DEKRA Certification, Inc.
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United States of America

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
3967ERM.012A2

Partial Test report

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

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices.

(*) Identification of item tested	Infotainment Head Unit
(*) Trademark	Garmin
(*) Model and /or type reference tested	MGU22
Other identification of the product	FCC ID: IPH-03910 IC: 1792A-03910 HVIN: B03910 Hw version: B03910
(*) Features	Bluetooth classic; BLE; Wi-Fi 2.4GHz; Wi-Fi 5GHz; GNSS
Manufacturer	Garmin International, Inc. 1200 E. 151st Street Olathe, Kansas 66062, USA
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 15.209, 10-1-20 Edition: Radiated emission limits; general requirements CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (March 2019). 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 558074 D01 15.247 Meas. Guidance v05r02 (April 2019). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	See Appendix A & B
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager  Digitally signed by Domingo Galvez DN: cn=Domingo Galvez, o=Dekra Certification Inc., ou=Regulatory Lab Manager, email=domingo.galvez@dekra.com, c=US
Date of issue	10-09-2023
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Acronyms

Acronym ID	Acronym Description
	Emission Bandwidth
# of Tx Chains	Number of Transmission Chains
Equipment	Equipment Type
Freq	Frequency
In band Peak Lvl	In band Peak Level
Lvl	Level
MP	Measurement Point
Mod	Modulation
Occ Ch BW	Occupied Channel Bandwidth
PSD	Power Spectrum Density
Peak Power	Maximum Peak Conducted Output Power
Port	Active Port

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.

DEKRA Certification Inc. 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.

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 Certification Inc.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Certification Inc. and the Accreditation Bodies.

Uncertainty

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

Test case	Frequency (MHz)	U (k=2)	Units
RF Power and PSD	2402-2483	0.88	dB
Occupied Bandwidth		1.87	%
Dwell Time		0.01	%
Band Edge		0.64	dB
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 Infotainment Head Unit to be installed in cars with the main functionalities: Navigation, USB, voice recognition and several interfaces to the vehicle and Bluetooth / WLAN.

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 used for test have been selected by: The client.

Sample S/01 is composed of the following elements:

Id	Control Number	Description	Model	Serial Nº	Date of Reception	Application
S/01	3967/35	Garmin MGU 22 sample	MGU22	GAG104P0000070	06/12/2023	Element Under Test
S/01	3428/73	Antenna	-	-	-	Element Under Test

Sample S/01 is composed of the following accessories:

Id	Control Number	Description	Model	Serial Nº	Date of Reception	Application
S/01	2874/11	Fakra to SMA Connector	-	-	03/26/2021	Accessory
S/01	2874/13	OABR Connector cable	-	-	03/26/2021	Accessory
S/01	3171/11	Ethernet Cable	-	-	03/05/2021	Accessory
S/01	3428/32	BMW Antenna-DA Fakra 5G-GNSS		6520 8705915-04	06/01/2022	Accessory
S/01	3967/42	CAN cable	-	-	06/14/2023	Accessory
S/01	3967/43	Harness	-	-	06/14/2023	Accessory

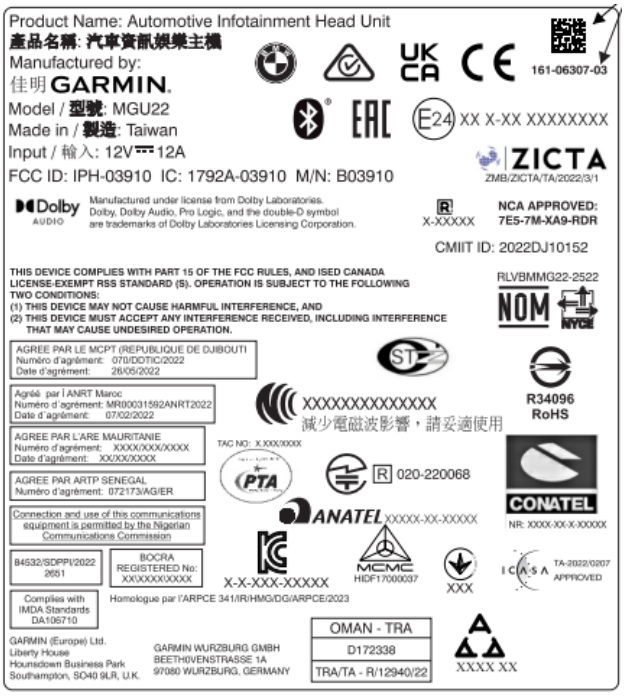
Sample S/01 was used for the test(s): All Radiated tests indicated in appendix A and B.

Test sample description

Ports..... :	Port name and description		Cable				
			Specified length [m]	Attached during test	Shielded		
	BT/Wi-Fi Antenna		2	☒	☐		
	USB1/2/3		2	☒	☐		
	Power		2	☒	☐		
	CID		2	☒	☐		
	AR-Cam		2	☒	☐		
	100 Base T1/1G Base T1/GPS		2	☒	☐		
Supplementary information to the ports..... :	N/A						
Rated power supply..... :	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 8V to 16V					
	☐	DC:					
Rated Power..... :	No Data Provided						
Clock frequencies..... :	No Data Provided						
Other parameters ..... :	No Data Provided						
Software version..... :	No Data Provided						
Hardware version ..... :	B03910						
Dimensions in cm (W x H x D) ... :	No Data Provided						
Mounting position ..... :	☐	*Tabletop equipment*					
	☐	*Wall/Ceiling mounted equipment*					
	☐	*Floor standing equipment*					
	☐	*Hand-held equipment*					
	☒	Other: Vehicle / Automotive					

Modules/parts ..... :	Module/parts of test item	Type	Manufacturer
	N/A		
Accessories (not part of the test item)..... :	Description	Type	Manufacturer
Documents as provided by the applicant ..... :	Description	File name	Issue date
	Declaration Equipment Data	FDT30_18 Declaration Equipment Data_MGU22_ver1	08/01/2023

Copy of marking plate:



Identification of the client

Garmin International, Inc.
1200 E. 151st Street,
Olathe, Kansas 66062, USA

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	06-27-2022
Date (finish)	10-06-2023

Document history

Report number	Date	Description
3967ERM.012	08-28-2023	First release
3967ERM.012A1	10-02-2023	Second release. Output power spot check test results were added for Bluetooth EDR and Wi-Fi 2.4 GHz in Appendix A & B. Testing period, Remarks and Comments, and Test Conditions sections were updated. This modification of the test report cancels and replaces the test report 3967ERM.012
3967ERM.012A2	10-09-2023	Third release. Output power spot check test results in Appendix A, B and Test Conditions sections were updated. This modification of the test report cancels and replaces the test report 3967ERM.012A1

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 %

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Juliana Cherry, Qi Zhang, and Koji Nishimoto.

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	Serial No	LAST CALIBRATION	NEXT CALIBRATION
878	Power supply (AMETEK / PROG-DC-PS)	1707A01783	N/A	N/A
1012	ESR26 Emi Test Receiver	101478	2022-04-12	2024-04-12
1014	FSV40 Signal Analyzer 40ghz	101626	2022-08-01	2024-08-01
1056	3116C Double-Ridged Waveguide Horn Antenna 18-40 GHz	213179	2023-02-23	2026-02-23
1058	3115 Double-Ridged Waveguide Horn Antenna 1-18 GHz	211373	2023-06-26	2026-06-26
1064	3142E Biconilog Antenna	208600	2021-12-13	2024-12-13
1108	Ethernet SNMP Thermometer- CR Room	60038026954	2022-10-18	2024-10-18
1111	Ethernet SNMP Thermometer	60038026577	2022-10-18	2024-10-18
1179	SEMI-ANECHOIC CHAMBER	F169021	N/A	N/A
1314	Wireless Measurement Software R&S Emc32	1040-OT102236	N/A	N/A
1461	Low Noise Preamplifier (1-18GHz)	2213857B	2022-06-01	2024-06-01

Testing verdicts

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

Summary

Bluetooth EDR

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.1 (b) / FCC 15.247 (a) (1) 20 dB Bandwidth		N/M	Refer 2
RSS-247 5.1 (b) / FCC 15.247 (a) (1) Carrier Frequency Separation		N/M	Refer 2
RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Time of Occupancy (Dwell Time)		N/M	Refer 2
RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Number of hopping channels		N/M	Refer 2
RSS-247 5.4 (b) / FCC 15.247 (b) (1) Maximum Peak Conducted output power & Antenna gain		P	N/A
RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter) - Conducted		N/M	Refer 2
FCC 2.1049 / 99dBw Occupied Channel Bandwidth 99%		N/M	Refer 2
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Conducted		N/M	Refer 2
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Radiated		P	Refer 1

Supplementary information and remarks:

1. The results show the worst case π/4-DQPSK modulation.
2. Only Partial testing has been requested.

Wi-Fi 2.4GHz

Requirement – Test case FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth	N/M	Refer 2
RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density	N/M	Refer 2
RSS-247 5.4 (d) e.i.r.p	N/M	Refer 2
RSS-247 5.4 (d) / FCC 15.247 (b) (1) Maximum Average Conducted output Power	P	N/A
RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter) - Conducted	N/M	Refer 2
FCC 2.1049 / Occupied Channel Bandwidth 99%	N/M	Refer 2
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Conducted	N/M	Refer 2
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Radiated	P	Refer 1
Supplementary information and remarks: 1. The results show the worst case 802.11n20 mode. 2. Only Partial testing has been requested.		

Appendix A: Test results (Bluetooth EDR)

Appendix A Content

PRODUCT INFORMATION

The following information is provided by the client:

Information	Description
Modulation	FHSS
Adaptive	Non-Adaptive Equipment
Operation mode 1:	
Operating Frequency Range	2400 – 2483.5 MHz
Nominal Channel Bandwidth	2 MHz
RF Output Power	4 dBm
Extreme operating conditions	-40 ºC to +70 ºC
- Temperature range	
Antenna type	
Antenna gain	-2.5 dBi
Nominal Voltage	
- Supply Voltage	12 Vdc
- Type of power source	DC voltage
Equipment type	Bluetooth Classic
Geo-location capability	Yes

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: GFSK Test Frequencies for Conducted tests: Highest range: 2480 MHz
TC#02	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: π/4-DQPSK Test Frequencies for Conducted/Radiated tests: Highest range: 2480 MHz
TC#03	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: 8-DPSK Test Frequencies for Conducted/Radiated tests: Highest range: 2480 MHz

See below the comparison table between previous test results (test report 3154ERM.009) and test results with the new sample shown in this test report:

Frequency (MHz)	Modulation	Maximum conducted power (dBm)		Delta
		MGU22 (test report 3154ERM.009)	MGU22 - 3967	
2480	GFSK	3.1	2.3	-0.8
2480	π/4-DQPSK	5.5	4.4	-1.1
2480	8-DPSK	5.3	4.7	-0.6

TEST CASE DETAILS

RSS-247 5.4 (b) / FCC 15.247 (b) (1) Maximum Peak Conducted & Antenna gain

Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (RSS-247).

Maximum declared antenna gain: -2.5 dBi

Modulation: BT (GFSK 1-DH5)
Results

Freq (MHz)	# of Tx Chains	Port	Peak Power (dBm)	Maximum EIRP power (dBm)
2480.00000	1	1	2.3	-0.2

Modulation: BT (π/4 DQPSK 2-DH5)
Results

Freq (MHz)	# of Tx Chains	Port	Peak Power (dBm)	Maximum EIRP power (dBm)
2480.00000	1	1	4.4	1.9

Modulation: BT (8DPSK 3-DH5)
Results

Freq (MHz)	# of Tx Chains	Port	Peak Power (dBm)	Maximum EIRP power (dBm)
2480.00000	1	1	4.7	2.2

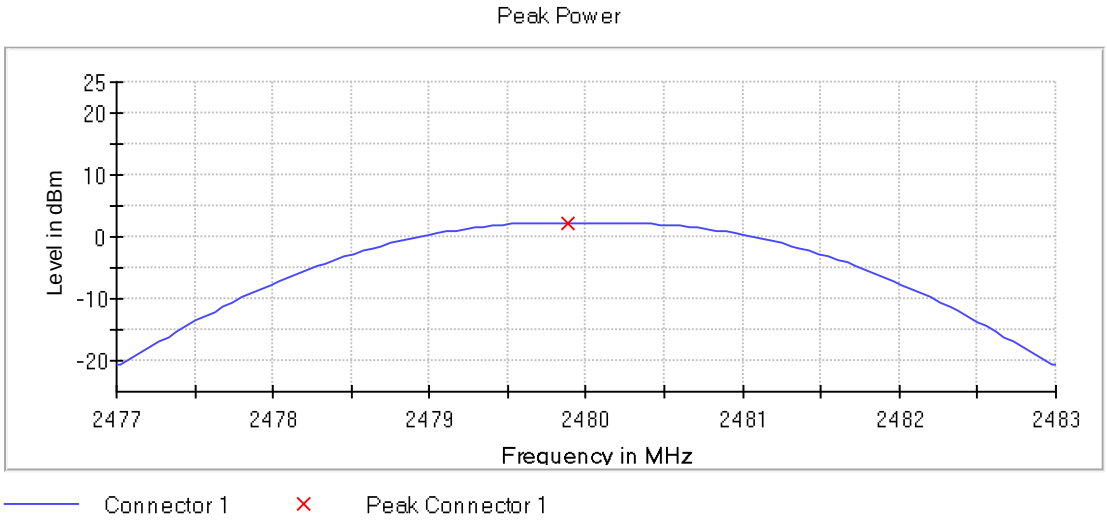
Verdict

Pass

Attachments

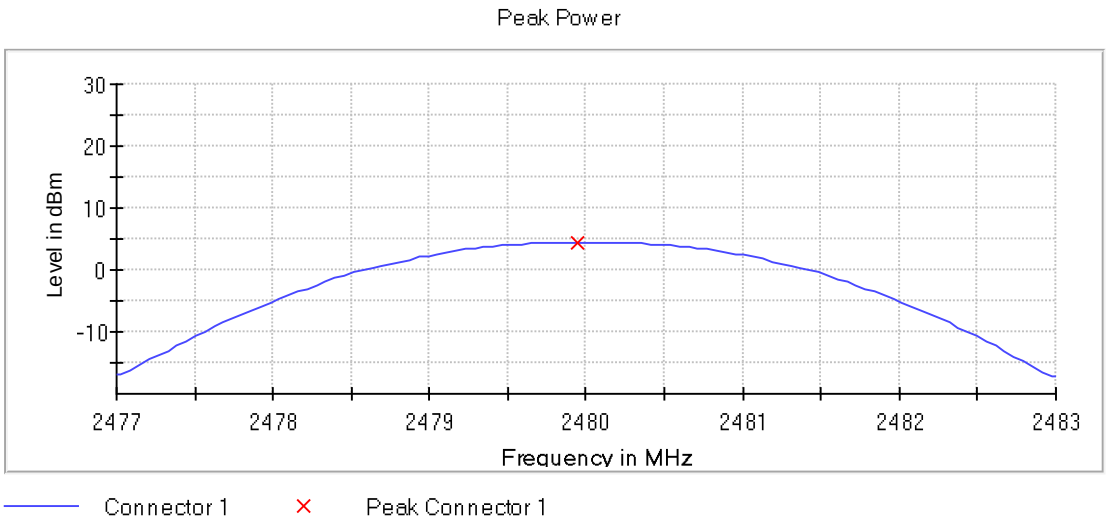
Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS), Modulation = BT (GFSK 1-DH5), Number of Transmission Chains = 1,

Images:



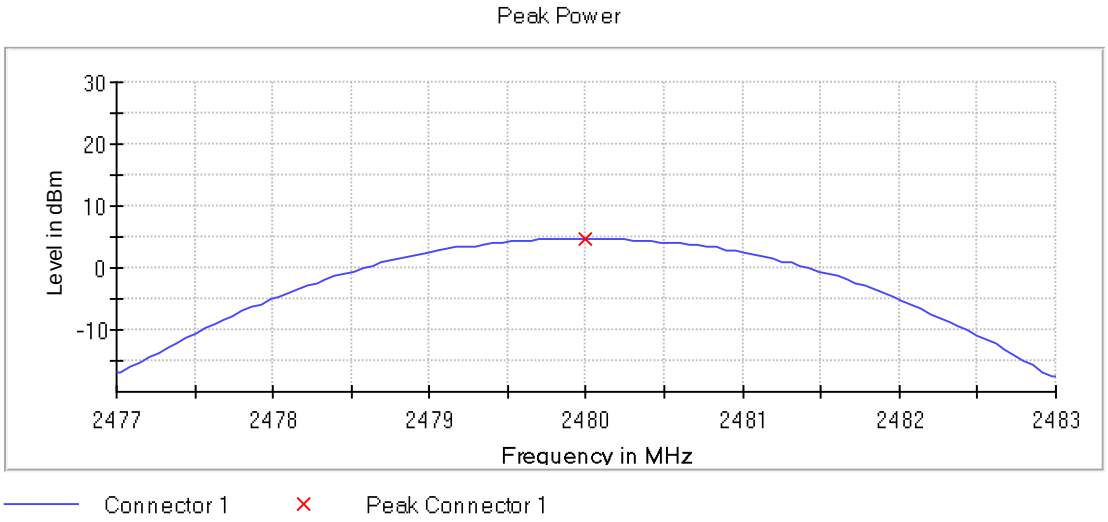
Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS), Modulation = BT (π/4 DQPSK 2-DH5), Number of Transmission Chains = 1,

Images:



Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS), Modulation = BT (8DPSK 3-DH5), Number of Transmission Chains = 1,

Images:



EMISSION LIMITATIONS RADIATED (TRANSMITTER)

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(d) and RSS-247 5.5

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.

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

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- 26 GHz (Double ridge horn antenna).

For radiated emissions in the range 18 - 26 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.

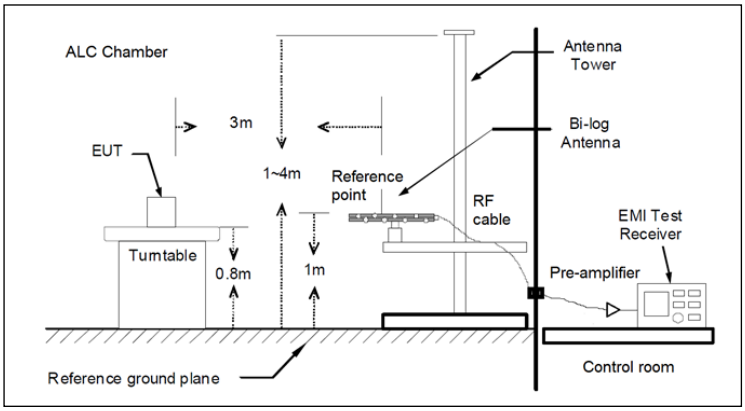
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

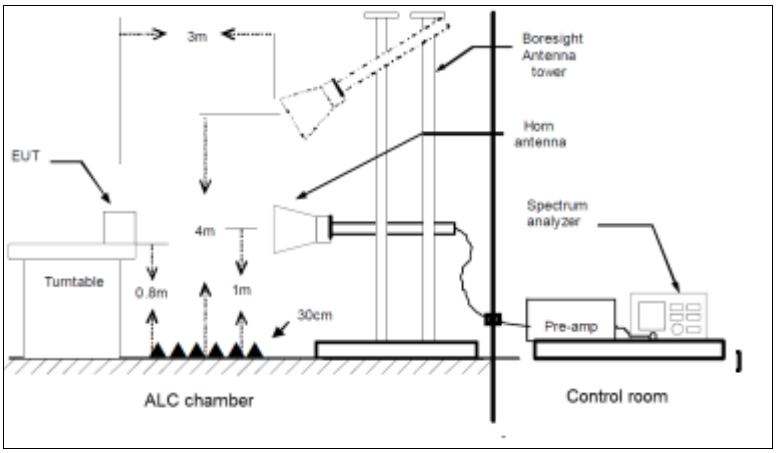
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

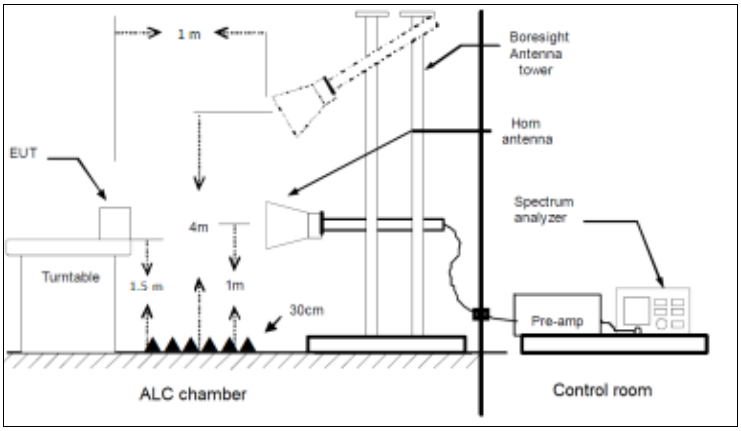
Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1-18 GHz



Radiated measurements setup f > 18 GHz



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (π/4-DQPSK)
TEST RESULTS:	PASS

Frequency range 30 MHz – 1000 MHz

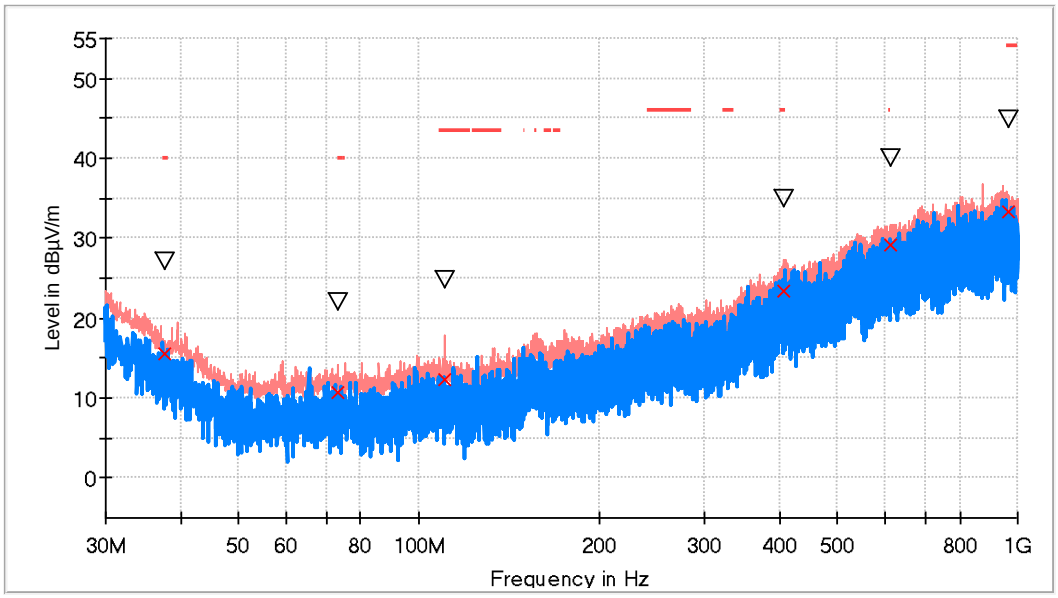
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the following plots and tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.5 GHz.

TEST RESULTS (Cont.):	**30 MHz – 1000 MHz (π/4-DQPSK)**

Highest Channel



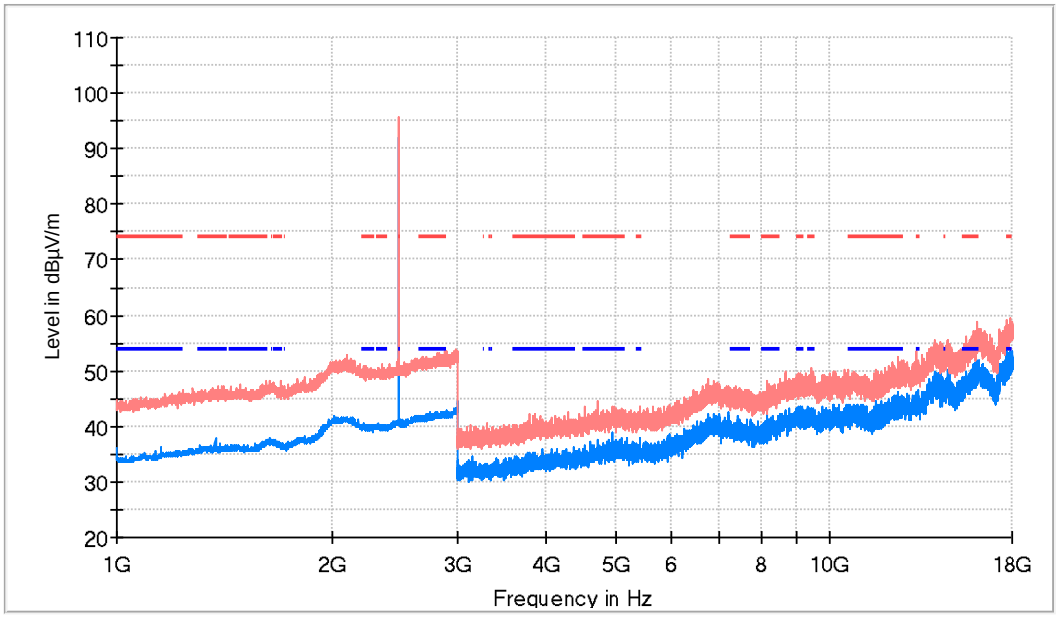
PK+_MAXH
PK+_CLRWR
TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
MaxPeak-PK+ (Single)
QuasiPeak-QPK (Single)

Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
37.663000	27.2	15.7	V	24.4	40.0
73.407500	22.0	10.8	H	29.2	40.0
110.801000	24.7	12.3	V	31.2	43.5
406.311500	35.0	23.4	V	22.6	46.0
613.261000	40.0	29.1	V	16.9	46.0
967.359500	44.9	33.3	V	20.7	54.0

TEST RESULTS (Cont.)	1 GHz – 18 GHz (π/4-DQPSK)

CHANNEL: Highest (2480 MHz)

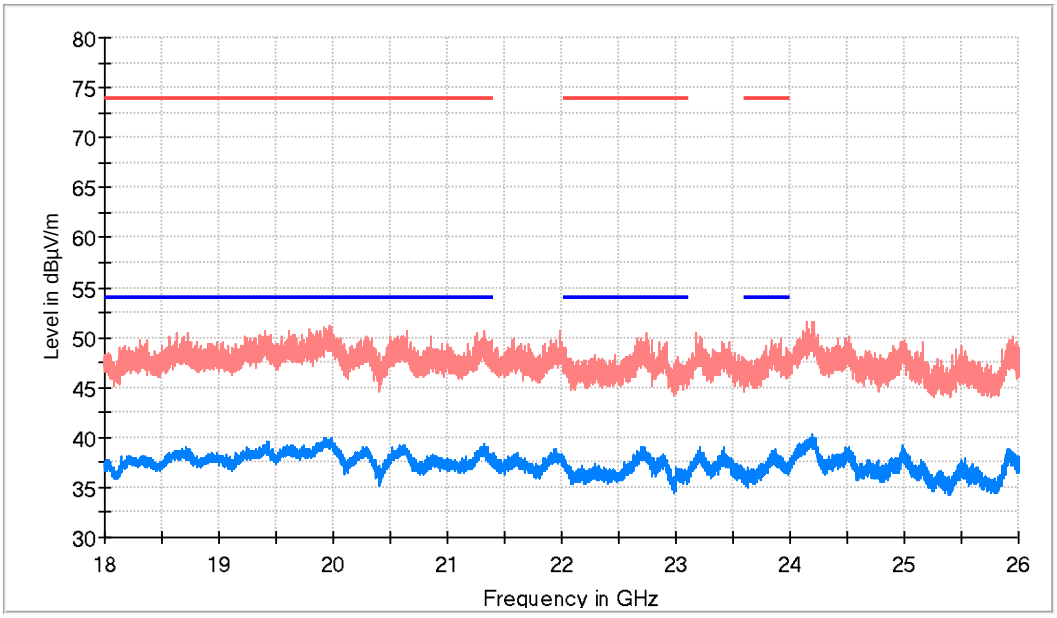


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2480.000000	95.7	92.0	H	---	---	Fundamental
2880.000000	53.4	41.8	H	12.2	54.0	
17929.500000	59.2	52.0	H	2.0	54.0	

TEST RESULTS (Cont.)	18 GHz – 26 GHz (π/4-DQPSK)
FREQUENCY RANGE	

CHANNEL: Highest (2480 MHz)

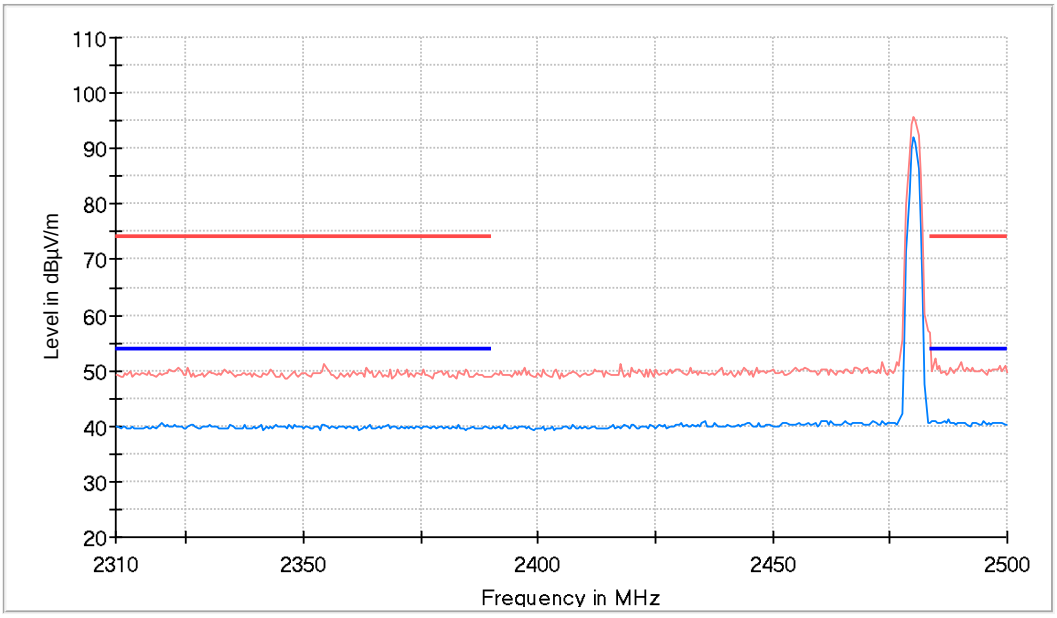


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
19974.500000	51.1	39.3	V	14.7	54.0
22748.500000	50.5	38.5	H	15.5	54.0
23915.000000	50.0	38.1	H	15.9	54.0

RESTRICTED BANDS	2.31 GHz – 2.5 GHz (π/4-DQPSK)

CHANNEL: Highest (2480 MHz)



Measurements

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	100 kHz	1 s	20 dB
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	0.1 s	20 dB
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	0.1 s	20 dB
18 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB

Appendix B: Test results (Wi-Fi 2.4GHz)

Appendix B Content

PRODUCT INFORMATION

Information	Description
Modulation	Other forms of modulation
Maximum RF Output Power	Adaptive Equipment without the possibility to switch to a non- adaptive mode.
Operation mode	
- Operating Frequency Range	2400 – 2483.5 MHz
- Nominal Channel Bandwidth	20 MHz 40 MHz
Extreme operating conditions	
- Temperature range	-40 ºC to +70 ºC
Antenna type	
Antenna gain	-2.5 dBi
Nominal Voltage	
- Supply Voltage	12 Vdc
- Type of power source	DC voltage
Equipment type	Wi-Fi 2.4 GHz b/g/n20/n40/ax20/ax40
Geo-location capability	No

DESCRIPTION OF TEST CONDITIONS

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.

TEST CONDITIONS	DESCRIPTION
TC#01(1) (b mode)	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted tests (Radio A & Radio B MIMO): Middle channel: 2437 MHz
TC#02(1) (g mode)	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted tests (Radio A + B MIMO): Middle channel: 2437 MHz
TC#03(1) (n mode)	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted/Radiated tests (Radio A + B MIMO): Lowest channel: 2412 MHz Middle channel: 2437 MHz Highest channel: 2452 MHz Channel Bandwidth: 40 MHz Test Frequencies for Conducted tests (Radio A + B MIMO): Highest channel: 2452 MHz

TEST CONDITIONS	DESCRIPTION
TC#04(1) (ax mode non-beam forming)	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted tests (Radio A + B MIMO): Middle channel: 2437 MHz Channel Bandwidth: 40 MHz Test Frequencies for Conducted tests (Radio A + B MIMO): Highest channel: 2452 MHz

Note (1): For spurious emissions for OFDM modes 802.11g, 802.11n20, 802.11n40, 802.11ax20 and 802.11ax40 a preliminary scan was performed to determine the worst case. The following tables and plots show the results for the worst case in OFDM modulation (802.11n).

The data rate of MCS7 for 802.11n was selected based on preliminary testing that identified that rate corresponding to the worst case.

See below the comparison table between previous test results (test report 3154ERM.009) and test results with the new sample shown in this test report:

Bandwidth (MHz)	Mode	Frequency (MHz)	Maximum conducted power (dBm)		Delta
			MGU22 (test report 3154ERM.009)	MGU22 - 3967	
20	b	2437	16.8	16.0	-0.8
	g	2437	16.8	16.4	-0.4
	n	2437	17.2	16.6	-0.6
	ax	2437	17.0	11.6	-5.4
40	n	2452	16.1	15.8	-0.3
	ax	2452	16.2	11.4	-4.8

TEST CASE DETAILS

RSS-247 5.4 (d) / FCC 15.247 (b) (1) Maximum Average Conducted Output Power

Limits

For systems using digital modulation in the 2400 -2483.5 MHz band: 1 watt (30 dBm).

The e.i.r.p. shall not exceed 4 W (36 dBm) (RSS-247).

Note:

1- The following test results are shown based on KDB 662911 D01 Multiple Transmitter Output v02r01 E) 1) In-Band Power Measurements.

2- The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

3- For 2Tx CDD MIMO modes, in accordance with KDB 662911 D01 v02r01 Section F)2)f)i), directional gain for power measurements: was calculated as follows:

Directional gain $_{POWER}$ = G_{ANT} dBi (N_{ANT} < 4)

Directional gain $_{POWER}$ = G_{ANT} = -2.5 dBi

Power Antenna Gain MIMO Chain 0 & 1: -2.5 dBi

For MIMO CDD operation modes, the limit should be reduced by the amount in dB the antenna gain exceeds 6 dBi. In this case the limit is not reduced due to the antenna gain calculations is -2.5 dBi.

4- For all operation modes, the antenna gain is less than 6 dBi.

Results

Antenna gain: -2.5 dBi

Modulation: 802.11b

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2437.00000	20	13.5

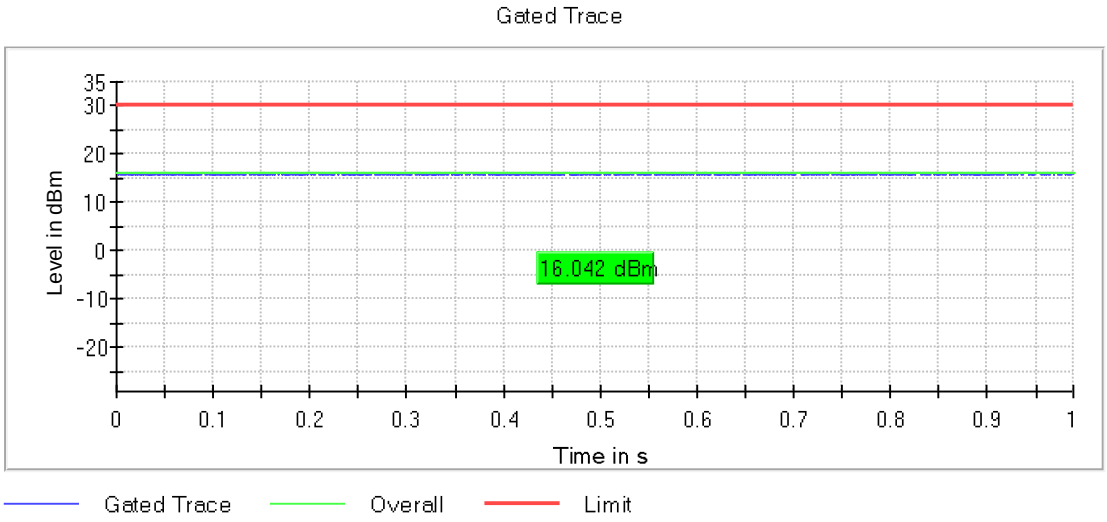
Verdict

Pass

Attachments

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 1, Modulation = 802.11b , Number of Transmission Chains = 2,

Images:



Antenna gain: -2.5 dBi

Modulation: 802.11g
Results

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2437.00000	20	13.9

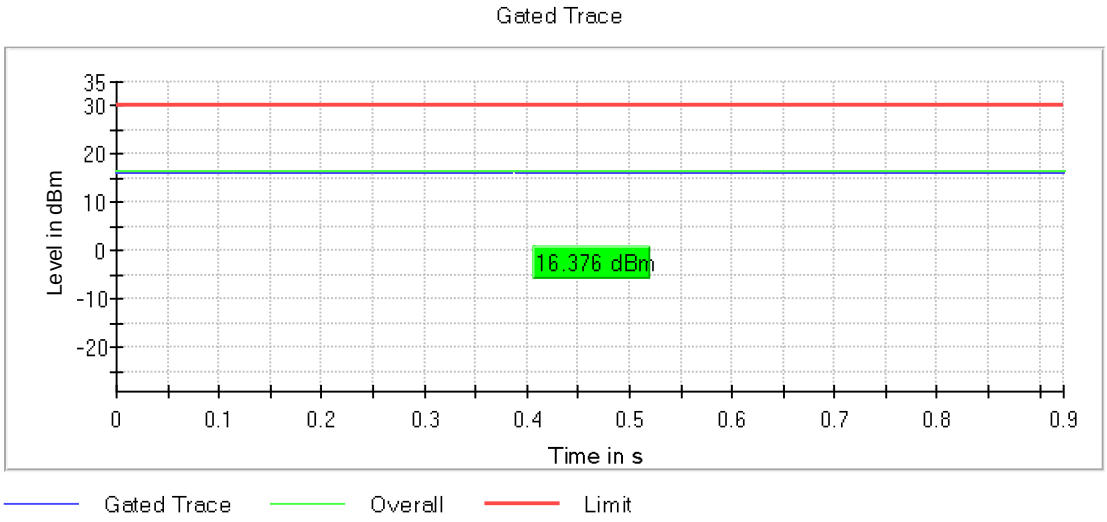
Verdict

Pass

Attachments

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 1, Modulation = 802.11g , Number of Transmission Chains = 2,

Images:



Antenna gain: -2.5 dBi

Modulation: 802.11n20
Results

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2437.00000	20	14.1

Modulation: 802.11n40
Results

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2452.00000	40	13.3

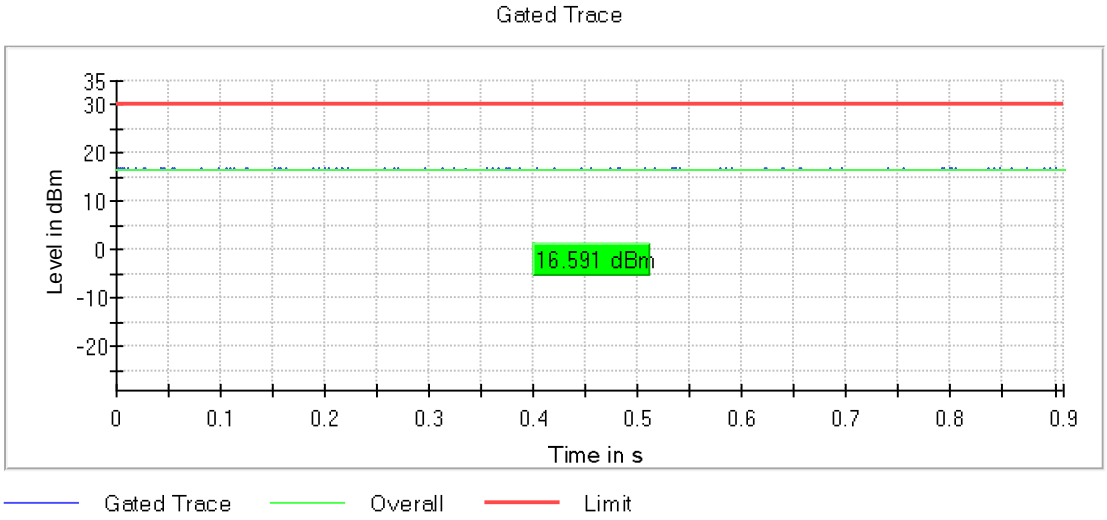
Verdict

Pass

Attachments

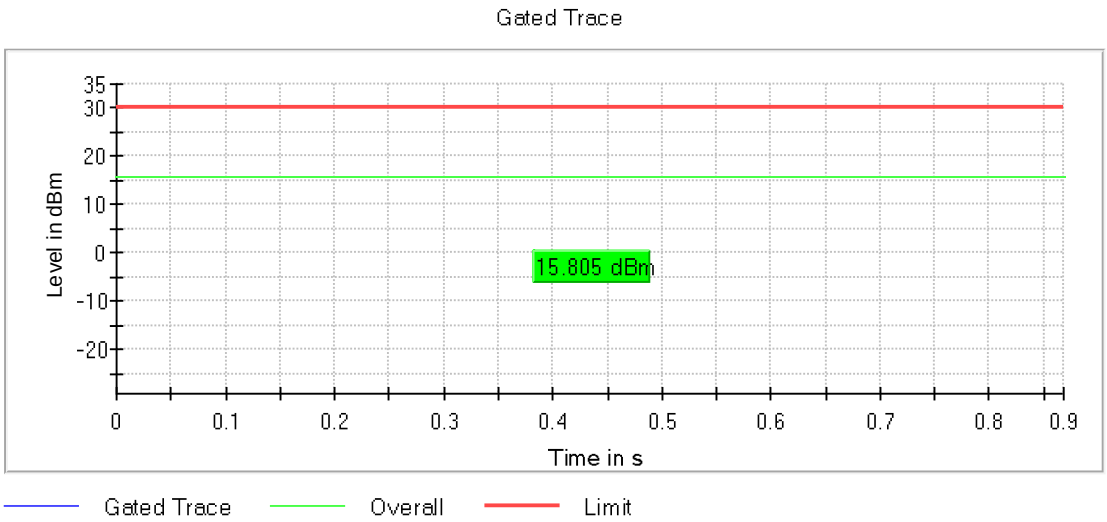
Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 1, Modulation = 802.11n , Number of Transmission Chains = 2,

Images:



Frequency MHz = 2452.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 1, Modulation = 802.11n , Number of Transmission Chains = 2,

Images:



Antenna gain: -2.5 dBi

Modulation: 802.11ax HE20 – Full RU
Results

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2437.00000	20	9.1

Modulation: 802.11ax HE40 – Full RU
Results

Freq (MHz)	BW (MHz)	E.I.R.P. (dBm)
2452.00000	40	8.9

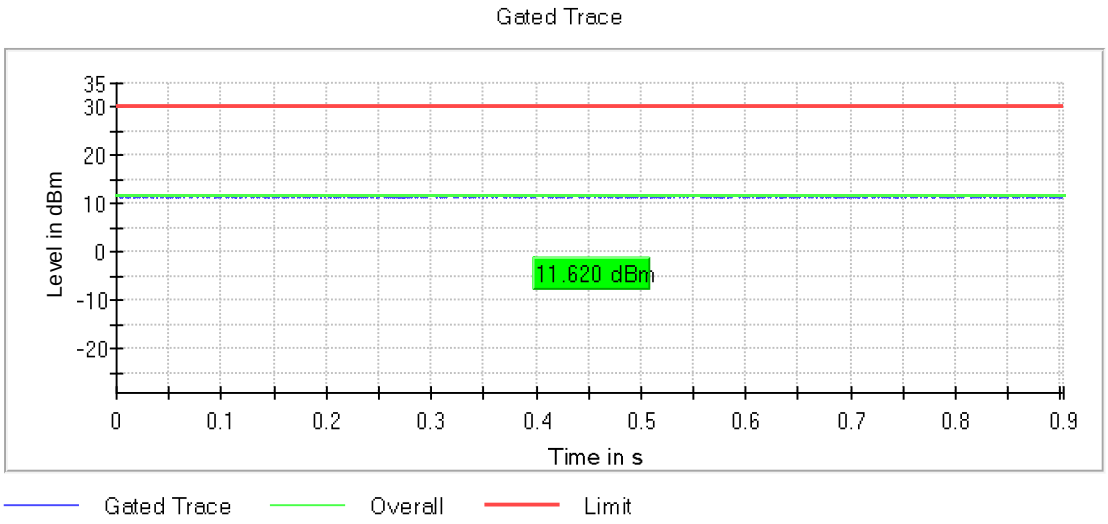
Verdict

Pass

Attachments

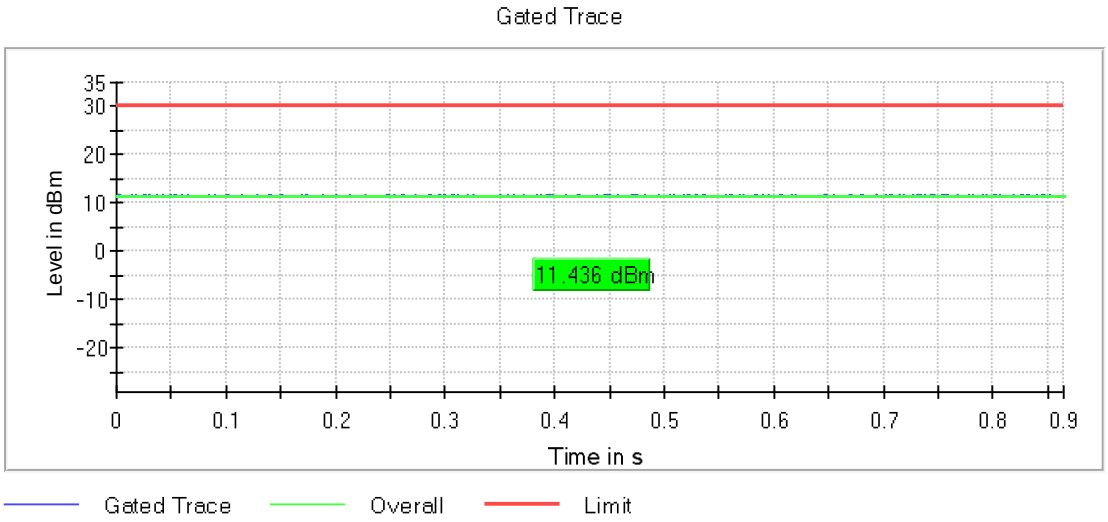
Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 1, Modulation = 802.11ax HE SS1 MCS 8 (OFDM MCS8), Number of Transmission Chains = 2,

Images:



Frequency MHz = 2452.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 40, Modulation = 802.11ax HE SS1 MCS 8, Number of Transmission Chains = 2,

Images:



OSP PowerMeter settings

Setting	Instrument Value
Measurement Time	**1.000 s**
Points	**1000000**
Time resolution	**1.000 µs**

EMISSION LIMITATIONS RADIATED (TRANSMITTER)

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(d) and RSS-247 5.5

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.

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

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 antennas, and 1m for the frequency range 18 GHz- 26 GHz Double ridge horn antenna.

For radiated emissions in the range 18 - 26 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.

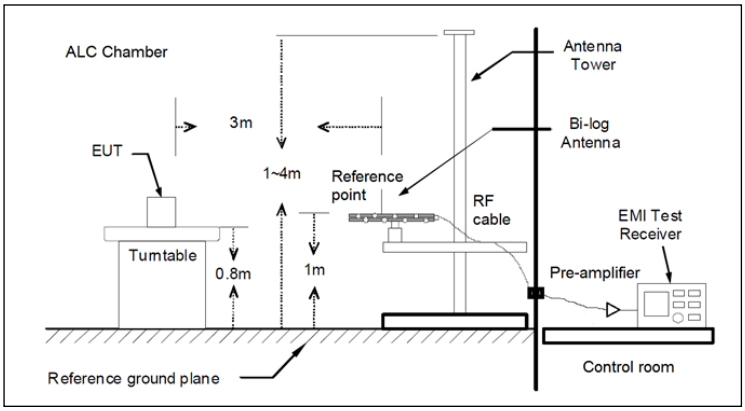
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

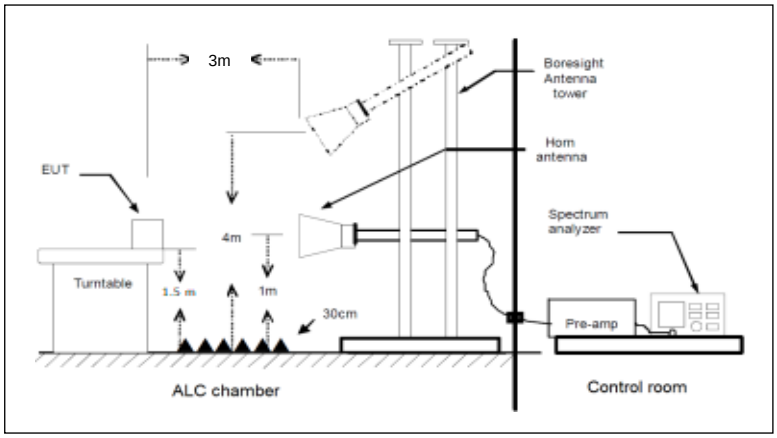
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

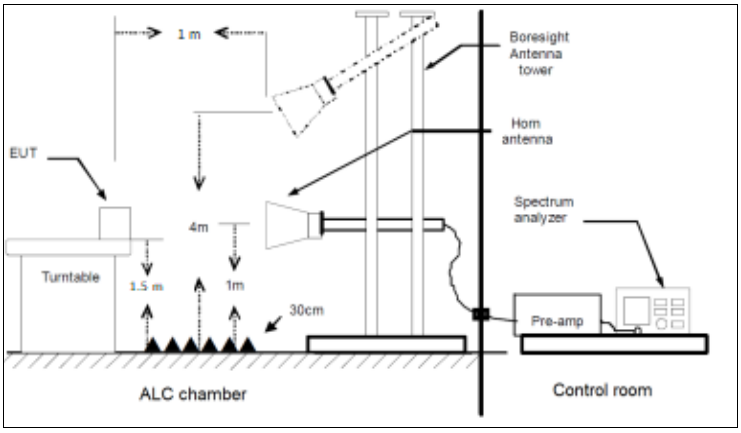
Radiated measurements Setup f < 1 GHz



Radiated measurements setup 1 < f < 18 GHz



Radiated measurements setup f > 18 GHz



TESTED SAMPLES:	S/02
TESTED CONDITIONS MODES:	TC#01 (n mode MIMO RADIO A + B)
TEST RESULTS:	PASS

The results for the worst operation mode selected for this range (b mode & N mode MIMO RADIO A + B) are shown below.

Frequency range 30 MHz – 1000 MHz

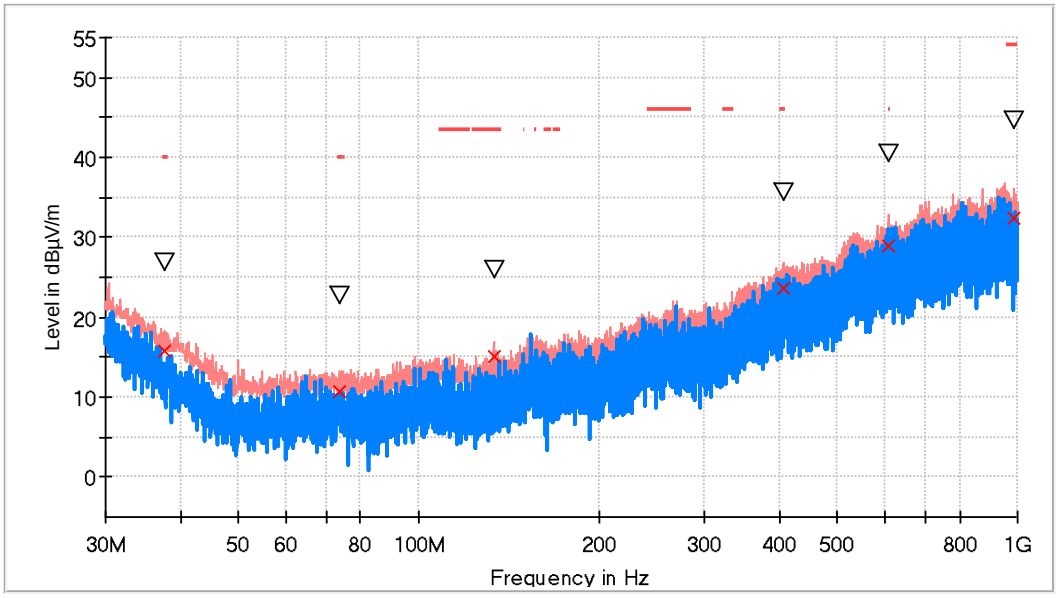
The spurious emissions below 1 GHz do not depend on the operating channel and mode selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.5 GHz.

FREQUENCY RANGE	**30 MHz – 1 GHz (MIMO RADIO A + B)**

CHANNEL: High (2462 MHz)

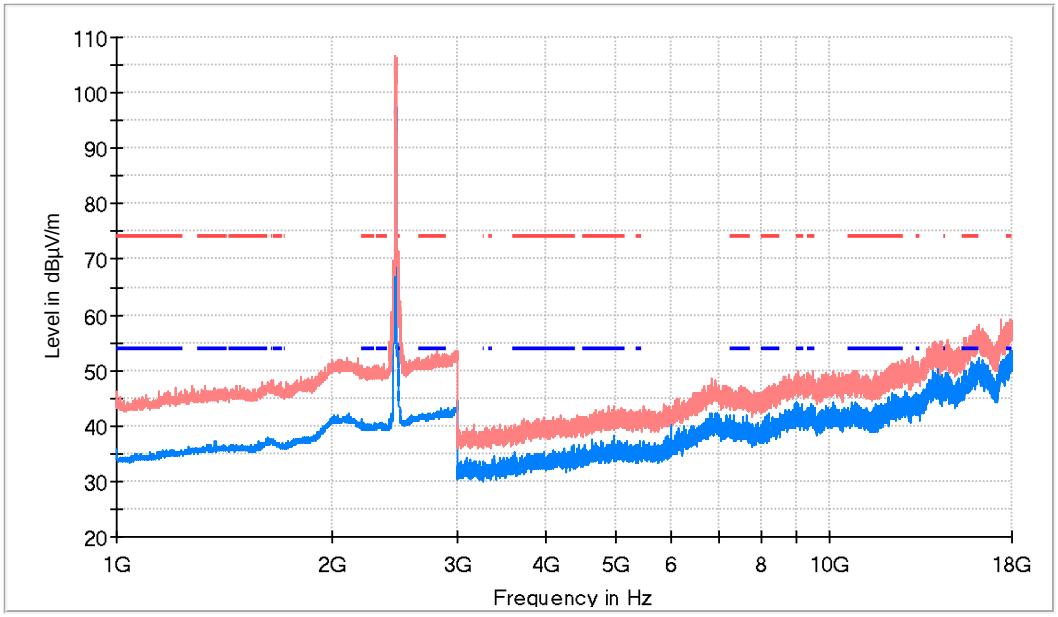


Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
37.517500	26.8	15.7	V	24.3	40.0
73.747000	22.6	10.7	V	29.3	40.0
133.305000	25.8	15.0	V	28.6	43.5
407.766500	35.6	23.6	V	22.4	46.0
610.351000	40.5	29.0	H	17.0	46.0
985.256000	44.6	32.3	H	21.7	54.0

TEST RESULTS (Cont.)	1 – 18 GHz (n mode MIMO RADIO A + B)

CHANNEL: High (2462 MHz)



Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2461.000000	106.7	98.6	H	---	---	Fundamental
2811.000000	53.6	42.6	V	11.4	54.0	
17992.500000	58.9	50.8	H	3.2	54.0	

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**18 GHz – 26 GHz**

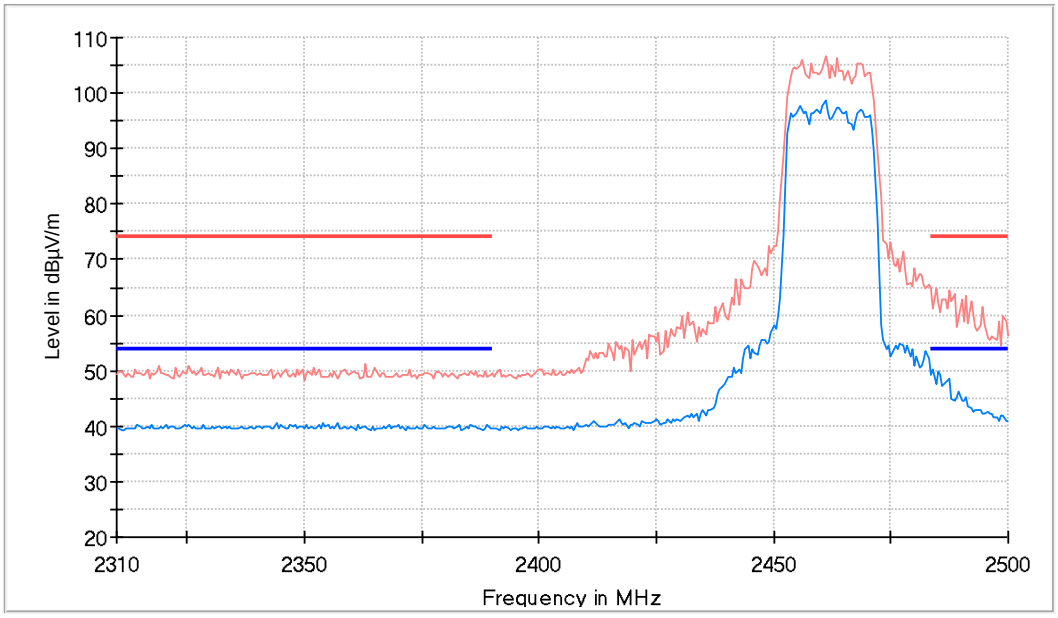
CHANNEL: Lowest (2412 MHz)

Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
19970.000000	51.5	39.7	H	14.3	54.0
22890.000000	50.7	37.5	H	16.5	54.0
23850.500000	49.5	38.4	V	15.6	54.0

RESTRICTED BANDS	2.31 GHz – 2.5 GHz

CHANNEL: Highest (2462 MHz)



AVG_MAXH
PK+_MAXH
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Measurements

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	100 kHz	1 s	20 dB
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	0.1 s	20 dB
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	0.1 s	20 dB
18 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB