



Test Lab
Cert 2764.01

FCC LISTED, REGISTRATION
NUMBER: 2764.01

ISED LISTED REGISTRATION
NUMBER: 23595-1


Test report No:
2617ERM.005

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	Automotive Infotainment System
Trademark	Mercedes-Benz
Model and /or type reference	NTG7 MID
Other identification of the product	FCC ID: T8GNTG7MID IC: 6434A-NTG7MID HW Version: D4 SW Version: E13.300
Features	FM, AM, USB, HDD, Bluetooth, WLAN, GPS
Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD 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). 558074 D01 15.247 Meas Guidance v05r02. Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under section §15.247 of the FCC Rules ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager 
Date of issue	2019-11-06
Report template No	FDT08_21

Digitally signed by Domingo Galvez
DN: cn=Domingo Galvez,
ou=DEKRA Certification Inc.,
ou=Regulatory Lab,
email=hdg.galvez@dekra.com, cn=US
Date: 2019.11.06 21:45:04 -05'00'

Index

Competences and guarantees	3
General conditions	3
Uncertainty	3
Data provided by the client.....	4
Usage of samples	4
Test sample description	5
Identification of the client.....	6
Testing period and place.....	6
Document history	7
Modifications to the reference test report	7
Environmental conditions	7
Remarks and comments	8
Testing verdicts.....	8
Summary	8
List of equipment used during the test.....	10
Appendix A: Test results (Bluetooth EDR)	11
Appendix B: Test results (WI-FI 2.4GHz)	87

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.

Frequency (MHz)	U(k=2)	Units
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

The test sample consist of an automotive head unit to be installed in cars with the following features: FM, AM, USB, HDD, Bluetooth, WLAN, GPS.

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 N°	Description	Model	Serial N°	Date of reception
2617/04	Car Radio Head Unit	NTG7 MID	HBM306KS000387	09/12/2019

1. Sample S/01 has undergone following test(s): All conducted tests indicated in appendix A & B.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
2617/24	Car Radio Head Unit w/o Raspberry board	NTG7 MID	HBM304K001660	09/19/2019
2617/03	Car Radio Head Unit	NTG7 MID	HBM306KS00387	09/12/2019

1. Sample S/02 has undergone following test(s): All radiated tests indicated in appendix A & B.

Sample S/01 & S/02 is composed of the following accessories:

Control N°	Description	Model	Serial N°	Date of reception
2617/12	BT/WLAN Antenna 1	LV19	005976	09/12/2019
2617/13	BT/WLAN Antenna 2	LV19	005948	09/12/2019
2617/14	BT/WLAN Antenna 3	LV19	005941	09/12/2019
2617/15	BT/WLAN Antenna 4	LV19	004666	09/12/2019
2617/06	Car Radio Display	NTG7	17148	09/12/2019
2617/05	Car Radio Display	NTG7	17159	09/12/2019
2617/23	Raspberry Board	3544931	--	09/12/2019

Test sample description

Ports..... :	Port name and description	Cable				
		Specified length [m]	Attached during test	Shielded		
	<i>Car Connector A</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>Car Connector B</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>Display Connector CID/PIP / RVC</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	<i>USB Connector</i>	<3m ^(x2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	<i>Eth Connector</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>BT/WLAN-Antenna</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	<i>FM/AM, TV/SDARS Ant</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	<i>GNSS Antenna</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
Supplementary information to the ports..... :	<i>Not provided data</i>					
Rated power supply	Voltage and Frequency	Reference poles				
		L1	L2	L3	N	PE
	<input type="checkbox"/> AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> DC: 12V Car battery / attenuator (9,5-15,5V normal operation)					
<input type="checkbox"/> DC:						
Rated Power	9,5-15,5V normal operation					
Clock frequencies	see schematics					
Other parameters..... :	See Technical Description					
Software version	<i>E13.300 (RF-Samples)</i> <i>E14.088 (EMC Samples)</i> <i>E17 – Serial Production.</i>					
Hardware version..... :	<i>D4</i>					
Dimensions in cm (L x W x D) :	182 x 78 x 160 mm					

Mounting position.....:	<input type="checkbox"/>	Table top equipment	
	<input type="checkbox"/>	Wall/Ceiling mounted equipment	
	<input type="checkbox"/>	Floor standing equipment	
	<input type="checkbox"/>	Hand-held equipment	
	<input checked="" type="checkbox"/>	Other: automotive headunit	
Modules/parts	Module/parts of test item	Type	Manufacturer
Accessories (not part of the test item)	Description	Type	Manufacturer
	Display	-	LG.
	HARMANeco RasPi	-	HBAS
	Cable harness	-	HBAS
	BT/WLAN-Antenna	-	Hirschmann
Documents as provided by the applicant.....:	Description	File name	Issue date
	Technical Description		

Copy of marking plate:



Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GOERING-STR. 16;76307 KARLSBAD GERMANY

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	2019-09-13
Date (finish)	2019-10-02

Document history

Report number	Date	Description
2617ERM.005	2019-10-18	First release
2617ERM.005A1	2019-11-06	Second release

Modifications to the reference test report

It was introduced the following modification in respect to the test report number 2617ERM.005 related with the same samples:

Clauses/ Sub-Clauses	Modification	Justification
Part 15 Subpart C §15.247(b) and RSS-247 5.4(d)	Antenna Gain Value modified	Client Request

This modification test report cancels and replaces the test report 2617ERM.005A1.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

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

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

Temperature	Min. = 15 °C Max. = 35 °C
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 °C Max. = 35 °C
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: Divya Adusumilli, BhagyaShree Chaudhary, Poojita Bhattu and Koji Nishimoto.

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247 (Bluetooth EDR)					
Section	15.247 Spec Clause	RSS Spec Clause	Test Description	Verdict	Remark
B.1	§ 2.1049 & § 15.247 (a) (1)	RSS-247 5.1 (b)	20dB Emission Bandwidth, Occupied Bandwidth & Carrier Frequency Separation	P	N/A
B.2	§ 15.247 (a) (1) (iii)	RSS-247 5.1 (d)	Number of hopping channels	P	N/A
B.3	§ 15.247 (a) (1) (iii)	RSS-247 5.1 (d)	Time of Occupancy (Dwell Time)	P	N/A
B.4	§ 15.247 (b) (3)	RSS-247 5.4 (b)	Maximum peak conducted output power and antenna gain	P	N/A
B.5	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	P	N/A
B.6	§ 15.247 (d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	P	N/A
B.7	§ 15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A
<u>Supplementary information and remarks:</u> N/A					

FCC PART 15 PARAGRAPH (WIFI 2.4GHz)					
Section	15.247 Spec Clause	RSS Spec Clause	Test Description	Verdict	Remark
C.1	§ 2.1049 & §15.247 (a) (2)	RSS-247 5.2 (a)	99% Occupied Bandwidth & 6dB Bandwidth	P	N/A
C.2	§ 15.247 (b)	RSS-247 5.4 (d)	Maximum Output Power and antenna gain	P	N/A
C.3	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	P	N/A
C.4	§ 15.247 (e)	RSS-247 5.2 (b)	Power Spectral Density	P	N/A
C.5	§15.247(d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	P	N/A
C.6	§15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A
<u>Supplementary information and remarks:</u> N/A.					

List of equipment used during the test

Conducted Measurements

Test system Rohde & Schwarz TS 8997:

CONTROL NUMBER	DESCRIPTION	LAST CALIBRATION	NEXT CALIBRATION
1039	Signal analyzer Rohde & Schwarz FSV40	2018/10	2020/10
1009	RF generator Rohde & Schwarz SMB100A	2019/08	2021/08
1042	RF generator Rohde & Schwarz SMBV100A	2018/01	2021/01
101	Climatic chamber Espec	2019/01	2020/01

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	LAST CALIBRATION	NEXT CALIBRATION
1179	Semi anechoic Absorber Lined Chamber Frankonia SAC 3 plus "L"	N/A	N/A
1064	BiconicalLog antenna ETS LINDGREN 3142E	2017/03	2020/03
1057	Double-ridge Waveguide Horn antenna 1-18 GHz	2017/03	2020/03
1056	Double-ridge Waveguide Horn antenna 18-40 GHz	2017/03	2020/03
1014	Spectrum analyzer Rohde & Schwarz FSV40	2019/04	2021/04
0980	RF pre-amplifier 30 MHz-6 GHz Bonn Elektronik BLMA 0360-01N	2019/08	2021/05
0981	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-2A	2018/10	2021/05
1015, 1017, 1019, 1020	Rohde & Schwarz EMC32 software	N/A	N/A

Appendix A:

Test results (Bluetooth EDR)

Appendix A Content

PRODUCT INFORMATION	14
DESCRIPTION OF TEST CONDITIONS	14
TEST A.1: 20DB EMISSION BANDWIDTH, OCCUPIED BANDWIDTH AND CARRIER FREQUENCY SEPARATION	15
TEST A.2: NUMBER OF HOPPING CHANNELS.....	32
TEST A.3: TIME OF OCCUPANCY (DWELL TIME)	36
TEST A.4: MAXIMUM PEAK CONDUCTED OUTPUT POWER AND ANTENNA GAIN.....	43
TEST A.5: BAND-EDGE EMISSIONS COMPLIANCE (TRANSMITTER).....	45
TEST A.6: EMISSION LIMITATIONS CONDUCTED (TRANSMITTER)	62
TEST A.7: EMISSION LIMITATIONS RADIATED (TRANSMITTER).....	69

PRODUCT INFORMATION

The following information is provided by the client

Information	Description
Modulation	FHSS
Adaptive	Non-adaptive equipment
Operation mode 1: Single Antenna Equipment	Equipment with only one antenna
Operating Frequency Range	2400 – 2483.5 MHz
Nominal Channel Bandwidth	20 MHz
RF Output Power	<10 dBm
Extreme operating conditions	
- Temperature range	-20 °C to +55 °C
Antenna type	Dedicated Antenna
Antenna gain	+3.0 dBi
Nominal Voltage	
- Supply Voltage	13.5 Vdc
- Type of power source	DC voltage
Equipment type	Bluetooth EDR
Geo-location capability	No

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01	<p><u>Power supply (V):</u> $V_{\text{nominal}} = 13.5 \text{ Vdc}$</p> <p><u>Modulation:</u> GFSK</p> <p><u>Test Frequencies for conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz</p>
TC#02	<p><u>Power supply (V):</u> $V_{\text{nominal}} = 13.5 \text{ Vdc}$</p> <p><u>Modulation:</u> PI/4-DQPSK</p> <p><u>Test Frequencies for Conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz</p>
TC#03	<p><u>Power supply (V):</u> $V_{\text{nominal}} = 13.5 \text{ Vdc}$</p> <p><u>Modulation:</u> 8-DPSK</p> <p><u>Test Frequencies for Conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz</p>

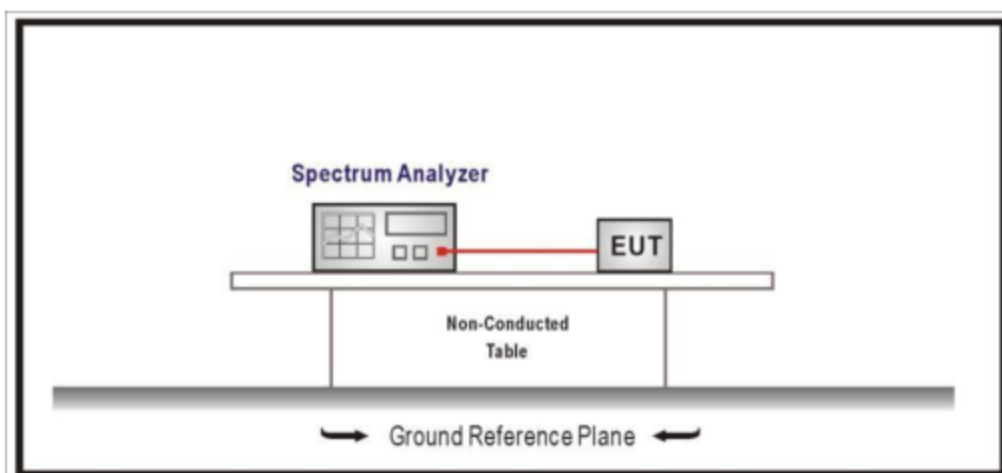
TEST A.1: 20DB EMISSION BANDWIDTH, OCCUPIED BANDWIDTH AND CARRIER FREQUENCY SEPARATION

LIMITS:	Product standard:	§ 2.1049, Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(a) (1) and RSS-247 5.1 (b)

LIMITS

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST SETUP:



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

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20dB Bandwidth (KHz)	930	930	930
Occupied bandwidth (kHz)	875	870	875
Measurement uncertainty (kHz)	<± 1.80		

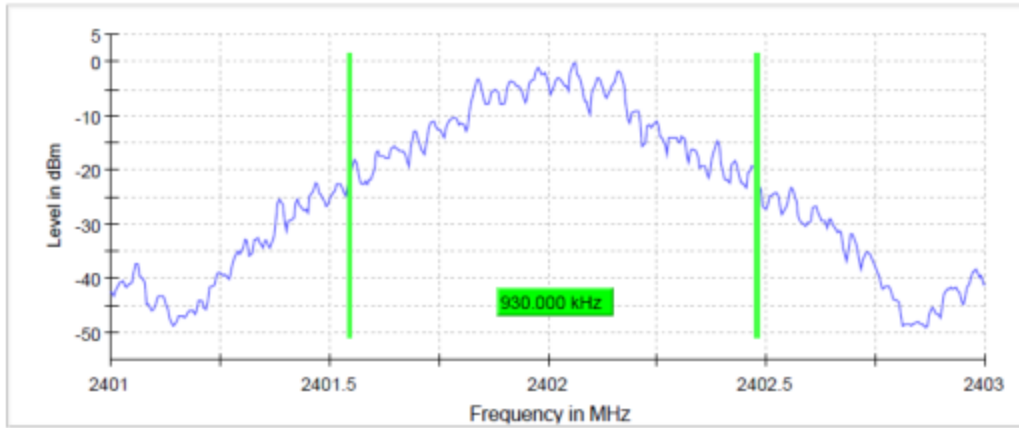
Measurement Set up

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz	2.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 µs	189.648 µs	189.648 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	200	200	200
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	12 / max. 150	7 / max.	9 / max. 150
Stable	5 / 5	5 / 5	5 / 5
Max Stable Difference	0.09 dB	0.38 dB	0.06 dB

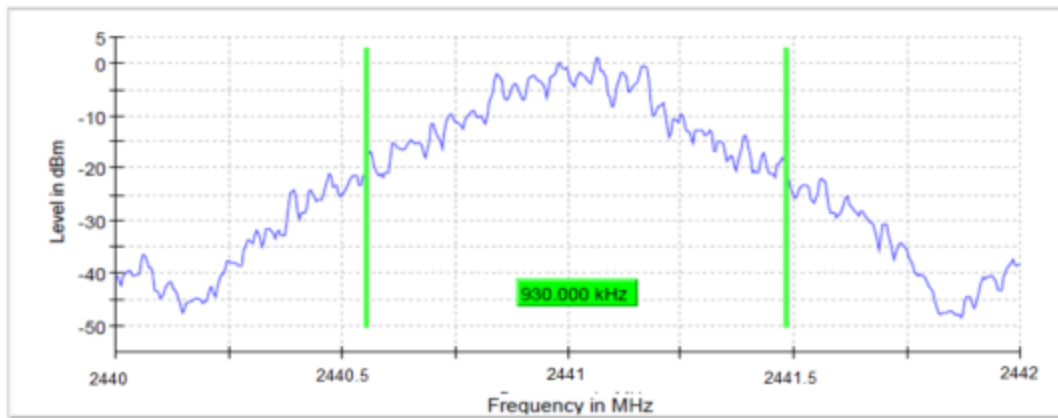
TEST RESULTS (Cont.):

20 dB BANDWIDTH

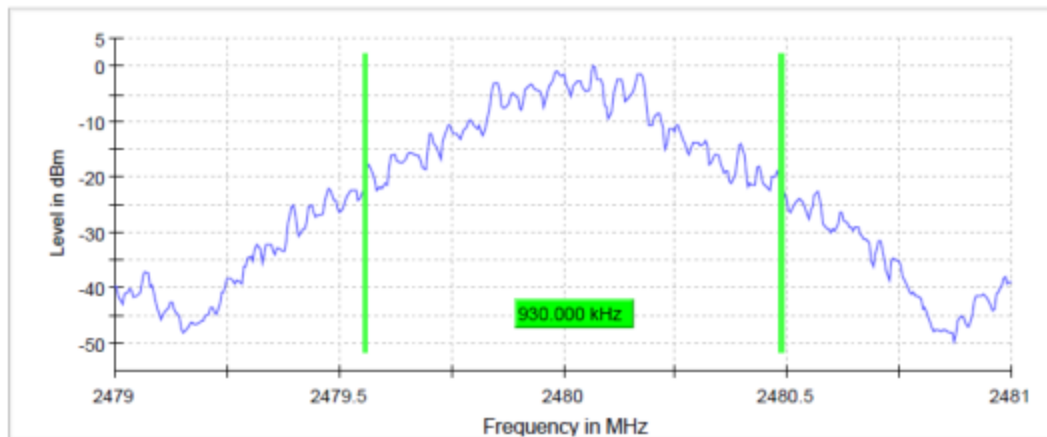
Lowest Channel



Middle Channel



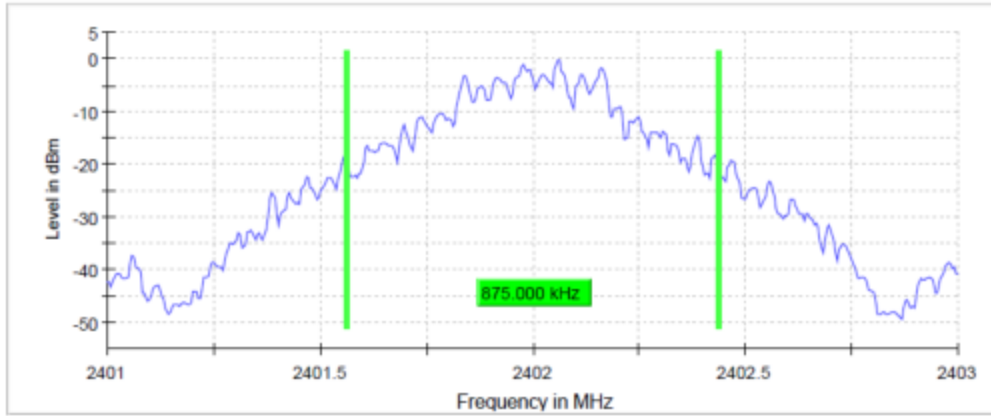
Highest Channel



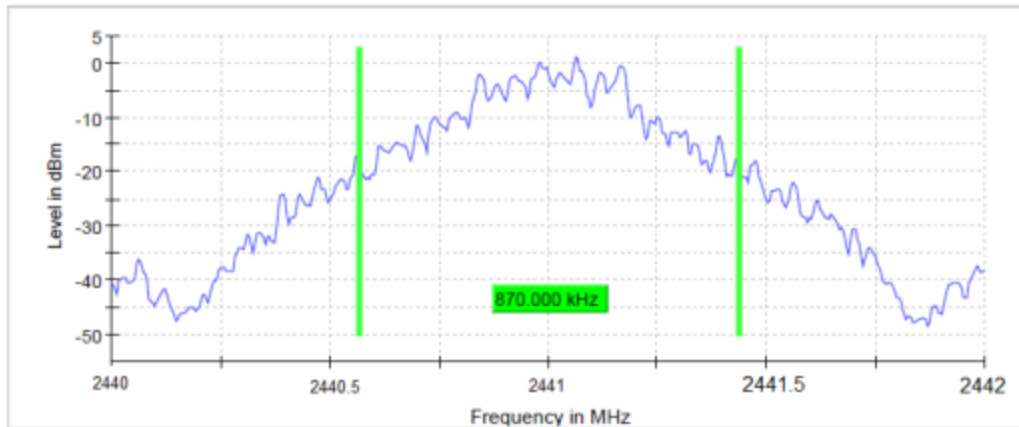
TEST RESULTS (Cont.):

OCCUPIED BANDWIDTH

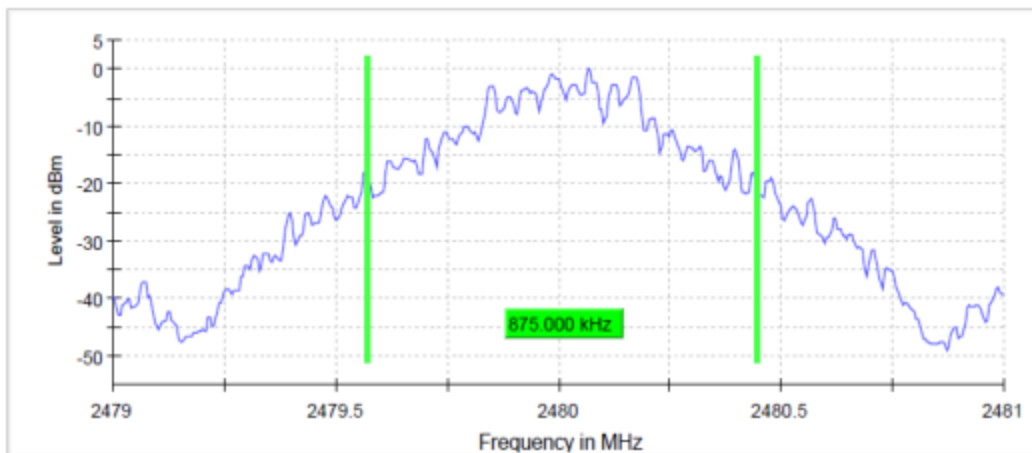
Lowest Channel



Middle Channel



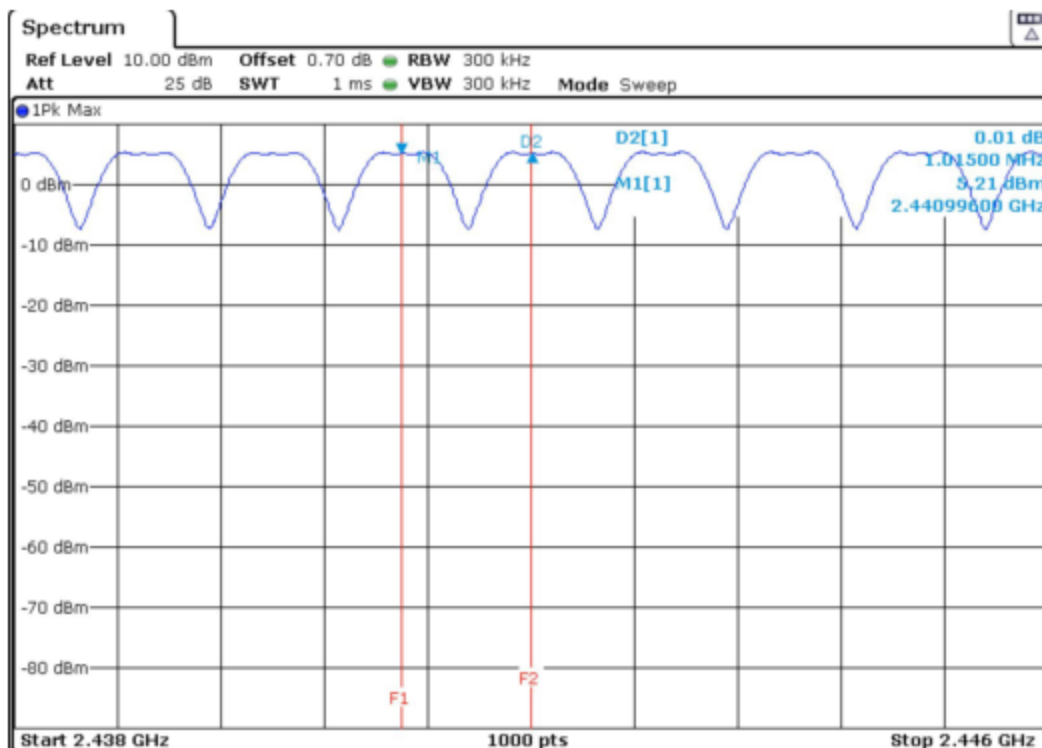
Highest Channel



TEST RESULTS (Cont.):	OCCUPIED BANDWIDTH		
Measurement Set- up			
Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz	2.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 μ s	189.648 μ s	189.648 μ s
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	500	500	500
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	7 / max. 150	4 / max.	6 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.07 dB	0.25 dB	0.11 dB

TEST RESULTS (Cont.)

CARRIER FREQUENCY SEPARATION



The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20dB bandwidth of the hopping channel.

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

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20dB bandwidth (MHz)	1.340	1.345	1.345
Occupied bandwidth (MHz)	1.21	1.215	1.215
Measurement uncertainty (kHz)	<± 1.80		

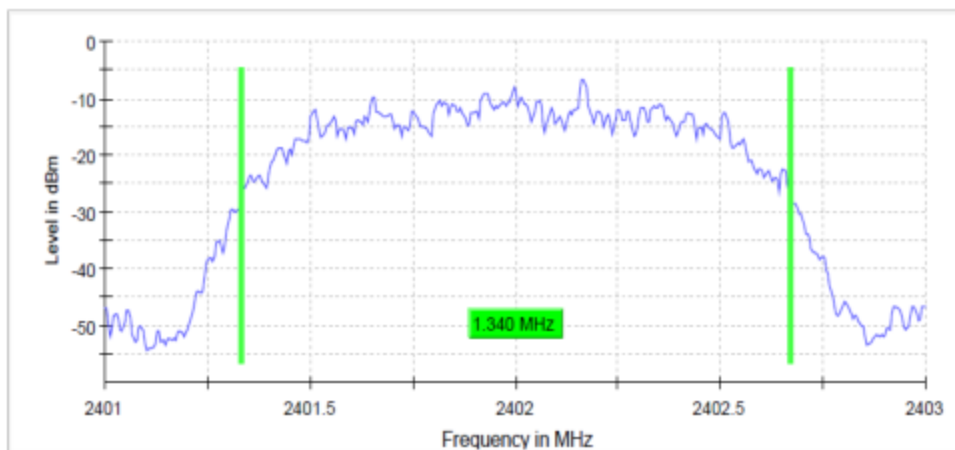
Measurement Setup

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.00 MHz	2.00 MHz	2.00 MHz
RBW	10.000 KHz	10.000 KHz	10.000 KHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 µs	189.648 µs	189.648 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	200	200	200
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	11 / max. 150	9 / max. 150	12 / max. 150
Stable	5 / 5	5 / 5	5 / 5
Max Stable Difference	0.27 dB	0.24 dB	0.07 dB

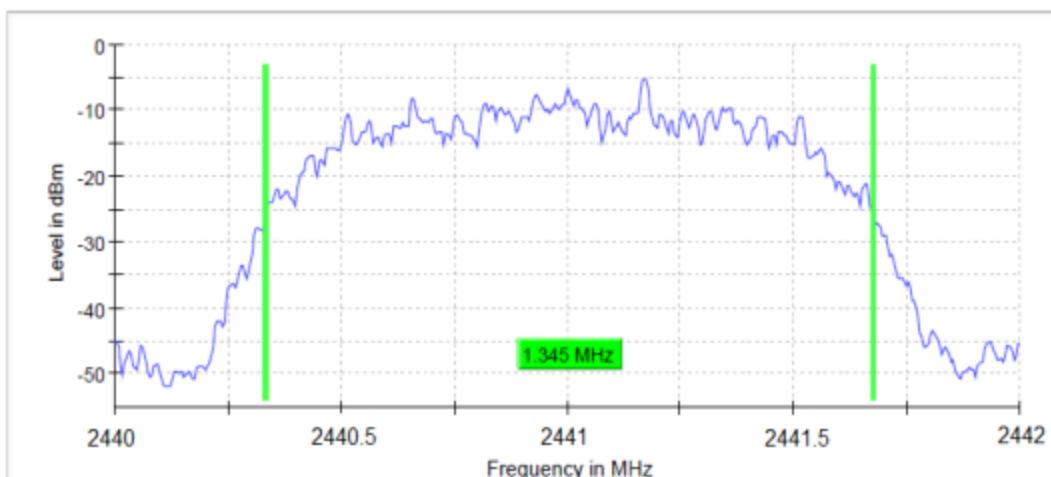
TEST RESULTS (Cont.):

20 dB BANDWIDTH

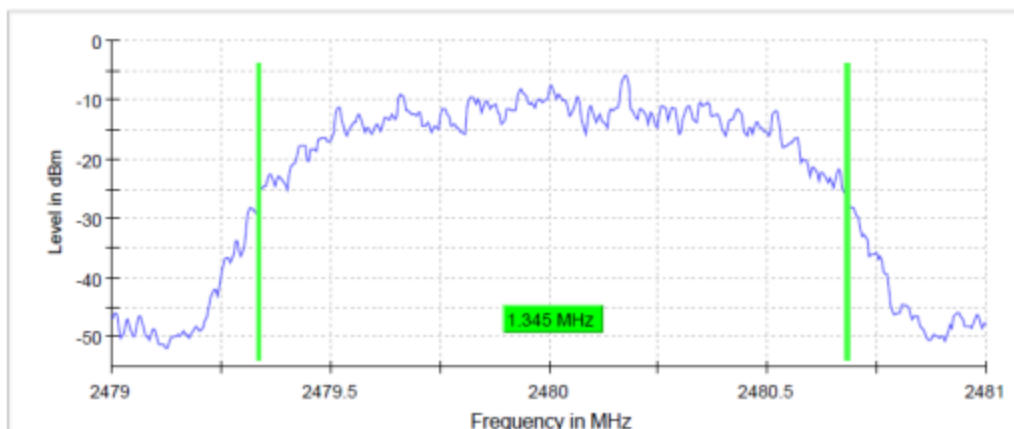
Lowest Channel



Middle Channel



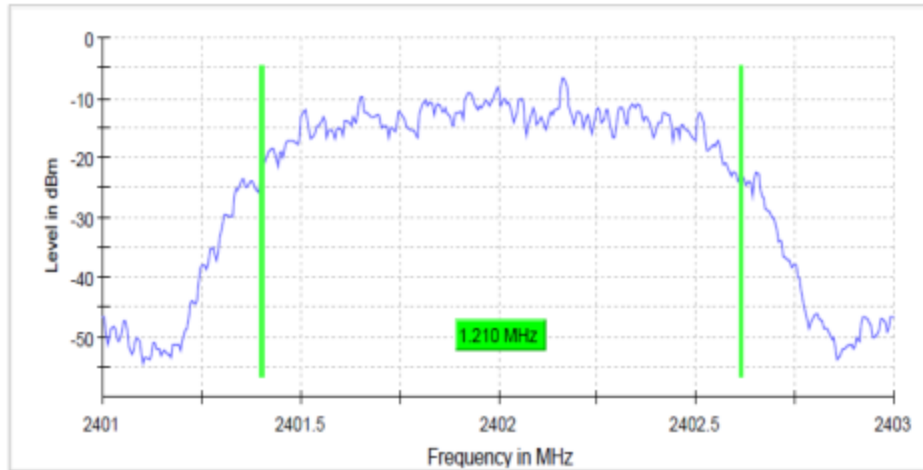
Highest Channel



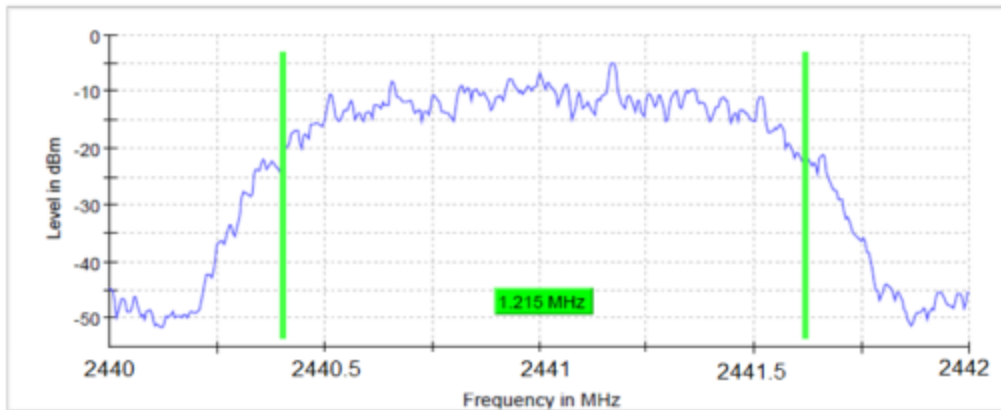
TEST RESULTS (Cont.):

OCCUPIED BANDWIDTH

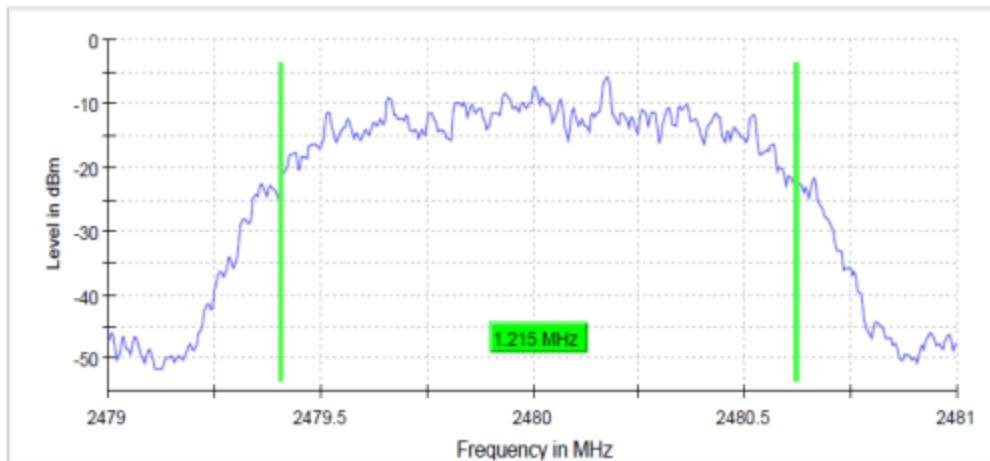
Lowest Channel



Middle Channel



Highest Channel



TEST RESULTS (Cont.):

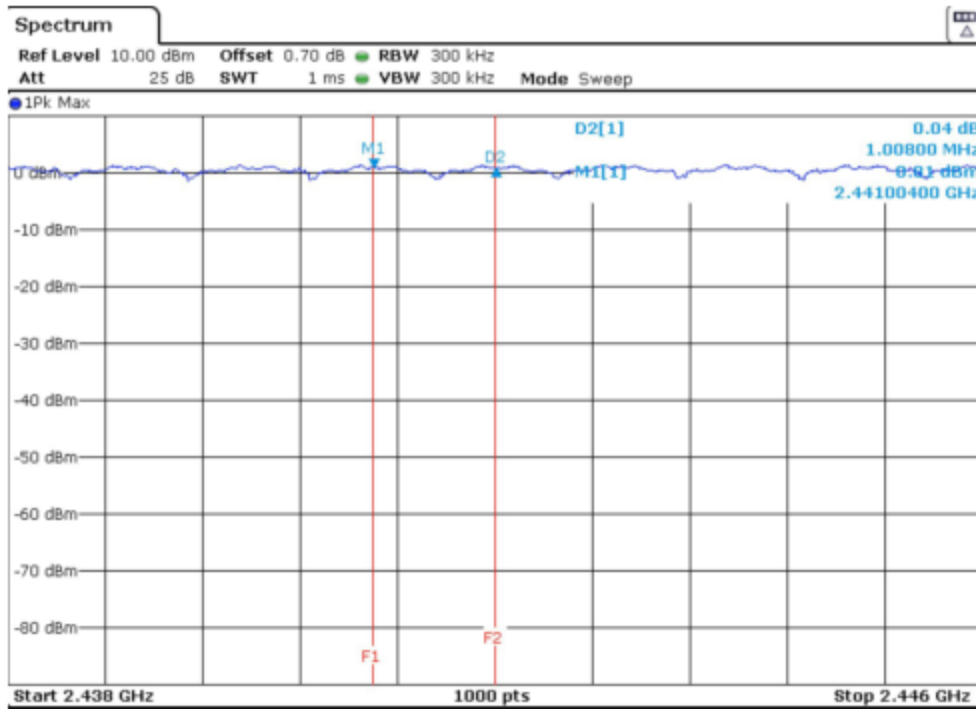
OCCUPIED BANDWIDTH

Measurement Set- up

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz	2.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 μ s	189.648 μ s	189.648 μ s
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	500	500	500
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	6 / max. 150	5 / max. 150	10 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.30 dB	0.14 dB	0.18 dB

TEST RESULTS (Cont.)

CARRIER FREQUENCY SEPARATION



The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20 dB bandwidth of the hopping channel.

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03
TEST RESULTS:	PASS

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
20dB bandwidth (MHz)	1.345	1.345	1.345
Occupied bandwidth (MHz)	1.215	1.215	1.215
Measurement uncertainty (kHz)	<± 1.80		

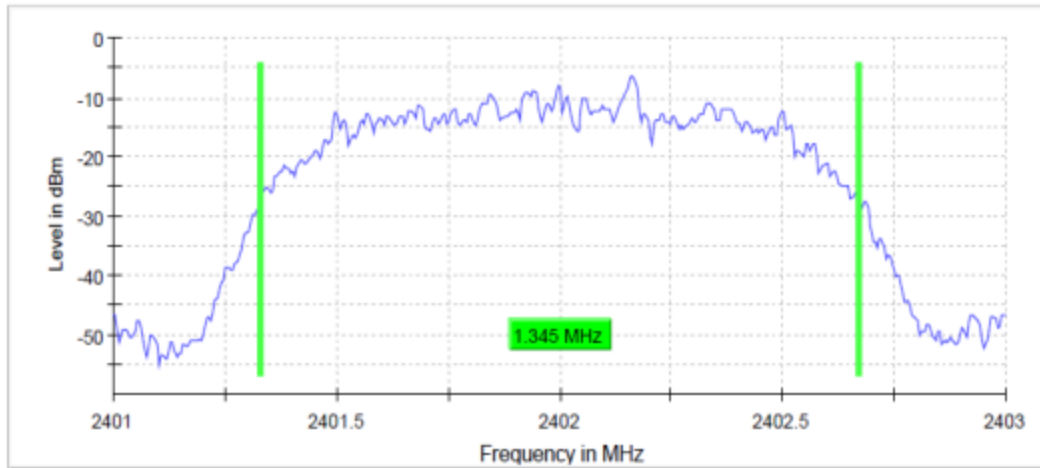
Measurement Setup

Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.00 MHz	2.00 MHz	2.00 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 µs	189.648 µs	189.648 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	200	200	200
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	9 / max. 150	9 / max. 150	7 / max. 150
Stable	5 / 5	3 / 3	5 / 5
Max Stable Difference	0.12 dB	0.14 dB	0.15 dB

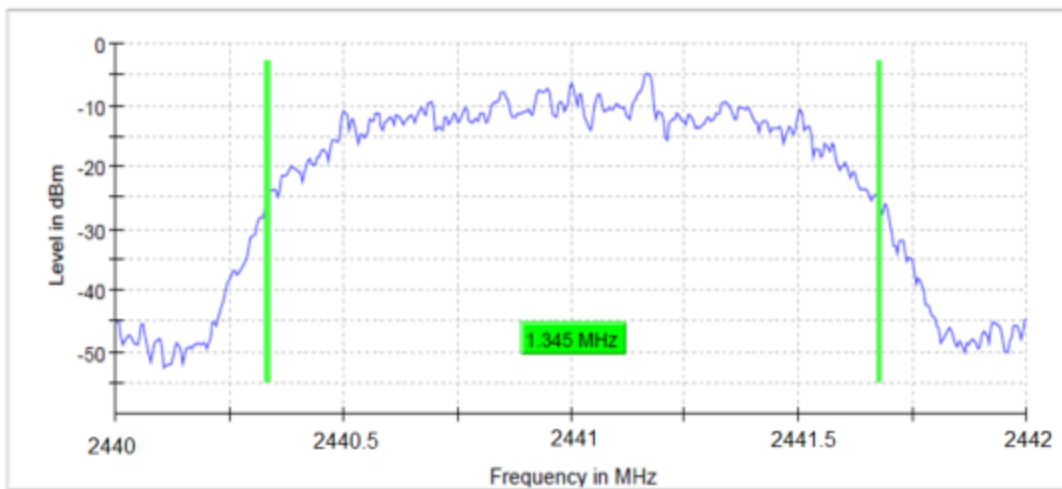
TEST RESULTS (Cont.):

20 dB BANDWIDTH

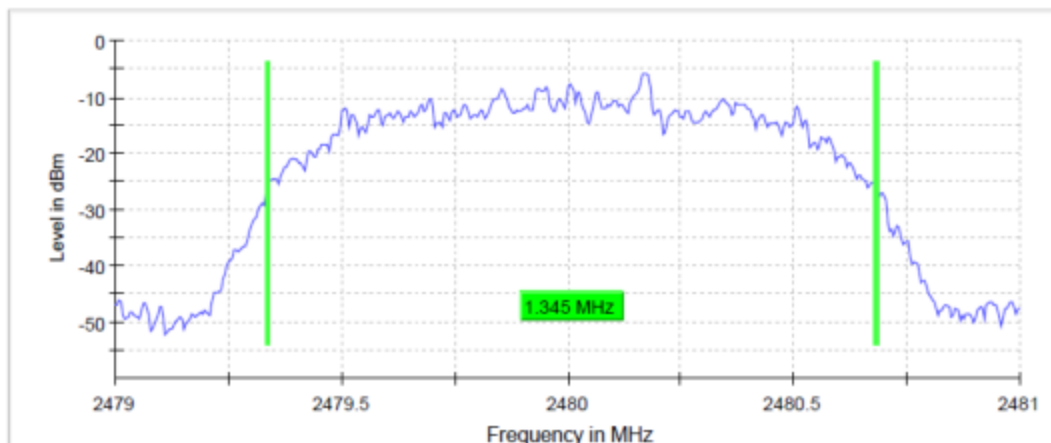
Lowest Channel



Middle Channel



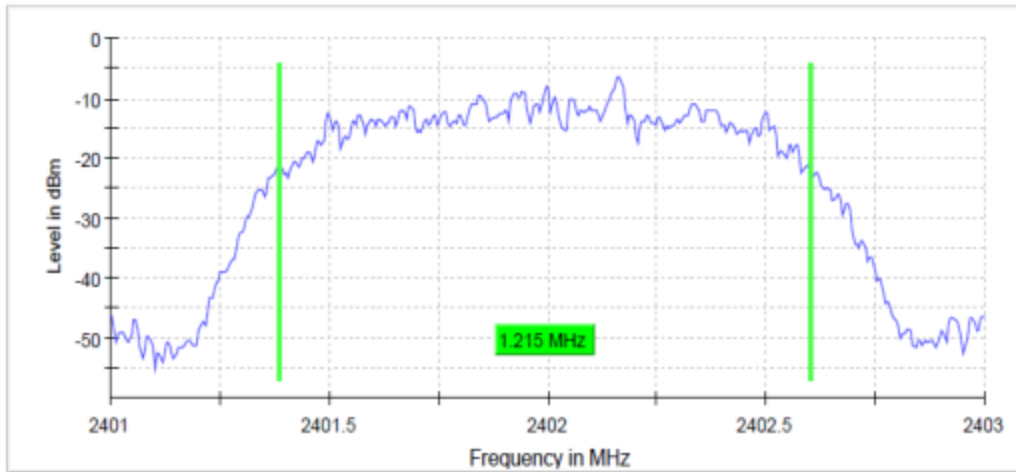
Highest Channel



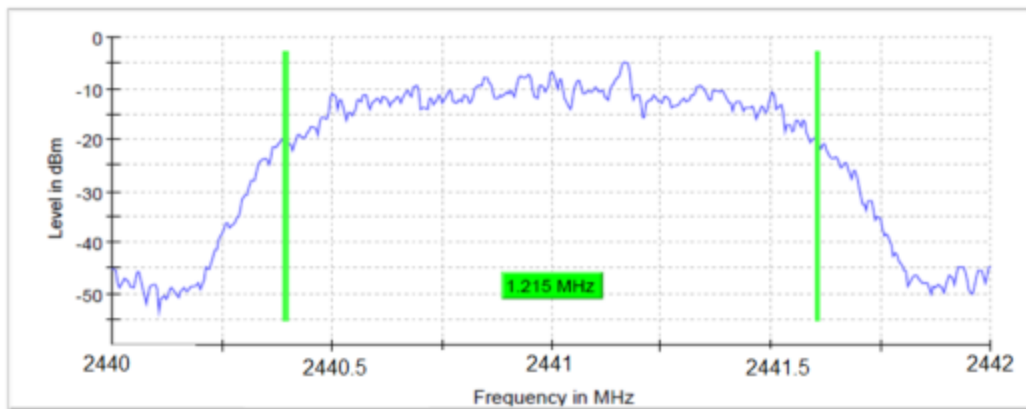
TEST RESULTS (Cont.)

OCCUPIED BANDWIDTH

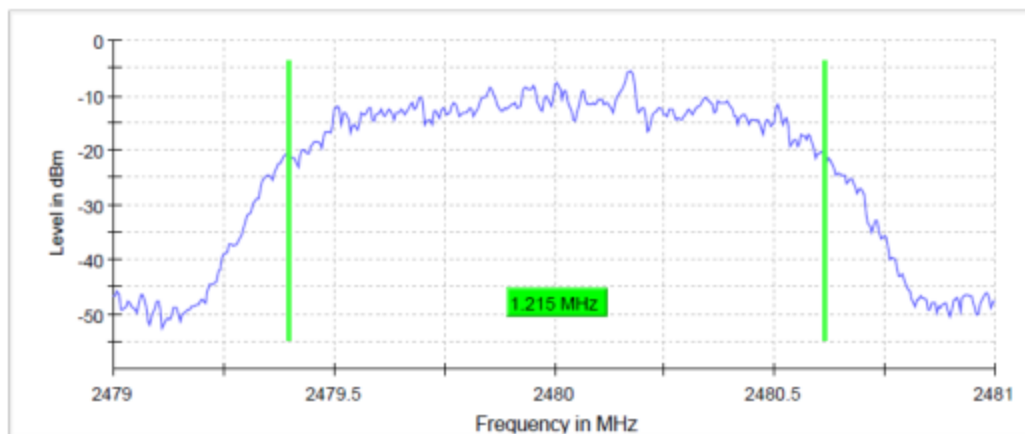
Lowest Channel



Middle Channel



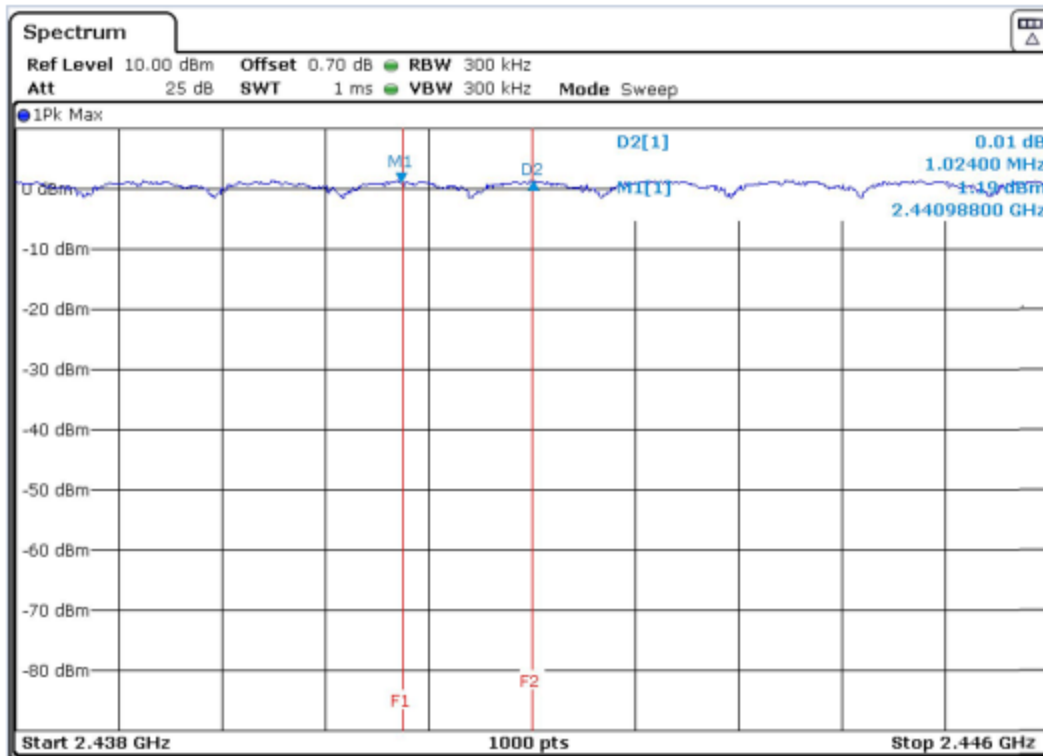
Highest Channel



TEST RESULTS (Cont.):	OCCUPIED BANDWIDTH		
Measurement Set- up			
Setting	Instrument Value	Instrument Value	Instrument Value
Start Frequency	2.40100 GHz	2.43900 GHz	2.47900 GHz
Stop Frequency	2.40300 GHz	2.44100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz	2.000 MHz
RBW	10.000 kHz	10.000 kHz	10.000 kHz
VBW	30.000 kHz	30.000 kHz	30.000 kHz
Sweep Points	400	400	400
Sweep time	189.648 μ s	189.648 μ s	189.648 μ s
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	500	500	500
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	5 / max. 150	6 / max. 150	5 / max. 150
Stable	3 / 3	3 / 3	3 / 3
Max Stable Difference	0.26 dB	0.17 dB	0.21 dB

TEST RESULTS (Cont.)

CARRIER FREQUENCY SEPARATION



The hopping channel carrier frequencies are separated by a minimum of the two-thirds of the 20 dB bandwidth of the hopping channel.

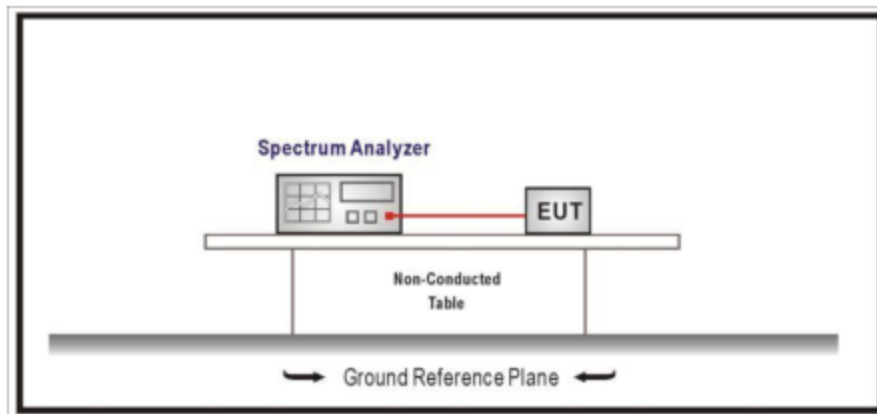
TEST A.2: NUMBER OF HOPPING CHANNELS

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(a) (1) (iii) and RSS-247 5.1 (d)

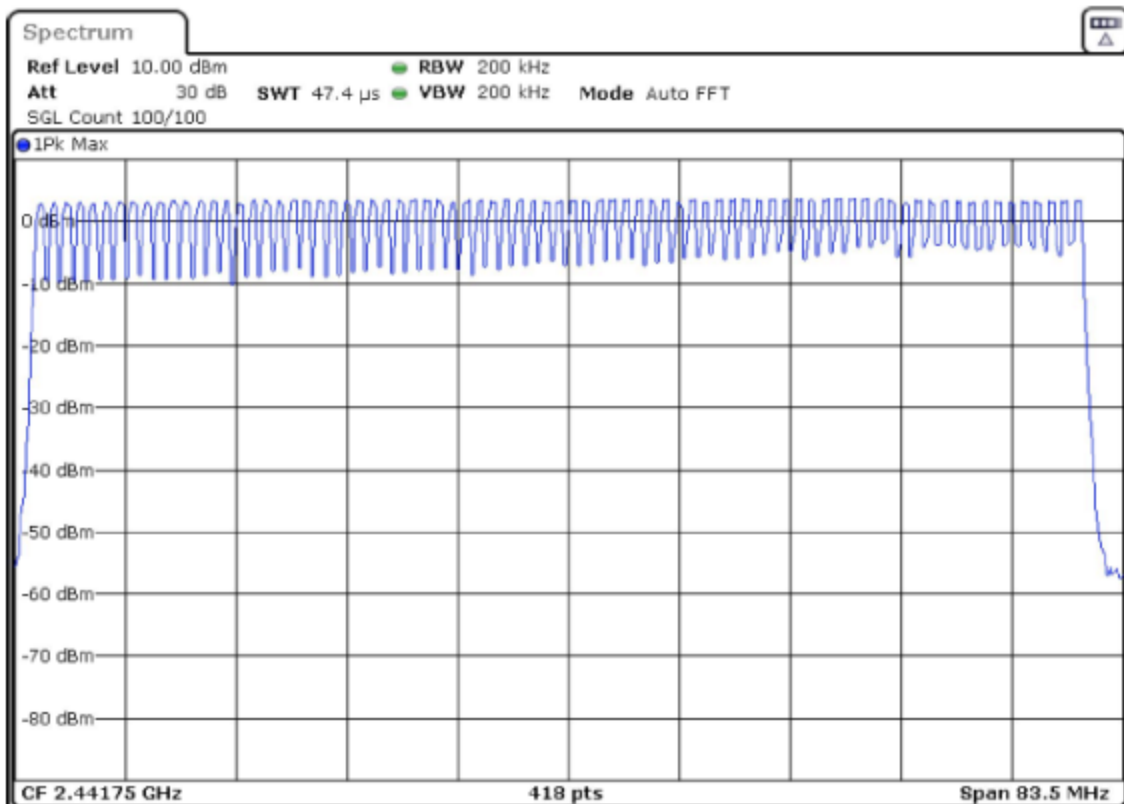
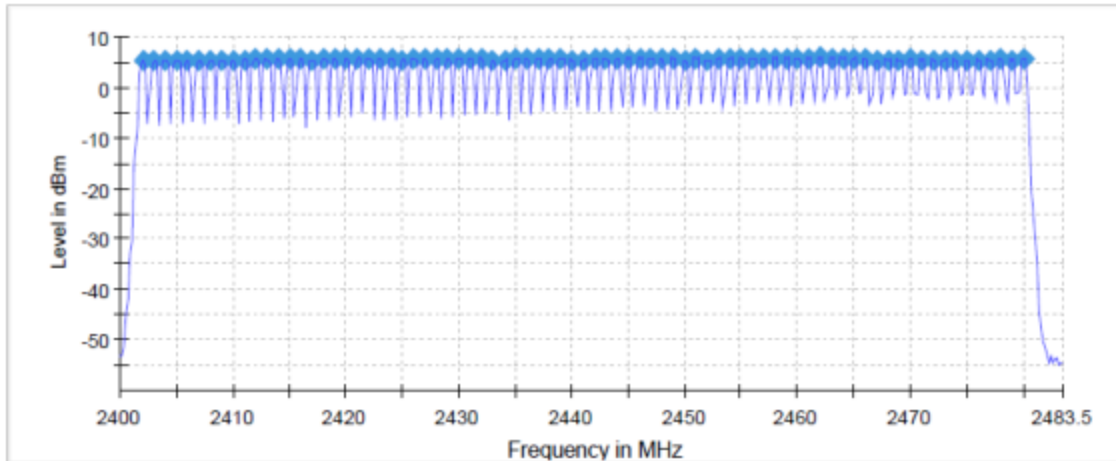
LIMITS

Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 channels.

TEST SETUP:

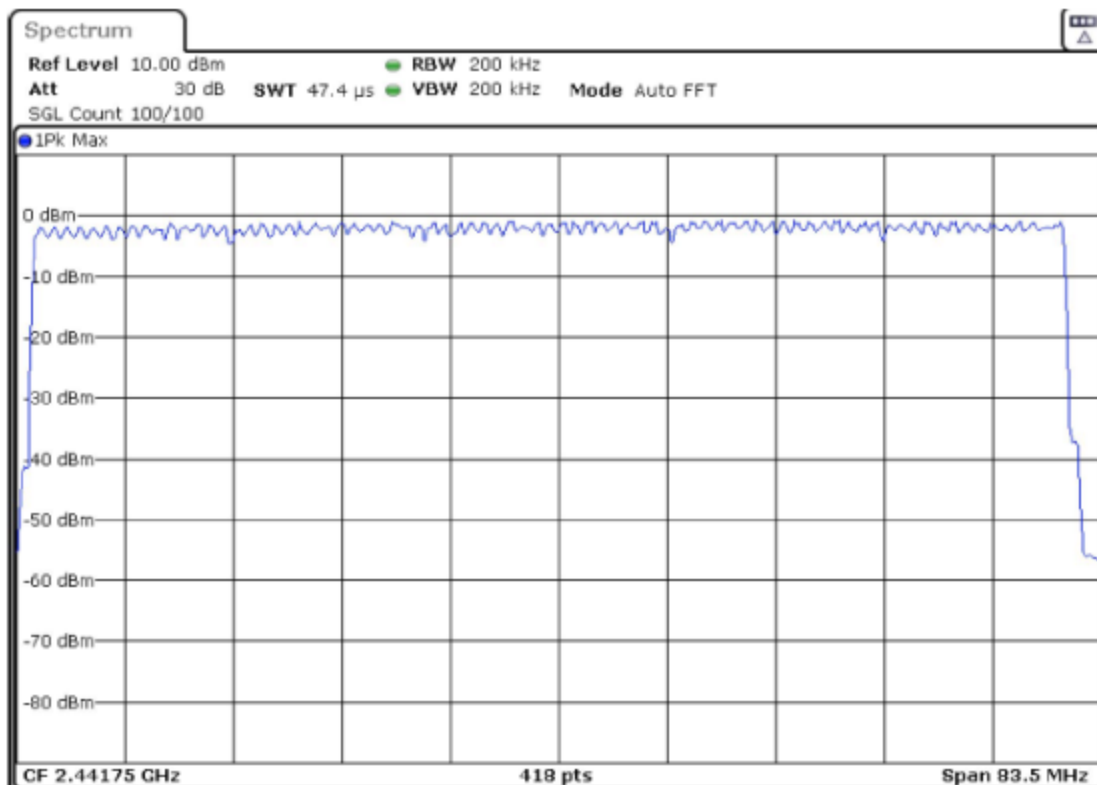
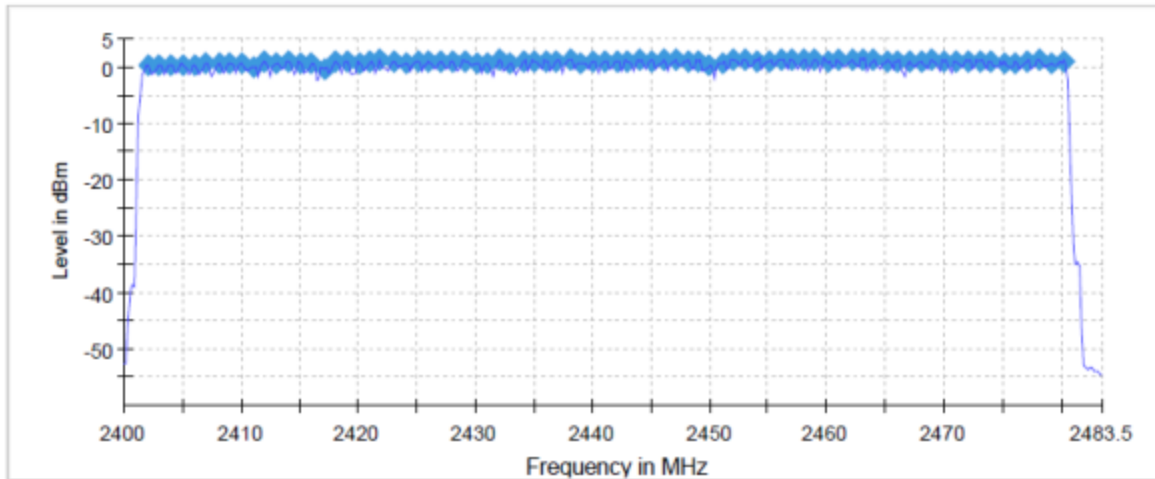


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS



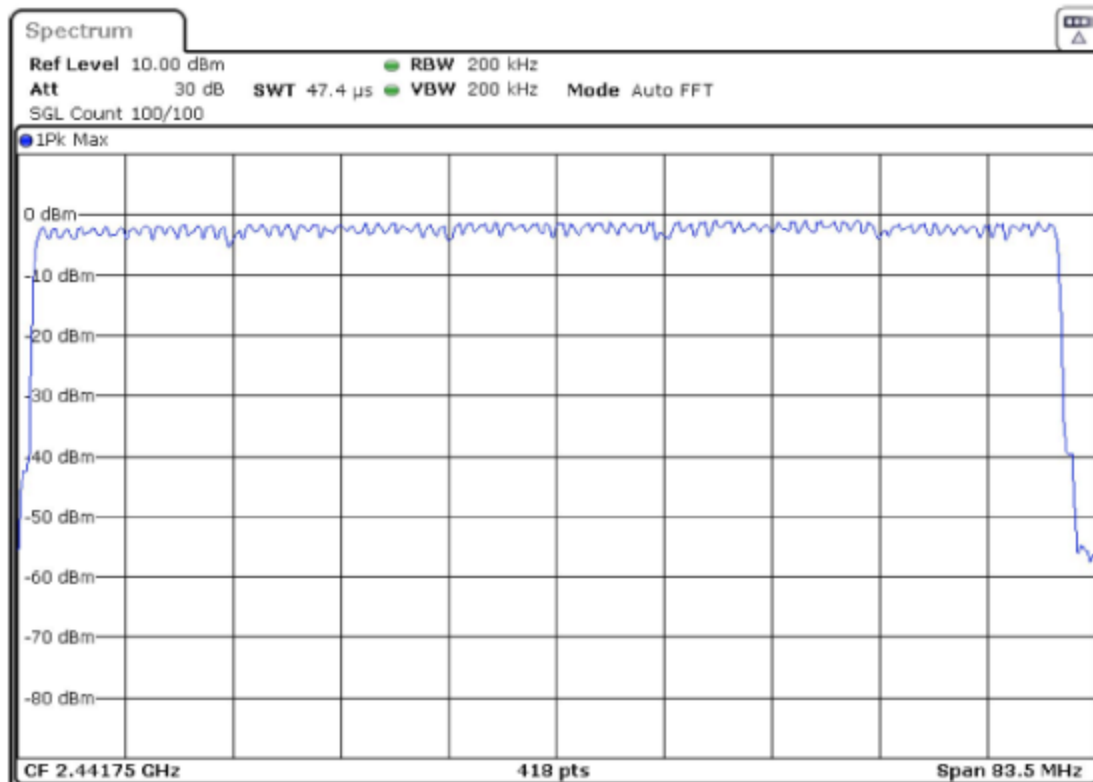
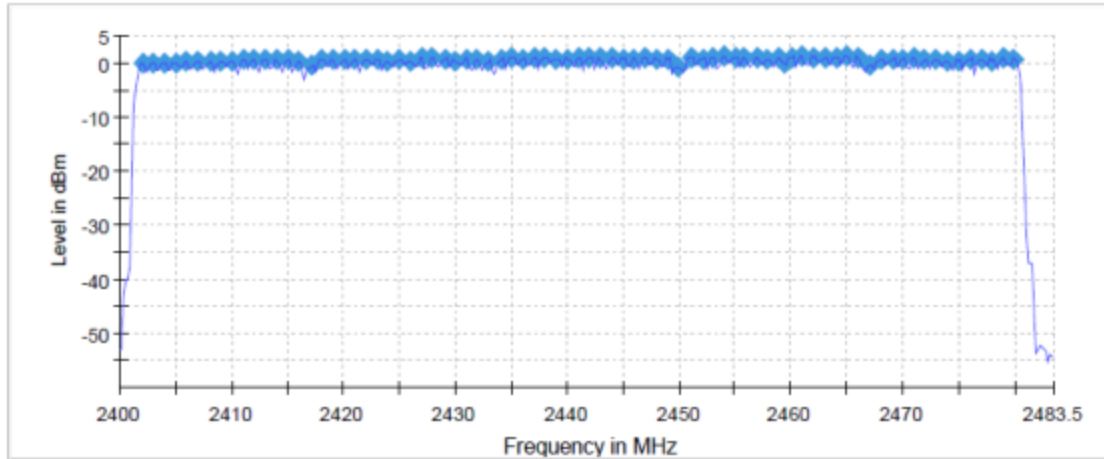
Number of Hopping Frequencies: 79

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



Number of Hopping Frequencies: 79

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03
TEST RESULTS:	PASS



Number of Hopping Frequencies: 79

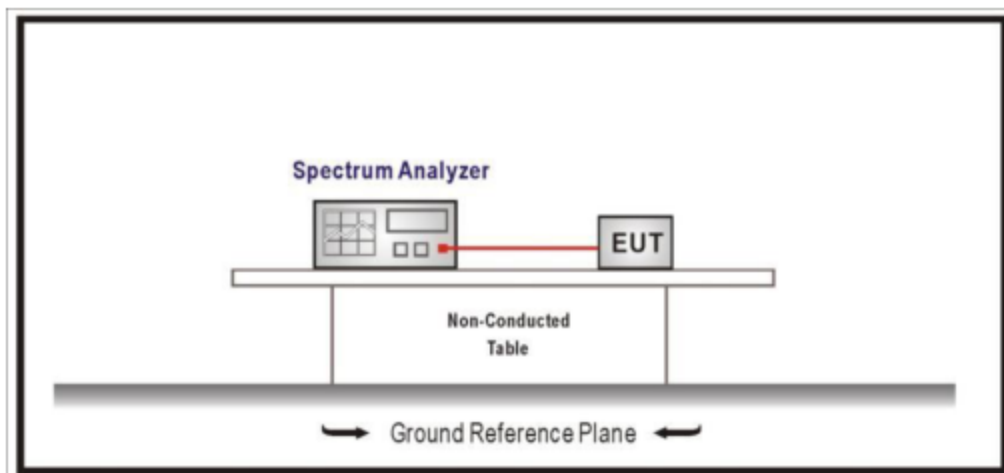
TEST A.3: TIME OF OCCUPANCY (DWELL TIME)

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(a)(1)(iii) and RSS-247 5.1(d)

LIMITS

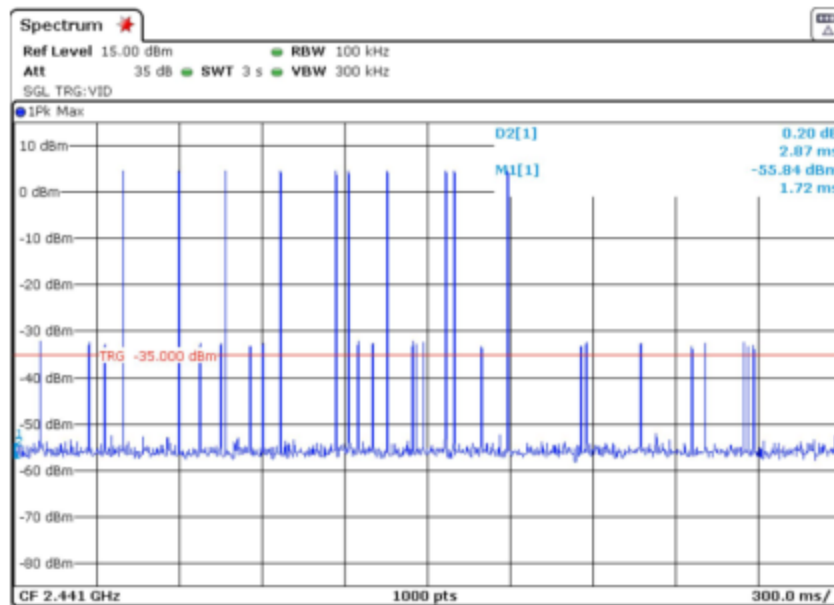
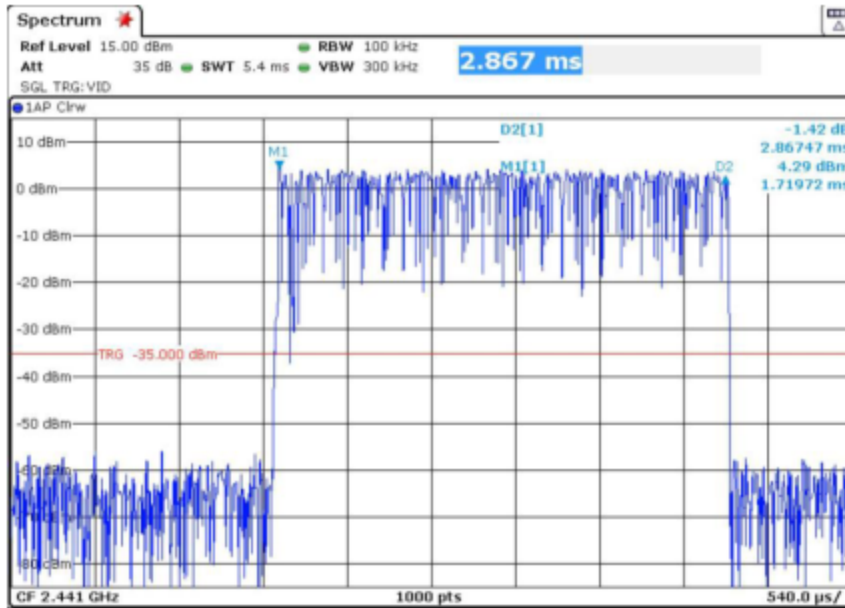
The average time of occupancy on any channel shall not be greater than 0.4 seconds (400 ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed = $0.4 \times 79 = 31.6$ seconds.

TEST SETUP:



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01 (GFSK)
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	PACKET TYPE DH5

Transmit Time per Hop: 2.867 ms



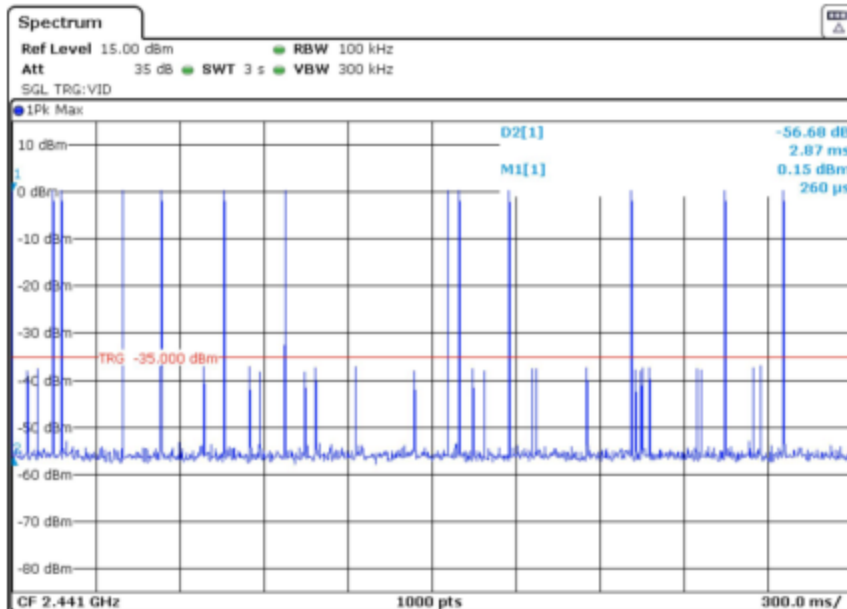
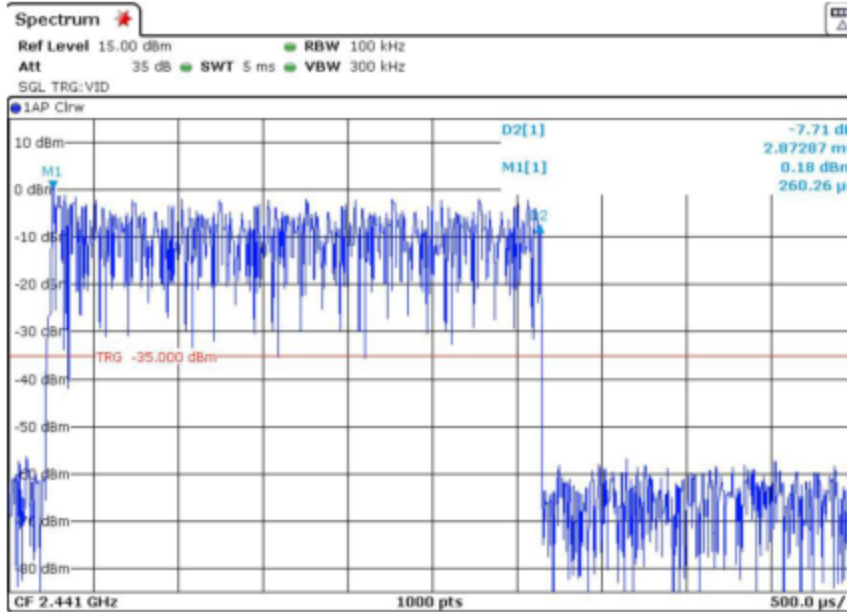
Number of hops over a period of 3 seconds: 10 hops.

Number of hops in the period specified in the requirements = (10 hops) x (31.6 s / 3 s) = 105.33 hops.
 Averaging time of occupancy = 2.867 ms x 105.33 hops = 301.98 ms per 31.6 seconds.

Measurement uncertainty (%)	<±0.12
-----------------------------	--------

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (PI4DQPSK)
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	PACKET TYPE 2DH5

Transmit Time per Hop: 2.873 ms



Number of hops over a period of 3 seconds: 12 hops.

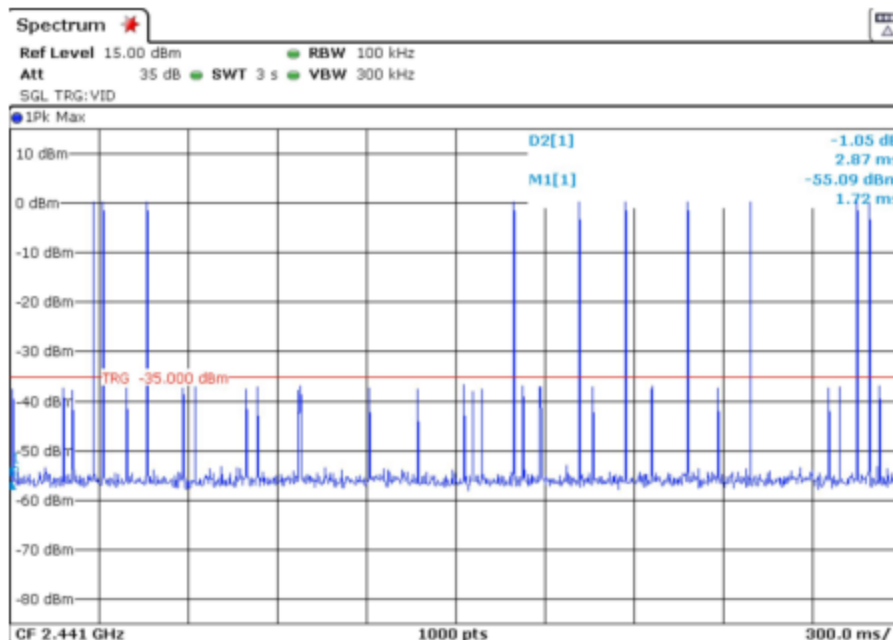
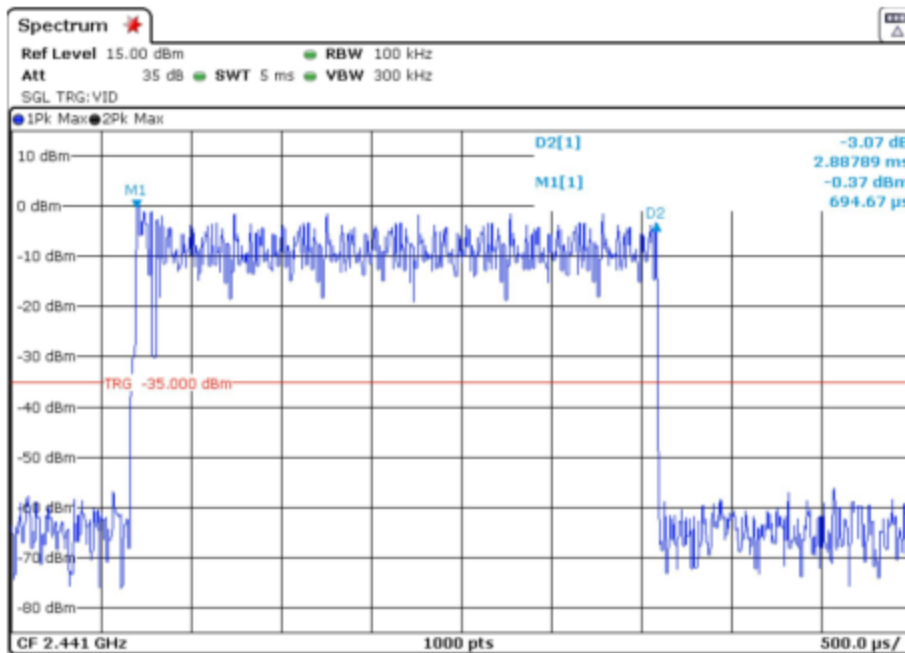
Number of hops in the period specified in the requirements = (12 hops) x (31.6 s / 3 s) = 126.4 hops.

Averaging time of occupancy = 2.873 ms x 126.4 hops = 363.15 ms per 31.6 seconds.

Measurement uncertainty (%)	<±0.12
-----------------------------	--------

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03 (8DPSK)
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	PACKET TYPE 3DH5

Transmit Time per Hop: 2.889 ms



Number of hops over a period of 3 seconds: 10 hops.

Number of hops in the period specified in the requirements = (10 hops) x (31.6 s / 3 s) = 105.33 hops.
 Averaging time of occupancy = 2.889 ms x 105.33 hops = 304.23 ms per 31.6 seconds.

Measurement uncertainty (%)	<±0.12
-----------------------------	--------

TEST A.4: 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(b)

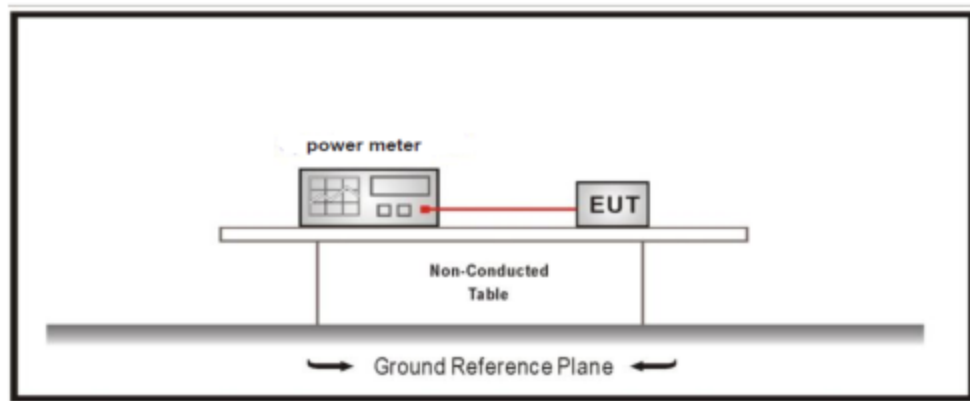
LIMITS

For Frequency Hopping systems operating in the 2400 – 2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm). (Part 15 Subpart C §15.247).

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

TEST SETUP

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
TEST RESULTS:	PASS

Maximum declared antenna gain: +3 dBi

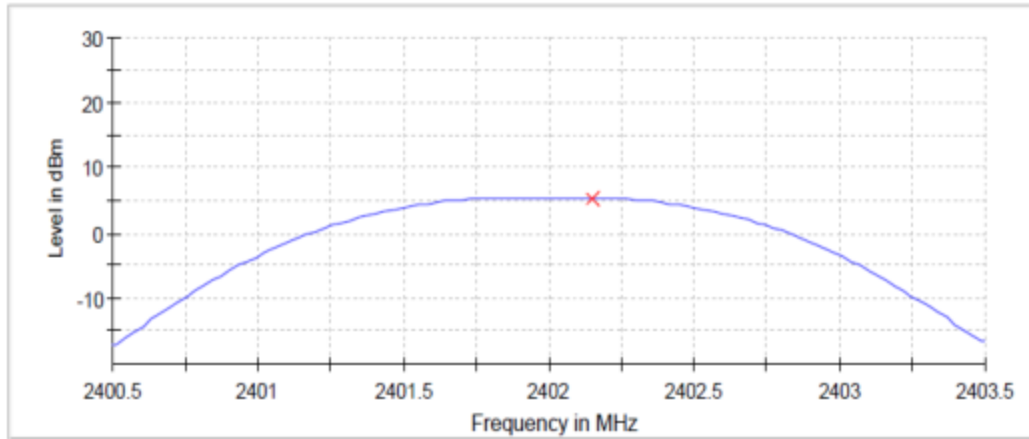
	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	5.4	6.5	5.8
Maximum EIRP power (dBm)	8.4	9.5	8.8
Measurement uncertainty (dB)	<±0.78		

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

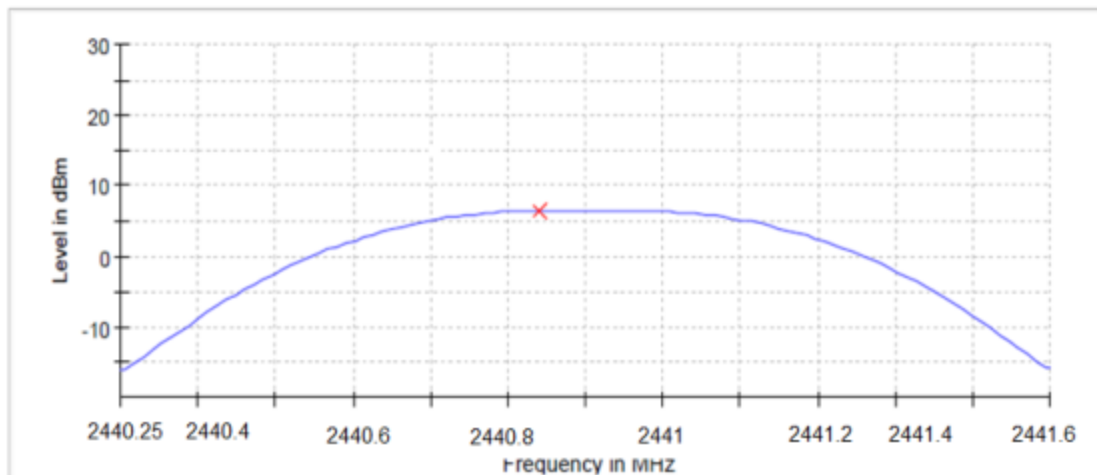
TEST RESULTS (Cont.):

CONDUCTED OUTPUT POWER

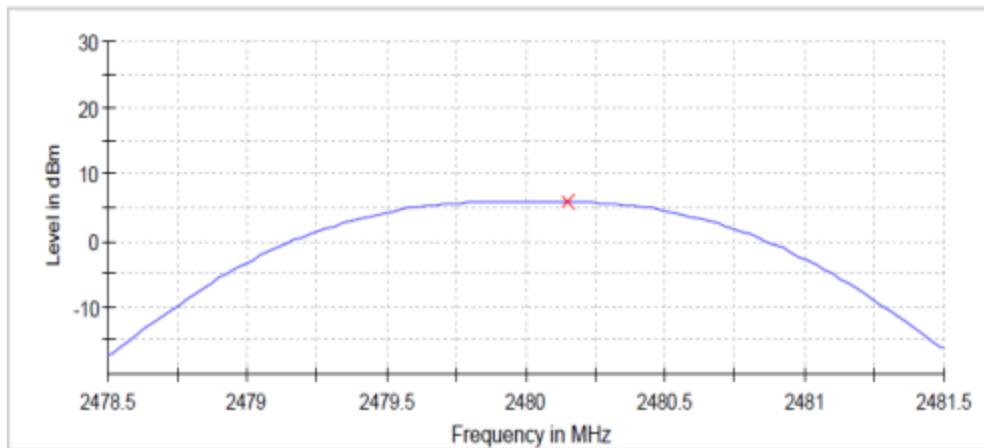
Lowest Channel



Middle Channel



Highest Channel



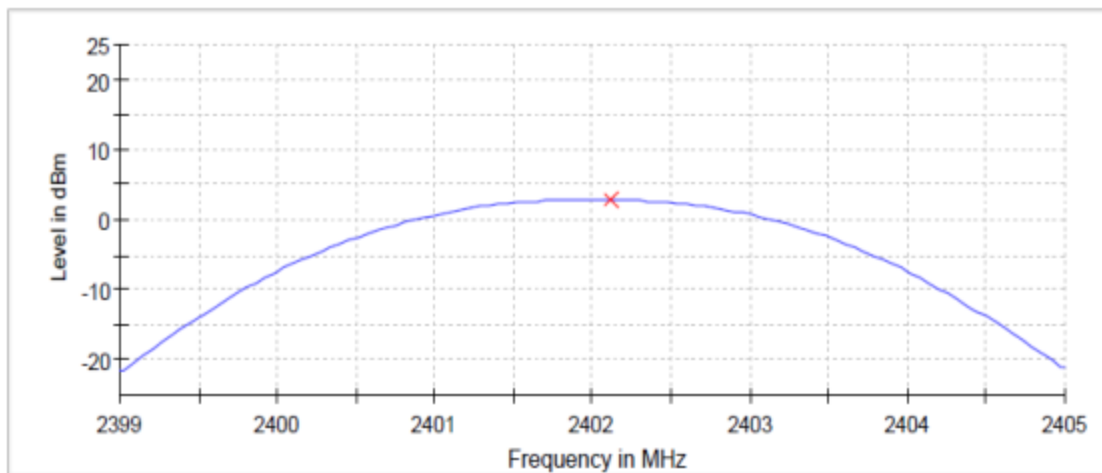
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02
TEST RESULTS:	PASS

Maximum declared antenna gain: +3 dBi

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	2.8	4.1	3.7
Maximum EIRP power (dBm)	5.8	7.1	6.7
Measurement uncertainty (dB)	<±0.78		

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

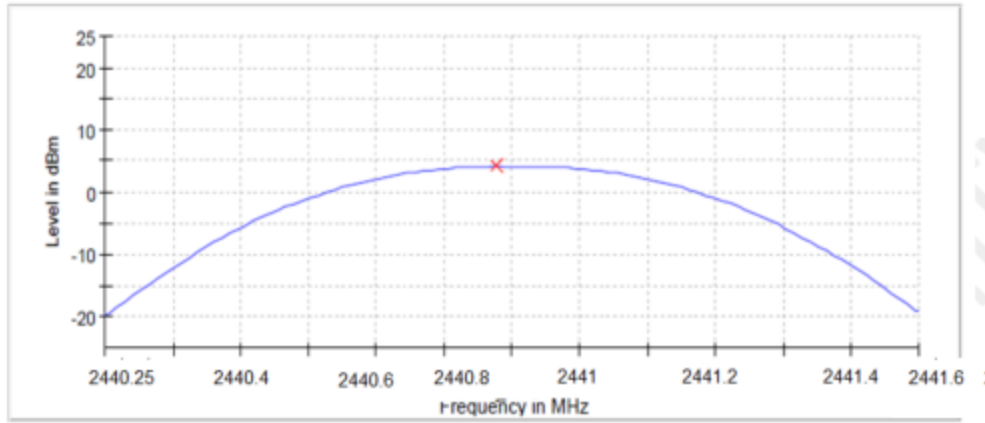
Lowest Channel



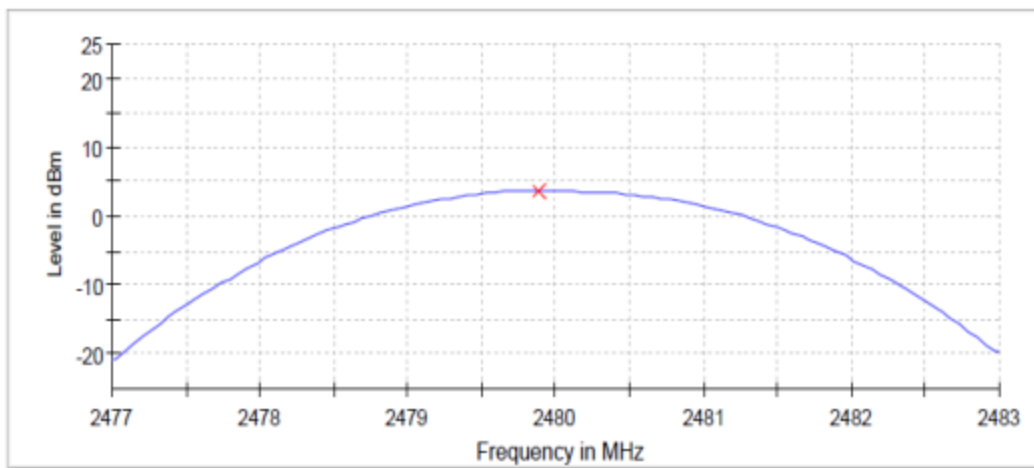
TEST RESULTS (Cont.)

CONDUCTED OUTPUT POWER

Middle Channel



Highest Channel



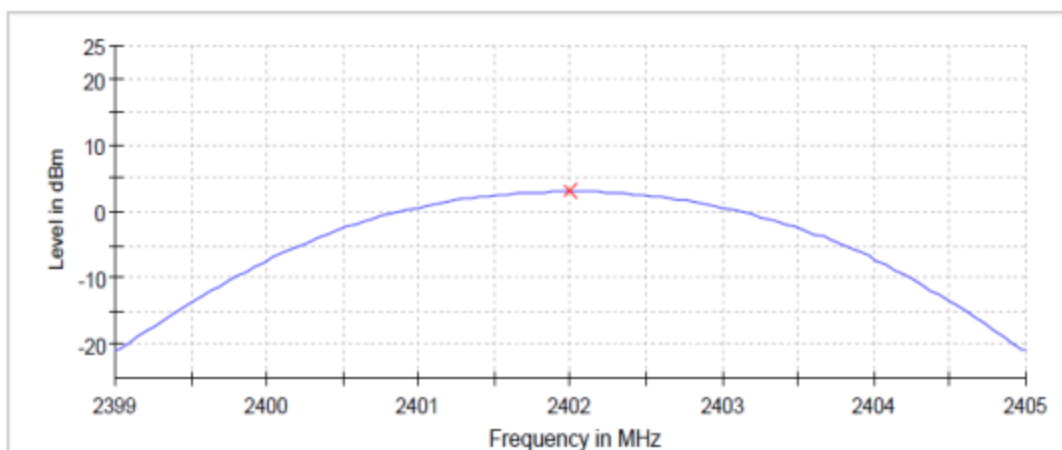
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03
TEST RESULTS:	PASS

Maximum declared antenna gain: +3 dBi

	Lowest frequency 2402 MHz	Middle frequency 2441 MHz	Highest frequency 2480 MHz
Maximum conducted power (dBm)	3.1	4.5	4.1
Maximum EIRP power (dBm)	6.1	7.5	7.1
Measurement uncertainty (dB)	$<\pm 0.78$		

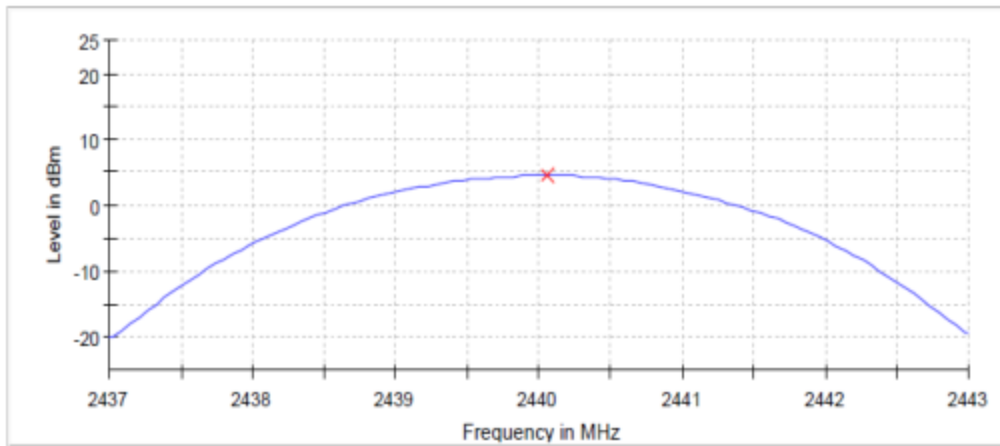
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Lowest Channel

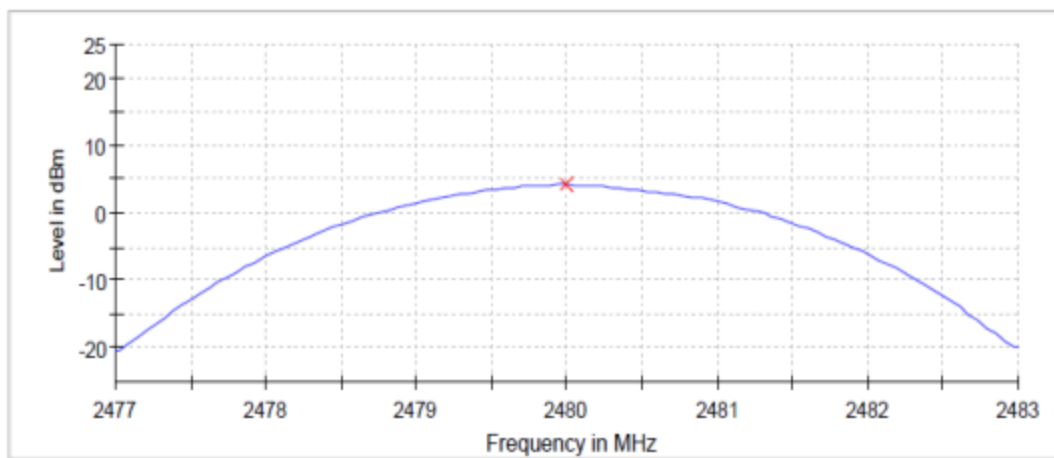


TEST RESULTS (Cont.)

Middle Channel



Highest Channel



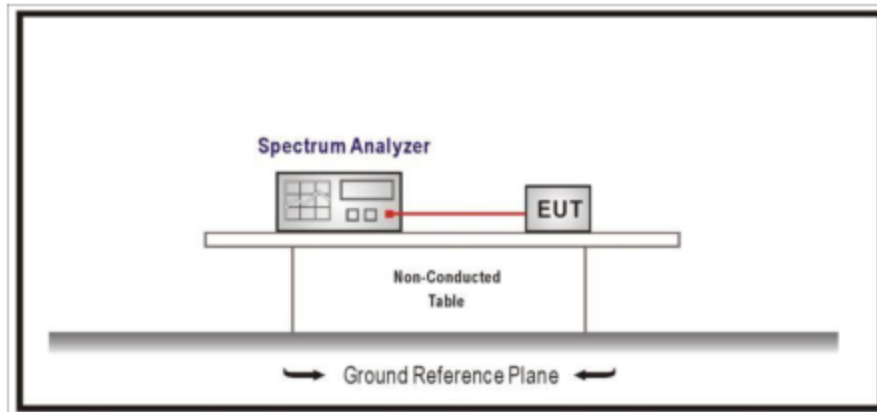
TEST A.5: BAND-EDGE EMISSIONS COMPLIANCE (TRANSMITTER)

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

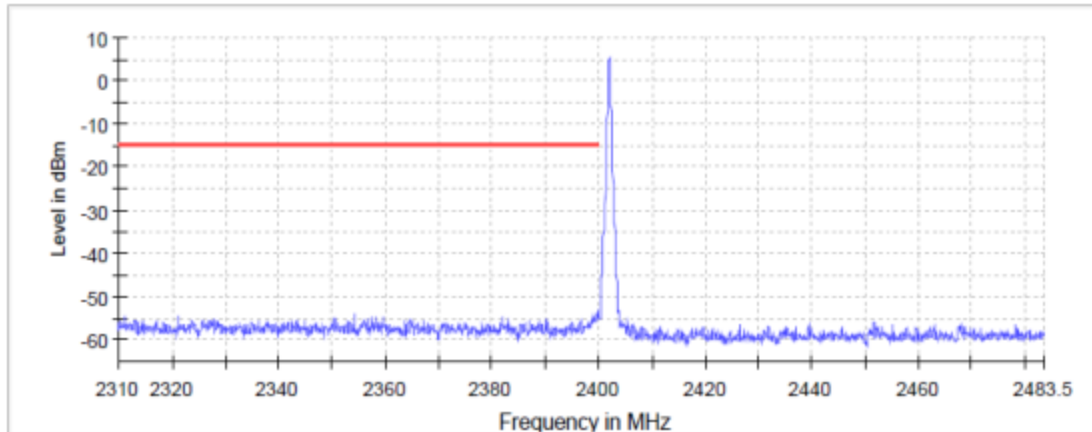
LIMITS

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20dB below the highest level of the desired power.

TEST SETUP



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	HOPPING OFF (Lowest channel)

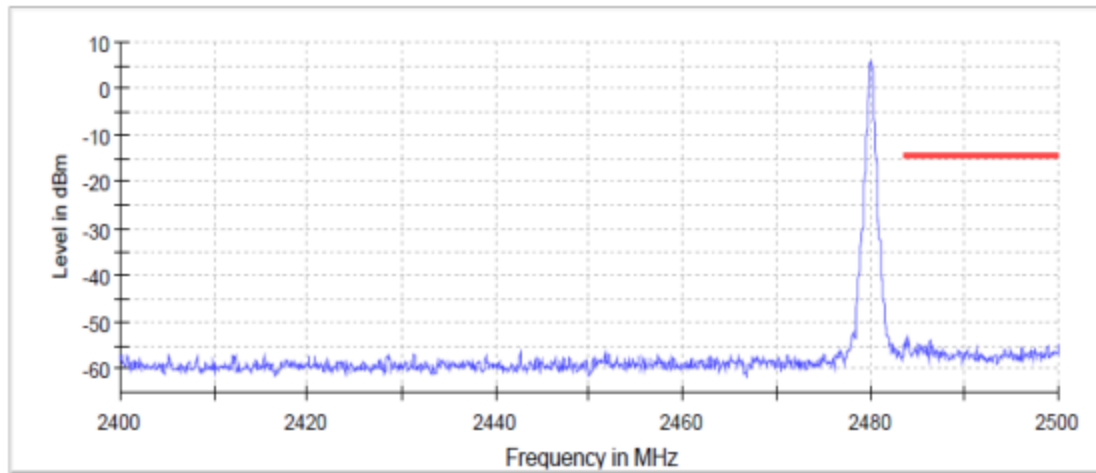


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.31000 GHz	2.40000 GHz
Stop Frequency	2.40000 GHz	2.48350 GHz
Span	90.000 MHz	83.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1800	1670
Sweep time	113.672 μ s	94.727 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	6 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.49 dB

TEST RESULTS (Cont.):

HOPPING OFF (Highest channel)

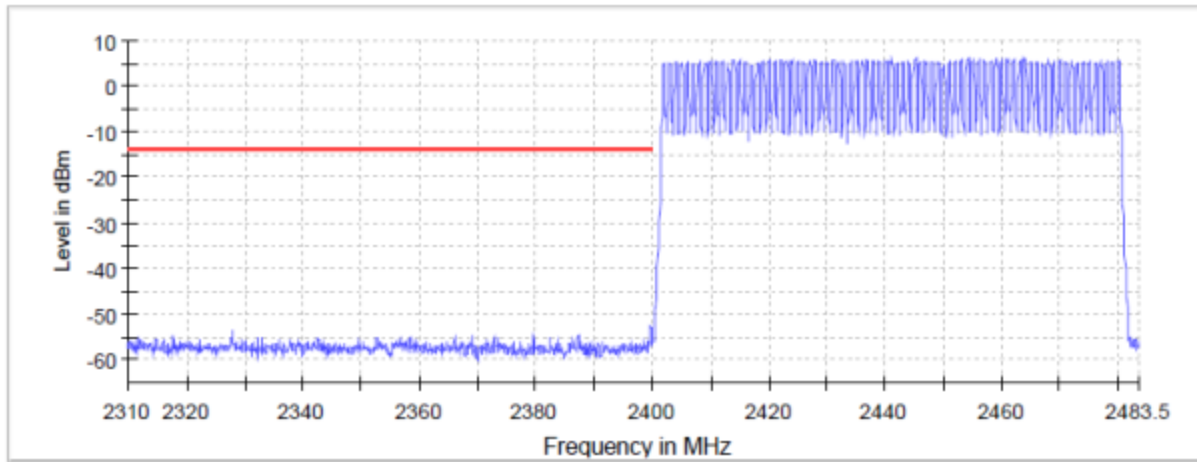


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.40000 GHz	2.48350 GHz
Stop Frequency	2.48350 GHz	2.50000 GHz
Span	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1670	330
Sweep time	94.727 μ s	18.945 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	5 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.11 dB	0.00 dB

TEST RESULTS (Cont.):

HOPPING ON (Lowest channel)

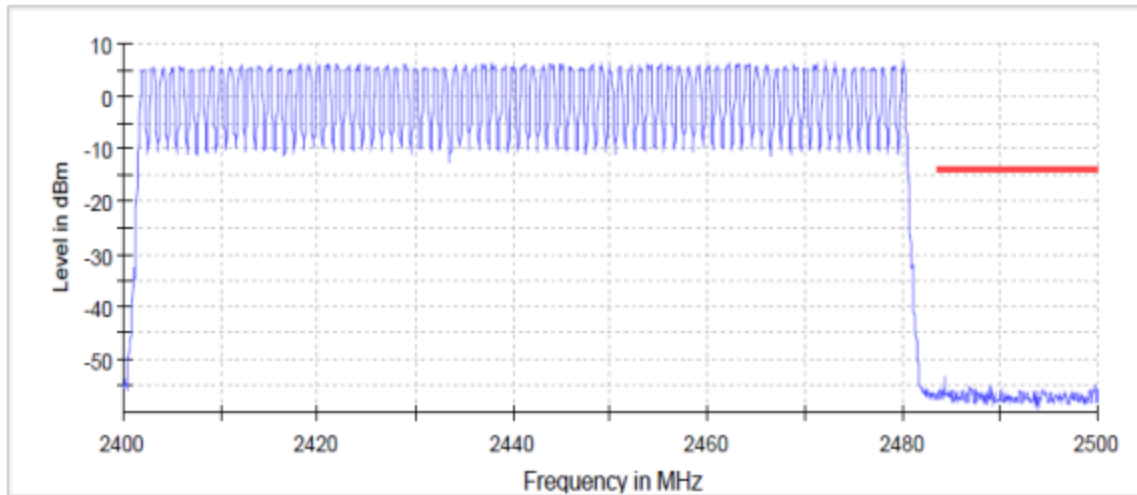


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.31000 GHz	2.40000 GHz
Stop Frequency	2.40000 GHz	2.48350 GHz
Span	90.000 MHz	83.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1800	1670
Sweep time	113.672 μ s	94.727 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	128 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.43 dB

TEST RESULTS (Cont.):

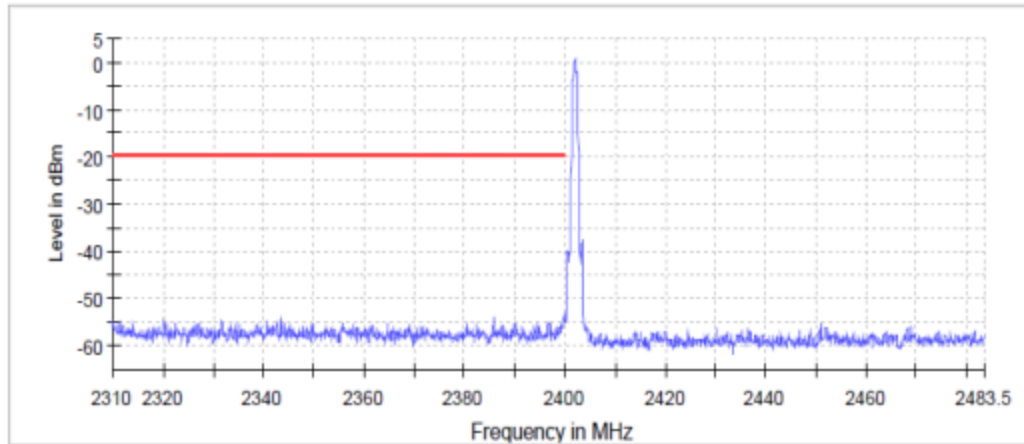
HOPPING ON (Highest channel)



Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.40000 GHz	2.48350 GHz
Stop Frequency	2.48350 GHz	2.50000 GHz
Span	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1670	330
Sweep time	94.727 μ s	18.945 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	138 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.44 dB	0.00 dB

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#02 (PI4DQPSK)
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	HOPPING OFF (Lowest channel)

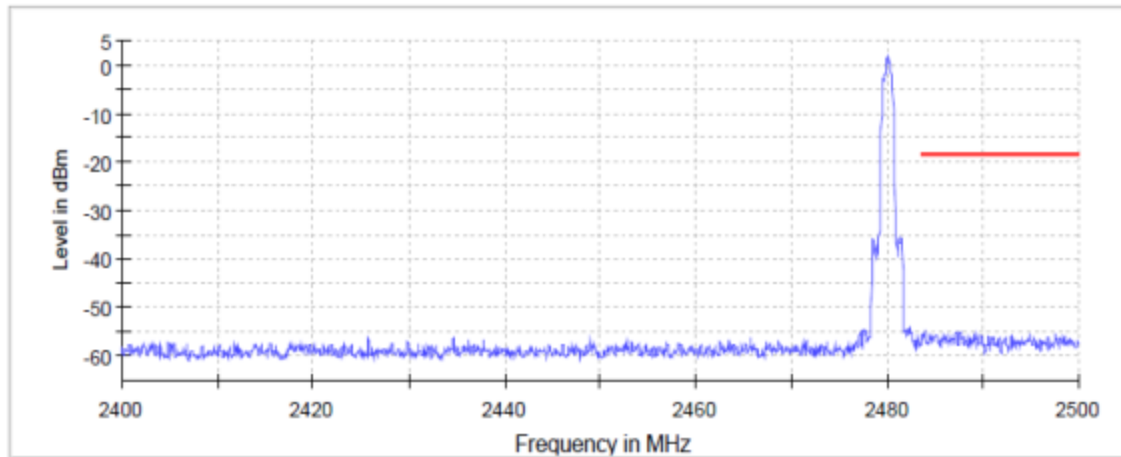


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	Instrument	2.40000 GHz
Stop Frequency	2.31000 GHz	2.48350 GHz
Span	2.40000 GHz	83.500 MHz
RBW	90.000 MHz	100.000 kHz
VBW	100.000 kHz	300.000 kHz
Sweep Points	300.000 kHz	1670
Sweep time	1800	94.727 μ s
Reference Level	113.672 μ s	10.000 dBm
Attenuation	10.000 dBm	30.000 dB
Detector	30.000 dB	MaxPeak
Sweep Count	MaxPeak	100
Filter	100	3 dB
Trace Mode	3 dB	Max Hold
Sweep type	Max Hold	FFT
Preamp	FFT	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	10 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.35 dB

TEST RESULTS (Cont.):

HOPPING OFF (Highest channel)



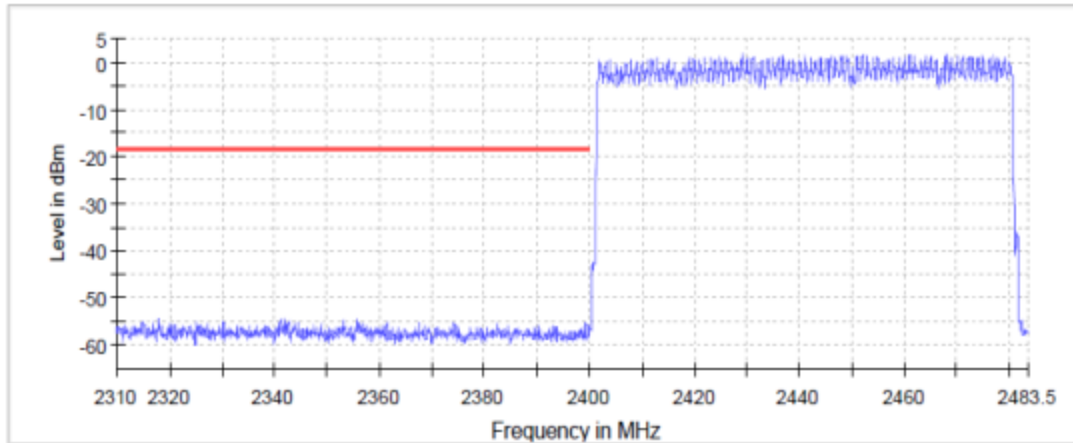
Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.40000 GHz	2.48350 GHz
Stop Frequency	2.48350 GHz	2.50000 GHz
Span	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1670	330
Sweep time	94.727 μ s	18.945 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	8 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.45 dB	0.00 dB

TEST RESULTS (Cont.):

HOPPING ON (Lowest channel)

Lowest Channel

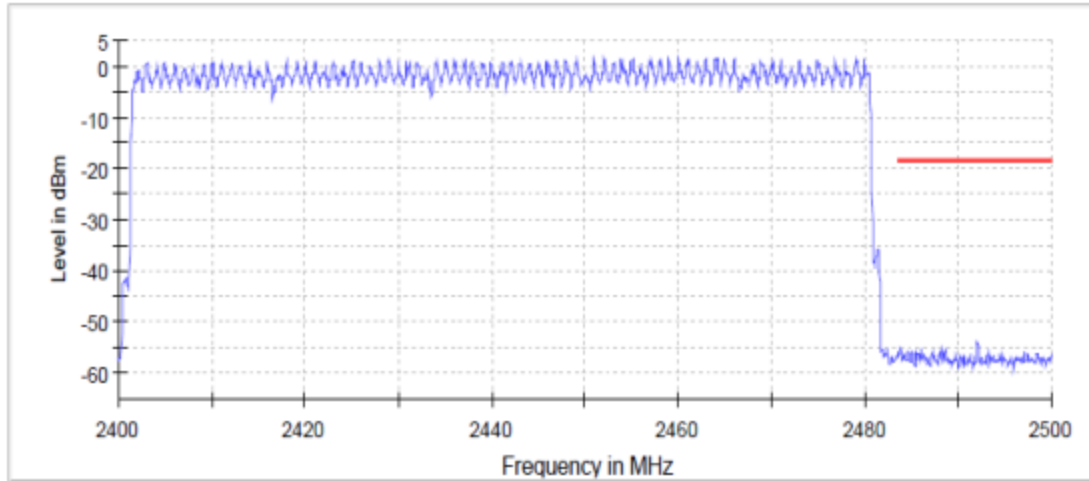


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.31000 GHz	2.40000 GHz
Stop Frequency	2.40000 GHz	2.48350 GHz
Span	90.000 MHz	83.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1800	1670
Sweep time	113.672 μ s	94.727 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	144 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.00 dB

TEST RESULTS (Cont.):

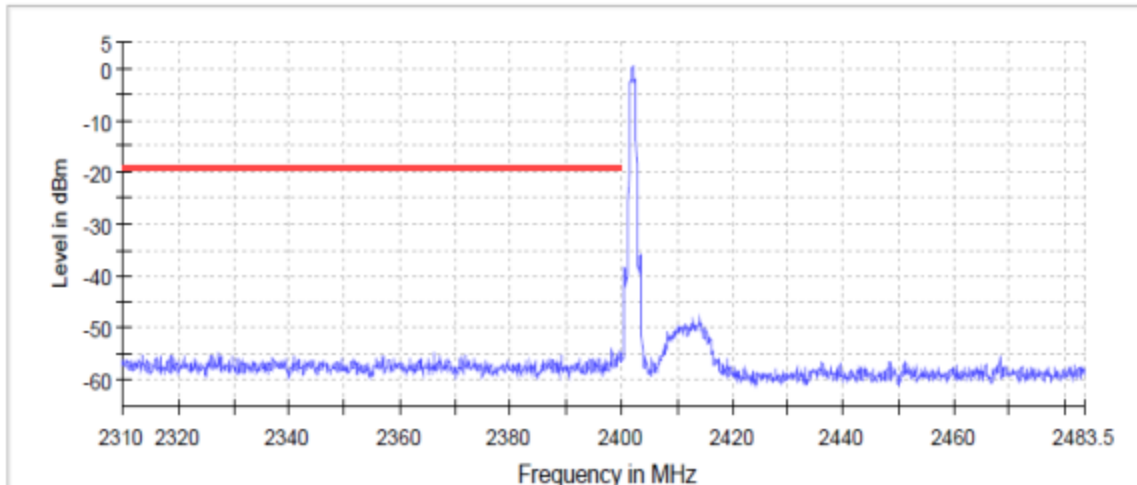
HOPPING ON (Highest channel)



Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.40000 GHz	2.48350 GHz
Stop Frequency	2.48350 GHz	2.50000 GHz
Span	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1670	330
Sweep time	94.727 μ s	18.945 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	134 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.22 dB	0.00 dB

TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#03 (8DPSK)
TEST RESULTS:	PASS
TEST RESULTS (Cont.)	HOPPING OFF (Lowest channel)

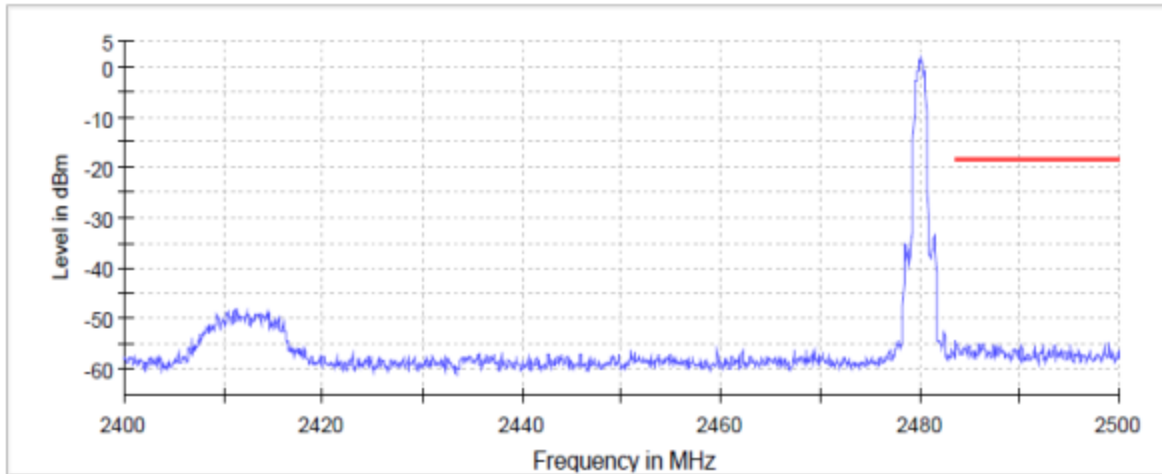


Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.31000 GHz	2.40000 GHz
Stop Frequency	2.40000 GHz	2.48350 GHz
Span	90.000 MHz	83.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1800	1670
Sweep time	113.672 μ s	94.727 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	4 / max. 150	8 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.00 dB	0.06 dB

TEST RESULTS (Cont.):

HOPPING OFF (Highest channel)



Measurement

Setting	Instrument Value	Instrument Value
Start Frequency	2.40000 GHz	2.48350 GHz
Stop Frequency	2.48350 GHz	2.50000 GHz
Span	83.500 MHz	16.500 MHz
RBW	100.000 kHz	100.000 kHz
VBW	300.000 kHz	300.000 kHz
Sweep Points	1670	330
Sweep time	94.727 μ s	18.945 μ s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	30.000 dB
Detector	MaxPeak	MaxPeak
Sweep Count	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweep type	FFT	FFT
Preamp	off	off
Stable mode	Trace	Trace
Stable value	0.50 dB	0.50 dB
Run	12 / max. 150	4 / max. 150
Stable	3 / 3	3 / 3
Max Stable Difference	0.01 dB	0.00 dB