

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test: Bluetooth Smart Module

Model: BGM121A
BGM121N
BGM123A
BGM123N

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: 2015
IC Rule Part: RSS-247, Issue 1, 2015
RSS-GEN Issue 4, 2014

KDB: Guidance for Performing Compliance
Measurements on Digital Transmission Systems
(DTS) Operating Under §15.247 (June 9, 2015)

Date: 27 October 2016

Issued by:

A blue ink signature of Emil Haverinen.

Emil Haverinen
Testing Engineer

Date: 27 October 2016

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Rauno Repo
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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	BGM121A, BGM121N, BGM123A, BGM123N
Type:	Bluetooth Smart Module
Serial no:	-
FCC ID:	QOQBGM12LMA
IC:	5123A-BGM12LMA

Description of the EUT

BGM121 and BGM123 are Bluetooth 4.1 compliant Bluetooth smart beacon modules. The only difference between A-variant and N-variant modules is that A has integrated antenna and N has RF connector for use of external antenna. Difference between BGM121 and BGM123 is that BGM123 has its transmit power limited to nominal of 3 dBm while BGM121 transmits at full power.

Classification of the device

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

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

Ratings and declarations

Operating Frequency Range (OFR):	2402 - 2480 MHz
Channels:	40
Channel separation:	2 MHz
99% Channel bandwidth:	1.114327062 MHz
Effective conducted power:	9.23 dBm (Peak)
Transmission technique:	DSSS
Modulation:	GFSK
Integral Antenna gain:	A-variant: 1 dBi
External Antenna gain:	N-variant: 2.14 dBi

Power Supply

Operating voltage range: 2.0 - 3.8 VDC (tested with 3.32V regulated by the development board)

Separate AC/DC adaptor, LPS 0012ADU00 (115 V, 60 Hz input / 5 V output) was used during the tests to power up the development board which feeds the module (EUT) during AC emissions test. Supply is not provided by the manufacturer. In other tests the development board was supplied with laboratory power supply.

Mechanical Size of the EUT

Height: 2 mm	Width: 20 mm	Length: 6 mm
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Samples

Three samples were used in the testing (BGM121A + dev. board, BGM121A and BGM121N)

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(4)	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-247 5.2(1)	6 dB Bandwidth	PASS
§15.247(e) / RSS-247 5.2(2)	Power Spectral Density	PASS
RSS-GEN 6.6	99% Occupied Bandwidth	PASS
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within The Restricted Bands	PASS

EUT Test Conditions During Testing

The EUT was in continuous transmit mode during all the tests. The hopping was stopped and the EUT was configured into the wanted channel using software provided by the manufacturer. Normal modulation and duty cycle was applied in all the tests. Tests were performed using power setting 104.

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

Radiated measurements were performed to both variants. General 2.14 dBi antenna was connected to RF connector of BGM121N with a short RF cable. The BGM121A used its integrated 1 dBi antenna.

During transmitter spurious emissions test for BGM121A, the sample was removed from the development board and tested separately (1-18 GHz).

Actual tests were only performed to BGM121A and BGM121N because of the higher possible transmit power.

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

Channel Low (Ch 0) = 2402 MHz

Channel Mid (Ch 19) = 2440 MHz

Channel High (Ch 39) = 2480 MHz

Test Facility

☐ Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
☒ Testing Location / address: FCC registration number: 178986 Industry Canada registration number: 8708A-2	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 23.9.2016
Temperature: 21 °C
Humidity: 45 % RH
Barometric pressure: 1009 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 (dB μ V)	
	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 Emission Mains FCC Part 15 Class B with ENV216

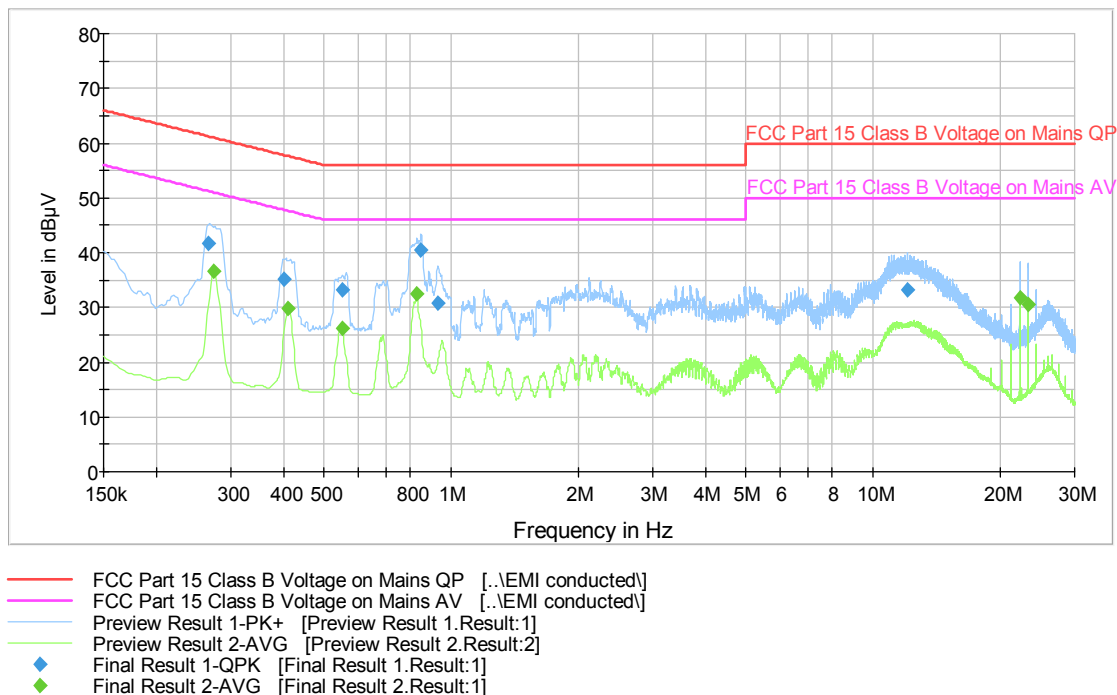


Figure 1: The measured curves with peak- and average detector

Conducted Emissions on Power Supply Lines

Final measurements from the worst frequencies

Table 1: Final QuasiPeak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Margin (dB)	Limit (dBµV)
0.265500	41.6	1000.0	9.000	19.7	61.3
0.400000	35.2	1000.0	9.000	22.7	57.9
0.551500	33.2	1000.0	9.000	22.8	56.0
0.848000	40.5	1000.0	9.000	15.5	56.0
0.928250	30.9	1000.0	9.000	25.1	56.0
12.031000	33.2	1000.0	9.000	26.8	60.0

Table 2: Final Average measurements from the worst frequencies

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Margin (dB)	Limit (dBµV)
0.273250	36.7	1000.0	9.000	14.3	51.0
0.411500	29.7	1000.0	9.000	17.9	47.6
0.552000	26.1	1000.0	9.000	19.9	46.0
0.827750	32.4	1000.0	9.000	13.6	46.0
22.229250	31.7	1000.0	9.000	18.3	50.0
23.286000	30.5	1000.0	9.000	19.5	50.0

Maximum Peak Conducted Output Power

Maximum Peak Conducted Output Power

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 1.11.2016
Temperature: 23 ± 3 °C
Humidity: 30 - 60 % RH
Measurement uncertainty: ± 2.87 dB Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b)(3)
RSS-247 5.4(4)

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	9.23	30	20.77	PASS
Mid	8.92	30	21.08	PASS
High	8.65	30	21.35	PASS



Figure 1: Conducted power (ch low)

Maximum Peak Conducted Output Power



Figure 1: Conducted power (ch mid)



Figure 1: Conducted power (ch high)

Transmitter Radiated Spurious Emissions

Transmitter Radiated Spurious Emissions 30 - 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: RRE / EHA
Date: 17.8 - 25.10.2016
Temperature: 23 ± 3 °C
Humidity: 30 - 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. Channel frequency 2442 MHz used as channel mid. (BGM121A)

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

Low channel, A-variant

Table 4: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	24.9	1000.0	120.000	147.0	H	259.0	13.0	18.6	43.5
300.028000	30.8	1000.0	120.000	100.0	H	297.0	15.3	15.2	46.0
941.894000	26.7	1000.0	120.000	100.0	V	284.0	27.7	19.3	46.0

Table 5: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	26.7	1000.0	120.000	147.0	H	259.0	13.0	-	-
300.028000	32.3	1000.0	120.000	100.0	H	297.0	15.3	-	-
941.894000	32.6	1000.0	120.000	100.0	V	284.0	27.7	-	-
2388.600000	49.6	1000.0	1000.000	281.0	H	9.0	2.9	24.3	73.9
2400.000000	66.5	1000.0	1000.000	294.0	H	9.0	3.0	7.4	73.9
2402.000000	106.2	1000.0	1000.000	291.0	H	1.0	3.0	-	-
4803.600000	45.2	1000.0	1000.000	150.0	H	189.0	-3.1	28.7	73.9

Transmitter Radiated Spurious Emissions

Table 6: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2388.600000	35.8	1000.0	1000.000	281.0	H	9.0	2.9	18.1	53.9
2400.000000	48.0	1000.0	1000.000	294.0	H	9.0	3.0	5.9	53.9
2402.000000	100.7	1000.0	1000.000	291.0	H	1.0	3.0	-	-
4803.600000	32.3	1000.0	1000.000	150.0	H	194.0	-3.1	21.6	53.9

Middle channel, A-variant

Table 7: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
952.390000	26.8	1000.0	120.000	254.0	V	0.0	27.8	19.2	46.0

Table 8: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
952.390000	32.5	1000.0	120.000	254.0	V	0.0	27.8	13.5	46.0
2441.750000	107.3	1000.0	1000.000	272.0	H	346.0	2.9	-	-
4884.600000	44.5	1000.0	1000.000	150.0	H	161.0	-3.0	29.4	73.9

Table 9: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2442.000000	102.8	1000.0	1000.000	279.0	H	345.0	2.9	-	-
4883.600000	31.8	1000.0	1000.000	150.0	H	160.0	-3.0	22.1	53.9

High channel, A-variant

Table 10: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2480.250000	107.7	1000.0	1000.000	240.0	H	0.0	-6.9	-	-
2483.500000	64.6	1000.0	1000.000	246.0	H	333.0	-6.9	9.3	73.9
4960.100000	43.9	1000.0	1000.000	150.0	H	162.0	-3.1	30.0	73.9
17367.20000	51.3	1000.0	1000.000	400.0	H	18.0	13.9	22.6	73.9

Table 11: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2480.250000	102.1	1000.0	1000.000	240.0	H	0.0	-6.9	-	-
2483.500000	47.9	1000.0	1000.000	246.0	H	333.0	-6.9	6.0	53.9
4959.900000	30.0	1000.0	1000.000	150.0	H	18.0	-3.1	23.9	53.9
17181.10000	39.1	1000.0	1000.000	150.0	H	319.0	14.2	14.8	53.9

Radiated Band Edge results, A-variant

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

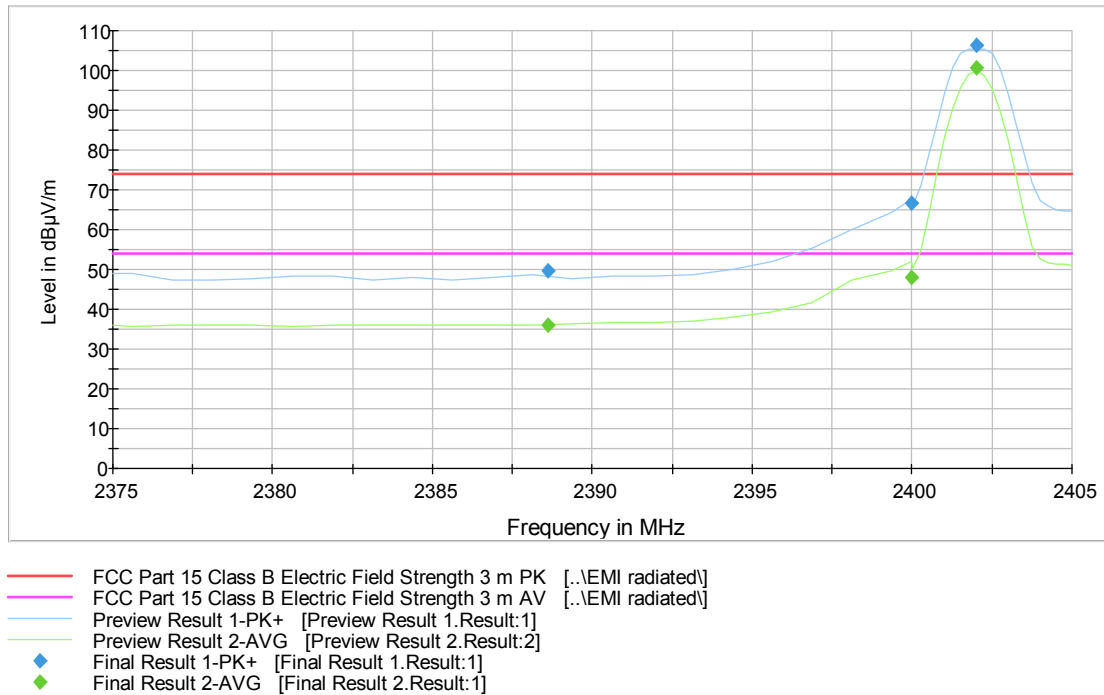


Figure 2: Radiated Band Edge measurement graph (ch low), A-variant

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

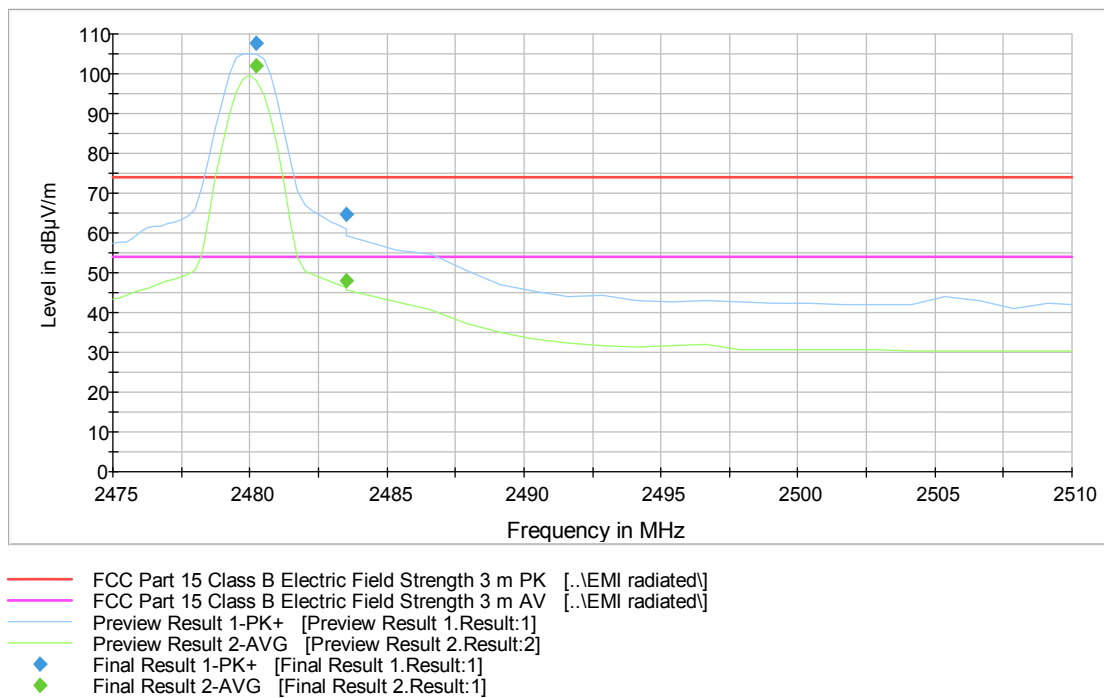


Figure 3: Radiated Band Edge measurement graph (ch high), A-variant

Transmitter Radiated Spurious Emissions

Low channel, N-variant

Table 12: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	27.4	1000.0	120.000	126.0	H	257.0	13.0	16.1	43.5
300.008000	35.1	1000.0	120.000	100.0	H	214.0	15.3	10.9	46.0
312.019000	30.1	1000.0	120.000	100.0	H	208.0	15.7	15.9	46.0
349.983000	30.0	1000.0	120.000	100.0	H	275.0	16.5	16.0	46.0
364.008000	29.9	1000.0	120.000	100.0	H	267.0	16.9	16.1	46.0
420.017000	28.2	1000.0	120.000	100.0	H	73.0	18.4	17.8	46.0

Table 13: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
180.002000	28.9	1000.0	120.000	126.0	H	257.0	13.0	-	-
300.008000	36.2	1000.0	120.000	100.0	H	214.0	15.3	-	-
312.019000	31.5	1000.0	120.000	100.0	H	208.0	15.7	-	-
349.983000	31.5	1000.0	120.000	100.0	H	275.0	16.5	-	-
364.008000	31.8	1000.0	120.000	100.0	H	267.0	16.9	-	-
420.017000	30.6	1000.0	120.000	100.0	H	73.0	18.4	-	-
2388.200000	49.0	1000.0	1000.000	256.0	V	316.0	2.9	24.9	73.9
2400.000000	65.5	1000.0	1000.000	335.0	V	177.0	3.0	8.4	73.9
2402.000000	103.8	1000.0	1000.000	191.0	V	202.0	3.0	-	-
4804.500000	51.8	1000.0	1000.000	258.0	V	283.0	-3.1	22.1	73.9
7206.100000	44.9	1000.0	1000.000	257.0	V	211.0	0.4	29.0	73.9

Table 14: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.800000	35.8	1000.0	1000.000	150.0	V	219.0	2.9	18.1	53.9
2400.000000	47.5	1000.0	1000.000	191.0	V	202.0	3.0	6.4	53.9
2402.000000	98.6	1000.0	1000.000	190.0	V	201.0	3.0	-	-
4803.800000	39.7	1000.0	1000.000	257.0	V	280.0	-3.1	14.2	53.9
7205.300000	31.6	1000.0	1000.000	259.0	V	155.0	0.4	22.3	53.9

Middle channel, N-variant

Table 15: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
113.297000	9.5	1000.0	120.000	179.0	V	148.0	11.8	34.0	43.5
300.008000	34.4	1000.0	120.000	126.0	H	206.0	15.3	11.6	46.0

Table 16: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
113.297000	15.3	1000.0	120.000	179.0	V	148.0	11.8	28.2	43.5
300.008000	35.5	1000.0	120.000	126.0	H	206.0	15.3	10.5	46.0
2439.750000	103.1	1000.0	1000.000	320.0	V	357.0	2.9	-	-
4880.600000	49.4	1000.0	1000.000	232.0	V	281.0	-3.0	24.5	73.9

Transmitter Radiated Spurious Emissions

Table 17: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2440.000000	96.5	1000.0	1000.000	267.0	V	356.0	2.9	-	-
4879.900000	39.5	1000.0	1000.000	296.0	V	173.0	-3.0	14.4	53.9
7319.400000	31.4	1000.0	1000.000	257.0	V	271.0	0.5	22.5	53.9

High channel, N-variant

Table 18: Quasi-peak results (ch high)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.008000	34.1	1000.0	120.000	126.0	H	217.0	15.3	11.9	46.0
312.019000	30.2	1000.0	120.000	100.0	H	214.0	15.7	15.8	46.0
349.983000	29.9	1000.0	120.000	100.0	H	282.0	16.5	16.1	46.0
364.031000	30.1	1000.0	120.000	100.0	H	264.0	16.9	15.9	46.0
420.017000	28.5	1000.0	120.000	100.0	H	297.0	18.4	17.5	46.0
926.819000	26.4	1000.0	120.000	210.0	H	325.0	27.5	19.6	46.0

Table 19: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.008000	35.1	1000.0	120.000	126.0	H	217.0	15.3	10.9	46.0
312.019000	31.8	1000.0	120.000	100.0	H	214.0	15.7	14.2	46.0
349.983000	31.7	1000.0	120.000	100.0	H	282.0	16.5	14.3	46.0
364.031000	31.9	1000.0	120.000	100.0	H	264.0	16.9	14.1	46.0
420.017000	31.0	1000.0	120.000	100.0	H	297.0	18.4	15.0	46.0
926.819000	31.9	1000.0	120.000	210.0	H	325.0	27.5	14.1	46.0
2480.250000	103.5	1000.0	1000.000	303.0	V	1.0	3.1	-	-
2483.500000	59.6	1000.0	1000.000	167.0	V	1.0	3.2	14.3	73.9
4959.400000	45.2	1000.0	1000.000	260.0	V	274.0	-3.1	28.7	73.9
17186.900000	52.3	1000.0	1000.000	400.0	V	147.0	14.2	21.6	73.9

Table 20: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2480.000000	98.8	1000.0	1000.000	280.0	V	0.0	3.1	-	-
2483.500000	41.4	1000.0	1000.000	165.0	V	1.0	3.2	12.5	53.9
4959.900000	33.8	1000.0	1000.000	245.0	V	278.0	-3.1	20.1	53.9
7439.300000	31.0	1000.0	1000.000	232.0	V	265.0	0.6	22.9	53.9
17184.600000	38.9	1000.0	1000.000	400.0	H	119.0	14.2	15.0	53.9

Transmitter Radiated Spurious Emissions

Radiated Band Edge results, N-variant

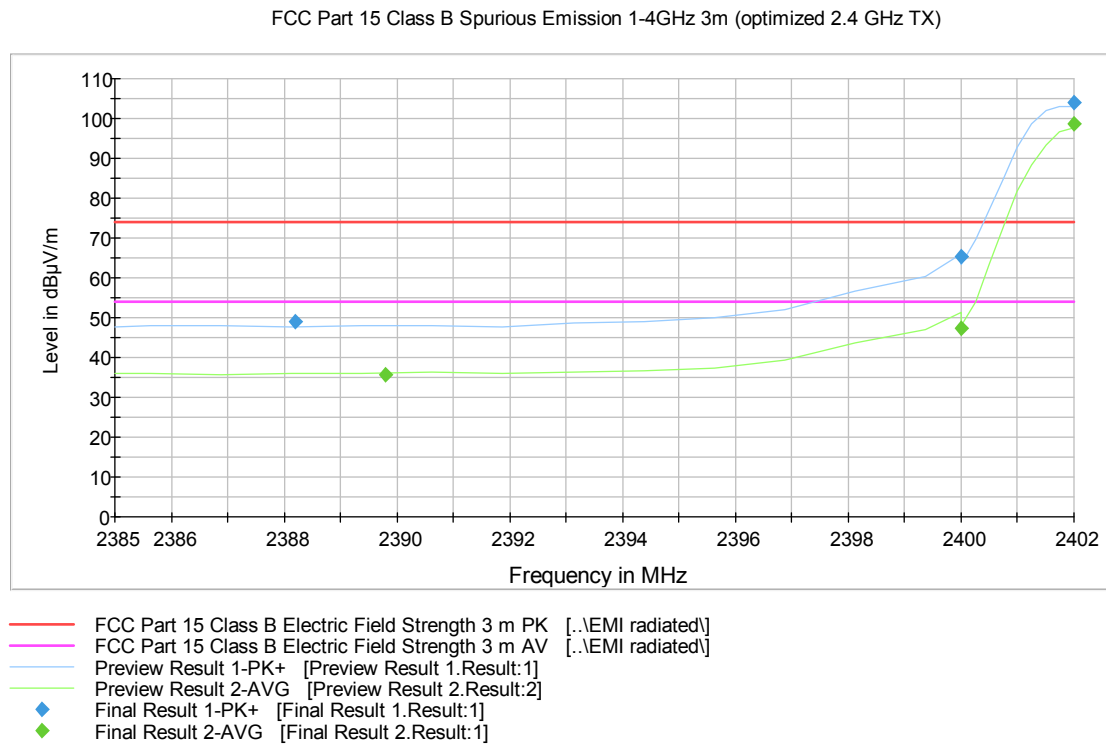


Figure 1: Radiated Band Edge measurement graph (ch low), N-variant

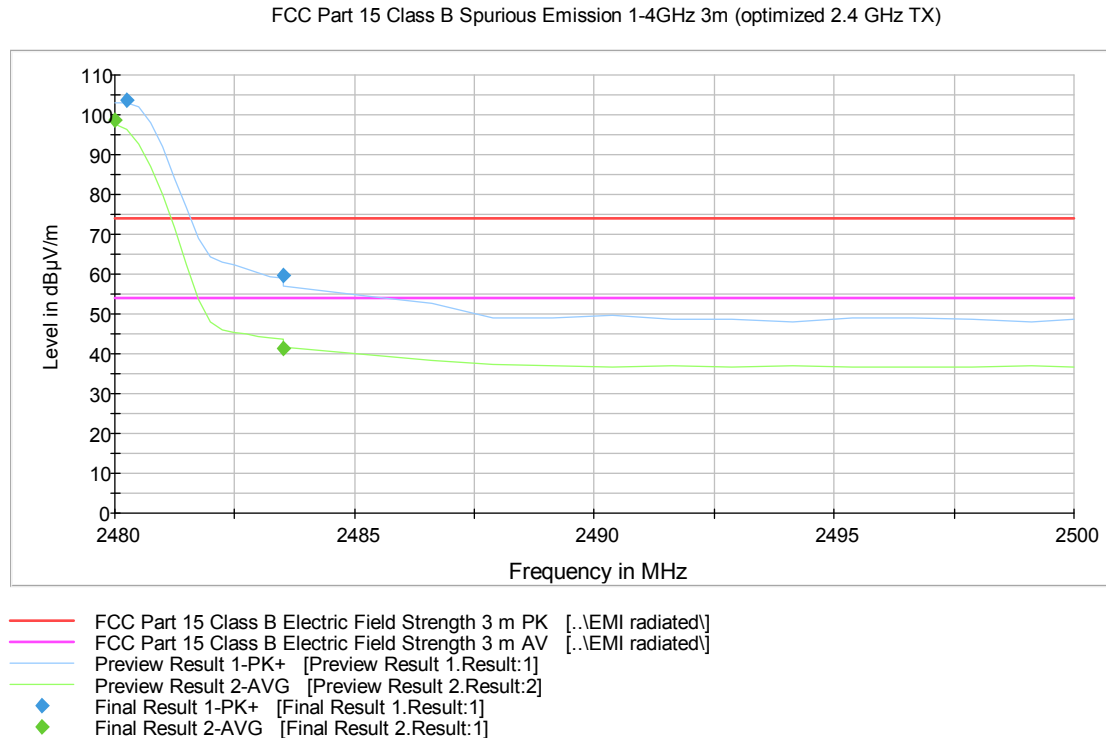


Figure 2: Radiated Band Edge measurement graph (ch high), N-variant

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 22.9 - 21.9.2016
Temperature: 23 - 24 °C
Humidity: 40 - 43 %
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 21: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-51.25 dBc	-55.01 dBc
Limit: -20dBc	

Table 22: Conducted spurious emissions channel low

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
946.61	-69.24	-11.31	-57.94	PASS
2399.98	-45.06	-11.31	-33.75	PASS
2402.24	8.69	-	-	Carrier
3749.10	-65.72	-11.31	-54.42	PASS
4803.46	-42.70	-11.31	-31.39	PASS
7206.76	-57.99	-11.31	-46.68	PASS
12468.69	-58.63	-11.31	-47.33	PASS
15474.69	-56.69	-11.31	-45.39	PASS
16157.26	-55.32	-11.31	-44.02	PASS
19179.76	-57.28	-11.31	-45.97	PASS
24464.10	-56.61	-11.31	-45.31	PASS
25414.95	-55.27	-11.31	-43.96	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 23: Conducted spurious emissions channel mid

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
863.86	-69.25	-11.64	-57.61	PASS
2363.49	-64.30	-11.64	-52.66	PASS
2440.24	8.36	-	-	Carrier
2516.65	-65.22	-11.64	-53.58	PASS
4879.49	-45.20	-11.64	-33.56	PASS
7319.26	-56.22	-11.64	-44.58	PASS
12541.81	-58.54	-11.64	-46.90	PASS
15834.68	-57.17	-11.64	-45.53	PASS
16316.82	-54.99	-11.64	-43.35	PASS
20024.52	-57.10	-11.64	-45.46	PASS
24905.93	-55.41	-11.64	-43.77	PASS
26282.72	-56.06	-11.64	-44.42	PASS

Table 24: Conducted spurious emissions channel high

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
947.85	-68.88	-11.78	-57.10	PASS
1643.30	-66.06	-11.78	-54.29	PASS
2480.24	8.22	-	-	Carrier
2483.52	-50.57	-11.78	-38.80	PASS
4959.55	-47.22	-11.78	-35.45	PASS
7440.75	-58.40	-11.78	-46.62	PASS
12520.16	-58.50	-11.78	-46.72	PASS
15503.00	-56.25	-11.78	-44.47	PASS
16157.54	-54.38	-11.78	-42.61	PASS
19834.40	-56.85	-11.78	-45.08	PASS
24461.75	-56.47	-11.78	-44.69	PASS
26251.08	-56.33	-11.78	-44.56	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

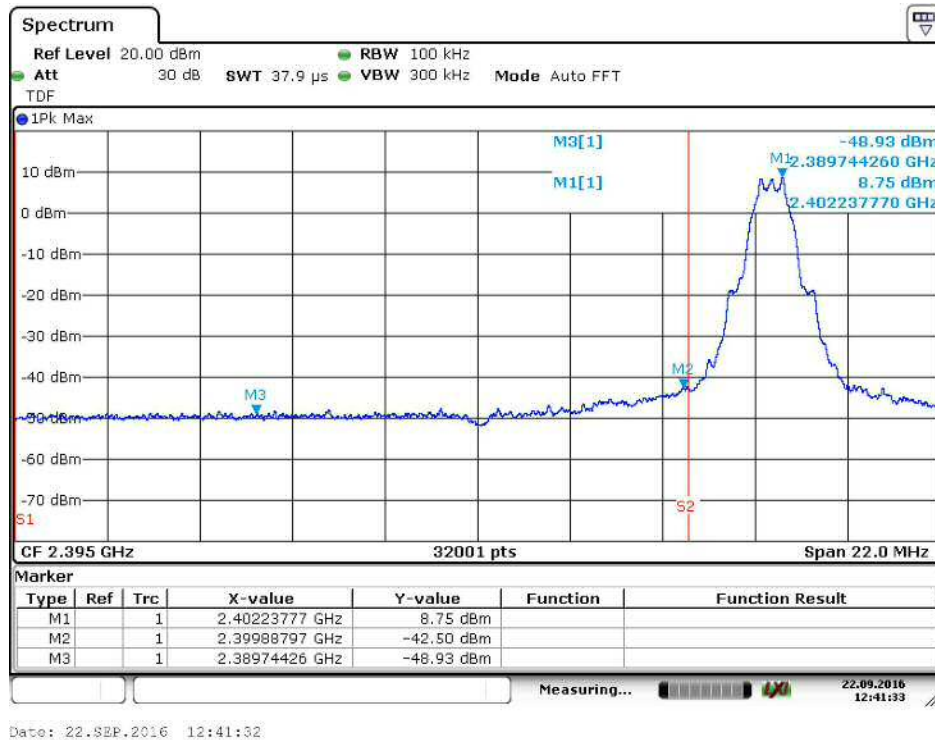


Figure 3: Lower Band Edge

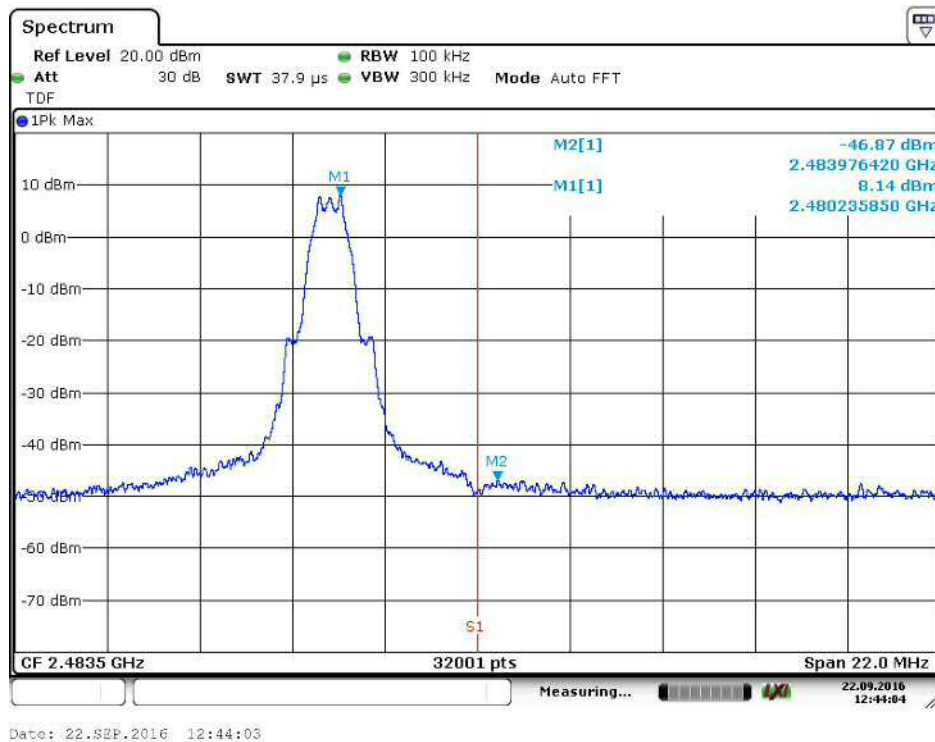


Figure 4: Upper Band Edge.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

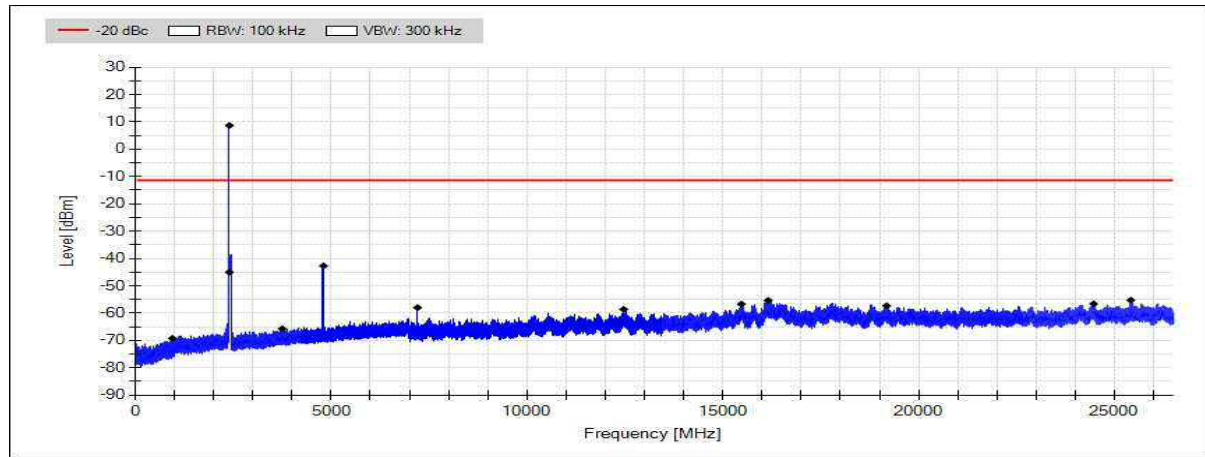


Figure 5: Conducted spurious emissions 30 - 26500 MHz channel low

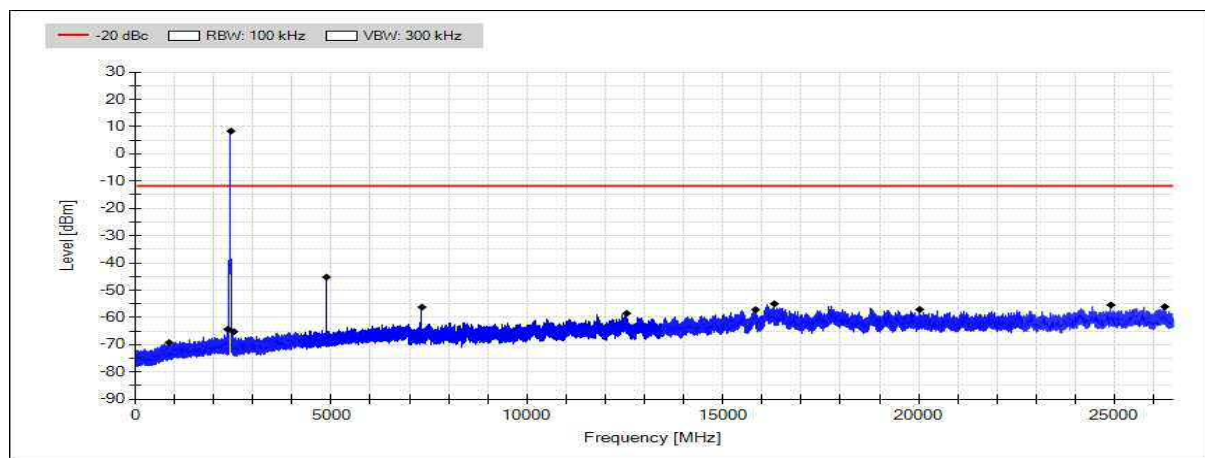


Figure 6: Conducted spurious emissions 30 - 26500 MHz channel mid

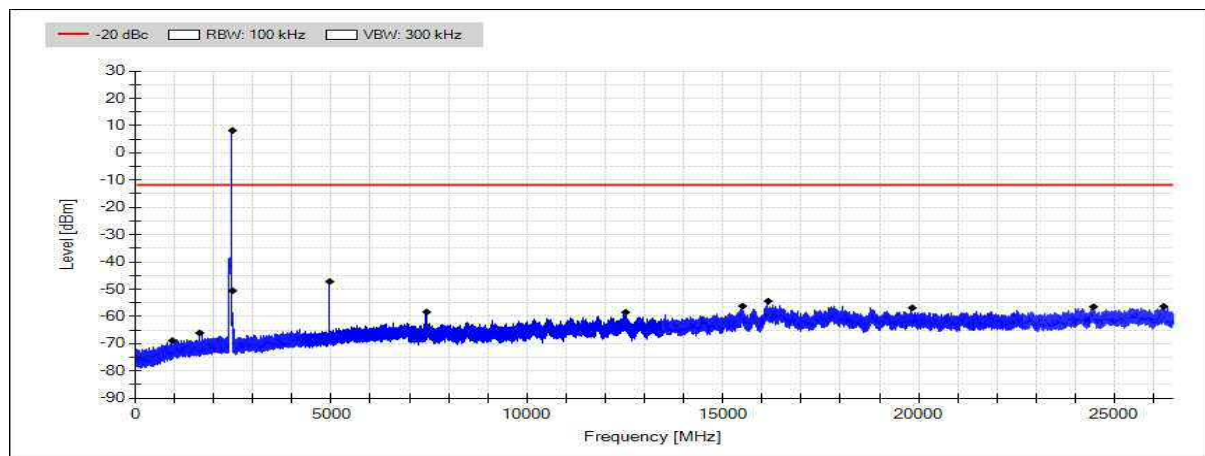


Figure 7: Conducted spurious emissions 30 - 26500 MHz channel high

6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 21.9.2016
Temperature: 24 °C
Humidity: 43 %

FCC Rule: 15.247(a)(2)
RSS-247 5.2(1)

Results:

Table 25: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	740.13	500
Mid	740.60	
High	737.01	



Figure 8: 6 dB bandwidth channel low

6 dB Bandwidth of the Channel

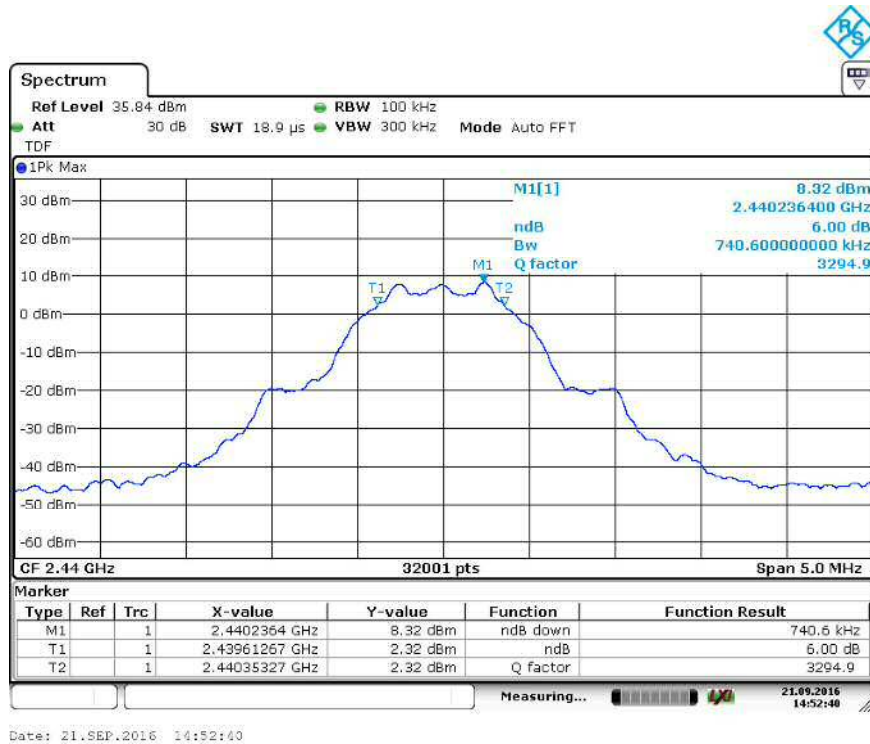


Figure 9: 6 dB bandwidth channel mid

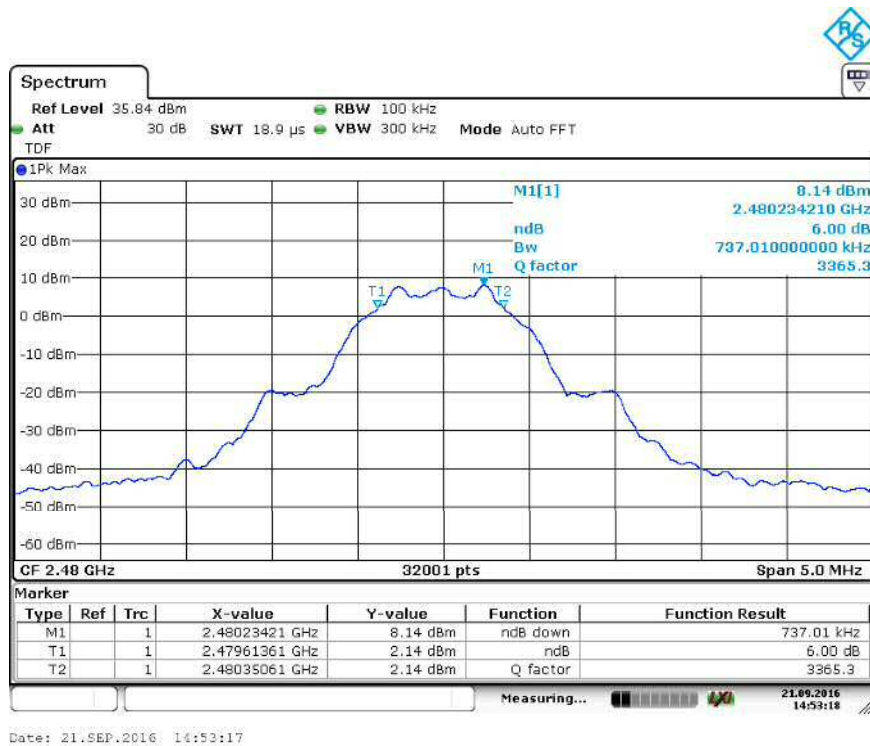


Figure 10: 6 dB bandwidth channel high

Power Spectral Density

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 21.9.2016
Temperature: 24 °C
Humidity: 43 %

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

Results:

Table 26: Power spectral density test results

Channel	PSD dBm/10 kHz	Maximum limit [dBm/3kHz]
Low	-1.39	+8.00
Mid	-1.84	
High	-1.98	

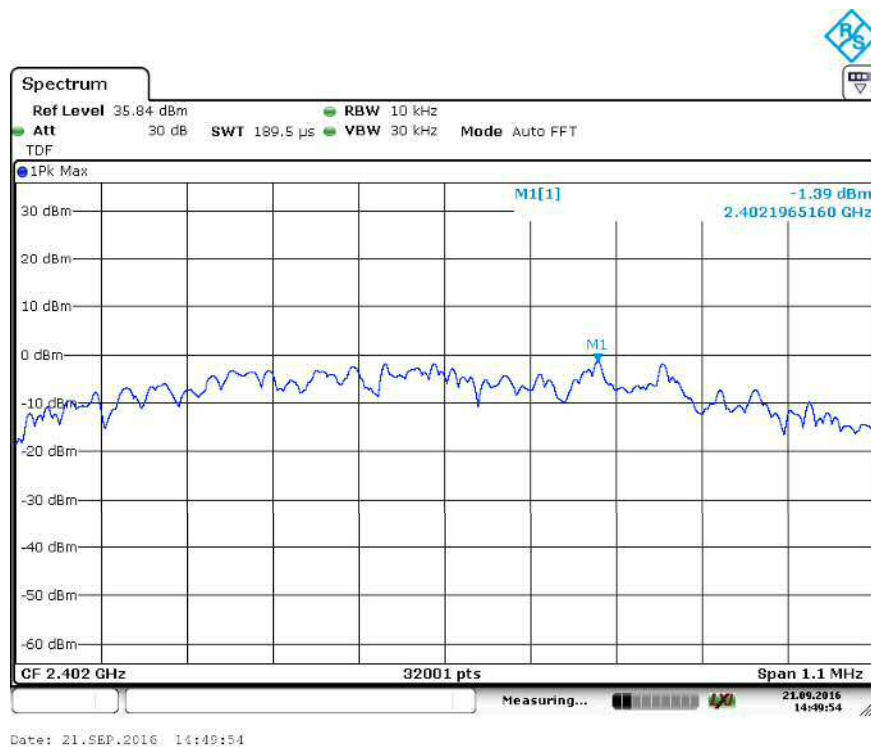


Figure 11: Power spectral density channel low

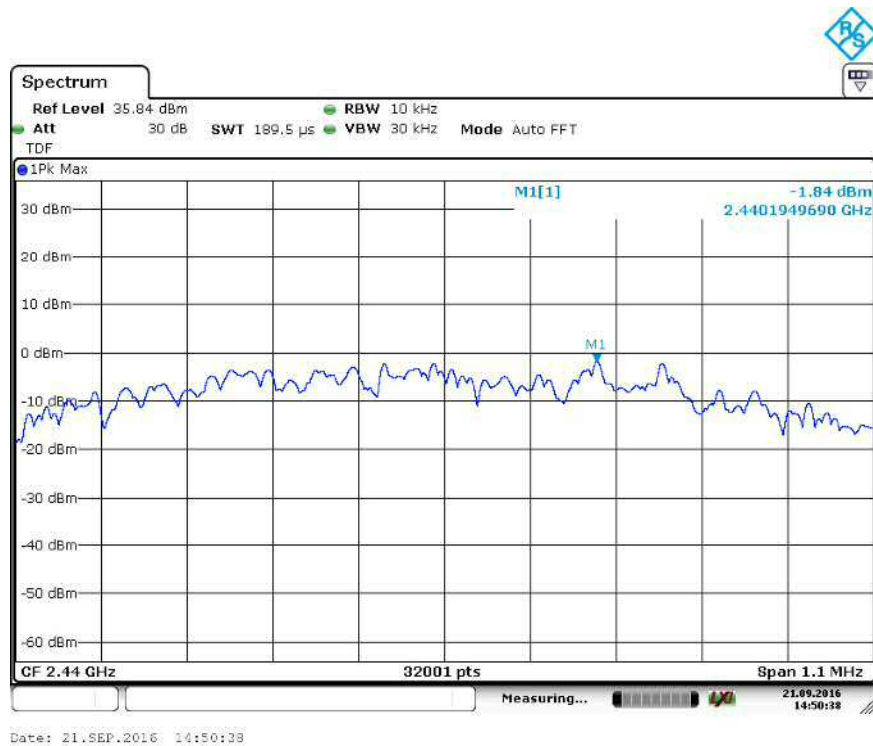


Figure 12: Power spectral density channel mid

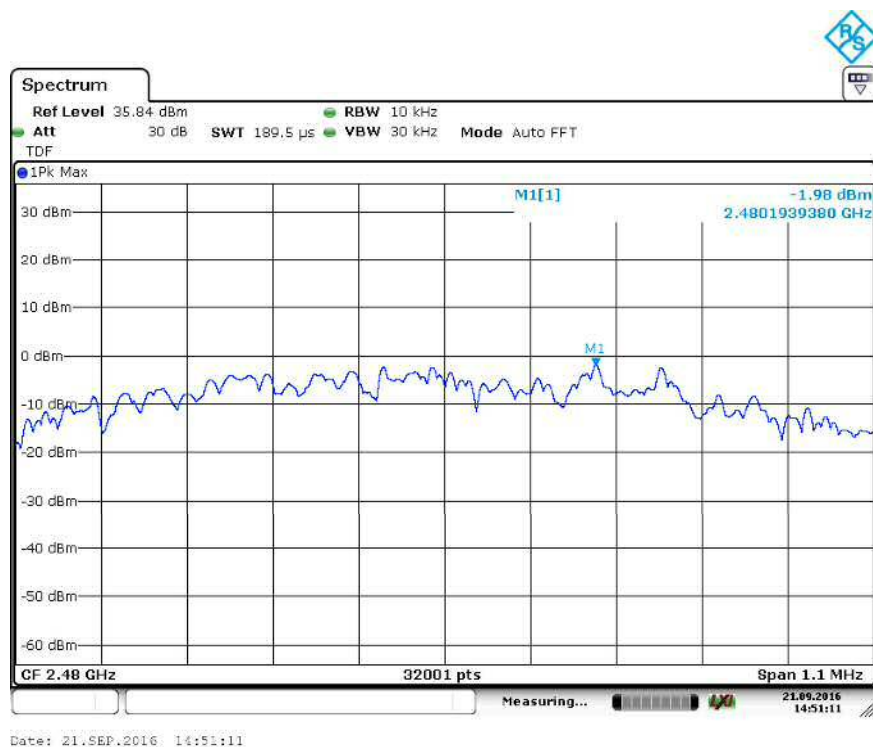


Figure 13: Power spectral density channel high

99% Occupied Bandwidth

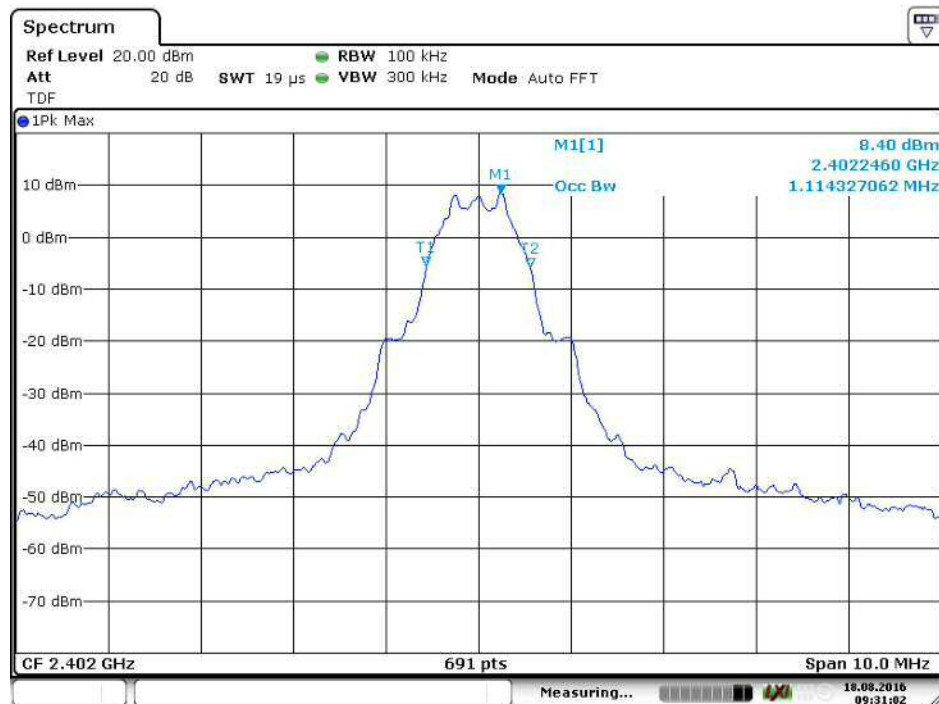
Standard: RSS-GEN (2014)
Tested by: RRE
Date: 18.8.2016
Temperature: 23 ± 3 °C
Humidity: 30 - 60 % RH

RSS-GEN 6.6

Channel frequency of 2442 MHz used as channel mid.

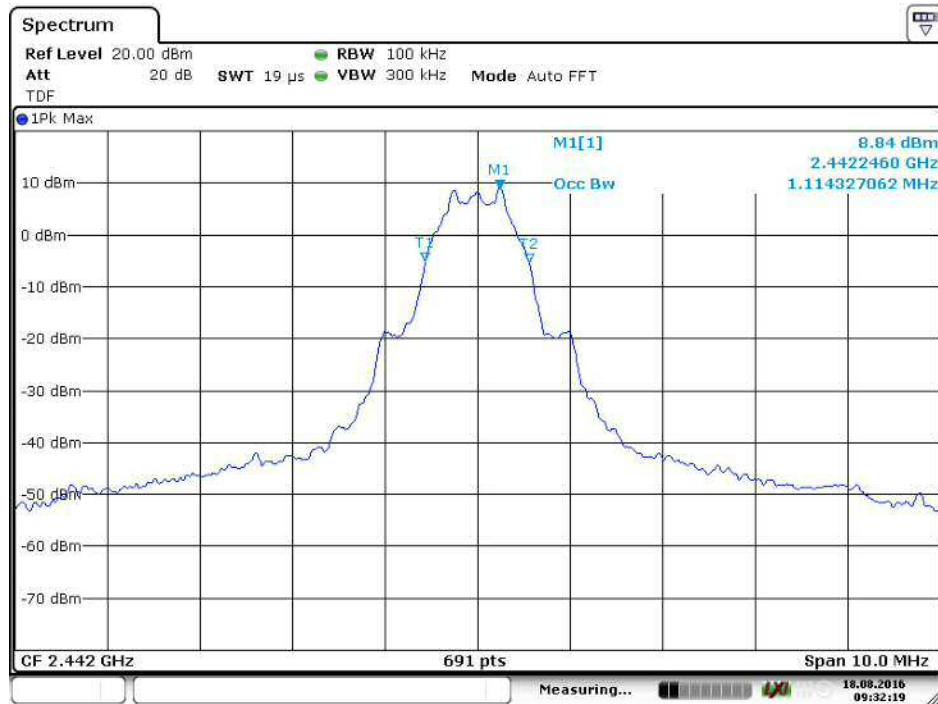
Table 27: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.114327062	PASS
Mid	-	1.114327062	PASS
High	-	1.114327062	PASS



Date: 18.AUG.2016 09:31:02

Figure 14: 99% OBW channel low



Date: 18.AUG.2016 09:32:19

Figure 15: 99% OBW channel mid


Date: 18.AUG.2016 09:29:33

Figure 16: 99% OBW channel high

TEST EQUIPMENT

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
MONITORING ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
MONITORING SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
PREAMPLIFIER	ALC MICROWAVE	AWB-2018-40-08	sn:14	2016-08-30	2017-08-30
PREAMPLIFIER	MERCURY SYSTEMS	ALS1826-41-12	-	2016-09-02	2017-09-02
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2016-06-10	2017-06-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2016-06-10	2017-06-10
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2014-11-04	2016-11-04
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2016-03-16	2017-03-16
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	sn:10	2016-01-22	2017-01-22
ATTENUATOR 10 dB	HUBER & SUHNER	6610.19.AA	sn:7	2016-02-02	2017-02-02
AC POWER SOURCE	CALIFORNIA INSTRUMENTS	5001 iX Series II	inv:7826	-	-
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2016-02-24	2017-02-24

All used measurement equipment was calibrated (if required).