

Test Report



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

Equipment Under Test: Multi-Protocol Wireless Module

Model: MGM12P32GA

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: 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 8, 2016)

Date: 22 May 2018

Issued by: 
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Date: 22 May 2018

Checked by: 
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Testing Engineer

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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	MGM12P32GA
Type:	Multi-Protocol Wireless Module
Serial no:	-
FCC ID:	QOQMGM12P3
IC:	5123A-MGM12P3

Description of the EUT

MGM12P is a multi-protocol wireless module. MGM12P32GA variant is equipped with integral chip antenna.

This test report contains test results for ZigBee.

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.

Ratings and declarations

Operating Frequency Range (OFR):	2405 - 2480 MHz
Channels:	15
Channel separation:	5 MHz
Modulation:	GFSK
Integral Antenna gain:	1 dBi

Power Supply

Operating voltage range: 2.0 - 3.8 VDC (tested with 3.3V regulated by the development board)

In 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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Disclaimer

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SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	N/T ⁽¹⁾
§15.247(b)(3) / RSS-247 5.4(d)	Maximum Peak Conducted Output Power	N/T ⁽¹⁾
§15.247(a)(2) / RSS-247 5.2(a)	6 dB Bandwidth	N/T ⁽¹⁾
§15.247(e) / RSS-247 5.2(b)	Power Spectral Density	N/T ⁽¹⁾
RSS-GEN 6.6	99% Occupied Bandwidth	N/T ⁽¹⁾
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	N/T ⁽¹⁾
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within the Restricted Bands	PASS

1) Not tested by the request of the customer

NOTE: RSS-247 and RSS-GEN not included accreditation scope of test laboratory.

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.

The EUT was installed in the development board.

Following channels and settings were used during the tests:

Table 1: Test frequencies and setting used in tests

Channel	Frequency (MHz)	Power setting
11	2405	200
19	2445	200
25	2475	200
26*	2480	180

*) channel 26 was used only for band edge measurement.

Test Facility

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

TEST RESULTS

Transmitter Radiated Spurious Emissions 9 kHz - 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: MIH / RRE
Date: 14 - 16 May 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.

In the frequency range 9 kHz – 30 MHz measurements were performed in middle channel.

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 9 kHz – 26500 MHz

Low channel (11)

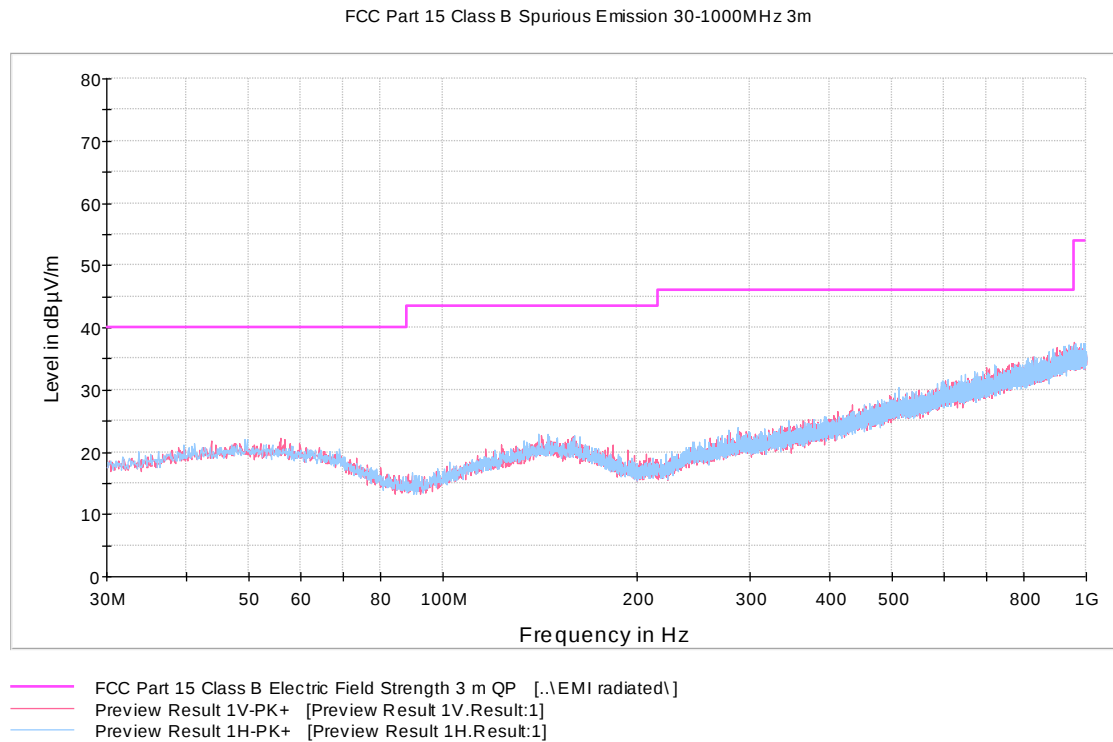


Figure 1: Channel 11 low 30 MHz – 1000 MHz

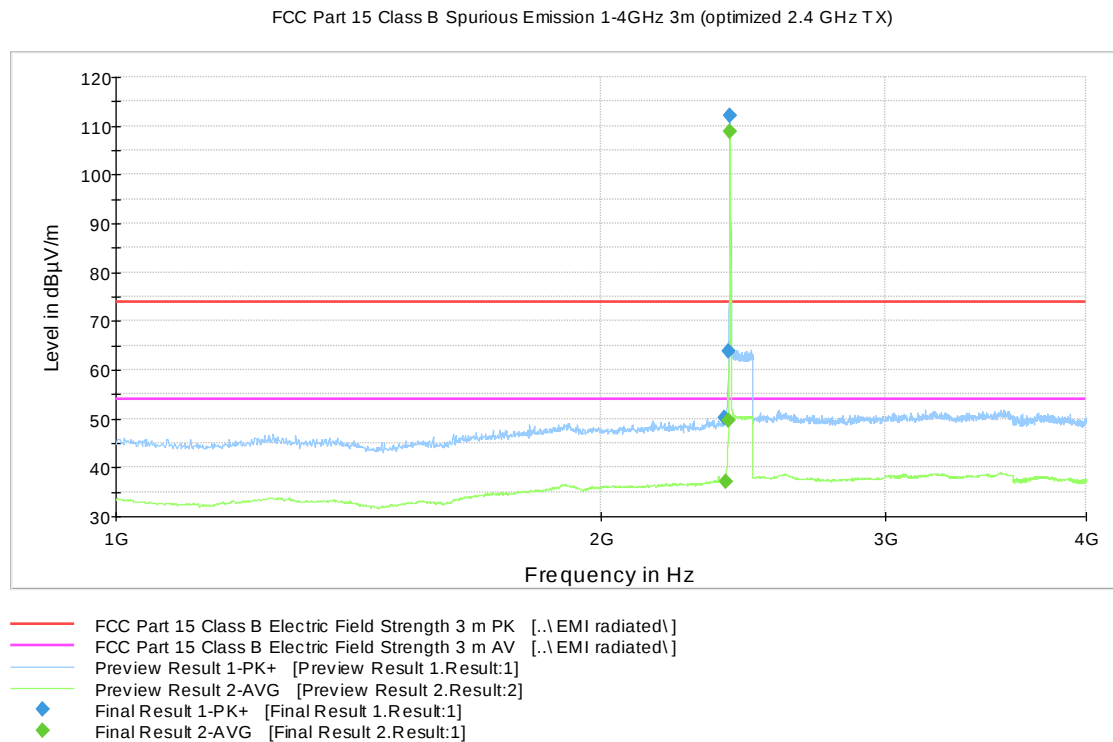


Figure 2: Channel 11 low 1 GHz – 4 GHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

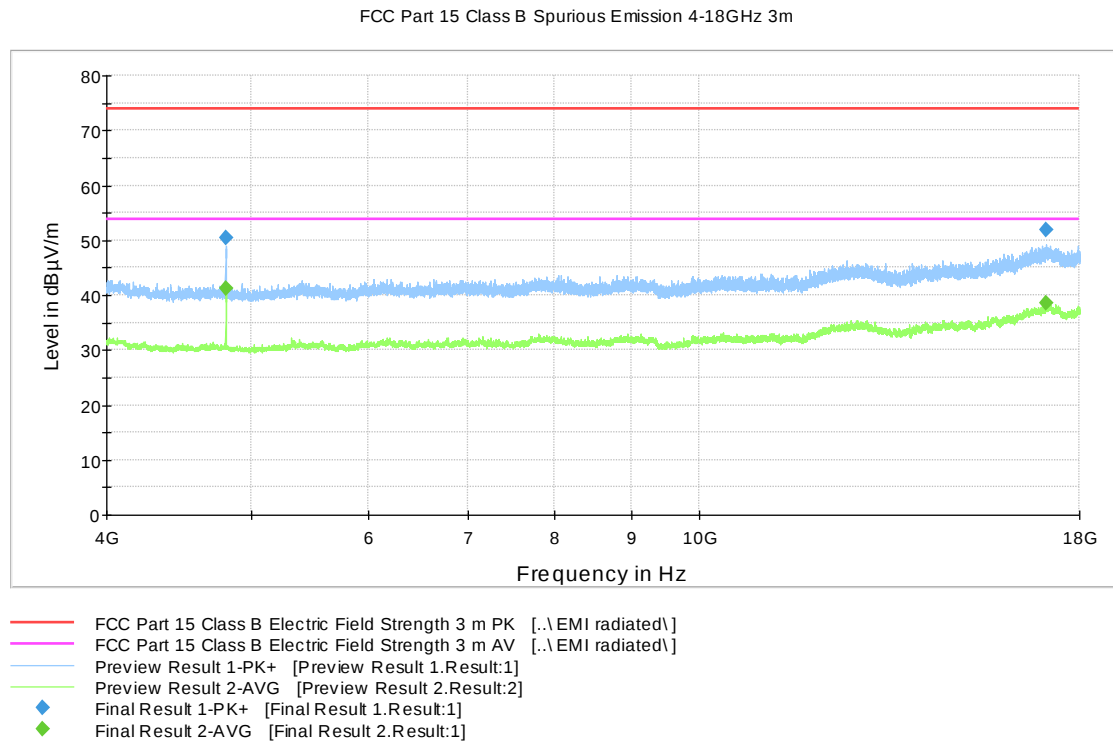


Figure 3: Channel 11 low 4 GHz – 18 GHz

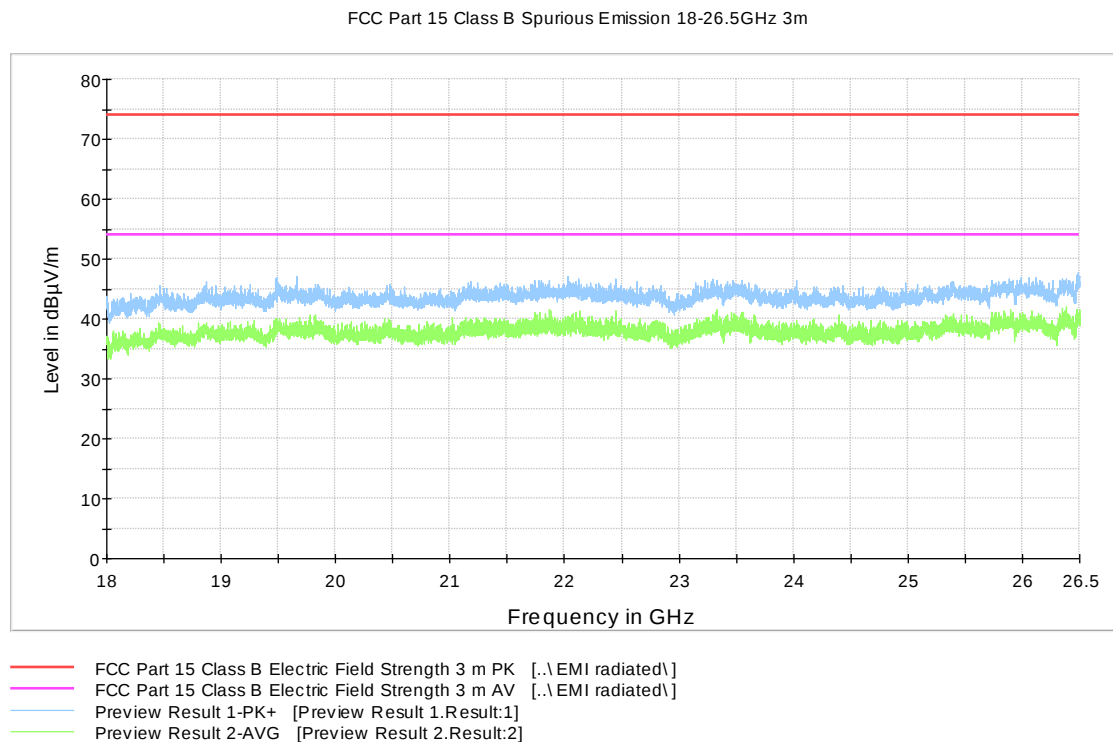


Figure 4: Channel 11 low 18 GHz – 26.5 GHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

Table 2: Peak results, channel 11 low

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2386.600000	50.2	1000.0	1000.000	385.0	H	74.0	14.6	23.7	73.9
2400.000000	63.7	1000.0	1000.000	308.0	H	324.0	14.7	28.3	92.0
4809.100000	50.5	1000.0	1000.000	150.0	V	341.0	8.4	23.4	73.9
17096.500000	51.8	1000.0	1000.000	370.0	V	337.0	28.8	22.1	73.9

Table 3: Average results, channel 11 low

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2389.200000	37.0	1000.0	1000.000	400.0	V	102.0	14.6	16.9	53.9
2400.000000	49.7	1000.0	1000.000	287.0	H	325.0	14.7	39.7	88.8
4808.900000	41.1	1000.0	1000.000	150.0	V	330.0	8.4	12.8	53.9
17089.200000	38.5	1000.0	1000.000	400.0	V	0.0	28.8	15.4	53.9

Middle channel (19)

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

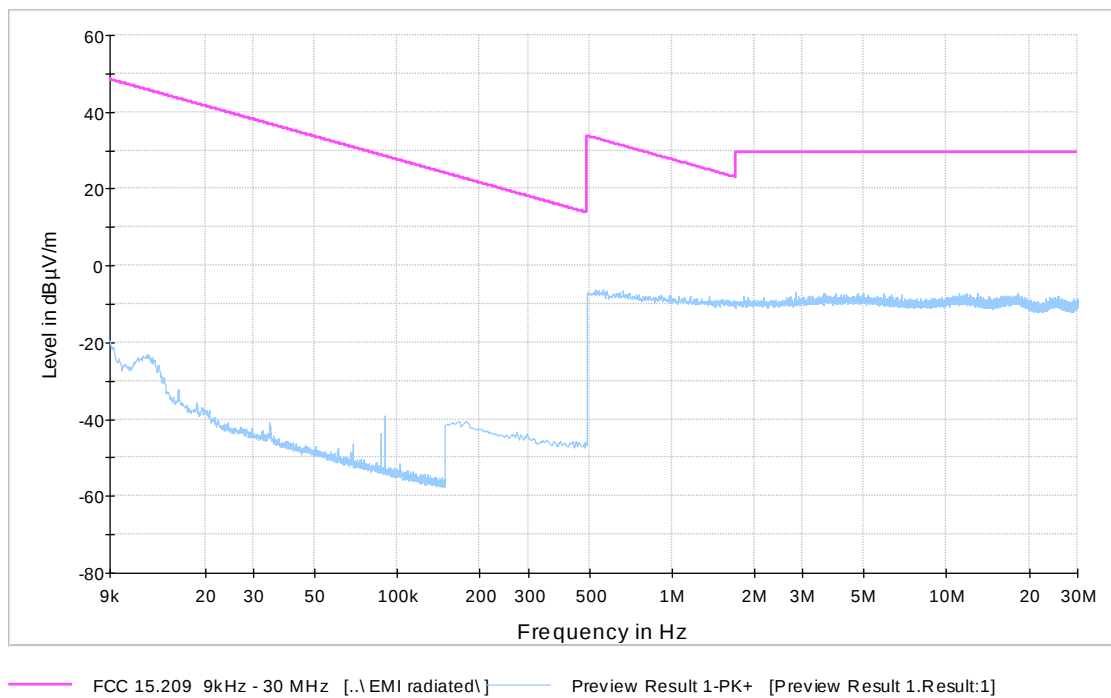


Figure 5: Channel 19 mid 9 kHz – 30 MHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

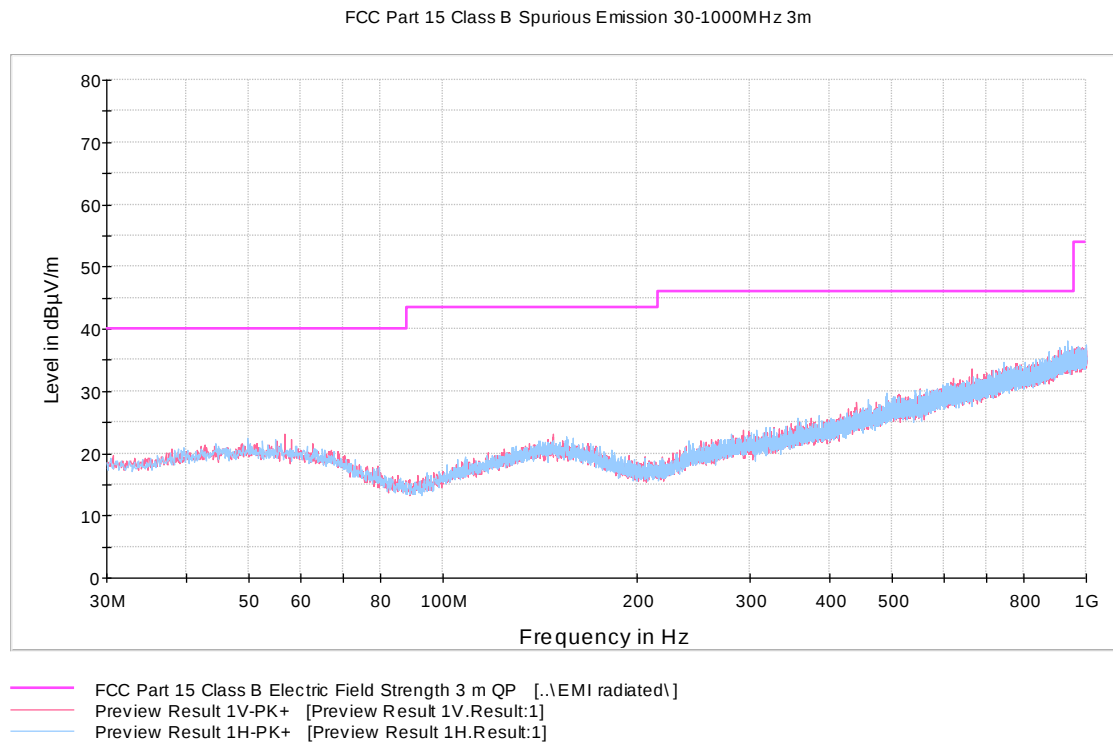


Figure 6: Channel 19 mid 30 MHz – 1000 MHz

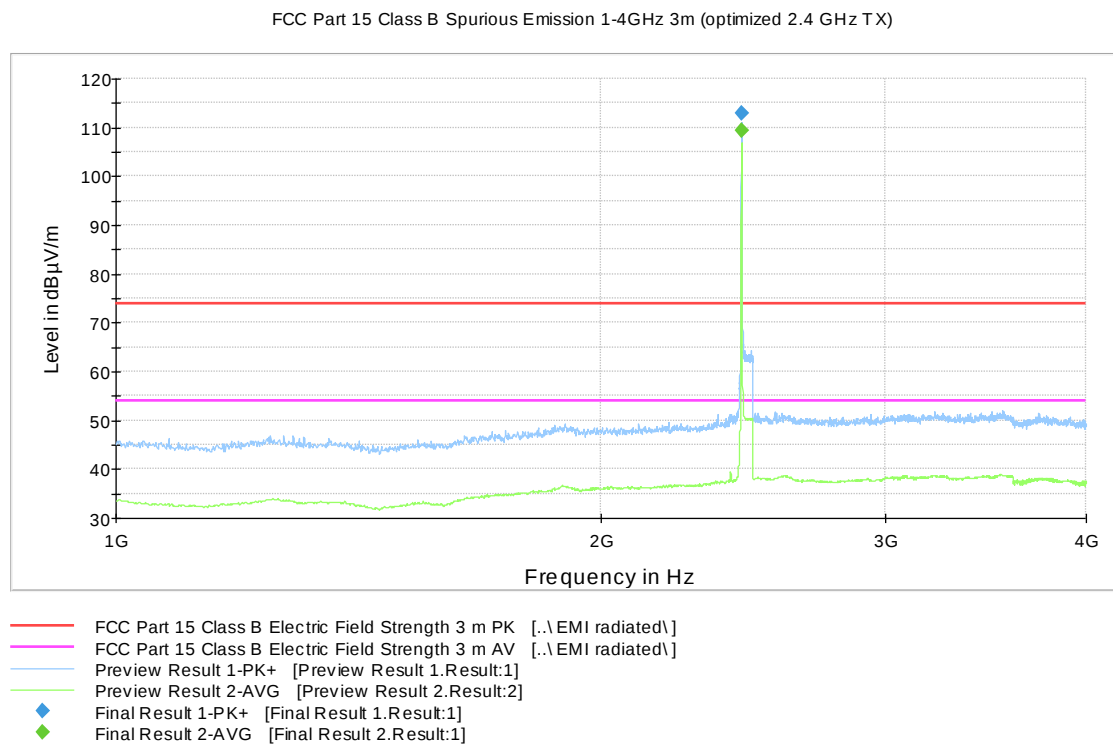


Figure 7: Channel 19 mid 1 GHz – 4 GHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

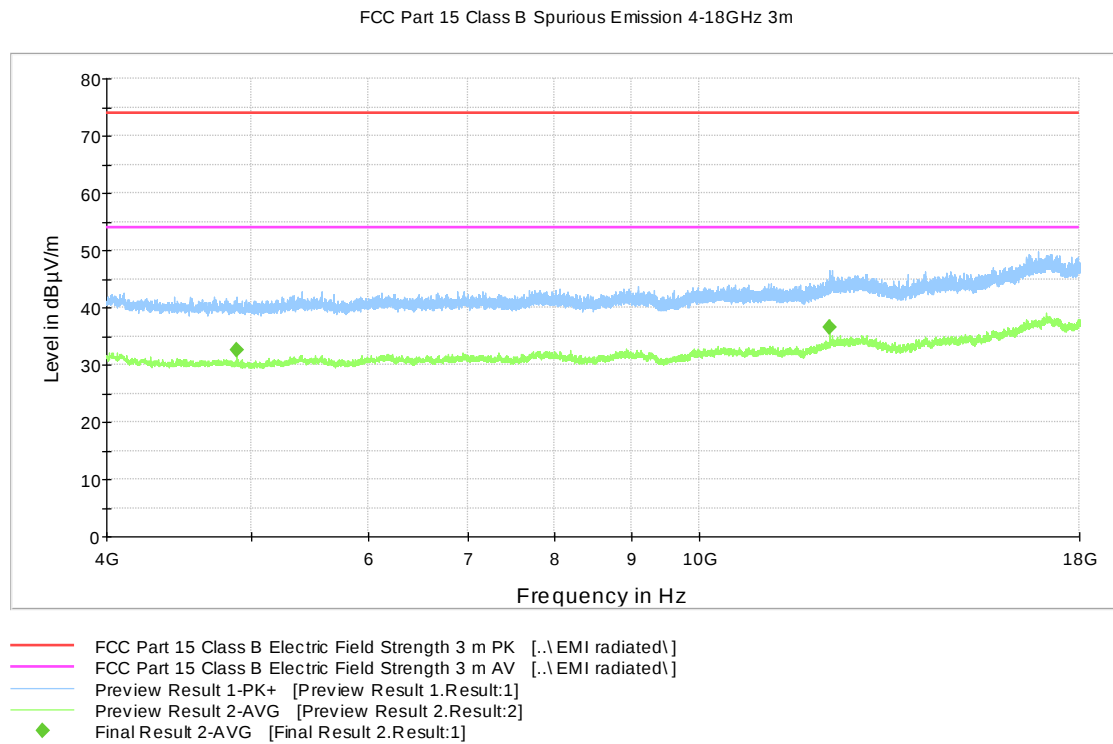


Figure 8: Channel 19 mid 4 GHz – 18 GHz

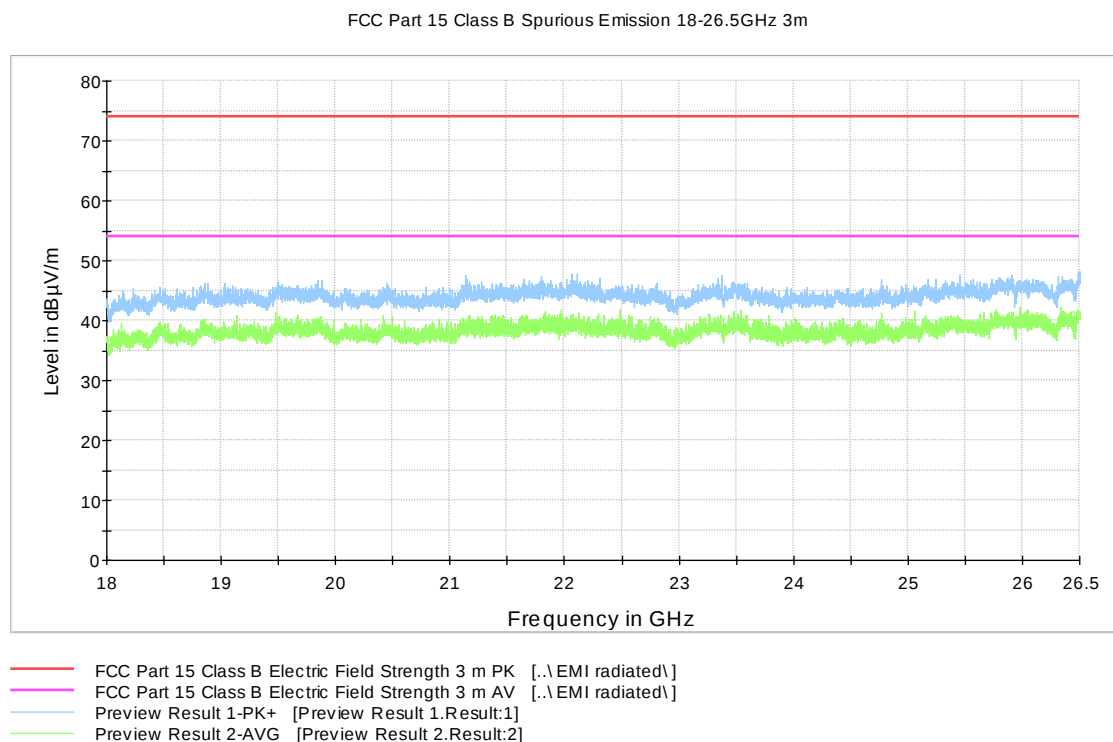


Figure 9: Channel 19 mid 18 GHz – 26.5 GHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

Table 4: Peak results, channel 19 mid

No final measurements were made; no emissions near the limit.									
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Table 5: Average results, channel 19 mid

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4891.000000	32.6	1000.0	1000.000	150.0	H	207.0	8.5	21.3	53.9
12227.80000	36.5	1000.0	1000.000	150.0	H	210.0	19.8	17.4	53.9

High channel (25)

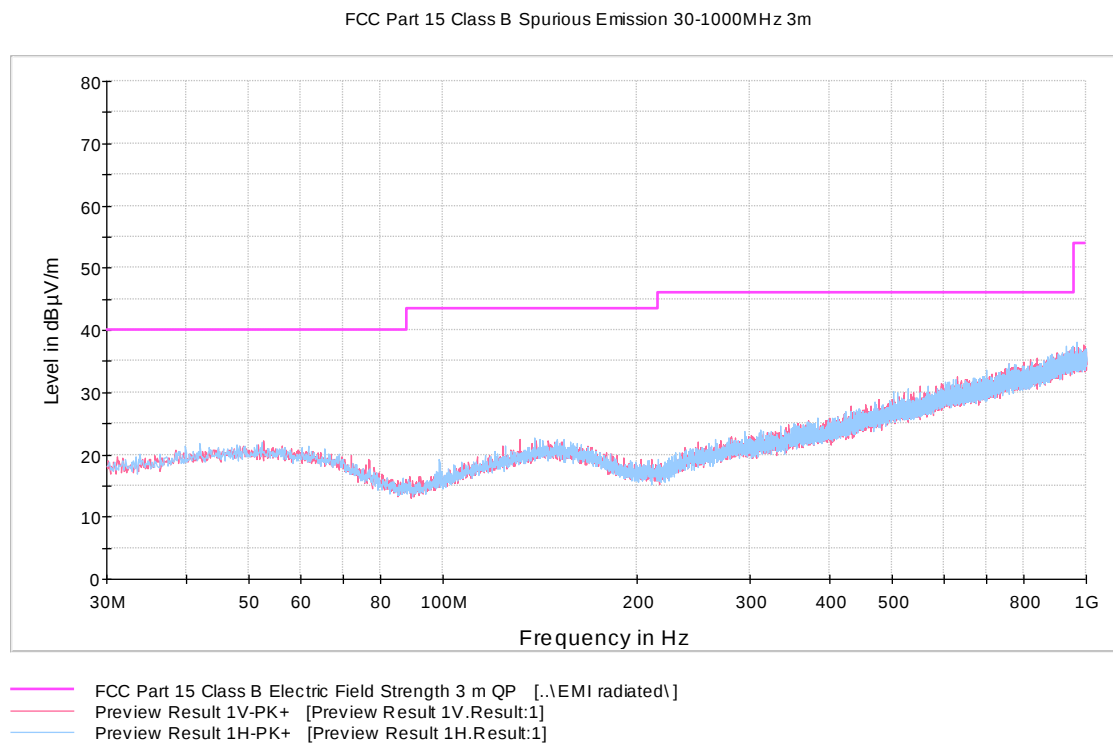


Figure 10: Channel 25 high 30 MHz – 1000 MHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

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

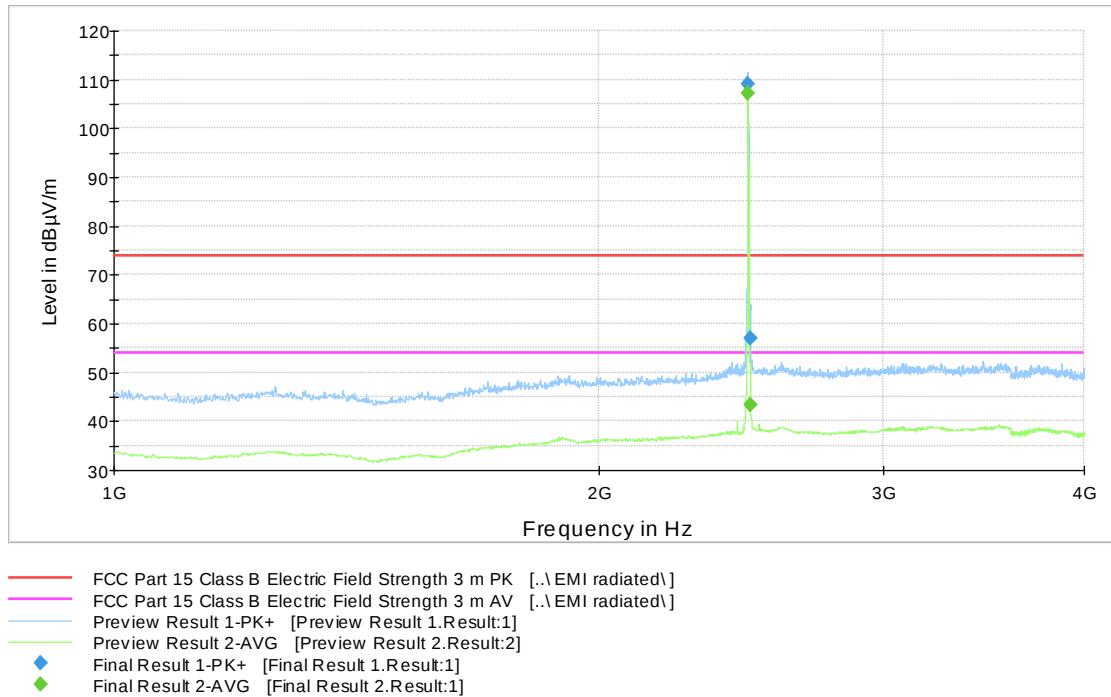


Figure 11: Channel 25 high 1 GHz – 4 GHz

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

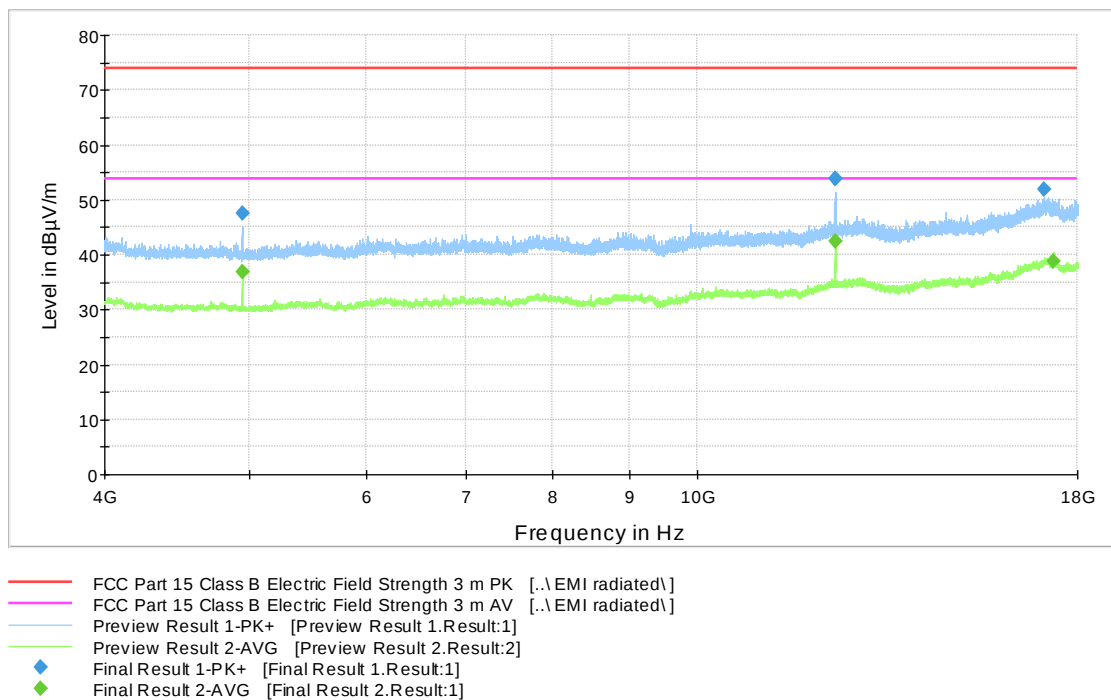


Figure 12: Channel 25 high 4 GHz – 18 GHz

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

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

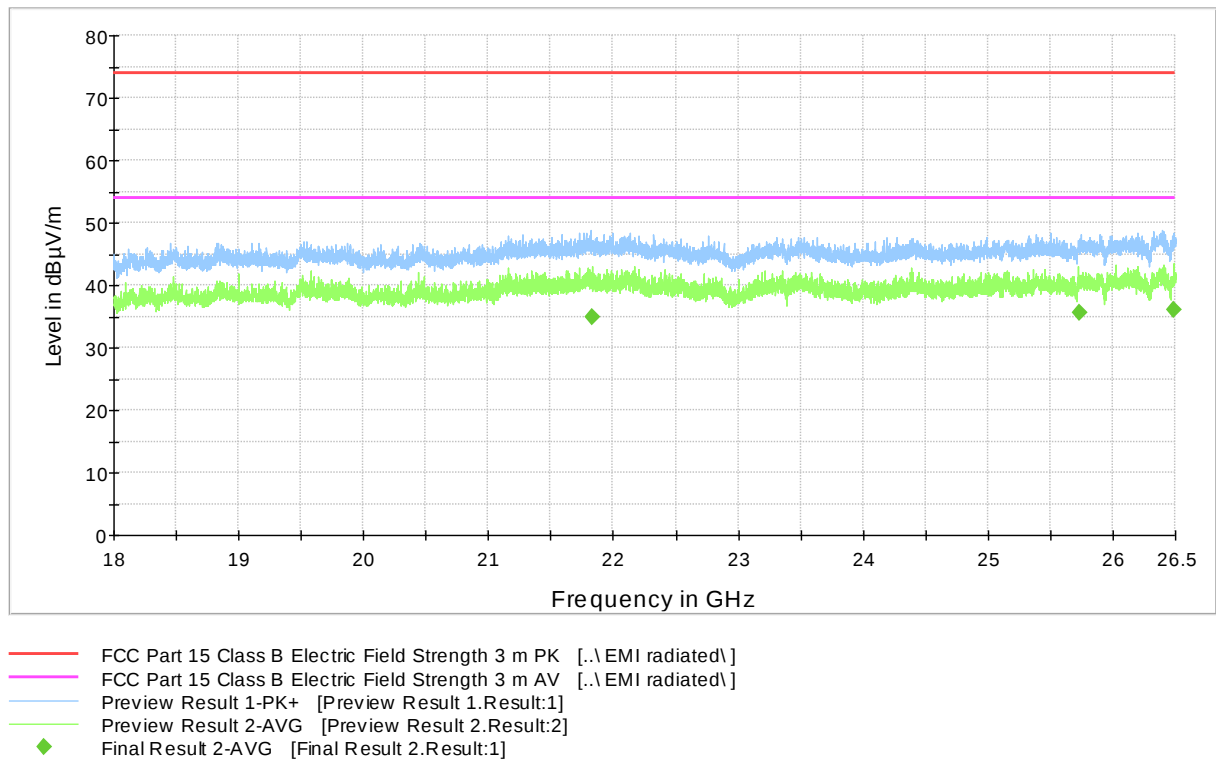


Figure 13: Channel 25 high 18 GHz – 26.5 GHz

Table 6: Peak results, channel 25 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	57.1	1000.0	1000.000	150.0	H	78.0	14.7	16.8	73.9
4949.000000	47.6	1000.0	1000.000	150.0	V	337.0	8.3	26.3	73.9
12377.60000	53.8	1000.0	1000.000	150.0	H	213.0	20.0	20.1	73.9
17108.00000	52.0	1000.0	1000.000	400.0	H	164.0	28.9	21.9	73.9

Table 7: Average results, channel 25 high

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
4951.000000	36.9	1000.0	1000.000	150.0	V	329.0	8.3	17.0	53.9
12377.80000	42.5	1000.0	1000.000	150.0	H	207.0	20.0	11.4	53.9
17329.00000	38.9	1000.0	1000.000	150.0	V	1.0	28.4	15.0	53.9

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

Radiated Band Edge results

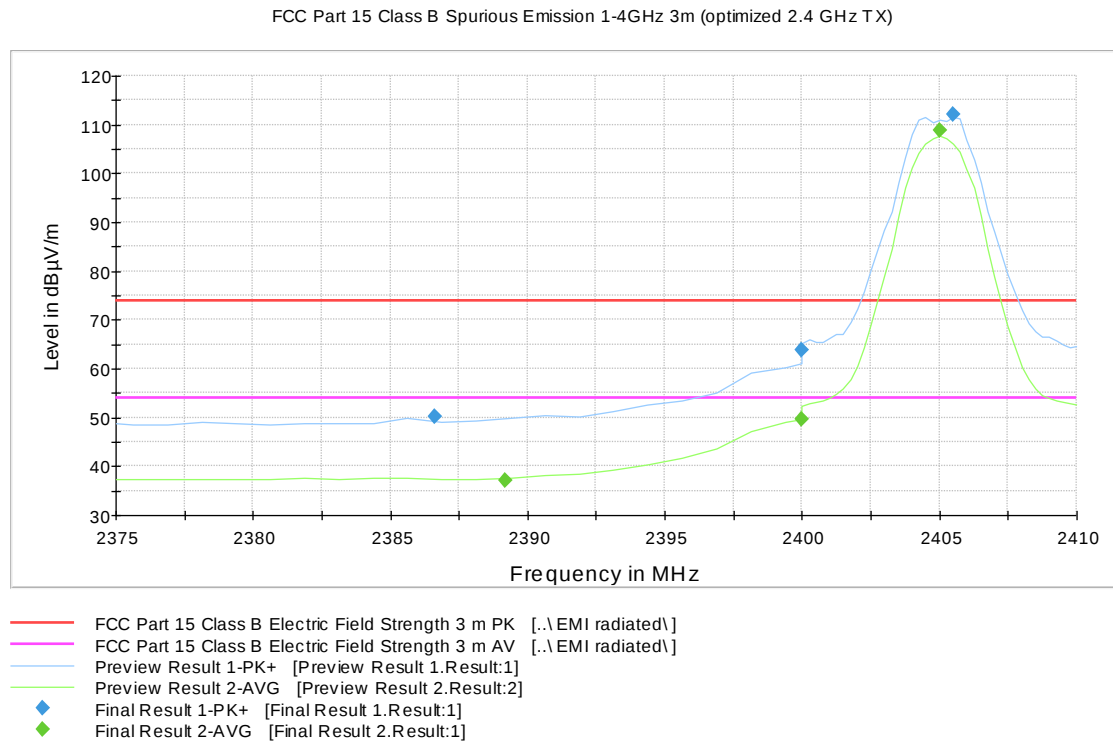


Figure 14: Radiated Band Edge measurement graph, Channel 11 low

Table 8: Peak results, channel 11 low

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2386.600000	50.2	1000.0	1000.000	385.0	H	74.0	14.6	23.7	73.9
2400.000000	63.7	1000.0	1000.000	308.0	H	324.0	14.7	28.3	92.0

Table 9: Average results, channel 11 low

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2389.200000	37.0	1000.0	1000.000	400.0	V	102.0	14.6	16.9	53.9
2400.000000	49.7	1000.0	1000.000	287.0	H	325.0	14.7	39.1	88.8

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

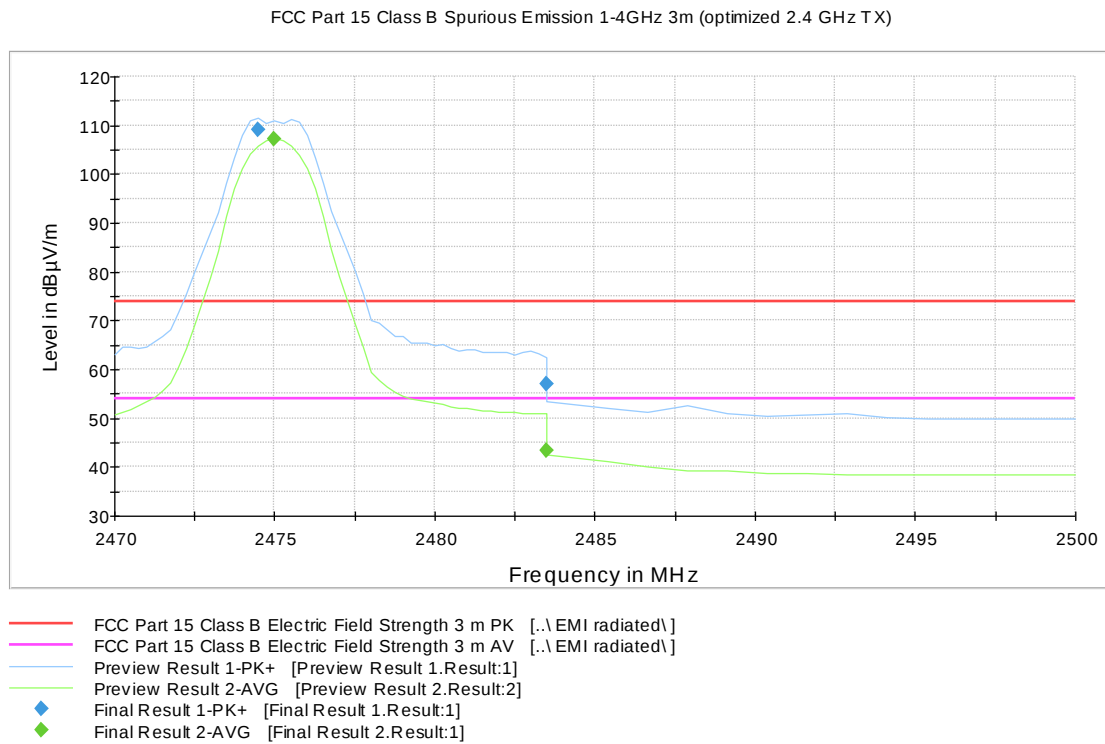


Figure 15: Radiated Band Edge measurement graph, Channel 25 high

Table 10: Peak results, channel 25 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	57.1	1000.0	1000.000	150.0	H	78.0	14.7	16.8	73.9

Table 11: Average results, channel 25 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	43.5	1000.0	1000.000	216.0	H	74.0	14.7	10.4	53.9

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

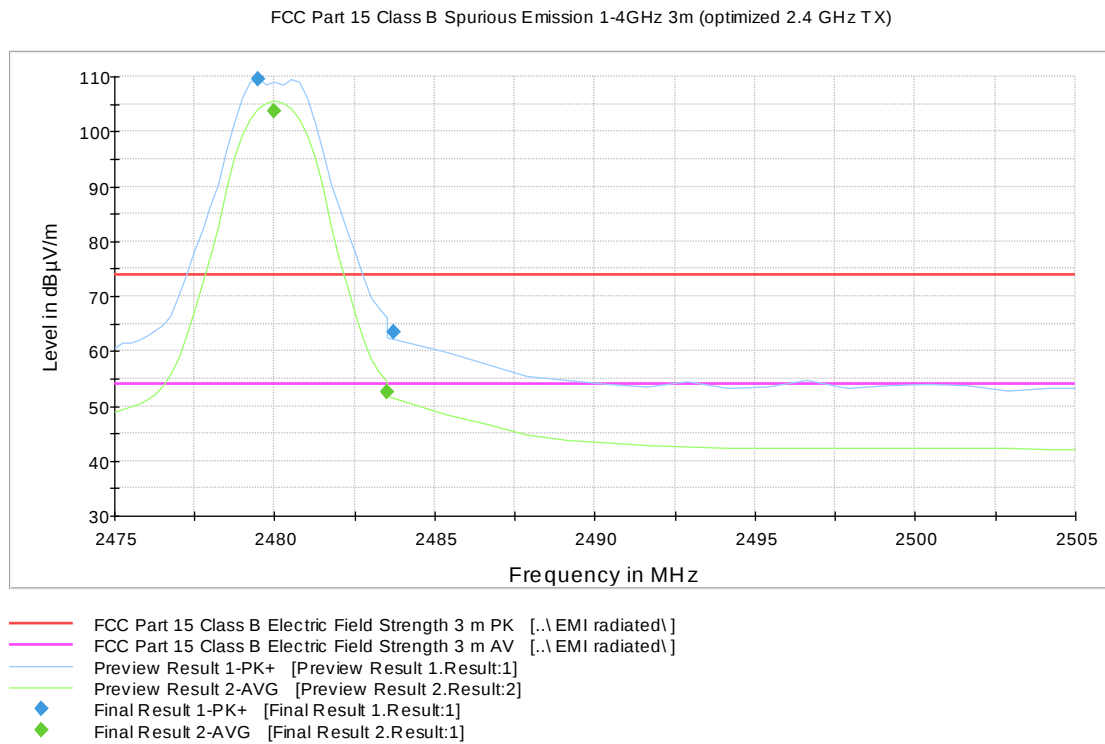


Figure 16: Radiated Band Edge measurement graph, Channel 26 high

Table 12: Peak results, channel 26 high

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2483.700000	63.4	1000.0	1000.000	169.0	H	77.0	14.7	10.5	73.9

Table 13: Average results, channel 26 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	52.5	1000.0	1000.000	150.0	H	74.0	14.7	1.4	53.9

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	THANDAR	TS3021S	inv:3484	-	-
MULTIMETER	FLUKE	Fluke 87	inv:9470	2017-12-19	2018-12-19
ANTENNA	EMCO	3117	inv:7293	2018-03-14	2020-03-14
ANTENNA	EMCO	3160-09	inv:7294	2018-03-19	2019-03-19
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
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2016-10-25	2018-10-25
TEMPERATURE/ HUMIDITY METER	VAISALA	HMT 333	inv:8638	2018-04-05	2019-04-05
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	inv:10403	2017-03-01	2019-03-01