DEKRA Certification, Inc.
405 Glenn Dr. Suite 12,
Sterling, VA 20164
United States of America

DEKRA

ACCREDITED
Test Lab
Cert 2764.01

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
2271ERM.003

Partial Test report

USA FCC Part 15.247, 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.
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

Identification of item tested	Head unit with radio and Bluetooth
Trademark	Panasonic
Model and /or type reference	MIB3E_MQB_BTWIFI
Other identification of the product	FCC ID: WUQ-MIB3HBTWIFI IC: 216R-MIB3HBTWIFI PN: 654.035.869.A HW Version: X31 SW Version: X450
Features	Bluetooth, WLAN, FM, AM, DAB, USB.
Manufacturer	PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH Robert Bosch Str. 27-29-63225 Langen- Germany
Test method requested, standard	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). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas. Guidance v04 dated 05/04/2017. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
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: 2019.02.12 05:32:15 -05'00'
Date of issue	1-22-2019
Report template No	FDT08_21

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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.

Frequency (MHz)	U(k=2)	Units
0,009 - 30	2.69	dB
30-180	3.82	dB
180-1000	2.61	dB
1000-18000	2.92	dB
18000-40000	2.15	dB

Data provided by the client

Automotive head unit to be installed in cars with the following features: Bluetooth, WLAN, FM, AM, DAB, USB

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:

Control Nº	Description	Model	Serial Nº	Date of reception
2271.044	Car Radio	MIB3E_MQB_BTWIFI	04S PM6-00124.07.18413E007	12/21/2018
2271.019	Antenna	-	380	10/02/2018
2271.038	Power Cable	-	-	12/21/2018
2271.052	BNC to FAKRA RF Cable	-	-	12/21/2018
2271.053	SMA to FAKRA RF Cable	-	-	12/21/2018
2271.054	BNC to FAKRA RF Cable	-	-	12/21/2018
2271.055	BNC 1 to 2-way splitter			12/28/2018

1. Sample S/01 has undergone following test(s):

   All radiated tests indicated in appendix A & B.

Test sample description

<table>
<tr><td>Ports…… :</td><td colspan="5">
<table>
<tr><td rowspan="2">Port name and description</td><td colspan="4">Cable</td></tr>
<tr><td>Specified max length [m]</td><td>Attached during test</td><td>Shielded</td><td>Coupled to patient(3)</td></tr>
<tr><td>Not Provided Data</td><td></td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td></td><td></td><td>☐</td><td>☐</td><td>☐</td></tr>
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</td></tr>
<tr><td>Supplementary information to the ports…… :</td><td colspan="5"></td></tr>
<tr><td>Rated power supply .....:</td><td colspan="5">
<table>
<tr><td colspan="2" rowspan="2">Voltage and Frequency</td><td colspan="5">Reference poles</td></tr>
<tr><td>L1</td><td>L2</td><td>L3</td><td>N</td><td>PE</td></tr>
<tr><td>☐</td><td>AC:</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>☐</td><td>AC:</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>☐</td><td colspan="5">DC:</td></tr>
<tr><td>☒</td><td colspan="5">DC: 12 Vdc</td></tr>
</table>
</td></tr>
<tr><td>Rated Power .....:</td><td colspan="5">No Data provided</td></tr>
<tr><td>Clock frequencies .....:</td><td colspan="5">No Data provided</td></tr>
<tr><td>Other parameters.....:</td><td colspan="5">No Data provided</td></tr>
<tr><td>Software version .....:</td><td colspan="5">X450</td></tr>
<tr><td>Hardware version.....:</td><td colspan="5">X31</td></tr>
<tr><td>Dimensions in cm (W x H x D)....:</td><td colspan="5">Data not provided</td></tr>
<tr><td>Mounting position.....:</td><td colspan="5">
<table>
<tr><td>☐</td><td>Table top equipment</td></tr>
<tr><td>☐</td><td>Wall/Ceiling mounted equipment</td></tr>
<tr><td>☐</td><td>Floor standing equipment</td></tr>
<tr><td>☐</td><td>Hand-held equipment</td></tr>
<tr><td>☒</td><td>Other: Car Equipment</td></tr>
</table>
</td></tr>
<tr><td>Modules/parts .....:</td><td colspan="5">
<table>
<tr><td>Module/parts of test item</td><td>Type</td><td>Manufacturer</td></tr>
<tr><td>Not Provided Data</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	Not Provided Data		
Documents as provided by the applicant.....:	Description	File name	Issue date
	FDT30_14 Data Declaration Equipment Data		

Copy of marking plate:

Identification of the client

PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH
Robert Bosch Str. 27-29-63225 Langen- Germany.

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	12-26-2018
Date (finish)	01-21-2018

Document history

Report number	Date	Description
2271ERM.003	01-25-2018	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

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. = 30 % Max. = 60 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Nasir khan and Poojita Bhattu.

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247 (Bluetooth EDR)					
Report Section	**15.247 Spec Clause**	**RSS Spec Clause**	**Test Description**	**Verdict**	**Remark**
-	§ 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) Testing not requested.					

FCC PART 15 PARAGRAPH / RSS-247 (WIFI 2.4GHz)					
Report Section	**15.247 Spec Clause**	**RSS Spec Clause**	**Test Description**	**Verdict**	**Remark**
-	§ 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	Emission limitations Conducted (Transmitter)	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
B.1	§15.247 (d)	RSS-247 5.5.	Emission limitations Radiated (Transmitter)	P	N/A
Supplementary information and remarks: 1) Testing not requested.					

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
1014	Signal Analyzer	ROHDE & SCHWARZ	FSV40	2017/03	2019/03
1012	EMI Test Receiver	ROHDE & SCHWARZ	ESR26	2018/09	2020/09
1058	Double Ridged Waveguide Horn Antenna	ETS LINDGREN	3115	2017/03	2020/03
1055	Double Ridged Waveguide Horn Antenna	ETS LINDGREN	3116C	2016/12	2019/12
1065	Biconilog Antenna	ETS LINDGREN	3142E	2017/03	2020/03
0981	Preamplifier	BONN ELEKTRONIK	BLMA 0118-2A	2017/05	2019/05
0980	Preamplifier	BONN ELEKTRONIK	BLNA 0360-01N	2017/05	2019/05
0982	Preamplifier	BONN ELEKTRONIK	BLMA1840-1M	2017/05	2019/05
1017	EMC measurement software	ROHDE & SCHWARZ	EMC32 V9.01	---	---

Appendix A: Test results (Bluetooth EDR)

Appendix A Content

PRODUCT INFORMATION

The following information is provided by the client

Information	Description
Modulation	FHSS
Adaptive	Adaptive Equipment without the possibility to switch to non-adaptive equipment.
Operation mode 1: Single Antenna Equipment	Equipment with only one antenna
Operating Frequency Range	2402 – 2480 MHz
Nominal Channel Bandwidth	1 MHz
RF Output Power	4 dBm
Extreme operating conditions	
Temperature range	-38 ºC to +70 ºC
Antenna type	Integral antenna
Antenna gain	BT: 1.3 dBi WIFI 2.4GHz: 0.4 dBi
Nominal Voltage	
Supply Voltage	12 Vdc
Type of power source	DC voltage from battery
Equipment type	Bluetooth EDR and WIFI
Geo-location capability	No

Test modes available:

- Continuous modulated carrier at 2402 MHz, 2440 MHz and 2480 MHz
- Continuous reception at 2402 MHz, 2440 MHz and 2480 MHz

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: GFSK Test Frequencies for Radiated tests: Lowest range: 2402 MHz Middle channel: 2440 MHz Highest range: 2480 MHz
TC#02	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: PI4DQPSK Test Frequencies for Radiated tests: Lowest range: 2402 MHz Middle channel: 2440 MHz Highest range: 2480 MHz
TC#03	Power supply (V): $V_{nominal}$ = 12 Vdc Modulation: 8DPSK Test Frequencies for Radiated tests: Lowest range: 2402 MHz Middle channel: 2440 MHz Highest range: 2480 MHz

TEST A.1: 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 at 1m for the frequency range 1-40 GHz (1 GHz-18 GHz and 18 GHz-40 GHz Double ridge horn antennas).

For radiated emissions in the range 1-40 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.

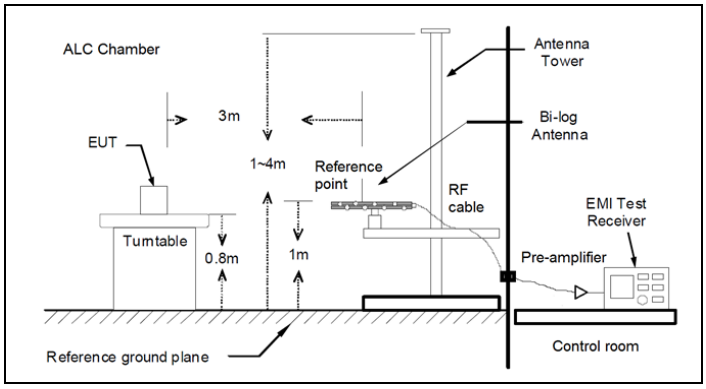
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

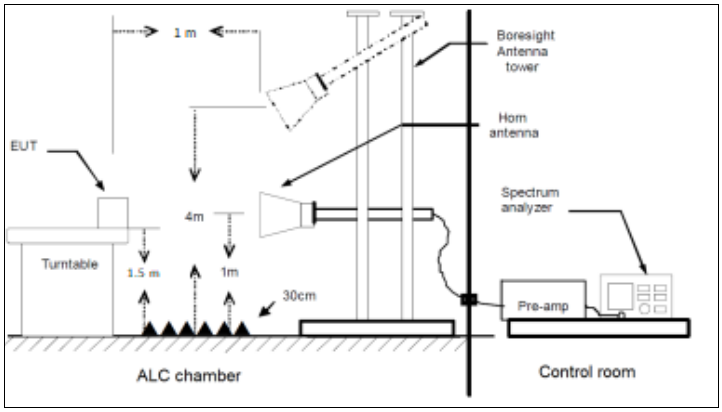
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)	

Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1 GHz



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (GFSK)
TEST RESULTS:	PASS

Co-Location

The test was performed with the equipment transmitting first with only the 2.4 GHz BT-EDR radio and repeated with the WiFi 2.4GHz (WLAN0 CORE1), and WiFi 5 GHz (WLAN0 CORE0) radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

Frequency range 30 MHz – 1000 MHz

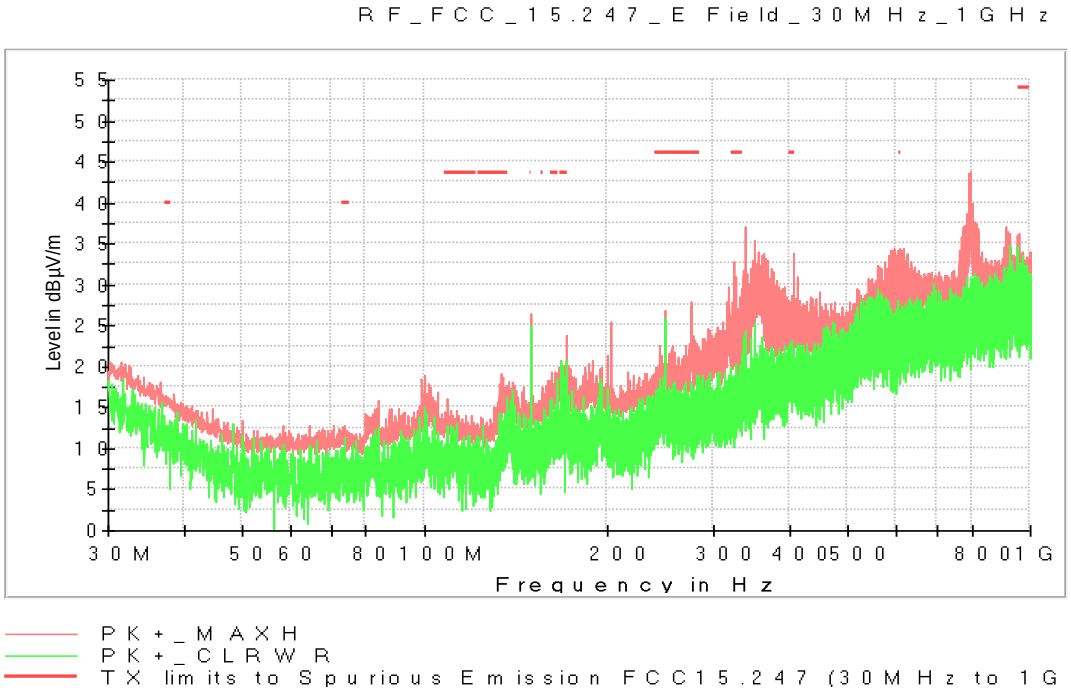
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

The radiated spurious signals detected at less than 10 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables below of each frequency range.

TEST RESULTS (Cont.):	
FREQUENCY RANGE	**30 MHz – 1000 MHz (GFSK)**

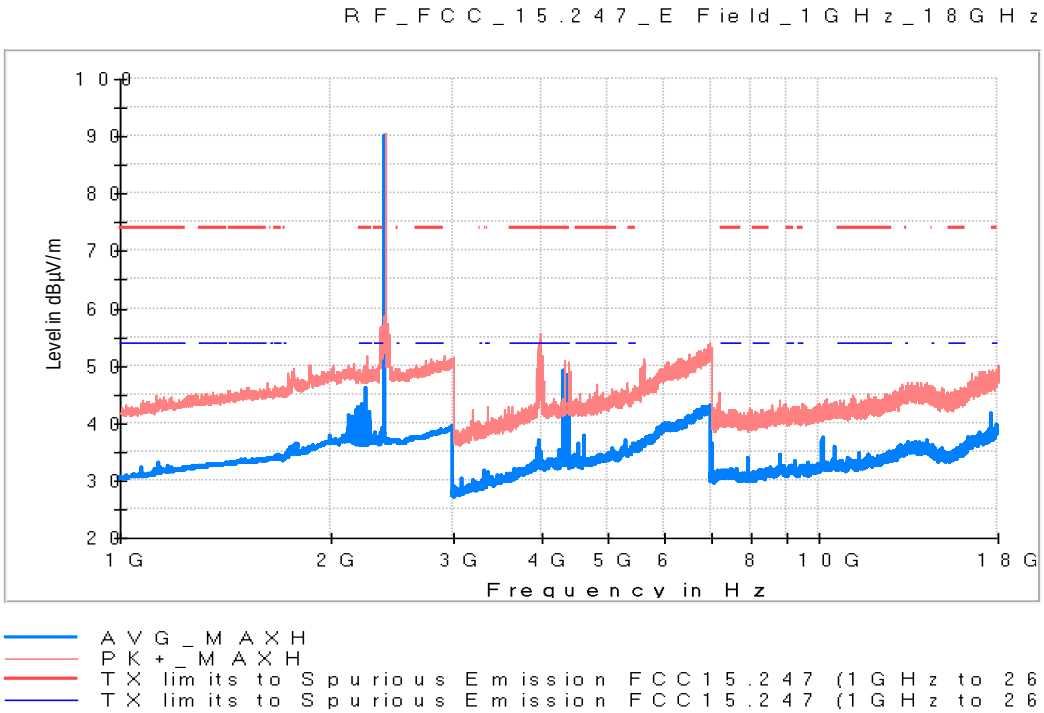


Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol
609.866000	34.8	26.1	H
338.654000	35.4	31.1	H
274.973500	24.2	13.9	H
796.979000	43.0	33.2	H
406.408500	33.5	28.9	V
149.989000	29.1	26.7	V
958.532500	37.4	27.6	V

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**1 GHz – 18 GHz (GFSK)**

CHANNEL: Lowest (2402 MHz).

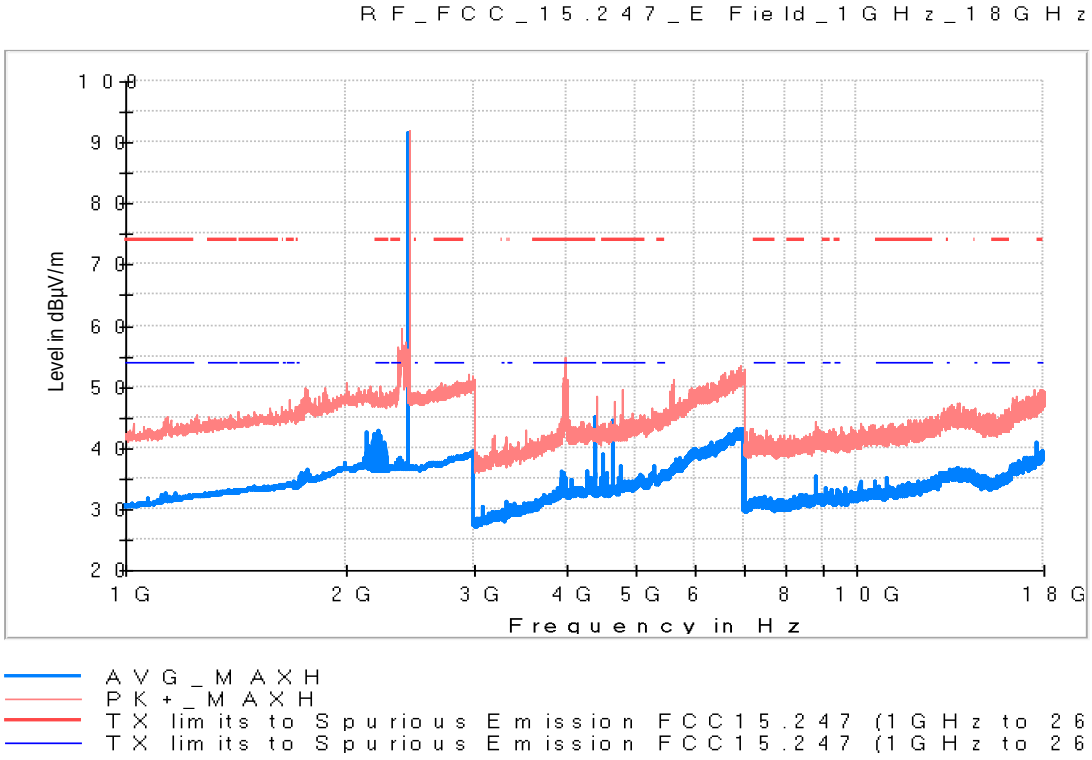


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2402.000000	**90.63**	**90.03**	**H**	Fundamental
4326.000000	**51.06**	**49.18**	**V**	
4385.500000	**50.73**	**48.29**	**V**	
7055.000000	**42.77**	**36.33**	**V**	
10142.000000	**43.70**	**37.57**	**V**	
17638.500000	**48.22**	**41.57**	**V**	

TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz).



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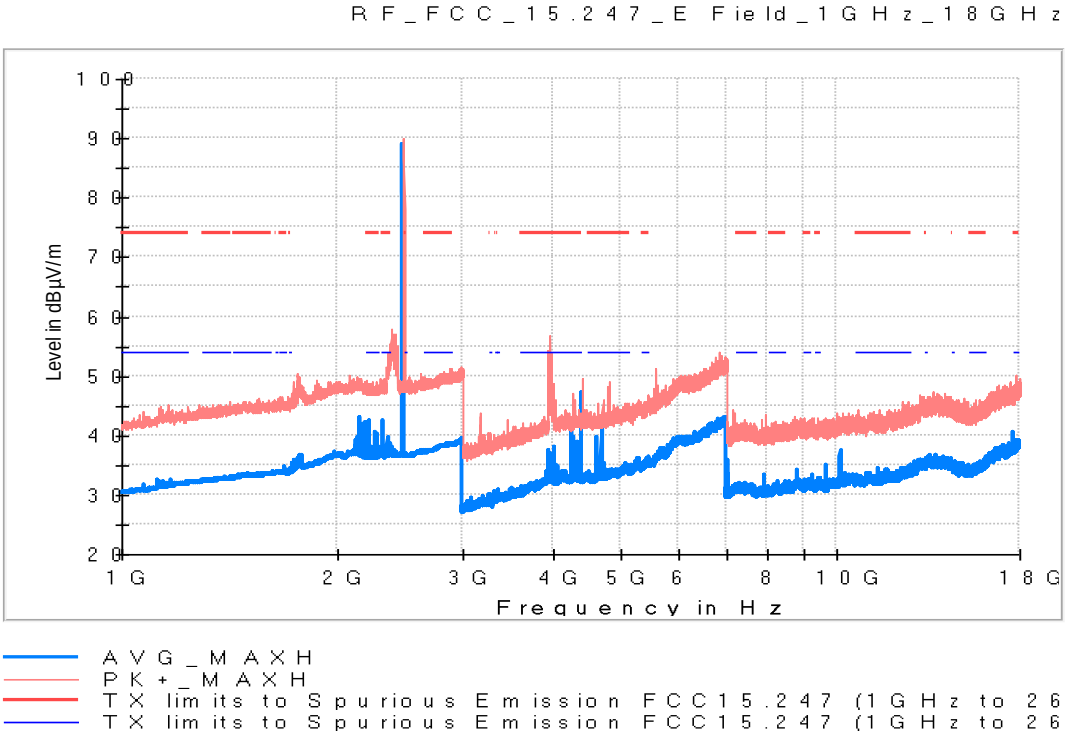
Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2441.00	91.91	91.3	H	Fundamental
4409.50	47.75	45.0	V	
4647.50	47.59	44.4	V	
7055.00	42.72	38.0	V	
8819.00	41.93	35.1	V	
11024.00	42.76	34.9	V	
17638.50	46.84	40.7	V	

TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz).

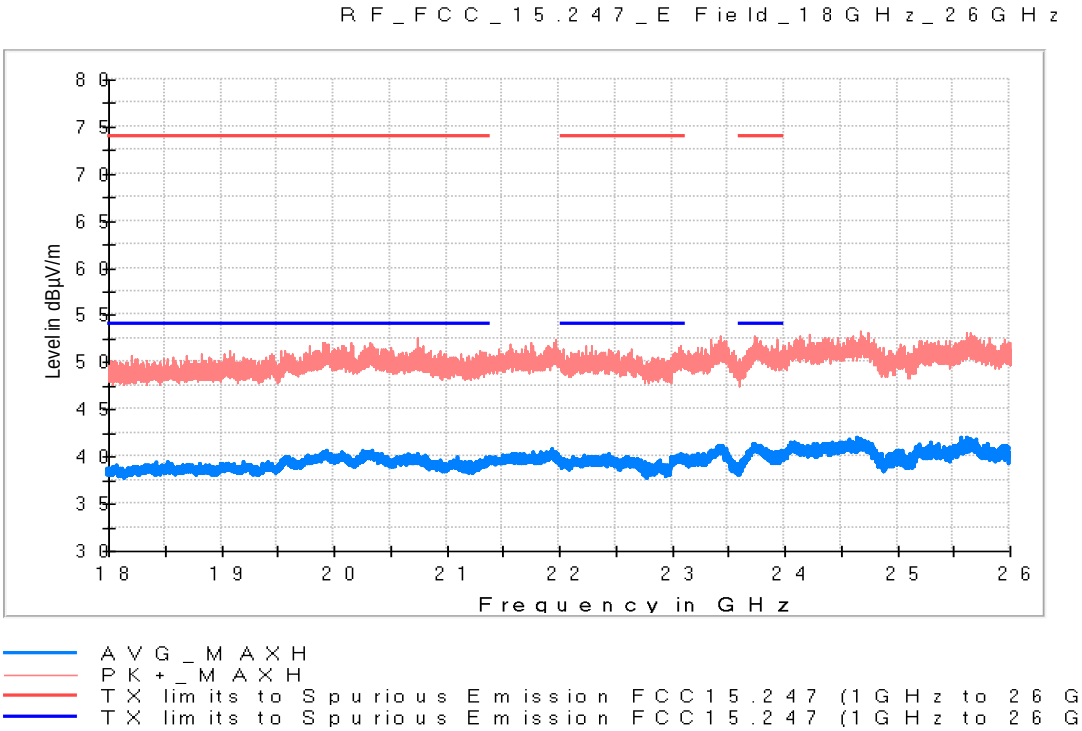


Maximizations

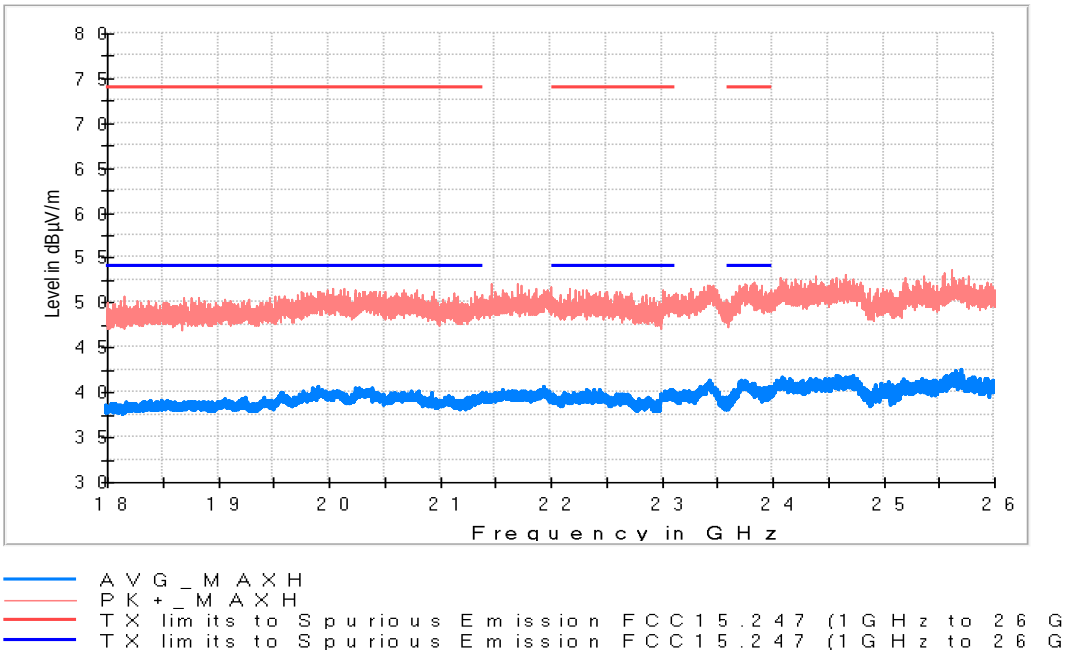
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2480.000000	90.05	88.92	H	Fundamental
4409.500000	49.66	47.22	V	
4700.500000	45.91	41.82	V	
7055.000000	41.20	35.90	V	
10142.000000	42.67	37.49	V	
17638.500000	48.02	40.57	V	

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

CHANNEL: Lowest (2402 MHz).

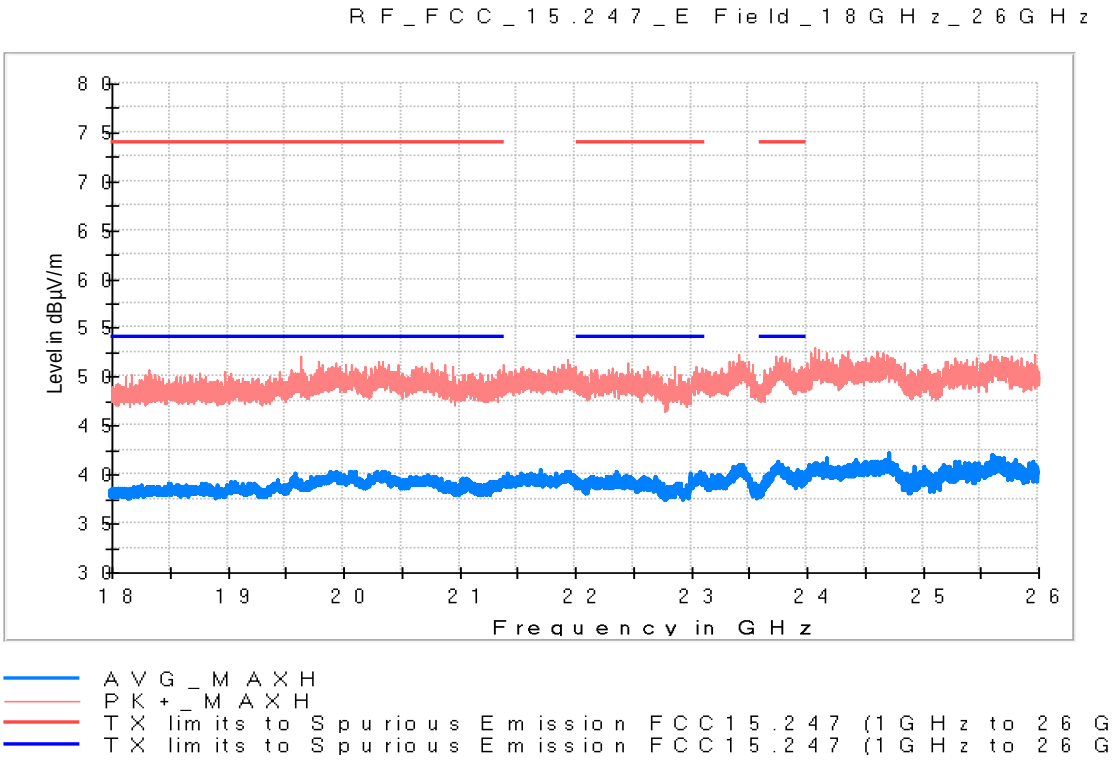


CHANNEL: Middle (2440 MHz).



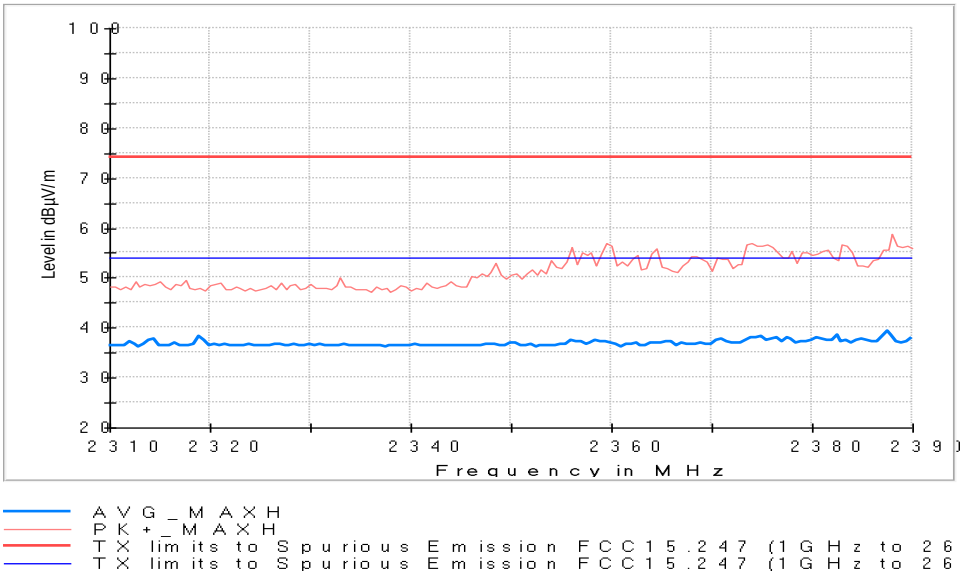
TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz).



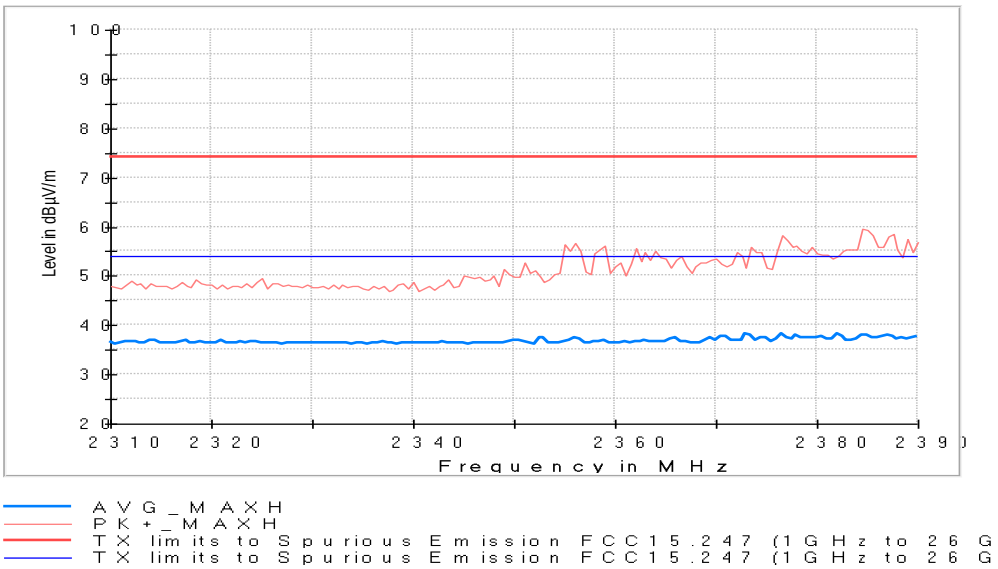
RESTRICTED BANDS	2.31 GHz – 2.39 GHz (GFSK)

CHANNEL: Lowest (2402 MHz)

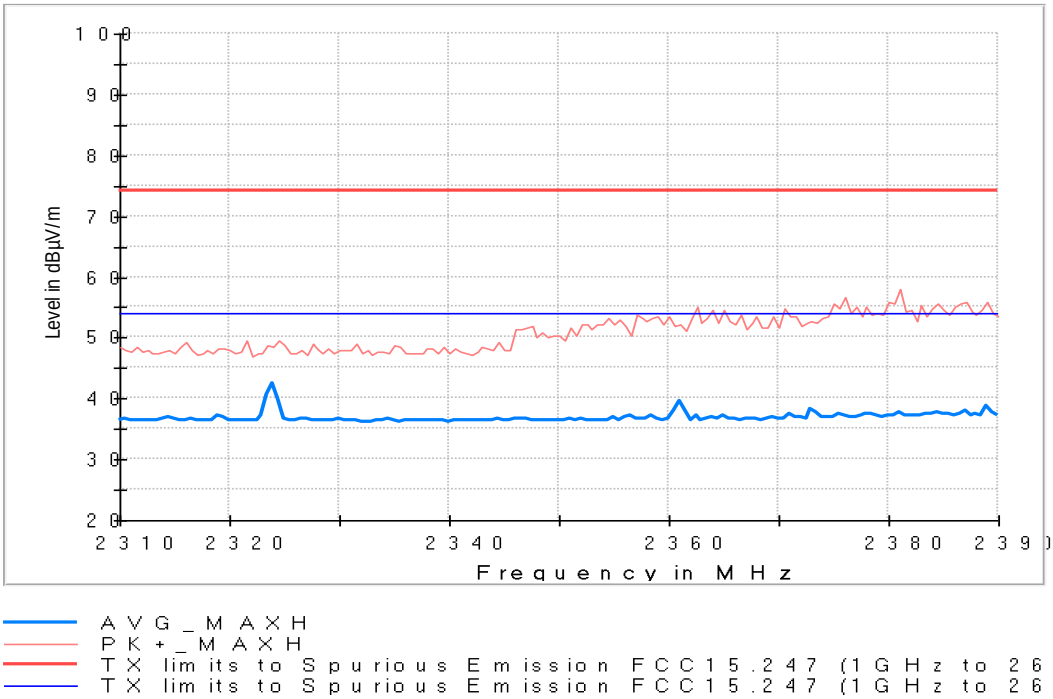


TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz)

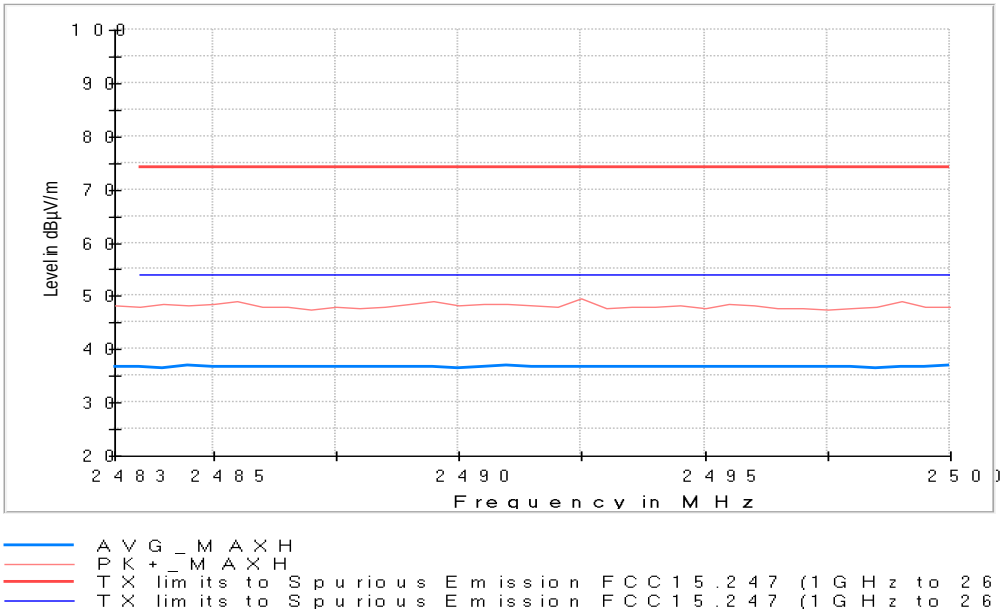


CHANNEL: Highest (2480 MHz)

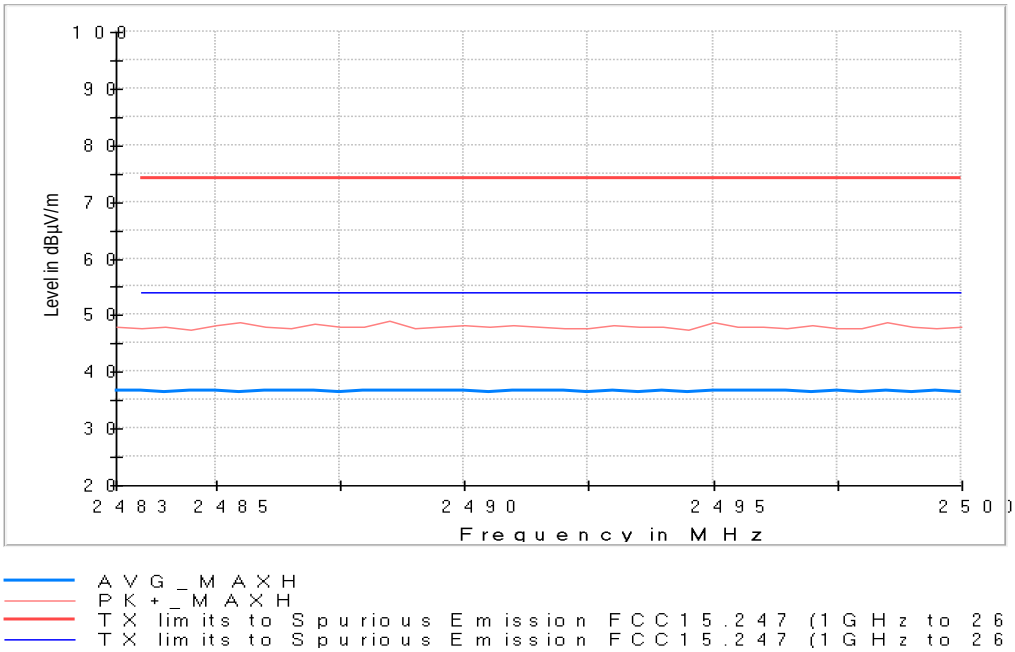


TEST RESULTS (Cont.)	
RESTRICTED BANDS	**2.483 GHz – 2.5 GHz (GFSK)**

CHANNEL: Lowest (2402 MHz)

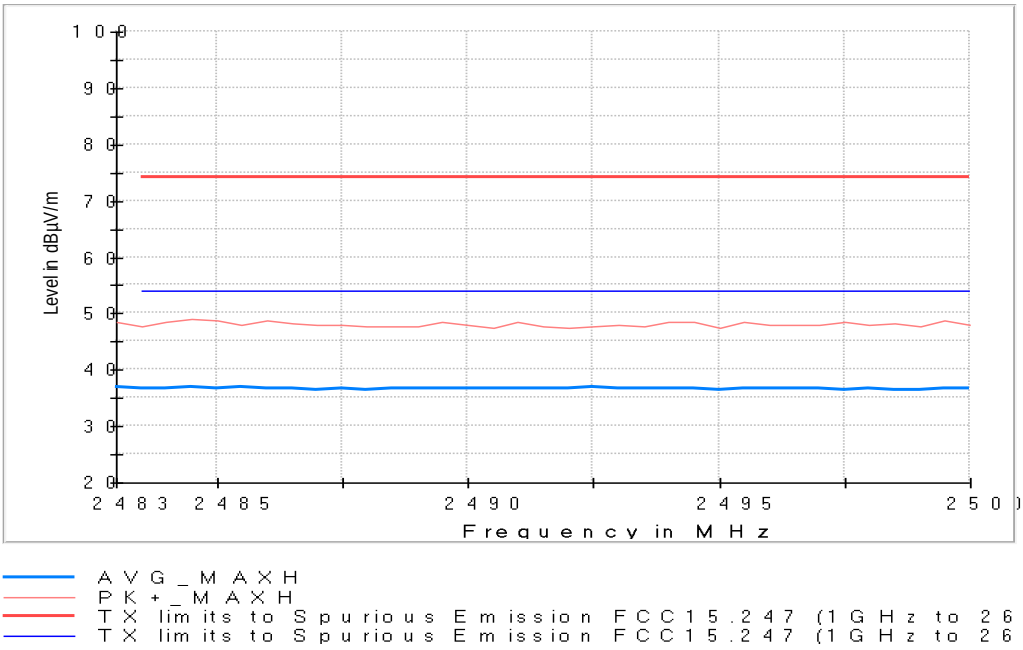


CHANNEL: Middle (2440 MHz)



TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (PI4DQPSK)
TEST RESULTS:	PASS

Co-Location

The test was performed with the equipment transmitting first with only the 2.4 GHz BT-EDR radio and repeated with the WiFi 2.4GHz (WLAN0 CORE1), and WiFi 5 GHz (WLAN0 CORE0) radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

Frequency range 30 MHz – 1000 MHz

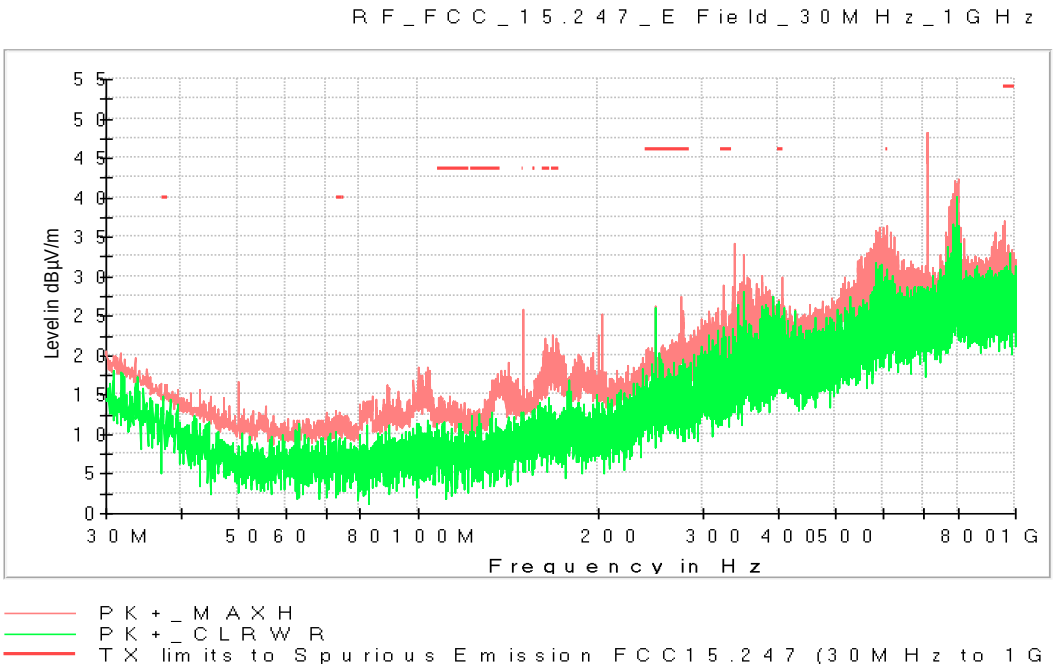
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

The radiated spurious signals detected at less than 10 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables below of each frequency range.

FREQUENCY RANGE	30 MHz – 1000 MHz (PI4DQPSK)

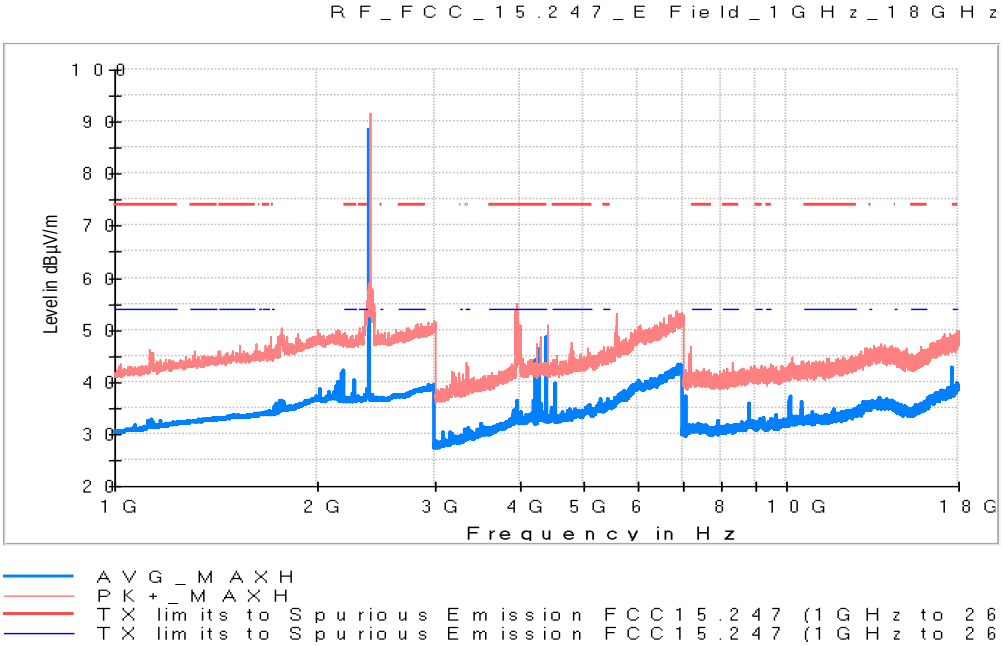


Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol
338.654000	28.4	19.6	H
609.720500	33.7	23.2	H
406.408500	38.4	34.2	H
275.022000	25.1	17.4	V
149.989000	29.8	27.5	V
712.540500	36.3	25.4	V
958.484000	37.8	28.4	V

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**1 GHz – 18 GHz (PI4DQPSK)**

CHANNEL: Lowest (2402 MHz).

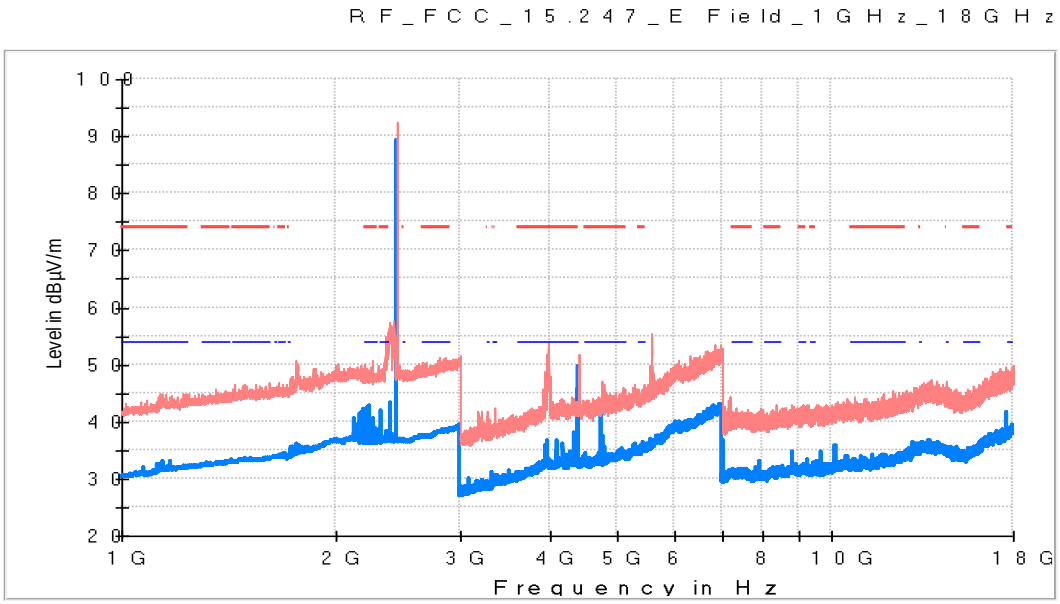


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2402.000000	91.63	88.51	H	Fundamental
4242.500000	47.41	44.02	V	
4302.000000	48.62	46.24	V	
4409.500000	50.93	48.54	V	
7082.500000	41.81	37.10	V	
10142.000000	44.81	37.18	V	
17638.000000	48.04	42.70	V	

TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz).

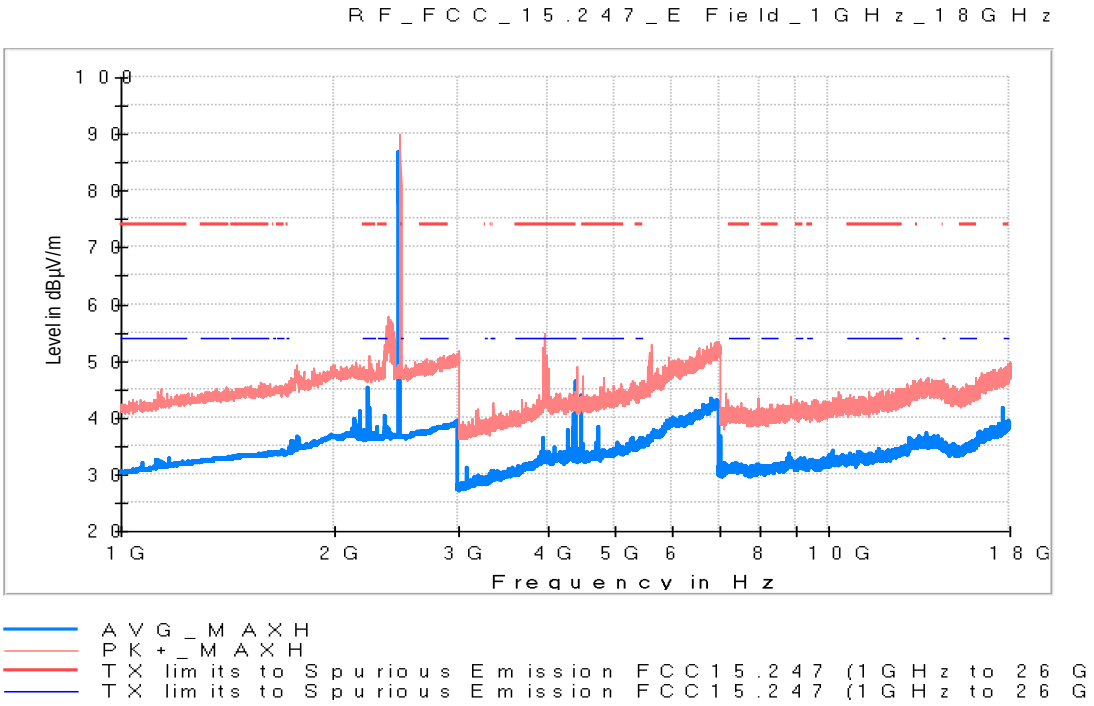


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2441.000000	**92.50**	**89.23**	**H**	Fundamental
4395.000000	**51.33**	**49.67**	**V**	
4734.000000	**47.05**	**43.51**	**V**	
7055.000000	**42.43**	**36.56**	**V**	
10141.500000	**42.45**	**35.73**	**V**	
17638.500000	**47.61**	**41.52**	**V**	

TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)

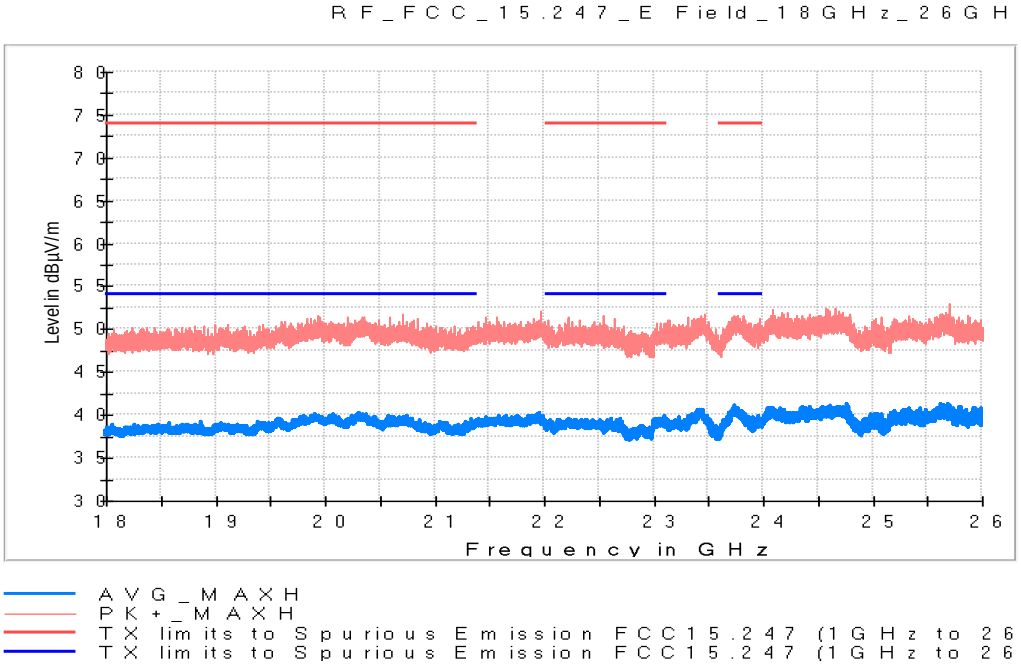


Maximizations

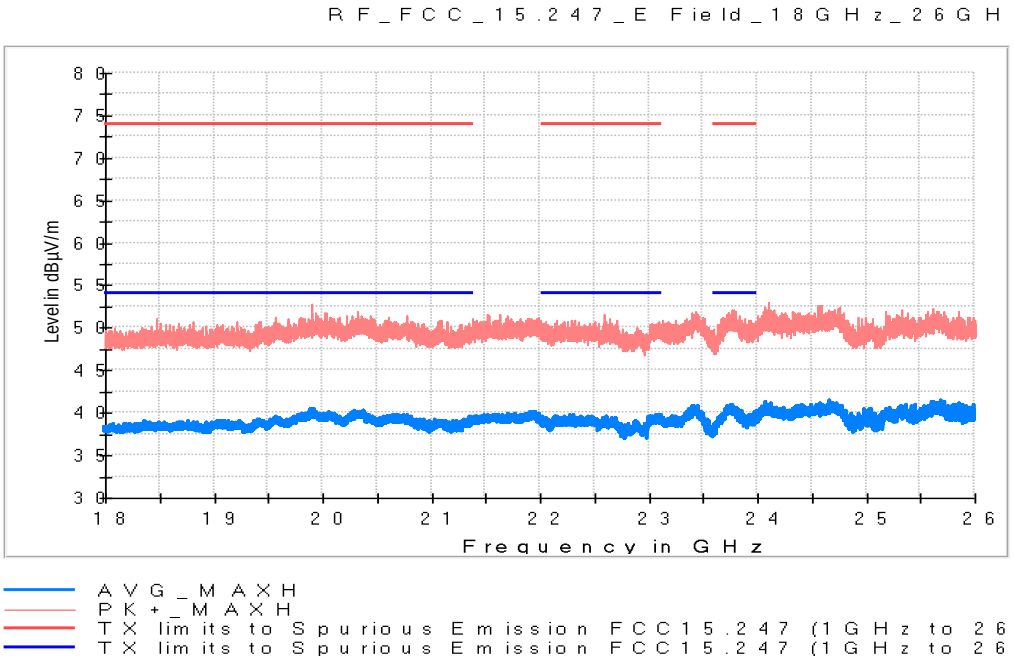
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2244.500000	50.91	45.24	V	Fundamental
2480.000000	89.86	86.77	H	
4409.500000	48.64	46.25	V	
4484.000000	47.34	43.74	V	
7055.000000	41.99	36.53	V	
17638.500000	47.37	41.69	H	

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**18 GHz – 26 GHz (PI4DQPSK)**

CHANNEL: Lowest (2402 MHz)

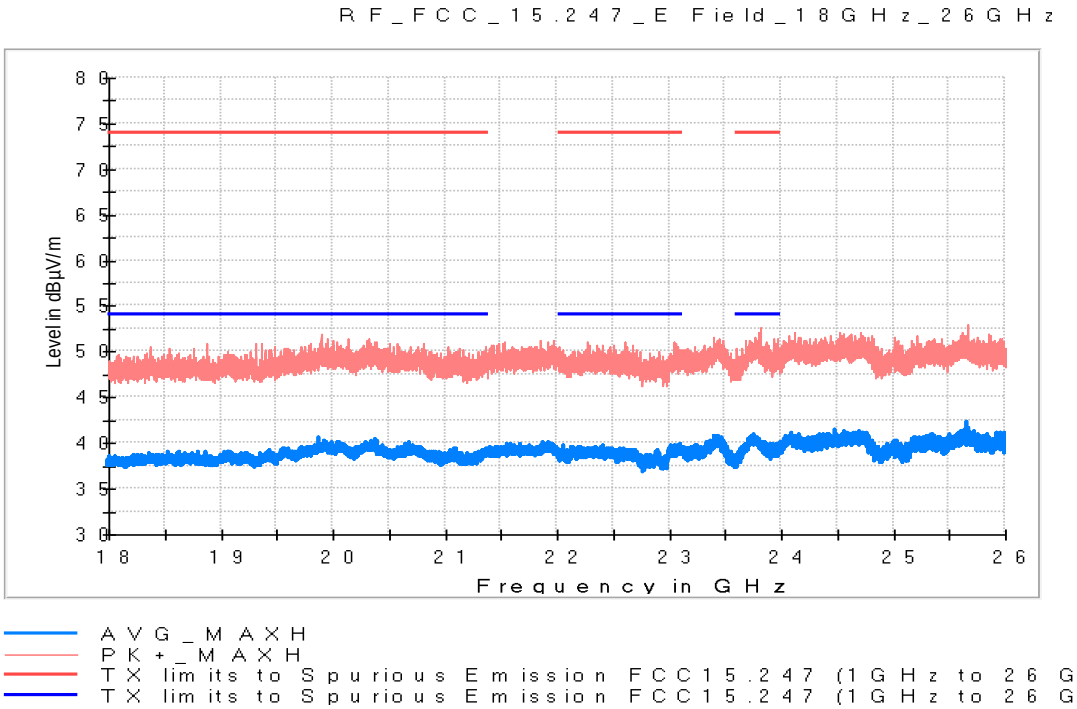


CHANNEL: Middle (2440 MHz)



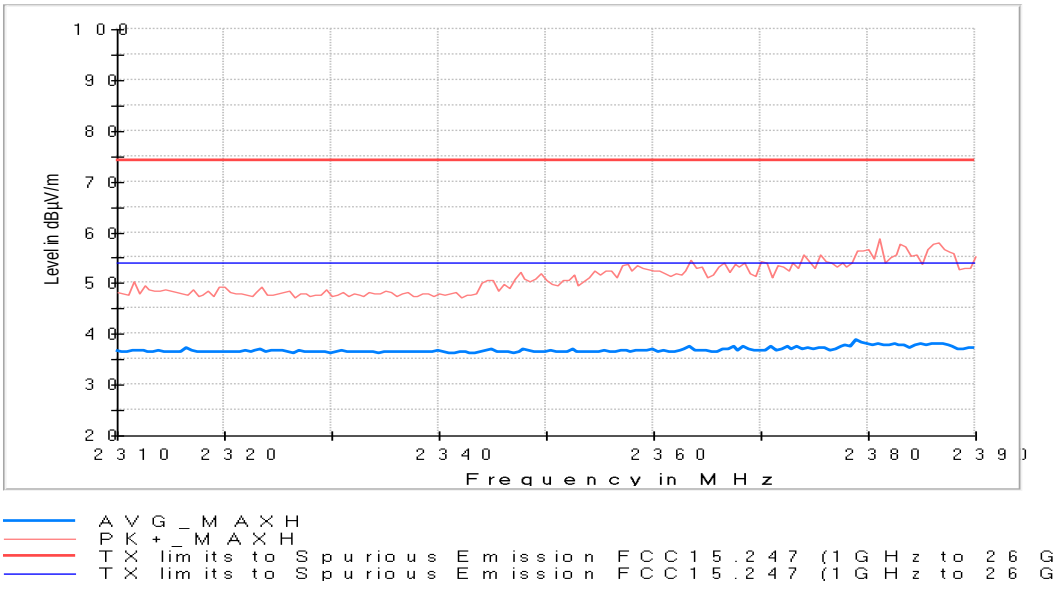
TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)



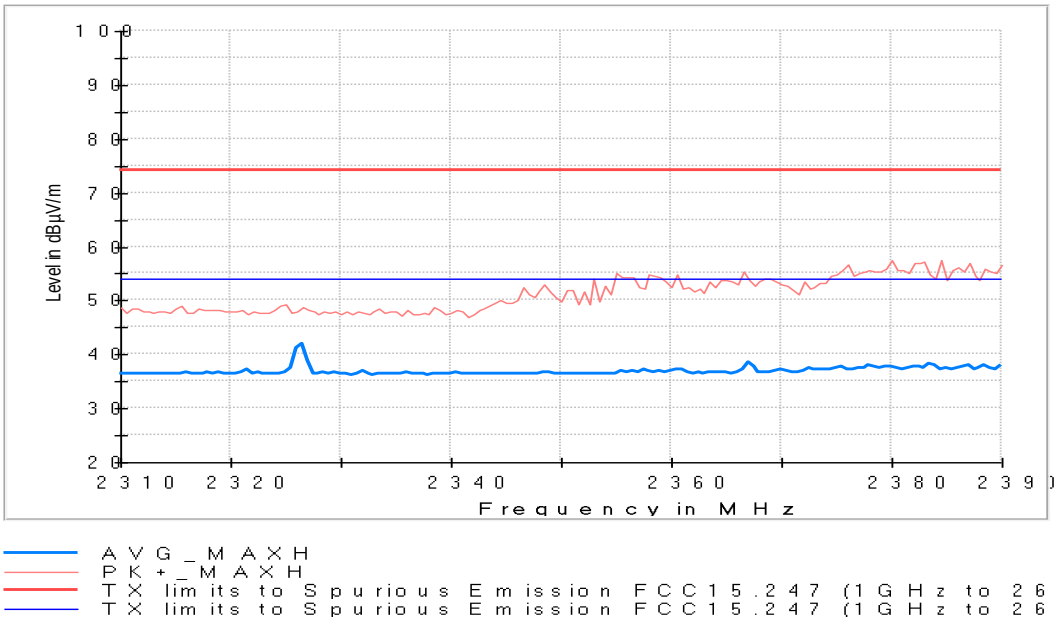
RESTRICTED BANDS	2.31 GHz – 2.39 GHz (PI4DQPSK)

CHANNEL: Lowest (2402 MHz)

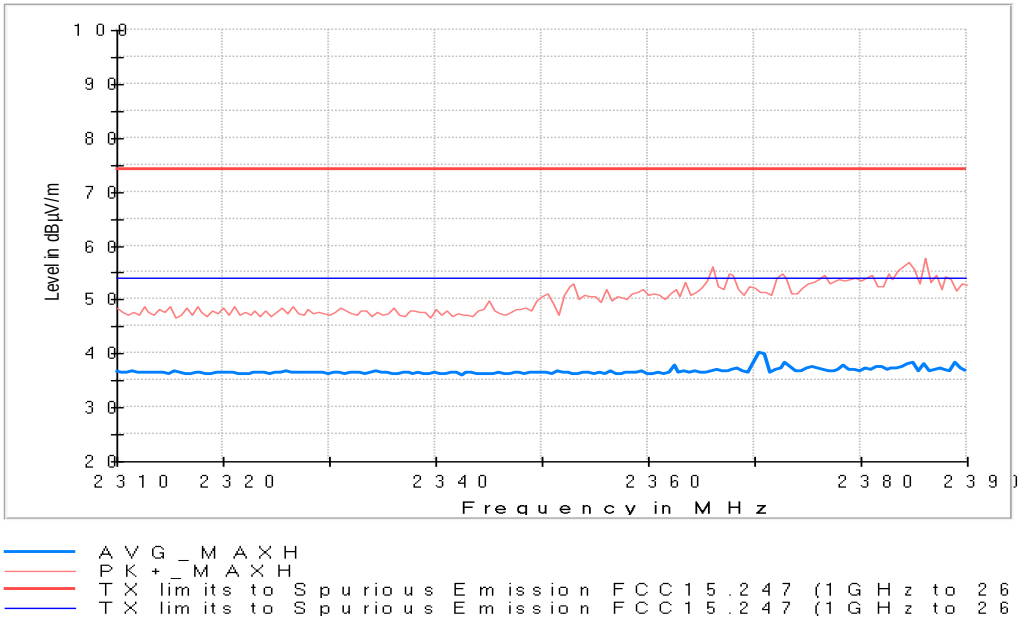


TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz)

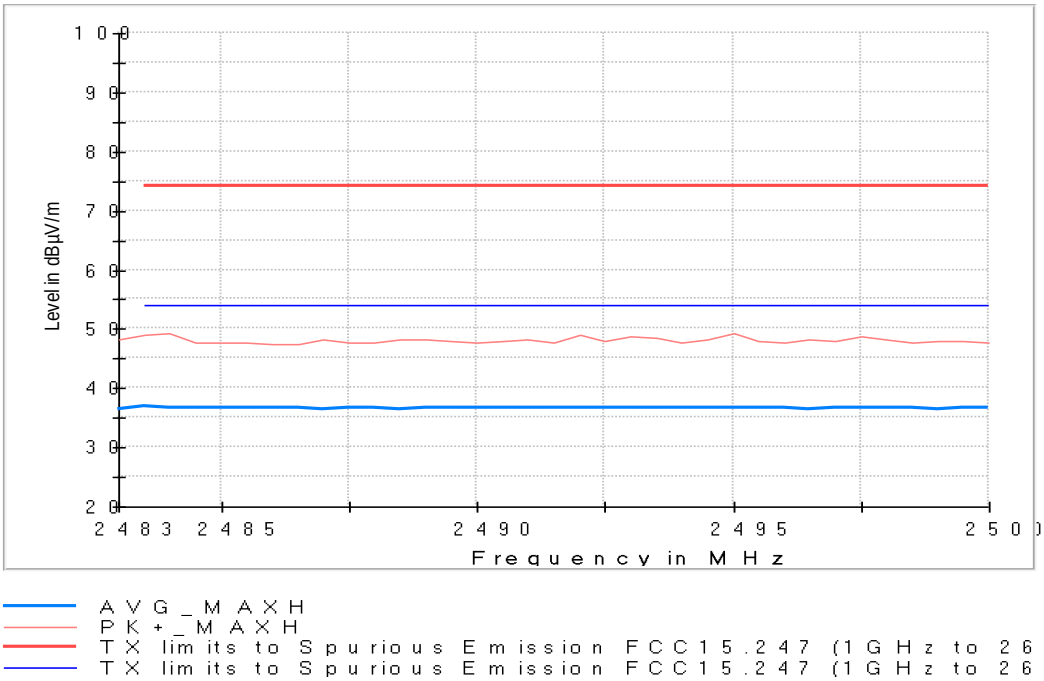


CHANNEL: Highest (2480 MHz)

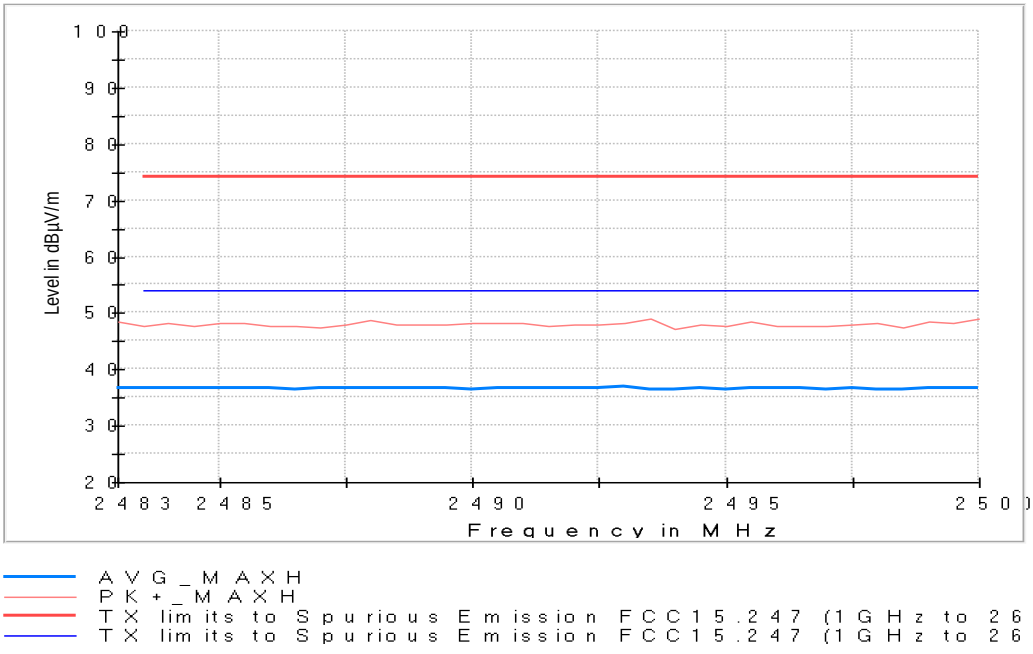


TEST RESULTS (Cont.)	
RESTRICTED BANDS	**2.483 GHz – 2.5 GHz (PI4DQPSK)**

CHANNEL: Lowest (2402 MHz)

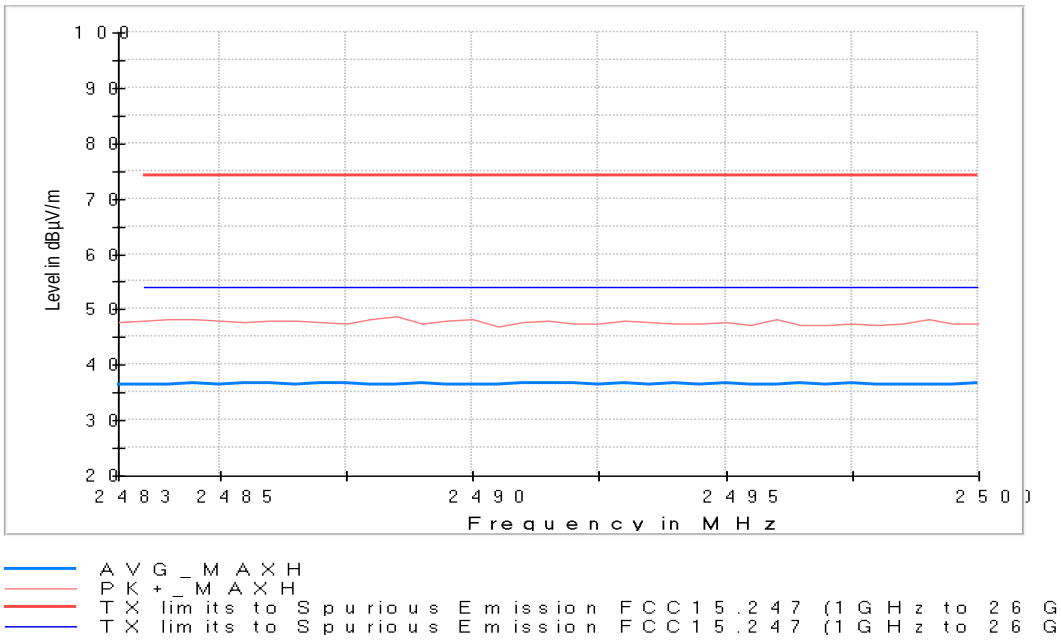


CHANNEL: Middle (2440 MHz)



TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03 (8DPSK)
TEST RESULTS:	PASS

Co-Location

The test was performed with the equipment transmitting first with only the 2.4 GHz BT-EDR radio and repeated with the WiFi 2.4GHz (WLAN0 CORE1), and WiFi 5 GHz (WLAN0 CORE0) radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

Frequency range 30 MHz – 1000 MHz

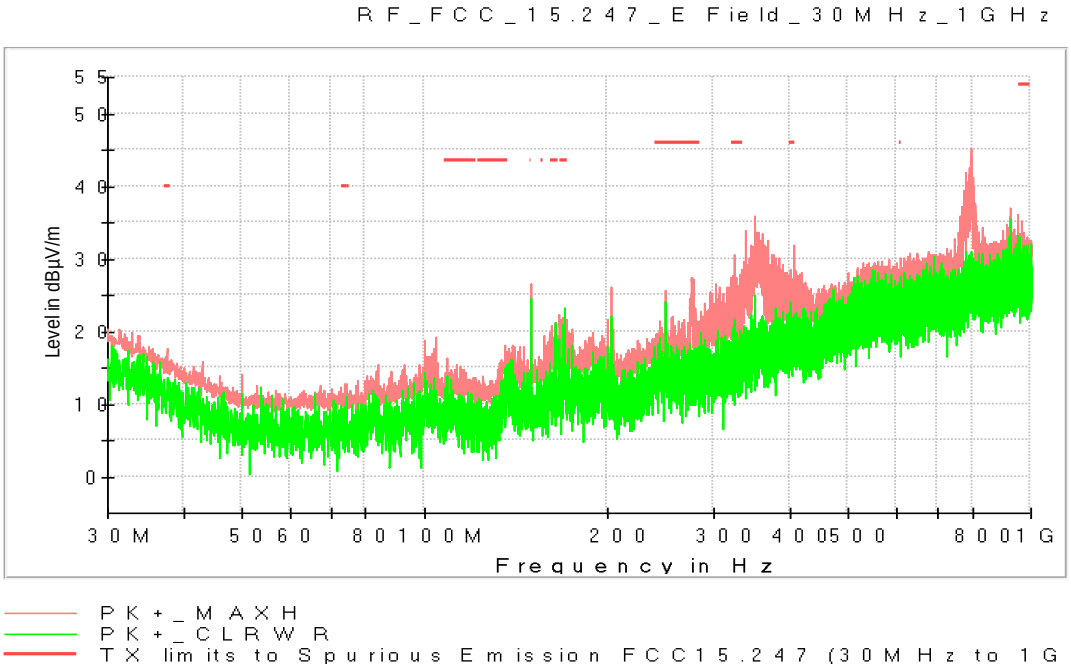
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

The radiated spurious signals detected at less than 10 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables below of each frequency range.

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**30 MHz – 1000 MHz (8DPSK)**

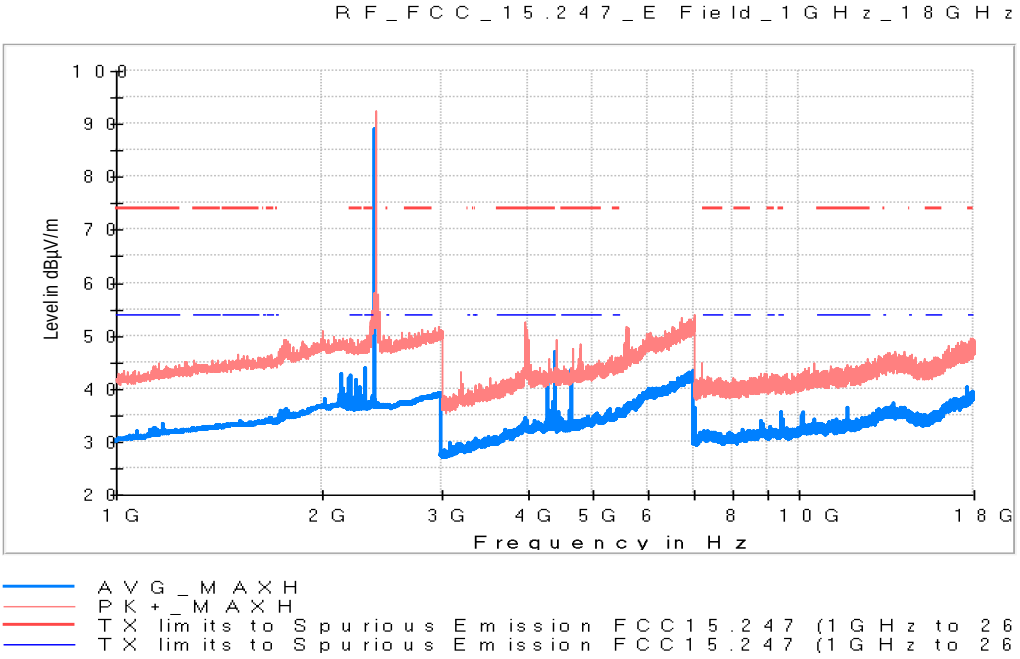


Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol
350.003000	33.6	28.7	H
338.654000	34.4	30.0	H
274.925000	24.1	13.3	H
406.408500	33.4	27.4	H
794.845000	39.5	29.0	H
963.188500	37.6	27.1	V
149.989000	31.3	28.8	V
950.045000	38.9	30.7	V

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**1 GHz – 18 GHz (8DPSK)**

CHANNEL: Lowest (2402 MHz)

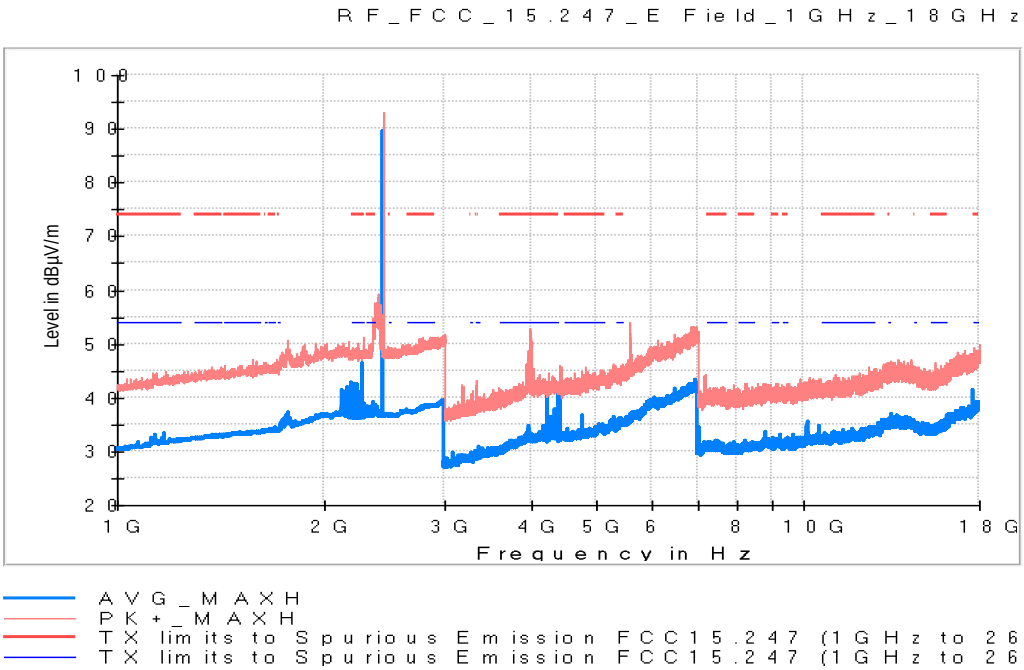


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2402.000000	92.63	88.86	H	Fundamental
4286.500000	45.64	41.18	V	
4409.500000	49.34	46.83	V	
4652.500000	47.72	43.52	V	
7055.000000	41.80	36.34	V	
11835.500000	42.68	36.40	V	
17638.500000	48.35	40.07	V	

TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz)

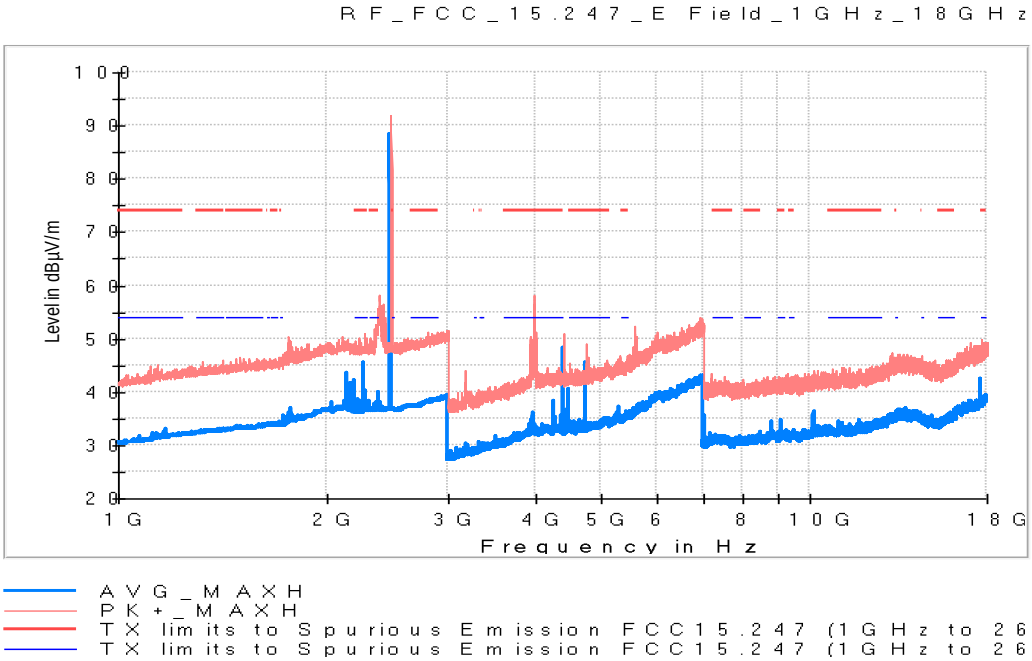


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2276.000000	51.21	46.37	V	
2441.000000	93.07	89.50	H	Fundamental
4254.500000	44.72	40.27	V	
4409.500000	45.64	42.46	V	
4441.000000	45.42	41.34	V	
10142.000000	42.37	35.53	V	
17638.500000	47.08	41.37	V	

TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)

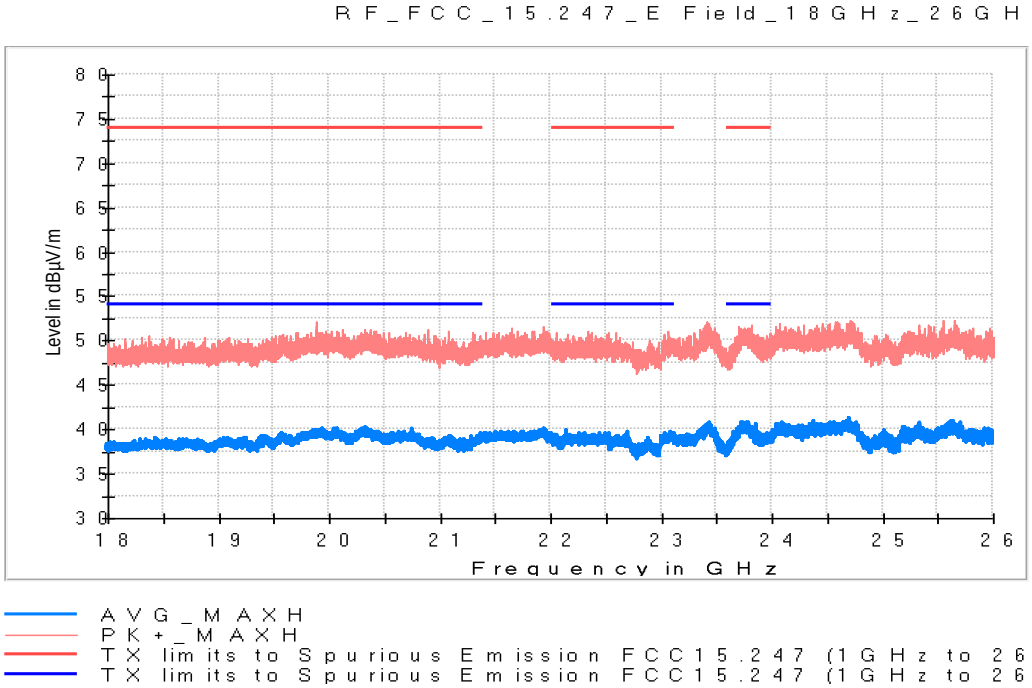


Maximizations

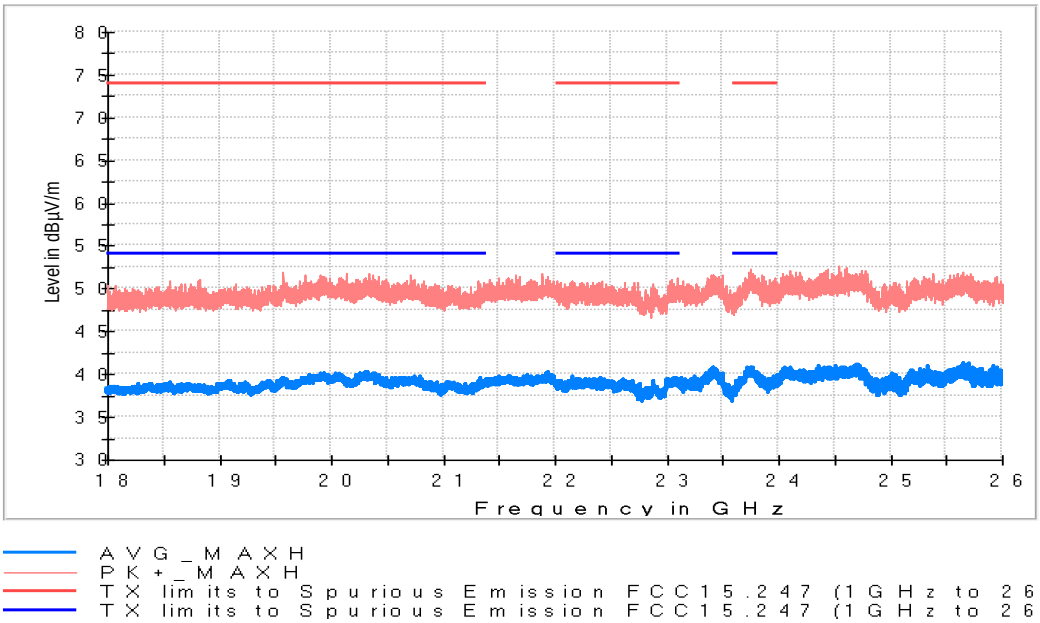
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2268.500000	51.06	45.56	V	
2480.000000	91.99	88.32	V	Fundamental
4409.500000	51.01	48.30	V	
4745.500000	49.13	45.55	V	
10142.000000	42.54	36.28	V	
17638.500000	49.79	42.36	H	

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**18 GHz – 26 GHz (8DPSK)**

CHANNEL: Lowest (2402 MHz)

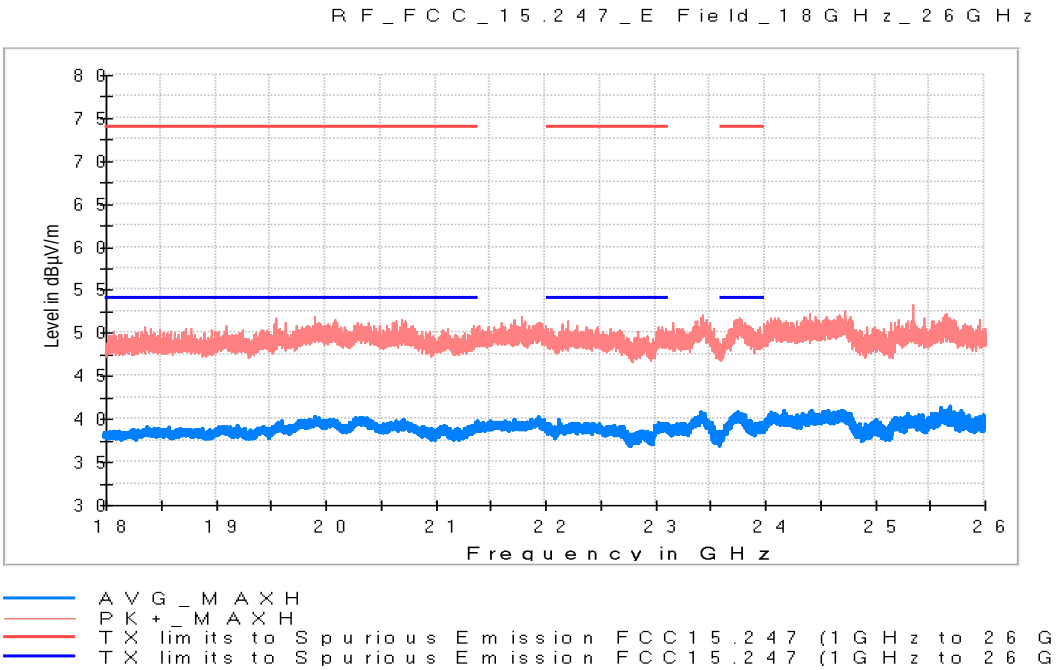


CHANNEL: Middle (2440 MHz)



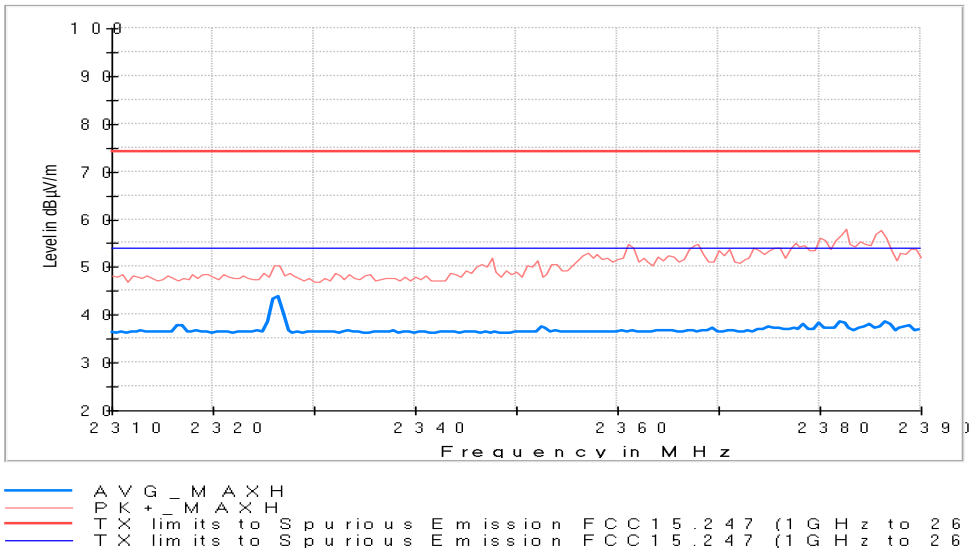
TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)



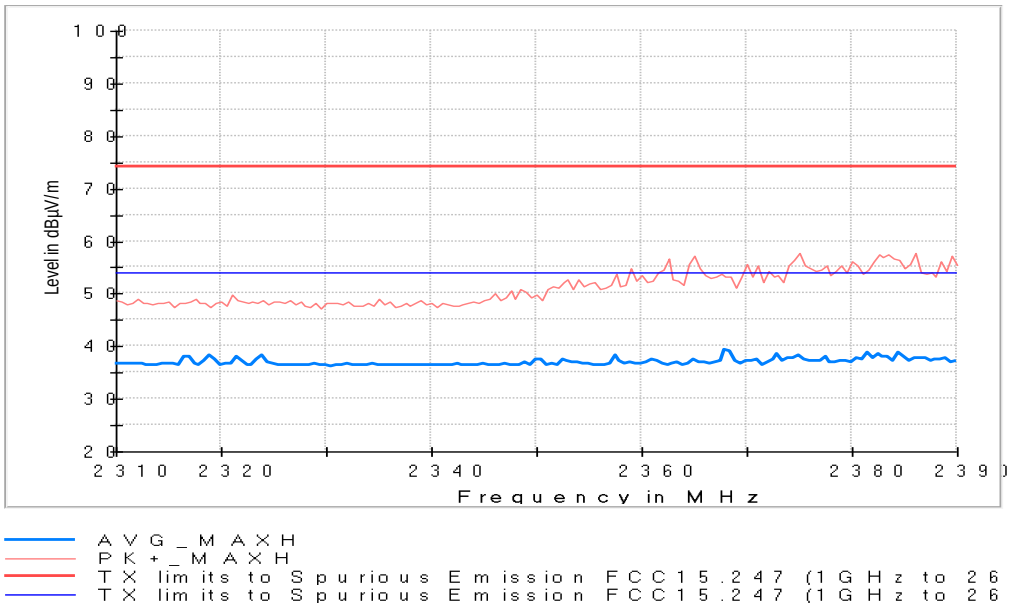
RESTRICTED BANDS	2.31 GHz – 2.39 GHz (8DPSK)

CHANNEL: Lowest (2402 MHz)

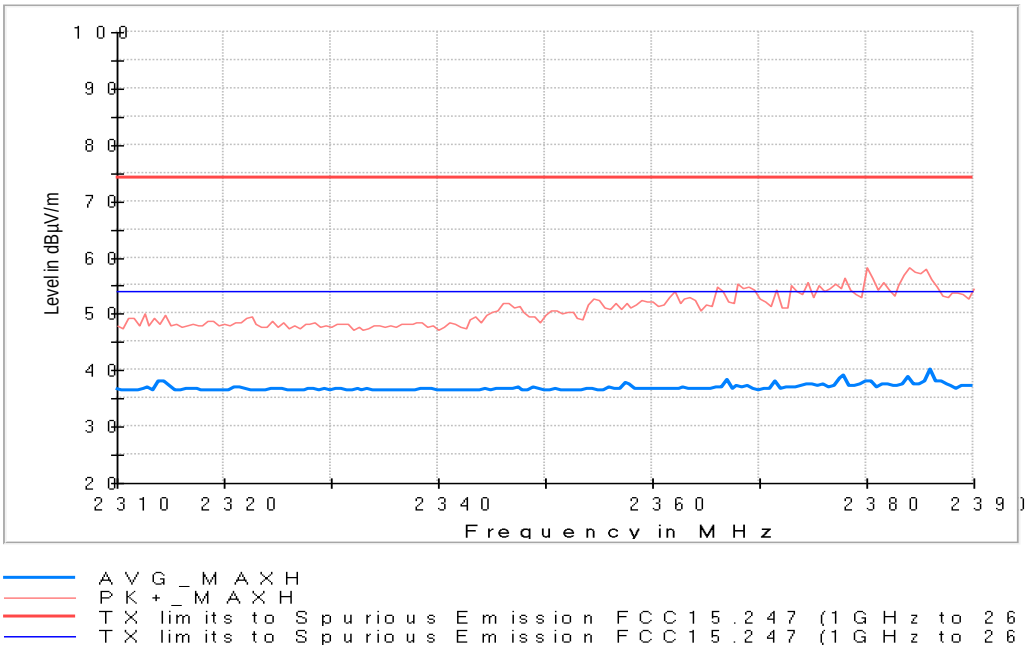


TEST RESULTS (Cont.)	

CHANNEL: Middle (2440 MHz)

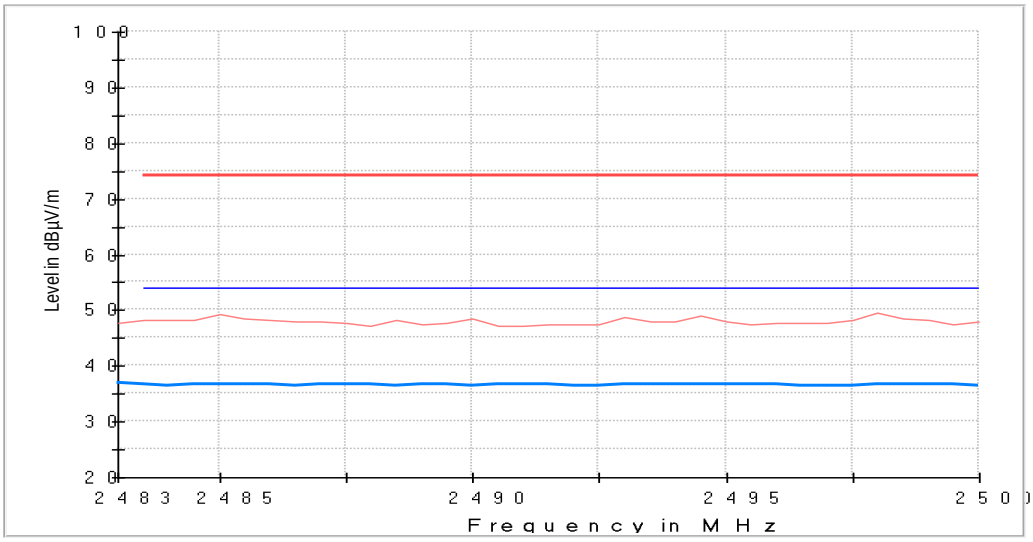


CHANNEL: Highest (2480 MHz)

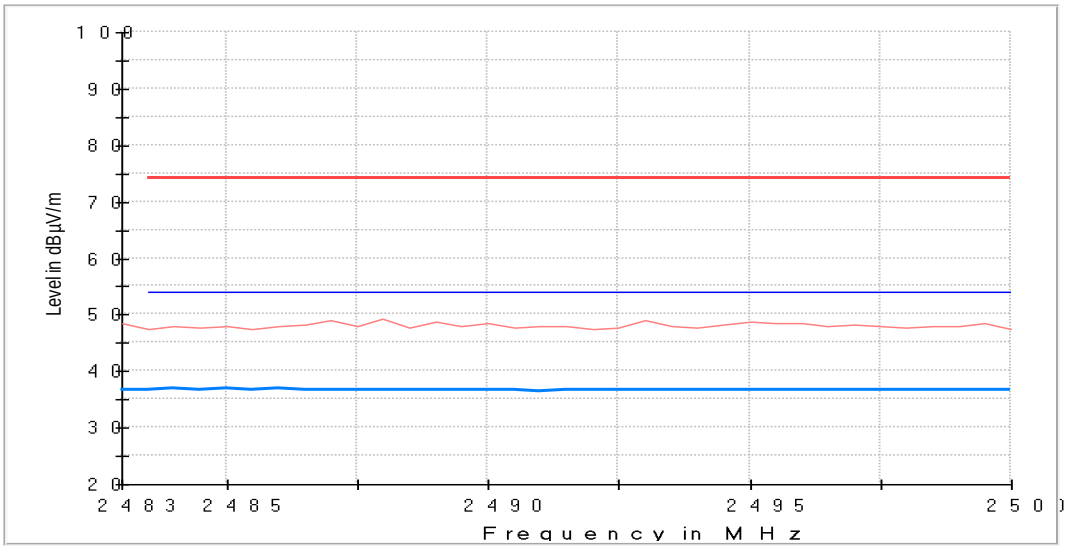


TEST RESULTS (Cont.)	
RESTRICTED BANDS	**2.483 GHz – 2.5 GHz (8DPSK)**

CHANNEL: Lowest (2402 MHz)

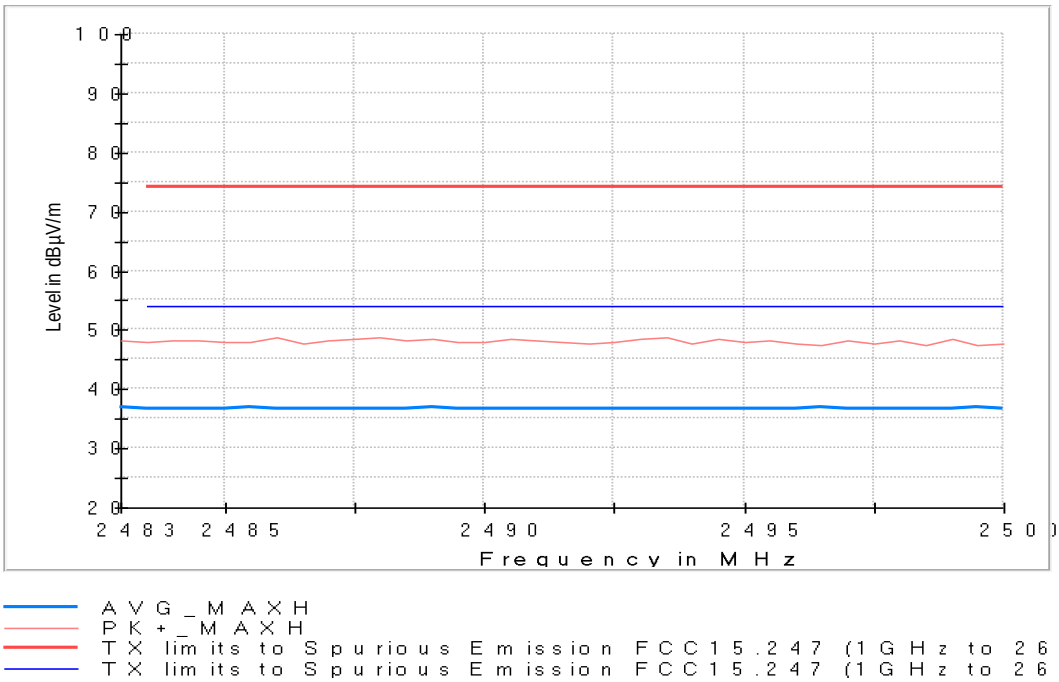


CHANNEL: Middle (2440 MHz)



TEST RESULTS (Cont.)	

CHANNEL: Highest (2480 MHz)



Appendix B: Test results (WIFI 2.4GHz)

Appendix B Content

PRODUCT INFORMATION

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

Information	**Description**
Modulation	FHSS
Adaptive	Adaptive Equipment without the possibility to switch to non-adaptive equipment.
Maximum RF Output Power	17 dBm
Operation mode 1: Single Antenna Equipment	Equipment with only one antenna
- Operating Frequency Range	2412 – 2462 MHz
- Nominal Channel Bandwidth	20 MHz
Extreme operating conditions	
- Temperature range	-38 ºC to +70 ºC
Antenna type	Integral Antenna
Antenna gain	0.4 dBi
Nominal Voltage	
- Supply Voltage	12V
- Type of power source	DC voltage
Equipment type	WIFI 2.4GHz b/g/n20
Geo-location capability	No

Test modes available:

- Continuous modulated carrier at 2412 MHz, 2437 MHz and 2462 MHz
- Continuous reception at 2412 MHz, 2437 MHz and 2462 MHz

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01(1) **(WIFI 2.4GHz b/g mode)**	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted/Radiated tests: Lowest channel: 2412 MHz Middle channel: 2437 MHz Highest channel: 2462 MHz 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.
TC#02(1) **(WIFI 2.4GHz n mode)**	Power supply (V): $V_{nominal}$ = 12 Vdc Channel Bandwidth: 20 MHz Test Frequencies for Conducted/Radiated tests: Lowest channel: 2412 MHz Middle channel: 2437 MHz Highest channel: 2462 MHz

Note (1): For spurious emissions for OFDM modes 802.11g and 802.11n20 a preliminary scan was performed to determine the worst case. The next tables and plots show the results for the worst case to DSSS modulation (802.11b) and OFDM modulation (802.11g).

The data rates of 1Mb/s for 802.11b, 6.5Mb/s for 802.11g, MSC0 for 802.11n20 were selected based on preliminary testing that identified those rates corresponding to the worst cases.

TEST B.1: 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 at 1m for the frequency range 1-40 GHz (1 GHz-18 GHz and 18 GHz-40 GHz Double ridge horn antennas).

For radiated emissions in the range 1-40 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.

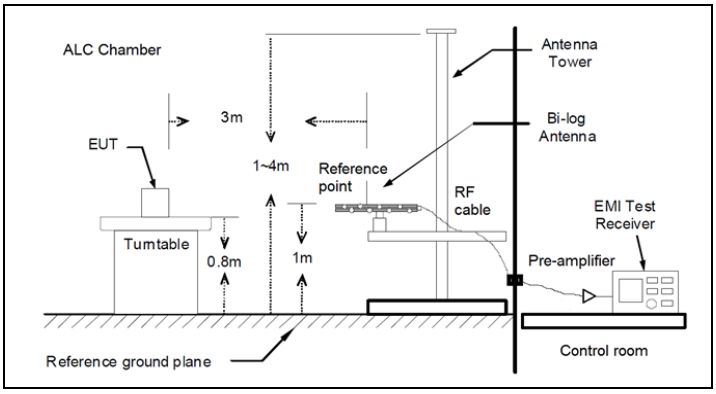
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

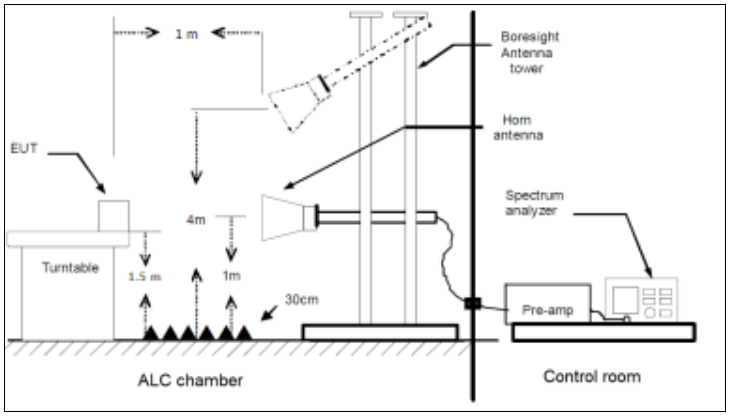
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)	

Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1 GHz



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (b/g mode)
TEST RESULTS:	PASS

Co-Location

The test was performed with the equipment transmitting first with only the WiFi 2.4GHz (WLAN1 CORE1) and repeated with the 2.4 GHz BT-EDR (WLAN 0), and WiFi 5 GHz (WLAN0 CORE0) radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

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. See worst operation mode selected for this range (N mode).

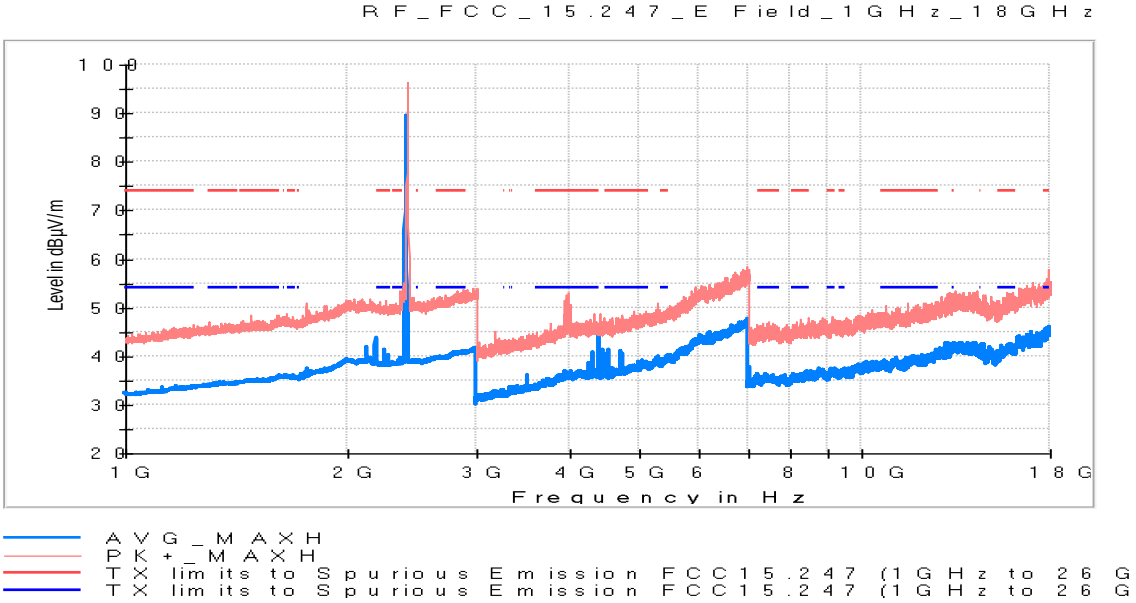
Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

The radiated spurious signals detected at less than 10 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables below of each frequency range.

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**1 GHz – 18 GHz**

CHANNEL: Lowest (2412 MHz).

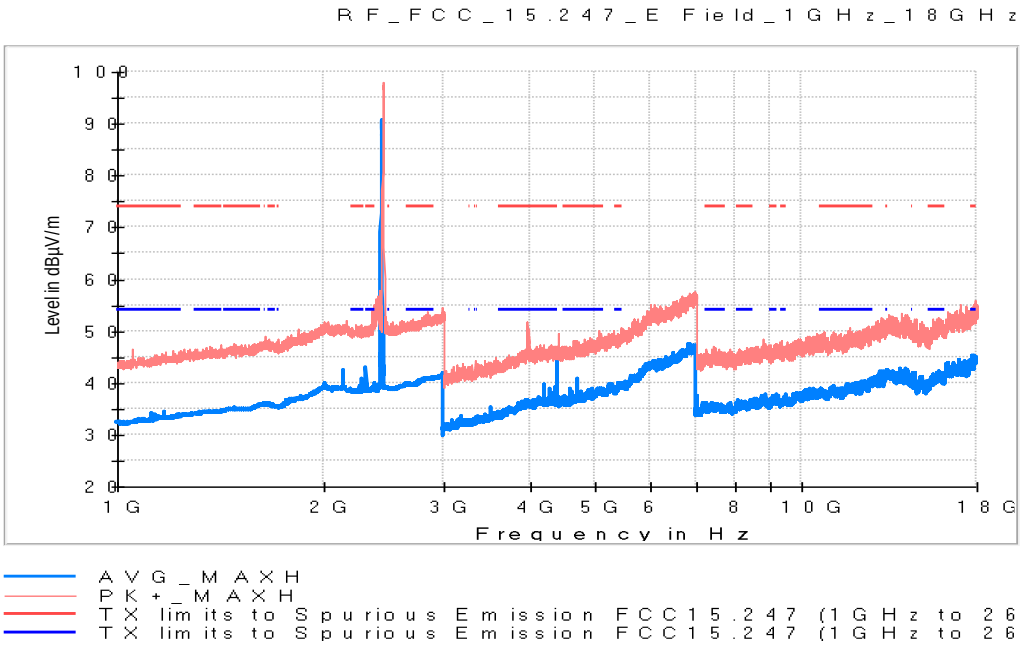


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2192.000000	50.26	43.75	V	
2413.500000	96.01	89.36	H	Fundamental
4409.500000	48.51	45.10	V	
4724.000000	47.29	41.07	V	

TEST RESULTS (Cont.)	

CHANNEL: Middle (2437 MHz).

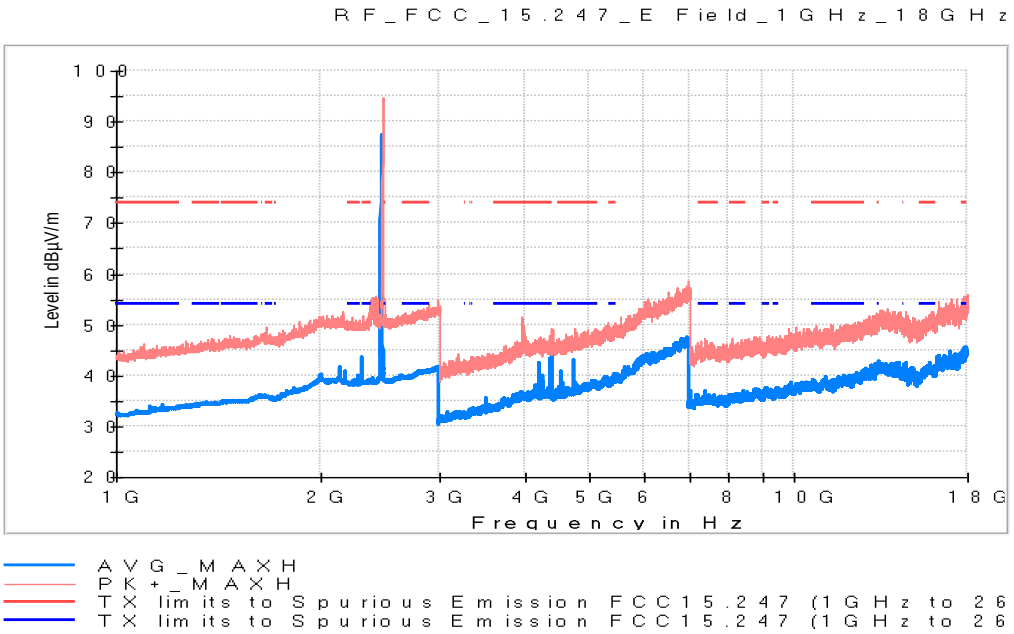


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2438.500000	98.06	90.52	H	Fundamental
4409.500000	49.59	45.97	V	
4726.500000	47.79	40.63	V	

TEST RESULTS (Cont.)	

CHANNEL: Highest (2462 MHz).

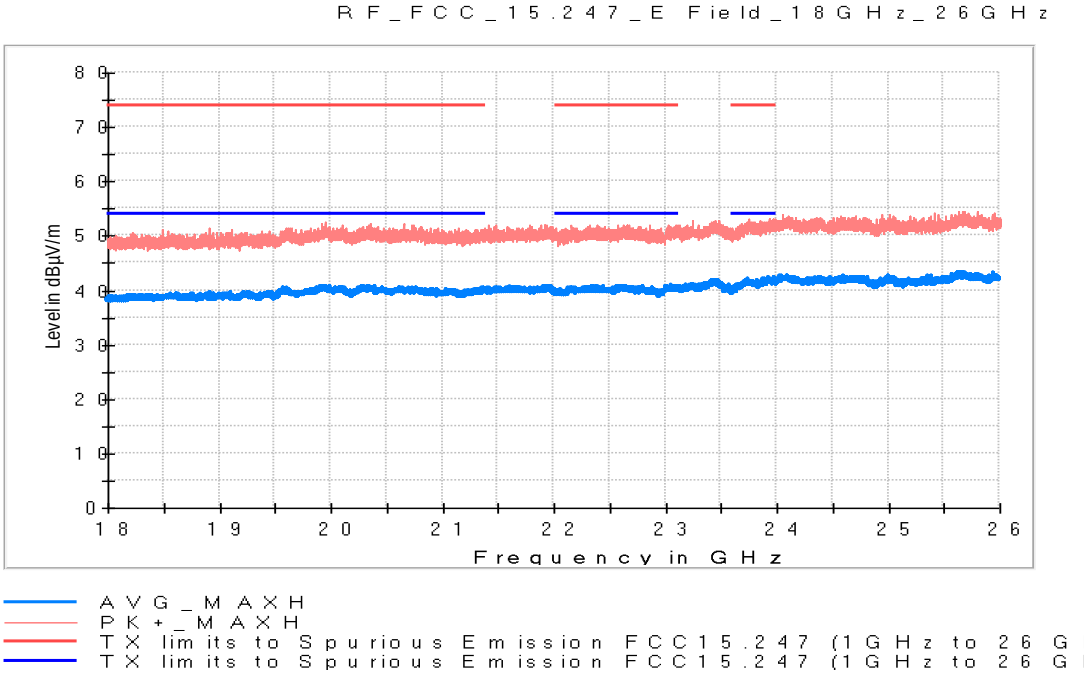


Maximizations

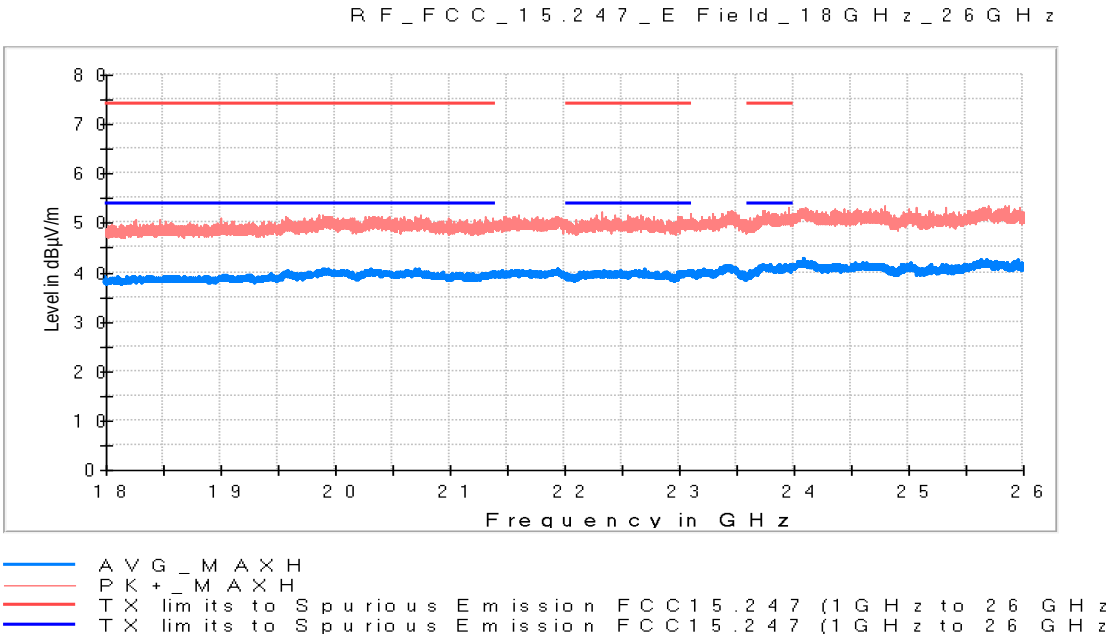
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Height (cm)	Comments
2463.500000	94.34	87.15	H	Fundamental
4306.500000	49.19	46.75	V	
6835.500000	50.66	42.92	V	
10077.000000	41.67	34.03	H	

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

CHANNEL: Lowest (2412 MHz)

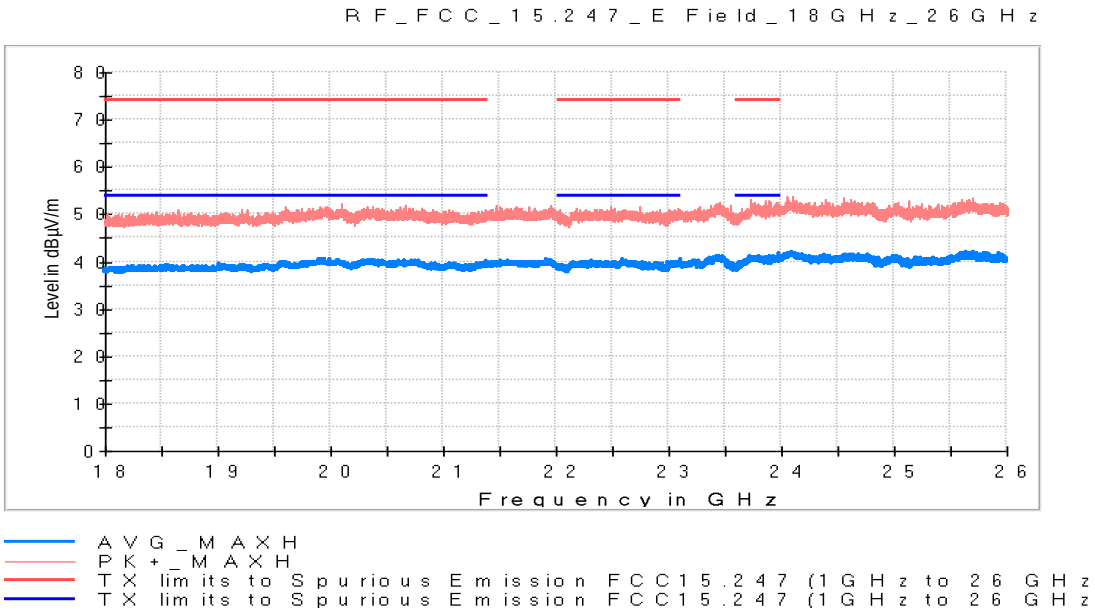


CHANNEL: Middle (2437 MHz).



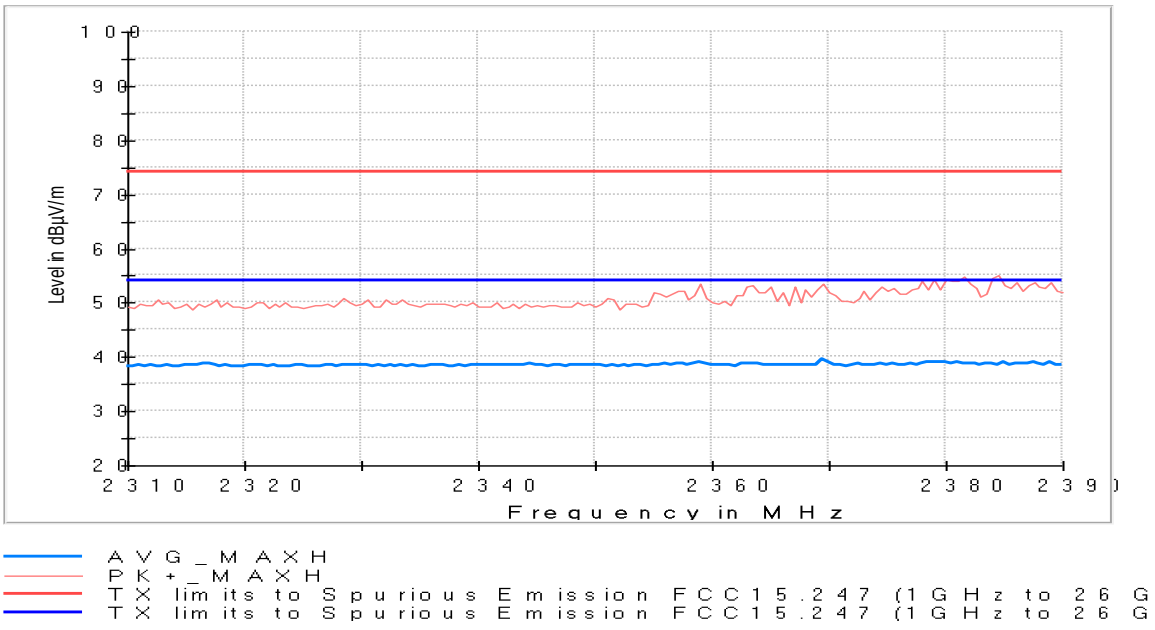
TEST RESULTS (Cont.)	

CHANNEL: Highest (2462 MHz).



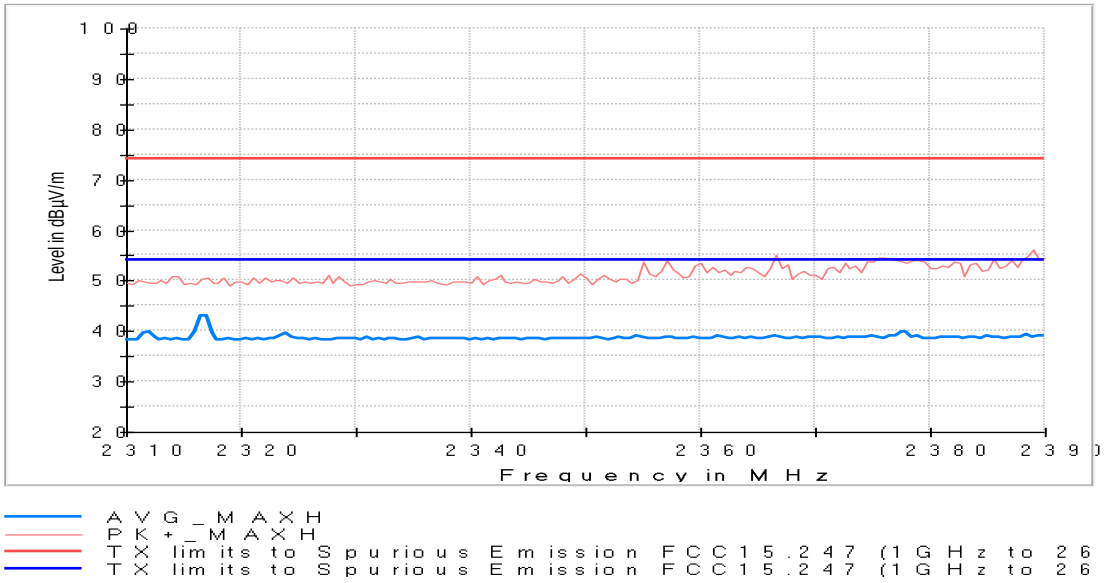
RESTRICTED BANDS	2.31 GHz – 2.39 GHz

CHANNEL: Lowest (2412 MHz)

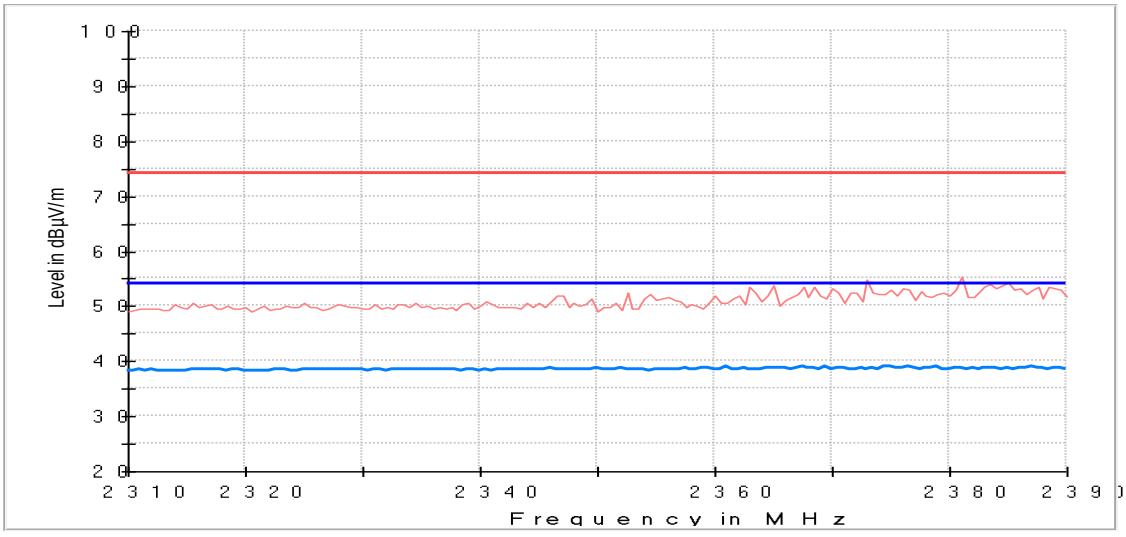


TEST RESULTS (Cont.)	

CHANNEL: Middle (2437 MHz)

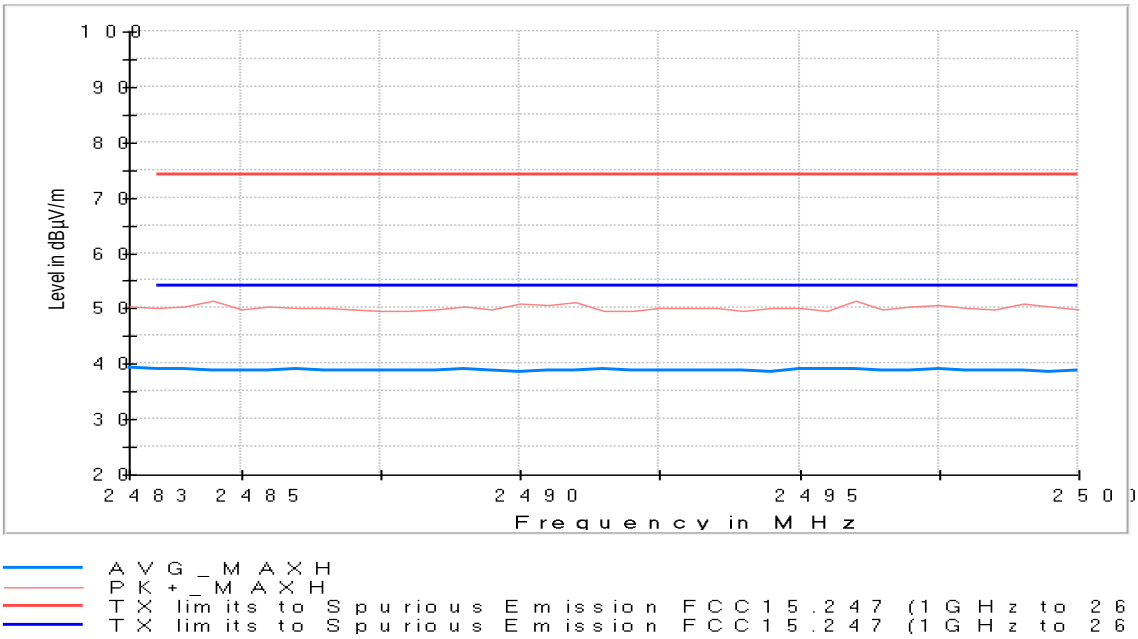


CHANNEL: Highest (2462 MHz)

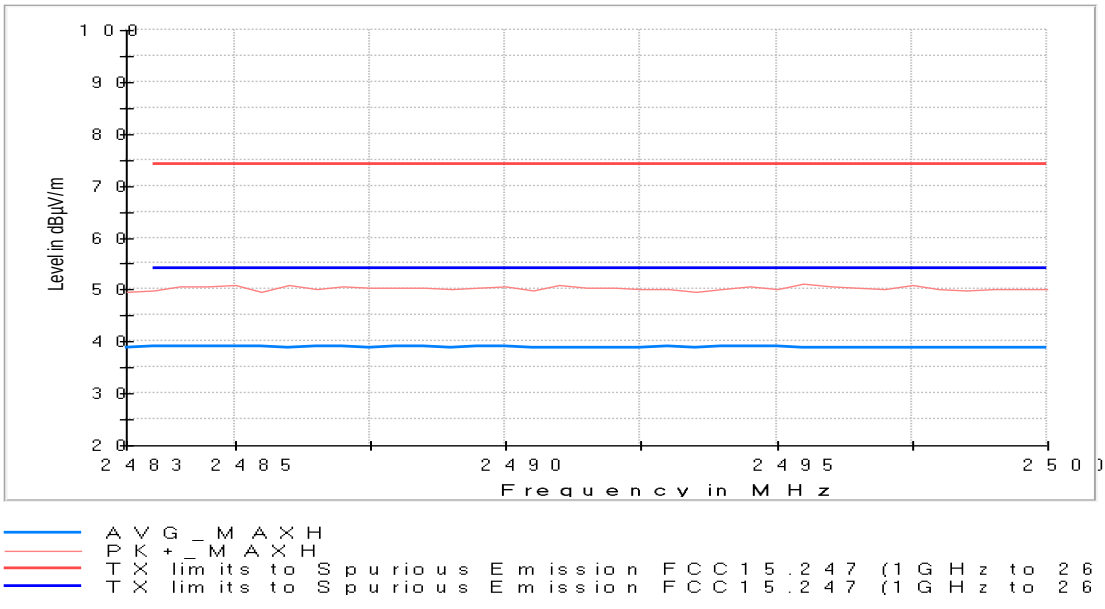


TEST RESULTS (Cont.)	
RESTRICTED BANDS	**2.483 GHz – 2.5 GHz**

CHANNEL: Lowest (2412 MHz)

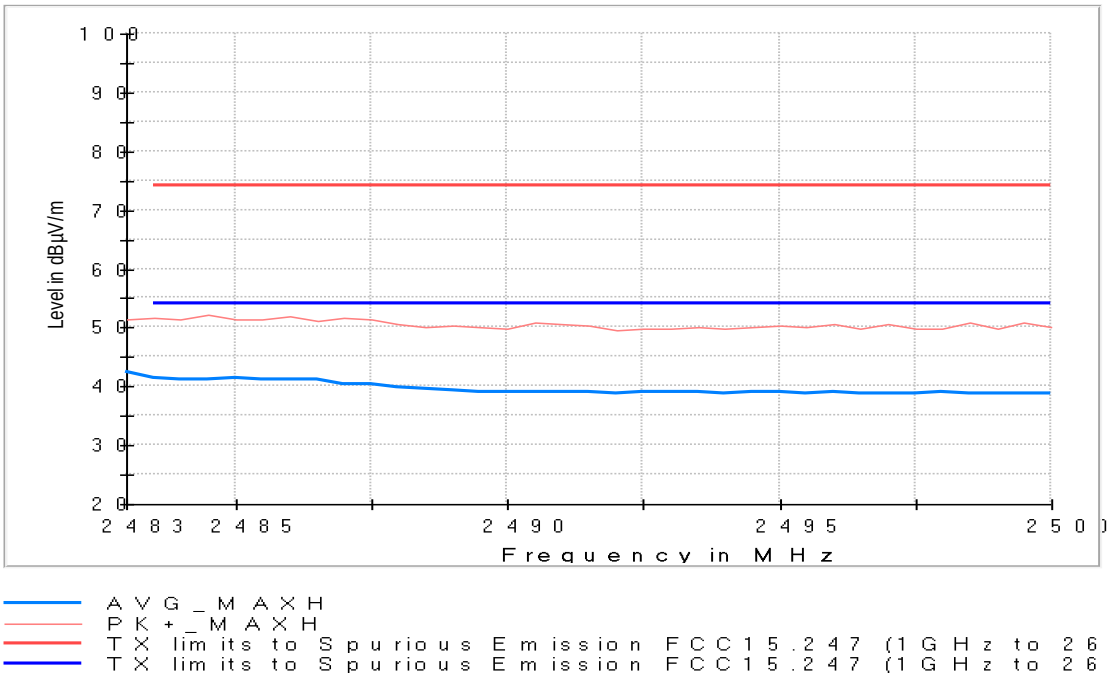


CHANNEL: Middle (2437 MHz)



TEST RESULTS (Cont.)	

CHANNEL: Highest (2462 MHz)



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (n mode)
TEST RESULTS:	PASS

Co-Location

The test was performed with the equipment transmitting first with only the WiFi 2.4GHz (WLAN1 CORE1) and repeated with the 2.4 GHz BT-EDR (WLAN 0), and WiFi 5 GHz (WLAN0 CORE0) radios transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained

Frequency range 30 MHz – 1000 MHz

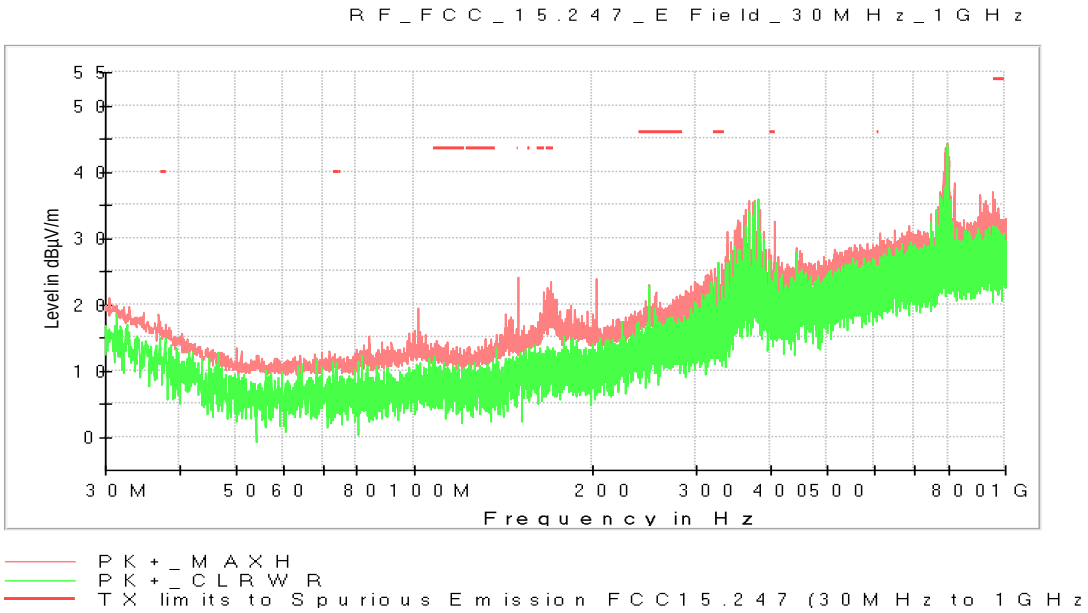
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Frequency range 1 GHz – 26 GHz

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

The radiated spurious signals detected at less than 10 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables below of each frequency range.

FREQUENCY RANGE	30 MHz – 1000 MHz

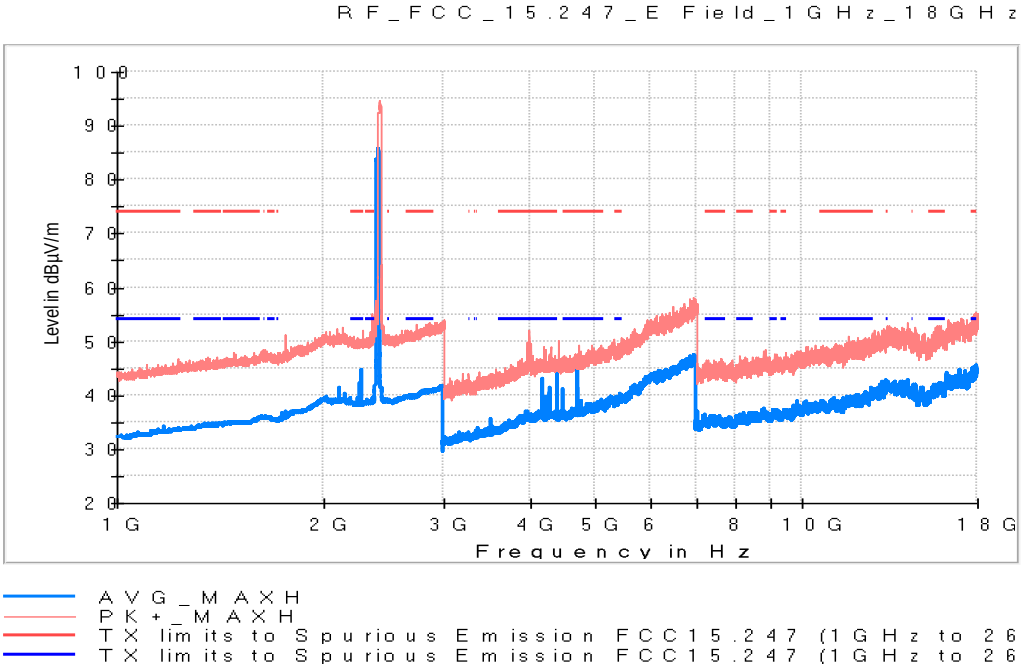


Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol
798.288500	42.6	32.8	H
169.922500	22.2	11.6	H
351.749000	29.6	22.0	H
380.946000	32.1	24.6	H
651.333500	34.8	24.1	H
149.989000	26.6	23.2	V
950.093500	37.8	27.9	V
406.408500	35.1	29.4	V
975.022500	37.8	29.5	V

TEST RESULTS (Cont.)	
FREQUENCY RANGE	**1 GHz – 18 GHz**

CHANNEL: Lowest (2412 MHz).

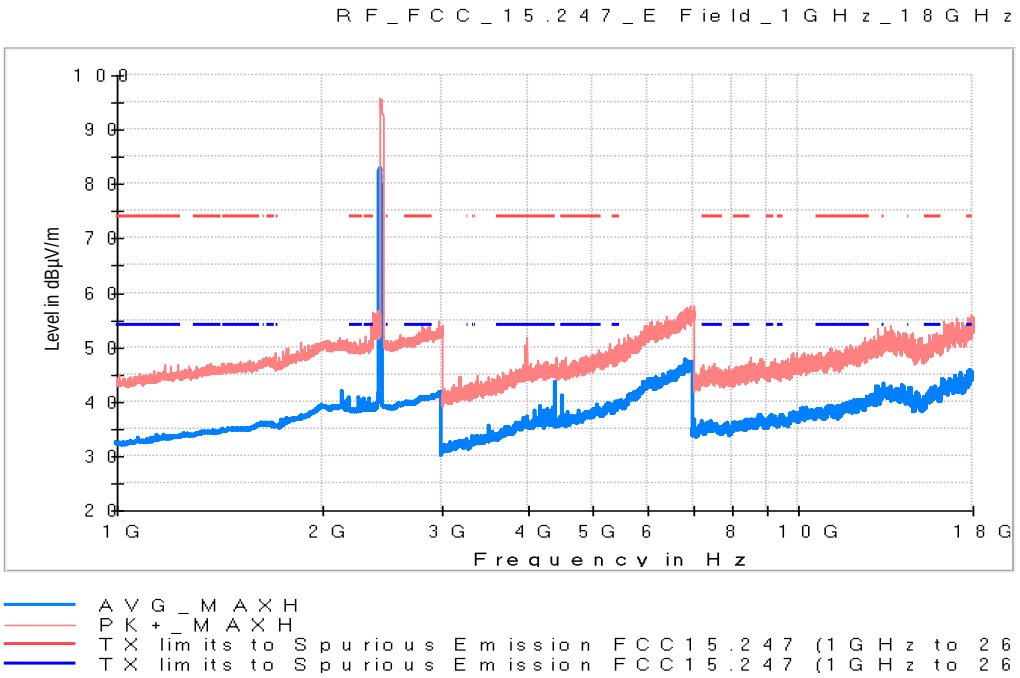


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2276.000000	51.99	44.51	V	
2418.500000	94.23	85.74	H	Fundamental
4190.500000	49.09	43.06	V	
4409.500000	49.60	46.18	V	
4721.500000	48.41	44.59	V	
17034.500000	53.04	44.60	V	

TEST RESULTS (Cont.)	

CHANNEL: Middle (2437 MHz).

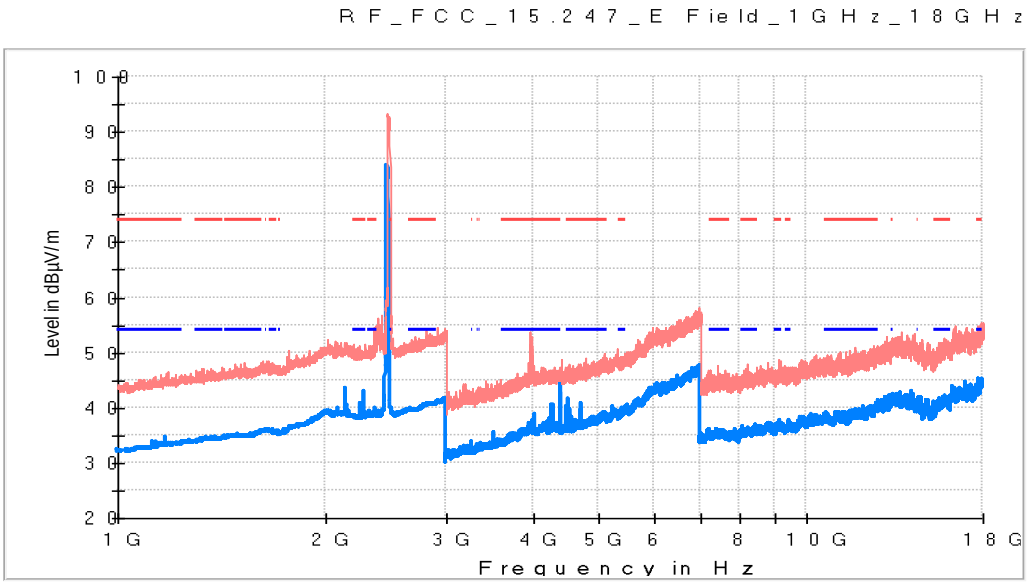


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2438.500000	94.77	82.78	H	Fundamental
4409.500000	48.23	43.43	V	
4523.000000	47.67	41.06	V	
17325.000000	52.72	45.14	V	

TEST RESULTS (Cont.)	

CHANNEL: Highest (2462 MHz)

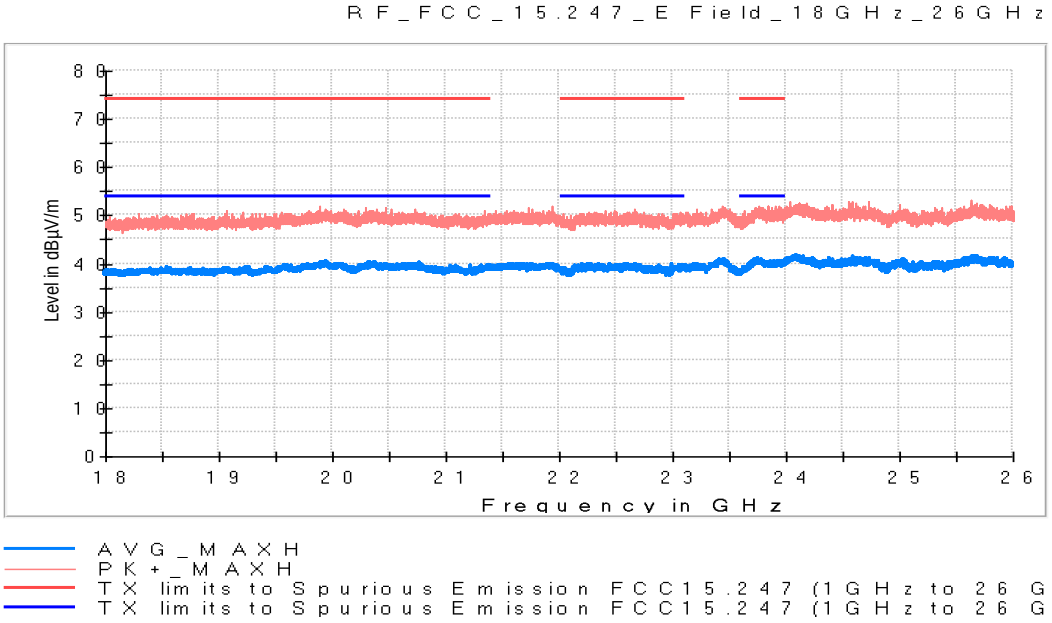


Maximizations

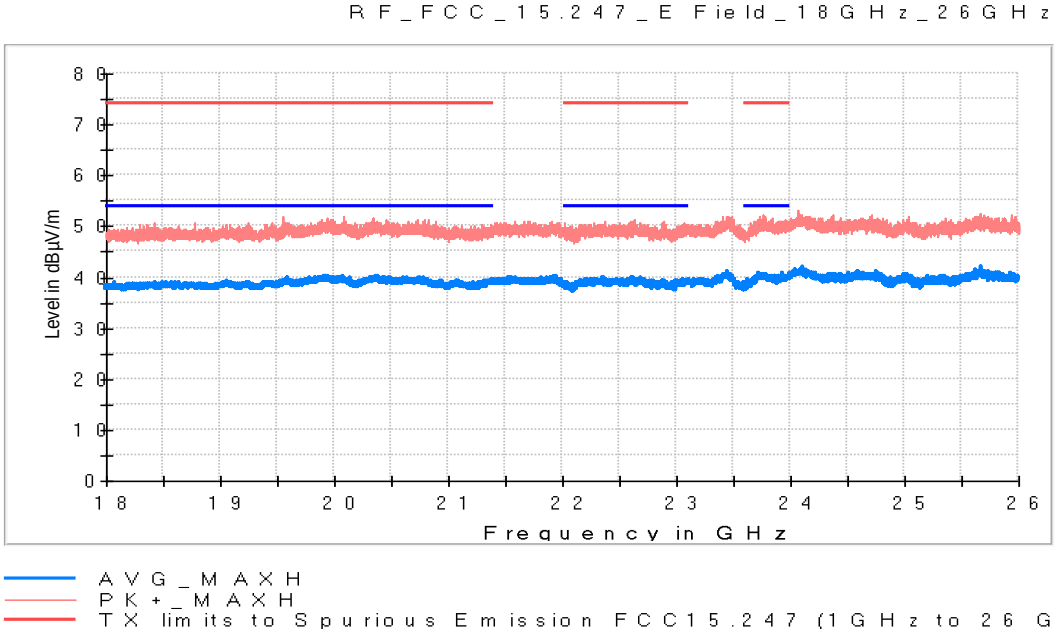
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Comments
2463.000000	92.87	83.98	H	Fundamental
4409.500000	48.59	45.39	V	
4527.500000	48.00	41.52	V	
4705.000000	46.62	40.70	V	
14241.000000	50.62	43.03	V	
17779.500000	53.70	45.18	V	

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

CHANNEL: Lowest (2412 MHz)

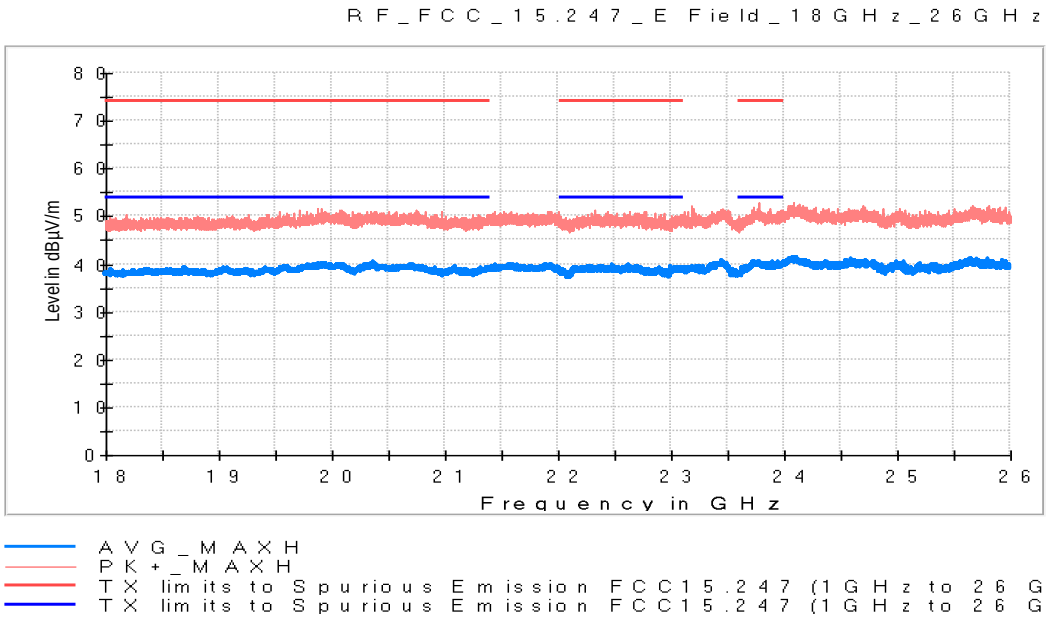


CHANNEL: Middle (2437 MHz)



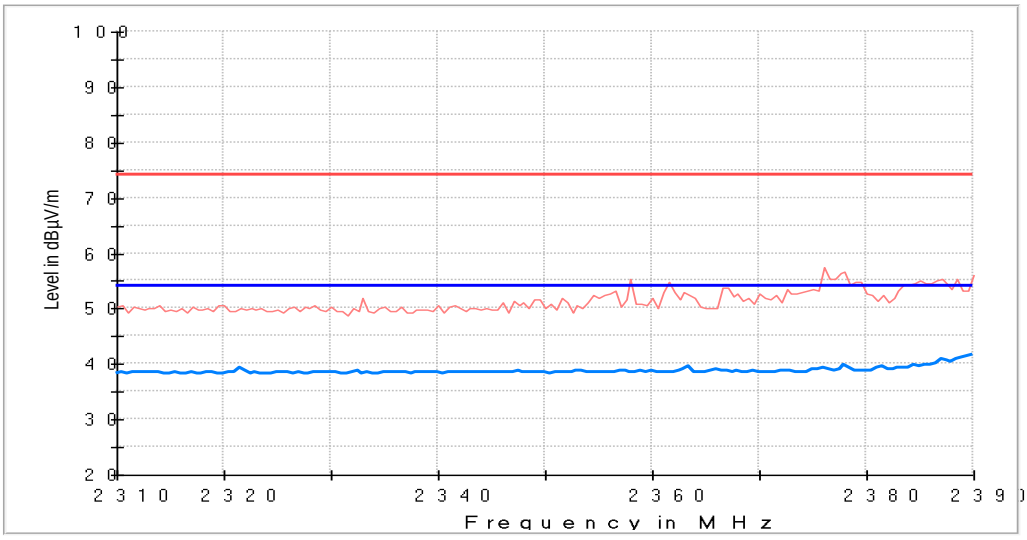
TEST RESULTS (Cont.)	

CHANNEL: Highest (2462 MHz)



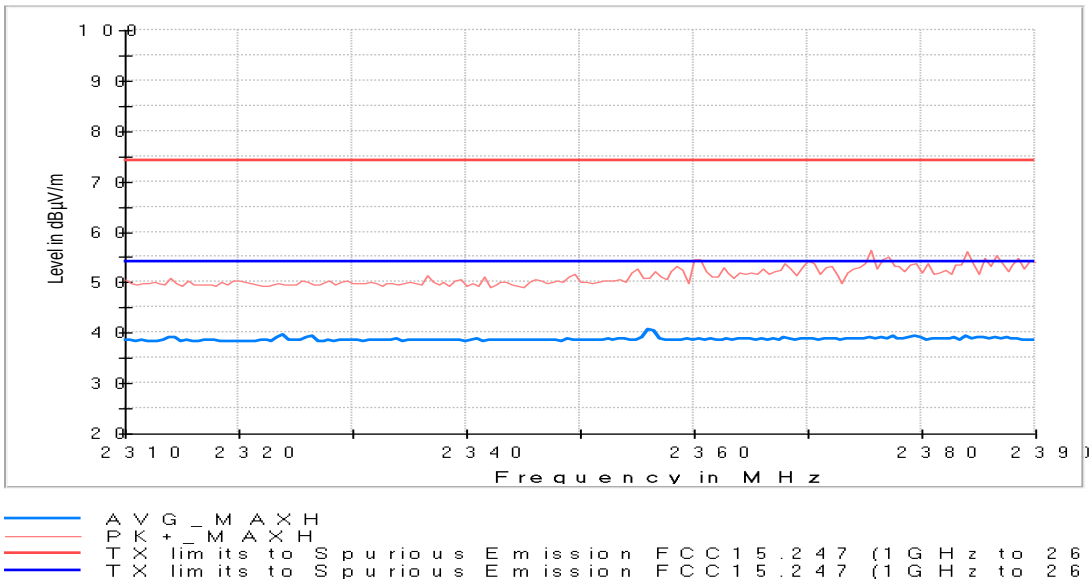
RESTRICTED BANDS	2.31 GHz – 2.39 GHz

CHANNEL: Lowest (2412 MHz)

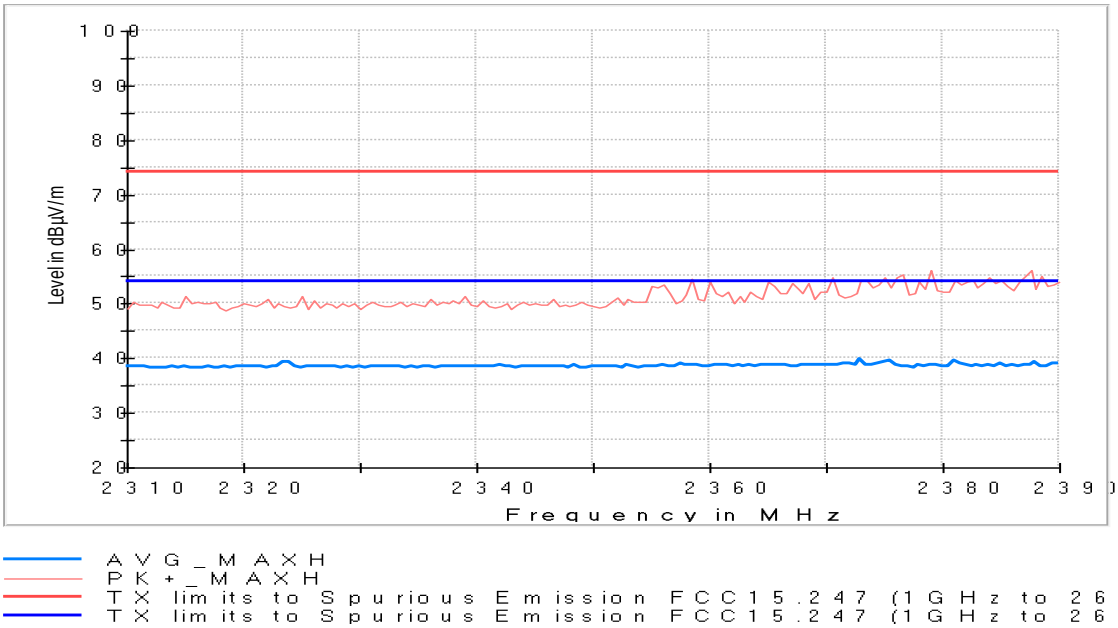


TEST RESULTS (Cont.)	

CHANNEL: Middle (2437 MHz)

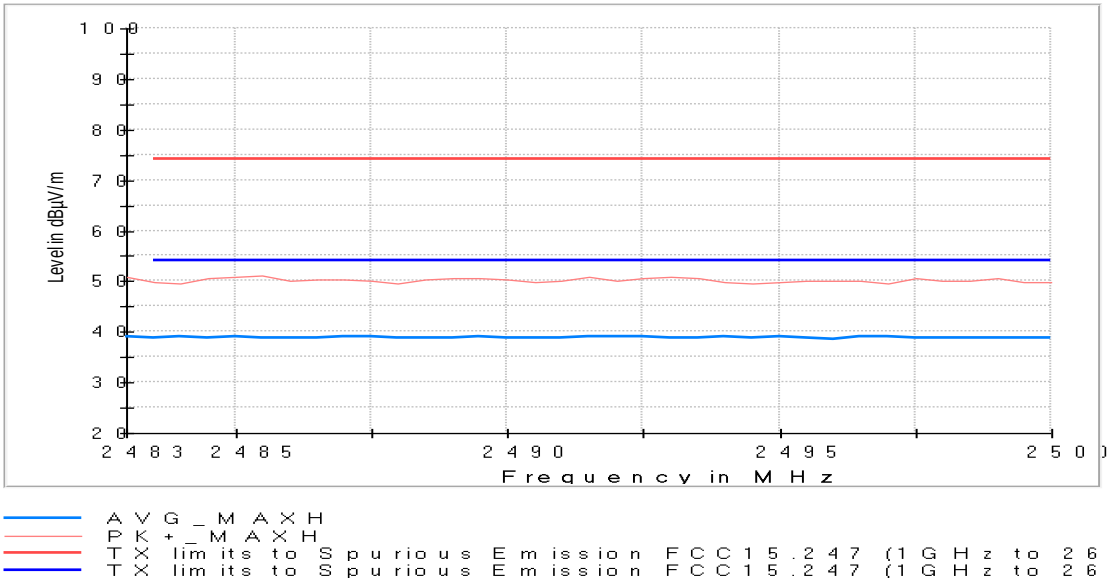


CHANNEL: Highest (2462 MHz)

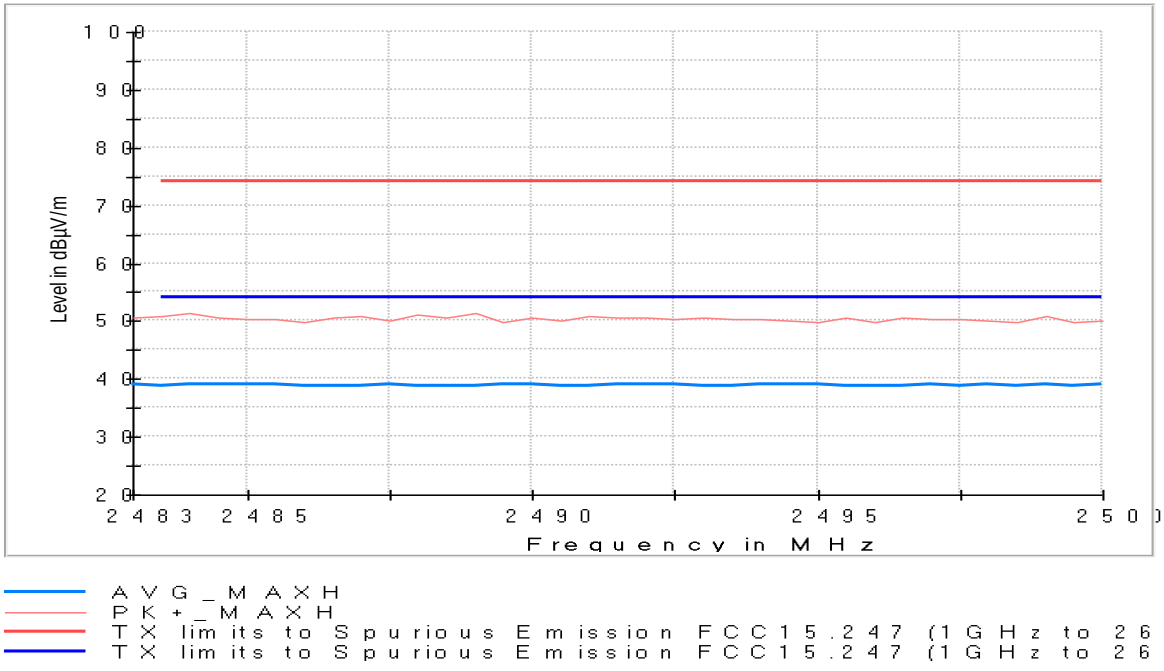


TEST RESULTS (Cont.)	
RESTRICTED BANDS	**2.483 GHz – 2.5 GHz**

CHANNEL: Lowest (2412 MHz)



CHANNEL: Middle (2442 MHz)



TEST RESULTS (Cont.)	

CHANNEL: Highest (2472 MHz)