DEKRA Certification, Inc.
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Sterling, VA 20164
United States of America

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
3428ERM.011

Partial Test report

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

(*) Identification of item tested	Infotainment Head Unit
(*) Trademark	Garmin
(*) Model and /or type reference tested	IDC23 High 8155
Other identification of the product	FCC ID: IPH-03911 IC:1792A-03911
(*) 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 15.407 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 Digitally signed by Domingo Galvez DN: cn=Domingo Galvez, o=DEKRA Certification Inc., ou=Regulatory Lab, email=dgalvez@dekra.com, c=US Date: 2022.07.28 19:55:29 -04'00'
Date of issue	07-28-2022
Report template No	FDT08_23 (*) "Data provided by the client"

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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
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 sample consists of an Infotainment Head Unit. The main functionalities are: Navigation, USB, voice recognition and several interfaces to the vehicle and Bluetooth / WLAN. The Head-unit provides different interfaces like: AR-CAM input, Video-out APIX3 (for the connection of an external Display), 3 USB interfaces.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
3428/04	Infotainment Head Unit - non beam forming sample	IDC23 High 8155	GAB443N0001134	03/16/2022
2874/05	Harness	-	-	03/26/2021
2874/73	Antenna port cable with SMA connectors	-	-	10/22/2021
3171/18	GPS Antenna	Taoglas- Magma AA.171	171TT20120060	03/12/2021

Sample S/01 is composed of the following accessories:

Control Nº	Description	Model	Serial Nº	Date of reception
2874/70	Automotive Ethernet Adapter	Rad Moon	13401	10/18/2021

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
3428/05	Infotainment Head Unit - beam forming sample	IDC23 High 8155	GAB443N0001212	03/16/2022
2874/05	Harness	-	-	03/26/2021
2874/73	Antenna port cable with SMA connectors	-	-	10/22/2021
3171/18	GPS Antenna	Taoglas- Magma AA.171	171TT20120060	03/12/2021

Sample S/02 is composed of the following accessories:

Control Nº	Description	Model	Serial Nº	Date of reception
2874/70	Automotive Ethernet Adapter	Rad Moon	13401	10/18/2021

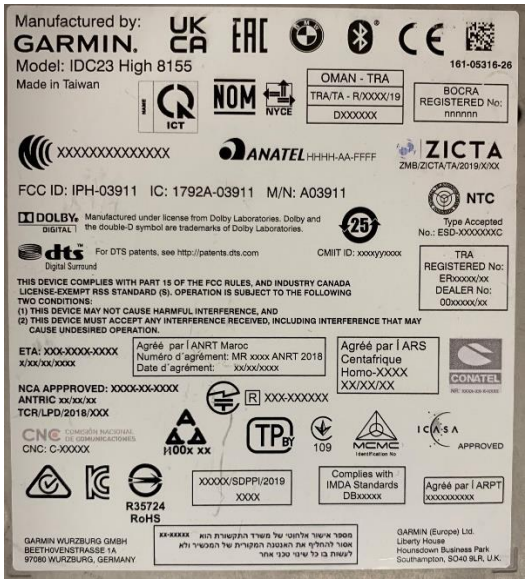
Sample S/01, & S/02 were used for the following test(s): Radiated emission test indicated in appendix A.

Test sample description

Ports…… :	Port name and description		Cable			
			Specified length [m]	Attached during test	Shielded	Coupled to patient
	BT/Wifi Antenna		2	☒	☐	☐
	USB1/2		2	☒	☐	☐
	Power		2	☒	☐	☐
	CID		2	☒	☐	☐
	AR-Cam		2	☒	☐	☐
	100 Base T1/1G Base T1/GPS/DCS/HUD/DFE		2	☒	☐	☐
Supplementary information to the ports…… :	N/A					
Rated power supply .....:	Voltage and Frequency		Reference poles			
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 8 - 16 Vdc					
	☐	DC:					
Rated Power .....:	No Data Provided						
Clock frequencies.....:	No Data Provided						
Other parameters .....:	No Data Provided						
Software version .....:	STS 21w24.4-1-41-072221-1409						
Hardware version .....:	1.5.2						
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					
	☒	Other: Automotive					

Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	N/A		
Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	N/A		
Documents as provided by the applicant.....:	Description	File name	Issue date
	Declaration Equipment Data	FDT30_18 Declaration Equipment Data IDC23_8155_20220318	05/24/2022

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)	06-03-2022
Date (finish)	06-15-2022

Document history

Report number	Date	Description
3428ERM.011	07-28-2022	First release

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. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

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

Testing verdicts

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

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
Supplementary information and remarks: 1) Only multi-transmitter radiated spurious emission test was requested.					

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
Supplementary information and remarks: 1) Only multi-transmitter radiated spurious emission test was requested.					

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
Supplementary information and remarks: 1) Only multi-transmitter radiated spurious emission test was requested.					

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
0981	RF pre-amplifier	Bonn Elektronik	BLMA0118-2A	2020/11	2022/11
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	2020/08	2022/08
1111	Ethernet SNMP T Thermometer	HW Group	HWg-STE Plain	2020/08	2022/08
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

Appendix A: Test results (Multi-transmitter)

Appendix A Content

PRODUCT INFORMATION

Information	Description
Modulation	BR/EDR: GFSK, π/4-DQPSK, 8-DPSK Wi-Fi 2.4 GHz: DSSS, OFDM, MIMO-OFDM Wi-Fi 5 GHz: DSSS, OFDM, MIMO-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 GHz: 20MHz, 40MHz Wi-Fi 5GHZ: 20MHz, 40MHz, 80MHz
- RF Output Power	BR/EDR: 4 dBm Wi-Fi 2.4 GHz: 14 dBm Wi-Fi 5 GHz: 14 dBm (Beamforming)
Antenna type	1/4 wave coax
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	12 Vdc
- Type of power source	DC voltage
Equipment type	Bluetooth, Wi-Fi 2.4 GHz, and Wi-Fi 5 GHz
Geo-location capability	No

DESCRIPTION OF TEST CONDITIONS

<table>
<tr><th>TEST CONDITIONS</th><th>DESCRIPTION</th></tr>
<tr><td>TC#01(1)</td><td>
Power supply (V):
DC 12 V

Test Frequencies for Radiated tests:
<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>FHSS</td><td>8DPSK</td></tr>
<tr><td>Wi-Fi 2.4 GHz MIMO (non - beamforming)</td><td>2437</td><td>20</td><td>OFDM</td><td>b mode</td></tr>
</table>
The test was performed with the equipment transmitting with Bluetooth and Wi-Fi 2.4GHz 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.
</td></tr>
<tr><td>TC#02(1)</td><td>
Power supply (V):
DC 12 V

Test Frequencies for Radiated tests:
<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>FHSS</td><td>8DPSK</td></tr>
<tr><td>Wi-Fi 5 GHz MIMO (beamforming)</td><td>5180</td><td>20</td><td>OFDM</td><td>ac mode</td></tr>
</table>
The test was performed with the equipment transmitting with Bluetooth 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.
</td></tr>
</table>

Note (1): Preliminary scan was performed to determine the worst case between two SISO ports (2.4 GHz or + 5 GHz) and MIMO (2.4 GHz or 5 GHz) ports. The following tables and plots show the results for the worst case in MIMO (2.4 GHz or 5 GHz) + BT.

TEST A.1: EMISSION LIMITATIONS RADIATED (TRANSMITTER)

LIMITS:	Product standard:	Part 15 Subpart C §15.247, Part 15.31(h), and RSS-247
	Test standard:	Part 15 Subpart C §15.247 (d) 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- 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.

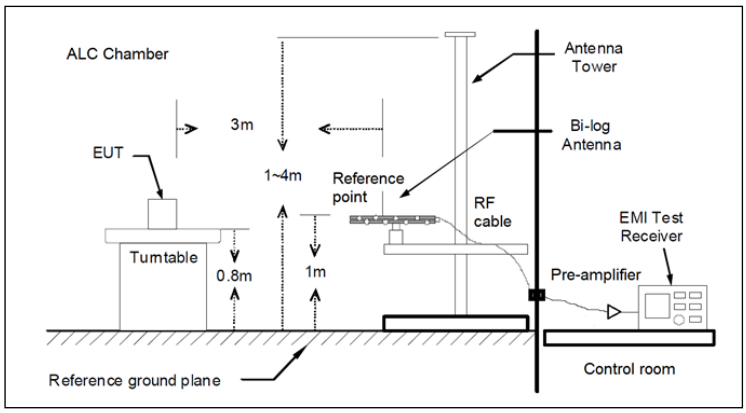
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

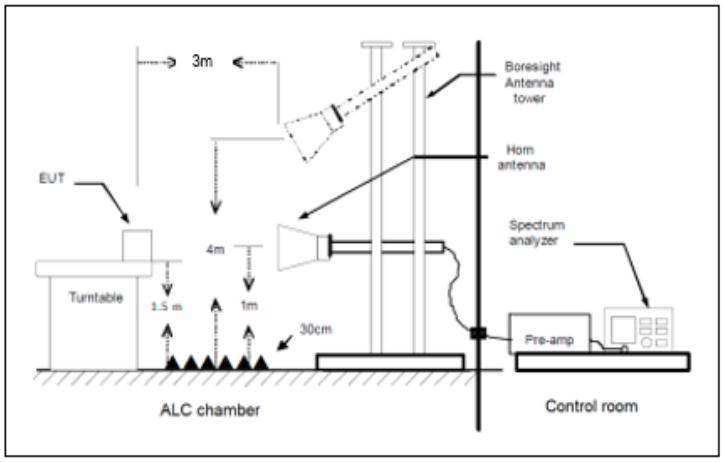
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

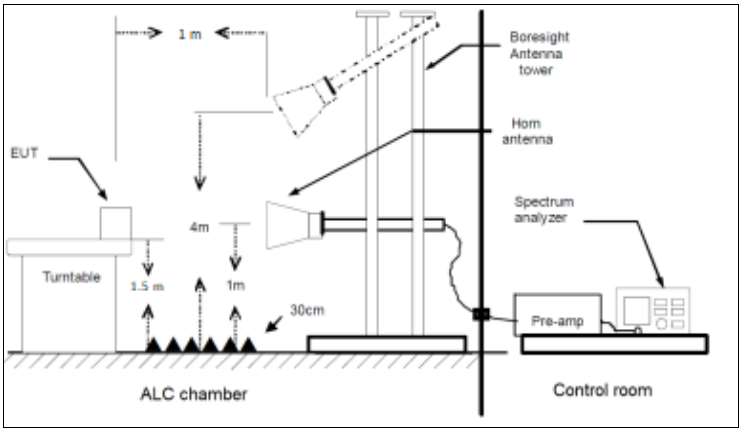
Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1-18 GHz

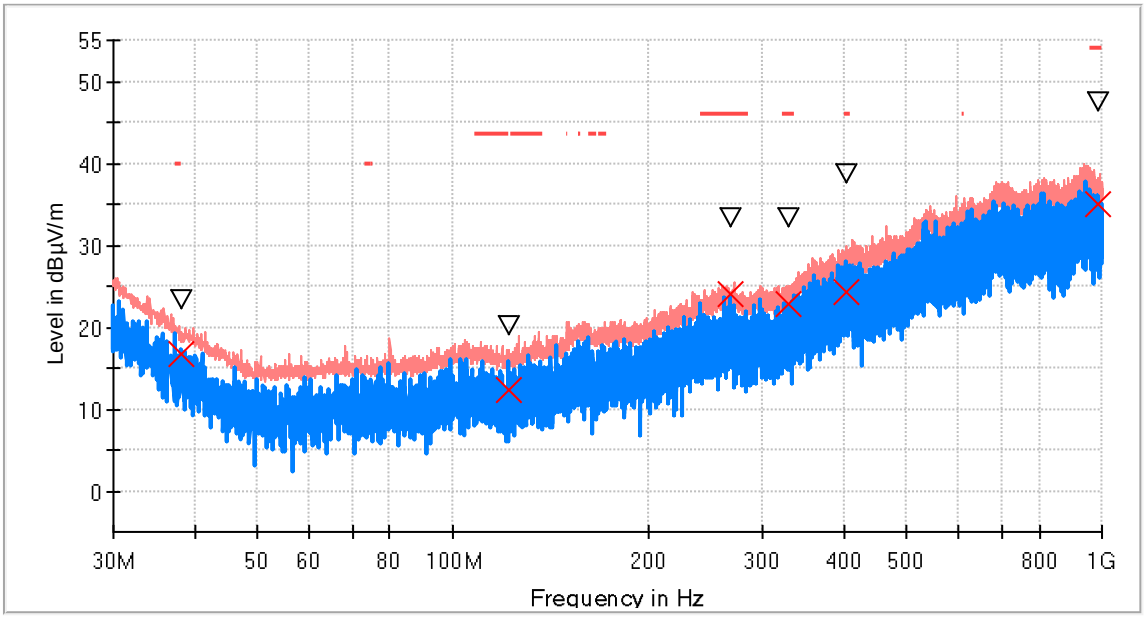


Radiated measurements setup f > 18 GHz



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

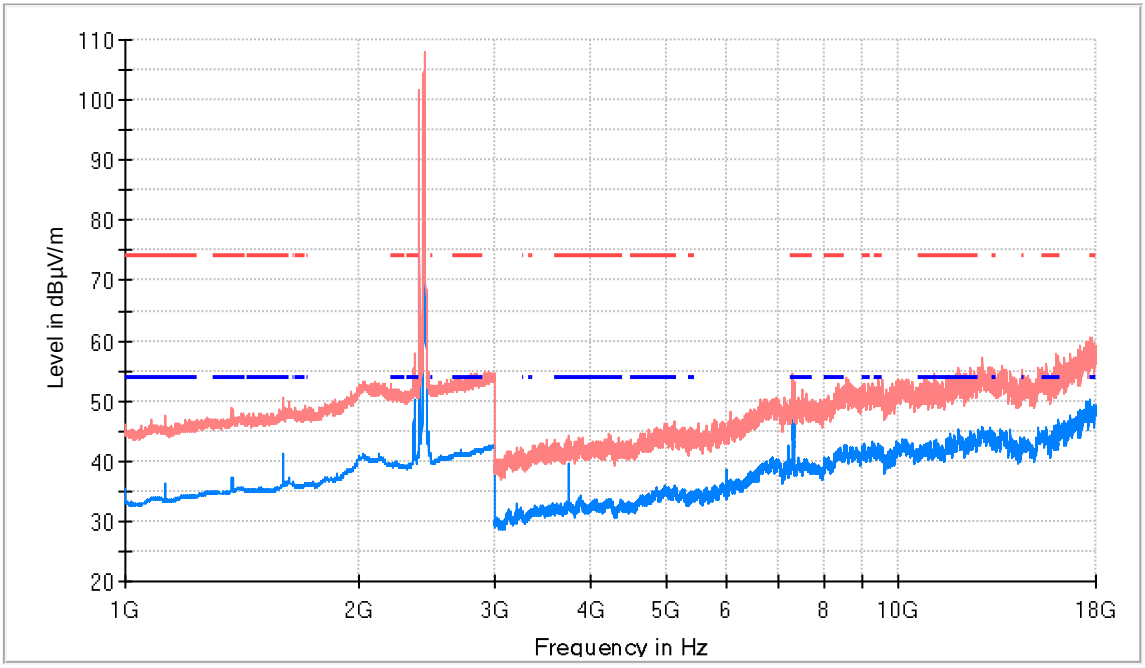
RF_FCC_15.247_E Field_30MHz_1GHz



Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
38.099500	23.4	16.6	V	23.4	40.0
121.859000	20.2	12.4	V	31.1	43.5
267.892500	33.2	24.1	H	21.9	46.0
328.081000	33.3	22.9	V	23.1	46.0
405.002000	38.6	24.4	V	21.6	46.0
988.117500	47.5	35.1	V	18.9	54.0

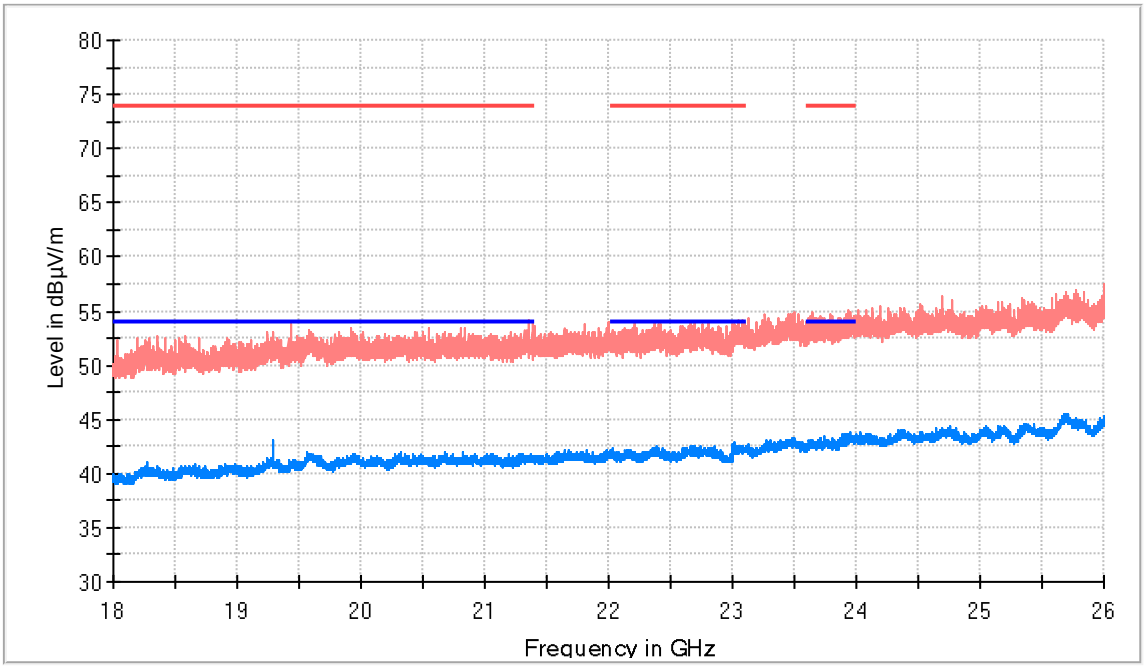
TEST RESULTS (Cont.):	1-18 GHz



Final Result

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2364.500000	57.7	50.2	H	3.8	54.0	
2402.000000	101.6	101.0	H	---	---	BT Fundamental
2437.500000	107.9	100.8	H	---	---	Wi-Fi Fundamental
7309.500000	54.4	47.4	H	6.6	54.0	
17928.000000	57.6	49.3	V	4.7	54.0	

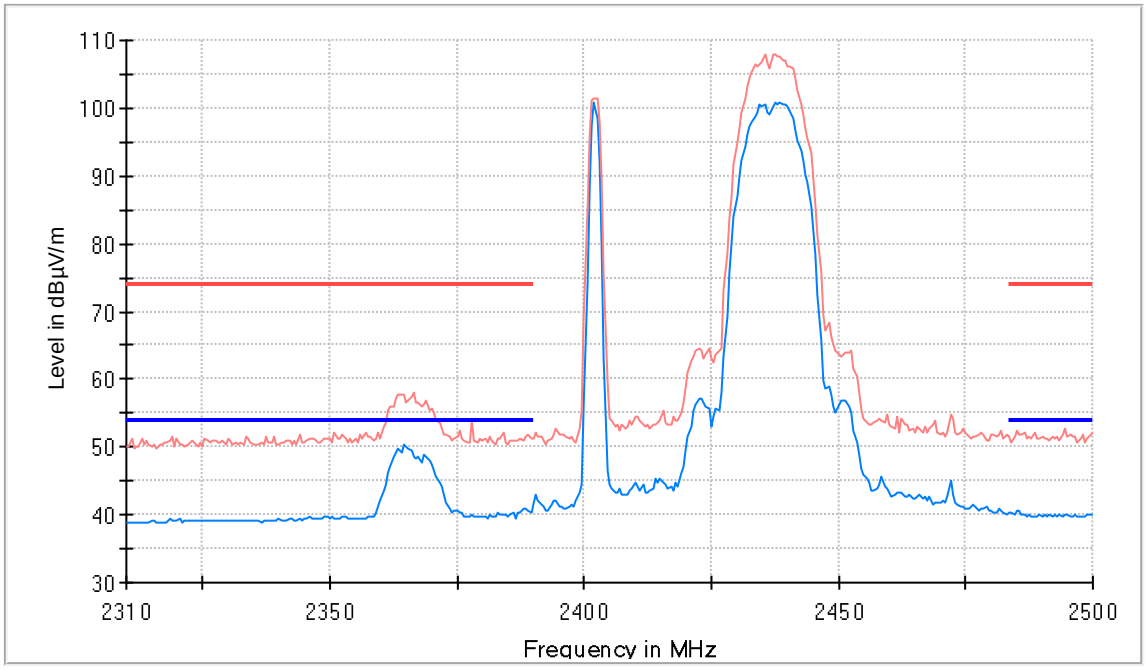
TEST RESULTS (Cont.):	18 – 26 GHz



Final Result

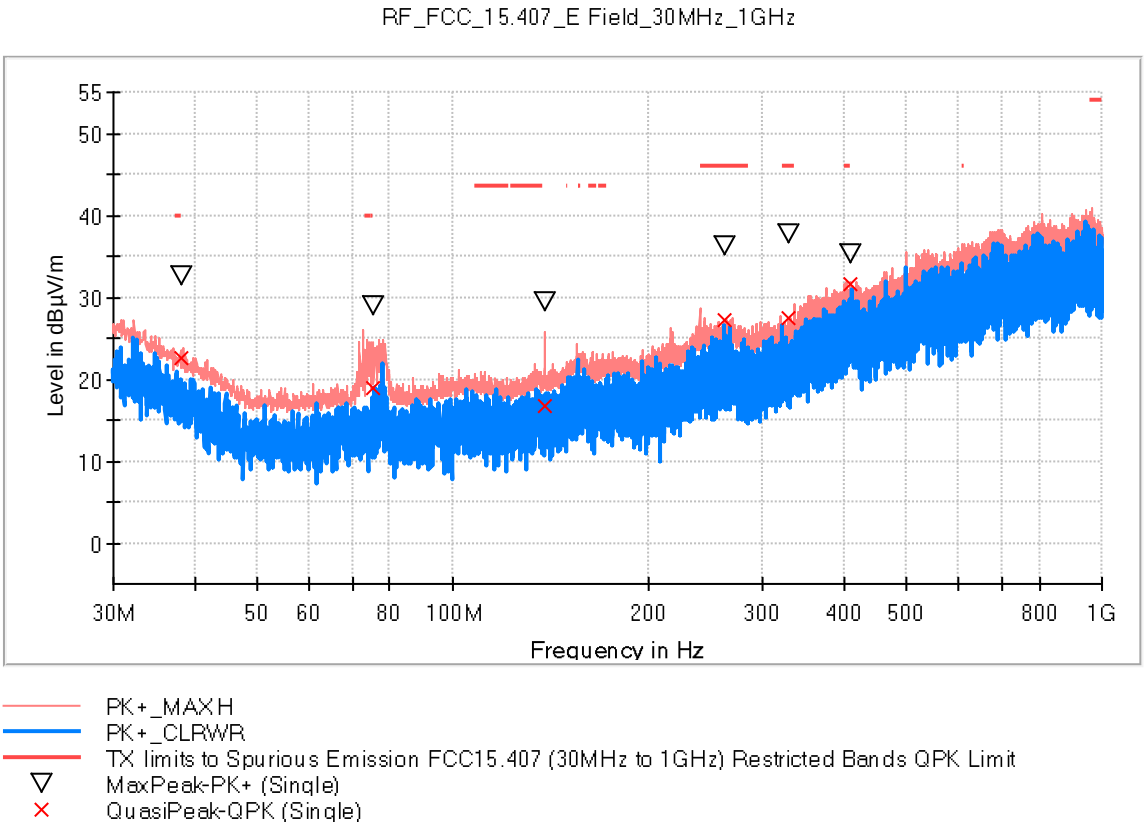
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
18275.500000	50.7	41.0	H	13.0	54.0
19295.500000	51.4	43.2	V	10.8	54.0
23905.000000	53.0	43.7	V	10.3	54.0

TEST RESULTS (Cont.):	Restricted Bands (2.31 GHz – 2.5 GHz)



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

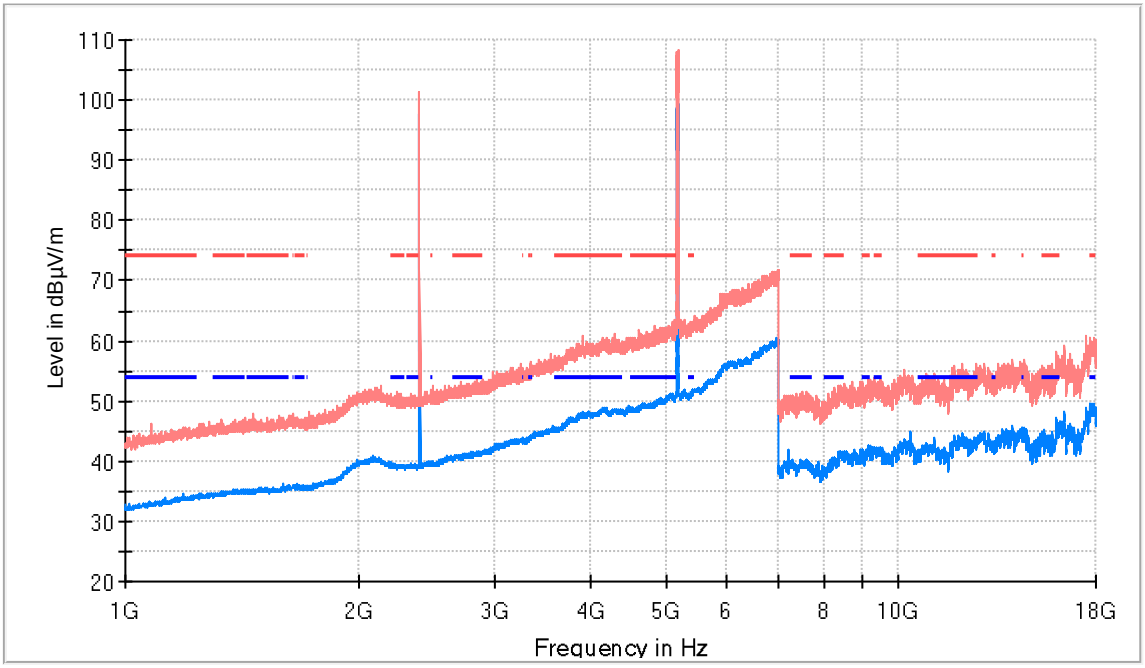
TESTED SAMPLES:	S/02
TESTED CONDITIONS MODES:	TC#02
TEST RESULTS :	30-1000 MHz



Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
38.051000	32.6	22.5	H	17.5	40.0
75.105000	28.9	19.0	V	21.0	40.0
138.203500	29.3	16.6	V	---	---
261.684500	36.3	27.2	V	18.8	46.0
328.469000	37.6	27.5	V	18.5	46.0
408.445500	35.2	31.6	V	14.4	46.0

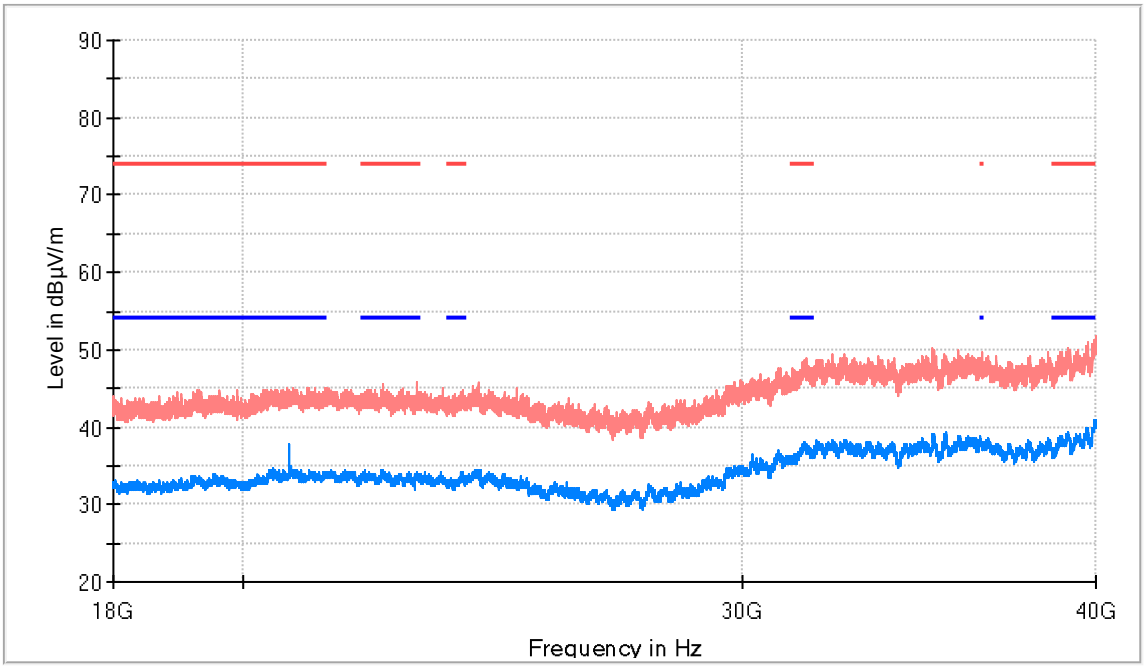
TEST RESULTS (Cont.):	1-18 GHz



Final Result

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2401.500000	101.1	96.9	H	---	---	BT Fundamental
5182.500000	108.2	99.1	H	---	---	Wi-Fi Fundamental
17933.500000	58.8	49.5	H	4.5	54.0	

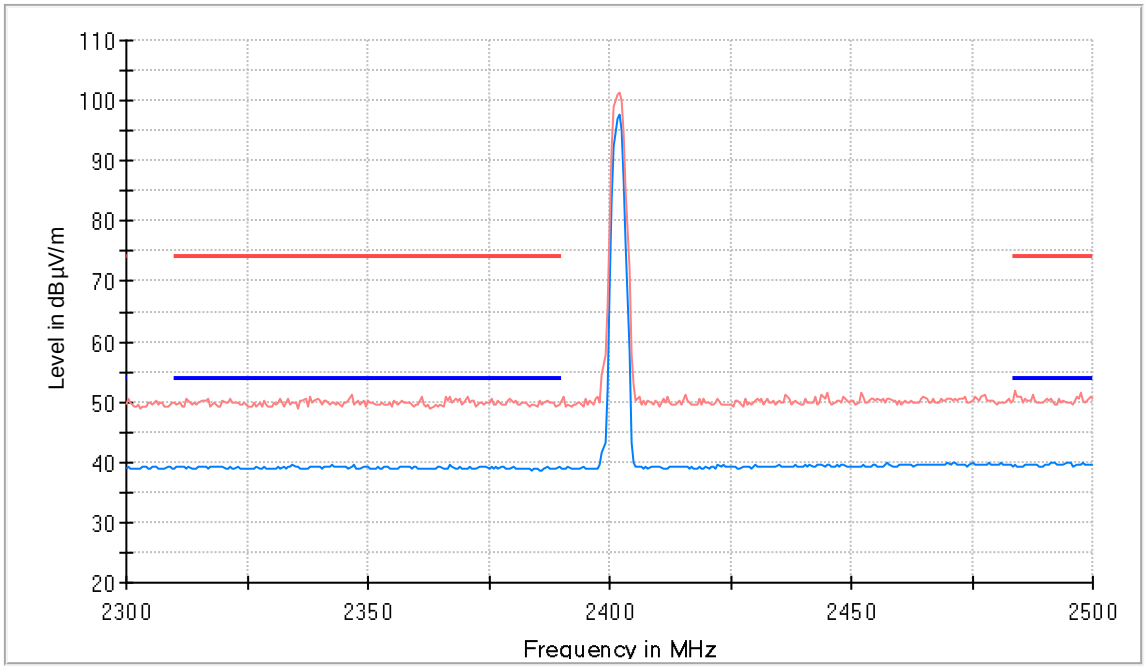
TEST RESULTS (Cont.):	18 – 40 GHz



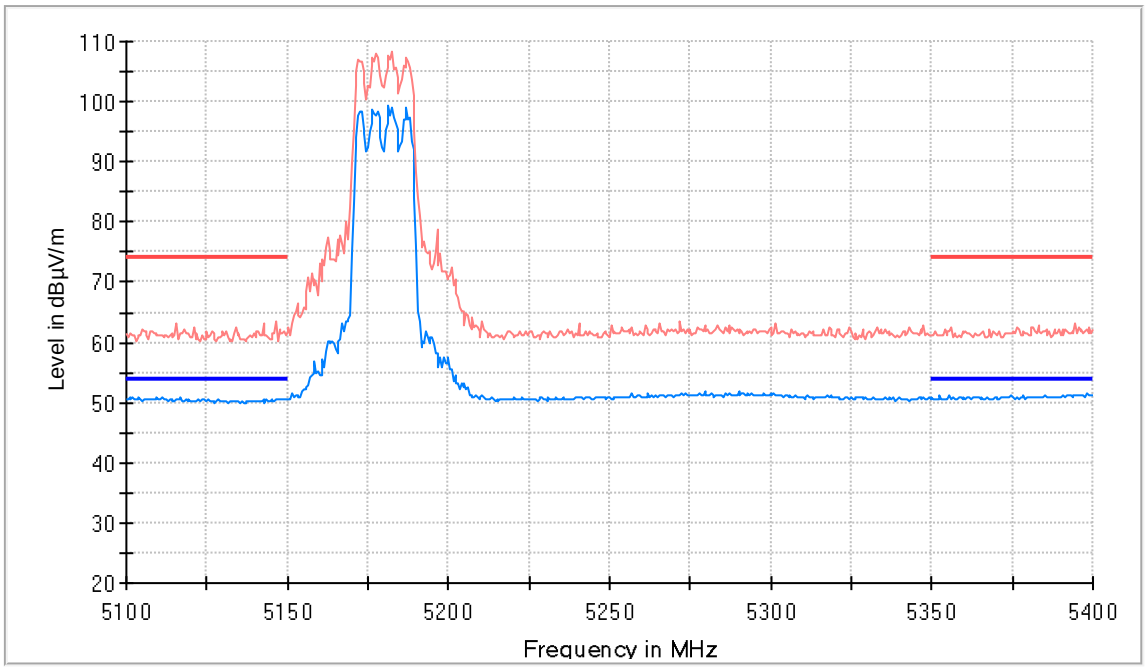
Final Result

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
20759.625000	43.2	37.8	H	16.2	54.0
39927.812500	49.3	40.6	H	13.4	54.0

TEST RESULTS (Cont.):	Restricted Bands (2.3 GHz – 2.5 GHz)



TEST RESULTS (Cont.):	Restricted Bands (5.1 GHz – 5.4 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