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Acronyms

Acronym ID	Acronym Description
# of Tx Chains	Number of Transmission Chains
Detector	Detector used
Equipment	Equipment Type
Freq	Frequency
Freq Rng	Frequency Range
MP	Measurement Point
Mod	Modulation
Pol	Polarization
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level

Competences and guarantees

DEKRA Testing and Certification 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 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 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.

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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 $k=2$).

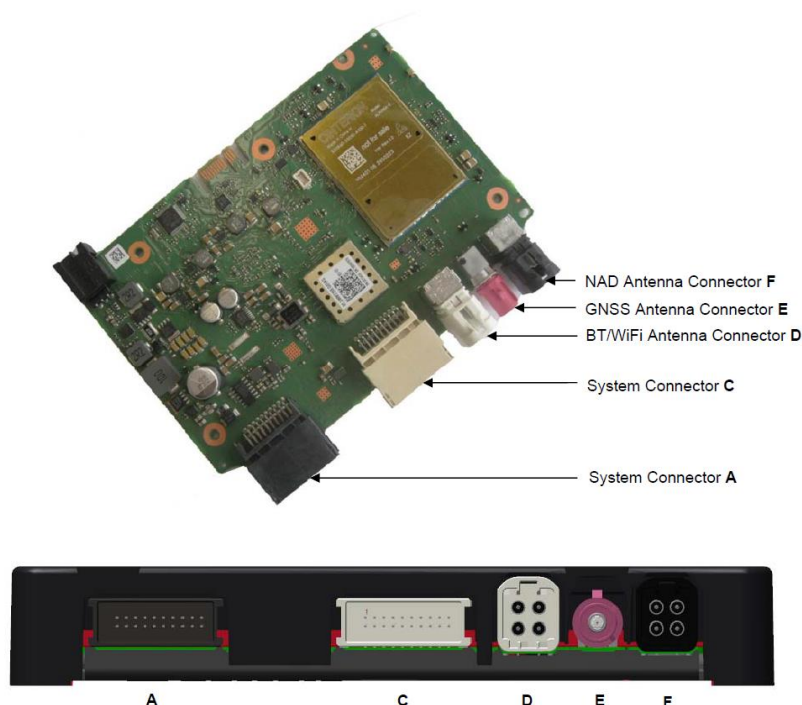
The total uncertainty of the measurement system for the radiated emissions of the EUT from 1 to 17 GHz is:
Measurement uncertainty $\leq \pm 4.32$ dB (with factor $k=2$).

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, GNSS, Wifi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.



3. Declaration of Comparability



Declaration of Comparability

HARMAN BECKER
Automotive Systems GmbH
Becker-Göring-Str. 16
D-76307 Karlsbad, Germany

declares under our sole responsibility, that the product

Description of object	: Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE
Brand/ Customer	: VW-Group / VW AG/ Audi
Model name	CONBOX-HIGH RD
Variant	: A970, A971, A972, A973, A974, A975, A976, A977, A978, A979, A980, A981, A982, A983, A984, P114, P115, P119
Hardware / Software version	: 045 / 0489 (corresponds CL37)

is comparable to:

Description of object	: Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE
Customer / Brand	: VW-Group / VW AG/ Audi
Model	CONBOX-HIGH RD
Variant	: A970, A971, A972, A973, A974, A975, A976, A977, A978, A979, A980, A981, A982, A983, A984, P114, P115, P119
Hardware / SW	: 045 / 0494 (corresponds CL37)

We declare as authorized responsible person, that the products above have HW and SW changes which have no impact for the certification activities.

The HW version used on CONBOX-HIGH RD will have the same schematics, the same layout, with the same BT/WLAN-Module and the same country specific NAD module and the HW index will remain 045.

The application SW will be changed to 0494 version. These SW changes do not impact the following parameters: used frequency ranges / used frequency bands, the used modulation type, the maximum RF power, the circumstances under which the transmitter operates, the basic frequency and/or stabilizing circuitry, frequency multiplication stages, the basic modulator circuitry or maximum RF power, the field strength ratings, slew rates for clocking of output pins and drivers.

More details about the HW/SW updates are included in: "CON-BOX-HIGH-RD_temp_test_20230120".

In conclusion, we can say the new SW/HW configuration do not influence the type-approval for all variants (listed above) on CONBOX-High RD - Cluster 37 (045/0494).

Declared by: **checked by:** Thomas Roesch (S-PM) / 28.03.2023

Mr. STOICA Iulian, Product Compliance Expert	<i>i.v. [Signature]</i>
Bucharest	28.03.2023
(Place)	(Date)
	(Signature)

Mr. OLTEANU Marius, Product Compliance Expert.	<i>i.v. [Signature]</i>
Bucharest	28.03.2023
(Place)	(Date)
	(Signature)

HW Changes on TCU side

From HW perspective, the main modifications are :

- replacing of unnecessary coupling capacitors C5940/C5941 220nF in PCIe bus with 0 Ohm resistors
- coupling capacitors are already on Qisda NXP module, therefore not needed on main PCB
- no change is made on the layout of main PCB.

The HW version used on CONBOX-HIGH RD will have the same schematics, the same layout, with the same BT/WLAN-Module and the same country specific NAD module and the HW index will remain 045.

SW Changes on TCU side

From SW perspective, the main updates are :

- change of BT/Wifi driver
- change of PCIe speed

There have been:

- No changes of the used frequency ranges / bands
- No changes of the used modulation type
- No changes of the maximum RF power
- No changes of the circumstances under which the transmitter operates
- No changes of the basic frequency and/or stabilizing circuitry
- No changes of the frequency multiplication stages
- No changes of the basic modulator circuitry or maximum RF power
- No changes of the field strength ratings
- No changes of slew rates for clocking of output pins and drivers

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.

Id	Control Number	Description	Model	Serial No.	Date of Reception	Application
S/01	72779_3	Telematic control unit	CONBOX HIGH RD	351998105022826	2022-10-17	Element Under Test
S/01	72779_6	Harness	--	--	2022-10-17	Element Under Test
S/01	72779_67	Antenna ConBox VW	--	--	2022-10-17	Element Under Test
S/01	72779_68	Antenna ConBox VW	--	--	2022-10-17	Element Under Test
S/01	72779_69	Antenna ConBox VW	--	--	2022-10-17	Element Under Test
S/01	72779_70	Antenna ConBox VW	--	--	2022-10-17	Element Under Test
S/01	72779_14	Power cable	--	--	2022-10-17	Auxiliary element
S/01	72779_49	OABR_Converter PCB Board	--	--	2022-10-17	Auxiliary element
S/01	72779_56	GPS antenna	--	--	2022-10-17	Auxiliary element
S/01	72779_58	Fakra 4 to 1 cable	--	--	2022-10-17	Auxiliary element
S/01	72779_59	Ethernet cable	--	--	2022-10-17	Auxiliary element
S/01	72779_66	Antenna cable 4 to 1	--	--	2022-10-17	Auxiliary element

Notes referenced to samples during the project:

Id	Type
S/01	Sample used for radiated tests

Test sample description

Ports.....:	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	RF connector – code		☐	☒	☐		
	RF connector – code		☒	☒	☐		
RF connector – code		☒	☐	☐			
Supplementary information to the ports.....:							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐ AC:	☐	☐	☐	☐	☐	
☒ DC: 12V car battery (4.8 VDC inside of TCU)							
Rated Power.....:	12V DC						
Clock frequencies.....:	25MHz; 26MHz; 32,768kHz; 49,58MHz;						
Other parameters	See Technical description						
Software version.....:	0494						
Hardware version	045						
Dimensions in cm (W x H x D) ...:	--						
Mounting position	☐	Table top equipment					
	☐	Wall/Ceiling mounted equipment					
	☐	Floor standing equipment					
	☐	Hand-held equipment					
	☒	Other: automotive telematics control unit					
Modules/parts.....:	Module/parts of test item		Type	Manufacturer			
	--		-	-			
	--		-	-			
Accessories (not part of the test item)	Description		Type	Manufacturer			
	Cable Harness		-	-			
	2G/3G/4G/5G Antenna		-	Hirschmann/Molex			
	eCall button/LED		-	-			
	SOS Loudspeaker		-	-			
	Wake-up unit Box		-	-			
Documents as provided by the applicant	Description		File name	Issue date			
	Technical Description		-	-			

⁽³⁾ Only for Medical Equipment

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)	2022-12-01
Date (finish)	2022-12-02

Document history

Report number	Date	Description
72779RRF.010	2022-12-12	First release.
72779RRF.010A1	2023-04-27	Second release. Modification due to typos.

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: Rafael Fernández Martín and Miguel Manuel López.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
4825	SEMIANECHOIC ABSORBER LINED CHAMBER IV	FACT 3 200 STP	ETS LINDGREN	2023-08-28
4826	SHIELDED ROOM	S101	ETS LINDGREN	N/A
4578	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2023-04-30
6142	PRE-AMPLIFIER G>38dB 30MHz-6GHz	BLNA 0360-01N	BONN ELEKTRONIK	2023-06-16
4716	SIGNAL AND SPECTRUM ANALYZER 2Hz-50GHz	FSW50	ROHDE AND SCHWARZ	2024-08-12
6496	HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK MESS-ELEKTRONIK	2023-08-24
5705	PRE-AMPLIFIER G>40dB 1-18 GHz	BLMA 0118-1M	BONN ELEKTRONIK	2023-07-21
4657	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2023-05-05
8856	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-4A	BONN ELEKTRONIK	2023-11-02
6165	EMI TEST RECEIVER 9kHz-7GHz	ESR7	ROHDE AND SCHWARZ	2023-11-08
6092	DC POWER SUPPLY 30V/5A	KEYSIGHT TECHNOLOGIES	U8002A	N/A
7758	DIGITAL MULTIMETER	FLUKE	175	2023-11-14
4848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A

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		
Requirement – Test case	Verdict	Remark
FCC 15.31 (h), 15.209 (a), 15.247 (d), 15.407 (b), FCC 22.917, FCC 24.238, FCC 27.53 / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2, 6.2.2.2, 6.2.3.2 & 6.2.4.2, RSS-132 5.5, RSS-133 6.5, RSS-199 4.5	Emission limitations radiated (Transmitter) P	(1), (2)
<u>Supplementary information and remarks:</u> (1) Only radiated simultaneous transmission spurious emission test was requested. (2) Radiated measurements were performed in the worst-case of combination between different capabilities of the equipment.		

Appendix A: Test results.

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 12 Vdc
Type of Power Supply: External DC (vehicle battery)

ANTENNA (*):

Type of Antennas: External antenna
Maximum Declared Gain for BT EDR: +0.11 dBi
Maximum Declared Gain for BLE: +0.11 dBi
Maximum Declared Gain for 2.4 GHz WLAN: +0.11 dBi
Maximum Declared Gain for 5 GHz WLAN: +2.38 dBi
Maximum Declared Gain for Cellular: +6.60 dBi

TEST FREQUENCIES (*):

	CELLULAR	
Band:	2G 850	
Frequency Range:	824 – 849 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low: 128	824.2
Band:	2G 1900	
Frequency Range:	1850 – 1910 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	High: 810	1909.8
Band:	LTE Band 7	
Frequency Range:	2500 – 2570 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	Low: 20850	2510 MHz (BW 20 MHz, RB Size 1, RB Offset 0, QPSK)

	WLAN 2.4 GHz (IEEE 802.11 b/g/n20) / DTS	
Mode:	802.11 g: 6Mbps (SISO)	
Channel Bandwidth:	20 MHz	
Frequency Range:	2400 MHz to 2483.5 MHz	
Transmit Channel:	Channel	Channel Frequency (MHz)
	CH3	2422

	WLAN 5 GHz (IEEE 802.11 a/n/ac 20/40/80) / U-NII	
Mode:	802.11 n20: index MCS0 (SISO)	
Channel Bandwidth:	20 MHz	
Frequency Range:	5150 MHz to 5250 MHz (U-NII-1)	
Transmit Channel:	Channel	Channel Frequency (MHz)
	CH40	5200

	Bluetooth EDR / FHSS	
Mode:	Basic Data Rate (GFSK – 1-DH5)	
Channel Bandwidth:	1 MHz	
Frequency Range:	2402 MHz to 2480 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	CH30	2432

	Bluetooth Low Energy / DTS	
Mode:	GFSK - 1DH5	
Channel Bandwidth:	1 MHz	
Frequency Range:	2402 MHz to 2480 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 0	2402

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 modes 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.

For WLAN and Bluetooth, the EUT was configured to transmit continuously on the test channels and modes as required.

Selected Transmission Mode for each Radio:

The following configurations were selected based on preliminary testing that identified these modes as the worst cases:

- * Cellular 2G 850: Cellular 2G 850 / Low Channel, GPRS mode configuration.
- * Cellular 2G 1900: Cellular 2G 1900 / High Channel, GPRS mode configuration.
- * Cellular LTE 7: LTE Band 7 / Low Channel, QPSK mode configuration.
- * Bluetooth Low Energy: GFSK 1 Mbps / Low Channel configuration.

According to the information provided by the manufacturer, the following configurations were selected as the worst cases:

- * Bluetooth BR/EDR: GFSK (DH-5) / CH30 (2432 MHz) configuration.
- * WLAN 2.4 GHz: 802.11g (6 Mbps) / CH3 (2422 MHz) configuration.
- * WLAN 5 GHz U-NII-1: 802.11 n20 (HT20 MCS0 index) / CH40 (5200 MHz) configuration.

TESTED SIMULTANEOUS TRANSMISSION MODES:

* **BLE 1 Mbps Low Channel (2402 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz)**, with the EUT configured to simultaneously transmit all these signals at maximum output power.

* **BT EDR GFSK (DH5) Channel 30 (2432 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz)**, with the EUT configured to simultaneously transmit all these signals at maximum output power.

* **BLE 1 Mbps Low Channel (2402 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + 2G 850 GPRS Low Channel (824.2 MHz)**, with the EUT configured to simultaneously transmit all these signals at maximum output power.

* **BT EDR GFSK (DH5) Channel 30 (2432 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + 2G 850 GPRS Low Channel (824.2)**, with the EUT configured to simultaneously transmit all these signals at maximum output power.

* **BLE 1 Mbps Low Channel (2402 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + 2G 1900 GPRS High Channel (1909.8 MHz)**, with the EUT configured to simultaneously transmit all these signals at maximum output power.

*** BT EDR GFSK (DH5) Channel 30 (2432 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + 2G 1900 GPRS High Channel (1909.8), with the EUT configured to simultaneously transmit all these signals at maximum output power.**

*** BLE 1 Mbps Low Channel (2402 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + LTE Band 7 QPSK Low Channel (2510 MHz), with the EUT configured to simultaneously transmit all these signals at maximum output power.**

*** BT EDR GFSK (DH5) Channel 30 (2432 MHz) + Wi-Fi 2.4GHz 802.11g Channel 3 (2422 MHz) + Wi-Fi 5GHz 802.11n20 U-NII-1 Channel 40 (5200 MHz) + LTE Band 7 QPSK Low Channel (2510 MHz), with the EUT configured to simultaneously transmit all these signals at maximum output power.**

TEST CASES DETAILS

FCC 15.209 (a), 15.247 (d), 15.407 (b), 22.917, 24.238, 27.53
RSS-Gen 8.9, RSS-247 5.5 & 6.2.1.2, RSS-132 5.5, RSS-133 6.5, RSS-199 4.5

Emission limitations radiated (Transmitter)

Limits

BT EDR, BLE, WLAN 2.4 GHz, 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
Above 960	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 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

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

2G 850. FCC §2.1053 & §22.917 / RSS-132 Issue 3 Clause 5.5:

FCC §22.917:

(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 Clause 5.5:

ii. 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.

2G 1900. FCC §2.1053 & §24.238 / RSS-133 Clause 6.5:

FCC §24.238:

(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 Clause 6.5:

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 / RSS-199 Clause 4.5:

FCC §27.53 (m):

(4) For mobile digital stations, the attenuation factor shall be not less than $55 + 10 \log(P)$ 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. 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.

RSS-199 Clause 4.5:

(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:

iii. $55 + 10 \log_{10} p$ 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 combined 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 height of the measuring antenna. The maximum meter reading was recorded. Measurements were made in both horizontal and vertical planes of polarization.

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

For radiated measurements above 17GHz 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 simultaneous transmission of all radio interfaces (that can transmit simultaneously).

Measurement Limit:

At P_o transmitting power, the specified minimum attenuation $43+10\log(P_o)$ becomes:

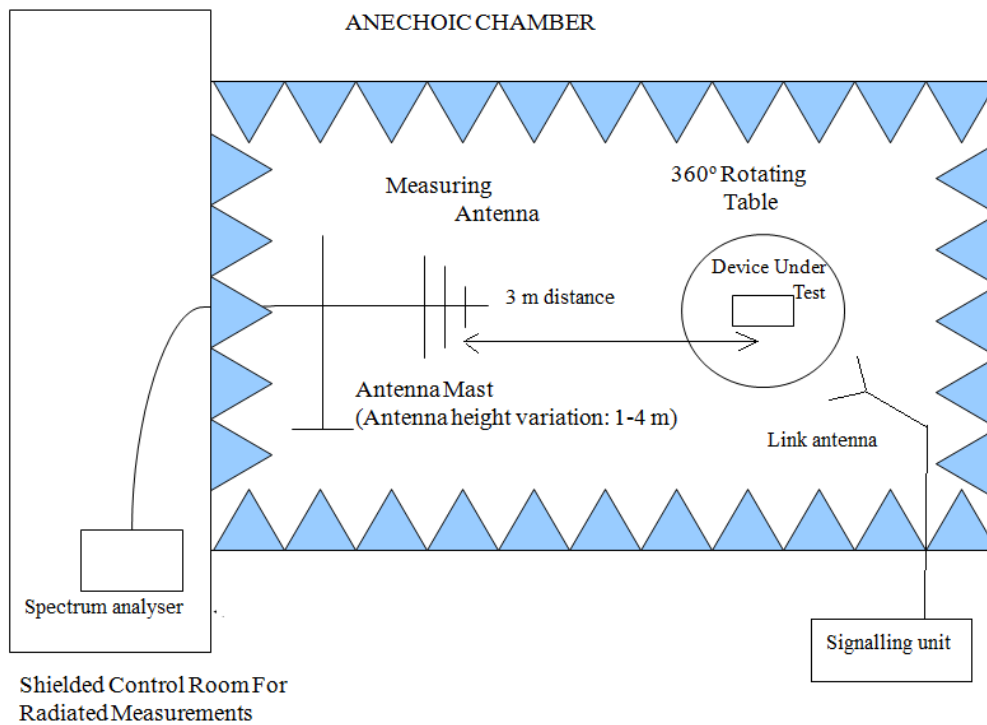
$$P_o \text{ (dBm)} - [43 + 10 \log(P_o \text{ in mWatts}) - 30] = -13 \text{ dBm}$$

At P_o transmitting power, the specified minimum attenuation $55+10\log(P_o)$ becomes:

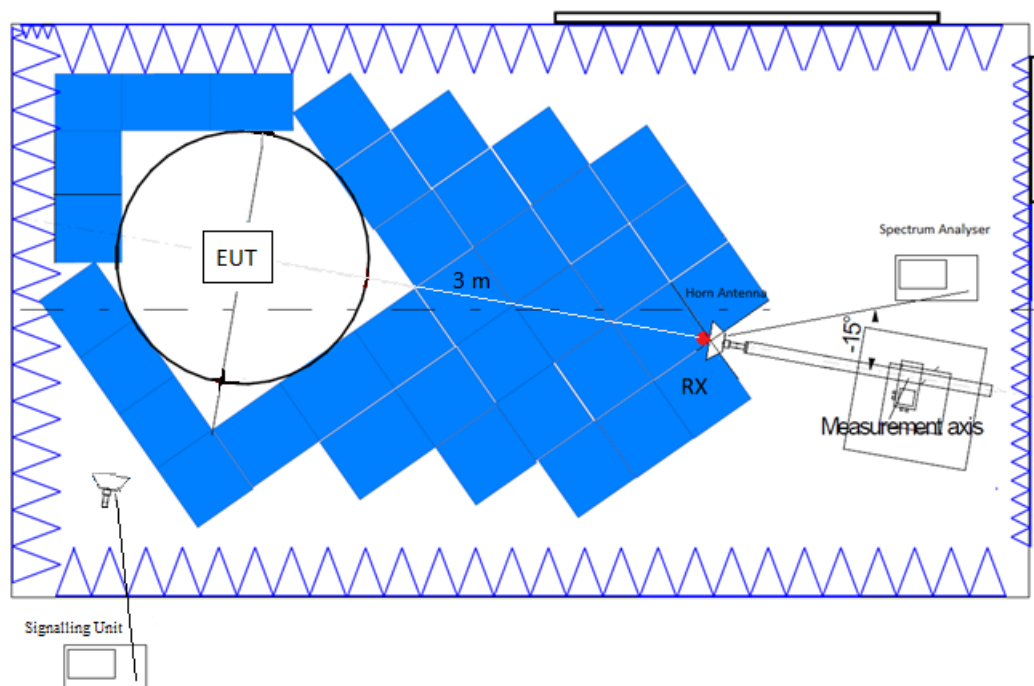
$$P_o \text{ (dBm)} - [55 + 10 \log(P_o \text{ in mW}) - 30] = -25 \text{ dBm}$$

Test setup

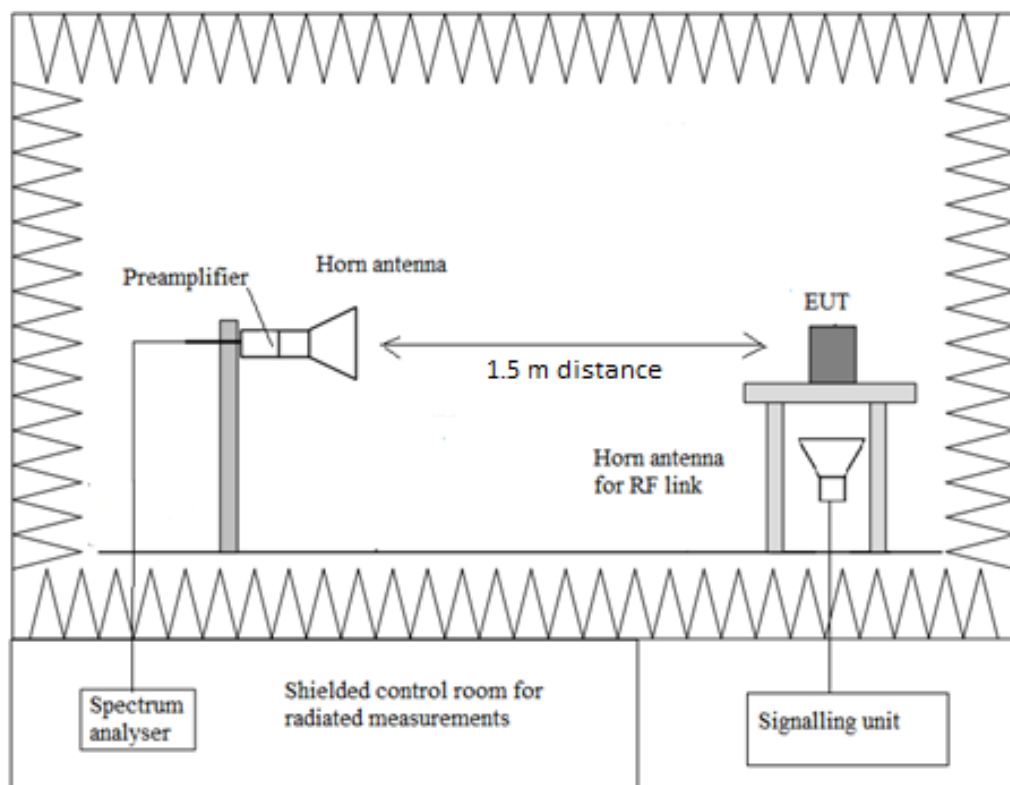
Radiated measurements below 1 GHz.



Radiated measurements between 1 GHz and 17 GHz.



Radiated measurements above 17 GHz.



Simultaneous transmission BLE, WLAN 2.4 GHz, WLAN 5 GHz U-NII-1

BLE: Low Channel (2402 MHz), 1 Mbps.
WLAN 2.4 GHz: CH3 (2422 MHz), 802.11 g.
WLAN 5 GHz: CH40 (5200 MHz), 802.11 n20.

The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 88 MHz	Quasi-PK	40 dBµV/m
88 MHz to 216 MHz	Quasi -PK	43.5 dBµV/m
216 MHz to 960 MHz	Quasi -PK	46 dBµV/m
1 GHz to 40 GHz	PK	68.23 dBµV/m (*) or 74 dBµV/m (**)
1 GHz 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).

Results

Frequency range 30 MHz – 1 GHz

Spurious frequencies found at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Level (dBµV/m)	Pol	Detector
674.9591	26.70	V	Quasi-Peak
774.9600	26.29	H	Quasi-Peak

Frequency range 1 GHz – 40 GHz

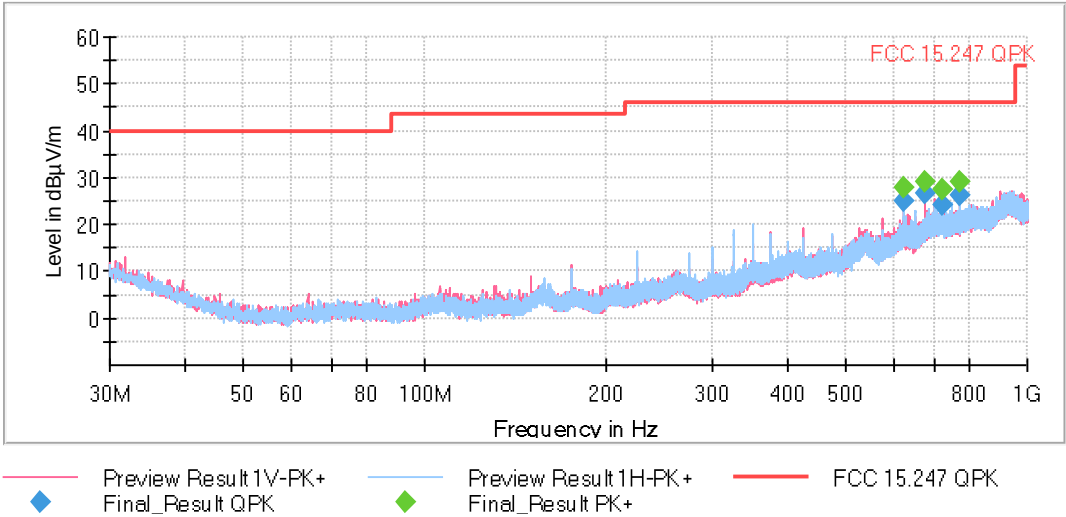
No spurious frequencies found close to the limit.

Verdict

Pass

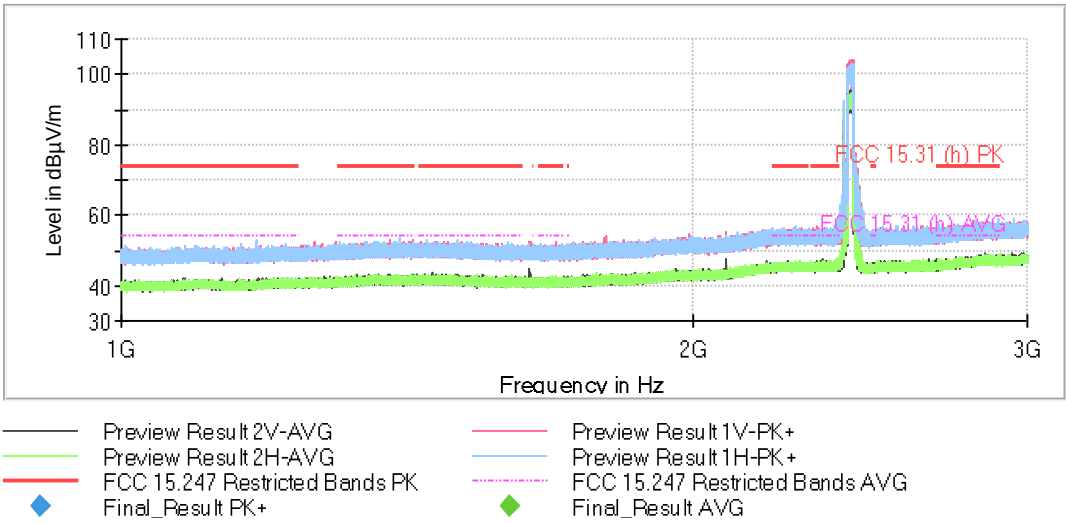
Attachments

Frequency range 30 MHz – 1 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB

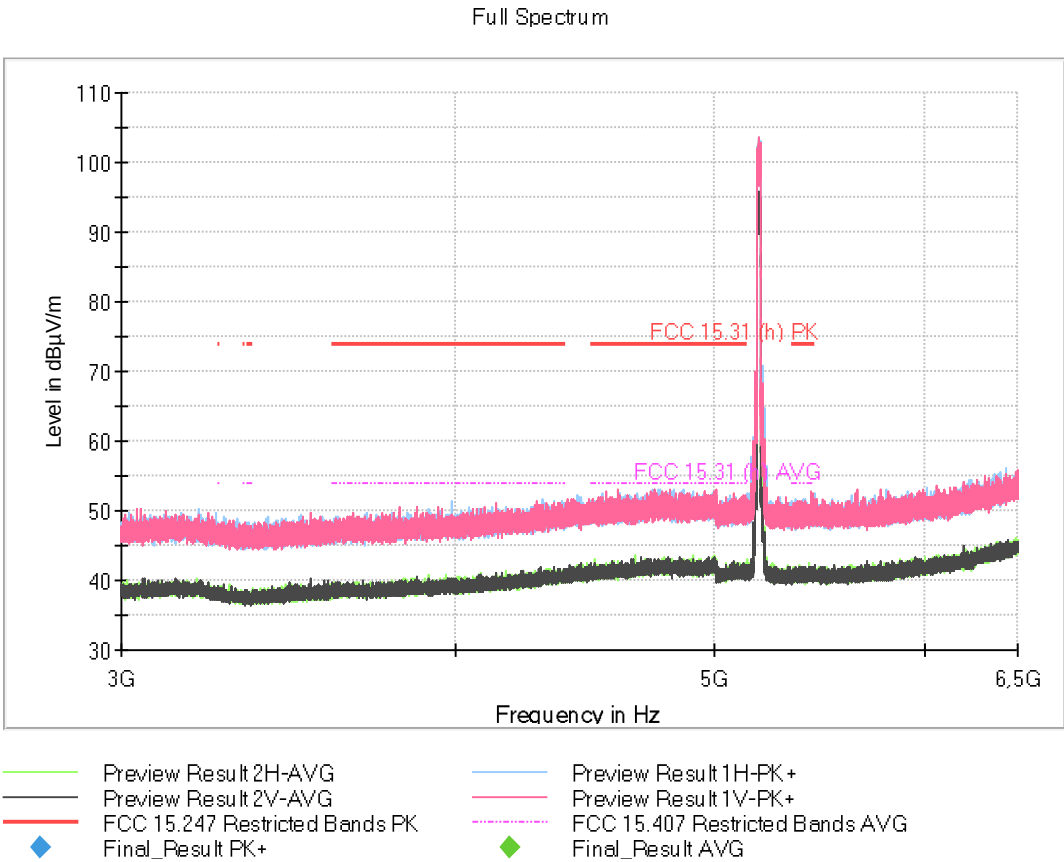
Frequency range 1 GHz – 3 GHz



The peaks above the limit are the BLE and WLAN 2.4 GHz carrier frequencies.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

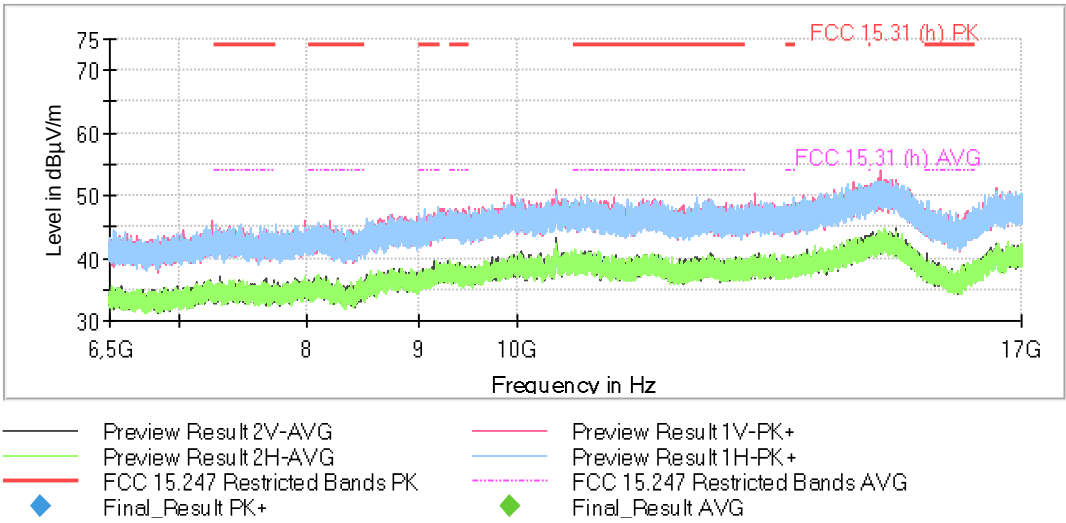
Frequency range 3 GHz – 6.5 GHz



The peak above the limit is the WLAN 5 GHz U-NII-1 carrier frequency.

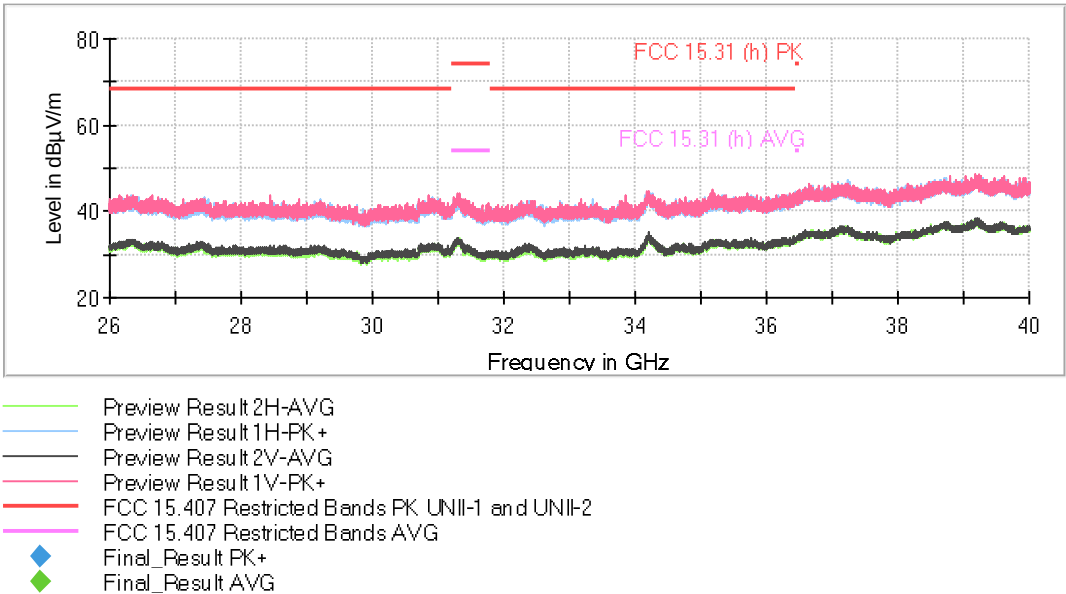
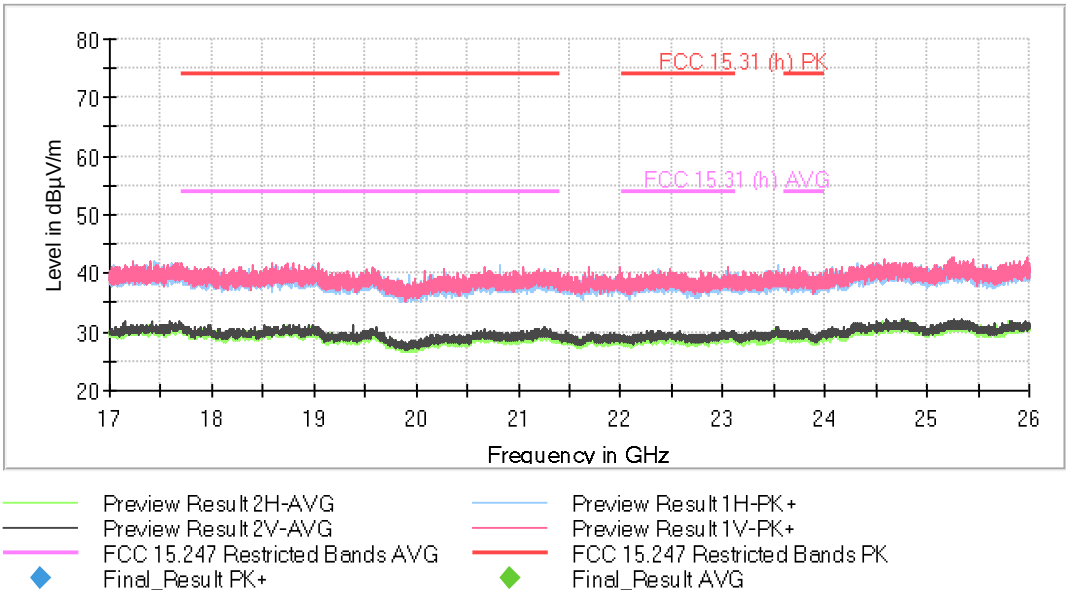
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 6.5 GHz – 17 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 17 GHz – 40 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 17 GHz - 40 GHz	766,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Simultaneous transmission BT EDR, WLAN 2.4 GHz, WLAN 5 GHz U-NII-1

BT EDR: CH30 (2432 MHz), GFSK.
WLAN 2.4 GHz: CH3 (2422 MHz), 802.11 g.
WLAN 5 GHz: CH40 (5200 MHz), 802.11 n20.

The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 88 MHz	Quasi-PK	40 dBµV/m
88 MHz to 216 MHz	Quasi -PK	43.5 dBµV/m
216 MHz to 960 MHz	Quasi -PK	46 dBµV/m
1 GHz to 40 GHz	PK	68.23 dBµV/m (*) or 74 dBµV/m (**)
1 GHz 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).

Results

Frequency range 30 MHz – 1 GHz

Spurious frequencies detected at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Level (dBµV/m)	Pol	Detector
174.9847	23.68	V	Quasi-Peak

Frequency range 1 GHz – 40 GHz

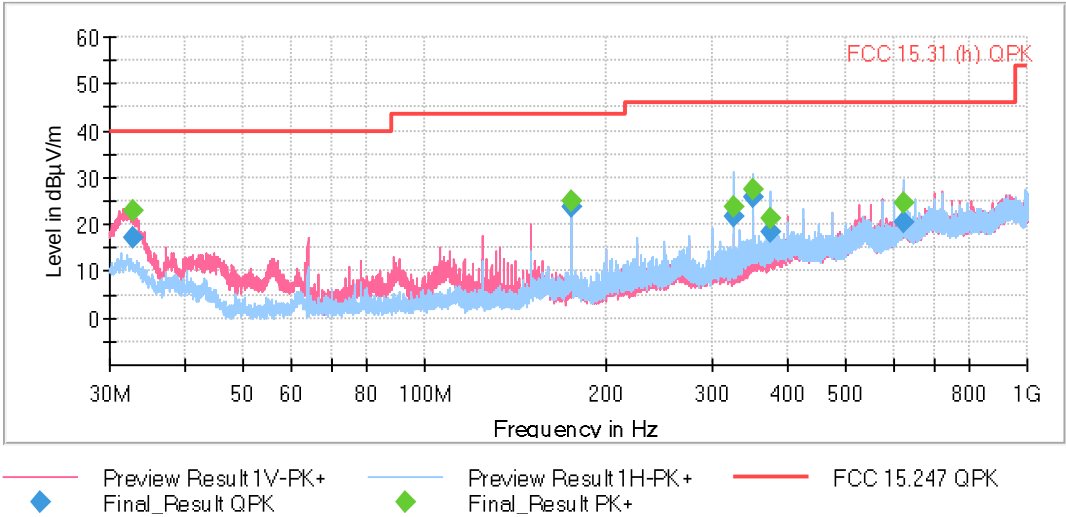
No spurious frequencies found close to the limit.

Verdict

Pass

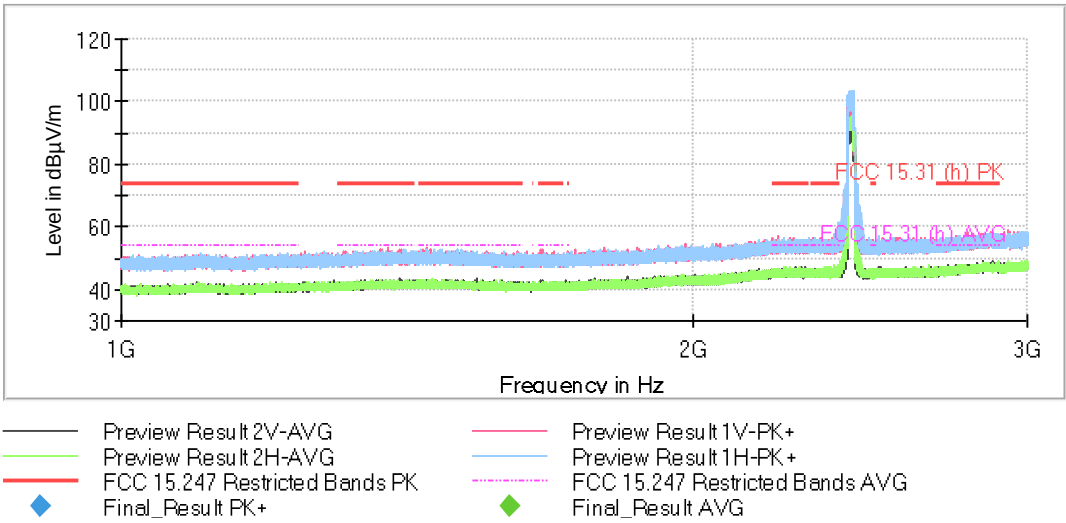
Attachments

Frequency range 30 MHz – 1 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB

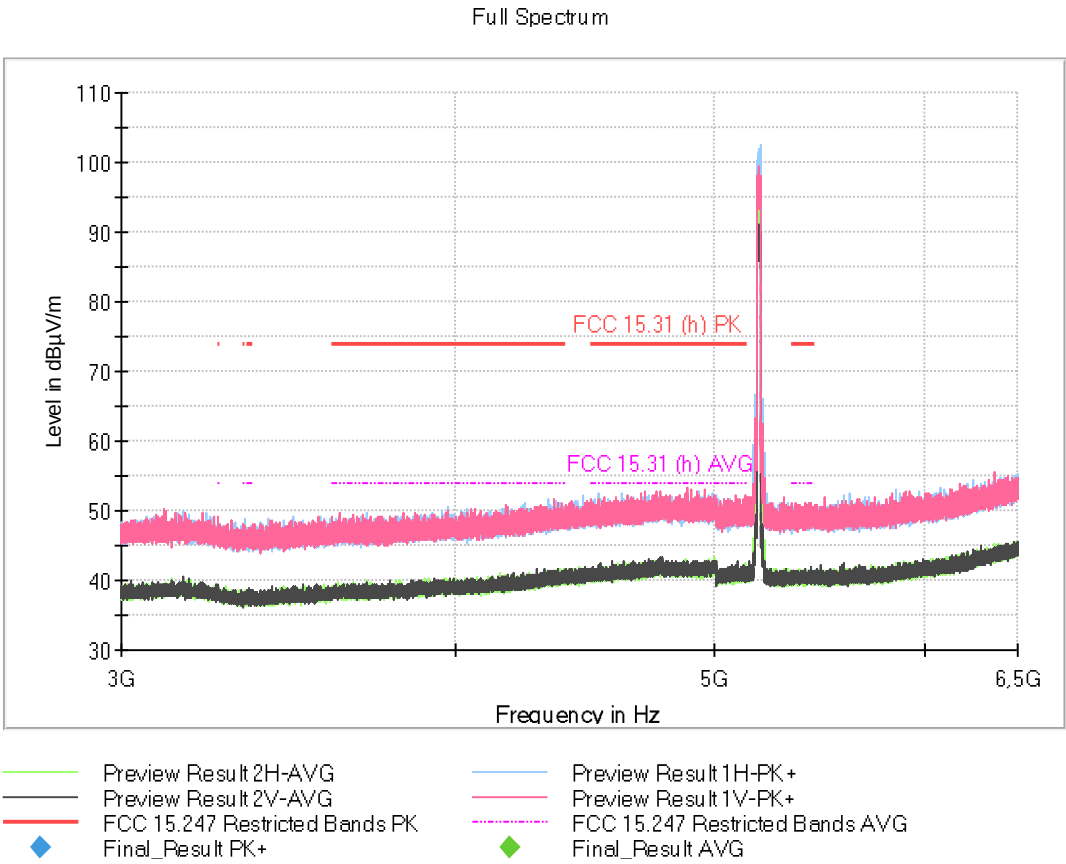
Frequency range 1 GHz – 3 GHz



The peaks above the limit are the BT EDR and WLAN 2.4 GHz carrier frequencies.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

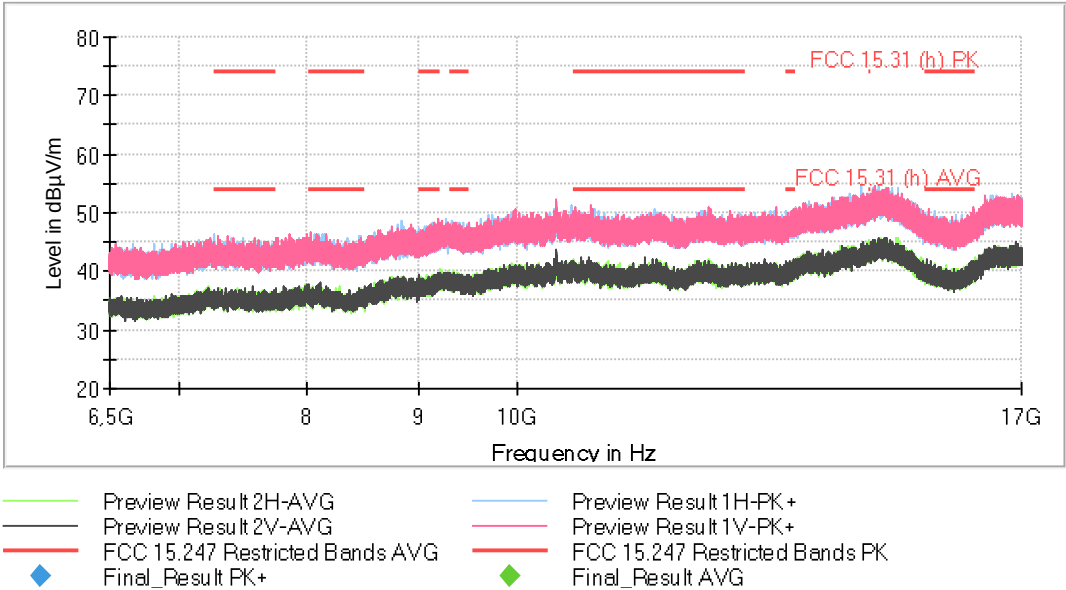
Frequency range 3 GHz – 6.5 GHz



The peak above the limit is the WLAN 5 GHz U-NII-1 carrier frequency.

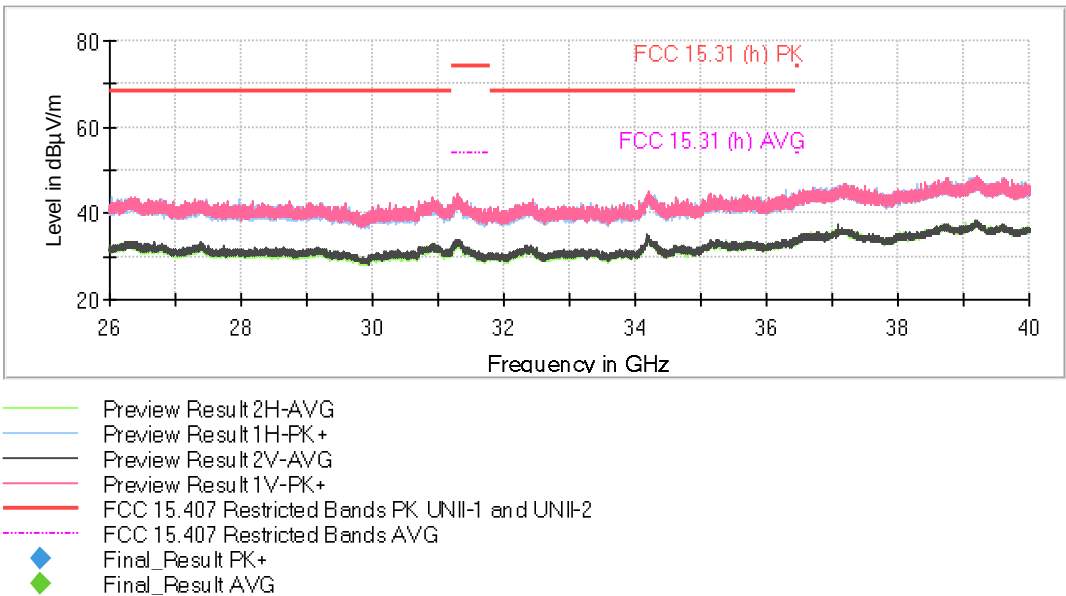
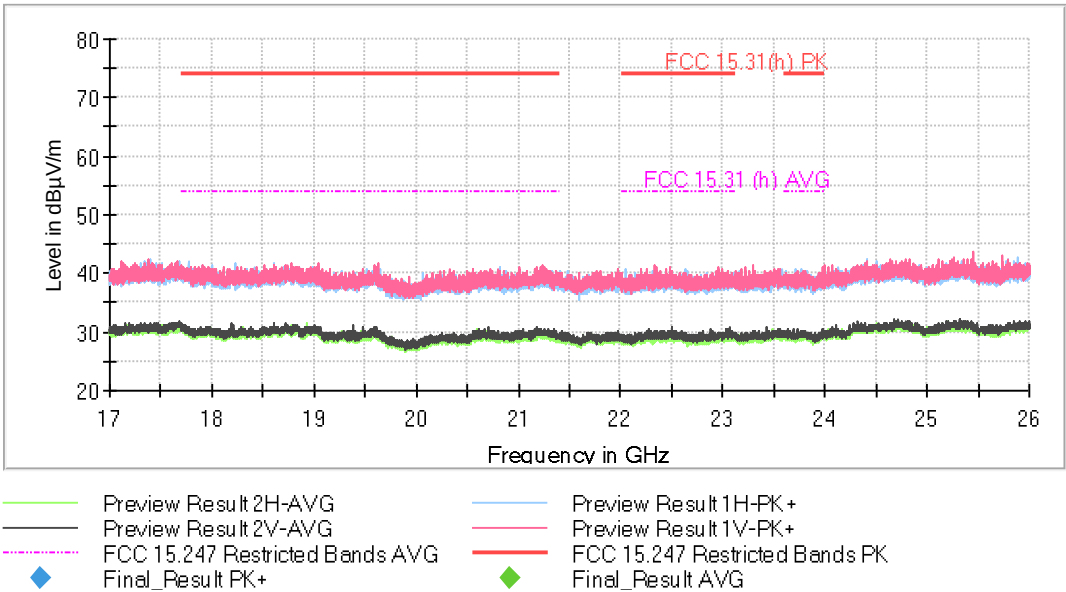
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 6.5 GHz – 17 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 6,5 GHz - 17 GHz	105 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 17 GHz – 40 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 17 GHz - 40 GHz	766,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Simultaneous transmission BLE, WLAN 2.4 GHz, WLAN 5 GHz U-NII-1, 2G 850

BLE: Low Channel (2402 MHz), 1 Mbps.
 WLAN 2.4 GHz: CH3 (2422 MHz), 802.11 g.
 WLAN 5 GHz: CH40 (5200 MHz), 802.11 n20.
 2G 850: Low Channel (824.2 MHz), GPRS.

The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBμV/m)
30 MHz to 8.49 GHz	Peak	$43 + 10 \log (P) \text{ dB} = -13 \text{ dBm} \rightarrow 82.23 \text{ dB}\mu\text{V/m}$
8.49 GHz to 40 GHz	Peak	68.23 dBμV/m (*) or 74 dBμV/m (**)
8.49 GHz 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).

Results

Frequency range 30 MHz – 1 GHz

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

Frequency range 1 GHz – 40 GHz

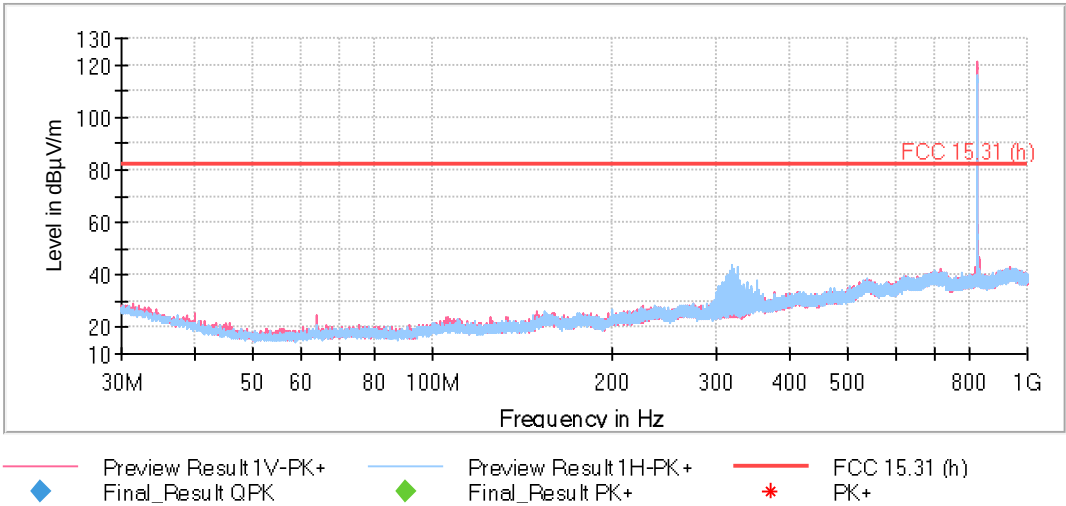
No spurious frequencies at less than 20 dB below the limit.

Verdict

Pass

Attachments

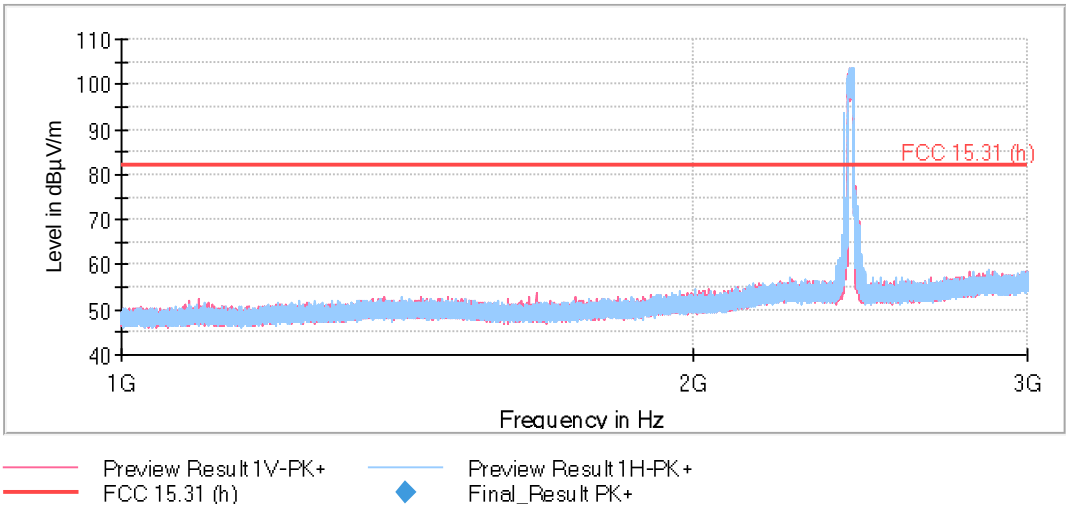
Frequency range 30 MHz – 1 GHz



The peak above the limit is the 2G 850 carrier frequency.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB

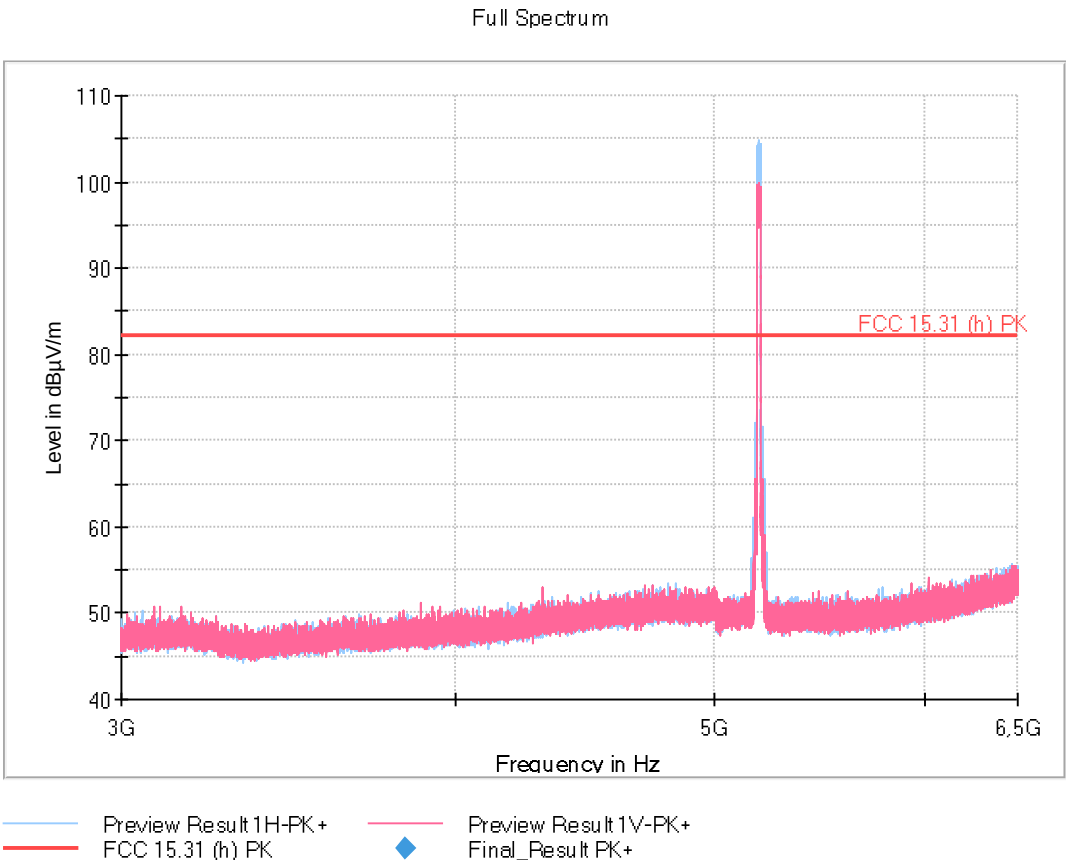
Frequency range 1 GHz – 3 GHz



The peak above the limit are the BLE and WLAN 2.4 GHz carrier frequencies.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

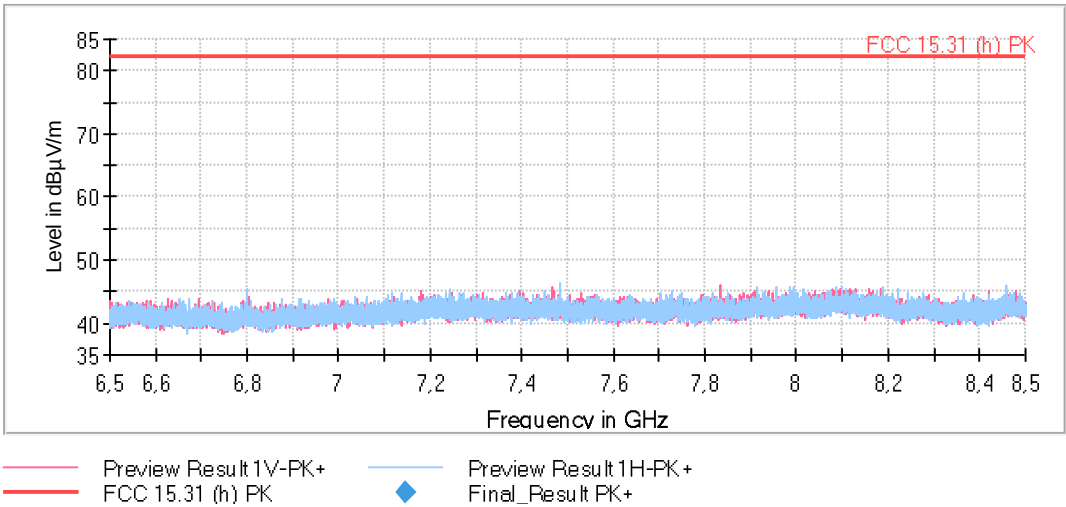
Frequency range 3 GHz – 6.5 GHz



The peak above the limit is the WLAN 5 GHz U-NII-1 carrier frequency.

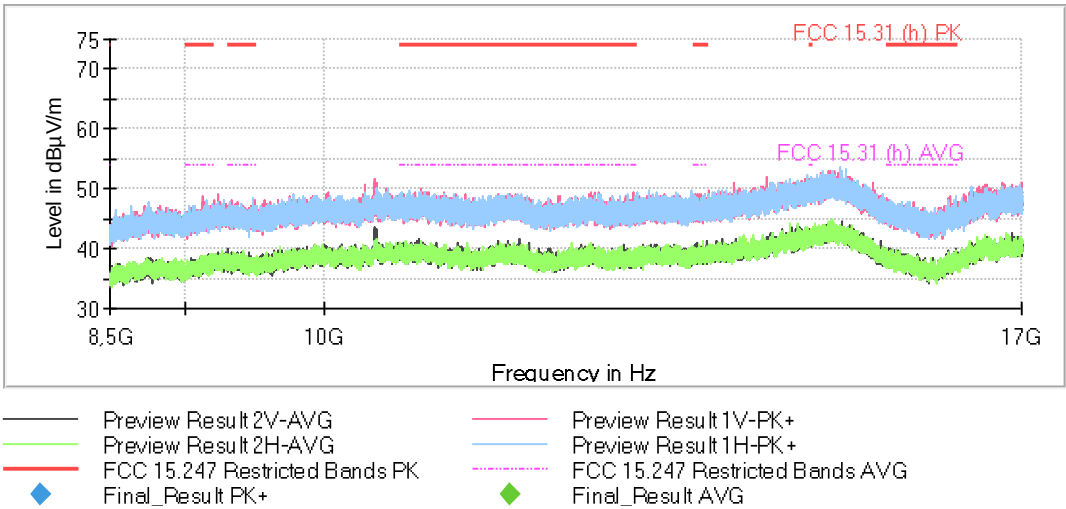
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 6.5 GHz – 8.5 GHz



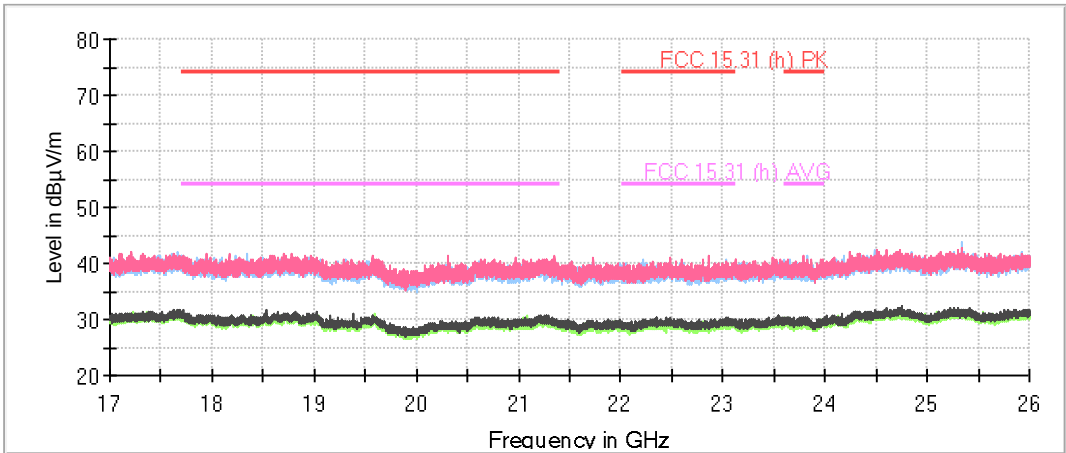
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 8.5 GHz – 17 GHz

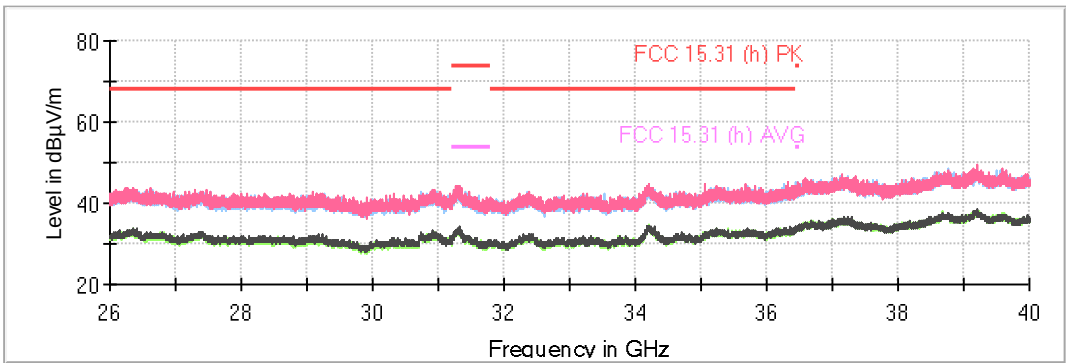


Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 17 GHz – 40 GHz



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



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
- FCC 15.407 Restricted Bands AVG
- Final_Result PK+
- Final_Result AVG

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 17 GHz - 40 GHz	766,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Simultaneous transmission BT EDR, WLAN 2.4 GHz, WLAN 5 GHz U-NII-1, 2G 850

BT EDR: CH30 (2432 MHz), GFSK
 WLAN 2.4 GHz: CH3 (2422 MHz), 802.11 g.
 WLAN 5 GHz: CH40 (5200 MHz), 802.11 n20.
 2G 850: Low Channel (824.2 MHz), GPRS.

The limit of the test is determined by:

Frequency Range	Detector	Limit at 3m (dBµV/m)
30 MHz to 8.49 GHz	Peak	$43 + 10 \log (P) \text{ dB} = -13 \text{ dBm} \rightarrow 82.23 \text{ dB}\mu\text{V/m}$
8.49 GHz to 40 GHz	Peak	68.23 dBµV/m (*) or 74 dBµV/m (**)
8.49 GHz 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).

Results

Frequency range 30 MHz – 1 GHz

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

Frequency range 1 GHz – 40 GHz

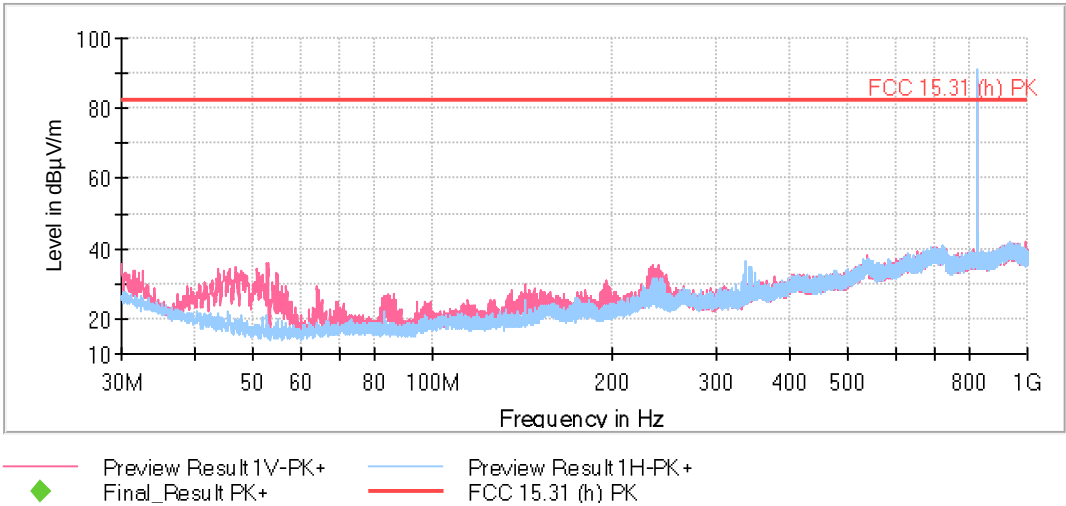
No spurious frequencies at less than 20 dB below the limit.

Verdict

Pass

Attachments

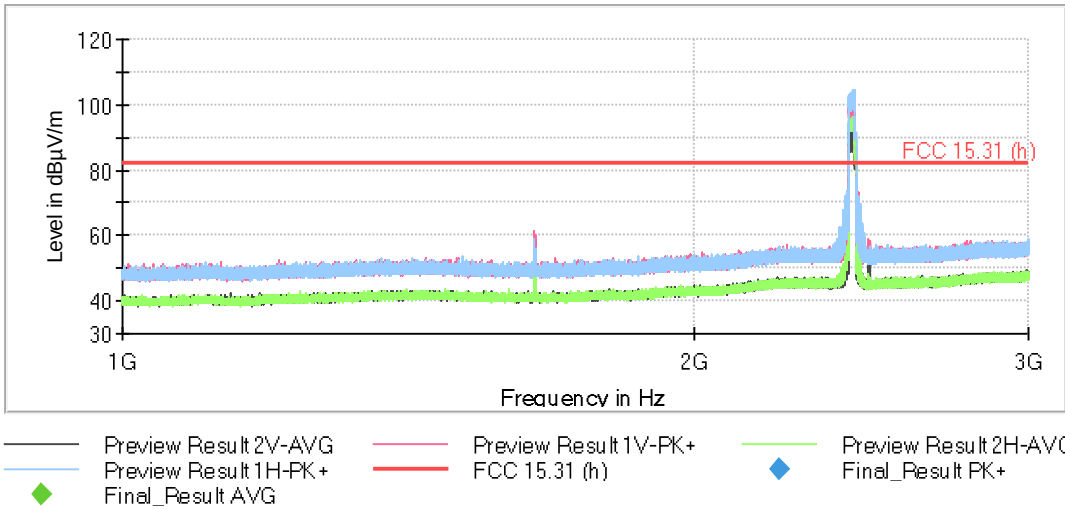
Frequency range 30 MHz – 1 GHz



The peak above the limit is the 2G 850 carrier frequency.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB

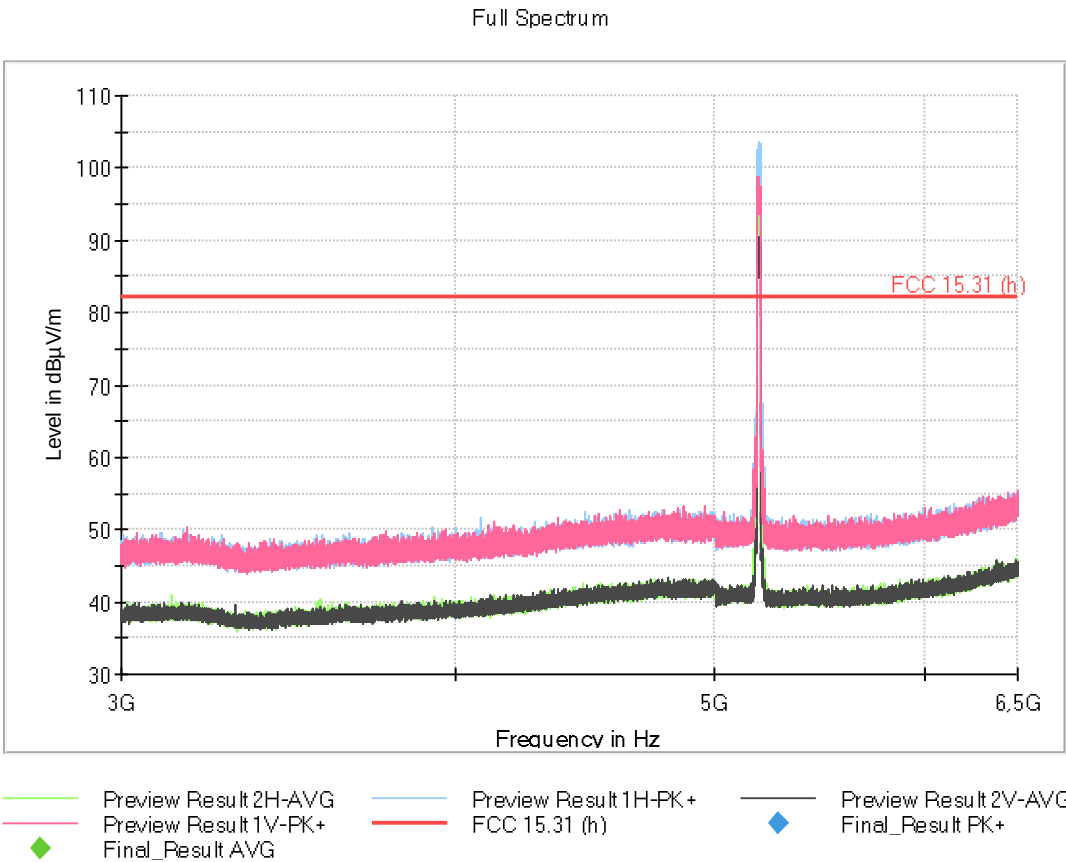
Frequency range 1 GHz – 3 GHz



The peaks above the limit are the BT EDR and WLAN 2.4 GHz carrier frequencies.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

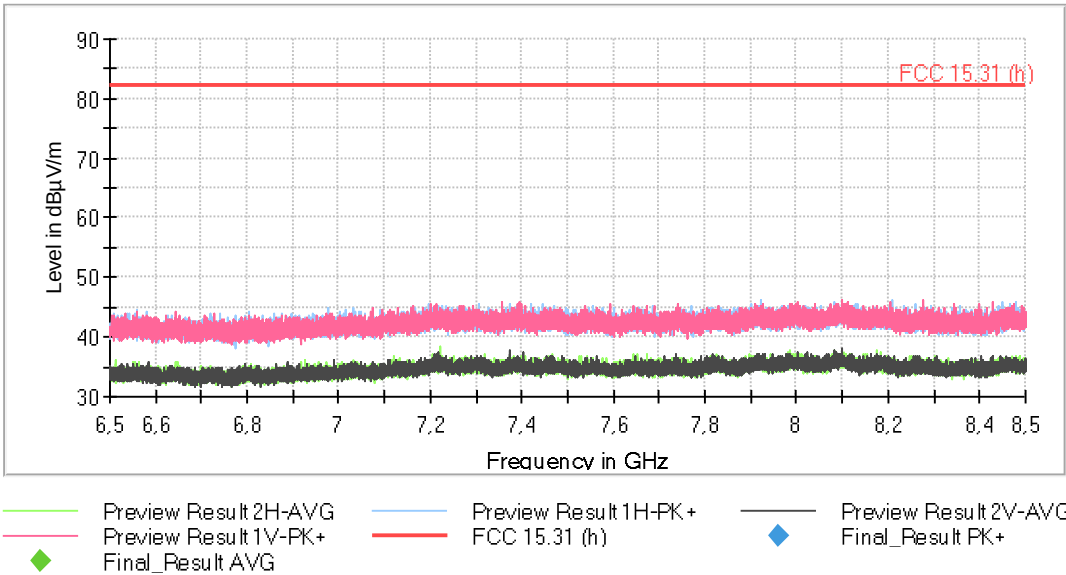
Frequency range 3 GHz – 6.5 GHz



The peak above the limit is the WLAN 5 GHz U-NII-1 carrier frequency.

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 1 GHz - 6,5 GHz	100 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency range 6.5 GHz – 8.5 GHz



Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSW 50] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	0 dB