RF Test Report

Project Number:	**5025746**	**Offer Number:**	**SUW-202210003579**
Report Number:	**5025746EMC08**	**Report Revision:**	**2**

Client: **Deere & Company**

Equipment Under Test: **Modular Telematics Gateway 4G LTE (MTG 4G LTE) with 18' LMR 240 UF Cable & MCR Whip Antenna**

Model: **MA4G**

FCC ID: **OV5-MA4G**

IC: **11137A-MA4G**

Applicable Standards: **FCC Part 15 Subpart C, § 15.247**

ANSI C63.10: 2013

RSS-247, Issue 2

RSS-GEN Issue 5

Report Revision on: **19 July 2023**

Test Result: **Compliant**

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01
Report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by: Daniel Alvarez, RF/EMC Sr. Staff Engineer

Reviewed by: Martin Taylor, EMC/RF Project Engineer

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1 Summary of Test Results

Test Description	Test Specification		Test Result
Bandwidth	15.247(a)(2)	RSS-247 5.2(a) RSS-GEN 6.7	NA[1]
(BTC) Peak Output Power	15.247(a)(1), (b)(1)	RSS-247 5.4(b), 5.1(b)	Compliant
(BLE) Peak Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant
(WLAN) Transmitter Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 5.2 (b)	NA[1]
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 5.5	NA[1]
Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN 8.9, 8.10	Compliant
Pseudo-Random Hop Sequence	15.247(a)(1)	RSS-247 5.1(a)	NA[1]
Channel Separation	15.247(a)(1)	RSS-247 5.1(b)	NA[1]
Number of Hopping Channels	15.247(a)(1)(iii)	RSS-247 5.1(d)	NA[1]
Dwell Time	15.247(a)(1)(iii)	RSS-247 5.1(d)	NA[1]
Antenna Requirement	15.203	RSS-GEN 6.8	Compliant
AC Powerline Conducted Emissions	15.107, 15.207	RSS-GEN 8.8	NA[2]

1) Testing to address antenna change with use of 18'LMR Cable. The test requirements were not affected by the modification and test requirements were covered in previous test reports: 3958632EMC04 Rev: 0 & 3958632EMC05 Rev: 0.
2) The device has no facility for connection to the AC mains.

1.1 *Modifications Required for Compliance*

None

2 General Information

2.1 *Client Information*

Name:	Deere & Company dba John Deere Intelligent Solutions Group
Address:	9505 Northpark Dr.
City, State, Zip, Country:	Urbandale, IA 50131 USA

2.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA
Accrediting Body:	A2LA
Type of lab:	Testing Laboratory
Certificate Number:	3212.01
CAB Identifier:	US0186

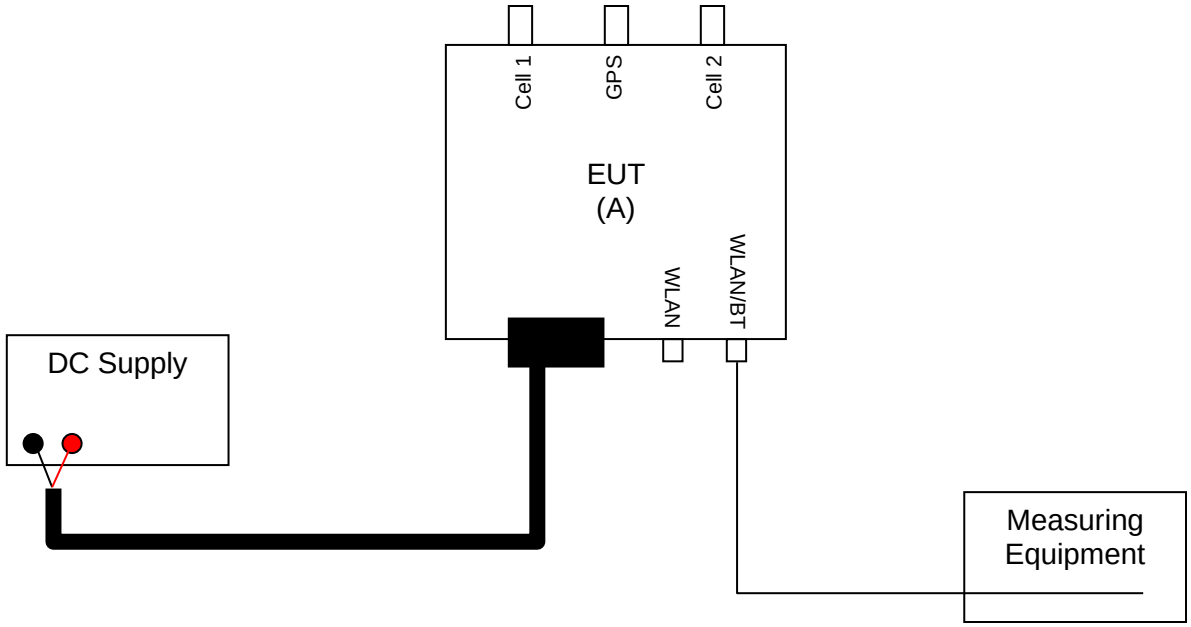
2.3 *General Information of EUT*

Manufacturer Name:	Deere & Company
Address:	One John Deere Place
City, State, Zip, Country:	Moline, IL 61265
Product Marketing Name (PMN):	MTG 4G LTE
Model Number (HVIN):	MA4G
Serial Number:	JD PH#: 90241530 805007
FCC ID:	OV5-MA4G
IC ID:	11137A-MA4G
Frequency Range:	BTC/BLE: 2402 – 2480 MHz / WLAN: 2412-2462
Data Mode / Modulation:	WLAN 802.11 b/g/nHT20/nHT40 Bluetooth Classic (BTC) GFSK/ Pi/4-DQPSK/8DPSK Bluetooth Low Energy (BLE) 1M
Antenna Type:	MCR Whip Antenna
Antenna Gain:	5 dBi
Rated Voltage:	9 – 32Vdc
Test Voltage:	12 VDC
Sample Received Date:	23 March 2023
Dates of testing:	27 March 2023 – 12 June 2023

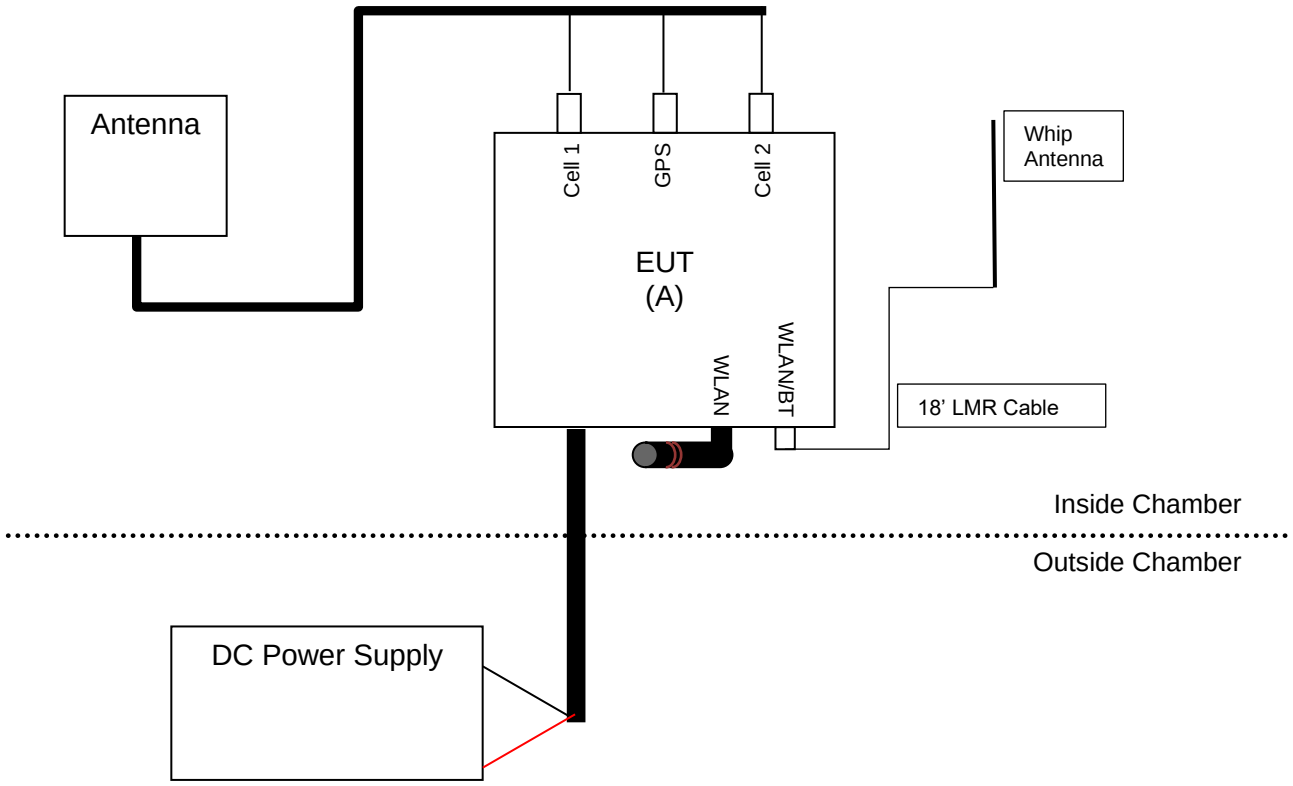
2.4 *Operating Modes and Conditions*

The EUT was programmed by the manufacturer to transmit on low, mid, and high channels in all necessary modulation and modes of operation.

2.5 *EUT Connection Block Diagram – Conducted Measurements*



2.6 *EUT Connection Block Diagram – Radiated Measurements*



2.7 *System Configurations*

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Deere & Company	MTG 4G LTE with 18' LMR 240 UF Cable & MCR Whip Antenna	MA4G	JD PH#: 90241530 805007

The EUT was configured using the harness and antenna connections from the previous submittal with the exception that we are now utilizing the MCR whip antenna to replace the PCTEL Antenna for WLAN primary port (5 dBi). This configuration will include a LMR 240 UF 18' cable. The 18' cable will be the shortest & only RF cable configuration available. Measurements were performed on the output of the 18' LMR cable.

4 (BTC) Peak Output Power

4.1 *Test Result*

Test Description	Test Specification	Test Result
Peak Output Power	ANSI C63.10:2013 15.247(a)(1), (b)(1) RSS-247 5.4(b), 5.1(b)	Compliant

4.2 *Test Method*

Output power measurements were taken using the methods defined an ANSI C63.10, Clause 7.8.5.

Limit
§15.247(b)(1): For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels…: 1 watt (30 dBm).
§15.247(a)(1): Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21 dBm).

4.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	24.11 °C
Relative Humidity:	32.6 %
Atmospheric Pressure:	98.2 kPa

4.4 *Test Equipment*

Test End Date: 5-May-2023 Tester: DA

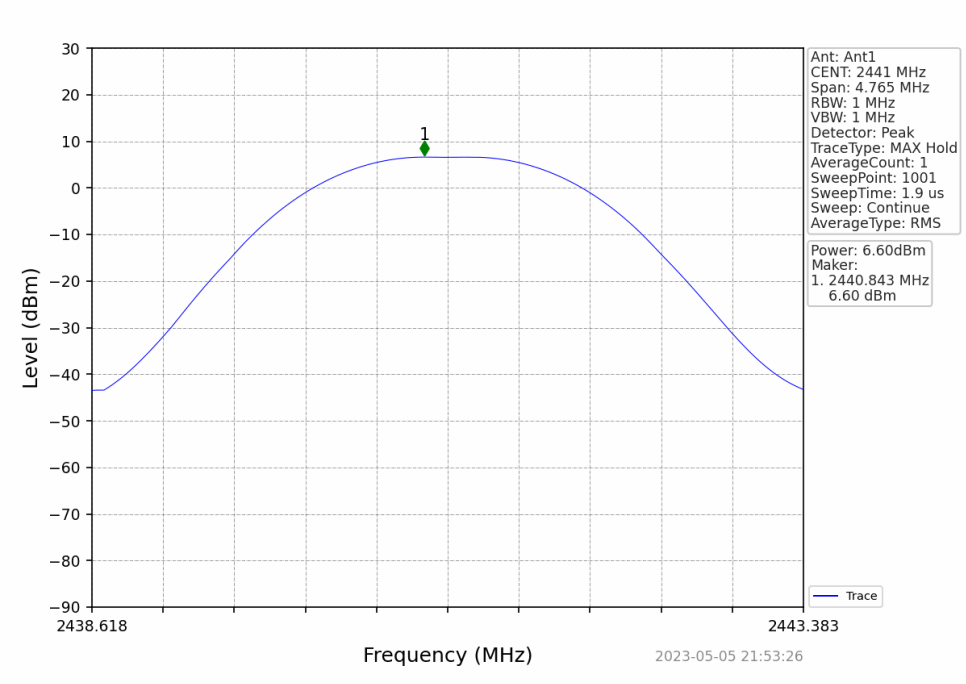
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	13-Mar-2023	13-Mar-2024
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	CNR	CNR

Test Software Profile: TSTPASS Version: 2.0, build 2023

4.5 *Data*

Test Mode	Frequency (MHz)	Tx Type	Measured Peak Output Power (dBm)	Limits (dBm)	Verdict
			Ant 1		
GFSK	2402	SISO	6.51	<=30	Pass
	2441	SISO	6.60	<=30	Pass
	2480	SISO	6.59	<=20.97	PASS
Pi/4DQPSK	2402	SISO	3.64	<=20.97	PASS
	2441	SISO	3.77	<=20.97	PASS
	2480	SISO	4.50	<=20.97	PASS
8DPSK	2402	SISO	4.14	<=20.97	PASS
	2441	SISO	4.13	<=20.97	PASS
	2480	SISO	4.93	<=20.97	PASS

Representative Plot



5 (BLE) Peak Output Power

5.1 *Test Result*

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant

5.2 *Test Method*

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm)

5.3 *Test Site*

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	24.11 °C
Relative Humidity:	32.6 %
Atmospheric Pressure:	98.2 kPa

5.4 *Test Equipment*

Test End Date: 5-Jun-2023 Tester: DA

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	13-Mar-2023	13-Mar-2024
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	CNR	CNR

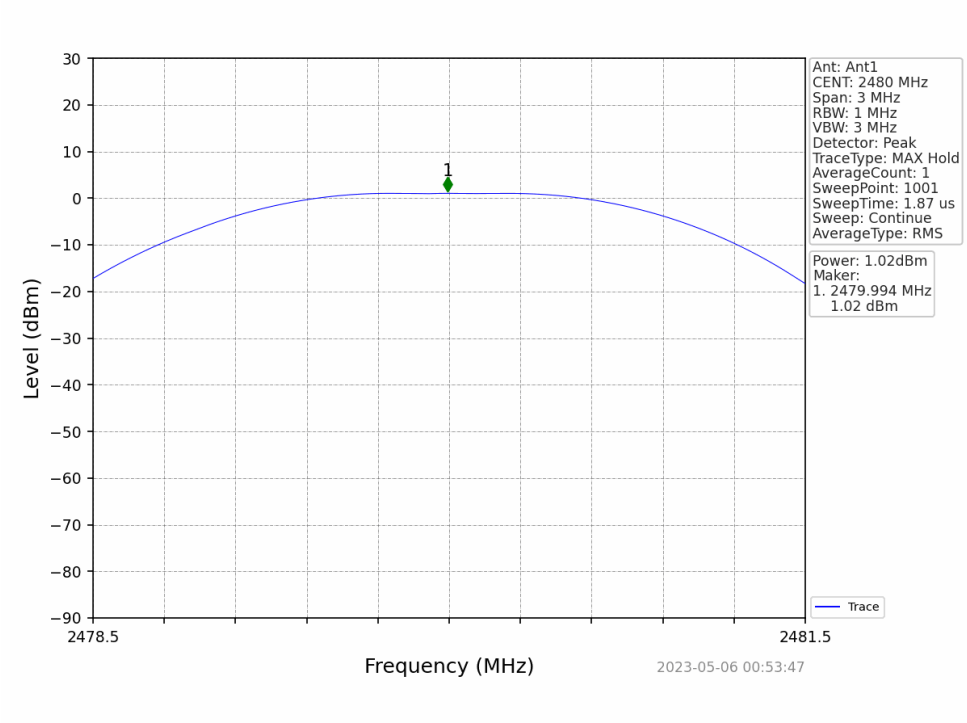
Software Profile:
TSTPASS Version: 2.0, build 2023

5.5 *Test Data*

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			ANT1	Limit	
1M	SISO	2402	0.30	<=30	Pass
		2440	0.44	<=30	Pass
		2480	1.02	<=30	Pass
Note1: Antenna Gain: Ant1: 5.00dBi;					

Sample Plot

High Channel (2480MHz)



6 (WLAN) Peak Output Power

6.1 *Test Result*

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant

6.2 *Test Method*

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm)

6.3 *Test Site*

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	24.11 °C
Relative Humidity:	32.6 %
Atmospheric Pressure:	98.2 kPa

6.4 *Test Equipment*

Test End Date: 24-Mar-2023 Tester: DA

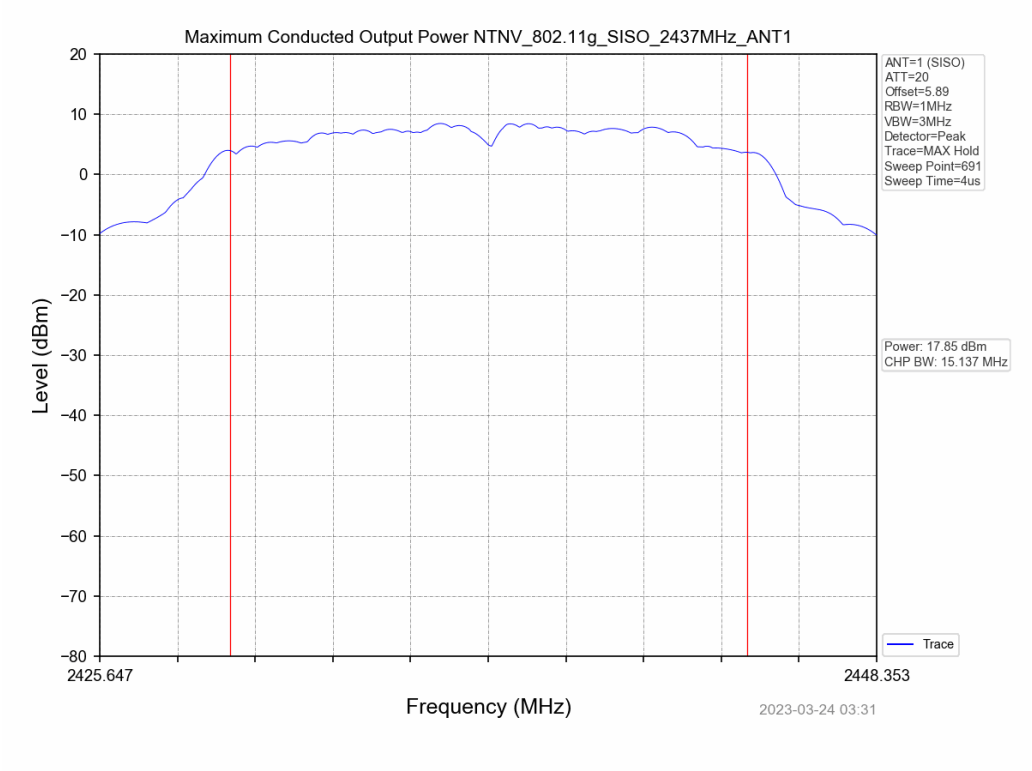
Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	13-Mar-2023	13-Mar-2024
TSTPASS SWITCHBOX	SB2	TSTPASS	23009	CNR	CNR

6.5 *Test Data*

Test Mode	Frequency (MHz)	Tx Type	Measured Peak Output Power (dBm) Ant 1	Limits (dBm)	Verdict
802.11b	2412	SISO	12.90	30	PASS
	2437	SISO	13.05	30	PASS
	2462	SISO	15.12	30	PASS
802.11g	2412	SISO	13.74	30	PASS
	2437	SISO	17.85	30	PASS
	2462	SISO	13.92	30	PASS
802.11n(HT20)	2412	SISO	12.69	30	PASS
	2437	SISO	14.94	30	PASS
	2462	SISO	13.44	30	PASS
802.11n(HT40)	2422	SISO	11.11	30	PASS
	2437	SISO	15.46	30	PASS
	2452	SISO	10.97	30	PASS

Sample Plot

Mid Channel – 802.11g, Ant1 (2437MHz)



7 Field Strength of Spurious Radiation

7.1 *Test Result*

Test Description	Test Specification		Test Result
Spurious Emissions	15.205 and 15.209	RSS-GEN 8.9, 8.10	Compliant

7.2 *Test Method*

The measurement methods defined in ANSI C63.10 method of clauses 6.3, 6.5, and 6.6 were used. The integral antenna was connected during test.

Worst-case rates were tested.

Test distance:

9k to 30 MHz – Near field prescan to determine if there were any emissions.
30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters
1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

Frequency	Limits(1)		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 (2)	--
88 - 216 MHz	150	43.5 (2)	--
216 - 960 MHz	200	46 (2)	--
960 - 1000 MHz	500	54 (2)	--
1 - 40 GHz	500	54 (3)	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.
(2) Quasi-peak limit
(3) Average limit

7.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions	30-1000MHz	1-18GHz
Temperature:	22.5 °C	22.5 °C
Relative Humidity:	48.2 %	48.2 %
Atmospheric Pressure:	97.4 kPa	97.4 kPa

7.4 *Test Equipment*

Test End Date: 2-May-2023 Tester: PL

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	26-May-2022	26-May-2024
N to N RF Cable	EM-B810NM-276	ECHELON	23007	31-Mar-2023	31-Mar-2024
RF CABLE NM TO NM, 0.01-12GHZ	90-078-079	TELEDYNE STORM MICROWAVE	20115	15-Mar-2023	15-Mar-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20123	9-Feb-2023	9-Feb-2024
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20132	13-Mar-2023	13-Mar-2024
ROTARY NM TO NF CONNECTOR	18-2120-0	DIAMOND ANTENNA AND MICROWAVE CORP	22008	13-Mar-2023	13-Mar-2024
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079800	14-Sep-2022	14-Sep-2023
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22032	24-Nov-2022	24-Nov-2023

Software:
“RSE 30-1000 MHz T7 220318” TILE! profile dated 20-Feb-2023

Test Start Date: 28-Apr-2023
Test End Date: 1-May-2023 Tester: PL, ZH

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	15-Aug-2022	15-Aug-2024
N to N RF Cable	EM-B810NM-276	ECHELON	23007	31-Mar-2023	31-Mar-2024
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20131	13-Mar-2023	13-Mar-2024
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	13-Jul-2022	13-Jul-2023
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
FILTER, HIGH PASS, >2800MHZ	HPM50111	MICRO-TRONICS	22017	16-Jun-2023	16-Jun-2024

Software:
“RSE 1-18 GHz T7 210212” TILE! profile dated 31-Oct

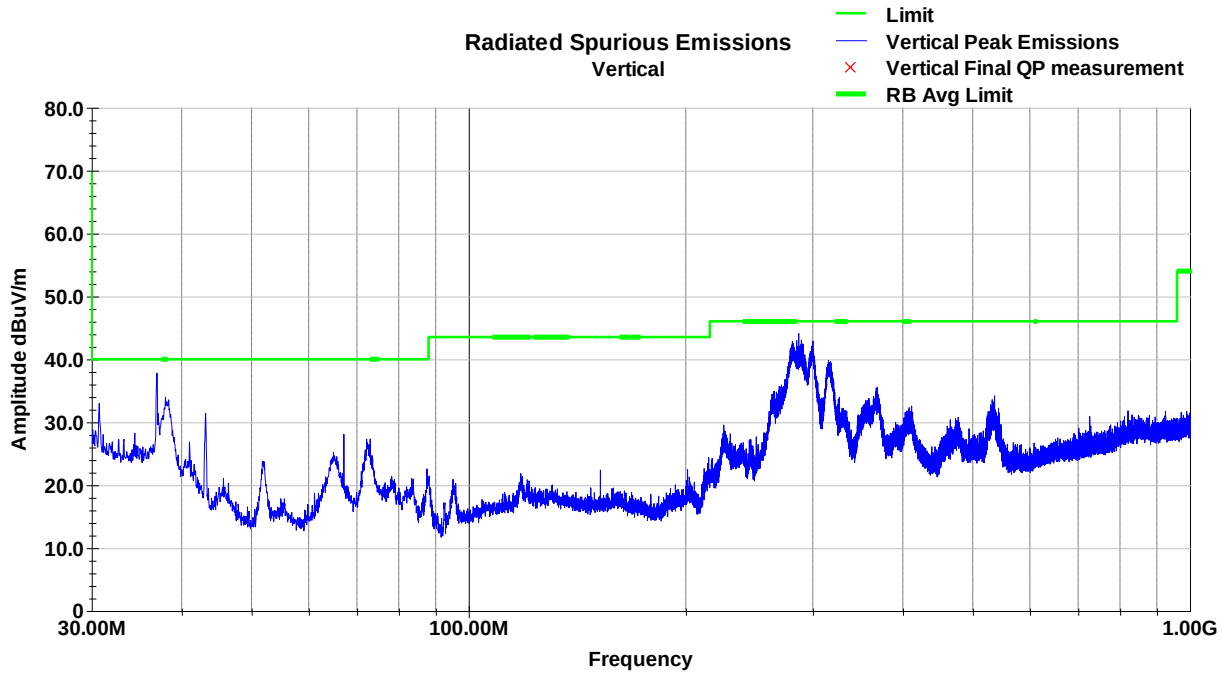
7.5 *Test Data – Peak Plots*

Notes:

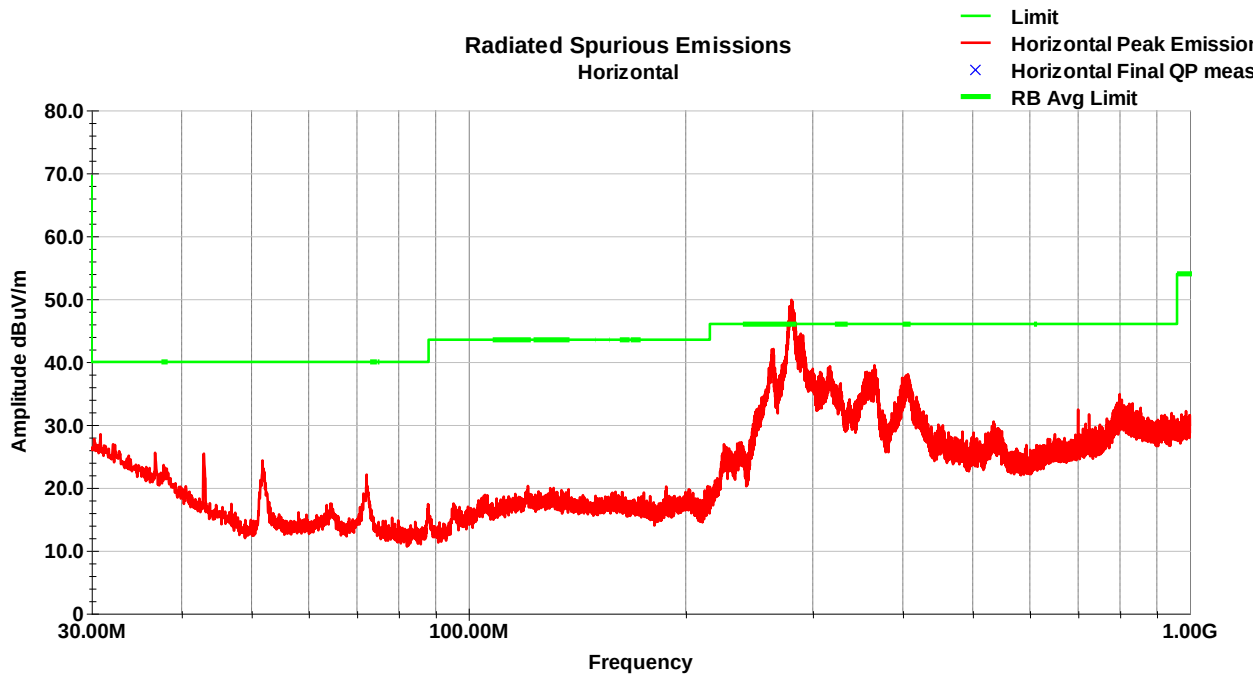
1) No discernable emissions detected below 30 MHz
2) No discernable emissions detected above 18 GHz.

7.5.1 **WLAN 802.11b**

Vertical (30-1000MHz) (WLAN 802.11b – LCH)

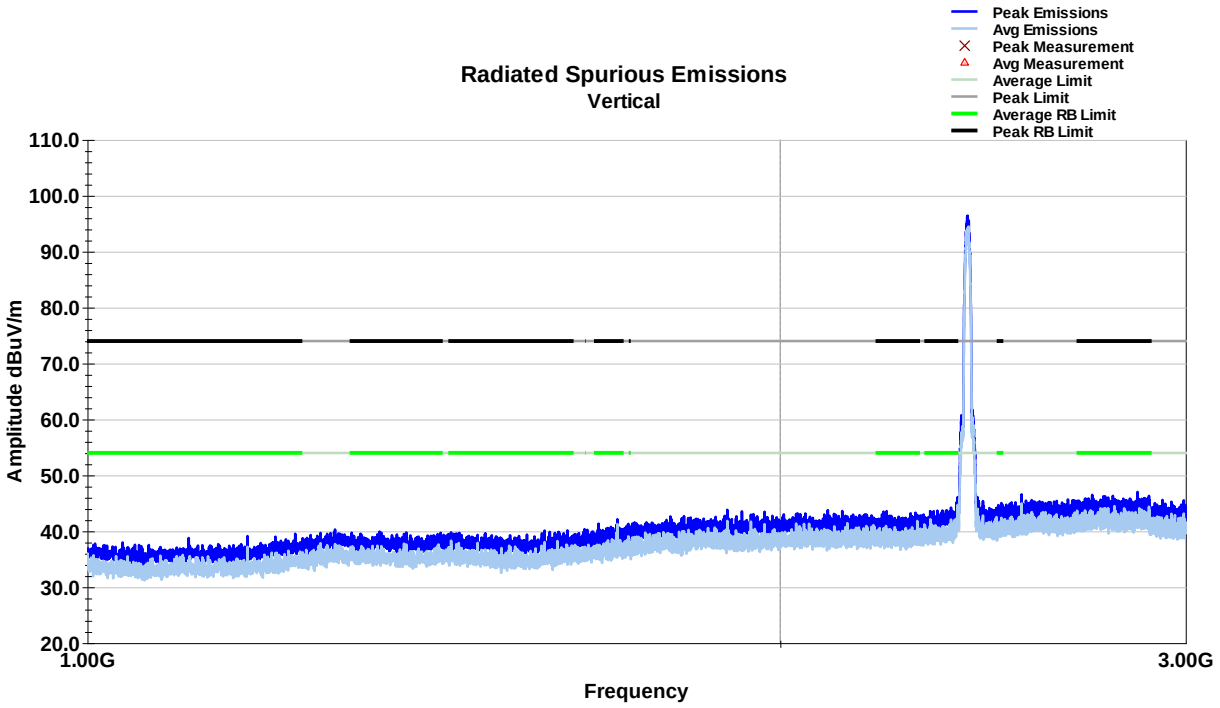


Horizontal (30-1000MHz) (WLAN 802.11b – LCH)

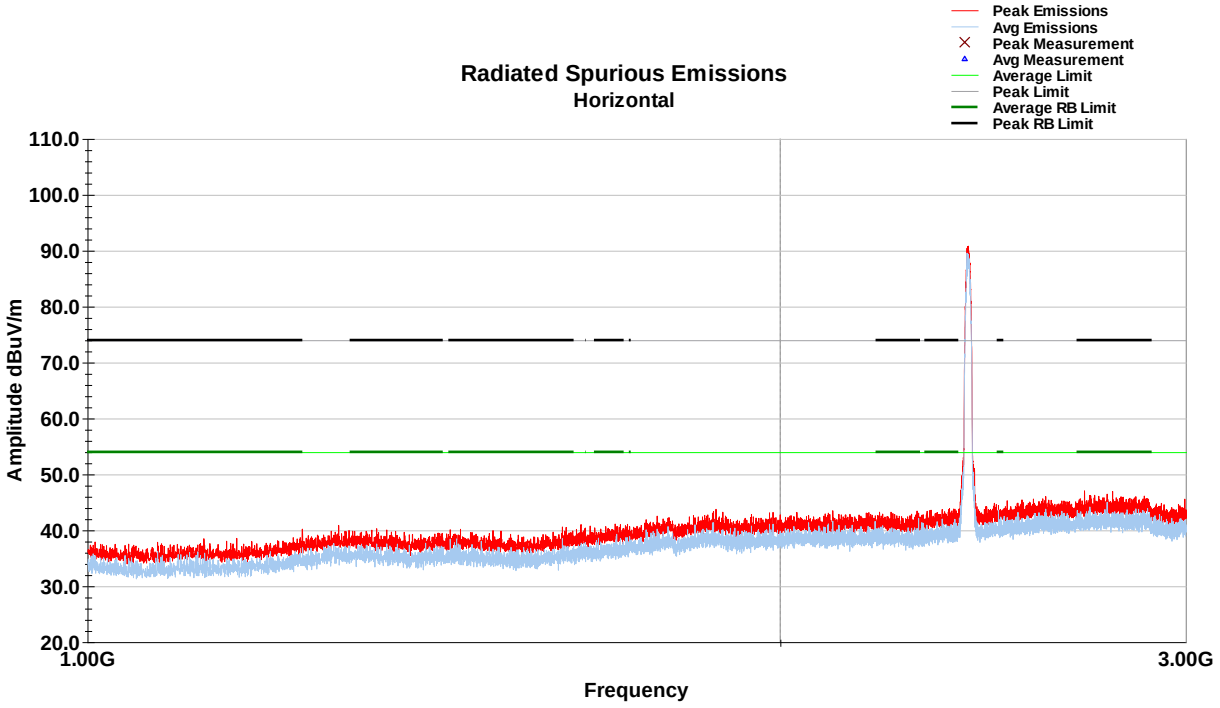


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

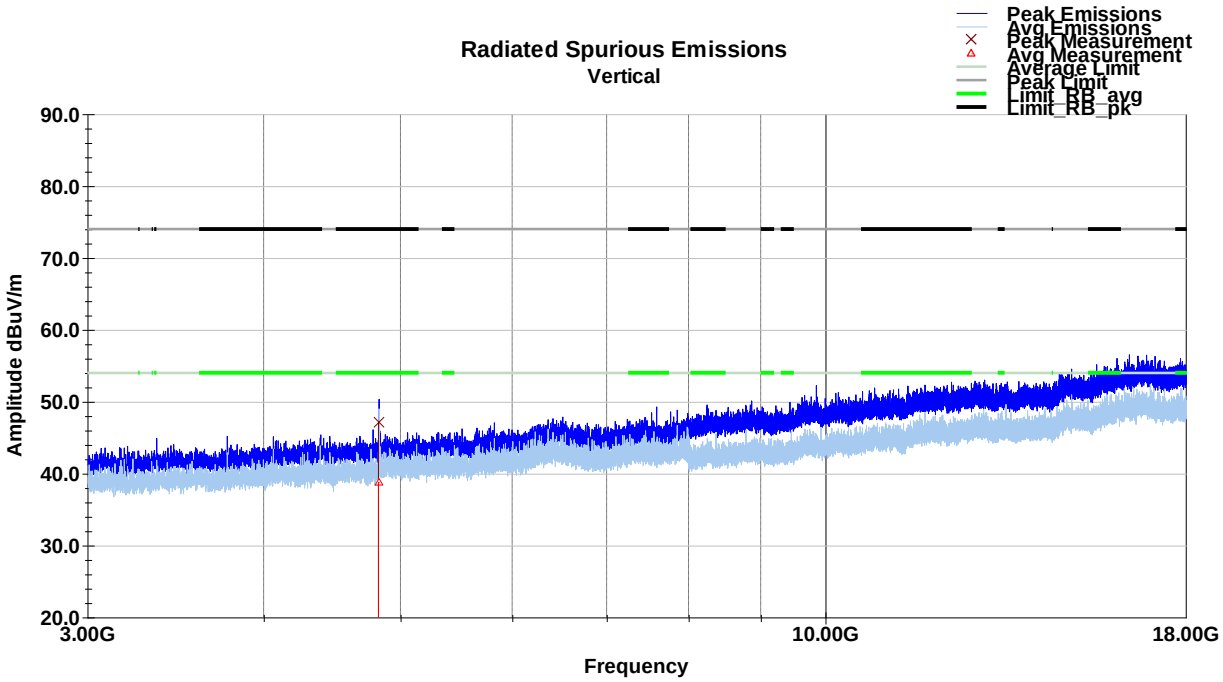
Vertical (1-3GHz) (WLAN 802.11b – LCH)



Horizontal (1-3GHz) (WLAN 802.11b – LCH)



Vertical (3-18GHz) (WLAN 802.11b – LCH)

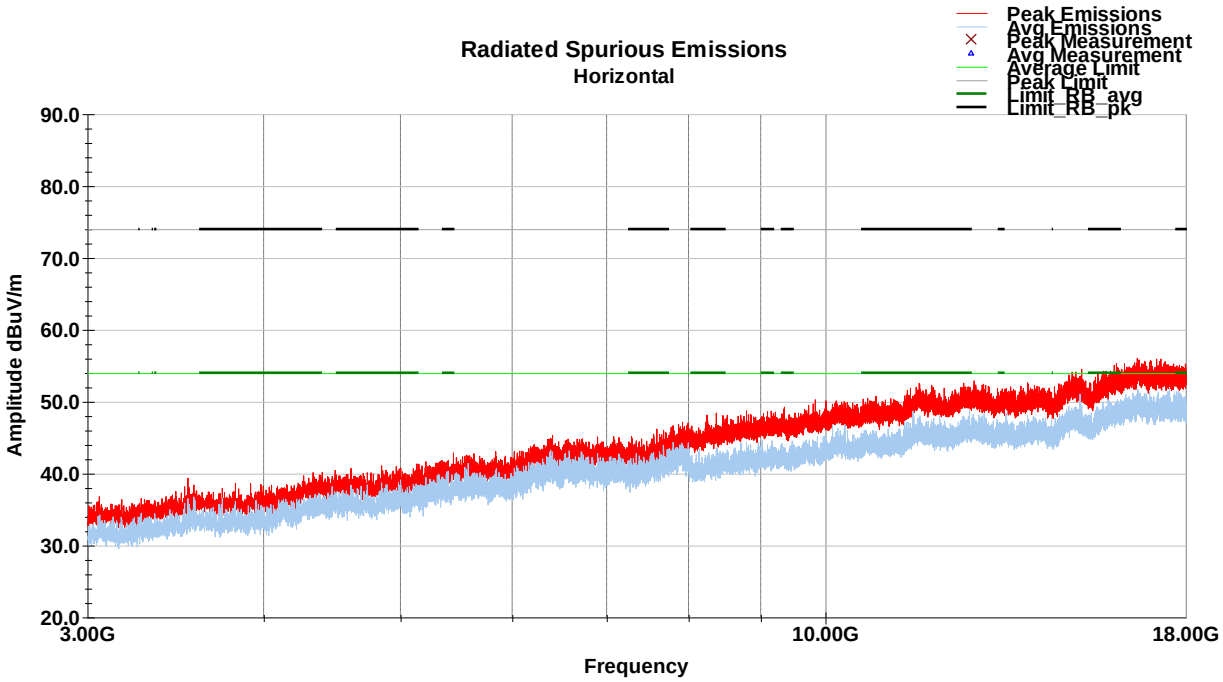


Vertical Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
4823.80	35.8	V	190.0	169.0	34.0	2.7	33.7	38.8	54.0	-15.2
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4823.80	44.2	V	190.0	169.0	34.0	2.7	33.7	47.1	74.0	-26.9
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

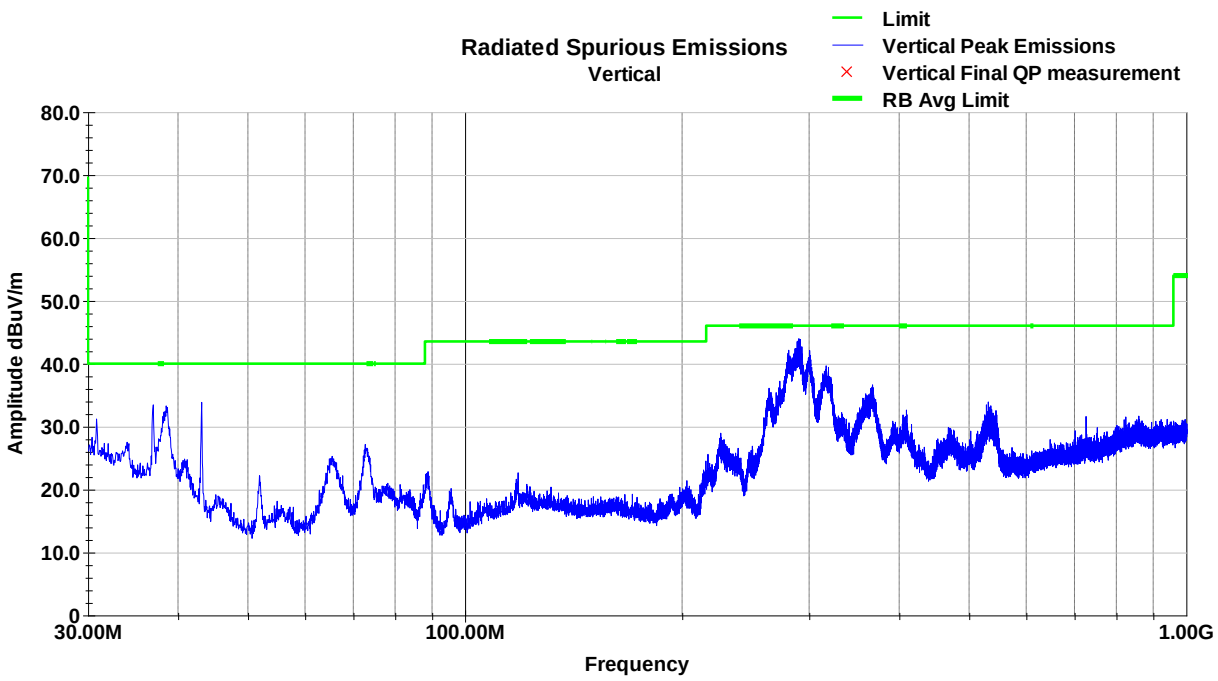
Horizontal (3-18GHz) (WLAN 802.11b – LCH)



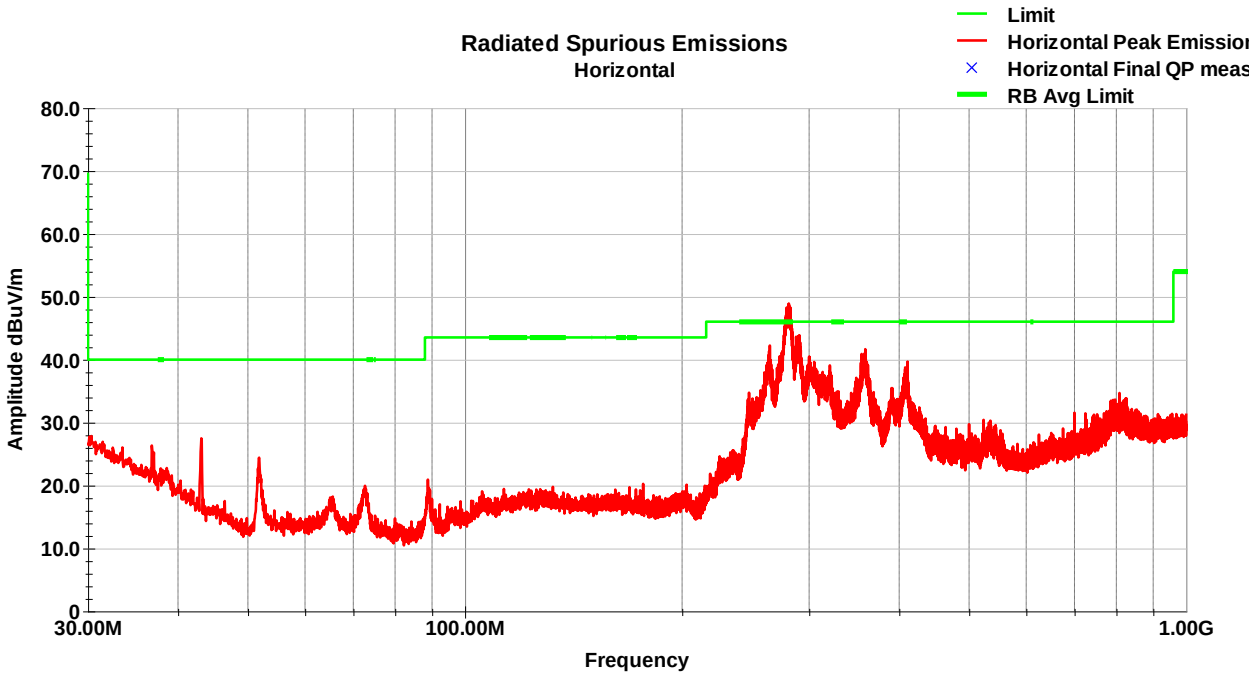
Horizontal Data

No emissions within 20dB of the limit.

Vertical (30-1000MHz) (WLAN 802.11b – MCH)

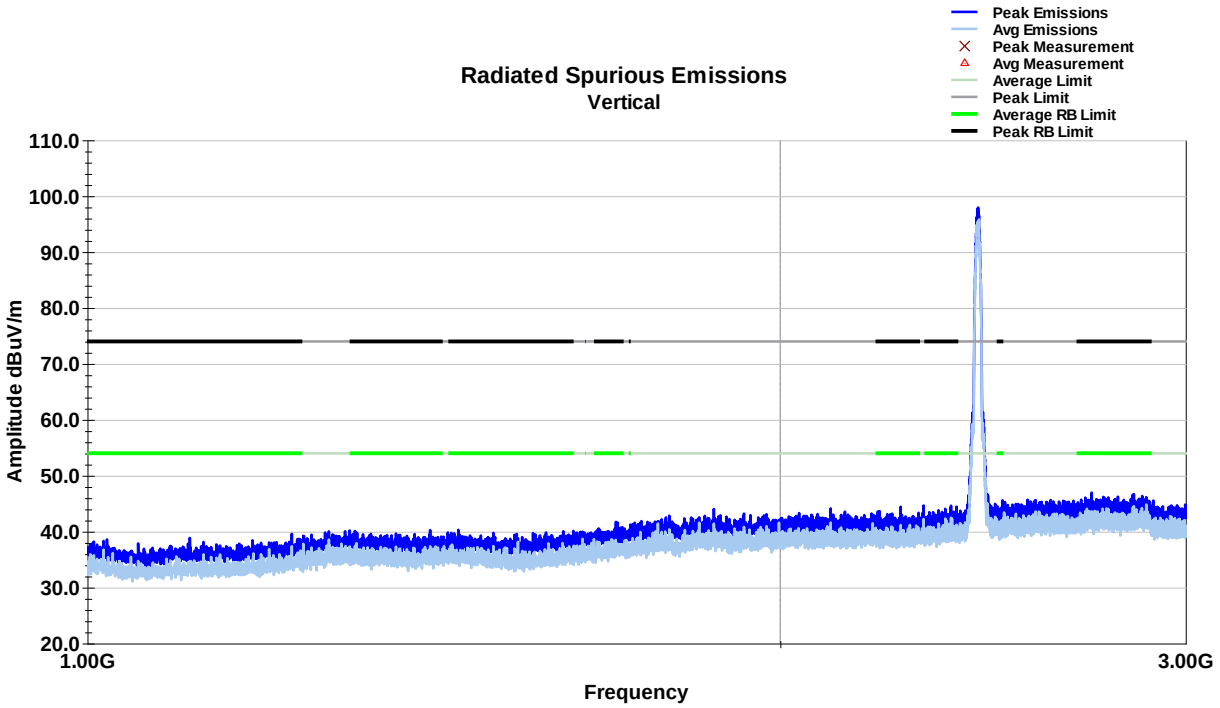


Horizontal (30-1000MHz) (WLAN 802.11b – MCH)

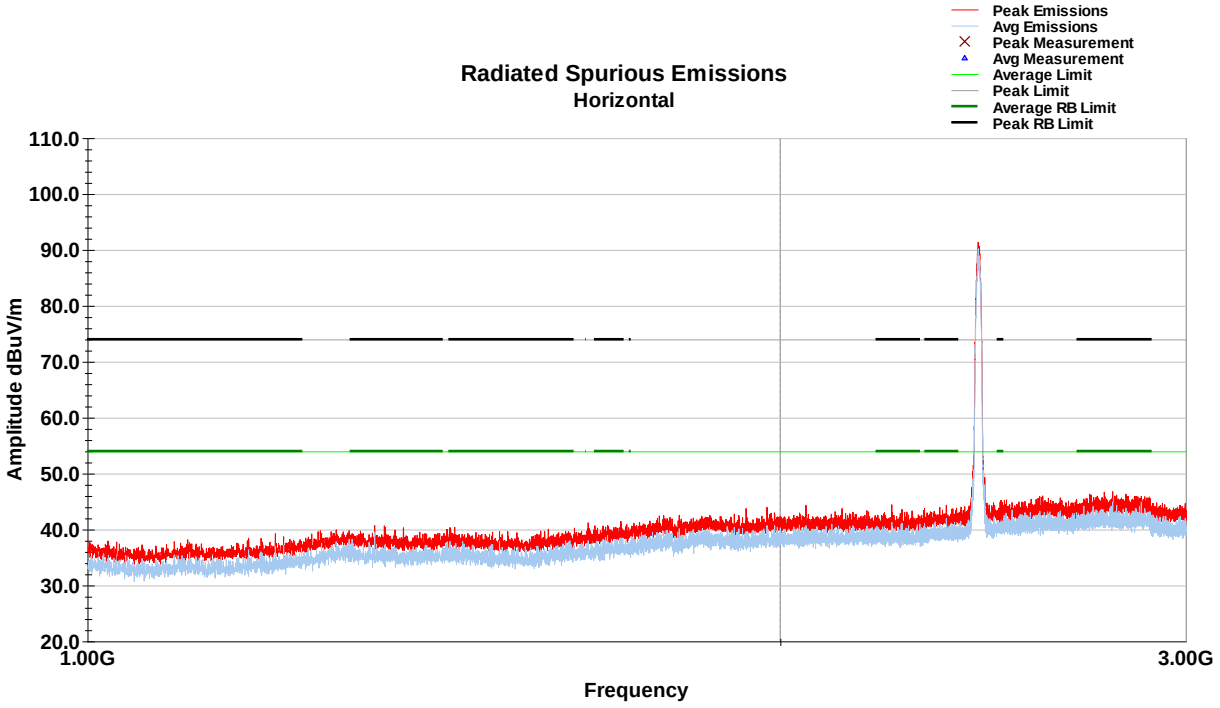


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

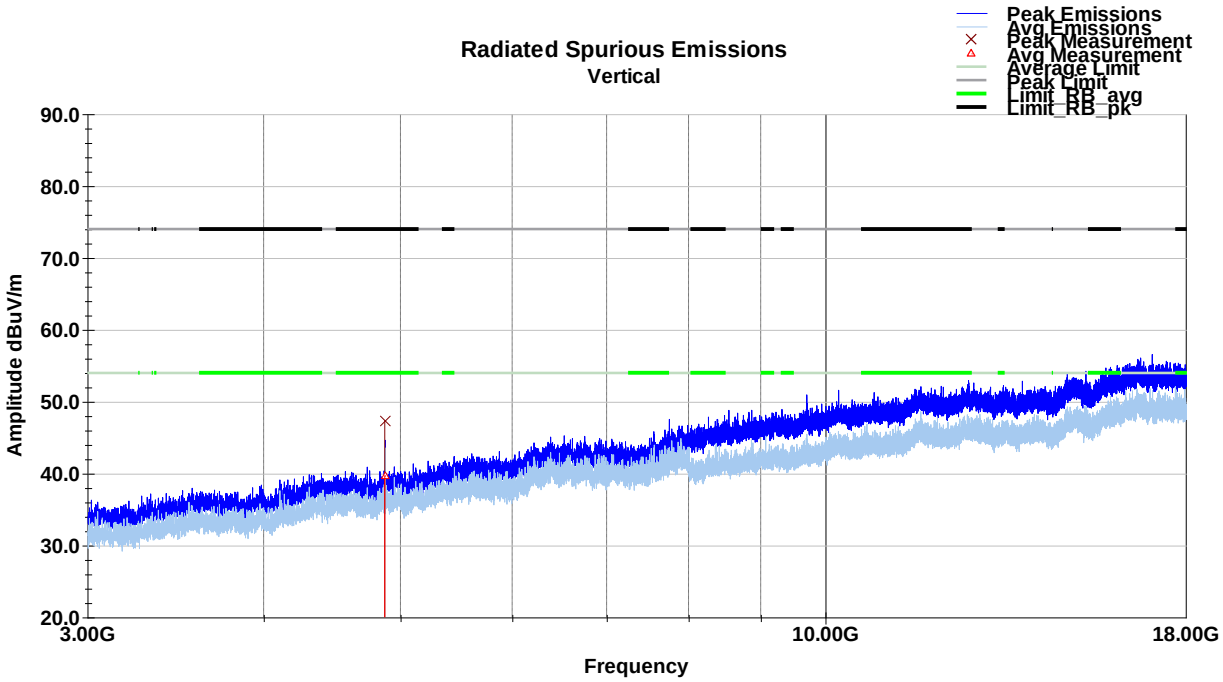
Vertical (1-3GHz) (WLAN 802.11b – MCH)



Horizontal (1-3GHz) (WLAN 802.11b – MCH)



Vertical (3-18GHz) (WLAN 802.11b – MCH)

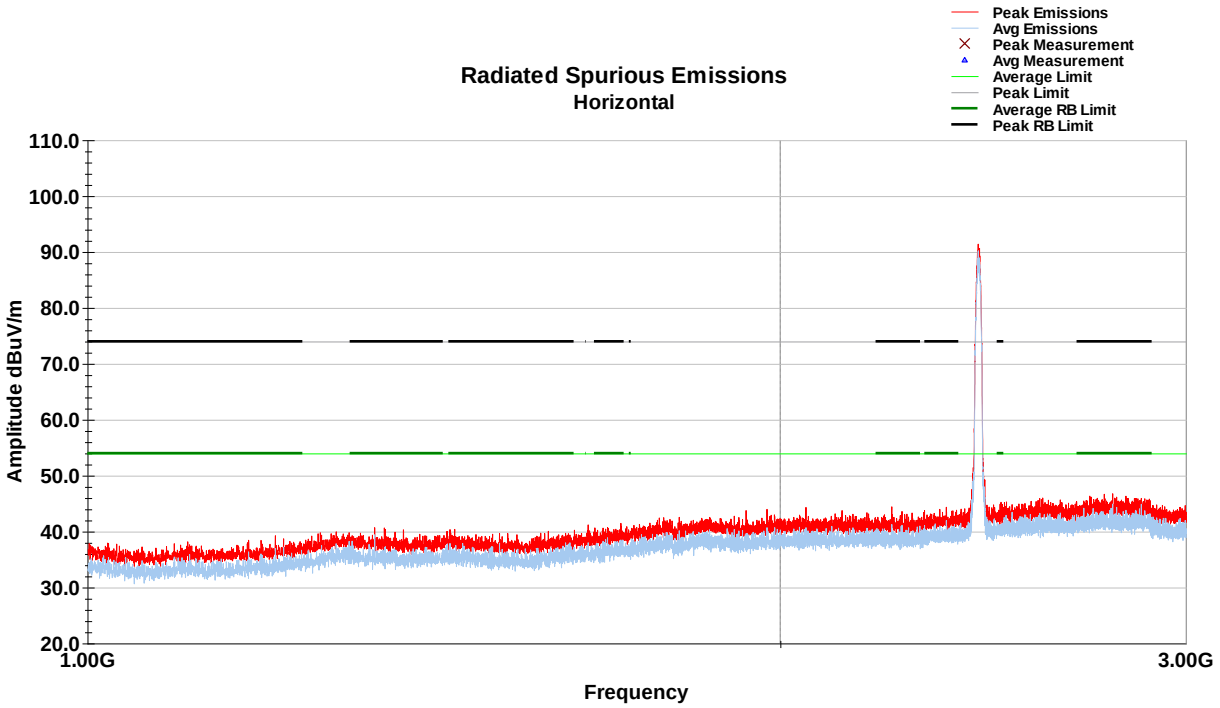


Vertical Data

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	Limit (dBuV/m)	Margin (dB)
4873.92	36.6	V	172.0	167.0	34.1	2.8	33.7	39.7	54.0	-14.2
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Frequency MHz	Raw Pk dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Pk dBuV/m	Limit dBuV/m	Margin dB
4873.92	44.2	V	172.0	167.0	34.1	2.8	33.7	47.4	74.0	-26.6
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

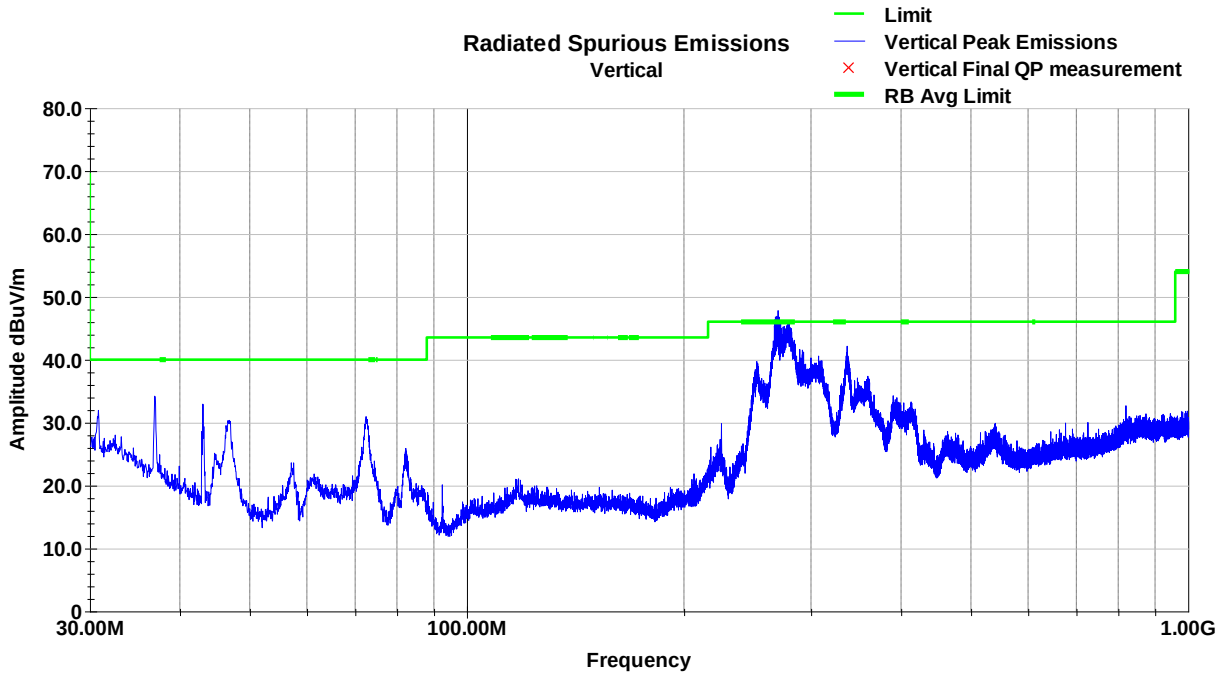
Horizontal (3-18GHz) (WLAN 802.11b – MCH)



Horizontal Data

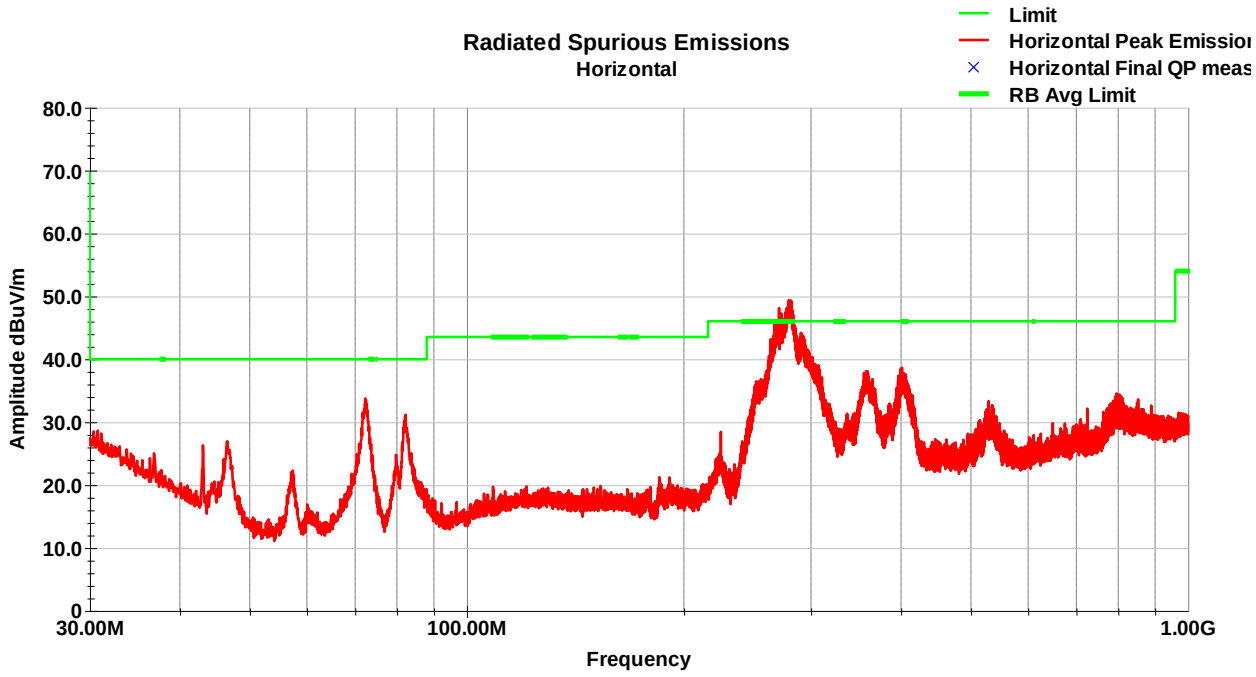
No emissions within 20dB of the limit.

Vertical (30-1000MHz) (WLAN 802.11b – HCH)



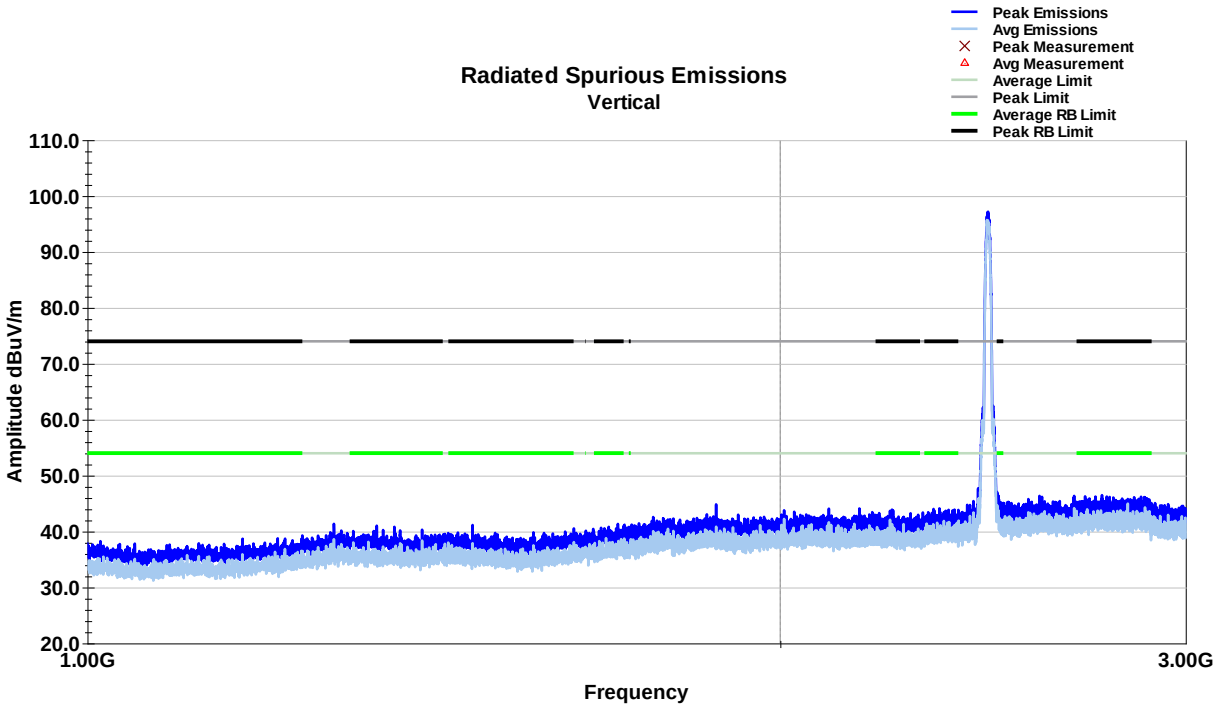
Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

Horizontal (30-1000MHz) (WLAN 802.11b – HCH)

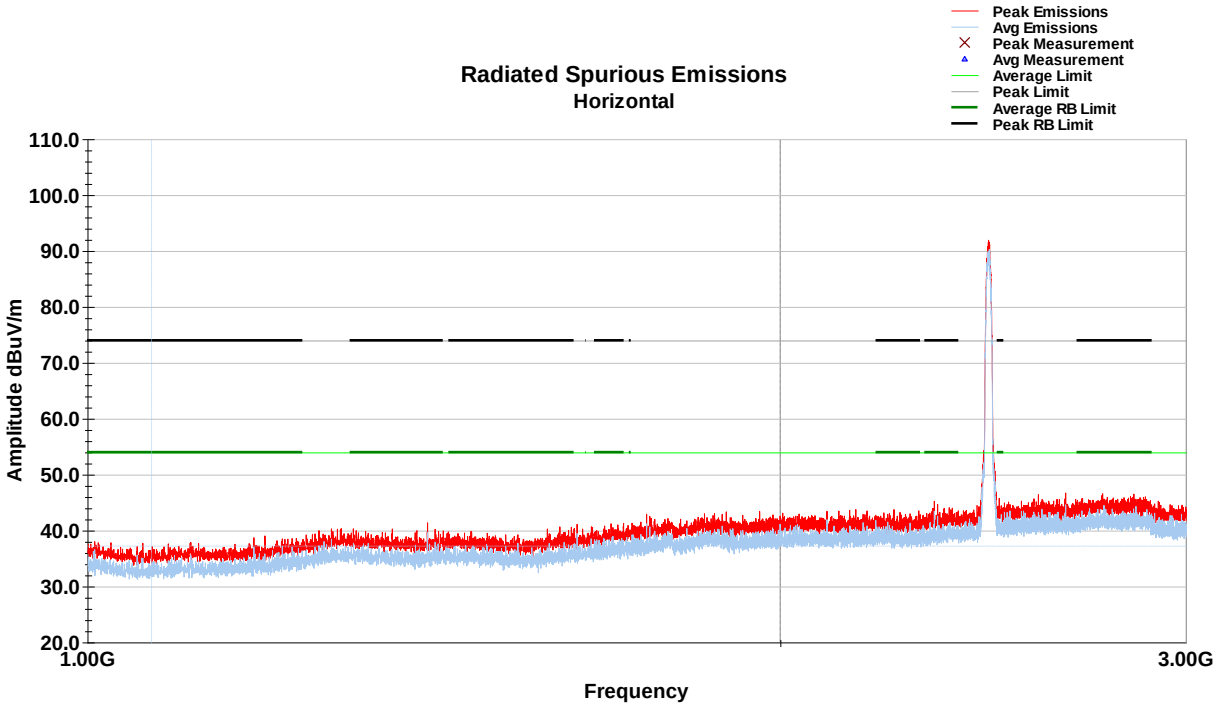


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

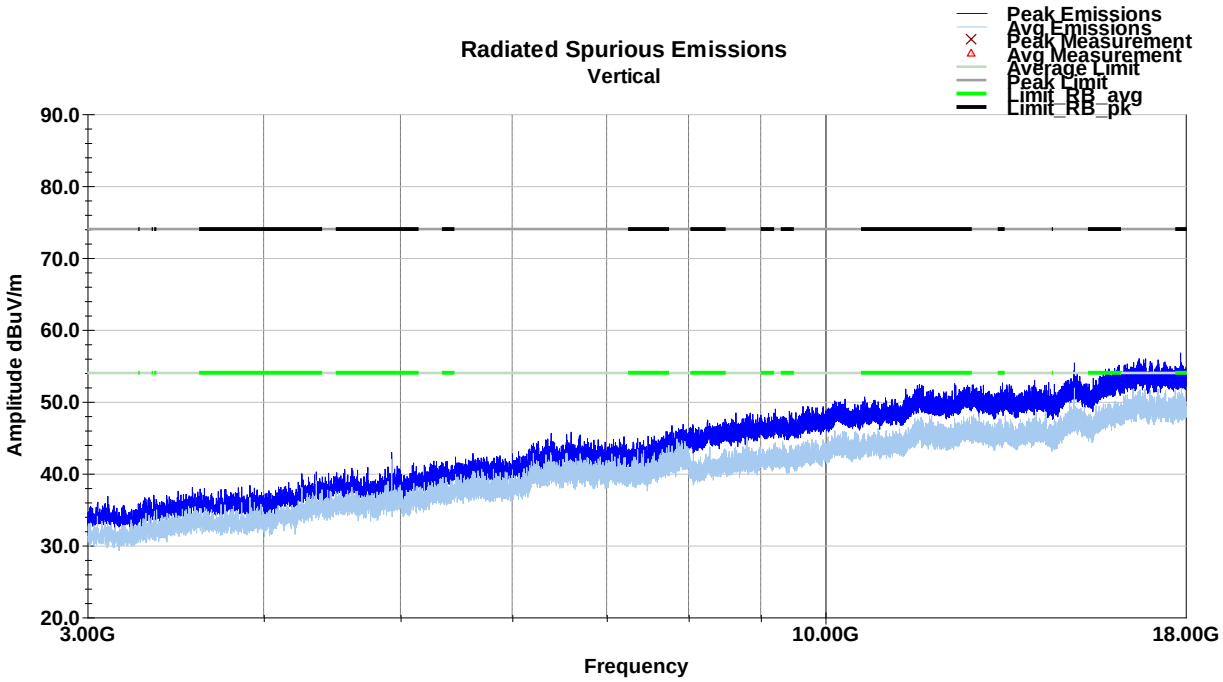
Vertical (1-3GHz) (WLAN 802.11b – HCH)



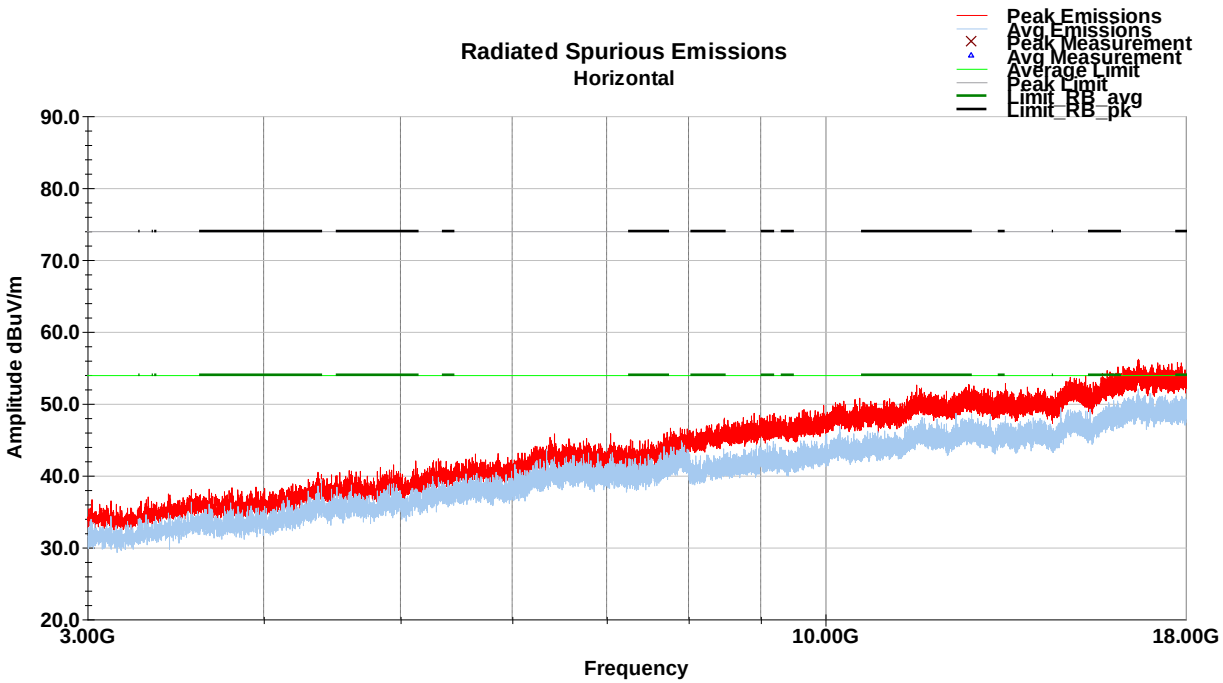
Horizontal (1-3GHz) (WLAN 802.11b – HCH)



Vertical (3-18GHz) (WLAN 802.11b – HCH)

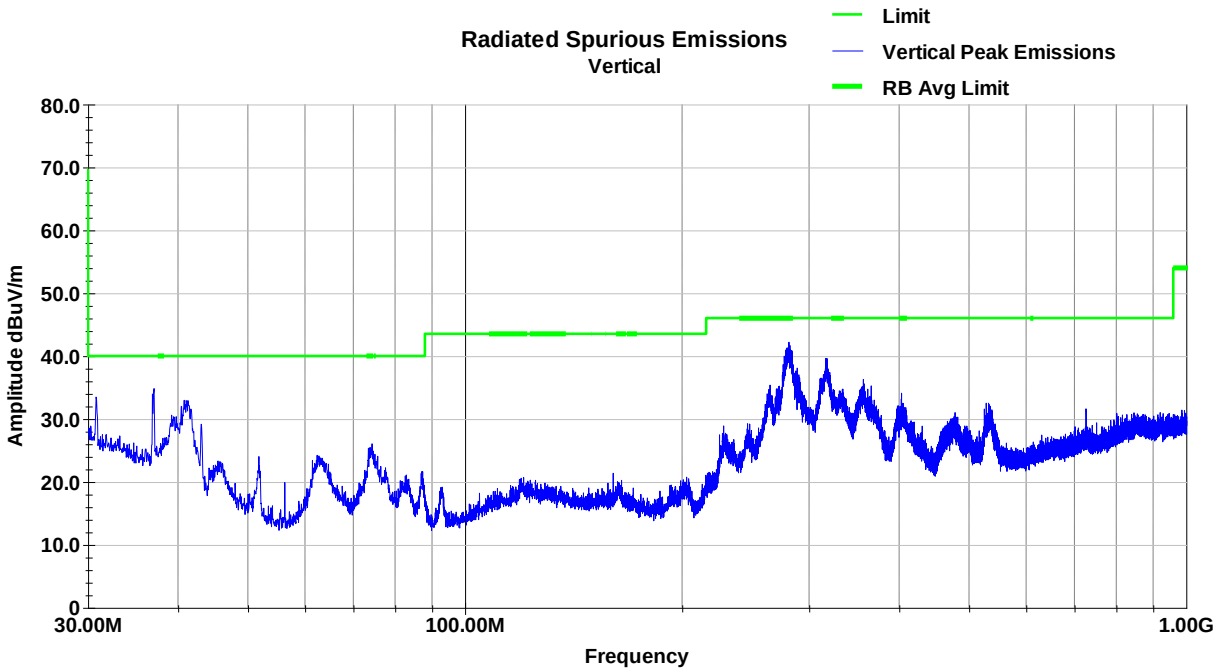


Horizontal (3-18GHz) (WLAN 802.11b – HCH)

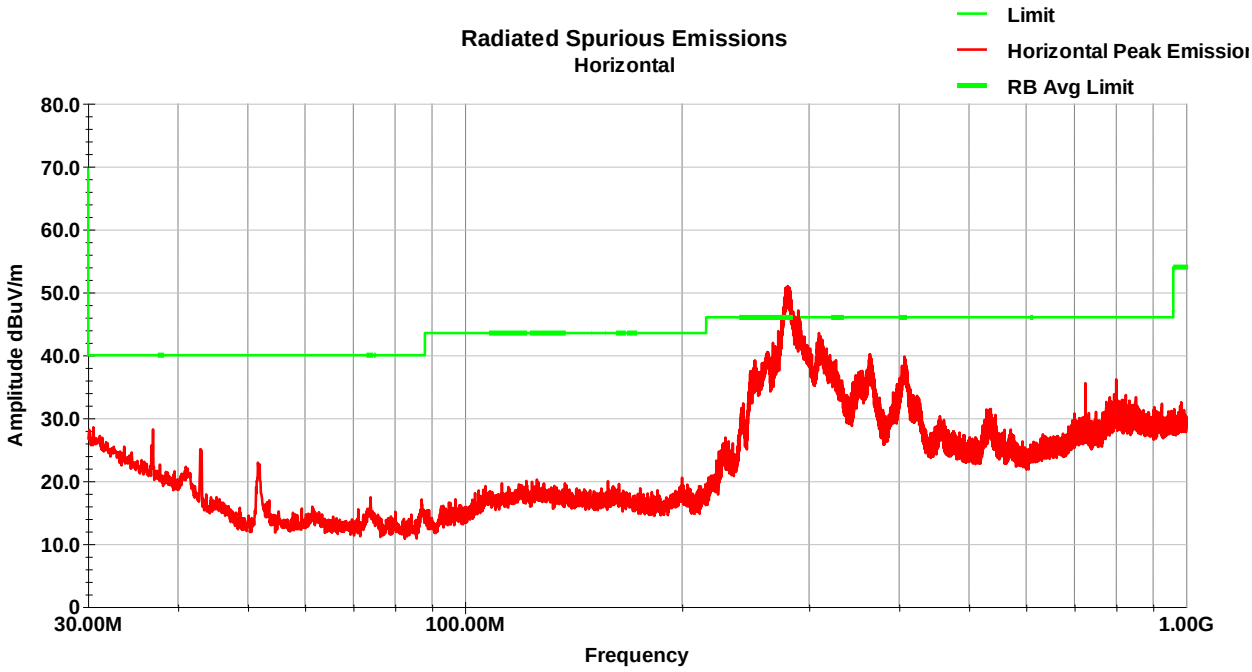


7.5.2 **WLAN 802.11g**

Vertical (30-1000MHz) (WLAN 802.11g – LCH)

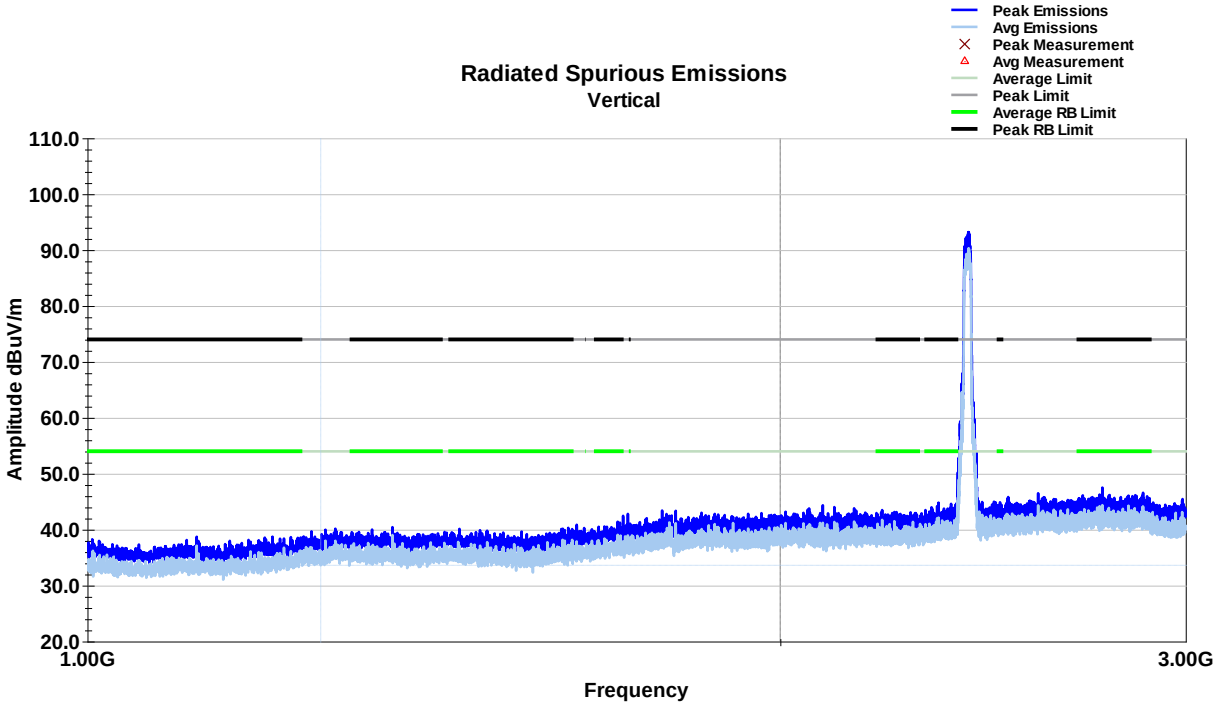


Horizontal (30-1000MHz) (WLAN 802.11g – LCH)

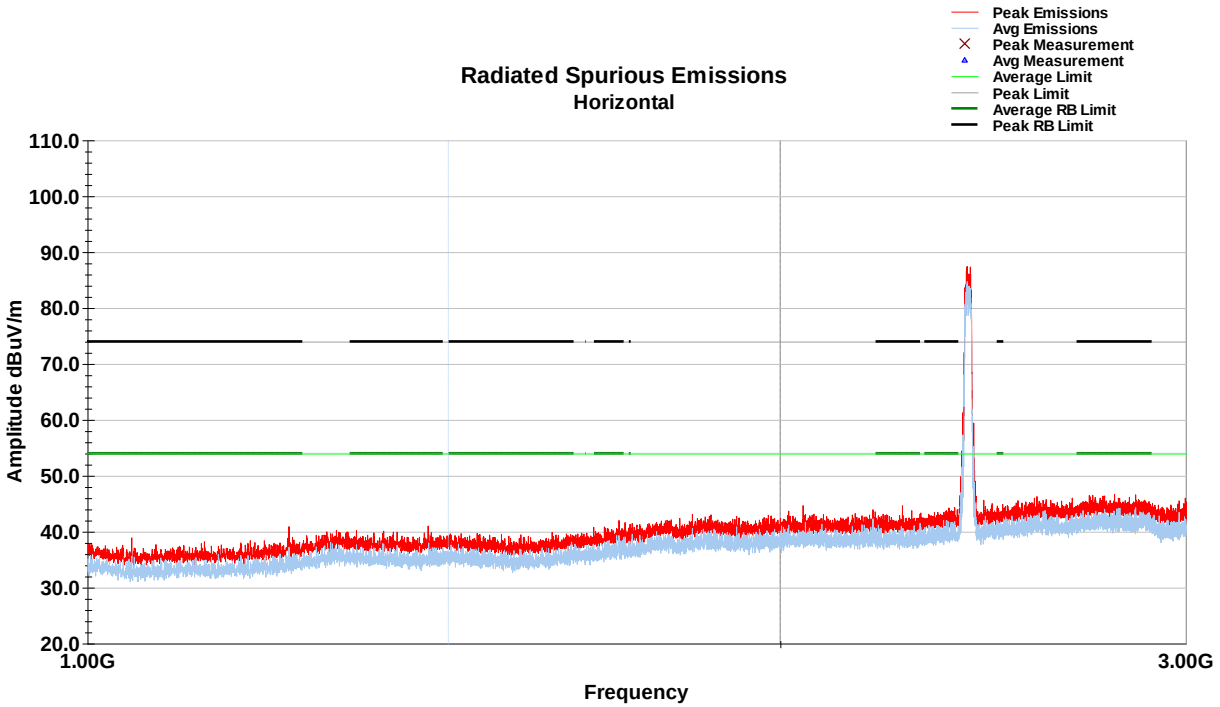


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

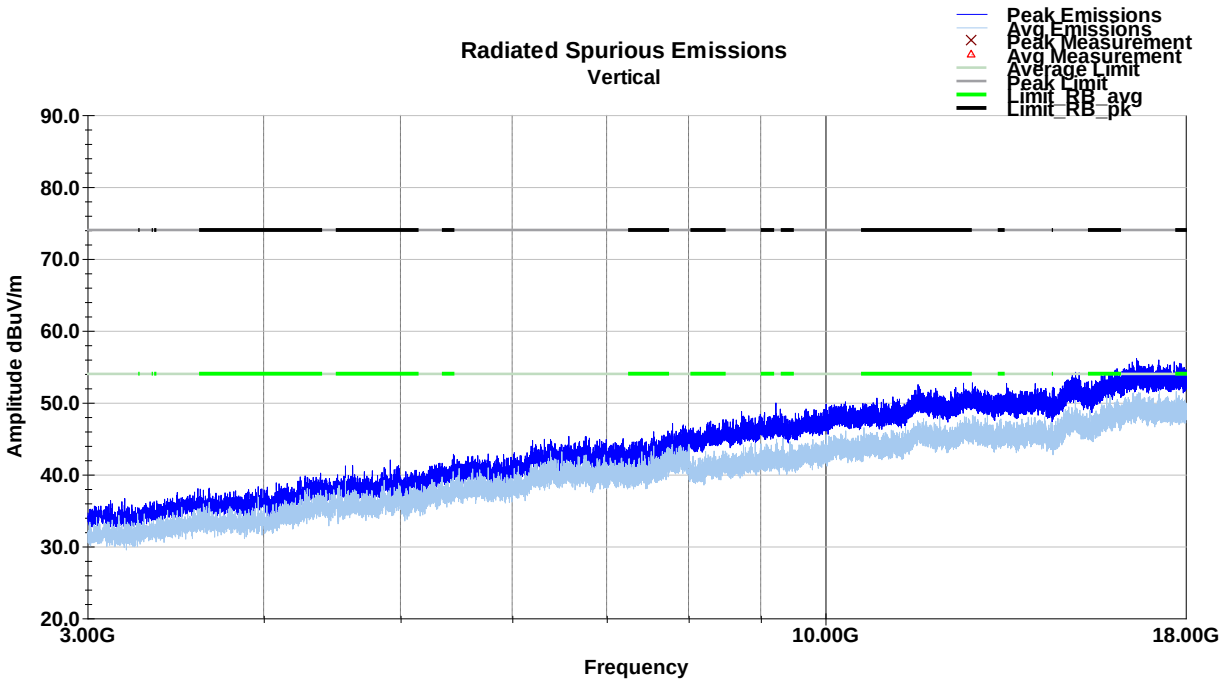
Vertical (1-3GHz) (WLAN 802.11g – LCH)



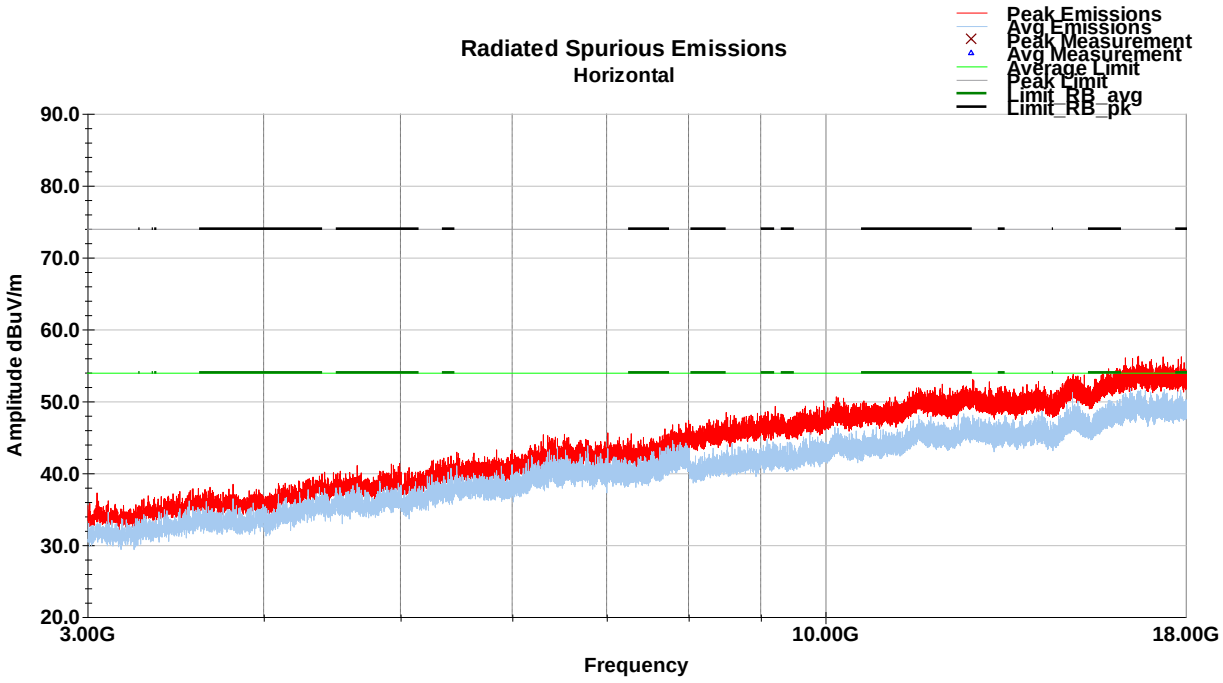
Horizontal (1-3GHz) (WLAN 802.11g – LCH)



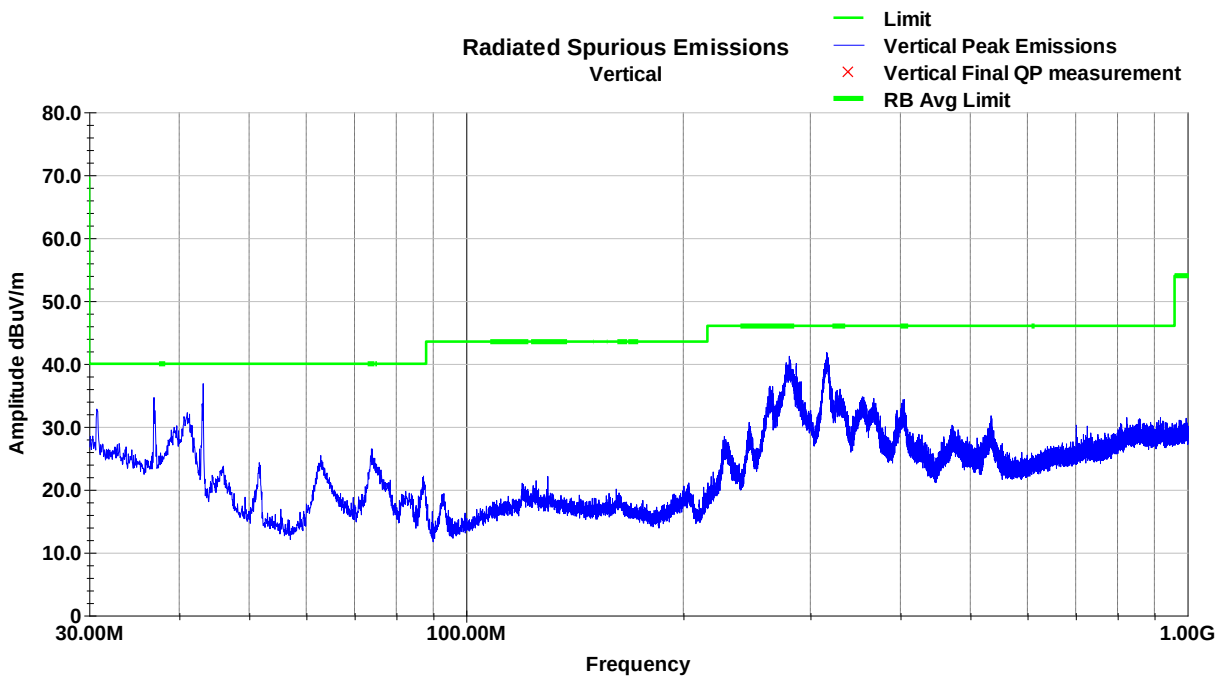
Vertical (3-18GHz) (WLAN 802.11g – LCH)



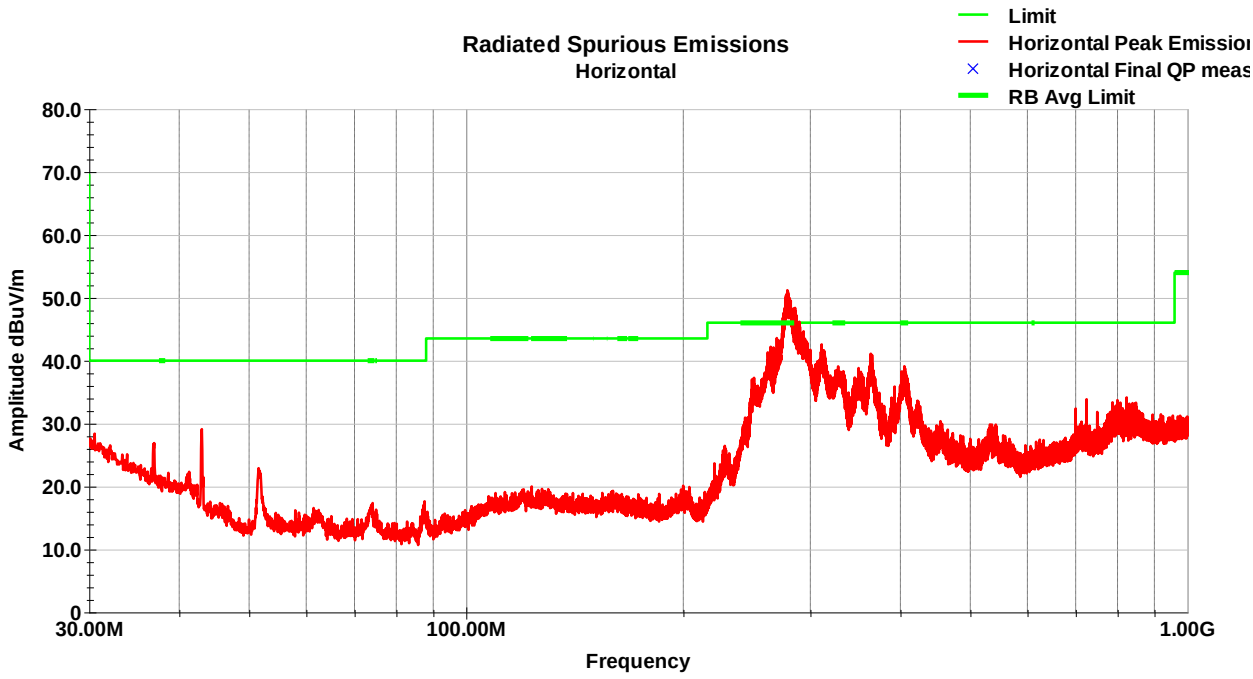
Horizontal (3-18GHz) (WLAN 802.11g – LCH)



Vertical (30-1000MHz) (WLAN 802.11g – MCH)

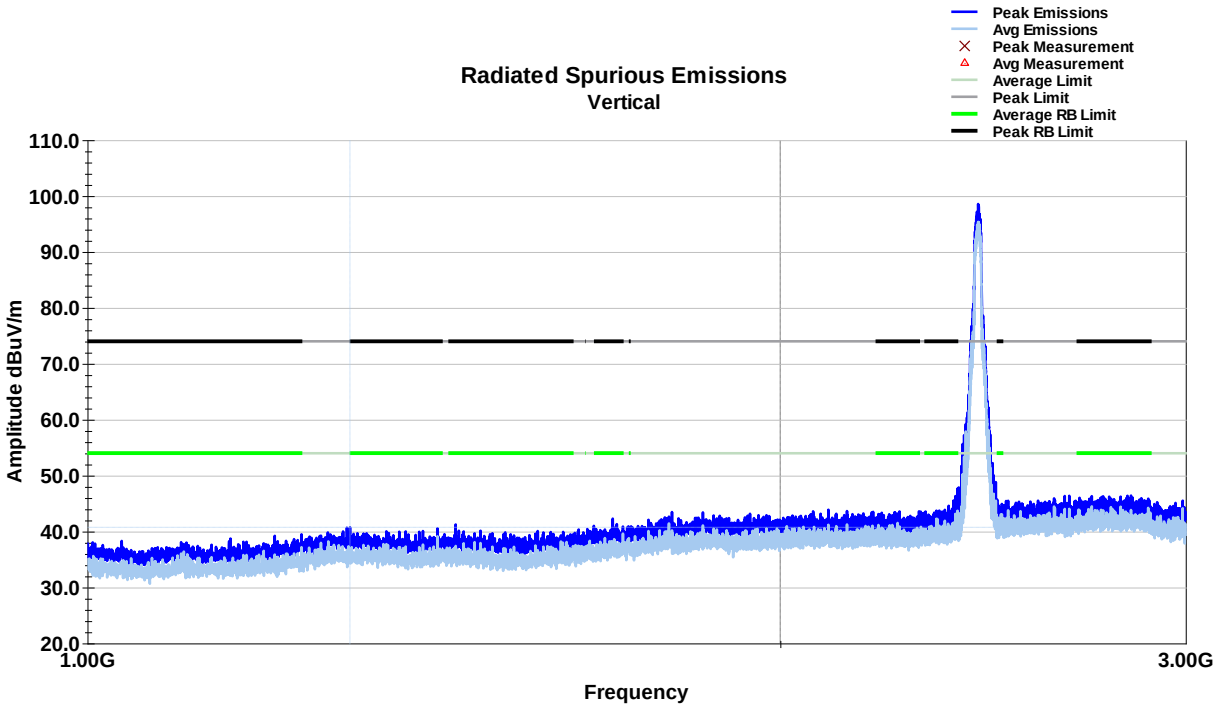


Horizontal (30-1000MHz) (WLAN 802.11g – MCH)

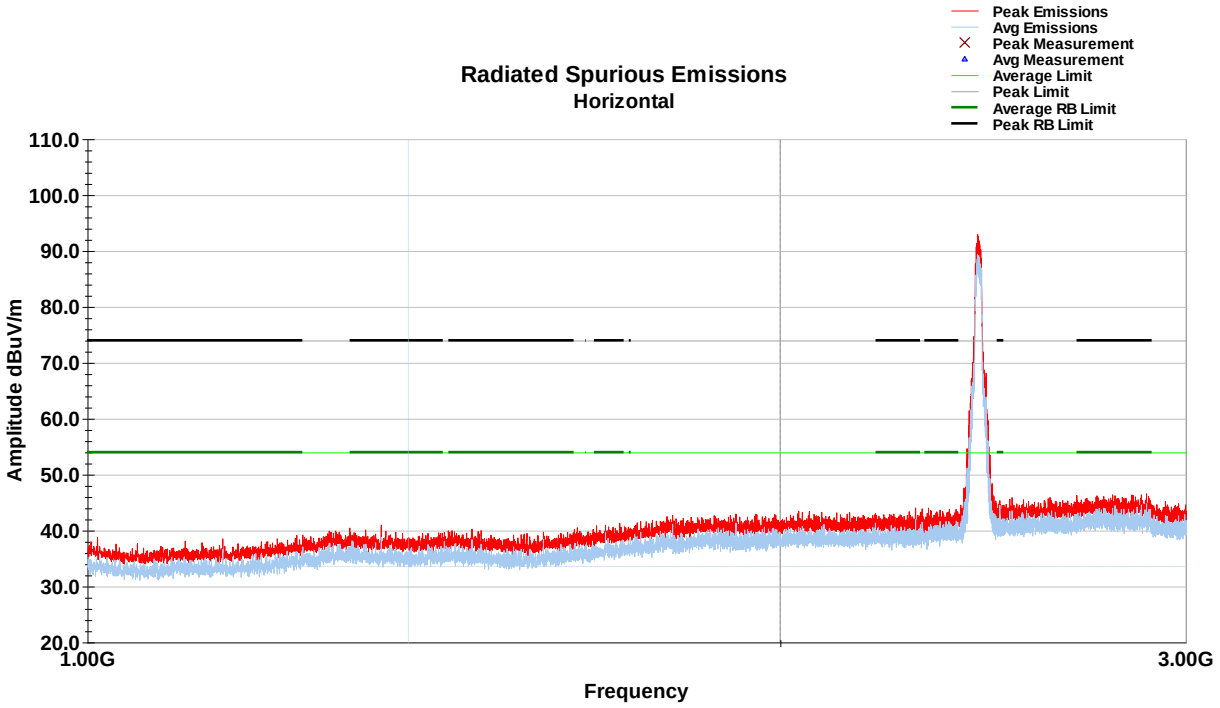


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

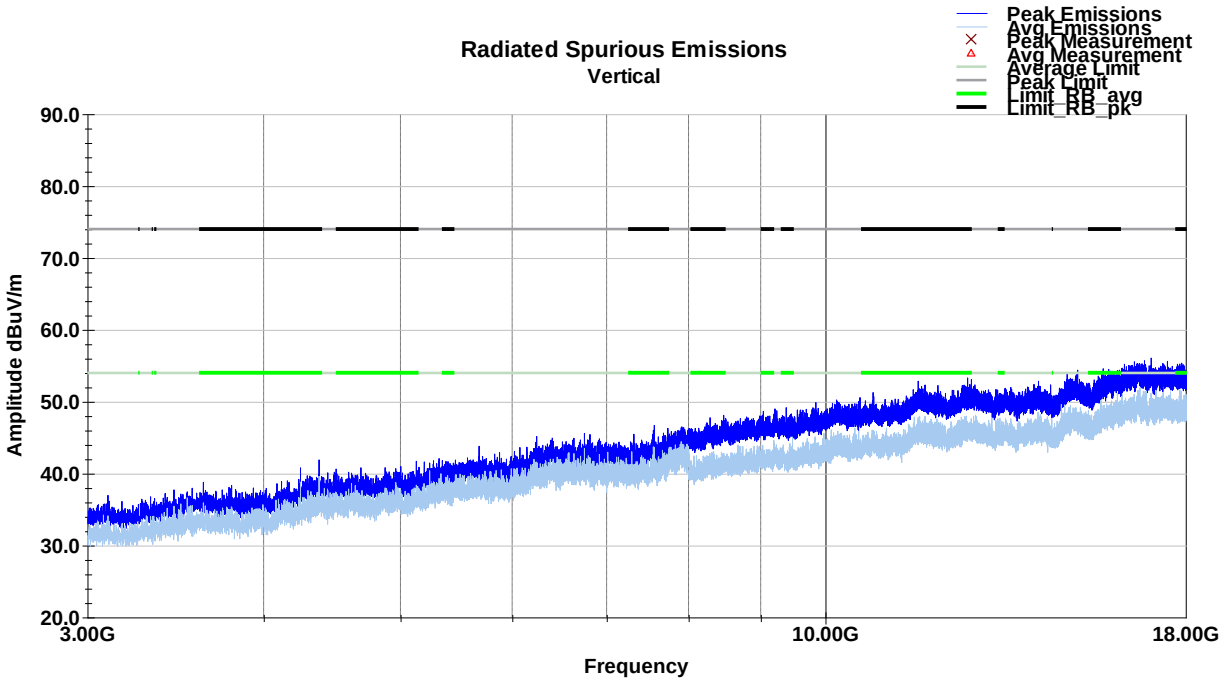
Vertical (1-3GHz) (WLAN 802.11g – MCH)



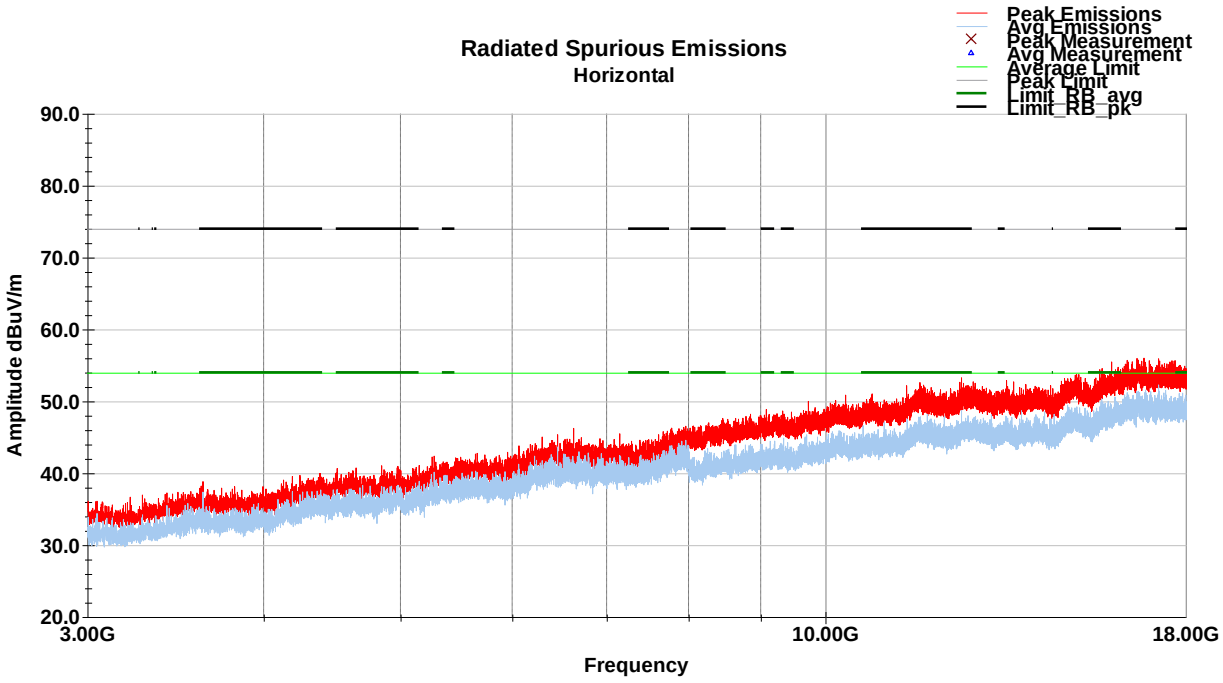
Horizontal (1-3GHz) (WLAN 802.11g – MCH)



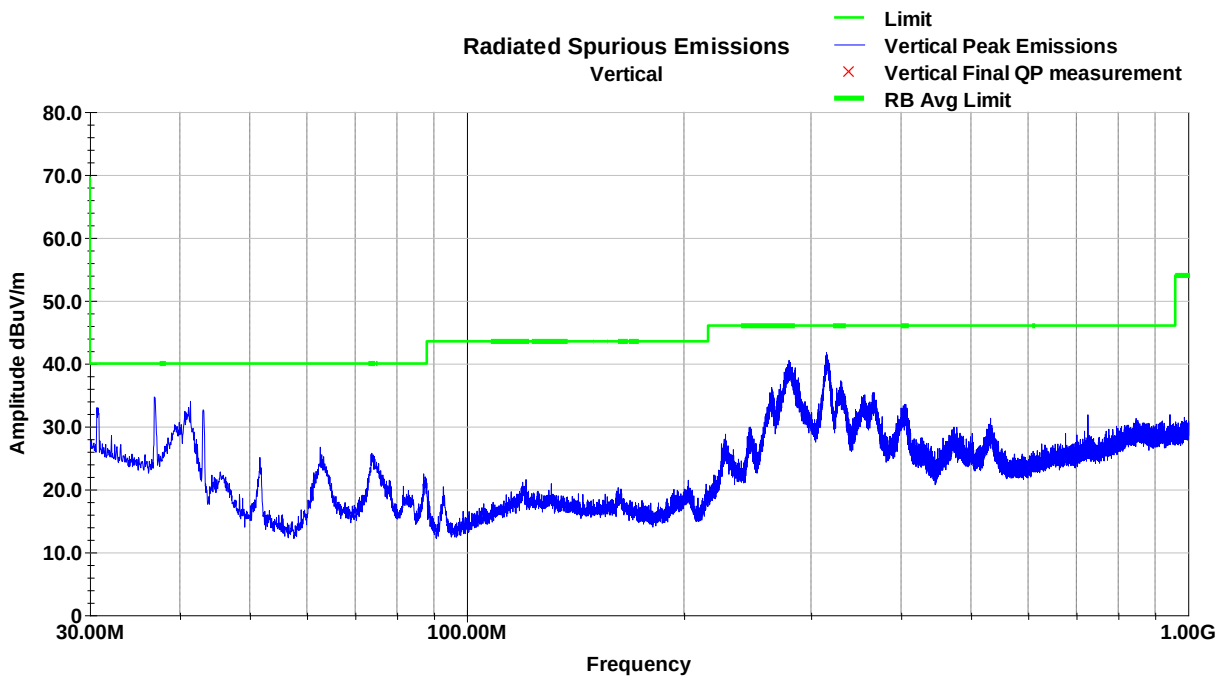
Vertical (3-18GHz) (WLAN 802.11g – MCH)



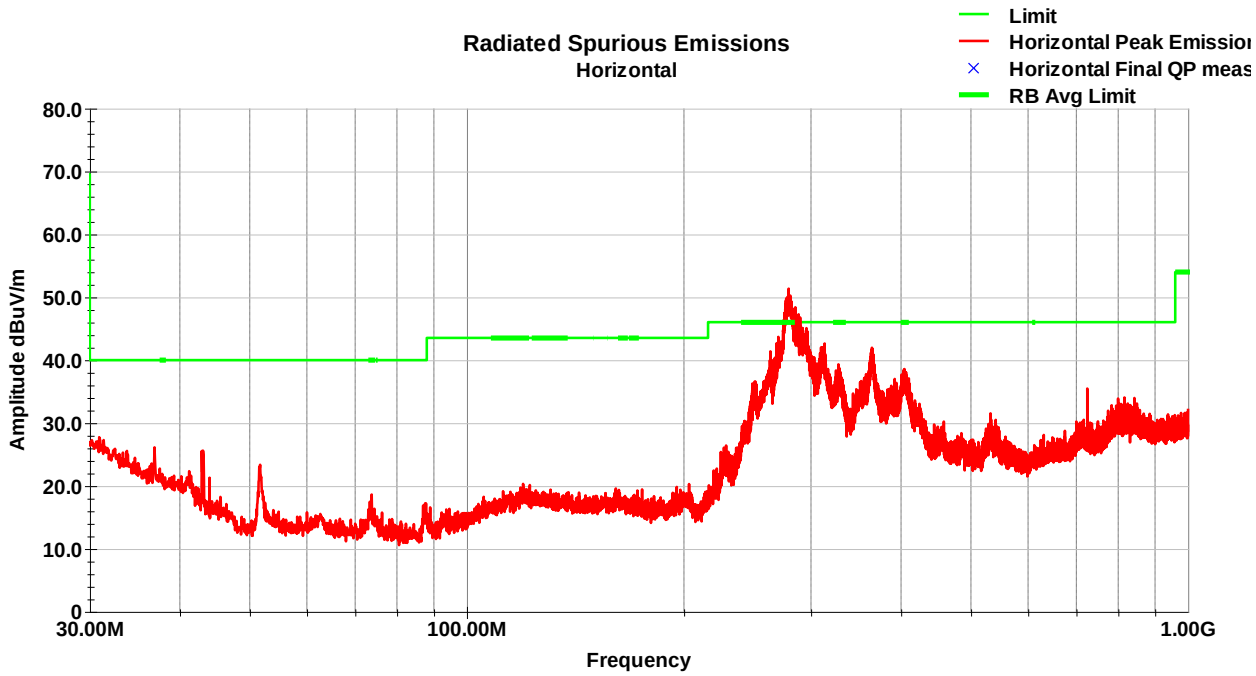
Horizontal (3-18GHz) (WLAN 802.11g – MCH)



Vertical (30-1000MHz) (WLAN 802.11g – HCH)

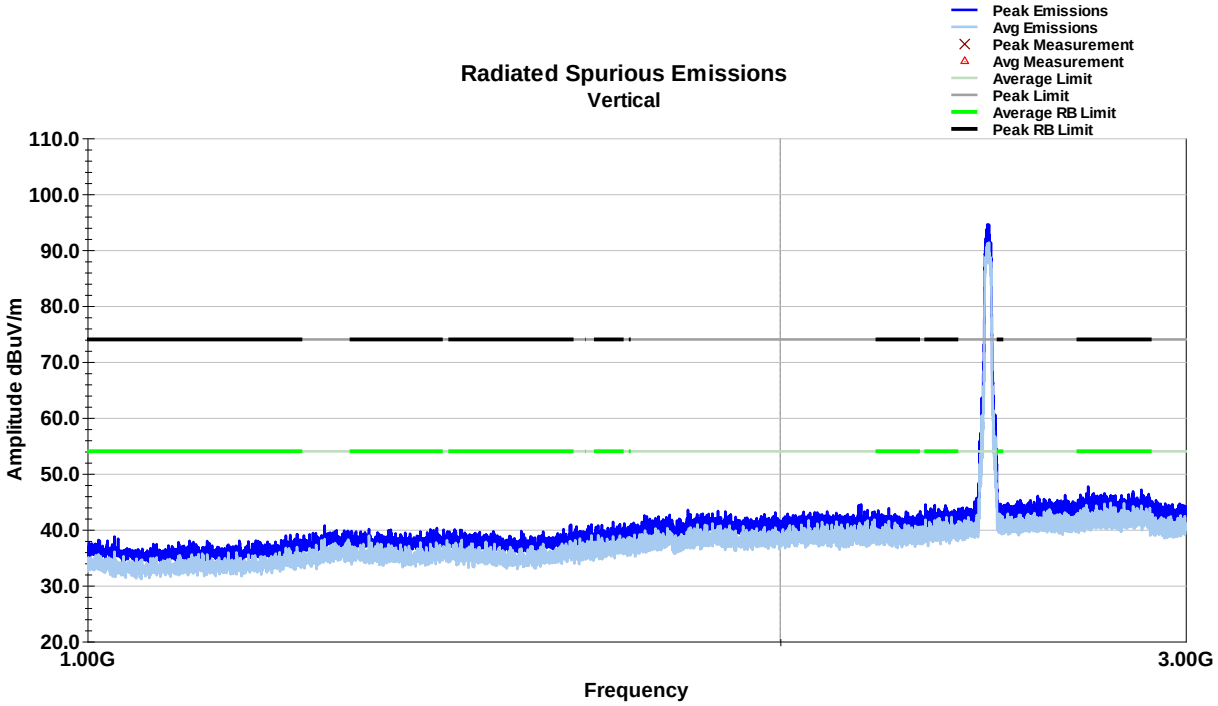


Horizontal (30-1000MHz) (WLAN 802.11g – HCH)

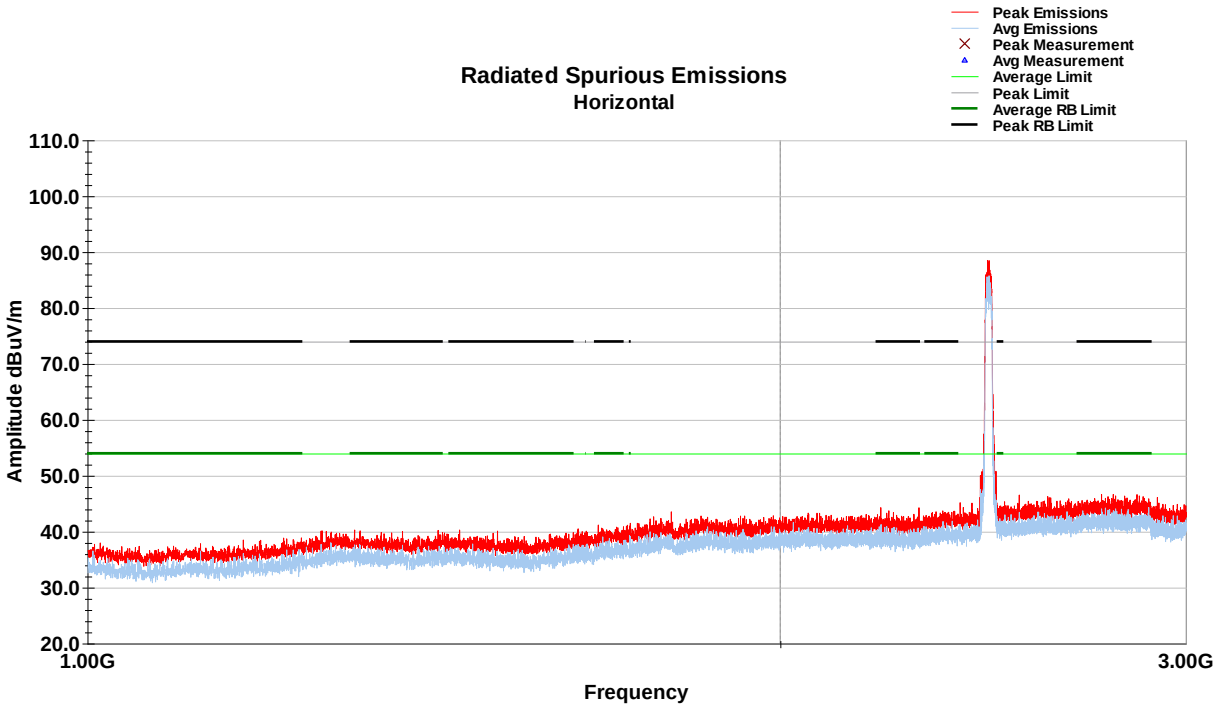


Note: The unintentional disturbances above the limit are not under evaluation and can be disregarded.

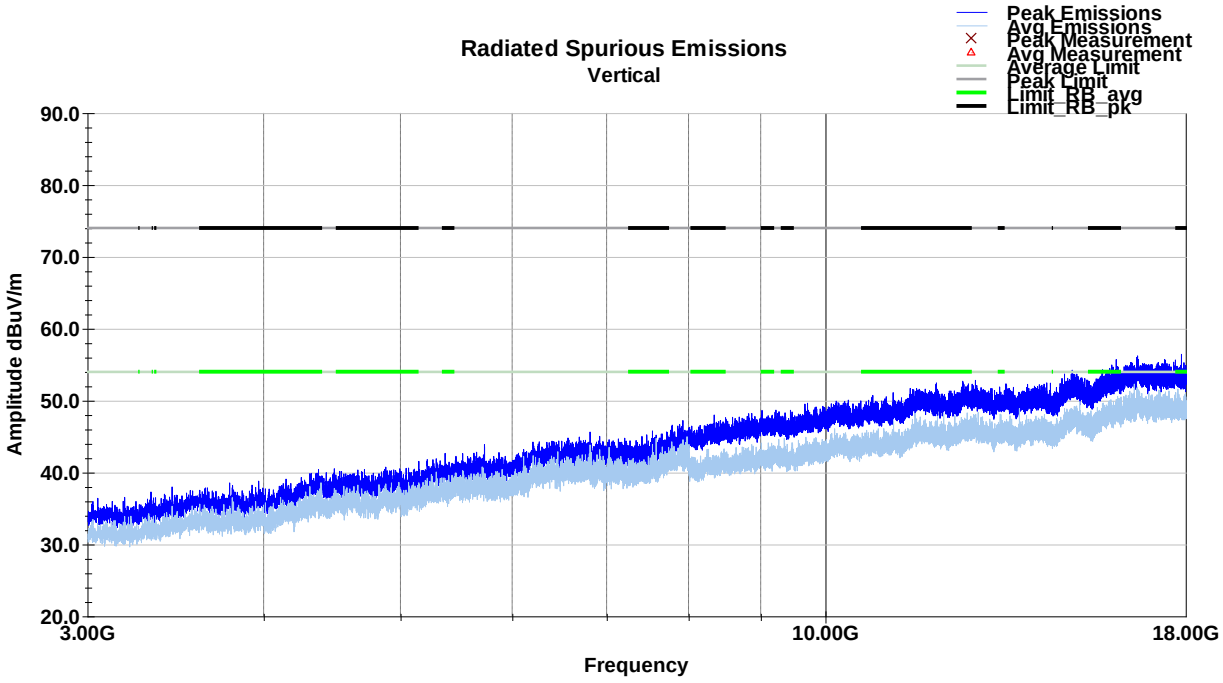
Vertical (1-3GHz) (WLAN 802.11g – HCH)



Horizontal (1-3GHz) (WLAN 802.11g – HCH)



Vertical (3-18GHz) (WLAN 802.11g – HCH)



Horizontal (3-18GHz) (WLAN 802.11g – HCH)