RF Test Report

Project Number:	**4926553**	**Proposal:**	**06072022NG-1.1**
Report Number:	**4926553EMC02**	**Revision Level:**	**1**
Client:	**Airgo Systems, LLC.**		

Equipment Under Test:	**Large Vehicle Monitoring Telematics**
Model:	**Drov-ABO**
Contains FCC ID:	**2AYTU-EG91-NA-ABO**

FCC Rule Parts:	**Part 22H, Part 24E, Part 27, Part 15.247, Part 15.407**
Industry Canada:	**RSS-GEN, Issue 5; RSS-130, Issue 2; RSS-132, Issue 4**
	RSS-133, Issue 6; RSS-139, Issue 4; RSS-247, Issue 2
	ANSI C63.10: 2013; ANSI C63.26: 2015

Report issued on:	**04 April 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: Brandon Osborn, EMC Project Engineer

Reviewed by: Martin Taylor, Sr RF Project Engineer

Table of Contents

1 Summary of Test Results

Reference Sections		Test Description	Test Condition	Test Result
FCC	IC			
2.1046	RSS-GEN (6.12)	Conducted Output Power	Conducted	NS[1]
24.232(d) 27.50(d)(5)	RSS-130 (4.6.1) RSS-132 (5.4) RSS-133 (6.4) RSS-139 (5.5)	Peak-to-Average Ratio		NS[1]
2.1049 22.917(b) 24.238(b) 27.53(h)(3)	RSS-GEN (6.7) RSS-133 (2.3)	Occupied Bandwidth Emission Bandwidth		NS[1]
2.1051 22.917 24.238 27.53(c,g,h)	RSS-130 (4.7) RSS-132 (5.5) RSS-133 (6.5) RSS-139 (5.6)	Band Edge / Conducted Spurious Emissions		NS[1]
22.913(a)(5) 24.232(c) 27.50(b)(9) 27.50(c)(9)	RSS-130 (4.6.3) RSS-132 (5.4)	Effective Radiated Power		NS[1]
27.50(d)(4)	RSS-133 (6.4) RSS-139 (6.5)	Effective Isotropic Radiated Power		NS[1]
2.1053 22.917 24.238 27.53(c,f,g,h)	RSS-GEN (6.13) RSS-130 (4.7) RSS-132 (5.5) RSS-133 (6.5) RSS-139 (6.6)	Radiated Spurious Emissions	Radiated	Compliant
2.1055 22.355 24.235 27.54	RSS-GEN (6.11) RSS-130 (4.5) RSS-132 (5.3) RSS-133 (6.3) RSS-139 (5.4)	Frequency Stability	Conducted	NS[1]
15.205, 15.209	RSS-GEN 8.9, 8.10	Emissions in Restricted Frequency Bands	Radiated	Compliant

1) Not in the scope of evaluation. The EUT contains FCC certified modules. Only radiated spurious emissions including simultaneous transmissions was performed per FCC KDB 996369 D04 Module Integration Guide v02.

1.1 *Modifications Required to Compliance*

Some spurious emissions which had exceeded the average limit were an intermodulation of the LoRA (908MHz) and Zigbee (2.44GHz) radios. Removing the external 2.4GHz WiFi antenna improved this issue. Zigbee also has a low duty cycle. The client provided internal patch WiFi antennas to replace the hard-dome external WiFi antenna. Manufacturer also provided a technical document for the lower Zigbee duty cycle. Refer to appendix A for the duty cycle correction document.

The patch antenna part number was Pulse W3918B0050.

2 General Information

2.1 *Client Information*

Name:	Airgo Systems, LLC.
Address:	8232 SW 23rd Place
City, State, Zip, Country:	Oklahoma City, OK 73128, 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
Designation Number:	US1126
CAB Identifier:	US0186

2.3 *General Information of EUT*

Type of Product:	Large Vehicle Monitoring Telematics
Model Number:	Drov-ABO
Serial Number:	FCC 9083 (on label), 2017100031 (date code on pcb)
HW Version:	4.0
Firmware Version:	Not provided
IMEI Number:	866258044356480
Contains FCC ID:	2AYTU-EG91-NA-ABO (cell) 2AKNO-VOLJN5179M16 (Zigbee) / VPYLB1YM (WLAN) / SH6MDBT50Q (BLE) / 2ADWC-S76S (LoRA)
LTE Frequency Range Tested:	1850 – 1910 MHz (LTE Band 2) 699 – 716 MHz (LTE Band 12)
Simultaneous Radiators:	LoRA – 908MHz Zigbee – 2440MHz 802.11n – 2412MHz, 5825MHz (not at same time) Bluetooth Low Energy – 2402MHz
Antenna Type/Gain*:	Taoglas Patch / LTE Band 2 (6 dBi), LTE Band 12 (3.5 dBi)
Rated Voltage:	12 VDC
Test Voltage:	12 VDC
Sample Received Date:	11 June 2022
Dates of testing:	30 June – 25 August 2022; 27 January 2023 & 27 March 2023

Note: Antenna gain was not measured at SGS. Gain was referenced from antenna datasheet.*

2.4 *Operating Modes and Conditions*

The cellular operation of the EUT was exercised by connecting a CMW 500 Radio Communication Tester to the device. The CMW was used to control signaling and channel during testing.

The EUT was programmed to turn on all other radios simultaneously on fixed channels. The cellular radio was configured to operate on LTE Band 2 and then LTE Band 12 to evaluate the potential for intermodulation products with the other radios.

The Wi-Fi module would only transmit on 2.4GHz or 5GHz; results for both were captured in the test data section. Below 1GHz, there was no marked difference between the 2.4 and 5GHz operations. Only worst-case is reported.

Spurious emissions from unlicensed radios were compared to the FCC 15.209 average limit of 54dBuV/m at a 3m distance, which converts to an EIRP of -41.2dBm.

3 Radiated Spurious Emissions

3.1 *Test Result*

Test Description	Specification	Test Result
Transmitter Spurious Emissions	ANSI C63.10; ANSI C63.26	Compliant

3.2 *Test Method*

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester.

Manufacturer provided a Duty Cycle Correction Factor (DCCF) for the Zigbee radio, which was included in the tabulated data of the after modifications test results. Both WLAN bands showed same Zigbee emissions, therefore only 2.4GHz WLAN with all radios was checked after modifications. Refer to Appendix A.

Initial measurements were performed at the low, middle and high channels of each band. Re-testing was performed at the middle channel of the worst-case band.

Spurious emissions from unlicensed radios were compared to FCC 15.209 limit: 54dBuV/m (-41.2dBm).

3.3 *Test Site*

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA
3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Jun – Aug 2022	30-1000MHz	Above 1GHz
Environmental Conditions		
Temperature:	24.4 °C	23.9 °C
Relative Humidity:	59.6 %	57.2 %
Atmospheric Pressure:	98.94 kPa	98.02 kPa

March 27 2023	Above 1GHz
Environmental Conditions	
Temperature:	24.8 °C
Relative Humidity:	43.4 %
Atmospheric Pressure:	97.6 kPa

3.4 *Test Equipment*

30-1000MHz

Test End Date: 30-Jun-2022 Tester: PL/LM

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	26-May-2022	26-May-2024
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22001	10-Jan-2022	10-Jan-2023
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20117	17-Feb-2022	17-Feb-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20124	14-Feb-2022	14-Feb-2023
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079800	18-Oct-2021	18-Oct-2022
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	26-Aug-2021	26-Aug-2022
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2021	9-Jul-2022

Above 1GHz

Test End Date: 11-Jul-2022 Tester: PL/LM/AB

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	10-Aug-2020	10-Aug-2022
RF CABLE, NM TO NM.	90-195-276	TELEDYNE STORM MICROWAVE	21020	16-Mar-2022	16-Mar-2023
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	7-Oct-2021	7-Oct-2022
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Aug-2021	24-Aug-2022
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	30-Jun-2022	30-Jun-2023
ATTENUATOR, 20DB	8491B 20DB	HEWLETT PACKARD	B079664-20	12-May-2022	12-May-2023
FILTER, HIGH PASS, >1000MHZ	HPM50108	MICRO-TRONICS	B079802	5-Jul-2022	5-Jul-2023

Above 1GHz

Test End Date: 25-Aug-2022 Tester: ZH

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	29-Jul-2022	29-Jul-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-157	TELEDYNE STORM MICROWAVE	20121	14-Feb-2022	14-Feb-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20125	25-Aug-2021	25-Aug-2022
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	13-Jul-2022	13-Jul-2023
RF CABLE	104PE	HUBER & SUHNER	B079793	25-Aug-2022	25-Aug-2023
EMI RECEIVER	ESW44	ROHDE & SCHWARZ	101585	26-Oct-2021	12-Mar-2023
FILTER, HIGH PASS, >1000MHZ	HPM50108	MICRO-TRONICS	B079802	5-Jul-2022	5-Jul-2023
ATTENUATOR, 20DB	8491B 20DB	HEWLETT PACKARD	B079664-20	12-May-2022	12-May-2023
FILTER, HIGH PASS, >6250MHZ	HPM50112	MICRO-TRONICS	B093647	11-Jul-2022	11-Jul-2023

After Modifications - Above 1 GHz

Test End Date: 27-Mar-2023 Tester: ZH

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20125	25-Aug-2022	25-Aug-2023
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20132	13-Mar-2023	13-Mar-2024
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	29-Jul-2022	29-Jul-2024
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	3-Oct-2022	3-Oct-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20126	9-Feb-2023	9-Feb-2024
FILTER, HIGH PASS, >1000MHZ	HPM50108	MICRO-TRONICS	B079802	5-Jul-2022	5-Jul-2023
FILTER, BAND REJECT, 1880MHZ	BRC50720	MICRO-TRONICS	B079784	5-Jul-2022	5-Jul-2023
TUNABLE NOTCH FILTER	NF-00051 3TNF-1500/3000-I	K&L MICROWAVE	21040	CNR	CNR

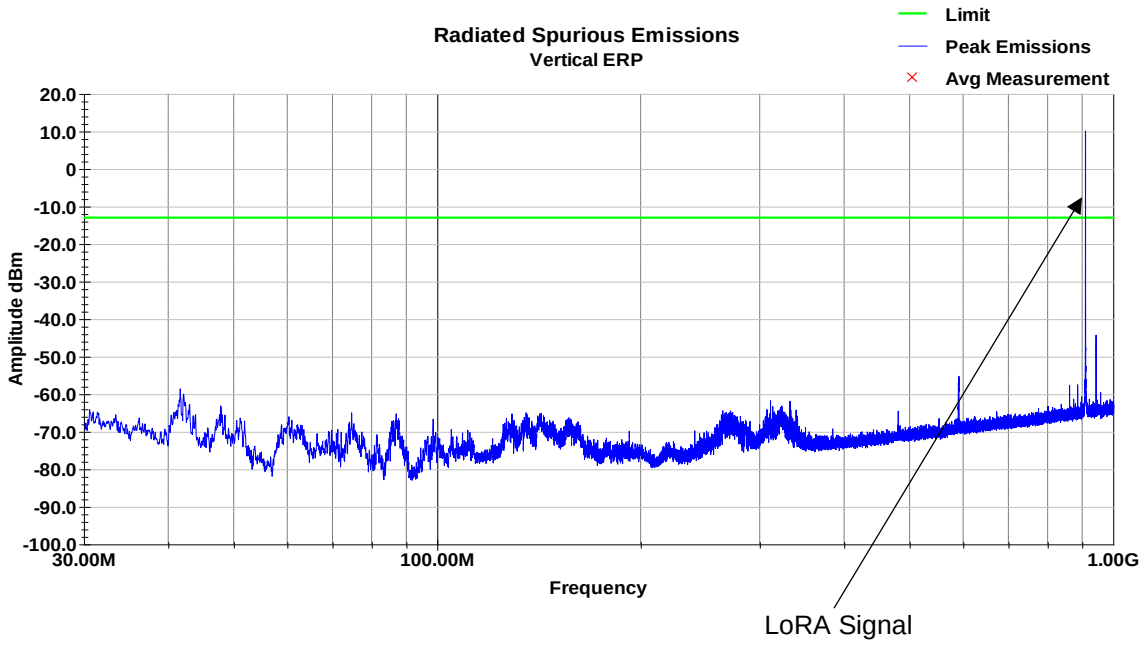
Note: Refer to equipment list for calibration intervals.

3.5 *Test Data*

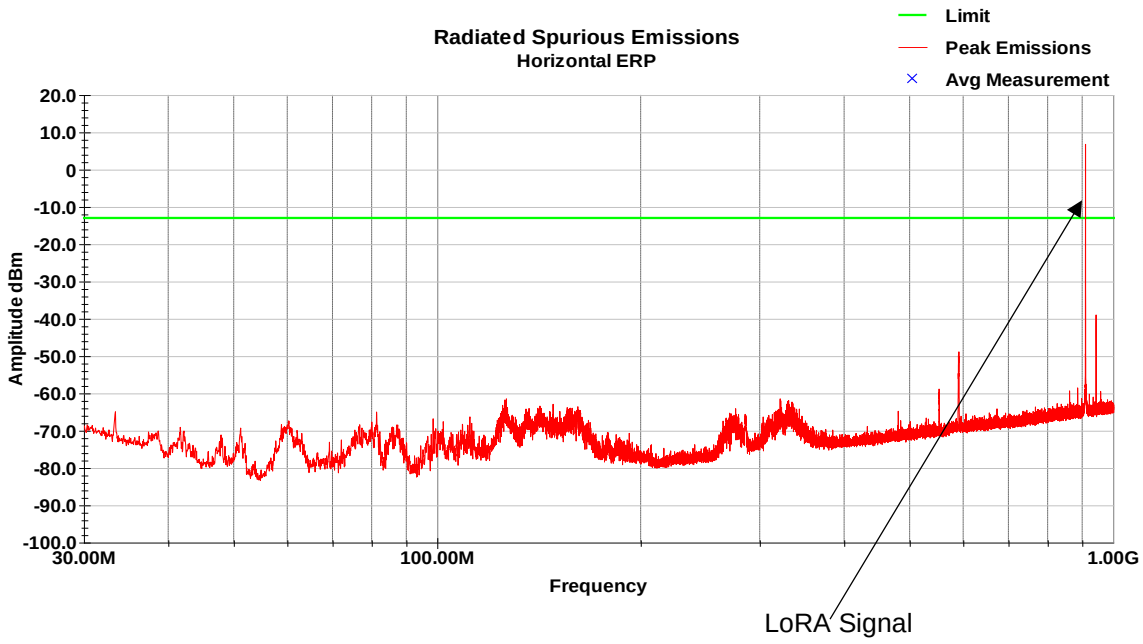
All radios w. 2.4GHz WLAN (before modifications)

LTE Band 2, QPSK modulation, 1.4MHz, Low Channel (18607)

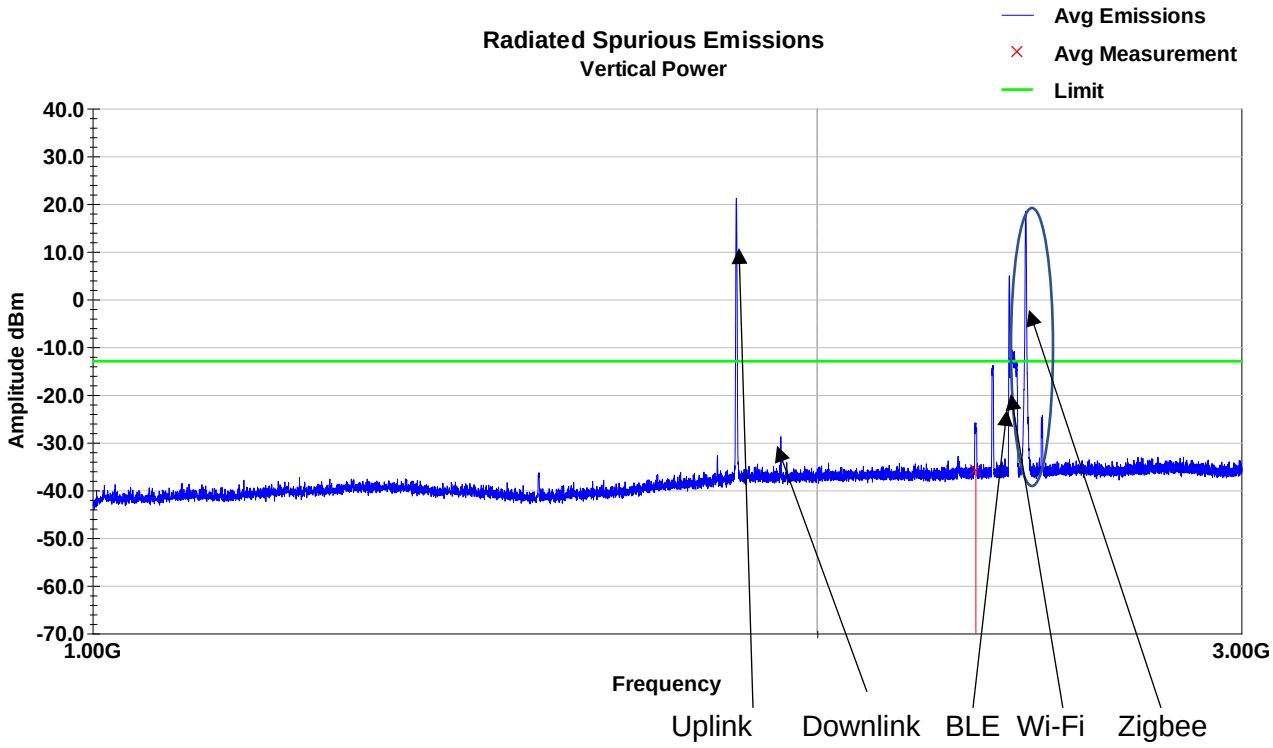
Vertical Plot (30-1000MHz)



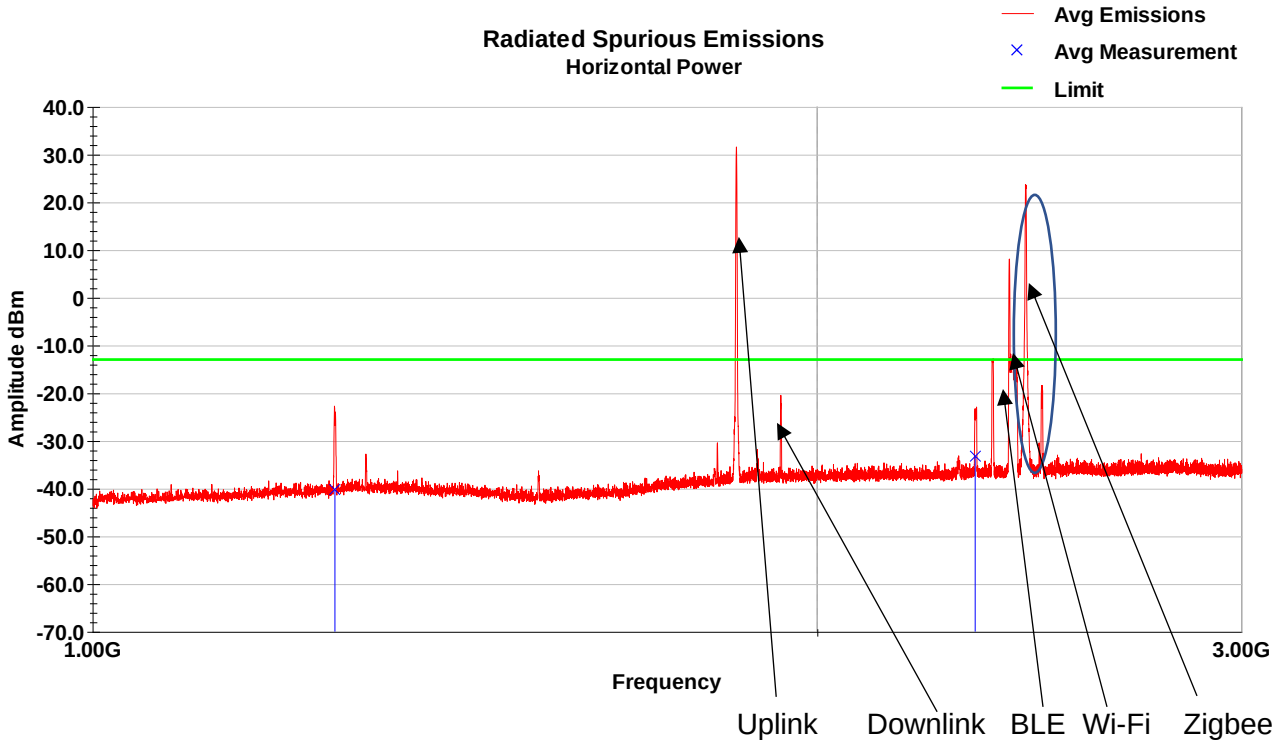
Horizontal Plot (30-1000MHz)



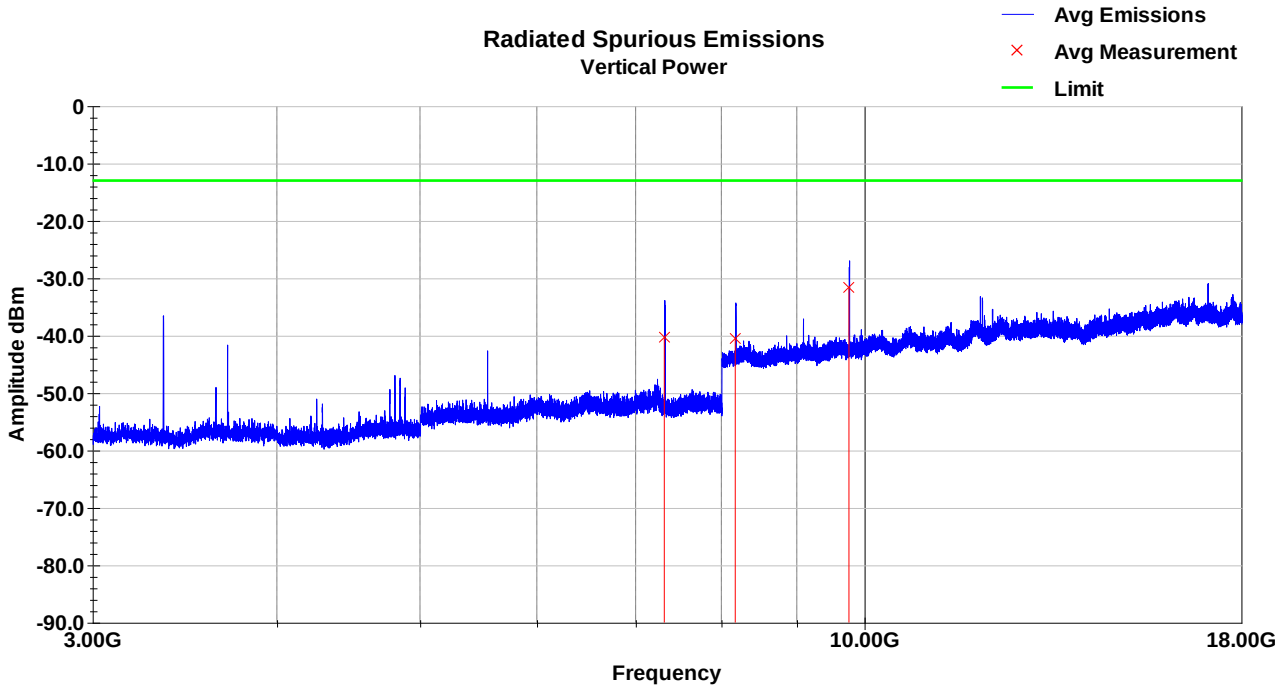
LTE Band 2, QPSK modulation, 1.4MHz
Low Channel (18607)
Vertical Plot (1-3GHz)



Horizontal Plot (1-3GHz)



LTE Band 2, QPSK modulation, 1.4MHz
Low Channel (19957)
Vertical Plot (3-18GHz)



Vertical LTE Tabulated Data 3-18GHz

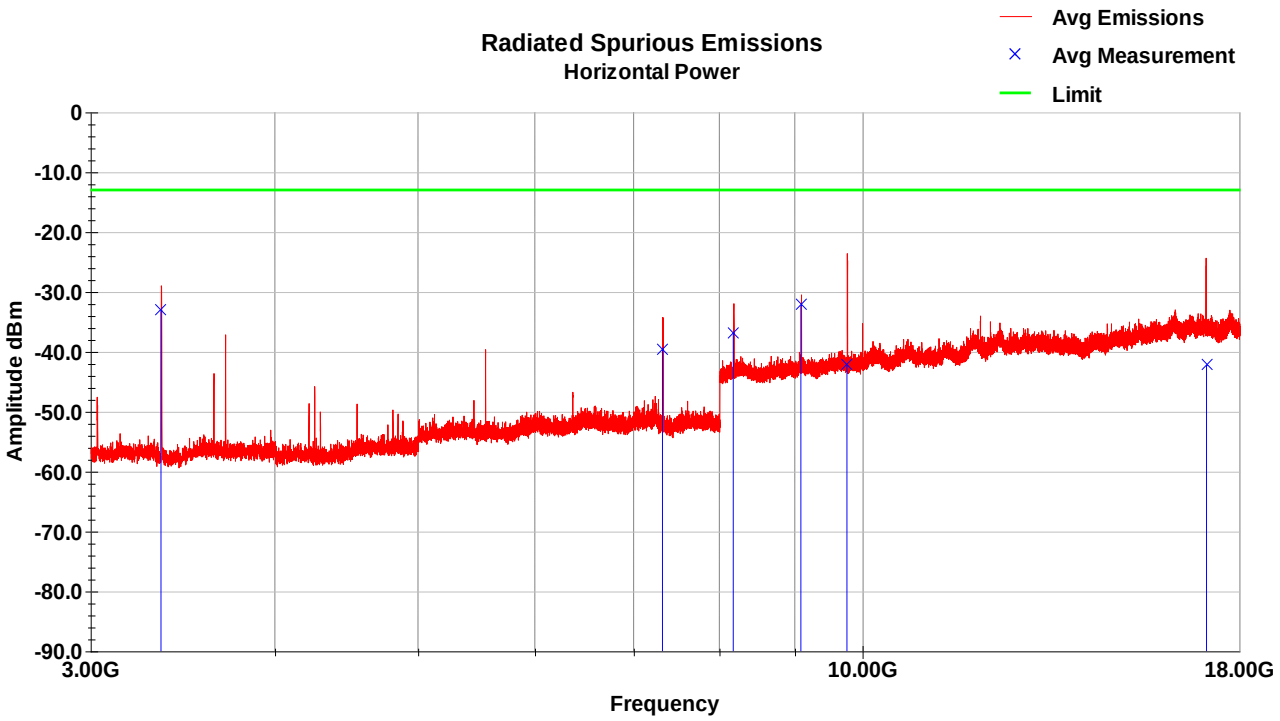
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
7318.68	-38.9	V	240.0	189.0	35.8	4.3	41.6	-40.3	-13.0	-27.3
8176.00	-39.4	V	319.0	195.0	35.8	4.4	41.4	-40.6	-13.0	-27.6
9762.16	-31.4	V	306.0	208.0	36.7	5.0	41.9	-31.6	-13.0	-18.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radios Tabulated Data

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
7318.68	-38.9	V	240.0	189.0	35.8	4.3	41.6	-40.3	-41.2	0.9
8176.00	-39.4	V	319.0	195.0	35.8	4.4	41.4	-40.6	-41.2	0.6
9762.16	-31.4	V	306.0	208.0	36.7	5.0	41.9	-31.6	-41.2	9.6
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above frequencies are harmonics of Zigbee and LoRA

Horizontal Plot (3-18GHz)



Horizontal LTE Tabulated Data 3-18GHz

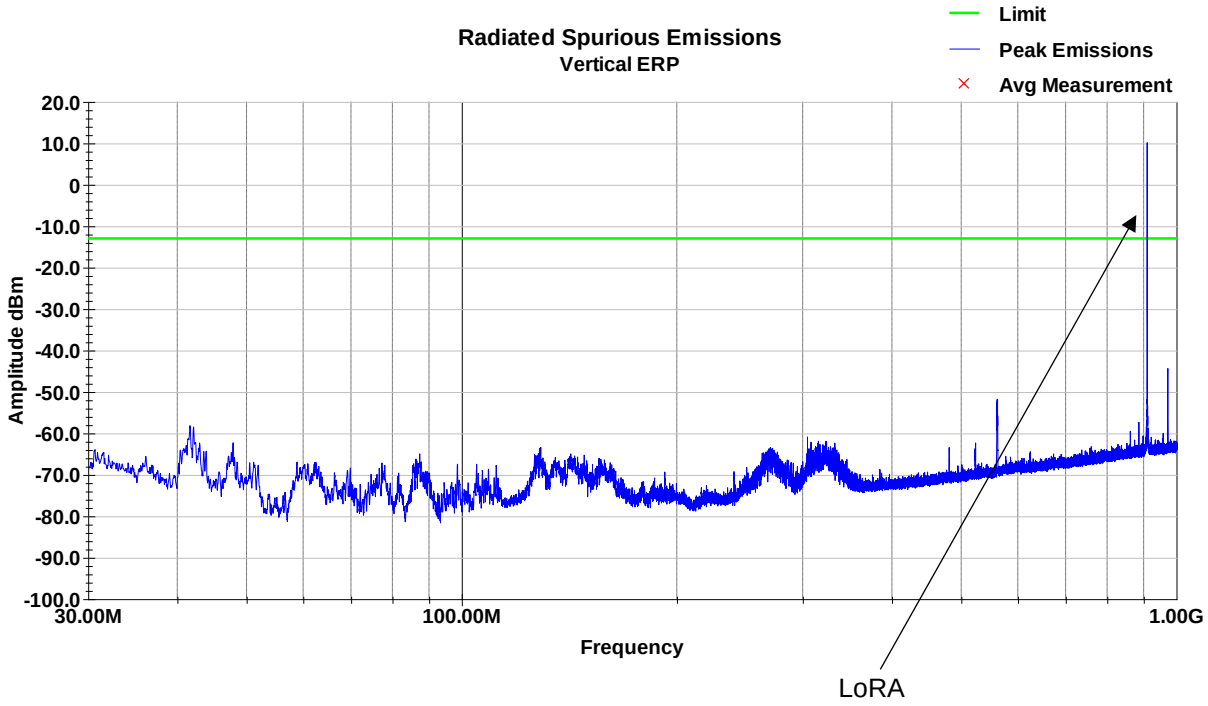
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3349.00	-26.8	H	281.0	199.0	32.7	3.0	41.9	-33.0	-13.0	-20.0
7321.56	-38.0	H	322.0	244.0	35.8	4.3	41.6	-39.5	-13.0	-26.5
8175.80	-35.7	H	251.0	249.0	35.8	4.4	41.4	-36.8	-13.0	-23.8
9084.76	-31.6	H	312.0	195.0	36.2	4.8	41.5	-32.2	-13.0	-19.2
9762.24	-42.1	H	314.0	250.0	36.7	5.0	41.9	-42.2	-13.0	-29.2
17104.60	-50.0	H	125.0	201.0	41.4	6.9	40.5	-42.2	-13.0	-29.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data 3-18GHz

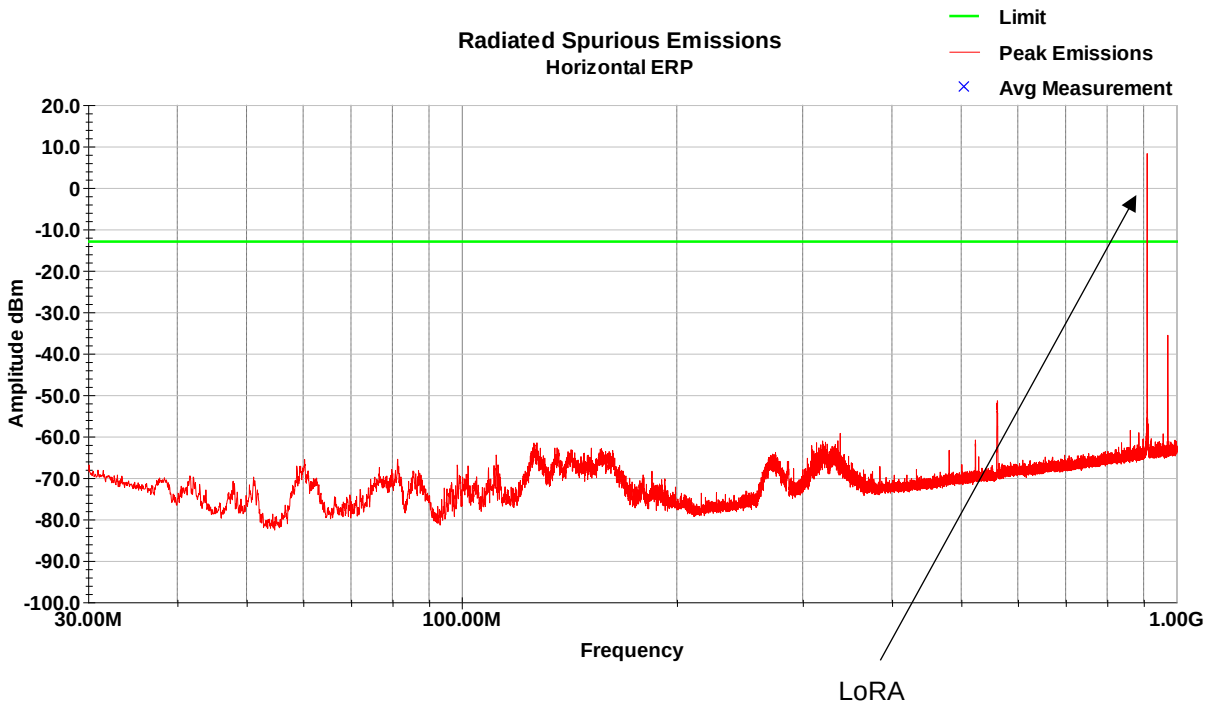
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3349.00	-26.8	H	281.0	199.0	32.7	3.0	41.9	-33.0	-41.2	8.2
7321.56	-38.0	H	322.0	244.0	35.8	4.3	41.6	-39.5	-41.2	1.7
8175.80	-35.7	H	251.0	249.0	35.8	4.4	41.4	-36.8	-41.2	4.4
9084.76	-31.6	H	312.0	195.0	36.2	4.8	41.5	-32.2	-41.2	9.0
9762.24	-42.1	H	314.0	250.0	36.7	5.0	41.9	-42.2	-41.2	-1.0
17104.60	-50.0	H	125.0	201.0	41.4	6.9	40.5	-42.2	-41.2	-1.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above frequencies are intermodulation and/or harmonics of LoRA and Zigbee

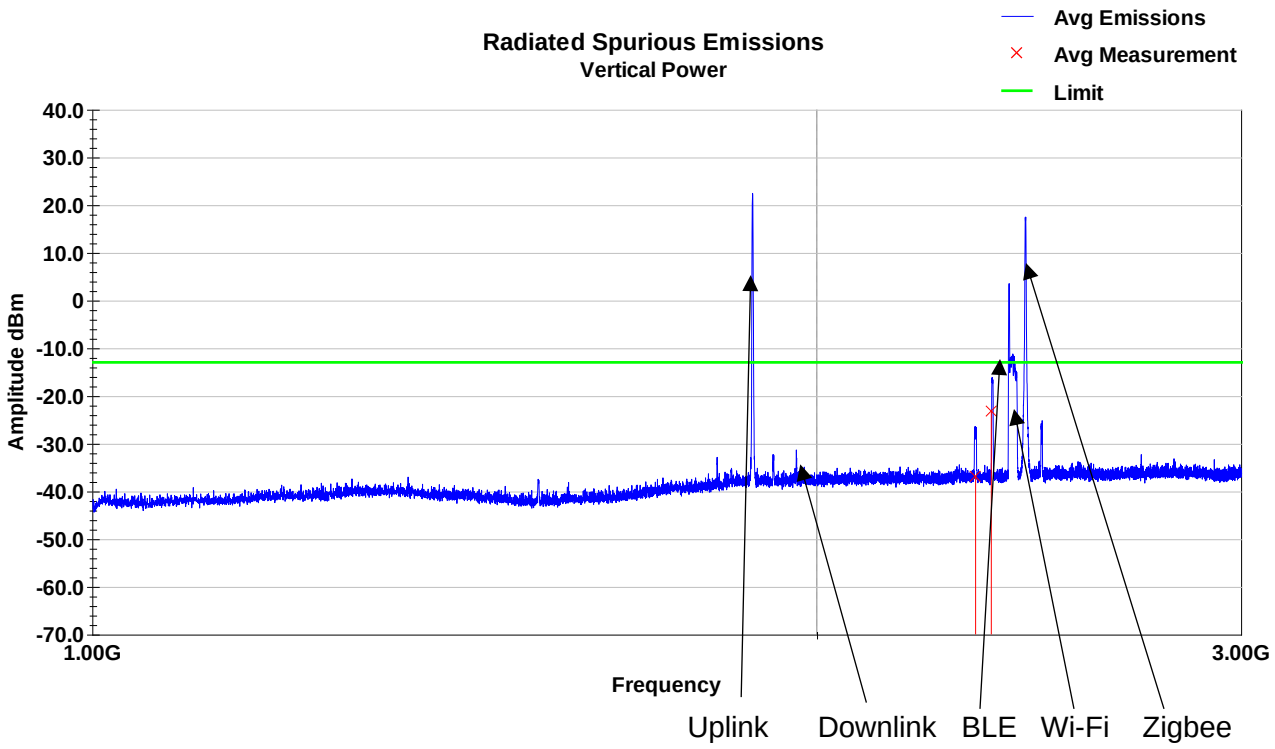
LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (30-1000MHz)



Horizontal Plot (30-1000MHz)



LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (1-3GHz)

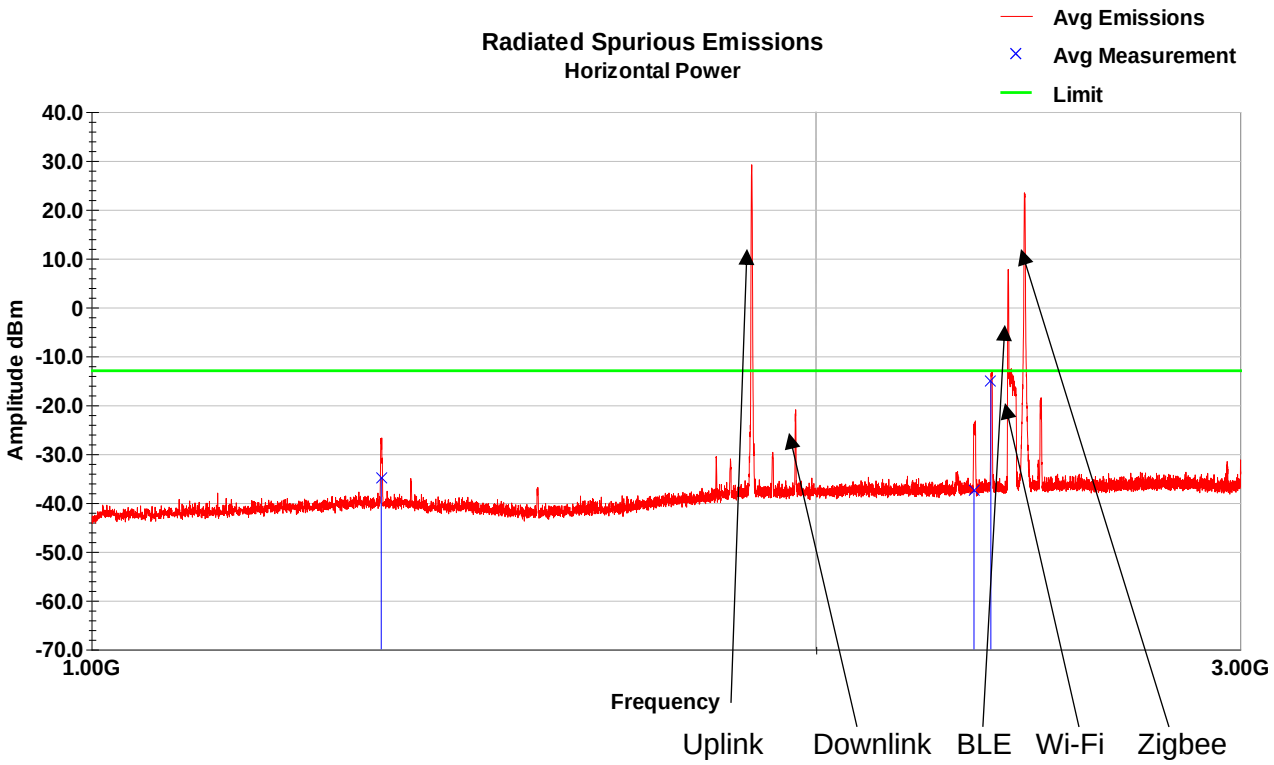


Vertical Tabular Data (1-3GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
2327.92	-57.2	V	0.0	233.0	31.7	22.0	33.4	-36.9	-13.0	-23.9
2363.04	-43.5	V	0.0	247.0	31.8	22.0	33.4	-23.1	-13.0	-10.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are intermodulation of Zigbee & BLE

Horizontal Plot (1-3GHz)

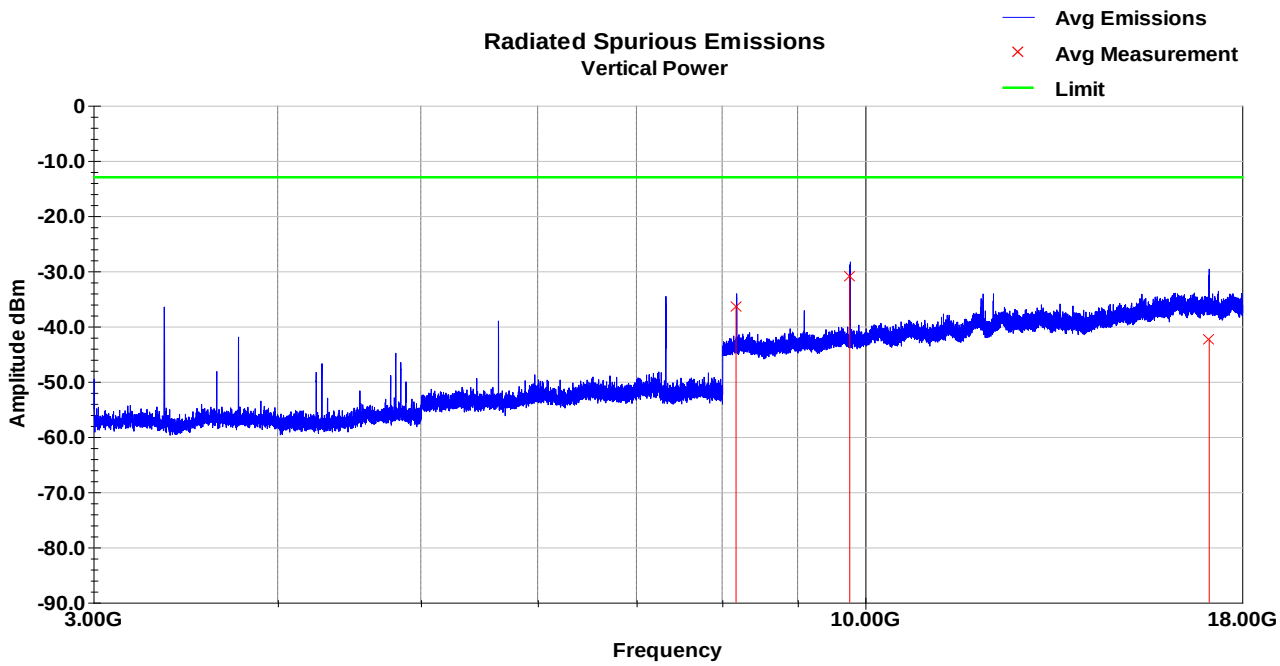


Horizontal Tabular Data (1-3GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1319.60	-52.3	H	217.0	232.0	29.5	21.4	33.5	-34.9	-13.0	-21.9
2326.16	-57.8	H	68.0	250.0	31.7	22.0	33.4	-37.5	-13.0	-24.5
2364.00	-35.5	H	288.0	213.0	31.8	22.0	33.4	-15.2	-13.0	-2.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are intermodulation of Zigbee & BLE

LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (3-18GHz)



Vertical LTE Tabulated Data 3-18GHz

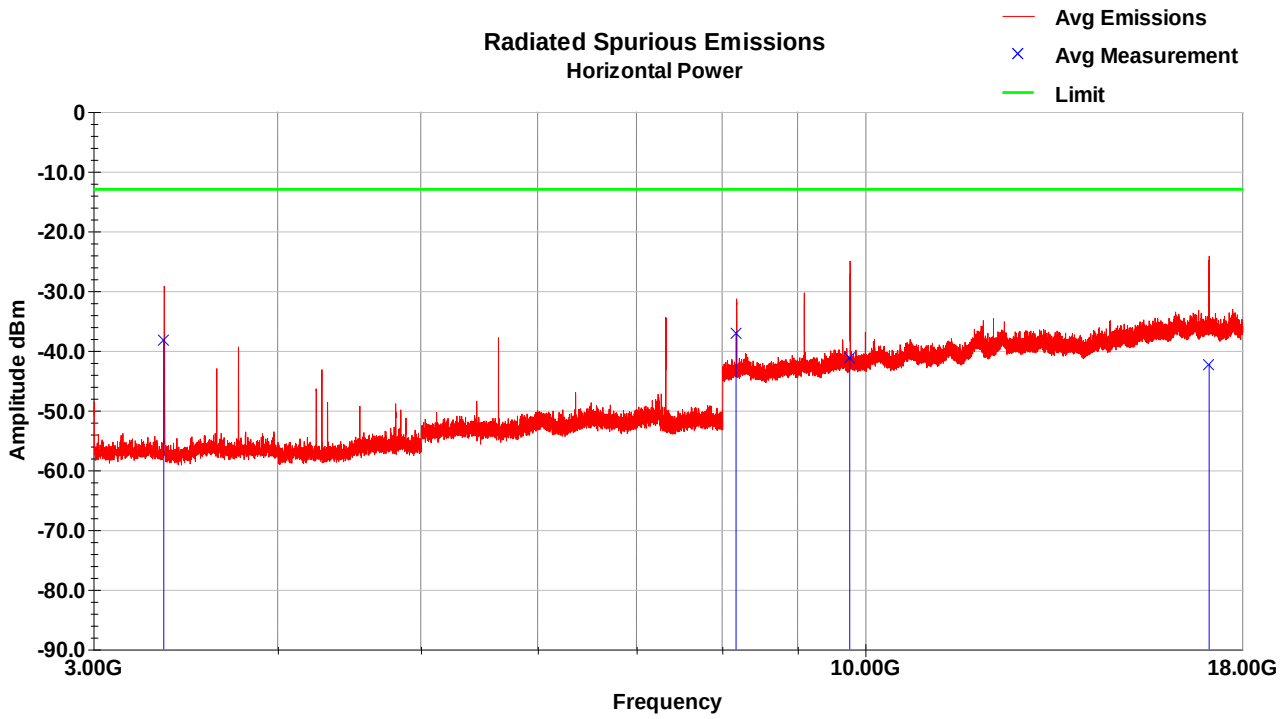
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
8176.72	-35.2	V	210.0	238.0	35.8	4.4	41.4	-36.4	-13.0	-23.4
9762.04	-30.9	V	306.0	207.0	36.7	5.0	41.9	-31.0	-13.0	-18.0
17103.76	-50.2	V	63.0	223.0	41.4	6.9	40.5	-42.4	-13.0	-29.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Tabulated Data 3-18GHz

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
8176.72	-35.2	V	210.0	238.0	35.8	4.4	41.4	-36.4	-41.2	4.8
9762.04	-30.9	V	306.0	207.0	36.7	5.0	41.9	-31.0	-41.2	10.2
17103.76	-50.2	V	63.0	223.0	41.4	6.9	40.5	-42.4	-41.2	-1.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are harmonics of LoRA and Zigbee radios

Horizontal Plot (3-18GHz)



Horizontal LTE Tabulated Data – 3-18GHz

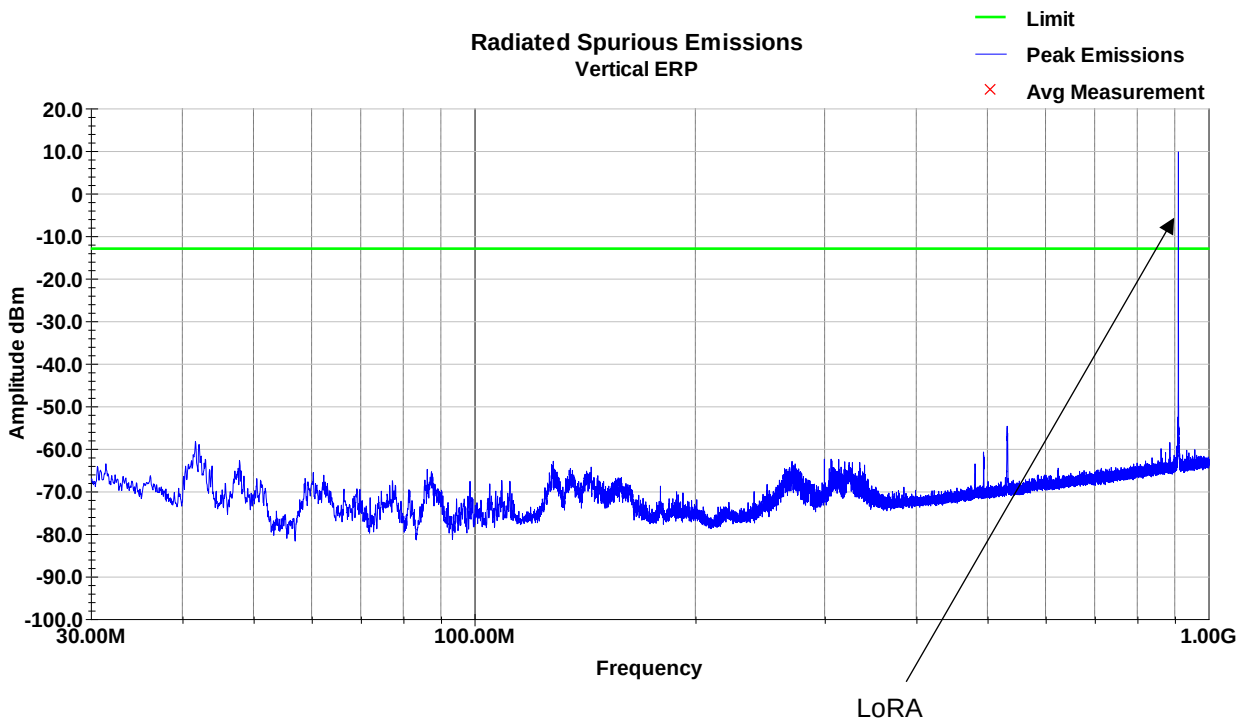
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3348.96	-32.0	H	282.0	250.0	32.7	3.0	41.9	-38.3	-13.0	-25.3
8176.44	-36.0	H	173.0	249.0	35.8	4.4	41.4	-37.2	-13.0	-24.2
9761.96	-41.0	H	313.0	250.0	36.7	5.0	41.9	-41.1	-13.0	-28.1
17099.56	-50.1	H	137.0	250.0	41.4	6.9	40.5	-42.3	-13.0	-29.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Tabulated Data – 3-18Ghz

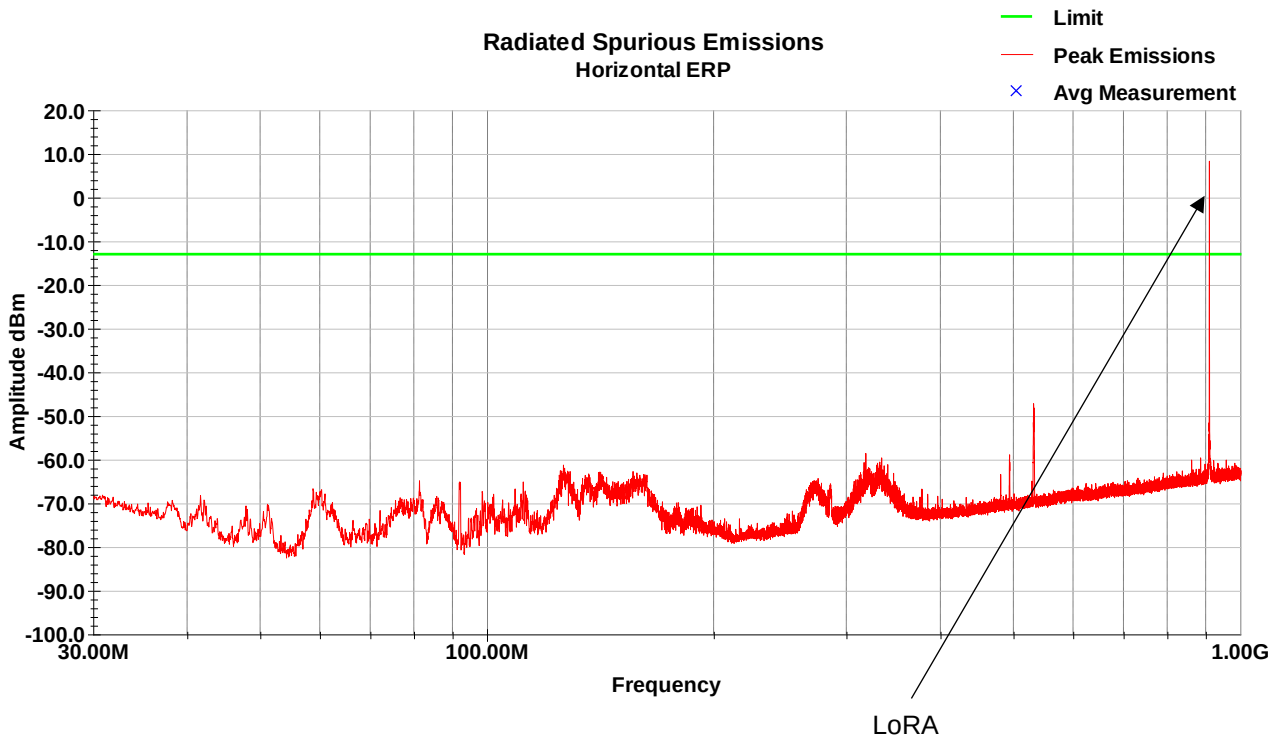
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3348.96	-32.0	H	282.0	250.0	32.7	3.0	41.9	-38.3	-41.2	2.9
8176.44	-36.0	H	173.0	249.0	35.8	4.4	41.4	-37.2	-41.2	4.0
9761.96	-41.0	H	313.0	250.0	36.7	5.0	41.9	-41.1	-41.2	0.1
17099.56	-50.1	H	137.0	250.0	41.4	6.9	40.5	-42.3	-41.2	-1.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are intermodulation and/or harmonics of LoRA and Zigbee radios.

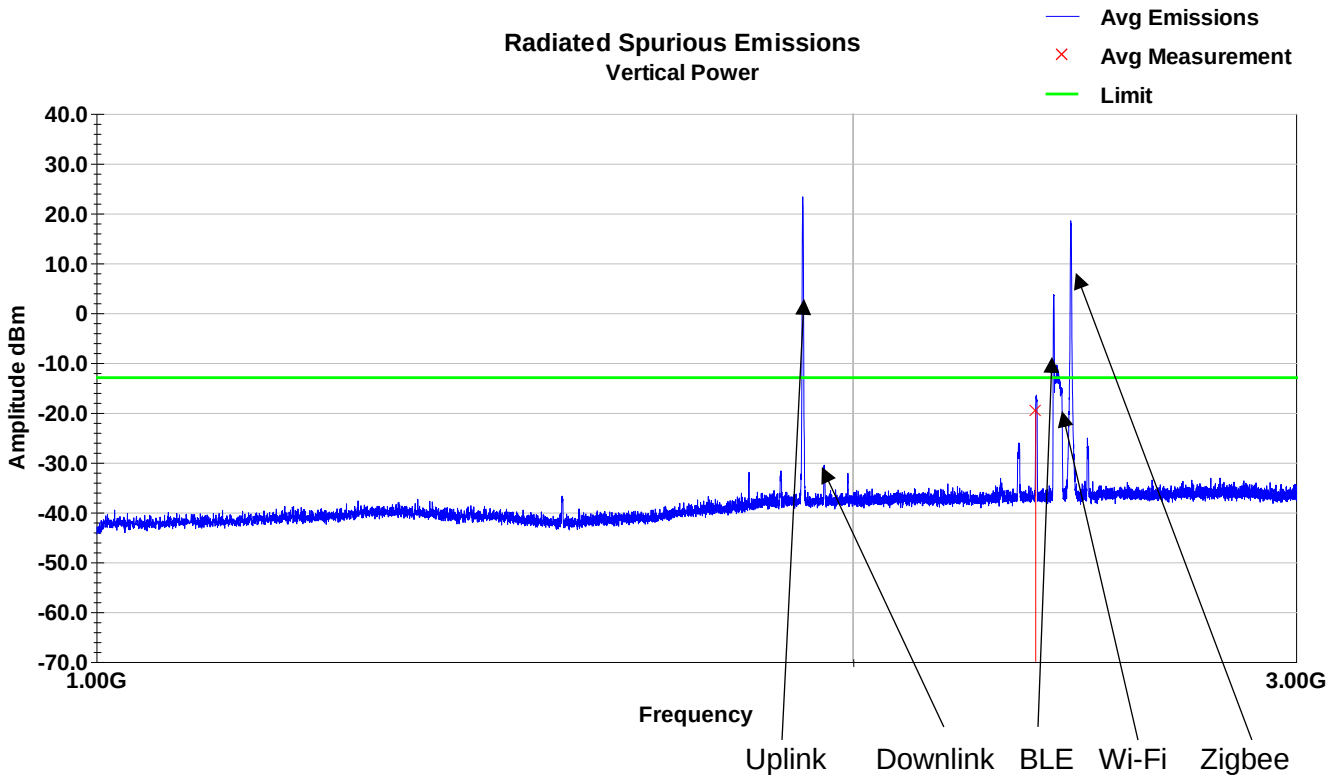
LTE Band 2, QPSK modulation, 1.4MHz
High Channel (19193)
Vertical Plot (30-1000MHz)



Horizontal Plot (30-1000MHz)



LTE Band 2, QPSK modulation, 1.4MHz
High Channel (19193)
Vertical Plot (1-3GHz)

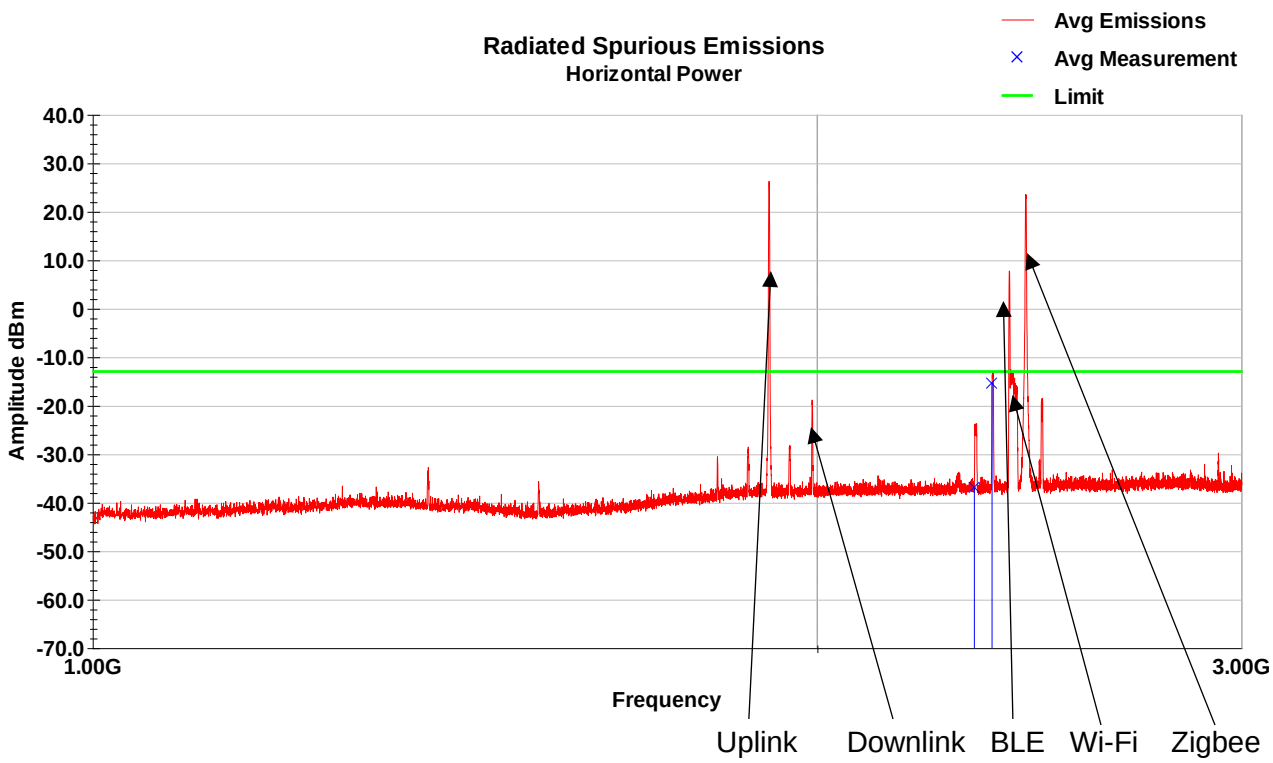


Vertical Tabular Data (1-3GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
2364.12	-39.9	V	8.0	220.0	31.8	22.0	33.4	-19.5	-13.0	-6.5
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emission is an intermodulation of Zigbee and BLE

Horizontal Plot (1-3GHz)

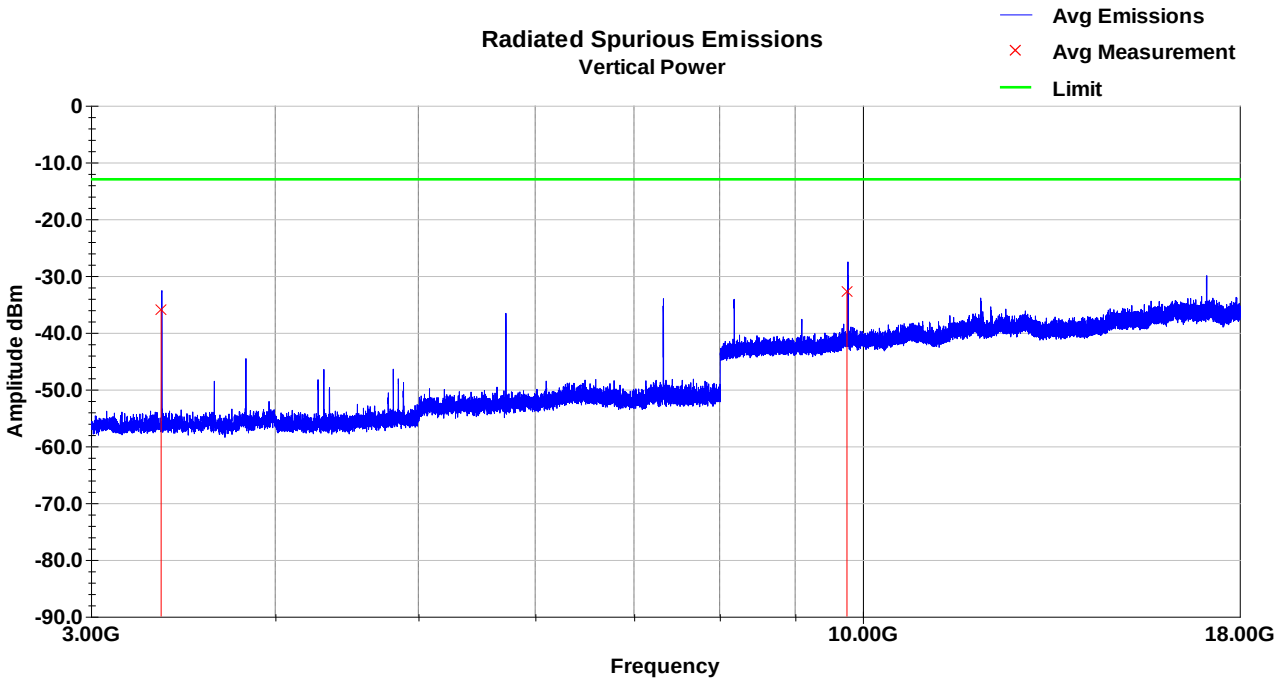


Horizontal Tabular Data (1-3GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
2324.24	-57.1	H	87.0	183.0	31.7	22.0	33.4	-36.8	-13.0	-23.8
2363.88	-35.7	H	288.0	214.0	31.8	22.0	33.4	-15.3	-13.0	-2.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are intermodulation of Zigbee and BLE

LTE Band 2, QPSK modulation, 1.4MHz
High Channel (19193)
Vertical Plot (3-18GHz)



Vertical LTE Tabulated Data – 3-18GHz

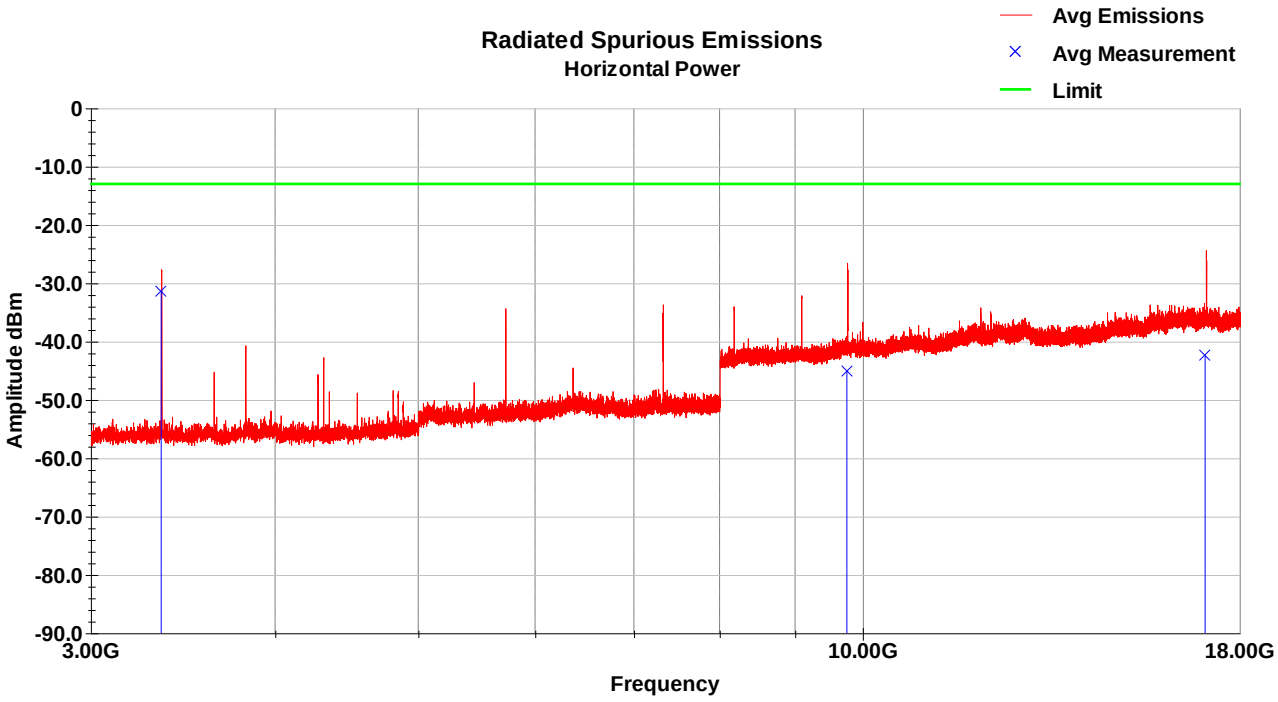
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3348.04	-37.0	V	224.0	194.0	32.7	2.0	33.7	-36.0	-13.0	-23.0
9758.08	-38.9	V	300.0	199.0	36.8	3.5	34.1	-32.8	-13.0	-19.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data – 3-18GHz

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3348.04	-37.0	V	224.0	194.0	32.7	2.0	33.7	-36.0	-41.2	5.2
9758.08	-38.9	V	300.0	199.0	36.8	3.5	34.1	-32.8	-41.2	8.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above emissions are intermodulation and/or harmonics of LoRA and Zigbee radios

Horizontal Plot (3-18GHz)



Horizontal LTE Tabulated Data – 3-18GHz

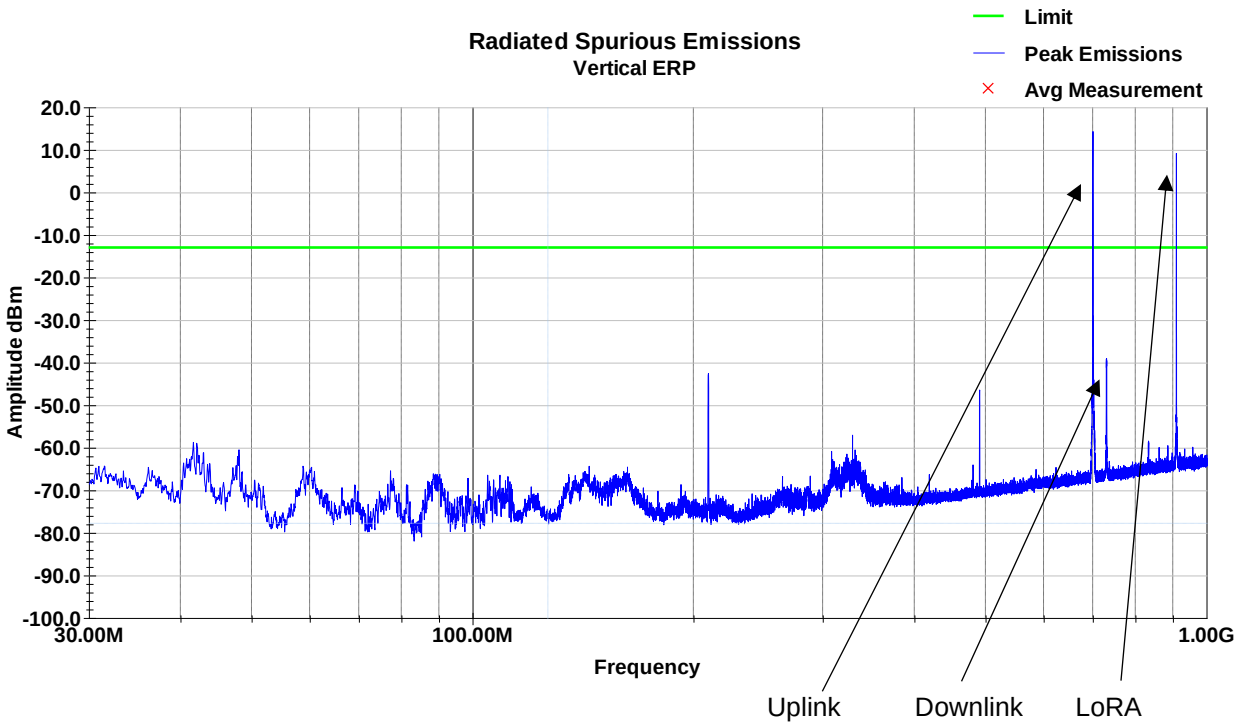
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3349.00	-32.3	H	274.0	198.0	32.7	2.0	33.7	-31.3	-13.0	-18.3
9758.12	-51.2	H	301.0	250.0	36.8	3.5	34.1	-45.1	-13.0	-32.1
17060.12	-52.6	H	34.0	250.0	41.1	4.7	35.7	-42.4	-13.0	-29.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data – 3-18GHz

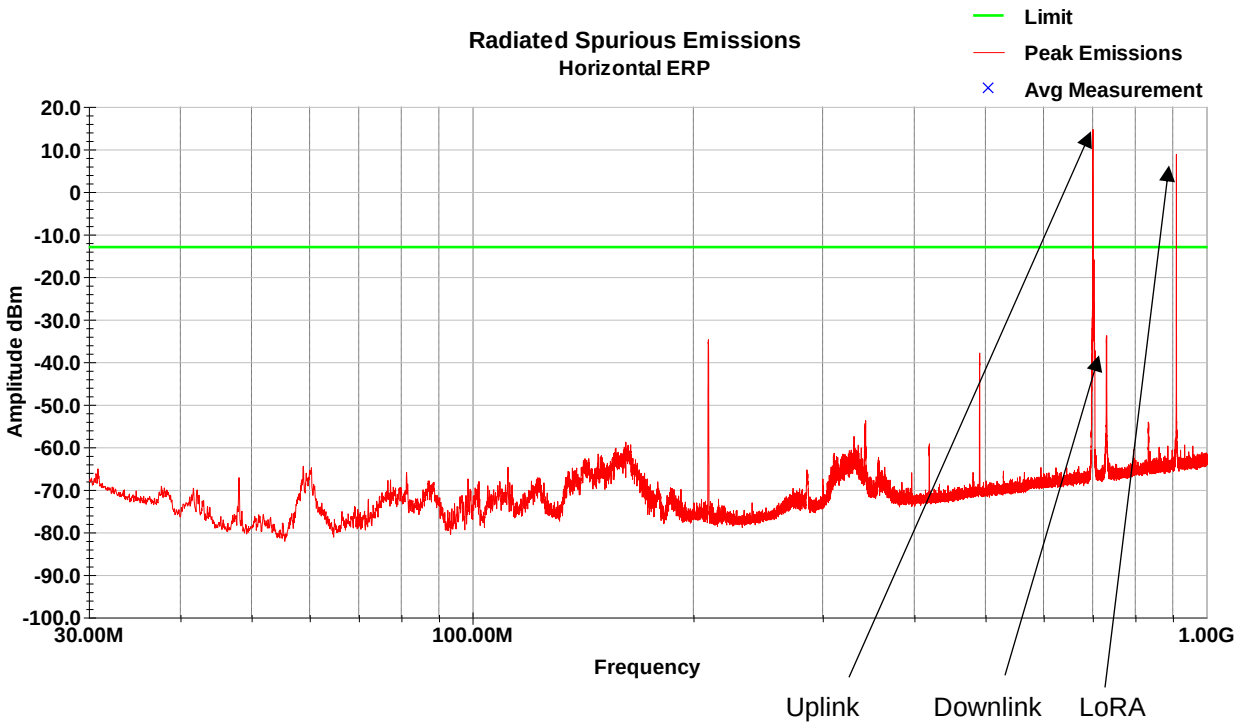
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
3349.00	-32.3	H	274.0	198.0	32.7	2.0	33.7	-31.3	-41.2	9.9
9758.12	-51.2	H	301.0	250.0	36.8	3.5	34.1	-45.1	-41.2	-3.9
17060.12	-52.6	H	34.0	250.0	41.1	4.7	35.7	-42.4	-41.2	-1.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

3349MHz is an intermodulation of LoRA and Zigbee radios.

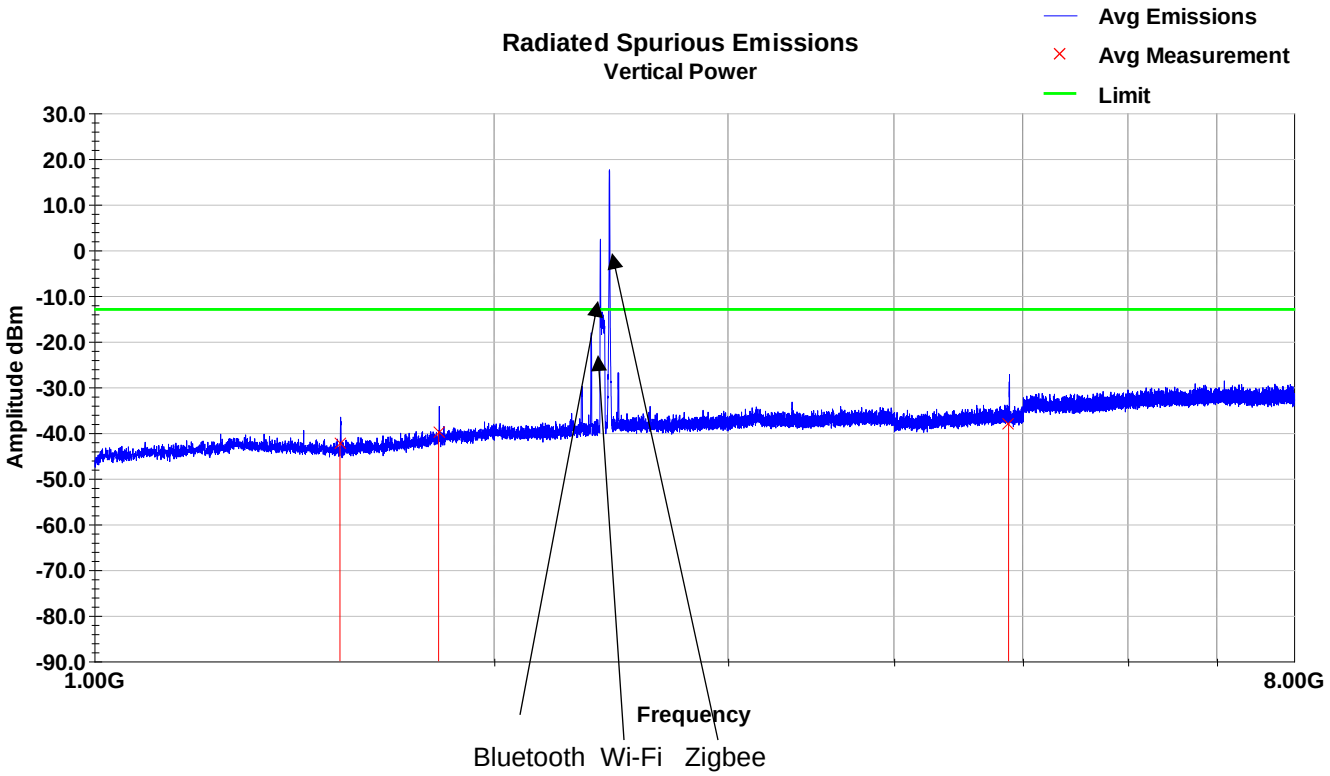
LTE Band 12, QPSK modulation, 1.4MHz
Low Channel (23017)
Vertical Plot (30-1000MHz)



Horizontal Plot (30-1000MHz)



LTE Band 12, QPSK modulation, 1.4MHz
Low Channel (23017)
Vertical Plot (1-8GHz)



Vertical Tabular Data (1-8GHz)

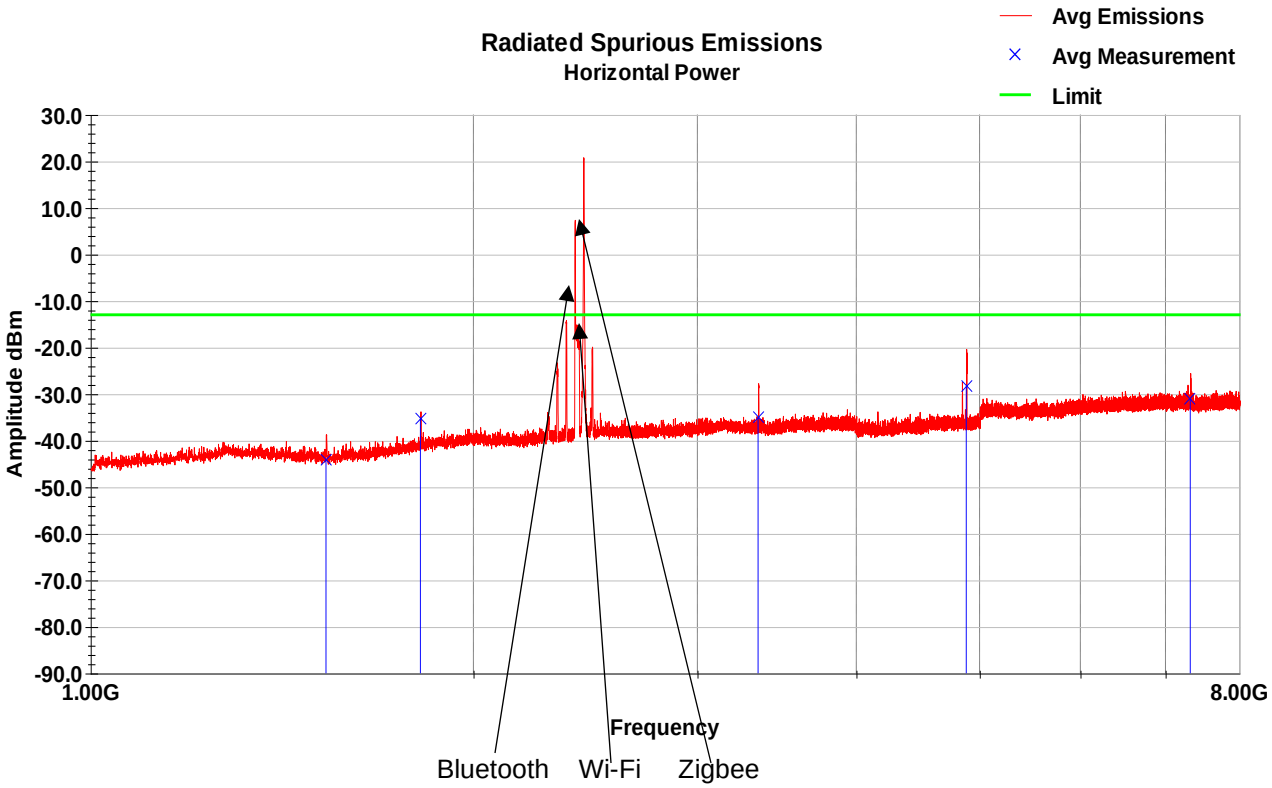
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1531.20	-49.4	V	306.0	233.0	27.7	22.1	42.7	-42.3	-13.0	-29.3
1816.68	-50.0	V	194.0	250.0	30.4	22.3	42.6	-39.9	-13.0	-26.9
4878.96	-54.2	V	110.0	250.0	34.5	23.7	42.0	-37.9	-13.0	-24.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1816.68	-50.0	V	194.0	250.0	30.4	22.3	42.6	-39.9	-41.2	-1.3
4878.96	-54.2	V	110.0	250.0	34.5	23.7	42.0	-37.9	-41.2	3.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

4878.96MHz is a harmonic of Zigbee

Horizontal Plot (1-8GHz)



Horizontal LTE Tabular Data (1-8GHz)

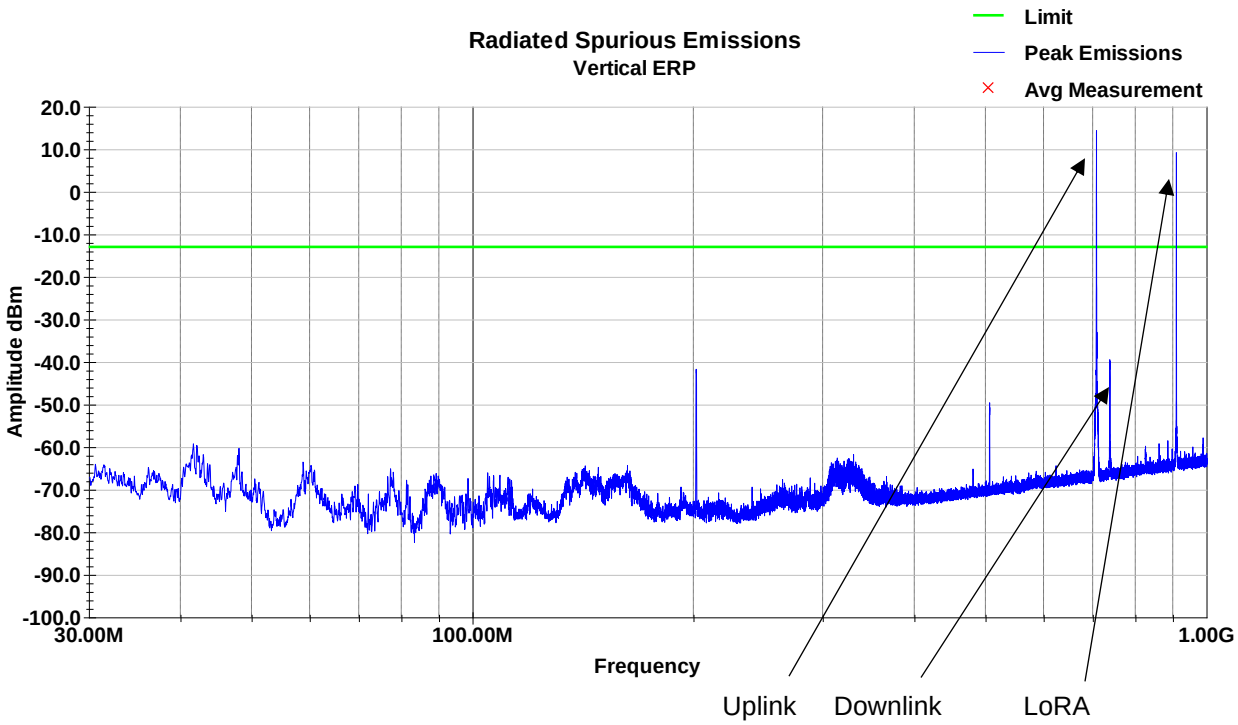
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1531.56	-51.2	H	267.0	250.0	27.7	22.1	42.7	-44.1	-13.0	-31.1
1817.04	-45.3	H	113.0	250.0	30.4	22.3	42.6	-35.2	-13.0	-22.2
3348.60	-49.1	H	185.0	250.0	32.7	23.3	41.9	-35.0	-13.0	-22.0
4881.12	-44.5	H	298.0	250.0	34.5	23.7	42.0	-28.2	-13.0	-15.2
7321.60	-49.7	H	304.0	250.0	35.8	24.4	41.6	-31.0	-13.0	-18.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

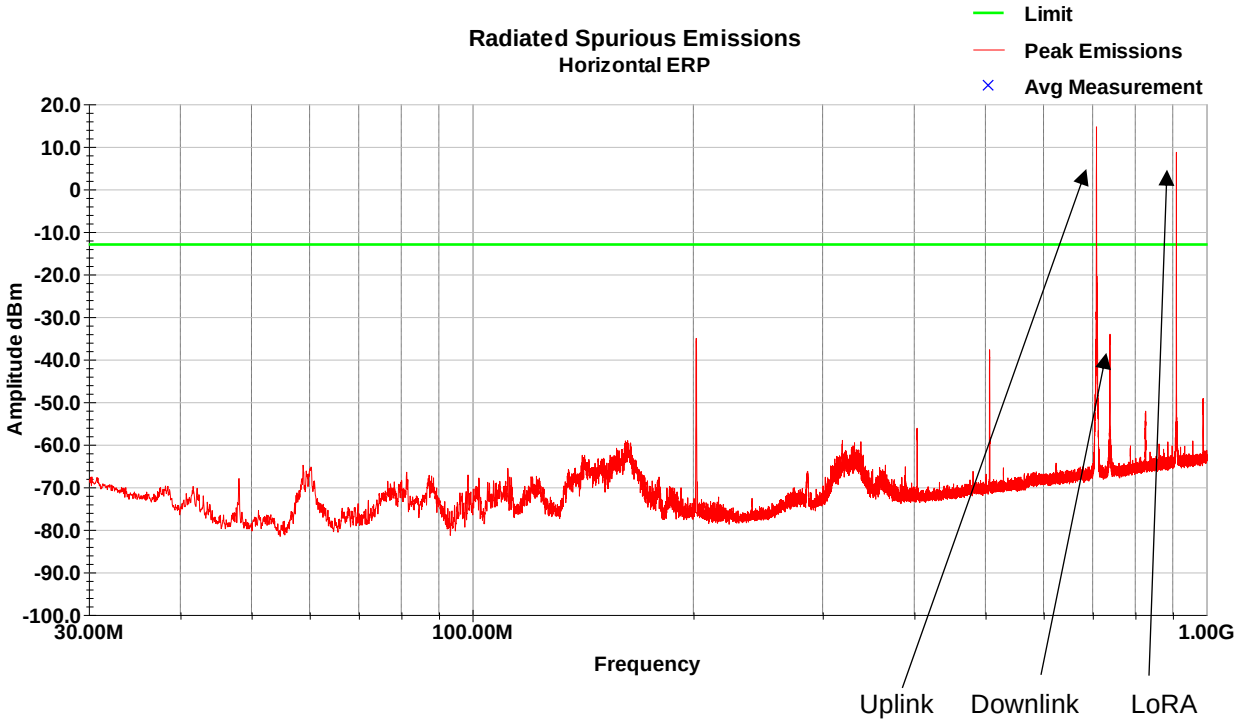
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1817.04	-45.3	H	113.0	250.0	30.4	22.3	42.6	-35.2	-41.2	6.0
3348.60	-49.1	H	185.0	250.0	32.7	23.3	41.9	-35.0	-41.2	6.2
4881.12	-44.5	H	298.0	250.0	34.5	23.7	42.0	-28.2	-41.2	13.0
7321.60	-49.7	H	304.0	250.0	35.8	24.4	41.6	-31.0	-41.2	10.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above frequencies are harmonics and/or intermodulation of LORA and Zigbee

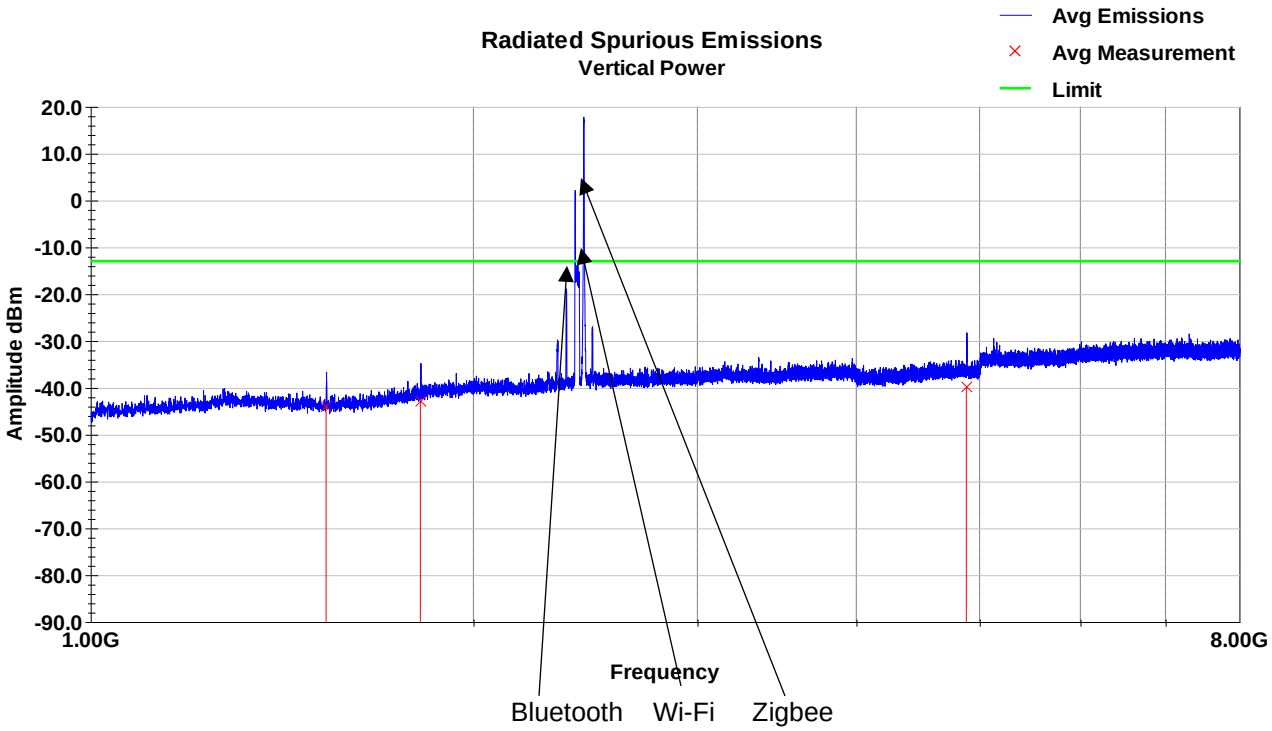
LTE Band 12, QPSK modulation, 1.4MHz
Mid Channel (23095)
Vertical Plot (30-1000MHz)



Horizontal Plot (30-1000MHz)



LTE Band 12, QPSK modulation, 1.4MHz
Mid Channel (23095)
Vertical Plot (1-8GHz)



Vertical LTE Tabular Data (1-8GHz)

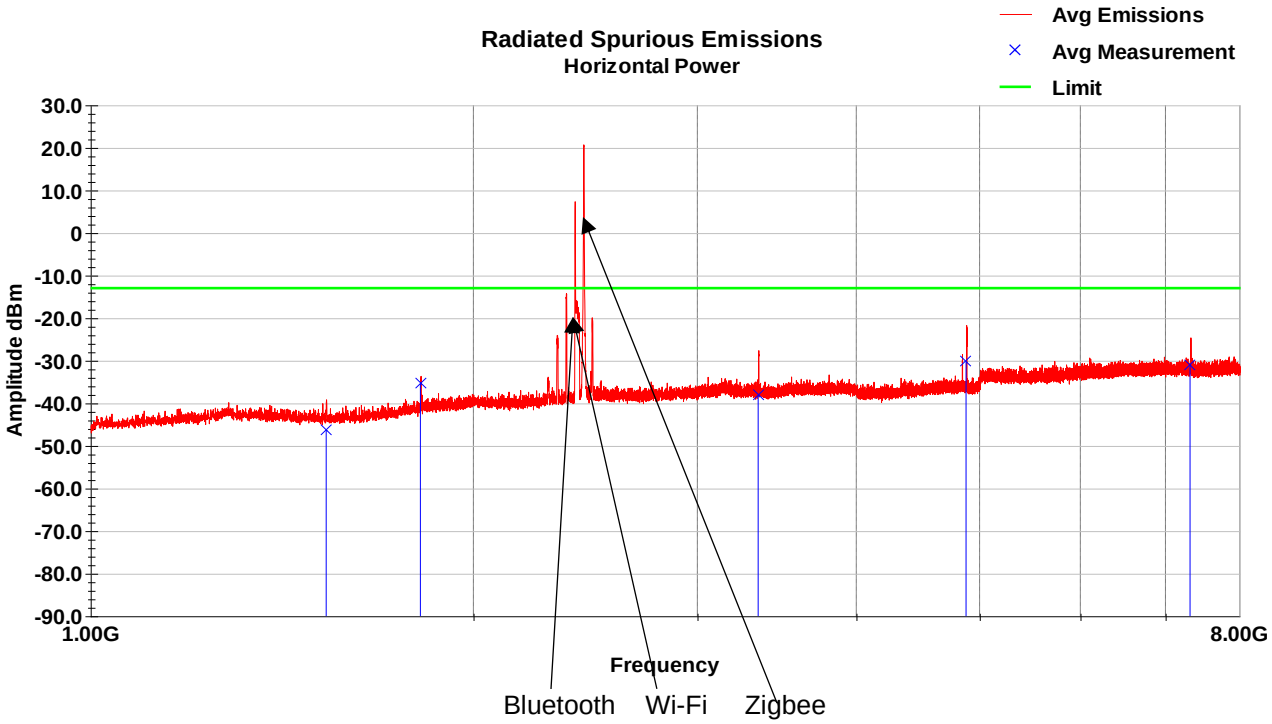
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1532.04	-51.2	V	321.0	194.0	27.7	22.1	42.7	-44.1	-13.0	-31.1
1817.00	-53.1	V	166.0	250.0	30.4	22.3	42.6	-42.9	-13.0	-29.9
4881.48	-56.2	V	105.0	250.0	34.5	23.7	42.0	-39.9	-13.0	-26.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1817.00	-53.1	V	166.0	250.0	30.4	22.3	42.6	-42.9	-41.2	-1.7
4881.48	-56.2	V	105.0	250.0	34.5	23.7	42.0	-39.9	-41.2	1.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

4881.48MHz is a harmonic of Zigbee

Horizontal Plot (1-8GHz)



Horizontal LTE Tabular Data (1-8GHz)

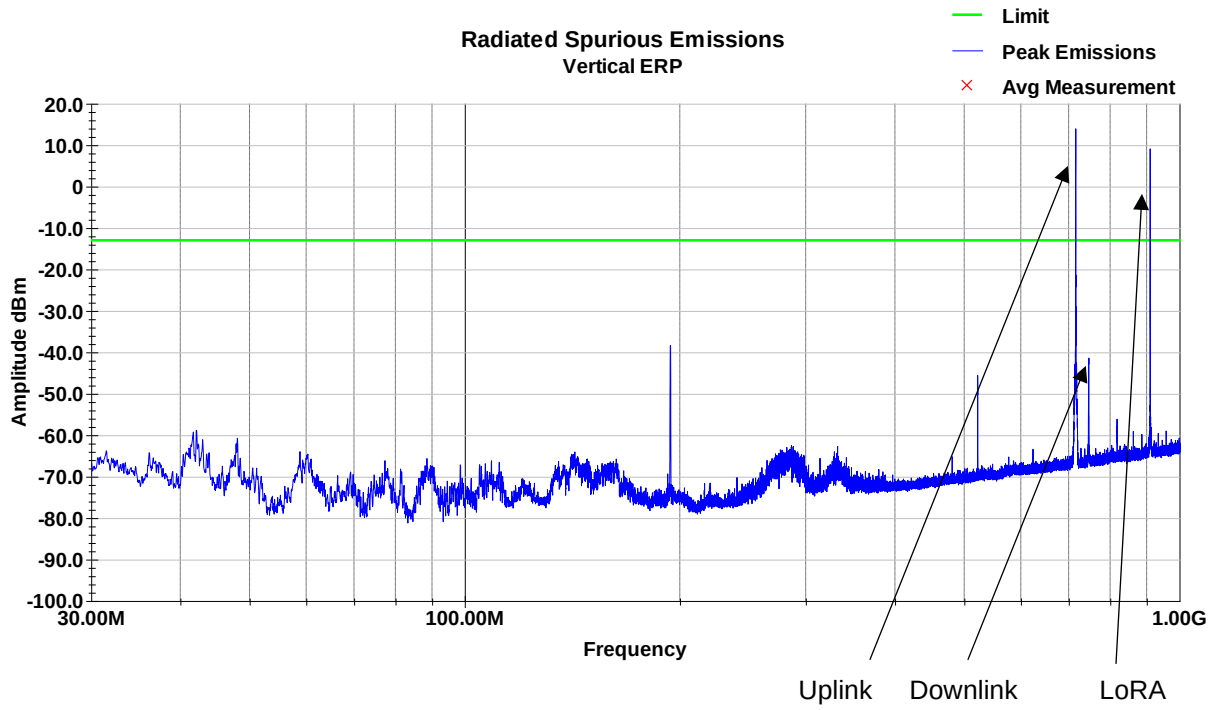
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1532.20	-53.4	H	267.0	250.0	27.7	22.1	42.7	-46.3	-13.0	-33.3
1817.04	-45.5	H	112.0	250.0	30.4	22.3	42.6	-35.4	-13.0	-22.4
3349.28	-52.2	H	189.0	250.0	32.7	23.3	41.9	-38.1	-13.0	-25.1
4878.60	-46.5	H	300.0	250.0	34.5	23.7	42.0	-30.2	-13.0	-17.2
7318.60	-49.6	H	305.0	250.0	35.8	24.4	41.6	-30.9	-13.0	-17.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

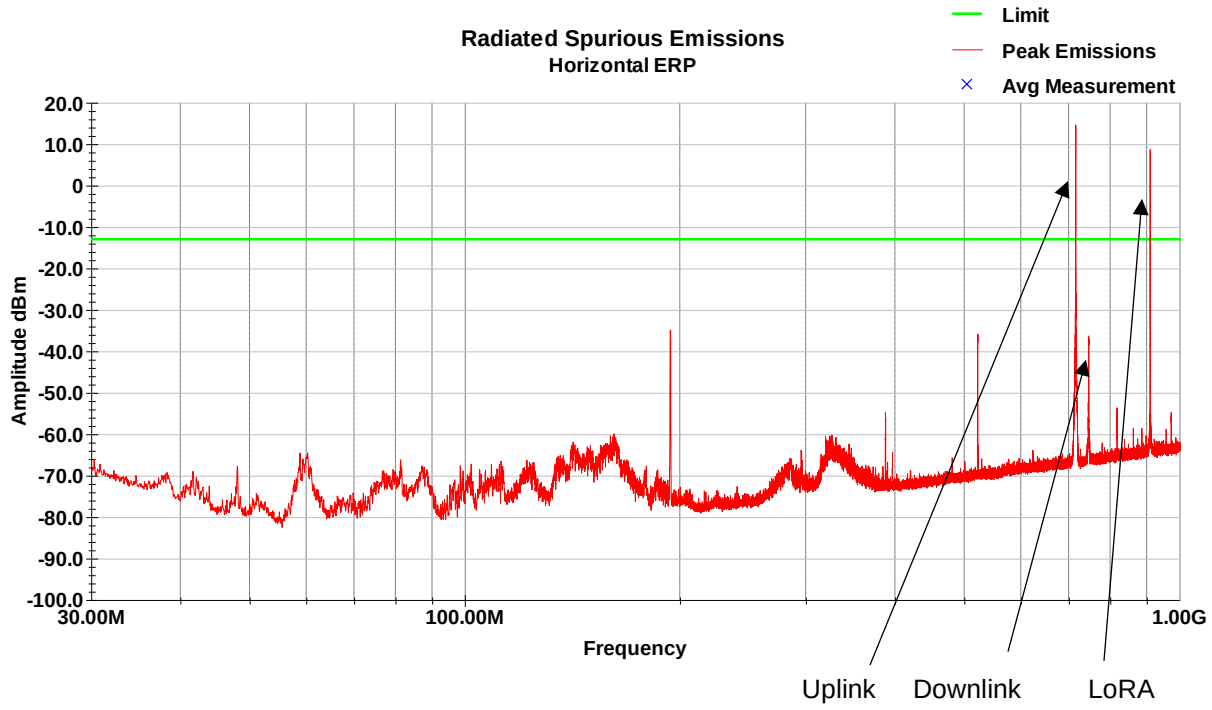
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1817.04	-45.5	H	112.0	250.0	30.4	22.3	42.6	-35.4	-41.2	5.8
3349.28	-52.2	H	189.0	250.0	32.7	23.3	41.9	-38.1	-41.2	3.1
4878.60	-46.5	H	300.0	250.0	34.5	23.7	42.0	-30.2	-41.2	11.0
7318.60	-49.6	H	305.0	250.0	35.8	24.4	41.6	-30.9	-41.2	10.3
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above frequencies are harmonics and/or intermodulation of LoRA and Zigbee

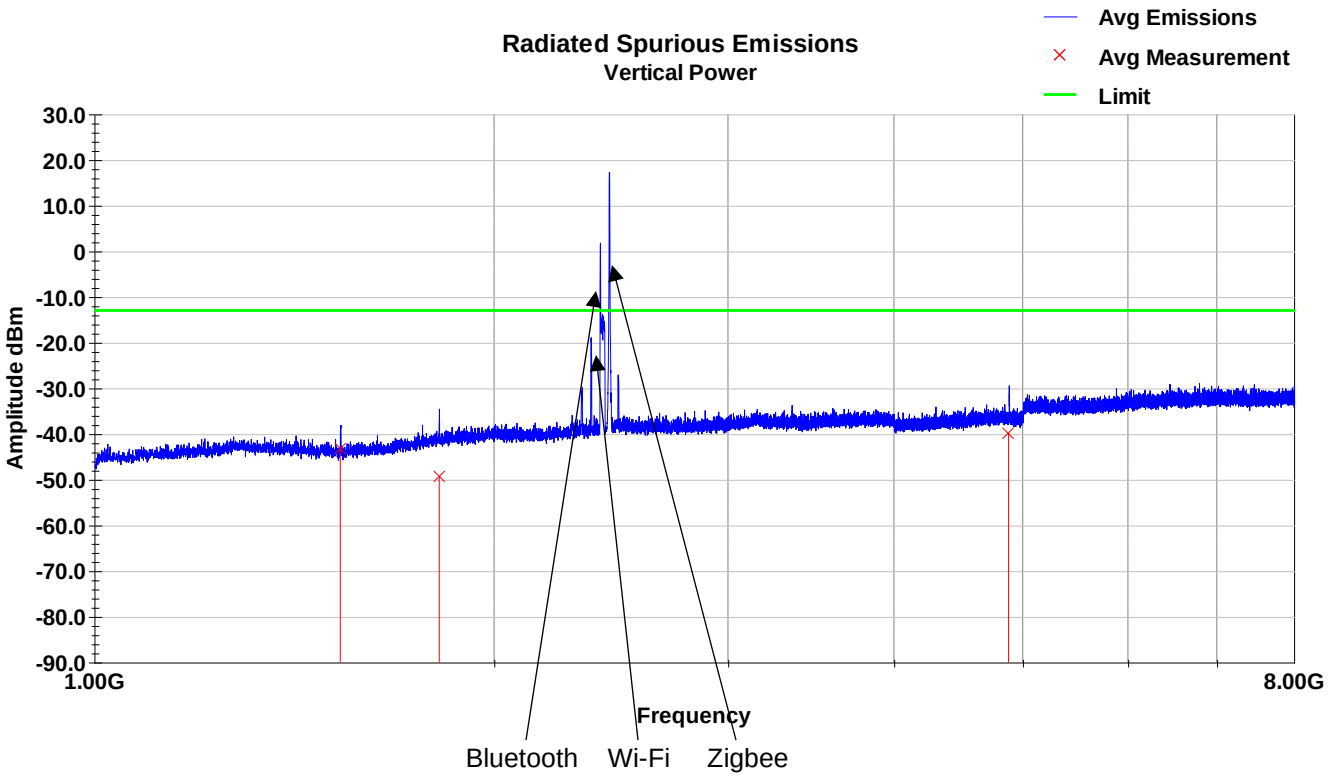
LTE Band 12, QPSK modulation, 1.4MHz
High Channel (23173)
Vertical Plot (30-1000MHz)



Horizontal Plot (30-1000MHz)



LTE Band 12, QPSK modulation, 1.4MHz
High Channel (23173)
Vertical Plot (1-8GHz)



Vertical Tabular Data (1-8GHz)

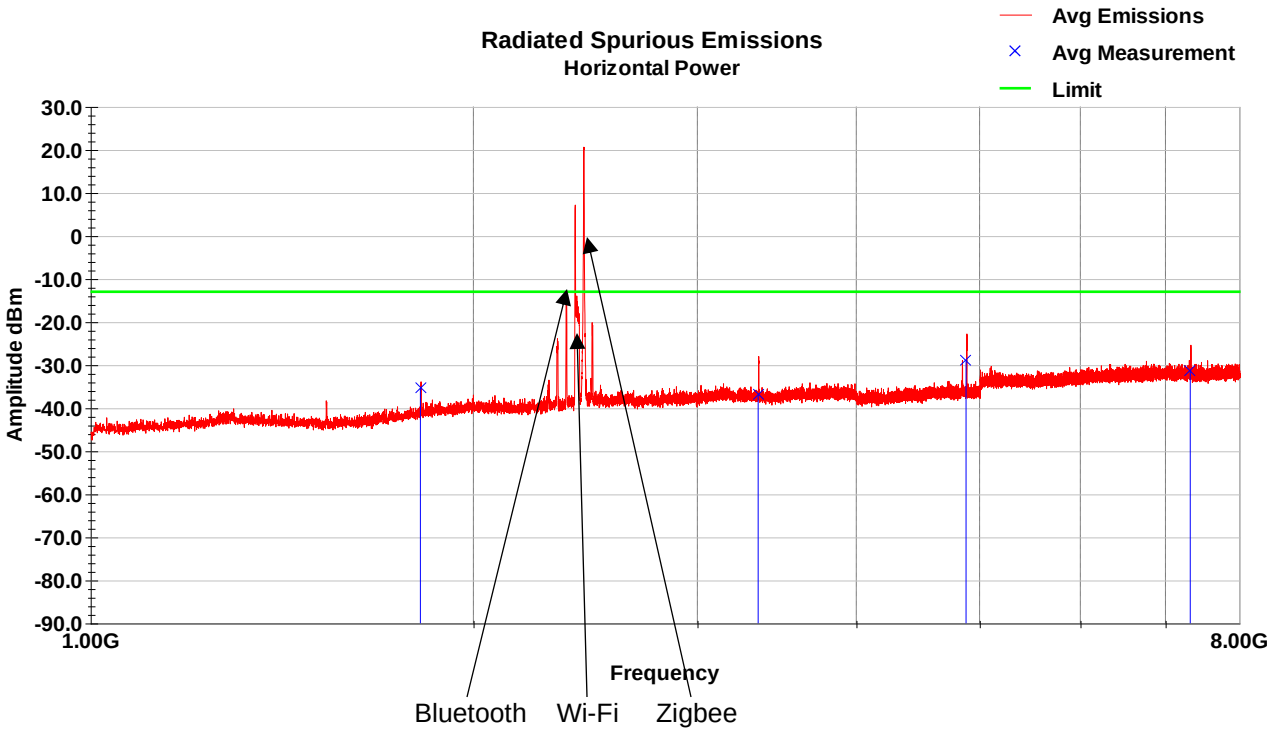
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1532.04	-50.4	V	313.0	204.0	27.7	22.1	42.7	-43.3	-13.0	-30.3
1818.60	-59.5	V	294.0	250.0	30.4	22.3	42.6	-49.3	-13.0	-36.3
4878.60	-56.1	V	106.0	250.0	34.5	23.7	42.0	-39.8	-13.0	-26.8
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1818.60	-59.5	V	294.0	250.0	30.4	22.3	42.6	-49.3	-41.2	-8.1
4878.60	-56.1	V	106.0	250.0	34.5	23.7	42.0	-39.8	-41.2	1.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

4878.6MHz in a harmonic of Zigbee

Horizontal Plot (1-8GHz)



Horizontal Tabular Data (1-8GHz)

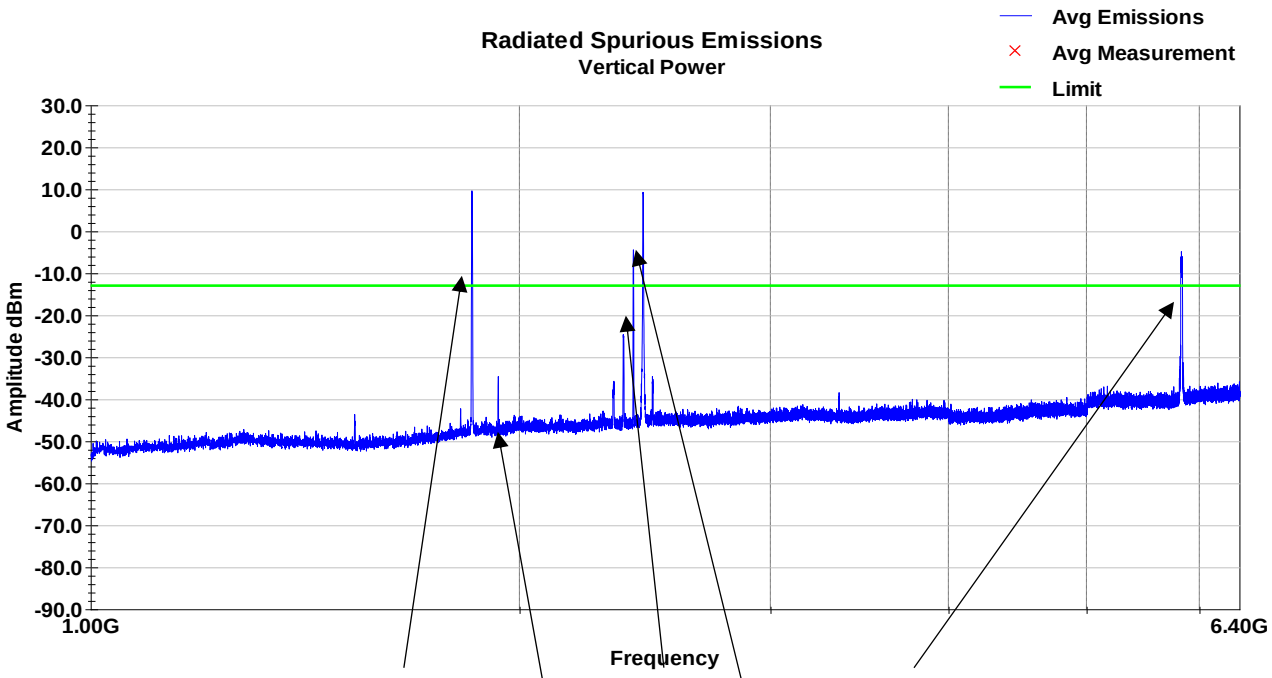
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1816.92	-45.5	H	112.0	250.0	30.4	22.3	42.6	-35.3	-13.0	-22.3
3348.88	-50.9	H	264.0	250.0	32.7	23.3	41.9	-36.9	-13.0	-23.9
4878.84	-45.1	H	300.0	250.0	34.5	23.7	42.0	-28.8	-13.0	-15.8
7321.60	-49.9	H	308.0	250.0	35.8	24.4	41.6	-31.2	-13.0	-18.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Unlicensed Radio Tabulated Data (1-8GHz)

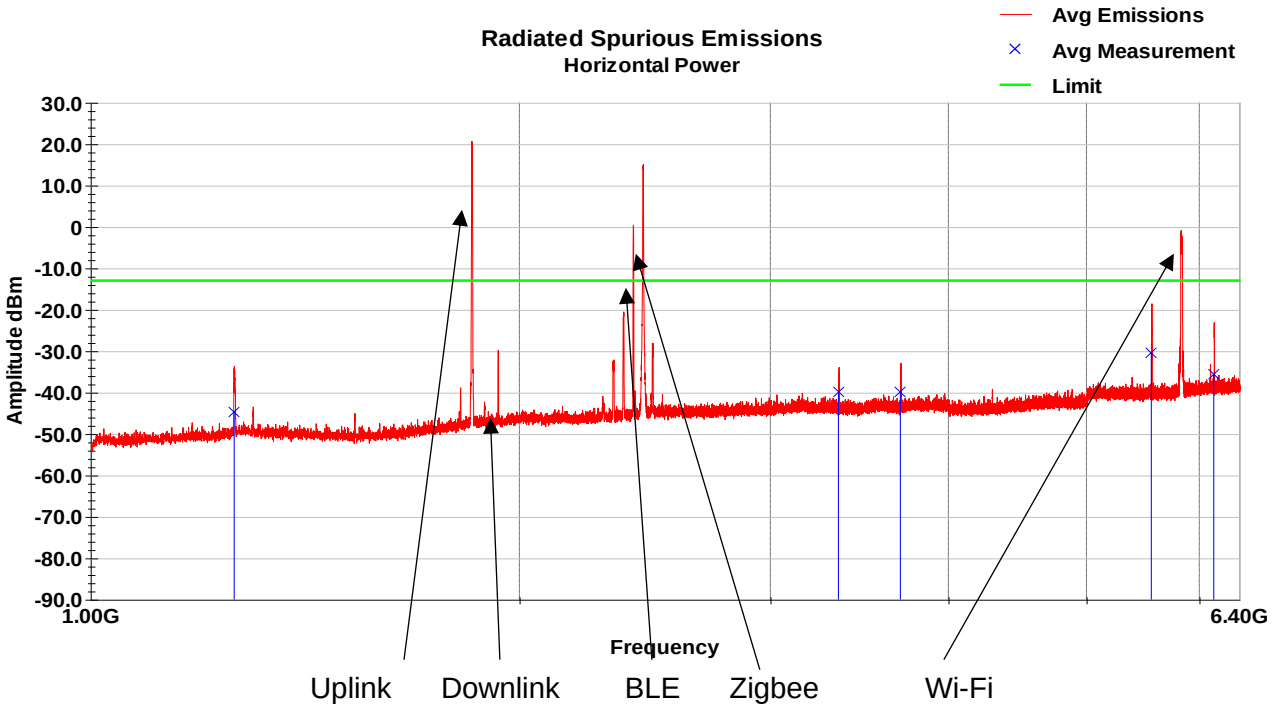
Frequency MHz	Raw Avg dBm	Polarity V/H	Azimuth degrees	Height cm	AF dB/m	Loss dB	Amp dB	Avg Value dBm	Limit dBm	Margin dB
1816.92	-45.5	H	112.0	250.0	30.4	22.3	42.6	-35.3	-41.2	5.9
3348.88	-50.9	H	264.0	250.0	32.7	23.3	41.9	-36.9	-41.2	4.3
4878.84	-45.1	H	300.0	250.0	34.5	23.7	42.0	-28.8	-41.2	12.4
7321.60	-49.9	H	308.0	250.0	35.8	24.4	41.6	-31.2	-41.2	10.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

Above frequencies are harmonics and/or intermodulation of LoRA and Zigbee

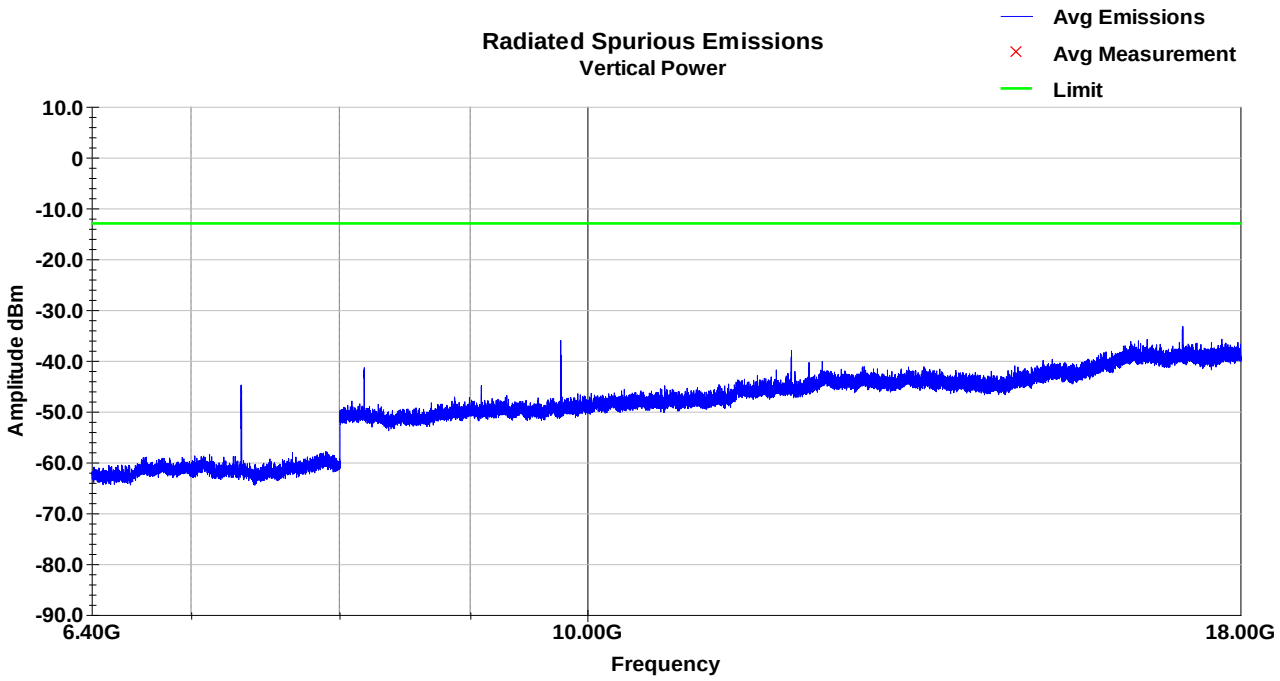
All Radios w. 5GHz WLAN (before modifications)
LTE Band 2, QPSK modulation, 1.4MHz
Low Channel (18607)
Vertical Plot (1-6.4GHz)



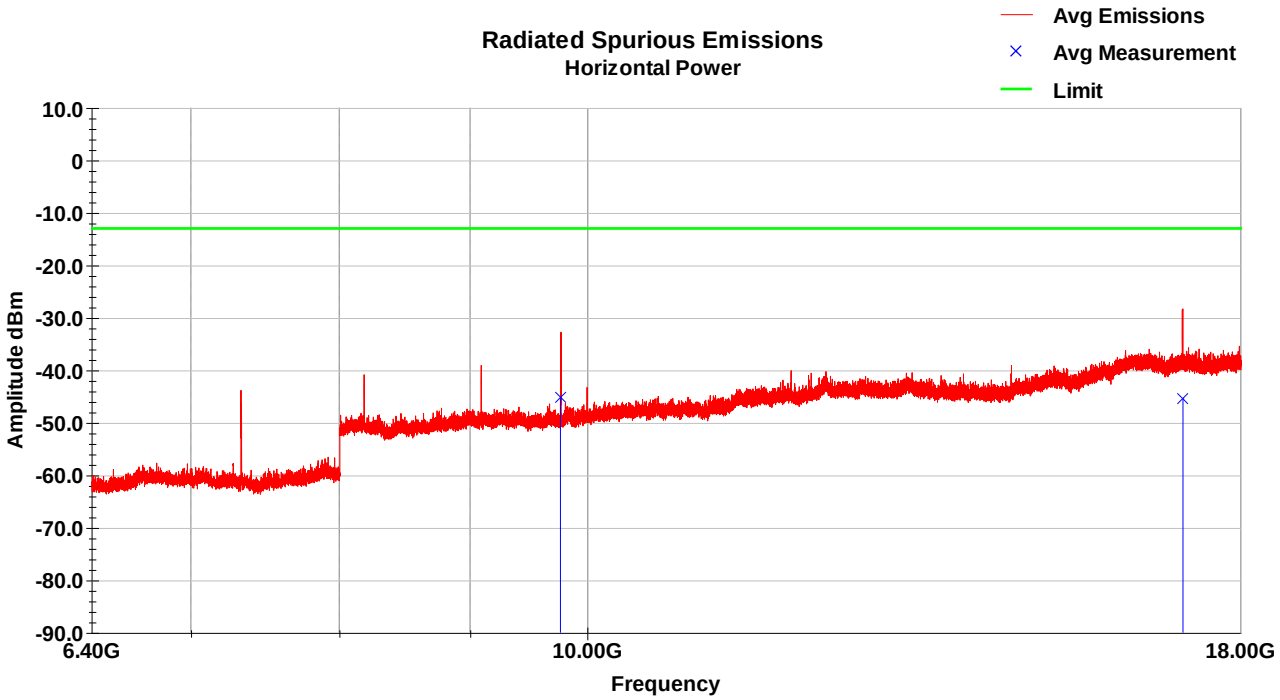
Horizontal Plot (1-6.4GHz)



LTE Band 2, QPSK modulation, 1.4MHz
Low Channel (19957)
Vertical Plot (6.4-18GHz)

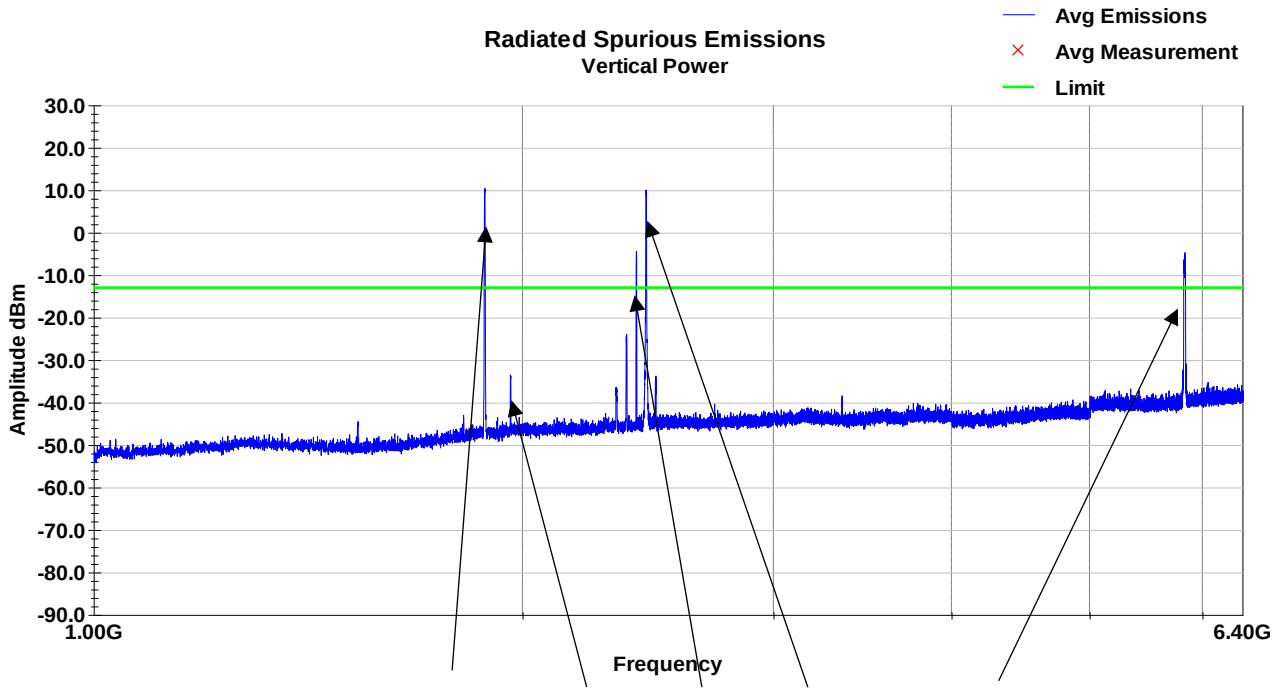


Horizontal Plot (6.4-18GHz)

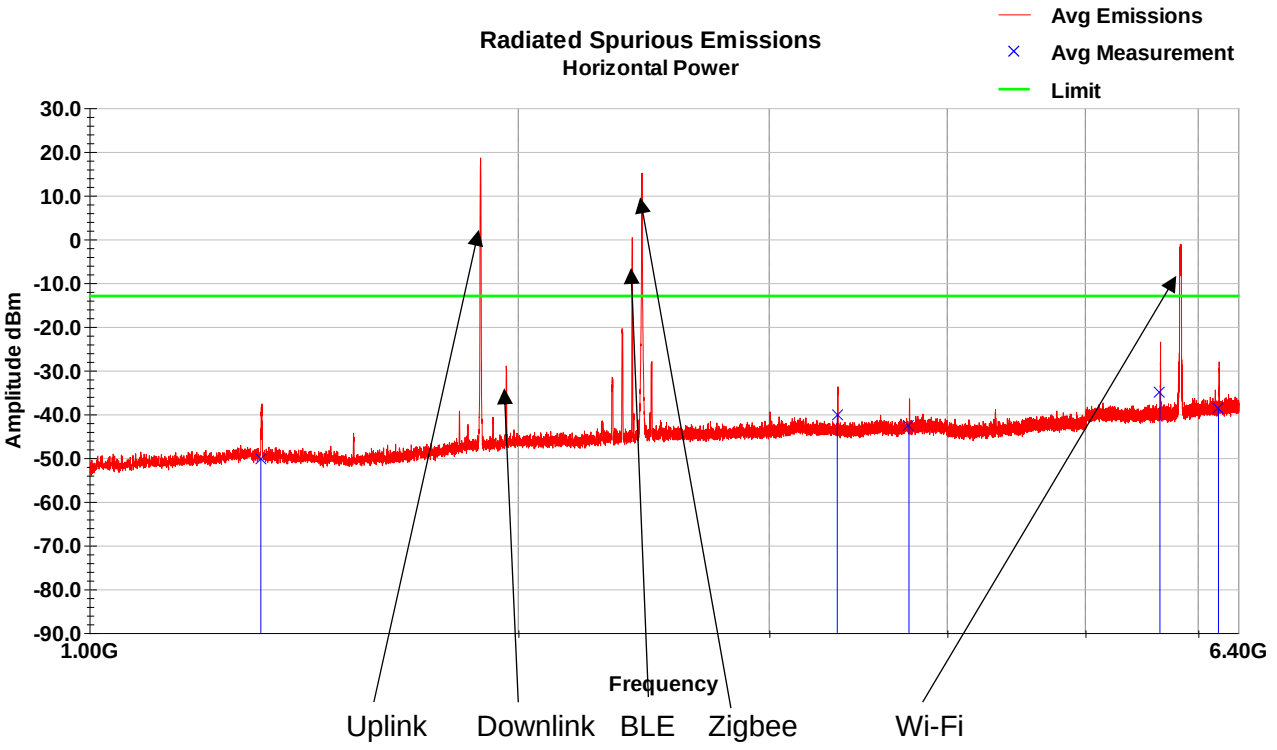


Same as with 2.4GHz Wi-Fi test data are harmonics and/or intermodulation of LoRA and Zigbee.

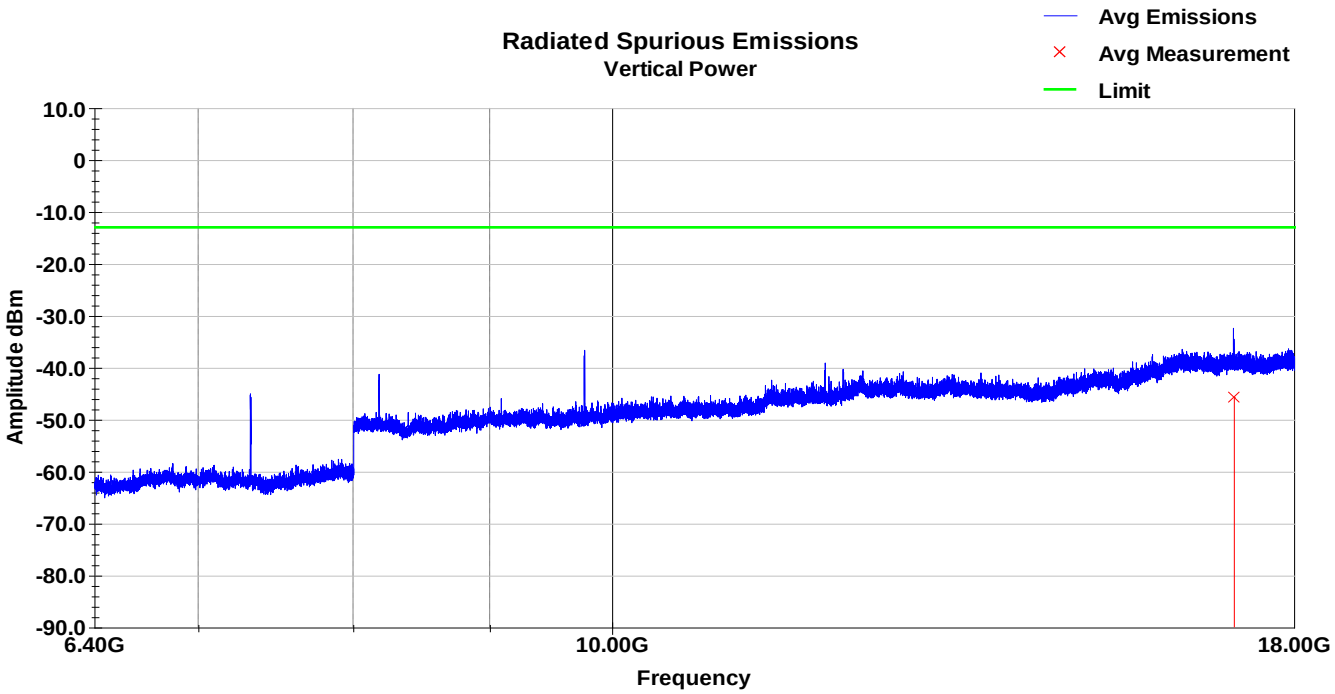
LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (1-6.4GHz)



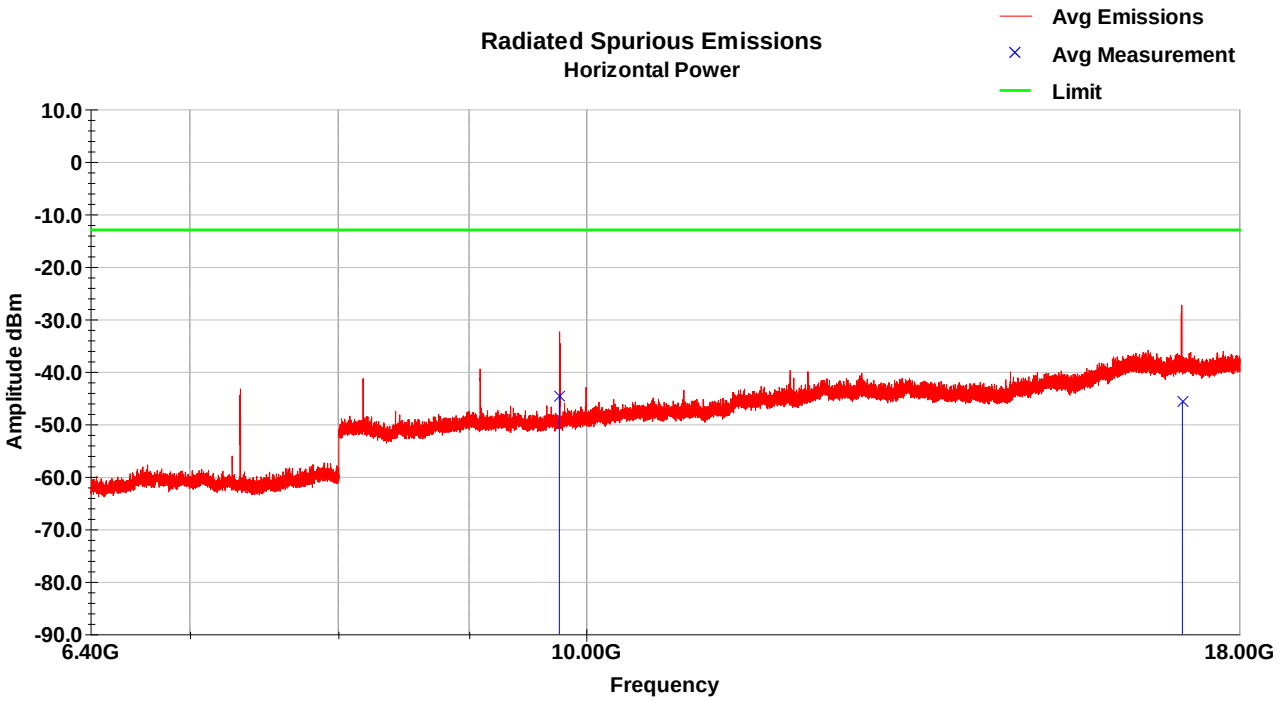
Horizontal Plot (1-6.4GHz)



LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (6.4-18GHz)

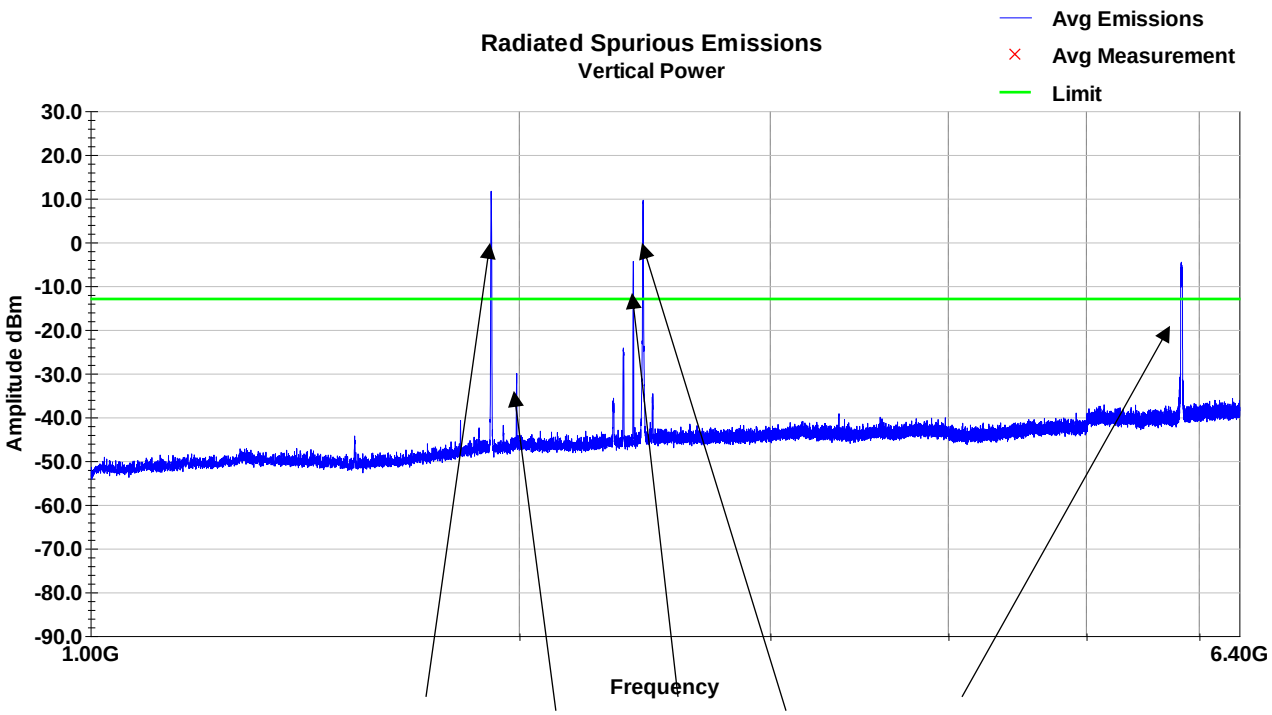


Horizontal Plot (6.4-18GHz)

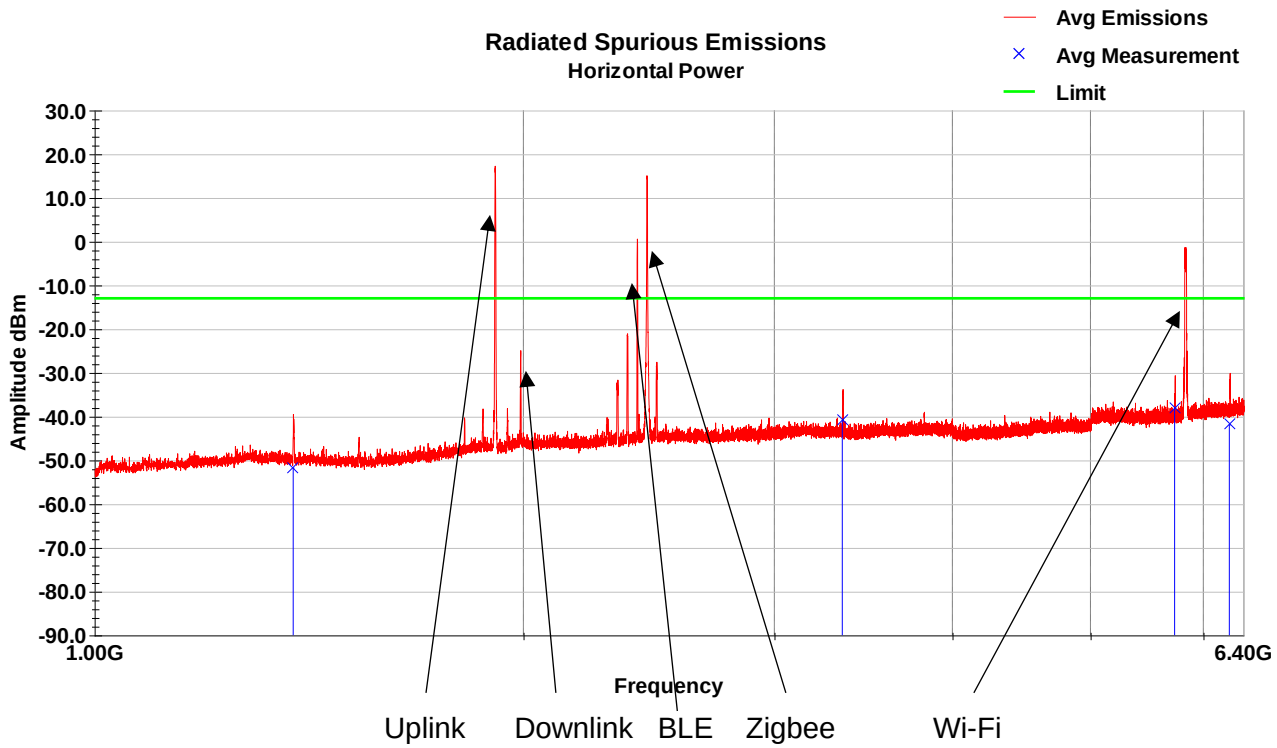


Same as with 2.4GHz Wi-Fi test data are harmonics and/or intermodulation of LoRA and Zigbee.

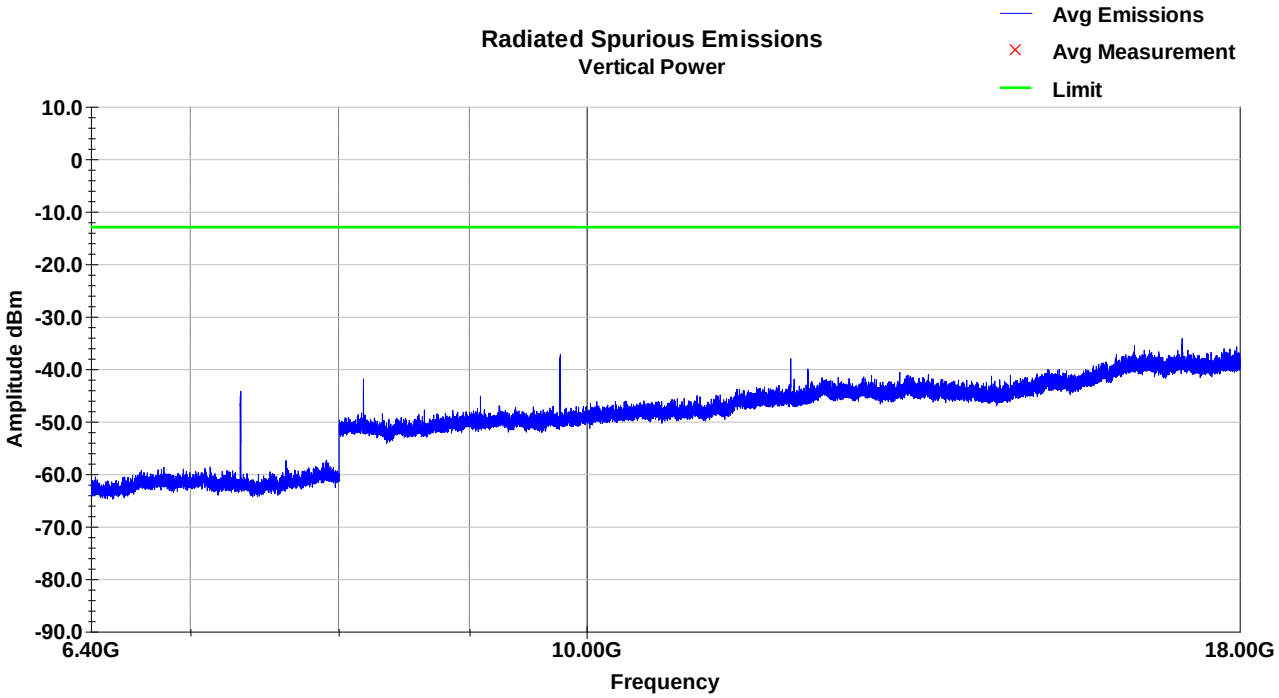
LTE Band 2, QPSK modulation, 1.4MHz
High Channel (19193)
Vertical Plot (1-6.4GHz)



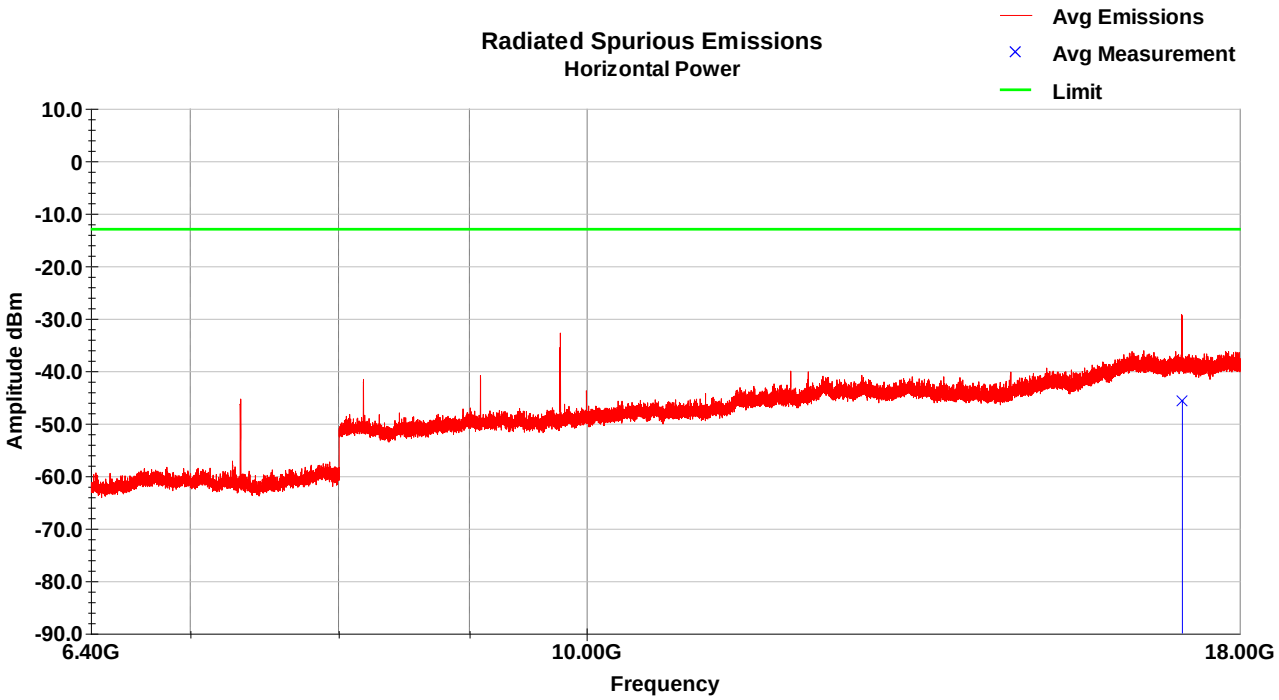
Horizontal Plot (1-6.4GHz)



LTE Band 2, QPSK modulation, 1.4MHz
High Channel (19193)
Vertical Plot (6.4-18GHz)

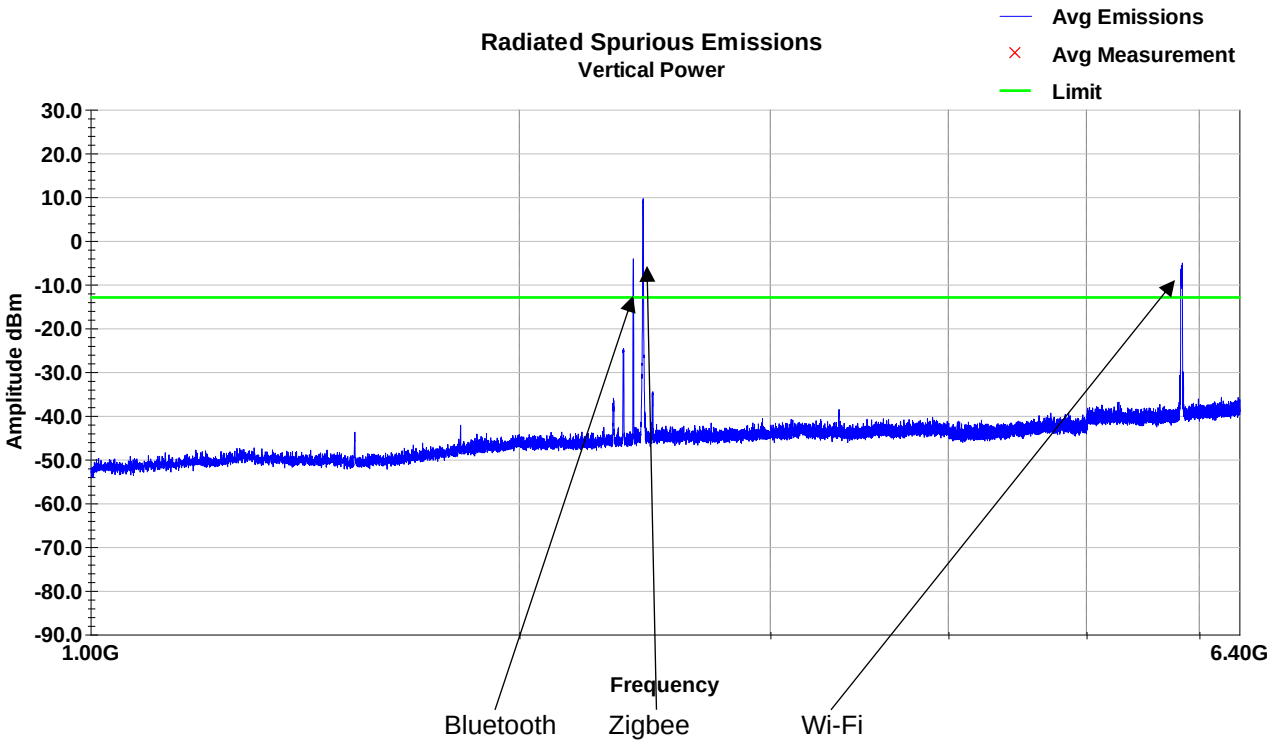


Horizontal Plot (6.4-18GHz)

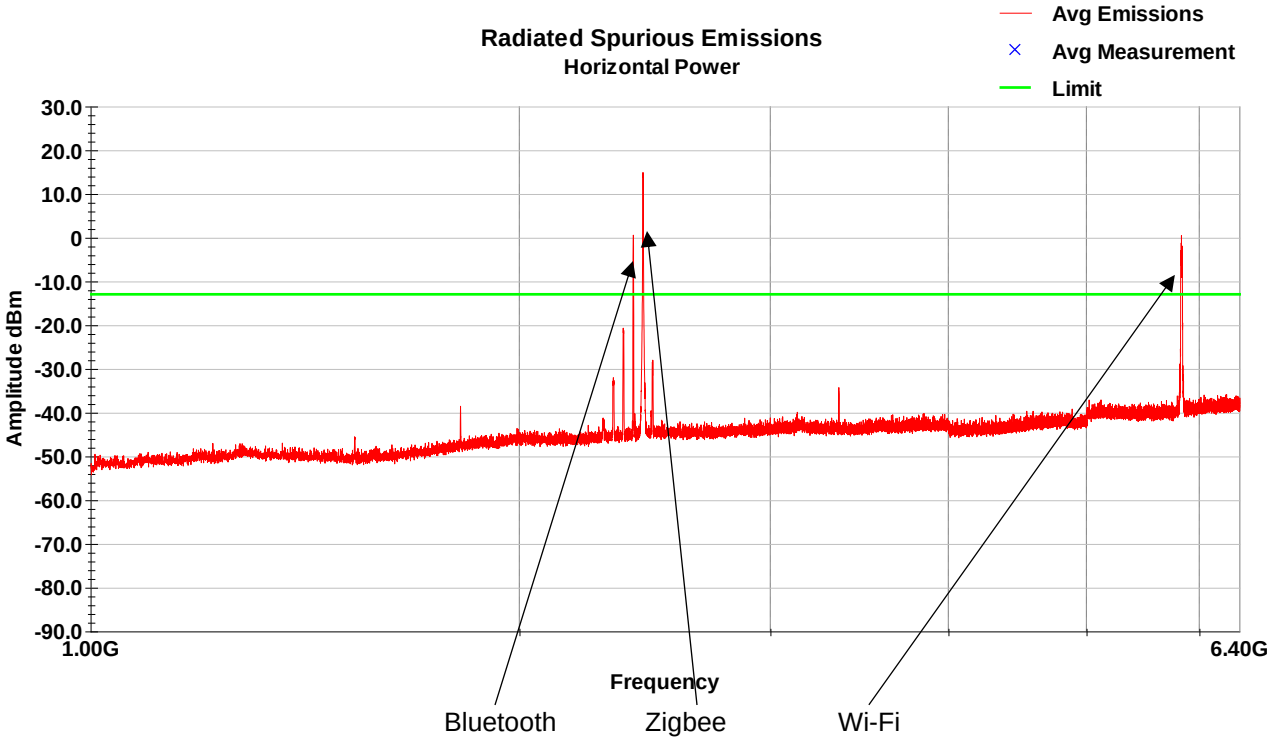


Same as with 2.4GHz Wi-Fi test data are harmonics and/or intermodulation of LoRA and Zigbee.

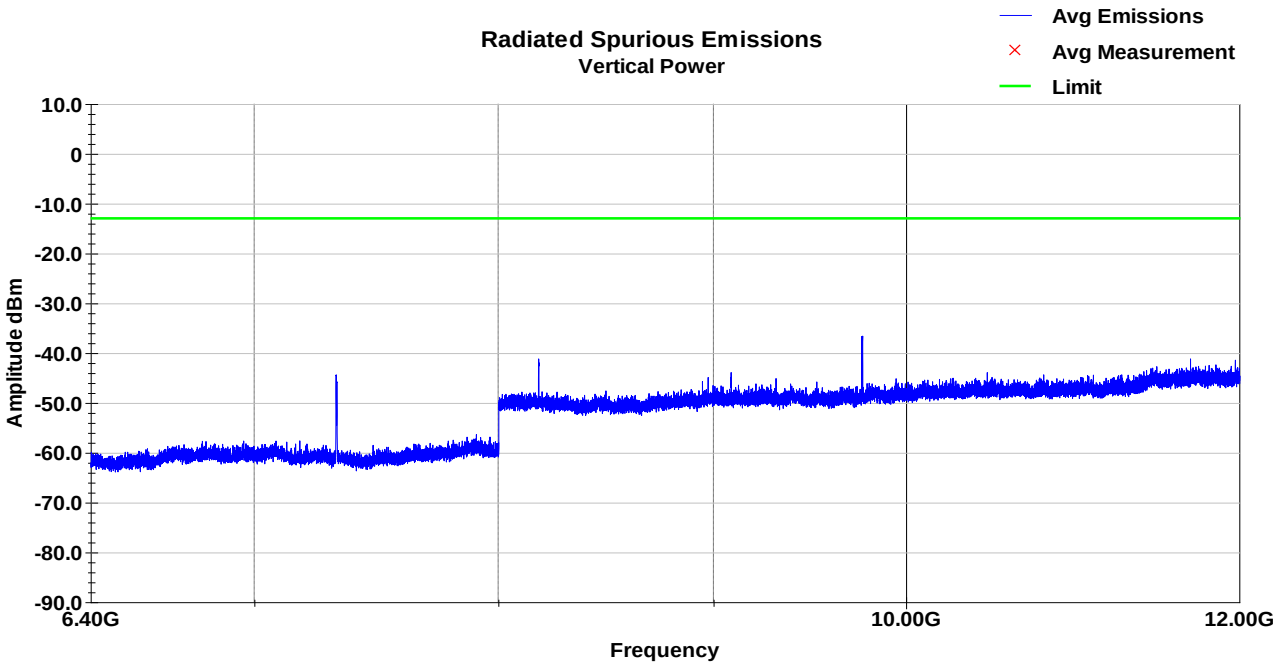
LTE Band 12, QPSK modulation, 1.4MHz
Low Channel (23017)
Vertical Plot (1-6.4GHz)



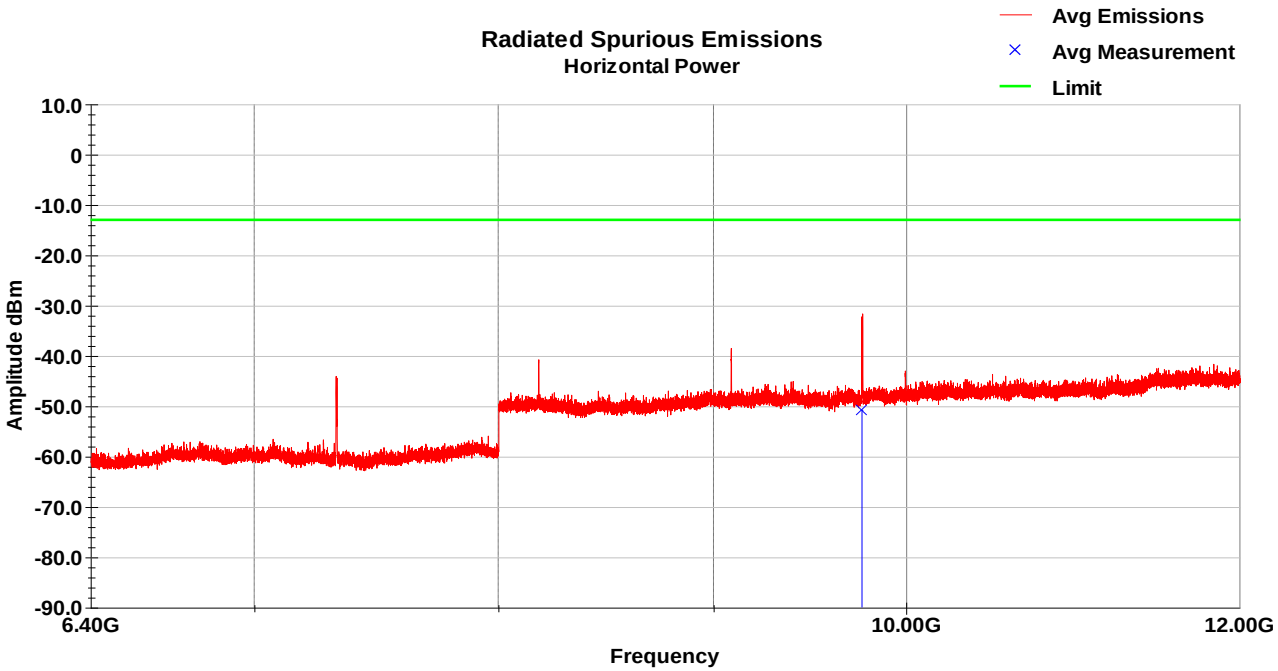
Horizontal Plot (1-6.4GHz)



LTE Band 12, QPSK modulation, 1.4MHz
Low Channel (23017)
Vertical Plot (6.4-12GHz)

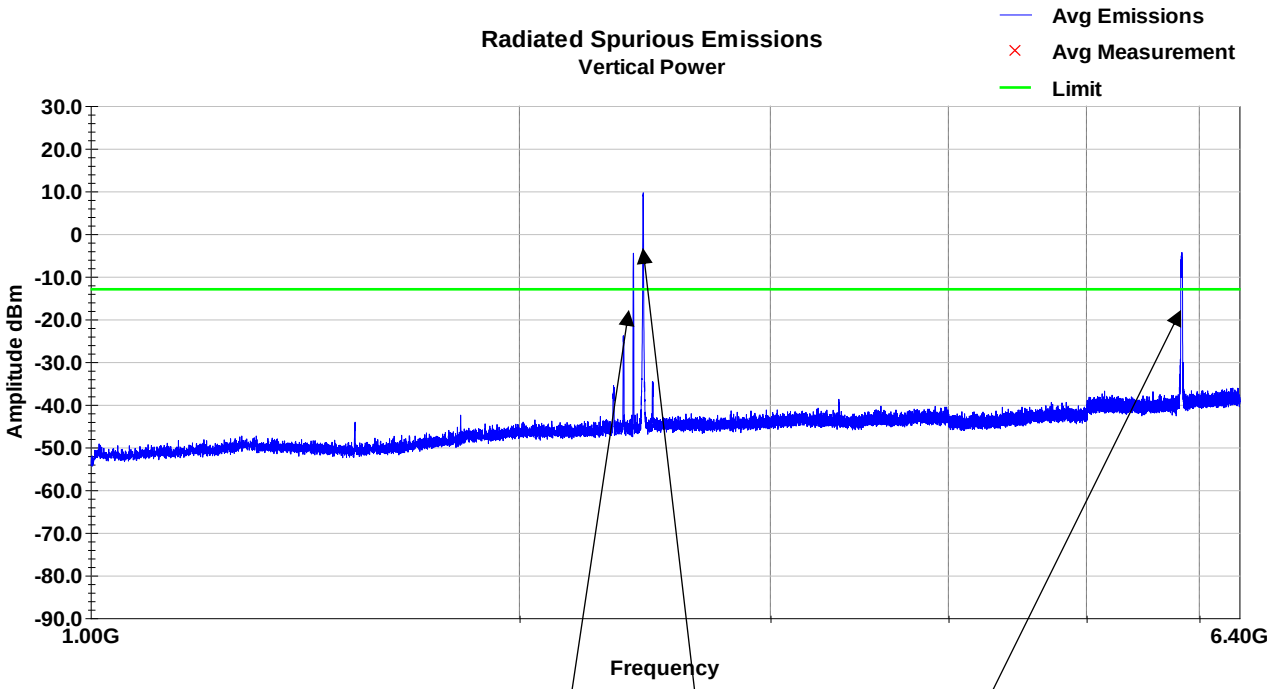


Horizontal Plot (6.4-12GHz)

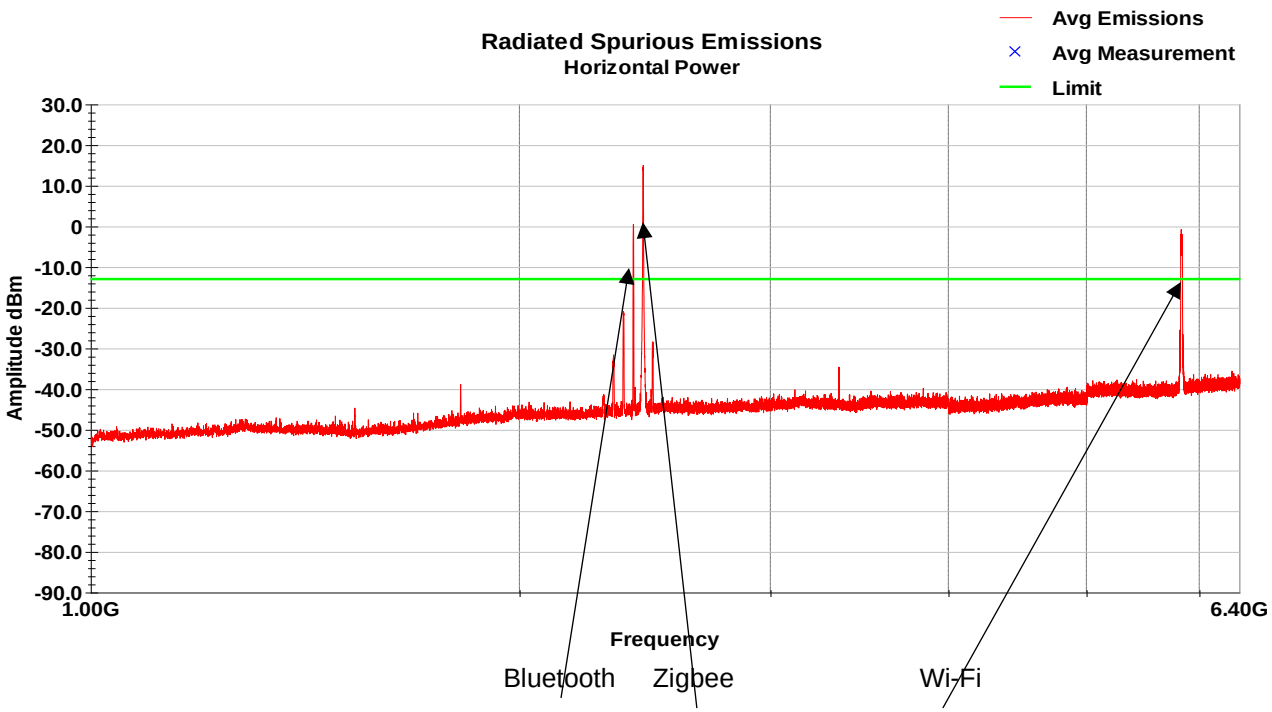


Same Emissions that are on 2.4GHz Wi-Fi test data are harmonics of LoRA and Zigbee.

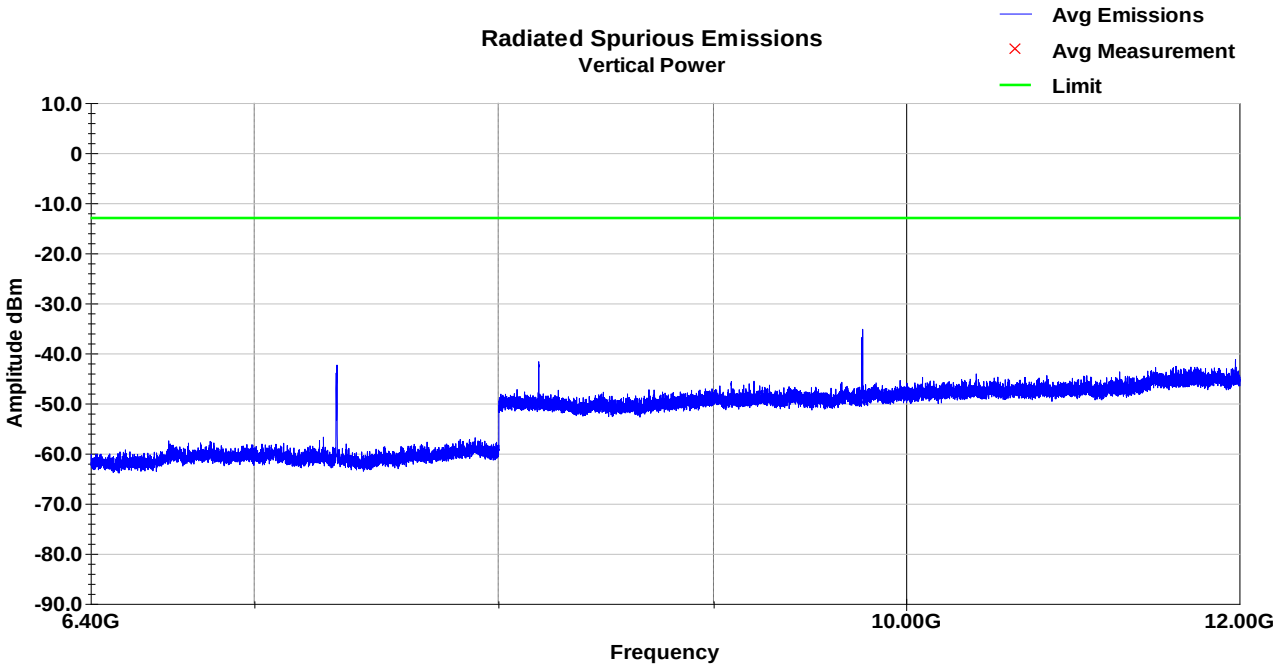
LTE Band 12, QPSK modulation, 1.4MHz
Mid Channel (23095)
Vertical Plot (1-6.4GHz)



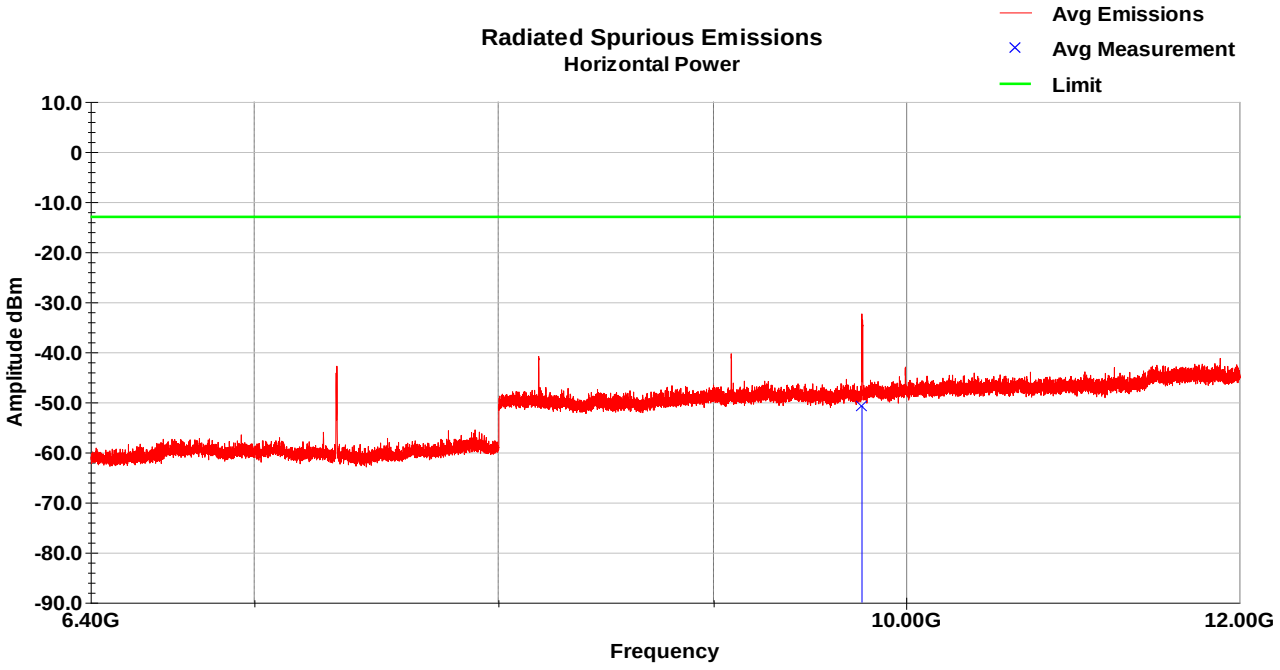
Horizontal Plot (1-6.4GHz)



LTE Band 12, QPSK modulation, 1.4MHz, Mid Channel (23095)
Vertical Plot (6.4-12GHz)

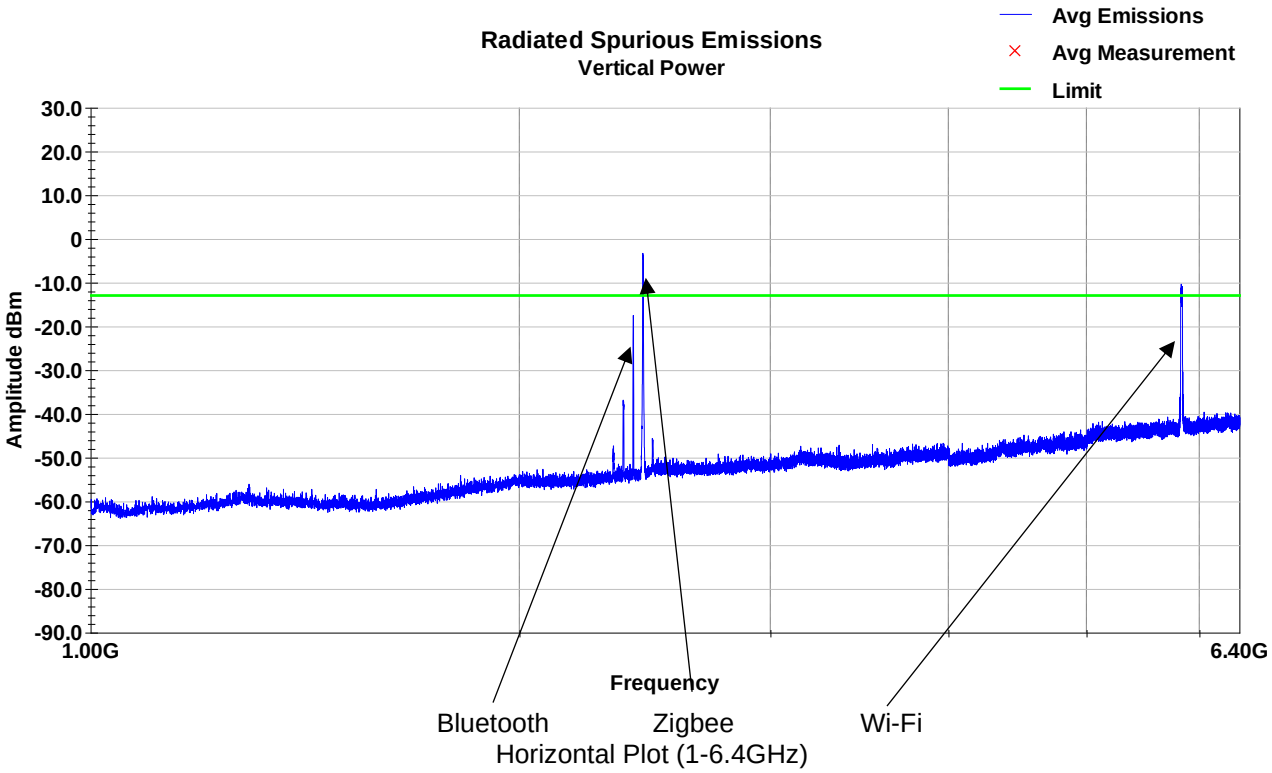


Horizontal Plot (6.4-12GHz)

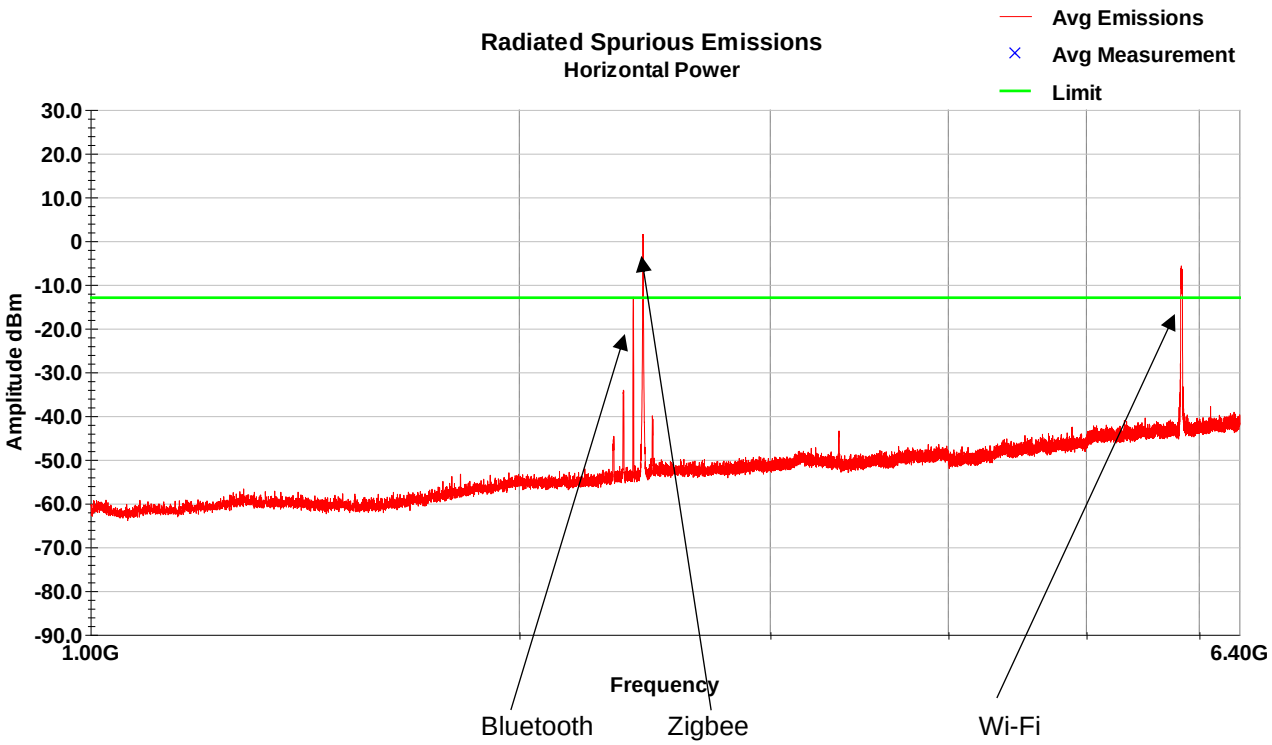


Same as with 2.4GHz Wi-Fi test data are harmonics and/or intermodulation of LoRA and Zigbee.

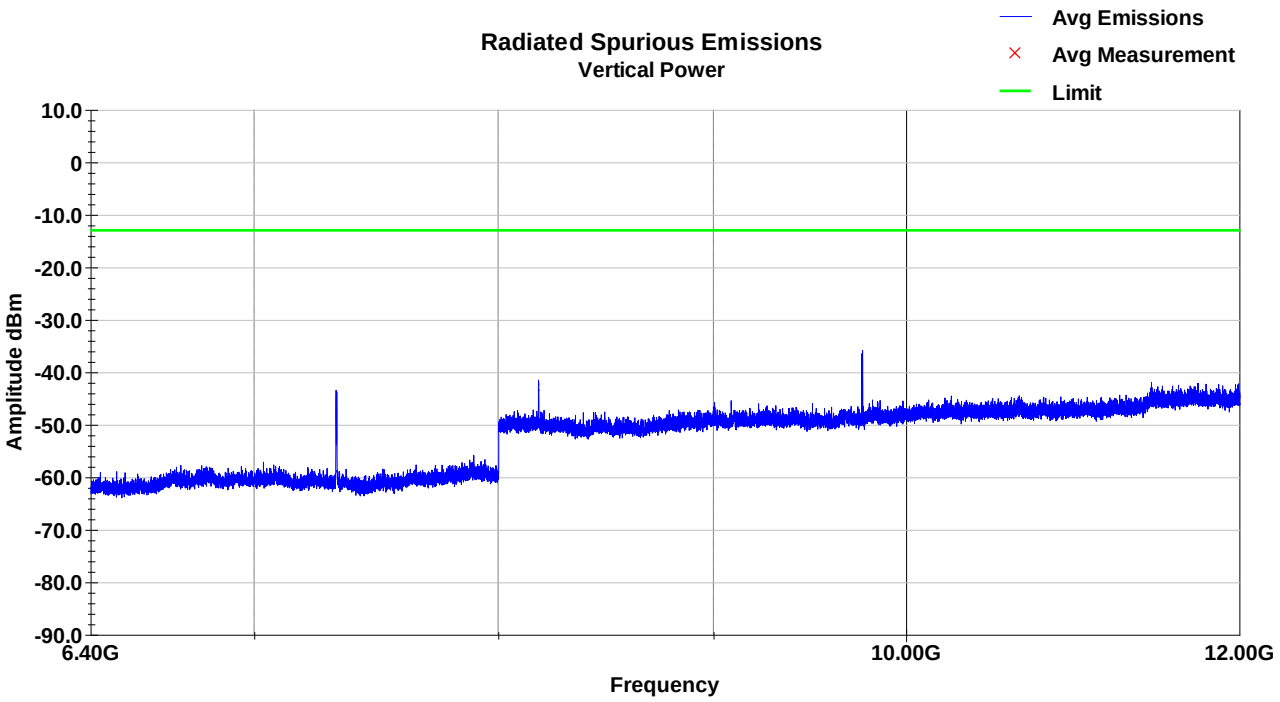
LTE Band 12, QPSK modulation, 1.4MHz
High Channel (23173)
Vertical Plot (1-6.4GHz)



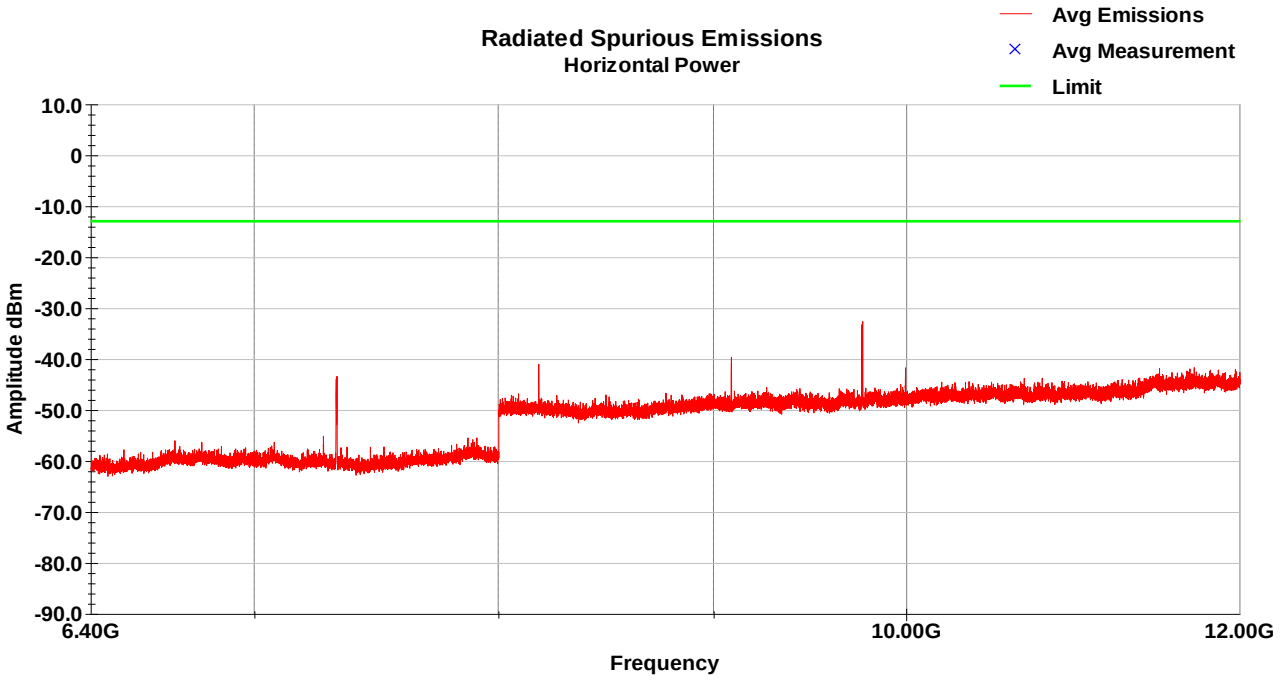
Horizontal Plot (1-6.4GHz)



LTE Band 12, QPSK modulation, 1.4MHz
High Channel (23173)
Vertical Plot (6.4-12GHz)



Horizontal Plot (6.4-12GHz)



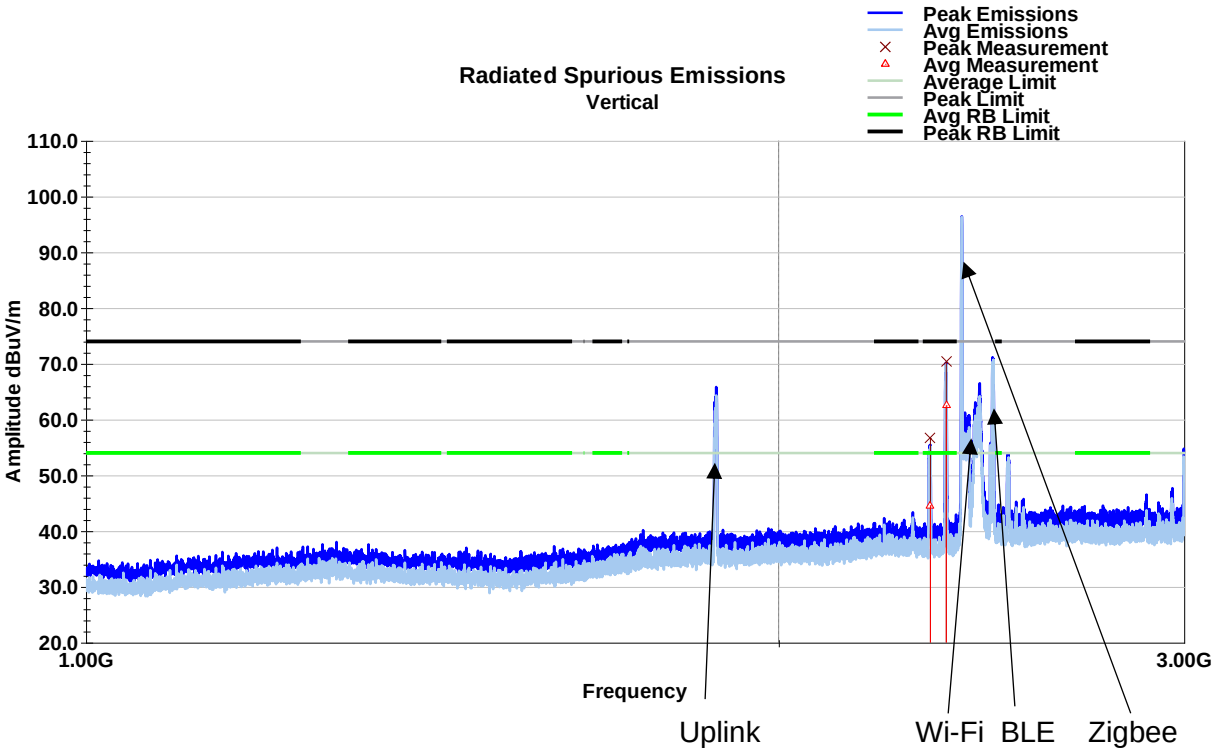
Same as with 2.4GHz Wi-Fi test data are harmonics and/or intermodulation of LoRA and Zigbee.

After Modifications - All radios w. 2.4GHz WLAN

LTE Band 2, QPSK modulation, 1.4MHz

Mid Channel (18900)

Vertical Plot (1-3GHz)



Vertical Tabular Data (1-3GHz)

Average

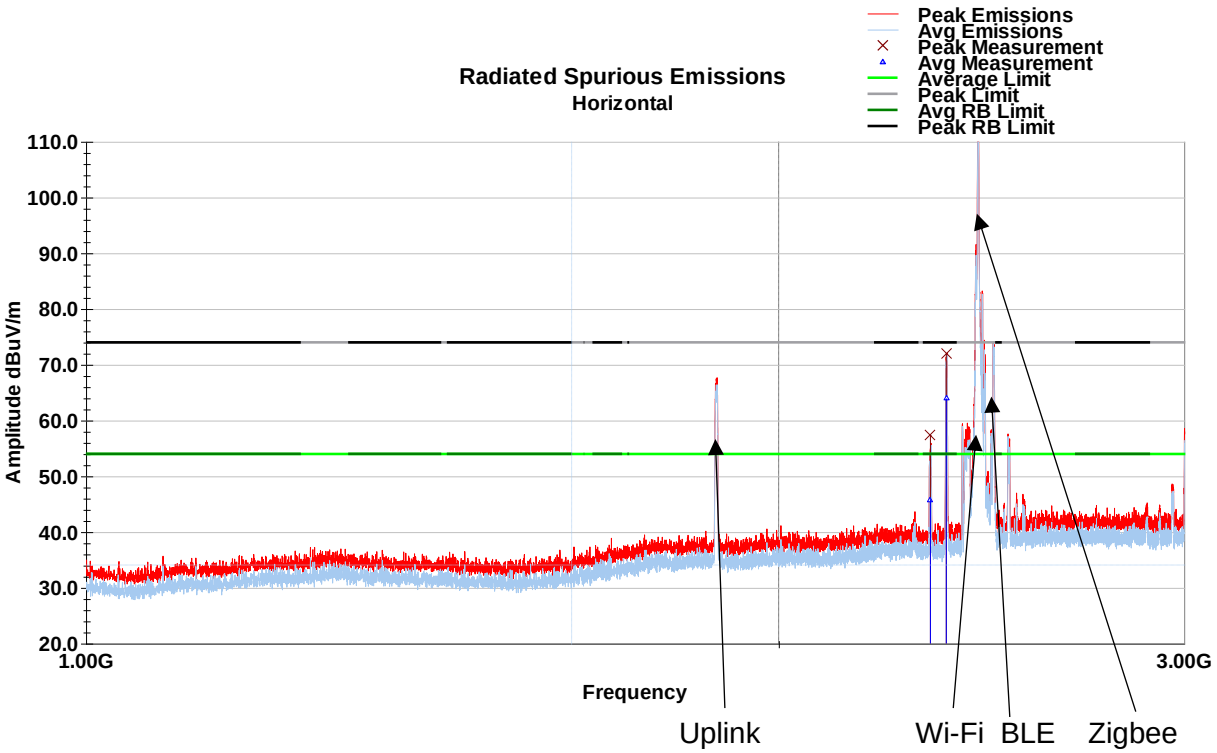
Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	DCCF dB	Tabular Data	Limit (dBuV/m)	Margin (dB)
2327.92	52.1	V	360.0	134.0	31.9	2.9	42.2	44.6	-21.0	23.7	54.0	-30.3
2365.00	69.8	V	359.0	153.0	32.0	2.9	42.2	62.5	-21.0	41.6	54.0	-12.4
Final Avg = Raw Avg + AF + Loss - Amp												
Tabular Data = Final Avg + DCCF												
Margin = Tabular Data - Limit												

Above are intermodulation of Zigbee, therefore DCCF was used in tabulation.

Peak

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
2327.92	64.1	V	360.0	134.0	31.9	2.9	42.2	56.7	74.0	-17.3
2365.00	77.7	V	359.0	153.0	32.0	2.9	42.2	70.3	74.0	-3.7
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Horizontal Plot (1-3GHz)



Horizontal Tabular Data (1-3GHz)

Average

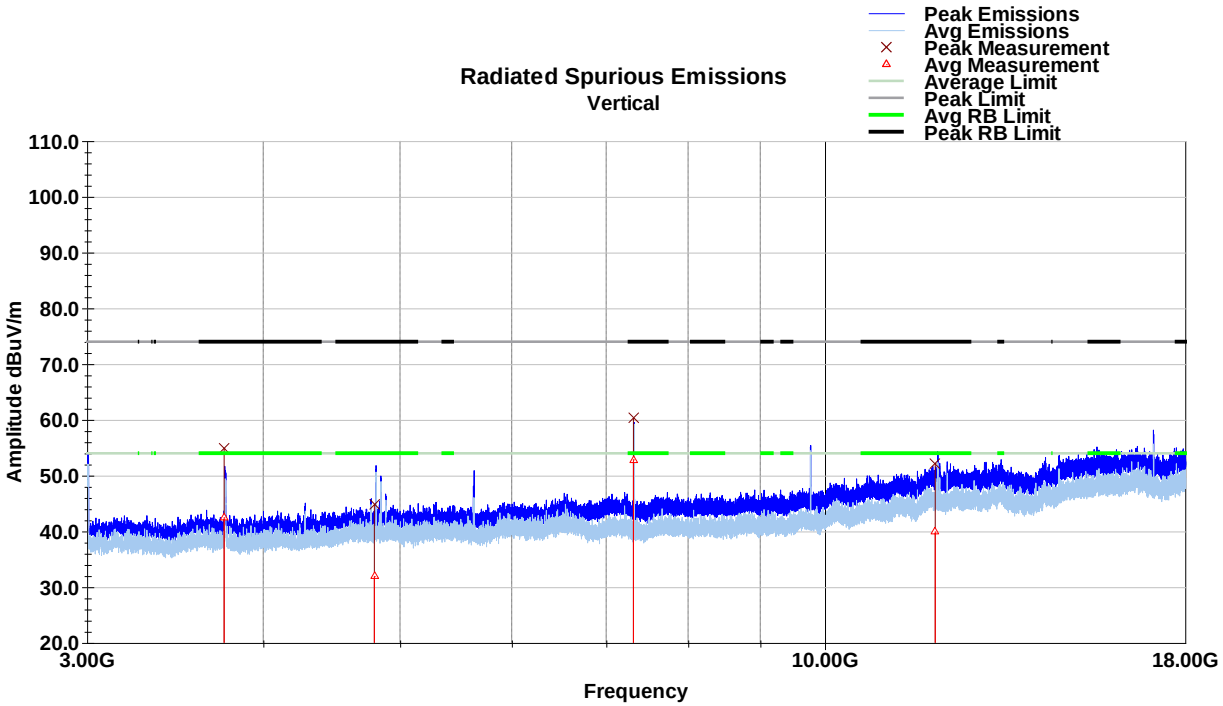
Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Final Avg dBuV/m	DCCF dB	Tabular Data	Limit (dBuV/m)	Margin (dB)
2327.80	56.3	H	81.0	183.0	31.9	2.9	42.2	48.9	-21.0	27.9	54.0	-26.1
2365.04	75.5	H	93.0	201.0	32.0	2.9	42.2	68.2	-21.0	47.2	54.0	-6.8
Final Avg = Raw Avg + AF + Loss - Amp												
Tabular Data = Final Avg + DCCF												
Margin = Tabular Data - Limit												

Above are intermodulation of Zigbee, therefore DCCF was used in tabulation.

Peak

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
2327.80	64.8	H	287.0	128.0	31.9	2.9	42.2	57.3	74.0	-16.7
2365.04	79.4	H	115.0	175.0	32.0	2.9	42.2	72.1	74.0	-1.9
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

LTE Band 2, QPSK modulation, 1.4MHz
Mid Channel (18900)
Vertical Plot (3-18GHz)



Unlicensed Tabulated Data 3-18GHz

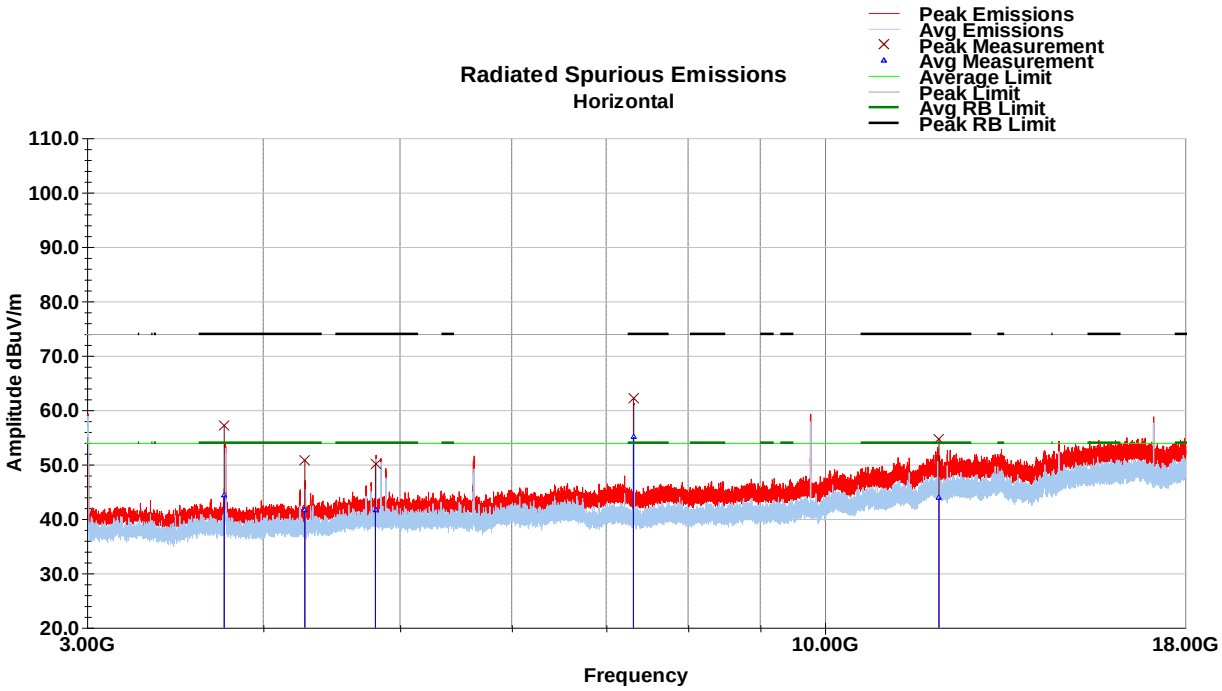
Average

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)
3753.04	48.4	V	239.0	202.0	33.4	2.7	42.0	42.5	54.0	-11.5
4795.36	36.6	V	77.0	225.0	34.6	2.9	42.1	32.0	54.0	-22.0
7318.60	55.1	V	133.0	177.0	35.8	4.0	42.0	52.9	54.0	-1.1
11974.48	37.6	V	325.0	113.0	38.8	5.2	41.6	40.0	54.0	-14.0
Final Avg = Raw Avg + AF + Loss - Amp										
Margin = Final Avg - Limit										

Peak

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
3753.04	60.8	V	239.0	202.0	33.4	2.7	42.0	54.9	74.0	-19.1
4795.36	49.4	V	77.0	225.0	34.6	2.9	42.1	44.8	74.0	-29.2
7318.60	62.5	V	133.0	177.0	35.8	4.0	42.0	60.3	74.0	-13.7
11974.48	49.9	V	325.0	113.0	38.8	5.2	41.6	52.2	74.0	-21.8
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Horizontal Plot (3-18GHz)



Unlicensed Tabulated Data – 3-18GHz

Average

Frequency MHz	Raw Avg dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	Avg Value dBuV/m	DCCF dB	Tabular Data	Limit (dBuV/m)	Margin (dB)
3753.16	50.2	H	211.0	100.0	33.4	2.7	42.0	44.4	0.0	44.4	54.0	-9.6
4281.00	47.2	H	110.0	212.0	33.5	2.8	42.0	41.6	0.0	41.6	54.0	-12.4
4803.64	46.2	H	313.0	231.0	34.6	2.9	42.1	41.6	0.0	41.6	54.0	-12.4
7318.60	57.2	H	24.0	189.0	35.8	4.0	42.0	55.0	-21.0	34.1	54.0	-19.9
12048.12	41.4	H	59.0	197.0	38.9	5.3	41.6	43.9	0.0	43.9	54.0	-10.1
Final Avg = Raw Avg + AF + Loss - Amp												
Tabular Data = Final Avg + DCCF												
Margin = Tabular Data - Limit												

7318MHz is third harmonic of Zigbee, therefore DCCF was used in above tabulation.

Peak

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
3753.16	63.0	H	211.0	100.0	33.4	2.7	42.0	57.2	74.0	-16.8
4281.00	56.5	H	110.0	212.0	33.5	2.8	42.0	50.8	74.0	-23.2
4803.64	54.7	H	313.0	231.0	34.6	2.9	42.1	50.1	74.0	-23.9
7318.60	64.3	H	24.0	189.0	35.8	4.0	42.0	62.1	74.0	-11.9
12048.12	52.2	H	59.0	197.0	38.9	5.3	41.6	54.7	74.0	-19.3
Final Pk = Raw Pk + AF + Loss - Amp										
Margin = Final Pk - Limit										

Note: 2.4GHz WLAN with all radios was worse case when compared to 5GHz WLAN.
Also, none of the failures before modification with LTE Band 12 transmitting were due to Band 12.

4 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	31 August 2022
1	Updated with modifications for compliance results	03 April 2023

Appendix A

Zigbee DCCF use-case scenarios and calculations

Zigbee Use case scenarios:

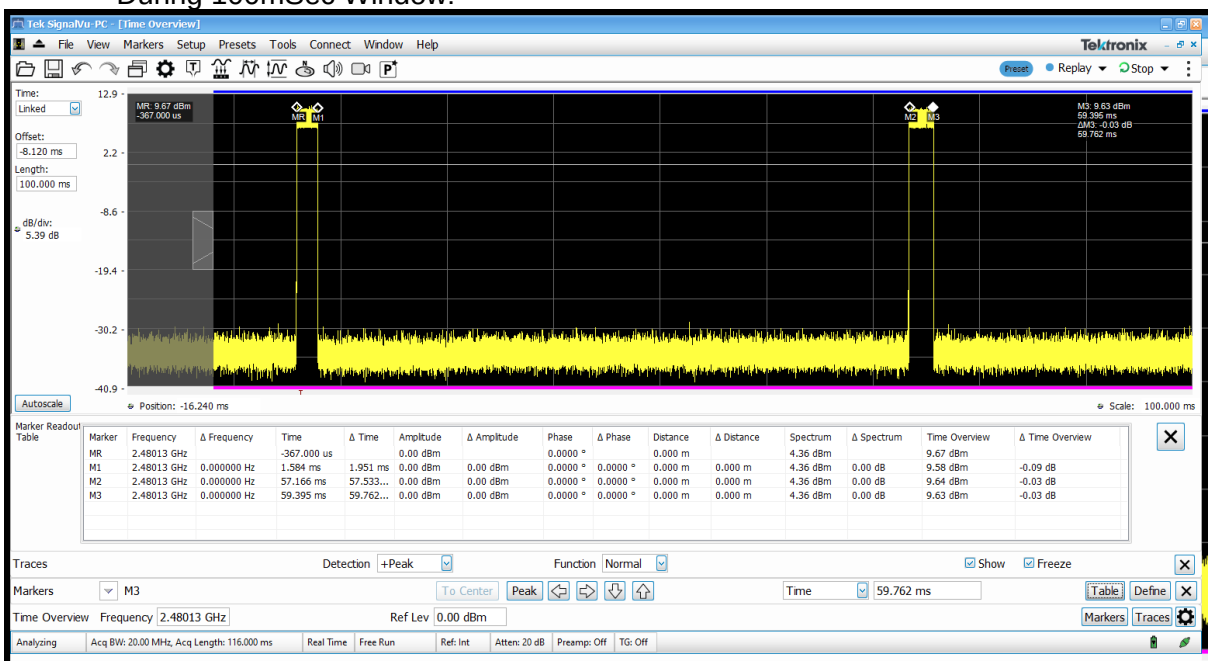
Scenario 1: Sensor Data Acquisition

a. Description:

The AirBoxOne receives the temperature sensor data over Zigbee every 5 minutes and the AirBoxOne replies with an AcK signal. This is the normal and most common scenario.

b. Captured Waveforms:

During 100mSec Window:



No of Signals = 2
S1 = 1.584-(-0.367) = 1.951mSec
S2 = 59.762-57.533 = 2.229mSec
Total On Time during 100mSec : 1.951+2.229 = 4.18mSec

c. Calculations:

Total On Time: 4.18 mSec
DCCF (Duty Cycle Correction Factor): 20*Log(4.18/100) = **-27.5764dB**

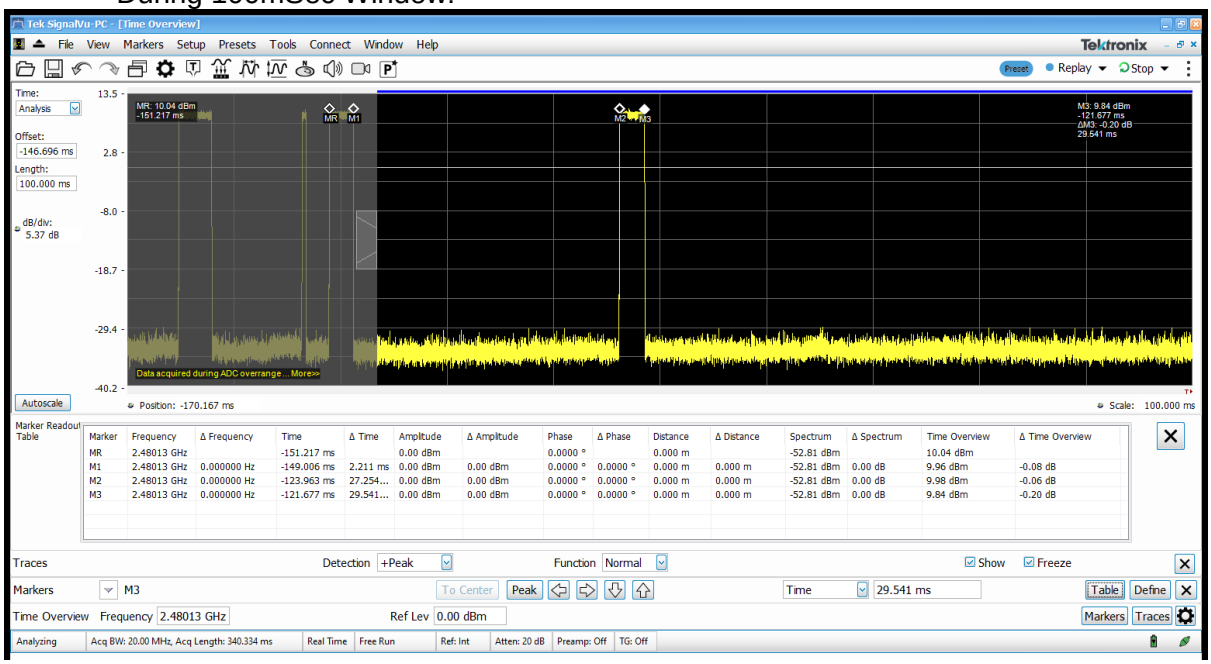
Scenario 2: Continuous Joining / Disjoining condition

d. Description:

When an invalid Sensor/Zigbee device tries to connect to AirBoxOne, it sends a network leave command to the sensor. This is a probable scenario where another truck having a Zigbee-based sensor is nearby and tries to connect to AirBoxOne.

e. Captured Waveforms:

During 100mSec Window:



No of Signals = 4
S1 = S2+S3 = 2.7637 mSec
S2 = S3/4 = 0.553 mSec
S3 = 151.217-149.006 = 2.211 mSec
S4= 123.963-121.677 = 2.286 mSec
Total On Time during 100mSec : 2.7637+0.553+2.211+2.286 = 7.8137 mSec

f. Calculations:

Total On Time: 7.8137 mSec
DCCF (Duty Cycle Correction Factor): 20*Log(7.8137/100) = **-22.1428dB**

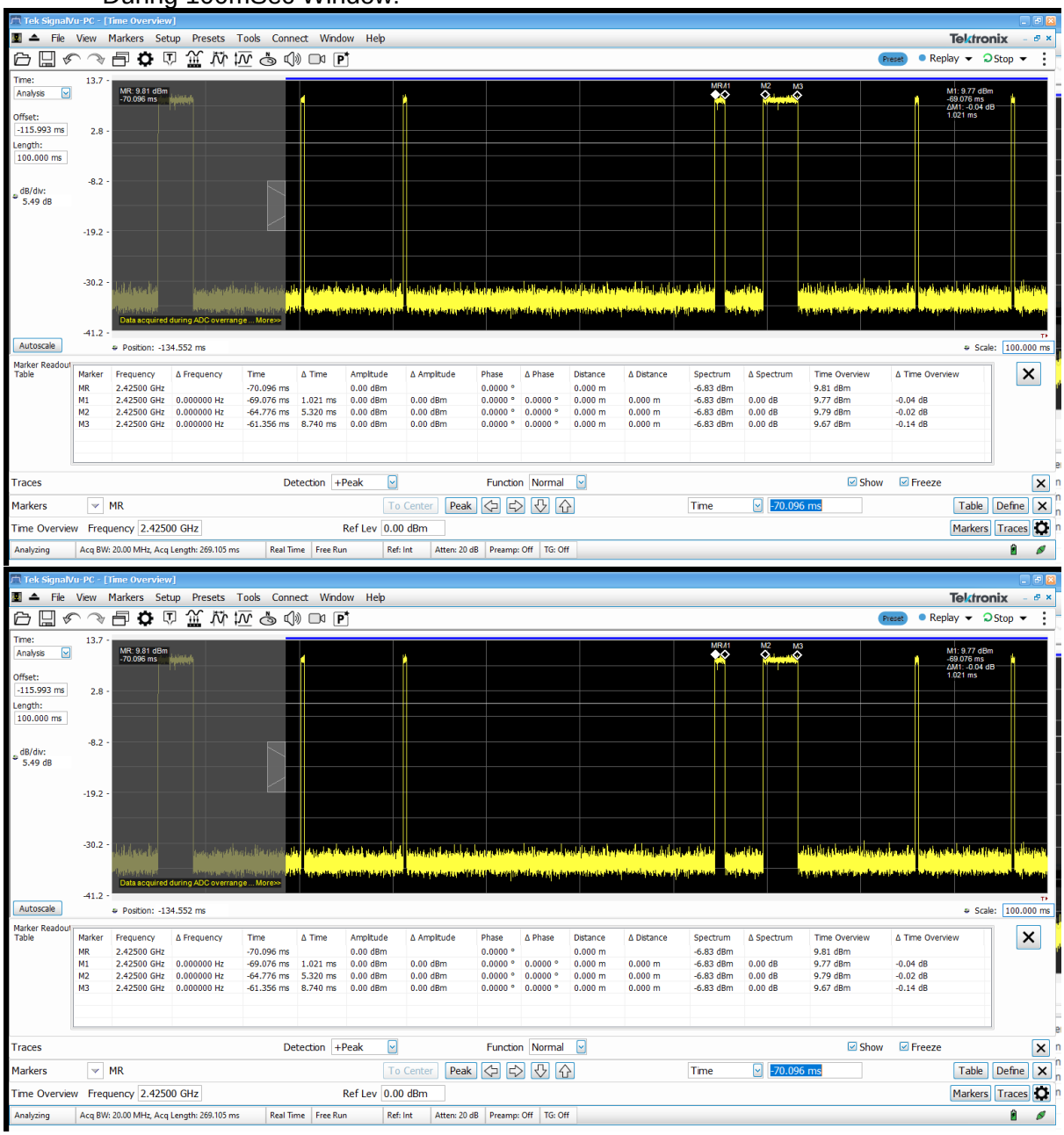
Scenario 3: OTA (On another system, with the same module and same series processor)

g. Description:

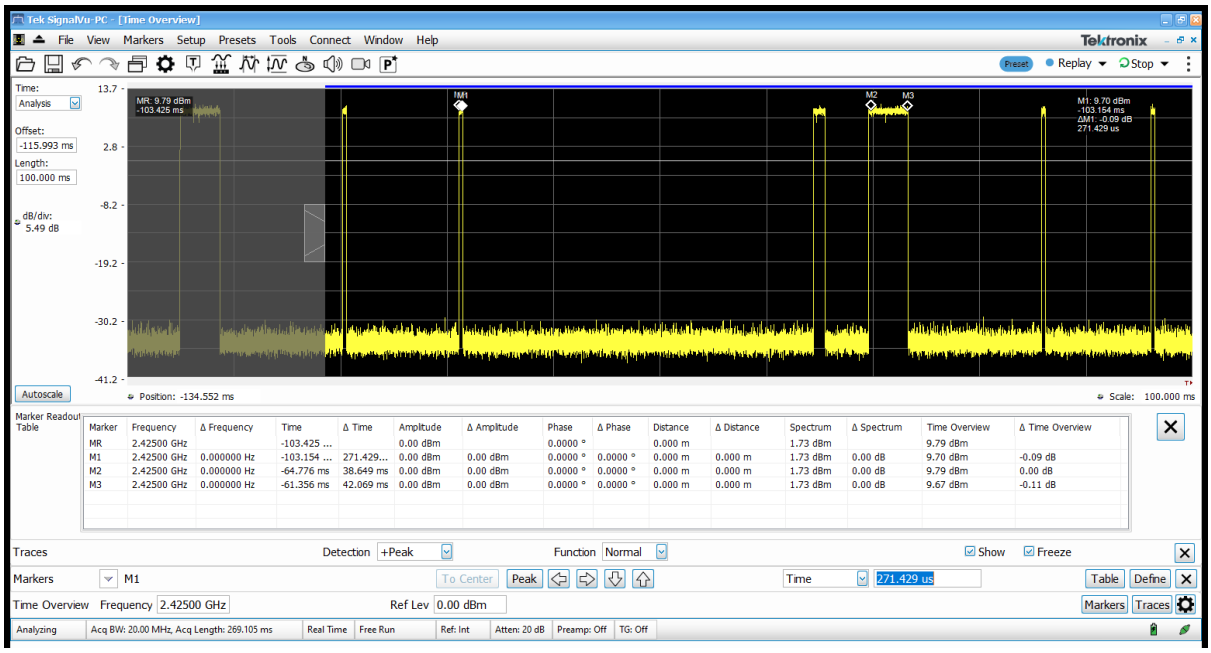
This scenario is a future provision where AirBoxOne is sending an OTA update to one of the Zigbee sensor/end devices. This feature has not yet been implemented, but it will be tested on the same platform as our other products. Both AirboxOne and our reference products use the same processor platform, OS, Zigbee module, SDK, and packet settings.

h. Captured Waveforms:

During 100mSec Window:



Continued below.



No of Signals = 7
S1 , S5 = 64.776-61.356 = 3.42mSec
S2,S3,S6,S7 = 103.425-103.154 = 0.271mSec
S4 = 70.096-69.076 = 1.02mSec
Total On Time during 100mSec : (2*3.42)+(4*0.271)+1.02= 8.944mSec

i. Calculations:

Total On Time: 8.944 mSec
DCCF (Duty Cycle Correction Factor): 20*Log(8.944/100) = **-20.969dB**