



Test report No:
NIE: 61152RRF.010

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 MID LFT2
Other identification of the product	HW version: D5 SW version: E17.100 FCC ID: 2AOUZNTG7MIDLFT2 IC: 23650-NTG7MIDLFT2
(*) Features	FM/AM/DAB, USB, Bluetooth, WLAN, GNSS.
Applicant	CONTINENTAL AUTOMOTIVE GMBH VDO-Strasse 1, 64832 Babenhausen, 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). 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.
Approved by (name / position & signature)	Jose Carlos Luque RF Lab. Supervisor
Date of issue	2020-08-14
Report template No	FDT08_22 (*) "Data provided by the client"

Index

Competences and guarantees4

General conditions.....4

Uncertainty.....4

Data provided by the client4

Usage of samples4

Test sample description.....5

Identification of the client6

Testing period and place6

Document history.....6

Environmental conditions7

Remarks and comments.....7

Testing verdicts.....8

Summary8

Appendix A: Test results.....9

Competences and guarantees

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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.

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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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General conditions

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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 MID LFT2 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
61152E/076	Automotive Infotainment System	NTG7 MID LFT2	COM652LB000002	2020/04/14
61152E/073	Harness	--	--	2020/04/14
60268/122	RF Cable with 4 Antennas	--	--	2019/09/30

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in 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)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Car Connector B	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Display Connector CID/PIP / RVC	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	USB Connector	<3m ^(x2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	Eth Connector (BR)	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	BT/WLAN-Antenna	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	FM/AM/DAB Ant	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	GNSS Antenna	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :	-						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input checked="" type="checkbox"/>	DC: 12V Car battery / attenuator (9,5-15,5V normal operation)					
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	<input checked="" type="checkbox"/>	Other: automotive headunit	
Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	n/a	-	
Accessories (not part of the test item)	Description	Type	Manufacturer
	Display	-	LG
	HARMANeco RasPi / headless	-	HBAS
	Cable harness	-	HBAS
	BT/WLAN-Antenna	-	Hirschmann
Documents as provided by the applicant	Description	File name	Issue date
	Technical Description	Technical Description NTG7_A15 200324 SOP2 AllVariant.doc	
	-		

⁽³⁾ Only for Medical Equipment

Identification of the client

CONTINENTAL AUTOMOTIVE GMBH
VDO-Strasse 1, 64832 Babenhausen, Germany

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-04-30
Date (finish)	2020-05-04

Document history

Report number	Date	Description
61152RRF.010	2020-08-14	First release

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

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

Temperature	Min. = 15 °C Max. = 35 °C
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: Nicolás Salguero, Javier Nadales and Cristina Calle.

Used instrumentation:

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. Hybrid Bilog Antenna 30MHz - 6GHz SUNOL SCIENCES CORPORATION JB6	2017/09	2020/09
4. RF Pre-amplifier, G>40 dB, 10 MHz-6 GHz BONN ELEKTRONIK BLNA 0160-01N	2020/02	2021/02
6. DC Power Supply 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
6. Digital Multimeter, FLUKE 175	2019/10	2020/10
7. Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
8. Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
9. RF Pre-amplifier G>40dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-1M	2020/05	2021/05
10. RF Pre-amplifier, 30dB, 500MHz-18GHz NARDA AMF-3D-00501800-24-10P	2019/12	2020/12
11. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
12. Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2019/09	2021/09
13. EMI Test Receiver 9kHz - 7GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10

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 15.31(h), 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2 & 6.2.4.2: - Emission limitations radiated (Transmitter)	P	(1)
<u>Supplementary information and remarks:</u> (1) Only co-location radiated spurious emission test was requested.		

Appendix A: Test results.

INDEX

TEST CONDITIONS.....11

FCC 15.31(h), 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2 & 6.2.4.2

Emission limitations radiated (Transmitter).....16

TEST CONDITIONS

POWER SUPPLY (V):

Vnominal: 12 Vdc
Type of Power Supply: External DC (Vehicle 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 wlan 0 core 1 (Worst Case):

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

802.11 a20 / n2040 / ac2040 / ac80:

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)
	Low	2402
	High	2480

	WLAN 2.4 GHz (IEEE 802.11 b/g/n20)/ DTS	
Mode:	802.11 n20 SISO: 1, 2, 5.5 & 11 Mbps.	
Channel Spacing:	20 MHz	
Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low	2412
	High	2462

	WLAN 5 GHz (IEEE 802.11 a20/n2040/ac204080) / U-NII-1	
Mode:	802.11ac VHT20: MCS0 to MCS9	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle	5200

	WLAN 5 GHz (IEEE 802.11 a20/n2040/ac204080) / U-NII-3	
Mode:	802.11n HT20: MCS0 to MCS7	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle	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 n20 / MCS0 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 ac20 / MCS0 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 n20 / MCS0 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 n20 / MCS0, WLAN 5GHz in 802.11 ac20 / MCS0.

* **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 n20 / MCS0, WLAN 5GHz in 802.11 n20 / MCS0.

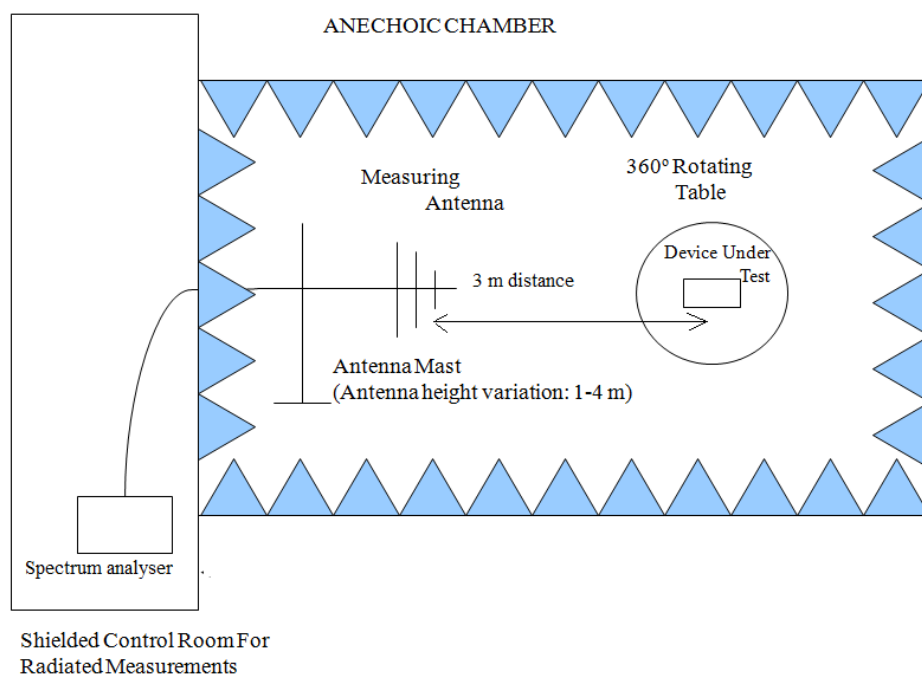
RADIATED MEASUREMENTS

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 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

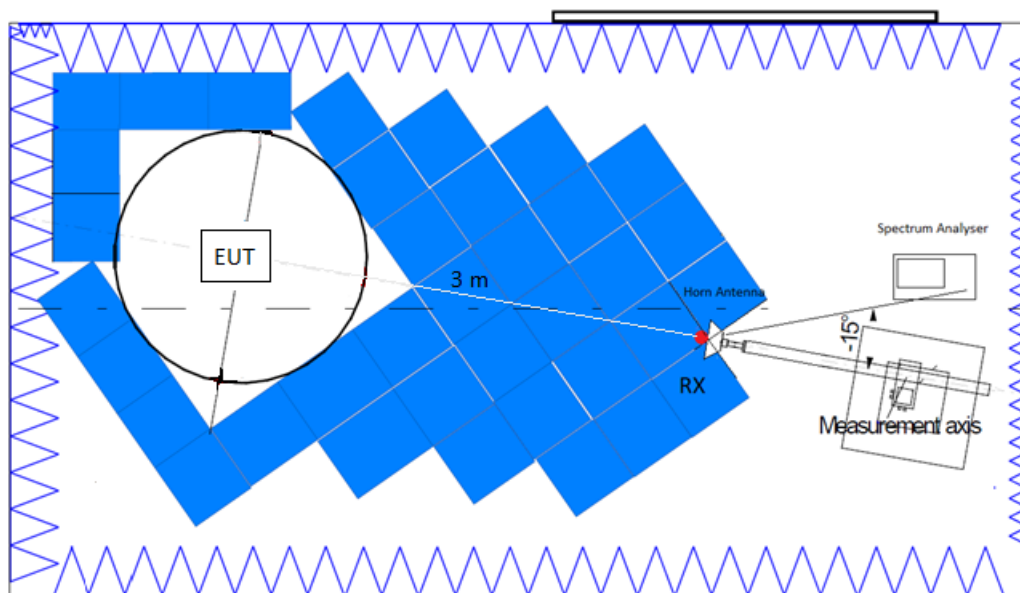
Measurements were made in both horizontal and vertical planes of polarization.

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

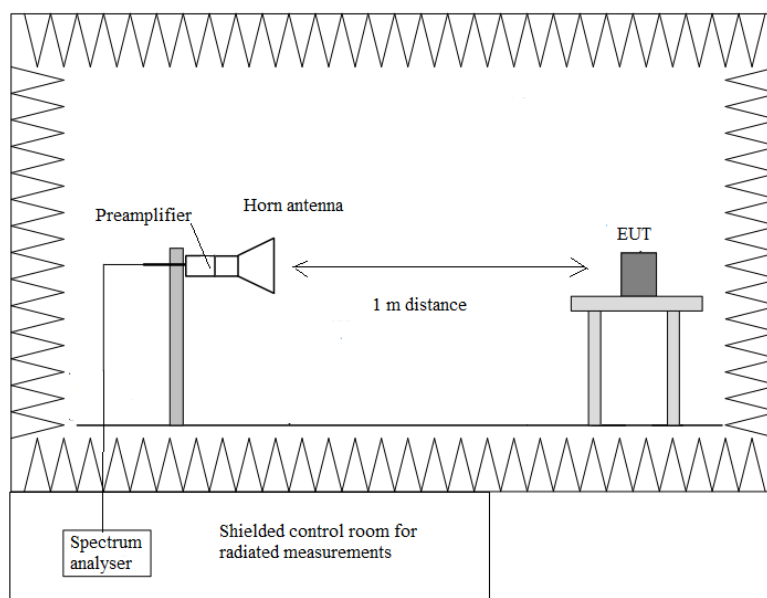
Radiated measurements setup 30 MHz < f < 1 GHz:



Radiated measurements setup $f > 1$ GHz up to 17 GHz:



Radiated measurements setup $f > 17$ GHz up to 40 GHz:



FCC 15.31(h), 15.209 (a), 15.247 (d), 15.407 (b) / RSS-Gen 8.9, RSS-247 5.5, 6.2.1.2 & 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 360° 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 1m for the frequency range 17 GHz-40 GHz and a distance of 3m for frequency range 30MHz-17GHz.

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 n20, 802.11 ac20 U-NII-1.**

Bluetooth EDR: Low Channel (2402 MHz). GFSK.
802.11 n20: BW=20 MHz, High Channel (2462 MHz), MCS0.
802.11 ac20: BW=20 MHz, Middle Channel (5200 MHz), MCS0.

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)	Polarization	Detector	Measurement Uncertainty (dB)
31.9400	22.57	V	Quasi-peak	<± 5.08
140.2890	23.22	V	Quasi-peak	<± 5.08
396.0295	24.90	H	Quasi-peak	<± 5.08
500.0135	28.62	H	Quasi-peak	<± 5.08
749.9825	28.20	H	Quasi-peak	<± 5.08
781.4590	24.16	V	Quasi-peak	<± 5.08

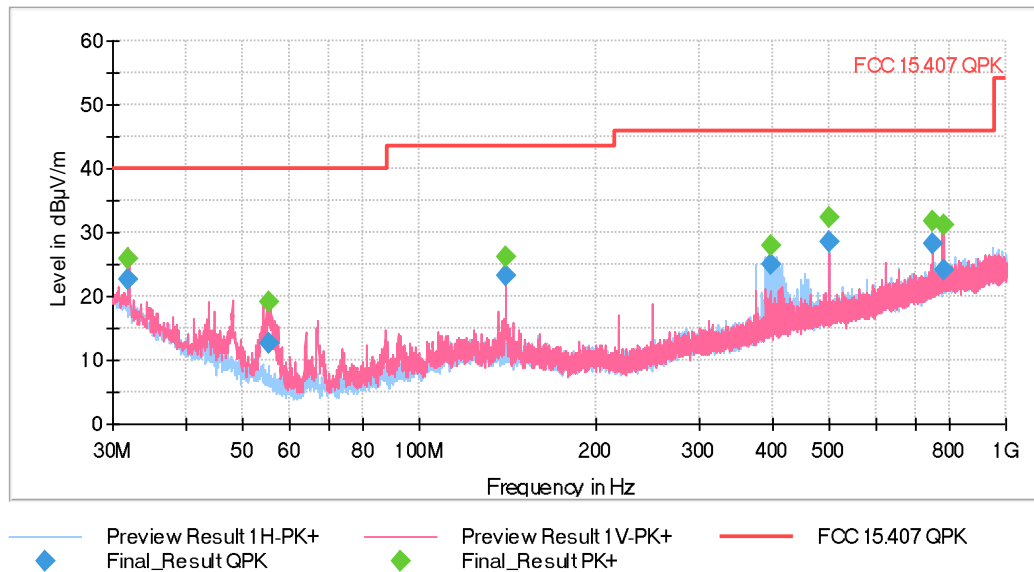
Frequency range 1 - 40 GHz

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

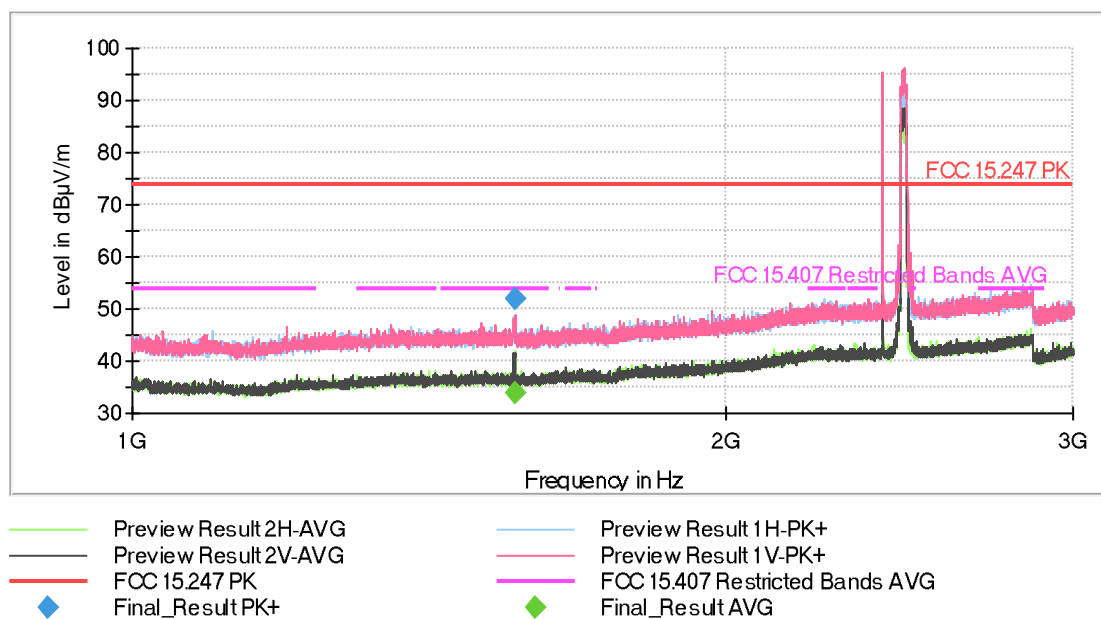
Spurious frequency (GHz)	Emission Level (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.5628	51.87	H	Peak	<± 4.11
10.3966	65.67	H	Peak	<± 5.13
	50.18		Average	<± 5.13

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

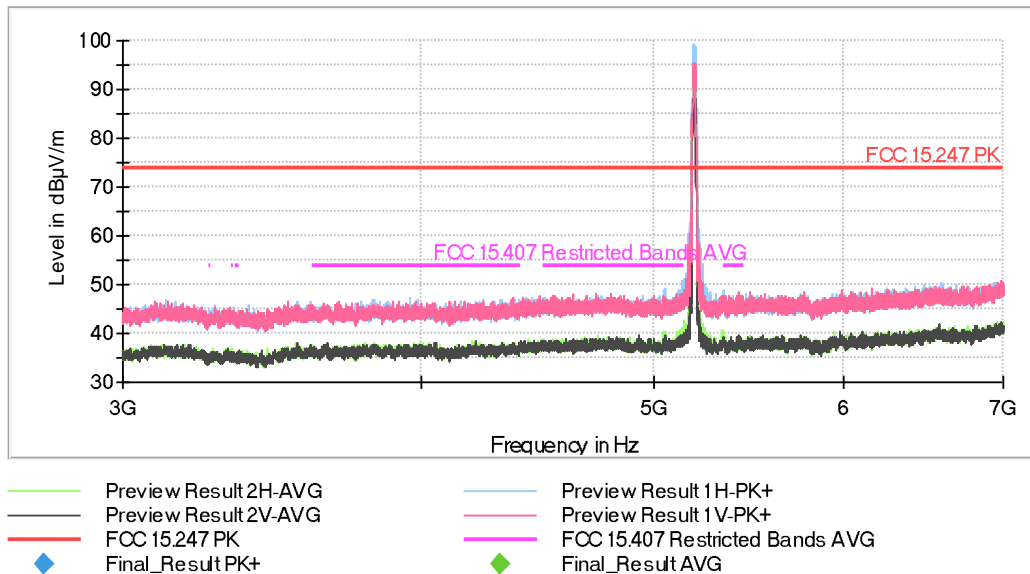


FREQUENCY RANGE 1 – 3 GHz



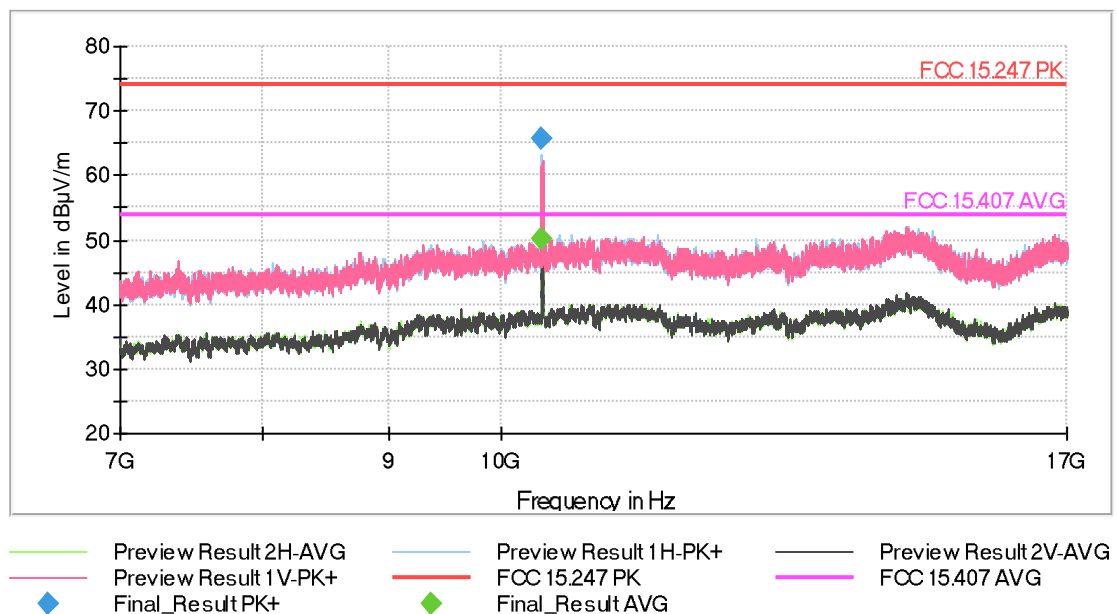
The peaks above the highest limit are the Bluetooth EDR and WLAN 2.4 GHz carrier frequencies.

FREQUENCY RANGE 3 - 7 GHz

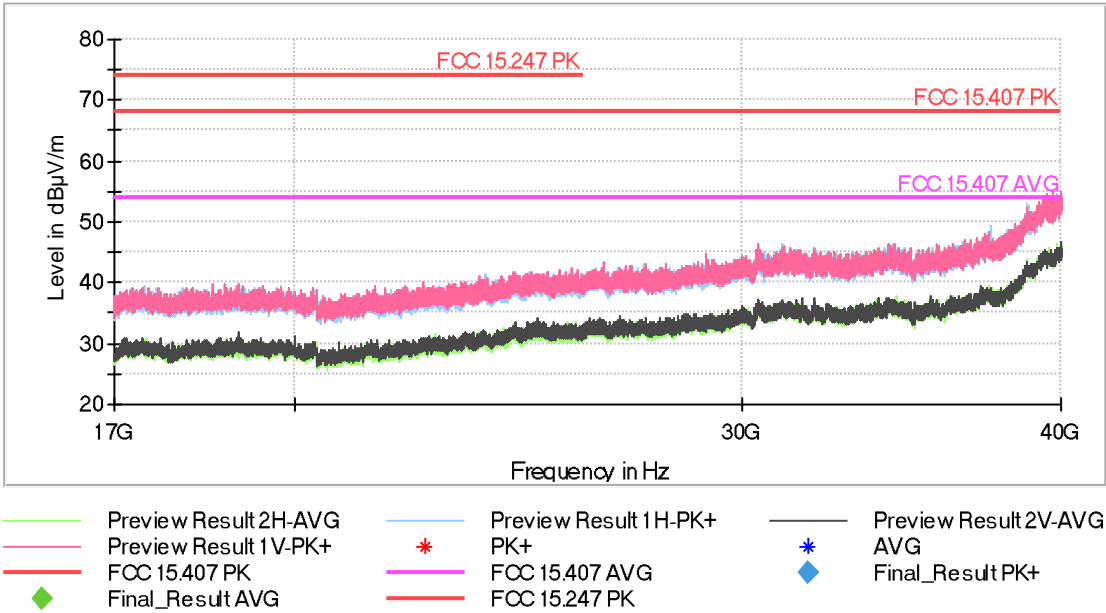


The peaks above the highest limit is the WLAN 5 GHz carrier frequencies.

FREQUENCY RANGE 7 - 17 GHz



FREQUENCY RANGE 17 - 40 GHz



• **Mode Bluetooth EDR, 802.11 n20, 802.11 n20 U-NII-3.**

Bluetooth EDR: High Channel (2480 MHz). GFSK.
802.11 n20: BW=20 MHz, Low Channel (2412 MHz), MSC0.
802.11 n20: BW=20 MHz, Middle Channel (5785 MHz), MSC0.

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)	Polarization	Detector	Measurement Uncertainty (dB)
31.988	21.53	V	Quasi-peak	<± 5.08
55.899	20.54	V	Quasi-peak	<± 5.08
140.289	25.92	V	Quasi-peak	<± 5.08
500.0135	28.18	H	Quasi-peak	<± 5.08
750.031	28.13	H	Quasi-peak	<± 5.08

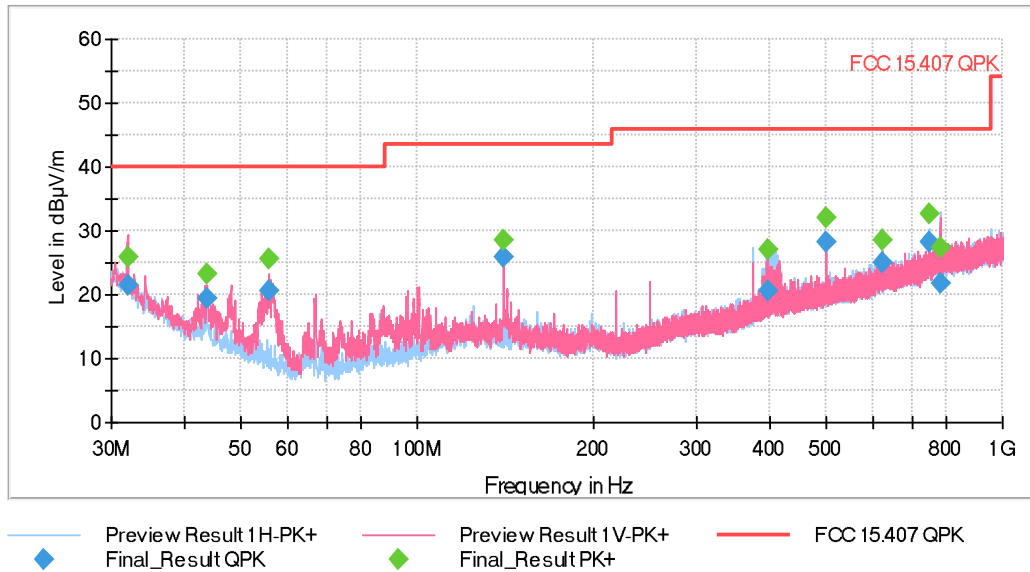
Frequency range 1 - 40 GHz

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

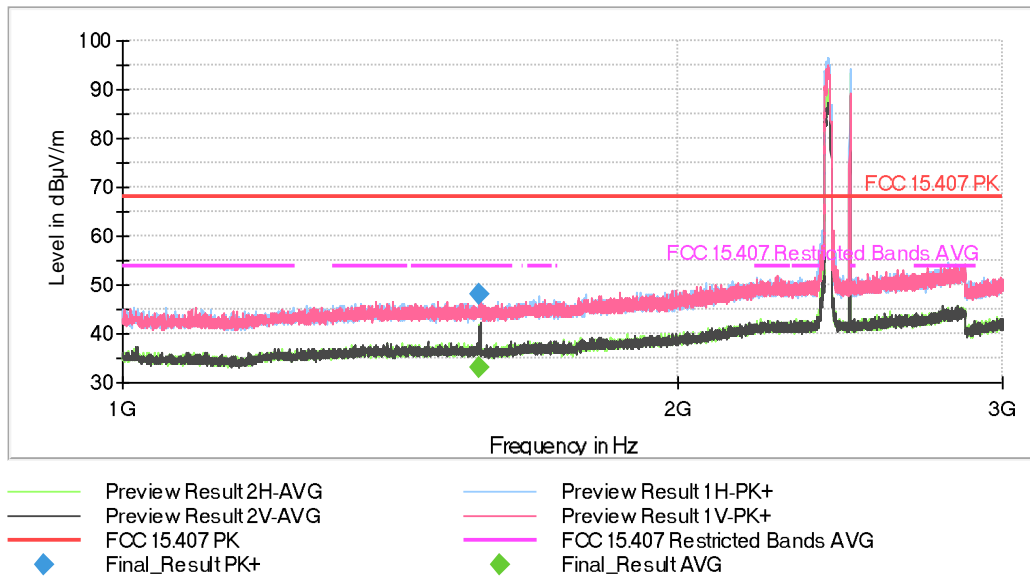
Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.5618	47.94	H	Peak	<± 4.11
11.5741	58.33	V	Peak	<± 5.13
	43.54		Average	<± 5.13

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

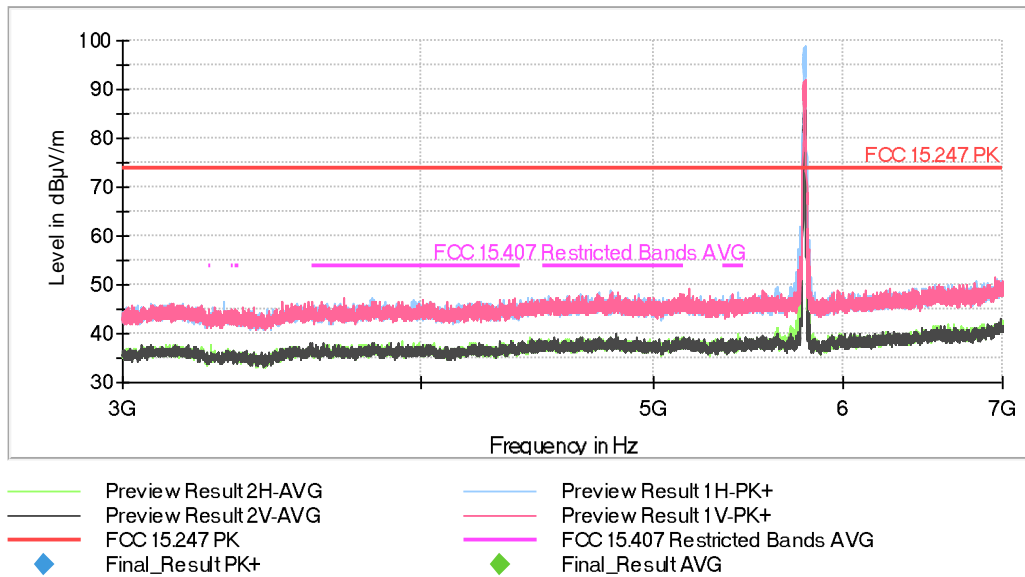


FREQUENCY RANGE 1 – 3 GHz



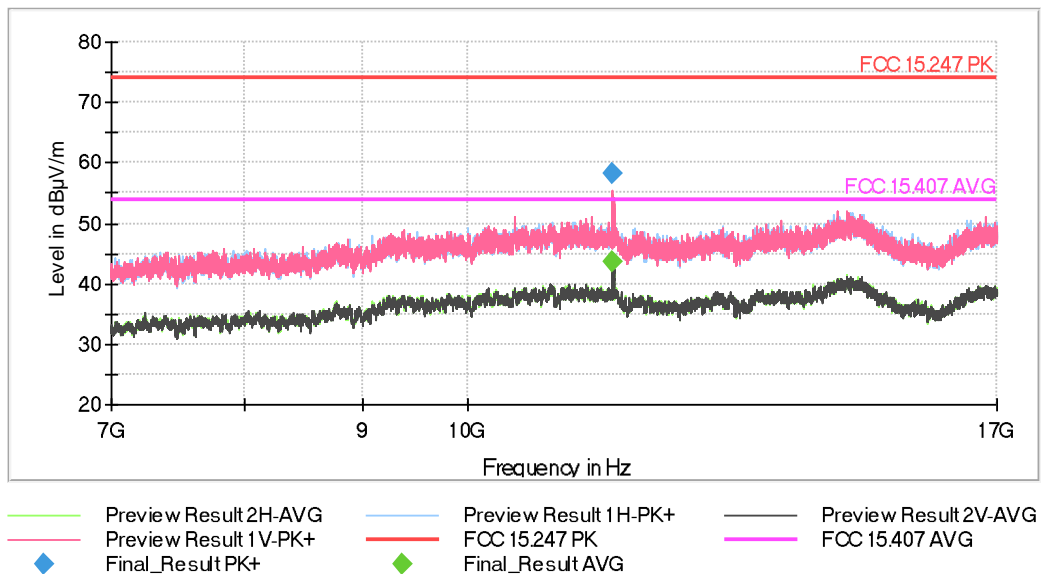
The peaks above the highest limit are the Bluetooth EDR and WLAN 2.4 GHz carrier frequencies.

FREQUENCY RANGE 3 – 7 GHz



The peaks above the highest limit is the WLAN 5 GHz carrier frequencies.

FREQUENCY RANGE 7 - 17 GHz



FREQUENCY RANGE 17 - 40 GHz

