

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
83304RRF004A1

Partial Test Report

USA FCC 15.31(h), 22, 24, 27, 15.209, 15.247, 15.407
CANADA RSS-132, RSS-133, RSS-199, RSS-247,
RSS-Gen

(*) Identification of item tested	Telematic control unit with wireless technologies, used in automotive industry.
(*) Trademark	VW AG
(*) Model and /or type reference	TKCMOD12N00W
Derived model not tested	TKCMOD11000W
Other identification of the product	FCC ID: T8GCONMODMQB IC: 6434A-CONMODMQB
(*) Features	GSM, UMTS, LTE, 5G, Bluetooth EDR, BT Low-Energy, Wi-Fi, GNSS receiver HW version: X07 SW version: Q113
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16, 76307, KARLSBAD, GERMANY
Test method requested, standard	USA FCC Part 15.31(h) (10-1-23 Edition): Measurement standard. USA FCC Part 22 (10-1-23 Edition): Public Mobile Services. USA FCC Part 24 (10-1-23 Edition): Personal Communications Services. USA FCC Part 27 (10-1-23 Edition): Miscellaneous Wireless Communications Services. USA FCC Part 15.209 (10-1-23 Edition): Radiated emission limits; general requirements. USA FCC Part 15.247 (10-1-23 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.407 (10-1-23 Edition): Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. Band U-NII-3 (5725 MHz – 5850 MHz). CANADA RSS-132 Issue 4, Jan. 2023. CANADA RSS-133 Issue 6, Amendment 1, Jan. 2018. CANADA RSS-199 Issue 4, Jul. 2023. CANADA RSS-247 Issue 3, Aug. 2023. CANADA RSS-Gen Issue 5, Amendment 2, Feb. 2021.

	<div>- Emission limitations radiated with simultaneous transmissions.</div> <div>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.</div> <div>Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec. 14, 2017.</div> <div>Measurement Guidance for Certification of Licensed Digital Transmitters. 971168 D01 Power Meas License Digital Systems v03r01 dated April 9, 2018.</div> <div>ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.</div> <div>ANSI C63.26-2015 IEEE/ANSI Standard for Testing of Transmitters Used in Licensed Radio Services.</div>
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager
Date of issue	2025-06-24
Report template No.	FDT08_25 (*) "Data provided by the client"

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Competences and guarantees

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

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, 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 has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification 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 at the time of performance of the test.

DEKRA Testing and Certification 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.

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1. This report is only referred to the item that has undergone the test.
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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.

The total uncertainty of the measurement system for the radiated emissions of the EUT from 30 MHz to 1 GHz is: Measurement uncertainty $\leq \pm 5.35$ dB (with factor $k=2$).

The total uncertainty of the measurement system for the radiated emissions of the EUT from 1 to 17 GHz is: Measurement uncertainty $\leq \pm 4.32$ dB (with factor $k=2$).

The total uncertainty of the measurement system for the radiated emissions of the EUT from 17 to 40 GHz is: Measurement uncertainty $\leq \pm 5.51$ dB (with factor $k=2$).

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 consists of a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, 5G, GNSS, Wifi (a, b, g, n, ac,ax) and Bluetooth EDR.

Antennas: the device supports several antennas for the following transmission technologies:

- LTE 1: model 3WA.035. 507.N and 3WA.035. 507.G, sub-antenna Tel 5G 1
- LTE 2: model 3WA.035. 507.N and 3WA.035. 507.G, sub-antenna Tel 5G 2
- LTE 3: model 4M0.035. 507.A
- Internal antenna
- BT_WLAN_1: model 83H.035.225.F, used for 802.11 2.4 GHz
- BT_WLAN_2: model 4N0.035.500, used for 802.11 2.4 GHz and 5GHz and Bluetooth
- BT_WLAN_3: model 3WA.035. 507.N and 83H.035.225.F used for 802.11 2.4 GHz and 5GHz
- BTLE_1: model 3WA.035. 507.N and 3WA.035. 507.G, used for BTLE

3. Derived model not tested. These models have been declared by the supplier of the sample as being the same as the model under test.

HARMAN Becker Automotive Systems GmbH

Becker-Goering-Str. 16
76307 Karlsbad, Germany



Date: January 28th, 2025

To whom it may concern,

We,

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
Becker-Goering-Str. 16; 76307 Karlsbad, Germany,

Hereby declare that the products listed below:

Type of equipment: Telematic control unit with wireless technologies used in automotive industry.

Brand name: VW AG

Model names: TKCMOD12N00W and TKCMOD11000W

are part of the same family and all the models are equal. The model TKCMOD12N00W is the most populated variant, and it is the one that has been tested. The model TKCMOD11000W is the same as TKCMOD12N00W but it has a different name because has the cellular module disabled (although is installed in the device).

The rest of interfaces (BT, WiFi, GNSS) are equal in all the variants.

In the table below you can find the different names based on the specific country target:

Country	Product Name	AUDI Part number	Variant	GNSS	Bluetooth WLAN	NAD (Activated)	WLAN P
NAR (online variant)	TKCMOD12N00W	57N.035.741	V160	x	x	x	-
Rest of the world (offline variant)	TKCMOD11000W	571.035.741	V333	x	x	-	-

As mentioned above, TKCMOD12N00W is the variant that has been tested and results are applicable to the rest of the variants.

Sincerely,

i.v. 

By: Iulian-George Stoica
Title: Customer Lead Certification
E-mail: iulian.stoica@harman.com
Telephone: +40799 306 699

Company: Harman Becker Automotive Systems GmbH

I. V. 

By: Alin Banica
Title: Regulatory Product Compliance Expert
E-mail: AlinLucian.Banica@harman.com

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. The laboratory is not responsible for such information and it is not covered by accreditation.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial N°	Date of Reception	Application
S/01	77617B_276.1	Telematic control unit	TKCMOD12N00W	354205700032680	2024-10-16	Element Under Test
	77617B_121.1	Module Circuit Board	--	--	2024-04-05	Auxiliary Element
	77617B_144.1	Harness	CONMOD MEB/MQBW	--	2024-04-05	Auxiliary Element
	77617B_151.1	Yellow Box	--	--	2024-04-05	Auxiliary Element
	77617B_163.1	Shark Antenna	3WA.035.507.N	--	2024-04-05	Auxiliary Element
	77617B_375.1	Antenna BTWLAN1	83H.035.225.F	--	2024-04-05	Auxiliary Element
	77617B_376.1	Antenna BTWLAN2	4N0.035.500	--	2024-04-05	Auxiliary Element
	77617B_377.1	Antenna LTE3	4M0.035.507.A	--	2024-04-05	Auxiliary Element

Notes referenced to samples during the project:

Id	Type
S/01	Samples used for radiated tests.

Test sample description

Ports..... :	Port name and description	Cable											
		Specified max length [m]	Attached during test	Shielded									
	RF connector – code	--	[]	[X]									
	RF connector – code	--	[X]	[X]									
	RF connector – code	--	[X]	[]									
	--	--	[]	[]									
Supplementary information to the ports..... :	--												
Rated power supply	Voltage and Frequency		Reference poles										
			L1	L2	L3	N	PE						
	[]	AC:	[]	[]	[]	[]	[]						
	[X]	DC: 12V car battery (4.8 VDC inside of TCU)											
Rated Power	12V DC												
Clock frequencies..... :	--												
Other parameters	See Technical description												
Software version	Q113												
Hardware version	X07												
Dimensions in cm (W x H x D)	--												
Mounting position	[]	Table top equipment											
	[]	Wall/Ceiling mounted equipment											
	[]	Floor standing equipment											
	[]	Hand-held equipment											
	[X]	Other: automotive telematics control unit											
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								
	--		--		--								

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GOERING-STR. 16, 76307 KARLSBAD, GERMANY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2025-01-24
Date (finish)	2025-01-30

Document history

Report number	Date	Description
83304RRF004	2025-06-06	First release.
83304RRF004A1	2025-06-24	Second release. Modification due to typos. This test report replaces and cancels to 83304RRF004

Environmental conditions

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

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

In the semi-anechoic chamber, the following limits were not exceeded during the test.

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

Remarks and comments

The tests have been performed by the technical personnel: Victoria Olmedo and Daniel Mejías

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
08130	SEMIANECHOIC ABSORBER LINED CHAMBER	P29419	ALBATROSS	N/A
08134	SHIELDED ROOM	P29419	ALBATROSS PROJECTS GMBH	N/A
07549	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
07550	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
10304	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-02-19
09968	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2026-09-22
07763	HORN ANTENNA 1-18GHz	BBHA 9120D	SCHWARZBECK MESS-ELEKTRONIK	2026-01-16
07769	PREAMPLIFIER 30dB 500MHz-18GHz	BBV 9718 C	SCHWARZBECK	2025-03-13
06495	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2027-07-11
07862	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-3G	BONN ELEKTRONIK	2025-04-02
04848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A
07702	DC POWER SUPPLY 30V/3A 90W	GPS-3030D	GW INSTEK	N/A
07755	DIGITAL MULTIMETER	175	FLUKE	2025-11-25

Testing verdicts

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

Summary

FCC 15, 22, 24, 27 / CANADA RSS-132, RSS-133, RSS-199, RSS-247, RSS-Gen PARAGRAPH		
Requirement – Test case	Verdict	Remark
FCC 15.31 (h), 15.209 (a), 15.247 (d), 15.407 (b), 22.917 (a), 24.238 (a), 27.53 (m) (4) / RSS-132 5.5, RSS-133 6.5, RSS-199 5.6, RSS- 247 5.5, 6.2.1.2 and 6.2.2.2, RSS-Gen 8.9 Emission limitations radiated (Transmitter)	P	(1)
<u>Supplementary information and remarks:</u> (1) Only simultaneous transmission radiated spurious emission test was requested.		

Appendix A: Test results

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TEST CONDITIONS14

FCC 15.31 (h), 15.209 (a), 15.247 (d), 15.407 (b), 22.917 (a), 24.238 (a), 27.53 (m) (4) RSS-132 5.5,
RSS-133 6.5, RSS-199 5.6, RSS-247 5.5, 6.2.1.2 and 6.2.2.2, RSS-Gen 6.13 Emission limitations
radiated (Transmitter)17

TEST CONDITIONS

(*): Data provided by the Applicant.

POWER SUPPLY (*):

Vnominal: 12 Vdc
Type of Power Supply: External power supply (Vehicle Battery)

ANTENNA (*):

Technologies	Antenna Gain	Type of Antenna
BT EDR (Module)	+0.11 dBi	External
BT LE (Chipset)	+4.70 dBi	External
WLAN 2.4 GHz (Port 3)	+7.45 dBi	External
WLAN 2.4 GHz (Port 1)	+2.70 dBi	External
WLAN 5 GHz (Port 2)	+2.38 dBi	External
WLAN 5 GHz (Port 3)	+7.70 dBi	External
Celullar 2G/3G/LTE	+7.60 dBi	External
Celullar 5G	+7.61 dBi	External

TEST FREQUENCIES (worst-cases):

Frequency range	Technologies	Modulations	Worst case
$f < 1 \text{ GHz}$	2G 850	GPRS	Channel Mid: 190 (836.5 MHz)
$1 \text{ GHz} < f < 2 \text{ GHz}$	2G 1900	GPRS	Channel Mid: 661 (1880 MHz)
$2 \text{ GHz} < f < 5 \text{ GHz}$	LTE Band 7	LTE (QPSK, 16QAM)	QPSK, Channel Mid: RB 1 Offset 0 (2535 MHz)
	Bluetooth EDR	Bluetooth EDR (GFSK, Pi/4-DQPSK, 8DPSK)	Bluetooth EDR Module (High Channel, GFSK)
	Bluetooth LE	Bluetooth LE (1M/2M, GFSK)	Bluetooth LE 1M Chipset (Mid Channel, GFSK, 1Mbit/s)
	WLAN 2.4 GHz	WLAN 2.4 GHz (802.11 bgn20)	WLAN 2.4 GHz MIMO (High Channel, 802.11 n20)
$f > 5 \text{ GHz}$	Wi-Fi 5 GHz	WLAN 5 GHz (a, ac, n, ax)	U-NII-1 MIMO AX20 RU26 / Offset Middle

The test set-up was made according to the general provisions of FCC 558074 D01 15.247 Meas Guidance v05r02 dated April 2, 2019.

The EUT was tested in the following operating mode during the transmitter tests:

For cellular technologies, the EUT was controlled by a communication tester to transmit at maximum power on the test channels and modes as required.

WLAN 2.4 GHz and WLAN 5 GHz technologies cannot transmit simultaneously.
Preliminary measurements have been carried out and WLAN 5 GHz technology is the worst case.

TEST FREQUENCIES FOR SIMULTANEOUS TRANSMISSION MODE RADIATED TESTS:

The EUT was configured to simultaneously transmit the following signals at maximum output power:

- **Operation Mode 1: Simultaneous transmission mode 2G 850, BT EDR, BT LE, WLAN 5 GHz U-NII-1:**

BT EDR:	High Channel (2480 MHz). GFSK. (Module)
BT LE:	Middle Channel (2440MHz). 1M. (Chipset)
WLAN 5 GHz U-NII-1:	Middle Channel (5220 MHz). MIMO 2x2 802.11 AX20. BW: 20 MHz.
2G 850:	Middle Channel (836.5 MHz). GPRS.

- **Operation Mode 2: Simultaneous transmission mode 2G 1900, BT EDR, BT LE, WLAN 5 GHz U-NII-1:**

BT EDR:	High Channel (2480 MHz). GFSK. (Module)
BT LE:	Middle Channel (2440MHz). 1M. (Chipset)
WLAN 5 GHz U-NII-1:	Middle Channel (5220 MHz). MIMO 2x2 802.11 AX20. BW: 20 MHz.
2G 1900:	Middle Channel (1880 MHz). GPRS.

- **Operation Mode 3: Simultaneous transmission mode LTE Band 7, BT EDR, BT LE, WLAN 5 GHz U-NII-1:**

BT EDR:	High Channel (2480 MHz). GFSK. (Module)
BT LE:	Middle Channel (2440MHz). 1M. (Chipset)
WLAN 5 GHz U-NII-1:	Middle Channel (5220 MHz). MIMO 2x2 802.11 AX20. BW: 20 MHz.
LTE Band 7:	Middle Channel (2535MHz). QPSK, RB 1 Offset 0.

FCC 15.31 (h), 15.209 (a), 15.247 (d), 15.407 (b), 22.917 (a), 24.238 (a), 27.53 (m) (4)
RSS-132 5.5, RSS-133 6.5, RSS-199 5.6, RSS-247 5.5, 6.2.1.2 and 6.2.2.2, RSS-Gen
6.13 Emission limitations radiated (Transmitter)

Limits:

BT EDR, BT LE, WLAN 5 GHz:

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 specified when measuring with peak detector function corresponding to 20 dB above the indicated values in the table above.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz (68.23 dBµV/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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

WLAN 5 GHz has been selected as the worst case of the different supported WLAN in terms of measured power.

2G 850. FCC §2.1053 & §22.917 (a) / RSS-132 5.5:

FCC §22.917 (a):

(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.

RSS-132 5.5:

Equipment shall meet the unwanted emission limits specified below:

- In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied 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 immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz 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 occupied bandwidth, power integration over 100 kHz is required.

p is the output power specified in watts.

Measurement Limit:

According to the specification the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in Watts.

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

$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mWatts}) - 30] = - 13 \text{ dBm}$$

2G 1900. FCC §2.1053 & §24.238 (a) / RSS-133 6.5:

FCC §24.238 (a):

(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.

RSS-133 6.5:

6.5.1 Out-of-Block Emissions:

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

i. 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).

ii. 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.

LTE Band 7. FCC §2.1053 & §27.53 (m) (4) / RSS-199 Clause 4.5.

FCC §27.53 (m) (4):

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

RSS-199 Clause 4.5:

4.5. In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

(b) for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

$40 + 10 \log_{10} p$ from the channel edges to 5 MHz away

$43 + 10 \log_{10} p$ between 5 MHz and X MHz from the channel edges, and

$55 + 10 \log_{10} p$ at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than $43 + 10 \log_{10} p$ on all frequencies between 2490.5 MHz and 2496 MHz, and $55 + 10 \log_{10} p$ at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

Method:

The measurement was performed with the EUT inside a semi-anechoic chamber.

The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency of the co-located radios up to 40 GHz.

The EUT was placed on a non-conductive stand at a 3-meter distance from the measuring antenna for measurements up to 17 GHz and at 1.5-meter distance for measurements above 17 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. Measurements were made in both horizontal and vertical planes of polarization.

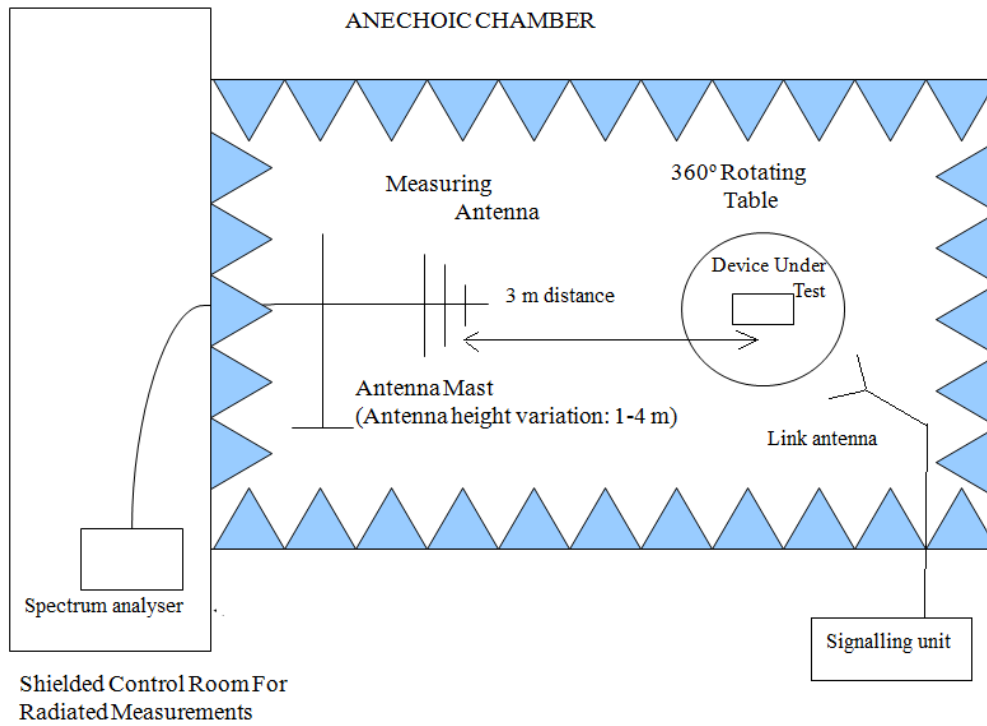
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

For radiated measurements above 17 GHz performed at a distance closer than the distance specified in standard, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

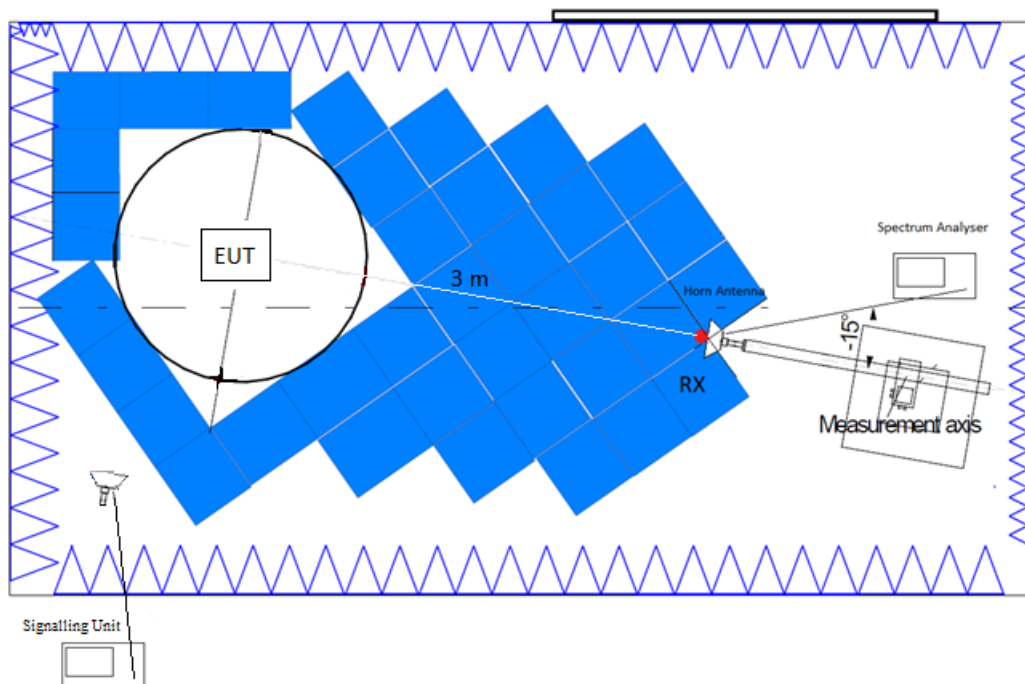
These measurements have been performed in order to check the impact of the Co-Location of all radio interfaces (that can transmit simultaneously).

Test setup:

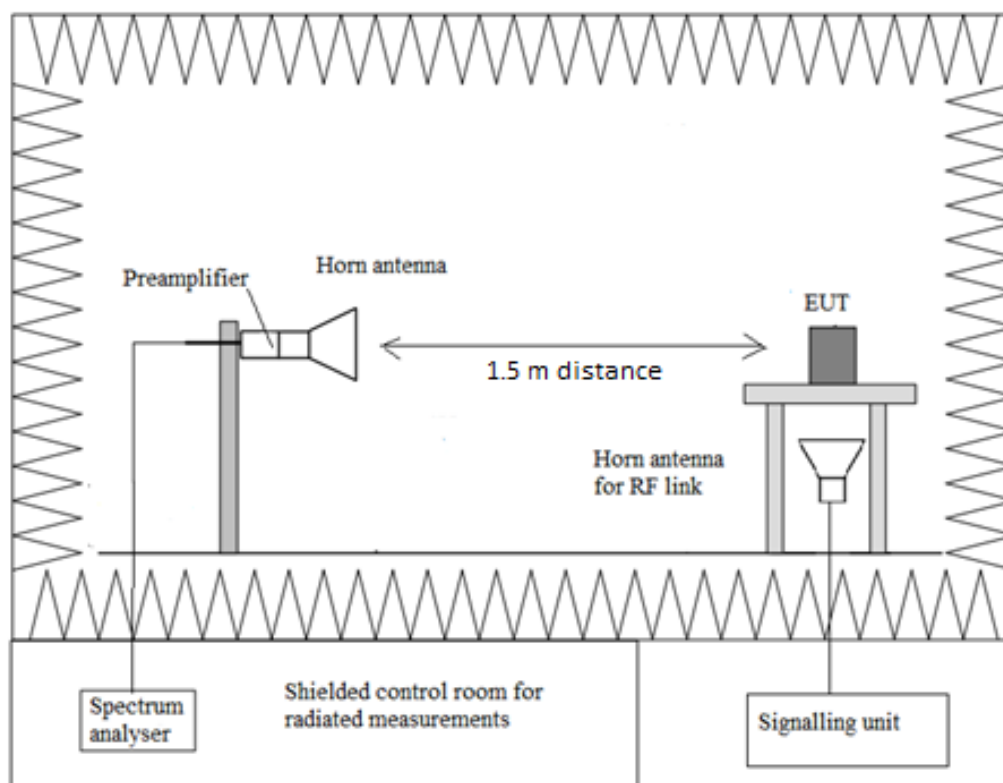
Radiated measurements below 1 GHz.



Radiated measurements between 1 GHz and 17 GHz.



Radiated measurements above 17 GHz.



Results:

- **Operation Mode 1**

Start frequency: no radiofrequency signal generated in the device found below 10th sub-harmonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th harmonic.

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 40 GHz

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

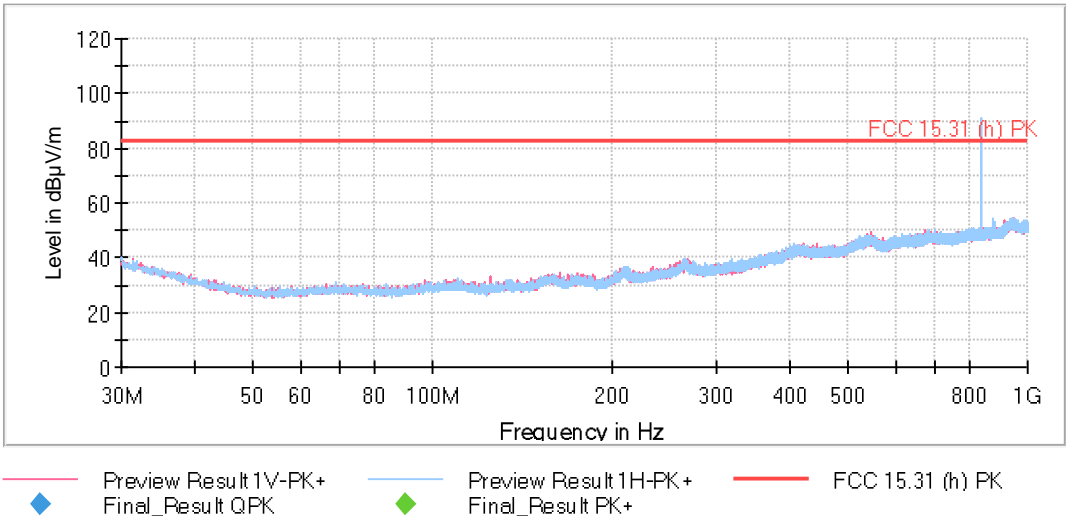
Verdict

Pass

Spectrum analyser parameters:

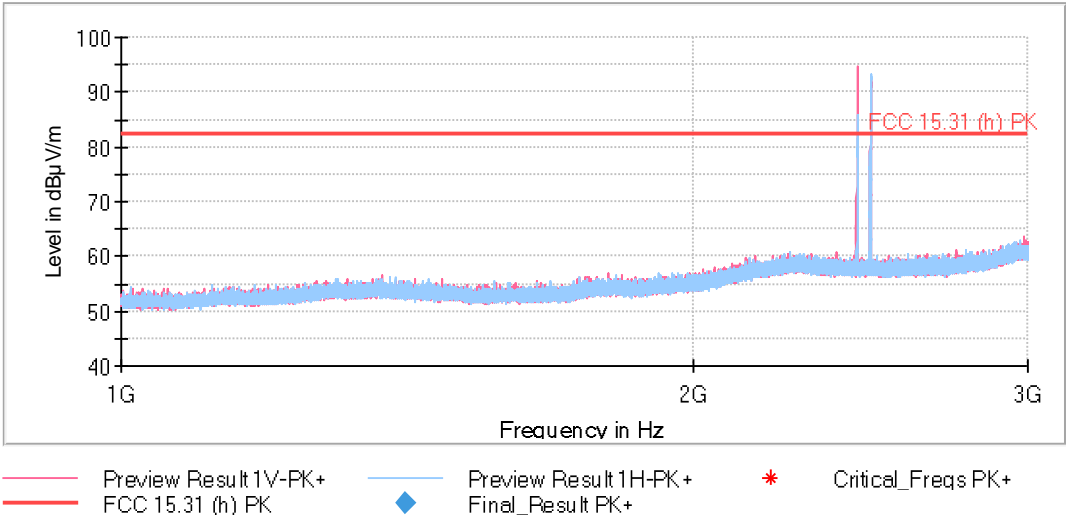
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	0 dB
1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
17 GHz - 40 GHz	115 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz

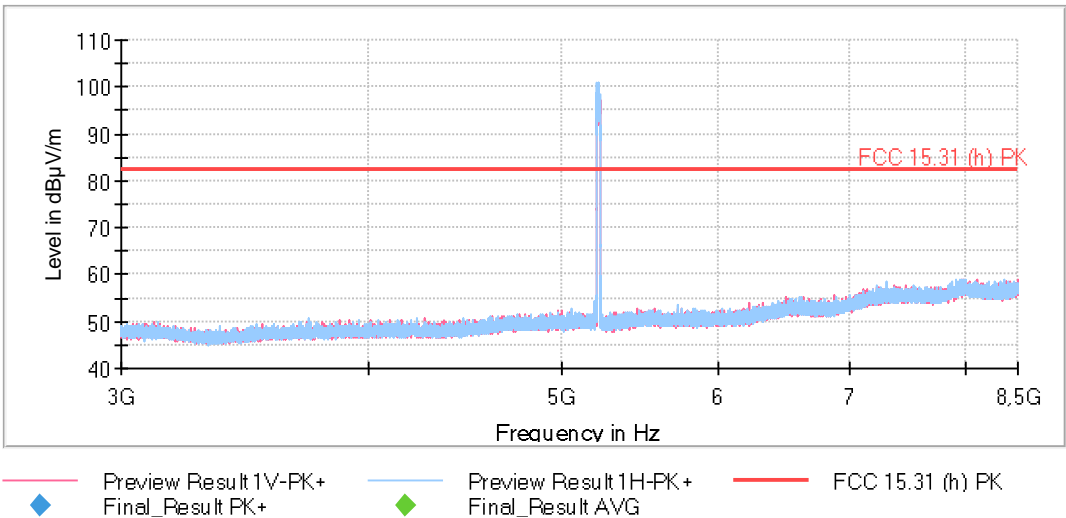


The peak above the limit is the 2G 850 carrier frequency (836.5 MHz).

FREQUENCY RANGE 1 - 8.5 GHz

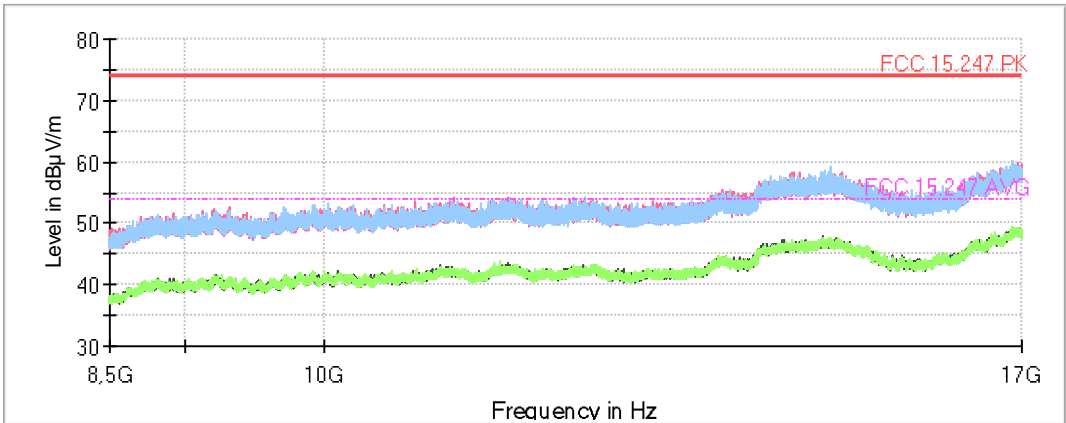


The peaks above the limit are the BT LE carrier frequency (2440 MHz) and BT EDR carrier frequency (2480 MHz), respectively.

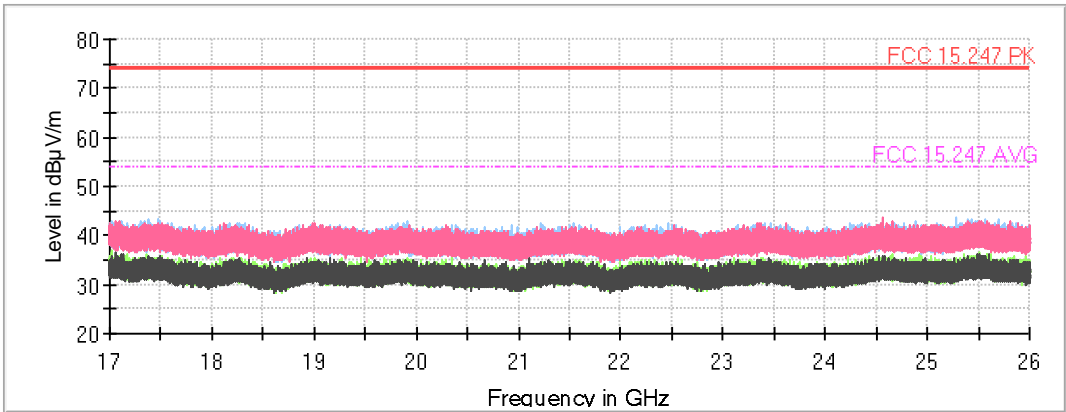


The peak above the limit is the WLAN 5 GHz carrier frequency (5220 MHz).

FREQUENCY RANGE 8.5 - 26 GHz

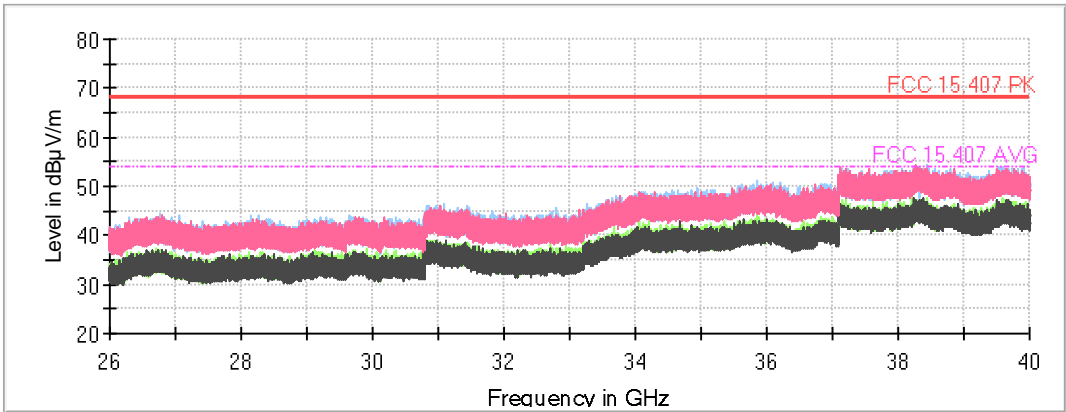


Preview Result 2V-AVG Preview Result 1V-PK+ Preview Result 2H-AVG
Preview Result 1H-PK+ FCC 15.247 PK FCC 15.247 AVG
Final_Result PK+ Final_Result AVG



Preview Result 2H-AVG Preview Result 1H-PK+ Preview Result 2V-AVG
Preview Result 1V-PK+ FCC 15.247 PK FCC 15.247 AVG
Final_Result PK+ Final_Result AVG

FREQUENCY RANGE 26 - 40 GHz



Preview Result 2H-AVG Preview Result 1H-PK+ Preview Result 2V-AVG
Preview Result 1V-PK+ FCC 15.407 PK FCC 15.407 AVG
Final_Result PK+ Final_Result AVG

- **Operation Mode 2**

Start frequency: no radiofrequency signal generated in the device found below 10th sub-harmonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th harmonic.

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 - 40 GHz:

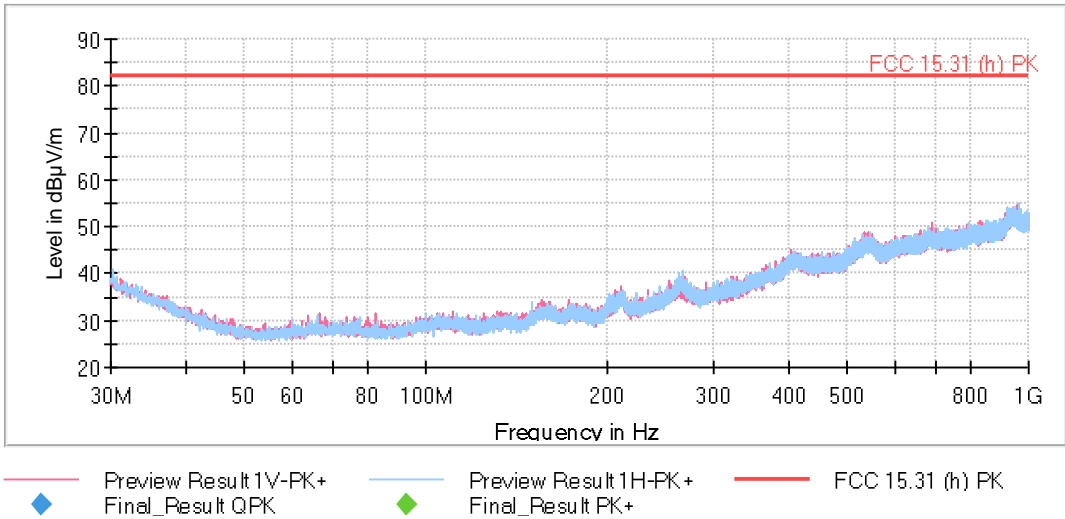
No spurious frequencies at less than 20 dB below the limit.

Verdict

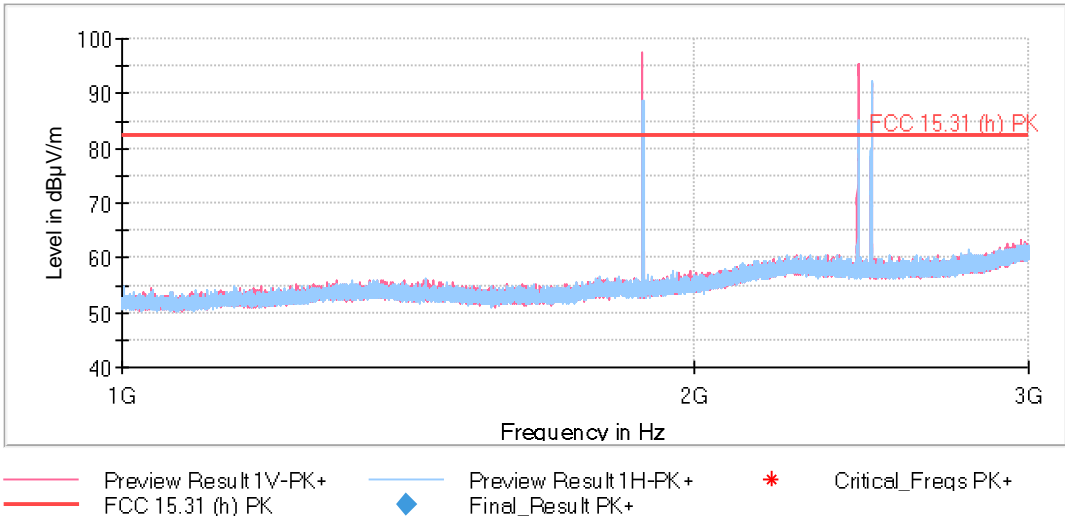
Pass

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	0 dB
1 GHz - 3 GHz	66,667 kHz	PK+	1 MHz	1 s	0 dB
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
17 GHz - 40 GHz	115 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

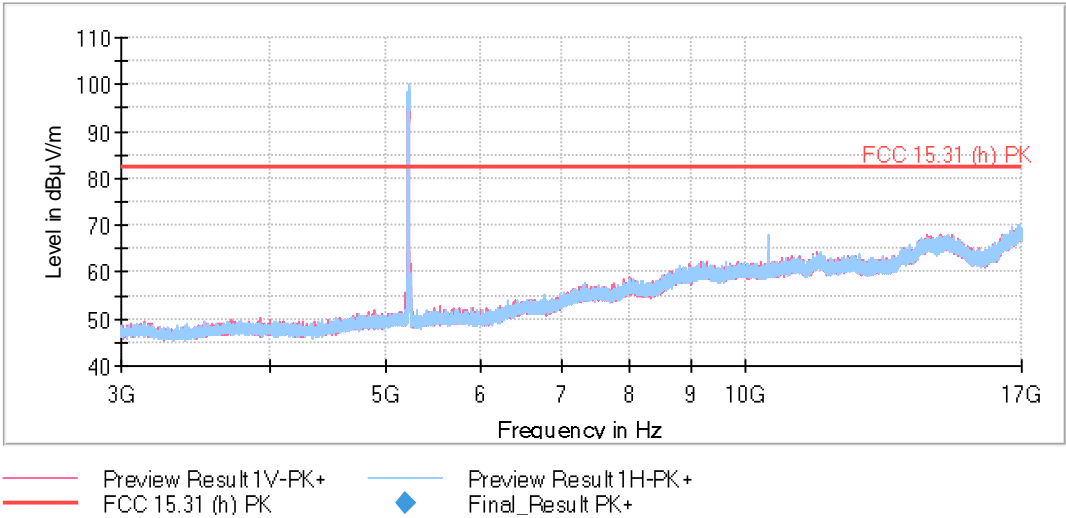
FREQUENCY RANGE 30 MHz - 1 GHz



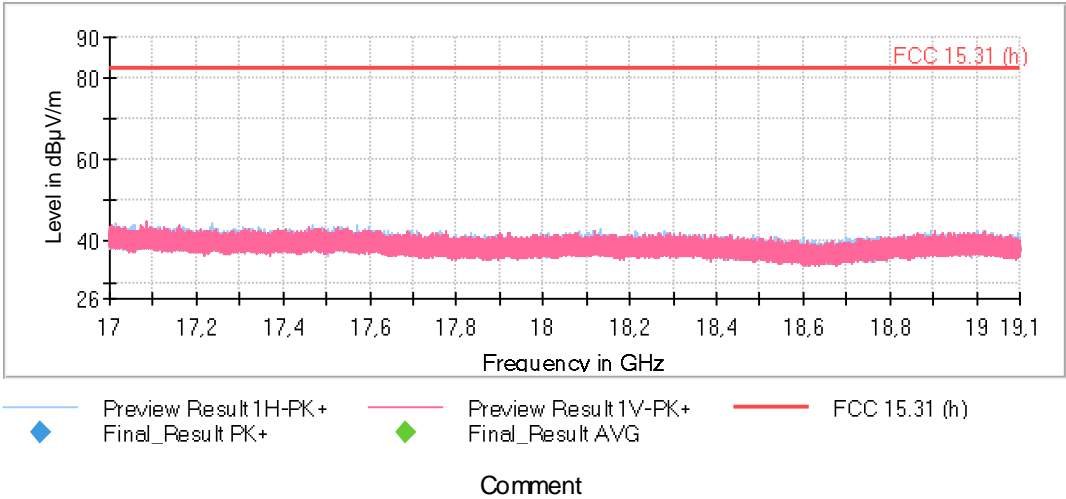
FREQUENCY RANGE 1 - 19.1 GHz



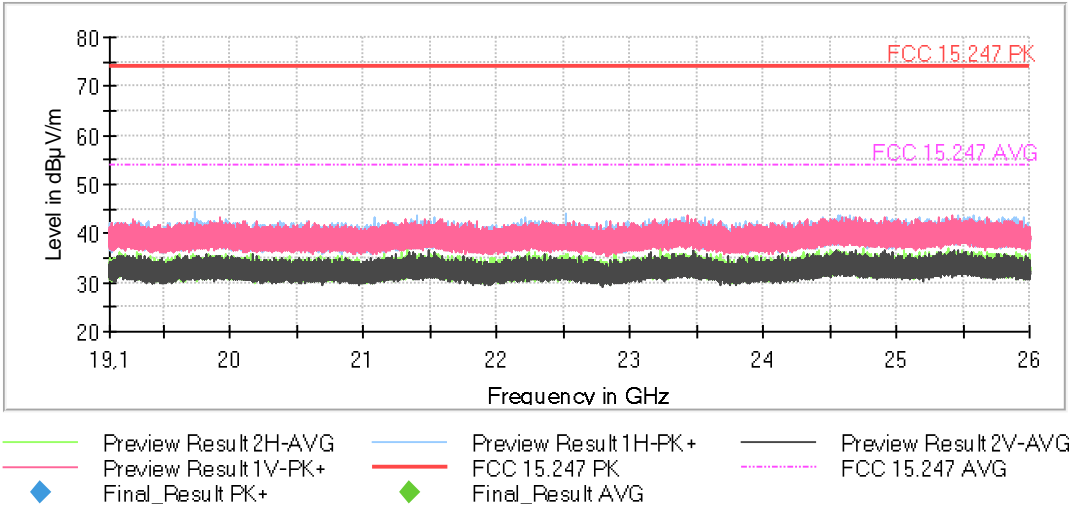
The peak above the limit on the left is the 2G 1900 carrier frequency (1880 MHz).
The peaks above the limit on the right are the BT LE carrier frequency (2440 MHz) and BT EDR carrier frequency (2480 MHz), respectively.



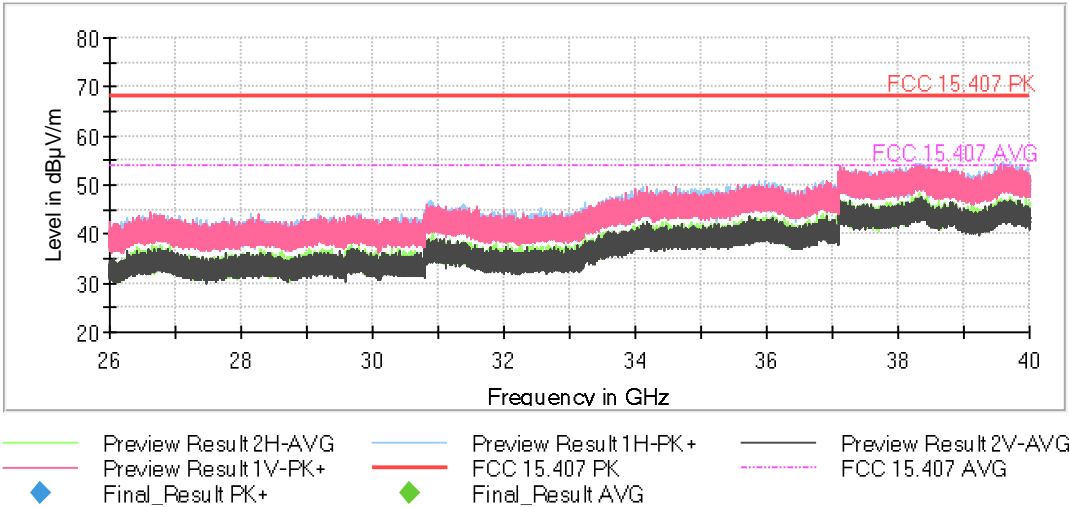
The peak above the limit is the WLAN 5 GHz carrier frequency (5220 MHz).



FREQUENCY RANGE 19.1 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



- **Operation Mode 3**

The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 26 GHz	PK	$55 + 10 \log (P) \text{ dB} = -25 \text{ dBm} \rightarrow 70.23 \text{ dB}\mu\text{V/m} (**)$ OR $-21.23 \text{ dBm} \rightarrow 74 \text{ dB}\mu\text{V/m} (*)$

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

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

Start frequency: no radiofrequency signal generated in the device found below 10th sub-harmonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th harmonic.

Frequency range 30 MHz - 1 GHz:

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

Frequency range 1 GHz - 40 GHz:

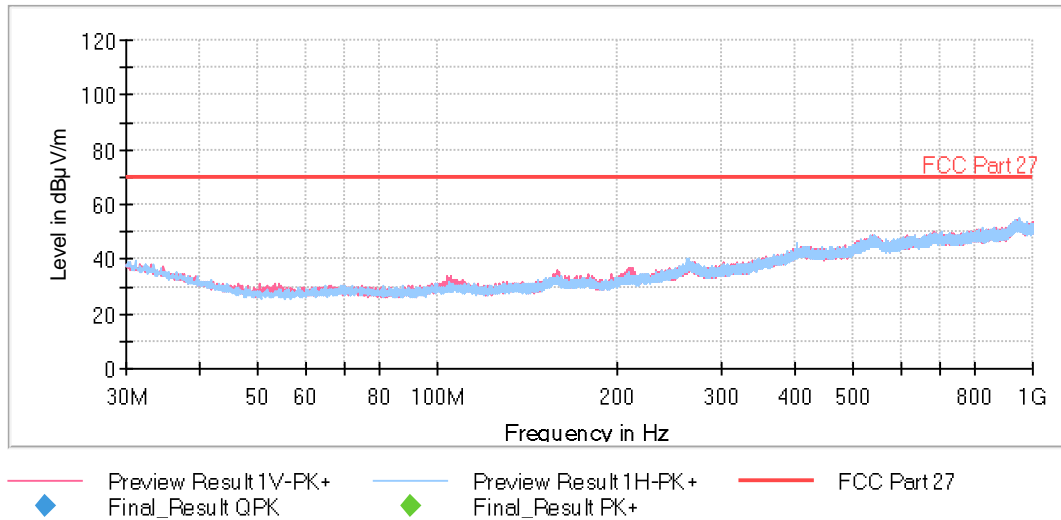
No spurious frequencies at less than 20 dB below the limit.

Verdict

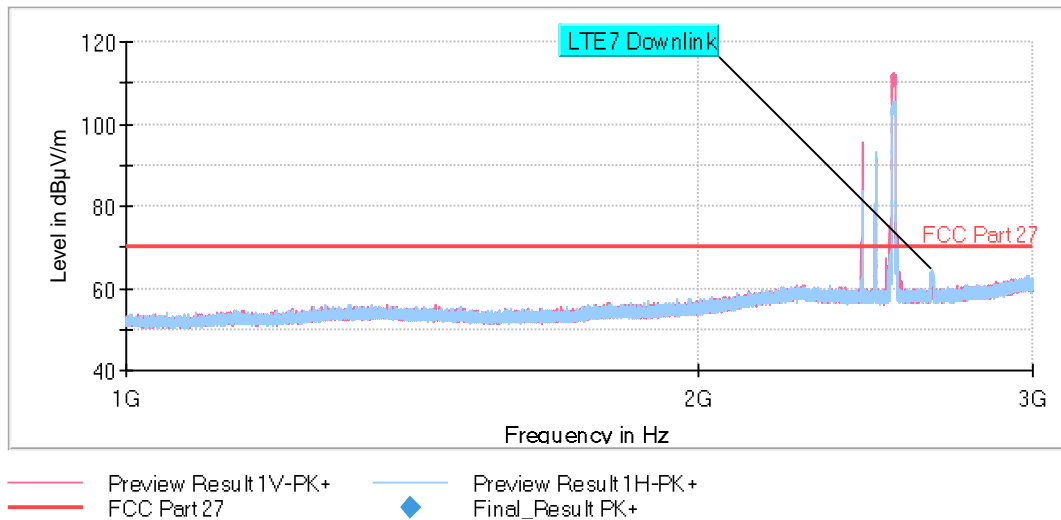
Pass

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	0 dB
1 GHz - 3 GHz	66,667 kHz	PK+	1 MHz	1 s	0 dB
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
17 GHz - 40 GHz	115 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

FREQUENCY RANGE 30 MHz - 1 GHz:



FREQUENCY RANGE 1 - 26 GHz



The peaks above the limit are the BT LE carrier frequency (2440 MHz) and BT EDR carrier frequency (2480 MHz), and LTE Band 7 carrier frequency (2535 MHz).