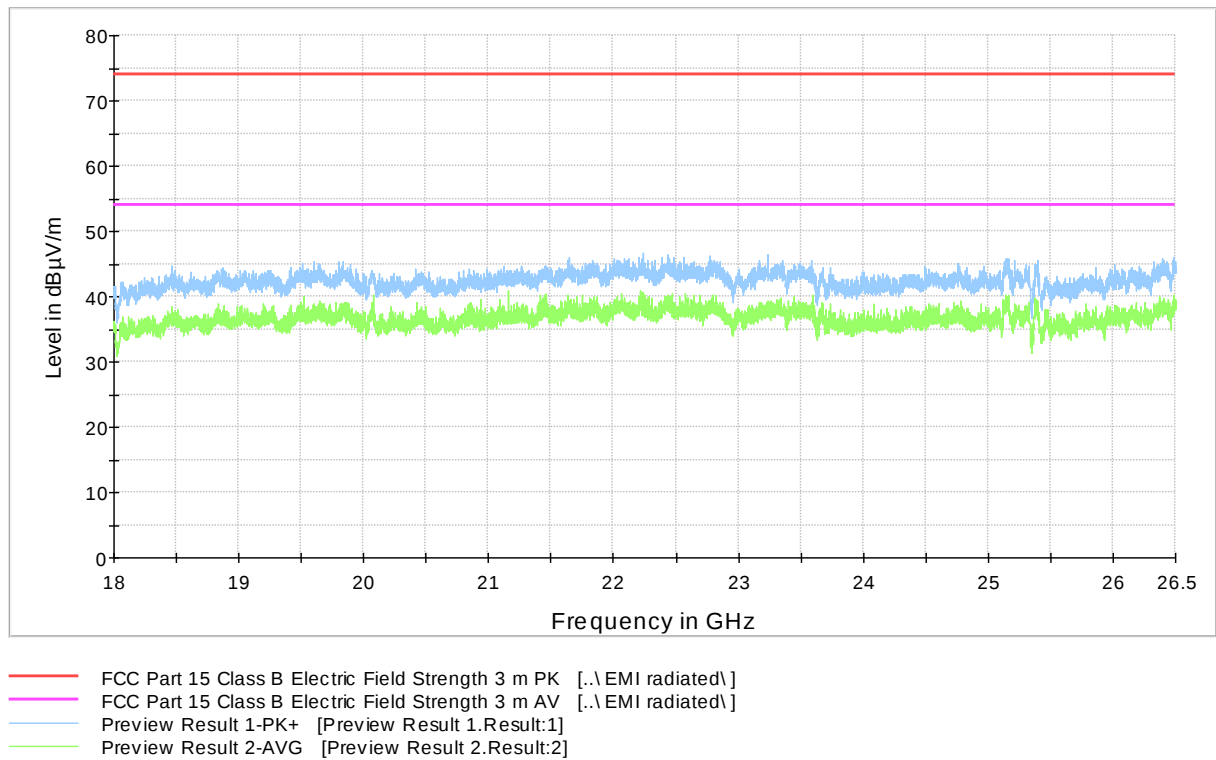


Figure 13: Channel mid 18 GHz – 26.5 GHz

Table 4: Peak results, channel mid

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4705.300000	43.8	1000.0	1000.000	150.0	V	217.0	8.4	30.1	73.9
4855.100000	43.8	1000.0	1000.000	150.0	V	176.0	8.4	30.1	73.9

Table 5: Average results, channel mid

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4705.400000	27.2	1000.0	1000.000	150.0	V	215.0	8.4	26.7	53.9
4855.400000	30.5	1000.0	1000.000	150.0	V	167.0	8.4	23.4	53.9

Transmitter Radiated Spurious Emissions

High channel

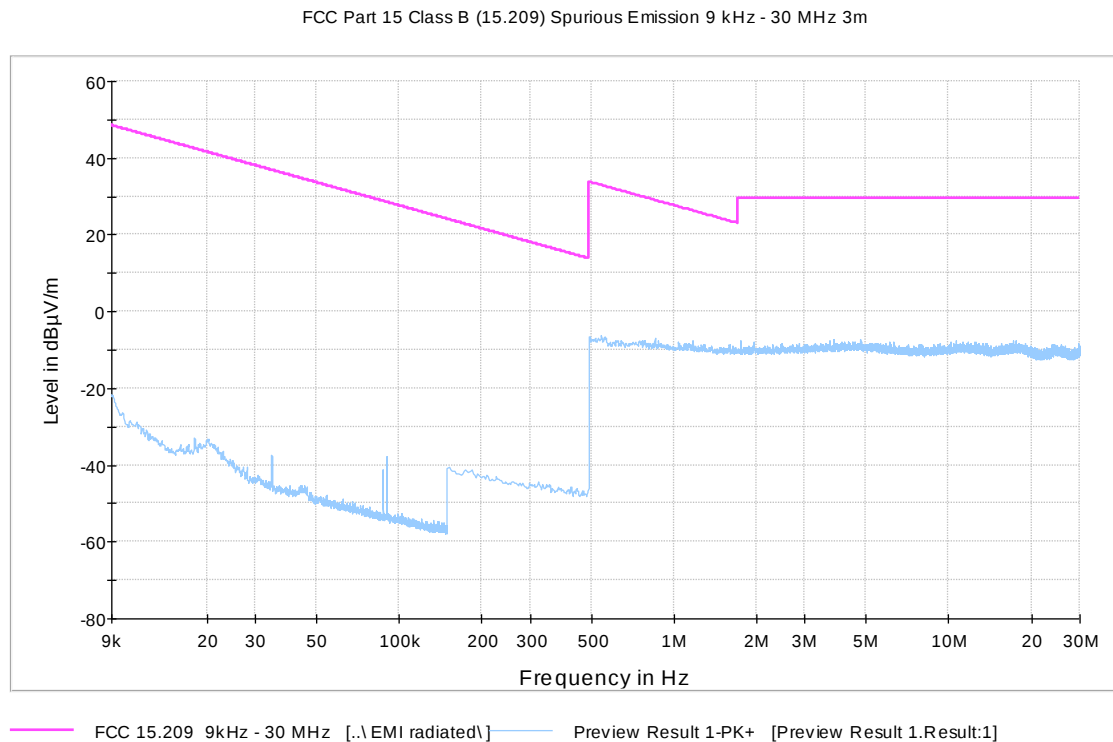


Figure 14: Channel high 9 kHz – 30 MHz

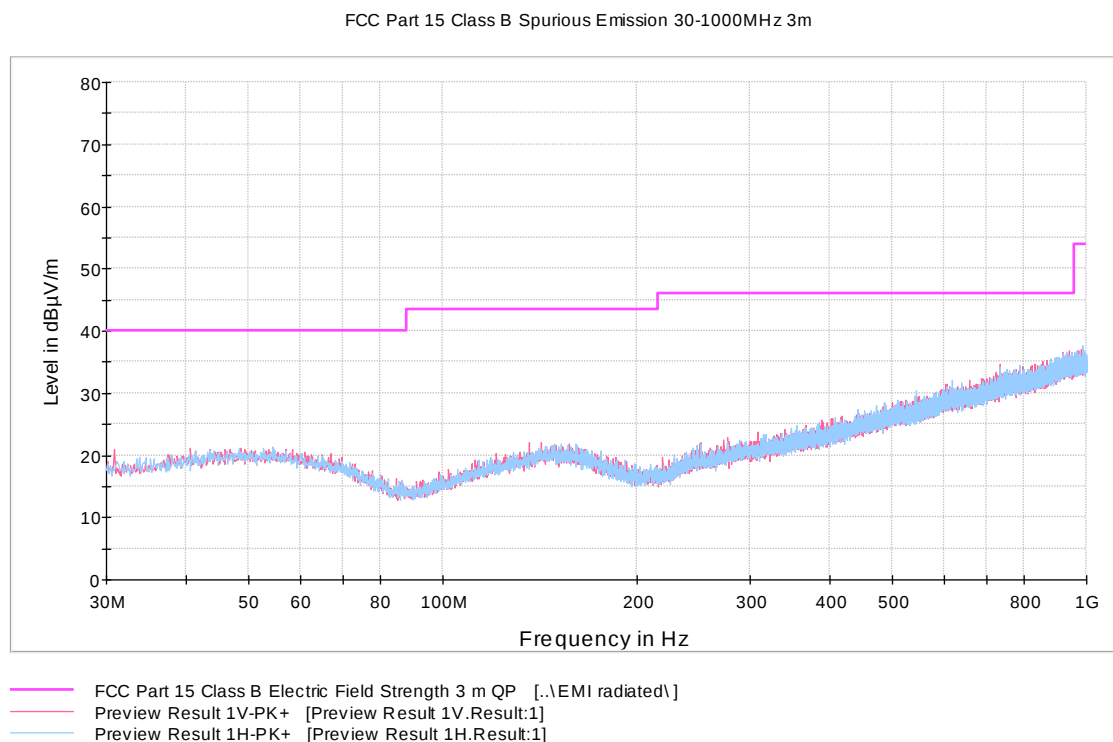


Figure 15: Channel high 30 MHz – 1000 MHz

Transmitter Radiated Spurious Emissions

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

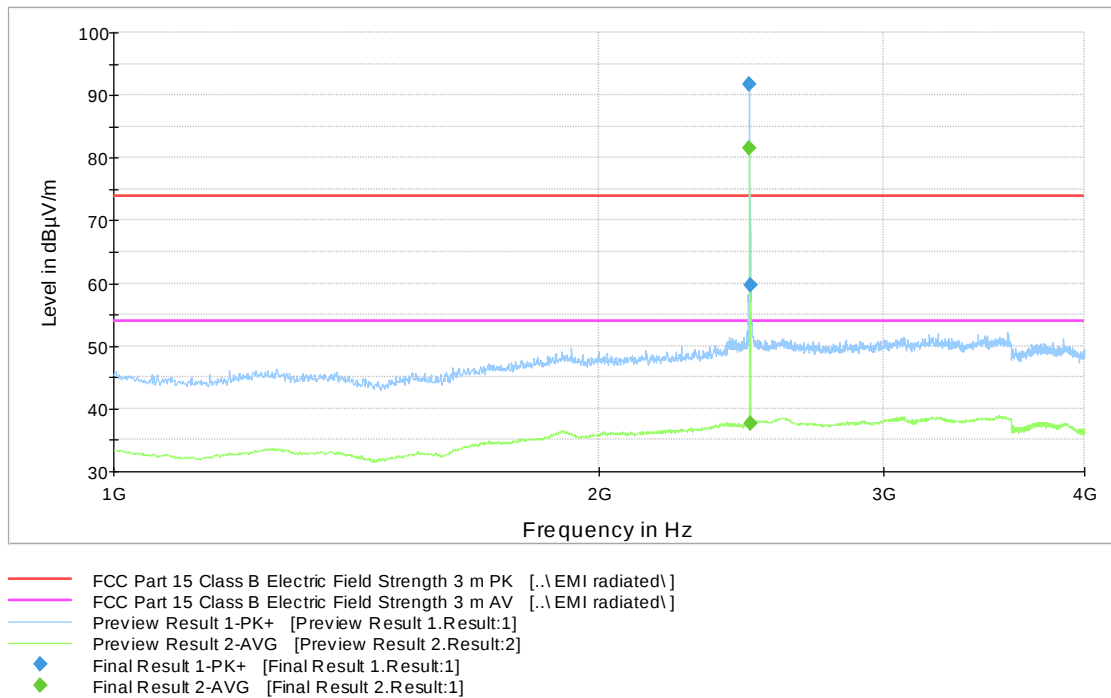


Figure 16: Channel high 1 GHz – 4 GHz

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

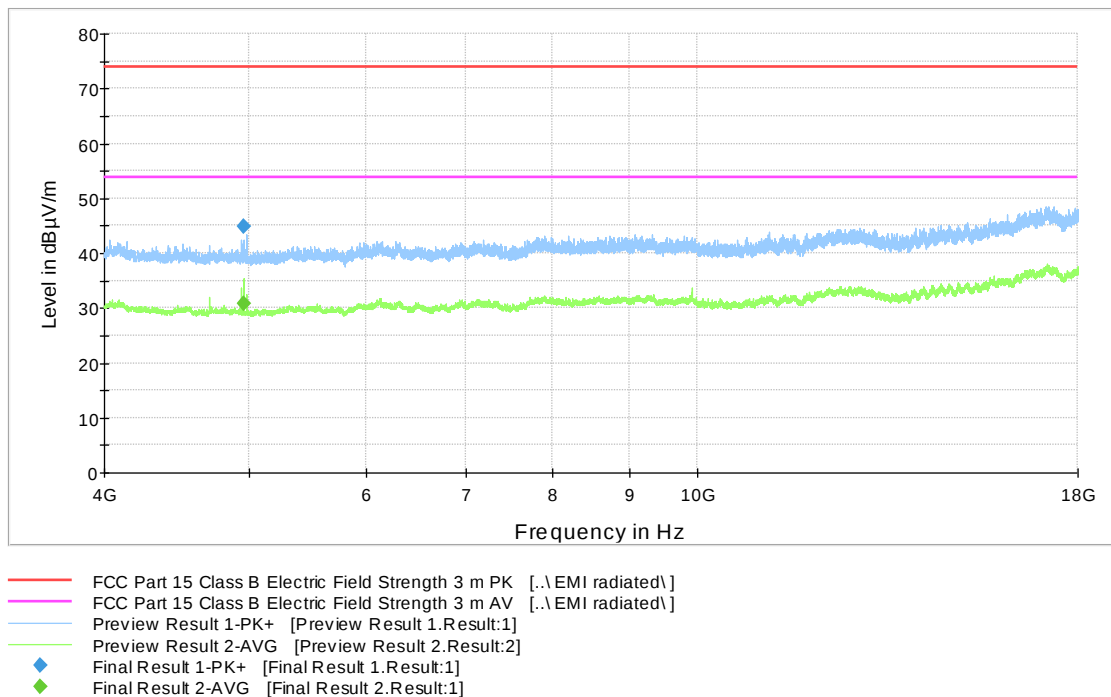


Figure 17: Channel high 4 GHz – 18 GHz

Transmitter Radiated Spurious Emissions

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

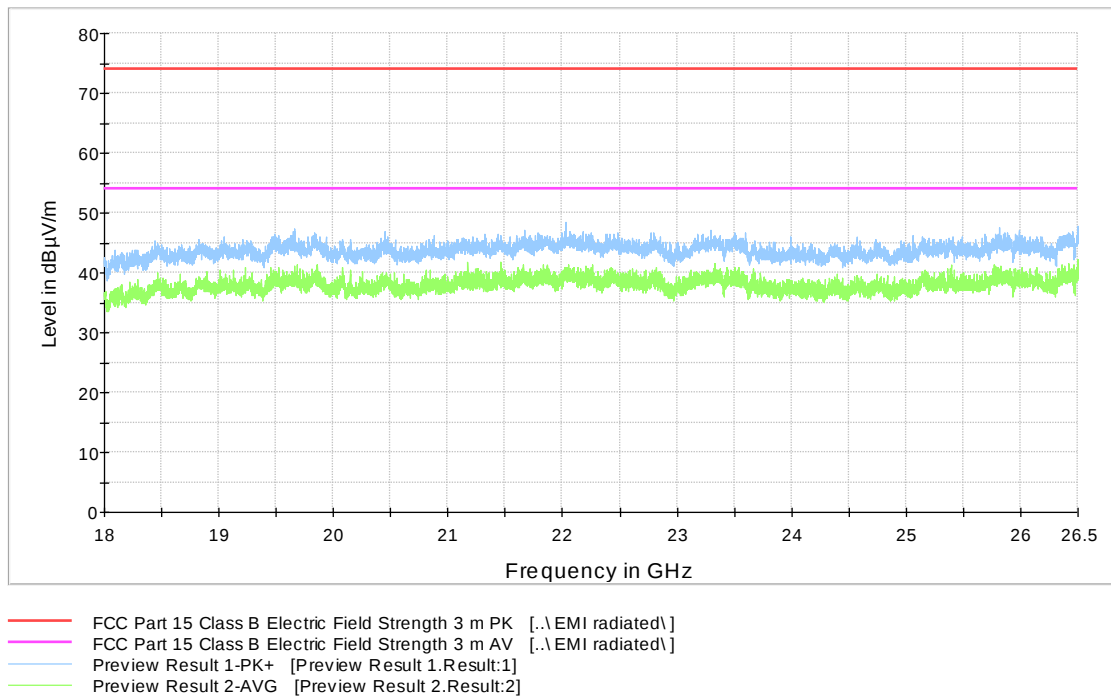


Figure 18: Channel high 18 GHz – 26.5 GHz

Table 6: Peak results, channel high

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2483.500000	59.7	1000.0	1000.000	314.0	H	74.0	14.7	14.2	73.9
4959.300000	44.8	1000.0	1000.000	150.0	V	211.0	8.3	29.1	73.9

Table 7: Average results, channel high

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2483.500000	37.6	1000.0	1000.000	354.0	H	71.0	14.7	16.3	53.9
4959.400000	30.8	1000.0	1000.000	179.0	V	210.0	8.3	23.1	53.9

Radiated Band Edge results

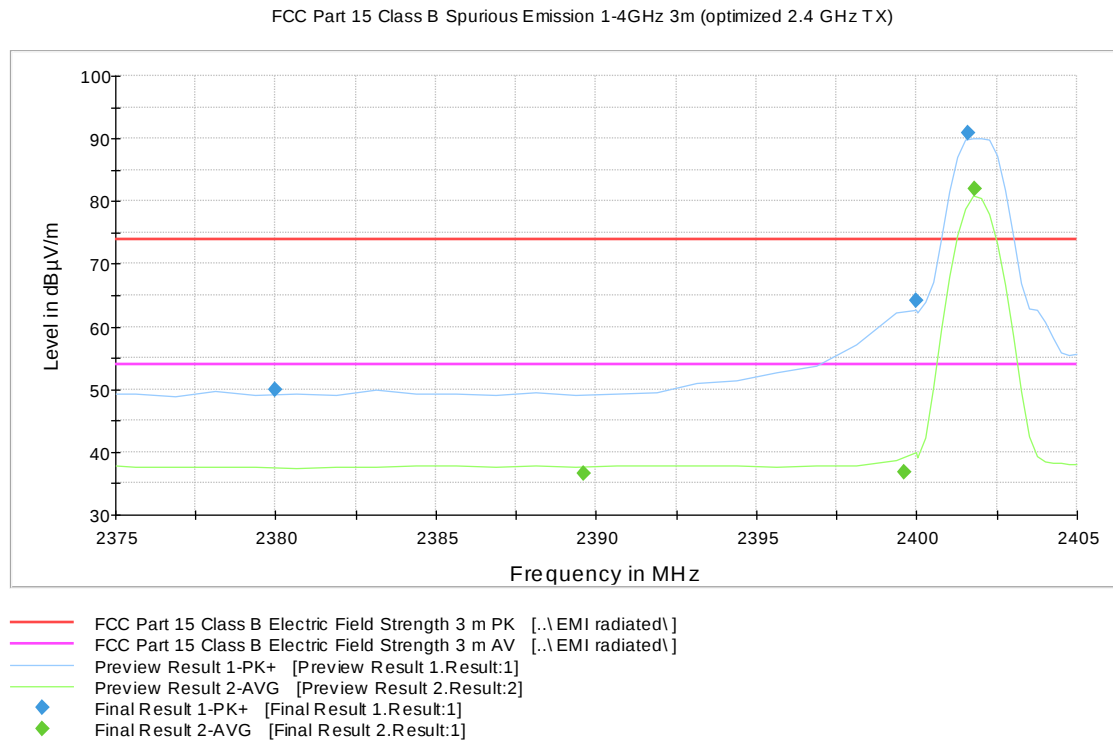


Figure 19: Radiated Band Edge measurement graph, Channel low

Table 8: Peak results, channel low

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2380.000000	50.0	1000.0	1000.000	150.0	V	195.0	14.5	23.9	73.9
2400.000000	64.2	1000.0	1000.000	305.0	H	46.0	14.7	9.7	73.9

Table 9: Average results, channel low

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.600000	36.5	1000.0	1000.000	400.0	V	275.0	14.6	17.4	53.9
2399.600000	36.8	1000.0	1000.000	240.0	V	96.0	14.7	17.1	53.9

Transmitter Radiated Spurious Emissions

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

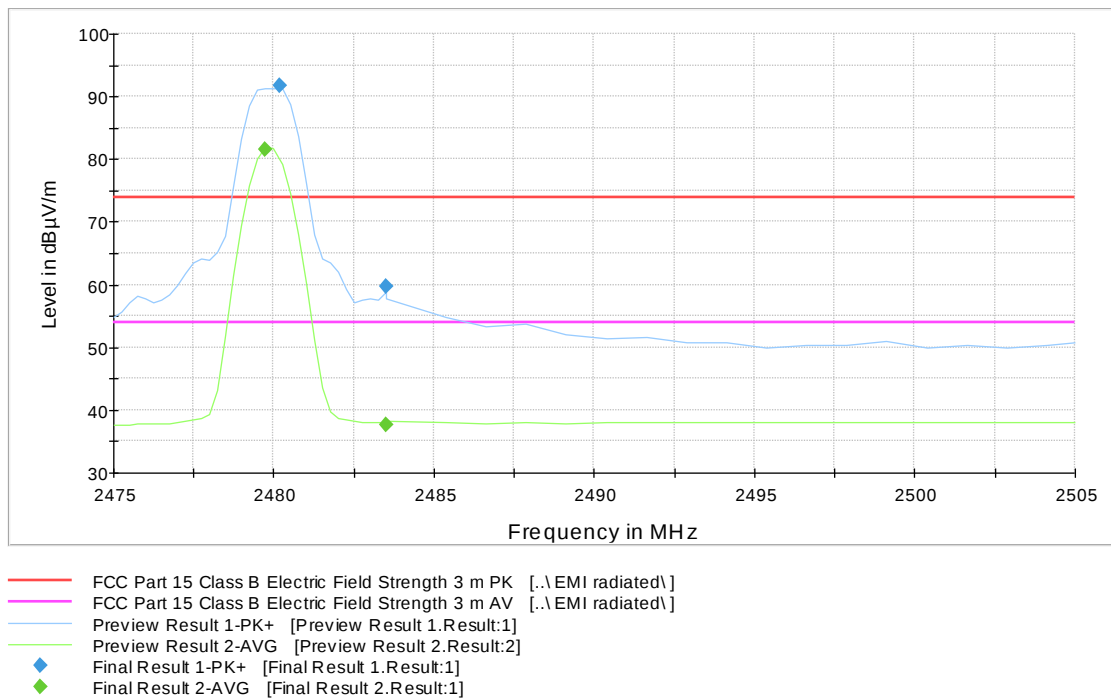


Figure 20: Radiated Band Edge measurement graph, Channel high

Table 10: Peak results, channel high

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	59.7	1000.0	1000.000	314.0	H	74.0	14.7	14.2	73.9

Table11: Average results, channel high

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	37.6	1000.0	1000.000	354.0	H	71.0	14.7	16.3	53.9

Transmitter Band Edge Measurement and Conducted Spurious Emissions

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 12: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge (ch 0)	Upper Band Edge (ch 39)
-29.41 dBc	-27.23 dBc
Limit: -20 dBc	

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 13: Conducted spurious emissions, Channel low

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
857,01	-69,93	-29,75	-40,18	PASS
2399,80	-47,11	-29,75	-17,36	PASS
3858,71	-65,14	-29,75	-35,39	PASS
6633,31	-61,43	-29,75	-31,68	PASS
9838,24	-61,48	-29,75	-31,73	PASS
12531,97	-57,96	-29,75	-28,21	PASS
15515,84	-56,00	-29,75	-26,25	PASS
16479,47	-55,31	-29,75	-25,56	PASS
19161,01	-56,66	-29,75	-26,91	PASS
24473,66	-55,99	-29,75	-26,25	PASS
25621,75	-55,67	-29,75	-25,93	PASS

Table 14: Conducted spurious emissions, Channel mid

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
985,62	-70,13	-30,02	-40,11	PASS
2395,60	-67,17	-30,02	-37,15	PASS
3942,73	-64,94	-30,02	-34,92	PASS
6994,61	-61,06	-30,02	-31,04	PASS
8477,22	-61,49	-30,02	-31,47	PASS
12558,12	-58,66	-30,02	-28,64	PASS
15822,49	-56,66	-30,02	-26,64	PASS
16174,04	-54,90	-30,02	-24,88	PASS
19175,54	-57,47	-30,02	-27,45	PASS
24153,60	-56,54	-30,02	-26,52	PASS
25409,79	-55,42	-30,02	-25,40	PASS

Table 15: Conducted spurious emissions, Channel high

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
793,29	-68,77	-30,98	-37,79	PASS
2198,95	-67,63	-30,98	-36,65	PASS
2483,57	-56,04	-30,98	-25,06	PASS
6970,89	-61,71	-30,98	-30,73	PASS
9779,93	-60,83	-30,98	-29,85	PASS
11807,96	-58,94	-30,98	-27,96	PASS
15504,59	-56,96	-30,98	-25,98	PASS
16159,04	-54,86	-30,98	-23,88	PASS
19201,42	-57,21	-30,98	-26,24	PASS
24127,64	-55,78	-30,98	-24,80	PASS
25461,59	-55,75	-30,98	-24,77	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

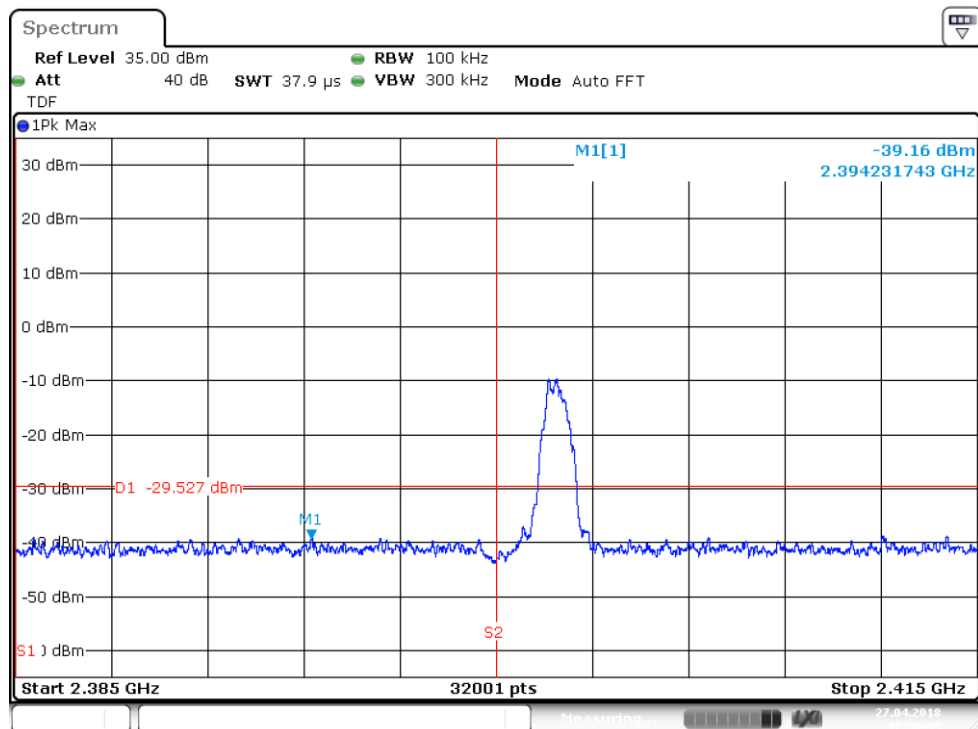


Figure 21: Lower Band Edge, channel low

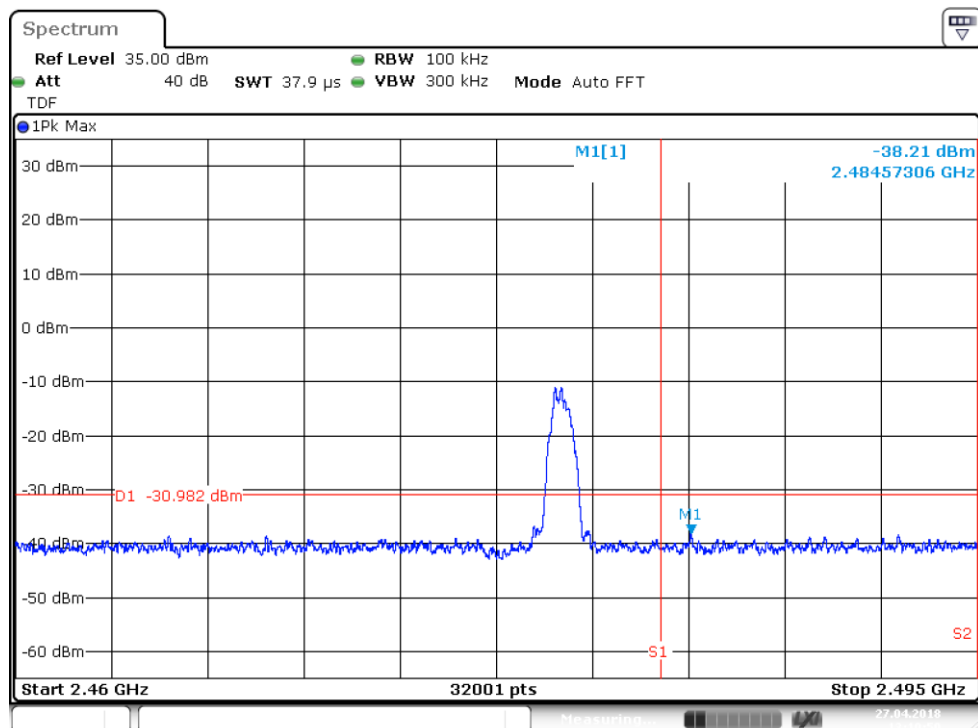


Figure 22: Upper Band Edge, channel high

Transmitter Band Edge Measurement and Conducted Spurious Emissions

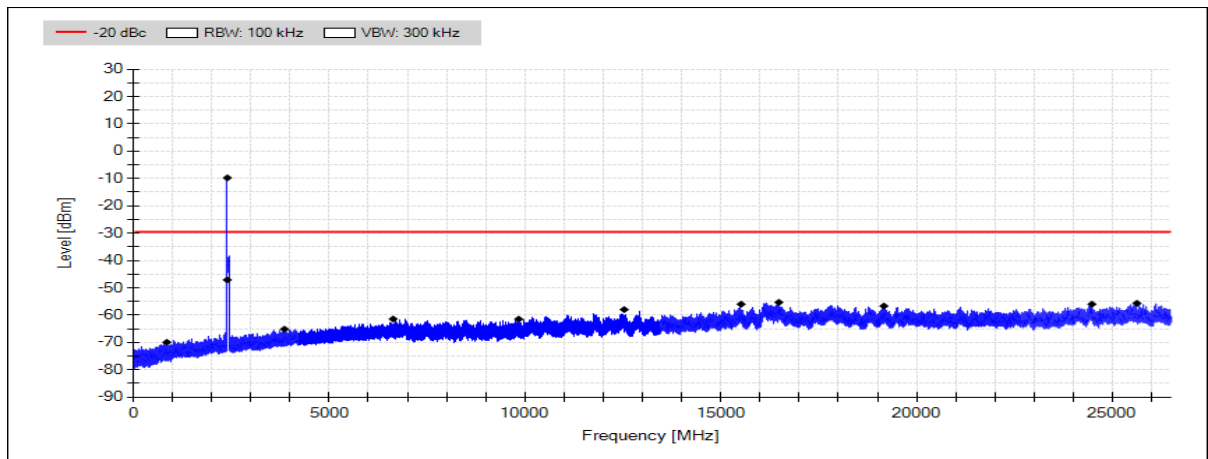


Figure 23: Conducted spurious emissions 30 - 26500 MHz channel low

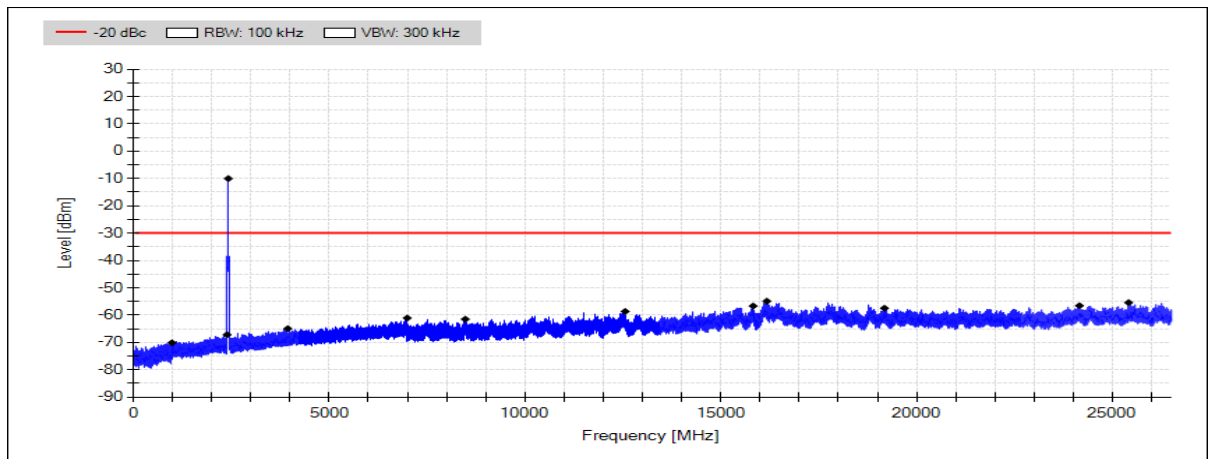


Figure 24: Conducted spurious emissions 30 - 26500 MHz channel mid

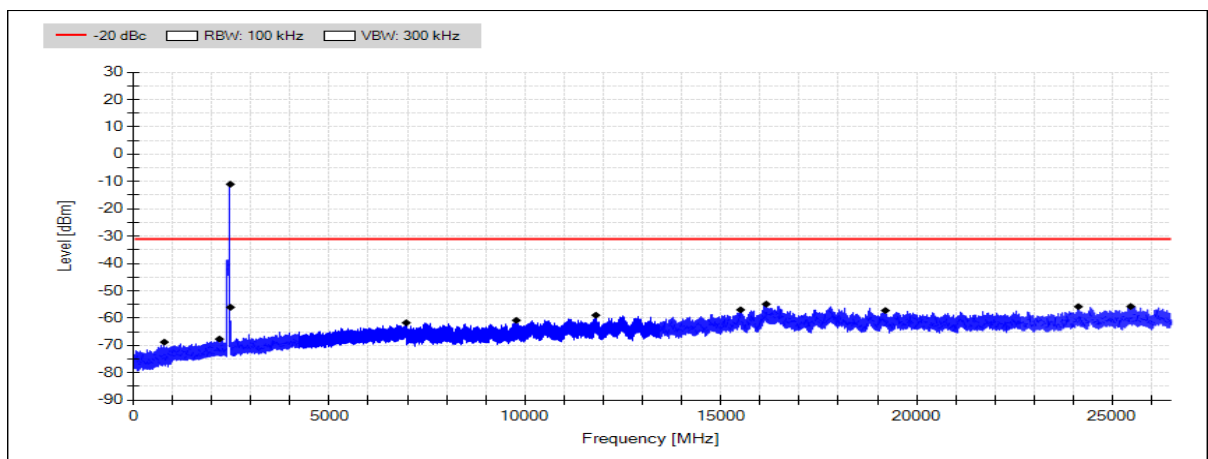


Figure 25: Conducted spurious emissions 30 - 26500 MHz channel high

6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 27 April 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 16: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	658.0	500
Mid	662.0	
High	668.0	

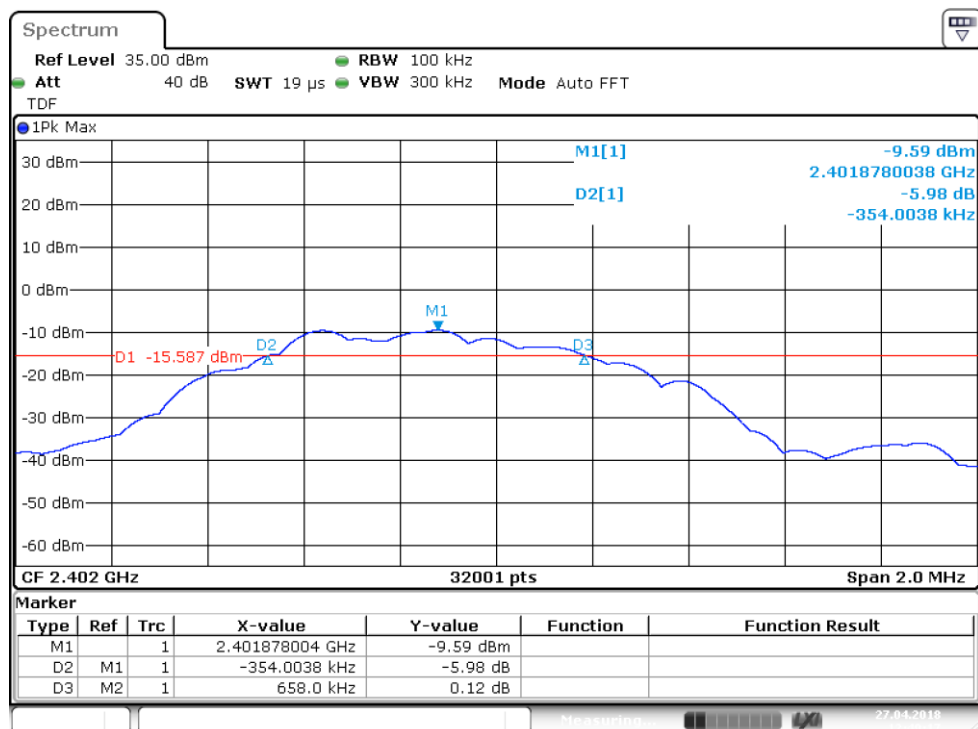


Figure 26: 6 dB bandwidth, channel low

6 dB Bandwidth of the Channel

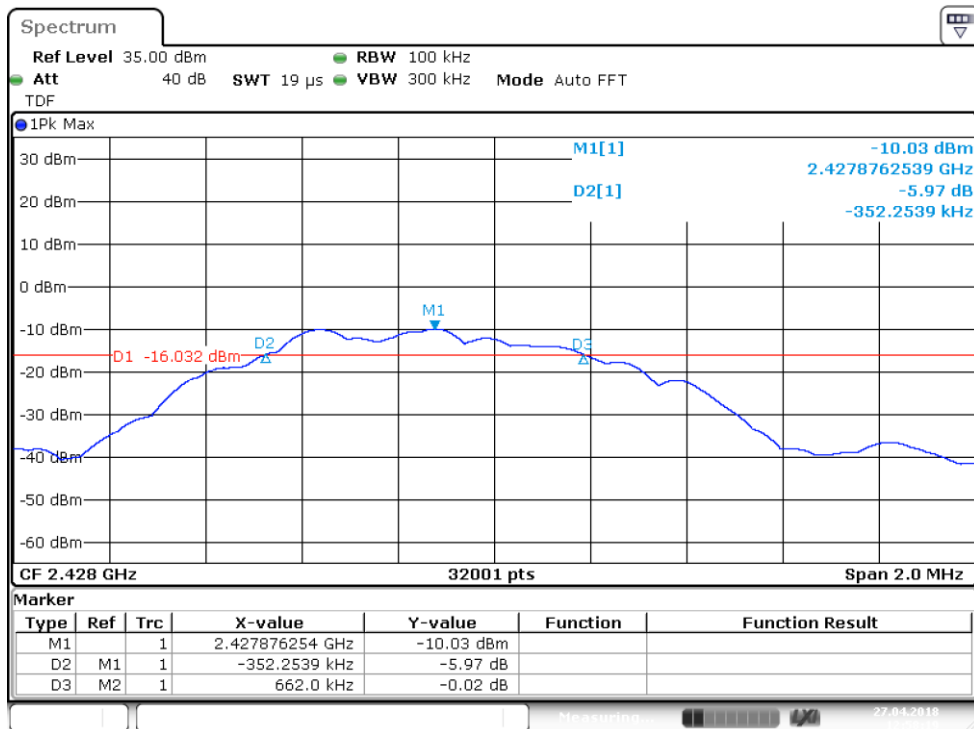


Figure 27: 6 dB bandwidth, channel mid

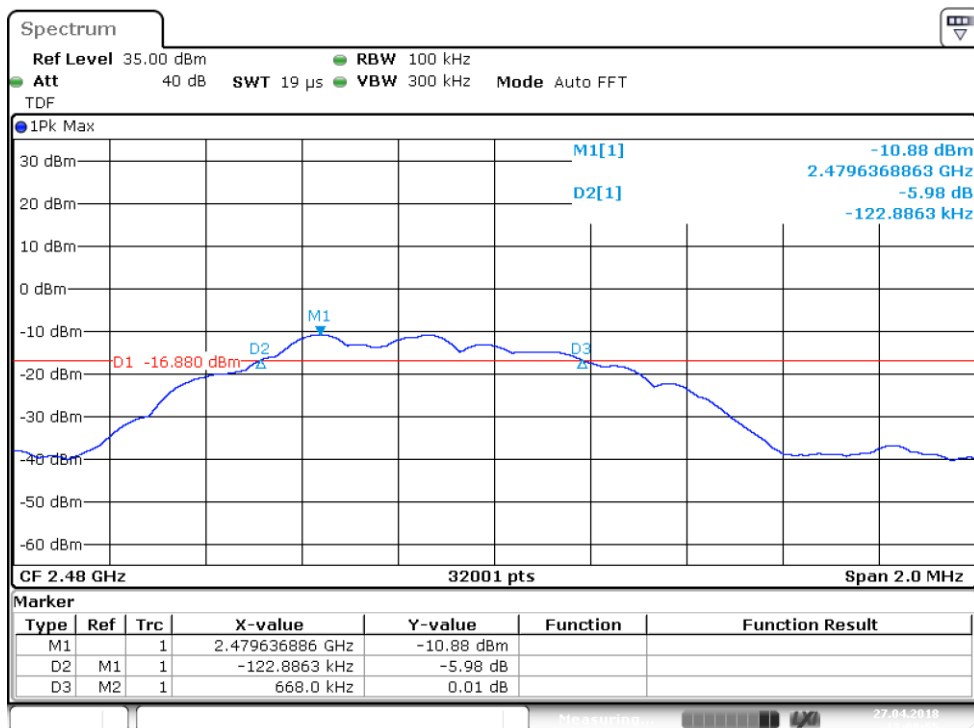


Figure 28: 6 dB bandwidth, channel high

Power Spectral Density

Standard: ANSI C63.10 (2013)
Tested by: MIH
Date: 27 April 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

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

Results:

Table 17: Power spectral density test results

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-17.33	+8.00
Mid	-17.75	
High	-18.53	

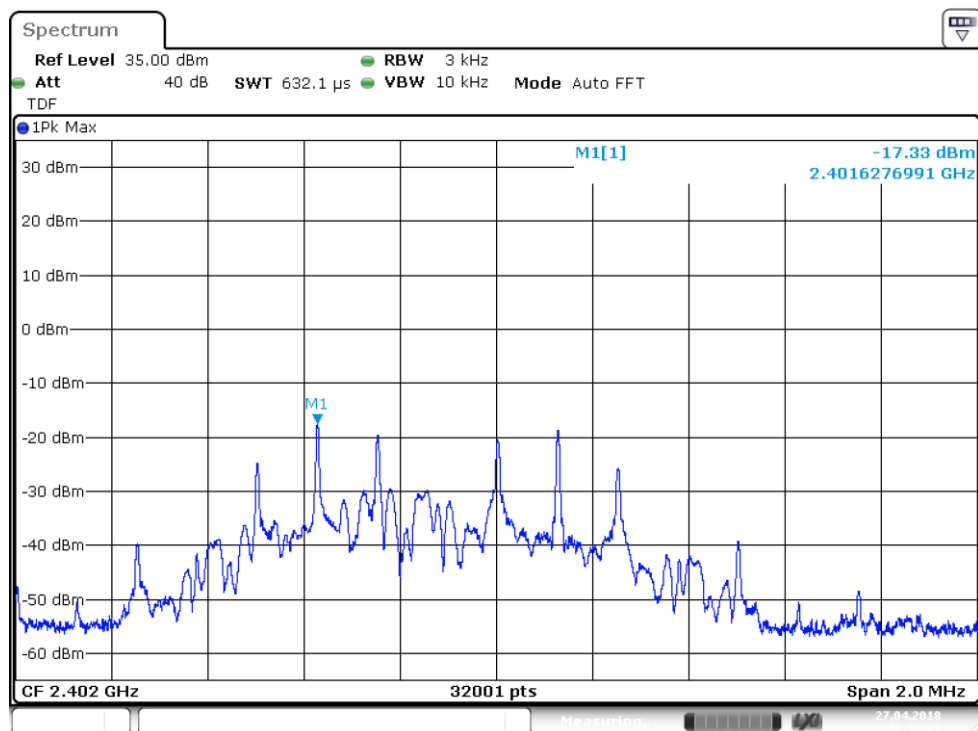


Figure 29: Power spectral density, channel low

Power Spectral Density

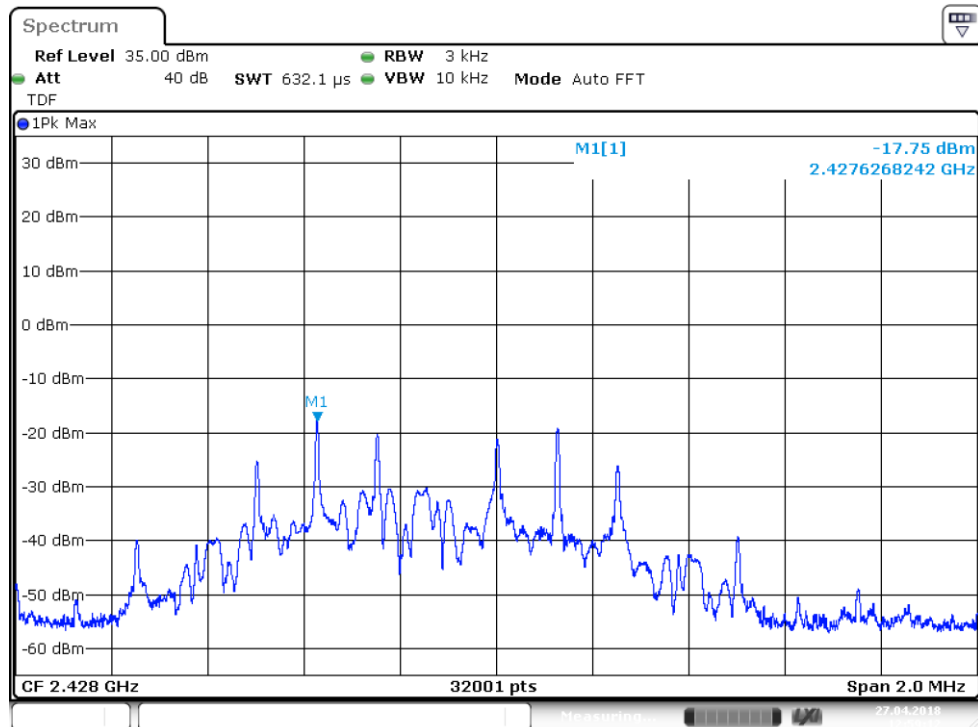


Figure 30: Power spectral density, channel mid

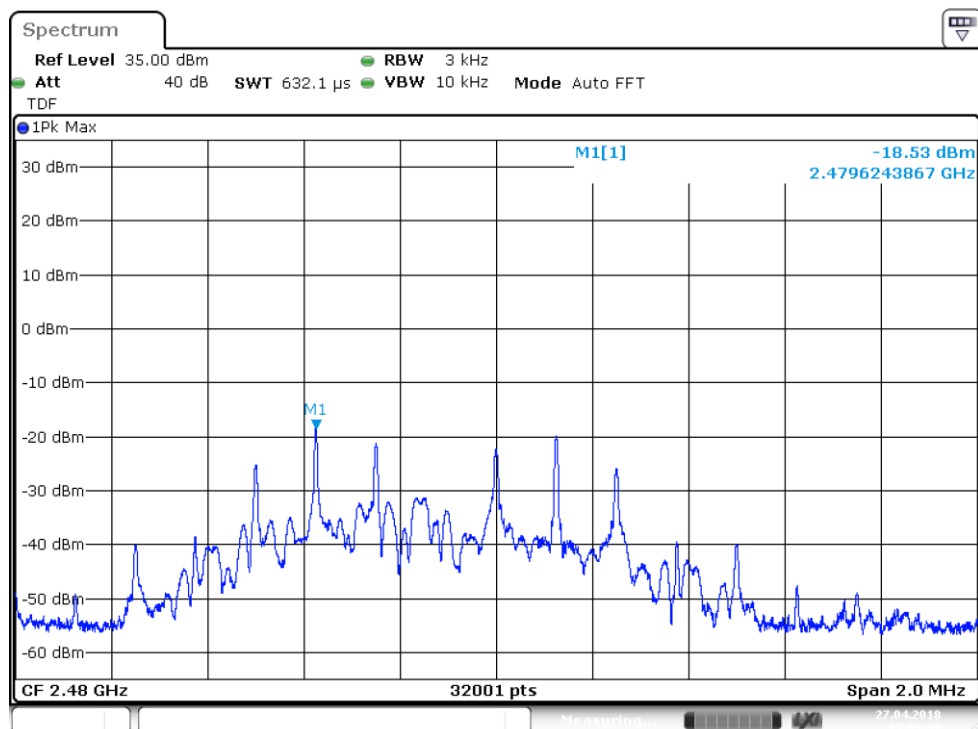


Figure 31: Power spectral density, channel high

99% Occupied Bandwidth

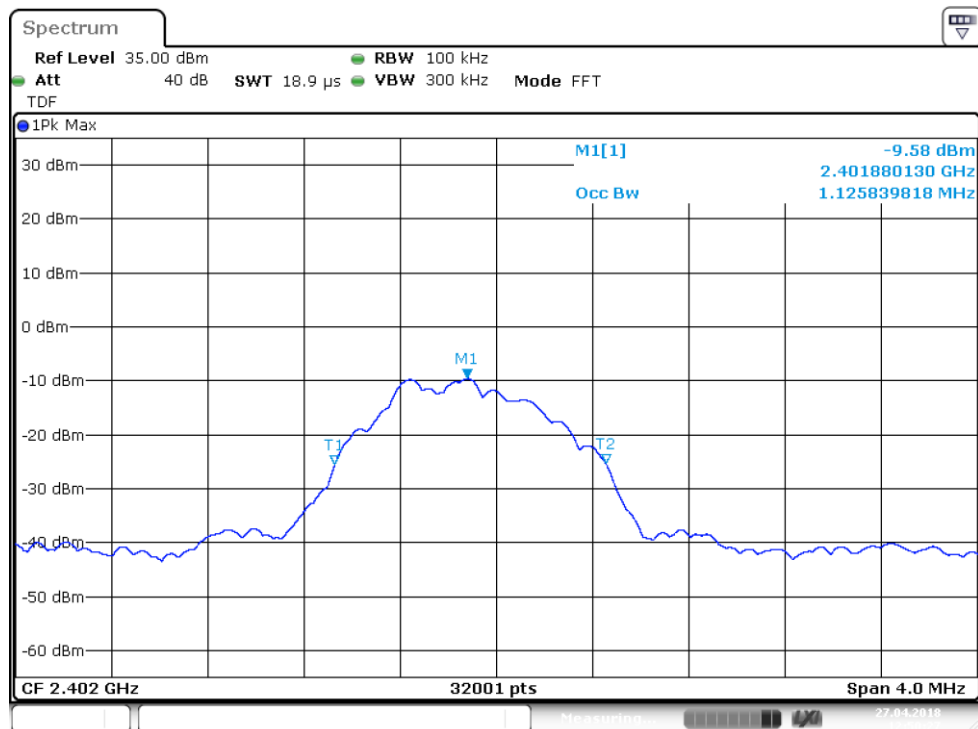
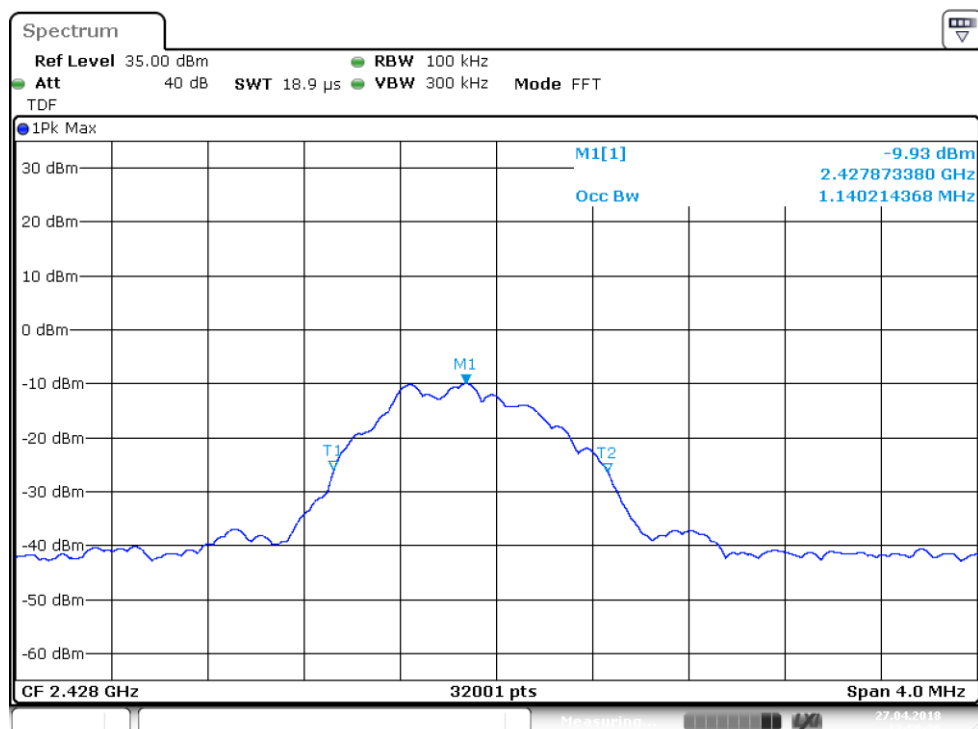
Standard: RSS-GEN (2014)
Tested by: MIH
Date: 27 April 2018
Temperature: 23 ± 3 °C
Humidity: 20 - 60 % RH

RSS-GEN 6.6

Results:

Table 18: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.125839818	PASS
Mid	-	1.140214368	PASS
High	-	1.200462486	PASS


Figure 32: 99% OBW, Channel low

Figure 33: 99% OBW, Channel mid

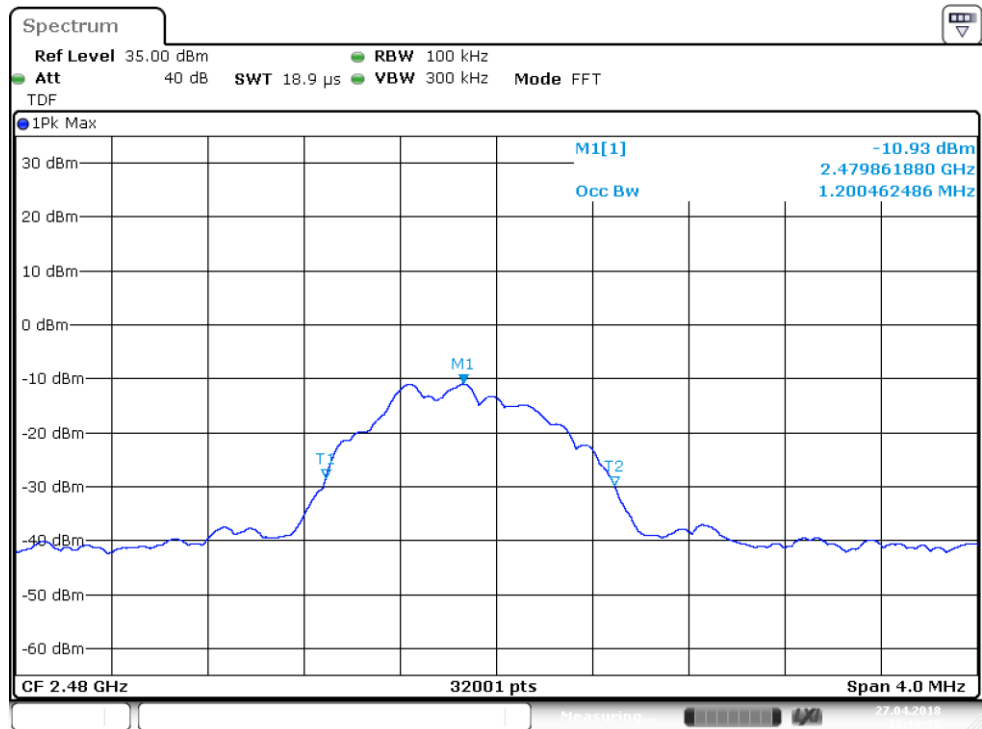


Figure 34: 99% OBW, Channel high

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	2018-01-08	2020-01-08
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2017-11-16	2018-11-16
PREAMPLIFIER	ALC MICROWAVE	AWX-2018-40-08	inv:9749	2017-08-30	2018-08-30
POWER SUPPLY	DELTA	SM 130-25D	inv:10406	-	-
ANTENNA	EMCO	3117	inv:7293	2018-03-23	2019-03-23
ANTENNA	EMCO	3160-09	inv:7294	2018-03-20	2019-03-20
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	DAVIS	VantagePro	inv:5296	2017-09-27	2018-09-27
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv:10403	2017-03-01	2019-03-01