DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

DEKRA

ENAC ENSAYOS Nº 51/LE147

Test report No:

NIE: 63927RRF.003A3

Partial Test Report

USA FCC Part 15.247,15.407, 15.209
CANADA RSS-247, RSS-Gen

Radio Frequency Devices.
Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.
Unlicensed National Information Infrastructure (U-NII) Devices:
General technical requirements.
Radiated emission limits; general requirements.
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Automotive Infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG7 PREMIUM
Other identification of the product	HW version: D5 SW version: E17.100 FCC ID: T8GNTG7PRE-US IC: 6434A-NTG7PREUS
(*) Features	FM/AM/DAB/DVBT USB, Bluetooth, WLAN, GNSS
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY
Test method requested, standard	USA FCC Part 15.407 (10-1-19) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. Band U-NII-3 (5725 MHz – 5850 MHz). USA FCC Part 15.247 (10-1-19) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-19) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (March 2019). -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 Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013 ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2020.08.13 10:09:44 +02'00'
Date of issue	2020-08-13
Report template No	FDT08_22 (*) "Data provided by the client"

Index

Competences and guarantees 4
General conditions 4
Uncertainty 4
Data provided by the client 4
Usage of samples 4
Test sample description 5
Identification of the client 7
Testing period and place 7
Document history 7
Environmental conditions 8
Remarks and comments 8
Testing verdicts 8
Summary 9
Appendix A: Test results. 10

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 a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test 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.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification.

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.
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 and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification 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 NTG7 PREMIUM is an Automotive head unit to be installed in cars with the following features: FM/AM/DAB/DVBT, USB, Bluetooth, WLAN and GNSS.

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 result.

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	Date of reception
60268/448	Automotive infotainment System	NTG7 PREMIUM	HBM642LS0000003	2020/04/23
60268/308	RF Harness	--	--	2020/02/26
60268/122	RF Cable with 4 Antennas	--	--	2019/09/30

Sample S/01 has undergone the following test(s): All Radiated 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)
	Car Connector A	>3m(x1)	☒	☐	☐
	Car Connector B	>3m(x1)	☒	☐	☐
	Display Connector CID/PIP / RVC	>3m(x1)	☒	☒	☐
	USB Connector	<3m(x2)	☒	☒	☐
	Eth Connector	>3m(x1)	☒	☐	☐
	BT/WLAN-Antenna	>3m(x1)	☒	☒	☐
	FM/AM, TV/SDARS Ant	>3m(x1)	☒	☒	☐
	GNSS Antenna	>3m(x1)	☒	☒	☐
Supplementary information to the ports…… :					

Rated power supply .....:		Voltage and Frequency	Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 12V Car battery / attenuator (9,5-15,5V normal operation)					

	☐	DC:
Rated Power .....:	9,5-15,5V normal operation	
Clock frequencies.....:	see schematics	
Other parameters .....:	See Technical Description	
Software version .....:	E17.100	
Hardware version .....:	D5	
Dimensions in cm (W x H x D) ....:	182 x 78 x 160 mm	
Mounting position .....:	☐	Table top equipment
	☐	Wall/Ceiling mounted equipment
	☐	Floor standing equipment
	☐	Hand-held equipment
	☒	Other: automotive headunit

	Module/parts of test item	Type	Manufacturer
Modules/parts.....:	n/a	-	
		-	
		-	
		-	

	Description	Type	Manufacturer
Accessories (not part of the test item) .....:	Display	-	LG.
	HARMANeco RasPi / headless	-	HBAS
	Cable harness	-	HBAS
	BT/WLAN-Antenna	-	Hirschmann

	Description	File name	Issue date
Documents as provided by the applicant .....:	Technical Description	Technical Description NTG7_ A16 200324 SOP2 AllVariant.doc	

(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)	2020-05-27
Date (finish)	2020-05-27

Document history

Report number	Date	Description
63927RRF.003	2020-07-22	First release
63927RRF.003A1	2020-08-12	First modification due to typos.
63927RRF.003A2	2020-08-12	Second modification due to typos with IC code.
63927RRF.003A3	2020-08-13	Third modification due to typos. This modification test report cancels and replaces the test report 63927RRF003A2**.**

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: José Gabriel Pendón and Miguel Angel Torres,

Used instrumentation:

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber FRANKONIA SAC-3	N.A.	N.A.
2.	Shielded Room FRANKONIA	N.A.	N.A.
3.	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2018/07	2021/07
4.	Horn Antenna 1-18GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2018/06	2021/06
5.	Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
6.	RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/09	2020/09
7.	Pre-amplifier, G>55dB 1-18GHz NARDA AMF-7D-01001800-22-10P	2020/05	2021/05
8.	Pre-Amplifier G>30dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
9.	EMI Test Receiver 20Hz-40GHz ROHDE AND SCHWARZ ESU40	2019/09	2021/09
10.	DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
11.	Digital Multimeter FLUKE 179	2019/10	2020/10
12.	PREAMPLIFIER 30dB 500MHz-18GHz NARDA AMF-3D-00501800-24-10P	2019/12	2020/12

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247		
Requirement – Test case	**Verdict**	**Remark**
FCC 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2, 6.2.2.2, 6.2.3.2 & 6.2.4.2: - Emission limitations radiated (Transmitter)	P	(1)
Supplementary information and remarks: (1) Only co-location radiated spurious emission test was requested.		

Appendix A: Test results.

INDEX

TEST CONDITIONS 12

FCC 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2, 6.2.2.2, 6.2.3.2 & 6.2.4.2 Emission limitations radiated (Transmitter).....15

TEST CONDITIONS

POWER SUPPLY (V):

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

ANTENNA:

Bluetooth EDR:

Type of Antenna: External antenna.
Maximum Declared Antenna Gain: +1.8 dBi (Antenna gain plus antenna cable loss).

802.11 bgn SISO CORE1_Port4:

Type of Antenna: External antenna.
Maximum Declared Antenna Gain: +2.4 dBi(Antenna gain plus antenna cable loss).

802.11 a20 / n2040 / ac2040 / ac80 SISO CORE0_Port3:

Type of Antenna: External antenna.
Maximum Declared Antenna Gain: +2.5 dBi. (Antenna gain plus antenna cable loss).

RADIOS AND CHANNELS TESTED:

	Bluetooth EDR / FHSS	
Mode:	Basic Rate (GFSK - DH5)	
Channel Spacing:	1 MHz	
Frequency Range:	2402 MHz to 2480 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle: 39	2441

	WLAN 2.4 GHz (IEEE 802.11 b/g/n20) / DTS	
Mode:	802.11 b SISO: 1, 2, 5.5 & 11 Mbps.	
Channel Spacing:	20 MHz	
Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle: 6	2437

	WLAN 5 GHz (IEEE 802.11 a20/n2040/ac204080) / U-NII-1	
Mode:	802.11 a20 SISO: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle: 40	5200

	WLAN 5 GHz (IEEE 802.11 a20/n2040/ac204080) / U-NII-3	
Mode:	802.11 ac20 SISO: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps.	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle: 157	5785

The test set-up was made in accordance to the general provisions of FCC DTS Measurement 558074 D01 DTS Meas Guidance v05r2 dated April 2, 2019 and FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

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 Mode for each Radio:

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

* Bluetooth Basic Rate: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in Basic Rate mode because its power is higher than EDR mode.

* WLAN 2.4 GHz: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 b / 1Mbps mode configuration as this mode was found as the worst case for spurious emissions than all the other 2.4 GHz WLAN SISO modes.

* WLAN 5 GHz U-NII-1 band: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 a20 / 6Mbps mode configuration as these modes were found as the worst case for spurious emissions than all the other 5 GHz WLAN U-NII-1 band SISO modes.

* WLAN 5 GHz U-NII-3 band: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 ac20 / 6Mbps mode configuration as these modes were found as the worst case for spurious emissions than all the other 5 GHz WLAN U-NII-3 band SISO modes.

TESTED SIMULTANEOUS TRANSMISSION MODES:

*** Co-location Bluetooth, WLAN 2.4 GHz, WLAN 5 GHz U-NII-1 band**, with the EUT configured to simultaneously transmit three signals at maximum output power:
Bluetooth Basic Rate in DH5 mode, WLAN 2.4GHz in 802.11 b / 1 Mbps, WLAN 5GHz in 802.11 a20 / 6 Mbps.

*** Co-location Bluetooth, WLAN 2.4 GHz, WLAN 5 GHz U-NII-3 band**, with the EUT configured to simultaneously transmit three signals at maximum output power:
Bluetooth Basic Rate in DH5 mode, WLAN 2.4GHz in 802.11 b / 1 Mbps, WLAN 5GHz in 802.11 a20 / 6 Mbps.

RADIATED MEASUREMENTS:

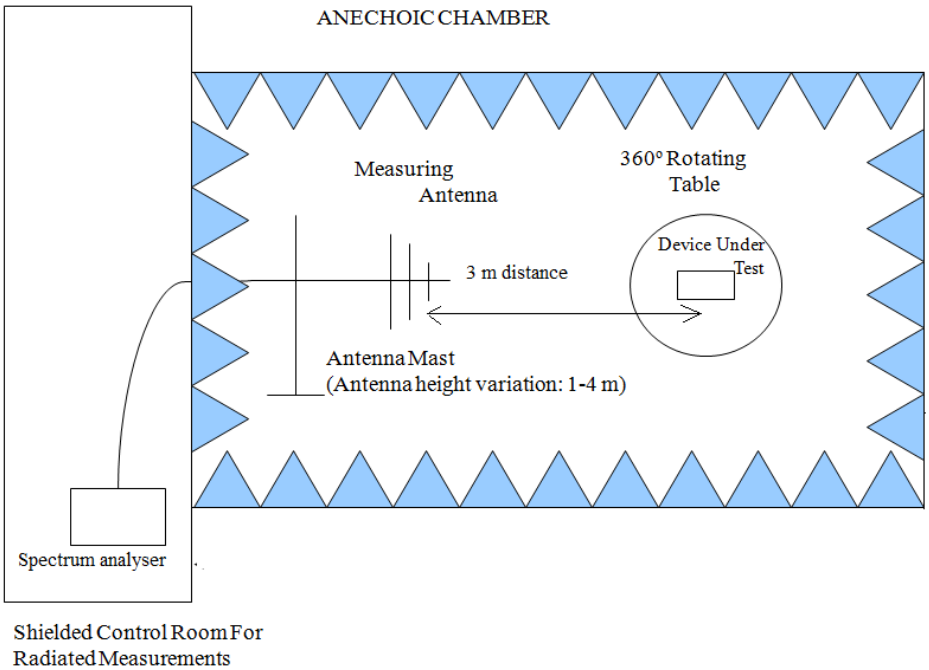
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-40 GHz (17 GHz-40 GHz horn antenna).

For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

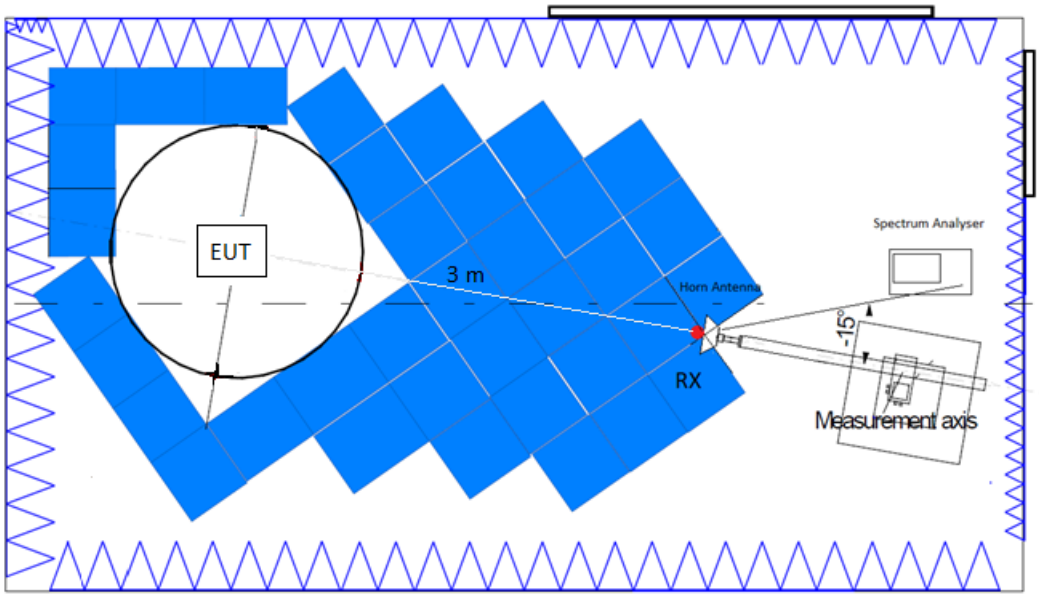
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

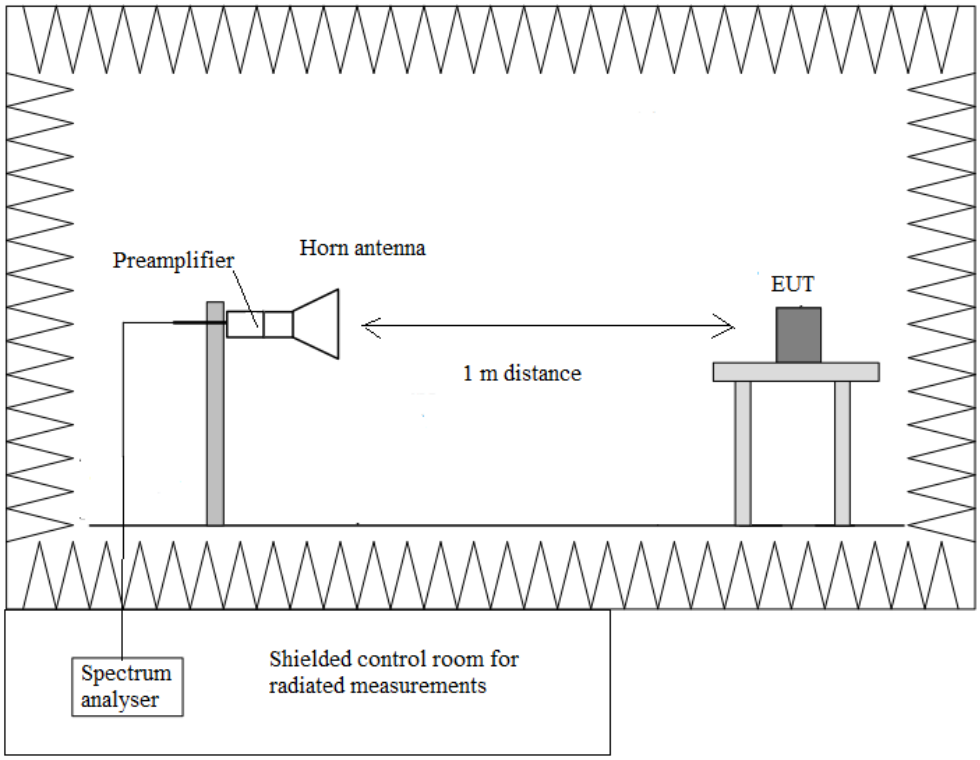
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz:



FCC 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2, 6.2.2.2, 6.2.3.2 & 6.2.4.2 Emission limitations radiated (Transmitter)

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), appearing outside of the band 13.110 MHz - 14.010 MHz band 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	29.54	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	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.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. 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.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-17 GHz and at distance of 1 m for the frequency range 17 GHz-40GHz.

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.

Test performed on the following worst cases in all relevant tests channels:

- **Mode Bluetooth EDR, 802.11 b, 802.11 a20 U-NII-1.**

Bluetooth EDR:	Middle Channel (2441 MHz). GFSK.
802.11 b:	Middle Channel (2437 MHz), BW=20 MHz, 1Mbps.
802.11 a20:	Middle Channel (5200 MHz), BW=20 MHz, 6Mbps.

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-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
960 MHz to 1 GHz	Quasi -PK	54 dBµV/m
1 GHz to 26 GHz	PK	74 dBµV/m
26 to 40 GHz	PK	68.23 dBµV/m (*) OR 74 dBµV/m (**)
1 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

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

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

Measurement Uncertainty (dB) <± 5.08

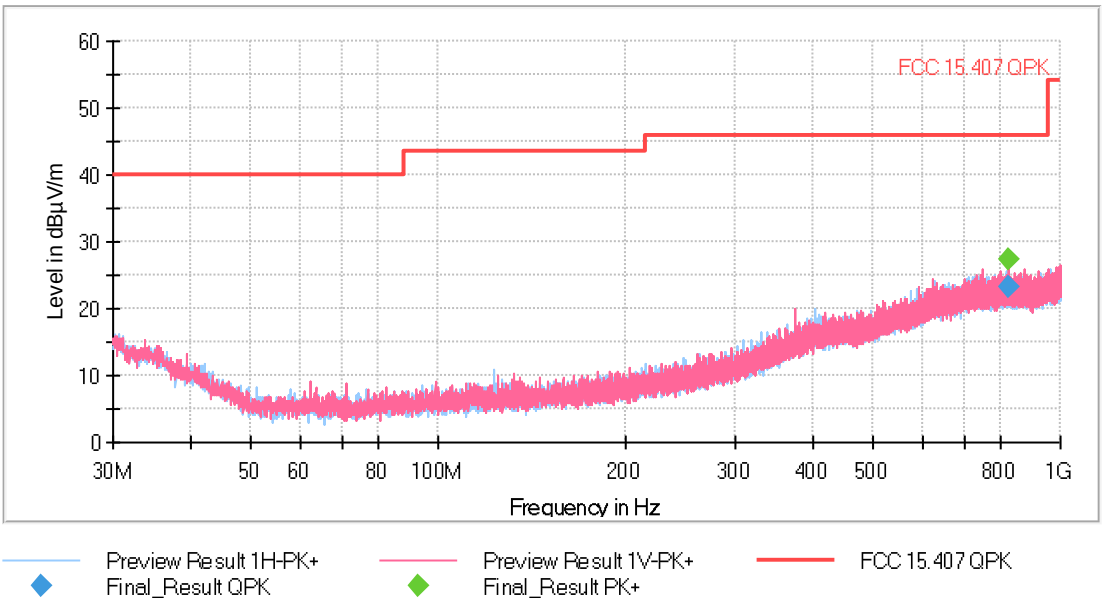
Frequency range 1 - 40 GHz

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

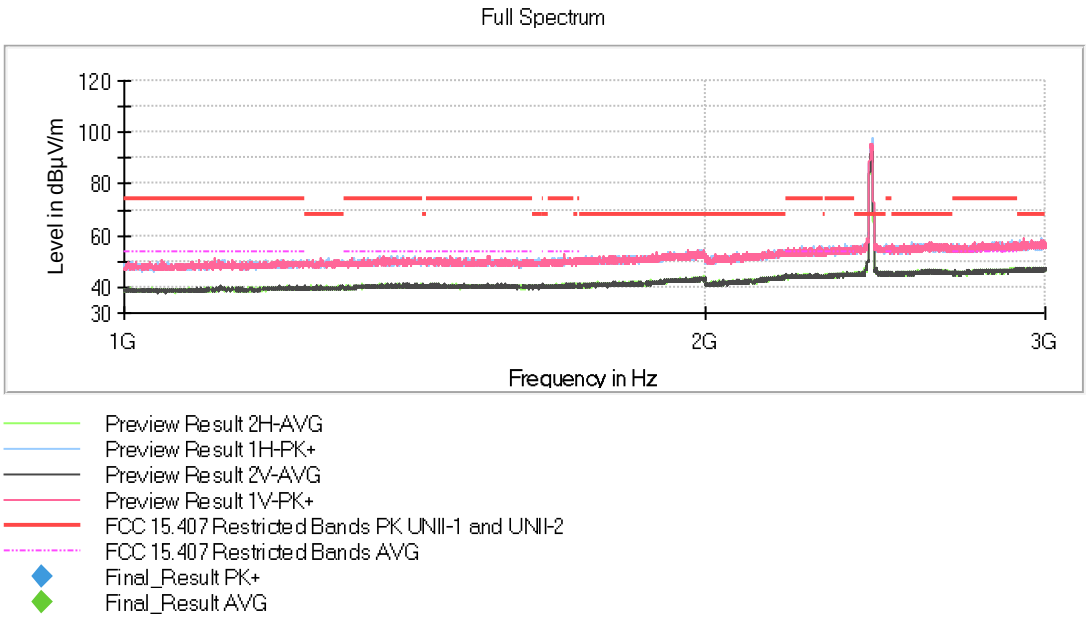
Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
10.39967	62.66	68.23	H	Peak	<± 5.13

Verdict: PASS

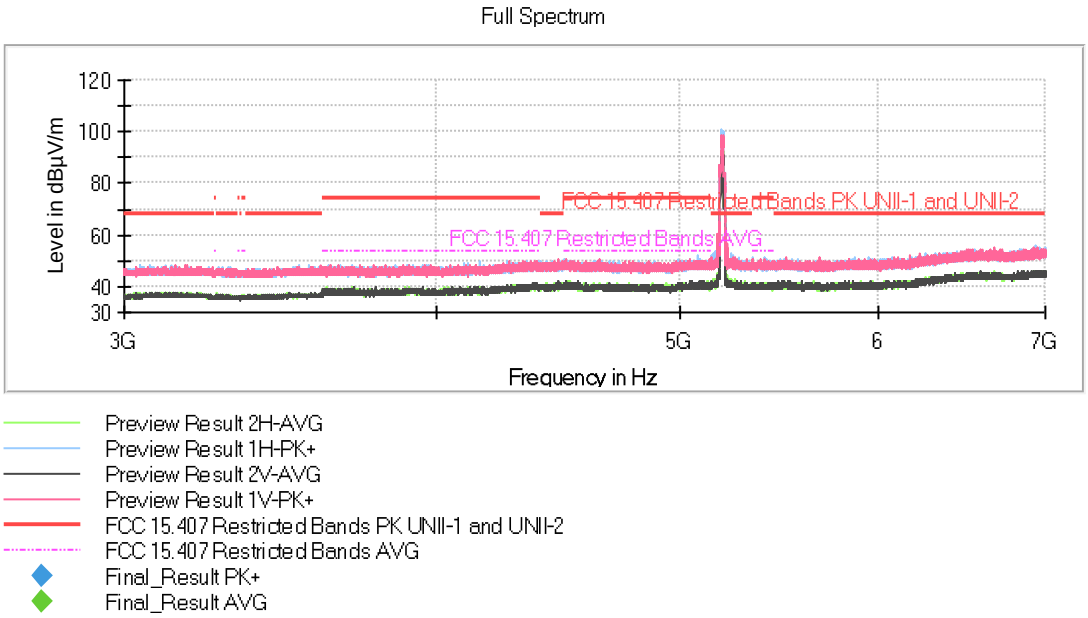
FREQUENCY RANGE 30 MHz - 1 GHz



FREQUENCY RANGE 1 – 7 GHz

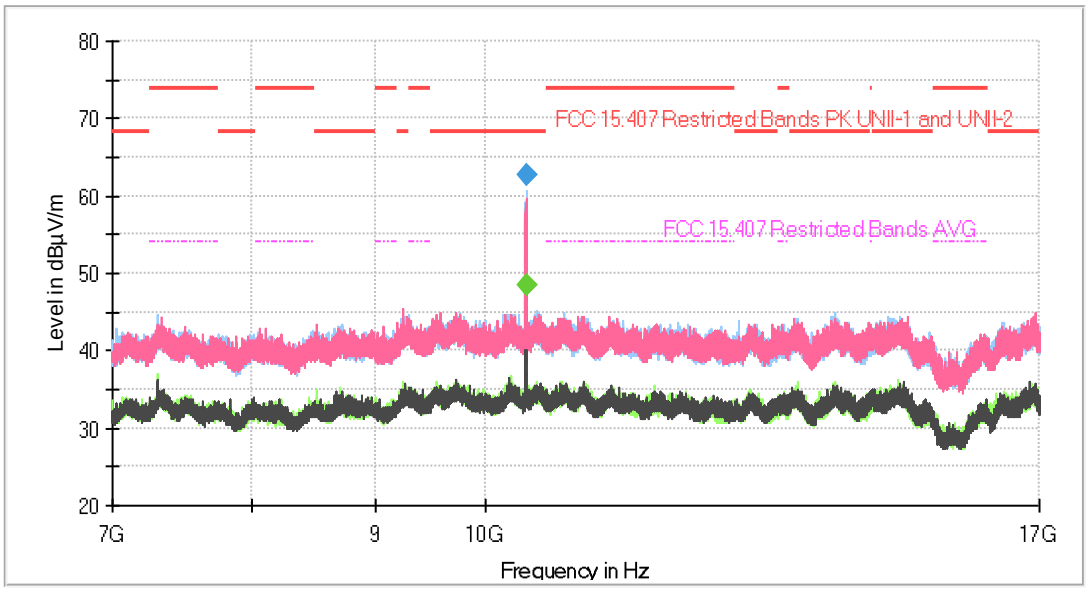


The peaks above the highest limit are the Bluetooth EDR, WLAN 2.4 GHz carrier frequencies.

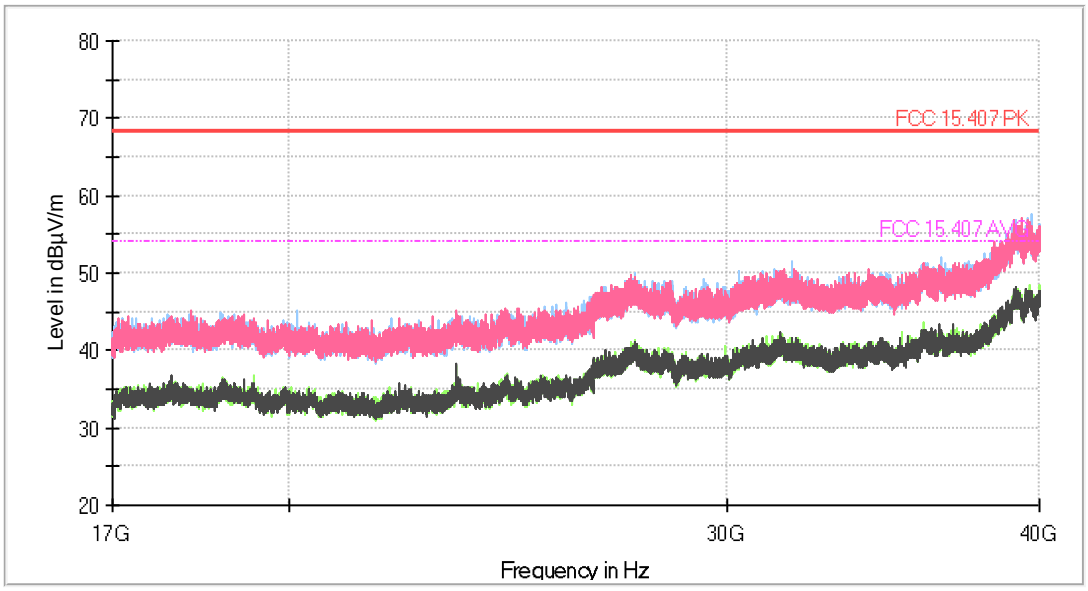


The peak above the highest limit is the WLAN 5 GHz carrier frequency.

FREQUENCY RANGE 7 - 17 GHz



FREQUENCY RANGE 17 - 40 GHz



- **Mode Bluetooth EDR, 802.11 b, 802.11 a20 U-NII-3.**

Bluetooth EDR:	Middle Channel (2441 MHz). GFSK.
802.11 b:	Middle Channel (2437 MHz), BW=20 MHz, 1Mbps.
802.11 a20:	Middle Channel (5785 MHz), BW=20 MHz, 6 Mbps.

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-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
960 MHz to 1 GHz	Quasi -PK	54 dBµV/m
1 GHz to 26 GHz	PK	74 dBµV/m
26 to 40 GHz	PK	68.23 dBµV/m (*) OR 74 dBµV/m (**)
1 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

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

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

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
823.3145	26.14	46	V	Quasi-peak	<± 5.08

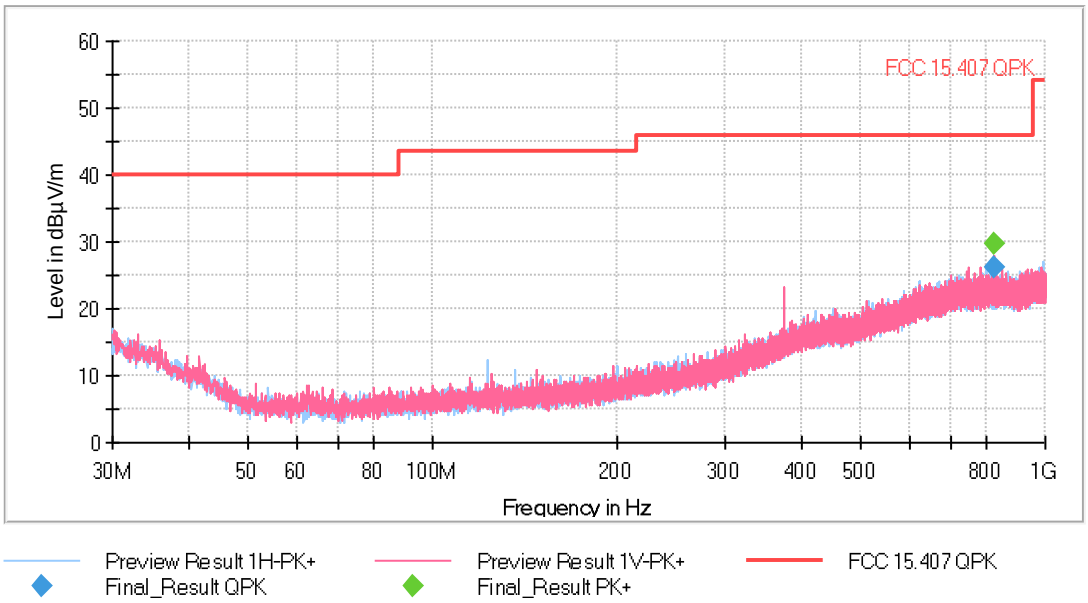
Frequency range 1 - 40 GHz

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

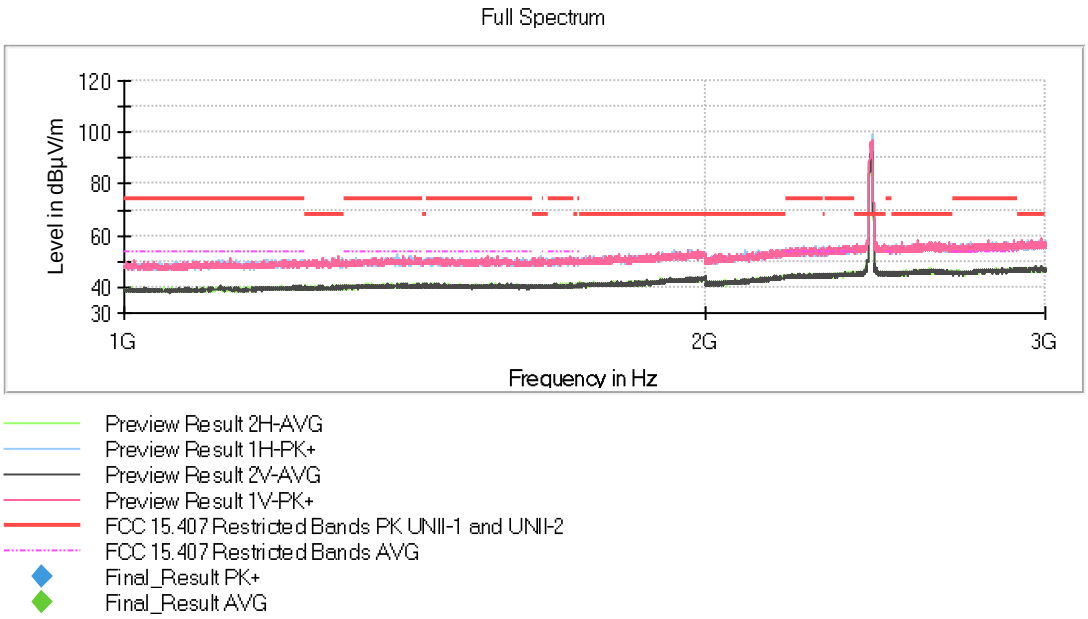
Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.5753	52.09	74	H	Peak	<± 5.13

Verdict: PASS

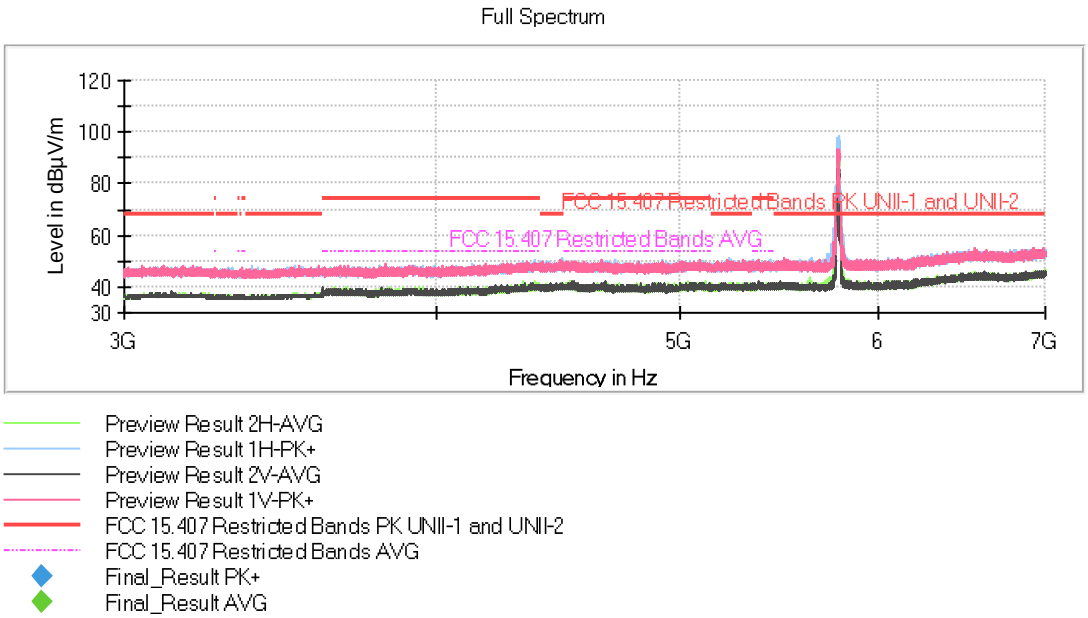
FREQUENCY RANGE 30 MHz - 1 GHz



FREQUENCY RANGE 1 – 7 GHz

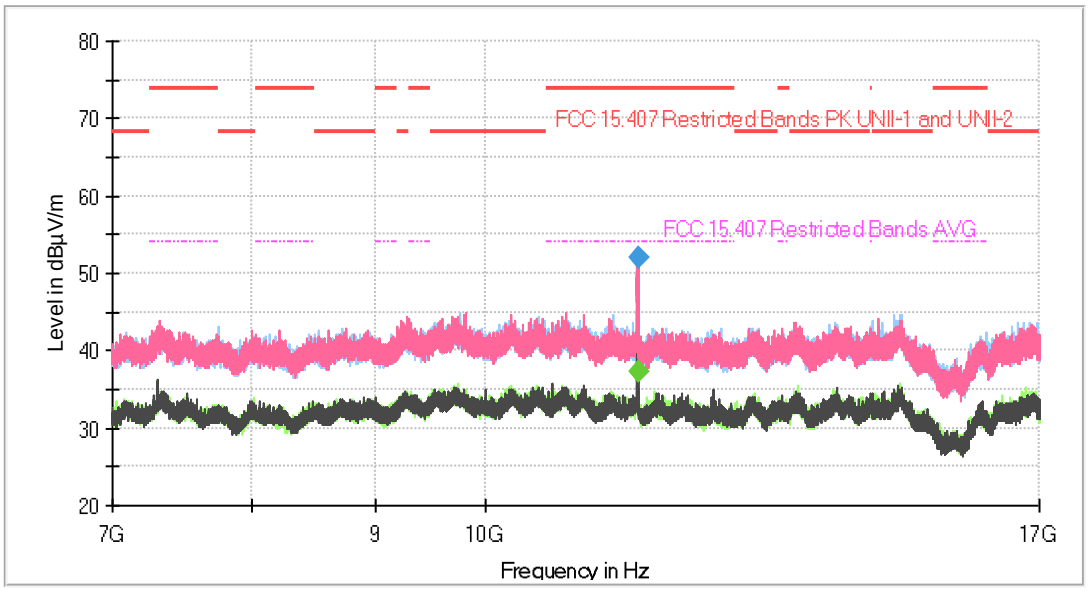
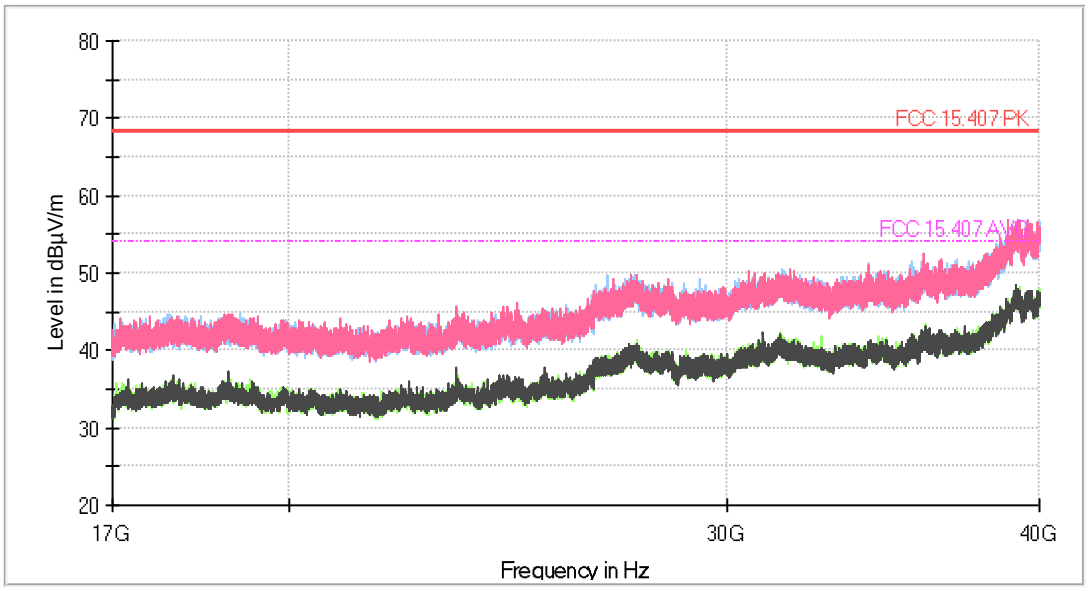


The peaks above the highest limit are the Bluetooth EDR, WLAN 2.4 GHz carrier frequencies.



The peak above the highest limit is the WLAN 5 GHz carrier frequency.

FREQUENCY RANGE 7 - 17 GHz



FREQUENCY RANGE 17 - 40 GHz