



Test report No:
NIE: 56925RRF.003

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	BMW
(*) Model and /or type reference	MGU F
Other identification of the product	HW version: HW3.1 SW version: 19w13.2-1-36 FCC ID: T8GMGUF IC: 6434A-MGUF
(*) Features	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 (10-1-18) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. Band U-NII-3 (5725 MHz – 5850 MHz). USA FCC Part 15.247 (10-1-18) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-18) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). -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)	Rafael López Martín EMC Consumer & RF Lab. Manager
Date of issue	2019-11-06
Report template No	FDT08_22 (*) "Data provided by the client"

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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 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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General conditions

1. This report is only referred to the item that has undergone the test.
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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 MGU F is an automotive head unit to be installed in cars with the following features: Bluetooth, WLAN, 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 N°	Description	Model	Serial N°	Date of reception
56925B/058	Automotive Infotainment System	MGU F	B264D\$0K8951102	2019/08/07
56925B/053	Antenna	--	--	2019/05/30
56925B/054	Antenna	--	--	2019/05/30
56925B/055	Antenna	--	--	2019/05/30
56925B/015	Harness	--	--	2019/05/30
56925B/024	Interface Board	--	--	2019/05/30

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 length [m]	Attached during test	Shielded			
	Not provided data			☐	☐			
Supplementary information to the ports..... :	Not provided data							
Rated power supply	Voltage and Frequency		Reference poles					
			L1	L2	L3	N	PE	
	☒	DC: 12Vdc.						
Rated Power	Not provided data							
Clock frequencies..... :	Not provided data							
Other parameters	Not provided data							
Software version	19w13.2-1-36							
Hardware version	HW3.1							
Dimensions in mm (W x H x D) ...:	Not provided data							
Mounting position	☒	Other: Car radio						
Modules/parts..... :	Module/parts of test item		Type			Manufacturer		
	Not provided data							

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)	2019-10-18
Date (finish)	2019-10-21

Document history

Report number	Date	Description
56925RRF.003	2019-11-06	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 %

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.

Used instrumentation:

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	EMI Receiver ROHDE AND SCHWARZ ESU40	2018/06	2020/06
3.	Pre-Amplifier G>40dB 10MHz-6GHz, BONN ELEKTRONIK, BLNA 0160-01N	2019/02	2020/02
4.	Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2017/04	2020/04
5.	Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2018/02	2020/02
6.	RF Pre-amplifier, 40 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2019/04	2020/04
7.	Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2018/02	2020/02
8.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2016/11	2019/11
9.	Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
10.	DC Power Supply Keysight Technologies U8002A	---	---
11.	Digital multimeter FLUKE 179	2019/06	2020/06

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)
<u>Supplementary information and remarks:</u> (1) Only co-location radiated spurious emission test was requested.		

Appendix A: Test results.

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TEST CONDITIONS12

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)17

TEST CONDITIONS

POWER SUPPLY (V):

V nominal: 12 Vdc.
Type of Power Supply: External power supply (Car Battery).

ANTENNA:

Bluetooth EDR and 802.11 bgn20 1x1:

Type of Antenna: External antenna.
Maximum Declared Antenna Gain: -6.2 dBi (Antenna gain plus antenna cable loss).

802.11 a20 / n2040 / ac2040 / ac80 1x1:

Type of Antenna: External antenna.
Maximum Declared Antenna Gain: -5.4 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: 38	2440

	WLAN (IEEE 802.11 b/g/n2040 1x1) / Digital Transmission System (DTS)	
Mode:	802.11 g: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
Channel Spacing:	20 MHz	
Frequency Range:	2412 MHz to 2472 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Middle: 6	2437

	WLAN (IEEE 802.11 a20/n2040/ac204080 1x1) / U-NII-1	
Mode:	802.11 a20: 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 (IEEE 802.11 anac) / U-NII-3	
Mode:	802.11 a20: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO)	
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.

Transmission modes selected with 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.

* 2.4 GHz WLAN: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 g / 6Mbps mode configuration as this mode was found to transmit higher EIRP than all the other 2.4 GHz WLAN modes.

* 5 GHz WLAN 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 to transmit higher EIRP than all the other 5 GHz WLAN modes.

* 5 GHz WLAN U-NII-3 band: Transmitter radiated spurious emissions tests were performed with the EUT transmitting in 802.11 a20 / 6Mbps mode configuration as these modes were found to transmit higher EIRP than all the other 5 GHz WLAN modes.

Simultaneous transmission modes selected:

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

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

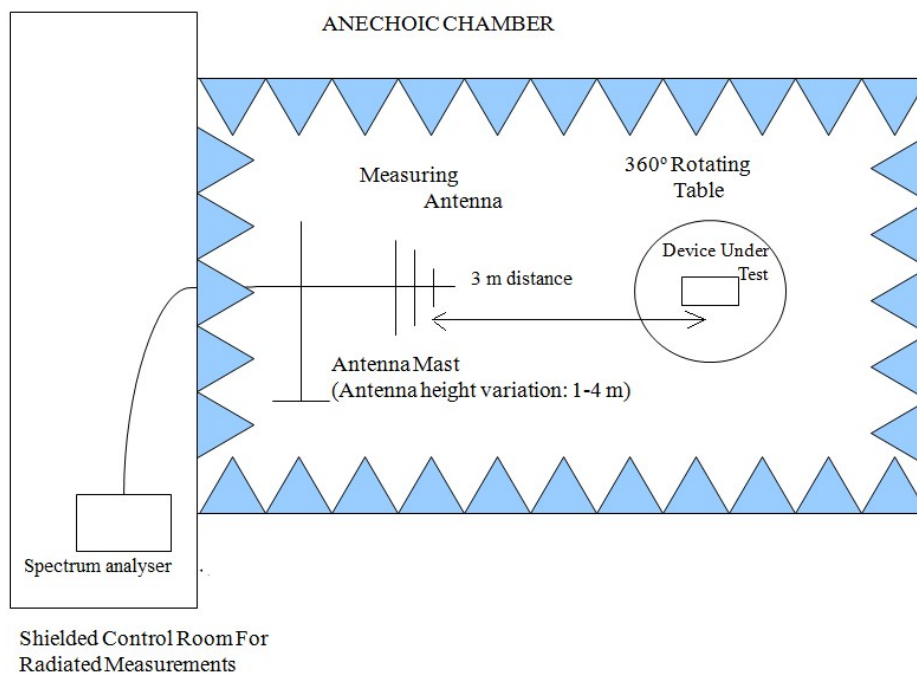
RADIATED MEASUREMENTS

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.

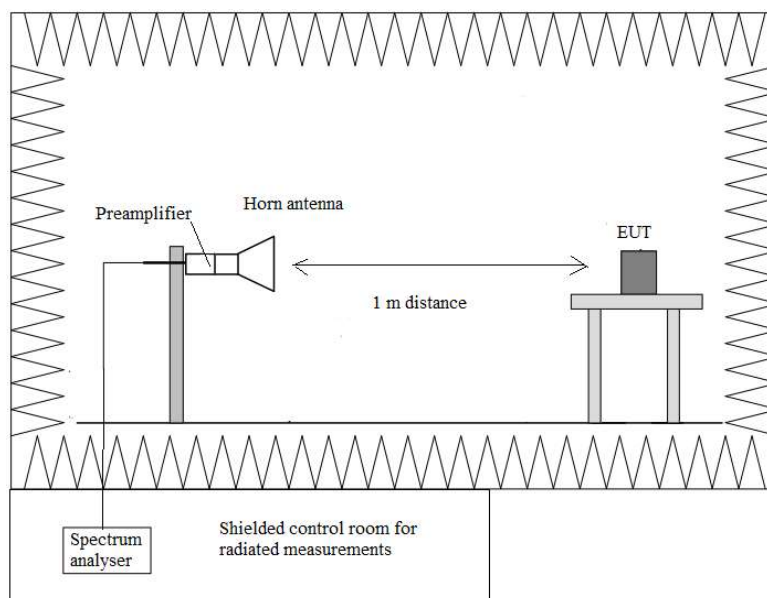
Measurements were made in both horizontal and vertical planes of polarization.

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

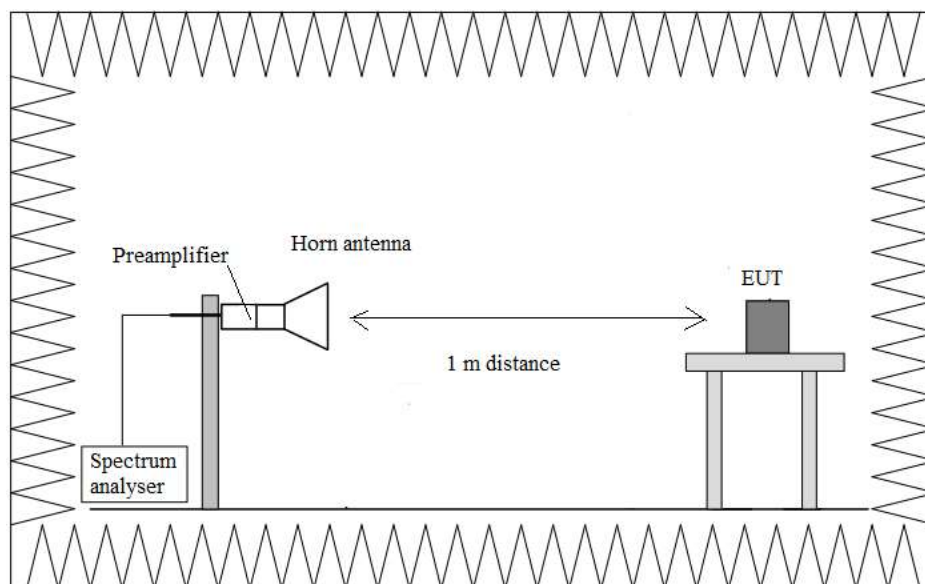
Radiated measurements setup $30 \text{ MHz} < f < 1 \text{ GHz}$:



Radiated measurements setup $f > 1 \text{ GHz}$ up to 18 GHz:



Radiated measurements setup $f > 18$ GHz up to 40 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	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 3 m for the frequency range 30 MHz-40 GHz.

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 BR, 802.11 b, 802.11 a20 U-NII-1.**

Bluetooth EDR:	GFSK (2440 MHz).
802.11 g:	20MHz, 6Mbps (2437 MHz).
802.11 a20:	20MHz, 6Mbps Port 0 (5200 MHz).

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)	<± 3.04
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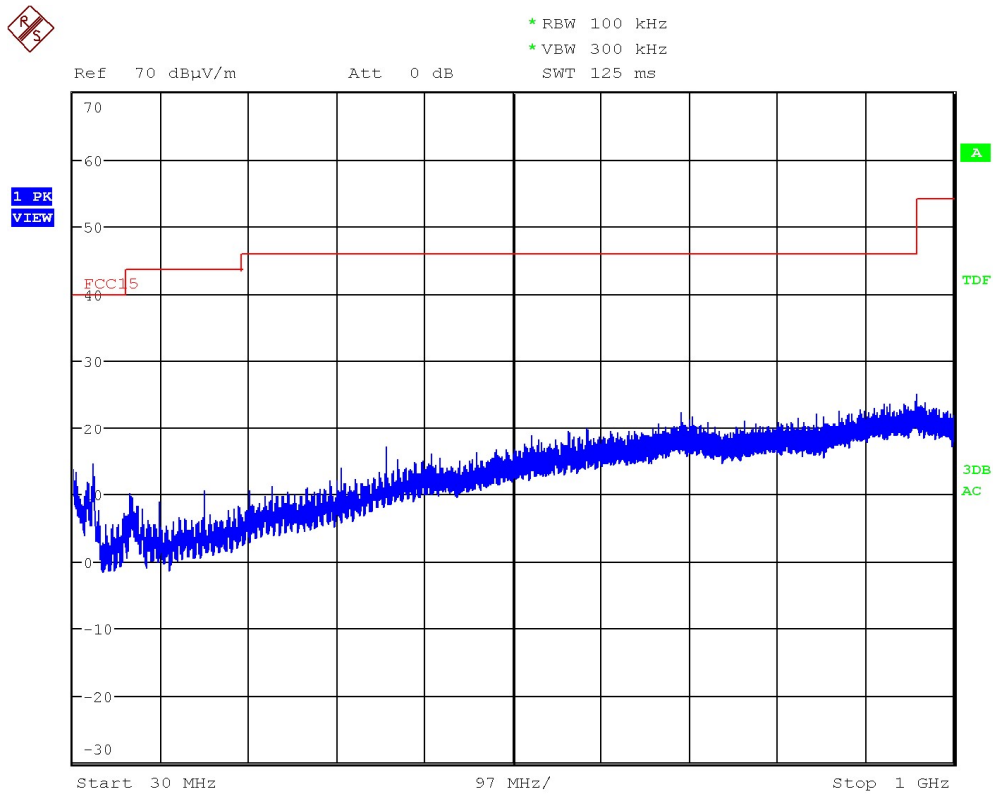
Frequency range 1 - 40 GHz

Spurious frequencies detected closest to and below the limit:

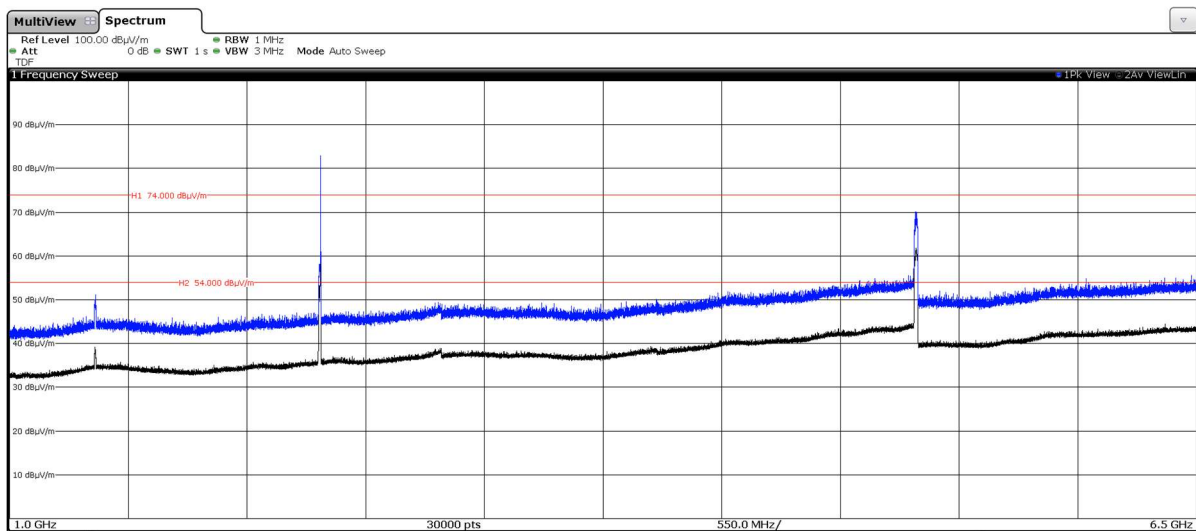
Spurious frequency (GHz)	Emission Level (dBμV/m)	Limit (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.39756	51.18	74	H	Peak	<±2.72
10.00053	44.54	74	V	Peak	<±4.72
10.39883	49.05	74	H	Peak	<±4.72
15.60299	43.16	74	H	Peak	<±4.72
20.00045	35.29	74	V	Peak	<±4.72

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

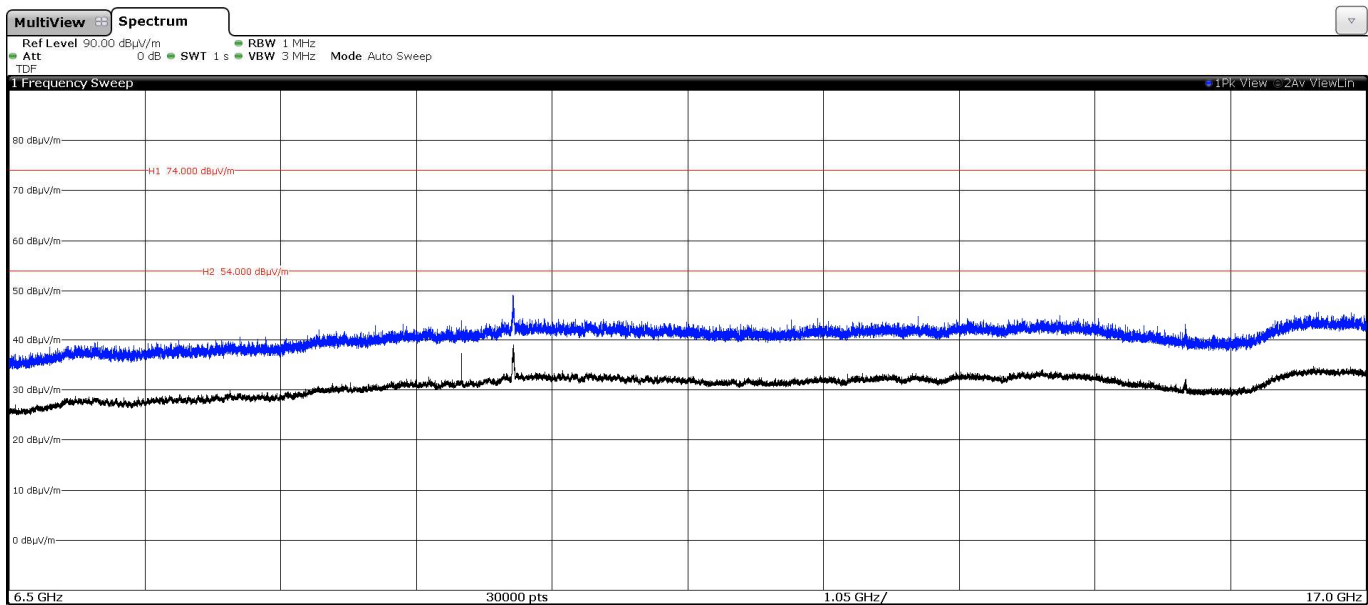


FREQUENCY RANGE 1 – 6.5 GHz

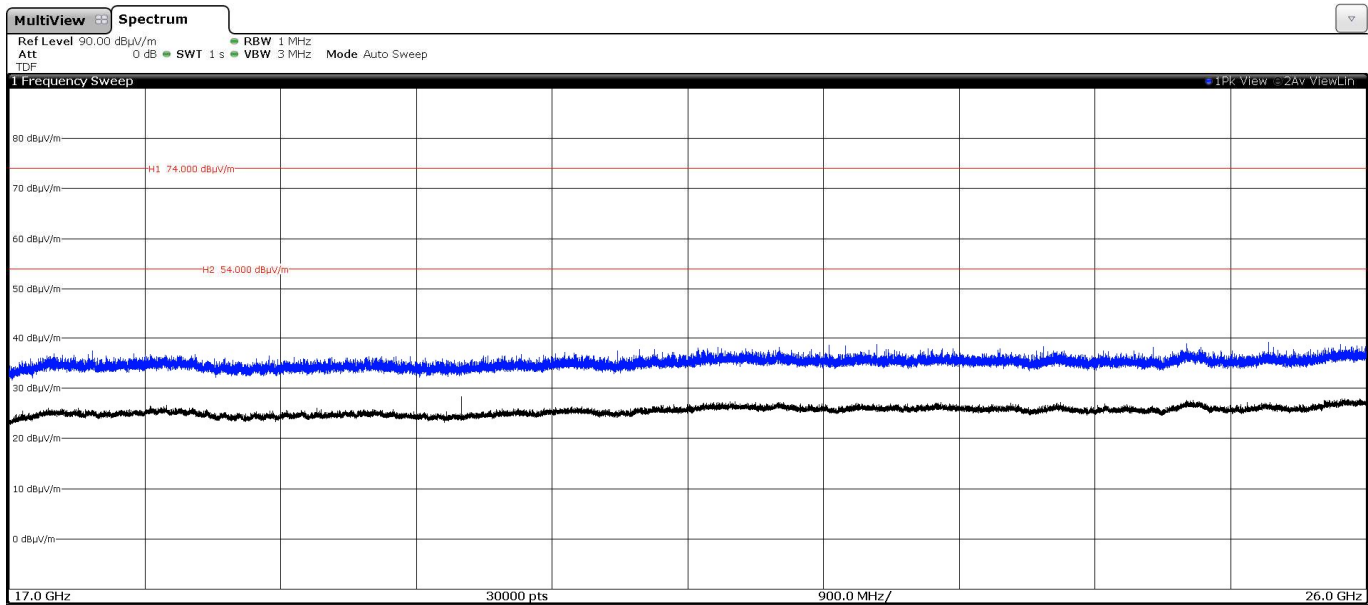


The peaks above the limits are the Bluetooth EDR, Wi-Fi 2.4 GHz and Wi-Fi 5 GHz carrier frequencies.

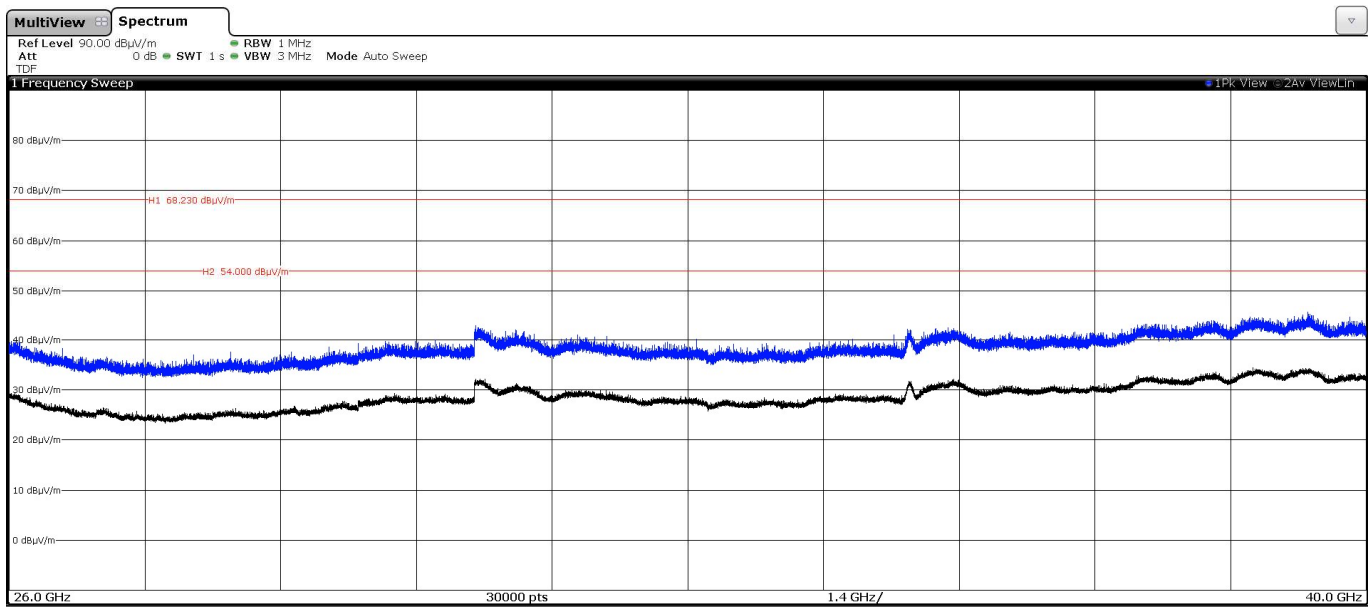
FREQUENCY RANGE 6.5 - 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz



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

Bluetooth EDR:	GFSK (2440 MHz).
802.11 b:	20MHz, 6Mbps (2437 MHz).
802.11 a20:	20MHz, 6Mbps (5785 MHz).

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.

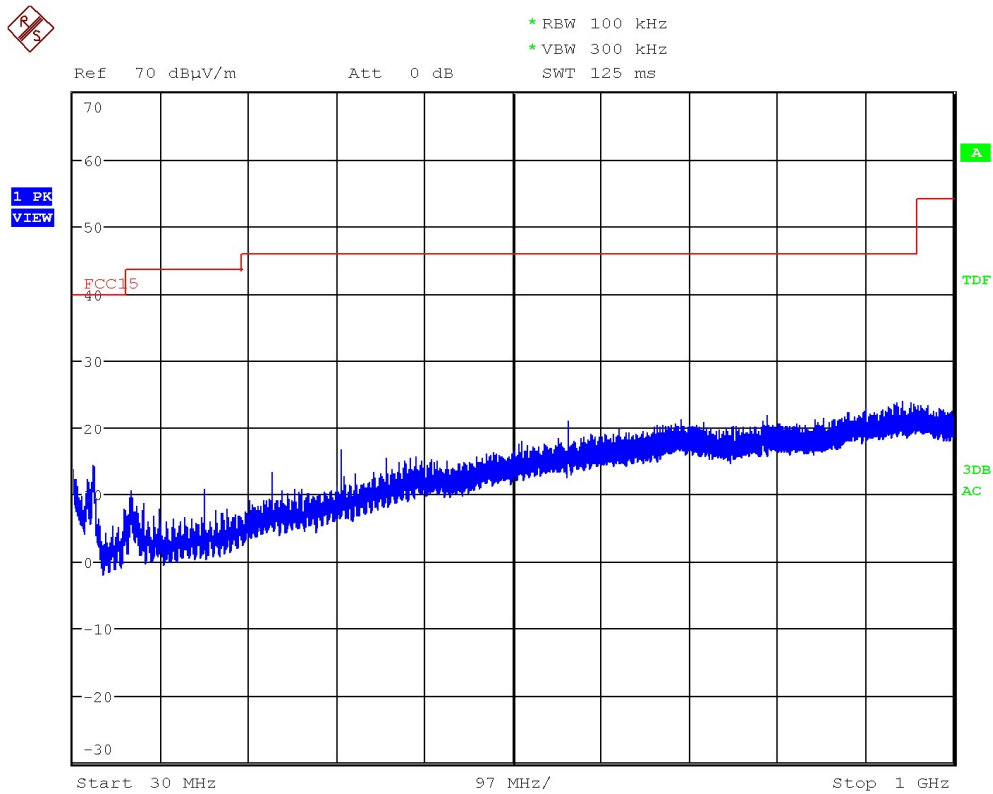
Frequency range 1 - 40 GHz

Spurious frequencies detected closest to and below the limit:

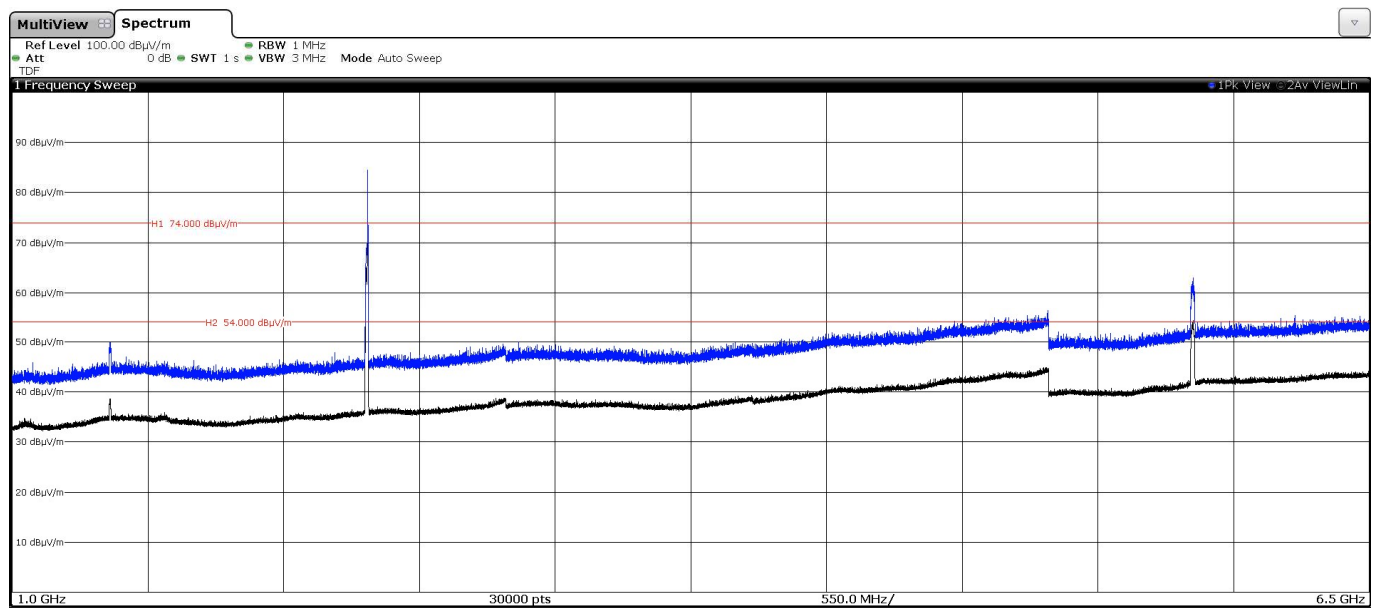
Spurious frequency (GHz)	Emission Level (dBμV/m)	Limit (dBμV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.39573	50.3	74	H	Peak	<±2.72
10.00018	44.49	74	V	Peak	<±4.72
11.56888	51.51	74	H	Peak	<±4.72
17.35805	48.68	74	H	Peak	<±4.72
20.00045	35.12	74	V	Peak	<±4.72

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

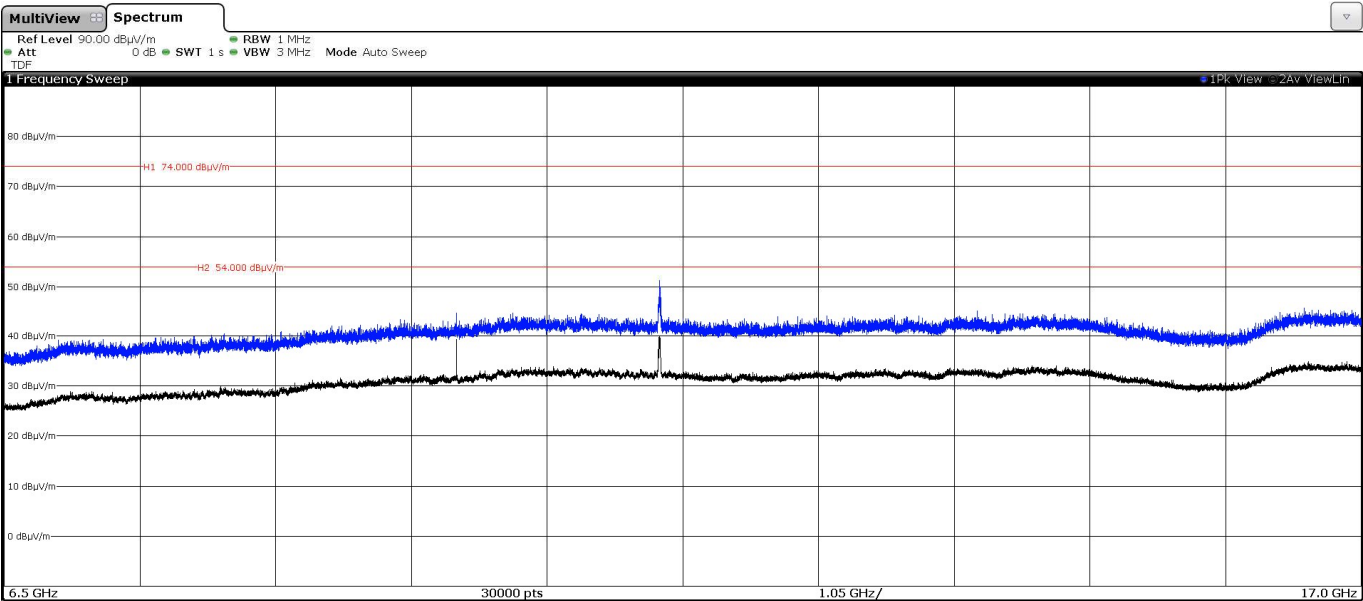


FREQUENCY RANGE 1 – 6.5 GHz

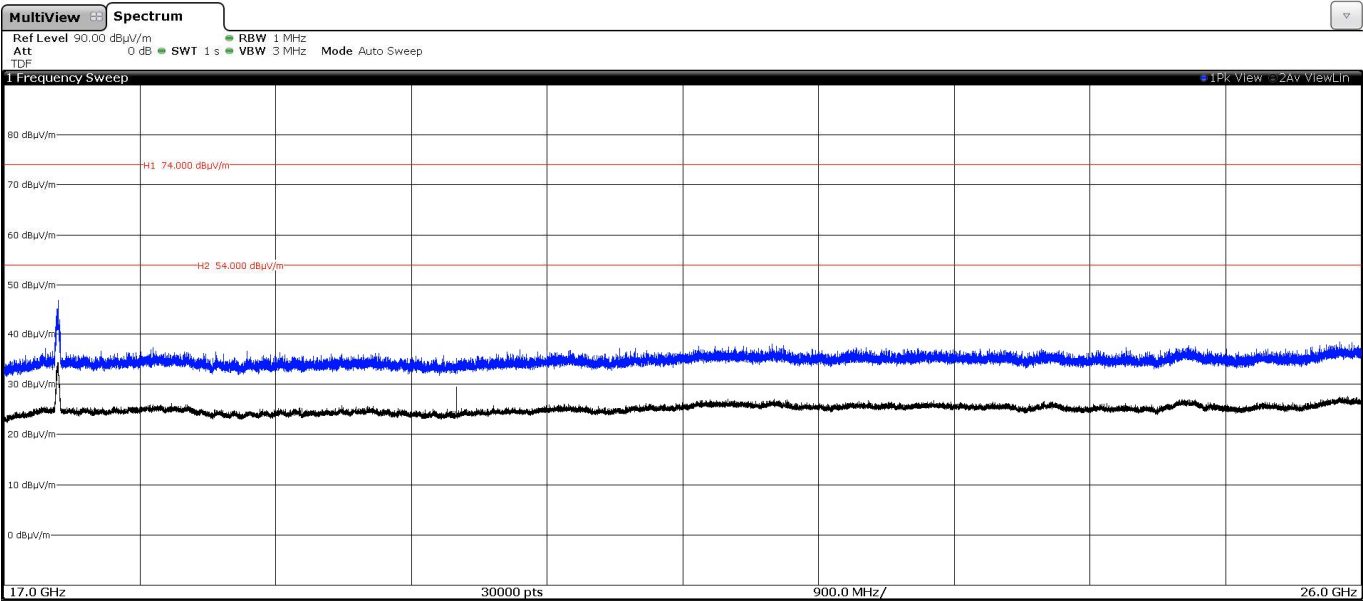


The peaks above the limits are the Bluetooth EDR, Wi-Fi 2.4 GHz and Wi-Fi 5 GHz carrier frequencies.

FREQUENCY RANGE 6.5 - 17 GHz



FREQUENCY RANGE 17 - 26 GHz



FREQUENCY RANGE 26 - 40 GHz

