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

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:

3183ERM.002

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	Battery Radiofrequency Module
(*) Trademark	Visteon
(*) Model and /or type reference tested	BRFM
Other identification of the product	FCC ID: NT8-BRFM IC: 3043A-BRFM
(*) Features	Wireless Battery Management
Manufacturer	Visteon Corporation One Village Center Drive, Van Buren Township, MI 48111, 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). 558074 D01 15.247 Meas. Guidance v05r02 (April 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 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: 2021.10.18 13:53:36 -04'00'
Date of issue	10-14-2021
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Competences and guarantees....3
General conditions....3
Uncertainty....3
Data provided by the client....4
Usage of samples....4
Test sample description....6
Identification of the client....7
Testing period and place....7
Document history....7
Environmental conditions....8
Remarks and comments....8
Testing verdicts....8
Summary....9
List of equipment used during the test....10
Appendix A: Test results (Proprietary Protocol)....11

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.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Certification Inc.

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	%
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 DUT is a Battery Radiofrequency Module.

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
3183/01	BRFM (MTF Conducted)	7079	1121169P00000109	08/02/2021

Following Accessory items were used with Sample S/01 to perform testing:

Control Nº	Description	Model	Serial Nº	Date of reception
3183/06	GM BRFM test Board	--	--	08/02/2021
3183/12	isoSPI 2 Wire Serial Interface	--	--	08/02/2021
3183/13	Ethernet Cable	--	--	08/02/2021

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

   All Conducted tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
3183/05	BRFM (MTF Radiated)	7079	1121169P00000110	08/02/2021

Following Accessory items were used with Sample S/01 to perform testing:

Control Nº	Description	Model	Serial Nº	Date of reception
3183/06	GM BRFM test Board	--	--	08/02/2021
3183/12	isoSPI 2 Wire Serial Interface	--	--	08/02/2021
3183/13	Ethernet Cable	--	--	08/02/2021

1. Sample S/02 has undergone following test(s)

   All Radiated tests indicated in appendix A.

Test sample description

Ports…… …. :	Port name and description		Cable				
			Specified length [m]	Attached during test	Shielded		
	Main connector/harness		60 cm	☐	☐		
				☐	☐		
Supplementary information to the ports……	No Data Provided						
Rated power supply .....:	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 5.4 V					
	☐	DC:					
Rated Power .....:	Current in normal mode: 0,5 A						
Clock frequencies .....:	40 MHz						
Other parameters.....:	No Data Provided						
Software version .....:	1.0						
Hardware version.....:	1.0						
Dimensions in mm (W x H x D):	No Data Provided						
Mounting position.....:	☐	*Tabletop equipment*					
	☐	*Wall/Ceiling mounted equipment*					
	☐	*Floor standing equipment*					
	☐	*Hand-held equipment*					
	☒	Other: Integrated in-side electric vehicle battery pack.					
Modules/parts .....:	Module/parts of test item		Type		Manufacturer		
	No Data Provided						

Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	Harness		
	Main connector		
	V71 board		
	Cheetah		
	CMUr		
Documents as provided by the applicant .....:	Description	File name	Issue date
	Declaration Equipment Data	FDT30_18 Declaration Equipment Data_October 13, 2021.pdf	10/13/2021

Copy of marking plate:
No Marking plate found.

Identification of the client

Visteon Corporation
One Village Center Drive, Van Buren Township, MI 48111, USA..

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	08-20-2021
Date (finish)	08-25-2021

Document history

Report number	Date	Description
3183ERM.002	10-14-2021	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: Sravani Gollamudi, Nasir Khan, Lourdes Maria Valverde and Koji Nishimoto.

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH (Proprietary protocol)					
Section	**FCC Spec Clause**	**RSS Spec Clause**	**Test Description**	**Verdict**	**Remark**
A.1	§ 2.1049	RSS-GEN 6.7	99% Occupied Bandwidth	P	N/A
A.2	§15.247 (a) (2)	RSS-247 5.2 (a)	6dB Bandwidth	P	N/A
A.3	§ 15.247 (b) (3)	RSS-247 5.4 (d)	Maximum Output Power and antenna gain	P	N/A
A.4	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	P	N/A
A.5	§ 15.247 (e)	RSS-247 5.2 (b)	Power Spectral Density	P	N/A
-	§15.247 (d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	N/A	Refer 1
A.6	§15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A

Supplementary information and remarks:

1. DUT has integral antenna.

List of equipment used during the test

Conducted Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
1038	TS8997 TEST SYSTEM	Rohde & Schwarz	TS8997	N/A	N/A
1107	ETHERNET SNMP THERMOMETER	HW GROUP	HWg-STE Plain	2020/08	2022/08
1313	WIRELESS MEASUREMENT SOFTWARE R&S WMS32	Rohde & Schwarz	N/A	N/A	N/A

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	ESR 26	2019/12	2021/12
1014	Spectrum analyzer	Rohde & Schwarz	FSV40	2021/05	2023/05
1056	Double-ridge Waveguide Horn antenna 18-40 GHz	ETS LINDGREN	3116C	2020/01	2023/01
1057	Double-ridge Waveguide Horn antenna 1-18 GHz	ETS LINDGREN	3115	2020/06	2023/06
1065	Biconical Log antenna	ETS LINDGREN	3142E	2020/08	2023/08
1111	ETHERNET SNMP 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 (Proprietary Protocol)

Appendix A Content

PRODUCT INFORMATION 13
DESCRIPTION OF TEST CONDITIONS 14
TEST A.1: 99% OCCUPIED BANDWIDTH 15
TEST A.2: 6DB BANDWIDTH 20
TEST A.3: MAXIMUM PEAK CONDUCTED OUTPUT POWER AND ANTENNA GAIN 25
TEST A.4: BAND-EDGE EMISSIONS COMPLIANCE (TRANSMITTER) 30
TEST A.5: POWER SPECTRAL DENSITY 35
TEST A.6: EMISSION LIMITATIONS RADIATED (TRANSMITTER) 40

PRODUCT INFORMATION

The following information is provided by the client

Information	**Description**
Modulation	GFSK
Adaptive	Non-adaptive equipment
Operation mode	
- Operating Frequency Range	2400 – 2480 MHz
- Nominal Channel Bandwidth	2 MHz
- RF Output Power	10 dBm
Antenna type	Integrated chip antenna
Antenna gain	2.6 dBi
Nominal Voltage	
- Supply Voltage	5.4 V nominal
- Type of power source	DC Power supply
Equipment type	Wireless Battery Management
Geo-location capability	No

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01 (Port 1)	Power supply (V): $V_{nominal}$ = 5.4 V dc Bandwidth: 2 MHz Test Frequencies for Conducted/ Radiated tests: Lowest channel: 2405 MHz Middle channel: 2445 MHz Highest channel: 2480 MHz
TC#02 (Port 2)	Power supply (V): $V_{nominal}$ = 5.4 V dc Bandwidth: 2 MHz Test Frequencies for Conducted/ Radiated tests: Lowest channel: 2405 MHz Middle channel: 2445 MHz Highest channel: 2480 MHz

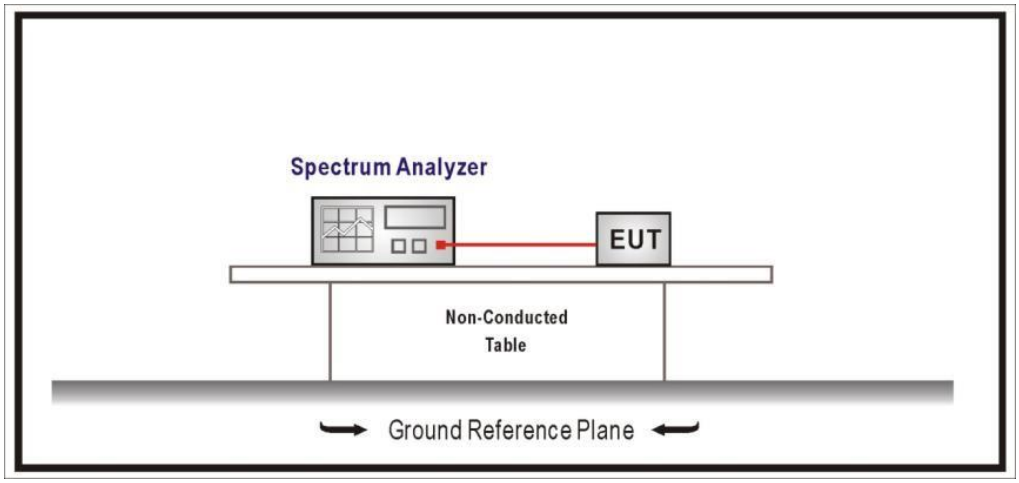
TEST A.1: 99% OCCUPIED BANDWIDTH

LIMITS:	Product standard:	§ 2.1049 and RSS-Gen
	Test standard:	§ 2.1049 and RSS-Gen 6.7

LIMITS

The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs

TEST SETUP	

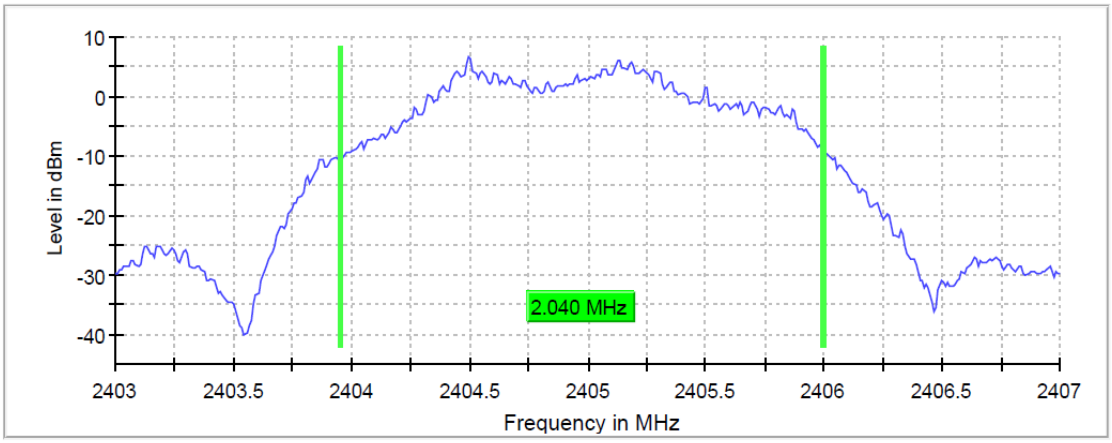


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (port 1)
TEST RESULTS:	PASS

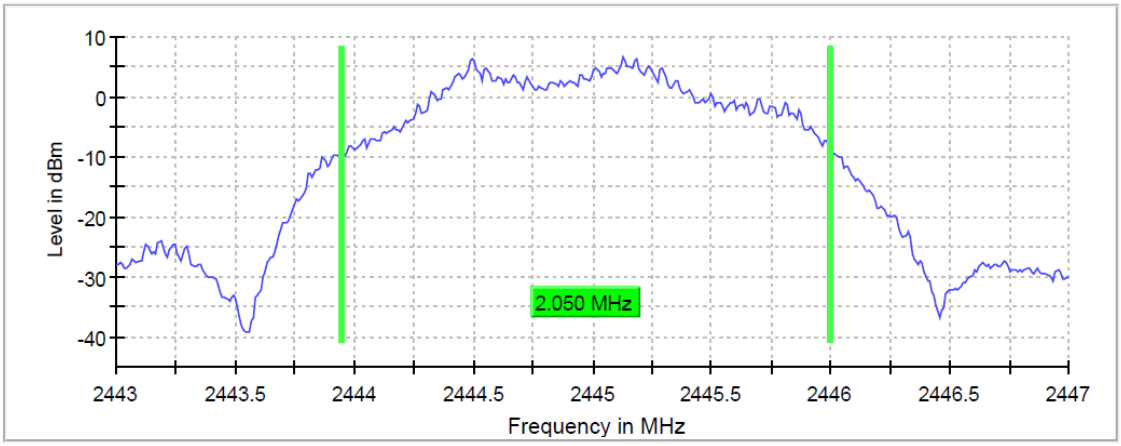
	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
99% bandwidth (MHz)	2.04	2.05	2.04

TEST RESULTS (Cont.):	

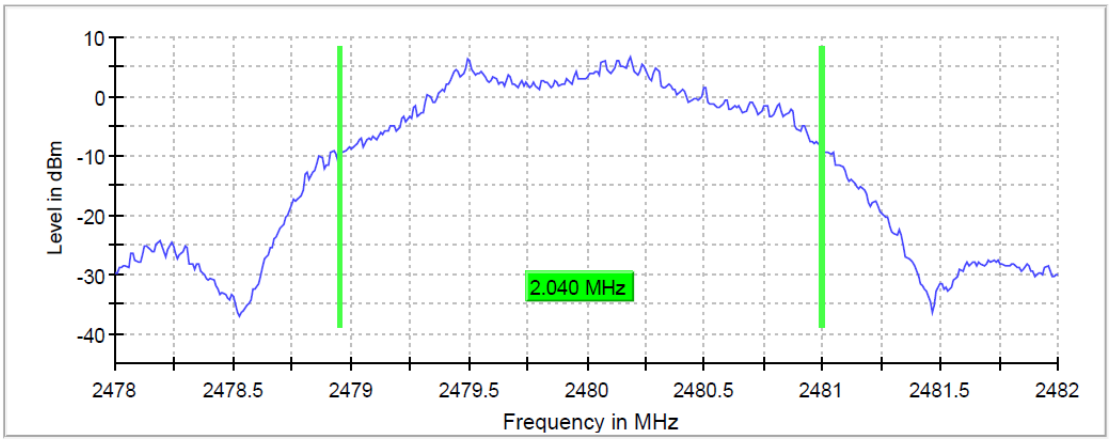
Lowest Channel



Middle Channel



Highest Channel



TEST RESULTS (Cont.):	

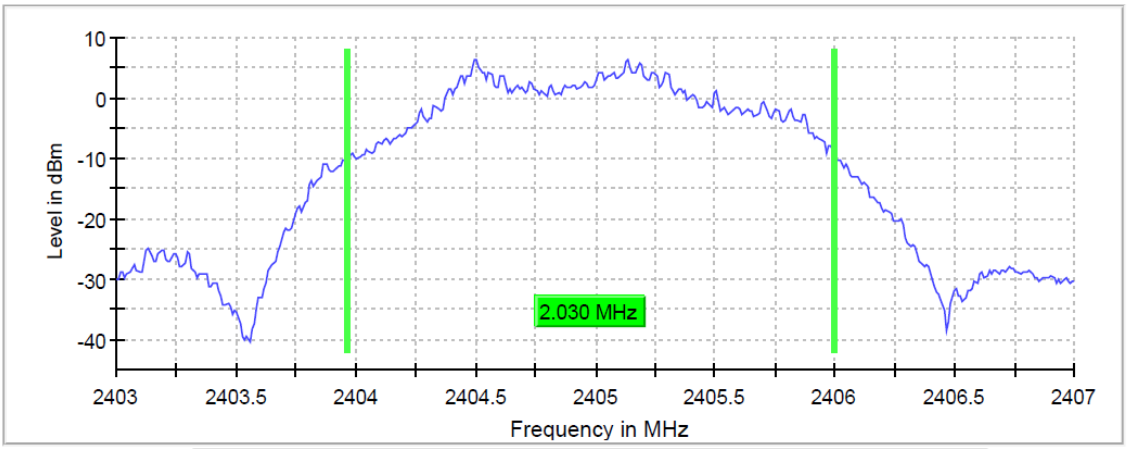
Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40300 GHz	2.44300 GHz	2.47800 GHz
Stop Frequency	2.40700 GHz	2.44700 GHz	2.48200 GHz
Span	4.000 MHz	4.000 MHz	4.000 MHz
RBW	20.000 kHz	20.000 kHz	20.000 kHz
VBW	100.000 kHz	100.000 kHz	100.000 kHz
Sweep Points	400	400	400
Sweep time	94.824 µs	94.824 µs	94.824 µs
Reference Level	10.000 dBm	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	Off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.30 dB	0.30 dB	0.30 dB
Run	48 / max. 150	6 / max. 150	10 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.00 dB	0.00 dB

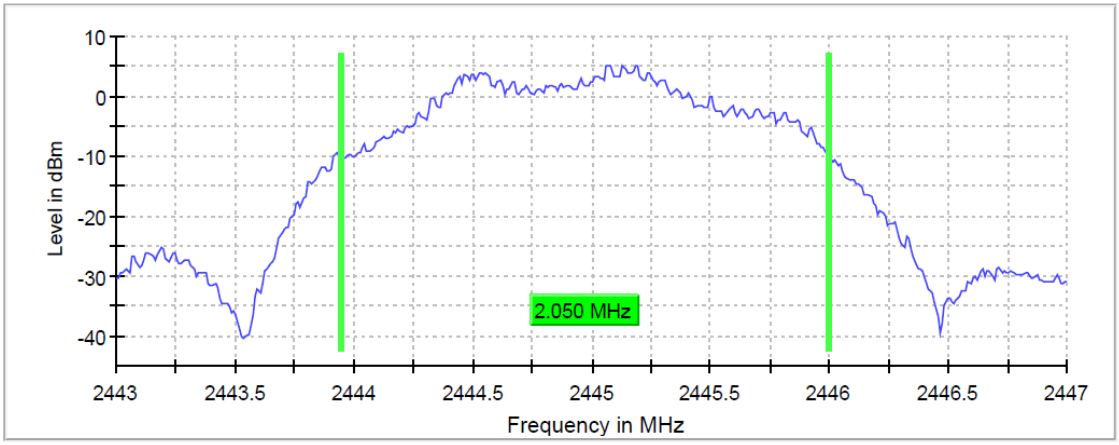
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (port 2)
TEST RESULTS:	PASS

	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
99% bandwidth (MHz)	2.03	2.05	2.05

Lowest Channel

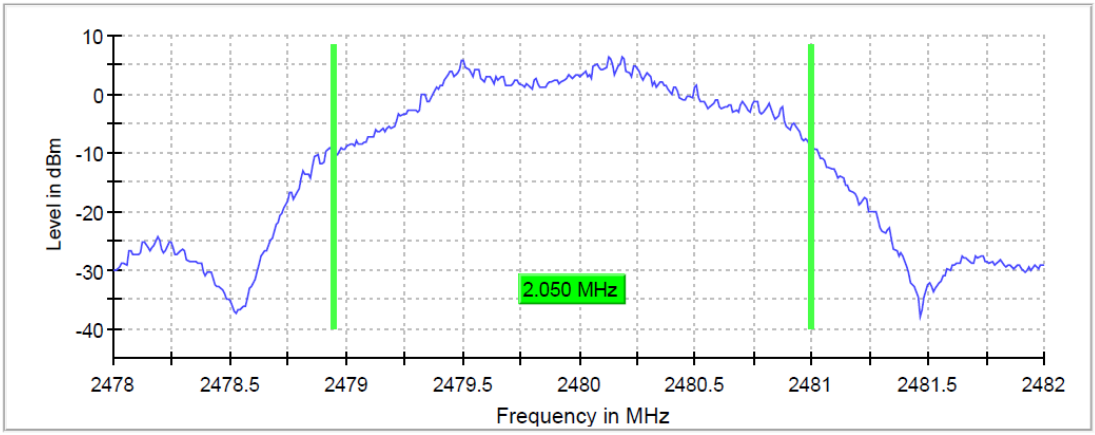


Middle Channel



TEST RESULTS (Cont.):	

Highest Channel



Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40300 GHz	2.44300 GHz	2.47800 GHz
Stop Frequency	2.40700 GHz	2.44700 GHz	2.48200 GHz
Span	4.000 MHz	4.000 MHz	4.000 MHz
RBW	20.000 kHz	20.000 kHz	20.000 kHz
VBW	100.000 kHz	100.000 kHz	100.000 kHz
Sweep Points	400	400	400
Sweep time	94.824 µs	94.824 µs	94.824 µs
Reference Level	10.000 dBm	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	Off	Off	Off
Stable mode	Trace	Trace	Trace
Stable value	0.30 dB	0.30 dB	0.30 dB
Run	57 / max. 150	49 / max. 150	60 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.00 dB	0.08 dB

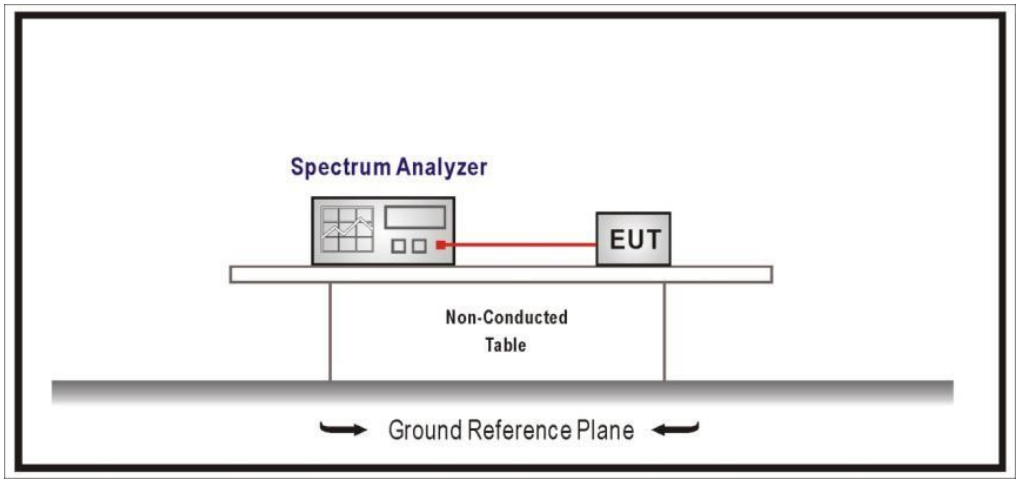
TEST A.2: 6DB BANDWIDTH

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(a)

LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST SETUP	

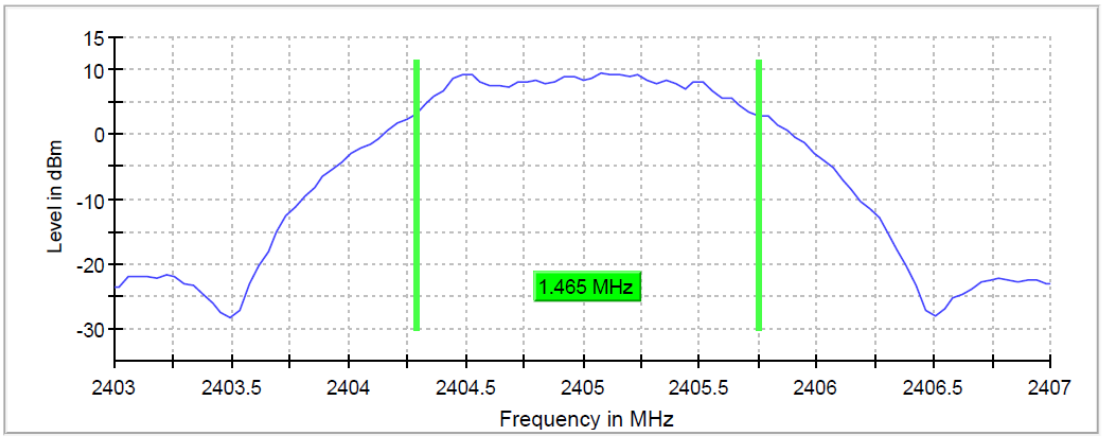


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (Port 1)
TEST RESULTS:	PASS

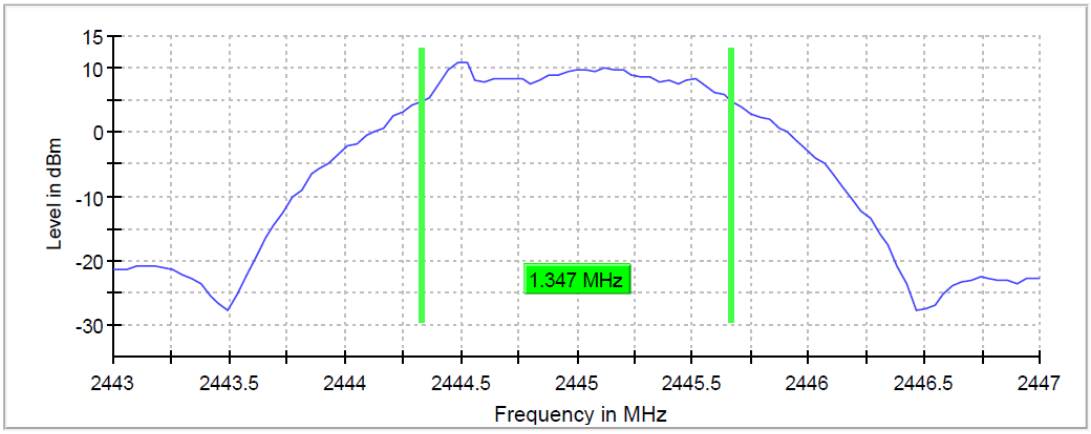
	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
6 dB Spectrum bandwidth (MHz)	1.465	1.347	1.465

TEST RESULTS (Cont.):	

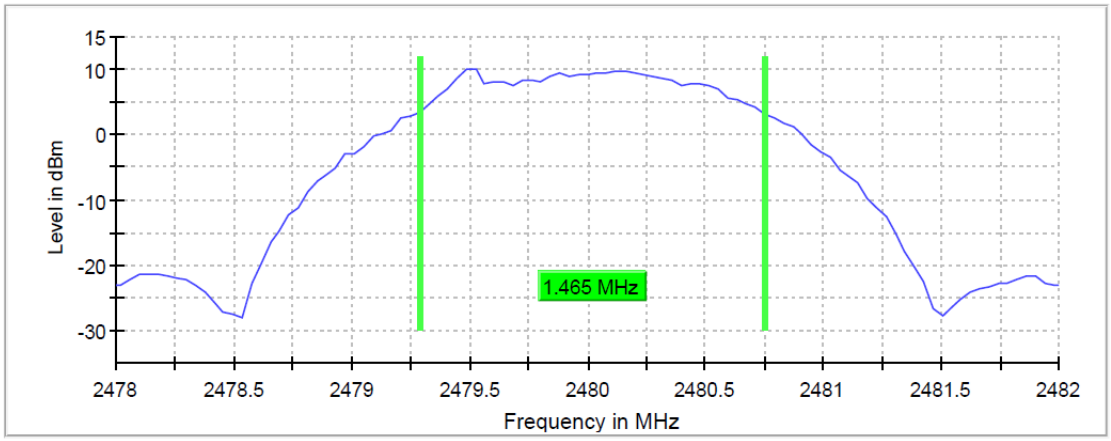
Lowest Channel:



Mid Channel:



High Channel:



TEST RESULTS (Cont.):	

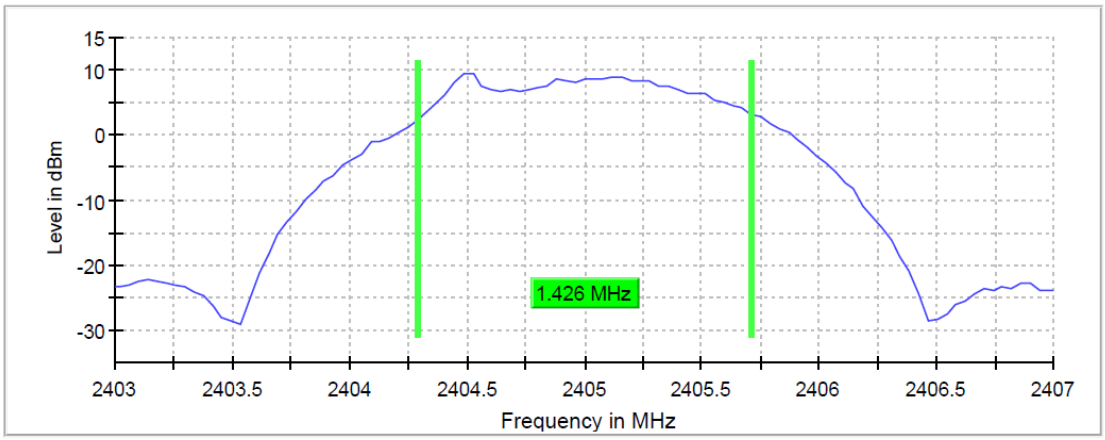
Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40300 GHz	2.44300 GHz	2.47800 GHz
Stop Frequency	2.40700 GHz	2.44700 GHz	2.48200 GHz
Span	4.000 MHz	4.000 MHz	4.000 MHz
RBW	100.000 kHz	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz	300.000 kHz
Sweep Points	101	101	101
Sweep time	18.938 µs	18.938 µs	18.938 µs
Reference Level	0.000 dBm	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	20.000 dB	20.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	10 / max. 150	19 / max. 150	24 / max. 150
Stable	5 / 5	5 / 5	5 / 5
Max Stable Difference	0.00 dB	0.25 dB	0.00 dB

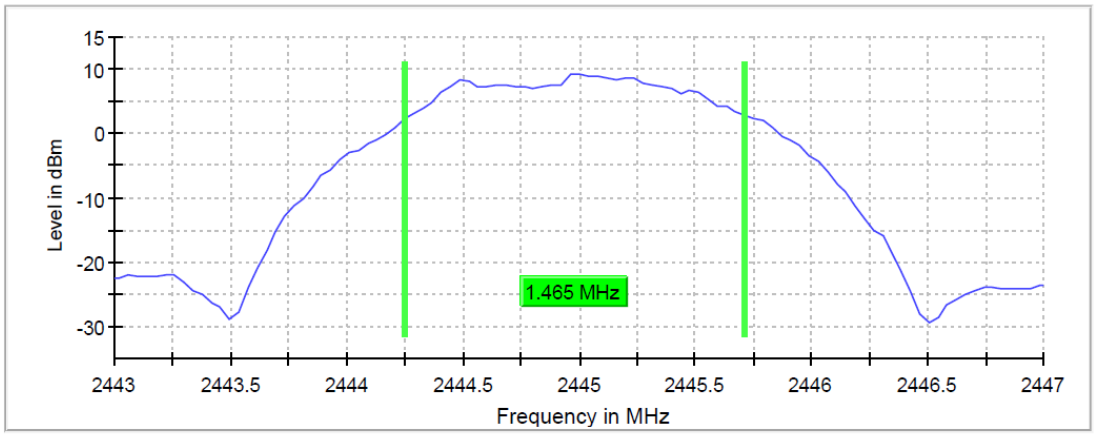
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (Port 2)
TEST RESULTS:	PASS

	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
6 dB Spectrum bandwidth (MHz)	1.426	1.465	1.426

Lowest Channel:

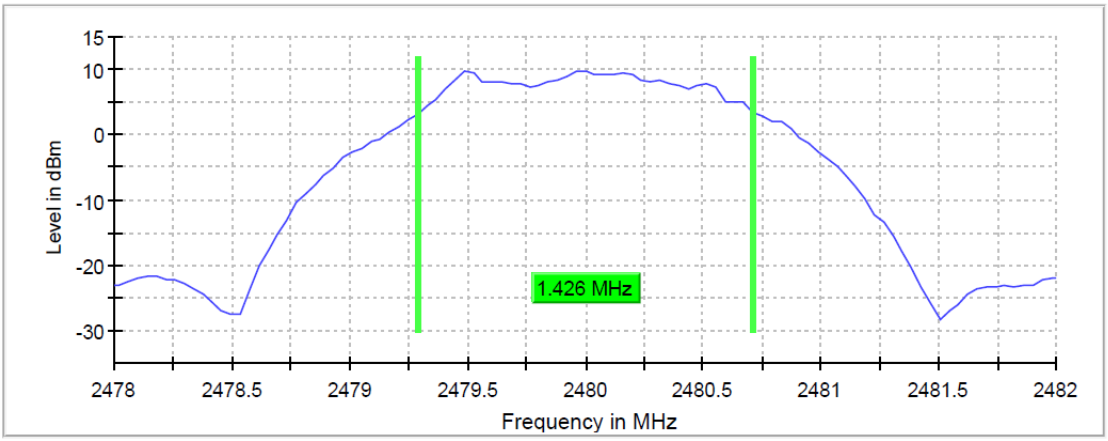


Mid Channel:



TEST RESULTS (Cont.):	

High Channel:



Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40300 GHz	2.44300 GHz	2.47800 GHz
Stop Frequency	2.40700 GHz	2.44700 GHz	2.48200 GHz
Span	4.000 MHz	4.000 MHz	4.000 MHz
RBW	100.000 kHz	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz	300.000 kHz
Sweep Points	101	101	101
Sweep time	18.938 µs	18.938 µs	18.938 µs
Reference Level	0.000 dBm	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	20.000 dB	20.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	Off	Off	Off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	16 / max. 150	24 / max. 150	25 / max. 150
Stable	5 / 5	5 / 5	5 / 5
Max Stable Difference	0.13 dB	0.37 dB	0.00 dB

TEST A.3: MAXIMUM PEAK CONDUCTED OUTPUT POWER AND ANTENNA GAIN

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(d)

LIMITS

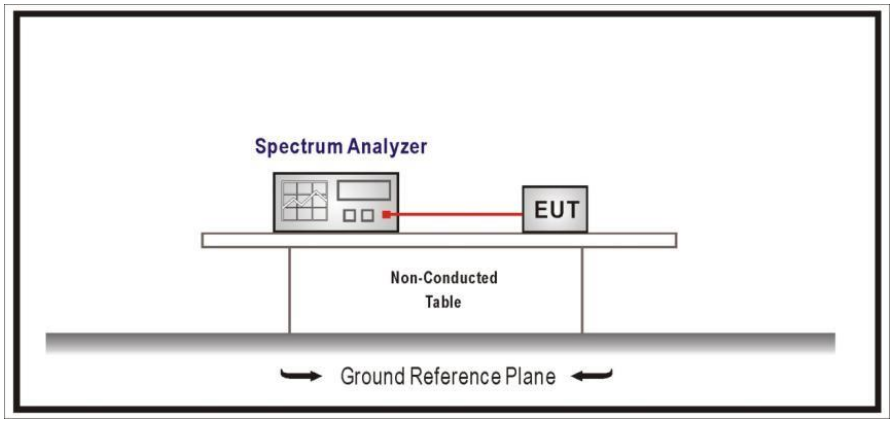
§15.247(b)(3) and RSS-247 5.4(d): For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).

RSS-247 5.4(d): The e.i.r.p. shall not exceed 4 W (36 dBm)

TEST SETUP	

The maximum peak conducted output power was measured using the method according to point 9.1.1. of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v04 dated 05/04/2017.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.



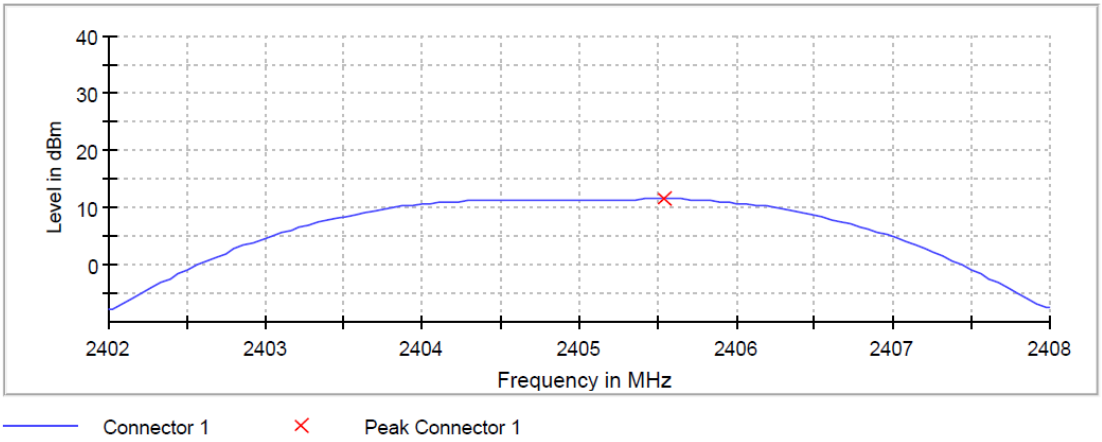
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (Port 1)
TEST RESULTS:	PASS

Maximum declared antenna gain: +2.6 dBi

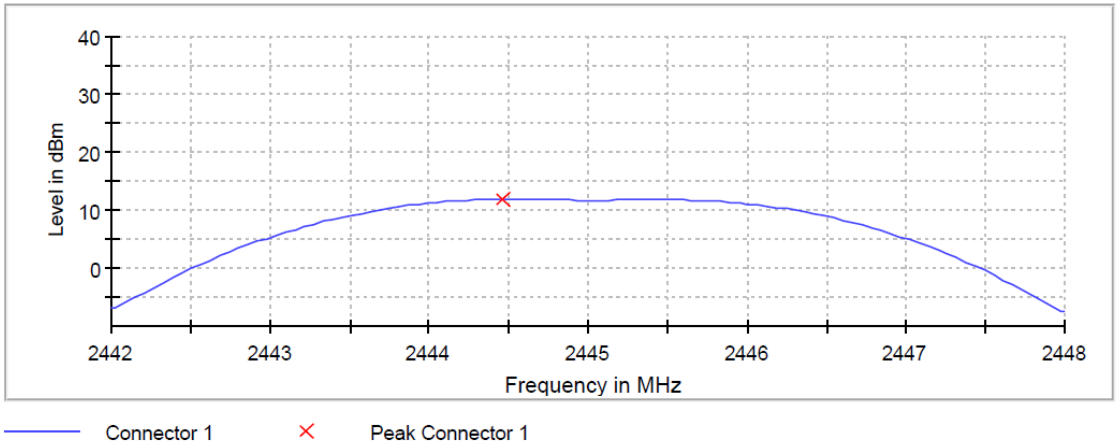
	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	11.5	11.9	11.6
Maximum EIRP power (dBm)	14.1	14.5	14.2

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power limit is not required to be reduced from the stated values.

Lowest Channel

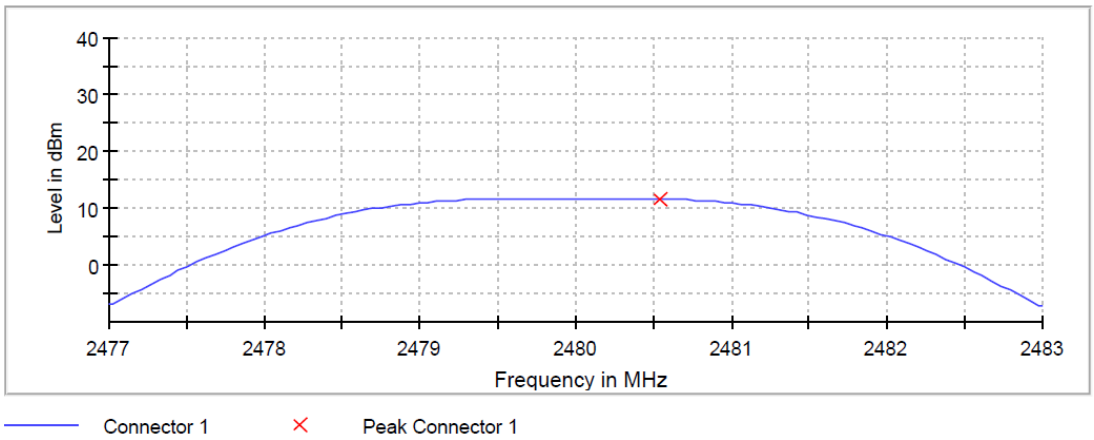


Middle Channel



TEST RESULTS (Cont.):	CONDUCTED PEAK POWER

Highest Channel



Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40200 GHz	2.44200 GHz	2.47700 GHz
Stop Frequency	2.40800 GHz	2.44800 GHz	2.48300 GHz
Span	6.000 MHz	6.000 MHz	6.000 MHz
RBW	2.000 MHz	2.000 MHz	2.000 MHz
VBW	10.000 MHz	10.000 MHz	10.000 MHz
Sweep Points	101	101	101
Sweep time	953.450 ns	953.450 ns	953.450 ns
Reference Level	20.000 dBm	20.000 dBm	20.000 dBm
Attenuation	40.000 dB	40.000 dB	40.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	4 / max. 150	4 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.02 dB	0.03 dB	0.03 dB

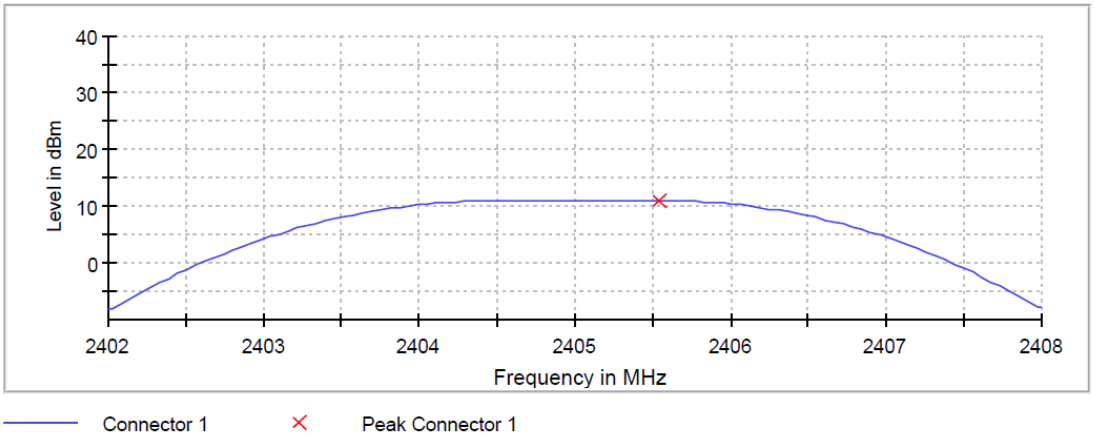
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (Port 2)
TEST RESULTS:	PASS

Maximum declared antenna gain: +2.6 dBi

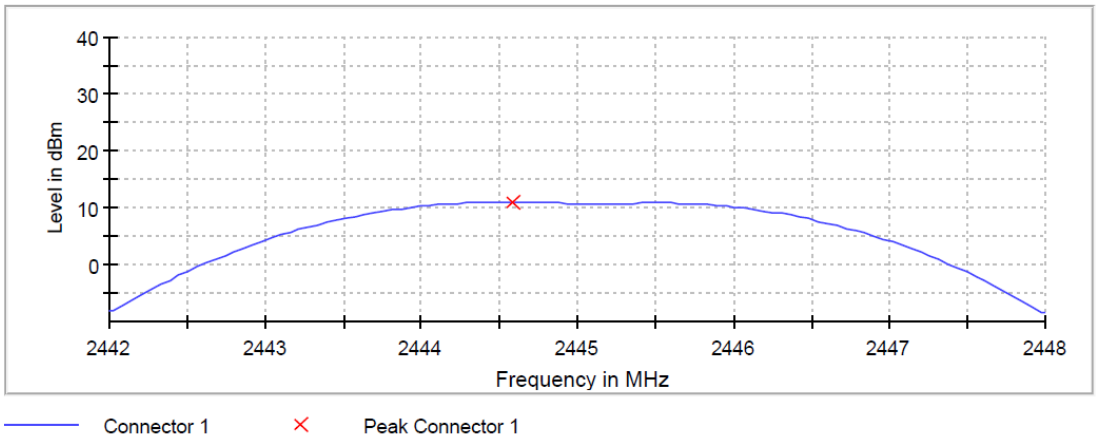
	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	11.1	10.9	11.5
Maximum EIRP power (dBm)	13.7	13.5	14.1

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power limit is not required to be reduced from the stated values.

Lowest Channel

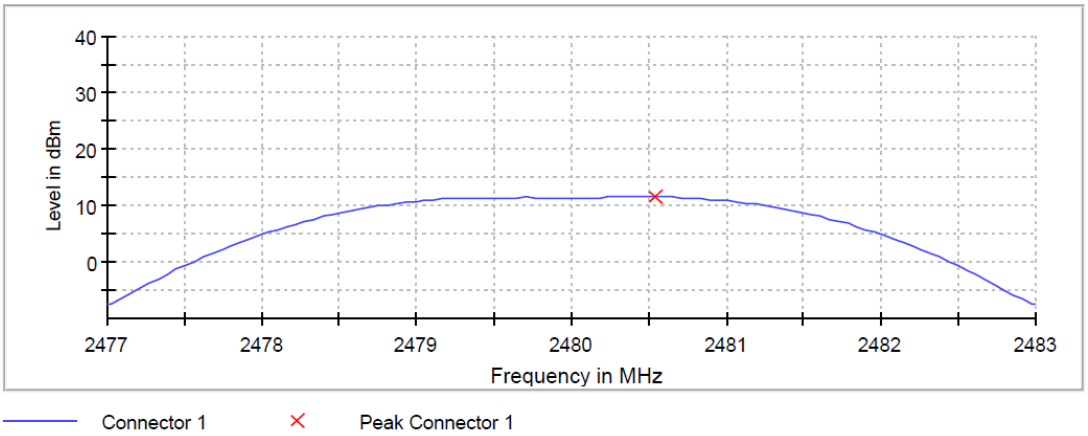


Middle Channel



TEST RESULTS (Cont.):	CONDUCTED PEAK POWER

Highest Channel



Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40200 GHz	2.44200 GHz	2.47700 GHz
Stop Frequency	2.40800 GHz	2.44800 GHz	2.48300 GHz
Span	6.000 MHz	6.000 MHz	6.000 MHz
RBW	2.000 MHz	2.000 MHz	2.000 MHz
VBW	10.000 MHz	10.000 MHz	10.000 MHz
Sweep Points	101	101	101
Sweep time	953.450 ns	953.450 ns	953.450 ns
Reference Level	20.000 dBm	20.000 dBm	20.000 dBm
Attenuation	40.000 dB	40.000 dB	40.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	FFT	FFT	FFT
Preamp	off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	4 / max. 150	4 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.06 dB	0.01 dB	0.00 dB

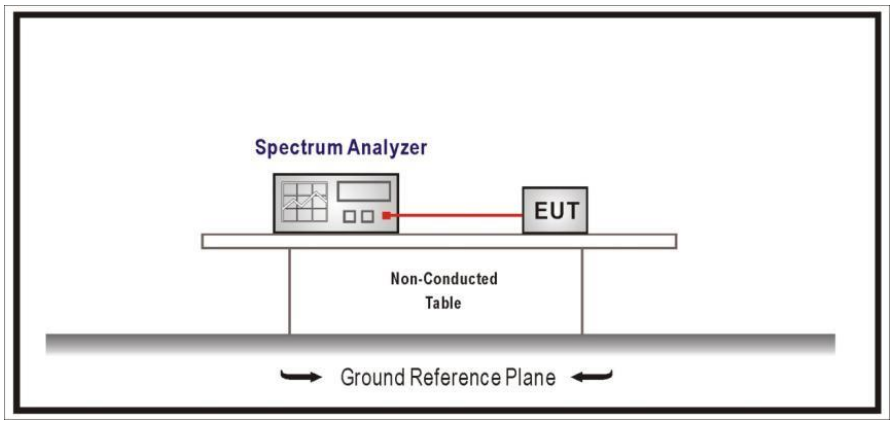
TEST A.4: BAND-EDGE EMISSIONS COMPLIANCE (TRANSMITTER)

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

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

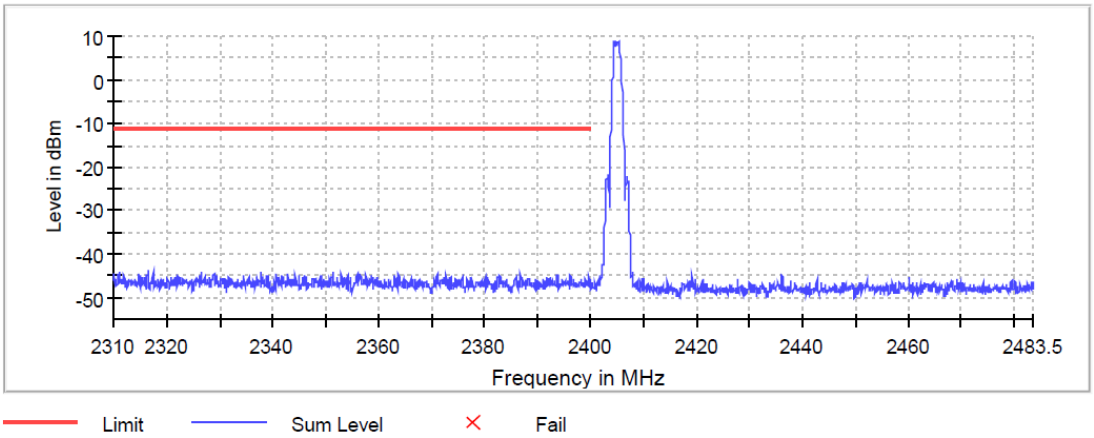
TEST SETUP	



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (Port 1)
TEST RESULTS:	PASS

Note: Radiated measurements are used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

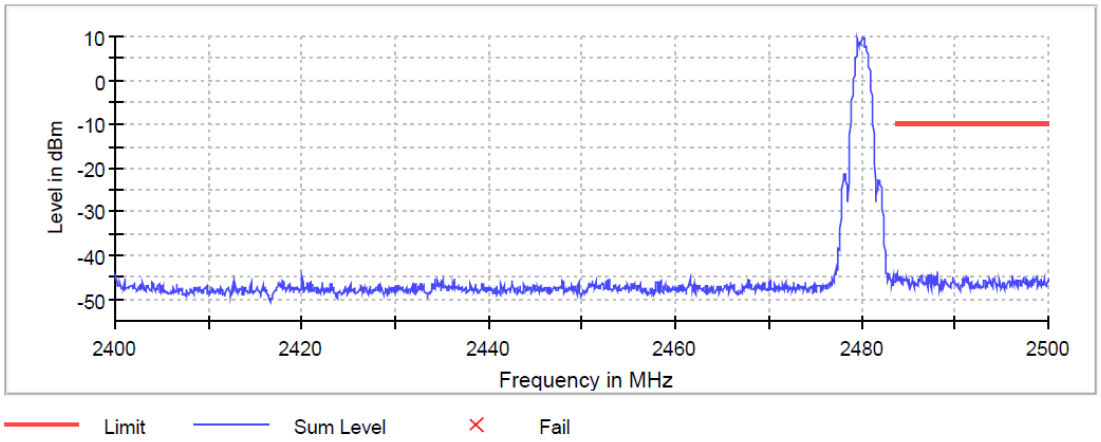
TEST RESULTS (Cont.):	Lowest Channel



Measurement

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2316.525000	-43.7	32.6	-11.0	PASS
2316.475000	-43.8	32.8	-11.0	PASS
2317.475000	-44.0	32.9	-11.0	PASS
2351.525000	-44.0	33.0	-11.0	PASS
2317.425000	-44.0	33.0	-11.0	PASS
2351.475000	-44.1	33.0	-11.0	PASS
2310.975000	-44.1	33.1	-11.0	PASS
2326.525000	-44.2	33.2	-11.0	PASS
2337.825000	-44.2	33.2	-11.0	PASS
2310.925000	-44.3	33.2	-11.0	PASS
2355.925000	-44.3	33.3	-11.0	PASS
2310.125000	-44.3	33.3	-11.0	PASS
2337.775000	-44.3	33.3	-11.0	PASS
2310.675000	-44.3	33.3	-11.0	PASS
2326.575000	-44.4	33.3	-11.0	PASS

TEST RESULTS (Cont.):	Highest Channel



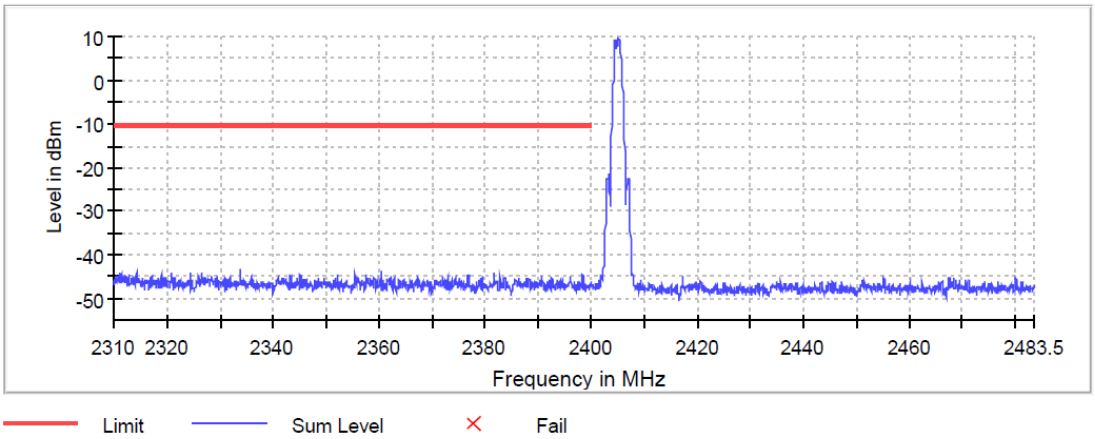
Measurement

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2488.125000	-43.8	33.7	-10.1	PASS
2483.775000	-43.9	33.8	-10.1	PASS
2483.725000	-43.9	33.9	-10.1	PASS
2488.075000	-44.1	34.0	-10.1	PASS
2483.525000	-44.1	34.0	-10.1	PASS
2491.125000	-44.2	34.2	-10.1	PASS
2487.175000	-44.5	34.4	-10.1	PASS
2496.125000	-44.5	34.4	-10.1	PASS
2488.025000	-44.5	34.5	-10.1	PASS
2491.175000	-44.5	34.5	-10.1	PASS
2486.375000	-44.5	34.5	-10.1	PASS
2487.125000	-44.6	34.5	-10.1	PASS
2498.725000	-44.6	34.5	-10.1	PASS
2498.675000	-44.7	34.6	-10.1	PASS
2486.325000	-44.7	34.6	-10.1	PASS

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (Port 2)
TEST RESULTS:	PASS

Note: Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

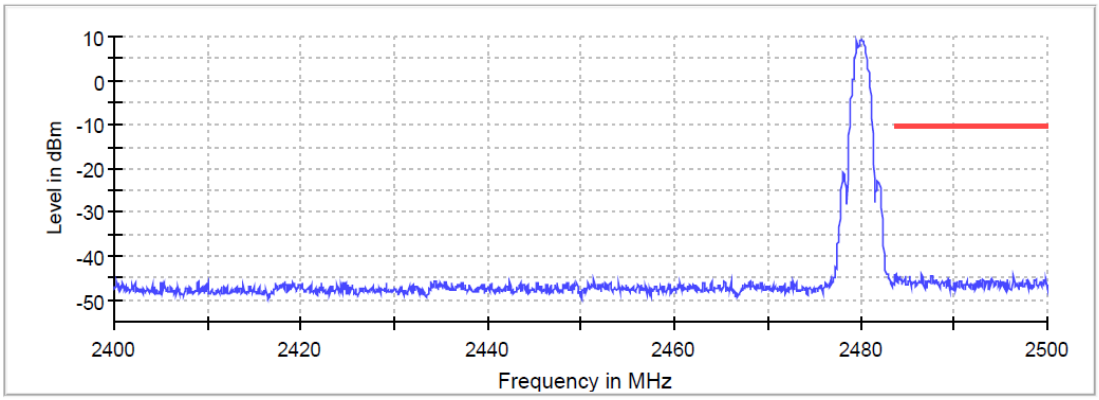
TEST RESULTS (Cont.):	**Lowest Channel**



Measurement

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2333.775000	-43.3	33.0	-10.4	PASS
2333.725000	-43.7	33.4	-10.4	PASS
2360.325000	-43.8	33.5	-10.4	PASS
2360.275000	-43.8	33.5	-10.4	PASS
2314.175000	-43.9	33.5	-10.4	PASS
2314.225000	-43.9	33.6	-10.4	PASS
2381.625000	-44.0	33.6	-10.4	PASS
2311.075000	-44.1	33.8	-10.4	PASS
2324.325000	-44.2	33.8	-10.4	PASS
2320.925000	-44.2	33.8	-10.4	PASS
2326.525000	-44.2	33.9	-10.4	PASS
2311.025000	-44.2	33.9	-10.4	PASS
2352.125000	-44.3	33.9	-10.4	PASS
2381.575000	-44.3	34.0	-10.4	PASS
2376.925000	-44.3	34.0	-10.4	PASS

TEST RESULTS (Cont.):	Highest Channel



Limit Sum Level Fail

Measurement

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.725000	-44.0	33.7	-10.3	PASS
2483.525000	-44.2	33.8	-10.3	PASS
2486.525000	-44.2	33.9	-10.3	PASS
2484.225000	-44.3	33.9	-10.3	PASS
2483.625000	-44.3	34.0	-10.3	PASS
2484.775000	-44.3	34.0	-10.3	PASS
2483.675000	-44.3	34.0	-10.3	PASS
2484.175000	-44.4	34.1	-10.3	PASS
2485.225000	-44.4	34.1	-10.3	PASS
2487.575000	-44.5	34.2	-10.3	PASS
2483.575000	-44.5	34.2	-10.3	PASS
2496.375000	-44.6	34.3	-10.3	PASS
2486.475000	-44.6	34.3	-10.3	PASS
2485.175000	-44.6	34.3	-10.3	PASS
2487.625000	-44.6	34.3	-10.3	PASS

TEST A.5: POWER SPECTRAL DENSITY

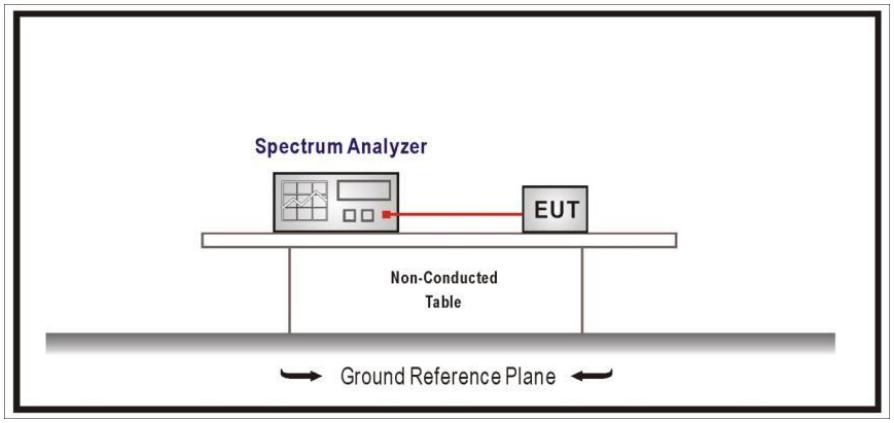
LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(e) and RSS-247 5.2 (b)

LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST SETUP	

The maximum power spectral density level in the fundamental emission was measured using the method PKPSD (Peak PSD) according to point 10.2. of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v05r02 (April 2019).

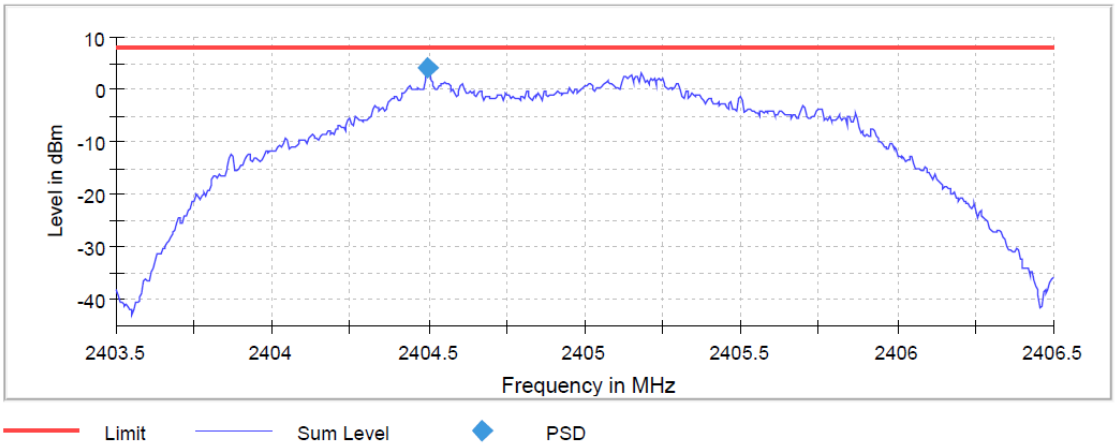


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (Port 1)
TEST RESULTS:	PASS

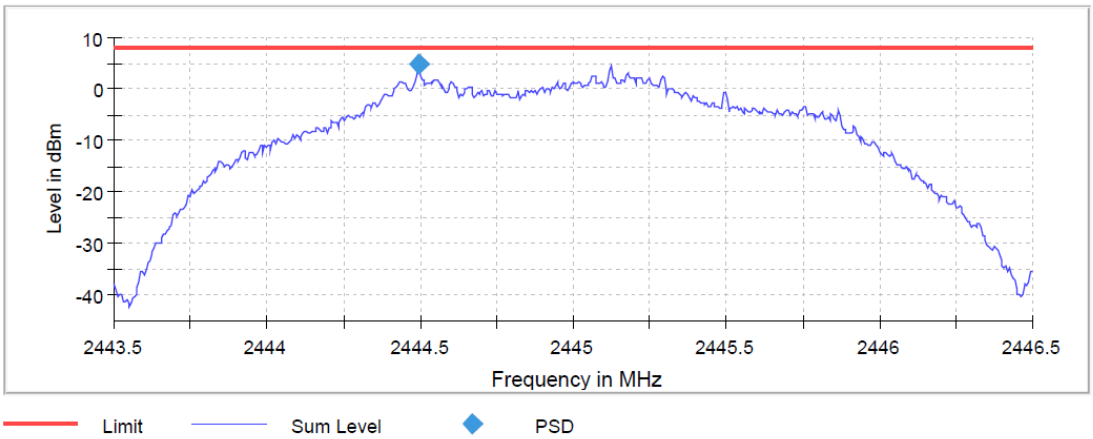
	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
Power spectral density (dBm)	4.222	4.813	4.471

TEST RESULTS (Cont.):	

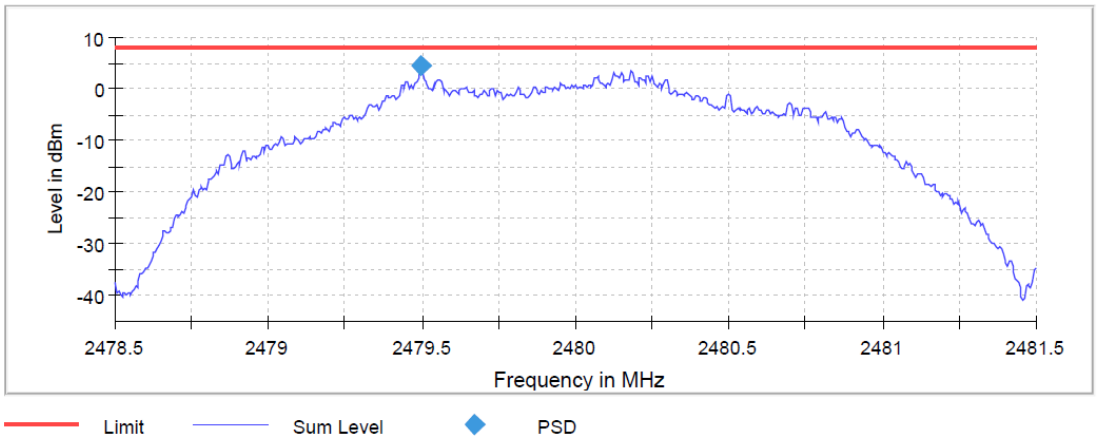
Lowest Channel:



Mid Channel:



High Channel:



TEST RESULTS (Cont.):	

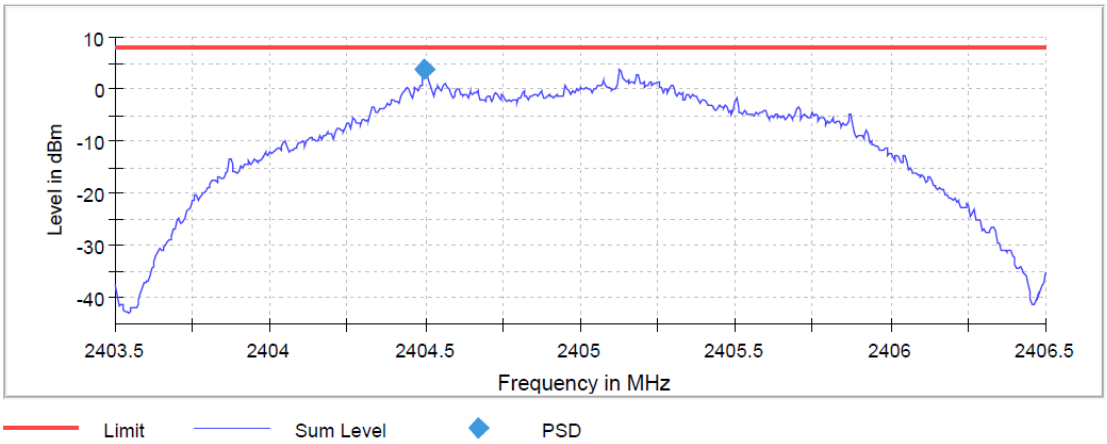
Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40350 GHz	2.44350 GHz	2.47850 GHz
Stop Frequency	2.40650 GHz	2.44650 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz	3.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	600	600	600
Sweep time	3.000 ms	3.000 ms	3.000 ms
Reference Level	10.000 dBm	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	Sweep	Sweep	Sweep
Preamp	off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	52 / max. 150	42 / max. 150	46 / max. 150
Stable	2 / 2	2 / 2	2 / 2
Max Stable Difference	0.00 dB	0.00 dB	0.41 dB

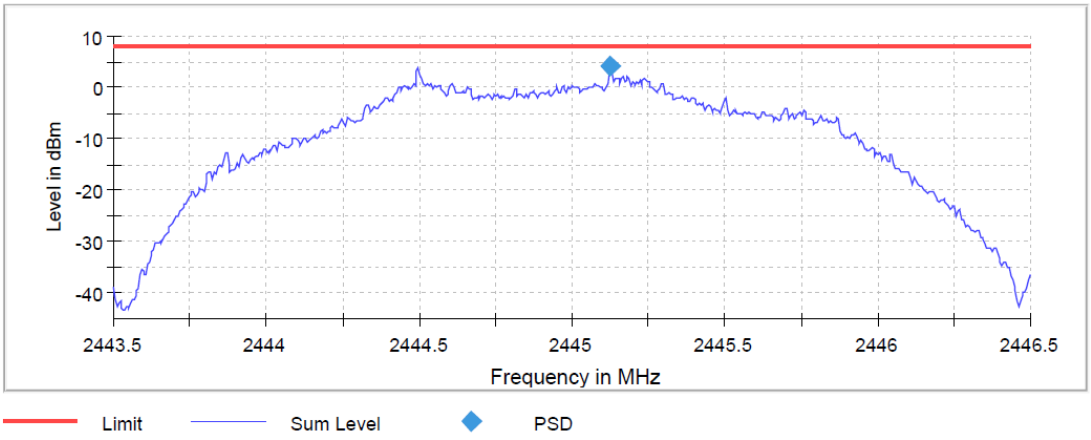
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (Port 2)
TEST RESULTS:	PASS

	Lowest frequency 2405 MHz	Middle frequency 2445 MHz	Highest frequency 2480 MHz
Power spectral density (dBm)	3.747	4.051	4.185

Lowest Channel:

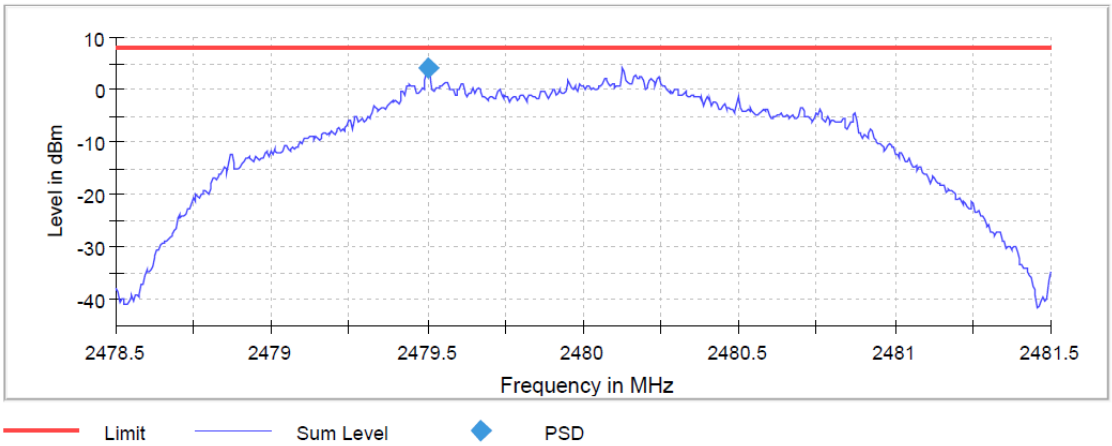


Mid Channel:



TEST RESULTS (Cont.):	

High Channel:



Measurement

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40350 GHz	2.44350 GHz	2.47850 GHz
Stop Frequency	2.40650 GHz	2.44650 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz	3.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	600	600	600
Sweep time	3.000 ms	3.000 ms	3.000 ms
Reference Level	0.000 dBm	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	20.000 dB	20.000 dB
Detector	MaxPeak	MaxPeak	MaxPeak
Sweep Count	100	100	100
Filter	3 dB	3 dB	3 dB
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep type	Sweep	Sweep	Sweep
Preamp	off	Off	off
Stable mode	Trace	Trace	Trace
Stable value	0.50 dB	0.50 dB	0.50 dB
Run	42 / max. 150	43 / max. 150	29 / max. 150
Stable	2 / 2	2 / 2	2 / 2
Max Stable Difference	0.32 dB	0.05 dB	0.47 dB

TEST A.6: 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-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 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.

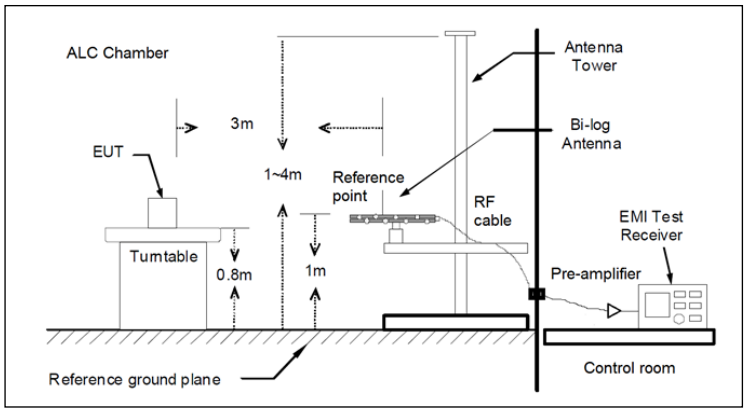
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

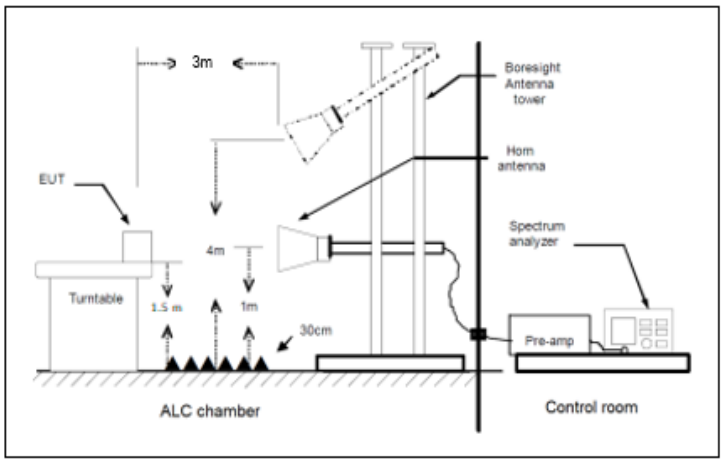
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

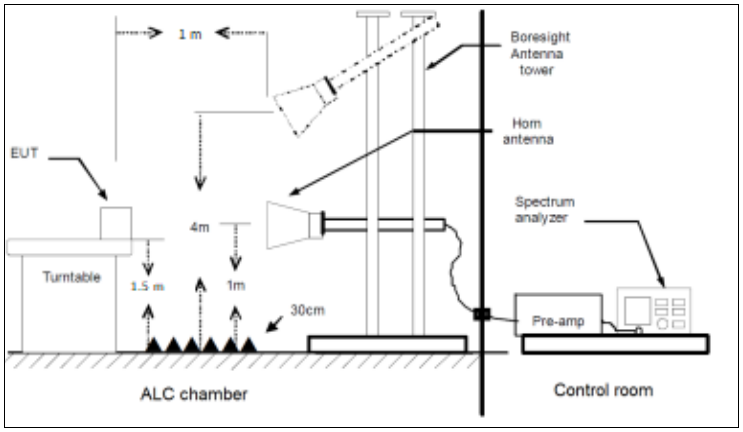
Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1-18 GHz



Radiated measurements setup f > 18 GHz



TESTED SAMPLES:	S/02
TESTED CONDITIONS MODES:	TC#01 (Port 1)
TEST RESULTS:	PASS

The preliminary test was performed in three different DUT orientations (X, Y and Z) to determine the worst case. The worst case results were shown in the following test results.

Frequency range 30 MHz – 1000 MHz

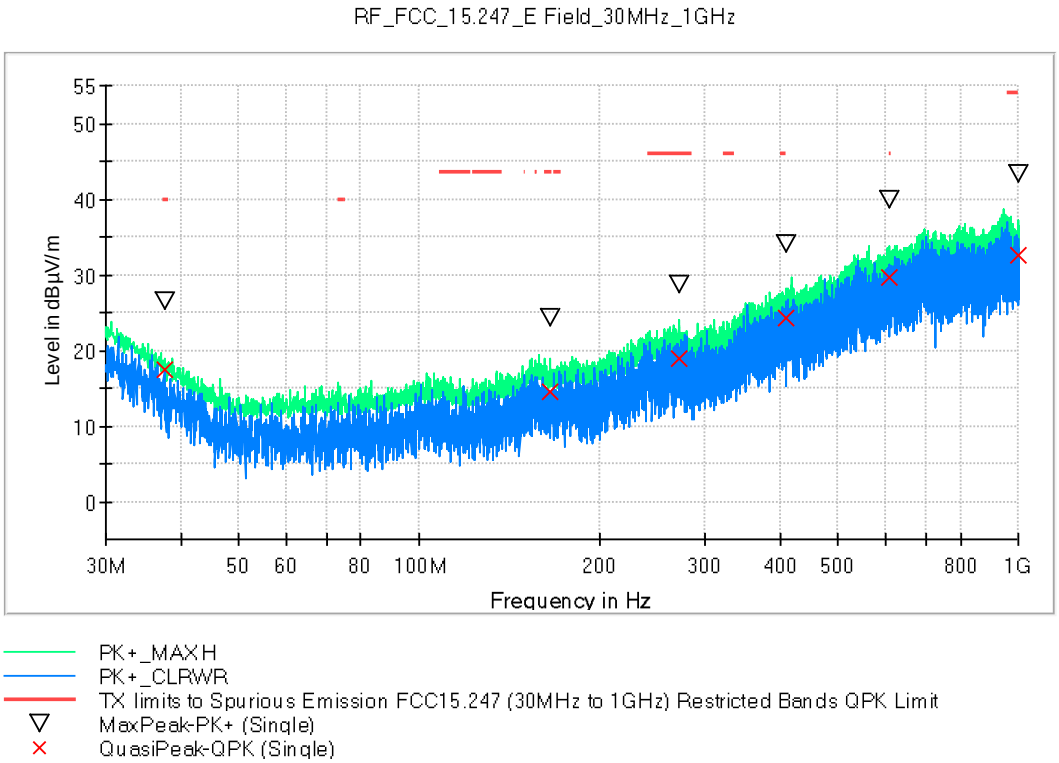
The spurious emissions below 1 GHz do not depend on the operating channel selected in the DUT.

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).

TEST RESULTS (Cont.):	30-1000 MHz

Mid Channel

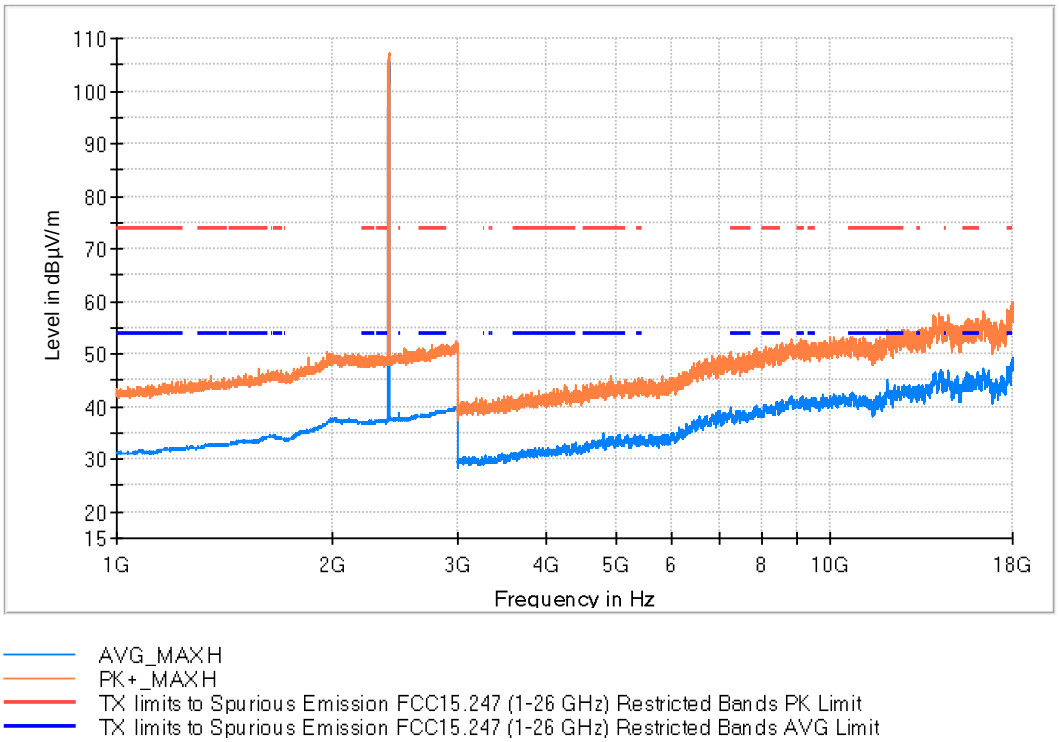


Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)
37.566000	26.5	17.5	V	22.5	40.0
165.800000	24.3	14.4	V	29.1	43.5
270.705500	28.7	19.0	H	27.0	46.0
408.736500	34.1	24.4	H	21.7	46.0
608.120000	39.9	29.7	H	16.3	46.0
997.623500	43.2	32.5	V	21.5	54.0

TEST RESULTS (Cont.):	1-18 GHz (Lowest Channel)

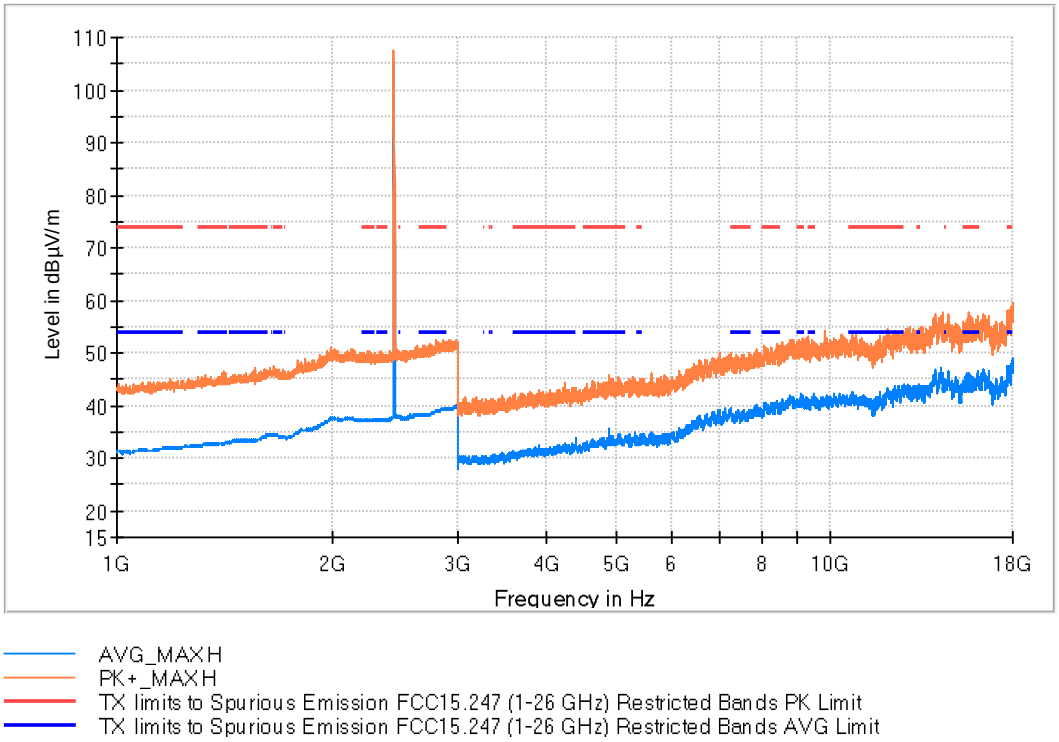
Lowest Channel



Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2404.500000	107.1	102.4	H	---	---	Fundamental
12027.500000	53.5	45.0	V	9.0	54.0	

TEST RESULTS (Cont.):	1-18 GHz (Middle Channel)

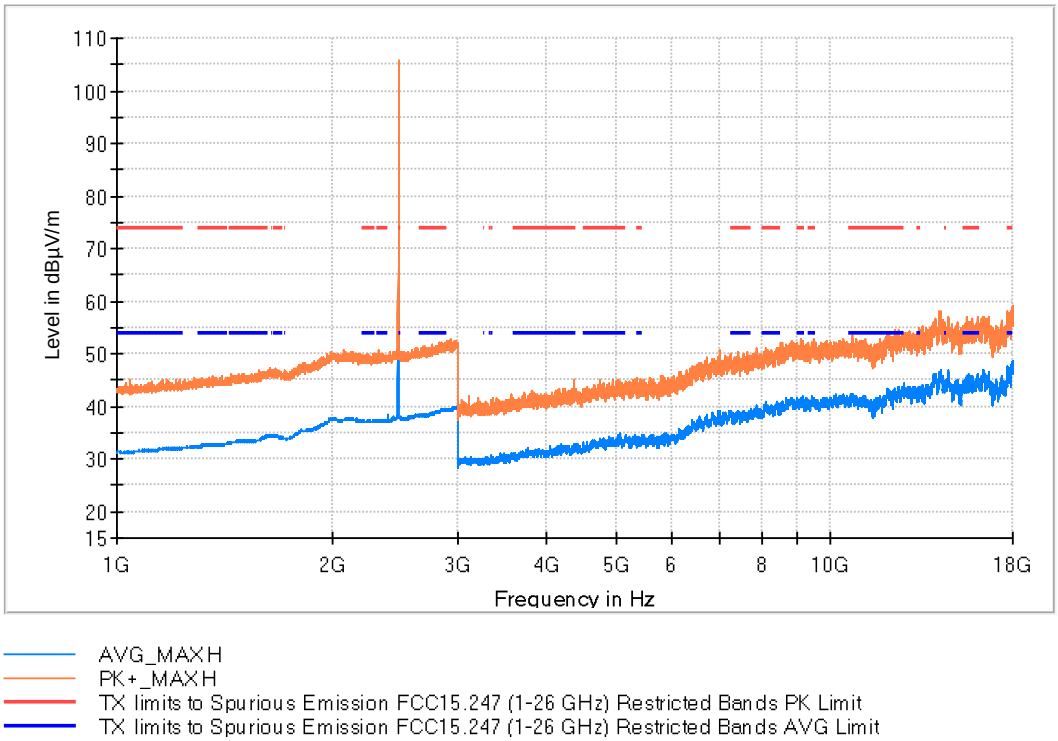
Middle Channel



Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2445.000000	107.3	105.6	H	---	---	Fundamental
4890.500000	45.1	35.7	H	18.3	54.0	

TEST RESULTS (Cont.):	1-18 GHz (Highest Channel)

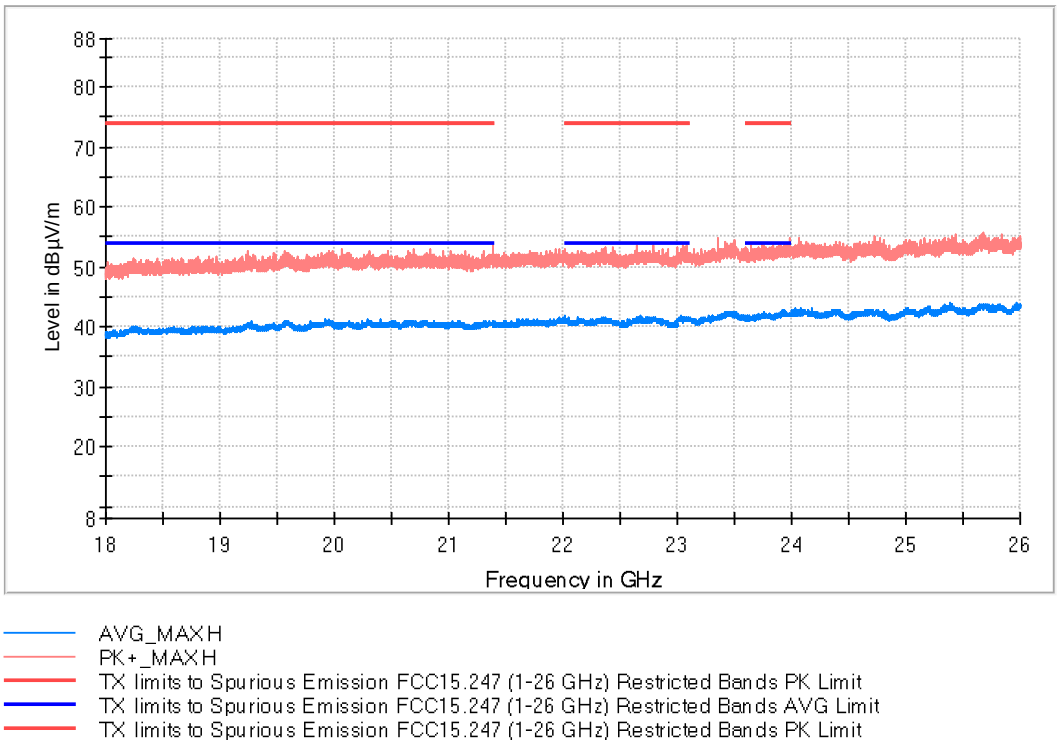
Highest Channel



Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2480.000000	105.7	103.9	H	---	---	Fundamental

TEST RESULTS (Cont.):	18 – 26 GHz

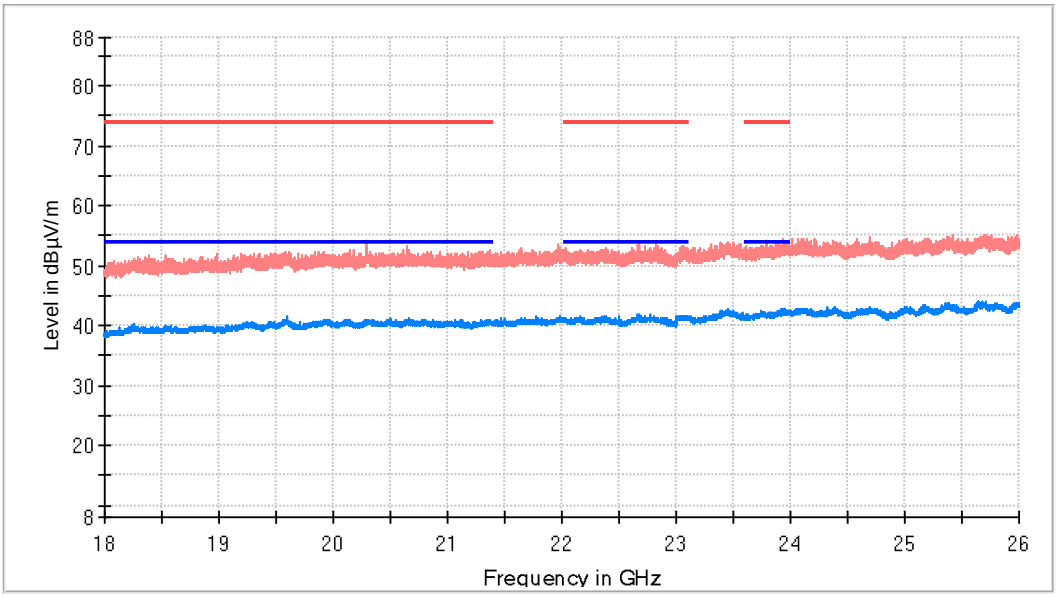
Lowest Channel



Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
25391.000000	54.0	43.8	V	---	---

TEST RESULTS (Cont.):	18 – 26 GHz

Middle Channel

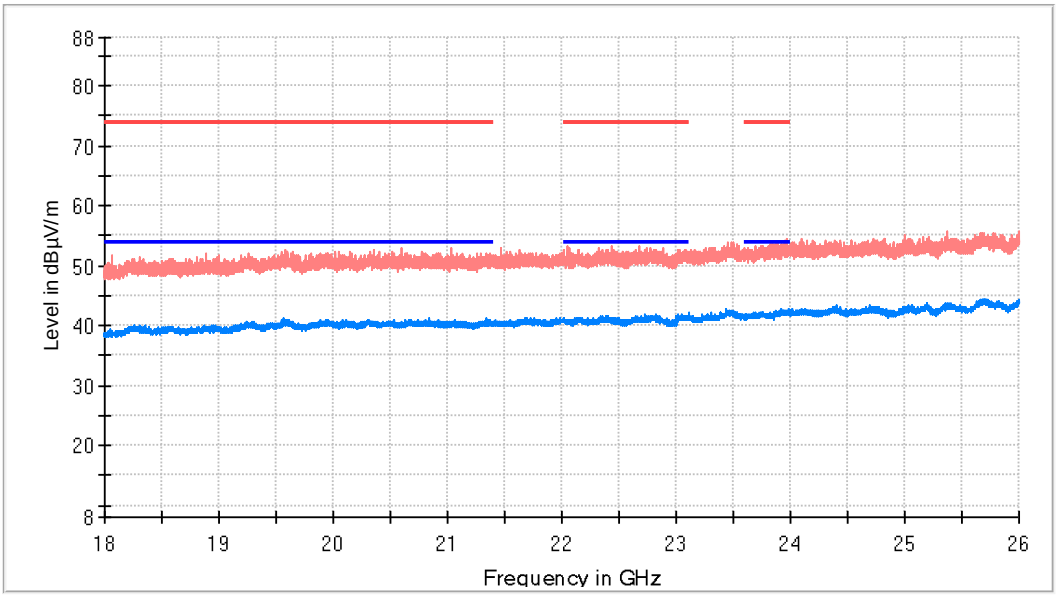


AVG_MAXH
PK+_MAXH
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
23453.000000	53.7	42.8	H	---	---

TEST RESULTS (Cont.):	18 – 26 GHz

Highest Channel

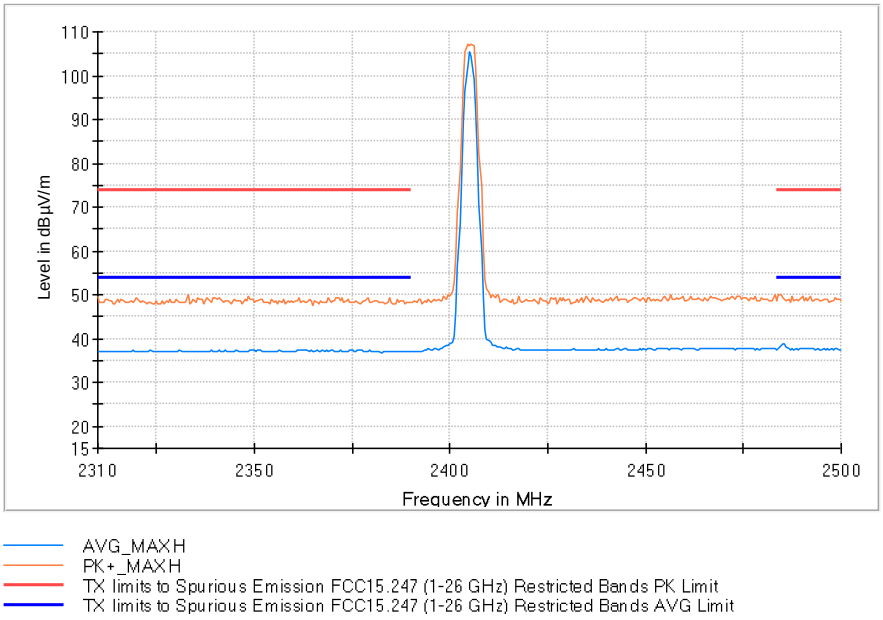
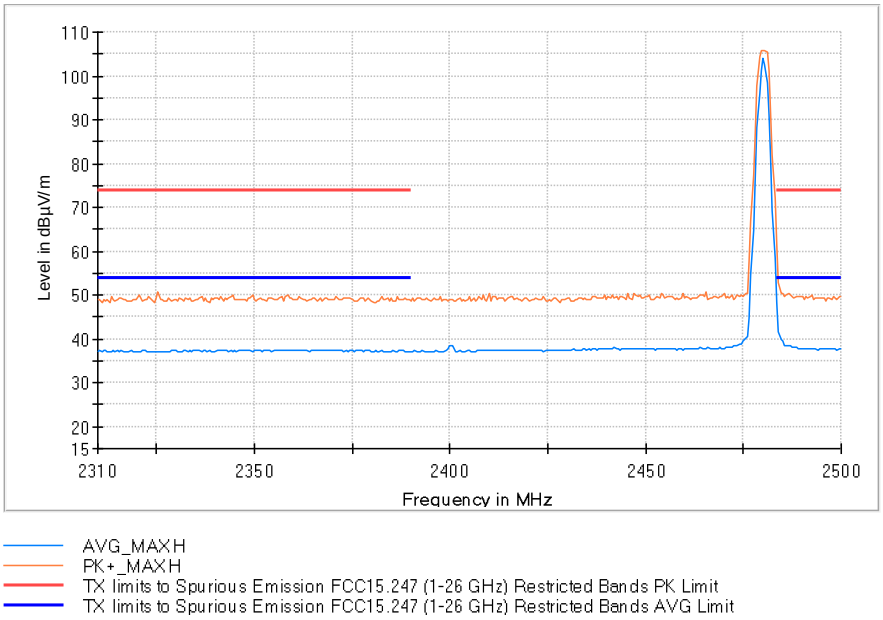


AVG_MAXH
PK+_MAXH
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit
TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
24845.000000	51.9	42.8	H	---	---

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

Lowest Channel



Highest Channel