



Test Report No:
3817ERM.009A2

Partial Test report

USA FCC Part 15.247, 15.407 15.209, 15.207
CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Automotive infotainment System
(*) Trademark	BMW
(*) Model and /or type reference	MGU21A
Other identification of the product	FCC ID: T8GMGU21A IC: 6434A-MGU21A
(*) Features	USB 2.0 (including support for Apple Devices), Bluetooth, WLAN Modul 2.4 / 5 GHz, GNSS, AR-CAM input, Video-out APIX3, CAN, 100Base-T1 and 1000Base-T1. HW Version: 2.1 SW Version: 22w36.5-1
Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH. Becker-Goering-Str. 16; 76307 Karlsbad, Germany
Test method requested, standard	USA FCC Part 15.247, 10-1-20 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz USA FCC Part 15.407 10-1-20 Edition : Unlicensed National Information Infrastructure Devices. General technical requirements. USA FCC Part 15.209 10-1-20 Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). 558074 D01 15.247 Meas Guidance v05r02. Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under section §15.247 of the FCC Rules ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	See Appendix A
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager
Date of issue	01-24-2023
Report template No	FDT08_23 (*) "Data provided by the client"

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Acronyms

Acronym ID	Acronym Description
# of Tx Chains	Number of Transmission Chains
BEL	Band Edge Left
BER	Band Edge Right
DC	Duty Cycle
Freq	Frequency
Freq Rng	Frequency Range
Lvl Meas Pk	Level Pre Measurement Peak
MP	Measurement Point
MU	Medium Utilization Factor
Max EIRP	Maximum Burst EIRP
Max RMS	Maximum Burst RMS
Max Tx Seq	Maximum Transmission Sequence Time
Min Tx Gap	Minimum Transmission Gap Time
Mod	Modulation
Occ Ch BW	Occupied Channel Bandwidth
PSD	Power Spectrum Density
Port	Active Port
T	Temperature
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level

Competences and guarantees

DEKRA Certification Inc. is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation), to perform the tests indicated in the Certificate 2764.01

DEKRA Certification Inc. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Certification Inc. has a calibration and maintenance program for its measurement equipment.

DEKRA Certification Inc. 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 Certification at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Certification Inc.
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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Certification internal document PODT000.

Test case	Frequency (MHz)	U ($k=2$)	Units
Radiated Spurious Emission	30-180	4.27	dB
	180-1000	3.14	dB
	1000-18000	3.30	dB
	18000-40000	3.49	dB

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 an Automotive infotainment System to be installed in cars.
3. The main functionalities: Navigation, USB, voice recognition, and several interfaces to the vehicle and Bluetooth / WLAN.
4. The Head-unit provides different interfaces like: AR-CAM input, Video-out APIX3 (for the connection of an external Display), 3 USB interfaces (including support for Apple devices), CAN, 100BaseT1, and 1000Base-T1

DEKRA 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.

Sample S/01 is composed of the following elements, accessories and auxiliary equipment:

Id	Control Number	Description	Manufacturer/ Model	Serial N°	Date of Reception	Application
S/01	3817/03	Infotainment Head Unit	Harman / MGU21A	B38229N181000014	10/07/2022	Element Under Test
S/01	3817/05	Harness	-	-	10/07/2022	Accessory
S/01	3817/06	Quad mate AXZ - High speed Fakra to SMA (male)	-	-	10/07/2022	Accessory
S/01	3817/07	Plug cable for BR-Adapter	-	-	10/07/2022	Accessory
S/01	3817/08	HSD (male) to OABR cable	-	-	10/07/2022	Accessory
S/01	3817/09	BT/WLAN Antenna with SMA (male) connector			10/07/2022	Accessory
S/01	3817/10	BT/WLAN Antenna with SMA (male) connector			10/07/2022	Accessory
S/01	3817/12	BR-Adapter	-	-	10/07/2022	Accessory
S/01	3669/44	Ethernet to USB Adapter	TP-Link / UE300	220B191005905	04/07/2022	Accessory
S/01	3810/17	Ethernet Cable RJ45 to RJ45	-	-	04/07/2022	Accessory
S/01	1484	Dekra Laptop	Lenovo / V14 G2 ITL	PF3Q2NKL	-	Auxiliary

1. Sample S/01 was used for the test(s): All Radiated test(S) indicated in appendix A.

Test sample description

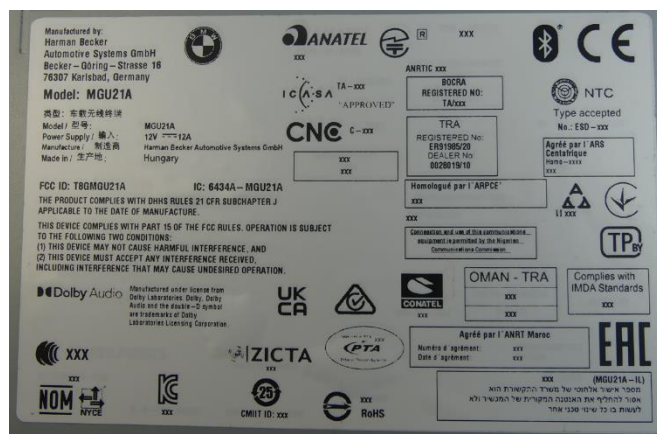
Test Sample description (compulsory information for EMC and RF testing services)

Ports.....:	Port name and description	Cable											
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾								
	BT/WIFI connector – 2X 1 POL ROS 59S2BT40MA5-1		[X]	[]	[]								
	USB1 connector – CONM-SM 4POL ROS D4S20Y-40MA5-B		[X]	[]	[]								
	USB2 connector – CONM-SM 4POL ROS D4S20Y-40MA5-C		[X]	[X]	[]								
	USB3 connector – CONM-SM 4POL ROS D4S20Y-40MA5-E		[X]	[X]	[]								
	APIX3 connector – CONM-SM 4+2POL ROS 99S22A-40MA5-D		[X]	[]	[]								
	Car Main-connector – ONM 16POL TYC 2300483-s		[X]	[X]	[]								
	AR-CAM connector – CONM 1POL ROS 59S2FT-40MA5-K		[X]	[X]	[]								
	Ethernet BroadR- Reach, 100 BASE-T1		[X]	[X]	[]								
	Ethernet, 1000 BASE- T1		[X]	[X]	[]								
	GNSS connector 1 POL ROS 59S2BT40MA5-C		[X]	[X]	[]								
Supplementary information to the ports..... :	No Data Provided												
Rated power supply :	Voltage and Frequency		Reference poles										
			L1	L2	L3	N	PE						
	[]	AC:	[]	[]	[]	[]	[]						
	[]	AC:	[]	[]	[]	[]	[]						
Rated Power :	[X]	DC: 13.2 V											
	No Data Provided												
	No Data Provided												
	No Data Provided												
Software version :	22w36.5-1												
Hardware version :	2.1												
Dimensions in cm (W x H x D) :	No Data Provided												

Mounting position	[]	Table top equipment	
	[]	Wall/Ceiling mounted equipment	
	[]	Floor standing equipment	
	[]	Hand-held equipment	
	[X]	Other: Automotive Infotainment Head Unit	
Modules/parts.....	Module/parts of test item	Type	Manufacturer
	N/A

Accessories (not part of the test item).....	Description	Type	Manufacturer
	HARMANeco (with Display or headless)		HBAS
	Cable harness		HBAS
	Display		L.G.
	BT/WLAN-Antenna		HIRSCHMANN
Documents as provided by the applicant.....	Description	File name	Issue date
	Declaration Equipment Data	FDT30_18 Declaration Equipment Data - MGU21A 2022.10.12	10/13/2022

Copy of marking plate:



Identification of the client

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

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	11-19-2022
Date (finish)	11-26-2022

Document history

Report number	Date	Description
3817ERM.009	12-14-2022	First release
3817ERM.009A1	12-20-2022	Second release. TC/01 was updated to include the co-location of BT, Wi-Fi 2.4 GHz and 5 GHz. This modification of the test report cancels and replaces the test report 3817ERM.009.
3817ERM.009A2	01-24-2023	Third release. Pag. 1, Add the FCC ID and IC number on the cover of the document. Pag. 15, Note was modified in the test conditions. This modification of test report cancels and replaces the test report 3817ERM.009A1.

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 %

In the chamber for conducted measurements, 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

1. The tests have been performed by the technical personnel: Koji Nishimoto.

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
1012	EMI Test Receiver	Rohde & Schwarz	ESR26	2022/04	2024/04
1014	FSV40 Signal Analyzer 40GHz	Rohde & Schwarz	FSV40	2021/05	2023/05
1055	3116C Double-Ridged Waveguide Horn Antennas	ETS Lindgren	3116C	2019/12	2022/12
1057	Double-ridge Waveguide Horn antenna	ETS Lindgren	3115	2020/06	2023/06
1065	Biconical Log antenna	ETS Lindgren	3142E	2020/08	2023/08
1108	Ethernet SNMP Thermometer- CR Room	HW Group	HWg-STE Plain	2022/10	2024/10
1111	Ethernet SNMP T Thermometer	HW Group	HWg-STE Plain	2022/10	2024/10
1179	Semi anechoic Absorber Lined Chamber	Frankonia	SAC 3 plus "L"	N/A	N/A
1314	Wireless Measurement Software R&S EMC32	Rohde & Schwarz	N/A	N/A	N/A
1461	Low Noise Preamplifier	Bonn Elektronik	BLMA0118-4A	2022/06	2024/06

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247 (Bluetooth BR/EDR)					
Report Section	15.247 Spec Clause	RSS Spec Clause	Test Description	Verdict	Remark
-	§ 2.1049 & § 15.247 (a) (1)	RSS-247 5.1 (b)	20dB Emission Bandwidth, Occupied Bandwidth & Carrier Frequency Separation	N/M	Refer 1
-	§ 15.247 (a) (1) (iii)	RSS-247 5.1 (d)	Number of hopping channels	N/M	Refer 1
-	§ 15.247 (a) (1) (iii)	RSS-247 5.1 (d)	Time of Occupancy (Dwell Time)	N/M	Refer 1
-	§ 15.247 (b) (3)	RSS-247 5.4 (b)	Maximum peak conducted output power and antenna gain	N/M	Refer 1
-	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	N/M	Refer 1
-	§ 15.247 (d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	N/M	Refer 1
A.1	§ 15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A
<u>Supplementary information and remarks:</u> 1) Please refer to the test report 3817ERM.006					

FCC PART 15 PARAGRAPH (Wi-Fi 2.4GHz)					
Report Section	15.247 Spec Clause	RSS Spec Clause	Test Description	Verdict	Remark
-	§ 2.1049 & §15.247 (a) (2)	RSS-247 5.2 (a)	99% Occupied Bandwidth & 6dB Bandwidth	N/M	Refer 1
-	§ 15.247 (b)	RSS-247 5.4 (d)	Maximum Output Power and antenna gain	N/M	Refer 1
-	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	N/M	Refer 1
-	§ 15.247 (e)	RSS-247 5.2 (b)	Power Spectral Density	N/M	Refer 1
-	§15.247(d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	N/M	Refer 1
A.1	§15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A
<u>Supplementary information and remarks:</u> 1) Please refer to the test report 3817ERM.006					

FCC PART 15 PARAGRAPH / RSS-247 (Wi-Fi 5GHz) UNII-1 5.150 - 5.250 GHz Band, UNII-3 5.725 - 5.825 GHz Band					
Report Section	15.407 Spec Clause	RSS Spec Clause	Test Description	Verdict	Remark
	§ 15.403 KDB 789033 D02	RSS 247 6.2.4	26dB Emission Bandwidth & Occupied Bandwidth	N/M	Refer 1
	§ 15.407 (e)	RSS 247 6.2.4.1	6dB Bandwidth	N/M	Refer 1
	§ 15.407 (a)(3)	RSS 247 6.2.4.1	Power Limits. Maximum Output Power	N/M	Refer 1
	§ 15.407 (a)(3)	RSS-247 6.2.4.1	Maximum Power Spectral Density	N/M	Refer 1
	§ 15.407 (b)(4)	RSS-247 6.2.4.2	Band-edge conducted emissions compliance (Transmitter)	N/M	Refer 1
	§ 15.407 (b)(6) § 15.207	RSS-Gen 8.8	Emission limitations Conducted (Transmitter)	N/M	Refer 1
A.1	§ 15.407 (b)(4),(7) § 15.209 § 15.205	RSS-247 6.2.4.2 RSS-Gen 8.9 & 8.10	Undesirable radiated emissions (Transmitter)	P	N/A
	§ 15.407 (g)	RSS-Gen 6.11 & 8.11	Frequency Stability	N/M	Refer 1
<u>Supplementary information and remarks:</u> 1) Please refer to the test report 3817ERM.007					

Appendix A: Test results (Multi-transmitter)

Appendix A Content

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PRODUCT INFORMATION

The following information is provided by the supplier, in accordance with clause 5.4.1:

Information	Description
Modulation	BR/EDR: GFSK, $\pi/4$ -DQPSK, 8-DPSK Wi-Fi 2.4 GHz: DSSS, OFDM Wi-Fi 5 GHz: DSSS, OFDM
Operation mode 1: Single Antenna Equipment	
- Operating Frequency Range	BR/EDR: 2400 - 2483.5 MHz Wi-Fi 2.4 GHz: 2.402 - 2.483.5 GHz Wi-Fi 5 GHz: 5.150 - 5.250 GHz 5.725 - 5.875 GHz
- Nominal Channel Bandwidth	BR/EDR: 1 MHz Wi-Fi 2.4 ⁽¹⁾ GHz: 20MHz, 40MHz Wi-Fi 5GHz: 20MHz, 40MHz, 80MHz <ul style="list-style-type: none"> (1) Please note: 802.11n mode is supported, however always/only with 20 MHz BW
- RF Output Power	BR/EDR: 10 dBm Wi-Fi 2.4 GHz: 10 dBm Wi-Fi 5 GHz: 14 dBm
Extreme operating conditions	
- Temperature range	-20 °C to +55 °C
Antenna type	External
Antenna gain	BR/EDR: -2.5 dBi Wi-Fi 2.4 GHz: -2.5 dBi Wi-Fi 5 GHz: -2.8 dBi
Nominal Voltage	
- Supply Voltage	13.2 Vdc
- Type of power source	DC voltage
Equipment type	Bluetooth, Wi-Fi 2.4 GHz, and Wi-Fi 5 GHz
Geo-location capability	Yes

TEST CONDITIONS

(*): Data provided by the client.

TEST CONDITIONS	DESCRIPTION																				
TC/01 ⁽¹⁾	<u>Power supply (V):</u> DC 12 V																				
	<u>Test Frequencies for Radiated tests:</u>																				
	<table><tr><th>Technology</th><th>Tested Frequency</th><th>BW (MHz)</th><th>Modulation</th><th>Mode</th></tr><tr><td>Bluetooth</td><td>2402</td><td>3</td><td>8DPSK</td><td>-</td></tr><tr><td>Wi-Fi 2.4 GHz SISO</td><td>2412</td><td>20</td><td>OFDM</td><td>g mode</td></tr><tr><td>Wi-Fi 5 GHz MIMO</td><td>5745</td><td>20</td><td>OFDM</td><td>ac mode</td></tr></table>	Technology	Tested Frequency	BW (MHz)	Modulation	Mode	Bluetooth	2402	3	8DPSK	-	Wi-Fi 2.4 GHz SISO	2412	20	OFDM	g mode	Wi-Fi 5 GHz MIMO	5745	20	OFDM	ac mode
	Technology	Tested Frequency	BW (MHz)	Modulation	Mode																
	Bluetooth	2402	3	8DPSK	-																
Wi-Fi 2.4 GHz SISO	2412	20	OFDM	g mode																	
Wi-Fi 5 GHz MIMO	5745	20	OFDM	ac mode																	
The test was performed with the equipment transmitting with Bluetooth, Wi-Fi 2.4GHz, and Wi-Fi 5GHz radios simultaneously. These measurements have been performed in order to check the impact of the multi-transmitter of all radio interfaces that can be transmitting simultaneously.																					

Note (1): Preliminary scan was performed to determine the worst case and the following tables and plots show the results for the worst case in BT + Wi-Fi 2.4 GHz + Wi-Fi 5 GHz.

TEST A.1: EMISSION LIMITATIONS RADIATED (TRANSMITTER)

LIMITS:

Product standard:	Part 15 Subpart C §15.247, 15.407, Part 15.31(h), and RSS-247
Test standard:	Part 15 Subpart C §15.247 (d), 15.407 (b), and RSS-Gen 8.9 and 8.10

LIMITS

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

TEST SETUP

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at 3 m for the frequency range 30-1000 MHz (Bilog antenna) and 1-18 GHz (Double ridge horn antenna), and 1m for the frequency range 18 GHz- 40 GHz (Double ridge horn antenna).

For radiated emissions in the range 18 - 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.

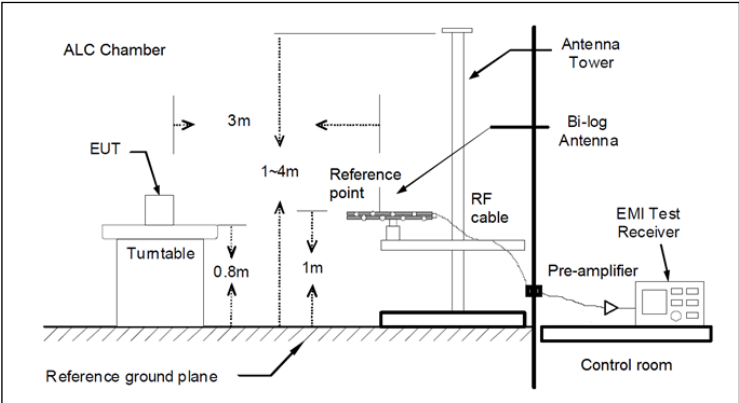
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

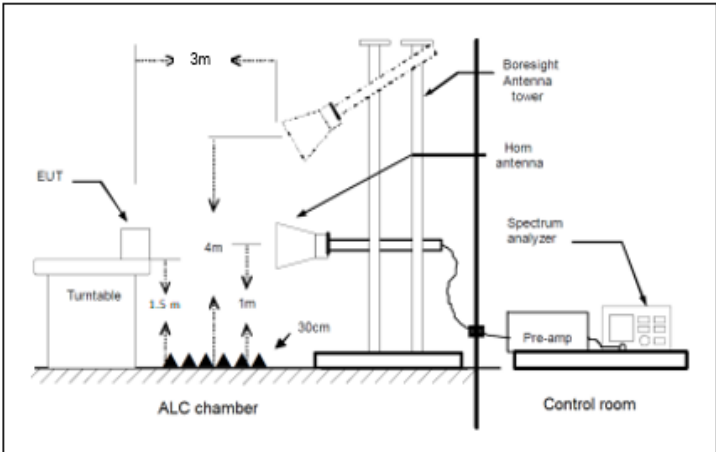
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

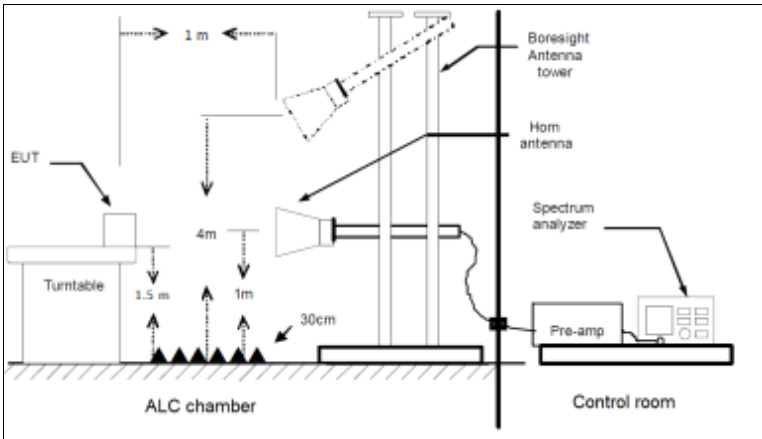
Radiated measurements Setup $f < 1\text{ GHz}$



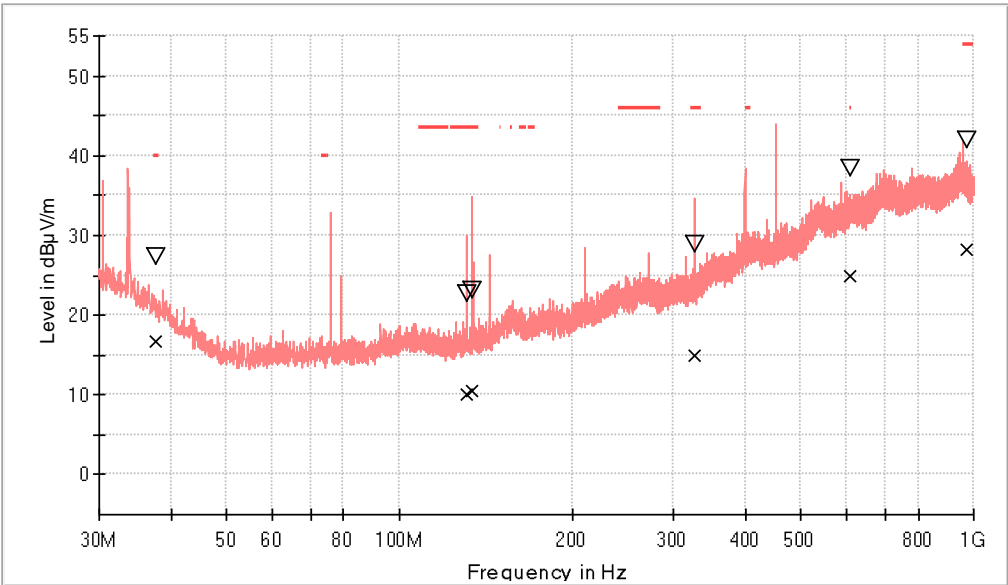
Radiated measurements setup $f > 1\text{--}18\text{ GHz}$



Radiated measurements setup $f > 18\text{ GHz}$



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC/01
TEST RESULTS :	30-1000 MHz
VERDICT:	PASS

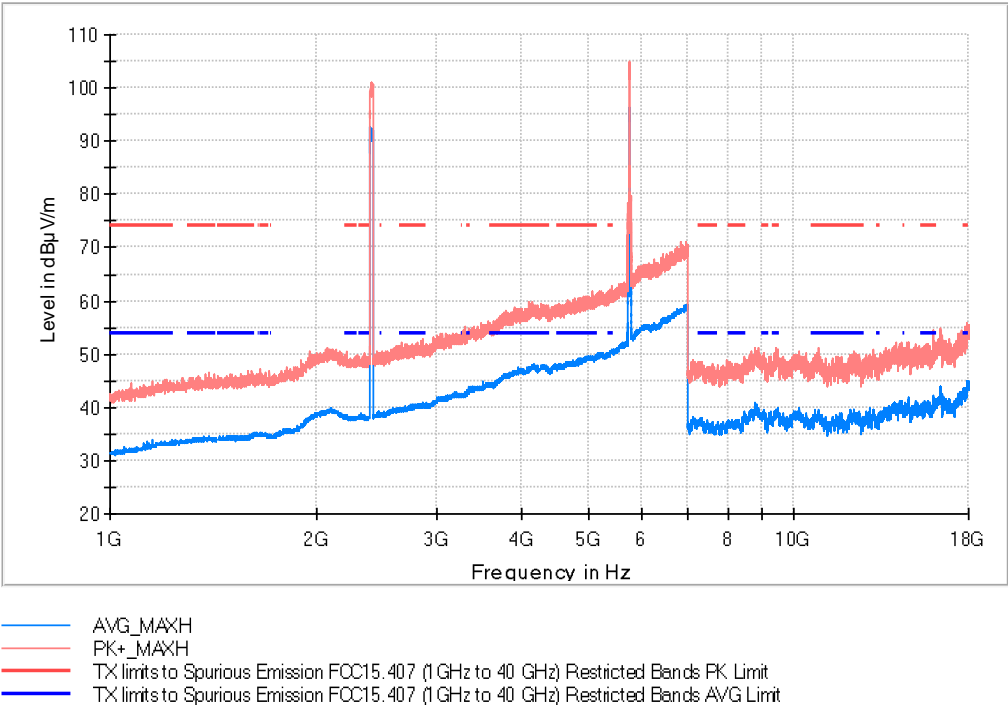


— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (30MHz to 1 GHz) Restricted Bands QPK Limit
v MaxPeak-PK+ (Single)
x QuasiPeak-QPK (Single)

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
37.614500	27.2	16.8	V	23.2	40.0
130.880000	22.8	10.1	H	33.4	43.5
134.129500	23.2	10.6	V	33.0	43.5
326.965500	29.0	15.0	V	31.0	46.0
609.332500	38.4	24.9	V	21.1	46.0
969.881500	41.9	28.1	V	25.9	54.0

TEST RESULTS (Cont.):

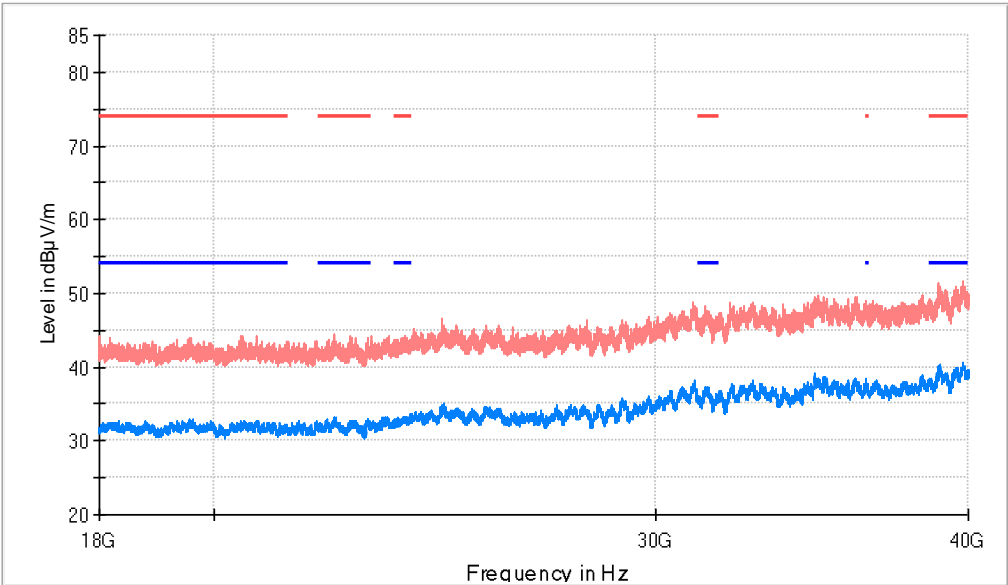
1-18 GHz



Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2401.500000	95.8	91.6	H	---	---	Fundamental BT
2410.000000	101.1	92.3	H	---	---	Fundamental Wi-Fi 2.4GHz
5421.000000	61.3	50.9	H	3.1	54.0	
5742.500000	104.8	96.4	H	---	---	Fundamental Wi-Fi 5GHz
17931.000000	55.1	44.9	H	9.1	54.0	

TEST RESULTS (Cont.):

18-40 GHz



- AVG_MAXH
- PK+_MAXH
- TX limits to Spurious Emission FCC15.407 (1GHz to 40 GHz) Restricted Bands PK Limit
- TX limits to Spurious Emission FCC15.407 (1GHz to 40 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
39795.100000	50.6	40.3	H	13.7	54.0

TEST RESULTS (Cont.):

Restricted Bands (2.31 GHz – 2.5 GHz)

