DEKRA Testing and Certification, S.A.U.
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C.I.F. A29507456

ISED CABid: ES1909

Test Report No:
NIE: 67442RRF.012

Partial Test Report

USA FCC 15.209, 15.247, 15.249, 15.407, 27 CANADA RSS-247, RSS-210, RSS-Gen, RSS-130, RSS-139

(*) Identification of item tested	Communications Device
(*) Trademark	Ring LLC
(*) Model and /or type reference	5AT3T3
Other identification of the product	FCC ID: 2AEUPBHAXN001 IC: 20271-BHAXN001
(*) Features	--
Applicant	Ring LLC 1523 26th Street, Santa Monica, 90404, California, United States of America
Test method requested, standard	USA FCC Part 15.209 (10-1-20 Edition): Radiated emission limits; general requirements. USA FCC Part 15.247 (10-1-20 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.249 (10-1-20 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, 5725 - 5875 MHz, and 24.0 – 24.25 GHz. USA FCC Part 15.407 (10-1-20 Edition): General technical requirements. USA FCC Part 27 (10-1-20 Edition): Miscellaneous Wireless Communications Services. CANADA RSS-130 Issue 2 (February 2019). CANADA RSS-139 Issue 3 (July 2015). CANADA RSS-Gen Issue 5 Amendment 1 (March 2019). CANADA RSS-210 Issue 10 (December 2019). CANADA RSS-247 Issue 2 (February 2017). -Transmitter out of band radiated emissions with simultaneous transmissions. Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.

	KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices. ANSI C63.26-2015.
Approved by (name / position & signature)	José Manuel Gómez Industrial & Automotive EMC Lab. Manager  Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456) Fecha: 2021.08.26 11:16:27 +02'00'
Date of issue	2021-08-26
Report template No	FDT08_23 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification S.A.U. is an FCC-recognized accredited testing laboratory with the appropriate scope of accreditation that covers the performed test in this report.

DEKRA Testing and Certification S.A.U. is an ISED-recognized accredited testing laboratory, CABid: ES1909, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of the model number 5AT3T3 is a communications device.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Reception
67442/030	Communications Device	5AT3T3	GCB1ES0011340001	2021/05/03

Auxiliary elements used with the Sample S/01:

Control Nº	Description	Model	Serial Nº	Reception
67442/031	AC/DC Power Adapter	DSA-36PDB FUS	GB51PR0110770072	2021/05/03

Sample S/01 has undergone the test(s): The tests indicated in the Appendix A.

Test sample description

Ports…… :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)		
			☐	☐	☐		
			☐	☐	☐		
			☐	☐	☐		
			☐	☐	☐		
Supplementary information to the ports…… :							
Rated power supply .....:	Voltage and Frequency			Reference poles			
				L1	L2	L3	N	PE
	☐	AC:		☐	☐	☐	☐	☐
	☒	AC:		☐	☐	☐	☐	☐
	☐	DC:						
	☐	DC:						
Rated Power .....:								
Clock frequencies.....:								
Other parameters .....:								
Software version .....:	Rev 1.0							
Hardware version .....:	Rev 1.3							
Dimensions in cm (W x H x D) ....:								
Mounting position .....:	☒	Table top equipment						
	☐	Wall/Ceiling mounted equipment						
	☐	Floor standing equipment						
	☐	Hand-held equipment						
	☐	Other:						
Modules/parts.....:	Module/parts of test item			Type		Manufacturer	
Accessories (not part of the test item) .....:	Description			Type		Manufacturer	
Documents as provided by the applicant.....:	Description			File name		Issue date	

(3) Only for Medical Equipment

Identification of the client

Ring LLC

1523 26th Street, Santa Monica, 90404, California, United States

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-06-24
Date (finish)	2021-07-02

Document history

Report number	Date	Description
67442RRF.012	2021-08-26	First release.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Daniel Mejías and Jaime Barranquero.

Used instrumentation:

Radiated Measurements

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ALBATROSS P29419	2020/01	2023/01
2.	Shielded Room ALBATROSS PROJECTS GMBH P29419	N/A	N/A
3.	EMI Test Receiver 2Hz-44GHz, ROHDE AND SCHWARZ ESW44	2019/10	2021/10
4.	Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
5.	Preamplifier 30 dB 500MHz-18GHz, SCHWARZBECK BBV 9718 C	2021/02	2022/02
6.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
7.	Preamplifier G>30 dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
8.	Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2021/03	2024/03

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

FCC 15, 27 / RSS-247, RSS-Gen, RSS-130, RSS-139 PARAGRAPH Requirement – Test case	Verdict	Remark
FCC 15.209 (a), FCC 15.247 (d), FCC 15.249 (d), FCC 15.407, FCC 27.53, / RSS-210 B.10 (b), RSS-247 5.5. & 6.2.1.2, RSS-Gen 8.9, RSS-130 4.6, RSS-139 6.6 Emission limitations radiated (Transmitter)	P	(1)
Supplementary information and remarks: (1) Only Co-Location radiated spurious emission test was requested.		

Appendix A: Test results FCC 15.209, 15.247, 15.249, 15.407, 27 / RSS-210, RSS-247, RSS-Gen, RSS-130, RSS-139

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TEST CONDITIONS

(*) Declared by the Client.

POWER SUPPLY (*):

Vnominal: 110 Vac

Type of Power Supply: AC/DC Adapter.

ANTENNA:

Type of Antennas: Internal (stamped metal).

Maximum Declared Gain for Z-Wave Long Range: +1.9 dBi

Maximum Declared Gain for Z-Wave Classic: +1.9 dBi

Maximum Declared Gain for Bluetooth LE (module (1)): +3.7 dBi

Maximum Declared Gain for Bluetooth LE (module (2)): +3.7 dBi

Maximum Declared Gain for ZigBee 2.4 GHz: +3.7 dBi

Maximum Declared Gain for Wi-Fi 2.4 GHz Ant1: +4.6 dBi

Maximum Declared Gain for Wi-Fi 2.4 GHz Ant2: +3.8 dBi

Maximum Declared Gain for Wi-Fi 5 GHz Ant1 (U-NII-1): +3.5 dBi

Maximum Declared Gain for Wi-Fi 5 GHz Ant2 (U-NII-1): +2.8 dBi

Maximum Declared Gain for CELLULAR:

MIDDLE Band	GAIN	ANTENNA TYPE
LTE Band 12 (707 MHz)	+2 dBi	Primary

HIGH Band	GAIN	ANTENNA TYPE
LTE Band 4 (1732 MHz)	+2.2 dBi	Internal.

TEST FREQUENCIES AND POWER SETTINGS:

Based on preliminary testing that identified the worst cases, in terms of the highest E.I.R.P.

CELLULAR LTE (Bands 4, 12)		
Band:	LTE 4	
Frequency Range:	1710 – 1755 MHz	
Bandwidth / Modulation / RB Size / RB Offset:	1.4 MHz / QPSK / RB Size 1 / RB Offset 0	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Middle: 20170	1732.5
Band:	LTE 12	
Frequency Range:	699 – 716 MHz	
Bandwidth / Modulation / RB Size / RB Offset:	1.4 MHz / QPSK / RB Size 1 / RB Offset 0	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Middle: 23090	707.5

WLAN (IEEE 802.11 a/n/ac/ax)		
Frequency Range:	5250 MHz – 5350 MHz / U-NII-1	
Mode:	802.11 he20 (MIMO WLAN12)	
Bandwidth:	20 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low: 48	5240

WLAN (IEEE 802.11 b/g/n/ax)		
Frequency Range:	2412 MHz – 2472 MHz	
Mode:	802.11 g (MIMO WLAN12)	
Bandwidth:	20 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Middle: 6	2437

ZigBee		
Mode:	OQPSK	
Bandwidth:	1 MHz	
Frequency Range:	2405 MHz – 2480 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low	2405

Z-Wave Long Range		
Modulation:	DSSS-OQPSK	
Bandwidth:	500 kHz	
Frequency Range:	910 MHz – 922 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	High	920

Z-Wave Classic		
Modulation:	FSK	
Bit rate:	250 kbps	
Frequency Range:	906 – 918 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Middle	915

The test set-up was made in accordance to the general provisions of FCC DTS Measurement 558074 D01 DTS Meas Guidance v05r02 dated April 2, 2019.

The EUT was tested in the following operating mode:

- Continuous transmission with a modulated carrier at maximum power in all required channels selecting the supported data rates/modulations types.

During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

Selected Transmission Modes for each Radio:

The following configurations were selected based on preliminary testing that identified those corresponding to the worst cases:

* CELLULAR LTE: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in LTE bands 4, 12 configuration as these channels were found to transmit higher EIRP than all the other LTE bands.

* WI-FI 5 GHz: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 he20 mode MIMO WLAN12 configuration as this mode was found to transmit higher EIRP than all the other 5 GHz WLAN modes.

* WI-FI 2.4 GHz: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 g mode MIMO WLAN12 configuration as this mode was found to transmit higher EIRP than all the other 2.4 GHz WLAN modes.

* BLUETOOTH (module (1)): Transmitter radiated spurious emissions tests were performed with the EUT transmitting in Bluetooth Low Energy (GFSK) mode configuration.

* BLUETOOTH (module (2)): Transmitter radiated spurious emissions tests were performed with the EUT transmitting in Bluetooth Low Energy (GFSK) mode configuration.

* ZIGBEE 2.4 GHz (module (2)): Transmitter radiated spurious emissions tests were performed with the EUT transmitting in ZigBee (OQPSK) mode configuration.

* Z-Wave Long Range: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 920 MHz (DSSS-OQPSK) mode configuration.

* Z-Wave Classic: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 915 MHz (FSK250) mode configuration.

SIMULTANEOUS TRANSMISSION MODES:

1. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz in 802.11 he20, Bluetooth Low Energy (module (1)) / GFSK, Z-Wave Long Range / DSSS-OQPSK.

2. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, WLAN 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz in 802.11 he20, WLAN 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

3. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz in 802.11 he20, Bluetooth Low Energy (module (2)) / GFSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

4. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, 802.15.4 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz in 802.11 he20, ZigBee 2.4 GHz / OQPSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

5. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, CELLULAR LTE Band 4, WI-FI 5 GHz in 802.11 he20, Bluetooth Low Energy (module (1)) / GFSK, Z-Wave Long Range / DSSS-OQPSK.

6. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, WI-FI 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 4, WI-FI 5 GHz in 802.11 he20, WI-FI 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

7. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 4, WI-FI 5 GHz in 802.11 he20, Bluetooth Low Energy (module (2)) / GFSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

8. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, 802.15.4 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 4, WI-FI 5 GHz in 802.11 he20, ZigBee 2.4 GHz / OQPSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

9. Co-Location mode WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE Co-Location, with the EUT configured to simultaneously transmit three signals at maximum output power, WI-FI 5 GHz in 802.11 he20, Bluetooth Low Energy (module (1)) / GFSK, Z-Wave Long Range / DSSS-OQPSK.

10. Co-Location mode WI-FI 5 GHz, WI-FI 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, WI-FI 5 GHz in 802.11 he20, WI-FI 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

11. Co-Location mode WI-FI 5 GHz, BLUETOOTH, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, WI-FI 5 GHz in 802.11 he20, Bluetooth Low Energy (module (2)) / GFSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

12. Co-Location mode WI-FI 5 GHz, 802.15.4 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, WI-FI 5 GHz in 802.11 he20, ZigBee 2.4 GHz / OQPSK, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

TESTED SIMULTANEOUS TRANSMISSION MODES (Worst cases):

1. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, WLAN 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 12, WLAN 5 GHz in 802.11 he20, WLAN 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

2. Co-Location mode CELLULAR LTE, WI-FI 5 GHz, WI-FI 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit five signals at maximum output power, CELLULAR LTE Band 4, WI-FI 5 GHz in 802.11 he20, WI-FI 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

3. Co-Location mode WI-FI 5 GHz, WI-FI 2.4 GHz, Z-WAVE LONG RANGE, Z-WAVE CLASSIC Co-Location, with the EUT configured to simultaneously transmit four signals at maximum output power, WI-FI 5 GHz in 802.11 he20, WI-FI 2.4 GHz in 802.11 g, Z-Wave Long Range / DSSS-OQPSK, Z-Wave Classic / FSK.

Transmitter out of band radiated emissions with simultaneous transmissions

SPECIFICATION:

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) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required.

1. LTE Band 4. FCC §2.1053 & §27.53 (h) / RSS-139 Issue 3 Clause 6.6.

FCC §27.53 (h):

> (h) 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 log10 (P) dB.

RSS-139 Clause 6.6:

> i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, 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 log10 p (watts) dB.
>
> ii. 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 log10 P (watts) dB.

LTE Band 4 MEASUREMENT LIMIT:

At Po transmitting power, the specified minimum attenuation becomes 43+10 log (Po), and the level in dBm relative Po becomes:

$$Po\ (dBm) - [43 + 10 \log (Po\ in\ mwatts) - 30] = -13\ dBm$$

METHOD:

The measurement was performed with the EUT inside an anechoic chamber.

The spectrum was scanned from 30 MHz to at least the 10th harmonic of the High frequency generated within the equipment.

The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz up to 18 GHz.
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

2. LTE Band 12. FCC §2.1053 & §27.53 (g) / RSS-130 Issue 2 Clause 4.7.

FCC §27.53 (g):

> (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.

RSS-130 Issue 2 Clause 4.7.:

> 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 log10 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.

METHOD:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m. The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and The EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Measurements were made in both horizontal and vertical planes of polarization.

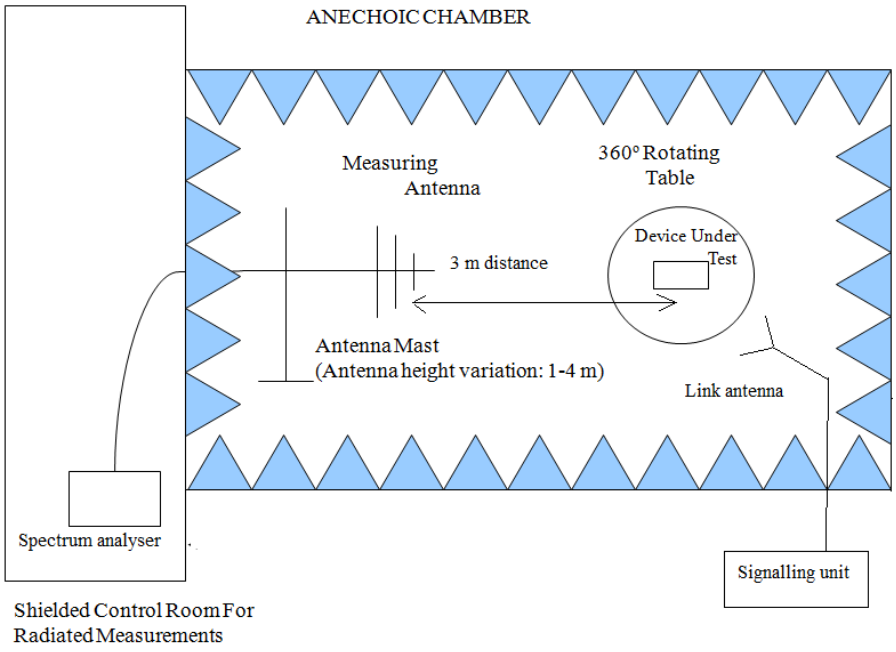
The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor, preamplifier gain (if used) and cable losses.

These measurements have been performed in order to check the impact of the Co-Location of all radio interfaces that can transmit simultaneously.

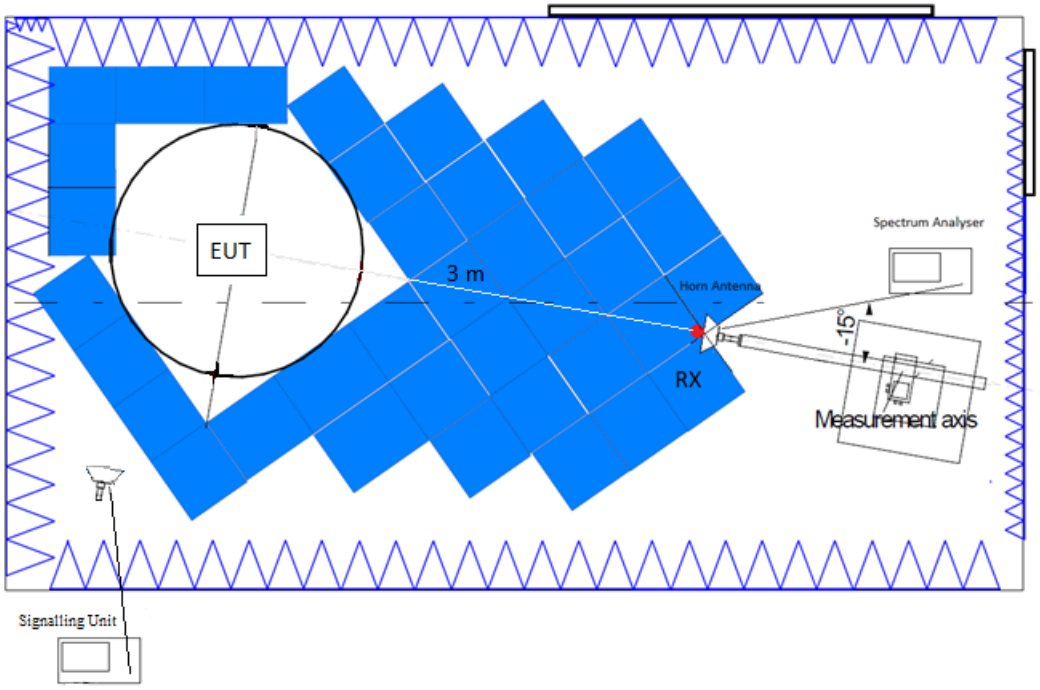
A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz or higher were used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

TEST SETUP:

Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz.



RESULTS:

- **1. Co-Location mode LTE Band 12, Wi-Fi 5 GHz, Wi-Fi 2.4 GHz, Z-Wave Long Range, Z-Wave Classic.**

LTE Band 12:	Middle Channel (707.5 MHz), QPSK, RB Size 1, RB Offset 0.
Wi-Fi 5 GHz:	U-NII-2A 802.11 he20 MIMO WLAN12, Low Channel (5280 MHz).
Wi-Fi 2.4 GHz:	802.11 g, Middle Channel (2437 MHz).
Z-Wave Long Range:	High Channel (920 MHz).
Z-Wave Classic:	Middle Channel (915 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 7.16 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
7.16 to 26 GHz	PK	74 dBµV/m
26 to 40 GHz	PK	68.23 dBµV/m (*) OR 74 dBµV/m (**)
7.16 to 40 GHz	AVG	54 dBµV/m (**)

(*) Radiated emissions which fall in the non-restricted bands.

(**) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

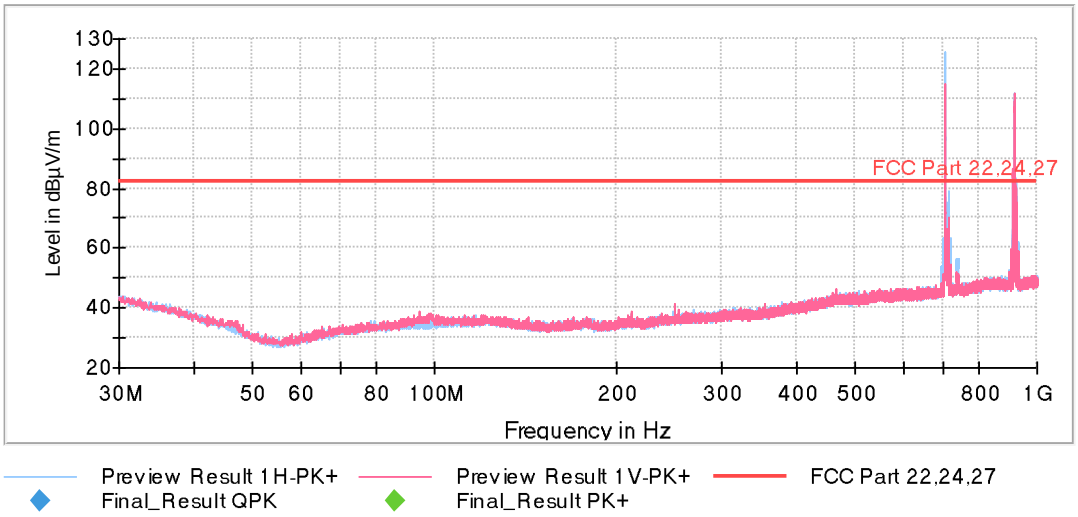
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
1126.50000	73.46	H	Peak
1518.16667	64.06	H	Peak
1729.33333	63.54	H	Peak
2109.16667	63.36	H	Peak
2744.33333	64.47	H	Peak
3353.46667	65.99	H	Peak
6403.72333	61.43	H	Peak
7318.50000	59.00	V	Peak
	53.34	V	Average
7684.50000	51.20	H	Peak
8238.50000	54.21	V	Peak
	46.36	V	Average
8444.50000	50.36	V	Peak
9147.00000	51.97	V	Peak
10063.50000	52.68	V	Peak
10978.00000	53.30	V	Peak
14622.00000	55.36	V	Peak
	43.17	V	Peak

Measurement uncertainty (dB)	<±3.81 for f < 1 GHz <±3.98 for f ≥ 1 GHz up to 7 GHz <±4.60 for f ≥ 7 GHz up to 17 GHz <±5.14 for f ≥ 17 GHz up to 40 GHz

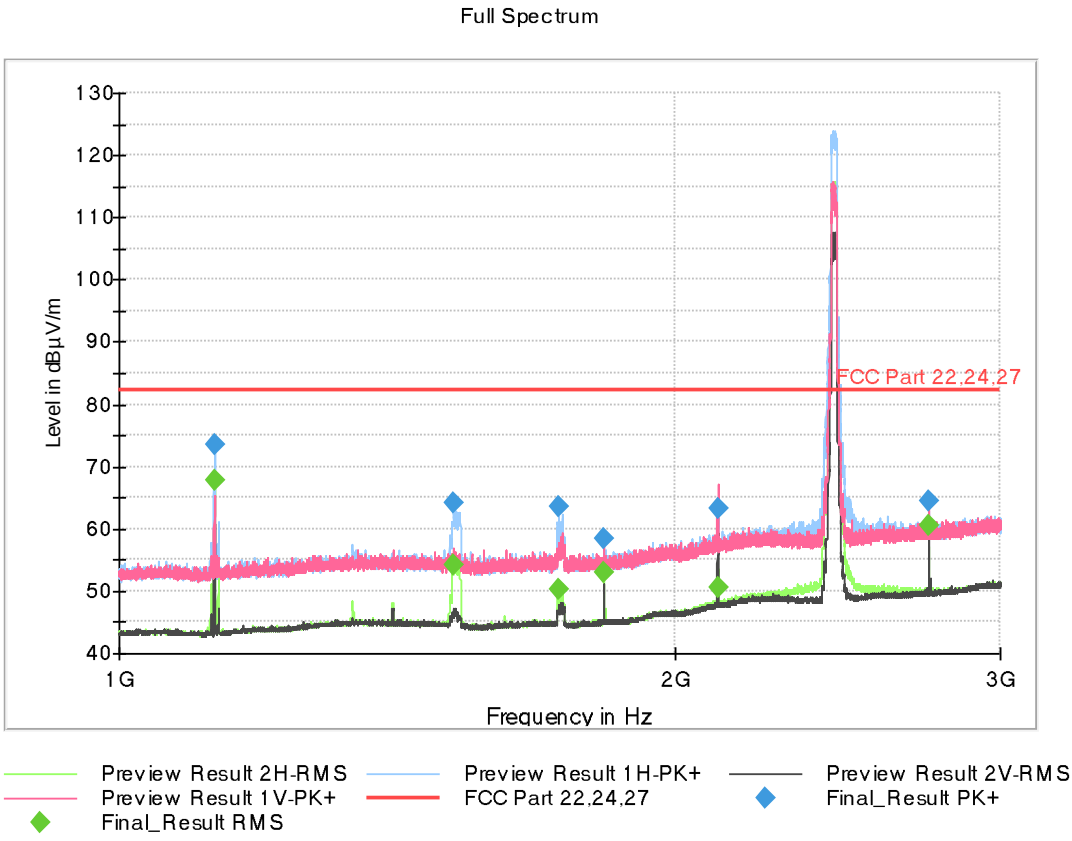
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



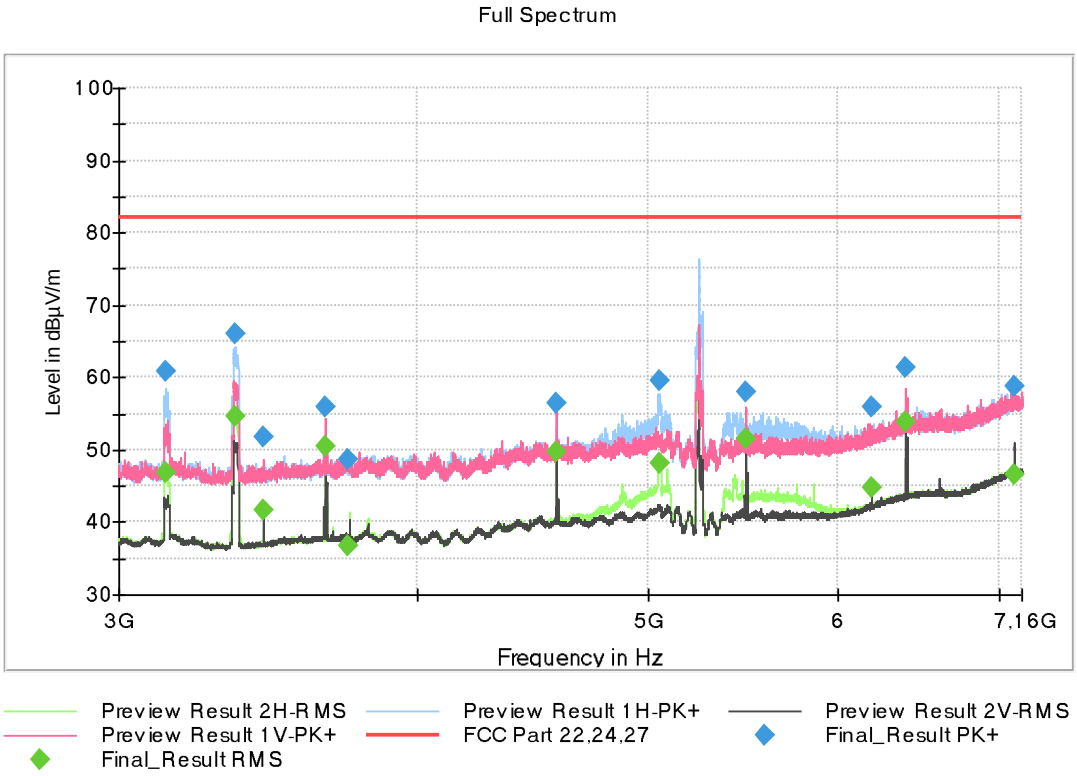
The peak on the left above the limit is the Carrier frequency LTE Band 12 (707.5 MHz).
The peaks on the right above the limit are the Carrier frequencies Z-Wave Classic (915 MHz) and Z-Wave Long Range (920 MHz).

FREQUENCY RANGE 1 – 3 GHz



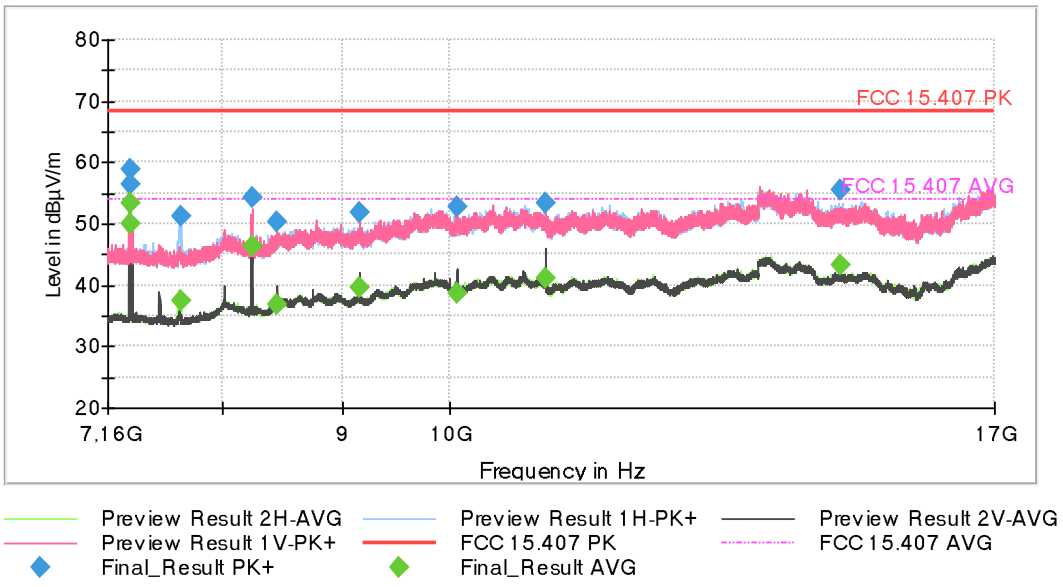
The peak above the limit is the Carrier frequency Wi-Fi 2.4 GHz (802.11 g, 2437 MHz).

FREQUENCY RANGE 3 – 7.16 GHz

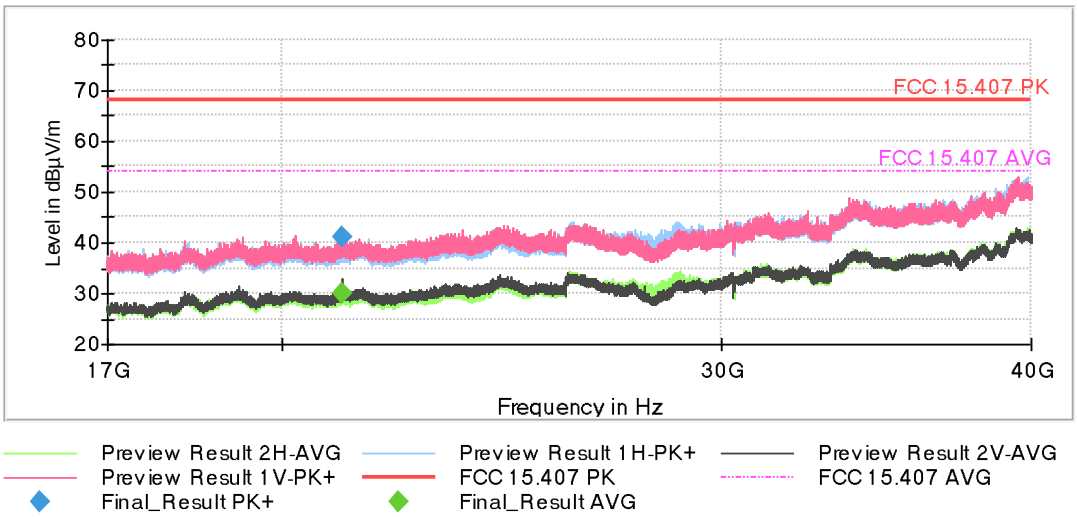


The highest peak is the Carrier frequency Wi-Fi 5 GHz 802.11 he20.

FREQUENCY RANGE 7.16 – 17 GHz



FREQUENCY RANGE 17 - 40 GHz



- **2. Co-Location mode LTE Band 4, Wi-Fi 5 GHz, Wi-Fi 2.4 GHz, Z-Wave Long Range, Z-Wave Classic.**

LTE Band 4:	Middle Channel (1732.5 MHz), QPSK, RB Size 1, RB Offset 0.
Wi-Fi 5 GHz:	U-NII-2A 802.11 he20 MIMO WLAN12, Low Channel (5280 MHz).
Wi-Fi 2.4 GHz:	802.11 g, Middle Channel (2437 MHz).
Z-Wave Long Range:	High Channel (920 MHz).
Z-Wave Classic:	Middle Channel 915 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 17.55 GHz	PK	43 + 10 log (P) dB = -13 dBm -> 82.23 dBµV/m
17.55 to 40 GHz	PK	68.23 dBµV/m (*) OR 74 dBµV/m (**)
17.55 to 40 GHz	AVG	54 dBµV/m (**)

(*) Radiated emissions which fall in the non-restricted bands.

(**) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 40 GHz

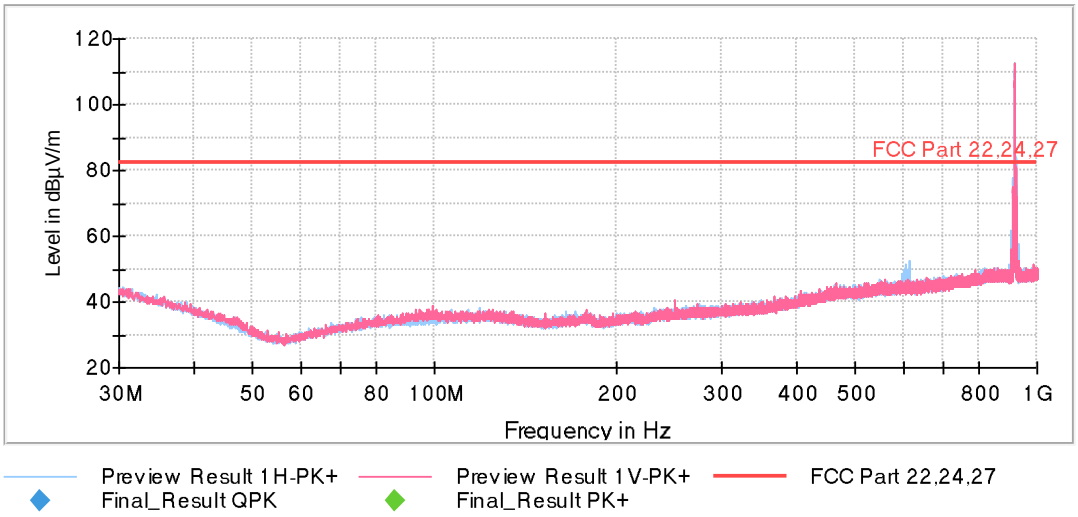
Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
1524.666667	64.37	H	Peak
2745.166667	64.84	V	Peak
3139.666667	63.06	H	Peak
3352.666667	66.47	H	Peak

Measurement uncertainty (dB)	<±3.81 for f < 1 GHz <±3.98 for f ≥ 1 GHz up to 7 GHz <±4.60 for f ≥ 7 GHz up to 17 GHz <±5.14 for f ≥ 17 GHz up to 40 GHz

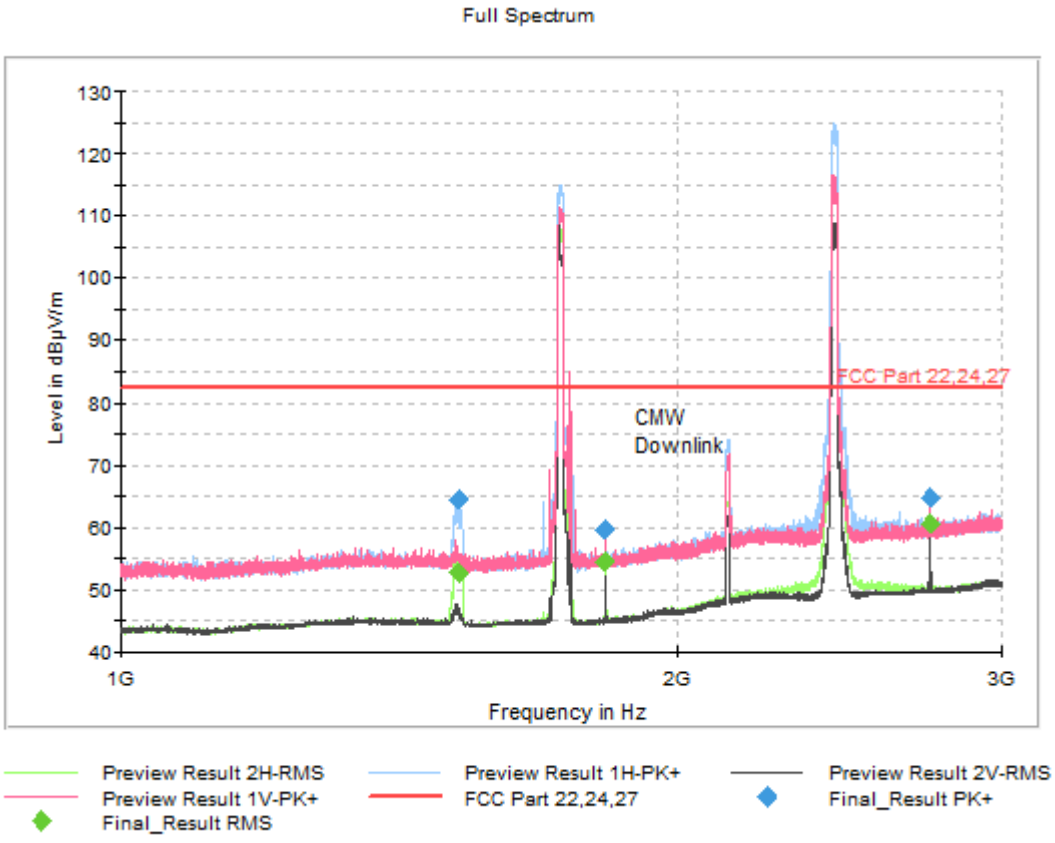
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



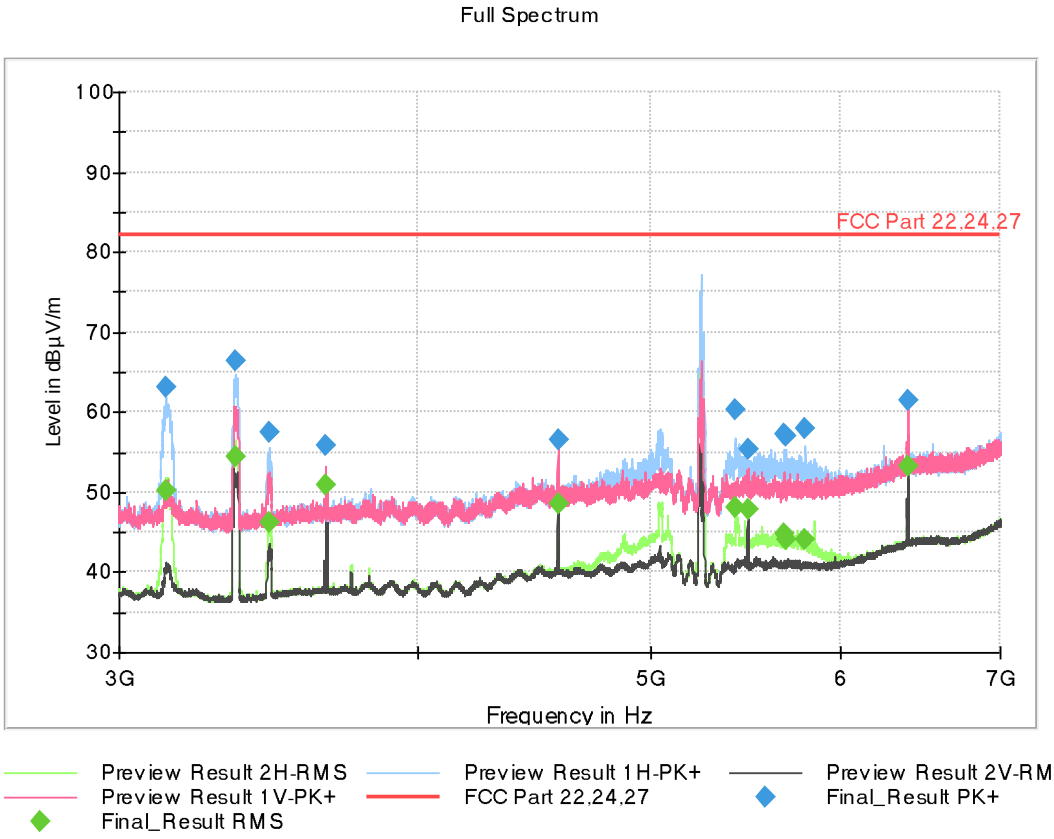
The peaks on the right above the limit are the Carrier frequencies Z-Wave Classic (915 MHz) and Z-Wave Long Range (920 MHz).

FREQUENCY RANGE 1 – 3 GHz



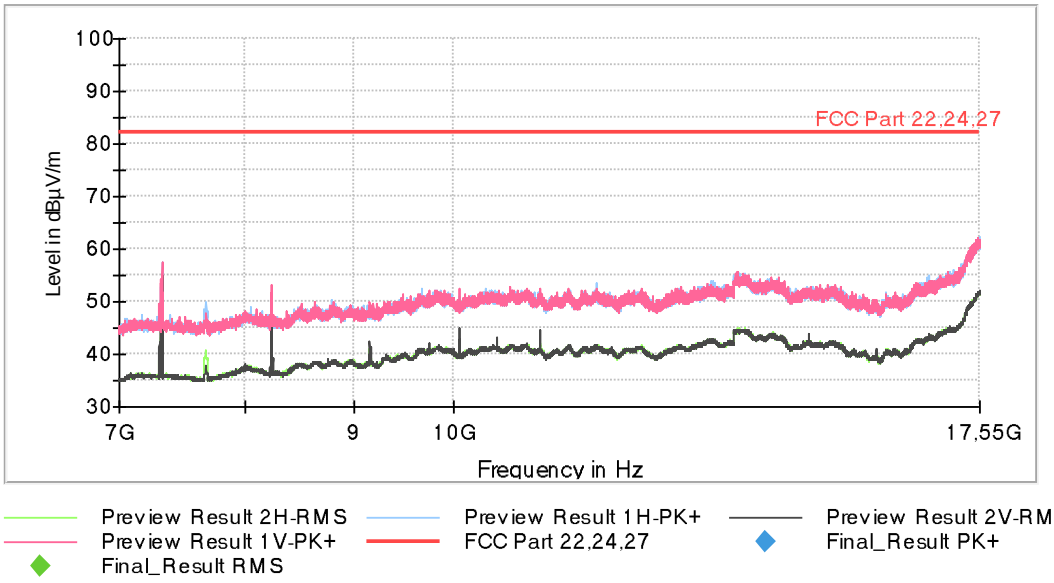
The peak above the limit on the left is the Carrier frequency LTE Band 4 (1732.5 MHz)
The peak above the limit is the Carrier frequency Wi-Fi 2.4 GHz (802.11 g, 2437 MHz).

FREQUENCY RANGE 3 – 7 GHz

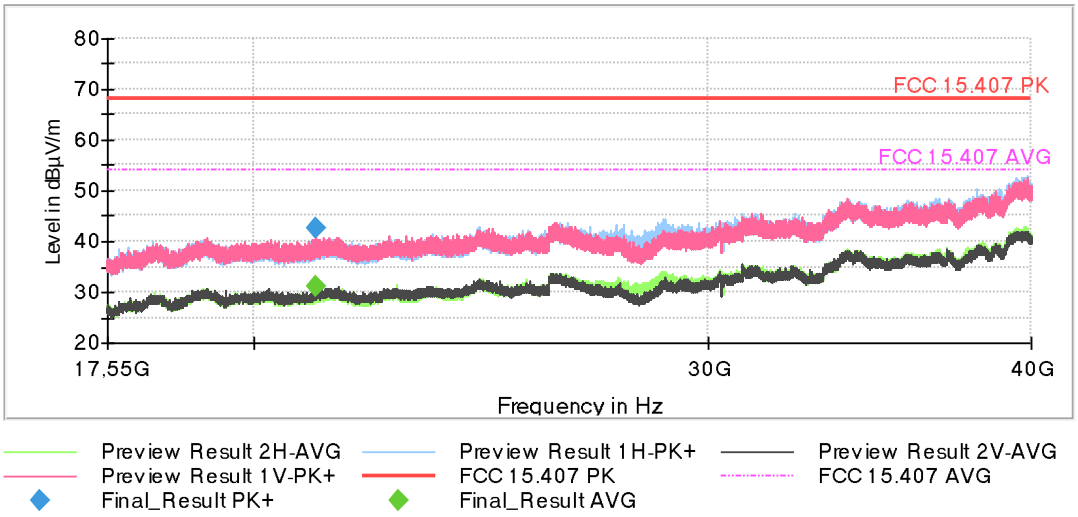


The highest peak is the Carrier frequency Wi-Fi 5 GHz 802.11 he20 (5280 MHz).

FREQUENCY RANGE 7 – 17.55 GHz



FREQUENCY RANGE 17.55 - 40 GHz



- **3. Co-Location mode Wi-Fi 5 GHz, Wi-Fi 2.4 GHz, Z-Wave Long Range, Z-Wave Classic.**

Wi-Fi 5 GHz:	U-NII-2A 802.11 he20 MIMO WLAN12, Low Channel (5280 MHz).
Wi-Fi 2.4 GHz:	802.11 g, Middle Channel (2437 MHz).
Z-Wave Long Range:	High Channel (920 MHz).
Z-Wave Classic:	Middle Channel 915 MHz).

LIMIT: The spurious frequencies were measured at 3 meter. The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 88 MHz	Quasi-peak	40 dBµV/m
88 MHz to 216 MHz	Quasi-peak	43.5 dBµV/m
216 MHz to 960 MHz	Quasi-peak	46 dBµV/m
960 MHz to 1 GHz	Quasi-peak	54 dBµV/m
1 GHz to 26 GHz	Peak	74 dBµV/m
26 to 40 GHz	Peak	68.23 dBµV/m (*) OR 74 dBµV/m (**)
1 to 40 GHz	Average	54 dBµV/m (**)

(*) Radiated emissions which fall in the non-restricted bands.

(**) Radiated emissions which fall in the restricted bands, as defined in §15.205(a).

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
96.542000	23.50	V	Peak
249.996000	35.58	V	Peak
601.475500	34.26	H	Peak
772.098500	33.18	H	Peak
818.949500	42.63	H	Peak
856.440000	26.37	H	Peak
866.964500	34.74	H	Peak

Frequency range 1 - 40 GHz
Spurious frequencies at less than 20 dB below the limit:

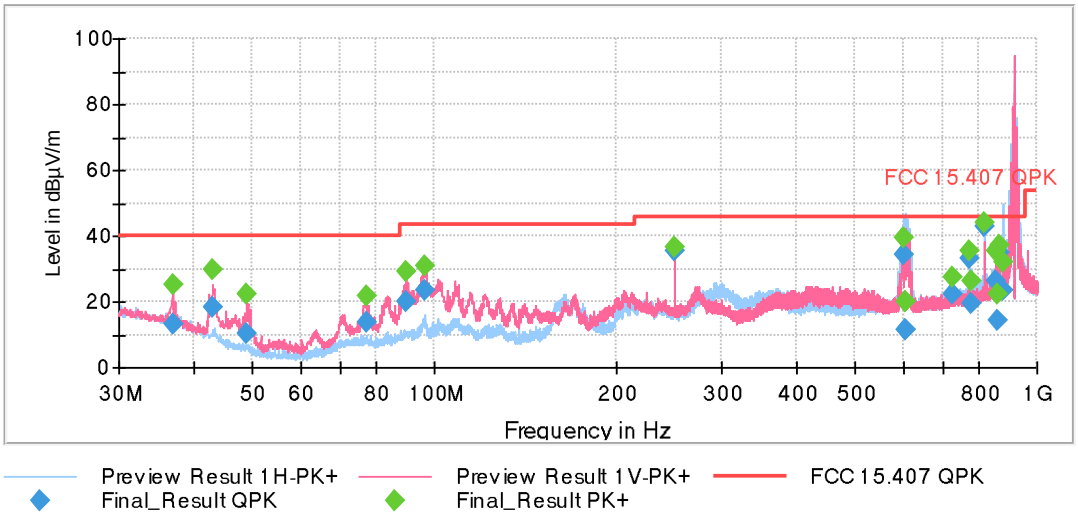
Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
1516.83333	64.86	H	Peak
	52.83		Average
1830.00000	58.28	H	Peak
	53.61		Average
2744.83333	62.79	H	Peak
	40.17		Average
3352.33333	67.28	V	Peak
	53.59		Average
3660.00000	57.67	V	Peak
	52.54		Average

3750.00000	51.22	H	Peak
3812.33333	50.75	H	Peak
4574.66666	57.02	V	Peak
	49.24		Average
4873.00000	55.93	H	Peak
	42.32		Average
5052.66667	60.03	H	Peak
	47.14		Average
5489.66667	58.13	H	Peak
	49.95		Average
5592.33333	56.80	H	Peak
	42.82		Average
5643.33333	56.95	H	Peak
	43.39		Average
6405.33333	62.38	V	Peak
7318.00000	60.59	V	Peak
	53.55		Average
7676.50000	52.63	H	Peak
8238.00000	54.96	V	Peak
	45.88		Average
9147.50000	51.31	V	Peak
10062.00000	52.53	V	Peak
10976.50000	54	V	Peak
	41.28		Average
13593.00000	55.93	V	Peak
	42.47		Average
14622.00000	55.19	V	Peak
	44.65		Average

Measurement Uncertainty (dB)	<±3.81 for f < 1 GHz <±3.98 for f ≥ 1 GHz up to 7 GHz <±4.60 for f ≥ 7 GHz up to 17 GHz <±5.14 for f ≥ 17 GHz up to 40 GHz

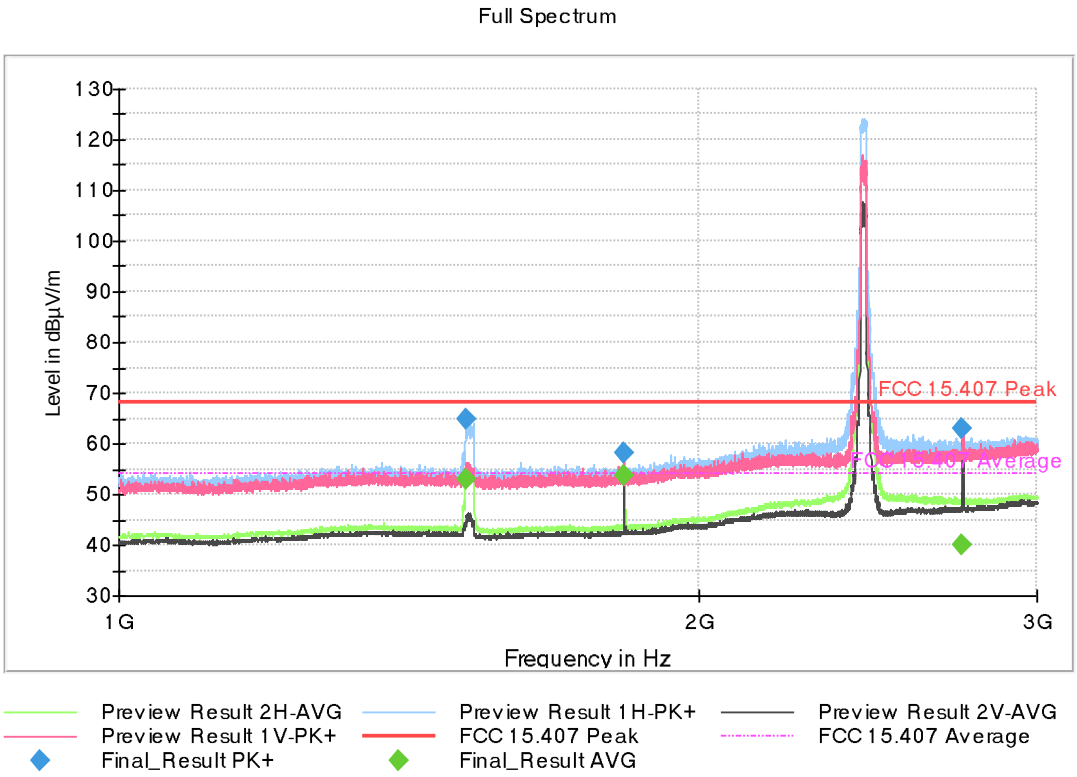
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz



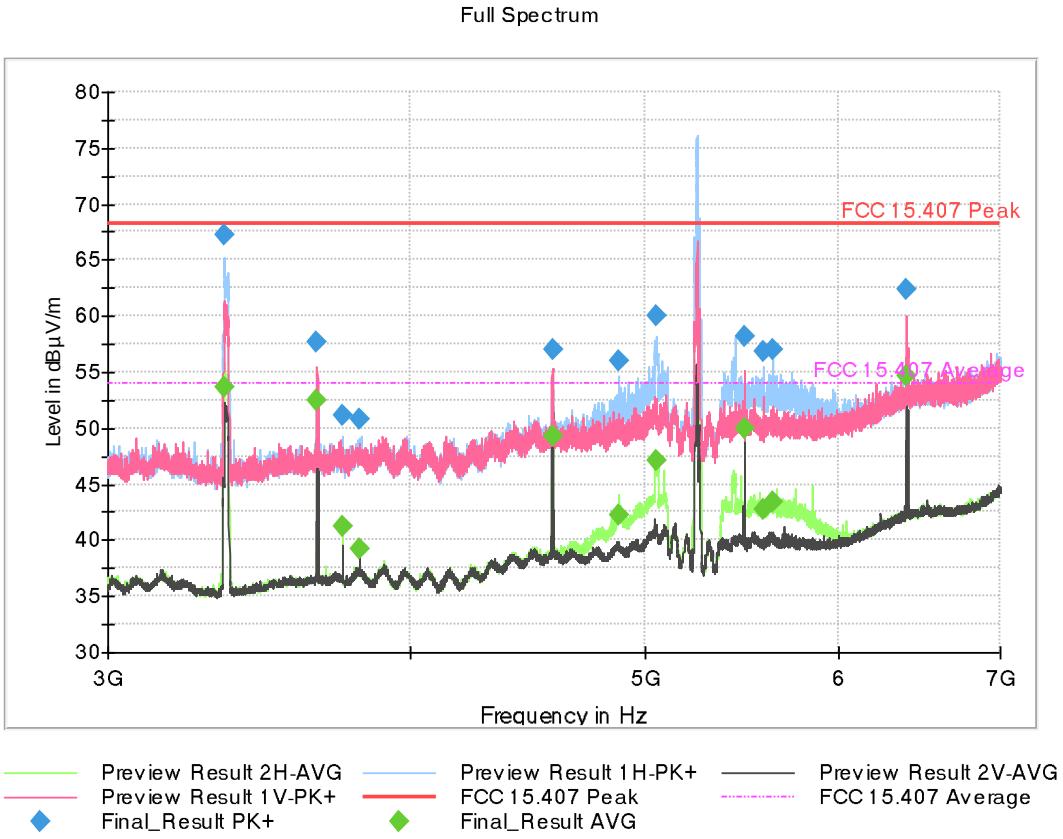
The peak above the limit on the right is the Carrier frequency Z-Wave Classic (915 MHz) and Z-Wave Long Range (920 MHz).

FREQUENCY RANGE 1 – 3 GHz



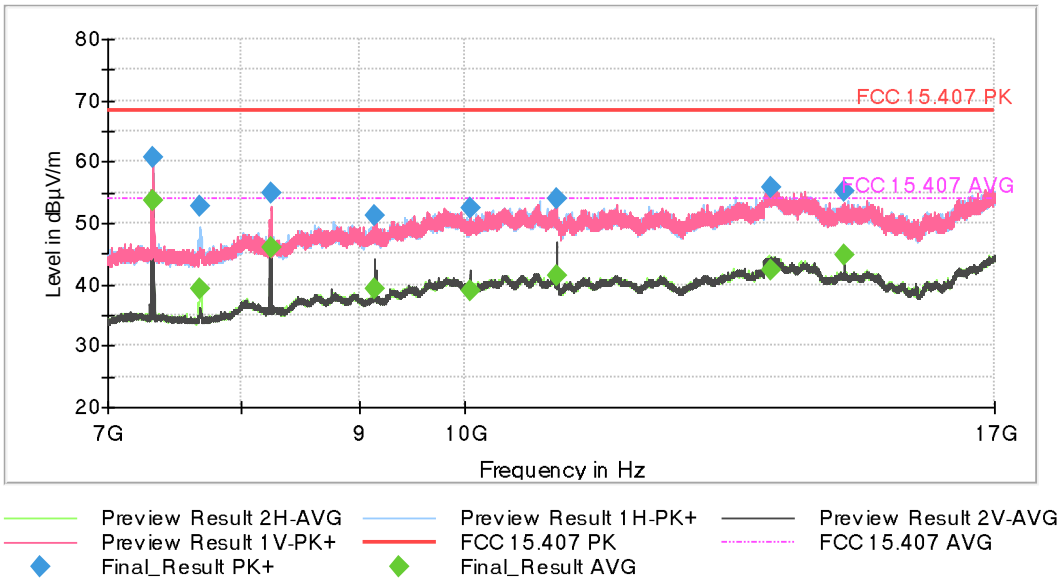
The peak above the limit is the Carrier frequency Wi-Fi 2.4 GHz (802.11 g, Low Channel 2437 MHz).

FREQUENCY RANGE 3 – 7 GHz



The highest peak is the Carrier frequency Wi-Fi 5 GHz (802.11 he20, 5280 MHz).

FREQUENCY RANGE 7 – 17 GHz



FREQUENCY RANGE 17 - 40 GHz