



Wireless test report – 383565-1R1TRFWL

Type of assessment:

Transmitters co-location

Applicant:

Isaac Instruments

Product name:

ISAAC InMetrics vehicular router

Model:

WRU201

FCC ID:

WIFI: 2ASYX1DXWRU201

LTE: 2ASYXEC21AWRU201

ISED Registration number:

WIFI: 24938-1DXWRU201

LTE: 24938-EC21AWRU201

Test Standard Specifications:

- ◆ FCC 47 CFR Part 15 Subpart C, §15.247 – Limited testing
- ◆ FCC 47 CFR Part 22 Subpart H – Limited testing
- ◆ FCC 47 CFR Part 24 Subpart E – Limited testing
- ◆ FCC 47 CFR Part 27 – Limited testing
- ◆ RSS-130 Issue 1, October 2013 – Limited testing
- ◆ RSS-133 Issue 6, Amendment 1, January.2018 – Limited testing
- ◆ RSS-139 Issue 3, July 2015 – Limited testing

Date of issue: October 30, 2020

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Tested by

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Reviewed by

Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation



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Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test standard specifications	4
1.3 Test methods	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Test results	5
2.2 RSS-130 test results	5
Section 3. Equipment under test (EUT) details	6
3.1 Sample information	6
3.2 EUT information	6
3.3 Technical information	6
3.4 Product description and theory of operation	6
3.5 EUT exercise details	7
3.6 EUT setup diagram	7
3.7 EUT sub assemblies	7
Section 4. Engineering considerations	8
4.1 Modifications incorporated in the EUT	8
4.2 Technical judgment	8
4.3 Deviations from laboratory tests procedures	8
Section 5. Test conditions	9
5.1 Atmospheric conditions	9
5.2 Power supply range	9
Section 6. Measurement uncertainty	10
6.1 Uncertainty of measurement	10
Section 7. Test equipment	11
7.1 Test equipment list	11
Section 8. Testing data	12
8.1 FCC Radiated emission limits; general requirements	12
Section 9. Block diagrams of test set-ups	27
9.1 Radiated emissions set-up for frequencies below 1 GHz	27
9.2 Radiated emissions set-up for frequencies above 1 GHz	27

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Isaac Instruments
Address	1300 Boulevard Clairevue O, Saint-Bruno-de-Montarville, QC J3V 0B7

1.2 Test standard specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
FCC 47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
FCC 47 CFR Part 22 Subpart H	Cellular radiotelephone service. (Partial testing)
FCC 47 CFR Part 24 Subpart E	Personal communications services. (Partial testing)
FCC 47 CFR Part 27	Miscellaneous wireless communications services(Partial testing)
RSS-130 Issue 1, October 2013	Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698–756 MHz and 777–787 MHz(Partial testing)
RSS-133 Issue 6, Amendment 1, January.2018	2 GHz Personal Communications Services(Partial testing)
RSS-139 Issue 3, July 2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz(Partial testing)

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
996369 D01 Module Certification Guide v02	Transmitter Module Equipment Authorization Guide
RSS-GEN, Issue 5, Apr. 2018, section 8.9	Transmitter Emission Limits for Licence-Exempt Radio Apparatus

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.5 below. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Exclusions

As per quote, the purpose of this report is host verification of transmitters colocation. Only radiated spurious emissions were assessed, other requirements were excluded from the scope of this report.

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	December 5, 2019	Original report issued
R1TRF	October 30, 2020	FCC/ISED IDs updated as per client

Section 2. Summary of test results

2.1 FCC Test results

Table 2.1-1: FCC Test results

Part	Test description	Verdict
§15.247(d)	Spurious emissions	Pass ¹
§27.53(g-h)	Emissions	Pass
§22.917(a)	Out of band emissions	Pass
§24.238(a)	Emissions	Pass

Notes: ¹ The EUT was only assessed for radiated spurious emissions requirements.

2.2 RSS-130 test results

Table 2.2-1: RSS Test results

Part	Test description	Verdict
RSS-247 (5.5)	Unwanted emissions	Pass
RSS-130 (4.7.1)	Radiated spurious emissions	Pass
RSS-133 (6.5.1)	Transmitter Unwanted emissions	Pass
RSS-139 (6.6)	Transmitter Unwanted emissions	Pass

Notes: As per scope of this report, only radiated emissions were evaluated.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 11, 2019
Nemko sample ID number	Item #1

3.2 EUT information

Product name	ISAAC InMetrics vehicular router
Model	WRU201
Serial number	2006

3.3 Technical information

Technologies	Wi-Fi, Cellular (LTE, WCDMA)
Frequency bands	2.4 GHz, LTE B12 (700 MHz), WCDMA B5 (850 MHz),), WCDMA B4 (1700 MHz), WCDMA B2 (1900 MHz,
Type of modulation	Digital
EUT power requirements	12 V battery
Antenna information	EUT is designed so that the end user may replace a broken antenna. (The EUT has a non-standard antenna jack or electrical connector.) Wi-Fi antenna: 2J0202-2.4-C934_IsCa, max peak gain 3.5 dBi Cellular antenna: 2J4941PGF-300LL195-C231_300LL100-C95_IsCa, max peak gain 3.9 dBi

3.4 Product description and theory of operation

Cellular - Wifi vehicular router with data acquisition capability.

3.5 EUT exercise details

EUT was configured and set up by client on site. Setting as below:

Cellular frequency coverage

LTE FDD: B2/B4/B12 WCDMA: B2/B4/B5

Channels	Max output per technology	AT Command (Min Band and Max Band)
700 MHz	LTE Band 12 with 23 dBm	AT+QRFTEST="LTE BAND12",23010,"ON",66,1
850 MHz	WCDMA Band 5 with 24 dBm	AT+QRFTEST="WCDMA BAND5",4132,"ON",68, 1
1700 MHz	WCDMA Band 4 with 24 dBm	AT+QRFTEST="WCDMA BAND4",1312,"ON",69, 1
1900 MHz	WCDMA Band 2 with 24 dBm	AT+QRFTEST="WCDMA BAND2",9262,"ON",68, 1

2.4 GHz band Wi-Fi Tx at Channel 1 and 11

Start Wifi : ./start_tx.sh 11 ou x = channel (1 or 11)

Start Cellular : ./power_up_SIM1.sh

Start minicom : « minicom »

Activate cellular test mode : AT+QRFTESTMODE=1

Activate the appropriate band like explained above Ex: AT+QRFTEST="LTE BAND12",23010,"ON",60,1

DC power supply was in place of the battery during test.

3.6 EUT setup diagram

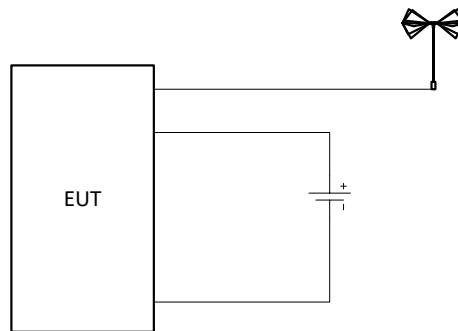


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
ISAAC InMetrics vehicular router	WRU201	--	2006
Power supply :	Triad	PN: WSU120-2000-13	--
Antennas	2J	Wifi :PN:2J0202-2.4-C934r Cellular :PN: 2J4941PGF-300LL195-C231_300LL100-C95_IsCa	--

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

For verification of transmitters' colocation, the Tx RF parameters (i.e. transmit frequencies, channel bandwidth, power level) of EUT was as provided by the customer .

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber (Emissions)	TDK	SAC-3	FA002532e	2 year	January 10, 2020
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	December 6, 2019
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	January 3, 2020
Horn antenna (1–18 GHz)	EMCO	3115	FA001451	1 year	April 12, 2020
Pre-amplifier (0.5–18 GHz)	Com-Power	PAM-118A	FA002561	1 year	September 18, 2020
50 Ω coax cable	C.C.A.	None	FA002603	—	VOU
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU
50 Ω coax cable	C.C.A.	None	FA002831	—	VOU

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC Radiated emission limits; general requirements

8.1.1 Definitions and limits

FCC § 15.247(d) FCC:

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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC § 27.53 Emission limits.

(g) For operations in the 600 MHz band and the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits -

(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB

FCC § 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC § 24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

8.1.1 Definitions and limits, continued

ISED RSS-247 Section 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

ISED RSS-130 Section 4.7.1:

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

ISED RSS-133 Section 6.5.1

6.5.1 Out-of-Block Emissions

Equipment shall comply with the limits in (i) and (ii) below.

In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

ISED RSS-139 Section 6.6

In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, Footnote 2 which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

8.1.2 Test summary

Test start date	November 11, 2019
Test engineer	Yong Huang

8.1.3 Observations, settings and special notes

- The spectrum was searched from 30 MHz to the 10th harmonic of the highest Tx frequency.
- EUT's transmitters were set to transmit continuously, different channel setting has been investigated as per provided by client's setup, only the worst-case is presented.
- Radiated measurements were performed at a distance of 3 m for frequency range below 18 GHz. No inter-modulation products emissions were detected above 18 GHz within 6 dB below the limit.

Spectrum analyser settings below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Average
Trace mode:	Max Hold

8.1.4 Test data

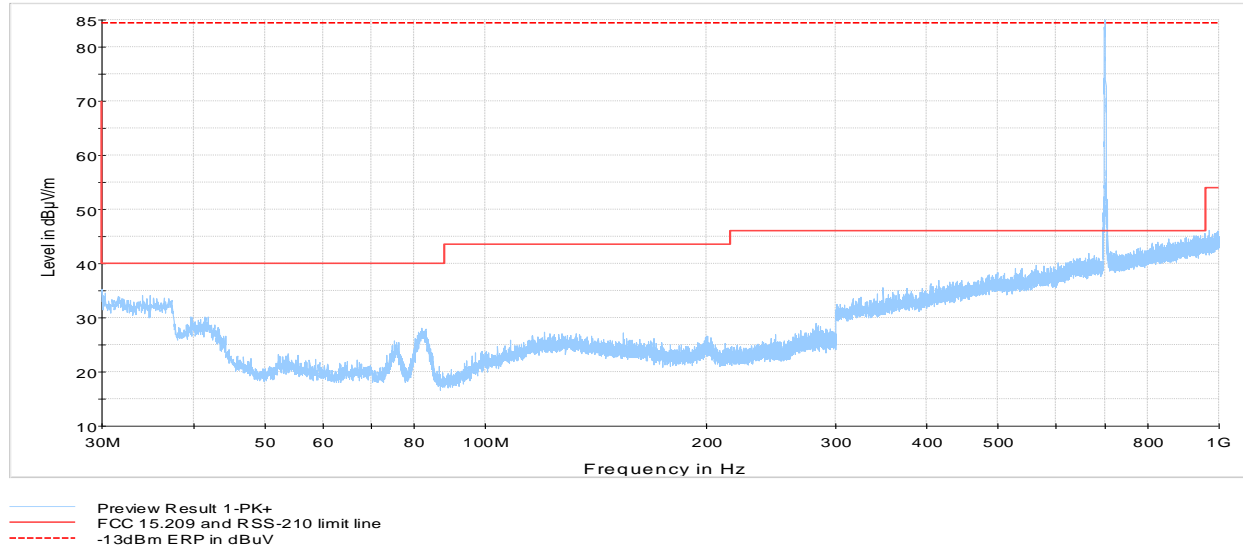


Figure 8.1-1: Radiated spurious emissions below 1 GHz(WIFI @ 2412 MHz / Cellular @ 700 MHz)

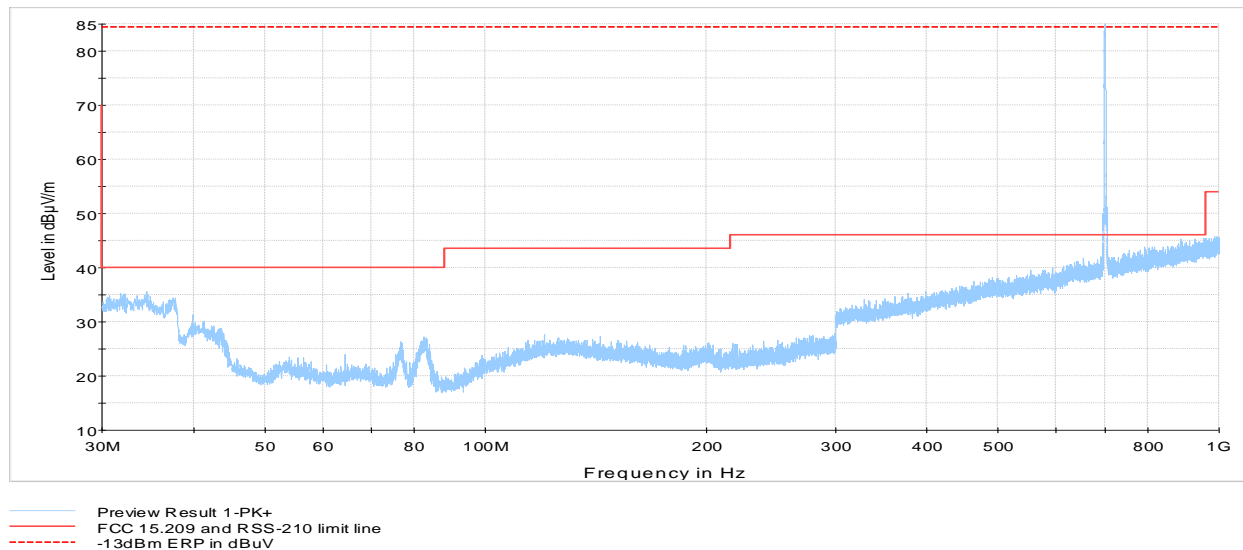


Figure 8.1-2: Radiated spurious emissions below 1 GHz(WIFI @ 2462 MHz / Cellular @ 700 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

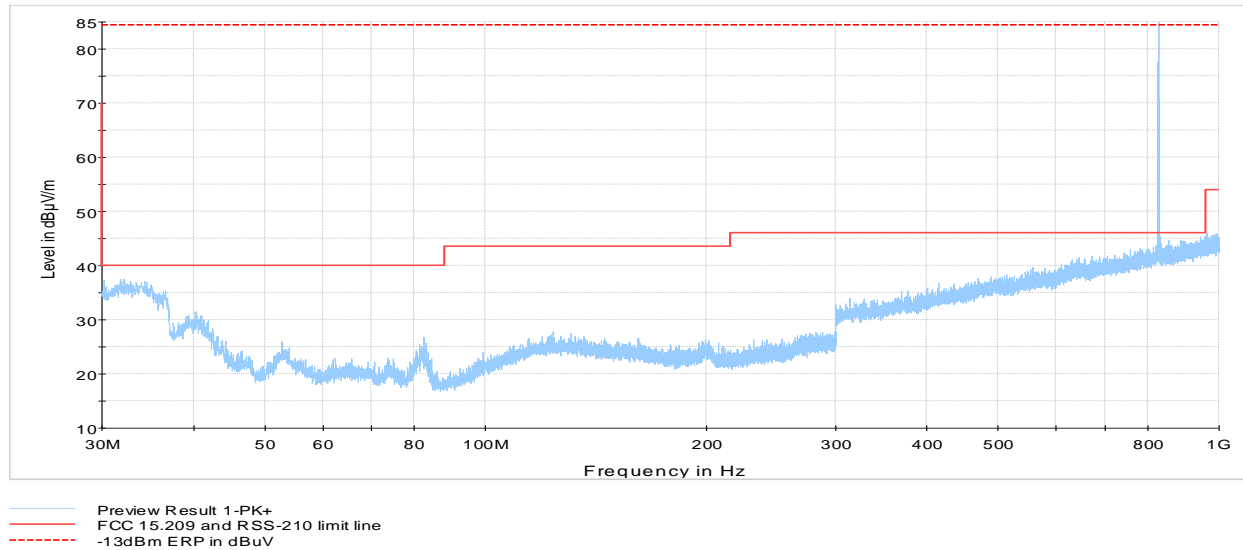


Figure 8.1-3: Radiated spurious emissions below 1 GHz(WIFI @ 2412 MHz / Cellular @ 827 MHz)

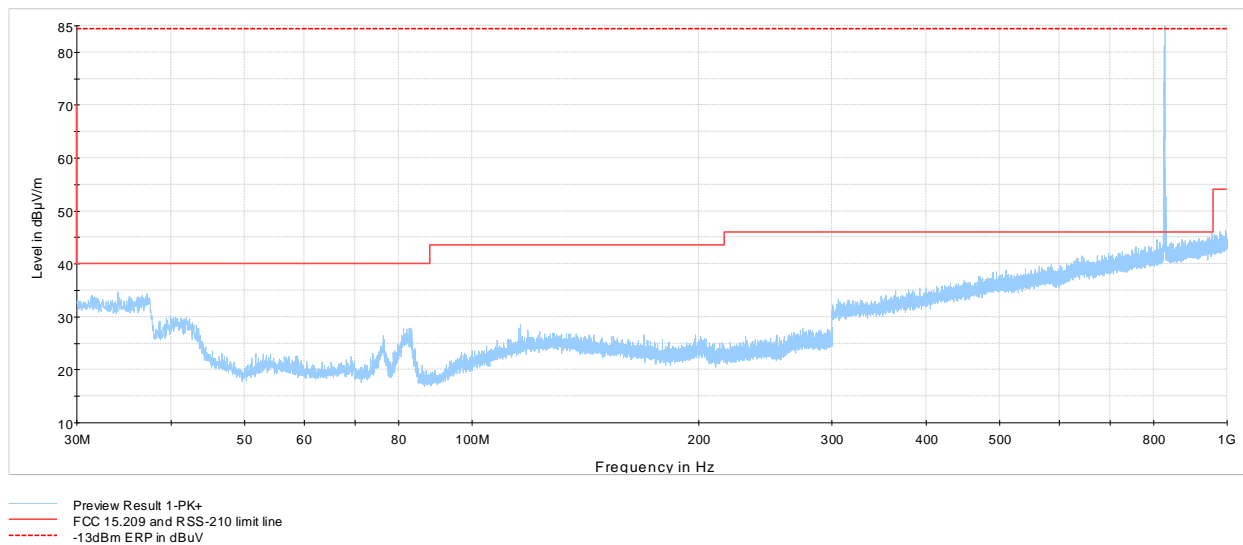


Figure 8.1-4: Radiated spurious emissions below 1 GHz(WIFI @ 2462 MHz / Cellular @ 827 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

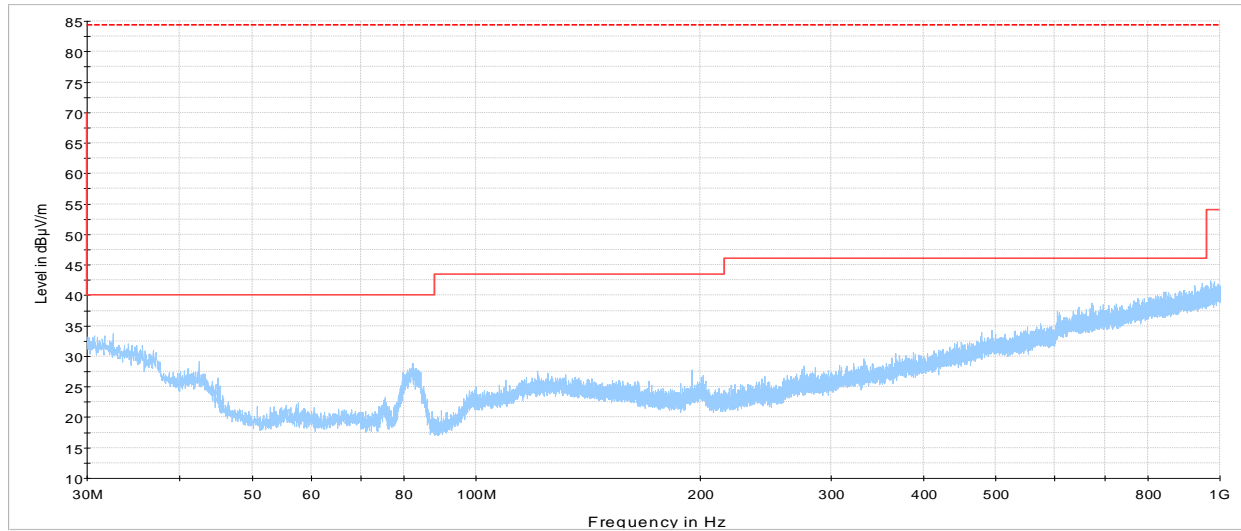
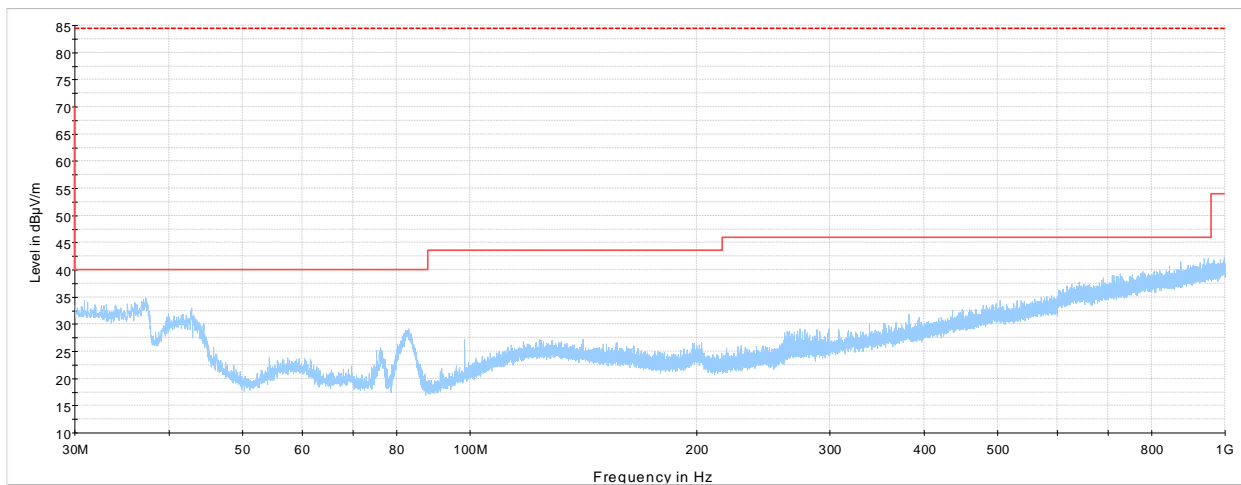


Figure 8.1-5: Radiated spurious emissions below 1 GHz(WIFI @ 2412 MHz / Cellular @ 1714 MHz)



— Preview Result 1-PK+
— FCC 15.209 and RSS-210 limit line
- - -13dBm ERP in dBuV

Figure 8.1-6: Radiated spurious emissions below 1 GHz(WIFI @ 2462 MHz / Cellular @ 1714 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

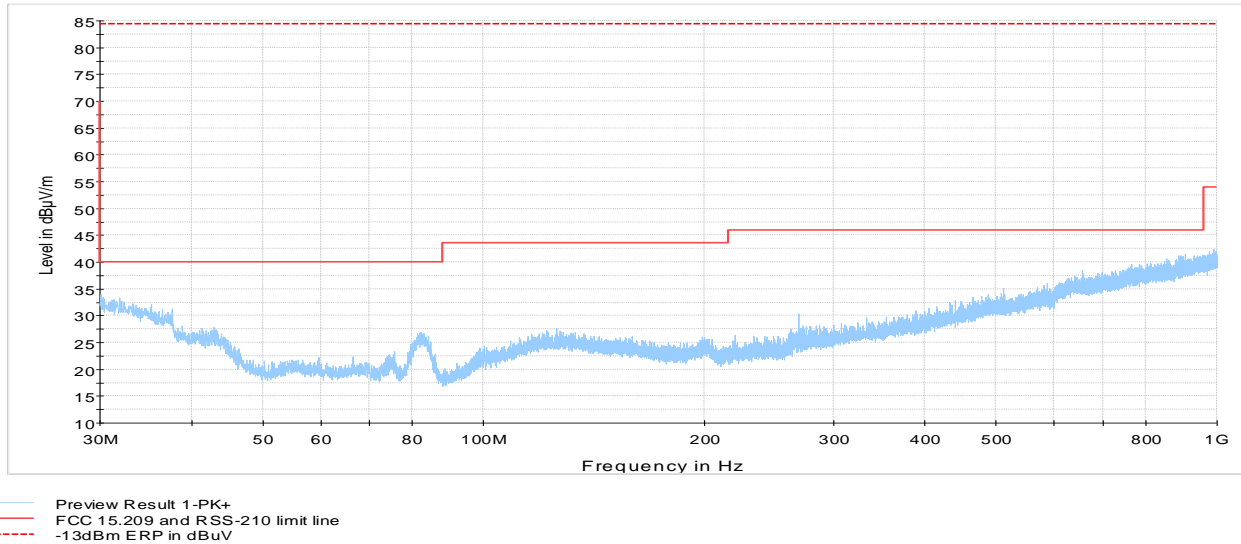


Figure 8.1-7: Radiated spurious emissions below 1 GHz(WIFI @ 2412 MHz / Cellular @ 1853 MHz)

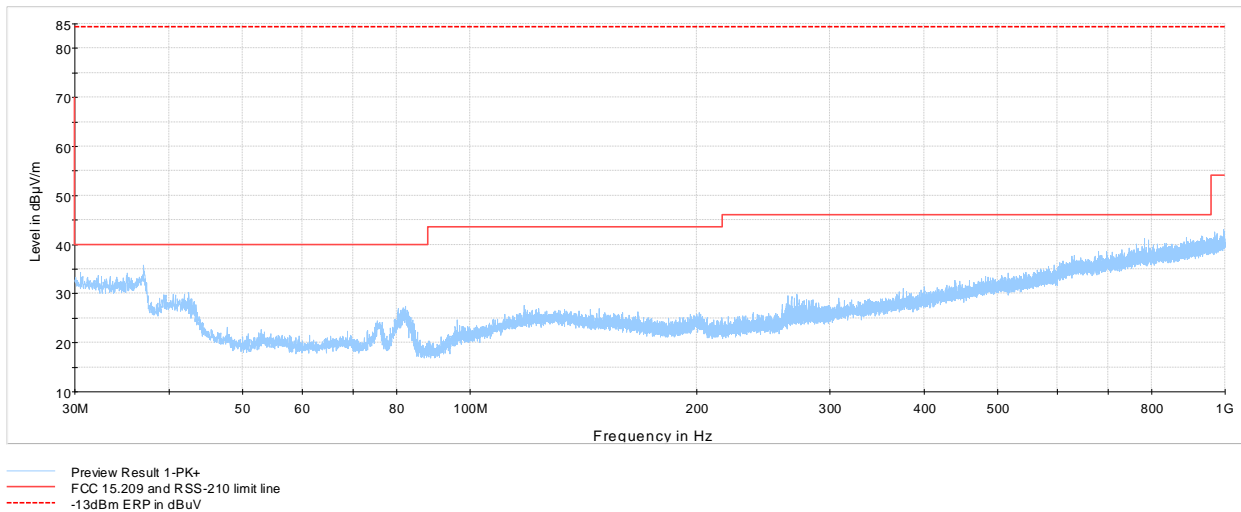


Figure 8.1-8: Radiated spurious emissions below 1 GHz(WIFI @ 2462 MHz / Cellular @ 1853 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

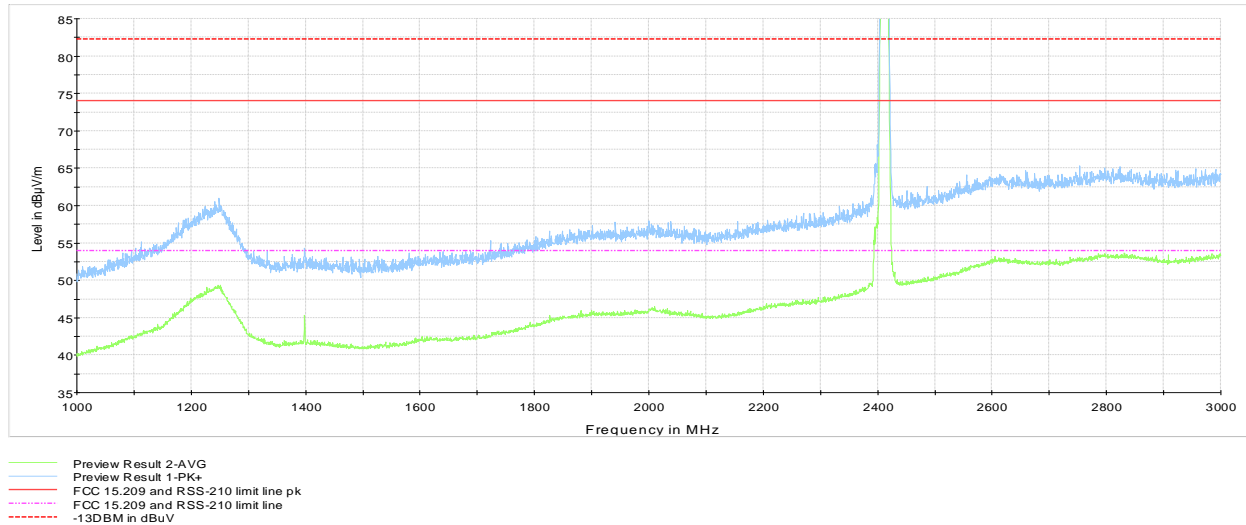


Figure 8.1-9: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2412 MHz / Cellular @ 700 MHz)

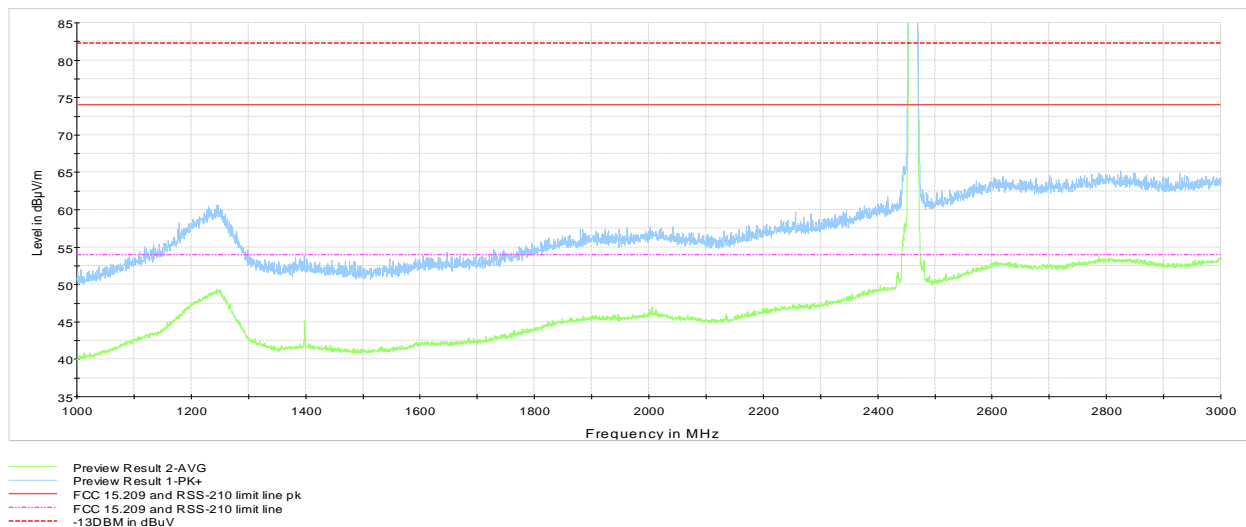


Figure 8.1-10: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2462 MHz / Cellular @ 700 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

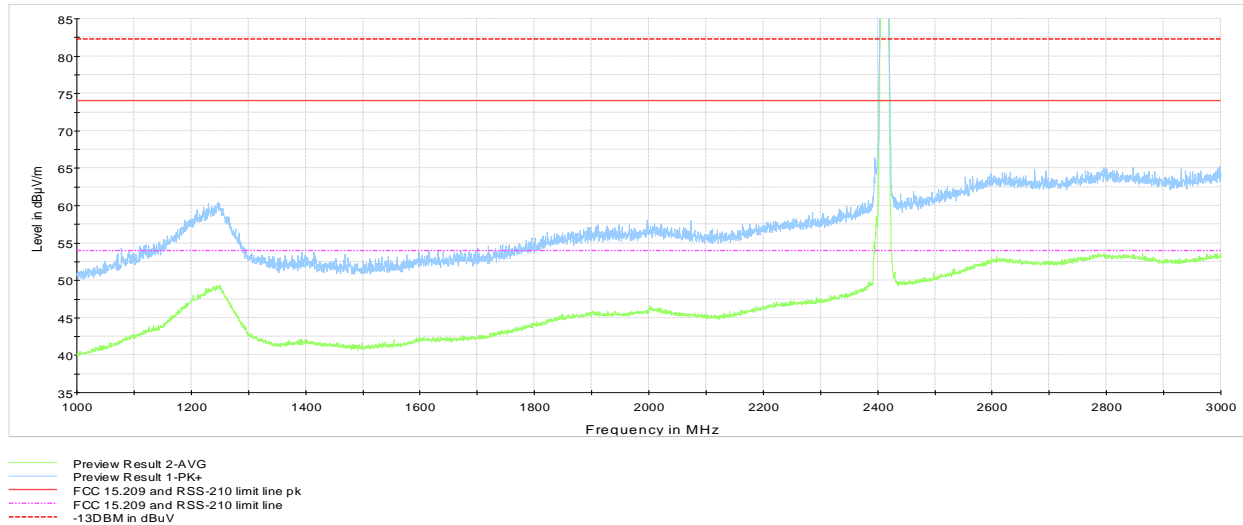


Figure 8.1-11: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2412 MHz / Cellular @ 827 MHz)

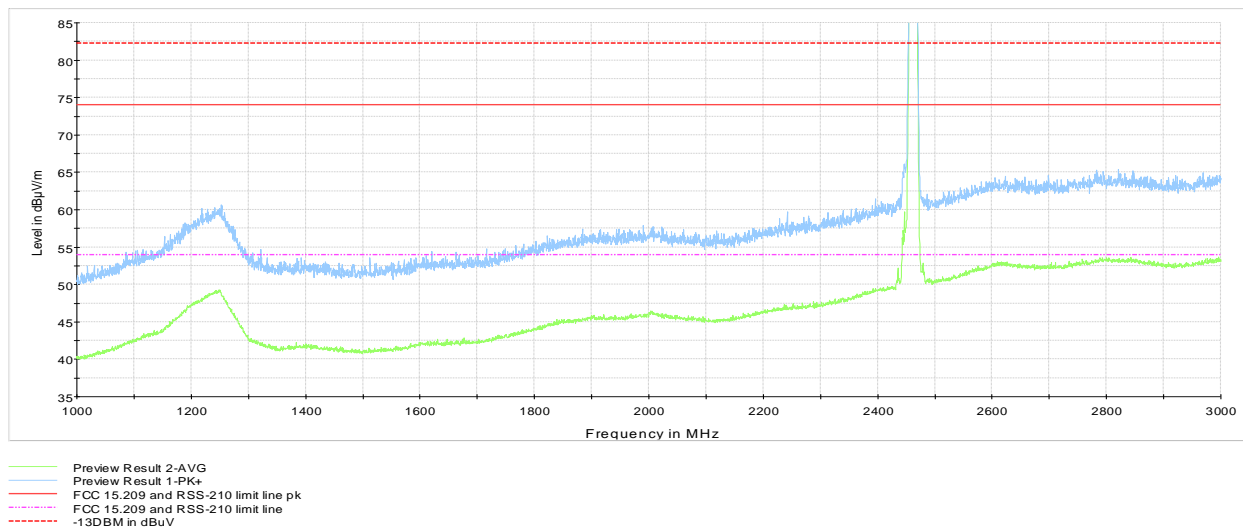


Figure 8.1-12: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2462 MHz / Cellular @ 827 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

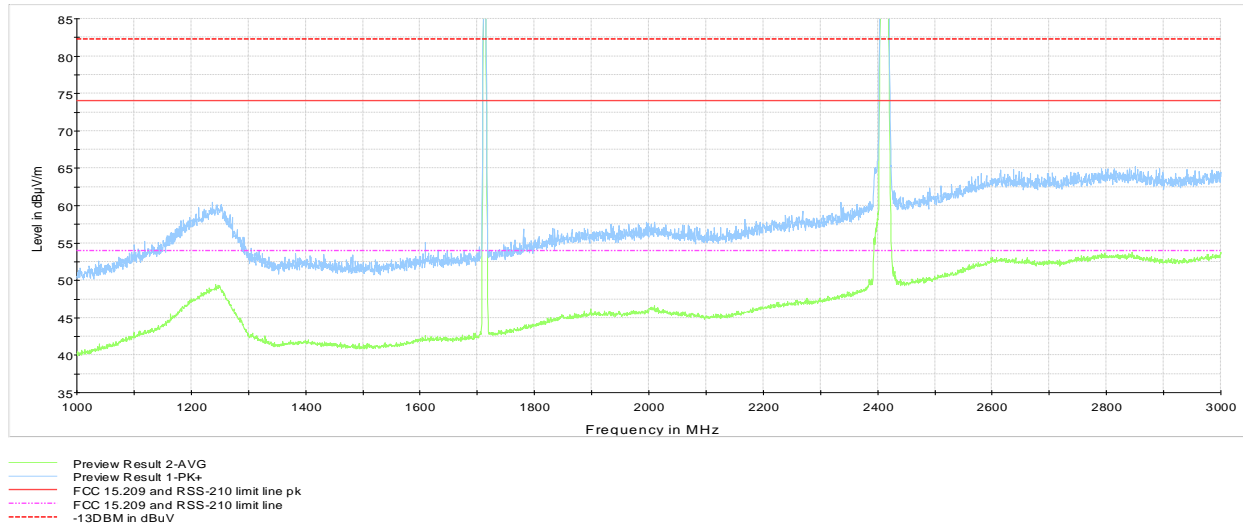


Figure 8.1-13: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2412 MHz / Cellular @ 1714 MHz)

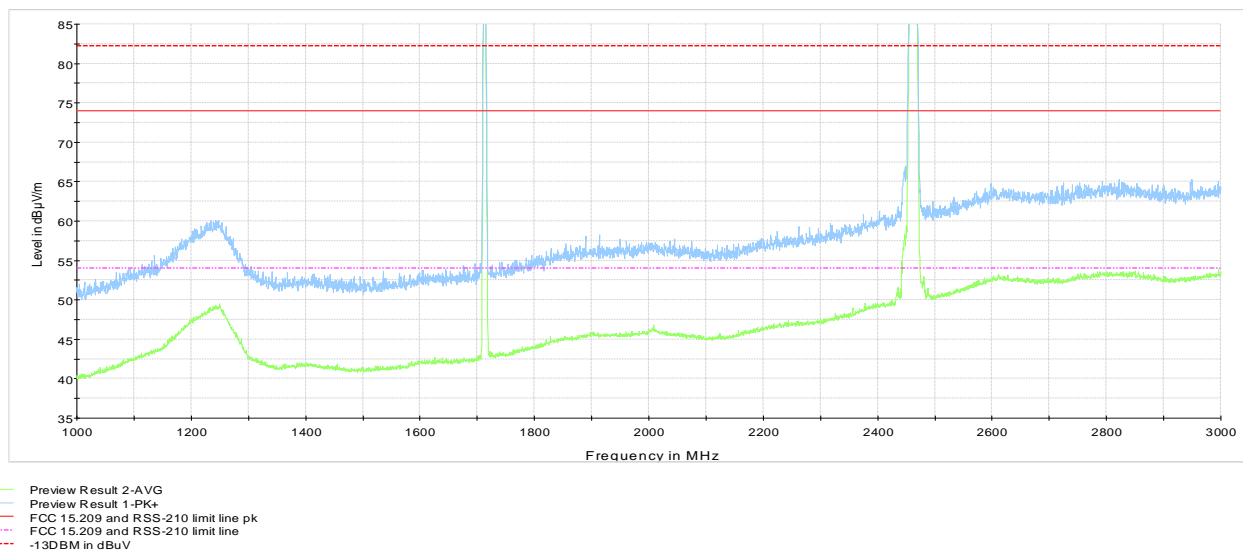


Figure 8.1-14: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2462 MHz / Cellular @ 1714 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

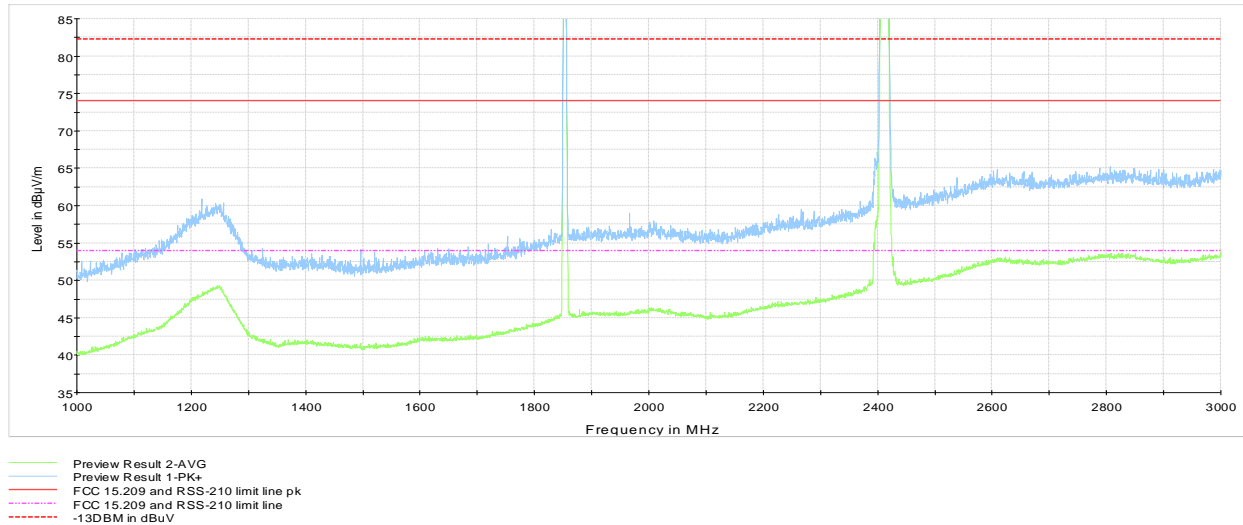


Figure 8.1-15: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2412 MHz / Cellular @ 1853 MHz)

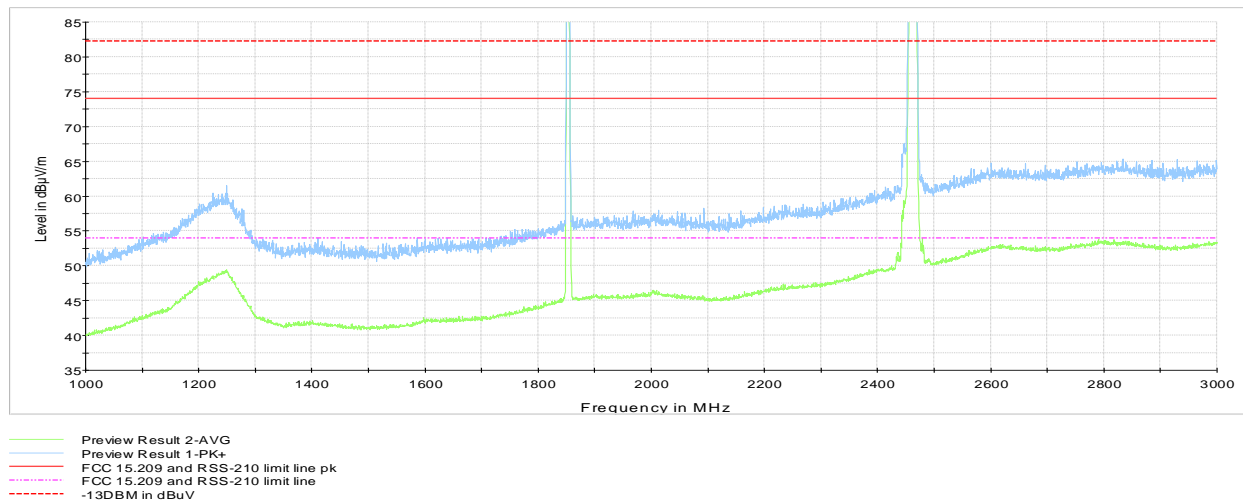


Figure 8.1-16: Radiated spurious emissions 1 to 3 GHz(WIFI @ 2462 MHz / Cellular @ 1853 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

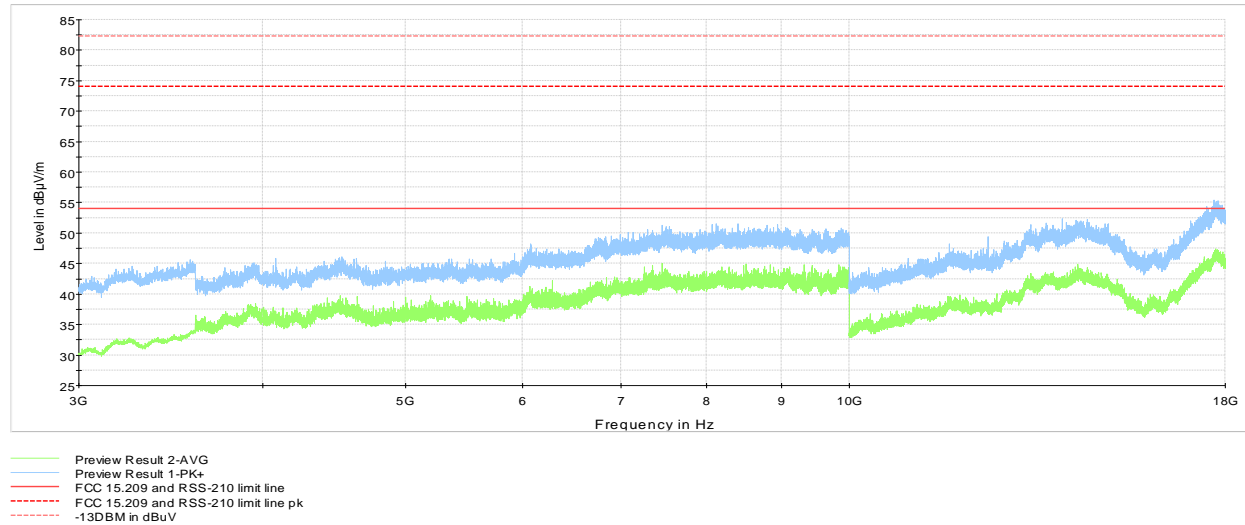


Figure 8.1-17: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2412 MHz / Cellular @ 700 MHz)

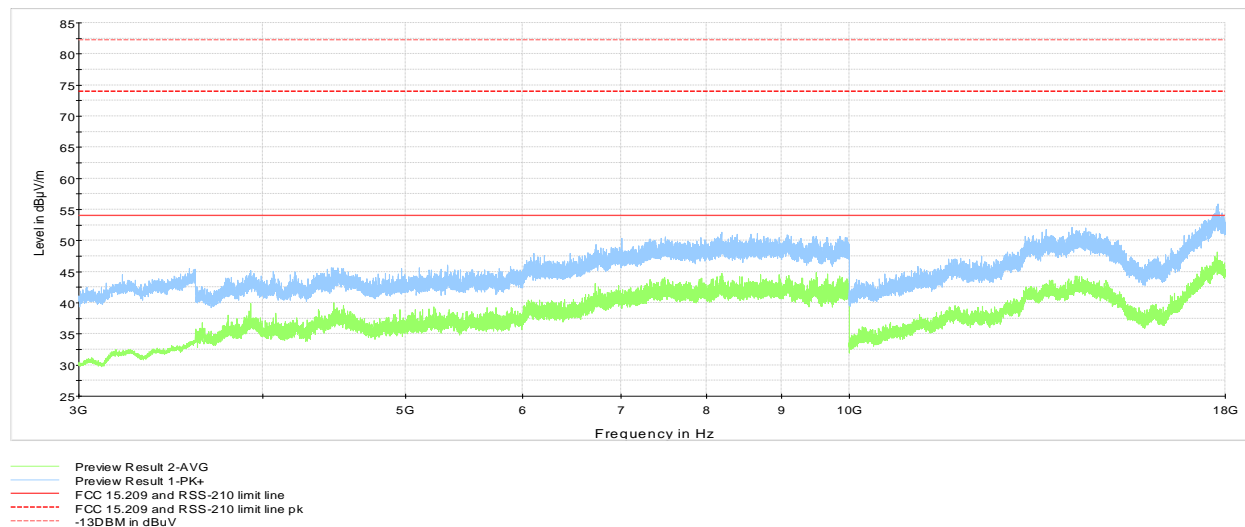


Figure 8.1-18: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2462 MHz / Cellular @ 700 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

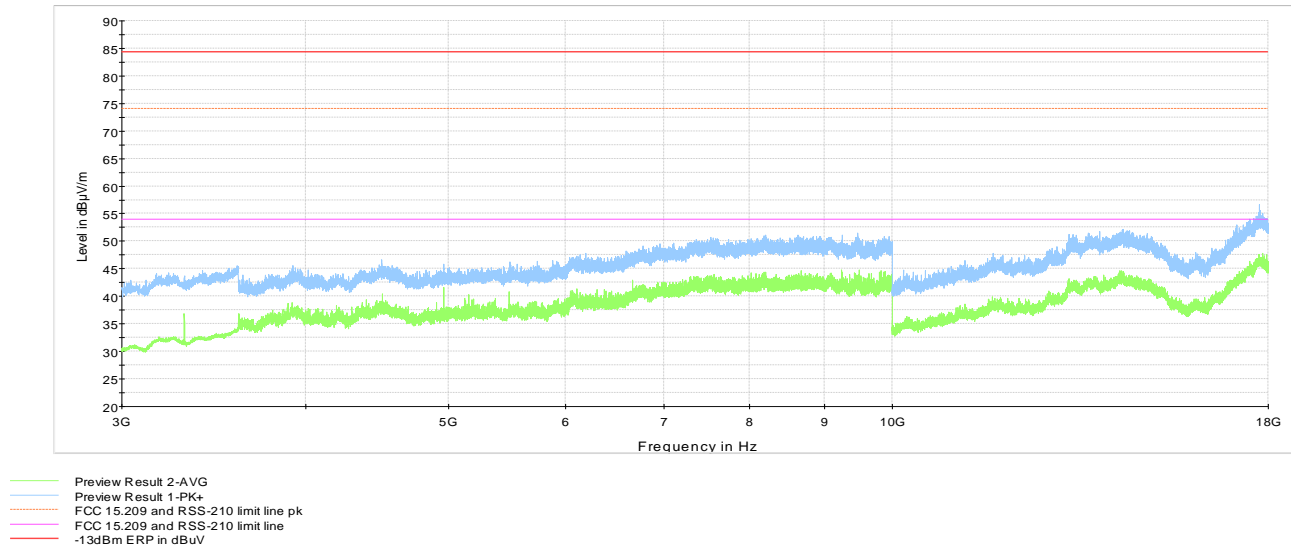


Figure 8.1-19: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2412 MHz / Cellular @ 827 MHz)

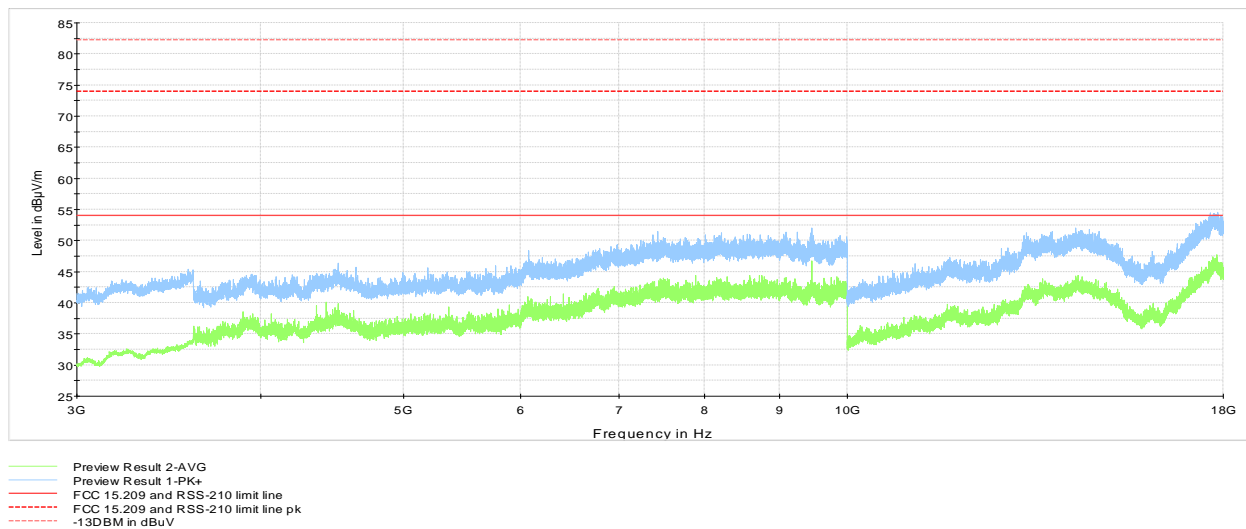


Figure 8.1-20: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2462 MHz / Cellular @ 827 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

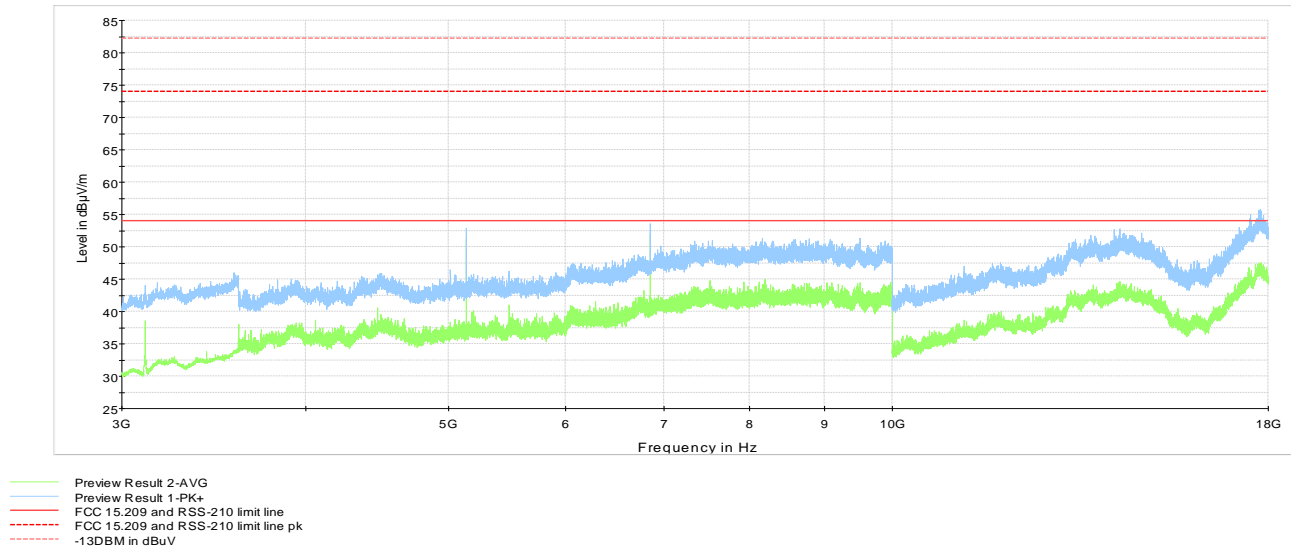


Figure 8.1-21: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2412 MHz / Cellular @ 1714 MHz)

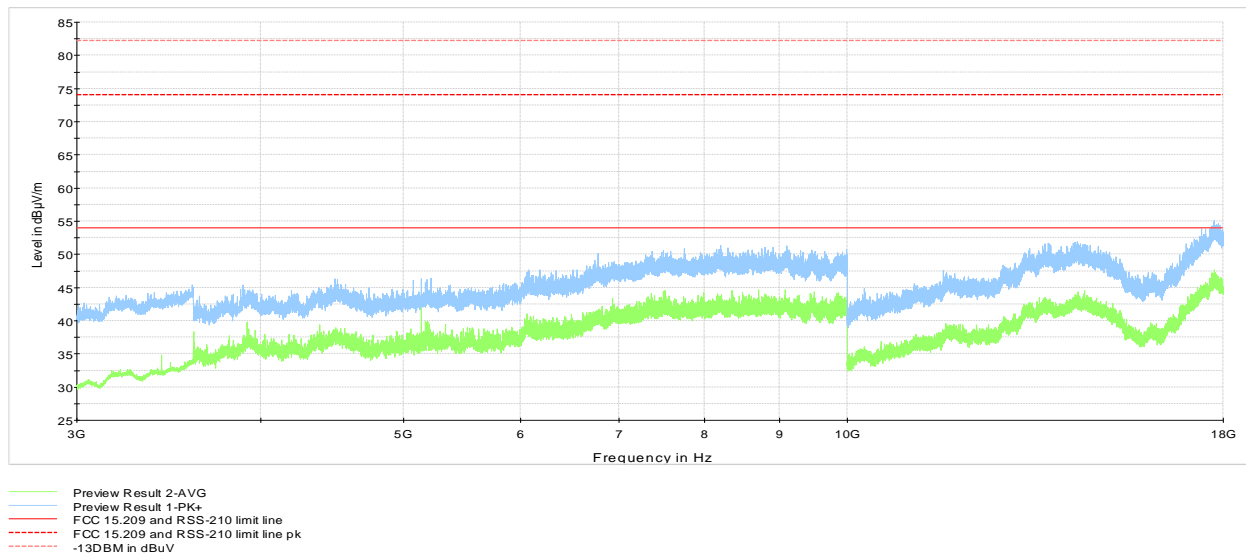


Figure 8.1-22: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2462 MHz / Cellular @ 1714 MHz)

Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

8.1.4 Test data, continued

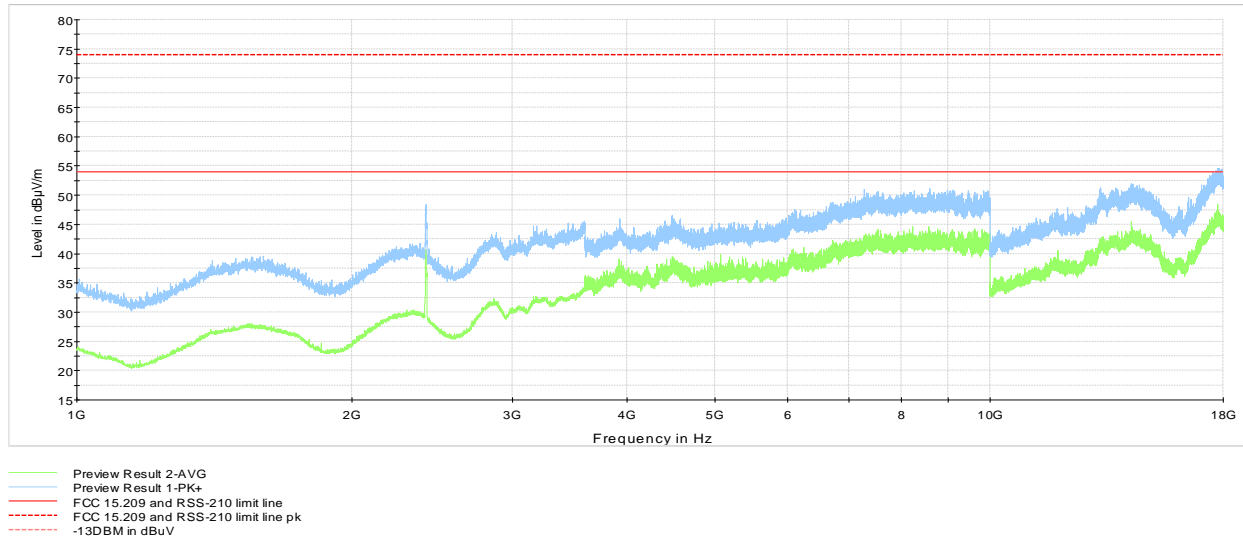


Figure 8.1-23: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2412 MHz / Cellular @ 1853 MHz)

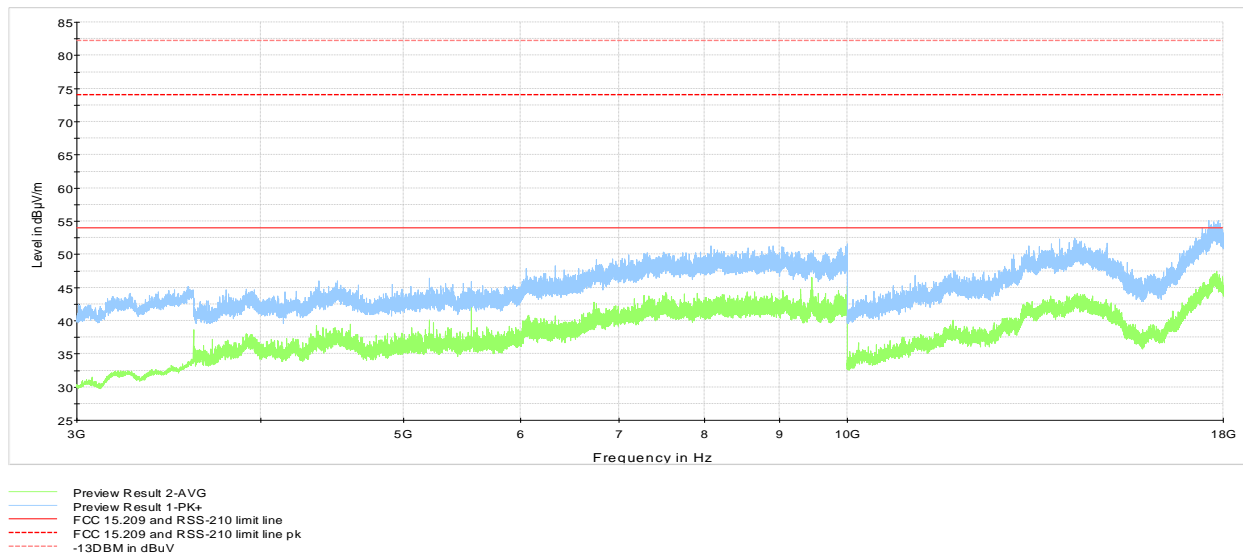
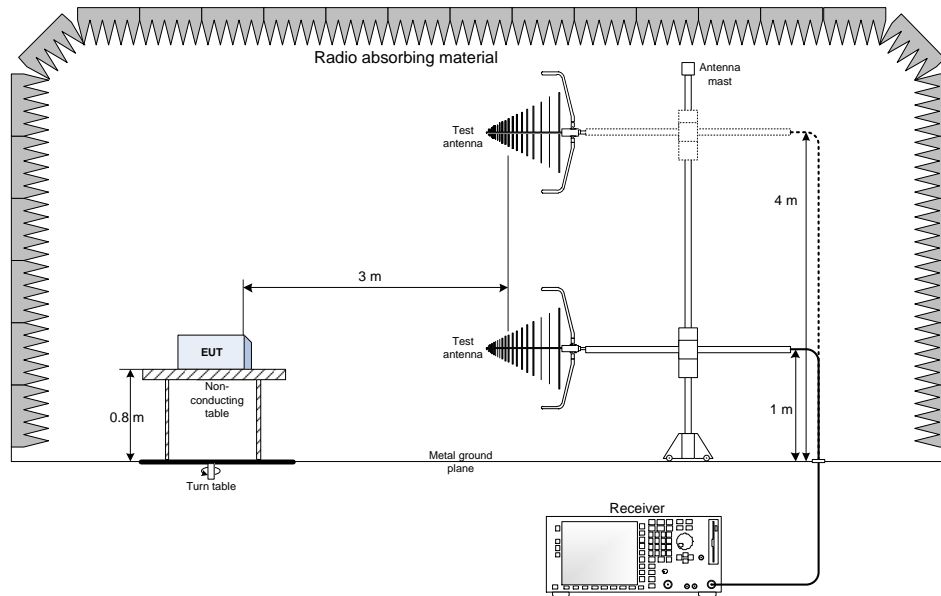


Figure 8.1-24: Radiated spurious emissions 3 to 18 GHz(WIFI @ 2462 MHz / Cellular @ 1853 MHz)

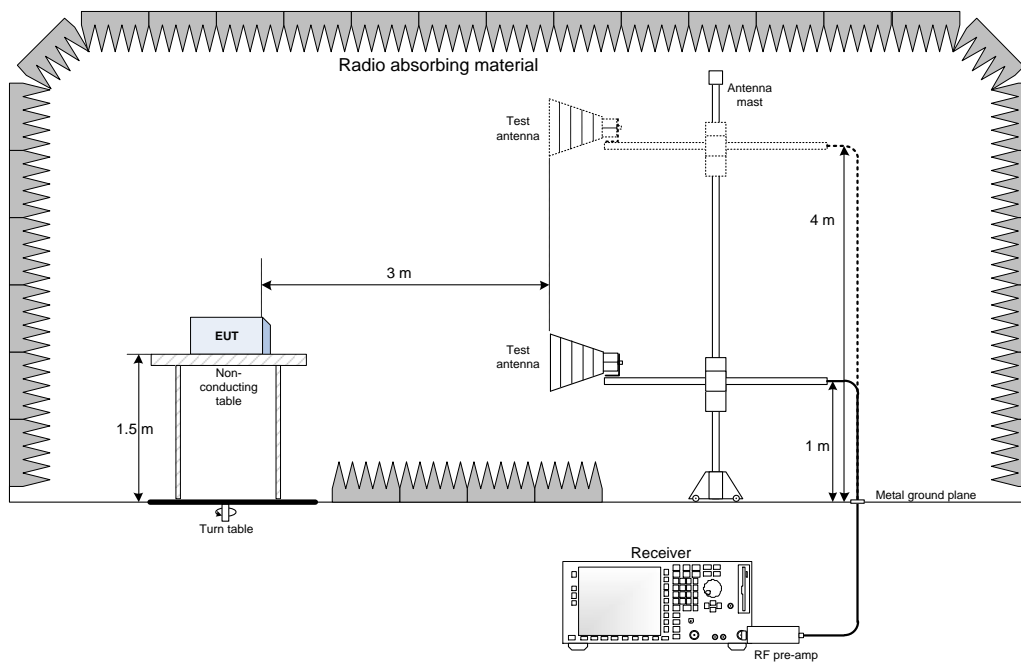
Note: No spurious emissions within restricted band were detected within 6 dB below the limits. No spurious emissions outside of restricted bands were detected within 6 dB below the spurious limit of licensed transmitters.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



(End of report)